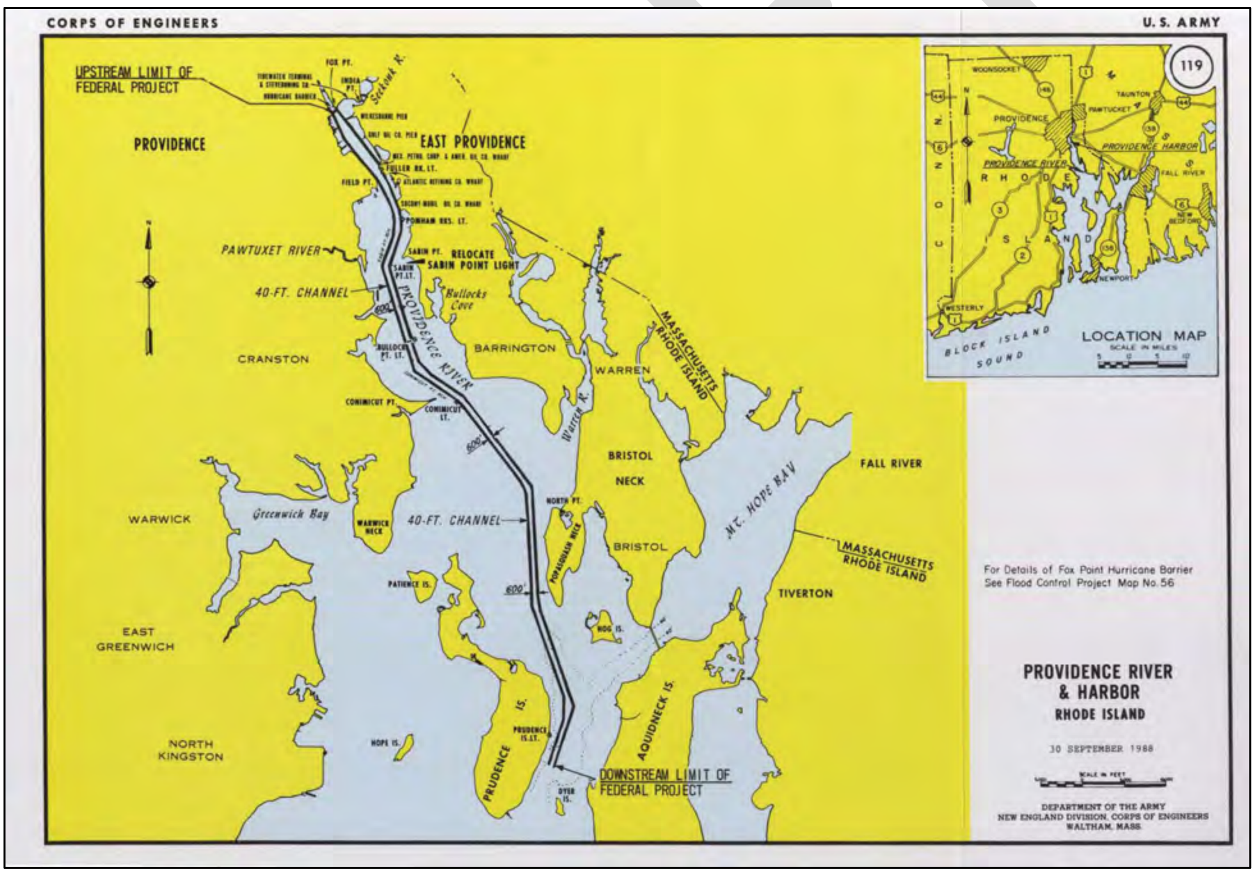
Providence River and Harbor
Federal Navigation Project
Rhode Island
Dredged Material Management Plan
and
Environmental Assessment
EAXX-202-00-E6P-1737974837



Draft May 2025

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Executive Summary

U.S. Army Corps of Engineers (USACE) proactively identifies and evaluates the full suite of maintenance needs and dredged material placement options at a particular federal navigation project (FNP), documented in a dredged material management plan (DMMP). In meeting the Federal Standard for FNPs, as defined and codified in law, USACE shall identify the least cost, practicable, and environmentally acceptable plan, referred to as the Base Plan, for maintaining the affected FNP along with considerations of adjacent FNPs and of local dredged material placement requests through at least a 20-year planning period. The purpose of this DMMP is to present the USACE, New England District's plan for maintenance dredging and placement of dredged material from the Providence River Estuary including the Providence River and Harbor FNP (Providence FNP) and three adjacent FNPs to restore full navigational utility of the Providence FNP and then to maintain full utility through at least the year 2048.

The Providence FNP is a 16.8-mile-long project extending north-south through the upper half of Narragansett Bay in Rhode Island. The Providence FNP serves a large commercial navigation traffic year-round for the greater Providence, Rhode Island area. The authorized depth of the project's channel and turning basin is -40 feet mean lower low water (MLLW).

USACE is responsible for the operations and maintenance of all general navigation features of the Providence FNP. As such, the responsibility to maintain authorized depths through dredging, as well as dredged material management, lies with USACE. This DMMP identifies the Federal Standard for managing the maintenance dredging and placement of material, including identifying dredged material placement facilities. Providence FNP and adjacent FNPs currently lack sufficient locations with placement capacity necessary to address placement needs of the FNPs immediately and in the future. USACE identified a need to prepare this DMMP due to excessive shoaling presently in the Providence FNP that impedes the economic utility of the authorized project and predicted future shoaling that will continue to degrade the economic utility. In addition, USACE does not have identified placement capacity for the material that would need to be dredged immediately nor in the future. USACE has demonstrated, through utilization analysis (Appendix B) and engineering specifications (Appendix E) for existing and expected commercial vessel use in the Providence FNP, that continued maintenance is warranted in terms of vessel traffic and related factors and needed immediately to full authorized depths of -40 feet MLLW, along with other authorized channel and turning basin dimensions.

This DMMP is an integrated report in that it serves as the decision document for the federal government to implement the proposed plan, as well as compliance with the National Environmental Policy Act (NEPA) through the Finding of No Significant Impacts (FONSI) after completing an Environmental Assessment (EA). The Non-Federal Sponsor for the Providence FNP is the Rhode Island Coastal Resources Management Council (RI CRMC). The Non-Federal Sponsor is required to cost-share general navigation features associated with the FNP, including design and construction of a confined aquatic disposal (CAD) cell for placement of dredged material. Once USACE approves this DMMP, then USACE can execute a Project Partnership Agreement (PPA) with the Non-Federal Sponsor to cost share and implement the upcoming placement facility construction in conjunction with FNP maintenance operations.

During this DMMP study, USACE coordinated with a range of project stakeholders and provided opportunities for public involvement, as required by USACE policy and NEPA (see Appendix A, Agency Coordination and Public Involvement). Additional stakeholders include the

City of Providence, Rhode Island Department of Environmental Management, the U.S. Environmental Protection Agency, National Marine Fisheries Service, and Save the Bay®.

This DMMP documents the formulation of dredged material management alternatives that allows for continued FNP maintenance through at least a 20-year period to provide the full use of the FNP. The DMMP followed the plan formulation process of identifying project purpose and need, problems and opportunities, future without management plan, formulation of management alternatives, and identification of the Base Plan (the least-cost, practicable, and environmentally acceptable alternative for FNP dredged material management). The DMMP then addresses local dredged material placement needs to combine with the Base Plan to select the Preferred Plan for consideration to be approved as the Recommended Plan for implementation.

During the 20-year planning period of this DMMP, two dredge cycles are planned based on predicted shoaling rates in the Providence FNP footprints, with the first maintenance cycle to be implemented in 2028 and the second maintenance cycle to be implemented in 2048. The DMMP also includes the addition of non-federal material needs within Narragansett Bay as a betterment to the plan.

The recommended plan involves:

- Dredging and placement of a total of 4,800,000 cubic yards (CY) of sediments from four FNPs within Narragansett Bay, including the Providence FNP and three adjacent shallow-draft FNPs (Pawtuxet Cove, Bullocks Point Cove, and Apponaug Cove).
- Construction and use of two large CAD cells in Edgewood Shoals, adjacent to the Providence FNP, involving over 5,000,000 CY of excavation.
- Beneficial uses of the excavated material.
- Placement capacity for local non-federal needs in the Narragansett Bay over a period of at least 20 years, as a betterment requested by the Non-Federal Sponsor, at 100% non-federal cost.

The project's purpose and need are to restore and maintain the general navigation features and local service facilities to fully utilize the system as authorized over a 20-year period of analysis. The project will provide for beneficial use of dredged material as a cost-saving measure, or when authorized under a federal authority. The project will also provide capacity for dredged material placement as a betterment for other state and local needs as requested by the Non-Federal Sponsor and at full non-federal expense.

The problem addressed in the DMMP focuses on transportation inefficiencies within the FNP due to shoaling and narrowing with no identified practicable placement facilities for dredged material. Without practicable placement facilities available, the navigation utility of the projects will continue to worsen with negative economic impacts to the region. Compounding the problem is that the material characterization identified the material as contaminated, unsuitable for open-water disposal. Future shoaled materials are most likely going to be found unsuitable for open-water disposal as well. No upland or confined placement sites were identified that could practicably hold this unsuitable material.

A broad range of measures were considered for dredging and placement of the dredged materials during the planning process resulting in the formulation of alternatives for dredged material placement. The measures were initially screened against the decision criteria that incorporated the ability of the measures to address the purpose and need of the study. Thirteen measures were carried forward to then be combined into eight action alternatives that meet formulation criteria under USACE Principles, Requirements, and Guidelines, including completeness, effectiveness, efficiency, and acceptability. The eight action alternatives, involving combinations of three alternative CAD cells and multiple beneficial-use sites, were then compared for implementation cost of FNP dredging and placement. The least-cost plan was identified as the Base Plan for implementation of maintenance of the Providence FNP and local placement needs for the three adjacent FNPs through the 20-year planning horizon. The three CAD cell measures considered were the Edgewood Shoals North (ESN), the Edgewood Shoals South (ESS), and the Fox Point Reach South (FPRS) for dredged material placement. The Base Plan was then expanded to include the local dredge placement needs by the Non-Federal Sponsor to identify the Preferred Plan for consideration to be approved as the Recommended Plan for implementation.

The Recommended Plan is Alternative 2A, which involves two complete dredging cycles of the Providence FNP: Cycle-One maintenance dredging in the year 2028, and Cycle-Two maintenance dredging in the year 2048. The Recommended Plan includes the construction of two large CAD cells and two access channels in Edgewood Shoals: the first, ESN CAD cell to be constructed in the year 2027, and the second, ESS CAD cell to be constructed in the year 2047. The access channels will not be made a part of the authorized federal navigation project. Each CAD cell will have the capacity to hold 2,400,000 CY of unsuitable materials, to be dredged from Providence FNP, three adjacent shallow-draft FNPs (Bullocks Cove, Pawtuxet Cove, and Apponaug Cove), and additional local non-federal dredged materials. Each cycle will include the complete dredging and placement from Providence FNP of approximately 2,015,000 CY of unsuitable material in the year 2028, and approximately 1,900,000 CY of unsuitable material in the year 2048.

For the Cycle-One dredging of the selected plan, the ESN CAD cell and access channel will be constructed in the year 2027, in time for the Providence FNP maintenance dredging and dredged material placement to be conducted in 2028. The CAD cell construction will require 3,200,000 CY of excavation and placement of unconsolidated materials. The CAD cell is sized to fit bulked dredged materials from the Providence FNP, three adjacent FNPs, and local non-federal dredging needs over a twenty-year period. The CAD cell location is a 51-acre area in the northern half of Edgewood Shoals, in an area approximately 6 to 15 feet below MLLW in depth. In the year 2028, the Providence FNP would be dredged to remove 2,015,000 CY of unsuitable shoaled materials and placement of this material in the constructed CAD cell. An additional 63,000 CY from three adjacent shallow-draft FNPs (Bullocks Cove, Pawtuxet Cove, and Apponaug Cove) would be placed in the CAD cell over the next 20 years. Additionally, the CAD cell would be sized for placement opportunities for 300,000 CY of local non-federal dredging needs through the year 2047. The CAD cell will be sized to account for expected 15% bulking of dredged materials during handling and placing. A total of 2,300,000 CY from the CAD cell construction will be beneficially used to cap and restore five of the old CAD cells in Fox Point Reach North, filling the abandoned Port Edgewood Basin, and capping and restoring an abandoned dredged material disposal area in the Prudence Island Basin. The remaining 900,000 CY of excavated material will be placed in the Rhode Island Sound Disposal Site (RISDS), a designated open-water disposal area. The ESN CAD cell will remain open for 20 years to receive additional unsuitable dredged material from nearby FNPs as well as the allocated 300,000 CY of space for local non-federal dredged material. Over the 20-year period, the material placed in the CAD cell is expected to consolidate and settle, allowing for additional capacity of approximately 160,000 CY, which can be used for additional unsuitable material along with final capping. Once the CAD cell has reached capacity, filled to no more than -13 feet below MLLW, in approximately 20 years, it will be capped and closed out with three feet of clean material, approximately 300,000 CY in volume, which will be excavated from the Cycle-Two CAD cell construction.

For the Cycle-Two dredging of the selected plan, the Edgewood Shoals South CAD cell and access channel will be constructed in the year 2047, in time for the Providence FNP maintenance dredging and dredged material placement to be conducted in 2048. The CAD cell construction will require 3,000,000 CY of excavation and placement of most of this material in the RISDS. The CAD cell location is a 50-acre area in the southern half of Edgewood Shoals, approximately 8 to 15 feet below MLLW in depth. As a beneficial use of dredged material and cost-savings measure, approximately 130,000 CY of the clean excavated material may be placed in two remaining unclosed CAD cells in Fox Point Reach North, in which the material will cap and close out these remaining old CAD cells. Additional beneficial uses of some of this material will be considered as opportunities arise over the 20-year period prior to CAD construction for the Cycle-Two dredging. The Cycle-One CAD cell will be constructed large enough to function as a starter cell for placement of any unsuitable materials to be excavated from the Cycle-Two CAD cell. The Cycle-One CAD cell will also be closed out, capped, and restored with 240,000 CY of clean material excavated from the Cycle-Two CAD cell in 2048, when the Cycle-One CAD cell is expected to reach capacity. Following the construction of the Cycle-Two CAD cell, the Cycle-Two maintenance dredging of the Providence FNP will commence in the year 2048 with dredging and placement of predicted 1,900,000 CY of unsuitable shoaled material into the Cycle-Two CAD cell. Over the following 20 years, an estimated 61,000 CY of unsuitable material will be dredged from the three adjacent shallow-draft FNPs and placed in the Cycle-Two CAD cell, along with placement of 300,000 CY of local non-federal dredged material. Over the 20-year period, the material placed in the CAD cell is expected to consolidate and settle, allowing for additional capacity of approximately 160,000 CY, which can be used for unsuitable material along with final capping. Once the CAD cell has reached capacity, filled to no more than -13 feet below MLLW, in approximately 20 years, it will be closed out, capped, and restored with three feet of clean material, approximately 300,000 CY in volume, to be excavated from a future CAD cell construction or other source of clean material.

CAD cell design and construction will be cost-shared with the Non-Federal Sponsor, the RI CRMC. FNP maintenance dredging and FNP dredged material placement design and construction are fully funded by the federal government. The cost-sharing requirements will be laid out in the PPA, anticipated to be executed in the year 2025. The Cycle-One fully funded cost (inflated cost to the midpoint date of the period in which the activity is performed) for design and construction is estimated to be $96,412,000, which includes the design and construction of the Cycle-One CAD cell for approximately $66,735,000 between the years 2025-2027 and maintenance dredging of the Providence FNP for $29,677,000 in the year 2028. As separate from this implementation cost, the Non-Federal Sponsor is required to pay an additional $5,845,000 to the US Treasury.

The Cycle-One fully funded cost for the CAD cell design and construction will be cost shared in the amount of $22,634,000 by the Non-Federal Sponsor along with the additional non-federal cost of $5,845,000 for a total non-federal fully funded cost of $28,479,000. Upon execution of the PPA, expected in 2025, the Non-Federal Sponsor will be responsible to pay

$607,000 for the non-federal cost share of the design of the Cycle-One CAD cell and final maintenance design, then pay $22,027,000 toward the cost share of CAD cell construction in 2027 followed by maintenance dredging in 2028, and lastly pay the US Treasury the additional amount of $5,845,000 over a 30-year period starting in 2028. The federal fully funded cost for the Cycle-One CAD cell design and construction is $44,101,000, and the federal fully funded cost of the Providence FNP maintenance design and implementation is expected to be the full $29,677,000, for a total Cycle-One federal fully funded cost of $73,778,000.

The Cycle-Two fully funded cost is estimated to be $183,915,000, which includes the design and construction of the Cycle-Two CAD cell and completion of FNP maintenance design for approximately $133,228,000 between the years 2045-2047, and maintenance dredging of the Providence FNP for $50,687,000 in the year 2048. As separate from this implementation cost, the Non-Federal Sponsor is required to pay an additional cost of $5,845,000 to the US Treasury.

The Cycle-Two fully funded cost for the CAD cell design and construction will be cost shared in the amount of $45,235,000 by the Non-Federal Sponsor along with the additional non-federal cost of $11,665,000 for a total non-federal fully funded cost of $56,900,000. After the PPA is executed, in 2025-2026, the Non-Federal Sponsor will be responsible to pay $1,535,000 for the non-federal cost share of the design of the Cycle-One CAD cell and final maintenance design, then pay $43,700,000 toward the cost share toward the cost share of CAD cell construction in 2027 followed by maintenance dredging in 2028, and lastly pay the U.S. Treasury the additional amount of $5,845,000 over a 30-year period starting in 2048. The federal fully funded cost for the Cycle-Two CAD cell design and construction is $87,993,000, and the federal fully funded cost of the Providence FNP maintenance is expected to be the full $50,687,000, for a total Cycle-One federal fully funded cost of $138,680,000.

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Cover Image: This archived map of the Providence River and Harbor Federal Navigation Project is dated 30 September 1988, produced by the US Army Corps of Engineers, New England Division. (New England Division, with headquarters located in Waltham, Massachusetts was converted to a district, joining the North Atlantic Division, on June 6, 1996, and its headquarters are currently located in Concord, Massachusetts.

Acronyms

Term	Definition
APE	Area of Potential Effect
ARA	Abbreviated Risk Analysis
AWOIS	Automated Wreck and Obstruction Information System
BCC	Birds of Conservation Concern
BU	Beneficial Use of Dredged Material
CAA	Clean Air Act
CAD	Confined Aquatic Disposal
CBRA	Coastal Barrier Resources Act
CDF	Confined Disposal Facility
CFR	Code of Federal Regulations
CI	Critical Infrastructure
COC	Contaminants of Concern
CSO	Combined Sewer Overflow
CSRA	Cost & Schedule Risk Analysis
CWA	Clean Water Act
CY	Cubic Yards
DAMOS	Disposal Area Monitoring System
dB	Decibels
DPS	Distinct Population Segment
DMMP	Dredged Material Management Plan
EA	Environmental Assessment
EFH	Essential Fish Habitat
EM	Engineer Manual
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ER	Engineer Regulation
ERDC	Engineer Research and Development Center (USACE)
ESA	Endangered Species Act
ESN	Edgewood Shoals North
ESS	Edgewood Shoals South
FEIS	Final Environmental Impact Statement
FNP	Federal Navigation Project
FONSI	Finding of No Significant Impact
FPRN	Fox Point Reach North
FPRS	Fox Point Reach South
HAPC	Habitat Areas of Particular Concern
Hz	Hertz
IPaC	Information for Planning and Consultation (USFWS)
MPRSA	Marine Protection, Research and Sanctuaries Act
MLLW	Mean Lower Low Water
Mg/l	Milligram per liter
NAGPRA	Native American Graves Protection and Repatriation Act
NAAQS	National Ambient Air Quality Standards

Term	**Definition**
NBC	Narragansett Bay Commission
NEPA	National Environmental Policy Act
NLEB	Northern Long-Eared Bat
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Association
NPS	National Park Service
NTU	Nephelometric Turbidity Units
NWI	National Wetlands Inventory
O&M	Operations and Maintenance
OPA	Otherwise Protected Area
OTR	Ozone Transport Region
P&G	Economic and Environmental Principles and Guidelines for Water and Land-Related Resource Implementation Studies
PR&G	Principles, Requirements, and Guidelines for Water and Land-Related Resource Implementation Studies
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated biphenyls
PEB	Port Edgewood Basin
PED	Preconstruction Engineering and Design
PIDS	Prudence Island Disposal Site
P.L.	Public Law
PPA	Project Partnership Agreement
RI CRMC	Rhode Island Coastal Resources Management Council
RIDEM	Rhode Island Department of Environmental Management
RIHS	Rhode Island Historical Society
RISDS	Rhode Island Sound Disposal Site
ROMs	Regional Oceanic Modeling System
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
TOY	Time of Year
uPa	Micro Pascal
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
USFWS	U.S. Fish and Wildlife Service
URI-GSO	University of Rhode Island’s Graduate School of Oceanography
WQC	Water Quality Certification
WRDA	Water Resources Development Act
WWTF	Wastewater Treatment Facility

1. Introduction

1.1. Study Overview and Scope

U.S. Army Corps of Engineers (USACE) proactively identifies and evaluates a suite of dredged sediment management options to address immediate and future dredging needs of an existing Federal Navigation Project (FNP) to provide continued operations and maintenance of the project for its navigation purpose to the maximum scale and extent, within project authorization, for which continued maintenance is warranted in terms of vessel traffic and related factors. USACE policy for dredged material management of FNPs is based on meeting the Base Plan as defined in U.S. Code of Federal Regulations (CFR) (33 CFR 335.7). The Federal Standard requires that USACE accomplish the management of dredged material associated with the construction or maintenance dredging of navigation projects in the least costly manner, consistent with sound engineering practices (practicable), and environmentally acceptable manner. Environmental acceptability includes meeting all federal environmental standards including the environmental standards established by Section 404 of the Clean Water Act (CWA) of 1972 or Section 103 of the Marine Protection, Research and Sanctuaries Act (MPRSA) of 1972, as amended. In cases where there is insufficient placement capacity to accommodate the warranted maintenance dredging over a period of at least 20 years, then a dredged material management study must be performed, which includes the preparation of a Dredged Material Management Plan (DMMP) (Engineer Regulation (ER) 1105-2-100).

This DMMP presents a plan for the Providence River and Harbor FNP (Providence FNP) along with three adjacent shallow-draft FNPs (Pawtuxet Cove, Bullocks Point Cove, and Apponaug Cove) all located in the Providence River Estuary in southern Rhode Island (Figure 1-1 and Figure 1-2). Providence FNP is a 16.8-mile-long deep-draft commercial navigation project with authorized depths of 40 feet below Mean Lower Low Water (MLLW). For the purposes of this DMMP, the period of analysis is through the year 2048.

Past shoaled material in 2005 was found to be unsuitable for open-water placement and, therefore, was placed in former CAD cells within the Providence FNP. In 2015, USACE conducted a preliminary assessment of maintenance needs for the Providence FNP and found that over 1,000,000 cubic yards (CY) of material had shoaled within the FNP since the project had last been dredged in 2005. USACE expected that most of this shoaled material would be unsuitable for placement in the existing United States Environmental Protection Agency (EPA) designated open-water placement site in Rhode Island Sound, known as the Rhode Island Sound Disposal Site (RISDS). USACE did not identify available placement sites for this expected unsuitable material, and therefore, per USACE regulations, initiated the dredged material management study and preparation of this Providence FNP DMMP.

This DMMP summarizes the results of a detailed multi-year investigation of dredged material management of the Providence FNP. This study demonstrated the level of continued maintenance of the FNP that is economically warranted based on high priority navigation benefits and necessary to support operation of the congressionally authorized project over the 20-year planning period. The study described existing and future problems that result from not implementing a maintenance plan. The study then formulated and investigated various measures and alternative plans that are environmentally acceptable to provide sufficient dredged material placement capacity for both the immediate needs of the Providence FNP, to be dredged in the year 2028, and for future dredging needs of the Providence FNP through the planning period of at least 20 years, out to the year 2048.

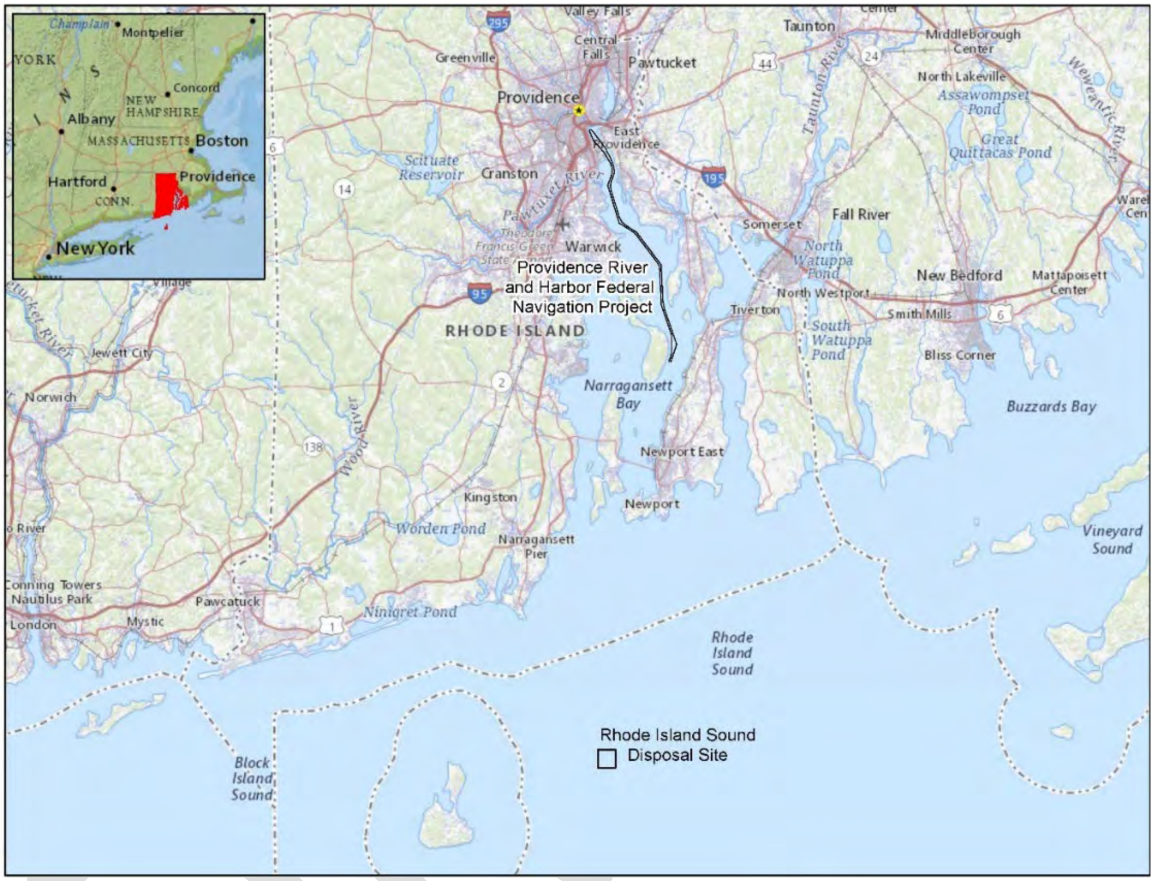


Figure 1-1. Providence River and Harbor Federal Navigation Project Study Area.

The study identifies the least-cost alternative meeting federal navigation needs over the 20-year planning period. The study also lays out the schedule for maintenance over the 20-year planning period and identifies the cost-sharing allocation between USACE and the Non-Federal Sponsor. This DMMP report documents a recommendation by the District Commander of USACE New England District to implement the proposed plan and to execute a Project Partnership Agreement (PPA) with a Non-Federal Sponsor to cost share and implement the upcoming maintenance operations. The final project approval is provided by the Division Commander of the USACE North Atlantic Division.

During this DMMP study, USACE coordinated with a range of agencies and provided for public involvement in developing and reviewing the plan (see Appendix A, Agency Coordination and Public Involvement). The primary stakeholder associated with this study is the Rhode Island Coastal Resources Management Council (RI CRMC), which is currently identified as the Non-Federal Sponsor of the project. Additional stakeholders include the City of Providence, Rhode Island Department of Environmental Management (RIDEM), the EPA, and the National Marine

Fisheries Service (NMFS). This DMMP is an integrated report that serves the purpose of documenting both the DMMP report requirements and Environmental Assessment (EA) report requirements complying with the National Environmental Policy Act (NEPA) by presenting an assessment of the environmental impacts associated with continued maintenance of the federally authorized navigation features within the study area, including management requirements for dredged material.

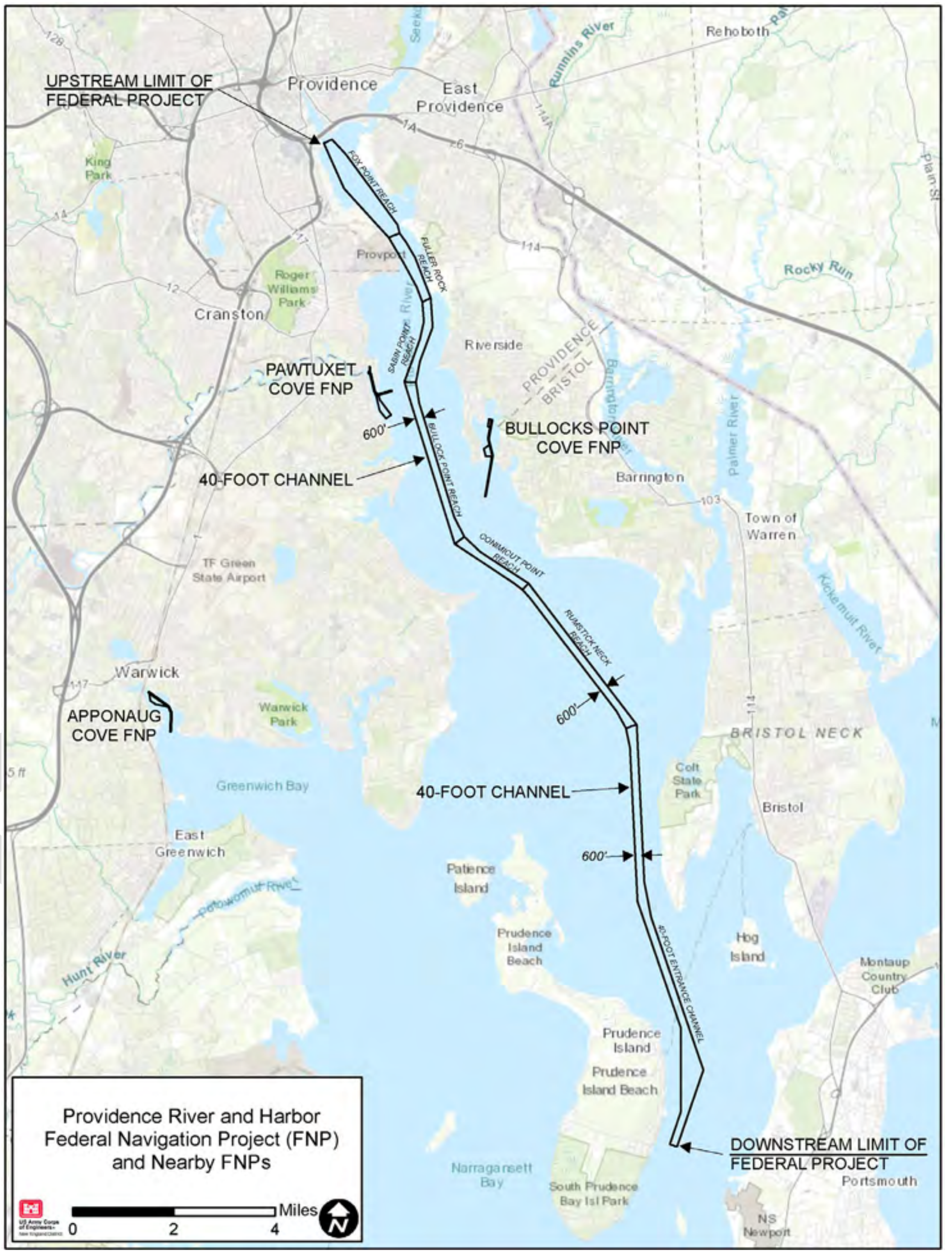


Figure 1-2. Providence River and Harbor Federal Navigation Project Features and Nearby Federal Navigation Projects.

In summary, this integrated report:

- Describes the present and future conditions of the Providence FNP and explains the need for continued dredging along with the characteristics and quantities of material that will need to be dredged to maintain an economically warranted project.
- Describes the formulation of alternative plans and the selection of the least-cost, environmentally acceptable, and practicable dredged materials management plan.
- Serves as a decision document supporting the PPA for the upcoming maintenance operations; and
- Meets the requirements of the NEPA.

1.2. Study Authority*

This DMMP is a USACE decision document for long-term management of the Providence FNP. As required by and consistent with USACE guidance and policy, USACE must demonstrate sufficient dredged material placement and disposal capacity for a minimum of 20 years to maintain economically warranted project utilization. Such guidance is included in the USACE Engineer Manual (EM) 1110-2-5025 (2015), USACE (ER) 1105-2-100 (2000) and ER 1105-2-103 (2023b); and more recent USACE guidance memoranda.

According to EM 1110-2-5025, 2.6.4 (2015):

> "Dredged material management planning for all Federal harbor projects is conducted by the USACE to ensure that maintenance dredging activities are performed in an environmentally acceptable manner, use sound engineering techniques, and are economically warranted, and that sufficient placement areas are available for at least the next 20 years. These plans address dredging needs, placement capabilities, capacities of placement areas, environmental compliance requirements, potential for beneficial usage of dredged material, and indicators of continued economic justification."

According to ER 1105-2-100, Appendix E-15 a (3), (2000):

> "It is the Corps of Engineers policy to accomplish the disposal of dredged material associated with the construction or maintenance dredging of navigation projects in the least costly manner. Disposal is to be consistent with sound engineering practice and meet all Federal environmental standards including the environmental standards established by Section 404 of the Clean Water Act of 1972 or Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972, as amended. This constitutes the base disposal plan for the navigation purpose. Each management plan study must establish this 'Base Plan'...".

Per Engineer Manual (EM) 1110-2-5025 (2015) (2000):

> "Non-Federal, permitted dredging within the related geographic area shall be considered in formulating Management Plans to the extent that disposal of material from these sources affects the size and capacity of disposal areas required for the Federal project(s). In those cases where two or more Federal projects are physically inter-related (e.g., harbors that share a common disposal

> area or a common channel) or are economically complementary, one Management Plan may encompass that group of projects."

Per ER 1105-2-100 E-15 e (2), (2000), each DMMP "shall include an assessment of potential beneficial uses of dredged material, for meeting both navigation and non-navigation objectives." USACE guidance, CECG - Beneficial Use of Dredged Material Command Philosophy Notice, 25 January 2023. (2023a), provides a goal to have 70% of dredged materials generated from maintenance of FNPs be used for beneficial use. The benefits associated with beneficial uses may include shoreline protection, protection against loss of life, damage to improved property, and environmental. The beneficial uses may be incorporated into the Base Plan if the beneficial use of dredged material (BU) does not add substantial cost or reduces cost of the proposed action. USACE Implementation Guidance Secretary of the Army, Civil Works, Memorandum (2022a) allows BU, which is not the least cost option, to be incorporated into the federal Base Plan if the incremental costs of the disposal method are reasonable in relation to the environmental benefits or the hurricane and storm or flood risk reduction benefits. If the BUs are more, then this guidance allows for up to 25% cost above the Base Plan cost that can be treated as part of the operations and maintenance (O&M) plan and cost-shared accordingly.

In summary, according to USACE guidance and policy, the DMMP must address the following:

- Accommodate the current and expected future needs of the Providence FNP to maintain economically warranted utilization as congressionally authorized over at least a 20-year planning period (to the year 2048).
- Consider the dredging needs of other FNPs associated with the Providence FNP over the 20-year planning period.
- Consider the non-federal needs for dredged material management associated with the Providence FNP over the 20-year planning period.
- Consider beneficial uses of dredged material produced by the O&M, as well as construction of facilities that are determined to be needed to perform the O&M, over the 20-year planning period.
- Consider a range of practicable alternatives that are environmentally acceptable and recommend a least-cost proposed action to meet all of the FNP needs over the 20-year planning period. and,
- Address cost-sharing between USACE and local Non-Federal Sponsor, based on USACE guidance.

1.3. Function of the Dredged Material Management Plan

This DMMP is a decision document that presents and directs USACE, New England District to implement the plan for maintenance dredging and placement of dredged sediment over at least a 20-year period (to the year 2048) from Providence FNP, along with sediment accumulated in three adjacent shallow-draft FNPs (Pawtuxet Cove, Bullocks Point Cove, and Apponaug Cove) (see Figure 1-2) and sediment accumulating in local non-federal dredging projects within the Providence River Estuary. This DMMP addresses the immediate maintenance of the Providence FNP scheduled to be dredged in 2028, and also the following 20-year period of dredging needs, between the years 2028 and 2048, to keep the FNP at full authorized dimensions, as determined to be economically warranted.

This report also serves the purpose of documenting NEPA requirements. For this project, this document will serve as an integrated DMMP and EA to meet both USACE policy and NEPA documentation requirements. This includes a proposed Finding of No Significant Impact (FONSI) statement.

1.4. Project Sponsor

In accordance with U.S. Code 33 U.S.C. § 2211 and EM 1110-2-5025, (2015), USACE requires that the project have a Non-Federal Sponsor and that any major maintenance facilities required to be constructed, including confined aquatic disposal (CAD) facilities, need to be cost-shared by the Non-Federal Sponsor. For this project, the Non-Federal Sponsor is the RI CRMC.

1.5. Planning Steps of the Dredged Material Management Plan

The planning process is iterative as the study progresses, resulting in the development, evaluation, and comparison of alternative plans to address the identified study problems. The DMMP study process, documented in this report, is as follows:

- Identify the study area.
- Identify project purpose and need, which includes demonstrating the level of continued operations and maintenance (O&M) that is warranted to meet the project purpose and need based on meeting channel utilization.
- Identify present and future problems without a management plan.
- Identify opportunities.
- Identify goals, objectives, constraints, and expected conditions, incorporating requirements to meet the Federal Standard.
- Identify existing conditions and affected environment.
- Formulate and screen measures and combine them into alternative plans that address the project purpose and need and meet the project goals, objectives, and constraints.
- Screen the alternatives based on their ability to address project objectives to establish the Base Plan that meets the Federal Standard.
- Consider beneficial uses of dredged materials and add such uses as part of the base plan if the implementation cost is not increased by more than 25% of the Base Plan without the beneficial uses.

- Consider addressing beneficial uses that are not part of the Base Plan through separate authority and that can be implemented as part of the management plan.
- Address accommodating local non-federal dredged material placement needs over the planning period, which can be combined with the Base Plan.
- Identify and document environmental impacts of the alternative plans and the no-action alternative.
- Provide opportunities for agency and public comment on the proposed management plan and address the comments.
- Identify the preferred plan for implementation and describe the plan in detail, including implementation steps, costs and cost-sharing responsibilities, and compliance with applicable laws and policies.
- Recommend the plan for final USACE approval.

2. Initial Planning Steps

The initial planning steps for a DMMP frame the study, including describing the study area, background and history, project purpose and need, current problems, future problems without a management plan, and opportunities.

2.1. Study Area*

Providence FNP is located in southern Rhode Island on the north shore of Rhode Island Sound in Providence County. The project is located in the upper reaches of Narragansett Bay in the municipalities of Providence, East Providence, Cranston, Barrington, Warwick, Bristol, and Portsmouth, Rhode Island, as shown above in Figure 1-1. The primary region served by the Providence Harbor is Rhode Island; however, portions of southeastern Massachusetts and eastern Connecticut are also serviced by Providence Harbor for various items of waterborne commerce.

Providence FNP is Rhode Island's largest seaport and is located in the northern reaches of Narragansett Bay. The bay extends northerly about 27 miles from Rhode Island Sound in the Atlantic Ocean, on the central Rhode Island Coast (Figure 1-1) to the confluence of the Providence and Seekonk Rivers at the City of Providence. The Providence River is a tidal river formed by the junction of the Woonasquatucket and Moshassuck Rivers, which flow from northern Rhode Island. From this confluence, the Providence River flows southerly for eight miles before emptying into upper Narragansett Bay.

2.1.1. Port Significance and Commercial Operations

Providence, located at the head of Narragansett Bay, is the capital and largest city in Rhode Island. The Port of Providence is the 4th largest commercial/industrial port in New England. Commerce in the Port of Providence consists mainly of liquid petroleum products shipped in tank vessels: about 65% of the 7.8 million metric tons landed in 2020. Remaining products shipped through the Port include cement, salt, asphalt, chemicals, scrap metal, steel, and iron. International tonnage in 2022 consisted of 65.44% of all commodity tonnage moving through the port, with domestic tonnage comprising the rest. More information is provided in the Channel Utilization Report, Appendix B.

2.1.2. Authorization of Providence River and Harbor Federal Navigation Project

The FNP for Providence River and Harbor was originally adopted in 1852 and was modified by 17 subsequent authorizations through and including the Water Resources Development Act (WRDA) of 1986, which deauthorized the India Point Channel. The existing project was authorized by the River and Harbor Act of 1965, in accordance with reports printed in Senate Document #93, 88th Congress, 2d Session, dated August 18, 1964. That project authorized deepening the main channel and turning basin in the Providence River to -40 feet MLLW. The complete list of authorizations is included in Appendix C. A continued federal responsibility for O&M of the navigation project, subject to the continued needs of existing commerce, is inherent in the authorization. Therefore, as long as there are existing commerce needs that are economically warranted, USACE is required to keep the FNP functioning at all times at the full capacity as intended in the authorizations.

Authority for federal participation in dredged material management planning and implementation of dredged material placement facilities in support of O&M of existing FNPs is specified in 33 U.S.C §2211 and Section 101 of WRDA 1986 (Public Law (P.L.) 99-662), as amended.

2.1.3. Providence River Federal Navigation Project Navigation Features

The Providence FNP is located in the Providence River and upper Narragansett Bay. This FNP consists principally of a -40-foot MLLW channel, 16.8 miles long by generally 600 feet wide from deep water in Narragansett Bay east of Prudence Island north to the city of Providence (Figure 1-2). A portion of the channel's upper reach widens to 1,700 feet wide for the maneuvering and turning of ships off the developed waterfront of Providence. A 25-foot-deep (-25 feet MLLW) anchorage at Green Jacket Shoal to the northeast of the head of the -40-foot (-40-foot MLLW) channel and turning basin has not been maintained in several decades and is not included in current O&M plans.

The Providence FNP is divided into seven reaches (Figure 1-2). The channel reaches from south to north are Entrance Channel, Rumstick Neck, Conimicut Point, Bullock Point, Sabin Point, Fuller Rock, and Fox Point.

The Entrance Channel is an area of about 1,300 acres. It is five miles long and 1,600 to 2,400 feet wide and is protected by an east breakwater (20,970 feet long) and a shore-connected west breakwater (6,048 feet long). There is a 201-foot gap in the west breakwater located about 662 feet from the shore end. The Entrance Channel is formed by the east and west arrowhead breakwaters, both of which are 1,250 feet long. The arrowhead breakwaters are 600 feet apart. The five reaches to the north of the Entrance Channel are generally 600 feet wide and serve as channels for two-way traffic. The Fox Point reach contains a widened area of up 1,700 feet wide serving as both a two-way channel and a maneuvering and turning area.

2.1.4. Providence River Federal Navigation Project Historic Maintenance

Federal improvement of Providence Harbor for navigation began in 1853 with the dredging of a nine-foot channel through the upper harbor to and above Fox Point. From 1854-1965, implementation of a series of congressional authorizations to modify the project would result in a gradual deepening and widening of the channel to depths of 12, 14, 23, 25, 30, 35 feet below MLLW, and finally -40 feet MLLW in 1965. A summary table of the maintenance history of the project is shown in Appendix D. Beginning in 1878, these improvements included creation of a large anchorage and maneuvering basin in the upper harbor between Fields Point and Fox Point, which ultimately covered all the area of the upper harbor between the harbor lines at the same depth as the channel.

The River and Harbors Act of 1886 authorized dredging a 25-foot (-25 feet MLLW) anchorage in the upper harbor below the mouth of the Seekonk River by removal of most of Green Jacket Shoal, located east of the upper harbor basin. Work on this feature began in 1886 and was completed in 1897, and the Act of 1902 incorporated this area into the Providence River project.

The 30-foot (-30 feet MLLW) India Point Channel, authorized together with the 40-foot (-40 feet MLLW) main channel in 1965, was never constructed and was deauthorized in 1986.

Over the 170 years of navigation improvements to Providence River and Harbor, a total of more than 60 million CY of material have been removed. A complete record of improvement and maintenance activity for the project is included as Appendix D. The 40-foot (-40 feet MLLW) improvement constructed between 1967 and 1976 accounts for 10 million CY of the total. Material from the 40-foot (-40 feet MLLW) project was disposed at an ocean site south of Brenton Reef in Rhode Island Sound. All other material removed over the years was disposed of either in deep areas of the River, along shore as fill for port development, or in deep water areas of the middle and lower reaches of Narragansett Bay.

The last dredging maintenance occurred in the years 2005 to 2006, during which time 3,800,000 CY of shoaled material was dredged from the 40-foot-deep (-40 feet MLLW) project features. Two-thirds of this dredged material (2,600,000 CY) was determined to be suitable for open-water placement at the RISDS (Figure 1-1). Approximately one-third of this material (1,200,000 CY) was determined to be unsuitable for unconfined open-water placement and was placed in a set of seven constructed CAD cells under the upper-most reach (Fox Point Reach) of this FNP (Figure 2-1). This set of CAD cells is termed the Fox Point Reach – North CAD cells (FPRN CAD cells). Federal participation of implementation of these FPRN CAD cells for one dredge cycle was approved through a Decision Document prepared by USACE in August 2002 along with an Environmental Impact Statement and Record of Decision signed in 2002. These seven CAD cells are to be capped with three feet of clean material upon completion of filling with unsuitable materials.

After USACE conducted the maintenance dredging of the FNP and placement of the dredged materials in the FPRN CAD cells in the year 2006, the CAD cells had additional space remaining for unsuitable materials, so USACE and the RI CRMC decided to leave the FPRN CAD cells open (uncapped) for the state's use, and these cells remain open and uncapped 18 years later. This additional space has been supplemented by capacity created by the post-placement consolidation of the dredged material in the cells. Recent surveys reveal that a volume of approximately 300,000 CY remains available in the FPRN CAD cells prior to the three feet of required cap, and several of the CAD cells are full or near full and require final capping. The DMMP will consider this remaining space, including capping, in determining future dredge placement needs.

During the 2005 maintenance dredging of Providence FNP, two large swaths of the project were not dredged: a 21-acre area on the eastern side of the southern portion of Fox Point Reach and a 6.4-acre area in the upper northern reach of Fox Point reach (see Figure 2-2). These two areas were designed for, and presently serve as, turning basins and vessel-passing areas to avoid impacts to berthed vessels along the western bank. USACE documented a decision in the 2002 Providence FNP Maintenance Plan to not dredge these areas during the 2005 maintenance dredging implementation. During this current DMMP planning process, USACE considered these areas for dredging to full authorized dimensions as part of the authorized FNP. Based on the recent channel utilization analysis and engineering calculations of vessel needs as part of this DMMP, USACE concluded that these areas need to be dredged to full authorized depths and widths, as discussed further in this report.

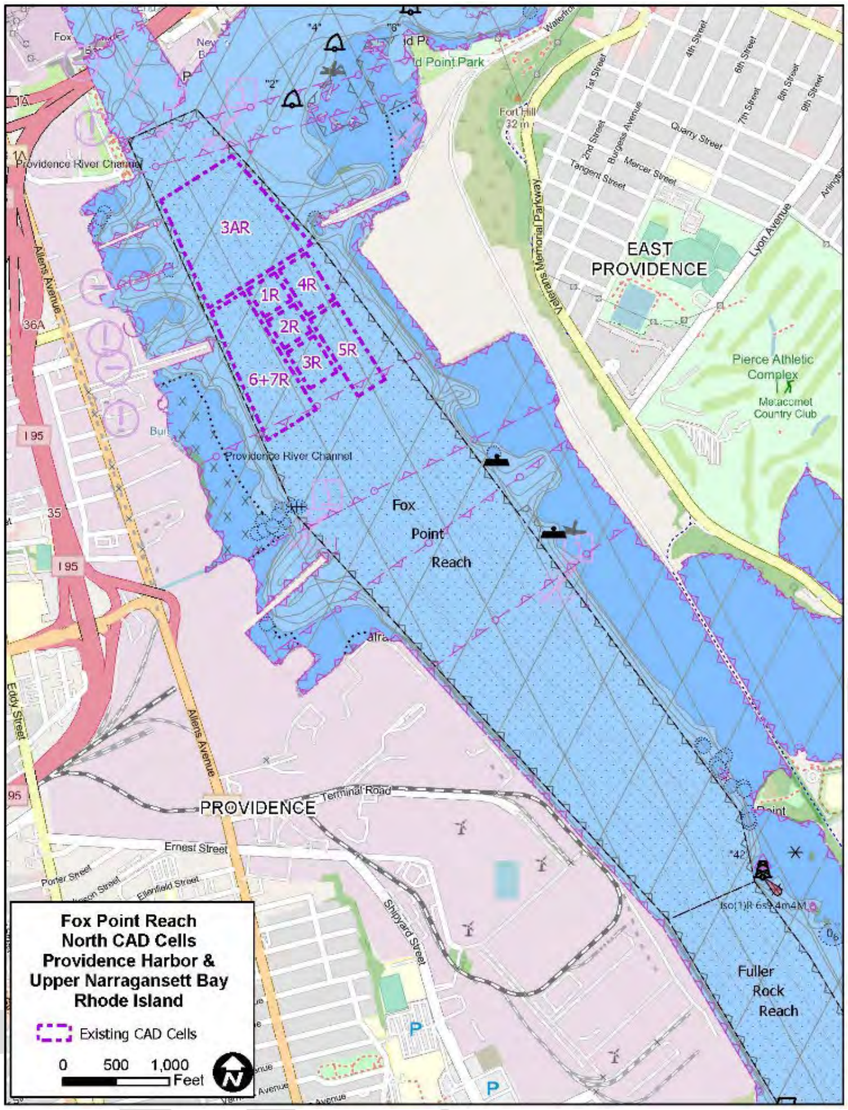


Figure 2-1. Fox Point Reach North Confined Aquatic Disposal Cells Location.

2.1.5. Previous Reports and Studies

The Providence FNP and associated features have been studied by the New England District. A short description of the recent pertinent reports can be found below in Table 2-1.

Table 2-1. Previously Completed Project Reports.

Report/Product	Document	Date
Providence River And Harbor, Rhode Island, Decision Document for Maintenance Dredging and Dredged Material Placement Facility Construction	Decision Document	August 2002
Providence River and Harbor Maintenance Dredging Project, Final Environmental Impact Statement	Environmental Impact Statement	August 2001

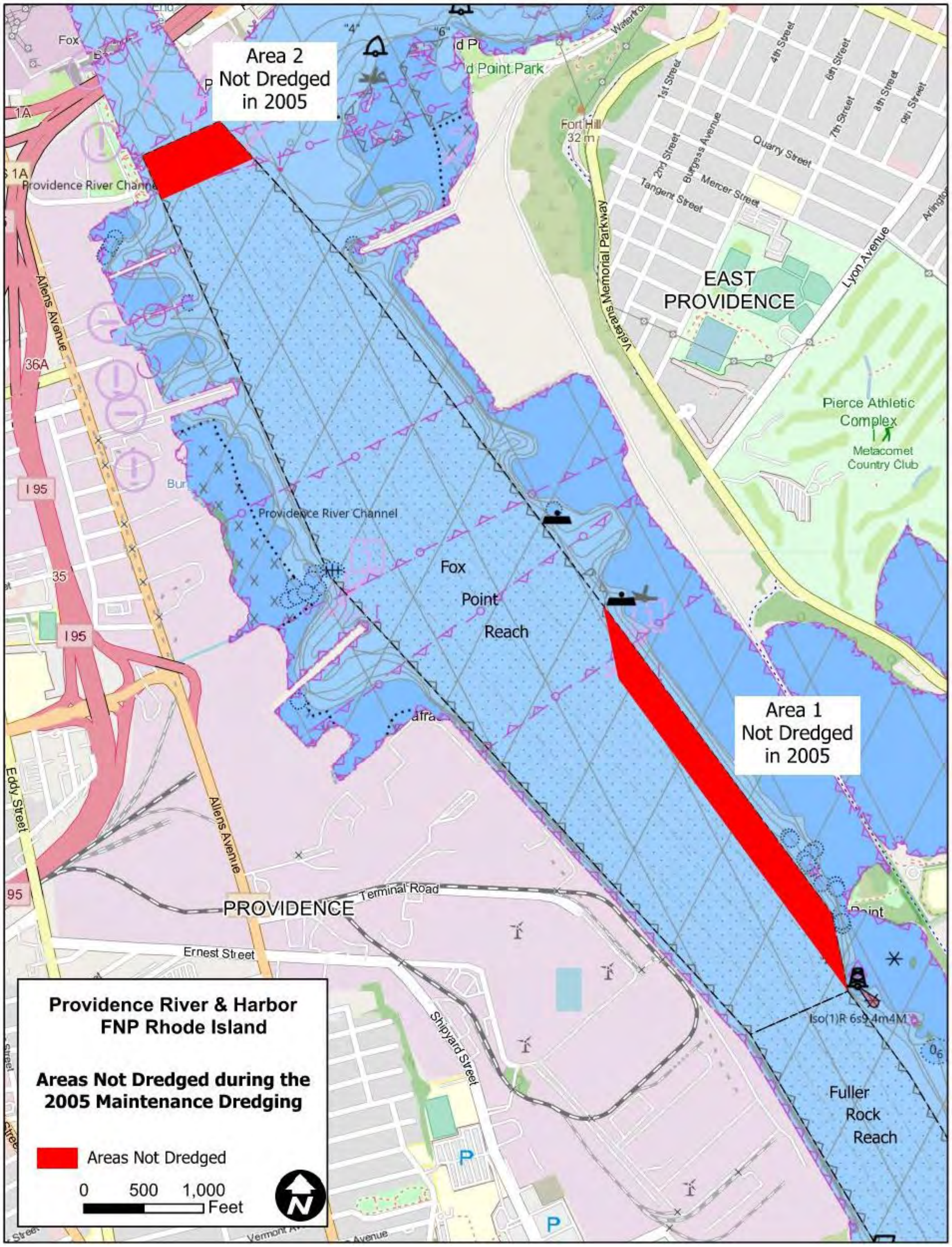


Figure 2-2. Areas of the Providence River and Harbor Federal Navigation Project that were not Dredged During the 2005 Maintenance Operation.

2.1.6. Other FNP Navigation Features Associated with the Providence River

Per USACE guidance (ER 1105-2-100, Appendix E), when two or more Federal projects are physically inter-related or are economically complementary, one DMMP may encompass that group of projects. . In the case of the Providence FNP, there are three FNPs within the greater Providence River and Harbor area, the Bullocks Point Cove FNP, the Pawtuxet Cove FNP, and the Apponaug Cove FNP. These features and dredging history of these FNPs are shown in Table 2-2.

Table 2-2. Adjacent Federal Navigation Projects and Dredging History.

Federal Navigation Project	Depth (Feet below MLLW)	Length (Miles)	Width (Feet)	Expected Dredging Need (CY)		Dredging History	
				2028	2048	Dredging Amount (CY)	Date (Year)
Bullocks Point Cove	8	1.15	75	7,300	7,000	45,000	2009
Pawtuxet Cove	6	0.67	100	34,300	26,000	94,000	2006
Apponaug Cove	6	0.74	100	22,000	10,000	188,430	1963
Total				63,000	43,000		

Due to the connectedness, interdependence, and complimentary maintenance needs of these three FNPs with the Providence FNP, the Study Team decided to include these adjacent FNPs as part of this DMMP. The total immediate dredge needs are 63,000 CY of materials, all of which are considered unsuitable for open-water disposal. Therefore, this material would need to be placed in a facility that is designed for unsuitable material placement. By the year 2048, based on historic shoaling rates, the total additional dredging needs are predicted to be 43,000 CY, all of which are also expected to be unsuitable for open-water disposal. Therefore, this future material is expected to be placed in a facility that is designed for unsuitable material placement.

2.1.7. Non-Federal Dredging Needs

Throughout the history and operation of Providence FNP, USACE, New England District has worked with the project's stakeholders, including but not limited to the RI CRMC, RIDEM, the City of Providence, Save the Bay®, and ProvPort, Inc. As part of the DMMP planning process, USACE is required to identify and consider providing placement needs for non-federal sources. Any additional capacity that is established for purely non-federal needs is considered additional work and subject to 100% cost sharing by the Non-Federal Sponsor, RI CRMC, as per ER 1105-2-100, E-275 (Exhibit E-1).

The Non-Federal Sponsor has identified the need to dredge a variety of non-federal ports, harbors, channels, and berths adjacent to the Providence FNP. These non-federal navigation features are anticipated to need dredging of up to 300,000 CY of material through the year 2047 that is unsuitable for placement in the RISDS, and then another 300,000 CY of unsuitable materials over the following 20 years. The existing old CAD cells in the upper Fox Point Reach are near capacity, so this 300,000 CY of unsuitable material will need to be placed elsewhere. The Non-Federal Sponsor has requested that a placement site have the additional capacity to accommodate this 300,000 CY of local dredged materials for the cycle-one maintenance placement, and then another 300,000 CY for placement after 2048.

2.2. Project Purpose and Need for Federal Action*

This section describes the basis for moving forward with the study and preparation of the DMMP.

2.2.1. Project Purpose

The purpose of dredging the Providence FNP is to restore and maintain long-term navigation efficiency and safety of the FNP for deep-draft vessel traffic. The Providence FNP constitutes the principal commercial waterway in Rhode Island, providing navigation to the Port of Providence. Deep-draft traffic in the FNP consists mainly of tankers, barges, and general cargo vessels, typically with drafts in excess of 39 feet, fully loaded.

Navigation in the Providence FNP, along with three adjacent shallow-draft FNPs (Pawtuxet Cove, Bullocks Point Cove, and Apponaug Cove) (Figure 1-2), is required to be maintained by USACE, including periodic dredging of the channel and facilities, in order to meet channel utilization requirements as economically warranted (ER 1105-2-100). USACE must ensure sufficient dredged material placement site capacity is readily available to accommodate a minimum of 20 years of maintenance dredging in the Providence FNP.

2.2.2. Need for Federal Action

USACE has demonstrated that continued maintenance to provide full authorized depth and widths of the Providence FNP is economically warranted based on high priority (non-recreation) benefits. Recent utilization analysis (Appendix B) and engineering specifications (Appendix E) for existing and expected commercial vessel use in the Providence FNP show that dredging is economically warranted and needed immediately to full congressionally authorized depths of -40 feet MLLW, along with full authorized channel and turning basin dimensions. However, the present conditions of the FNP do not fully provide for such economically warranted commercial uses, and both immediate and future predicted dredging and dredged material placement are needed to reestablish and then maintain the intended commercial uses. In addition, USACE has not have identified placement capacity for the material that would need to be dredged immediately nor in the future. Therefore, USACE has a need to prepare and implement a DMMP to identify an implementable plan to address the navigation requirements.

For the purposes of long-term planning, USACE estimated present and future dredging needs to maintain authorized depths in the FNP for the near-term and the 20-year period of 2028 to 2048. The analysis is based on the channel condition surveys conducted for the Providence FNP from the years 1971 through 2020 and calculating average short-term and long-term shoaling rates by comparing previous condition surveys to the 2020 survey. In general, the channel condition surveys revealed that shoaling has reduced the depths of the Providence FNP throughout the length of the project, with depths reduced in some places to less than 20 feet below MLLW, when the authorized channel depth is -40 feet MLLW. Therefore, immediate maintenance by dredging out the shoaled material is needed to maintain project utilization as shown to be economically warranted. Using the past long-term sediment shoaling rates in the project area, USACE predicts that the FNP will require dredging again within 20 years to maintain channel utilization. More details about shoaling amounts and rates and predicted future rates are shown in Section 3 Dredging Needs and Future Without Maintenance Plan.

Chemical and biological testing of the shoaled materials revealed that all of the materials were unsuitable for dredged material placement in existing EPA designated open-water disposal sites and would have to be placed in other sites where such unsuitable material could be placed in an environmentally acceptable manner. All present available nearby sites approved for placement of unsuitable materials are at or near capacity; therefore, new sites and facilities will need to be identified and approved for immediate dredged material placement, as well as placement of dredged material over the next 20 years. More detailed information about sediment characteristics is found in Chapter 4 Existing Conditions and Affected Environment.

This report will document the utilization analysis and engineering specifications for economically warranted commercial vessel use in the Providence FNP and show that dredging is required to full authorized depths and dimensions to maintain full utilization as authorized by Congress, and to meet the needs of current and expected future vessel traffic. This DMMP will describe shoal rates and expected maintenance needs through the year 2048 for the Providence FNP, as well as nearby FNPs and local facilities to meet the project needs.

Expected shoal rates throughout the FNP average a foot every four years based on recent channel condition surveys. USACE predicts that by 2028 over 2,015,000 CY of sediment will need to be dredged to return the FNP to full authorized depths and widths. Extrapolating long-term shoal rates, the FNP would shallow as much as five or more feet over the next 20-year period and would require an additional 1,900,000 CY of dredging over the 20-year planning period to maintain channel authorized depths and widths to provide full utilization. Thus, total placement of 4,400,000 CY will need to be proposed and implemented to maintain FNP utilization. This DMMP is required because the remaining capacity of existing placement locations cannot accommodate the quantity and characteristics of 4,400,000 CY of dredged material from O&M to meet the full channel utilization. This DMMP will formulate alternatives for placement capacity of this dredged material the through the year 2048.

A material management plan, including placement locations of the dredged material, must be developed, and implemented so that channel maintenance can continue and for the estimated 4,400,000 CY of dredged material to be appropriately placed. Without a well-defined plan to cover current and near future dredging needs in the year 2028, as well as the following 20 years, through the year 2048, there is high risk the O&M dredging may be interrupted at Providence FNP, thus negatively affecting channel utilization. The recent channel utilization analysis provides evidence that the proposed O&M dredging of the FNP to provide full authorized depths and widths throughout the FNP will eliminate the existing safety hazards associated with the shoaling of the FNP and result in cost efficiencies for shippers into the port. Without immediate, as well as long-term dredging, navigation conditions in the FNP will continue to deteriorate, resulting in greater restricted access for large vessels entering the Port of Providence. Eventually, much of the economic value of the port would be lost.

2.3. Cost Sharing Responsibilities

Cost sharing is required by 33 U.S.C. § 2211 and Section 101 of WRDA 1986, as amended, and is detailed in ER 1105-2-100. Cost sharing is required and further detailed in Policy Guidance Letter (PGL) No. 47 for construction of FNPs and for any additional improvements and facilities needed for the long-term maintenance, including CAD cells, which are considered general navigation features subject to cost sharing (USACE, 1998). The cost-share requirements for

FNPs of various depths are shown in Table 2-3. Estimated cost-sharing amounts will be identified for the recommend plan later in the report.

Table 2-3. Cost-sharing Responsibilities of the Non-Federal Sponsor for Operation & Maintenance Dredging Operations, including placement facility construction, including CAD cell construction, which are considered general navigation features of the project.

Source of Material for CAD Cell Capacity	Up-Front Percentage	Post Construction Percentage	Total Percentage of Cost Share
Providence FNP (40-Foot-Deep (MLLW) Project)	25.00%	10.00%	35.00%
Shallow Draft FNP Volumes (up to 20-Foot-Deep (MLLW))	10.00%	10.00%	25.00%
Non-federal Capacity Volume	100.00%	0.00%	100.00%

2.4. The Base Plan and Federal Standard for Dredged Material Management

Federal regulations (ER 1105-2-100, Appendix E) require USACE to establish the Base Plan, which is defined as the plan that provides dredged material management associated with the construction or maintenance dredging of FNPs in the least costly manner, consistent with sound engineering practice and environmentally acceptable. Environmental acceptability is defined as meeting all federal environmental standards including the environmental standards established by Section 404 of the CWA of 1972 or Section 103 of the MPRSA of 1972, as amended. This set of requirements meets the “Federal Standard” under 33 CFR 335.7, defined in the CFR as “the dredged material disposal alternative or alternatives identified by the Corps [USACE] which represent the least costly alternatives consistent with sound engineering practices and meeting the environmental standards established by the [The CWA Section] 404(b)(1) evaluation process or ocean dumping criteria."

This DMMP will identify the maintenance and construction management plan for the Providence FNP and associated FNPs covering a period through 2048, by the following steps:

1) Identify the level of maintenance required for the Providence FNP and associated FNPs over at least the next 20 years that is economically warranted based on commercial benefits.
2) Identify the alternative that meets required level of maintenance that is economically warranted and also satisfies the Federal Standard requirements, and this alternative would then be the initial Base Plan. General navigation features, including CAD cells, associated with the Base Plan would be cost-shared with the Non-Federal Sponsor as laid out in statute and USACE regulations (33 U.S.C § 2211, 1998 PGL 47, and ER 1105-2-100.
3) Assess beneficial uses of dredged materials associated with the maintenance and construction operations and revise the Base Plan to include these proposed beneficial uses that do not increase the initial Base Plan cost.

4) If the cost of the Beneficial Use does not add more than 25% of the original Base Plan cost (USACE, 2022a), then the alternative can be added to an alternative that is considered further and cost-shared under Section 204(d) requirements.
5) Identify beneficial uses that are more than 25% more than the Base Plan, and these beneficial uses can be pursued under separate authorities. And,
6) Consider adding placement capability for local non-federal dredging needs as requested by the Non-Federal Sponsor and combine this additional capability with the Base Plan as practical to be included in the recommended plan, and the additional capability would be 100% covered by non-federal funds.

2.5. Problems and Opportunities*

Existing and predicted future navigation problems, along with opportunities for resolving the problems, form the basis for defining the project objectives and conducting plan formulation.

2.5.1. Problems and Projections of Future Conditions in the Absence of a Management Plan

Approximately two million CY of shoaled material have accumulated throughout the entire length of the Providence FNP and adjacent FNPs since the last dredging operation in 2005, resulted in significant reductions in channel water depth and channel width and causing economic impacts to the project navigation utilization. USACE predicts that another two million CY of sediment will shoal in the FNPs within Narragansett Bay through the year 2048, which will cause ongoing and worsening navigation problems without a management plan to address the shoaling problem. Section 3 of this report will provide more details about dredging needs, including volumes and rates of sedimentation in the past 40 years, predicted shoaling rates through 2048, and predicted accumulations in terms of both quantity and thickness within the FNP footprint.

This accumulated sediment has shallowed portions of the channel and turning basin by as much as 10 feet shallower than the -40-foot (MLLW) authorized depth, which impedes commercial navigation and reduces the utilization of the FNP. The channel utilization analysis (Appendix B), along with the vessel channel needs analysis (Appendix E), shows that the Providence FNP must be maintained to full authorized depths and full widths throughout the length of the FNP in order to meet the level of channel utilization that is economically warranted. In order to bring the FNP to full required and authorized dimensions, over two million CY of shoaled material will need to be dredged and placed in one or more appropriate locations by the year 2028. Then, another two million CY of additional material, expected to shoal over the following 20 years, through the year 2048, will need to be dredged over the 20-year period in order to maintain the FNP at full authorized dimensions and to maintain full project utilization capability. Overall, approximately four million CY of shoaled material will need to be managed through the year 2048 to maintain project utilization as economically warranted.

Another problem is that no sites are available currently or in the future to place the material that the USACE must dredge out of the FNPs to maintain economically warranted commercial utilization. Currently, EPA has designated an open-water placement area for dredged material that is located in Rhode Island Sound (Figure 1-1). This RISDS is only available for placement of materials deemed suitable, in that USACE determines the materials meet chemical and biological viability criteria. However, in recent comprehensive evaluation of the shoaled sediments in the Providence FNP, USACE determined that all of the shoaled materials are not suitable for placement in the RISDS.

USACE also expects that all of the material to be dredged from the local FNPs, as well as future dredging needs in the Providence FNP, will also produce unsuitable materials. Therefore, before USACE can perform any maintenance dredging of the Providence FNP and other local FNPs, USACE must find other placement sites where such unsuitable materials can be placed with acceptable environmental impacts. USACE has not identified available sites for unsuitable material that would be dredged from the Providence River area.

The current FPRN CAD cells are near capacity, and the only available capacity remaining is already designated for non-federal needs and is not available for the placement of material from the Providence FNP nor other FNPs. More details about the sediment quality are provided in Section 4.2 of this report.

Future conditions, through the year 2048, in the absence of a management plan, are described in terms of the economic, social, and environmental conditions that would be expected in the study area during the period of analysis in the absence of a plan for dredged material placement. The future conditions without a management plan provide the basis for justifying whether a management plan is economically warranted. The absence of a management plan to meet the channel utilization needs is considered in the report to be the "no-action plan". This no-action plan is used as a benchmark to measure the economic, social, and environmental effects of the alternative management plans considered to meet future channel utilization needs.

Without a management plan, USACE would have no placement facilities for the unsuitable materials needed to be dredged presently nor for expected dredged material placement needs through 2048, so USACE would not be able to conduct any FNP dredging maintenance of the Providence FNP. Sediment would continue to accumulate within the Providence FNP, and navigational and safety hazards are expected to worsen without the maintenance. Without maintenance dredging, commercial navigation interests would incur increased costs of waterborne transportation and associated economic impacts. Likewise, USACE would not be able to dredge and place the probable unsuitable materials that will be shoaled in the nearby shallow-draft FNPs, and these other FNPs would become shallower than the authorized navigation depths and would incur navigational restrictions.

A well-defined plan, a DMMP, to address placement of expected shoaling over the next 20 years is needed to have an effective long-term O&M program for Providence FNP and associated local FNPs. Without such a DMMP, followed by plan implementation, the utilization of the FNP will continue to be impeded, with increasing navigation impacts.

In summary:

- The Providence FNP must be maintained regularly to full authorized depths and widths throughout the entire length of the FNP in order to provide economically warranted commercial utilization.
- The navigation problems with the Providence FNP and adjacent FNPs are associated with the continual shoaling of the channels and turning basins resulting in the need for regular

maintenance dredging and dredged material placement. The Providence FNP was last dredged in 2005, and the accumulation of sediment is several feet deep in places, which is now adversely affecting commercial utilization of the FNP

- A broad area in the wider portion of the channel in Fox Point Reach is needed for turning and docking. This additional authorized width was not dredged in 2005, and the current utilization analysis shows that this additional width is needed.
- The sediments accumulated in the Providence FNP are unsuitable for open ocean disposal, so other locations are needed for the safe and environmentally acceptable placement of the unsuitable dredged material.
- Existing CAD cells in the upper Fox Point Reach, constructed and used for placement of dredged material in 2005 and additional materials over the last 15 years have nearly filled these CAD cells, and remaining capacity is already allotted to non-federal dredging placement needs over the next few years. These existing CAD cells have no allocated space for the extensive amount of dredged material needed to be removed from the Providence FNP to bring the project back to authorized depths and widths.
- There are no additional approved locations for placement of the shoaled material already impeding the Providence FNP nor locations to place the additional material that is expected to be shoaled through the planning period (through 2048). The total expected volume of shoaled material in the greater Providence River complex that has already shoaled and will continue to shoal through the year 2048 is expected to be approximately 4,000,000 CY. All of this shoaled material is expected to be unsuitable for open-water placement or placement for most beneficial uses. Identification of new dredged material management alternatives must be formulated and implemented immediately to allow for uninterrupted maintenance dredging of Providence FNP through 2048.

2.5.2. Opportunities

- Over the last decade, USACE has been collaborating with state and local stakeholders through stakeholder meetings and the Providence River Channel Task Force to identify dredged material management opportunities to address the problems at Providence River channel and estuary.
- There are existing areas in the greater Providence River estuary and in Narragansett Bay with relatively deep underlying clean glacial sediments where CAD cells could be constructed for placement of unsuitable dredged materials.
- There are several locations throughout the greater Providence River estuary where clean dredged material can be placed to provide beneficial uses, including filling human-made depressions that currently create poor water quality conditions and capping placed dredged materials that have been placed in certain locations over the last 60 years that contain contaminants. Additional possible beneficial-use sites within the greater Providence River estuary include shallow open water areas and degraded marsh areas where clean fill material can be added to restore or create new intertidal marshes. Beneficial-use of dredged material is generally supported by project partners and stakeholders.

- An old, abandoned dredged channel and port forming a 30-foot-deep (MLLW) hole within Edgewood Shoals, adjacent to the Providence FNP, is no longer needed and is causing negative environmental conditions. This old facility, hereby called Port Edgewood Basin (PEB), can be filled, and capped to restore this site. There is an opportunity to place both unsuitable and suitable materials in this port and then cap the site with suitable materials.
- State and local partners also need placement space for local navigation dredging needs, and they want to collaborate to develop mutually beneficial solutions to dredged material management.

2.6. Goals, Objectives, Considerations, and Constraints

WRDA of 2007 established the Federal Objectives for water resources investments, which directs USACE to make sure federal water resources investments reflect national priorities, encourage economic development, and protect the environment by:

1. Seeking to maximize sustainable economic development.
2. Seeking to avoid the unwise use of floodplains and flood-prone areas and minimizing adverse impacts and vulnerabilities in any case in which a floodplain or flood-prone area must be used; and
3. Protecting and restoring the functions of natural systems and mitigating any unavoidable damage to natural systems.

For the purposes of the DMMP, the Federal Objectives will be addressed by identifying and selecting a plan that meets the Federal Standard in that the plan is least-cost for maintenance of the federal navigation projects, is technically feasible, and is environmentally acceptable. The following formulation goals and objects for this DMMP were developed by the Study Team to meet both the intent of the Federal Objectives.

The goals and objectives of this DMMP are statements that describe the desired results of the planning process by solving the stated problems and taking advantage of the opportunities identified. The goals and objectives must be directly related to the problems and opportunities identified for the study and are used for the formulation and evaluation of plans.

Planning considerations are factors that the Study Team expects to address in formulating and evaluating measures and alternatives to address the project goals and objectives. Constraints are likely restrictions that limit the planning process. This decision document will consider resource, legal, and policy constraints. Resource constraints are associated with limits on knowledge, expertise, experience, ability, data, information, money, and time. Legal and policy constraints are those defined by law, and USACE policy and guidance. Alternative plans are formulated to meet study goals and objectives and avoid violating constraints.

2.6.1. DMMP Goals and Objectives:

- *Goal 1:* Develop a plan, consisting of a least cost, technically feasible, and environmentally acceptable alternative for managing all material needing dredging from Providence FNP to maintain the FNP to Congressionally authorized depths and widths. *Objective 1:* The plan needs to meet the Federal Standard in that it is the least cost, technically feasible, and environmentally acceptable method to address removal and placement of the existing and near-future shoaled material in the Providence FNP up to the year 2028 and expected material that will shoal through the 20-year period of 2028-2048. The plan will meet all applicable USACE policies and address federal legal requirements by identifying federal and state requirements during the DMMP preparation and addressing permit needs during the design phases.
- *Goal 2:* The plan will address dredged material placement requirements in other FNPs branching off of the main Providence FNP. *Objective 2:* Address placement of material that will need to be dredged from the three adjacent FNPs (Bullocks Point Cove, Pawtuxet Cove, and Apponaug Cove) for the 20-year planning period of 2028 to 2048.
- *Goal 3:* The plan will consider possible beneficial uses of dredged materials. *Objective 3:* Identify the beneficial use placement needs for possible sites in the vicinity of Providence FNP during the DMMP planning process through the year 2025, including material characteristics and quantities needed.
- *Goal 4:* The plan will consider the O&M dredged material placement requests of the Non-Federal Sponsor for local (non-federal) projects. *Objective 4:* Obtain local requests during the DMMP planning period through the year 2025 to address needs through the 20-year period of 2028-2048.

2.6.2. DMMP Considerations and Constraints:

- *Consideration:* There are several environmental conditions that limit dredging activities to certain areas and certain times. These considerations will be described in greater detail in Chapter 7, Environmental Impacts.
- *Consideration:* Providence FNP as a viable commercial navigation project, and the PDT predicted that Providence FNP will remain as the major commercial port in Rhode Island and will remain critical to Rhode Island's economy over the next 20 years. The entire authorized FNP is needed for commercial benefits, and USACE will not seek any deauthorization of any portion of the FNP. The PDT predicted that vessels will continue to use the FNP, and sizes will be the same or become larger over time.
- *Consideration:* The PDT predicted that the Providence FNP will continue to experience shoaling over the next 20 years at the same past measured rates, based on USACE-performed channel condition surveys.
- *Consideration:* The PDT predicted that the adjacent shallow-draft FNPs (Bullocks Point Cove, Pawtuxet Cove, and Apponaug Cove) will remain viable over 20 years, shoaling from past measured rates will continue over the next 20 years, and that the material needing to be dredged and placed will not be suitable for open-water disposal.

- *Consideration:* USACE tested the materials that had shoaled in Providence FNP and determined that all of the shoaled material was unsuitable for open-water placement. The PDT predicted that sediments continuing to be shoaled in the Providence FNP and adjacent shallow-draft FNPs over the following 20 years (through 2048) will continue to the unsuitable for designated open-water placement in approved sites. CAD cells or other specially designated or designed facilities will be needed for all the existing shoaled material as well as the future shoaled material through 2048.
- *Consideration:* Historically, non-federal interests for dredged material placement (from local marinas, dock owners, ProvPort, etc.) have dredged areas and placement needs in the Providence River complex, and this placement has averaged as much as 30,000 CY per year. The PDT predicted that a total of 300,000 CY of material will need to be dredged within the 20-year planning period and will be unsuitable for offshore placement.
- *Constraint:* Projects will be subject to financial constraints and availability of funds, both federal and non-federal.

3. Dredging Needs and Future Without Maintenance Plan*

To determine potential dredging needs in the Providence FNP, the Study Team used data from periodic project hydrographic condition surveys that were conducted over the last 50 years, and the Study Team estimated both short-term shoaling rates and long-term shoaling rates to predict existing and future project conditions through the year 2048. The latest hydrographic condition survey was conducted in the year 2020 (see Figure 3-1 and Figure 3-2).

To determine future dredging needs, the USACE Study Team performed the following steps:

Step 1: Determine the extent of dredging needed in terms of depth and width throughout the project to obtain full project utilization as intended by the project authorizations and that continues to be economically warranted. The Channel Utilization Analysis (Appendix B) showed that the entire authorized footprint needs to be dredged to full authorized depths to remove restrictions to navigation and to restore full utilization. The channel width requirements for vessel passage and turning are shown in the Engineering Appendix (Appendix E), and this analysis revealed that the entire authorized widths of the channel and turning basin reaches must be maintained down to the full authorized depth of -40 feet MLLW to meet the economically warranted commercial use of the FNP.

Step 2: Determine the quantity of dredging needed to meet the intended utilization, i.e., full authorized depths and widths throughout the FNP. This quantity is determined by calculating the dredge quantity needed from the most recent (2020) condition survey to bring the entire project down to the authorized depths, plus allowable overdepth of 2 feet, and then adding on estimated recent shoal rates to account for shoaled material from the condition survey year (2020) to the planned dredge year (2028).

Step 3: Using long-term average shoal rates to account for the uncertainty of future major flood and storm events, estimate when dredging will be needed again within the 20-year planning horizon (to 2048), which will be when the FNP condition is compromised to the point where utilization of the FNP is again impacted and anticipated commerce is limited or curtailed.

Following these three steps, the Study Team determined navigation conditions and dredging needs for two maintenance cycles from 2028 through 2048:

Cycle One: Using the latest hydrographic condition survey, from the year 2020, plus predicted shoaling amounts using recent short-term shoaling rates, the Study Team predicted dredging volumes needed to restore the Providence FNP to fully obtain authorized depths and widths, earliest planned in 2028, and

Cycle Two: based on long-term shoaling rates, the FNP conditions will deteriorate causing navigation impacts with a threshold reached by the year 2048, at which point the entire FNP will need maintenance to full authorized depths and widths to restore economically warranted commercial navigation conditions.

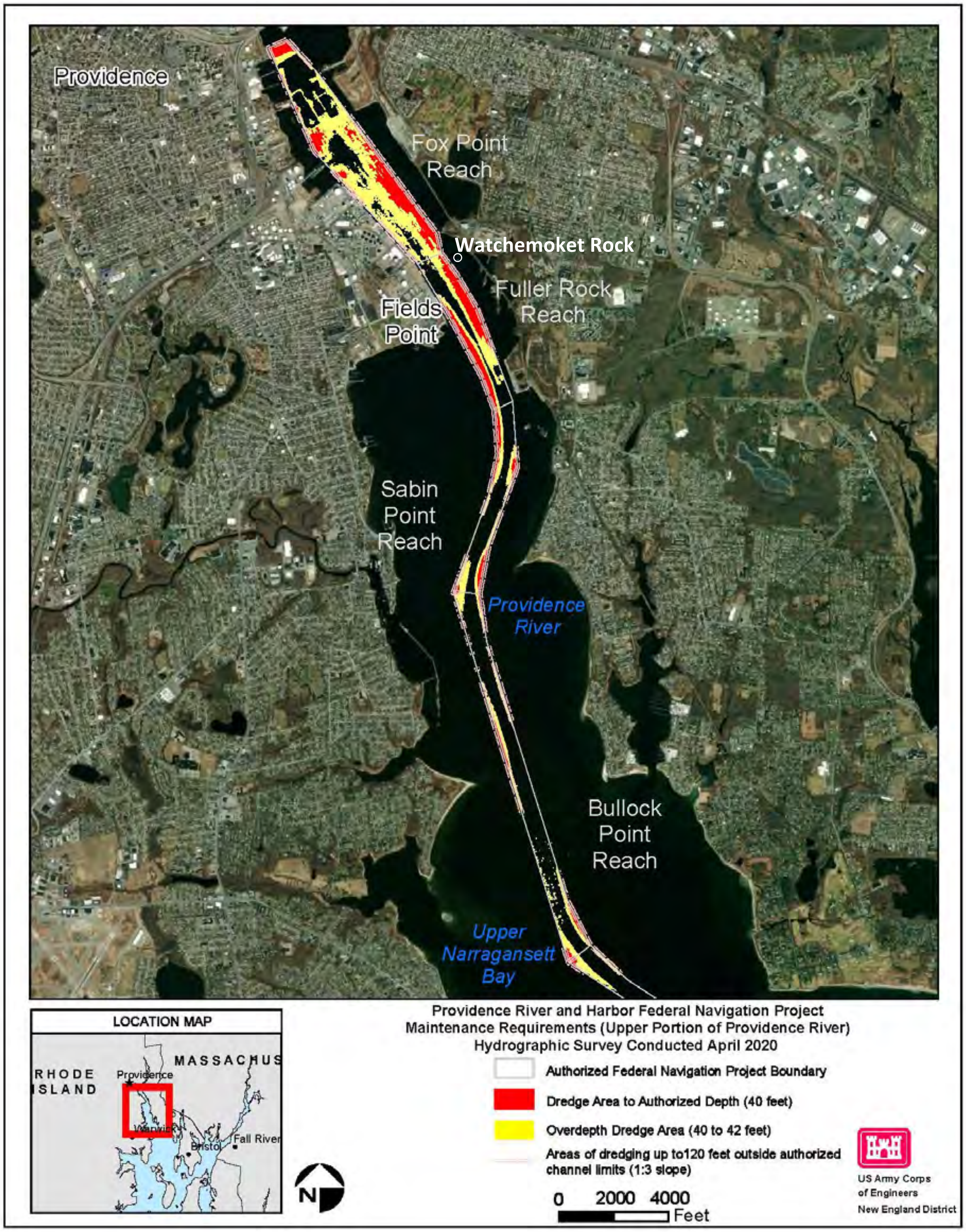


Figure 3-1. Providence River and Harbor Navigation Project Maintenance Requirements (Upper Portion of Providence River). Hydrographic Survey Conducted April 2020.

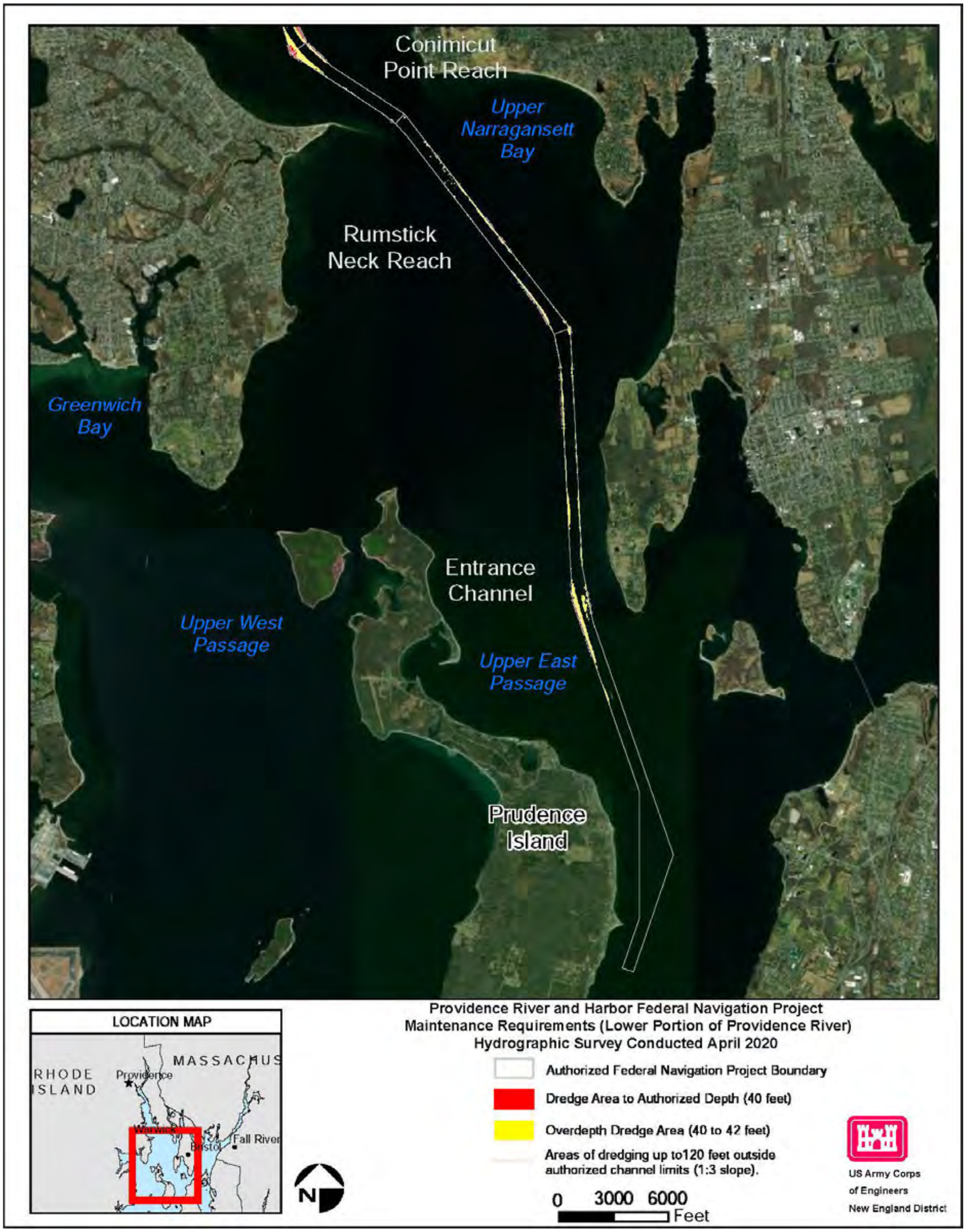


Figure 3-2. Providence River and Harbor Navigation Project Maintenance Requirements (Lower Portion of Providence River). Hydrographic Survey Conducted April 2020.

The Study Team determined dredging needs in terms of predicted shoaling and reduced depths in the project area and in terms of dredge volumes needed to return the FNP to full dimensions as economically warranted. The Study Team determined future conditions if no dredging occurred throughout the 20-year horizon, and the future conditions if only Cycle-One maintenance was performed and Cycle-Two maintenance was not performed, in order to understand the expected future conditions with and without dredging activities.

Based on the last condition survey, conducted in 2020, approximately 1,631,000 CY of shoaled material has accumulated in Providence FNP through the year 2020. Table 3-1 shows shoaled amounts and average shoaling rates by time period, along with projected average short-term and long-term shoal rates that may incur in the FNP.

Table 3-1. Expected Shoal Rates and Volumes in Providence Federal Navigation Project since Last Condition Survey (2020) by Comparing Past Condition Surveys.

Start Date	End Date	Difference (Months)	Start Volume (CY)	End Volume (CY)	Difference (CY)	Shoal Rate	
						(CY/Month)	(CY/Year)
Jun-71	Jun-99	336	0	3,899,100	3,899,100	11,604	139,000
Jun-07	Nov-15	101	890,349	1,438,133	547,784	5,424	65,000
Nov-15	Apr-20	53	1,438,133	1,630,690	192,557	3,633	44,000
Short-term Average (2007-2020)		**154**			**740,341**	**4,807**	**58,000**
Long-term Average (1971-2020)		**591**			**4,639,441**	**7,900**	**95,000**

The overall FNP footprint was determined to shoal at a short-term (recent) rate of about 4,807 CY per month (58,000 CY per year), based on more recent data, from the year 2007 through 2020 (Table 3-1). This short-term rate can be used to predict the near-term shoaling rates between the years 2020 and 2027, since most of the predicted period already occurred as of the publication of this report. Therefore, the estimated shoaling rate from the year 2020 through December 2026 is 384,000 CY, as shown in Table 3-2.

Table 3-2. Providence River Estimated Shoaling Volumes for Future Conditions.

Start Date	End Date	Difference (Months)	Assumed Shoal Rate (CY/Month)	Estimated Shoaling Volume (CY)	Comment
Apr-20	Dec-26	80	4,807 (58,000 CY/Year)	384,000	Based on short-term average shoal rate, due to low uncertainty with known hydrological conditions from 2020-2024, similar to the 13-year period between 2007-2020
Dec-26	Dec-46	240	7,900 (95,000 CY/Year)	1,900,000	Based on long-term average shoal rate, due to high uncertainty of future events, so accounting for longer period that captures significant shoaling events

To estimate long-term shoaling rate into the distant future (from the year 2028 through 2048), the Study Team used a more conservative shoaling rate to account for uncertainties in future hydrologic and storm conditions in the watershed and coastal area. This more conservative shoaling rate pulled in data from the year 1971 through 2020, for an estimated shoaling rate of 7,900 CY per month (95,000 CY per year). Therefore, the estimated shoaling rate from the year 2027 through December 2046 is 1,900,000 CY, as shown in Table 3-2.

The impact of this shoaling on navigation is discussed in terms of controlling depths for each channel reach and the effect those depths have on the maximum allowable draft of large vessels, considering the under-keel clearance requirements and tidal elevations. Controlling depth is typically expressed as the shallowest depth at MLLW in any portion of the channel that affects vessel traffic. The controlling depths measured during the condition surveys are not taken at the same point each survey; they are the shallowest (termed “shoalest”) measurement within the reach and may be an isolated point or an entire area. Controlling depths are computed and published for each reach by channel quarter width (i.e., left and right inside quarters and outside quarters). In actual practice, harbor pilots will deviate from the channel center line to avoid the shallowest outside quarter slopes, using the deepest three-quarters of the channel in each reach as a guide to controlling depth. Controlling depths from the 2020 condition survey are shown in Table 3-3.

The Study Team first examined each shoalest point and excluded those points that were within 50 feet of the outer banks, assuming that vessels can navigate around them, and those points that could be mounds caused by factors other than shoaling. The shallowest controlling reaches currently are Fox Point Reach, with effective controlling depths as shallow as 26.1 feet below MLLW, and Bullock Point at 33.6 feet below MLLW (see Table 3-3). These controlling depths currently restrict navigational access, as further explained in the Channel Utilization Report, Appendix B.

Without at least one proposed maintenance dredging cycle (Cycle One) to restore the Providence FNP to its authorized depth, the channel and turning basin will continue to become even shallower, further restricting navigational access for large vessels and creating increasingly hazardous conditions for navigation. To predict how much shallower the FNP may become over the planning horizon of 20 years without a maintenance plan, using these adjusted shoalest points for each reach, the Study Team calculated predicted shoaling thickness rates using the shoaled depth at the year 2020 minus the fully maintained depth of -40 feet MLLW and the amount of time passed since the particular shallowest portion of each reach had been last dredged. Most of the reaches were last dredged entirely to -40 feet MLLW in 2007. However, the shallowest portions of Fox Point Reach were last dredged in 1971 and were not dredged in 2007.

Currently, the FNP has shoaled areas with navigation controlling depths as shallow as -20.4 feet below MLLW. These shallow navigation controlling depths are reducing the project navigation utility, requiring vessels to be light-loaded or off-loaded onto smaller barges (lightering) outside the FNP. Shoaling has occurred in areas that limit turning and maneuvering room and disrupts channel operations for many larger vessels, including all vessels requiring depths of 35 feet or more. This shoaling has resulted in some vessels being partially unloaded of cargo in deeper water onto smaller barges (called lightering) prior to entering the Providence FNP. Narrowing of Fox Point Reach due to shoaling, vessels are maneuvered closer to berthed vessels at ProvPort, posing risks to both vessels and wear and tear to facilities, resulting in additional safety concerns.

Moored vessels are at risk of being jostled due to these close encounters. More detailed information is provided in Appendix B, Channel Utilization Report.

As shown in Table 3-3, if immediate maintenance dredging does not occur, then over the next 20 years, controlling depths could get as shallow as -18 feet MLLW in Fox Point Reach and -20.2 feet MLLW in Sabin Reach by the year 2048, thus causing even greater long-term impacts to navigation.

Table 3-3. Expected Shoal Thicknesses and Controlling Depths in Providence Federal Navigation Project since Last Channel Condition Survey (2020) if No Action is Taken over the 20-Year Planning Period (2048).

Providence Federal Navigation Project Shoaling Depths by Reaches															
		Entrance		Rumstick Neck		Conimicut Point		Bullock Point		Sabin Point		Fuller Rock		Fox Point	
		From Chart	Excluded Points Removed*	From Chart	Excluded Points Removed*	From Chart	Excluded Points Removed*	From Chart	Excluded Points Removed*	From Chart	Excluded Points Removed*	From Chart	Excluded Points Removed*	From Chart	Excluded Points Removed*
Shoalest Depth (W to E) from 2020 Channel Condition Survey	(feet below MLLW)	38.5	39.7	38.5	40.2	36.0	36.6	30.4	36.6	30.0	33.5	32.1	35.5	11.7	25.2
		41.2	41.2	41.3	41.3	39.1	39.1	31.8	39.1	39.4	39.4	38.3	38.3	24.5	27.3
		41.1	41.1	40.9	40.9	42.9	42.9	37.7	40.2	39.5	39.5	37.9	37.9	27.4	27.4
		38.2	41.5	38.8	41.3	37.8	40.0	33.6	33.6	28.8	33.7	34.1	35.8	20.4	26.1
Controlling Depth (excluding the shallowest outer quarter)	(feet below MLLW)	38.5	41.1	38.8	40.9	37.8	39.1	31.8	36.6	30.0	33.7	34.1	35.8	20.4	26.1
Shoal Thickness (Assuming last dredged to -40 feet MLLW)	(feet)	1.5	0.0	1.2	0.0	2.2	0.9	8.2	3.4	10.0	6.3	5.9	4.2	19.6	13.9
Length of time since last dredge	(years)	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	49.0	49.0
Shoaling Thickness Rate	(feet per year)	0.1	0.0	0.1	0.0	0.2	0.1	0.6	0.3	0.8	0.5	0.5	0.3	0.4	0.3
Shoaling Thickness after 20 years (2048) - No Action	(feet)	3.5	0.0	3.2	0.0	6.2	2.9	20.2	9.4	26.0	16.3	15.9	10.2	27.6	19.9
Controlling Depth after 20 years (2048) - No Action	(feet below MLLW)	36.5	41.1	36.8	40.9	33.8	37.1	19.8	30.6	14.0	23.7	24.1	29.8	12.4	20.1

* Excluded Points include points within 50 feet of the channel side slopes and apparent human-made features.

If the Providence FNP is dredged to authorized depths and widths in the year 2028, the FNP will begin to shoal again after 2028 at predicted long-term shoaling rates shown in Table 3-2. Table 3-4 shows predicted shoalest depths by reach in the year 2048 after a single maintenance cycle in the year 2028. As shown in Table 3-4, by the year 2048 following immediate Cycle-One maintenance, the shallowest reach is predicted to be the Sabin Point Reach, with up to 10 feet of shoaling and a controlling depth of -30 feet MLLW. Such a shallow controlling depth would severely effect navigation by forcing cargo ships to light-load or unload prior to entering the harbor or delaying berthing based upon tides. Similarly, tankers would be required to utilize high tides to safely enter the port.

Table 3-4. Expected Shoal Thicknesses and Controlling Depths in Providence Federal Navigation Project Reaches over the 20-Year Planning Period if Only One Dredge Cycle (Cycle One) is Implemented in 2028.

		Entrance		Rumstick Neck		Conimicut Point		Bullock Point		Sabin Point		Fuller Rock		Fox Point	
Shoaling Thickness Rate (ft/yr)		0.0		0.0		0.1		0.3		0.5		0.3		0.3	
Years Following Dredge Cycle One	Year	Shoal Thickness*	Controlling Depth**	Shoal Thickness	Controlling Depth	Shoal Thickness	Controlling Depth	Shoal Thickness	Controlling Depth	Shoal Thickness	Controlling Depth	Shoal Thickness	Controlling Depth	Shoal Thickness	Controlling Depth
	1	0	41.1	0	40.9	0.1	39.9	0.3	39.7	0.5	39.5	0.3	39.7	0.3	39.7
	2	0	41.1	0	40.9	0.2	39.8	0.6	39.4	1	39.0	0.6	39.4	0.6	39.4
	3	0	41.1	0	40.9	0.3	39.7	0.9	39.1	1.5	38.5	0.9	39.1	0.9	39.1
	4	0	41.1	0	40.9	0.4	39.6	1.2	38.8	2	38.0	1.2	38.8	1.2	38.8
	5	0	41.1	0	40.9	0.5	39.5	1.5	38.5	2.5	37.5	1.5	38.5	1.5	38.5
	6	0	41.1	0	40.9	0.6	39.4	1.8	38.2	3	37.0	1.8	38.2	1.8	38.2
	7	0	41.1	0	40.9	0.7	39.3	2.1	37.9	3.5	36.5	2.1	37.9	2.1	37.9
	8	0	41.1	0	40.9	0.8	39.2	2.4	37.6	4	36.0	2.4	37.6	2.4	37.6
	9	0	41.1	0	40.9	0.9	39.1	2.7	37.3	4.5	35.5	2.7	37.3	2.7	37.3
	10	0	41.1	0	40.9	1	39.0	3	37.0	5	35.0	3	37.0	3	37.0
	11	0	41.1	0	40.9	1.1	38.9	3.3	36.7	5.5	34.5	3.3	36.7	3.3	36.7
	12	0	41.1	0	40.9	1.2	38.8	3.6	36.4	6	34.0	3.6	36.4	3.6	36.4
	13	0	41.1	0	40.9	1.3	38.7	3.9	36.1	6.5	33.5	3.9	36.1	3.9	36.1
	14	0	41.1	0	40.9	1.4	38.6	4.2	35.8	7	33.0	4.2	35.8	4.2	35.8
	15	0	41.1	0	40.9	1.5	38.5	4.5	35.5	7.5	32.5	4.5	35.5	4.5	35.5
	16	0	41.1	0	40.9	1.6	38.4	4.8	35.2	8	32.0	4.8	35.2	4.8	35.2
	17	0	41.1	0	40.9	1.7	38.3	5.1	34.9	8.5	31.5	5.1	34.9	5.1	34.9
	18	0	41.1	0	40.9	1.8	38.2	5.4	34.6	9	31.0	5.4	34.6	5.4	34.6
	19	0	41.1	0	40.9	1.9	38.1	5.7	34.3	9.5	30.5	5.7	34.3	5.7	34.3
	20	0	41.1	0	40.9	2	38.0	6	34.0	10	30.0	6	34.0	6	34.0

*Shoal Thickness reported in feet.
**Controlling Depth reported in feet below MLLW.

To avoid the predicted impacts of shoaling on the project utilization, the Study Team concluded that at least two major dredging cycles would be needed: Dredge Cycle One in 2028, and Dredge Cycle Two to be initiated on or before the year 2048. For the Cycle One estimated dredging needs, in order to avoid impacting shoaling and to meet economically warranted project widths and depths, the Study Team combined the latest condition survey data with expected short-term shoaling rates, as shown in Table 3-4.

As shown in Table 3-5, the 2020 channel condition survey determined that a total of 1,631,000 CY of material shoaled in the seven FNP reaches. From 2020 to 2027, an additional estimated shoaling quantity of 384,000 CY is expected to have accumulated extrapolating the calculated recent historic shoaling rate, so a total of 2,015,000 CY will need to be dredged from the Providence FNP during a first dredging cycle (Cycle One) to bring the channel to full authorized depths and widths.

Table 3-5. Expected Dredging and Placement Requirement in 2028 to Maintain Authorized Depths as Economically Warranted.

Providence River Complex Federal Navigation Project (FNP) Maintenance Dredging (Maintenance Cycle One - 2028)	Volume Needed to be Dredged (CY)
Providence FNP Maintenance (2020 shoaling volume)	
Entrance Reach	33,411
Rumstick Neck Reach	11,924
Conimicut Point Reach	23,817
Bullock Point Reach	114,952
Sabin Point Reach	229,092
Fuller Rock Reach	381,119
Fox Point Reach	836,374
Total as of 2020 Survey (rounded to 1,000 CY)	**1,631,000**
Providence FNP Shoaling from 2020 through December 2026 (based on average short-term shoaling rates from 2007 through 2020)	384,000
Total Providence FNP Shoaling through December 2026	**2,015,000**
Adjacent Shallow-Draft FNPs* (2026 shoaling volume)	
Bullocks Point Cove	7,300
Pawtuxet Cove	34,300
Apponaug Cove	22,000
Total Shallow-Draft FNPs	**63,600**
Starter Cell Allowance for Cycle Two**	**38,000**
State Allowance Total	**300,000**
Total All Sources of Dredged Volume	**2,417,000**
(Rounded)	**2,400,000**
Placement Capacity Needs ** (Cycle One – starting 2028)**	**Capacity Volume (CY)**
Total All Sources of dredged volume (Rounded)	**2,417,000**
15% Bulking Factor (during handling and placement)	363,000
Total with Bulking (capacity required in a placement site) ***	**2,780,000**
(Rounded*)**	**2,800,000**

* Refer to Engineering Appendix (Appendix E) for shoal rates
** Assumed future starter cell needs
***Does not include capping requirement

Table 3-5 shows the predicted 2,015,000 CY of dredging to be needed in the Providence FNP, along with 63,600 CY from the three adjacent FNPs, potential starter cell material placement needs of up to 38,000 CY (based on potential future CAD cell locations) and anticipated additional 300,000 CY dredging from local requests, for a total dredging placement need in 2028 of approximately 2,400,000 CY. Since dredging material typically expands by 15% during handling and placement, the total placement capacity needs are expected to be 2,800,000 CY, not including any final capping needs of a potential placement site to maintain channel utility as economically warranted.

The Study Team then determined the amount of additional shoaling that would accumulate through the year 2048, after a potential Cycle-One maintenance dredging (in year 2028). As shown in Table 3-6, if dredging occurs in Cycle One in 2028, then from 2028 to 2048, an additional estimated 1,900,000 CY will accumulate in the Providence FNP, extrapolating the calculated long-term historic shoaling rate (as shown in Table 3-2). Therefore, a total of 1,900,000 CY will need to be dredged during a second dredging cycle (Cycle Two) in Year 2048 to bring the Providence FNP back to full authorized depths and widths and full utility. Table 3-6 shows the predicted 1,900,000 CY of dredging to be needed in the Providence FNP in a Cycle Two maintenance, along with 61,000 CY from the three adjacent FNPs, potential starter cell material placement needs of up to 150,000 CY (based on potential future CAD cell locations) and anticipated additional 300,000 CY dredging from local requests, for a total dredging placement need in 2048, again, of approximately 2,400,000 CY. Since dredging material typically expands by 15% during handling and placement, the total placement capacity needs during Cycle Two, in the Year 2048, are expected to be, again, 2,800,000 CY, not including any final capping needs of a potential placement site, in order to continue to maintain channel utility as economically warranted.

Table 3-6. Providence River Complex Maintenance Cycle Two Dredging Volumes Through 20-Year Planning Period (2028-2048).

Providence River Complex Maintenance Dredging Maintenance Cycle Two Total Dredge Needs (2048)	Volume Needed to be Dredged (CY)
Providence River Federal Navigation Project (FNP) Maintenance (2027 shoaling volume) *	
Entrance Reach	0
Rumstick Neck Reach	0
Conimicut Point Reach	0
Bullock Point Reach	0
Sabin Point Reach	0
Fuller Rock Reach	0
Fox Point Reach	0
Subtotal after 2027 Dredging Cycle Completed*	**0**
Providence River Shoaling Jan 2027 to Dec 2046 (based on long-term shoaling rates between 1997-2020 to account for future uncertainty)	**1,900,000**
Total Providence FNP Shoaling through December 2046 (Rounded)	**1,900,000**
Other Shallow Draft FNPs (Jan 2027-Dec 2046 – 20-year shoal rate)**	
Bullocks Point Cove	7,000
Pawtuxet Cove	26,000
Apponaug Cove	10,000
Total Shallow-Draft FNPs	**43,000**
Allowance for starter cell needs for future FNP dredging***	**150,000**
State Allowance Total	**300,000**
Total All Sources of Dredged Volume	**2,392,000**
Placement Capacity Needs ** (Cycle Two – starting 2048)**	**Capacity Volume (CY)**
Total All Sources of dredged volume	**2,392,000**
15% Bulking Factor (during handling and placement)	**358,800**
Total with Bulking (capacity required in a placement site) ******	**2,750,800**
Rounded (nearest 100,000)	**2,800,000**

* Assumed fully maintained after dredge operation in 2028
** Refer to Engineering Appendix (Appendix E) for shoal rates
*** Assumed future starter cell needs
**** Does not include capping requirement

4. Existing Conditions and Affected Environment*

This chapter presents a summary of existing conditions in the Study Area. It is organized by resource categories relevant to the project. Resources within each project region are described in each subsection.

The 2001 Final Environmental Impact Statement (FEIS) for maintenance dredging of the project (USACE, 2001) contains a detailed evaluation of the physical and biological resources of Narragansett Bay, the Providence River and Harbor FNP, and Rhode Island Sound. USACE collected supplemental sediment chemistry and benthic data for the FNP in 2013, and for the FNP and Edgewood Shoals in 2017-2022. Sediment chemistry was also collected in 2023 at the Prudence Island Disposal Site (PIDS). Summaries of the 2001 FEIS findings as well as the recent data collection efforts are presented below. Figure 4-1 demonstrates the location of the Providence FNP relative to the FPRN CAD cells, PEB, Edgewood Shoals and Prudence Island Disposal Site.

4.1. General Setting

4.1.1. Providence River, Prudence Island Disposal Site, and Narragansett Bay

Narragansett Bay, which includes Providence River Estuary and PIDS is located within Rhode Island's territorial waters. The Providence River is formed by the junction of two small streams, the Woonasquatucket and Moshassuck Rivers, which originate in northern Rhode Island. It flows southerly for one mile to the head of Providence Harbor at Fox Point in Providence, where it is joined by the Seekonk River. The FNP, a 16.8-mile-long channel, begins near the head of Providence Harbor and follows the river on a southerly course through the communities of East Providence, Cranston, Barrington, Warwick, Bristol, and Portsmouth. The FNP is comprised of seven reaches (Fox Point Reach, Fuller Rock Reach, Sabin Point Reach, Bullock Point Reach, Conimicut Point Reach, Rumstick Neck Reach, and the Entrance Channel Reach) shown in Figure 1-2. The upper two and one-half miles comprise the Main Harbor, which is that portion of the river south of Fox Point and India Point and extending generally south of Fields Point. The Outer Harbor consists of the approach channel extending from the Main Harbor to deep water in Narragansett Bay just south of Prudence Island. Providence River and Harbor together constitute the principal commercial waterway in Rhode Island.

Figure 4-2 shows the major geographic subdivisions of Narragansett Bay, which has a water surface of 147 square miles and a watershed of 1,657 square miles. The average depth of Narragansett Bay is 27 feet. The mean range of tides is 3.8 feet at the southern end of Prudence Island (the middle of Narragansett Bay), 4.6 feet at Nayatt Point (upper Narragansett Bay) and 5.6 feet at Providence (upstream end of project). The current speed at Nayatt Point is 0.2 knots for flood and ebb tides, and at Fox Point 0.2 knots at flood and 0.1 knots at ebb tide (NOAA, 2024).

The PIDS, originally known as the East Passage Dumping Grounds, centered at 41º 23.470' N, 71º 18.126' W, is located in the lower east passage of Narragansett Bay southeast of Prudence Island (Figure 4-2). Water depths at PIDS range between 50 to 100 feet.

Figure 4-1. Potential Sites Being Considered for Measures, Including Beneficial Use Sites.

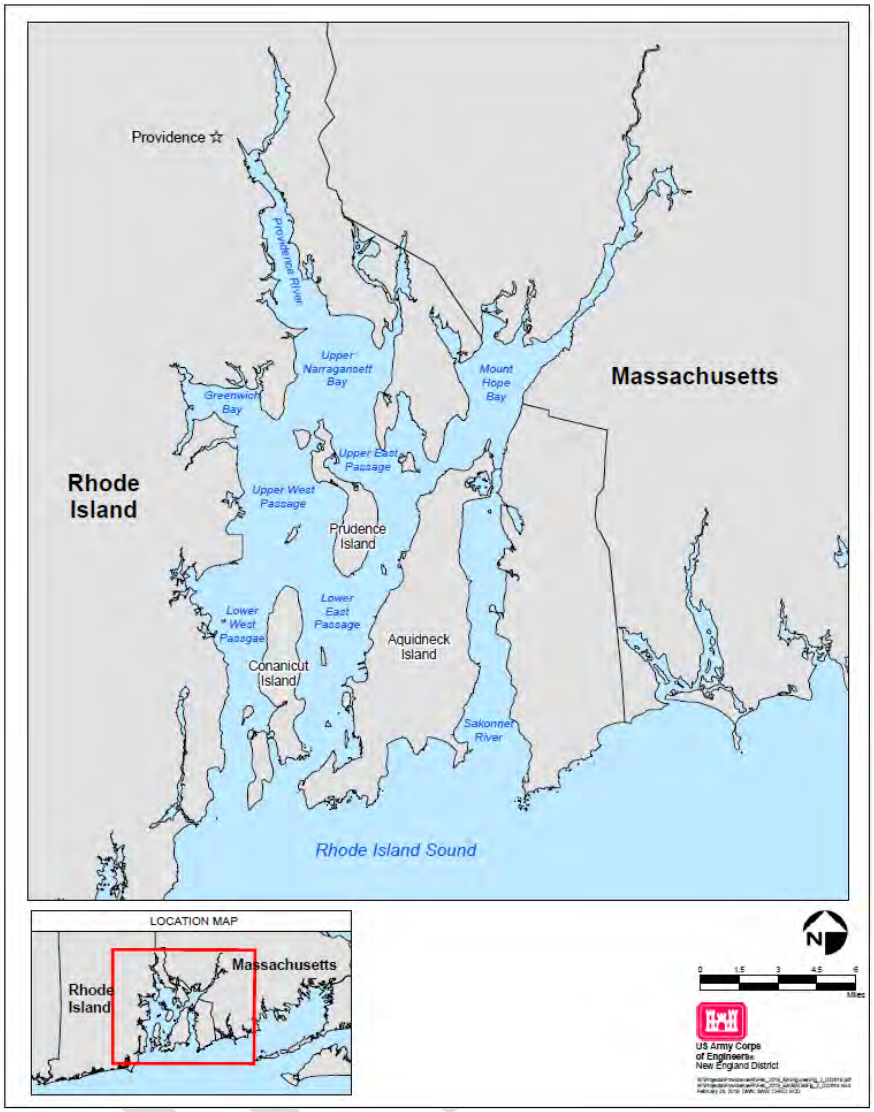


Figure 4-2. Geographic Subdivisions of Narragansett Bay.

4.1.2. Edgewood Shoals & Port Edgewood Basin

Edgewood Shoals is located in Narragansett Bay, south of Fields Point in the city of Providence, Rhode Island, which is within the state's territorial waters (Figure 4-1) and is a natural shallow area in the Providence River located between Fields Point and the mouth of the Pawtuxet River. The eastern edge of the shoal abuts the 40-foot deep (MLLW) FNP. A 13-foot-deep (MLLW) channel and basin was dredged through the shoal in the early 1940s to provide access to a shipyard commissioned by the US Maritime Commission as part of the Nation's Emergency Shipbuilding Program. This existing channel has been allowed to shoal in overtime and recent nautical charts indicate a reported depth of 8 feet. The site of the former Fields Point Shipyard is currently occupied by a combined Navy, Marine Corps, and Army Reserve center and an educational facility run by Save the Bay®. Land use along the western shoreline of Edgewood Shoals includes a mix of urban residential development and small marinas. This location is being considered for the construction of CAD cell.

4.1.3. Rhode Island Sound Disposal Site

Rhode Island Sound is a strait of water off the coast of Rhode Island at the mouth of Narragansett Bay. This water body forms the eastern extension of Block Island Sound and opens out to the Atlantic Ocean between Block Island and Martha's Vineyard. The EPA designated the RISDS in December 2004 (USACE, 2004). The site is one square nautical mile centered at 41° 13.850' N, 71° 22.817' W (North American Datum of 1983) and lies approximately 13 miles south of the entrance to Narragansett Bay, located outside the jurisdiction of Rhode Island (outside the territorial sea boundary) (Figure 4-3). The RISDS is situated within the Separation Zone for the Narragansett Bay Inbound and Outbound Traffic Lanes and lies within a topographic depression, with water depths from 111 to 128 feet.

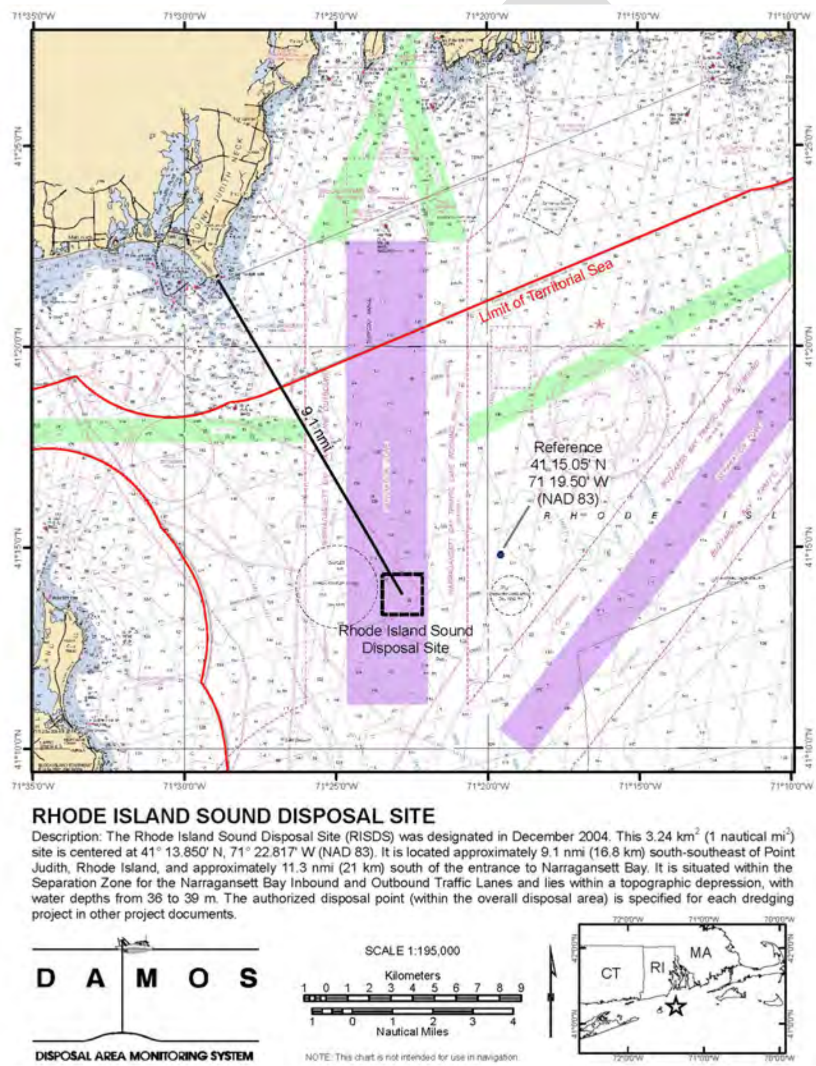


Figure 4-3. Rhode Island Sound Disposal Site.

4.2. Sediment Characteristics

Recent sediment accumulation within the 16.8-mile reach of the Narragansett Bay containing the Providence FNP is the result of suspended load and bedload transport of sediments from upstream carried down into the bay from a watershed over 1,000 square miles by several rivers, including the Blackstone River and Ten Mile river, which confluence to become the Seekonk River in Providence and the Woonasquatucket River and Moshassuck River, which confluence to become the Providence River in Providence. These sediments tend to be carried downstream and deposited during major storm events, and then reworked by vessel traffic. Older sediments deep in the channel were laid down prior to industrial development of the many cities and towns along the Narragansett Bay and the river corridors feeding into the bay. These deeper and older sediments tend to be relatively free of human-caused contaminants and tend to meet suitability criteria for open-water disposal. However, the upper layers of sediment have been impacted with human caused chemicals, and these characteristics will be explained in more detail further in this section.

4.2.1. Providence River and Narragansett Bay

This section summarizes results obtained from physical, chemical, and biological testing of sediments collected from the 40-foot channel of the Providence River FNP in Rhode Island. For full sampling details and expanded results see the final Providence River Suitability Determination (Appendix F).

The FNP in the Providence River was last dredged in 2005 when 3,800,000 CY of shoaled material were mechanically removed to restore the project to its authorized dimensions. Approximately two-thirds of this material was found to be suitable for unconfined open-water placement. Due to elevated levels of metals and polychlorinated biphenyls (PCBs), the remainder of the material was placed in a series of CAD cells located in the FNP footprint at the head of Providence Harbor.

Testing performed in 2013 and 2014 found the FNP sediment to consist of poorly graded medium to fine sand with silt. Grain size analysis of the samples indicated that these sediments contain between 66% and 97% coarse grained material (cobble, gravel, sand) and between 3 and 34% fines (i.e., silt and clay) (Table 4-1). A noticeable petroleum odor was observed in sediments from multiple stations in the upper portion of the FNP (samples B, G, E, F, J, N, O, P, Q, and R shown on Figure 4-4). In addition, sediments collected from station V smelled strongly of sewage (USACE, 2013).

These samples were analyzed for the standard suite of contaminants of concern (COC) from the New England Regional Implementation Manual (EPA/USACE, 2004a). With the exception of Composite 9 from the extreme outer portion of the FNP, results indicated elevated concentrations of most COCs including metals, Polycyclic Aromatic Hydrocarbons (PAHs), PCBs, and pesticides throughout Providence Harbor with concentrations generally increasing towards the head of navigation (USACE, 2013). Subsequent biological testing of the sediments revealed elevated toxicity from exposure to elutriate samples from Composites 3-8 and significant bioaccumulation of COCs in test organisms, which resulted in unacceptable risk to human health from the unconfined open-water placement of Composites 1-8 (Appendix F). Based on these results, only Composite 9, the outer portion of the FNP in Narragansett Bay, was determined to be suitable for unconfined open-water placement at RISDS. Complete testing results are provided in the sampling and testing reports (USACE, 2013 and Battelle, 2014).

Table 4-1. Summary of Grain Size and Moisture Content Results for Providence River FNP (2013).

Sample ID	% Cobble	% Gravel	% Coarse Sand	% Medium Sand	% Fine Sand	% Total Fines	% Moisture
B	0.1(U)	2.19	12.5	36.6	33.6	15.1	66.4
D	0.1(U)	2.44	8.45	31.3	36.9	20.9	62.4
E	0.1(U)	0.1(U)	1.52	34.1	38.3	26.1	67.3
F	0.1(U)	0.1(U)	2.8	41.1	51.6	4.45	70.8
G	0.1(U)	2.58	16.3	49.4	28.8	2.88	68.2
H	0.1(U)	0.46	7.28	43.6	27.4	21.3	69.4
I	0.1(U)	0.91	5.21	47.3	36.2	10.4	63.8
J	0.1(U)	0.99	11.1	46.2	37.4	4.29	67.1
K	0.1(U)	0.1(U)	7.57	43.6	34.3	14.5	68.4
L	0.1(U)	0.32	10.4	45.1	30.9	13.3	66.5
M	0.1(U)	0.1(U)	3.5	42.9	33.7	19.9	66.1
N	0.1(U)	0.46	9.59	41.5	28	20.5	65.4
O	0.1(U)	0.1(U)	2.52	40.8	29.8	27	69.6
P	0.1(U)	0.1(U)	1.9	34.7	29.3	34.1	63.8
Q	0.1(U)	2.46	12.8	43.2	23.1	18.4	63.9
R	0.1(U)	0.1(U)	9.45	43.6	27.3	19.6	66.5
S	0.1(U)	3.71	14.6	40.3	24.1	17.4	65.1
T	0.1(U)	0.62	11	39.2	28.8	20.4	65.2
U	0.1(U)	5.7	22.2	42.8	24.2	5.09	63.3
V	0.1(U)	0.1(U)	8.48	45.8	42.8	2.87	67.6
W	0.1(U)	1.03	19.9	42.8	27.2	9.11	61.2
X	0.1(U)	1.6	20.3	39.7	24.3	14.1	64.7
Y	0.1(U)	5.18	18	35.4	28.1	13.3	42.9
Z	0.1(U)	6.11	16.4	35.6	23.6	18.3	44.2

(U) = Non-detected analytes are reported as the RL and qualified with a “U”.

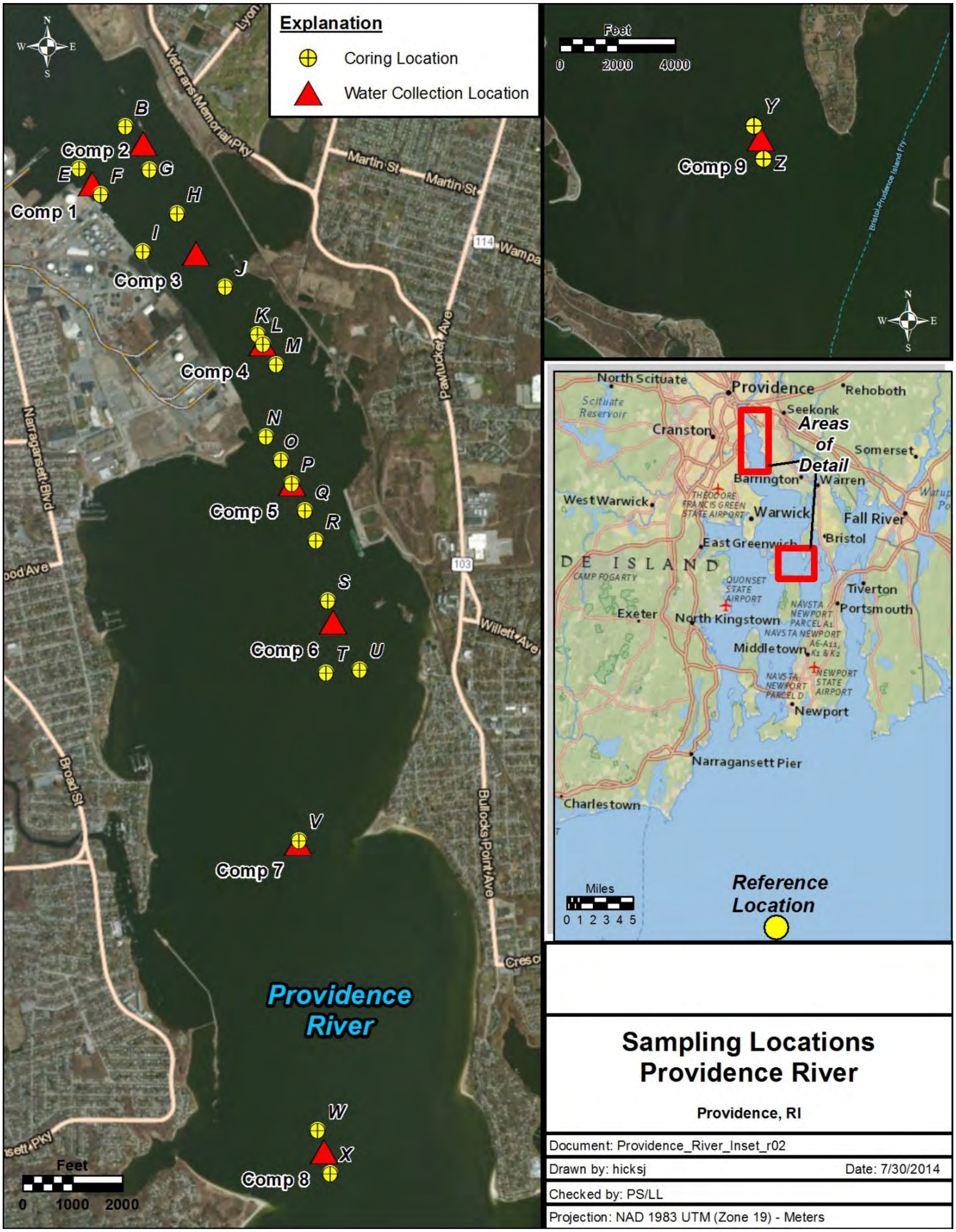


Figure 4-4. 2013 and 2014 Sampling Plan and Sample Composite Locations.

Shoal materials in the Fox Point and Fuller Rock reaches of the Providence River FNP have historically been composed of organic silt; however, the most recent sampling and testing conducted in 2013 showed a shift to much coarser sediments. To examine how sediment composition has changed over time and evaluate potential causes, we compared grain-size data from 1992, 1994, 1997, 1999, and 2013 (after maintenance dredging was completed in 2005).

Grain-size analysis of sediments sampled between 1992-1997 showed substrate consisting of nearly 85% silt by weight. Sediments sampled in 1999 were similar except in the vicinity of Fields Point, where stations previously composed of nearly 80% silt were composed of a mix of sand (49%) and gravel (48%). Grain-size analysis in the focus area from 2013 documented a substantial shift from silt with sand (>80% silt) to silty sand (>80% sand). Sediment coring logs from the 2013 sampling effort indicated the material as black, poorly graded fine sand with silt with a hydrogen sulfide odor. Several of the cores also contained a notable sheen and petroleum odor.

4.2.2. Edgewood Shoals & Port Edgewood Basin

In 2019, USACE conducted a series of sub-bottom profile surveys in the Edgewood Shoals area to identify the optimal location for potential CAD cells. In 2020, 16 sediment core samples were collected to characterize the sediments within the proposed CAD cell area, the proposed CAD cell access channel to the FNP, and the Port Edgewood channel and basin (Figure 4-5). All cores were collected to a maximum depth of 12 feet below the sediment surface.

Samples taken at the proposed CAD cell in Edgewood Shoals indicated that sediments are primarily soft grey to black organic silt over a layer of firm sandy silt. More coarse-grained material and shell fragments were found in the northern half of the CAD cell location. The three cores taken from the vicinity of the proposed access channel contained a mix of sandy silt and shell fragments. Results of the grain size analysis are presented in the suitability determination for Edgewood Shoals (Appendix F).

Based on the results of the 2020 sampling and testing effort, the project footprint was refined and shifted south to avoid elevated levels of COCs within the PEB. NAE collected a second round of sediment cores in April 2021 (Figure 4-6) for bulk chemistry concurrently with sampling for biological testing to further evaluate the material for the proposed disposal alternatives (Appendix F).

Samples collected from the PEB (stations F, L, and M - Figure 4-5) and from the upper 2 feet of the historic Port Edgewood channel (stations C1 and C3 - Figure 4-6) contained moderate to high levels of most analyzed COCs. These stations had concentrations of metals, PAHs, total PCBs, and multiple pesticides above the effects-range low sediment quality screening guideline (USACE, 2022b). Several of these stations also contained multiple metals, PCBs, and pesticides above the effects-range median sediment quality screening guideline (Appendix F).

Concentrations of COCs in the remainder of the samples, including the deeper portions of the historic Port Edgewood channel, were generally below the effects-range low with the exception of slightly elevated arsenic throughout the basin and some metals at station W1. Complete bulk chemistry results, sediment quality guidelines, and reference area concentrations for Edgewood Shoals are presented in Appendix F.

Samples for biological testing of the Edgewood Shoals material were collected in April of 2021 along with the second round of cores for additional bulk sediment chemistry analysis. Sediment toxicity was measured through a 10-day whole sediment acute toxicity test, human health risk was determined through a 28-day bioaccumulation test, and water column toxicity was determined through a suspended particulate phase test as described in the Evaluation of Dredged Material Proposed for Ocean Disposal – Testing Manual (Green Book, EPA/USACE, 1991).

Based on the results of the biological testing and subsequent risk modeling, no significant adverse impacts were found for the proposed access channel or CAD cell area within Edgewood Shoals with the exception of the surficial 2 feet of sediment that corresponds with the historic Port Edgewood channel. Based on the testing and evaluation requirements of Section 103 of the MPRSA, the sediments to be dredged from the proposed access channel and CAD cell, with the exception of the surficial 2 feet of sediment in the historic Port Edgewood channel, are considered suitable for unconfined open-water disposal at RISDS (Figure 4-7). In addition, these sediments are also suitable for placement into the existing PEB (as a cap) according to the CWA Section 404 Guidelines.

The upper 2 feet of material from the historic Port Edgewood channel is not suitable for unconfined open-water disposal but the material can be discharged into the PEB and covered with a three-foot layer of suitable material to isolate the unsuitable sediments from the environment and comply with the CWA Section 404 Guidelines. See the Final Edgewood Shoals Suitability Determination in Appendix F for more details.

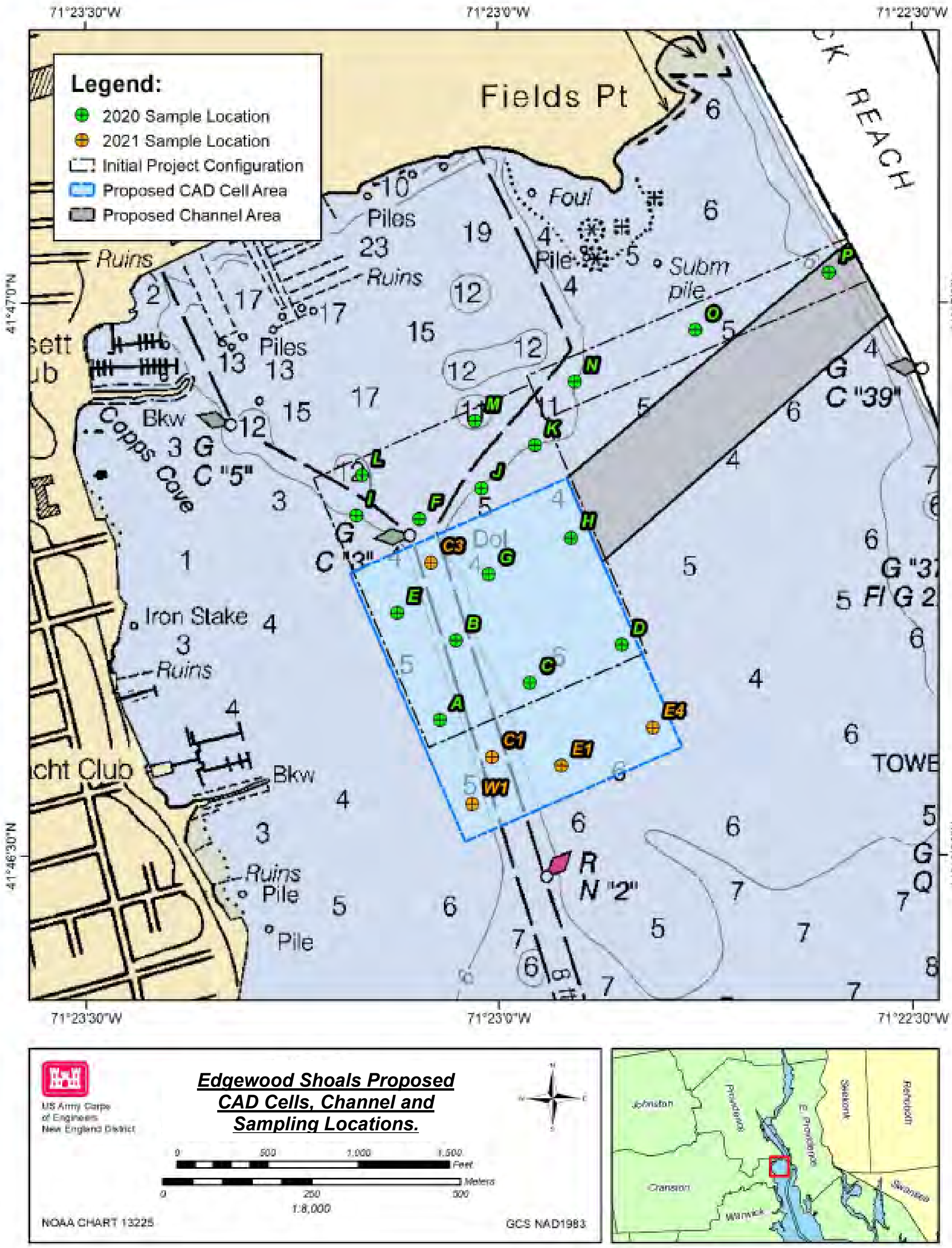


Figure 4-5. Sampling Locations for Proposed Confined Aquatic Disposal Cell Locations in 2020 and 2021.

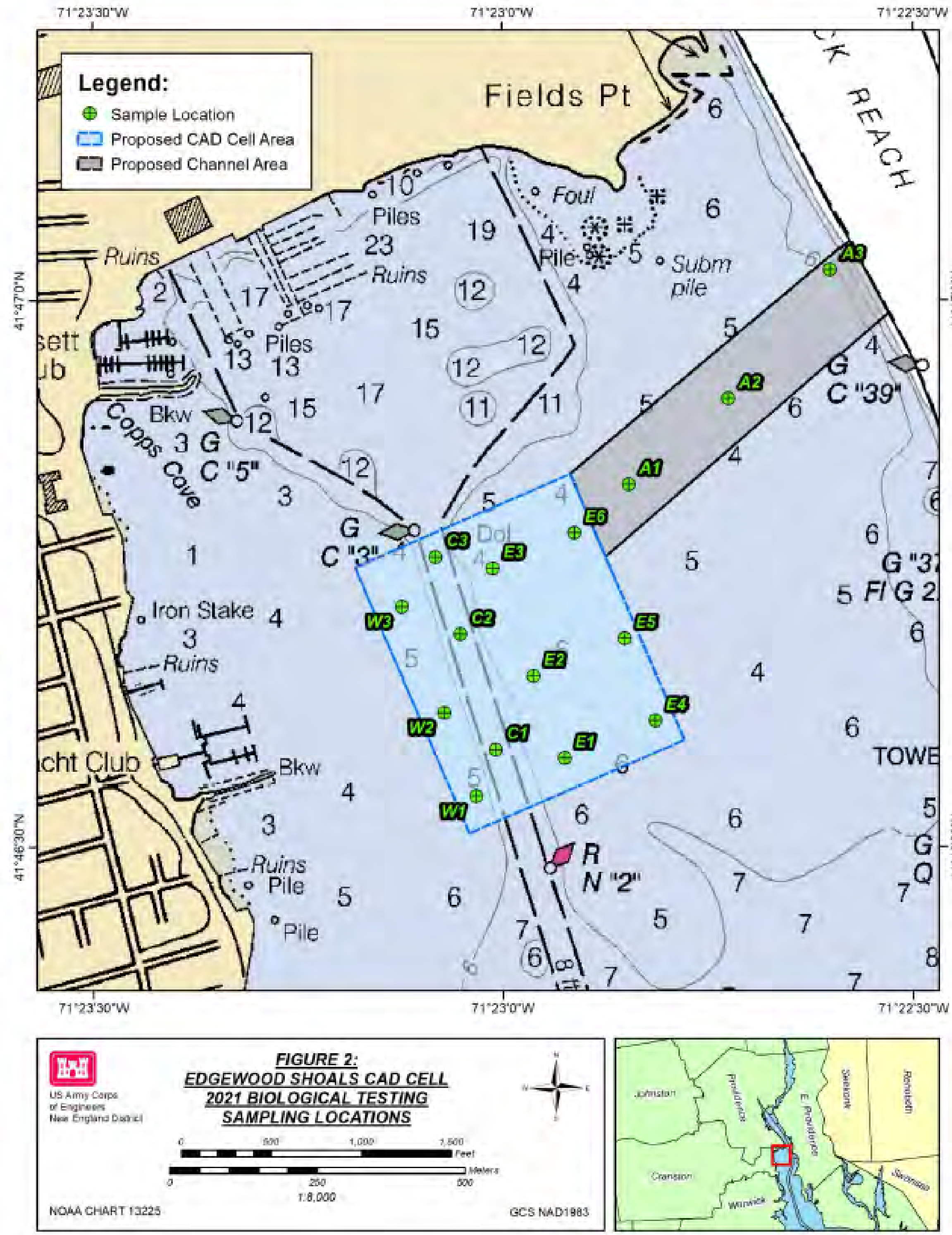


Figure 4-6. Edgewood Shoals North Confined Aquatic Disposal Cell Sampling Locations in 2021.

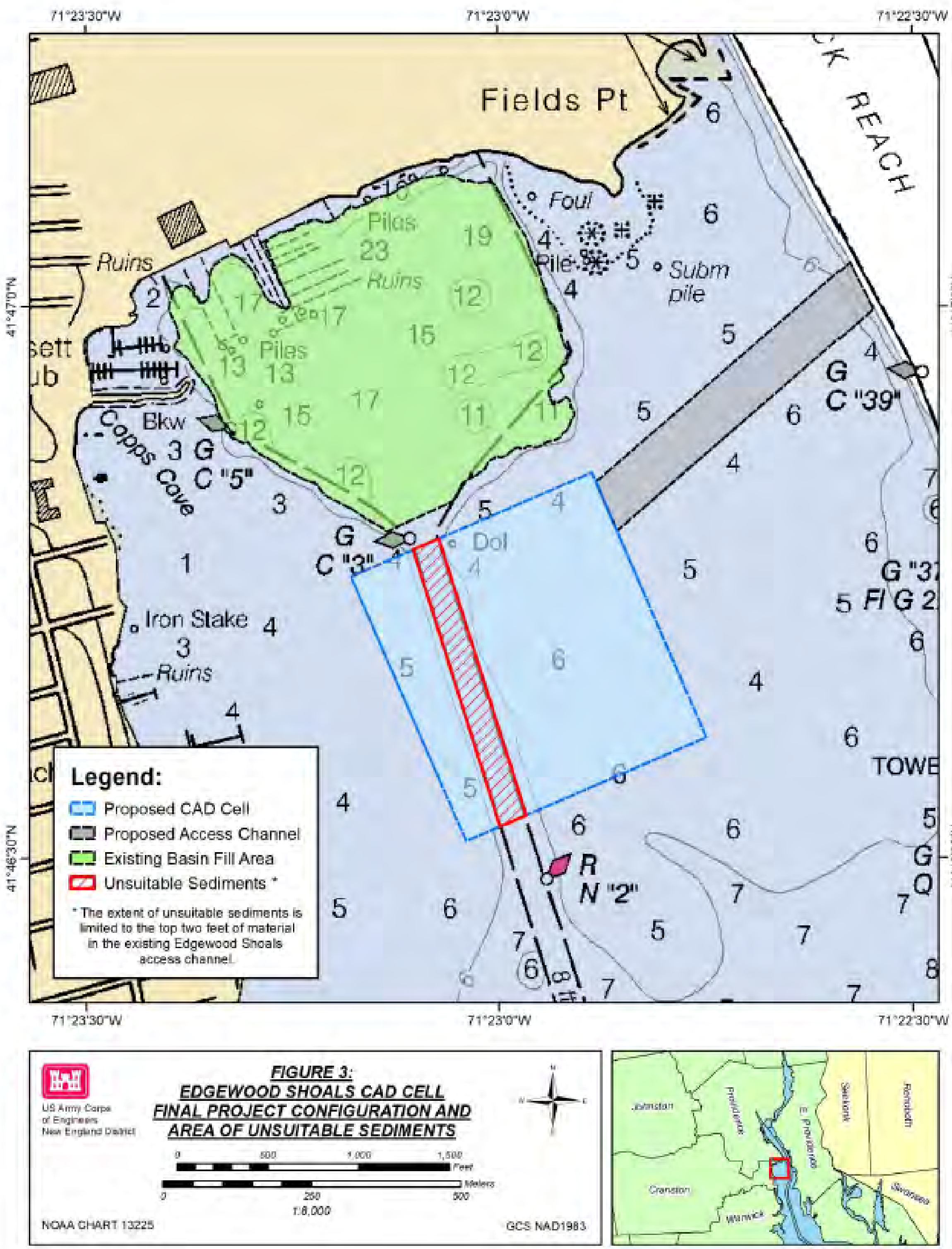
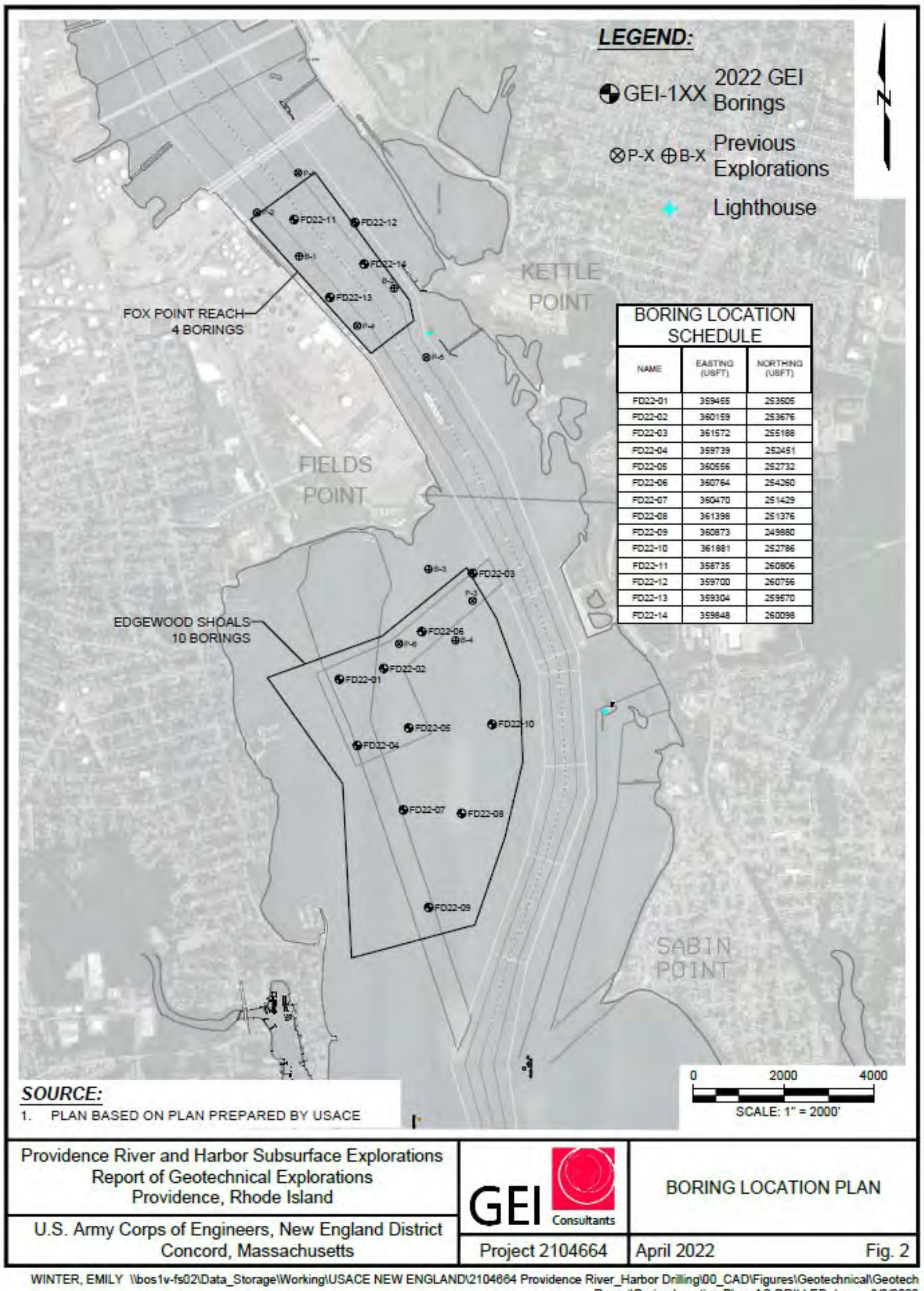


Figure 4-7. Edgewood Shoals North Confined Aquatic Disposal Cell and Port Edgewood Basin Placement Area Final Configuration.

4.2.3. Geotechnical Boring Results

The Subsurface Site Investigation Appendix (Appendix G) presents data from Edgewood Shoals and Fox Point Reach potential CAD cell locations for the Providence River FNP. Figure 4-8 shows the location of the geotechnical borings. Results from the borings found the material to be predominantly fine-grained fluvial deposits from 5-52 feet in depth (Appendix G).



NAME	EASTING (USFT)	NORTHING (USFT)
FD22-01	359455	253505
FD22-02	360159	253676
FD22-03	361572	255188
FD22-04	359739	252451
FD22-05	360556	252732
FD22-06	360764	254260
FD22-07	360470	251429
FD22-08	361398	251376
FD22-09	360873	249880
FD22-10	361881	252786
FD22-11	358735	260806
FD22-12	359700	260756
FD22-13	359304	259570
FD22-14	359848	260098

Figure 4-8. Geotechnical Boring Locations (GEI, 2022).

4.2.4. Prudence Island Disposal Site

USACE performed a series of investigations to characterize the sediment quality at the PIDS (Figure 4-9). PIDS is a historic disposal site in Narraganset Bay that was used for the disposal of dredged material by the USACE from Providence Harbor until 1964. This disposal activity pre-dates the CWA, so there was no testing data to characterize the sediments or determine the potential environmental impacts associated with the disposal. Since the source of the historic dredged material corresponds with areas of the harbor that are currently unsuitable for open-water disposal, USACE investigated PIDS to determine if the sediments exhibit a legacy of contamination and would benefit from restoration with a cover layer of suitable material.

In 2022, USACE conducted a hydroacoustic survey of PIDS to identify any historic disposal features and collected 10 grab samples for physical, chemical, and benthic community analysis and one short (1.5’) core for chemical analysis. The hydroacoustic survey successfully identified historic dredged material disposals and delineated the boundaries of the site (Figure 4-9). The surficial sediments within the historic PIDS were predominately comprised of silt (69.7 ± 16.6%) and fine sand (18.4 ± 10%). The sediment samples also contained varying amounts of medium sand, coarse sand, and gravel (Table 4-2).

Table 4-2. Summary of Prudence Island Disposal Site Grain-Size Analysis Results.

Sample	% Cobble	% Gravel	% Sand			% Fines	ATSM Description
			Coarse	Medium	Fine		
1	0.0	21.9	2.8	10.7	13.5	51.0	Sandy silt with gravel
2	0.0	0.1	0.2	1.6	9.0	89.0	Silt
3	0.0	0.3	0.8	8.2	22.7	68.0	Sandy silt
4	0.0	3.2	1.2	11.6	33.9	50.0	Sandy silt
5	0.0	0.7	0.8	3.0	15.2	80.3	Silt with sand
6	0.0	0.1	0.6	3.1	14.4	81.9	Silt with sand
7	0.0	1.6	0.1	0.8	7.3	90.2	Silt
8	0.0	3.7	2.8	4.6	9.3	79.5	Silt with sand
9	0.0	3.3	3.0	10.9	24.0	58.7	Sandy silt
10	0.0	3.6	2.1	11.5	34.9	48.0	Sandy silt

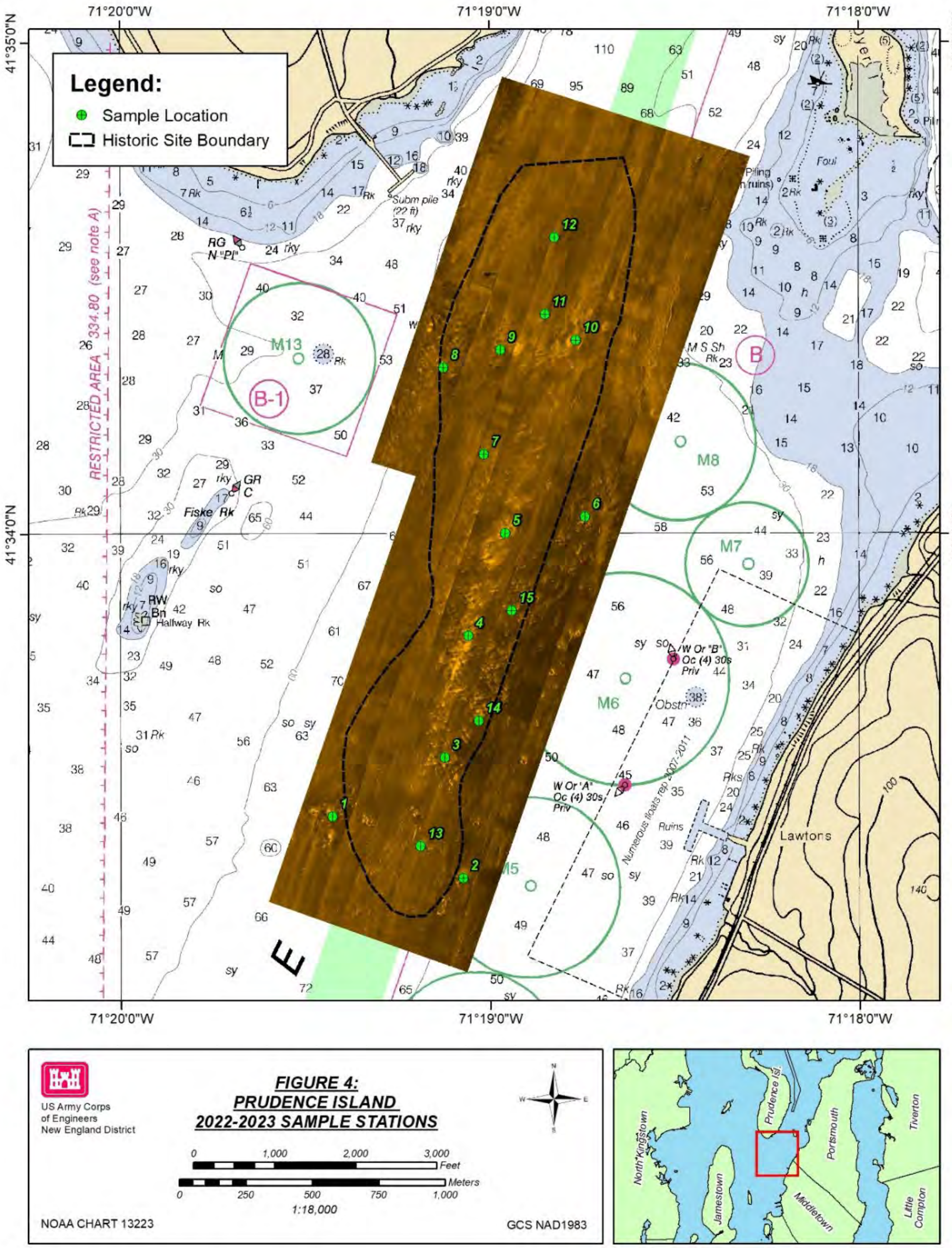


Figure 4-9. Prudence Island Disposal Site Side Scan Sonar Image with Historic Dredged Material Disposals and Sampling Locations.

The 2022 sediment chemistry results from PIDS showed a surficial layer, approximately four to six inches thick, with low concentrations of all COCs throughout the site with the exception of slightly elevated mercury concentrations at three stations and PCBs at one station. The one short core that was collected revealed a layer of increasing metals concentrations including arsenic, copper, lead, and mercury just below the surficial layer. Based on these data, USACE conducted a second sampling event in 2023 to collect additional short cores to further characterize this subsurface layer. These data confirmed the presence of a subsurface sediment layer with elevated concentrations of metals (arsenic, chromium, copper, lead, mercury, nickel, and zinc), PAHs, PCBs, and pesticides at multiple locations within PIDS (Table 4-3).

Table 4-3. Summary of Prudence Island Disposal Site Sediment Chemistry Analysis (2023).

Station	**1**		**2**		**6**		**10**	**15**
Interval (ft)	**0.5-1.2**	**1.2-.2.1**	**0.5-1.9**	**1.9-3.0**	**0.5-2.1**	**2.1-3.6**	**0.5-1.1**	**0.5-2.1**
TOTAL METALS								
Arsenic, Total	8.1	36.5	10.5	12.7	7.2	7.2	8.4	6.4
Cadmium, Total	0.2	0.6	0.1	0.1	0.1	0.1	0.2	0.1
Chromium, Total	31.2	97.2	20.9	13.1	18.0	12.5	31.0	19.0
Copper, Total	31.6	95.2	26.8	11.9	16.1	15.3	27.6	18.1
Lead, Total	33.1	86.4	22.5	8.0	17.7	11.2	30.5	17.5
Mercury, Total	0.3	0.1	0.2	0.0	0.1	0.0	0.1	0.1
Nickel, Total	16.0	88.2	13.3	20.8	14.6	14.0	13.5	13.3
Zinc, Total	66.8	263.0	58.3	58.9	49.8	40.0	57.4	45.0
PAHS								
Acenaphthene	8.2	4.3	6.6	3.13	1.4	3.19	6.6	3.3
Acenaphthylene	46.1	25.8	22.0	3.2	9.1	4.6	22.4	16.3
Anthracene	108.0	25.3	30.8	2.8	9.7	4.4	33.1	19.3
Fluorene	32.1	12.3	13.0	1.6	4.2	2.1	16.7	8.2
Naphthalene	40.2	23.4	19.8	4.6	8.8	4.7	32.0	16.1
Phenanthrene	271.0	59.6	76.8	6.2	21.7	9.5	83.1	40.2
Total LMW PAHs	*505.6*	*150.7*	*169.0*	*18.6*	*54.9*	*25.6*	*193.9*	*103.4*
Benz(a)anthracene	346.0	80.1	87.8	5.7	33.4	12.7	75.0	45.5
Benzo(a)pyrene	336.0	109.0	118.0	5.9	44.0	16.9	98.7	62.1
Benzo(b)fluoranthene	265.0	81.3	92.7	5.1	43.9	15.8	89.4	51.3
Benzo(ghi)perylene	195.0	79.4	74.3	4.3	34.5	15.0	81.3	42.5
Benzo(k)fluoranthene	237.0	76.3	90.2	4.9	32.4	12.1	76.8	47.4
Chrysene	285.0	79.3	88.8	6.2	35.0	13.5	75.9	50.1
Dibenz(a,h)anthracene	52.5	17.9	21.2	1.0	9.3	4.0	19.9	10.6
Fluoranthene	546.0	113.0	145.0	10.8	51.3	20.4	124.0	74.2
Indeno(1,2,3-cd)Pyrene	203.0	73.2	83.8	3.7	35.1	14.8	80.4	42.4
Pyrene	512.0	173.0	152.0	12.8	55.4	22.6	192.0	84.6
Total HMW PAHs	*2977.5*	*882.5*	*953.8*	*60.4*	*374.3*	*147.8*	*913.4*	*510.7*
PCB CONGENERS								
Total PCBs	*41.6*	*28.9*	*35.9*	*2.6*	*12.8*	*4.4*	*23.3*	*18.9*
PESTICIDES								
4,4'-DDD	0.428	0.4	0.432	0.313	0.362	0.319	0.3	0.377
4,4'-DDE	0.9	0.7	0.432	0.313	0.362	0.319	0.473	0.377
4,4'-DDT	0.428	0.6	1.6	0.313	1.4	2.1	2.3	1.3
Total DDx	*1.0*	*1.7*	*1.6*	*0.0*	*1.4*	*2.1*	*2.6*	*1.4*

* Highlighted values exceed the NOAA Effects Range Low (ERL)

4.3. Water Quality

4.3.1. Providence River, Prudence Island Disposal Site, and Narragansett Bay

Narragansett Bay water quality is monitored with network of fixed-site monitoring stations established by a number of local, regional, and state agencies (Figure 4-10). Stations are located deliberately to transect the length of Narragansett Bay and be a first warning for changing environmental conditions. There are more sites located in upper Narragansett Bay due to the presence of wastewater treatment facilities (WWTF) and large tributary rivers. Monitoring stations collect data on salinity, pH, dissolved oxygen, chlorophyll, and temperature. During the warmer summer months, stations in southern Narragansett Bay report lower readings for temperature and chlorophyll and higher for dissolved oxygen than northern station. The waters in the lower (southern) Narragansett Bay are less likely to suffer algal bloom problems and fish kills than those in the north (RIDEM, 2022a).

The Providence River and Narragansett Bay have significant sources of pollution: industrial and urban development in and around Providence and the WWTF. Impairment in estuarine waters occurs from bacterial contamination, low dissolved oxygen, and nutrient enrichment. Combined Sewage Overflows (CSO) and stormwater discharges are found in northern Narragansett Bay and Newport Harbor. WWTF discharges, failing on-site wastewater systems and urban runoff are additional sources of the nutrient enrichment which contribute to low dissolved oxygen problems in the estuarine Providence and Seekonk rivers, northern Narragansett Bay, and other coastal areas (RIDEM, 2012).

The impacts of CSOs, and of individual sewage disposal systems include the presence of human wastes, which can aesthetically limit use of the shore, and actual or suspected contamination from sewage-derived bacteria and viruses that can curtail shellfish harvesting. The Providence River has been permanently closed to shellfish harvesting since the 1940s. Other locations, including northern Narragansett Bay, are routinely closed following rainstorms.

Many coves and smaller bays around Narragansett Bay and portions of Mount Hope Bay are known to exhibit seasonal depletion of dissolved oxygen, algal blooms, and occasional fish kills related to excess nutrients contributed by various sources, including WWTF discharges and failing septic systems.

RIDEM established water quality classifications for surface waters each defined by its designated uses (Table 4-4). No waters of the state are currently classified as SC, the lowest category for water quality. The latest State of Rhode Island 2018-2020 303(d) List of Impaired Waters (RIDEM, 2021) classified the waters of the upper Providence River (north of Bullock Point Reach) as SB1{a}. Bullock Point Reach and Conimicut Point Reach waters are classified as SB{a}. The waters south of Conimicut Point are classified as SA (RIDEM, 2021).

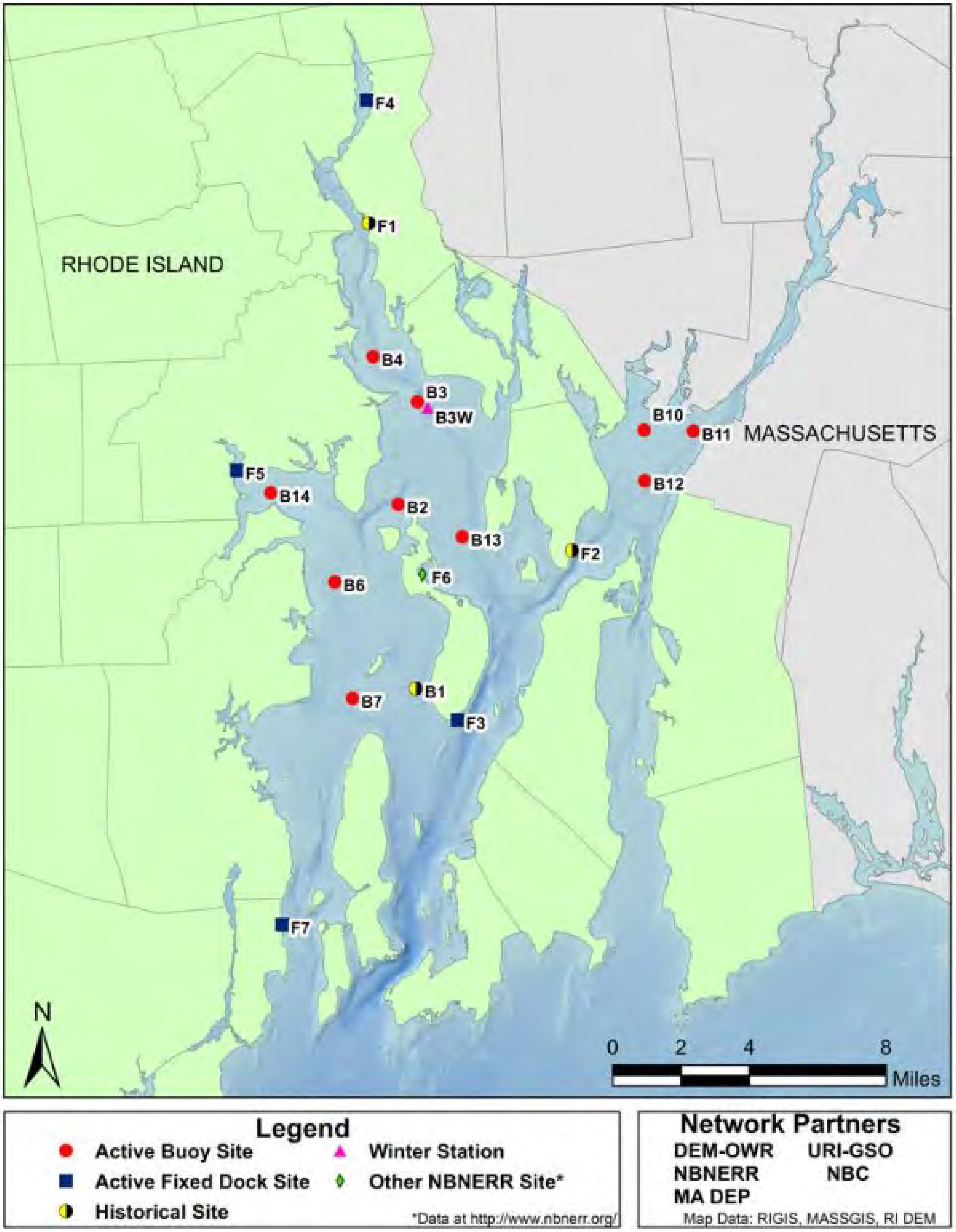


Figure 4-10. Fixed Water Quality Monitoring Stations in Rhode Island (RIDEM, 2022a).

Table 4-4. State of Rhode Island Water Quality Classifications (RIDEM, 2021).

Water Classes	Designated Uses
SA	❑ Harvesting of shellfish for direct human consumption (Some SA waters contain Closed Safety Zones in the vicinity of approved sanitary discharges which may be impacted in the event of complete failure of treatment and are, therefore, currently prohibited to shellfishing. Although shellfishing use is restricted, all SA criteria must be met.) ❑ Primary and secondary contact recreational activities ❑ Fish and wildlife habitat ❑ Aquaculture ❑ Navigation ❑ Industrial cooling ❑ Good aesthetic value
SB	❑ Primary and secondary contact recreational activities ❑ Shellfish harvesting for controlled relay and depuration ❑ Fish and wildlife habitat ❑ Aquaculture ❑ Navigation ❑ Industrial cooling ❑ Good aesthetic value
SB1	❑ Primary and secondary contact recreational activities (primary contact activities may, at times, be impacted due to pathogens from approved wastewater discharges. However, all SB criteria must be met) ❑ Fish and wildlife habitat ❑ Aquaculture ❑ Navigation ❑ Industrial cooling ❑ Good aesthetic value
SC	❑ Secondary contact recreational activities ❑ Fish and wildlife habitat ❑ Aquaculture ❑ Navigation ❑ Industrial cooling ❑ Good aesthetic value

{a}	❑ Partial use- waters likely to be impacted by combined sewer overflows in accordance with approved CSO Facilities Plan and in compliance with rule 19.E.1 of these regulations and the Rhode Island CSO Policy. Therefore, the following may be restricted
	  ❑ Primary contact recreational activities
	  ❑ Shellfishing uses
	  ❑ Fish and wildlife habitat

{b}	❑ Concentration of Vessels - These waters are in the vicinity of marinas and/or mooring fields and therefore seasonal shellfishing closures will likely be required as listed in the most recent (revised annually) RIDEM document entitled Shellfish Closure Areas. However, all Class SA criteria must be attained.

4.3.2. Edgewood Shoals & Port Edgewood Basin

The waters of Edgewood Shoals are classified as class SB1{a}. Class SB1 waters are designated for: primary and secondary contact recreational activities, fish and wildlife habitat, aquaculture use (other than shellfish for direct human consumption), navigation, and industrial cooling. However, partial use-waters like those found in Edgewood Shoals are likely to be impacted by CSOs and the potential for primary contact recreational activities, shellfishing and fish and wildlife habitat is likely compromised.

In general, water is transported from north to south in the Providence River. This flow can spread out onto adjacent shallow areas including Edgewood Shoals which receives high nutrient inputs from the Blackstone River and Pawtuxet River, as well as effluent from Field's Point WWTF (Kincaid, 2012). In cases of low wind or northward winds (common in the summer), high nutrient water remains within the rotating currents or "gyre."

The gyre in Edgewood Shoals is due to the interaction between the existing bathymetry of the area, currents over the (much) deeper federal channel to the east and river outflows from the Pawtuxet River to the south. Development of a CAD cell, creation of an access channel, and the filling of PEB within Edgewood Shoals area could provide an opportunity to re-shape the bathymetry of this area with the intent of eliminating the gyre and thus improving water quality and estuarine habitat. The University of Rhode Island - Graduate School of Oceanography (URI-GSO) scientists have been studying the gyre formation since 2004 and created a detailed hydrodynamic model to evaluate the effects of various bathymetric configurations in the area (Kinkaid, 2012; Medley, 2019).

4.3.3. Rhode Island Sound Disposal Site

Studies conducted in 2002 and 2003 within the RISDS (USACE, 2002a; USACE, 2002b; SAIC, 2004) gathered physical and chemical information about the water column (e.g., temperature, salinity, density, turbidity, dissolved oxygen), including concentrations of organic and inorganic contaminants. When compared to similar data collected elsewhere within the region, the water quality was found to be consistent with and representative of the water quality of the general area in Rhode Island Sound. Rhode Island has designated these waters as "SA" (RIDEM, 2021).

In summary, data characterizing the hydrographic structure (temperature, salinity, and density), turbidity, dissolved oxygen levels, and concentrations of nutrients and contaminants in the RISDS indicate that the water quality of the RISDS is typical of New England offshore waters. Contaminant levels are low and do not appear to be directly affected by anthropogenic sources of pollution. Dissolved oxygen and contaminant concentrations are well within the water quality guidelines established by the State of Rhode Island (RIDEM, 2021; USACE, 2004).

4.4. Air Quality

In accordance with the Clean Air Act (CAA) of 1977, as amended, (42 U.S.C. 7401), the EPA developed National Ambient Air Quality Standards (NAAQS) to establish the maximum allowable atmospheric concentrations of pollutants that may occur while ensuring protection of public health and welfare, and with a reasonable margin of safety. The EPA measures community-wide air quality based on NAAQS measured concentrations of six criteria air pollutants: carbon monoxide, sulfur dioxide, respirable particulate matter, lead, nitrogen dioxide, and ozone. Using this information, the EPA designates attainment areas and non-attainment areas nationwide. Non-attainment areas are designated in areas where air pollution levels persistently exceed the NAAQS. The entire state of Rhode Island meets the attainment criteria for all NAAQS priority pollutants (EPA, 2021).

The state of Rhode Island is located within the Ozone Transport Region (OTR), which extends northeast from Maryland and includes all six New England states. The interstate transport of air pollution from other states can contribute significantly to violations of the 2008 ozone NAAQS within the OTR. Under the CAA, states within the OTR are required to submit a State Implementation Plan (SIP) and install a certain level of controls for the pollutants that form ozone, even if they meet the ozone standards. The state of Rhode Island has an approved SIP and has submitted periodic revisions to the EPA for approval in conformance with the CAA. The latest revision was submitted to the EPA in September 2020 (RIDEM, 2020).

4.5. Tidal Wetlands and Seagrasses

4.5.1. Wetlands

Approximately 550 acres of estuarine and marine wetlands were identified as bordering the proposed project area (Figure 4-11). These wetlands are identified and cataloged in the U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) mapping tool (USFWS, 2024a). The NWI definition of estuarine and marine wetlands includes salt marsh habitat as well as unvegetated intertidal habitat. The majority of the wetlands adjacent to the project area occur along the shores of Prudence Island and Warren River (Rumstick Point) in the southern reaches of the FNP. Some fringing wetland resources do occur in the northern reaches of the FNP. However, a significant portion of the northern Providence River shoreline is highly developed and does not support wetlands.

4.5.2. Seagrasses

Two types of seagrasses are found in Narragansett Bay: eelgrass (*Zostera marina*) and widgeon grass (*Ruppia maritima*). Eelgrass is largely an estuarine species, while widgeon grass is found in lower salinity waters (Katrud, 1994 as cited in Save the Bay, 2017). Eelgrass is a rooted, vascular, flowering plant that grows below the water surface in coastal and estuarine waters (RI CRMC, 2017). Based on data from University of Rhode Island Data Center (updated May 2021) there are no eelgrass beds or other types of submerged aquatic vegetation located within upper Narragansett Bay, Edgewood Shoals or within the FNP (Figure 4-12). The northernmost eelgrass bed is located off the southern end of Prudence Island, while the northernmost widgeon grass bed is in Greenwich Bay.

Figure 4-11. Wetlands in Narragansett Bay, Rhode Island (Source: USFWS, 2024a).

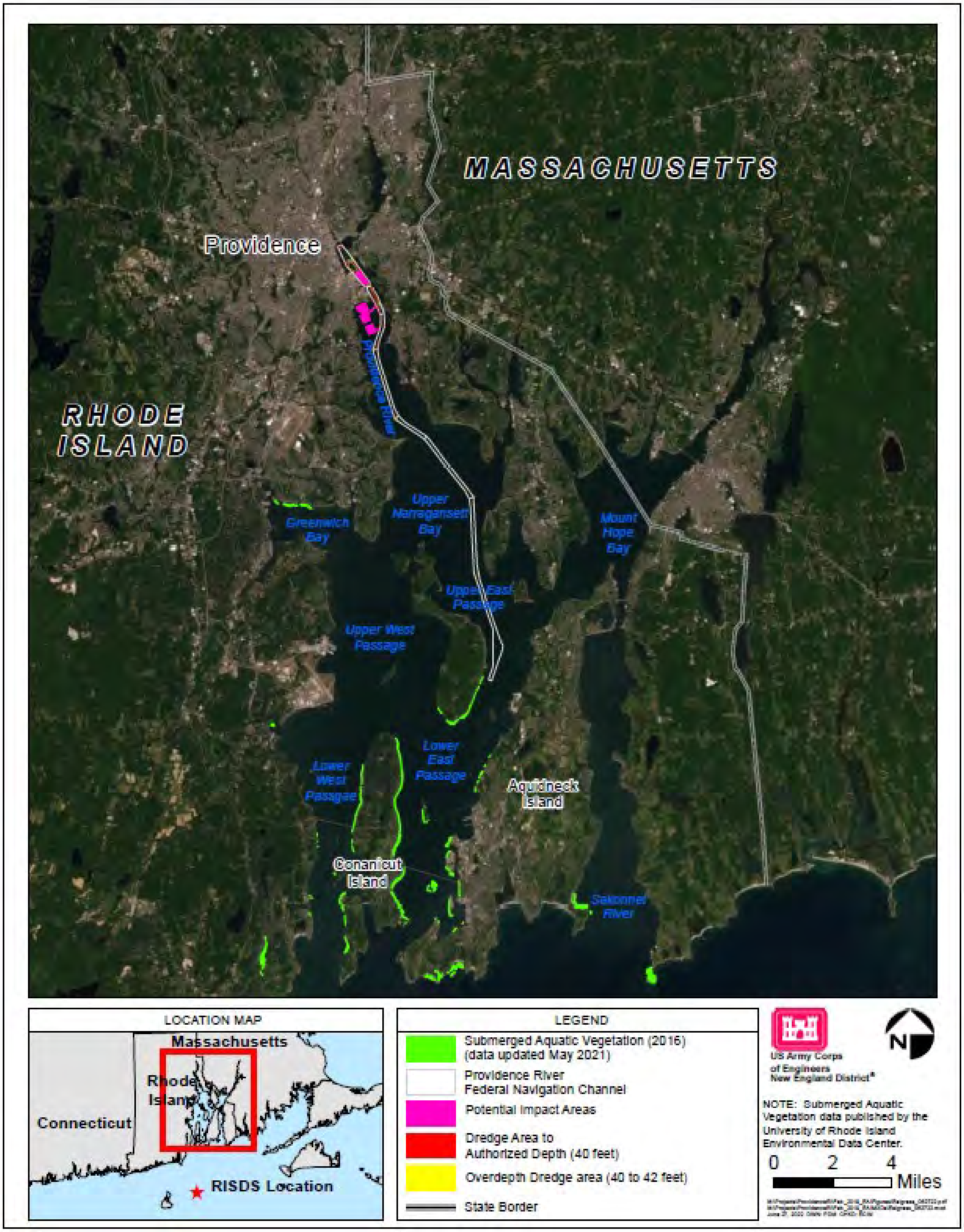


Figure 4-12. Seagrasses in Narragansett Bay, Rhode Island.

4.6. Biological Resources

4.6.1. Fish

Narragansett Bay

Narragansett Bay is an estuary that is an important habitat for many fish species. Estuaries such as Narragansett Bay provide important habitat for sensitive life stages of many fish species (Morson et al., 2019). Since 1959, The URI-GSO, performs weekly trawl surveys in Narragansett Bay and Rhode Island Sound (URI, 2022). Table 4-5 lists the most abundant fish species noted within Narragansett Bay and Rhode Island Sound in the surveys between 1959-2020.

Table 4-5. Most Common Fish Species Noted in Weekly Trawls between 1959-2020 (URI, 2022).

Common Name	Scientific Name	Common Name	Scientific Name
Scup	*Stenotomus chrysops*	Striped Searobin	*Prionotus evolans*
Winter Flounder	*Pseudopleuronectes americanus*	Bluefish	*Pomatomus saltatrix*
Butterfish	*Peprilus triacanthus*	Tautog	*Tautoga onitis*
Silver Hake	*Merluccius bilinearis*	Weakfish	*Cynoscion regalis*
Little Skate	*Leucoraja erinacea*	Blueback Herring	*Alosa aestivalis*
Windowpane Flounder	*Scophthalmus aquosus*	Spiny Dogfish	*Squalus acanthias*
Red Hake	*Urophycis chuss*	Spotted Hake	*Urophycis regia*
Ocean Pout	*Zoarces americanus*	Menhaden	*Brevoortia tyrannus*
Atlantic Herring	*Clupea harengus*	Gulf Stream Flounder	*Citharichthys arctifrons*
Northern Searobin	*Prionotus carolinus*	Smooth Dogfish	*Mustelus canis*
Fourspot Flounder	*Hippoglossina oblonga*	Goosefish	*Lophius americanus*
Longhorn Sculpin	*Myoxocephalus octodecemspinosus*	Mackerel	*Scomber scombrus*
Summer Flounder	*Paralichthys dentatus*	Moonfish	*Selene setapinnis*
Alewife	*Alosa pseudoharengus*	Cunner	*Tautogolabrus adspersus*

According to the URI-GSO 2020 Annual Fish Trawl Survey Report (2022) and Collie et al. (2008), species composition in Narragansett Bay has changed several times over the last six decades. Catch composition in the Bay shifted from mostly demersal fish species (e.g., winter flounder, silver hake, and red hake) in the first 20 years of the survey to more pelagic fish (butterfish and scup) and squid species from the 1980s through present (URI, 2022). However, the data shows that the proportion of pelagic species has begun to decline slightly in the past 15 years, possibly indicating a shift back towards a system dominated by demersal fish species (URI, 2022).

Based on surveys from the RIDEM Division of Marine Fisheries, the most common finfish resources in the Providence River include Atlantic silversides (*Menidia menidia*), striped killifish (*Fundulus majalis*), Atlantic menhaden (*Brevoortia tyrannus*), bluefish (*Pomatomus saltatrix*), Atlantic herring, alewife, and white perch (*Morone americana*). This fish community is composed of both resident fish and seasonal migrants. The Providence River also provides spawning and nursery grounds for winter flounder and tautog. Both the winter flounder and tautog are commercially and recreationally important fishes in Narragansett Bay and the Providence River (USACE, 2001).

In addition to the various species that use the Providence River as spawning and nursery habitat, several anadromous fish runs are located in the Providence River/ Upper Bay system. River herring (*Alosa aestivalis* and *A. pseudoharengus*) spawn in the Ten Mile River system and in Turner Reservoir. River herring have also been stocked in Brickyard Pond and Echo Lake in the Mussachuck Creek system. Spring Green Brook and Old Mill Creek (particularly Buckeye Brook and Warwick Pond) also appear to support self-sustaining populations of river herring. Both American shad (*Alosa sapidissima*) and river herring have been reported in the Warren River (RIDEM, personal communication, February 2001, as reported in USACE, 2001).

Although there is poor sediment and water quality within the Edgewood Shoals area, fish species are expected to be generally the same as the immediate surrounding area of the Providence River and FNP.

Rhode Island Sound Disposal Site

The comparison of selected adult finfish species catch abundances at the RISDS in the 2001 FEIS (USACE, 2001) determined several finfish species are common at the site throughout the year: little skate (*Leucoraja erinacea)*, longhorn sculpin, sea raven (*Hemitripteridae* sp.), silver hake, windowpane and winter flounder, and American lobster. Species that were common only during the spring are alewife, Atlantic cod (*Gadus morhua*), Atlantic herring, and ocean pout. These species are similar to other study areas within the Rhode Island Sound and 2001 trawl data indicated that the site is within a region that has relatively low fish productivity.

4.6.2. Mammals

Narragansett Bay

As this project involves dredging and dredged material placement in subtidal locations, no terrestrial mammals are expected in the action areas of the project. Small mammals, such as meadow voles (*Microtus pennsylvanicus*), white-footed mice (*Peromyscus leucopus*), and masked shrews (*Sorex cinereus*), may be found in adjacent salt marshes. Larger mammals, such as raccoons (*Procyon lotor*), mink (*Mustela vison*), skunks (*Mephitis mephitis*), weasels (*Mustela* spp.), and muskrats (*Ondatra zibethicus*) may also be present in marshes adjacent to the proposed construction areas (Nixon, 1982).

Harbor seals (*Phoca vitulina concolor)* are marine mammals common to Narragansett Bay. Harbor seals are found on both the east and west coasts of the United States, and they inhabit most of Canada's coastline and all of Alaska's. They live in coastal waters off beaches and rocky shores, estuaries, and river mouths. Harbor seals are active year-round. The seals found in Rhode Island waters migrate from northern waters to Narragansett Bay from mid-November to December. They spend the winter and leave for northern waters again in mid-March to April.

Rhode Island Sound Disposal Site

Rhode Island Sound waters are on the migratory pathway of several marine mammal species including the harbor seal, harp seal (*Pagophilus groenlandicus)*, hooded seal (*Cystophora cristata)*, white-sided dolphin (*Lagenorhynchus acutus)*, harbor porpoise (*Phocoena phocoena)*, and minke whale (*Balaenoptera acutorostrata)*. These species may be found transiting or feeding on local concentrations of prey items within the area; however, it is not a specific destination or concentration area for any of the marine mammals identified above (USACE, 2001).

4.6.3. Birds

4.6.3.1. Coastal Birds

Narragansett Bay

Narragansett Bay is an important feeding and resting area for many migrating and wintering shorebirds, gulls, and waterfowl. The habitats that birds utilize and can be found within Narragansett Bay include subtidal estuarine waters, intertidal flats, beaches, salt marshes, and upland areas (including island habitats).

Intertidal flats provide feeding, resting and migratory habitat for shorebirds, gulls, and terns, wading birds, waterfowl, diving birds, and raptors. These habitats are most important for shorebirds and, when flooded with shallow water, for wading birds because they feed almost exclusively in this habitat type (Whitlatch, 1982). Dabbling ducks, such as mallards (*Anas platyrhynchos*) and black ducks (*Anas rubripes)*, and Canada geese (*Branta canadensis)*, do not dive and feed in the shallow subtidal and intertidal areas. Diving ducks, such as greater scaup (*Aythya marila*), dive to about 25 feet (7.6 meters) or more to feed on clams, other invertebrates, fish, and plants. Sea ducks, such as scoters (*Melanitta* spp.) and eiders (*Somateria* spp.), may feed at much deeper depths, some at well over 100 feet (30.5 meters).

Salt marshes are also important habitats in Narragansett Bay for coastal birds. More than 100 species of invertebrates, including insects, snails, and crabs, have been found on New England salt marshes and are used as forage bases for many bird species. The seeds of the dominant plants of the high salt marsh (e.g., salt meadow grass, black grass, and spike grass) provide food for black ducks, Canada geese and other waterfowl, marsh and shore birds, and small mammals.

The islands of Narragansett Bay provide important habitats for colonial nesting waterbirds. The RIDEM Division of Fish and Wildlife conducts an annual census of colony nesting waterbird sites in Rhode Island. Species included in the census are common terns (*Sterna hirundo*), least terns (*Sternula antillarum*), and American oystercatchers (*Haematopus palliatus*) (RIDEM, 2023).

Rhode Island Sound Disposal Site

Many different types of coastal birds may use RISDS as a feeding habitat or resting area. Deep open-water areas may provide resting and feeding habitat for several species of waterfowl and waterbirds such as cormorants, grebes, and loons. Several species of pelagic birds have been identified in the waters around RISDS, including Leach's storm-petrel (*Oceanodroma leucorhoa*), common loon (*Gavia immer*), and the red-throated loon (*Gavia stellata)*. These birds are classified as generally open ocean birds during the winter in tropical seas and do not come near the coast except when nesting or breeding in the spring and summer (USACE, 2001).

Potential waterfowl species in the general Rhode Island Sound area include bufflehead ducks (*Bucephala albeola)*, common goldeneye (*Bucephala clangula)*, hooded mergansers (*Lophodytes cucullatus)*, red-breasted mergansers (*Mergus serrator)*, ruddy duck (*Oxyura jamaicensis)*, American black duck, greater scaup, common eider (*Somateria mollissima)*, harlequin duck (*Histrionicus histrionicus)*, surf scoter (*Melanitta perspicillata)*, white-winged scoter (*Melanitta deglandi)*, and black scoter (*Melanitta americana*).

Several colonial water birds have been observed in the vicinity of the RISDS including the common tern, arctic tern (*Sterna paradisaea)*, least tern, sooty shearwater (*Ardenna grisea)*, northern gannet (*Morus bassanus)*, double-crested cormorant (*Phalacrocorax auritus)*, great cormorant (*Phalacrocorax carbo)*, Bonaparte's gull (*Chroicocephalus philadelphia)*, herring gull (*Larus argentatus)*, great black-backed gull (*Larus marinus)*, laughing gull (*Leucophaeus atricilla)*, ring-billed gull (*Larus delawarensis)*, black-legged kittiwake (*Rissa tridactyla)*, and razorbill (*Alca torda*) (USACE, 2001).

4.6.3.2. **Migratory Birds**

Migratory birds in the area identified by the USFWS's Information for Planning and Consultation System (IPAC) are listed in Table 4-6. Birds that are of Conservation Concern (BCC) by the USFWS are denoted in the table with an asterisk (*). Bird species considered for the BCC list include nongame birds, game birds without hunting season, subsistence-hunted nongame birds in Alaska, and Endangered Species Act (ESA) candidate, proposed, and recently de-listed species. The overall goal of the BCC designation is to accurately identify the migratory and non-migratory bird species (beyond those already designated as Federally threatened or endangered) that represent the USFWS's highest conservation priorities (USFWS, 2021).

Some migratory birds identified in Table 4-6 may be present in the project and surrounding areas year-round while others are expected to be present during the spring to summer timeframe, or only during their migrations in early spring and late summer/early fall. Migratory birds that have the potential to breed in the project area generally do so between April 1 and October 31 of each year (USFWS, 2022).

Table 4-6. Migratory Birds in the Project Area. * Indicates species is a Bird of Conservation Concern. (Source: USFWS, 2022).

Common Name	Scientific Name	Breeding Season
American Oystercatcher*	*Haematopus palliatus*	Apr 15 to Aug 31
Bald Eagle	*Haliaeetus leucocephalus*	Oct 15 to Aug 31
Black Scoter	*Melanitta nigra*	Breeds elsewhere
Black Skimmer*	*Rynchops niger*	May 20 to Sep 15
Black-billed Cuckoo*	*Coccyzus erythropthalmus*	May 15 to Oct 10
Blue-winged Warbler*	*Vermivora pinus*	May 1 to Jun 30
Bobolink*	*Dolichonyx oryzivorus*	May 20 to Jul 31
Canada Warbler*	*Cardellina canadensis*	May 20 to Aug 10
Cerulean Warbler*	*Dendroica cerulea*	Apr 29 to Jul 20
Common Eider	*Somateria mollissima*	Jun 1 to Sep 30
Common Loon	*Gavia immer*	Apr 15 to Oct 31
Cory's Shearwater*	*Calonectris diomedea*	Breeds elsewhere
Eastern Whip-poor-will*	*Antrostomus vociferus*	May 1 to Aug 20
Great Shearwater	*Puffinus gravis*	Breeds elsewhere
Kentucky Warbler*	*Oporornis formosus*	Apr 20 to Aug 20
Lesser Yellowlegs*	*Tringa flavipes*	Breeds elsewhere
Long-tailed Duck	*Clangula hyemalis*	Breeds elsewhere
Prairie Warbler*	*Dendroica discolor*	May 1 to Jul 31
Prothonotary Warbler*	*Protonotaria citrea*	Apr 1 to Jul 31
Purple Sandpiper*	*Calidris maritima*	Breeds elsewhere
Razorbill	*Alca torda*	Jun 15 to Sep 10
Red-breasted Merganser	*Mergus serrator*	Breeds elsewhere
Red-headed Woodpecker*	*Melanerpes erythrocephalus*	May 10 to Sep 10
Red-throated Loon	*Gavia stellata*	Breeds elsewhere
Ring-billed Gull	*Larus delawarensis*	Breeds elsewhere
Roseate Tern	*Sterna dougallii*	May 10 to Aug 31
Royal Tern	*Thalasseus maximus*	Apr 15 to Aug 31
Ruddy Turnstone*	*Arenaria interpres morinella*	Breeds elsewhere
Rusty Blackbird*	*Euphagus carolinus*	Breeds elsewhere
Short-billed Dowitcher*	*Limnodromus griseus*	Breeds elsewhere
Sooty Tern	*Onychoprion fuscatus*	Mar 10 to Jul 31
South Polar Skua	*Stercorarius maccormicki*	Breeds elsewhere
Surf Scoter	*Melanitta perspicillata*	Breeds elsewhere
White-winged Scoter	*Melanitta deglandi*	Breeds elsewhere
Willet*	*Tringa semipalmata*	Apr 20 to Aug 5
Wilson's Storm-petrel	*Oceanites oceanicus*	Breeds elsewhere
Wood Thrush*	*Hylocichla mustelina*	May 10 to Aug 31

4.6.4. Benthos

Providence River, Prudence Island Disposal Site, and Narragansett Bay

The Providence River, Narragansett Bay, and associated waters are comprised of distinct geographical regions having unique hydrodynamic and geologic features that directly influence the type, abundance, and diversity of benthic organisms. The benthic habitat of the upper and lower Providence River consists of the dredged channel and the adjacent subtidal and intertidal areas comprised primarily of unconsolidated soft sediments and shells, which are low in dissolved oxygen and high in water content. Benthic organisms are typical of those found in stressed environments dominated by low densities of short-lived species (opportunistic) capable of exploiting stressed or disturbed sediments.

The Federal Navigational Channel in the upper Providence River south to Fields Point consists of a fluid noncohesive bottom, low in oxygen, with various chemically impacted sediments. Consequently, the benthic fauna has historically had low diversity, consisting of many pollution-tolerant species, such as the bivalve (*Nucula annulata)*, and the polychaete worms, *Nephtys incisa*, *Streblospio benedicti*, and *Polydora ligni* (French et al., 1992). Large amounts of shell hash were also observed here. The shallow portions of the river adjacent to the channel consist primarily of loose, soft sediments and shell beds over silt, with some small sandy patches as indicated by sediment profile samples taken on the outer flanks for the FNP (see Section 4.2). Species inhabiting these areas historically include the mollusk (*Crepidula fornicate)*, soft-shell clams (*Mya arenaria)*, and the polychaete worms *Mediomastus ambiseta, Streblospio benedicti*, and *Tharyx acutus* (French et al., 1992).

Shumchenia et al. (2016) performed an analysis of a 20-year period of benthic habitat change (1988-2008) throughout Narragansett Bay and found that benthic communities throughout the bay were trending toward higher diversity and more “mature” benthic communities such as *Ampelisca* (a tube dwelling crustacean) bed communities. The shifting of benthic communities throughout the Narragansett Bay system is likely due to the large reduction in nutrient input into the bay that has occurred though sewage treatment facility upgrades and more stringent regulations pertaining to the release of nutrients (Shumchenia et al., 2016).

Historic Prudence Island Disposal Site

Two distinct benthic communities were present within the historic PIDS and were delineated by substrate (Table 4-7) by USACE for this report. Most of the seafloor habitat within the nearshore placement site (corresponding to Stations 1-6 and Station 8) was comprised of silt with varying portions of sand and contained a relatively homogenous soft-bottom benthic community. However, Station 11 was located on mixed-bottom habitat consisting of epifaunal mollusc species attached to silty gravel substrate. This patchy mixed-bottom habitat interlaced the shallower, northwestern portion of the historic disposal site and contained a dissimilar benthic community than that of the soft-bottom habitat.

The soft-bottom community was mostly comprised of burrowing bivalves (46%) and polychaete worms (42%) by abundance (Table 4-7). The most abundant and indicative members of this community were the *Nucula proxima* (a burrowing, deposit feeding bivalve, which often serves as an important prey item for demersal fish and other benthic organisms), *Periploma papyratium* (a burrowing, filter feeding bivalve), and *Ninoe nigripes* (a large-bodied, motile, burrowing/tube-building, predatory polychaete worm). Other indicative mollusc species included *Macoploma tenta* (a burrowing, deposit feeding bivalve), and *Ilyanassa trivittata* (an epifaunal, scavenging gastropod). Additionally, bamboo worms *Maldanidae* spp. (large-bodied, head-down tube-building deposit feeders indicative of a stage 3 benthic community) and the catworm, *Nephtys incisa (*a large-bodied, motile, burrowing predator), were important polychaete species. The threadworm, *Levinsenia gracilis* (a motile, burrowing, deposit feeding polychaete), was numerically abundant, but comprised a tiny fraction of the biomass due to its minute size. This community contained moderate species richness (mean *S* = 16.7) and diversity (mean *H'* = 2.0) and relatively high evenness (mean *J'* = 0.7). According to AZTI's Marine Biotic Index, the community is classified as slightly disturbed, and the community quality is considered good to very good. The slight disturbance present in the area may be attributable to either slight nutrient enrichment present within this natural depository environment or slight residual sediment contamination from historic disposal events, as *N. proxima* and *L. gracilis* are known to be moderately tolerant to organic enrichment, and *N. incisa* is known to tolerate chemical contamination (notably metals).

The mixed-bottom community was mostly comprised of molluscs (47%), malacostracan arthropods (28%), and polychaete worms (26%) by abundance. The foundational species in this community were *Crepidula fornicata* and *Anadara transversa* (reef-building, filter-feeding molluscs). The mud crab, *Dyspanopeus sayi* (a predator of clam spat and barnacles), and *N. nigripes* were the next most abundant species, suggesting that the shell-reef habitat is situation on and around the ambient muddy, soft-bottom habitat. Other indicative hard-bottom species included *Caprella penantis* (an amphipod species adapted to attach to substrata and sessile organisms) and *Astyris lunata* (a mobile gastropod which preys upon sessile organisms found in hard-bottom habitats). Species richness (*S* = 15.0) and diversity (*H'* = 2.3) were comparable to the soft-bottom community, though species evenness was greater (*J'* = 0.9).

Table 4-7. Summary of Benthic Invertebrate Data at Prudence Island Disposal Site.

Taxon		Prudence Island Historic Disposal Site							
		1	2	3	4	5	6	8	11
Annelida	**Polychaeta**								
	Aricidea sp.	0	0	0	0	0	0	0	1
	Glycera americana	0	1	0	0	0	0	1	1
	Haplosyllis spongiphila	0	0	0	0	1	0	0	2
	Levinsenia gracilis	0	0	0	19	44	28	38	0
	Maldanidae spp.	1	3	2	2	1	5	1	0
	Nephtys incisa	3	1	1	7	9	8	8	0
	Nereis sp.	0	2	0	1	0	0	1	0
	Ninoe nigripes	35	25	48	50	37	38	49	5
	Pectinaria gouldii	0	0	0	0	0	1	2	0
	Phyllodocidae sp.	0	1	0	0	1	2	0	0
	Polynoidae sp.	1	0	0	0	0	0	0	1
	Spiochaetopterus oculatus	0	0	0	0	0	1	0	0
	Terebellidae sp.	0	0	0	0	0	1	1	1
Arthropoda	**Malacostraca**								
	Ampelisca abdita	3	1	1	10	16	4	0	1
	Callinectes sapidus	0	0	0	0	1	0	0	0
	Caprella penantis	0	0	0	0	0	0	0	2
	Dyspanopeus sayi	0	0	0	0	0	0	0	6
	Harpinia propinqva	0	0	0	0	0	0	0	2
	Leptocheirus pinguis	0	0	0	3	0	0	0	0
	Oxyurostylis smithi	0	0	2	0	0	0	0	0
	Pagurus sp.	0	0	0	0	0	0	0	1
	Pinnixa sp.	0	1	1	2	0	0	0	0
	Unciola irrorata	0	1	0	0	2	2	0	0
Mollusca	**Bivalvia**								
	Agriopoma morrhuanum	1	2	6	4	2	3	2	0
	Anadara transversa	0	0	0	0	1	1	0	4
	Lucinoma filosa	0	1	0	1	0	0	0	0
	Lyonsia hyalina	1	0	0	0	0	0	0	0
	Macoploma tenta	1	2	10	3	9	24	2	0
	Nucula proxima	13	25	55	40	64	84	28	0
	Nuculana acuta	1	1	0	0	2	1	5	0
	Pandora gouldiana	0	0	1	0	0	0	0	0
	Parvicardium pinnulatum	1	2	0	1	0	0	0	0
	Periploma papyratium	22	6	33	18	23	15	17	0
	Gastropoda								
	Astyris lunata	0	0	0	0	0	0	0	3
	Busycon carica	0	0	0	0	1	0	0	0
	Crepidula fornicata	0	0	0	0	0	0	0	12
	Haminella solitaria	4	1	3	0	0	8	2	0
	Ilyanassa trivittata	4	1	17	1	12	2	12	0
	Rissoidae spp.	1	1	3	1	3	5	2	0
	Seila adamsii	0	0	0	0	0	0	0	1
TOTAL INDIVIDUALS		**92**	**78**	**183**	**163**	**229**	**233**	**171**	**43**
TOTAL SPECIES		**15**	**19**	**14**	**16**	**18**	**19**	**16**	**15**

Edgewood Shoals

In October 2021, USACE collected benthic grab samples from areas within Edgewood Shoals to document the macrobenthic communities (Figure 4-13). The surficial sediments and associated habitat types within the proposed access channel and adjacent areas were also characterized in the Edgewood Shoals Suitability Report (Appendix F).

The benthic community of Edgewood Shoals contained many large, head-down, tube-building deposit-feeding polychaetes such as *Clymenella torquata*, *Sabaco elongatus*, and *Pectinaria gouldii*, as well as large, tube-building, filter-feeders such as *Spiochaetopterus oculatus* (an ecosystem engineer which can create reefs of worm tubes) and *Paraprionospio pinnata* (Pollack, 1997). There were high counts of small, tube/burrow-building, deposit-feeders such as the polychaetes *Streblospio benedicti*, *Polydora cornuta*, and *Polycirrus eximius*, as well as the amphipod *Ampelisca abdita*, and larger, burrowing, deposit-feeding polychaetes such as *Cirriformia grandis* and *Chaetozone setosa*. There were also high counts of more mobile, burrowing, deposit-feeders such as the small, disturbance-tolerant, *Heteromastus filiformis* and the large-bodied, highly mobile polychaete, *Leitoscoloplos fragilis*. The community also contained many mobile scavengers and carnivorous predators such as the polychaetes *Glycera* spp., *Eteone* spp., *Oxydromus obscurus*, and *Nereis* spp., and isopods within the genus *Chiridotea* (Pollack, 1997). Many epifaunal invertebrates were also present within the benthic community, such as species within the genus, *Lembos* (filter/deposit-feeding amphipods associated with benthic macroalgae), and the ecosystem-engineer, *Crepidula fornicata* (large, filter-feeding gastropods whose shells provide structure for the attachment of benthic macroalgae and other fouling organisms), and their tiny ectoparasitic gastropod, *Boonea seminuda*.

The benthic community also contained burrowing bivalves, including large, commercial-sized quahogs (*Mercenaria mercenaria*) and the smaller, organic-pollution-tolerant *Nucula proxima*. The bivalve, *Petrasma borealis*, which relies on sulfur-oxidizing chemosynthetic bacteria for sustenance, was also present within the benthic community (Pollack, 1997). Species that rely on sulfur-oxidizing symbionts are typical of anoxic environments.

Correspondingly, the combination of poor water circulation due to the steep bathymetric gradient created by the Providence FNP, and the presence of six different wastewater outfalls within the Edgewood Shoals area is known to create anoxic conditions in portions of the shoals during summer months (Medley, 2019). The benthic community within the extent of the historic Fields Point Shipyard channel and Port Edgewood turning basin (corresponding to sampling Stations 3, 6, 7, 8, 9, 10) was moderately (Stations 3 and 6) to severely (Stations 7-10) reduced from the surrounding community.

A complete report including sample location coordinates, all macrobenthic data, and visual descriptions of the sediments is included in Appendix H of this document.

Other recent benthic surveys in Edgewood Shoals completed by the Narragansett Bay Commission (NBC) from March 2016 to June 2017 indicated the sparse and trace presence of larger burrowing fauna, tunneling megafauna, small tube-building fauna, *Nassariid*, and *Arenicola* species, as well as varying coverages of diatom felt (trace amounts to moderate and dense coverage) (NBC, 2017).

Rhode Island Sound Disposal Site

Disposal Area Monitoring System (DAMOS) surveys of RISDS were conducted in 2005 and 2009 to characterize the status of benthic recolonization following material disposal from maintenance dredging of the Providence FNP. The July 2005 DAMOS monitoring survey of RISDS found that the benthic community was recovering relatively rapidly over the disposal site (ENSR, 2007). As the July 2005 survey was conducted only six months following the cessation of disposal activities (relatively early in the recolonization process), the results showing lower densities of Stage 2 and 3 fauna at the disposal site as compared to the reference areas were expected and well within the normal range of observed recolonization patterns seen at other DAMOS disposal sites (Germano et al., 1994; Valente et al., 2011).

The 2009 DAMOS survey found that the berm created on the western side of the disposal site was characterized by a variety of benthic habitat types ranging from silt/clay to small rocks (pebbles and cobbles) (Valente et al., 2011). Many of the rocks were found to be covered with encrusting epifauna and small crustaceans. Overall, the hard bottom conditions on the berm were providing habitat for a variety of epifauna, including hydroids, bryozoans, shrimp, crabs, and sea stars. Although they were not observed in the images collected during the 2009 survey, it is possible that juvenile lobsters might also be attracted to these hard bottom conditions. Dredged material placed in late 2008 and early 2009 was determined to have advanced successional stage community (i.e., a community indicative of recovering well) (Valente et al., 2011).

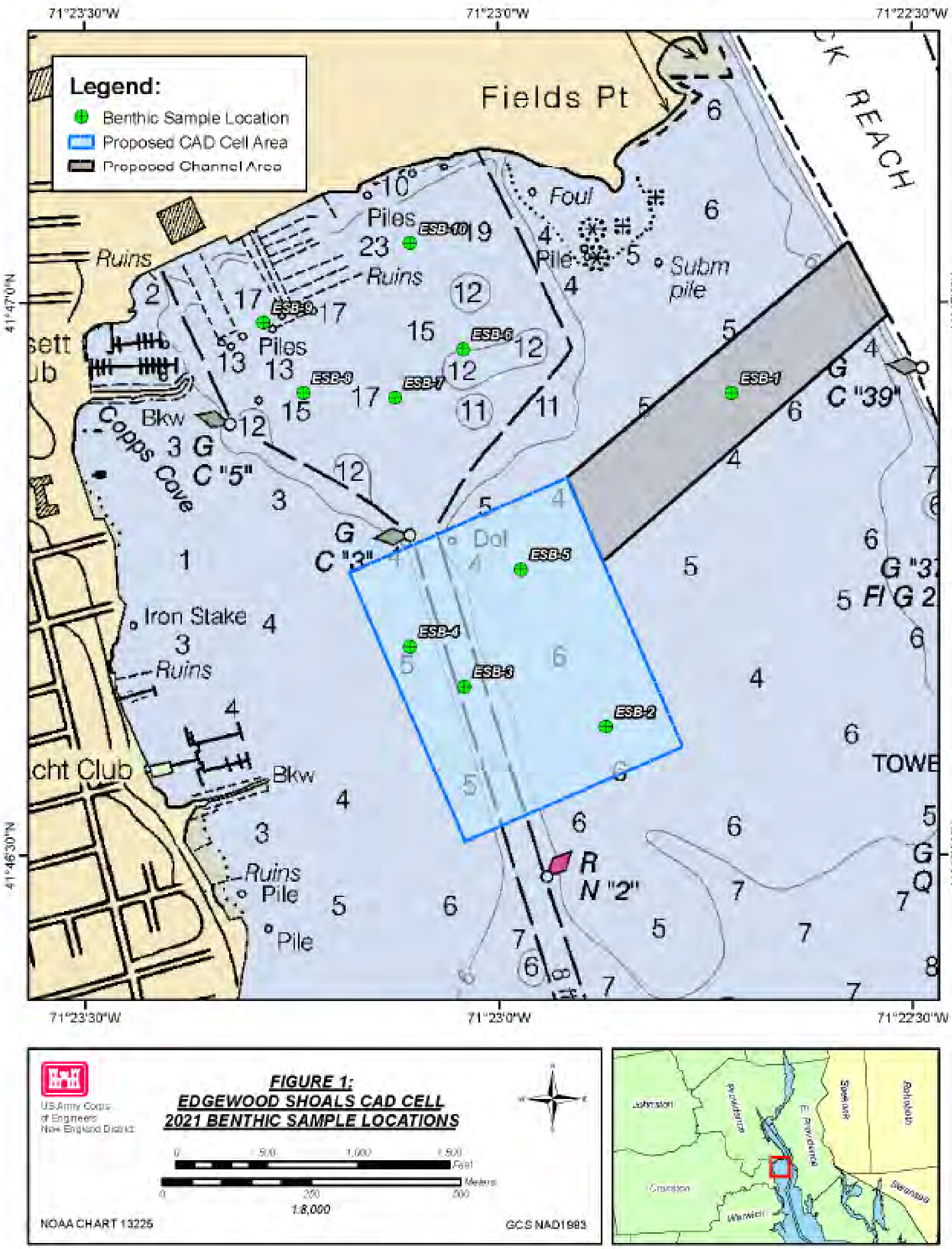


Figure 4-13. Edgewood Shoals Benthic Sample Locations (2021).

4.6.5. Shellfish

Providence River, Prudence Island Disposal Site, and Narragansett Bay

The waters of Narragansett Bay support several species of shellfish that are commercially harvested. The largest fishery in the bay is the quahog or hard clam (*Mercenaria mercenaria*) fishery (Boyd, 1991; McManus et al., 2020) and is discussed in more detail below. Soft shell clam (*Mya arenaria*) and blue mussel (*Mytilus edulis*) also support lesser fisheries in the bay (Boyd, 1991). Additionally, oyster (*Crassostrea virginica*) resources are found in the bay but most commercial oyster fishing in the bay is aquaculture based.

The Providence FNP and the PIDS do support populations of the shellfish species noted above. However, due to the deep-water nature of the FNP and PIDS and the quality of the sediments at both locations, there is no commercial harvest of shellfish from the channel bottom or side slopes of the channel or from within the PIDS.

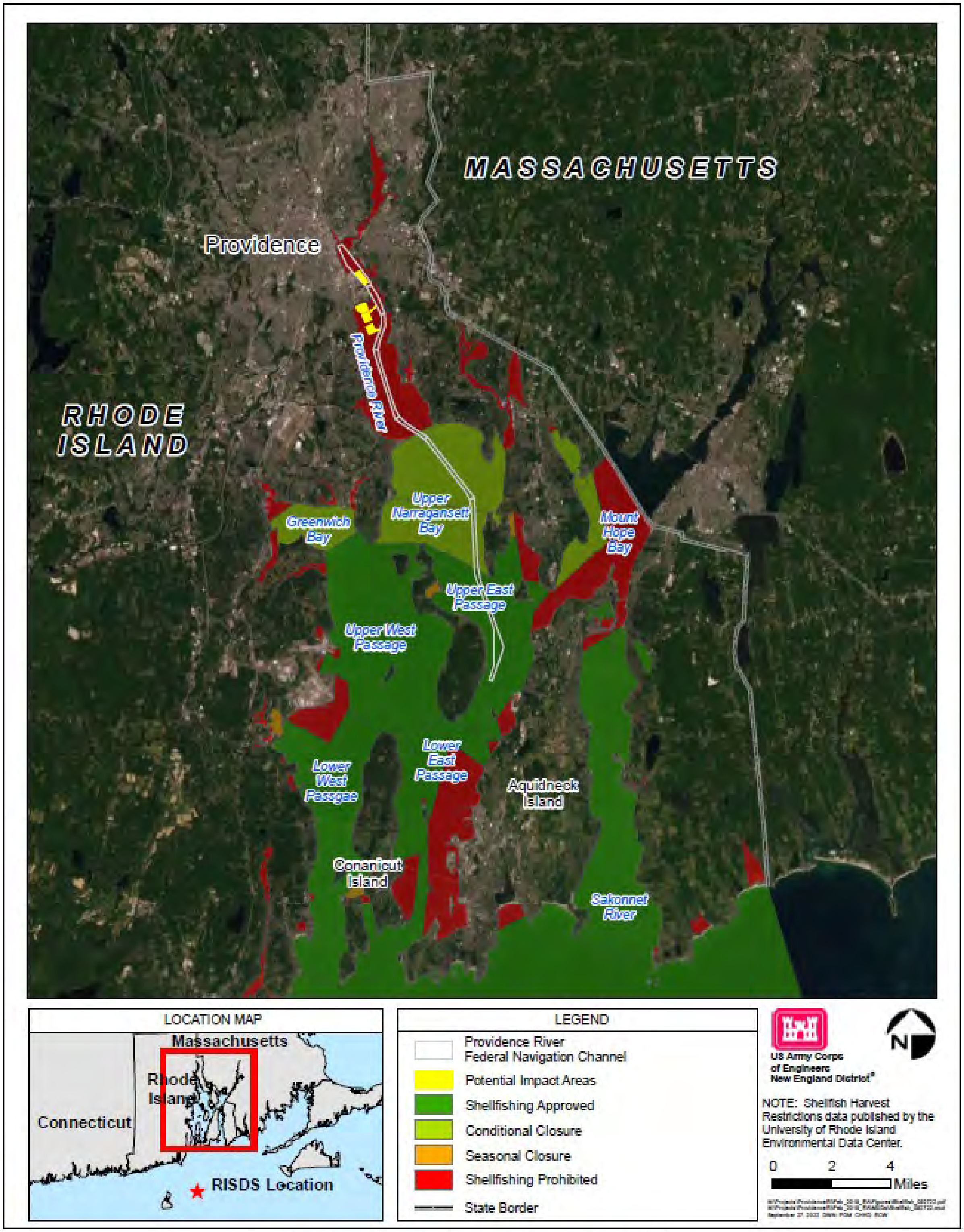
The RIDEM classifies shellfish grounds as approved, conditionally closed, seasonally closed and prohibited areas (RIDEM, 2022c). Figure 4-14 shows that the FNP is located across areas that are prohibited, conditionally closed, and approved.

Quahog Fishery

Bay quahogs (*Mercenaria mercenaria*) are generally found in estuarine and near-coastal waters up to 60 feet deep (MLLW). Quahogs are a commercially important species and distributed widely within Narragansett Bay in various densities (Figure 4-15)(RIDEM, 2022b). The distribution of bay quahogs in Narragansett Bay is non-random (Ganz et al., 1994) with distribution correlated with sediment type (Kassner et al., 1991). Upper Narragansett Bay is one of the richest quahog areas in the state of Rhode Island, supporting an important commercial and recreational fishery.

Although closed to commercial fishing for many years because of pollution, the upper portion of Narragansett Bay was re-certified in the 1960s as conditionally suitable for shellfish harvesting. Heavy rains contribute to significant bacterial contamination from upstream areas, resulting in periodic closures of the conditional areas; however, the waters of upper Narragansett Bay yield more than 55% of the annual quahog harvest in Rhode Island (McManus et al., 2020). In 2021, the lower Providence River, from Conimicut Point to Gaspee Point, was opened as a conditional area due to continued improvements to water quality. Quahog harvest from the Providence River conditional Area E accounted for 34% of the harvest in 2021 (Pat Barrett, RIDEM, personal communication, 2022b).

The RIDEM manages bay quahogs within state waters along with the Rhode Island Marine Fisheries Council using a rotational transplant/harvest system. Permanent and conditional pollution closures restrict the fishery in addition to seasons, possession limits, and management closures (RIDEM, 2008). Rhode Island’s Shellfish Management Plan specifies that the rotational harvest and transplant/spawner sanctuary programs should be expanded to include more areas. Stock assessments based on fishery landings, fishery effort, and fishery-independent survey data indicate that quahog stock biomass is at a relatively low level. However, a decline observed between the mid-1980s and mid-1990s has since leveled off.



Shellfish Harvest Restrictions Providence DMMP

Figure 4-14. Narragansett Bay Shellfish Harvest Restriction Areas (RIDEM, 2022c).

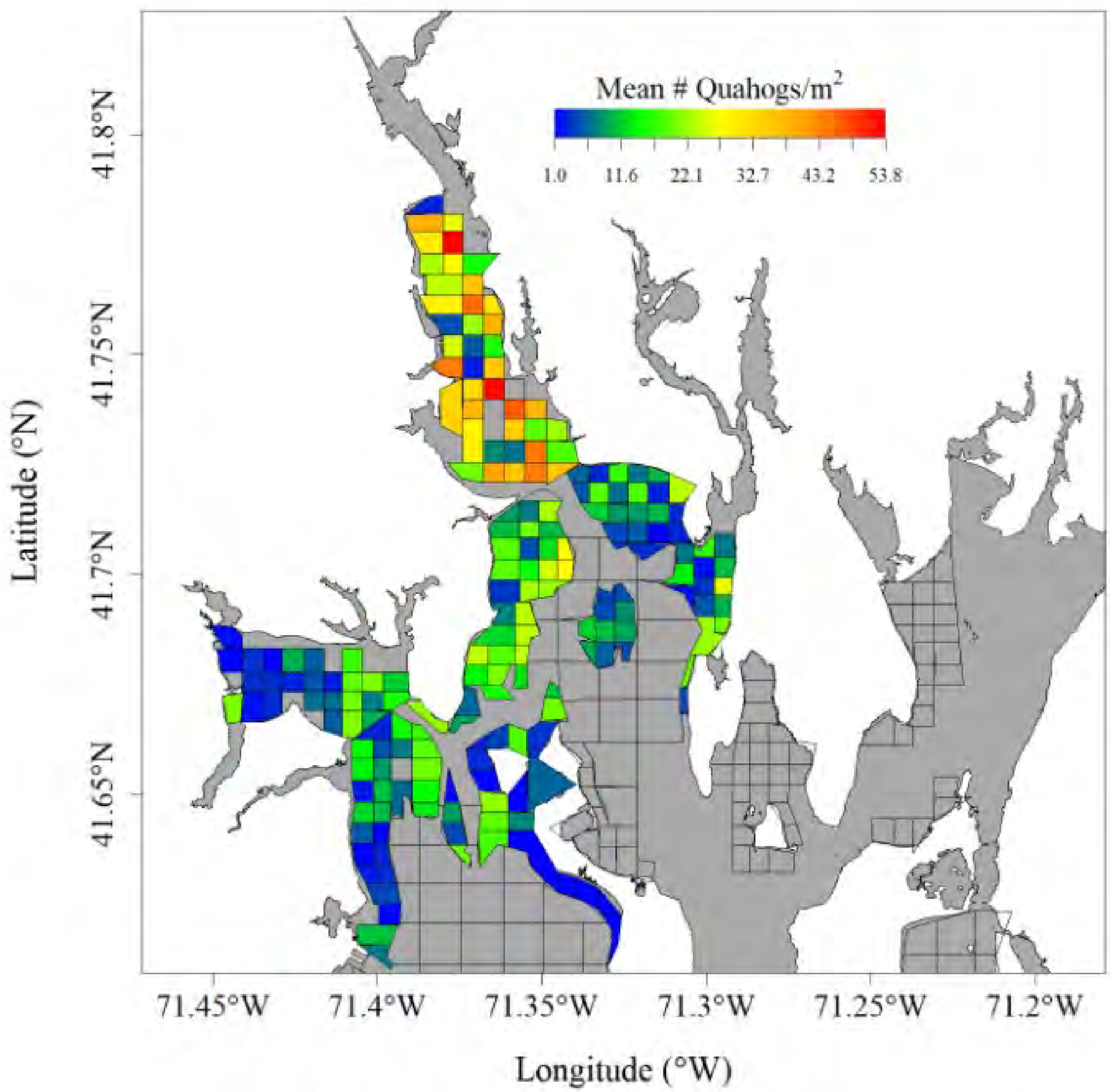


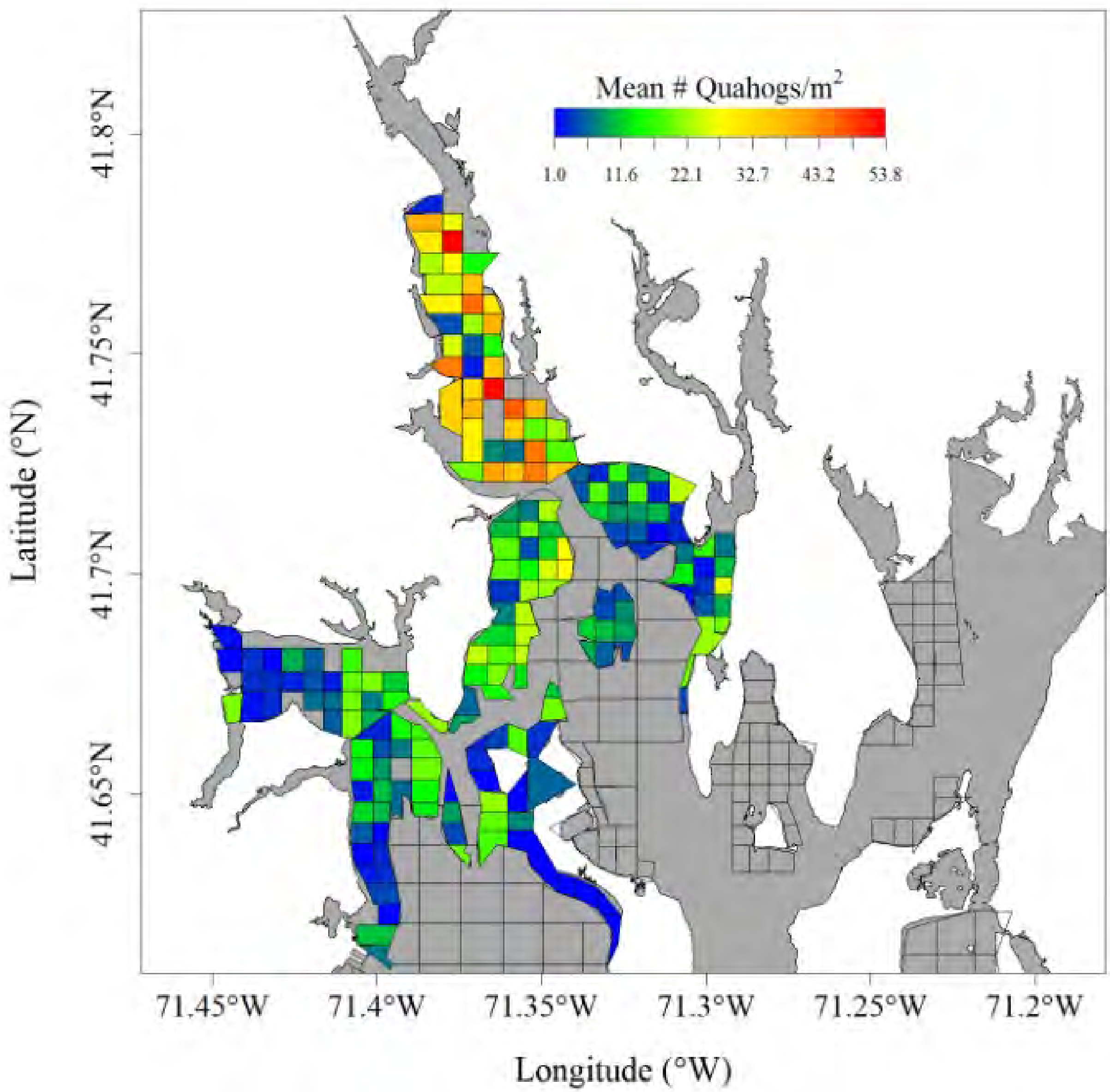
Figure 4-15. Mean Quahog Density per Square Meter in Upper Narragansett Bay (RIDEM, 2022b).

Edgewood Shoals

Quahogs are abundantly present in Edgewood Shoals. Soft shell clams are also present in the Edgewood Shoals to a lesser extent.

Rhode Island Sound Disposal Site

A stable population of ocean quahog (*Arctica islandica*) is in the vicinity of the disposal site, but it is not as prolific as other populations in Rhode Island Sound. No sea scallops, surf clams or whelks were collected at RISDS during the studies of the RISDS (USACE, 2004).



4.6.6. Lobster

Narragansett Bay and Edgewood Shoals

There are no significant lobster (*Homarus americanus*) resources within the FNP or within the Edgewood Shoals area. Per a 2019 RIDEM personal communication with Mr. Eric Schneider, Fisheries Biologist with the RIDEM Marine Fisheries, the northern limit of the lobster fishery is in the vicinity of Ohio Ledge (just south of Rumstick Neck Reach) and the mouth of Mount Hope Bay.

Rhode Island Sound Disposal Site

Lobsters are found within the RISDS, but higher concentrations were found outside the disposal site boundaries in studies conducted between 1999 and 2003 (EPA/USACE, 2004b). An assessment of lobster abundance was conducted at the RISDS in 2005 after the disposal of the Providence FNP maintenance dredging material. While the average abundance and size of lobsters generally decreased between 1999 and 2005 at all sampled sites within Rhode Island Sound, the magnitude of this decrease was always less at the RISDS (Valente et al., 2007).

4.7. Threatened and Endangered Species

4.7.1. Federally Listed Species

4.7.1.1. U.S. Fish and Wildlife Service Jurisdiction

According to the USFWS's IPaC system (project code: 2025-0094639), the federally endangered roseate tern (*Sterna dougalliii dougallii*), endangered northern long-eared bat (*Myotis septentrionalis*), proposed endangered tricolored bat (*Perimyotis subflavus*), and proposed threatened monarch butterfly (*Danaus plexippus*) may be found in the general project area (USFWS, 2025). There are no critical habitats within the project areas under USFWS jurisdiction.

Northern Long-Eared Bat

The northern long-eared bat (NLEB) (*Myotis septentrionalis*) is a federally endangered species found expansively across central and northeastern United States and Canada, ranging from British Columbia and the Northwest Territories to the Atlantic coast. Its natural habitat includes forests in the summer and caves or similar habitat suitable for hibernating in the winter. The species' range includes 37 states. White-nose syndrome, a fungal disease known to affect bats, is currently the predominant threat to this bat, especially throughout the Northeast where the species has declined by up to 99% from pre-white-nose syndrome levels at many hibernation sites (USFWS, 2022a). During summer, NLEBs roost singly or in colonies. Males and non-reproductive females may also roost in cooler places, like caves, mines, and forts. NLEBs emerge at dusk to fly through the understory of forested hillsides and ridges feeding on moths, flies, leafhoppers, caddisflies, and beetles, which they catch while in flight using echolocation. Breeding begins in late summer or early fall when males begin swarming near hibernacula. Most females within a maternity colony give birth around the same time, which may occur from late May or early June to late July, depending on where the colony is located within the species' range. Young bats start flying by 18 to 21 days after birth (USFWS, 2022a). Although NLEB may transit through the area, there are no known hibernacula, maternity roost trees, or suitable summer habitat within the project area.

Tricolored Bat

The tricolored bat (*Perimyotis subflavus*) has been listed as proposed endangered. One of the smallest species of bats native to North America, it has an expansive range from the central U.S.

to the eastern seaboard, spanning into parts of Canada and as far south as central America (USFWS, 2022b). Like the NLEB, tricolored bats can be found hibernating in caves and mines in the winter and roosting in forested habitats in the spring, summer, and fall. These bats prefer to roost in live or dead deciduous hardwood trees, primarily in leaf clusters. They are also being significantly impacted by white-nose syndrome, with areas affected by the disease showing 90-100% declines in winter colony abundance (USFWS, 2022b). Although, like NLEB, tricolored bats may transit through the project areas, the immediate habitat does not support persistent bat presence.

Monarch Butterfly

The monarch butterfly (*Danaus plexippus*) is a candidate species not yet listed or proposed for listing. As such, coordination under Section 7 of the ESA is not required for this study. Monarch butterfly populations found in the northeastern U.S. breed and lay eggs in their overwintering sites along the southern U.S. and northern Mexico (USFWS, 2024b). After breeding, they embark on a northward migration arriving in New England around May. Many of the local spring/summertime populations only live for two to five weeks while their overwintering counterparts can survive for six to nine months (USFWS, 2024b). The overwintering generation initiates a southward migration around September. Monarch caterpillars have a highly specialized diet that only includes species of milkweed (*Asclepias* spp.).

Roseate Tern

Roseate terns nest on small rocky or sandy islands, barrier beaches, salt marshes, and rarely on the mainland (USFWS, 1989; Kress & Hall, 2004). Most colonies are close to shallow water foraging areas with sandy bottoms, bars, or shoals (Gochfeld et al., 1998). In the Northeast, roseate terns nest within common tern colonies (Nisbet & Spendelow, 1999; USFWS, 1998). Within these mixed colonies, roseate terns usually select habitat with dense vegetation or the protection of rocks and driftwood (Burger & Gochfeld, 1988). They will also use artificial nest sites (e.g., boxes and half-buried tires) (Spendelow, 1982). Roseate terns forage over shallow sandbars, shoals, inlets, or schools of predatory fish, often in mixed flocks with other terns (Safina et al., 1990; Shealer & Burger, 1993 and 1995). Roseates feed on at least 15 species of small marine fish but prefer sand lance (*Ammodytes spp.)* (Gochfeld et al., 1998; Kress & Hall, 2004).

Rhode Island has no nesting roseate terns currently. The last confirmed nesting pair of roseates in Rhode Island was in the 1980s. Roseate terns can be found in the state, mostly after the breeding period and before southbound migration. They can also be observed during the breeding period but are likely non-breeders and/or moving around the region. According to Cornell's eBird.org website (eBird, 2024), roseate terns in Rhode Island are most frequently observed on the southern coast: Camp Cronin, the Newport cliff walk, Sachuest Point, and Little Compton. These sightings ranged from May to August of 2022 and from one to five individuals (eBird, 2024).

4.7.1.2. National Marine Fisheries Service Jurisdiction

The following threatened and endangered species were determined as potentially present within the project areas using the NMFS Mapper for the Greater Atlantic Region Consultation Areas for

Section 7 of the ESA on June 28, 2022, and by coordinating directly with the NMFS-Greater Atlantic Regional Fisheries Office staff:

- Fin whale (*Balaenoptera physalus*) Endangered
- Northern right whale (*Eubalaena glacialis*) Endangered
- Kemp's ridley sea turtle (*Lepidochelys kempii*) Endangered
- Atlantic loggerhead sea turtle (*Caretta caretta*) Threatened (North Atlantic distinct population segment [DPS])
- Atlantic leatherback sea turtle (*Dermochelys coriacea*) Endangered
- Atlantic green sea turtle (*Chelonia mydas*) Endangered (North Atlantic DPS)
- Shortnose sturgeon (*Acipenser brevirostrum)* Endangered, and
- Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) Endangered.

Whales and sea turtles are unlikely to occur in the Providence River or upper Narragansett Bay where the majority of work would occur. However, two federally endangered species of whales (fin whale and Northern right whale) and four species of federally listed threatened or endangered sea turtles may be seasonally found in coastal waters of New England and the RISDS. These species include the threatened Northwest Atlantic Ocean DPS of loggerhead turtles, the North Atlantic DPS of green sea turtles, the endangered Kemp’s ridley and the endangered leatherback turtle. Sea turtles are highly migratory and generally distributed in coastal Atlantic waters from Florida to New England. As water temperatures of coastal New England rise in the spring, turtles begin to migrate north from their overwintering waters in the south.

The loggerhead, Kemp's ridley, and green sea turtles are mostly juvenile and subadult individuals foraging in nearshore coastal waters. The Kemp's ridley appears to prefer estuarine areas where green crabs and mussels are found. Loggerheads feed on benthic organisms found in large bay systems and leatherbacks forage in the open waters in search of jellyfish (USACE, 2001).

Two species of sturgeon, the state and federally endangered shortnose sturgeon and Atlantic sturgeon may occur in the vicinity of the general project area. Atlantic sturgeon from any of the five DPSs may be present in the general project area. After emigration from the natal estuary, subadult and adult Atlantic sturgeon forage within the marine environment, typically in waters less than 50 meters depth (ASSRT, 2007). Atlantic sturgeons may be occasional visitors to the general area, most likely while making coastal migrations or while foraging for benthic invertebrates and small fish such as sand lance. In bays and harbors, foraging often occurs at or near areas with submerged vegetation or shellfish resources. The project area does not provide suitable habitat for overwintering; so, the presence of Atlantic sturgeon is likely limited to the warmer months. The nearest spawning rivers are the Kennebec River, in Maine and the Hudson River, in New York; therefore, no eggs, larvae or juvenile Atlantic sturgeon are likely to occur in the project area. Although their presence is not expected, both Atlantic and shortnose sturgeon may occur in the Providence River, Narragansett Bay and RISDS. Their presence is more relevant along the coast for placement operations as these species could be migrating and/or foraging. There are no critical habitats within the project areas under NMFS jurisdiction.

4.7.2. State Listed Species

Coordination with RIDEM indicated no state endangered or threatened species are located within half a mile of the project areas (John Herbert, RIDEM, personal communication, 2022d). Five species of special concern status were identified in the geographic vicinity (Table 4-8). However, only two species, the American oyster catcher and the common tern, have the potential to be affected by the project.

Table 4-8. Rhode Island Species of Special Concern within ½ Mile of the Project Area.

Common Name	Scientific Name	LAT	LONG	Community	Site Name	Year of Last Observation
Featherfoil, Water-violet	*Hottonia inflata*	41.6695	-71.3021	Bristol	Colt State Park	2006
Obedience, False Dragonhead	*Physostegia virginiana* ssp. *virginiana*	41.7958	-71.3792	East Providence	Kettle Point	1884
Salt Reedgrass, Big Cordgrass	*Spartina cynosuroides*	41.81551	-71.3913	East Providence	Bold Point	2015
American Oystercatcher	*Haematopus palliatus*	41.79336	-71.3767	East Providence	Watchemoket Rock	2020
Common Tern	*Sterna hirundo*	41.79336	-71.3767	East Providence	Watchemoket Rock	2022

American Oystercatcher

American oystercatchers nest along the Atlantic Coast from Maine to Florida, along the Gulf Coast, Baja, Mexico, and throughout coastal South America. American oystercatchers prefer habitat found along coastal beaches and tidal flats, extensive sandy beaches, tidal mudflats, and salt marshes. American oystercatchers nest in dunes, salt marsh, or islands. The American oystercatcher has expanded their breeding distribution in the past 40 years from the southern United States. There is now a rare, localized breeding species in Rhode Island with approximately 30 nesting pairs (Durkin, 2020; John Herbert, RIDEM, personal communication, 2022d).

The last sighting of this species recorded by the state of Rhode Island within half a mile of the project areas was at Watchemoket Rock in East Providence in 2022 (John Herbert, RIDEM, personal communication, 2022d). Cornell University's eBird website lists many sightings of 1-3 individual American oystercatchers in spring and summer of 2022 from the East Bay bike path in East Providence as well as individuals and pairs in Bristol, Allen Harbor Marina, and Newport (eBird, 2024).

Common Tern

Common terns can use freshwater, estuarine, and/or the ocean's shallow waters for fishing. They are usually found foraging close to undisturbed flat islands or beaches they use as nesting habitat (Audubon, 2022). The closest nesting colony to the project area is found on Watchemoket Rock in East Providence (John Herbert, RIDEM, personal communication, 2022d).

According to Cornell's eBird website, common terns are frequently observed in Rhode Island in the spring and summer, from India Point Park and the East Providence bike path, south to Prudence Island, Jamestown, and the southern coast (eBird, 2024).

4.8. Essential Fish Habitat

Pursuant to the Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Act of 1996, an Essential Fish Habitat (EFH) consultation is necessary for this project. NMFS has broadly defined EFH as "those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity." The Providence River DMMP area has the potential to provide EFH habitat for 35 fish species (NEFMC/NMFS, 2017). Table 4-9 lists the 33 federally managed species and their associated life stages that have EFH within the project area. Habitat areas of particular concern (HAPC) for summer flounder and juvenile cod also have the potential to occur in the project area. A detailed EFH assessment for the proposed action can be found in Appendix H.

Table 4-9. Essential Fish Habitat Species and Associated Life Stages Found in the Project Area. The following symbols represent three distinct EFH areas: "P" represents the Providence River including the FNP and the Edgewood Shoals Disposal Sites, "N" represents the Narragansett Bay, "R" represents the Rhode Island Sound.

Species	**Eggs**	**Larvae**	**Juveniles**	**Adults**
Albacore Tuna (*Thunnus alalunga)*			R	R
Atlantic Butterfish (*Peprilus triacanthus)*	P, N	P, N, R	P, N, R	P, N, R
Atlantic Cod (*Gadus morhua)*	P, N, R	P, N, R	P, N, R	R
Atlantic Herring (*Clupea harengus)*		P, N	P, N, R	P, N
Atlantic Mackerel (*Scomber scombrus)*	P, N, R	P, N, R	P, N	P, N
Atlantic Sea Scallop *(Placopecten magellanicus)*	R	R	R	R
Basking Shark (*Cetorhinus maximus)*			R	R
Black Sea Bass (*Centropristis striatus)*			P, N, R	P, N, R
Bluefin Tuna (*Thunnus thynnus)*			R	R
Bluefish (*Pomatomus saltatrix)*		R	P, N, R	P, N, R
Common Thresher Shark (*Alopias vulpinus)*			R	R
Haddock *(Melanogrammus aeglefinus)*		R		
Little Skate (*Leucoraja erinacea)*			P, N, R	P, N, R
Longfin Inshore Squid (*Doryteuthis pealeii)*	R		P, N	P, N
Monkfish (*Lophius americanus)*	R	R		
Ocean Pout (*Zoarces americanus)*	N, R		R	N, R
Pollock (*Pollachius virens*)			P, N, R	
Red Hake (*Urophycis chuss)*	P, N, R	P, N, R	P, N, R	P, N

Species	Eggs	Larvae	Juveniles	Adults
Sand Tiger Shark (*Carcharias taurus)*			P, N, R	
Sandbar Shark *(Carcharhinus plumbeus)*			R	R
Scup (*Stenotomus chrysops)*	P, N	P, N	P, N, R	P, N, R
Shortfin Mako Shark *(Isurus oxyrinchus)*			R	R
Silver Hake (*Merluccius bilinearis)*	P, N, R	P, N, R		R
Skipjack Tuna (*Katsuwonus pelamis)*				R
Smooth Dogfish (*Mustelus canis)*			R	R
Spiny Dogfish (*Squalus acanthias)*			R	R
Summer Flounder (*Paralichthys dentatus)*	R	P, N, R	P, N	P, N, R
White Hake (*Urophycis tenuis)*		R	R	
White Shark (*Carcharodon carcharias)*			P, N, R	R
Windowpane Flounder (*Scophthalmus aquosus)*	P, N, R	P, N, R	P, N, R	P, N, R
Winter Flounder (*Pseudopleuronectes americanus)*	P, N	P, N, R	P, N, R	P, N, R
Winter Skate (*Leucoraja ocellata)*			P, N, R	P, N, R
Witch Flounder *(Glyptocephalus cynoglossus)*		R		
Yellowfin Tuna (*Thunnus albacares)*			N, R	
Yellowtail Flounder (*Limanda ferruginea)*	R	R	R	R

4.9. Invasive Species

Invasive species can adversely impact native plant and animal populations by disrupting natural ecosystem functions. Impacts range from impaired recreational uses, fouled boat hulls, and reduced property value to degraded water quality, declines in finfish and shellfish population, and reduced biodiversity. Invasive species that may occur in the project area or in the area of influence include Common Reed (*Phragmites australis)* and Asian Shore Crab (*Hemigrapsus sanguineus).*

Invasive species are generally introduced into ecosystems via direct stocking, aquarium releases, shipping, and bait releases. Of these pathways, commercial shipping is the only direct mechanism related to this project. The principal way aquatic invasive species can enter state waters through shipping is by the discharge of ballast water while vessels are in port. Ballast water is pumped into the hull of a vessel to stabilize the vessel and keep it upright while carrying cargo. This water can be discharged at the receiving port as the cargo is loaded or unloaded. Each vessel may take on and discharge millions of gallons of water. Ballast water taken on in foreign ports may include an abundance of aquatic plants, animals, and pathogens not native to Rhode Island. If discharged into state waters, these foreign species may become problematic.

In addition to ballast water discharge, another important source for the introduction of nonindigenous organisms is the fouling community that grows on the hull, rudder, propellers, anchor, anchor chain, or any other submerged structure of vessels that are not properly cleaned or maintained. Historically, such fouling communities were composed of massive layers of a variety of organisms, both attached and merely entrained in or living on that growth. Although such extensive growth is not as common on seagoing vessels in recent times, it still provides an opportunity for worldwide transport of fouling organisms.

4.10. Cultural Resources

4.10.1. General Historic Context

The first recorded encounter between Europeans and the local native American populations occurred in the summer of 1524, when Verrazzano entered Narragansett Bay during his exploration of the northern coast of North America. Although his search for a fabled passage to the wealth of the Indies ended in failure, Verrazzano assessed the land and its peoples in glowing terms. His narratives describe native culture prior to its alteration by European colonization. The absence of material resources and riches for European use, however, labeled this area as the "lost coast" between established English and European settlements to the north and the south. The remoteness of this area attracted those religious dissenters who broke from the religious theocracy of the Puritan leaders in the Massachusetts Bay Colony. Beginning with Roger Williams in 1636, Narragansett Bay became a haven for individuals seeking independence from the rigid orthodoxy of the day. Critics often regarded these early Rhode Island settlements as a threat to civilization (Danforth in Rhode Island Historical Society (RIHS), 1993).

The Native Americans that Verrazzano described in 1524 were from the Narragansett or Wampanoag tribes and had occupied the lands for more than 12,000 years. They were horticulturists who grew legumes and corn, and supplemented this diet with hunting, fishing, and the gathering of nuts, berries, and other plants. The landscape was characterized as an open woodland, which had been formed by generations of Indian alternations of burning, planting, and harvesting domestic and wild plants. Burning of the land helped to maintain the soil's fertility, and the alternating of field and burning created a mosaic of environments for different animals used for food and clothing (Rhode Island Historical Preservation Commission (RIHPC), 1989).

This period of European discovery and exploration concluded with Roger Williams' settlement at Moshassuck or Providence in 1636. In the interim period of European contact, the native people began to experience the effects of disease, land encroachment, and alteration and misuse of the land. Tribes living in the vicinity of Narragansett Bay were little affected by European contact until 1616, when a severe epidemic decimated Indians along the coast from Maine to Cape Cod. Although the Narragansetts were physically unaffected by the epidemic, the catastrophe increased their power and prestige throughout the region (RIHPC, 1989).

After an early period of relative cooperation, relationships between the Narragansetts and coastal Rhode Islanders began to deteriorate in the 1650s, finally collapsing with the outbreak of King Philip's War in 1675. Although the Narragansetts attempted to remain neutral in the conflict, they were invaded by the United Colonies as a means of forcing native sachems to return Wampanoag war refugees. The Narragansetts were militarily defeated by the colonies in 1676. Surviving Indians were sold into slavery, moved west, or settled with their Niantic neighbors who had remained neutral during the war. Following the war, Narragansett lands were taken over, settled, and the formation of Rhode Island communities, mostly as agricultural settlements, commenced (RIHPC, 1989).

Providence grew slowly, initially as a farming community, then as a small seaport. The town spread along the waterfront, conforming to the topography of the land without changing it. The head of navigation in the 17th century was the mouth of the Moshassuck River at the Cove, now at Smith and Canal Streets. This became the earliest town center of Providence, with several early mills located at this site (Warner, 1985).

Having been established on the banks of the Providence River in 1636, Providence has a long waterfront tradition. For 300 years, shipping was a source of the City's economic growth. First trade, then manufacturing brought hundreds of ships to the Providence waterfront. As the ships grew larger, wharves and the land itself were extended to accommodate them. Warehouses and shops were built along the new land to serve these larger ocean-going vessels. It is interesting to note that during the 18th century, Newport was the preeminent city of Rhode Island, with all trade clearing the Newport custom house until 1790. It is not until the British occupation of Newport from 1776-1779 when this era ended, and Providence's waterfront, fleet, and population arose to take over Newport's shattered trade (Warner, 1985).

Substantial modification of the natural shoreline began in 1680 with wharf construction. By the early 18th century, the active waterfront included the entire stretch of South Main Street. The landscape consisted of wharves and gangways between them. Gangways are public alleys giving access to wharf lots on either side of them, to the water for shellfishing, landing small boats, and drawing water to fight fires. These public ways also provided public access to the water. A process called "wharving out," whereby the shallow water along the waterfront was filled in, both to create warehouse space and to allow large vessels to unload directly to land, was used to create additional space as required or for the accommodation of deeper-draft vessels (Warner, 1985).

All trade and most travel in and out of Providence was by sea, in spite of the absence of wharves before 1680. Most of the small craft that were utilized did not require wharves. Larger craft could anchor in the Providence River and send passengers and cargo in small boats to the beach. International trade from Providence began as early as 1654, mainly on voyages to the West Indies until the mid-18th century. Eventually, ships from Providence traveled among Caribbean, South American, African, European, and Oriental ports, bartering goods all along the way (Warner, 1985).

Providence's life as a prosperous international seaport was short. Beginning after Newport's decline during the American Revolution and until the War of 1812, Providence gradually lost out to larger ports with better western connections, especially to New York after completion of the Erie Canal in 1826. The Blackstone Canal, which opened in 1828, helped Providence by creating a route to Massachusetts' interior markets. Although the canal's lifespan was brief, it became an important part of the transportation network of the city and helped to support a warehouse district on Canal Street, which was no longer a part of the sea trade (Warner, 1985).

However, as the foreign trade of the Port of Providence began to fall off, this was offset by the increase in coastal shipping, particularly after the Civil War. Traffic in the harbor increased as never before, but the cargoes and their ports of call were less glamorous. With the rise of steam engines in the 1820s and 1830s, coal became a major import (Warner, 1985).

While Providence was still a major international shipping port, packet lines connected the city to other ports along the coast. Packets were essentially fast sloops carrying freight, passengers, mail, and news. They helped to link foreign trade with domestic markets and distribute the growing Rhode Island manufacturing output. They were also the fastest way to travel along the coast and were an essential component of communications before the telegraph (Warner, 1985).

During the 19th century, the City of Providence grew into a metropolis. The waterfront changed accordingly, both rapidly and radically, to accommodate greater sea trade, and then to adjust to the importance of land interests relative to the harbor. The Great Gale of 1815 wiped out most of the existing waterfront and helped to assure a more radical and sudden restructuring.

Frontage streets replaced the congested wharf heads with a continuous quay, so that cargo could either be carried across the street to a warehouse, or efficiently carted elsewhere in the city. These streets also helped to keep the channel free of the encroachment of expanding wharves (Warner, 1985).

The first successful steamboat lines on Narragansett Bay were established in 1822, traveling from Newport to New York. Over time, steamers replaced the packets in terms of speed and reliability. Passenger and express travel became the steamboat's forte, while packet lines dealt with bulk freight, for which speed was not important. One of Providence's leading industries became the production of stationary steam engines, especially the Corliss Steam Engine Company (Warner, 1985).

The first railroad came to Providence as a complement to the steamer route, which transported passengers to stagecoaches enroute to Boston. The Boston and Providence Railroad opened in 1835 at India Point, and quickly surpassed the stagecoach for ease of travel. As stagecoaches, carriages, and omnibuses transferred people between railroad stations, the railroad saw more value in connecting with each other than with steamships. By 1848, the railroad moved to the center of the city from the waterfront. This change was made by the Providence and Worcester Railroad, which replaced the Blackstone Canal. Because the Providence and Worcester Railroad came from the north, a central downtown location was needed. This was chosen as the old Canal Basin, which had been filled in, and now would be utilized as a railroad yard. Eventually, a common terminal was established with other rail companies, and Providence's Union Depot was among the first and the largest multiple-railroad stations in the world (Warner, 1985).

Gradually, the rise of the railroad replaced ships, and the cove and canal basin at the foot of Smith Hill were filled in to make way for tracks and freight yards. The once-bustling waterfront was now deserted, with abandoned buildings adapting to new uses, and many disappearing, their sites turned into parking lots or remaining vacant. With the advent of the interstate highway system, much of the waterfront became used for the highway and exit ramps. Views and access to the water were blocked by the asphalt and concrete monolith, which carried automobile commuters from Cape Cod to Providence and points north and south. Gradually, people forgot about the waterfront (Warner, 1985).

As the city of Providence became more and more congested, the solution was to put the river largely out of sight, bridging it not only as a crossing, but also for widened streets carrying traffic along its bank (Warner, 1985). By the 20th century, the port was no longer central to the Providence economy, and shipping moved south to below Fox Point. The old waterfront became, for the most part, an ancient artifact within the growing center of the city. As the metropolis grew, the former working harbor suffered (Warner, 1985). However, with the recent daylighting of the river in downtown Providence today, the importance of the river as a visible element of the landscape has been restored.

4.10.2. Historic Properties: Port Edgewood Basin, Fields Point (Former Naval Shipyard)

According to archaeological site files from the Rhode Island Heritage and Historical Preservation Commission, one pre-Contact archaeological site (#693) is recorded for the Fields Point area, which is approximately two miles southeast of downtown Providence. This site is noted as a midden/burial site with artifacts from throughout the pre-Contact period. The Narragansett Historical Register from 1888 (Dennison 6(1):25-29) reported the finding of “Indian implements” and a reference to “photos of a spearhead, slate pendant and ‘soapstone mask’ carved on the bottom of a bowl found at Fields Point” in articles from the Rhode Island Historical Society Collections Volumes XVII and XIX. However, a reconnaissance archaeological survey conducted for additions to the Fields Point wastewater treatment plant in 1982 by The Public Archeology Laboratory, Inc. concluded that the “site [was] too disturbed to yield any information of value” due to the extensive construction throughout the area (Gallagher & Rubertone, 1982:11-12).

As of 1982, the Fields Point area soils were characterized as urban land and had been heavily disturbed by grading, filling, and erosional activities. Facilities present during the reconnaissance survey included gas and petroleum storage tanks, piers, scrap metal yards, sewage treatment plant, and a naval installation. Little, if any, residential occupation or usage is noted for the Point. Prior to construction of the sewage treatment plant in 1884, photographs from the RIHS depicted the area as a landscape of open fields with wooden fences, small hills and a pond and stream. Later photos showed a pier and a clambake house and stables circa 1882. This land was originally known as Pumegansett and in 1682, it was purchased by Thomas Field and called the “old cleare ground” where Field maintained a livestock farm encompassing all of Pumegansett Neck. The Thomas Field farmhouse was constructed in the 1690s south of the treatment plant and was not demolished until 1894 (Gallagher & Rubertone, 1982: 2, 4-6).

In 1776-1777, a small, one-and-a-half story wooden smallpox hospital was built on Fields Point, one of three in the Providence area that was used sporadically throughout the 19th century for the citizens of Providence to locate patients far from large residential areas. It remained until approximately 1890 as it was still visible on RIHS photographs depicting construction of the sewage treatment plant. At about the same time as the smallpox hospital, a small fort was built (circa 1775) on Robin Hill which was part of the original Field Farm. Following the Revolution, the fort became known as Fort Independence and was further fortified and improved in time for the War of 1812 but was never utilized. The fort was later made into a park in 1937 but was leveled in order to create a shipyard in 1942 in preparations for World War II (Gallagher & Rubertone, 1982:6-10).

The shipyard at Fields Point was built in 1942 as a temporary facility to support the war effort. Unlike other U.S. shipyards, it was entirely new and designed to build large ocean-going vessels. The U.S. Maritime Commission established 18 emergency shipyards throughout the country to build ships required by the U.S. Navy and the merchant marine. Three types of ships were built at Fields Point including: merchant vessels for civilian mariners; naval escort vessels for use by the British Navy; and U.S. Navy cargo and transport ships that were designed as combat support vessels. From 1942-1945, as many as 21,000 workers were employed at Fields Point, producing a total of 64 ships over a three-year period. Today, the former shipyard is now the site of the waterfront campus of Johnson and Wales University. There are no extant remains of the shipyard site present today (Wallin, 2017: 1-2, 6, 149).

4.10.3. Historic Properties: Port Edgewood Basin, Fields Point Recorded Sites

Fields Point, Providence

Pre-Contact Site Number 0693: Pre-contact through Woodland Periods, possible midden/burial, likely disturbed by sewage treatment plant and naval shipyard construction.

Providence Shipyard (Fields Point), Sewage Treatment Facilities, Providence

North of the Edgewood Shoals North Area (Fields Point) is the former naval shipyard and the Providence Sewage Treatment Facilities which are listed on the National Register with a period of significance of 1895-1935. Components of these facilities include the Washington Park Sewage Pumping Station (1912-13) on Shipyard Street; the Return Sludge Pumping Station (1934-35), the Sludge Press House (1901), and the Chemical Building (1901), all on Ernest Street, Fields Point Sewage Treatment Plant, and all of which are listed on the National Register individually and as part of the Providence Sewage Treatment Facilities Multiple Resource listing. However, these historic properties are outside of the area of potential effect and will not be impacted by the project.

4.10.4. Historic Properties: Providence River Federal Navigation Channel and Harbor, including the Pawtuxet Cove FNP, Bullocks Cove FNP, and Apponaug Cove FNP), Edgewood Shoals (North and South), Fox Point Reach, Prudence Island Disposal Site, and Rhode Island Sound Disposal Site, Narragansett Bay

A review of the RI State Historic Preservation Office's (SHPO) site files and survey report, as well as the National Park Service's National Register of Historic Places webpage, identified the following historic properties within the vicinity of the FNP, associated FNPs, and the two open-water disposal sites.

Pre-contact archaeological sites are noted in the Bullock Cove Area, with the Bullock Cove Site (1725) in East Providence, which has been destroyed, and the Cedar Tree Point Site (2311) in Warwick, which has likely eroded away and washed into the nearby beach.

Crescent Park Carousel National Historic Landmark, East Providence

The Crescent Park Carousel is a National Historic Landmark located at the former Crescent Park amusement park in the Bullocks Cove area of East Providence. Built circa 1898, it is noted as one of the finest examples of its type in the country built by one of the foremost manufacturers of carousels, Charles I.D. Looff. Trained as a furniture maker, Looff began constructing a carousel at Coney Island in 1876. He is known as likely the first man to carve the horses for these rides, with upwards of 66 figures including jumping horses, chariots, dragons, serpents and camels, with no two figures exactly alike (Crescent Park Carousel National Register Inventory -- Nomination Form, 1976).

Apponaug Historic District, Warwick

The Apponaug Historic District is a cluster of seven buildings located at the intersection of Post Road and Arnold's Neck Drive south of the Apponaug Bridge. The District is composed of five architecturally significant Colonial and Federal dwellings that is the largest concentration of these structures in the former seaport and mill village founded in 1696. The structures are associated with prominent local figures and Apponaug is one of the earliest areas to be settled within the city of Warwick. It later became a prominent seaport in the 18th Century and manufacturing community in the 19th Century as well as the civic center of Warwick (Apponaug Historic District National Register Inventory -- Nomination Form, 1983).

Edgewood Historic District, Cranston

The Edgewood area is located on the eastern side of Cranston, with the Providence city line to the north and the Pawtuxet River to the south. Its period of significance dates from 1636-1975 charting the evolution from a rural agrarian landscape during the Colonial and Federal periods to a borderland and later a suburb of Providence from the mid-19th through the mid-20th centuries. Primarily residential in nature, Edgewood is listed on the National Register of Historic Places under Criteria A (community planning and development) and C (architecture) (Jones, 2009).

Narragansett Bay Wreck Sites (H.M.S. Cerberus and Lark), Portsmouth Shoreline

The wreck sites of the H.M.S. Cerberus and Lark are located off the Portsmouth shoreline and were listed on the National Register in 1973. During the Revolutionary War, these British warships were purposely destroyed to avoid falling into French hands at what is known as the Battle of Rhode Island in 1778. French ships sailed into the west passage of Narragansett Bay and anchored off Jamestown, causing the British to abandon the island and concentrate their forces at Newport. The two ships are separate wreck sites several miles apart and are outside of the main shipping and travel lanes of the Bay (Davis, Jr., 1973).

Pawtuxet Village Historic District, Warwick and Cranston

Pawtuxet Village is one the oldest communities in Rhode Island dating back to the earliest settlement in 17th century and Roger Williams, with settlers attracted by Pawtuxet Cove and its sheltered harbor located on the west side of Narragansett Bay. Composed of 414 contributing elements with a period of significance from the 17th throughout the 20th century, it was listed on the National Register of Historic Places in 1973.

Providence Dry Dock and Marine Railway Company (Green Jacket Shoal, East Providence)

A marine archaeological reconnaissance survey of the Green Jacket Shoal area was conducted in response to a proposed marine debris removal project (Robinson, 2016). Although shoreline debris was known to be present, this survey resulted in the identification and documentation of 29 wooden ships including scow-barges, sailing vessels, screw-propelled harbor steamers, possible steam or diesel-motor screw-propelled vessels, and one unknown vessel type that may be a sailing vessel.

> "Also documented as part of the study were the archaeological remains of the massive pier that served as the slip for Rhode Island's first floating dry dock, and other shoreline infrastructure related to the 35 year-long operation of the last shipyard in Providence to build wooden merchant sailing vessels – the Providence Dry Dock and Marine Railway Company at Bold Point." (i-ii)

Although not within the current project area of potential effect, this potential state underwater archaeological preserve is noted due to its proximity to the Fox Point Reach.

Prudence Island Lighthouse

Prudence Island Lighthouse or Light Station as it was originally known was established in 1851 and is located on the east end of Sandy Point on the eastern shore of Prudence Island within the East Passage of Narragansett Bay. Originally built on Goat Island in Newport in 1823 before being moved to its present location in 1851, it is the oldest surviving tower in Rhode Island and the only lighthouse that has served on two different sites. A one-and-a-half story keeper's dwelling was built 200 feet to the west of the tower along with additional structures (shed, oil house, barn, boathouse) by 1908. The 1938 hurricane destroyed all structures except the light tower. Rather than rebuild the destroyed keeper's residence, the light was automated in 1939 (York, 1987).

Prudence Island Shipwreck Sites (NOAA AWOIS 14106, 14108, 14110 and RIHPHC 2312)

A review of the National Oceanic and Atmospheric Association (NOAA) Automated Wreck and Obstruction Information System (AWOIS) database identified several wreck sites off the southeast side of Prudence Island and adjacent to the northwest boundary of the PIDS. The AWOIS 14108 has been identified as a barge at a depth of 46 feet. AWOIS 14106/14110 appear to be additional unidentified wreck sites. The Rhode Island SHPO Marine Archaeologist provided a side scan sonar survey data image from a 2008 Narragansett Bay Archaeological Survey that identified these sites. SHPO site file number 2312 appears to refer to the sites listed above, stating that the wrecks were identified by NOAA in 2004 and later studied during the 2008 survey. However, these sites and their coordinates will be depicted on project drawings and avoided during dredged material disposal activities at the PIDS, with a corresponding buffer of 50 feet around each. Impacts to these sites are not expected.

4.11. Socioeconomic Setting

In 2023, the U.S. Census Bureau reported the population of the State of Rhode Island to be 1,095,962. Table 4-10 outlines the race distribution for Rhode Island. According to the U.S. Census Bureau report, 48.7% of the population were male, 51.3% female, 5.1% under 5 years, 19.3% 5 years to 19 years, and 17.7% over 65 years. The median household income was $70,305 and the per-capita income was $37,504. Approximately 10.6% of the population was below the poverty level.

Table 4-10. Distribution of All Races in Rhode Island.

Race	%
White alone	82.4
Black or African American alone	9.3
American Indian and Alaska native alone	1.3
Asian alone	3.7
Native Hawaiian and other Pacific Islander alone	0.2
Two or more races present	3.1

4.12. Hazardous, Toxic, and Radioactive Waste

Providence is Rhode Island's largest commercial port with several possible sources for accidental releases of hazardous waste. The port is a crucial import location for refined petroleum products, which supplies demand within Rhode Island and the broader Northeast region and has several terminals that receive the petroleum products. There have been a number of historic releases of petroleum products into the Providence River from the terminal facilities.

A review of historic testing data, previous environmental assessments, water quality data, adjacent land-use information, and interviews with local officials for the project's suitability determination indicated measurable spills (e.g., spills capable of being quantified) of diesel fuel, gasoline, home heating oil (#2 fuel oil), hydraulic oils, raw sewage, waste motor oil, and antifreeze. Locations ranged throughout the Providence FNP.

4.13. Traffic and Transportation

Most of the Providence FNP channel was last dredged to its authorized depth of -40 feet between the years 2003 and 2007. Two sections in the Fox Point Reach have not been dredged for over 40 years, including the north end of the turning basin and a widened section of channel intended for vessel maneuvering and passage along docking areas. Shoaling has occurred over the intervening years, reducing the controlling depth the channel reaches to approximately 38 feet, particularly in the Fox Point reach, and maneuvering areas have controlling depths as shallow as 20 feet. Conditions will continue to worsen with forecasted shoaling.

According to Port officials, Panamax and Handymax vessels, which can draft up to 46 feet and 40 feet, respectively, have been forced to light-load offshore using cranes and barges. Additionally, larger vessel personnel are currently expressing concern about depth uncertainty and needing soundings to get accurate readings for under keel clearance. Since vessels are avoiding the turning basin and maneuvering area due to shoaling, they are getting closer to berthed vessels at ProvPort, Inc., on the west side of the Fox Point reach, and posing risks to both vessels and wear and tear to facilities, resulting in additional safety concerns. Moored vessels are at risk of being jostled due to the forced close passages. The alternative is to light load with shallower draft ships that can travel closer to the shoaled area in east side of the reach, resulting in inefficient deliveries to port. Due to the shoaled section of channel that was not dredged in 2005, vessels of 600-ft length or greater are required to make smaller swings, rely on tugs more, and have longer wait times to navigate the channel, see Appendix B. These conditions will continue to occur if the channel remains undredged.

4.14. Noise

According to the 1972 Noise Control Act (42 U.S.C. §4901 et seq.), inadequately controlled noise presents a growing danger to the health and welfare of the Nation's population, particularly in urban areas. 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 stationary or mobile sources. Noise is described by a weighted sound intensity (or level), which represents sound heard by the human ear and is measured in units called decibels (dB).

Narragansett Bay and the Providence River have functioned as shipping harbors since colonial times. Over the last 250 years, the Port of Providence has evolved to accommodate the growing shipping industry as larger vessels continued to arrive. At the same time, recreational and other commercial boat traffic and industrial noise has continued to increase. Several sources of ambient noise are present in the Providence River. The ambient noise level of an area includes sounds from both natural (wind waves, fish, tidal currents, mammals) and artificial (commercial and recreational vessels, dredging, pile driving, etc.) sources. Tidal currents produce hydrodynamic sounds, which are most significant at very low frequencies (< 100 hertz (Hz)). Vessel traffic, including vessels passing through the Providence FNP, generate sounds that can travel considerable distances, in frequencies ranging from 10 to 1000 Hz. Sea state, the surface condition of the water characterized by wave height, period and power, also produces ambient sounds above 500 Hz. As a commercial and industrial area, the Providence FNP experiences a wide range of noise from a variety of industrial activities. Biological sounds associated with mammals, fishes, and invertebrates can also generate broadband noise in the frequency of 1 to 10 kilohertz with intensities as high as 60 to 90 dB.

The Providence FNP has the typical noise characteristics of a busy harbor. Sources include recreational and commercial vessel traffic, dredging vessels and dockside facilities. Noise sources for vessels include cranes, whistles, and various motors for propulsion. Dockside noise sources include cranes, trucks, cars, and loading and unloading equipment. In addition to the noise in the water/marine environment, noise can impact the human environment. Background noise exposures change during the course of the day in a gradual manner, which reflects the addition and subtraction of distant noise sources.

4.15. Coastal Barrier Resources

The Coastal Barrier Resources Act (CBRA) was enacted by Congress in 1982. The CBRA was implemented to prevent development of coastal barriers that provide quality habitat for migratory birds and other wildlife and spawning, nursery, nesting, and feeding grounds for a variety of commercially and recreationally important species of finfish and shellfish. As a deterrent to development, federal insurance is not available for property within designated high-hazard areas. These high-hazard areas are called CBRA units.

CBRA units are areas of fragile, high-risk, and ecologically sensitive coastal barriers. Development conducted in these areas is ineligible for both direct and indirect federal expenditures and financial assistance. Along with CBRA units are Otherwise Protected Areas (OPAs) which are national, state, or local areas that include coastal barriers that are held for conservation or recreation. The only federal funding prohibition within OPAs is federal flood insurance. There is one CBRA unit complex (made up of 11 areas) located within the project area: Unit D02B shown in Figure 4-16. There is also one OPA located within Narragansett Bay: OPA D02BP shown in Figure 4-16.

Habitats in both the CBRA unit and OPA include intertidal sand shoals (estuarine intertidal unconsolidated shore wetlands), shallow open water (estuarine subtidal unconsolidated bottom), marsh (estuarine intertidal emergent wetland), and uplands (dunes and maritime forest). Wetlands of the units provide spawning, nursery, and feeding habitat for commercially and recreationally important species of estuarine-dependent fish and wildlife. The units also provide feeding, nesting, and resting areas for piping plover (*Charadrius melodus*), terns, shorebirds, and wading birds.

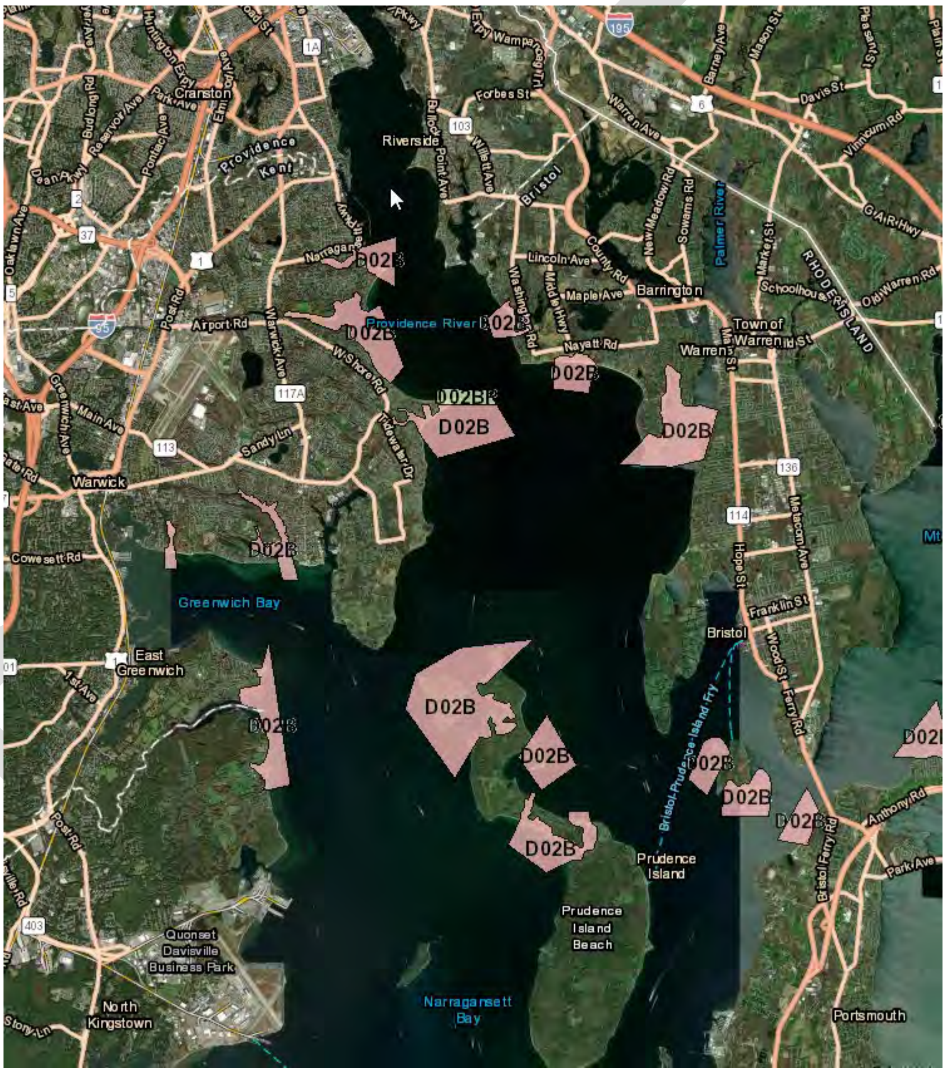


Figure 4-16. Coastal Resource Barrier Units Adjacent to the Project Area.

4.16. Recreation

Land use around Narragansett Bay ranges from dense urban development to undeveloped open space. The bay area includes the cities of Providence, East Providence, Warwick, and Cranston, as well as the towns of Narragansett, North Kingston, East Greenwich, Barrington, Warren, Bristol, Portsmouth, Middletown, Newport, and Jamestown. The cities, particularly Providence, contain areas of dense industrial and commercial development. To the south of Providence and East Providence, the land areas are generally suburban in nature, with large areas of residential development, some areas of commercial and industrial use, and some areas of undeveloped open space. The T.F. Green Airport, which serves the greater Providence region is located in Warwick (USACE, 2001).

Narragansett Bay has many small harbors and protected sandy beaches, which make it a prime recreation and scenic area. Activities include sailing, kayaking, swimming, fishing, surfing, diving, picnicking, music festivals, and yachting regattas. Approximately 170 marinas dot the coastline, and many tourism and recreation-related businesses are located throughout the bay area. Between 5 and 10 million tourists visit Rhode Island each year, primarily in the summer and primarily around Narragansett Bay, making tourism one of the top industries in the state.

Narragansett Bay is a major resource for recreational fishing. The most significant recreational fisheries include striped bass, black sea bass, bluefish, tautog, flounder, scup, and Atlantic cod. Recreational fishing occurs nearly all year, from March through December. Diving is also very popular in Narragansett Bay. The rocky shores, reefs, and relatively warm waters of Narragansett Bay make it a prime diving location. Shore diving is most popular and is focused along the rocky mouth of the bay, from Point Judith, north to Bonnet Point, across southern Jamestown, along Newport, and ending at Sakonnet Point in the east (letter correspondence from Eric Klos, URI to Sandra Thornton Whitehouse, RI CRMC, June 24, 1996, in USACE, 2001).

The surrounding area of Narragansett Bay contains many public parks, including Goddard State Park, Colt State Park, Bay Islands Park, and many smaller city and town parks. These parks contain a variety of recreational resources, including open-space areas, wildlife conservation areas, picnic areas, shoreline access, boat ramps, and swimming areas. Bay Islands Park is a collection of island and mainland parks and includes conservation areas on the northern and southern ends of Prudence Island, Patience Island, Hope Island, Dutch Island, two parks in Jamestown, and two parks in Newport.

The FNP channel and Edgewood Shoals are located close to the shore in the upper reaches of the Providence River, in the cities of Providence and East Providence, and, therefore, land use along the shore is generally commercial and industrial, with some residential areas and public parks. South of Providence and East Providence, the channel is located a greater distance from the shoreline, and the land use along the shore is generally either residential development or open space. The channel itself is used by a variety of vessels, but is especially important for oil tankers, other fuel ships, and cargo ships. In addition, thousands of recreational boats, including sailboats, power boats and large yachts, use the channel and bay every year. In addition, at any given time, the channel may contain any of the fish species caught by recreational fishermen (USACE, 2001). RISDS is located in the open waters of Rhode Island Sound. This area can be used for recreational boating, fishing, or diving.

5. Plan Formulation

5.1. Plan Formulation Process

Plan formulation for DMMP studies is a critical step in the planning process that follows identifying purpose and need, problems and opportunities and inventorying and forecasting conditions, which were described in Chapters 2, 3, and 4 of this report. Plan formulation involves estimating present and future dredging quantities, determining appropriate dredged material management techniques, and formulating an array of potential alternatives. Alternatives are evaluated and compared to identify the alternative that is the least-cost, environmentally acceptable, and technically feasible alternative for recommendation. Implementation of the recommended plan is subject to reviews by local, state, and federal agencies, and the public. In addition, the decision process will involve several levels of reviews and approvals through USACE.

The plan formulation process for a DMMP is based on identification of problems and opportunities followed by an inventory and forecast of conditions (see Chapter 1 of this report for documentation of these processes). Plan formulation then involves identifying a set of potential federal actions, called measures that address the project problems and project needs to meet the warranted commercial benefits identified in the channel utilization analysis for maintaining the Providence FNP. Measures are identified for dredged material placement opportunities, labeled with a "P". Other measures are identified for maintenance dredging opportunities labeled with a "D". The measures are then screened based on how well they address the maintenance needs as described in Chapter 2, how they contribute to meeting the Federal Standard, and other social and environmental screening factors, as explained later in this section.

The remaining screened measures are then combined to formulate alternative plans, with each plan meeting the needs to meet the economically warranted utility of the project. BU is also considered. Once alternatives have been formulated, they are evaluated and compared in order to support selection of a Base Plan, which is the least cost plan to fully address maintenance needs for at least 20 years. The Base Plan can be modified further to address additional BUs. The Base Plan then can be expanded to address local needs for identification of a preferred plan.

5.2. Principles, Requirements, and Guidelines for Evaluation of Alternative Plans

Alternative plans are evaluated under USACE principles, requirements, and guidelines (PR&G) using the "Four Formulation Criteria", as defined in the Principles and Requirements for Federal Investments in Water Resources, March 2013 (Council on Environmental Quality, 2013) and Final Interagency Guidelines, December 2014 (Council on Environmental Quality, 2014), and originally established by the Economic and Environmental Principles and Guidelines for Water and Land-Related Resource Implementation Studies (P&G) (U.S. Water Resources Council, 1983).

The PR&G formulation criteria are defined and considered below:

- **Acceptability** is the 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. Two primary dimensions to acceptability are environmental compliance and sponsor satisfaction. Addressing environmental effects and appropriate mitigation of adverse effects will be integral components of each alternative plan.
- **Completeness** is the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planning objectives, including BU and actions by other Federal and non-federal entities.
- **Effectiveness** is the extent to which an alternative plan alleviates the specified problems and achieves the specified opportunities. For this study, an effective plan is one that provides dredged material storage capacity for both federal and local needs during the planning period.
- **Efficiency** is the extent to which an alternative plan is the most cost-effective means of alleviating the specified problems and realizing the specified opportunities, consistent with protecting the Nation's environment.

This DMMP addresses the continued maintenance of the Providence FNP, along with consideration of associated FNPs, all of which are authorized FNPs. Therefore, this study will not be addressing a feasibility analysis of modifying these projects, and will instead focus on meeting the O&M needs of the FNPs. The plan formulation process for this is DMMP follows the specific USACE guidance outlined in ER-1105-2-100 Appendix E for DMMPs, including the criteria for meeting the Federal Standard in that the project is the least cost method for addressing warranted maintenance needs, technically feasible, and environmentally acceptable, as well as incorporating beneficial use of dredged materials as appropriate and addressing non-federal needs as appropriate. The alternatives will be compared and screened for their ability to meet the goals and objectives described in Chapter 2.6 of this DMMP.

5.3. Base Plan Determination

The proposed alternative will include the Base Plan as defined under ER-1105-2-100. The Base Plan portion of the proposed alternative will meet the requirements of the Federal Standard and also address USACE guidance involving beneficial uses. The Base Plan will address the maintenance requirements of Providence FNP, along with the local FNPs, for least-cost comparison and selection. The proposed action will include the Base Plan and will also consider non-federal dredged material placement needs. The Base Plan portion of the proposed action will be treated as a maintenance project and cost-shared according to USACE regulations. The non-federal needs portion of the proposed action will be 100% the cost of the sponsor and will not be considered in the least-cost analysis.

The Study Team decided to include all the dredging needs in the greater Providence River Harbor. The Base Plan will include the following dredging needs through the year 2048:

- Providence FNP
- Bullocks Point Cove
- Pawtuxet Cove, and
- Apponaug Cove.

Each of the alternatives, from which the proposed plan will be selected, will include the following O&M needs through the year 2048:

- Base Plan
    - Providence FNP
    - Bullocks Point Cove
    - Pawtuxet Cove
    - Apponaug Cove, and
- Local non-federal dredging needs in local public harbors, berths, channels.

To meet utilization needs over planning period of the DMMP (Years 2028-2048), the action alternatives will need to address the dredging needs as shown in Chapter 3 of this report. In combination, the measures will meet the following total dredging needs:

- Dredge Cycle One (Year 2028): 2,400,000 CY total dredging needs, including Providence FNP, three adjacent FNPs, and local dredging needs
- Dredge Cycle Two (One or more dredging cycle no later than Year 2048): 2,400,000 CY total dredging needs, including Providence FNP, three adjacent FNPs, and local dredging needs.

5.4. Beneficial Uses of Dredged Materials

USACE regulations (ER 1105-2-100, Appendix E) and policy require that BUs be identified and addressed. According to the regulations, “Each Management Plan study shall include an assessment of potential beneficial uses of dredged material, for meeting both navigation and non-navigation objectives, including fish and wildlife habitat creation and restoration, hurricane and storm damage reduction, and recreation.” Possible beneficial uses are handled as follows:

1) If the beneficial use is a critical component for practicability and environmental acceptability of a particular alternative, then that BU will be considered part of the Base Plan. If the BU is not a critical component, then it may be reviewed as a supplemental BU.
2) If supplemental beneficial uses do not increase or they reduce the cost of the Base Plan, then they are added to the Base Plan as the least cost alternative.
3) If supplemental beneficial uses alternatives costs do not exceed 25% of the Base Plan costs, then the increased costs are considered “reasonable” and can be added included in the Federal standard Base Plan. These requirements are outlined in SACW memorandum, Implementation Guidance for Section 125(a)(2)(C) of the Water Resources Development Act of 2020, Beneficial Use of Dredged Material, (USACE SACW, 2022a).
4) If supplemental beneficial uses costs exceed 25% of the Base Plan disposal costs, those alternatives are not addressed further in this DMMP.

The Study Team identified several sites for beneficial placement of dredged materials in the vicinity of the Providence River, in which dredged materials could be used for the construction of restored ecosystems or facilities. Facility construction, along with materials excavated during the construction of a CAD cell or dredging of an FNP, could provide beneficial value, including using dredged material used as fill material for one or more of these sites if the material were suitable for such site restoration or facility construction. The Study Team conducted outreach to organizations and agencies to request any interest in adding a beneficial use project onto the Base Plan, either incorporating the project into the Base Plan or adding the plan as a locally preferred plan. Based on feedback, availability, and practicability to be added to the management plan, the Study Team considered the following potential beneficial-use sites:

- Port Edgewood Bain (PEB) aquatic ecosystem restoration by filling and capping with excavated/dredged material,
- Prudence Island Disposal Site (PIDS) aquatic ecosystem restoration by capping with excavated/dredged material, and
- Fox Point Reach North (FPRN) CAD cells – filling, capping, and closing out the seven CAD cells with excavated/dredged material.

These four potential beneficial-use sites are located within the immediate vicinity of the Providence FNP, as shown in Figure 4-1. These sites are considered in development of the measures and included in the Base Plan if they do not add costs.

The Study Team addressed the requirement by USACE to close out and cap the seven FPRN CAD cells, as described in the 2001 Providence River Dredging FEIS. The 2001 FEIS required capping of the FPRN CAD cells with clean dredged material. RI CRMC has been managing capacity of the FPRN CAD cells. RI CRMC requested that FPRN CAD cells with additional capacity remain open and not be capped. The Study Team assessed filling and capping those CAD cells that are substantially filled and no longer have utility for additional placement based on recent bathymetric surveys of the site. Capping the FPRN CAD cells is a BU because capping would restore the biological function of these sites and reduce exposure of the placed unsuitable materials from potentially mobilizing and spreading into other areas of the Providence River.

5.5. Development of Measures

A management measure is a feature or an activity that can be implemented at a specific geographic site to address one or more planning objectives. (ER 1105-2-100, Chapter 2). Management measures are the building blocks that can be combined in various ways to identify a range of action alternative plans to address the study purpose and need. The Study Team developed and considered a total of 20 measures for dredged material management, including 19 action measures and the “No Action” measure, for this DMMP.

The measures for this study were developed to help address the study purpose and need, as described in Section 2.2, to maintain full economically warranted utilization of the Providence FNP and associated shallow-draft FNPs over at least the 20-year period (through the year 2048). The action measures were identified to meet one or more of the four objectives described in Section 2.6, along with working within the considerations and constraints also listed in Section 2.6.

The following placement measures were identified (and listed in Table 5-1).

Table 5-1. Initial Measures.

Measure ID	Measure Description
NA-1	No action
P-1	Upland placement
P-2	Open-water placement – RISDS
P-3	Construction of a new confined disposal facility (CDF)*
P-4	CAD cell – Edgewood Shoals North
P-5	CAD cell – Edgewood Shoals South
P-6	CAD cell – Fox Point Reach South
P-7	CAD cell – Fuller Rock Reach
P-8	CAD cell – Sabin Point Reach
P-9	CAD cell – other Providence FNP reaches
P-10	Beneficial use: Filling Port Edgewood Basin with unsuitable and suitable materials and capping the basin with clean material; fill materials could be derived from either O&M dredging of Providence FNP or CAD cell construction
P-11	Beneficial use: filling and capping existing FPRN CAD cells to restore and close them out. The material used for filling and capping could be sourced from excavation of clean material from CAD cell construction
P-12	Beneficial use: PIDS – capping with dredged material for placement of clean materials from CAD cell construction
P-13	Other beneficial use sites for placement of materials excavated from construction of a possible CAD cell
P-14	Beneficial use: Final capping possible CAD cell constructed, in which the possible Cycle One CAD cell would be left open for up to 20 years, and then capped with clean material to restore and close it out. The filled and capped material could be sources from excavation of clean material from CAD cell construction.
P-15	CAD cell sized and used as a starter cell for next dredging cycle for placement of unsuitable material during construction of a next-cycle CAD cell or other placement facility
P-16	Opportunities for placement of local non-federal dredged material
D-1	Maintenance Dredging of Providence FNP to full depth and widths, as economically warranted
D-2	Maintenance Dredging of three adjacent shallow-draft FNPs to full depth and widths, as economically warranted
D-3	Sediment reduction measures

Note: "P" Measures were identified for dredged material placement opportunities. "D" Measures were identified for maintenance dredging opportunities.
*A CDF is an engineered structure for containment of dredged material, which can be constructed as an island containment area, upland site, or nearshore site with one or more side in water (USACE, 2015).

Measure NA-1: No Action

The No Action Alternative serves as a baseline against which the proposed action and alternatives can be evaluated. Under this measure, the federal government would do nothing to address the need for management of dredged material from Providence FNP. Once all currently available FPRN CAD cells are filled to capacity, dredging would decrease to the level of available placement space. With this decrease in dredging, or without any dredging, the navigation channel would eventually shoal-in and impede commercial navigation. The capacity of the existing CAD cells is anticipated to be depleted by 2027 based on current management practices.

Consistent with NEPA and USACE guidance (ER 1105-2-100 and ER 200-2-2 (Procedures for Implementing NEPA)), this measure will be carried forward into alternative comparison.

Measure P-1: Upland Placement

Innovative uses of dredged material have been made by the agriculture, forestry, horticulture, and aquaculture industries. Topsoil can be replaced with dredged material by applying it to upland areas. Additionally, suitable dredged material can be incorporated into marginal agricultural soils to enhance the physical and chemical characteristics of the soils for particular crops.

The dredged material of Providence FNP contains levels of contaminants that limit the potential upland placement use to fill material in industrial areas, if appropriately lined and later capped with clean material. The dredged material is mainly made up of fine particles of sand, silt, and clay. Due to the high percentage of fine-grained sediment within the dredged material, its suitability as fill or for use as soil cover for land-based disposal sites may be limited. The fine materials are not structural soils and are not suitable for filling or leveling as they liquify when water saturated.

Mined land reclamation is also a potential use for dredged material use. Former mining sites, where both tunnel and strip-mining operations occurred, offer opportunities for dredged material placement. Any suitable upland beneficial uses will be considered as part of this measure.

The Study Team conducted an initial assessment of the availability and practicality of upland sites for the placement of the unsuitable materials to be dredged from Providence FNP. During the development of the 2001 FEIS for the Providence FNP maintenance plan, USACE identified over 150 upland sites that potentially could be used for dredged material placement, including functioning landfills, contaminated sites, and vacant areas. During the evaluation, USACE had narrowed down the upland site possibilities to three final sites that were practicable. Two sites required suitable materials, relatively clean of contaminants, and only the Rhode Island Central Landfill was available for unsuitable material as a temporary capping material. All the sites would require dewatering requirements prior to trucking, and large amounts of trucking with high costs, congestion, and pollution impacts. The Study Team also could not find adequate dewatering sites that would be needed for the processing of the dredged materials. The Study Team concluded that any upland sites would be excessively expensive compared to water-placement sites. In 2022, the Study Team checked with the RIDEM to see if any of the potential upland sites were currently available, and no sites are currently available that can receive the large quantity of unsuitable material that USACE needs to dredge from the Providence FNP currently.

Measure P-2: Open-Water Placement

The nearest EPA designated open-water location that is approved for suitable material placement and has current capacity is the RISDS (see Figure 1-1). This site is located 40 miles south of the mouth of the Providence FNP in open water. Several other open-water sites were identified during the 2001 Providence River FEIS, and all of those sites, except for the RISDS, were eliminated from further consideration. The Study Team reexamined those sites, and again determined that only the RISDS was available, and no confined disposal facilities (CDF) were identified during this planning effort.

This open-water placement site is available for "suitable material" that meets strict EPA and USACE chemical and biological criteria. The material to be excavated from the Providence FNP has been evaluated and found to be not suitable for placement in the RISDS. Based on former sediment analysis, the three shallow-draft FNPs will likely have dredged material unsuitable for open-water placement. Therefore, none of the material from the Providence FNP and the three adjacent shallow-draft FNPs will be placed in the RISDS.

Construction of a CAD cell is included in the mix of measures; therefore excavated materials from the construction of the CAD cell would contain large quantities of material deemed to be suitable and could potentially be placed in the RISDS. However, USACE strives to beneficially use suitable dredged material prior to open-ocean disposal. One goal of the management of the RISDS is to extend the useability of the site, and to beneficially use dredged material to the degree practicable prior to disposal in the open-water facility.

Measure P-3: Construction of a New Confined Disposal Facility

No CDFs were identified during this planning effort. CDFs were identified during the 2002 analysis, but none of these potential locations were available. The material to be dredged from the Providence FNP is silt containing contaminants and not structurally sound foundation material. Additionally, costs of constructing a CDF would be high due to required "double handling" and construction of the containment structure.

Measure P-4: Confined Aquatic Disposal Cell – Edgewood Shoals North

The Study Team performed probes, borings, and sediment cores within the reach and concluded that a large CAD cell could be constructed within the northern portion of Edgewood Shoals (see Appendices F and G). This initial evaluation of the unconsolidated depth of materials within the northern half of Edgewood Shoals embayment showed the underlying material was composed of silt and sand down to an adequate depth (up to 60 feet below the present bottom) for potential design of a CAD cell with dimensions to hold over 2,400,000 CY of dredged material (bulked to 2,800,000 CY upon placement). The possible Edgewood Shoals North (ESN) CAD cell site would be located directly south and adjacent to the PEB (see Figure 5-1). The ESN site was positioned to avoid an existing mooring field on the eastern side of the embayment.

The ESN CAD cell would be a rectangular-shaped area covering approximately 51 acres (2,200,000 square feet), with lateral dimensions of approximately 1,600 ft north-south and 1,400 ft east-west, dredged at a 1V:5H slope to an elevation of -60 feet MLLW. The relatively shallow side slopes are needed due to the silty nature of the material (see Appendices F and G). The site is shallow (-6 feet MLLW), so overburden would need to be removed, and shallow-draft equipment would be need initially for dredging and barging the material.

Additionally, a new access channel would need to be constructed between the proposed ESN CAD cell location and the Providence FNP channel to allow access to the CAD cell by large dredging equipment and scows. The 2,000-ft-long access channel would be 280 feet wide at the surface footprint, with a 13-acre footprint. The access channel would have a 100-foot-wide channel bottom width dredged to a depth of -25 feet MLLW, with 1V:5H side slopes, in order to accommodate large dredge equipment. The access channel would not be made a part of the authorize federal navigation project.

The ESN CAD cell and access channel construction would require a total of approximately 3,200,000 CY of material to be excavated, composed of silts and sands. Complete suitability determination was conducted of the material to be excavated, and the testing revealed nearly all of material was suitable for open-water placement. This suitable material would be placed in an approved open-water placement site such as the RISDS or in an appropriate beneficial-use site, or the suitable material could be used to cap former CAD cells to be closed out. A small amount of the material to be excavated (37,000 CY) was determined to be unsuitable for open-water placement, which is located in a 1,600-foot section (approximately 11.5 acres) of an abandoned channel crossing north-south across the CAD cell. This old navigation channel accessed the PEB, and the old channel is 6,000 feet in total length, 300 feet wide, covering 44 acres, and contains approximately 2 feet of overlying unsuitable material for open-water placement. This unsuitable material within the footprint of the CAD cell would be dredged with shallow-draft equipment and placed in an appropriate location, such as another available CAD cell or another location that could accept unsuitable materials. All of the excavated material would bulk during excavation and placement by approximately 15%, requiring placement options that can accommodate 3,700,000 CY of bulked material.

Prior to ESN CAD cell construction, any relocation of resources will be determined in accordance with applicable federal law, regulation, and executive order. During construction and use of this site, as well as upon completion, this measure must accommodate vessel traffic into and out of Edgewood Shoals.

The CAD cell could remain open for 20 years and is sized appropriately to contain enough disposal capacity to hold the material to be dredged in Cycle One from the Providence FNP, including the expectation that dredged material would bulk 15% during handling and placement. The CAD cell would also be able to hold all expected material to be dredged from the three adjacent shallow-draft FNPs during the 20-year period and requested local placement needs. The CAD cell could also function as a starter cell holding unsuitable material from the construction of a possible future CAD cell. The CAD cell would need to be sized large enough to fit a functional environmental cap with clean material to restore and close out the site.

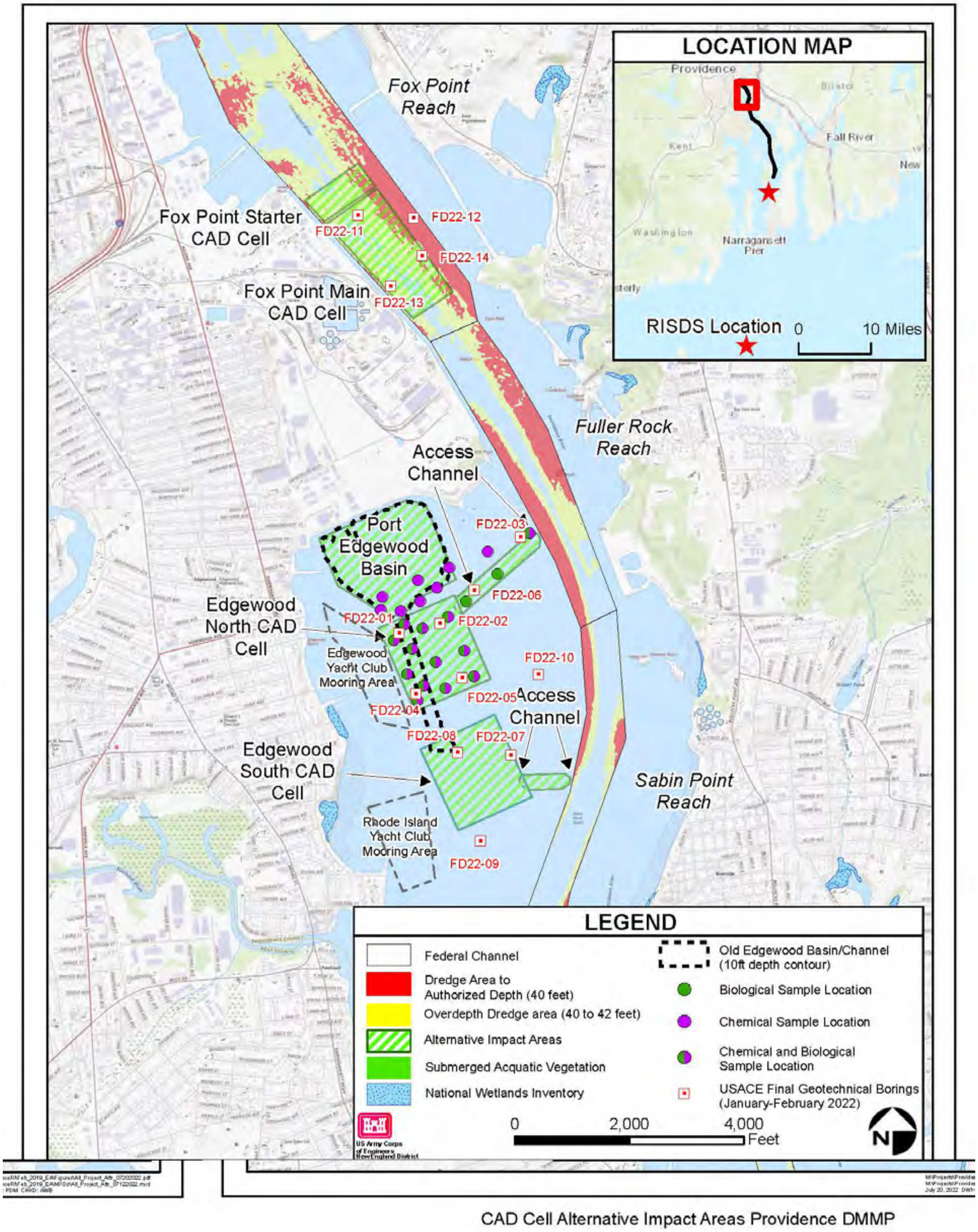


Figure 5-1. Location of Measures: Fox Point Reach South CAD cell (Main CAD Cell and Starter Cell), Edgewood Shoals North CAD Cell, Edgewood Shoals South CAD Cell, and Port Edgewood Basin.

Over the 20-year period, material placed in the CAD cell would consolidate with resultant consolidation and minor settling of the material by perhaps two to three feet, allowing for additional space for possible additional unsuitable material and for final capping in order to restore and close out the site. The final capping would require at least three feet of clean material (approximately 300,000 CY of clean material) up to approximately -13 feet MLLW, at the end of its life cycle, in approximately 20 years. The clean material could be sourced from excavation of underlying clean material during construction of a new CAD cell or dredging of clean material.

This CAD cell construction, along with the access channel, would result in a deeper corridor through Edgewood Shoals, since the final capped CAD cell would be approximately 10-13 feet deep (MLLW), and the access channel would remain approximately 25 feet deep (MLLW). Analysis conducted by URI-GSO showed that the Edgewood Shoals currently does not flush effectively, developing a gyre, resulting in stagnant water and low oxygen conditions. The URI-GSO performed research that showed that placement of a deepened corridor through the shoaled area could allow better flushing and improved habitat conditions. The construction of the CAD cell and access channel could provide the deepened corridor necessary to provide better flushing and thus improved habitat condition in Edgewood Shoals. Therefore, this measure may result in a long-term positive environmental benefit, thus helping to address the environmental acceptability criterion in the Federal Standard. The access channel could have an alignment adjustment during design with similar excavation volume.

Measure P-5: Confined Aquatic Disposal Cell - Edgewood Shoals South

The Study Team performed probes and borings within the reach and concluded that a large CAD cell could be constructed within the southern portion of Edgewood Shoals (see Appendices F and G). This initial evaluation of the unconsolidated depth of materials, within the southern half of Edgewood Shoals embayment, showed that the underlying material consists of silt and sand to an adequate depth (up to 60 feet below the present bottom) for potential design of a CAD cell with dimensions to hold over 2,400,000 CY of dredged material (bulked to 2,800,000 CY upon placement). The possible Edgewood Shoals South (ESS) CAD cell site would be in the southern half of Edgewood Shoals (see Figure 5-1). The site was positioned to avoid an existing mooring field on the eastern side of the embayment.

The ESS CAD cell would be a rectangular-shaped area covering approximately 51 acres (2,200,000 square feet), with lateral dimensions of approximately 1,600 ft north-south and 1,400 ft east-west, dredged at a 1V:5H slope to an elevation of -60 feet MLLW. The relatively shallow side slopes are needed due to the silty nature of the material (see Appendices F and G). The site is shallow (-7 feet MLLW), so overburden would need to be removed, and shallow-draft equipment would be need initially for dredging and barging the material.

Additionally, a new access channel would need to be constructed between the proposed ESS CAD cell location and the Providence FNP channel to allow access to the CAD cell by large dredging equipment and scows. The 900-foot-long access channel would be 250 feet wide at the surface footprint, with a 13-acre footprint. The access channel would have a 100-foot-wide channel bottom width dredged to a depth of -25 ft MLLW, with 1V:5H side slopes, in order to accommodate large dredge equipment. The access channel would not be made a part of the authorized FNP.

The ESS CAD cell and access channel construction would require a total of approximately 2,900,000 CY of material to be dredged. A suitability determination of the material to be excavated was not conducted and would be needed prior to final design and determination of appropriate placement locations for the excavated material. During this feasibility phase of the project, the Study Team decided that, due to the similar nature of sediments and immediate proximity of the ESS to the ESN, that the material to be excavated would probably have similar suitability characteristics to that of ESN. Therefore, for this feasibility-level design and cost estimating, the Study Team assumed that most of the 2,900,000 of material to be excavated would be clean and suitable for open-water placement. Similar to the ESN, a 1,600-foot section, approximately 11.5 acres, of the abandoned channel that accessed the PEB crosses, north-south, the possible CAD cell footprint. Assuming 2 feet of material in this channel is unsuitable, then this small quantity would need to be dredged with shallow-draft equipment and placed in an appropriate location, such as another available CAD cell or another location that could accept unsuitable materials. The approximately 2,900,000 CY of suitable silty material would need to be placed in appropriate locations, such as a designated open-water disposal area (e.g., RISDS) or appropriate beneficial use sites that can accommodate clean silty material or capping a former CAD cell to be closed out. All of the excavated material would bulk during excavation and placement by approximately 15%, requiring placement options that can accommodate 3,300,000 CY of bulked material.

Prior to ESS CAD cell construction, any relocation of resources will be determined in accordance with applicable federal law, regulation, and executive order. During construction and use of this site, as well as upon completion, this measure must accommodate vessel traffic into and out of Edgewood Shoals.

The CAD cell could remain open for 20 years and is sized appropriately to contain enough disposal capacity to hold all of the material to be dredged in Cycle One from the Providence FNP, including the expectation that dredged material would bulk 15% during handling and placement. The CAD cell would also be able to hold all of the expected material to be dredged from the three adjacent shallow-draft FNPs during the 20-year period as well as requested local placement needs. The CAD cell could also function as a starter cell holing unsuitable material from the construction of a possible future CAD cell. The CAD cell would need to be sized large enough to fit a functional environmental cap with clean material to restore and close out the site. Over the 20-year period, material placed in the CAD cell would consolidate with resultant consolidation and minor settling of the material by perhaps two to three feet, allowing for additional space for possible additional unsuitable material and for final capping in order to restore and close out the site. The final capping would require at least three feet of clean material (approximately 300,000 CY of clean material) up to approximately -13 feet MLLW, at the end of its life cycle, in approximately 20 years. The clean material could be sourced from excavation of underlying clean material during construction of a new CAD cell or dredging of clean material.

The ESS CAD cell and access channel would provide the deepened corridor through Edgewood Shoals, since the final capped CAD cell would be approximately 10-13 feet deep (MLLW), and the access channel would be approximately 25 feet deep (MLLW). The access channel could have an alignment adjustment during design with similar excavation volume.

Measure P-6: Confined Aquatic Disposal Cell – Fox Point Reach South

The Study Team performed probes, borings, and sediment cores within the reach and concluded that a series of two CAD cells could be constructed within the southern portion of Fox Point Reach (see Figure 5-1). This initial evaluation of the unconsolidated depth of materials within the southern half of Fox Point Reach, showed that the underlying material is composed of silt and sand to an adequate depth (up to 60 feet below the present channel bottom) for potential design of a FPRS CAD cell with dimensions to hold over 2,400,000 CY of dredged material (bulked to 2,800,000 CY upon placement). The presence of underground cables in the central portion of the Fox Point Reach limited the location of the CAD cell placement to the southern portion of the reach. Complete suitability determination was conducted of the material to be excavated, and the testing revealed that 8 feet of material beneath the channel bottom contained contaminants making it unsuitable for open-water placement and unsuitable for capping material (over 400,000 CY of unsuitable material) (see Appendix F). To address additional placement needs for this unsuitable material, the initial design called for a starter cell to be constructed along with the main cell. The starter cell location also contains unsuitable materials, which would need to be placed in a location that could accept unsuitable materials, such as another available CAD cell.

The starter cell of the FPRS CAD cell would be a rectangular-shaped area covering approximately 12 acres (534,000 square feet), with lateral dimensions of 500 feet by 1,130 feet. The main FPRS CAD cell would cover approximately 49 acres (2,119,000 square feet), with lateral dimensions of 1,100 feet by 2,200 feet. Both cells would be dredged at 1V:3H slopes to an elevation of -90 ft MLLW. The side slopes are needed due to the silty sand characteristics of the material (see Appendix G). The starter cell would require a total of approximately 580,000 CY be dredged, with a 140,000-CY-layer of unsuitable material (160,000 CY with 15% bulking upon placement) and 437,000 CY of suitable material (500,000 CY with 15% bulking). The unsuitable material would need to be disposed of in an appropriate location, and the remaining suitable material could be placed in a designated open-water disposal site or placed in a beneficial-use site that can accept clean silty material.

The main FPRS CAD cell has a 447,000-CY layer of unsuitable material that would be disposed of in the starter cell. The starter cell would then be capped with 57,000 CY (-45 feet to -42 feet MLLW) of suitable material from the main cell with the remaining 2,520,000 CY of suitable material being placed at a designated open-water site or beneficial-use site that can accept silty sand material. The main FPRS CAD cell would have a capacity of 2,700,000 CY for unsuitable material (-90 feet to ¬45 feet MLLW) and could be capped (at least 3-foot-deep cap) with 300,000 CY of suitable material (-45-foot to -42-foot MLLW) from a clean source, such as underlying material from a future CAD cell construction. The main cell would provide enough capacity for the 2,400,000 CY (2,700,000 CY with 15% bulking) from various sources.

The main FPRS CAD cell could remain open for 20 years and is sized appropriately to contain enough disposal capacity to hold all of the material to be dredged in Cycle One from the Providence FNP, including the expectation that dredged material would bulk 15% during handling and placement. The main FPRS CAD cell would also be able to hold all of the expected material to be dredged from the three adjacent shallow-draft FNPs during the 20-year period as well as requested local placement needs. The main FPRS CAD cell could also function as a starter cell holing unsuitable material from the construction of a possible future CAD cell. The main FPRS CAD cell would need to be sized large enough to fit a functional environmental cap with clean material to restore and close out the site. Over the 20-year period, material placed in the main FPRS CAD cell would consolidate with resultant consolidation and minor settling of the material by perhaps two to three feet, allowing for additional space for possible additional unsuitable material and for final capping in order to restore and close out the site. The final capping would require at least three feet of suitable material (approximately 240,000 to 30,000 CY of clean material) up to approximately -13 feet MLLW, at the end of its life cycle, in approximately 20 years. The suitable material could be sourced from excavation of underlying suitable material during construction of a new CAD cell or dredging of clean material.

The FPRS CAD cell construction and subsequent filling could be impactive to navigation in the Providence FNP, so timing and accommodations would have to be made to reduce this navigation impact.

Measure P-7: Confined Aquatic Disposal Cell – Fuller Rock Reach

The Study Team performed a cursory look at placement of a CAD cell in Fuller Rock Reach and performed an initial examination of potential depth of sediment below the channel in the Fuller Rock Reach. The bedrock in this reach is very close to the edges of the channel, and the Study Team concluded that there was inadequate depth to bedrock in a wide enough portion of the reach to place a sizeable CAD cell required to hold the necessary 2,400,000 CY of dredged material coming from Providence FNP and other identified sources.

Measure P-8: Confined Aquatic Disposal Cell – Sabin Point Reach

Initial evaluation of the unconsolidated depth of materials within the Sabin Point Reach, showed that there was adequate depth (up to 60 feet below the present channel bottom) for potential design of a CAD cell with dimensions to hold 2,400,000 CY of dredged material. However, this reach narrows down where the Sabin Point juts out into the channel on the east bank. This narrowed section causes relatively high currents compared to other reaches, and a nearby public beach Sabin Point Waterfront Park, at Sabin Point, could receive some deposition of suspended load that could possibly drift from currents over to the beach during dumping and placement of the dredged material into the CAD cell. Other reaches are available with lower currents and no nearby beaches.

Measure P-9: Confined Aquatic Disposal Cell – Other Reaches

The Study Team performed a cursory analysis of reaches further downstream of Sabin Point Reach and determined through an initial review of surficial geologic maps of the Providence River estuary showed relatively deep unconsolidated sediments down to 100 feet beneath the river channel. The Study Team decided to select one location that was the closest to the bulk of shoaled materials in the FNP that would need to be dredged. The bulk of material to be dredged is 1,033,000 CY at Fox Point Reach, 470,000 CY at Fuller Rock Reach, and 283,000 CY at Sabin Point Reach. The Study Team concluded that a CAD cell placed somewhere in the channel would have lower haul distances and thus lower costs the further north the CAD cell was placed.

Measure P-10: Filling Port Edgewood Basin (Beneficial Use of Dredged Material)

PEB is a formerly dredged-out area, approximately 63 acres, in the northern most portion of Edgewood Shoals (Figure 5-1). The basin currently has depths from 15 feet to 30 feet below MLLW, and the basin is associated with a north-south-oriented dredged channel, approximately 15 feet below MLLW depth connecting the basin with the main Providence FNP. This area no longer functions as a port, and the remnants of piers and docks are rotted away and no longer functional. The remaining basin creates stagnant and low-oxygen (anoxic) conditions that are detrimental to wildlife. The Study Team collected and tested sediment samples from the basin and determined that the materials contained contaminants (see Appendix F).

Filling PEB would provide environmental benefits and eliminate the stagnant conditions, increase the oxygen conditions in the shallower water, and cap the existing contaminated materials in the basin, thus improving the water quality and benthic environment for wildlife. Placement of unsuitable material in the PEB would require capping the basin with at least three feet of clean material as an integral and essential part of the restoration effort. When this site is being used as placement of unsuitable material from a CAD cell (in effect a starter cell), then this BU would be considered a critical component for practicability and environmental acceptability and not a supplement BU.

Total capacity for filled material is approximately 389,000 CY, with placement capacity for up to 155,000 CY of unsuitable material, to be capped with at least three feet of clean (suitable) materials (at least 234,000 CY up to -10 feet MLLW) during the dredging cycle that the PEB is filled (Table 5-2).

Table 5-2. Quantities that can be Placed in the Port Edgewood Basin.

	Capacity (CY)		
	Up to -13 feet MLLW	**Capping Between-13 MLLW and -10 feet MLLW**	**Total Capacity to -10 feet MLLW**
Material that can be placed	Suitable and Unsuitable	Suitable only	
Capacity of Basin	178,800	268,700	447,500
Quantity to Place (unbulked, assuming bulked 15% upon placement)	155,480	233,650	389,130

The unsuitable material would need time to consolidate prior to placement of the clean cap. If less than 50,000 CY of unsuitable material is placed, then that unsuitable material could be capped immediately without substantial displacement. Placement of more than 50,000 CY of unsuitable material would require a period of time for settlement and consolidation depending on the depth of unsuitable material placed. If the entire capacity of unsuitable material is placed, then a year or more of consolidation could be needed prior to placement of a clean cap in order for the cap not to displace the unsuitable material upward.

Access to the site would require a shallow-draft barge. Unsuitable materials to fill the lower depths could be excavated material from construction of a CAD cell or dredged material from the Providence FNP. Suitable material to fill and cap the basin could be excavated underlying clean material from construction of a CAD cell.

The Study Team dropped the consideration of filling the PEB with unsuitable dredged material from the Providence FNP because this placement would require shallow-draft equipment and multiple mobilizations for FNP dredging. The Providence FNP dredging requires large equipment, which would not be able to navigate to the PEB. Use of a shallow-draft (relatively small capacity) barge for dredging the FNP could require over 30 round-trip hauls, with either the use of many barges or long idle periods for the dredging equipment in the FNP. This additional operation would be inefficient because larger deep-draft barges would be the most efficient equipment for use during dredging of the Providence FNP.

Measure P-11: Existing Fox Point Reach North CAD Cell Use for Capping with Suitable Material (Beneficial Use of Dredged Material)

The seven existing FPRN CAD cells have limited remaining capacity for unsuitable or suitable materials, and will need to be capped with clean material, as described in Section 5.4. The final capping and closing out of the CAD cells are considered supplemental BU because this capping is not a critical component of this DMMP. See Table 5-3.

Table 5-3. Fox Point Reach North Confined Aquatic Disposal Cells Volumes Remaining Based on 2022 Survey. Amounts in Cubic Yards. *(See Civil Engineering Appendix).*

CAD Cell	Capacity up to -45 ft MLLW	Capping between -45 MLLW and -42 ft MLLW	Total Capacity to -42 ft MLLW	Fill and Cap or Leave Open	Fill and Cap to no shallower than -42 ft MLLW	Remaining Capacity for Unsuitable Material	Remaining Capping
1R	5,100	9,000	14,100	Fill and Cap	14,100	0	0
3R	13,600	12,600	26,200	Fill and Cap	26,200	0	0
3AR	208,300	103,000	311,300	Leave Open	0	208,300	103,000
4R	2,400	11,800	14,200	Fill and Cap	14,200	0	0
5R	53,400	25,400	78,800	Leave Open	0	53,400	25,400
6R	11,900	23,700	35,600	Fill and Cap	35,600	0	0
7R	12,400	27,700	40,100	Fill and Cap	40,100	0	0
Total Capacity (CY)	**307,100**	**213,200**	**520,300**		**130,200**	**261,700**	**128,400**
Total amount of original (unbulked) material to be excavated to fill to capacity of fill and cap (to -42 ft MLLW) and not initially overfill (based on 15% expansion during placement)					**113,200**		

The FPRN CAD cells have remained open for the continued use by RIDEM for placement of local unsuitable and suitable material from local sources not managed by USACE. Additional capacity had been originally paid for by Rhode Island exclusively for non-federal use, and the Study Team concluded that the only opportunity for federal use would be filling and capping those cells that were no longer practically available for non-federal use. The Study Team, in communication with RIDEM, concluded that two of the cells had enough remaining capacity to remain open for non-federal use (3AR and 5R), and that USACE could fill and cap the remaining five cells. The Study Team determined that the small amount of remaining capacities of the five cells to be closed were insufficient for placement of unsuitable material. The remaining capacity, along with three feet of suitable material for capping, could be performed during Cycle-One, with approximately 113,000 CY of clean material. Such clean material could come from excavation of a CAD cell during Cycle-One, in which underlying materials that are excavated would be deemed clean and suitable for capping the existing FPRN CAD cells. The remaining two CAD cells to remain open during Cycle-One could be filled, capped, and closed out in Cycle-Two with approximately 128,000 CY of clean material (see Table 5-3). Such clean material could come from excavation of a CAD cell during Cycle Two, in which underlying materials that are excavated would be deemed clean and suitable for capping the two remaining open FPRN CAD cells.

Measure P-12: Prudence Island Disposal Site Capping Beneficial Use of Dredged Material for Placement of Suitable Materials from Confined Aquatic Disposal Cell Construction

The PIDS is a 100-foot-deep (MLLW) natural basin, 377 acres in size, on the east side of Prudence Island in Narragansett Bay at the southern terminus of the Providence FNP. This disposal site, which is no longer considered a designated dredged material disposal site, was formerly known as East Passage Disposal Area. USACE placed dredged contaminated material from maintenance dredging of the Pawtuxet Cove FNP in the deep natural basin in 1964. In 2022 and 2023, the Study Team conducted investigations of the basin to determine its bathymetric condition, including the extent and nature of contaminants (see Appendix F). The Study Team concluded that materials had contaminants at depths of 1.5 feet and deeper. The Study Team concluded that capping the entire basin with at least three feet of clean material would isolate those contaminants and help to restore the bathymetric habitats. Capping the entire site with at least three feet would require placement of 1,825,000 CY of clean material (see Table 5-4). Such material would need to be suitable for open-water placement, so dredged material from the Providence FNP or the adjacent three FNPs would not be placed in this basin. However, clean material could come from excavation of a CAD cell, in which underlying materials that are excavated would be deemed clean and suitable for capping the old contaminated dredged materials in PIDS. This measure is considered a supplemental BU because this capping is not a critical component of this DMMP.

Table 5-4. Prudence Island Disposal Site Beneficial Use Site Volume.

Prudence Island Disposal Site	
Activity	Capping three feet Deep (once settled)
Cap Quantity that is Minimum of three feet Deep	1,825,000
Initial Placed Quantity (Expanded 15% immediately during placement)	2,098,750
Original material to be excavated for cap (prior to placement)	1,825,000
Final Consolidated Material, at least three feet deep (assumes re-consolidation of placed material by up to 15%)	1,825,000

Measure P-13: Other Beneficial Use Sites for Placement of Suitable Materials in Construction of the Confined Aquatic Disposal Cell (Beneficial Use of Dredged Material)

The material excavated from Providence FNP is not suitable for marsh restoration. Use of CAD cell excavated material could be suitable for marsh restoration, but would require additional analysis, authorized study areas ready to be implemented over the next year, and Non-Federal Sponsors to cost-share the studies and implementation. The Study Team did not identify any available site, for which an agency had already performed the appropriate analysis and secured funding to place materials excavated from a proposed CAD cell by 2027. This measure is considered a supplemental BU because this marsh restoration is not a critical component of this DMMP.

Measure P-14: Final Capping of CAD Cell Constructed as Part of DMMP (Beneficial Use of Dredged Material)

Possible Cycle-One and Cycle-Two CAD cells would need to be capped and closed out after their life cycles. These possible CAD cells could be capped with suitable materials from numerous possible sources, including during construction of a possible next-cycle CAD cell involving excavation and placement of clean underlying material. This final capping is required for environmental acceptability of the construction of the CAD cell and therefore a critical component, and not a supplement BU.

Measure P-15: Confined Aquatic Disposal Cell Used as Starter Cell for Unsuitable Material

If a CAD cell were developed during Cycle-One, then this CAD cell could be designed to have additional space for the placement of unsuitable materials from a possible Cycle-Two CAD cell construction. A Cycle-One CAD cell could be left open for a 15-20-year period, making it available for placement of unsuitable material from both Cycle-One maintenance dredging and a possible Cycle-Two CAD cell construction.

Measure P-16: Providing Placement Opportunities for Local Dredged Material Placement Needs

Under this measure, placement opportunities would be expanded to include additional space for local unsuitable dredged materials. The placement facilities would remain open for up to 20 years to allow for opportunities for placement.. The unsuitable materials would typically have very limited beneficial uses and would need to be placed in a facility such as a CAD cell.

Measure D-1: Maintenance Dredging of Providence Federal Navigation Project to Full Depth and Widths, as Economically Warranted

Under this measure, placement opportunities that are designed to receive unsuitable materials would be sized to place dredged material from Providence FNP for both maintenance cycles. The Study Team determined that the Providence FNP would need to be dredged to fully authorized widths and depths to provide full economically warranted utility of the FNP. To reestablish these authorized dimensions, the Study Team concluded that due to existing shoaled conditions and predicted shoaling rates, that the Providence FNP would need to be dredged immediately, in maintenance Cycle-One (year 2028) and then again within 20 years in maintenance Cycle-Two (year 2048). The Cycle-One dredging volume is expected to be 2,015,000 CY (see Table 3-5), and after handling, the material is expected to bulk by 15% to 2,320,000 CY. The Cycle-Two dredging volume is expected to be 1,900,000 CY (see Table 3-6), and after handling, the material is expected to bulk by 15% to 2,200,000 CY.

The shoaled materials currently in the Providence FNP were determined to be unsuitable for placement in a designated open-water placement site, such as the RISDS. The Study Team expects that all of the materials predicted to shoal over the next 20 or more years will continue to be unsuitable for open-water placement. The unsuitable materials would have very limited beneficial uses and would need to be placed in a facility, such as a CAD cell.

Measure D-2: Maintenance Dredging of Three Adjacent Shallow-draft Federal Navigation Projects to Full Depth and Widths, as Economically Warranted

The shoaled materials currently in the three adjacent shallow-draft FNPs are expected, based on past dredging conditions, to be unsuitable for placement in a designated open-water placement site, such as the RISDS. Under this measure, placement opportunities for unsuitable materials are expanded to include space for dredged material from the three shallow-draft FNPs adjacent to the Providence FNP, which are the Bullock Point Cove FNP, the Pawtuxet Cove FNP, and the Apponaug Cove FNP. The placement opportunities would need to cover two dredge cycles over at least a 20-year period. In each dredge cycle, the placement facilities would remain open for up to 20 years to allow for opportunities for placement through that time prior to final closeout of the facility. These unsuitable materials would have very limited beneficial uses, and would require placement in a facility, such as a CAD cell.

The Study Team concluded that due to existing shoaled conditions and predicted shoaling rates, that the three adjacent shallow-draft FNPs would need to be dredged immediately, in maintenance Cycle-One (year 2028) and then again in 20 years in maintenance Cycle-Two (year 2048). The Cycle-One dredging volume is expected to be 63,000 CY (see Table 3-5), and after handling, the material is expected to bulk by 15% to 72,000 CY. The Cycle-Two dredging volume is expected to be 61,000 CY (see Table 3-6), and after handling, the material is expected to bulk by 15% to 70,000 CY.

Measure D-3: Sediment Reduction Measures

Sediment that ends up in the federal navigation channel that ultimately requires dredging comes from upstream areas of the Providence River and its tributaries. This measure would evaluate the watershed to identify any areas that contribute significantly to the sedimentation in the federal navigation channel. Once identified, measures and best management practices could be evaluated by USACE or RI state agencies that, if implemented, could reduce sediment loading to the Providence River and their eventual deposition in the federal navigation channel. No immediate studies or projects are available for implementation. This measure would not address existing shoaling in the FNPs.

5.6. Screening of Measures*

The Study Team had identified each of the 19 action measures, described in Section 5.5, based on the measure potentially being able to contribute to the study's purpose and need by addressing one or more of the four DMMP goals and objectives, along with working within the considerations and constraints, described in Section 2.6. The Study Team then screened the measures for combining the most effective and acceptable measures into potential alternatives. The Study Team first screened the measures based on each measure's potential for meeting the two PR&G formulation criteria of effectiveness and acceptability and as described in Section 5.2. Following this screening of measures, the Study Team the other two PR&G criteria – completeness and efficiency – to combine the measures to develop more complete alternative plans and then screen the plans for their efficiency in meeting the objectives.Incorporating the PR&G criteria of effectiveness and acceptability, the Study Team screened the measures in their ability to meet the following screening criteria:

1) The measure must be effective in contributing to the management needs (incorporates the "effectiveness" guideline). The measure must adequately achieve the maintenance requirements through the planning period – through 2048 – of the Providence FNP, the three local FNPs, and the non-federal dredged material placement needs. The measure must meet one or more of the DMMP objectives laid out in Section 2.6.
2) To be effective, the measure must also be practicable, as in "available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes" (33 CFR 335.7). The measure must have implementation timeframes that could clearly be achieved to meet the first dredge cycle, scheduled to be implemented in a timely manner, in Cycle-One and/or Cycle-Two.
3) The degree that the measure is acceptable, including whether the measure is environmentally acceptable, e.g., that the measure can meet the requirements of CWA Section 404(b)(1) evaluation process (incorporates the "acceptability" guideline). The measure should be acceptable to the Non-Federal Sponsor, since the sponsor must cost share the design and construction of additional navigational features such as a CAD cell. The measure may also consider positive impacts on economic, social, and environmental conditions.

For each of the three criteria, the measures were ranked as high, medium, or low based on how effectively they met each screening criteria, as defined in Table 5-5. Those measures that did not satisfy all the screening criteria, in that they had a low rating in at least one criterion, were dropped from consideration, and not carried forward to alternative formulation. The screening process is described in detail in Table 5-5, in a matrix showing how each measure addressed each decision criterion.

Based on a preliminary evaluation, measures, P-1, P-3, P-7, P-8, P-9, P-14, and D-3 were dropped from further consideration as they did not achieve one or more of the decision criteria, getting a "low" rating in at least one of the measure screening criteria. The No-Action Measure (Measure NA-1) was retained to be carried forward to meet the requirements of NEPA. Eleven action measures (Measures P-2, P-4, P-5, P-6, P-10, P-11, P-12, P-13, P-15, D-1, and D-2) were retained to be carried forward and combined for alternative formulation for one or both maintenance dredge cycles. Measures P-10 and P-12 were only retained for dredge Cycle-One, and Measures P-5 and P-13 were only retained for Cycle-Two.

Table 5-5. Measures Screening Matrix. Measures were retained (green) or eliminated (white) during preliminary screening based on ability to meet the screening criteria

Key:

Effective: H = High – fully functional at meeting at least one of the project goals, and the measure is fully available and can be implemented after taking into consideration cost, existing technology, and logistics in light of overall project purposes M = Medium – marginally or partially functional at meeting at least one project goal, L = Low – does not meet any project goals.

Practicable: H = High – implementation method known, and cost is predicted to be reasonable compared to other acceptable methods, M = Medium – implementation method unknown or cost is predicted to be high compared to other acceptable methods, L = Low – the measure is not available (ownership, access), unknown technology to implement, excessively costly, or cannot be performed in the required timeframe.

Acceptable: H = High – Measure has fully acceptable environmental effects that are addressed under an environmental assessment, and the measure has support of federal and regional agencies, M = Medium – Measure has environmental impacts that require additional protections or mitigation, L = Low – Measure has major environmental impacts, including long term duration impacting a large area, or results in impacts that cannot be addressed in an environmental assessment, requiring the need for an environmental impact statement, or the measure is unacceptable to the Non-Federal Sponsor, or is not permittable under state requirements.

Measure Number	Measure Description	Measure Screening Criteria			Screening Action		Justification
		1	2	3			
		Effective	Practicable	Acceptable	Cycle One of Maintenance Dredging	Cycle Two of Maintenance Dredging	
NA-1	No Action	L	L	L	Retained	Retained	Does not meet project purpose and need, and the unsuitable material to be dredged cannot be placed in existing placement sites; however, this measure will be retained to meet NEPA regulations and USACE guidance.
P-1	Upland placement	L	L	L	Dropped	Dropped	Transportation costs and environmental impacts associated with this measure were determined to be not practicable (cost prohibitive) and, therefore, were unlikely to meet the efficiency criteria. Additionally, the acceptability of this alternative is low, partly because of excessive trucking and emissions. For this reason, this measure will not be carried forward into alternative formulation.

Measure Number	Measure Description	Measure Screening Criteria			Screening Action		Justification
		1	2	3	Cycle One of Maintenance Dredging	Cycle Two of Maintenance Dredging	
		Effective	Practicable	Acceptable			
P-2	Open Water Placement	H	H	M	Retained	Retained	Available for suitable material placement after beneficial use sites consideration. Retained for disposal of materials from CAD cell construction. Combined with BU, to the extent possible, to reduce the amount of material placed at RISDS.
P-3	Construction of a CDF	L	L	L	Dropped	Dropped	Silt material not structurally sound foundation material. No locations identified by USACE. High costs due to "double handling" of unsuitable material and construction of the containment structure.
P-4	CAD cell: Edgewood Shoals North, construction	H	H	H	Retained	Retained	Adequate space and unconsolidated depths to construct a CAD cell to hold 2,400,000 CY of unsuitable materials. Construction involves excavating unsuitable and suitable material and require a combination of placement sites for unsuitable material and suitable material. Design must include adequate space for 3-foot cap of clean material for closure. Suitability determination already conducted, so this measure is ready for Cycle One implementation. Environmental benefits by improving flushing in Edgewood Shoals.
P-5	CAD cell: Edgewood Shoals South, construction	H	H	H	Dropped	Retained	Adequate space and unconsolidated depths to construct a CAD cell to hold 2,400,000 CY of unsuitable materials. Construction involves excavating unsuitable and suitable material and requires a combination of placement sites for unsuitable material and suitable material. Design must include adequate space for 3-foot cap of clean material for closure. A suitability determination is needed prior to design, which requires an additional year of study. Environmental benefits by improving flushing in Edgewood Shoals. Measure retained for Dredge Cycle Two.

Measure Number	Measure Description	Measure Screening Criteria			Screening Action		Justification
		1	2	3			
		Effective	Practicable	Acceptable	Cycle One of Maintenance Dredging	Cycle Two of Maintenance Dredging	
P-6	CAD cell: Fox Point Reach South construction	H	M	H	Retained	Retained	Adequate space and unconsolidated depths to construct a CAD cell to hold 2,400,000 CY of unsuitable materials in the southern portion of the reach. Site previously disturbed. . The central portion of the reach has several buried cables and pipelines that need to be avoided. Requires a second CAD cell constructed in Fox Point Reach as a primary starter cell for a large quantity of unsuitable material to be excavated from the main cell. Construction involves excavating unsuitable and suitable material, and requires a combination of placement sites for unsuitable material and suitable material. Design must include adequate space for 3-foot cap of clean material for closure. Suitability determination already conducted for this site, so this measure is ready for Cycle One implementation.
P-7	CAD cell: Fuller Rock Reach	L	L	L	Dropped	Dropped	Inadequate subsurface volume to practically construct a CAD cell.
P-8	CAD cell: Sabin Point Reach	L	L	L	Dropped	Dropped	Impacts to nearby public beach due to possible sediment drifting and deposition. The Fox Point Reach is more suitable, so this reach was dropped from further consideration to avoid the possible adverse impacts.
P-9	CAD cell: other reaches	M	L	M	Dropped	Dropped	Increased distance of hauling to potential CAD cell sites compared to Fox Point Reach, so increased cost and eliminated from further analysis.
P-10	Beneficial Use: Filling Port Edgewood Basin	H	H	H	Retained for placement of limited unsuitable dredged material and suitable material as a cap excavated from possible CAD cell	Dropped, if implemented in Cycle One	The PEB is currently environmentally degraded, with a low-oxygen environment and contaminated sediments in the bottom of the basin. Beneficial use of dredged material to fill this basin and cap with clean material would provide environmental benefits. If filled to capacity with unsuitable material (up to 155,000 CY), that material requires considerable time (a year or more) to consolidate prior to placement of suitable material for a cap. If less than 50,000 CY of unsuitable material is placed, then that unsuitable material could be capped immediately without substantial displacement. The Study Team decided to keep this measure for possible placement of unsuitable material excavated during construction of a CAD cell and capping with clean material. Placement of a small amount of unsuitable material in the PEB could be immediately capped and restored with suitable material as part of CAD cell construction. Placement of more than 50,000 CY would require timing to cap until settlement is acceptable.

Measure Number	Measure Description	Measure Screening Criteria			Screening Action		Justification
		1	2	3	Cycle One of Maintenance Dredging	Cycle Two of Maintenance Dredging	
		Effective	Practicable	Acceptable			
P-11	Beneficial Use: Existing Fox Point Reach - North CAD cell filling and capping	H	H	H	Retained for capping five cells that are near capacity, with clean dredged material excavated from possible CAD cell	Retained for capping two remaining cells with clean dredged material excavated from possible CAD cell	Placement of suitable materials excavated from construction of a CAD cell. Beneficial use due to environmental benefits of capping unsuitable materials in existing FPRN CAD cells with clean material. Five of seven FPRN CAD cells are currently at or near capacity for placement of unsuitable dredged material and can be capped in Cycle One. Two CAD cells with remaining capacity f will remain open for continued placement of unsuitable dredged material and can be capped in Cycle-2.
P-12	Beneficial Use: Prudence Island Disposal Site - cap and restore	H	H	H	Retained only for use of suitable dredged material excavated from possible CAD cell	Dropped, if implemented in Cycle One	Placement of suitable materials from construction of a CAD cell. will provide environmental benefits by capping existing unsuitable materials in PIDS.
P-13	Beneficial Use: other beneficial uses	L	L	H	Dropped	Dropped, but could be added in the future as studies are initiated	The material excavated from the Providence FNP is unsuitable for marsh restoration. CAD cell construction material may be suitable for marsh restoration; however, this use requires additional analysis, an additional authorized project, and a Non-Federal Sponsor cost share. No identified authorized project or sponsor, so dropped.
P-14	Final capping of CAD cell constructed as part of DMMP	H	H	H	Retained if CAD cell is constructed in Cycle One	Retained if CAD cell is constructed during a cycle, and another in next cycle	Possible Cycle-One and Cycle-Two CAD cells can be capped with suitable materials from numerous possible sources, including during construction of a possible next-cycle CAD cell. Possible suitable material from construction of the Cycle-Two CAD cell can be used to cap the Cycle-One CAD cell.
P-15	CAD cell sized and used as starter cell for next dredging cycle for placement of unsuitable material	H	H	H	Retained if CAD cell is constructed in Cycle One	Retained only if CAD cell is constructed during a cycle, and another in next cycle	Cycle-One CAD cell can be used as a starter cell for placement of unsuitable materials that would be excavated from construction of Cycle-Two CAD cell. Cycle-One CAD cell would need to be sized large enough to function as a starter cell for Cycle-Two construction unsuitable material placement.

Measure Number	Measure Description	Measure Screening Criteria			Screening Action		Justification
		1	2	3	Cycle One of Maintenance Dredging	Cycle Two of Maintenance Dredging	
		Effective	Practicable	Acceptable			
P-16	Opportunities for placement of local non-federal dredged material	H	H	H	Retained	Retained	Meets the purpose and need of the DMMP, which include addressing requests of the Non-Federal Sponsor to provide placement opportunities for local non-federal dredged material placement needs through the planning cycle of at least 20 years.
D-1	Maintenance dredging of Providence FNP	H	H	H	Retained	Retained	Meets the purpose and need of the DMMP, to maintain the Providence FNP to full depth and width through the planning cycle of at least 20 years.
D-2	Maintenance dredging of three adjacent FNPs	H	H	H	Retained	Retained	Meets the purpose and need of the DMMP, to maintain the adjacent FNPs, associated with the Providence FNP, to full depth and width as economically warranted through the planning cycle of at least 20 years.
D-3	Sediment reduction measures	L	L	H	Dropped	Dropped, but could be added in the future as studies are initiated	No immediate studies or projects are available for implementation. Additionally, this measure would not address existing shoaling in the FNPs.

5.7. Development of Alternative Plans*

The Study Team conducted an iterative process to formulate a range of action alternatives to be compared to the No-Action Alternative, and then to select the least-cost, practicable, and environmentally acceptable Base Plan that addresses BU, and lastly to select a preferred plan that addresses local needs with the determination of appropriate cost-sharing responsibilities. The final preferred plan must ultimately meet the purpose and need of the study.

The No-Action Alternative (Alternative 1) is composed of the No-Action Measure only and is carried forward as required by NEPA. This No-Action Alternative serves as a baseline against which the proposed action and alternatives can be evaluated.

The Study Team formulated a range of action alternatives from various combinations of the final 12 action measures that had been screened and retained (see Section 5.6) for alternative development. The Study Team derived a seven-step process to identify the action alternatives and ultimately select a recommended plan that captures addressing the study drivers as laid out in Chapter 2, including purpose and need, problems and opportunities, and objectives, constraints, and considerations and constraints.

The seven-step process is as follows:

1) The alternative is effective towards meeting the planning purpose and needs – This step was already accomplished through the vetting of the measures, so all combinations of the measures that are retained in screening of measures (Section 5.6) meet this step.
2) The alternative is practicable – This step was already accomplished through the vetting of the measures, so all combinations of the measures that are retained in screening of measures (Section 5.6) meet this step.
3) The alternative is environmentally acceptable – This step was already accomplished through the vetting of the measures, so all combinations of the measures that are retained in screening of measures (Section 5.6) meet this step.
4) The alternative is complete – Addresses all dredging needs for the 20-year planning period. The measures must be combined to address both Cycle-One and Cycle-Two dredging needs of the Providence FNP, the three adjacent shallow-draft FNPs, and the local dredged material placement needs.
5) The alternative addresses supplemental BU – The alternatives are combined with and without the supplemental beneficial-use measures P-11 and P-12 to determine whether supplemental BU increases or decrease costs. This determination affects whether supplemental BU options will be recommended and whether a cost-share is necessary.
6) The alternative is assessed for implementation costs of meeting the federal need to maintain the FNPs through the planning period, and the least-cost Base Plan is identified with and without supplemental beneficial uses added, and cost-sharing requirements for the supplemental beneficial uses are determined. If the plan with beneficial uses has the least cost, then the beneficial uses are integrated into the Base Plan. If the beneficial uses add to the cost, then the separable cost of the BU needs to be addressed with sponsor concurrence to cost share the differential cost of the BUs.

7) The alternative addresses the local requests, which can be added to the Base Plan alternative to become the preferred plan. The Base Plan alternative (that meets FNP dredging needs) is selected with or without beneficial uses depending on the outcome of Step 6 and preference of the local sponsor if the beneficial use addition increases the cost to the Base Plan.

Steps 1-5 of alternative plan development are covered in this chapter (Chapter 5), and Steps 6 and 7 are covered in Chapter 6, Analysis and Comparison of Alternatives.

As all action alternatives are combinations of the 12 vetted measures that met Steps 1, 2, and 3, the Study Team focused on Steps 4 and 5 of the Alternative Formulation process in exploring multiple combinations of the 12 action measures carried forward to meet the completeness criterion. Using Steps 4 and 5, the Study Team derived eight action alternatives, as shown in Table 5-6.

Each of the eight action alternatives fully address the study purpose and need of meeting the maintenance requirements for the four FNPs, considering BU, and considering requested local non-federal dredging needs throughout the entire planning period. To consider beneficial uses, the alternatives combine various levels of beneficial uses. The Study Team considered the beneficial-use measure P-10 (filling Port Edgewood Basin) as a key measure to address placement of unsuitable materials associated with construction of the CAD cell measures, so the team kept this measure in all potential alternatives. Therefore, the options to add or not add BU measures were limited to considering the two BU measures P-11 and P-12 for the purpose of comparing beneficial-use costs. Four of the action alternatives (2A, 2B, 3A, and 3B) incorporate additional BU measures P-11 and P-12. The other four action alternatives (2C, 2D, 3C, and 3D) exclude the additional BU measures P-11 and P-12.

All eight action alternatives require CAD cell capacity to provide for dredging and capping requirements for Cycle-One and Cycle-Two to meet the following:

- Providence FNP (Measure D-1)
- Three adjacent FNPs (Measure D-2)
- Local needs for local dredged material from non-federal sources (Measure P-16)
- Starter cell capacity for unsuitable materials excavated during the next dredging cycle Measure P-15
- Final CAD cell capping requirements (Measure P-14), as beneficial use.

The dredging volumes of these four measures and the capacity requirements of the three CAD cells being considered in all eight action alternatives are summarized in Table 5-7.

Requirements for CAD cell construction for each of the eight action alternative plans to meet the dredging requirements and capacity requirements shown in Table 5-8. For each action alternative, Table 5-8 provides excavation locations and volumes of both suitable and unsuitable materials for CAD cell construction. The table then shows the distribution of the dredged materials that would be hauled to placement locations, along with required dredging equipment drafts and required haul distances.

Table 5-6. Formulation of Alternatives by Combining Screened Measures. (Measures that are in play during Cycle One and/or Cycle Two for each alternative are indicated by a checkmark.)

Alternatives			Screened Measures Brought Forward												
			NA-1	P-2	P-4	P-5	P-6	P-10	P-11	P-12	P-14	P-15	P-16	D-1	D-2
No.	**Dredge Cycle**	**Description**	No Action	Open Water Placement	CAD Cell: ESN	CAD Cell: ESS	CAD Cell: FPRS	Beneficial Use: Filling PEB	Beneficial Use: Existing FPRN CAD Cell Filling and Capping	Beneficial Use: Prudence Island Disposal Site - Cap and Restore	Final capping of CAD cell constructed as part of DMMP	CAD cell as starter cell for next dredging cycle for placement of unsuitable material	Provide CAD Cell Space for Non-federal Needs	Dredge Providence FNP to Full Authorized Depths and Widths	Provide CAD Cell Space for Three Adjacent FNPs
1	Cycle One	No Action	✔												
	Cycle Two	No Action	✔												
2A	Cycle One	ESN CAD Cell with P-11 and P-12 BUs		✔	✔			✔	✔	✔	✔	✔	✔	✔	✔
	Cycle Two	ESS CAD Cell			✔ *	✔			✔		✔	✔	✔	✔	✔
2B	Cycle One	ESN CAD Cell with P-11 and P-12 BUs		✔	✔			✔	✔	✔	✔	✔	✔	✔	✔
	Cycle Two	FPRS CAD Cell			✔ *		✔		✔		✔	✔	✔	✔	✔
2C	Cycle One	ESN CAD Cell without P-11 and P-12 BUs		✔	✔						✔	✔	✔	✔	✔
	Cycle Two	ESS CAD Cell			✔ *	✔					✔	✔	✔	✔	✔
2D	Cycle One	ESN CAD Cell without P-11 and P-12 BUs		✔	✔						✔	✔	✔	✔	✔
	Cycle Two	FPRS CAD Cell			✔ *		✔				✔	✔	✔	✔	✔
3A	Cycle One	FPRS CAD Cell with P-11 and P-12 BUs		✔			✔	✔	✔	✔	✔	✔	✔	✔	✔
	Cycle Two	ESN CAD Cell			✔		✔ *		✔		✔	✔	✔	✔	✔
3B	Cycle One	FPRS CAD Cell with P-11 and P-12 BUs		✔			✔	✔	✔	✔	✔	✔	✔	✔	✔
	Cycle Two	ESS CAD Cell				✔	✔ *		✔		✔	✔	✔	✔	✔
3C	Cycle One	FPRS CAD Cell without P-11 and P-12 BUs		✔			✔				✔	✔	✔	✔	✔
	Cycle Two	ESN CAD Cell			✔		✔ *				✔	✔	✔	✔	✔
3D	Cycle One	FPRS CAD Cell without P-11 and P-12 BUs		✔			✔				✔	✔	✔	✔	✔
	Cycle Two	ESS CAD Cell				✔	✔ *				✔	✔	✔	✔	✔

* Cycle One CAD cell used as starter cell for Cycle Two CAD cell.

Table 5-7. The Dredging Volumes and the Capacity Requirements of the Three CAD Cells Being Considered in all Eight Action Alternatives.

Dredging Volumes of Unsuitable Materials Requiring Special Placement		
Providence River Complex Maintenance Dredging	**Volume Needed to be Dredged (Cubic Yards) (Note*1)**	
	Cycle One	**Cycle Two**
Total Providence FNP Shoaling expected to need to be dredged	2,014,689	1,900,000
Total Shallow-Draft FNPs	63,600	61,000
Starter Cell allowance for next cycle	38,000	150,000
State Allowance total	300,000	300,000
Total All Sources of dredged volume to place in CAD Cell over 20 years	2,416,289	2,411,000
Rounded (nearest 100,000)	2,400,000	2,400,000
Total Dredging Needs		**4,800,000**
Capacity Needs in CAD Cells	**Capacity Volume (Cubic Yards)**	
	Cycle One	**Cycle Two**
Total All Sources of dredged volume to be placed in placement facility over 20 years	2,416,289	2,411,000
15% Bulking Factor (during initial placement) (Note*2)	362,443	361,650
Total with Bulking (Capacity required in CAD cell for the 20-year period to be left open)	2,778,732	2,772,650
Rounded (nearest 100,000)	2,800,000	2,800,000
Capping requirements (typical, rounded up), at least 3 feet (rounded up to nearest 100,000) (Note*3)	300,000	300,000
Total Capacity needed (nearest 100,000) (Note*4)	3,100,000	3,100,000
Potential additional capacity generated over 20 years of settlement (Note *5)	200,000	200,000
Total placement capacity provided per cycle	3,300,000	3,300,000
Total Capacity Provided		**6,600,000**

Note*1: All dredging needs volumes are in-situ.
Note*2: Dredged materials typically expand by 15% during dredging and placement, requiring additional placement capacity.

Note*3: Capping requirements of at least 3 feet clean material covering at least 50 acres.

Note*4: Actual excavation required depends on original bathymetry and final depth required, as shown in Table 5-8.

Note*5: Based on 3,770 CY per acre for 50-acre CAD cell, per actual consolidation amounts at CAD cell 3AR in Fox Point Reach.

Table 5-8. Action Alternative Plans Showing Requirements for CAD Cell Construction. Excavation locations and volumes for CAD cell construction placement locations, dredging equipment drafts, and haul distances required.

Placement To → / Placement From ↓				Total Volume (Note*1)	Fox Point South Starter Cell - Fill and 3-foot Cap		Cycle-One CAD Cell - Fill as Starter Cell and 3-foot Cap		Port Edgewood Basin - Fill and 3-foot Cap		Fox Point Reach - North CAD – 3-foot Cap		Prudence Island Disposal Site – 3-foot Cap		Rhode Island Sound Disposal Site - Fill	
					25-foot draft equipment		8-foot draft equipment		8-foot draft equipment		25-foot draft equipment		25-foot draft equipment		25-foot draft equipment	
					Volume	Haul Dist. (Note*2)	Volume	Haul Dist. (Note*2)	Volume	Haul Dist. (Note*2)	Volume	Haul Dist. (Note*2)	Volume	Haul Dist. (Note*2)	Volume	Haul Dist. (Note*2)
				Cubic Yards	Cubic Yards	Miles	Cubic Yards	Miles	Cubic Yards	Miles	Cubic Yards	Miles	Cubic Yards	Miles	Cubic Yards	Miles
Alternative 2A	Cycle One	Edgewood Shoals North	Main Cell - Unsuitable	37,000	0	n/a			37,000	0.2	0	n/a	0	n/a	0	n/a
			Access Channel - All Suitable	246,000	0	n/a			0	n/a	0	n/a	0	n/a	246,000	40.2
			Main Cell - Suitable	2,929,000	0	n/a			352,000	0.2	113,000	2.5	1,825,000	17.2	639,000	40.5
			Total	**3,212,000**	**0**				**389,000**		**113,000**		**1,825,000**		**885,000**	
	Cycle Two	Edgewood Shoals South	Main Cell - Unsuitable	38,000	0	n/a	38,000	0.4	0	n/a	0	n/a	0	n/a	0	n/a
			Access Channel - All Suitable	95,000	0	n/a	0	n/a	0	n/a	0	n/a	0	n/a	95,000	39.4
			Main Cell - Suitable	2,824,000	0	n/a	300,000	0.4	0	n/a	128,000	3.2	0	n/a	2,696,000	39.6
			Total	**2,957,000**	**0**		**338,000**		0		**128,000**		**0**		**2,791,000**	
Alternative 2B	Cycle One	Edgewood Shoals North	Main Cell - Unsuitable	37,000	0	n/a			37,000	0.2	0	n/a	0	n/a	0	n/a
			Access Channel - All Suitable	246,000	0	n/a			0	n/a	0	n/a	0	n/a	246,000	40.2
			Main Cell - Suitable	2,929,000	0	n/a			352,000	0.2	113,000	2.5	1,825,000	17.2	639,000	40.5
			Total	**3,212,000**	**0**				**389,000**		**113,000**		**1,825,000**		**885,000**	
	Cycle Two	Fox Point Reach South	Starter Cell - Unsuitable	141,000	0	n/a	141,000	1.5	0	n/a	0	n/a	0	n/a	0	n/a
			Starter Cell - Suitable	437,000	0	n/a	300,000	1.5	0	n/a	0	n/a	0	n/a	137,000	41.7
			Main Cell - Unsuitable	447,000	447,000	0.2	0	n/a	0	n/a	0	n/a	0	n/a	0	n/a
			Main Cell - Suitable	2,578,000	57,000	0.2	0	n/a	0	n/a	128,000	1.1	0	n/a	2,393,000	41.5
			Total	**3,603,000**	**504,000**		**441,000**		**0**		**128,000**		**0**		**2,530,000**	

Note 1. Volumes are all unbulked (in-situ). **Note 2. Haul distances are all one-way.**

Placement To → / Placement From ↓				Total Volume (Note*1)	Fox Point South Starter Cell - Fill and 3-foot Cap		Cycle-One CAD Cell - Fill as Starter Cell and 3-foot Cap		Port Edgewood Basin - Fill and 3-foot Cap		Fox Point Reach - North CAD – 3-foot Cap		Prudence Island Disposal Site – 3-foot Cap		Rhode Island Sound Disposal Site - Fill	
					25-foot draft equipment		8-foot draft equipment		8-foot draft equipment		25-foot draft equipment		25-foot draft equipment		25-foot draft equipment	
					Volume	Haul Dist. (Note*2)	Volume	Haul Dist. (Note*2)	Volume	Haul Dist. (Note*2)	Volume	Haul Dist. (Note*2)	Volume	Haul Dist. (Note*2)	Volume	Haul Dist. (Note*2)
				Cubic Yards	Cubic Yards	Miles	Cubic Yards	Miles	Cubic Yards	Miles	Cubic Yards	Miles	Cubic Yards	Miles	Cubic Yards	Miles
Alternative 2C	Cycle One	Edgewood Shoals North	Main Cell - Unsuitable	37,000	0	n/a			37,000	0.2	0	n/a	0	n/a	0	n/a
			Access Channel - All Suitable	246,000	0	n/a			0	n/a	0	n/a	0	n/a	246,000	40.2
			Main Cell - Suitable	2,929,000	0	n/a			352,000	0.2	0	n/a	0	n/a	2,577,000	40.5
			Total	**3,212,000**	**0**				**389,000**		**0**		**0**		**2,823,000**	
	Cycle Two	Edgewood Shoals South	Main Cell - Unsuitable	38,000	0	n/a	38,000	0.4	0	n/a	0	n/a	0	n/a	0	n/a
			Access Channel - All Suitable	95,000	0	n/a	0	n/a	0	n/a	0	n/a	0	n/a	95,000	39.4
			Main Cell - Suitable	2,824,000	0	n/a	300,000	0.4	0	n/a	0	n/a	0	n/a	2,524,000	39.6
			Total	**2,957,000**	**0**		**338,000**		**0**		**0**		**0**		**2,619,000**	
Alternative 2D	Cycle One	Edgewood Shoals North	Main Cell - Unsuitable	37,000	0	n/a			37,000	0.2	0	n/a	0	n/a	0	n/a
			Access Channel - All Suitable	246,000	0	n/a			0	n/a	0	n/a	0	n/a	246,000	40.2
			Main Cell - Suitable	2,929,000	0	n/a			352,000	0.2	0	n/a	0	n/a	2,577,000	40.5
			Total	**3,212,000**	**0**				**389,000**		**0**		**0**		**2,823,000**	
	Cycle Two	Fox Point Reach South	Starter Cell - Unsuitable	141,000	0	n/a	141,000	1.5	0	n/a	0	n/a	0	n/a	0	n/a
			Starter Cell - Suitable	437,000	0	n/a	300,000	1.5	0	n/a	0	n/a	0	n/a	137,000	41.7
			Main Cell - Unsuitable	447,000	447,000	0.2	0	n/a	0	n/a	0	n/a	0	n/a	0	n/a
			Main Cell - Suitable	2,578,000	57,000	0.2	0	n/a	0	n/a	0	n/a	0	n/a	2,521,000	41.5
			Total	**3,603,000**	**504,000**		**441,000**		**0**		**0**		**0**		**2,658,000**	

Note 1. Volumes are all unbulked (in-situ). **Note 2. Haul distances are all one-way.**

Placement To → / Placement From ↓				Total Volume (Note*1)	Fox Point South Starter Cell - Fill and 3-foot Cap		Cycle-One CAD Cell - Fill as Starter Cell and 3-foot Cap		Port Edgewood Basin - Fill and 3-foot Cap		Fox Point Reach - North CAD – 3-foot Cap		Prudence Island Disposal Site – 3-foot Cap		Rhode Island Sound Disposal Site - Fill	
					25-foot draft equipment		8-foot draft equipment		8-foot draft equipment		25-foot draft equipment		25-foot draft equipment		25-foot draft equipment	
					Volume	Haul Dist. (Note*2)	Volume	Haul Dist. (Note*2)	Volume	Haul Dist. (Note*2)	Volume	Haul Dist. (Note*2)	Volume	Haul Dist. (Note*2)	Volume	Haul Dist. (Note*2)
				Cubic Yards	Cubic Yards	Miles	Cubic Yards	Miles	Cubic Yards	Miles	Cubic Yards	Miles	Cubic Yards	Miles	Cubic Yards	Miles
Alternative 3A	Cycle One	Fox Point Reach South	Starter Cell - Unsuitable	141,000	0	n/a			141,000	4.2	0	n/a	0	n/a	0	n/a
			Starter Cell - Suitable	437,000	0	n/a			0	n/a	0	n/a	0	n/a	437,000	41.7
			Main Cell - Unsuitable	447,000	447,000	0.2			0	n/a	0	n/a	0	n/a	0	n/a
			Main Cell - Suitable	2,578,000	57,000	0.2			248,000	4.2	113,000	1.1	1,825,000	18.2	335,000	41.5
			Total	**3,603,000**	**504,000**				**389,000**		**113,000**		**1,825,000**		**772,000**	
	Cycle Two	Edgewood Shoals North	Main Cell - Unsuitable	37,000	0	n/a	37,000	1.5	0	n/a	0	n/a	0	n/a	0	n/a
			Access Channel - All Suitable	246,000	0	n/a	0	n/a	0	n/a	0	n/a	0	n/a	246,000	40.2
			Main Cell - Suitable	2,929,000	0	n/a	300,000	1.5	0	n/a	128,000	2.5	0	n/a	2,801,000	40.5
			Total	**3,212,000**	**0**		**337,000**		**0**		**128,000**		**0**		**3,047,000**	
Alternative 3B	Cycle One	Fox Point Reach South	Starter Cell - Unsuitable	141,000	0	n/a			141,000	4.2	0	n/a	0	n/a	0	n/a
			Starter Cell - Suitable	437,000	0	n/a			0	n/a	0	n/a	0	n/a	437,000	41.7
			Main Cell - Unsuitable	447,000	447,000	0.2			0	n/a	0	n/a	0	n/a	0	n/a
			Main Cell - Suitable	2,578,000	57,000	0.2			248,000	4.2	113,000	1.1	1,825,000	18.2	335,000	41.5
			Total	**3,603,000**	**504,000**				**389,000**		**113,000**		**1,825,000**		**772,000**	
	Cycle Two	Edgewood Shoals South	Main Cell - Unsuitable	38,000	0	n/a	38,000	2.3	0	n/a	0	n/a	0	n/a	0	n/a
			Access Channel - All Suitable	95,000	0	n/a	0	n/a	0	n/a	0	n/a	0	n/a	95,000	39.4
			Main Cell - Suitable	2,824,000	0	n/a	300,000	2.3	0	n/a	128,000	3.2	0	n/a	2,696,000	39.6
			Total	**2,957,000**	**0**		**338,000**		**0**		**128,000**		**0**		**2,791,000**	

Note 1. Volumes are all unbulked (in-situ).

Note 2. Haul distances are all one-way.

Placement To → / Placement From ↓				Total Volume (Note*1)	Fox Point South Starter Cell - Fill and 3-foot Cap		Cycle-One CAD Cell - Fill as Starter Cell and 3-foot Cap		Port Edgewood Basin - Fill and 3-foot Cap		Fox Point Reach - North CAD – 3-foot Cap		Prudence Island Disposal Site – 3-foot Cap		Rhode Island Sound Disposal Site - Fill	
					25-foot draft equipment		8-foot draft equipment		8-foot draft equipment		25-foot draft equipment		25-foot draft equipment		25-foot draft equipment	
					Volume	Haul Dist. (Note*2)	Volume	Haul Dist. (Note*2)	Volume	Haul Dist. (Note*2)	Volume	Haul Dist. (Note*2)	Volume	Haul Dist. (Note*2)	Volume	Haul Dist. (Note*2)
				Cubic Yards	Cubic Yards	Miles	Cubic Yards	Miles	Cubic Yards	Miles	Cubic Yards	Miles	Cubic Yards	Miles	Cubic Yards	Miles
Alternative 3C	Cycle One	Fox Point Reach South	Starter Cell - Unsuitable	141,000	0	n/a			141,000	4.2	0	n/a	0	n/a	0	n/a
			Starter Cell - Suitable	437,000	0	n/a			0	n/a	0	n/a	0	n/a	437,000	41.7
			Main Cell - Unsuitable	447,000	447,000	0.2			0	n/a	0	n/a	0	n/a	0	n/a
			Main Cell - Suitable	2,578,000	57,000	0.2			248,000	4.2	0	n/a	0	n/a	2,273,000	41.5
			Total	**3,603,000**	**504,000**				**389,000**		**0**		**0**		**2,710,000**	
	Cycle Two	Edgewood Shoals North	Main Cell - Unsuitable	37,000	0	n/a	37,000	1.5	0	n/a	0	n/a	0	n/a	0	n/a
			Access Channel - All Suitable	246,000	0	n/a	0	n/a	0	n/a	0	n/a	0	n/a	246,000	40.2
			Main Cell - Suitable	2,929,000	0	n/a	300,000	1.5	0	n/a	0	n/a	0	n/a	2,929,000	40.5
			Total	**3,212,000**	**0**		**337,000**		**0**		**0**		**0**		**3,175,000**	
Alternative 3D	Cycle One	Fox Point Reach South	Starter Cell - Unsuitable	141,000	0	n/a			141,000	4.2	0	n/a	0	n/a	0	n/a
			Starter Cell - Suitable	437,000	0	n/a			0	n/a	0	n/a	0	n/a	437,000	41.7
			Main Cell - Unsuitable	447,000	447,000	0.2			0	n/a	0	n/a	0	n/a	0	n/a
			Main Cell - Suitable	**2,578,000**	57,000	0.2			248,000	4.2	0	n/a	0	n/a	2,273,000	41.5
			Total	**3,603,000**	**504,000**				**389,000**		**0**		**0**		**2,710,000**	
	Cycle Two	Edgewood Shoals South	Main Cell - Unsuitable	38,000	0	n/a	38,000	2.3	0	n/a	0	n/a	0	n/a	0	n/a
			Access Channel - All Suitable	95,000	0	n/a	0	n/a	0	n/a	0	n/a	0	n/a	95,000	39.4
			Main Cell - Suitable	2,824,000	0	n/a	300,000	2.3	0	n/a	0	n/a	0	n/a	2,824,000	39.6
			Total	**2,957,000**	**0**		**338,000**		**0**		**0**		**0**		**2,919,000**	

Note 1. Volumes are all unbulked (in-situ). **Note 2. Haul distances are all one-way.**

5.8. Description of Alternative Plans*

Eight action alternatives and the No-Action Alternative were brought forward for cost comparison in order to identify the federal Base Plan, as described in more detail in this section, and to select the recommended preferred plan for approval. All eight action alternatives fully address the dredging needs identified for the Providence FNP and surrounding areas over at least a 20-year period, through 2048. The dredging needs addressed include maintaining the Providence FNP to full authorized widths and depths, maintaining three adjacent shallow-draft FNPs, and addressing placement needs for sponsor-requested non-federal dredging. Quantities of dredged materials and potential placement capacity required during the two dredged material cycles are shown in Table 3-5 for Cycle-One and Table 3-6 for Cycle-Two and summarized in Table 5-7. All eight action alternatives require construction of two CAD cells, one in the year 2027 and the second during or before the year 2047, and each cell will be constructed in time for Providence FNP dredging and placement. The alternatives combine two of three CAD cells brought forward for alternative formulation. The CAD cell construction requirements, including excavation and placement locations, dredged material suitability, dredging equipment size, and haul distances, of the various CAD cell measures are shown in Table 5-8.

<u>Alternative 1 – No Action</u>

Under this alternative the federal government would do nothing to address the need for O&M dredging of the Providence FNP. Once all currently available confined placement locations are filled to capacity by local non-federal dredging operations, the non-federal dredging would decrease to the level of available placement space. Without dredging of the FNP and the decrease in local non-federal dredging, the navigation channel would continue to shoal-in and impede commercial navigation. The current rates of shoaling are estimated to continue, and the channel would continue to decrease in depth and width. Reduced channel depths and widths would result in light loading commercial navigation vessels, delays to traffic, and an overall negative economic impact. The capacity of the existing CAD cells is anticipated to be depleted by 2027 based on current management practices.

<u>Alternative 2A – Edgewood Shoals North CAD Cell with Supplemental Beneficial Uses (Cycle One – 2028) and Edgewood Shoals South CAD Cell (Cycle Two – 2048)</u>

<u>Alternative 2A Cycle-One</u> would involve the construction of the ESN CAD cell, including an access channel (Measure P-4) in the year 2027. The access channel would be 2,000 feet long, by 280 feet wide by 25 feet deep (MLLW). The ESN CAD cell would have a 51-acre footprint, be 60 feet deep (MLLW), and have the capacity to accommodate 2,400,000 CY of unbulked unsuitable dredged material (2,800,000 CY bulked) from a variety of sources, as follows:

- Capacity for 300,000 CY of unsuitable material for non-federal needs (Measure P-16)
- Capacity for 2,015,000 CY of unsuitable material to be dredged from the Providence FNP (Measure D-1)
- Capacity for 63,600 CY of unsuitable material to be dredged from the adjacent shallow-draft FNPs (Measure D-2)

- Capacity to function as a starter cell for 38,000 CY of unsuitable material (Measure P-15) from the Cycle-Two ESS CAD cell
- Capacity to be capped with three feet of clean material (300,000 CY) at the end of the life cycle, after 2048, to close out and restore the site (Measure P-14), as beneficial use.

In 2027, the construction would require excavation and placement of 3,212,000 CY of unconsolidated material (3,175,000 CY suitable, and 37,000 CY unsuitable), including excavation of a new access channel. Excavation and placement of materials to construct the ESN CAD cell and access channel would require the following activities in the year 2027:

- The access channel would be constructed first, requiring 246,000 CY of suitable material to be excavated and placed in RISDS (Measure P-2).
- The ESN CAD cell would be constructed requiring:
  - 37,000 CY of unsuitable material excavated and placed in PEB (Measure P-10)
  - 352,000 CY of suitable material to cap PEB (Measure P-10), as a beneficial use, which could be placed immediately on top of the relatively small amount of unsuitable material
  - 113,000 CY of suitable material to cap and close out five of the FPRN CAD cells with three feet of clean material (Measure P-11), as a beneficial use
  - 1,825,000 CY of suitable material to cap and environmentally restore the PIDS (Measure P-12), as a beneficial use
  - Remaining 639,000 CY of suitable material to be placed in RISDS (Measure P-2).

Following the ESN CAD cell construction, in the year 2028, the Providence FNP would be dredged to full authorized widths and depth (-40 feet MLLW) (Measure D-1). The Providence FNP dredging would involve dredging and placement of 2,015,000 CY of unsuitable material in the ESN CAD cell. The CAD cell would be about 88% filled and remain open through the year 2048 for placement of 300,000 CY of unsuitable material from non-federal local sources (Measure P-16), coordinated by RI CRMC, and 63,600 CY of unsuitable material dredged from the three adjacent FNPs (Measure D-2), coordinated by USACE. The ESN CAD cell would remain open into Cycle-Two, and then finally be capped, and closed out.

<u>Alternative 2A Cycle-Two</u> would involve the construction of the ESS CAD cell, including an access channel (Measure P-4) in the year 2047. The access channel would be 900 feet long, by 280 feet wide by 25 feet deep (MLLW). The ESS CAD cell would have a 51-acre footprint, be 60 feet deep (MLLW), and have capacity to accommodate 2,400,000 CY of unbulked unsuitable dredged material (2,800,000 CY bulked) from a variety of sources, as follows:

- Capacity for 300,000 CY of unsuitable material for non-federal needs (Measure P-16)
- Capacity for 1,900,000 CY of unsuitable material to be dredged from the Providence FNP (Measure D-1)
- Capacity for 61,000 CY of unsuitable material to be dredged from the adjacent shallow-draft FNPs (Measure D-2)
- Capacity to function as a starter cell for an assumed 150,000 CY of unsuitable material (Measure P-15) that could be excavated from construction of a possible future CAD cell
- Capacity to be capped with three feet of clean material (300,000 CY) at the end of the life cycle, after 2067, to close out and restore the site (Measure P-14), as beneficial use.

Then, in 2047, the construction would require excavation and placement of 2,957,000 CY of unconsolidated material (2,919,000 CY suitable, and 38,000 CY unsuitable), including excavation of a new access channel. Excavation and placement of materials to construct the ESS CAD cell and access channel would require the following activities in the year 2047:

- The access channel, constructed first, would require 95,000 CY of suitable material to be excavated and placed in RISDS (Measure P-2)
- Then the ESS CAD cell would be constructed requiring:
  - 38,000 CY of unsuitable material excavated and placed in Cycle-One ESN CAD cell (as a starter cell) (Measure P-15),
  - 300,000 CY of suitable material to cap Cycle-One ESN CAD cell (Measure P-14), as beneficial use
  - 128,000 CY of suitable material to cap and close out the two-remaining FPRN CAD cells (Measure P-11), as beneficial use
  - Remaining 2,696,000 CY of suitable material to be placed in RISDS (Measure P-2).

Following the ESS CAD cell construction, in the year 2048, the Providence FNP would be dredged to full authorized widths and depth (-40 feet MLLW) (Measure D-1), involving dredging and placement of 1,900,000 CY of unsuitable material in the ESS CAD cell. The CAD cell would be about 88% filled and remain open through the year 2067 for placement of 300,000 CY of unsuitable material from non-federal local sources (Measure P-16), coordinated by RI CRMC, and 61,000 CY of unsuitable material dredged from the three adjacent FNPs (Measure D-2), coordinated by USACE. The ESS CAD cell would then finally be capped, restored, and closed out during the beginning of a future dredge cycle.

Alternative 2B – Edgewood Shoals North CAD Cell with Supplemental Beneficial Uses (Cycle One – 2028) and Fox Point Reach South CAD Cell (Cycle Two – 2048)

Alternative 2B Cycle-One would involve the construction of the ESN CAD cell, including an access channel (Measure P-4) in the year 2027. The access channel would be 2,000 feet long, by 280 feet wide by 25 feet deep (MLLW). The ESN CAD cell would have a 51-acre footprint, be 60 feet deep (MLLW), and have capacity to accommodate 2,400,000 CY of unbulked unsuitable dredged material (2,800,000 CY bulked) from a variety of sources, as follows:

- Capacity for 300,000 CY of unsuitable material for non-federal needs (Measure P-16)
- Capacity for 2,015,000 CY of unsuitable material to be dredged from the Providence FNP (Measure D-1)
- Capacity for 63,600 CY of unsuitable material to be dredged from the adjacent shallow-draft FNPs (Measure D-2)
- Capacity to function as a starter cell for 141,000 CY of unsuitable material (Measure P-15) from the Cycle-Two FPRS CAD starter cell
- Capacity to be capped with three feet of clean material (300,000 CY) at the end of the life cycle, after 2047, to close out and restore the site (Measure P-14), as beneficial use.

Then, in 2027, the construction would require excavation and placement of 3,212,000 CY of unconsolidated material (3,175,000 CY suitable, and 37,000 CY unsuitable), including excavation of a new access channel. Excavation and placement of materials to construct the ESN CAD cell and access channel would require the following activities in the year 2027:

- The access channel would be constructed first, requiring 246,000 CY of suitable material to be excavated and placed in RISDS (Measure P-2)
- Then the ESN CAD cell would be constructed requiring:
  - 37,000 CY of unsuitable material excavated and placed in PEB (Measure P-10)
  - 352,000 CY of suitable material to cap PEB (Measure P-10), as a beneficial use, which could be placed immediately on top of the relatively small amount of unsuitable material
  - 113,000 CY of suitable material to cap and close out five of the FPRN CAD cells with three feet of clean material (Measure P-11), as a beneficial use
  - 1,825,000 CY of suitable material to cap and environmentally restore the PIDS (Measure P-12), as a beneficial use
  - Remaining 639,000 CY of suitable material to be placed in RISDS (Measure P-2).

Following the ESN CAD cell construction, in the year 2028, the Providence FNP would be dredged to full authorized widths and depth (-40 feet MLLW) (Measure D-1). The Providence FNP dredging would involve dredging and placement of 2,015,000 CY of unsuitable material in the ESN CAD cell. The CAD cell would be about 88% filled and remain open through the year 2047 for placement of 300,000 CY of unsuitable material from non-federal local sources (Measure P-16), coordinated by RI CRMC, and 63,600 CY of unsuitable material dredged from the three adjacent FNPs (Measure D-2), coordinated by USACE. The ESN CAD cell would remain open into Cycle Two, and then finally be capped, restored, and closed out.

Alternative 2B Cycle-Two would involve the construction of the FPRS CAD cell, including a starter cell immediately north of the main CAD cell (Measure P-6) in the year 2027. The starter cell would have a 12-acre footprint. Both cells would be dredged at 1V:3H slopes to an elevation of -90 ft MLLW. The main CAD cell would have a 49-acre footprint and capacity to accommodate 2,400,000 CY of unbulked unsuitable dredged material (2,800,000 CY bulked) from a variety of sources, as follows:

- Capacity for 300,000 CY of unsuitable material for non-federal needs (Measure P-16)
- Capacity for 1,900,000 CY of unsuitable material to be dredged from the Providence FNP (Measure D-1)
- Capacity for 61,000 CY of unsuitable material to be dredged from the adjacent shallow-draft FNPs (Measure D-2)
- Capacity to function as a starter cell for an assumed 150,000 CY of unsuitable material (Measure P-15) that could be excavated from construction of a possible future CAD cell
- Capacity to be capped with three feet of clean material (300,000 CY) at the end of the life cycle, after 2047, to close out and restore the site (Measure P-14), as beneficial use.

This FPRS CAD cell construction would first require a total excavation and placement of 3,603,000 CY of material, including 588,000 CY of unsuitable material and 3,015,000 CY of suitable material, per the following activities in the year 2027:

- The starter cell would involve excavation and placement of 141,000 CY of unsuitable material placed in the Cycle-One ESN CAD cell (as a starter cell) (Measure P-15), 300,000 CY of suitable material placed in the ESN CAD cell for final capping (Measure P-14), as beneficial use, and 137,000 of suitable material to be placed in RISDS (Measure P-2)

- Then, the main CAD cell would be constructed requiring:
  - 447,000 CY of unsuitable material placed in Cycle-Two FPRS CAD starter cell
  - 57,000 CY of suitable material to cap Cycle-Two FPRS CAD starter cell
  - 128,000 CY of suitable material to cap and close out the two-remaining open FPRN CAD cells (Measure P-11), as beneficial use
  - Remaining 2,393,000 CY of suitable material to be placed in RISDS (Measure P-2).

Following the FPRS CAD cell construction, in the year 2048, the Providence FNP would be dredged to full authorized widths and depth (-40 feet MLLW) (Measure D-1), involving dredging and placement of 1,900,000 CY of unsuitable material in the FPRS CAD cell. The CAD cell would be about 88% filled and remain open through the year 2067 for placement of 300,000 CY of unsuitable material from non-federal local sources (Measure P-16), coordinated by RI CRMC, and 61,000 CY of unsuitable material dredged from the three adjacent FNPs (Measure D-2), coordinated by USACE. The FPRS CAD cell would then finally be capped, restored, and closed out during the beginning of a future dredge cycle.

Alternative 2C - Edgewood Shoals North CAD Cell without Supplemental Beneficial Uses (Cycle One – 2028) and Edgewood Shoals South CAD Cell (Cycle Two – 2048)

Alternative 2C Cycle-One would involve the construction of the ESN CAD cell, including an access channel (Measure P-4) in the year 2027. The access channel would be 2,000 feet long, by 280 feet wide by 25 feet deep (MLLW). The CAD cell would have a 51-acre footprint, be 60 feet deep (MLLW), and have capacity to accommodate 2,400,000 CY of unbulked unsuitable dredged material (2,800,000 CY bulked) from a variety of sources, as follows:

- Capacity for 300,000 CY of unsuitable material for non-federal needs (Measure P-16)
- Capacity for 2,015,000 CY of unsuitable material to be dredged from the Providence FNP (Measure D-1)
- Capacity for 63,600 CY of unsuitable material to be dredged from the adjacent shallow-draft FNPs (Measure D-2)
- Capacity to function as a starter cell for 38,000 CY of unsuitable material (Measure P-15) from the Cycle-Two ESS CAD cell
- Capacity to be capped with three feet of clean material (300,000 CY) at the end of the life cycle, after 2047, to close out and restore the site (Measure P-14), as beneficial use.

In 2027, the construction would require excavation and placement of 3,212,000 CY of unconsolidated material (3,175,000 CY suitable, and 37,000 CY unsuitable), including excavation of a new access channel. Excavation and placement of materials to construct the ESN CAD cell and access channel would require the following activities in the year 2027:

- The access channel would be constructed first, requiring 246,000 CY of suitable material to be excavated and placed in RISDS (Measure P-2)
- Then the ESN CAD cell would be constructed requiring:
  - 37,000 CY of unsuitable material excavated and placed in PEB (Measure P-10)
  - 352,000 CY of suitable material to cap PEB (Measure P-10), as beneficial use, which could be placed immediately on top of the relatively small amount of unsuitable material
  - Remaining 2,577,000 CY of suitable material to be placed in RISDS (Measure P-2).

Following the ESN CAD cell construction, in the year 2028, the Providence FNP would be dredged to full authorized widths and depth (-40 feet MLLW) (Measure D-1). The Providence FNP dredging would involve dredging and placement of 2,015,000 CY of unsuitable material in the ESN CAD cell. The CAD cell would be about 88% filled and remain open through the year 2047 for placement of 300,000 CY of unsuitable material from non-federal local sources (Measure P-16), coordinated by RI CRMC, and 63,600 CY of unsuitable material dredged from the three adjacent FNPs (Measure D-2), coordinated by USACE. The ESN CAD cell would remain open into Cycle-Two, and then finally be capped, restored, and closed out.

Alternative 2C Cycle-Two would involve the construction of the ESS CAD cell, including an access channel (Measure P-4) in the year 2047. The access channel would be 900 feet long, by 280 feet wide by 25 feet deep (MLLW). The ESS CAD cell would have a 51-acre footprint, be 60 feet deep (MLLW), and have capacity to accommodate 2,400,000 CY of unbulked unsuitable dredged material (2,800,000 CY bulked) from a variety of sources, as follows:

- Capacity for 300,000 CY of unsuitable material for non-federal needs (Measure P-16)
- Capacity for 1,900,000 CY of unsuitable material to be dredged from the Providence FNP (Measure D-1)
- Capacity for 61,000 CY of unsuitable material to be dredged from the adjacent shallow-draft FNPs (Measure D-2)
- Capacity to function as a starter cell for an assumed 150,000 CY of unsuitable material (Measure P-15) that could be excavated from construction of a possible future CAD cell
- Capacity to be capped with three feet of clean material (300,000 CY) at the end of the life cycle, after 2067, to close out and restore the site (Measure P-14), as beneficial use.

In 2047, the construction would require excavation and placement of 2,957,000 CY of unconsolidated material (2,919,000 CY suitable, and 38,000 CY unsuitable), including excavation of a new access channel. Excavation and placement of materials to construct the CAD cell and access channel would require the following activities in the year 2047:

- The access channel, constructed first, would require 95,000 CY of suitable material to be excavated and placed in RISDS (Measure P-2)
- Then the ESS CAD cell would be constructed requiring:
  - 38,000 CY of unsuitable material excavated and placed in Cycle-One ESN CAD cell (as a starter cell) (Measure P-15)
  - 300,000 CY of suitable material to cap Cycle-One ESN CAD cell (Measure P-14), as beneficial use.
  - Remaining 2,524,000 CY of suitable material to be placed in RISDS (Measure P-2).

Following the ESS CAD cell construction, in the year 2048, the Providence FNP would be dredged to full authorized widths and depth (-40 feet MLLW) (Measure D-1), involving dredging and placement of 1,900,000 CY of unsuitable material in the ESS CAD cell. The CAD cell would be about 88% filled and remain open through the year 2067 for placement of 300,000 CY of unsuitable material from non-federal local sources (Measure P-16), coordinated by RI CRMC, and 61,000 CY of unsuitable material dredged from the three adjacent FNPs (Measure D-2), coordinated by USACE. The ESS CAD cell would then finally be capped, restored, and closed out during the beginning of a future dredge cycle.

Alternative 2D – Edgewood Shoals North CAD Cell without Supplemental Beneficial Uses (Cycle One – 2028) and Fox Point Reach South CAD Cell (Cycle Two – 2048)

Alternative 2D Cycle One would involve the construction of the ESN CAD cell, including an access channel (Measure P-4) in the year 2027. The access channel would be 2,000 feet long, by 280 feet wide by 25 feet deep (MLLW). The CAD cell would have a 51-acre footprint, be 60 feet deep (MLLW), and have capacity to accommodate 2,400,000 CY of unbulked unsuitable dredged material (2,800,000 CY bulked) from a variety of sources, as follows:

- Capacity for 300,000 CY of unsuitable material for non-federal needs (Measure P-16)
- Capacity for 2,015,000 CY of unsuitable material to be dredged from the Providence FNP (Measure D-1)
- Capacity for 63,600 CY of unsuitable material to be dredged from the adjacent shallow-draft FNPs (Measure D-2)
- Capacity to function as a starter cell for 141,000 CY of unsuitable material (Measure P-15) from the Cycle-Two FPRS CAD cell
- Capacity to be capped with three feet of clean material (300,000 CY) at the end of the life cycle, after 2047, to close out and restore the site (Measure P-14), as beneficial use..

In 2027, the construction would require excavation and placement of 3,212,000 CY of unconsolidated material (3,175,000 CY suitable, and 37,000 CY unsuitable), including excavation of a new access channel. Excavation and placement of materials to construct the CAD cell and access channel would require the following activities in the year 2027:

- The access channel would be constructed first, requiring 246,000 CY of suitable material to be excavated and placed in RISDS (Measure P-2)
- Then the ESN CAD cell would be constructed requiring:
  - 37,000 CY of unsuitable material excavated and placed in PEB (Measure P-10)
  - 352,000 CY of suitable material to cap PEB (Measure P-10), as beneficial use, which could be placed immediately on top of the relatively small amount of unsuitable material
  - Remaining 2,577,000 CY of suitable material to be placed in RISDS (Measure P-2).

Following the ESN CAD cell construction, in the year 2028, the Providence FNP would be dredged to full authorized widths and depth (-40 feet MLLW) (Measure D-1). The Providence FNP dredging would involve dredging and placement of 2,015,000 CY of unsuitable material in the ESN CAD cell. The CAD cell would be about 88% filled and remain open through the year 2048 for placement of 300,000 CY of unsuitable material from non-federal local sources (Measure P-16), coordinated by RI CRMC, and 63,600 CY of unsuitable material dredged from the three adjacent FNPs (Measure D-2), coordinated by USACE. The ESN CAD cell would remain open into Cycle-Two, and then finally be capped, restored, and closed out.

Alternative 2D Cycle Two would involve the construction of the FPRS CAD cell, including a starter cell immediately north of the main CAD cell (Measure P-6) in the year 2027. The starter cell would have a 12-acre footprint. The main CAD cell would have a 49-acre footprint and have capacity to accommodate 2,400,000 CY of unbulked unsuitable dredged material (2,800,000 CY bulked) from a variety of sources, as follows:

- Capacity for 300,000 CY of unsuitable material for non-federal needs (Measure P-16)

- Capacity for 1,900,000 CY of unsuitable material to be dredged from the Providence FNP (Measure D-1)
- Capacity for 61,000 CY of unsuitable material to be dredged from the adjacent shallow-draft FNPs (Measure D-2)
- Capacity to function as a starter cell for an assumed 150,000 CY of unsuitable material (Measure P-15) that could be excavated from construction of a possible future CAD cell
- Capacity to be capped with three feet of clean material (300,000 CY) at the end of the life cycle, after 2047, to close out and restore the site (Measure P-14), as beneficial use..

This FPRS CAD cell construction would first require a total excavation and placement of 3,603,000 CY of material, including 588,000 CY of unsuitable material and 3,015,000 CY of suitable material, per the following activities in the year 2027:

- The starter cell would involve excavation and placement of 141,000 CY of unsuitable material placed in the Cycle-One ESN CAD cell (as a starter cell) (Measure P-15), 300,000 CY of suitable material placed in the ESN CAD cell for final capping (Measure P-14), as beneficial use., and 137,000 of suitable material to be placed in RISDS (Measure P-2)
- Then, the main CAD cell would be constructed requiring:
  - 447,000 CY of unsuitable material placed in cycle-Two FPRS CAD starter cell
  - 57,000 CY of suitable material to cap cycle-Two FPRS CAD starter cell
  - Remaining 2,521,000 CY of suitable material to be placed in RISDS (Measure P-2).

Following the FPRS CAD cell construction, in the year 2048, the Providence FNP would be dredged to full authorized widths and depth (-40 feet MLLW) (Measure D-1), involving dredging and placement of 1,900,000 CY of unsuitable material in the FPRS CAD cell. The CAD cell would be about 88% filled and remain open through the year 2067 for placement of 300,000 CY of unsuitable material from non-federal local sources (Measure P-16), coordinated by RI CRMC, and 61,000 CY of unsuitable material dredged from the three adjacent FNPs (Measure D-2), coordinated by USACE. The FPRS CAD cell would then finally be capped, restored, and closed out during the beginning of a future dredge cycle.

Alternative 3A – Fox Point Reach South CAD Cell with Supplemental Beneficial Uses (Cycle One – 2028) and Edgewood Shoals North CAD Cell (Cycle Two – 2048)

Alternative 3A Cycle One would involve the construction of the FPRS CAD cell, including a starter cell immediately north of the main CAD cell (Measure P-6) in the year 2027. The starter cell would have a 12-acre footprint. The main CAD cell would have a 49-acre footprint and have capacity to accommodate 2,400,000 CY of unbulked unsuitable dredged material (2,800,000 CY bulked) from a variety of sources, as follows:

- Capacity for 300,000 CY of unsuitable material for non-federal needs (Measure P-16)
- Capacity for 2,015,000 CY of unsuitable material to be dredged from the Providence FNP (Measure D-1)
- Capacity for 63,600 CY of unsuitable material to be dredged from the adjacent shallow-draft FNPs (Measure D-2)
- Capacity to function as a starter cell for 37,000 CY of unsuitable material (Measure P-15) from the Cycle-Two ESN CAD cell

- Capacity to be capped with three feet of clean material (300,000 CY) at the end of the life cycle, after 2047, to close out and restore the site (Measure P-14), as beneficial use..

This FPRS CAD cell construction would first require a total excavation and placement of 3,603,000 CY of material, including 588,000 CY of unsuitable material and 3,015,000 CY of suitable material, per the following activities in the year 2027:

- The starter cell would involve excavation and placement of 141,000 CY of unsuitable material in PEB (Measure P-10), followed by 437,000 of suitable material placed in RISDS (Measure P-2)
- Then, the main CAD cell would be constructed requiring:
  - 447,000 CY of unsuitable material placed in cycle-Two FPRS CAD starter cell
  - 57,000 CY of suitable material to cap cycle-Two FPRS CAD starter cell (Measure P-14), as beneficial use
  - 113,000 CY of suitable material to cap and close out five of the FPRN CAD cells with three feet of clean material (Measure P-11), as a beneficial use
  - 1,825,000 CY of suitable material to cap and environmentally restore the PIDS (Measure P-12), as a beneficial use
  - 335,000 CY of suitable material to be placed in RISDS (Measure P-2).
  - Capping of PEB with 248,000 CY of suitable material (Measure P-10), as beneficial use

Following the FPRS CAD cell construction, in the year 2028, the Providence FNP would be dredged to full authorized widths and depth (-40 feet MLLW) (Measure D-1). The Providence FNP dredging would involve dredging and placement of 2,015,000 CY of unsuitable material in the FPRS CAD cell. The CAD cell would be about 88% filled and remain open through the year 2047 for placement of 300,000 CY of unsuitable material from non-federal local sources (Measure P-16), coordinated by RI CRMC, and 63,600 CY of unsuitable material dredged from the three adjacent FNPs (Measure D-2), coordinated by USACE. The FPRS CAD cell would remain open into Cycle Two, and then finally be capped, restored, and closed out.

Alternative 3A Cycle Two would involve the construction of the ESN CAD cell, including an access channel (Measure P-4) in the year 2047. The access channel would be 2,000 feet long, by 280 feet wide by 25 feet deep (MLLW). The CAD cell would have a 51-acre footprint, be 60 feet deep (MLLW), and have capacity to accommodate 2,400,000 CY of unbulked unsuitable dredged material (2,800,000 CY bulked) from a variety of sources, as follows:

- Capacity for 300,000 CY of unsuitable material for non-federal needs (Measure P-16)
- Capacity for 1,900,000 CY of unsuitable material to be dredged from the Providence FNP (Measure D-1)
- Capacity for 61,000 CY of unsuitable material to be dredged from the adjacent shallow-draft FNPs (Measure D-2)
- Capacity to function as a starter cell for an assumed 150,000 CY of unsuitable material (Measure P-15) that could be excavated from construction of a possible future CAD cell
- Capacity to be capped with three feet of clean material (300,000 CY) at the end of the life cycle, in year 2067, to close out and restore the site (Measure P-14), as beneficial use.

Then, in 2047, the construction would require excavation and placement of 3,212,000 CY of unconsolidated material (3,175,000 CY suitable, and 37,000 CY unsuitable), including excavation of a new access channel. Excavation and placement of materials to construct the CAD cell and access channel would require the following activities in the year 2047:

- The access channel, constructed first, would require 246,000 CY of suitable material to be excavated and placed in RISDS (Measure P-2).
- Then the ESN CAD cell would be constructed requiring:
  - 37,000 CY of unsuitable material excavated and placed in Cycle-One FPRS CAD cell (as a starter cell) (Measure P-15)
  - 300,000 CY of suitable material to cap Cycle-One FPRS CAD cell (Measure P-14), as beneficial use
  - 128,000 CY of suitable material to cap and close out the two-remaining FPRN CAD cells (Measure P-11), as beneficial use
  - Remaining 2,801,000 CY of suitable material to be placed in RISDS (Measure P-2).

Following the ESN CAD cell construction, in the year 2048, the Providence FNP would be dredged to full authorized widths and depth (-40 feet MLLW) (Measure D-1), involving dredging and placement of 1,900,000 CY of unsuitable material in the ESN CAD cell. The CAD cell would be about 88% filled and remain open through the year 2067 for placement of 300,000 CY of unsuitable material from non-federal local sources (Measure P-16), coordinated by RI CRMC, and 61,000 CY of unsuitable material dredged from the three adjacent FNPs (Measure D-2), coordinated by USACE. The ESN CAD cell would then finally be capped, restored, and closed out during the beginning of a future dredge cycle.

Alternative 3B – Fox Point Reach South CAD Cell with Supplemental Beneficial Uses (Cycle One – 2028) and Edgewood Shoals South CAD Cell (Cycle Two – 2048)

Alternative 3B Cycle One would involve the construction of the FPRS CAD cell, including a starter cell immediately north of the main CAD cell (Measure P-6) in the year 2027. The starter cell would have a 12-acre footprint. The main CAD cell would have a 49-acre footprint, large enough capacity to accommodate 2,400,000 CY of unbulked unsuitable dredged material (2,800,000 CY bulked) from a variety of sources, as follows:

- Capacity for 300,000 CY of unsuitable material for non-federal needs (Measure P-16)
- Capacity for 2,015,000 CY of unsuitable material to be dredged from the Providence FNP (Measure D-1)
- Capacity for 63,600 CY of unsuitable material to be dredged from the adjacent shallow-draft FNPs (Measure D-2)
- Capacity to function as a starter cell for 38,000 CY of unsuitable material (Measure P-15) from the Cycle-Two ESS CAD cell
- Capacity to be capped with three feet of clean material (300,000 CY) at the end of the life cycle, after 2047, to close out and restore the site (Measure P-14), as beneficial use.

This FPRS CAD cell construction would first require a total excavation and placement of 3,603,000 CY of material, including 588,000 CY of unsuitable material and 3,015,000 CY of suitable material, per the following activities in the year 2027:

- The starter cell would involve excavation and placement of 141,000 CY of unsuitable material in PEB (Measure P-10), followed by 437,000 of suitable material placed in RISDS (Measure P-2)

- Then, the main CAD cell would be constructed requiring:
    - 447,000 CY of unsuitable material placed in cycle-Two FPRS CAD starter cell
    - 57,000 CY of suitable material to cap cycle-Two FPRS CAD starter cell (Measure P-14), as beneficial use
    - 113,000 CY of suitable material to cap and close out five of the FPRN CAD cells with three feet of clean material (Measure P-11), as a beneficial use
    - 1,825,000 CY of suitable material to cap and environmentally restore the PIDS (Measure P-12), as a beneficial use
    - 335,000 CY of suitable material to be placed in RISDS (Measure P-2)
    - Capping of PEB with 248,000 CY of suitable material (Measure P-10), as beneficial use.

Following the FPRS CAD cell construction, in the year 2028, the Providence FNP would be dredged to full authorized widths and depth (-40 feet MLLW) (Measure D-1). The Providence FNP dredging would involve dredging and placement of 2,015,000 CY of unsuitable material in the FPRS CAD cell. The CAD cell would be about 88% filled and remain open through the year 2047 for placement of 300,000 CY of unsuitable material from non-federal local sources (Measure P-16), coordinated by RI CRMC, and 63,600 CY of unsuitable material dredged from the three adjacent FNPs (Measure D-2), coordinated by USACE. The FPRS CAD cell would remain open into Cycle-Two, and then finally be capped, restored, and closed out.

Alternative 3B Cycle Two would involve the construction of the ESS CAD cell, including an access channel (Measure P-4) in the year 2047. The access channel would be 900 feet long, by 280 feet wide by 25 feet deep (MLLW). The CAD cell would have a 51-acre footprint, be 60 feet deep (MLLW), and have capacity to accommodate 2,400,000 CY of unbulked unsuitable dredged material (2,800,000 CY bulked) from a variety of sources, as follows:

- Capacity for 300,000 CY of unsuitable material for non-federal needs (Measure P-16)
- Capacity for 1,900,000 CY of unsuitable material to be dredged from the Providence FNP (Measure D-1)
- Capacity for 61,000 CY of unsuitable material to be dredged from the adjacent shallow-draft FNPs (Measure D-2)
- Capacity to function as a starter cell for an assumed 150,000 CY of unsuitable material (Measure P-15) that could be excavated from construction of a possible future CAD cell
- Capacity to be capped with three feet of clean material (300,000 CY) at the end of the life cycle, in year 2067, to close out and restore the site (Measure P-14), as beneficial use.

In 2047, the construction would require excavation and placement of 2,957,000 CY of unconsolidated material (2,919,000 CY suitable, and 38,000 CY unsuitable), including excavation of a new access channel. Excavation and placement of materials to construct the CAD cell and access channel would require the following activities in the year 2047:

- The access channel, constructed first, would require 95,000 CY of suitable material to be excavated and placed in RISDS (Measure P-2).
- Then the ESS CAD cell would be constructed requiring:
    - 38,000 CY of unsuitable material excavated and placed in Cycle-One FPRS CAD cell (as a starter cell) (Measure P-15)

- 300,000 CY of suitable material to cap Cycle-One FPRS CAD cell (Measure P-14), as beneficial use.
- 128,000 CY of suitable material to cap and close out the two-remaining FPRN CAD cells (Measure P-11), as beneficial use
- Remaining 2,696,000 CY of suitable material to be placed in RISDS (Measure P-2).

Following the ESS CAD cell construction, in the year 2048, the Providence FNP would be dredged to full authorized widths and depth (-40 feet MLLW) (Measure D-1), involving dredging and placement of 1,900,000 CY of unsuitable material in the ESS CAD cell. The CAD cell would be about 88% filled and remain open through the year 2067 for placement of 300,000 CY of unsuitable material from non-federal local sources (Measure P-16), coordinated by RI CRMC, and 61,000 CY of unsuitable material dredged from the three adjacent FNPs (Measure D-2), coordinated by USACE. The ESS CAD cell would then finally be capped, restored, and closed out during the beginning of a future dredge cycle.

<u>Alternative 3C – Fox Point Reach South CAD Cell without Supplemental Beneficial Uses (Cycle One – 2028) and Edgewood Shoals North CAD Cell (Cycle Two – 2048)</u>

<u>Alternative 3C Cycle One</u> would involve the construction of the FPRS CAD cell, including a starter cell immediately north of the main CAD cell (Measure P-6) in the year 2027. The starter cell would have a 12-acre footprint. The main CAD cell would have a 49-acre footprint, large enough capacity to accommodate 2,400,000 CY of unbulked unsuitable dredged material (2,800,000 CY bulked) from a variety of sources, as follows:

- Capacity for 300,000 CY of unsuitable material for non-federal needs (Measure P-16)
- Capacity for 2,015,000 CY of unsuitable material to be dredged from the Providence FNP (Measure D-1)
- Capacity for 63,600 CY of unsuitable material to be dredged from the adjacent shallow-draft FNPs (Measure D-2)
- Capacity to function as a starter cell for 37,000 CY of unsuitable material (Measure P-15) from the Cycle-Two ESN CAD cell
- Capacity to be capped with three feet of clean material (300,000 CY) at the end of the life cycle, after 2047, to close out and restore the site (Measure P-14), as beneficial use.

This FPRS CAD cell construction would first require a total excavation and placement of 3,603,000 CY of material, including 588,000 CY of unsuitable material and 3,015,000 CY of suitable material, per the following activities in the year 2027:

- The starter cell would involve excavation and placement of 141,000 CY of unsuitable material in PEB (Measure P-10), and 437,000 of suitable material placed in RISDS (Measure P-2).
- Then, the main CAD cell would be constructed requiring:
    - 447,000 CY of unsuitable material placed in Cycle-Two FPRS CAD starter cell
    - 57,000 CY of suitable material to cap Cycle-Two FPRS CAD starter cell
    - 2,273,000 CY of suitable material to be placed in RISDS (Measure P-2)
    - Followed by capping of PEB with 248,000 CY of suitable material (Measure P-10)

Following the FPRS CAD cell construction, in the year 2028, the Providence FNP would be dredged to full authorized widths and depth (-40 feet MLLW) (Measure D-1). The Providence

FNP dredging would involve dredging and placement of 2,015,000 CY of unsuitable material in the FPRS CAD cell. The CAD cell would be about 88% filled and remain open through the year 2047 for placement of 300,000 CY of unsuitable material from non-federal local sources (Measure P-16), coordinated by RI CRMC, and 63,600 CY of unsuitable material dredged from the three adjacent FNPs (Measure D-2), coordinated by USACE. The FPRS CAD cell would remain open into Cycle Two, and then finally be capped, restored, and closed out.

Alternative 3C Cycle Two would involve the construction of the ESN CAD cell, including an access channel (Measure P-4) in the year 2047. The access channel would be 2,000 feet long, by 280 feet wide by 25 feet deep (MLLW). The CAD cell would have a 51-acre footprint, be 60 feet deep (MLLW), and have capacity to accommodate 2,400,000 CY of unbulked unsuitable dredged material (2,800,000 CY bulked) from a variety of sources, as follows:

- Capacity for 300,000 CY of unsuitable material for non-federal needs (Measure P-16)
- Capacity for 1,900,000 CY of unsuitable material to be dredged from the Providence FNP (Measure D-1)
- Capacity for 61,000 CY of unsuitable material to be dredged from the adjacent shallow-draft FNPs (Measure D-2)
- Capacity to function as a starter cell for an assumed 150,000 CY of unsuitable material (Measure P-15) that could be excavated from construction of a possible future CAD cell
- Capacity to be capped with three feet of clean material (300,000 CY) at the end of the life cycle, in year 2067, to close out and restore the site (Measure P-14), as beneficial use.

In 2047, the construction would require excavation and placement of 3,212,000 CY of unconsolidated material (3,175,000 CY suitable, and 37,000 CY unsuitable), including excavation of a new access channel. Excavation and placement of materials to construct the CAD cell and access channel would require the following activities in the year 2047:

- The access channel, constructed first, would require 246,000 CY of suitable material to be excavated and placed in RISDS (Measure P-2).
- Then the ESN CAD cell would be constructed requiring:
  - 37,000 CY of unsuitable material excavated and placed in Cycle-One FPRS CAD cell (as a starter cell) (Measure P-15)
  - 300,000 CY of suitable material to cap Cycle-One FPRS CAD cell (Measure P-14), as beneficial use.
  - Remaining 2,929,000 CY of suitable material to be placed in RISDS (Measure P-2).

Following the ESN CAD cell construction, in the year 2048, the Providence FNP would be dredged to full authorized widths and depth (-40 feet MLLW) (Measure D-1), involving dredging and placement of 1,900,000 CY of unsuitable material in the ESN CAD cell. The CAD cell would be about 88% filled and remain open through the year 2067 for placement of 300,000 CY of unsuitable material from non-federal local sources (Measure P-16), coordinated by RI CRMC, and 61,000 CY of unsuitable material dredged from the three adjacent FNPs (Measure D-2), coordinated by USACE. The ESN CAD cell would then finally be capped, restored, and closed out during the beginning of a future dredge cycle.

Alternative 3D – Fox Point Reach South CAD Cell without Supplemental Beneficial Uses (Cycle One – 2028) and Edgewood Shoals South CAD Cell (Cycle Two – 2048)

Alternative 3D Cycle One would involve the construction of the FPRS CAD cell, including a starter cell immediately north of the main CAD cell (Measure P-6) in the year 2027. The starter cell would have a 12-acre footprint. The main CAD cell would have a 49-acre footprint, large enough capacity to accommodate 2,400,000 CY of unbulked unsuitable dredged material (2,800,000 CY bulked) from a variety of sources, as follows:

- Capacity for 300,000 CY of unsuitable material for non-federal needs (Measure P-16)
- Capacity for 2,015,000 CY of unsuitable material to be dredged from the Providence FNP (Measure D-1)
- Capacity for 63,600 CY of unsuitable material to be dredged from the adjacent shallow-draft FNPs (Measure D-2)
- Capacity to function as a starter cell for 38,000 CY of unsuitable material (Measure P-15) from the Cycle-Two ESS CAD cell
- Capacity to be capped with three feet of clean material (300,000 CY) at the end of the life cycle, after 2047, to close out and restore the site (Measure P-14), as beneficial use.

This FPRS CAD cell construction would first require a total excavation and placement of 3,603,000 CY of material, including 588,000 CY of unsuitable material and 3,015,000 CY of suitable material, per the following activities in the year 2027:

- The starter cell would involve excavation and placement of 141,000 CY of unsuitable material in PEB (Measure P-10), and 437,000 of suitable material placed in RISDS (Measure P-2).
- Then, the main CAD cell would be constructed requiring:
  - 447,000 CY of unsuitable material placed in Cycle-Two FPRS CAD starter cell
  - 57,000 CY of suitable material to cap Cycle-Two FPRS CAD starter cell
  - 2,273,000 CY of suitable material to be placed in RISDS (Measure P-2)
  - Followed by capping of PEB with 248,000 CY of suitable material (Measure P-10), as beneficial use

Following the FPRS CAD cell construction, in the year 2028, the Providence FNP would be dredged to full authorized widths and depth (-40 feet MLLW) (Measure D-1). The Providence FNP dredging would involve dredging and placement of 2,015,000 CY of unsuitable material in the FPRS CAD cell. The CAD cell would be about 88% filled and remain open through the year 2047 for placement of 300,000 CY of unsuitable material from non-federal local sources (Measure P-16), coordinated by RI CRMC, and 63,600 CY of unsuitable material dredged from the three adjacent FNPs (Measure D-2), coordinated by USACE. The FPRS CAD cell would remain open into Cycle-Two, and then finally be capped, restored, and closed out.

Alternative 3D Cycle Two would involve the construction of the ESS CAD cell, including an access channel (Measure P-4) in the year 2047. The access channel would be 900 feet long, by 280 feet wide by 25 feet deep (MLLW). The CAD cell would have a 51-acre footprint, be 60 feet deep (MLLW), and have capacity to accommodate 2,400,000 CY of unbulked unsuitable dredged material (2,800,000 CY bulked) from a variety of sources, as follows:

- Capacity for 300,000 CY of unsuitable material for non-federal needs (Measure P-16)

- Capacity for 1,900,000 CY of unsuitable material to be dredged from the Providence FNP (Measure D-1)
- Capacity for 61,000 CY of unsuitable material to be dredged from the adjacent shallow-draft FNPs (Measure D-2)
- Capacity to function as a starter cell for an assumed 150,000 CY of unsuitable material (Measure P-15) that could be excavated from construction of a possible future CAD cell
- Capacity to be capped with three feet of clean material (300,000 CY) at the end of the life cycle, in year 2067, to close out and restore the site (Measure P-14), as beneficial use.

In 2047, the construction would require excavation and placement of 2,957,000 CY of unconsolidated material (2,919,000 CY suitable, and 38,000 CY unsuitable), including excavation of a new access channel. Excavation and placement of materials to construct the CAD cell and access channel would require the following activities in the year 2047:

- The access channel, constructed first, would require 95,000 CY of suitable material to be excavated and placed in RISDS (Measure P-2).
- Then the ESS CAD cell would be constructed requiring:
    - 38,000 CY of unsuitable material excavated and placed in Cycle-One FPRS CAD cell (as a starter cell) (Measure P-15)
    - 300,000 CY of suitable material to cap Cycle-One FPRS CAD cell (Measure P-14), as beneficial use
    - Remaining 2,824,000 CY of suitable material to be placed in RISDS (Measure P-2).

Following the ESS CAD cell construction, in the year 2048, the Providence FNP would be dredged to full authorized widths and depth (-40 feet MLLW) (Measure D-1), involving dredging and placement of 1,900,000 CY of unsuitable material in the ESS CAD cell. The CAD cell would be about 88% filled and remain open through the year 2067 for placement of 300,000 CY of unsuitable material from non-federal local sources (Measure P-16), coordinated by RI CRMC, and 61,000 CY of unsuitable material dredged from the three adjacent FNPs (Measure D-2), coordinated by USACE. The ESS CAD cell would then finally be capped, restored, and closed out during the beginning of a future dredge cycle.

6. Analysis and Comparison of Alternatives*

This Chapter evaluates costs for the final array of alternatives. It also includes consideration of USACE decision criteria to compare alternatives and select the federal Base Plan and then the recommended plan. In this Chapter, Steps 6 and 7 of the alternative development and selection process (described in Chapter 5) are addressed.

6.1. Costs of Alternatives

Cost estimates to implement (design and construct) each alternative are the basis of selecting the least-cost Base Plan, with and without supplemental beneficial uses, and then to select the preferred plan. Step 6 in the alternative development and selection process is assessing the implementation costs of the eight action alternatives and identifying the least cost plan to meet the federal need to maintain the FNPs through the planning period. The detailed cost estimates are shown in Appendix J, Design and Construction Cost Appendix. In order to develop reasonable implementation costs, the Study Team considered the risks and uncertainty associated with the ability to implement the alternatives and the accuracy of estimates in the feasibility-level dredge quantities, conceptual drawings, and construction quantities. The Study Team initially developed cost estimates for cost comparison of alternatives to a Class 4 level as defined in the USACE Civil Works Cost Engineering Regulations ER-1110-2-1302 (30-June-2016).

6.1.1. Risk and Uncertainty Identification

Risk-based analysis is defined as an approach to evaluate decision-making that explicitly, and to the extent practical, analytically incorporates considerations of risk and uncertainty (ER 1105-2-100, Chapter 2, Section 2-4(g)). USACE uses a process called cost and schedule risk analysis (CSRA) to systematically go through aspects of the project, as laid out in ER 1110-2-1302.

For the initial planning stages of alternative comparison and identification of a least-cost federal Base Plan, the Study Team followed the abbreviated risk analysis (ARA) method, as defined in ER-1100-2-1302 and further described in the USACE Cost and Schedule Risk Analysis Best Practices Handbook (2024). Using the ARA method, the Study Team identified and characterized various factors causing risk and uncertainty associated with developing the alternatives to determine the amount of contingency that must be added to the initial Class 4 level cost estimates to reduce the uncertainty to an acceptable level of cost confidence. Once the preferred plan was identified, the Study then further refined the cost estimate, to a Class 3 level cost estimate using a Cost and Schedule Risk Analysis for costing out the recommended plan for budgeting and cost-sharing purposes, as shown in Chapter 8.

The ARA report, showing the detailed risk assessment, is shown in Appendix J, Design and Construction Cost Appendix. The risks and uncertainties are summarized in Table 6-1, as follows.

Table 6-1. Abbreviated Risk Assessment Summary for Alternative formulation and Cost Comparisons.

Concern	How Addressed	Impact	Likelihood
Local Request Increase	Based on Non-Federal Sponsor Estimate, and extrapolation of former needs	Marginal	Possible
Shoal Rates underestimated	Shoal Rates were based on many years of past channel condition surveys and actual shoaling quantities. For long-term forecasting, the higher sediment rate averaged to account for past large-scale storm events, and accounting for possible large-scale events in the future. Additionally, consolidation of placed dredged material will allow for an additional 5 to 10% volume capacity for additional placed dredged material, which is additional volume to the sizing of the CAD cell.	Marginal	Possible
Over-dredging	Accounted for 100% of allowable overdepth, and the total of non-pay dredged volume plus allowable over depth dredged volume is not expected to be greater than the total allowable overdepth volume	Marginal	Possible
CAD cell constructability and BU sites capacity	Bathymetry and subsurface characterizations based on bathymetric surveys and an adequate number and distribution of cores and borings.	Marginal	Possible
Planning, Engineering, Design, and Construction Management Cost Increases	Possible to have changing environmental considerations, and currently unknown	Moderate	Possible
Acquisition Strategy - Unknown contracting plan and limited bidding	Possible and unknown	Moderate	Possible
Unsuitable material in Providence FNP	Sediment testing and suitability determination already performed for the Providence FNP - all unsuitable and expected worse case still all unsuitable in 20 years.	Marginal	Possible
Unsuitable material in CAD cells	Sediment testing and suitability determinations conducted on ESN and FPRS CAD cells; ESS CAD cell site similar condition to ESN, so similar conditions expected in 20 years.	Marginal	Possible
Cost Estimate Assumptions on equipment, crew, productivities	Impact considered a moderate risk	Moderate	Possible
External factors - increased costs to fuel and supplies and delays	External factors possible and moderate impacts expected	Moderate	Possible

Based on the results of the ARA, the Study Team identified the following cost contingencies, as shown in Table 6-2.

Table 6-2. Implementation Cost Contingencies Applied to Level-4 Cost Estimates of Alternative Plans, Based on ARA Results.

Feature of Work	Contingency Assigned (%)
Dredge Cycle One ESN CAD cell design and construction, including BUs	30%
Dredge Cycle One Providence FNP Dredging	30%
Dredge Cycle Two ESS CAD cell design and construction, including BUs	30%
Dredge Cycle Two Providence FNP Dredging	30%
Planning, Engineering, & Design (4% budgeted) (Both Dredge Cycles)	20%
Construction Management (2.5% budgeted) *(Both Dredge Cycles)	26%

6.1.2. Cost Estimates for Alternative Comparison and Selection of a Least-Cost Plan

The Study Team derived the implementation costs of each action alternative and then identified the proportionate cost for each alternative of providing federal navigation needs, excluding the proportionate cost to cover local needs. The proportionate federal-needs costs of the eight alternatives are then compared in order to select the least-cost alternative with BU and the least cost alternative without BU, in order to select the federal Base Plan (see Section 2.4). If the addition of beneficial uses is a cost savings (reduces the cost), then the least-cost alternative with beneficial uses becomes the Base Plan.

First, full implementation costs (all FNP needs plus local needs) were derived for each of five measure combinations that are the building blocks for each of the eight action alternatives, as shown in Table 6-3. Implementation costs were prepared for various alternative combinations and compiled in Total Project Cost Sheets, which are provided in Appendix I. Costs were estimated using a price level of 1-October-2024, and then first costs were escalated to 1-October-2025 to correspond with DMMP completion using the USACE Civil Works Construction Cost Index System. These first costs are used as the reference costs for comparing alternatives. The total costs are for construction of a placement facility that can hold all of the FNP dredged material placement requirements as well as the non-federal requests for local dredged materials, along with space for potential future starter cell use, as shown in Table 3-5 and Table 3-6, and space for a three-foot cap of clean material to close out the facility.

Then, the proportionate percentage of the costs were calculated using the proportionate volume needs of the FNP dredged material compared to the total dredged material placement needs. Based on volume estimates, the FNP dredged material needs are 88% of the total placement needs, as shown in Table 6-3. Therefore, the Study Team used this proportionate measurement of 88% to calculate the proportionate cost of the facility to address federal Base Plan needs. The proportionate costs are shown alongside the total costs in Table 6-3 for each measure combination.

Then, the proportionate costs of the five measure combinations were compiled into the eight action alternative combinations to show proportionate costs of each alternative, as shown in Table 6-4. All Costs shown are first costs, escalated to 01-October-2025. Costs are proportionate, in that they are for the federal need portion of proposed alternatives (proportionate costs of CAD cell construction, dredging, and placing the FNP materials without local needs).

Table 6-3. Total Implementation Costs of Alternative Plans, Along with Proportionate Costs of the Federal Navigation Project Placement Capacity Needs for Five Measure Combinations to be Used for Development of the Eight Action Alternatives.

First Cost - Combined Measures - with and without Local Capacity - for Cycle One and Cycle Two							
First Cost Date: 01-October-2025							
CAD Cell Volume (CY)			Measure Combination				
			ESN - With BU	FPRS - With BU	ESN - No BU	ESS - No BU	FPRS - No BU
			3,212,230	3,603,200	3,212,230	2,957,580	3,603,200
Total Capacity of Unbulked FNP Dredged Material (CY)			2,400,000	2,400,000	2,400,000	2,400,000	2,400,000
Capacity to be Used for Unbulked FNP Dredged Material (CY)			2,100,000	2,100,000	2,100,000	2,100,000	2,100,000
Percentage of Capacity for FNP Dredged Material Portion			88%	88%	88%	88%	88%
CAD Cell Construction	CAD-Design Resources	FNPs + Local Total Capacity	$1,701,000	$2,158,000	$2,092,000	$2,010,000	$2,509,000
		FNPs Proportionate Capacity	$1,488,375	$1,888,250	$1,830,500	$1,758,750	$2,195,375
	CAD-Shellfish Relocation (if needed)	FNPs + Local Total Capacity	$60,000	$60,000	$60,000	$60,000	$60,000
		FNPs Proportionate Capacity	$52,500	$52,500	$52,500	$52,500	$52,500
	Suitability Determination (if needed)	FNPs + Local Total Capacity	$350,000	$350,000	$350,000	$350,000	$350,000
		FNPs Proportionate Capacity	$306,250	$306,250	$306,250	$306,250	$306,250
	CAD-Construction	FNPs + Local Total Capacity	$60,098,000	$76,259,000	$73,939,000	$71,052,000	$88,662,000
		FNPs Proportionate Capacity	$52,585,750	$66,726,625	$64,696,625	$62,170,500	$77,579,250
	CAD-Construction Resources	FNPs + Local Total Capacity	$1,964,000	$2,492,000	$2,415,000	$2,321,000	$2,897,000
		FNPs Proportionate Capacity	$1,718,500	$2,180,500	$2,113,125	$2,030,875	$2,534,875
Providence FNP Dredging and Placement	O&M-Design Resources	FNPs Dredging and Placement	$738,000	$734,000	$738,000	$752,000	$734,000
	O&M-Construction	FNPs Dredging and Placement	$26,085,000	$25,883,000	$26,085,000	$26,514,000	$25,883,000
	O&M-Construction Resources	FNPs Dredging and Placement	$853,000	$846,000	$853,000	$866,000	$846,000

Table 6-4. Providence FNP - First Cost for Alternative Plans to Select Federal Base Plan (without local needs).

Providence FNP - First Cost for Alternative Plans to Select Federal Base Plan (without local needs)											
All Costs shown are first costs, escalated to 01-October-2025. Costs are proportionate, in that they are for the federal need portion of proposed alternatives (proportionate costs of CAD cell construction, dredging, and placing the FNP materials without local needs)											
Dredge Cycle			**Alternative 1**	**Alternative 2A**	**Alternative 2B**	**Alternative 2C**	**Alternative 2D**	**Alternative 3A**	**Alternative 3B**	**Alternative 3C**	**Alternative 3D**
Cycle One			No Action	ESN - With BU	ESN - With BU	ESN - No BU	ESN - No BU	FPRS - With BU	FPRS - With BU	FPRS - No BU	FPRS - No BU
Cycle Two			No Action	ESS - No BU	FPRS - No BU	ESS - No BU	FPRS - No BU	ESN - No BU	ESS - No BU	ESN - No BU	ESS - No BU
Cycle	**Activity**	**Activity Date**	Cost $	Cost $	Cost $	Cost $	Cost $	Cost $	Cost $	Cost $	Cost $
Cycle One	CAD-Design Resources	2026-Q3	$0	$1,488,375	$1,488,375	$1,830,500	$1,830,500	$1,888,250	$1,888,250	$2,195,375	$2,195,375
	CAD-Environmental	2026-Q3	$0	$52,500	$52,500	$52,500	$52,500	$52,500	$52,500	$52,500	$52,500
	Suitability Determination	2026-Q3	$0	$0	$0	$0	$0	$0	$0	$0	$0
	CAD-Construction	2027-Q4	$0	$52,585,750	$52,585,750	$64,696,625	$64,696,625	$66,726,625	$66,726,625	$77,579,250	$77,579,250
	CAD-Constr. Resources	2027-Q4	$0	$1,718,500	$1,718,500	$2,113,125	$2,113,125	$2,180,500	$2,180,500	$2,534,875	$2,534,875
	O&M-Design Resources	2026-Q3	$0	$738,000	$738,000	$738,000	$738,000	$734,000	$734,000	$734,000	$734,000
	O&M-Construction	2028-Q4	$0	$26,085,000	$26,085,000	$26,085,000	$26,085,000	$25,883,000	$25,883,000	$25,883,000	$25,883,000
	O&M-Constr. Resources	2028-Q4	$0	$853,000	$853,000	$853,000	$853,000	$846,000	$846,000	$846,000	$846,000
	Cycle One - Subtotal		**$0**	**$83,521,125**	**$83,521,125**	**$96,368,750**	**$96,368,750**	**$98,310,875**	**$98,310,875**	**$109,825,000**	**$109,825,000**
Cycle Two	CAD-Design Resources	2046-Q3	$0	$1,758,750	$2,195,375	$1,758,750	$2,195,375	$1,830,500	$1,758,750	$1,830,500	$1,758,750
	CAD-Environmental	2046-Q3	$0	$52,500	$0	$52,500	$0	$52,500	$52,500	$52,500	$52,500
	Suitability Determination	2046-Q3	$0	$306,250	$306,250	$306,250	$306,250	$306,250	$306,250	$306,250	$306,250
	CAD-Construction	2047-Q4	$0	$62,170,500	$77,579,250	$62,170,500	$77,579,250	$64,696,625	$62,170,500	$64,696,625	$62,170,500
	CAD-Constr. Resources	2047-Q4	$0	$2,030,875	$2,534,875	$2,030,875	$2,534,875	$2,113,125	$2,030,875	$2,113,125	$2,030,875
	O&M-Design Resources	2046-Q3	$0	$752,000	$734,000	$752,000	$734,000	$738,000	$752,000	$738,000	$752,000
	O&M-Construction	2048-Q4	$0	$26,514,000	$25,883,000	$26,514,000	$25,883,000	$26,085,000	$26,514,000	$26,085,000	$26,514,000
	O&M-Constr. Resources	2048-Q4	$0	$866,000	$846,000	$866,000	$846,000	$853,000	$866,000	$853,000	$866,000
	Cycle Two - Subtotal		**$0**	**$94,450,875**	**$110,078,750**	**$94,450,875**	**$110,078,750**	**$96,675,000**	**$94,450,875**	**$96,675,000**	**$94,450,875**
FPN Needs - Total First Cost			$0	**$177,972,000**	**$193,599,875**	**$190,819,625**	**$206,447,500**	**$194,985,875**	**$192,761,750**	**$206,500,000**	**$204,275,875**

6.2. Cost Comparison of Alternative Plans and Selection of the Base Plan

The federal Base Plan is the least cost plan that fully meets the federal needs.. Since all of the action alternatives were screened to already meet the effectiveness and acceptability and criteria, as well as the completeness criterion, the next step is to address the efficiency criterion by costing out and selecting the least-cost plans - with and without beneficial uses to fully maintain the FNPs. In order to determine the least cost plans, the proportionate implementation costs of the alternatives, as shown in Table 6-3, were then annualized and compared. The proportionate first costs and annualized costs for each of the alternative plans to select federal Base Plan (without local needs) are compared in Table 6-5. Refer to Appendix K: Annual Average Cost of Design and Construction by Alternative for additional detail.

Table 6-5. Screening of Alternatives Annualized Cost by Least Cost to Select the Federal Base Plan (without local needs).

Alternative	Supplemental Beneficial Uses	Cycle One (Year 2028)		Cycle Two (Year 2048)		Total FNP First Cost ($)	Total FNP Annualized Cost ($)	Notes
		Measures	FNP First Cost ($)	Measures	FNP First Cost ($)			
1	No	No Action	$0	No Action	$0	$0	$0	
2A	Yes	ESN - With BUs	$83,521,125	ESS – No BUs	$94,450,875	$177,972,000	$4,934,887	Least Cost with BUs
2B	Yes	ESN - With BUs	$83,521,125	FPRS - No BUs	$110,078,750	$193,599,875	$5,252,484	
3A	Yes	FPRS - With BUs	$98,310,875	ESN – No BUs	$96,675,000	$194,985,875	$5,522,769	
3B	Yes	FPRS - With BUs	$98,310,875	ESS – No BUs	$94,450,875	$192,761,750	$5,477,360	
2C	No	ESN – No BUs	$96,368,750	ESS – No BUs	$94,450,875	$190,819,625	$5,405,929	Least Cost without BUs
2D	No	ESN – No BUs	$96,368,750	FPRS - No BUs	$110,078,750	$206,447,500	$5,723,526	
3C	No	FPRS – No BUs	$109,825,000	ESN – No BUs	$96,675,000	$206,500,000	$5,944,921	
3D	No	FPRS – No BUs	$109,825,000	ESS – No BUs	$94,450,875	$204,275,875	$5,899,511	
Note: Costs estimated for the proportionate dredging and placement needs for the federal dredging needs only. First Cost set at 1-October-2025. Annualized Cost calculated from future financial costs discounted to First Cost date.								

Costs shown in Table 6-5 are estimated for the proportionate dredging and placement needs for the federal dredging needs only. The first costs are set at 1-October-2025. The annualized costs are calculated from future financial costs discounted to first cost date.

The results of the screening by least-cost show that Alternative 2A has the least-cost for the federal proportionate share of implementation with BU measures, in the amount of $4,934,887 annualized cost, and Alternative 2C has the least-cost for federal proportionate share of implementation without BU measures, in the amount of $5,405,929 annualized cost. Since the plan with BU (Alternative 2A) is less costly, with a reduction in the total FNP Annualized Cost of $471,052, and a total FNP first cost reduction of $12,847,625, then the beneficial-use component is not separated out for cost sharing purposes (as explained in Section 5.4, Beneficial Uses of Dredged Material).This is consistent with ER 1105-2-100 Appendix E-15, which details that if the addition of BU measures reduces the cost of the least-cost alternative, then the BU measures can be incorporated in the federal Base Plan and cost-shared under operations and maintenance requirements of FNPs. Therefore, Alternative 2A is selected as the federal Base Plan.

6.3. Selection of a Preferred Plan

The final step, Step 7, is addressing the local needs component of the study by adding the placement capacity for identified local needs to the federal Base Plan to finalize the preferred plan and to define the total capacity needs of the placement facilities. The array of alternatives and how they address the four DMMP criteria, including the local dredging placement request, is shown in Table 6-6. As shown in the table, the only alternative that fully meets all criteria, including the least-cost plan, is Alternative 2A with the added placement needs to address local requests. The proportionate cost of the added capacity for local needs is added back to the federal Base Plan cost to derive the total cost of the preferred plan. Since the BU additions resulted in cost-saving measures, then the preferred plan includes the BU measures, along with fully addressing FNP placement capacity needs and local needs, and the total recommend plan cost is cost-shared as required by 33 U.S.C. § 2211 and Section 101 of WRDA 1986, as amended, and is detailed in ER 1105-2-100.

The description of the Preferred Plan (Alternative 2A) is summarized in Section 5.8. The environmental consequences of the Preferred Plan compared to those of the No-Action Alternative are addressed in Chapter 7. The detailed description of the Preferred Plan, along with detailed implementation costs and schedule, cost-sharing, and real estate requirements, are described in Chapter 8.

Table 6-6. Final Comparison of Alternatives for Meeting the Study Objectives. Alternative 2A fully meets all of the four objectives.

Alternatives			Objective 1			Objective 2	Objective 3	Objective 4
No.	**Dredge Cycle**	**Description**	**Least Cost**	**Technically Feasible**	**Environmentally Acceptable**	**Additional FNPs**	**Beneficial Uses**	**Local Needs can be Accommodated**
1	Cycle One	No Action	NO	NO	NO	NO	NO	NO
	Cycle Two	No Action						
2A	Cycle One	ESN CAD Cell with P-11 and P-12 BUs	YES	YES	YES	YES	YES	YES
	Cycle Two	ESS CAD Cell						
2B	Cycle One	ESN CAD ell with P-11 and P-12 BUs	NO	YES	YES	YES	YES	YES
	Cycle Two	FPRS CAD Cell						
2C	Cycle One	ESN CAD Cell without P-11 and P-12 BUs	NO	YES	YES	YES	NO	YES
	Cycle Two	ESS CAD Cell						
2D	Cycle One	ESN CAD Cell without P-11 and P-12 BUs	NO	YES	YES	YES	NO	YES
	Cycle Two	FPRS CAD Cell						
3A	Cycle One	FPRS CAD Cell with P-11 and P-12 BUs	NO	YES	YES	YES	YES	YES
	Cycle Two	ESN CAD Cell						
3B	Cycle One	FPRS CAD Cell with P-11 and P-12 BUs	NO	YES	YES	YES	YES	YES
	Cycle Two	ESS CAD Cell						
3C	Cycle One	FPRS CAD Cell without P-11 and P-12 BUs	NO	YES	YES	YES	NO	YES
	Cycle Two	ESN CAD Cell						
3D	Cycle One	FPRS CAD Cell without P-11 and P-12 BUs	NO	YES	YES	YES	NO	YES
	Cycle Two	ESS CAD Cell						

7. Environmental Impacts*

7.1. General

In general, the main environmental impact of dredging is a temporary increase in the concentrations of suspended solids, nutrients, and contaminants in the water column, which, in turn, affects aquatic resources. For placement of dredged material in CAD cells, the main effects are also increased suspension of solids and contaminants during excavation and filling, followed by recovery of the benthic habitat after dredged material placement. Placement in open water also results in increased concentrations of suspended solids, as well as burial of aquatic organisms and benthos with sediment and changes in bathymetry. Excluding physical changes in bathymetry, environmental resources impacted by open-water placement generally recover over time.

To minimize impacts to various resources (detailed below), USACE anticipates implementing RIDEM's recommended time of year (TOY) restrictions within various reaches of the Providence FNP. Table 7-1 details the TOY restrictions for dredging and material placement within the various FNP reaches and placement site locations.

The following sections of Chapter 7 are first broken out by environmental condition or biological resource. Within each section, the impacts to the resource are split out by no action alternative and preferred alternative. For the preferred alternative, impacts are further split by areas inside Narragansett Bay, which is within Rhode Island's territorial water jurisdiction, and RISDS, which is outside Rhode Island's territorial water jurisdiction, as needed.

Table 7-1. Time of Year Restrictions for Dredging the Providence River and Harbor Federal Navigation Project Reaches and for Material Placement at Disposal Sites.

Location	Restriction Description	Time of Year Restriction											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fox Point Reach	Avoid North of Field's Point – Winter Flounder larvae		X	X	X								
Fuller Rock Reach	Avoid North of Field's Point – Winter Flounder larvae		X	X	X								
	585-foot buffer between Channel and Watchemoket Rock- Nesting species of State Concern				X	X	X	X	X	X			
	Combined		X	X	X	X	X	X	X	X			
Sabin Point Reach	Avoid Quahog Spawning Areas between Sabin Point and Conimicut Point						X	X					
Bullock Point Reach	Avoid between Bullock Point and 3,500 feet South of Conimicut Point for Winter Flounder Spawning		X	X									
	Avoid Quahog Spawning Areas between Sabin Point and Conimicut Point						X	X					
	Combined		X	X			X	X					
Conimicut Point Reach	Avoid between Bullock Point and 3,500 feet South of Conimicut Point for Winter Flounder Spawning		X	X									
	Avoid Quahog Spawning Areas between Sabin Point and Conimicut Point						X	X					
	Combined		X	X			X	X					
Rumstick Neck Reach	Avoid Rumstick Neck Reach for Conditional Shellfishing Area except April 1 to April 30	X	X	X		X	X	X	X	X	X	X	X
Entrance Channel	No restrictions												
Prudence Island Disposal Site	No restrictions												
Rhode Island Sound Disposal Site	No restrictions												
Edgewood Shoals	Avoid North of Field's Point – Winter Flounder larvae		X	X	X								

Legend	
Dredging and Material Placement Prohibited	X
Dredging and Material Placement Allowed	

7.2. Sediment Characteristics

The following section describes the impacts to the sediments within the Providence FNP as well as the sediments within the various dredged material placement locations.

7.2.1. No Action Alternative

Sediment evaluations of material in the Providence FNP show that the sediments proposed to be dredged are a mix of sand and silt that are unsuitable for open-water disposal due to a number of contaminants (see Section 4.2). If the No Action Alternative is implemented, no changes to the sediments in the FNP would occur and the contaminated sediments would remain in place.

7.2.2. Preferred Alternative

If the proposed maintenance dredging project is implemented, the dredged areas of the FNP are anticipated to have sediments similar to the pre-dredge conditions (i.e., sand and silt) following construction. Future shoaling from upstream and adjacent sediment sources is expected to bring in low quality sediment (i.e., contaminated) as occurred between the 2002-2024 interval that will be similar to the material being dredged.

Narraganset Bay

Placement of clean material from the construction of the Edgewood Shoals CAD cell at PIDS will cover the historic dredged material and improve sediment quality at the site by sequestering the elevated metals and organic compounds from the environment. The PIDS restoration effort will isolate the contaminated sediment from the biologically active zone and improve benthic habitat quality for this portion of Narragansett Bay. The material to be placed at PIDS is predominately silt, which is similar to existing conditions at the site. Therefore, the surficial sediments at PIDS will remain silt following dredged material placement.

Placement of CAD cells in Edgewood Shoals, the creation of an access channel, and the placement of dredged material in PEB will include bathymetric modifications to the area. The sediments in the vicinity of the CAD cell and in the PEB are predominately fine-grained silts with some fine sands. The sandy-silt material from the CAD cell will be placed in the basin. Thus, the surficial sediments in the area will be similar to the existing sediments following construction.

Rhode Island Sound Disposal Site

The placement of suitable material from the creation of the proposed CAD cells should not have significant effects on the sediment chemistry at the RISDS. The material from the CAD cell is glacial till and not a carrier of contaminants. The CAD cell material has been found suitable for unconfined open-water disposal at RISDS (Appendix E).

7.3. Water Quality

7.3.1. No Action Alternative

Water quality classifications in the Providence FNP, the Edgewood Shoals area, the PIDS, and the RISDS would not change if the No Action Alternative is implemented. The water quality issues (i.e., low dissolved oxygen conditions) in Edgewood Shoals as described above in Section 4.3 would continue to persist. Additionally, the short-term and localized impacts to water quality associated with dredging and placement activities would not occur.

7.3.2. Preferred Alternative

The proposed project is not expected to change any of the water quality classifications noted in Section 4.3 for any of the action areas if the proposed project is implemented.

Turbidity

Narragansett Bay

Dredging efforts are proposed to be performed with a mechanical clamshell dredge. This action will remove and suspend some of the bottom sediments, causing localized increases in turbidity and sedimentation. Numerous studies (ranging over decades) have been conducted to document levels of suspended sediments and sediment plume distances associated with mechanical dredging and are discussed below.

<u>New London Harbor Monitoring Example:</u>

Analysis of the spatial and temporal persistence of the turbidity plume from the dredging of silts was quantified in 1977 from dredging the Thames River/New London Harbor channels (Bohlen et. al., 1996). The conclusions of this study defined the measurable suspended sediment plume as extending 700 meters downstream. Analysis of the composition and concentration of the plume indicated the majority of material suspended occurred within 300 meters of the dredge. Suspended material concentrations closest to the dredge ranged from 200 milligram per liter (mg/l) to 400 mg/l resulting from suspension of approximately 1.5 to 3.0% of the substrate in each bucket load. Suspended material concentrations were reduced by a factor of 10 within the first 200 meters downstream of the dredge. Surface concentrations returned to normal 250 meters downstream of the dredge. Mid-water and near bottom concentrations returned to background levels 700 meters downstream of the dredge.

<u>New Haven Harbor Monitoring Example:</u>

Sediment plumes were monitored during a maintenance dredging effort of the New Haven Harbor FNP (New Haven, Connecticut) between October 1993 and January 1994 (Bohlen et al, 1996). Dredging of silty material from New Haven Harbor was conducted with an enclosed mechanical bucket. The two major objectives of the New Haven monitoring were to: 1) establish the background suspended solids concentration before and after dredging, and 2) document the movement of the dredge plume relative to fisheries resource areas. The results of the survey revealed that background suspended sediments in the harbor average 8 mg/l prior to dredging efforts, and that during dredging, numerous aperiodic short duration spikes of 100 mg/l were observed.

The study also concluded that there were dredge-induced sediment plumes, and that the plumes did travel outside of the navigation channel. However, these excursions onto the shoal areas outside the channel only occurred when the dredge was in the immediate vicinity (i.e., dredging the side of the channel directly adjacent to the shoal areas).

The study also noted that several long-duration (1-3 days) high suspended sediment perturbations (concentrations reaching 700 mg/l) were not likely related to dredging operations. Evidence from meteorological data and wastewater effluent records indicate that these high suspended sediment events were likely the result of winds and wind-generated waves, alone or in combination with discharges from wastewater treatment plant outfalls.

The study concluded that dredged induced sediment resuspension was found to be a minor perturbation to the much longer duration, larger amplitude events associated with wind, wind-waves, and effluent discharges from outfalls. The effects of dredge related spikes in suspended sediments on the winter flounder spawning grounds (i.e., the shoal areas outside the channel), and the regional water quality in general, appear to have been limited in duration and of relatively low amplitude (Bohlen et al., 1996).

Boston Harbor Monitoring Example:

Monitoring was conducted in 1996 for dredging of the surface silty material during construction of a CAD cell for the Boston Harbor Navigation Improvement Project. This monitoring included: 1) documentation of the spatial and temporal distribution of the sediment plume for the four extremes of tidal currents (high water slack, maximum ebb, low water slack, maximum flood) on two days within the first week of dredging; 2) collection of water samples from the lower half of the water column at two locations – 1,000 feet up current of the dredging and 500 feet down current from the dredging; and 3) analysis of water samples for total suspended solids.

During dredging, turbidity measurements ranged from 3-5 Nephelometric Turbidity Units (NTUs) at the reference station 1,000 feet up current from dredging the silty surface material using an environmental bucket. Turbidity was only slightly elevated at the station 500 feet down current of the dredging ranging from 4-11 NTU. Total suspended solids ranged from 4-5 mg/l at the reference station and from 5-9 mg/l at the down current station. No plume was visible at the surface outside the immediate area of the dredging operation, and no significant plume was detected in the water column (ENSR, 1997).

Monitoring of turbidity plumes in 1998 associated with the dredging of silty maintenance material from Boston Harbor was also performed (USACE/Normandeau, 1998). Mapping of the turbidity associated with use of a closed mechanical bucket (i.e., an environmental bucket) to dredge silty material in Boston Harbor was performed during periods of high and low water slack and during maximum flood and ebb tides. The mapping required generation of plan views of turbidity at mid-depth and near bottom extending from 300 feet up current to 1,000 feet down current of continuous dredging operations. Generation of a cross section of turbidity located 300 feet down current of the dredging was also required. Near bottom turbidity values were highest for all measurements with values no higher than 100 NTU approximately 300 feet down current of the dredging operation. Mid-depth turbidity was much less, and all values returned to background levels (10-20 NTU) between 600 and 1,000 feet down current (ENSR, 2002).

The monitoring studies noted above show that turbidity plumes associated with mechanical bucket dredges are produced during dredging; however, they are generally limited to the immediate vicinity of the dredge. Therefore, while suspended sediment plumes will be produced during the construction of the proposed project, they are not anticipated to significantly impact water quality.

Rhode Island Sound Disposal Site

In the 2004 DAMOS report on plume tracking (SAIC, 2005), it was noted that:

> "Water column monitoring performed following disposal at RISDS, the open-water disposal site, demonstrated that the suspended solids plumes predominantly remained within the boundaries of the site and that modeling predictions provided a conservative estimate of plume footprint and suspended solids concentrations. Biological monitoring performed within a year of completion of disposal at RISDS identified that the benthic community was re-colonizing quickly and that lobster populations were not significantly impacted."

Therefore, no long-term effects are anticipated at the RISDS due to dredged material disposal.

Dissolved Oxygen

The resuspension of sediments by dredging activities has the potential to depress dissolved oxygen concentrations in the water column. Dissolved oxygen concentrations were monitored during dredging of parent (natural underlying) materials to construct CAD cells in Boston Harbor (ENSR, 1997) in conditions similar to Providence River. Dissolved oxygen concentrations during CAD cell construction varied by a maximum of 0.6 mg/l between the upstream reference and downstream monitoring stations and never dropped below the level specified in the water quality standards of 5.0 mg/l for Class SB waters or 6.0 mg/l for Class SA waters. While small decreases in dissolved oxygen are expected during dredging operations, no long-term impairment to dissolved oxygen is expected from the dredging process.

As discussed in Section 4.3, a gyre in the Edgewood Shoals area exists because of the depth differences between the shallow shoal area and the deeper channel of the FNP. The gyre limits water exchange between the two areas which in turn depresses dissolved oxygen in the Edgewood Shoals area. Medley (2019), using a 3-dimensional hydrodynamic model called ROMS (The Regional Ocean Modeling System) that has been configured for Narragansett Bay, reported that the most effective way to force exchange between the Edgewood Shoals and the FNP would be to create an east-west channel to act as a conduit for flow between the ship channel and the bottom water of the PEB and decrease the depth of the basin. Forcing the exchange would improve flushing and lower the prevalence of low dissolved oxygen levels. The proposed project will create such a channel to access the CAD cell and portions of the material from the CAD cell will be placed into the PEB to decrease depths. Therefore, the proposed project is anticipated to improve dissolved oxygen levels in the Edgewood Shoals area.

Nutrients

The proposed project would not result in an increase of nutrients into Narragansett Bay waters. However, dredge operations can increase nutrient concentrations in the immediate vicinity of the dredge as sediment bound nutrients are disturbed during material removal. The effect of releasing sediment bound nutrients would be temporary and minor. The proposed project would not affect nutrient concentrations, nutrient loading, or nutrient cycling within Narragansett Bay waters.

7.4. Air Quality

7.4.1. No Action Alternative

Under the No Action Alternative, the air quality in the vicinity of the Providence FNP and at all the disposal sites under consideration would remain unchanged as no impacts would occur.

7.4.2. Preferred Alternative

Narragansett Bay and Rhode Island Sound Disposal Site

The entire state of Rhode Island meets the attainment criteria for all NAAQS priority pollutants (EPA, 2021). The project is expected to have only minor impacts on air quality. The impacts would occur only during construction and would come from operation of equipment. All equipment would be properly outfitted with air pollution controls, as required by the Rhode Island air quality control regulations, and proper controls for minimizing the generation of dust would be implemented. Some volatile organic compounds may be released from exposed placement sites. Operation of dredges would result in minor increases in air pollutants, including nitrogen dioxide, during the construction phase. All dredges, tugs, and other equipment would be properly outfitted with air pollution controls, as required by the Rhode Island air quality control regulations. Once the project is completed, ship traffic would continue to generate minor amounts of air pollutants, but far less than would be generated by the trucks required to transport the same goods if navigation were precluded by shoaling.

During transport of the dredged material from dredging sites to placement sites, tugs and other equipment used in the process would generate minor amounts of air pollutants. Because the material would be placed under water with these placement alternatives, dust and volatilization would not occur and there would be no long-term effects on air quality from these alternatives.

Section 176 (c) of the CAA requires that Federal agencies assure that their activities are in conformance with Federally approved CAA SIP for geographic areas designated as non-attainment and maintenance areas under the CAA. The EPA General Conformity Rule to implement Section 176 (c) is found in 40 CFR Part 93. Also, Section 309 of CAA, authorizes EPA to review certain proposed actions of other Federal agencies in accordance with the NEPA. CAA compliance, specifically with EPA's General Conformity Rule, requires that all Federal agencies, including the USACE, review new actions and decide whether the actions would worsen an existing NAAQS violation, cause a new NAAQS violation, delay the SIP attainment schedule of the NAAQS, or otherwise contradict the State's SIP (EPA, 2012).

The general conformity rule was designed to ensure that Federal actions do not impede local efforts to control air pollution. It is called a conformity rule because Federal agencies are required to demonstrate that their actions "conform with" the approved SIP for their geographic area. However, maintenance dredging projects are exempt from performing a conformity review based on 40 CFR 93.153(c) (2):

> "The following actions which would result in no emissions increase or an increase in emissions that is clearly de minimis: ... (ix) Maintenance dredging and debris

> disposal where no new depths are required, applicable permits are secured, and disposal will be at an approved disposal site."

This exemption applies to the planned Providence FNP and three adjacent FNPs maintenance dredging and disposal. For the CAD cell construction, USACE is currently performing an air quality analysis to ensure emissions for pollutants that form ozone (nitrogen dioxide and particulate matter) would not exceed the general conformity applicability rate established in the state's SIP. USACE anticipates that the exemption in 40 CFR 93.153(c)(1) will apply. The results of this analysis will be provided in the final report.

7.5. Tidal Wetlands and Seagrasses

7.5.1. No Action Alternative

Under the No Action Alternative, wetlands and seagrasses in the vicinity of the Providence FNP would remain unchanged, subject to projected sea level changes.

7.5.2. Preferred Alternative

Narragansett Bay and Rhode Island Sound Disposal Site

In general, the Providence FNP is subtidal estuarine water with surficial sediments dominated by sand and silt. No impacts to salt marsh areas or other wetlands in the Narragansett Bay system adjacent to the dredging and/or placement operations are anticipated.

The closest area of eelgrass in Upper Narragansett Bay is located on the southern end of Prudence Island (Figure 4-12) and is approximately two miles from areas within the FNP that are proposed to be dredged. The closest point of dredged material placement at PIDS would occur approximately 1,500 feet away from the eelgrass beds off Prudence Island. Placement of dredged material is sufficiently accurate to avoid and not impact the eelgrass beds. There will be no impacts to wetlands or submerged aquatic vegetation resources at the RISDS as these resources do not exist at this site.

7.6. Biological Resources

7.6.1. Fish

7.6.1.1. No Action Alternative

Under the No Action Alternative, fish resources in the vicinity of the Providence FNP and Narragansett Bay would remain unchanged.

7.6.1.2. Preferred Alternative

Narragansett Bay and Rhode Island Sound Disposal Site

The proposed project would impact fish species in the project area. Effects of the proposed project include possible death and injury of fish, interference with fish movements, disruption of the forage base, and changes in water quality during dredging operations. As noted in the Benthos Section below (Section 7.6.4), direct removal of soft bottom habitats will occur in the dredging areas and direct covering of soft bottom habitats will occur in the placement areas. As noted in Section 7.3, direct impacts due to changes in water quality will occur; however, they are anticipated to be short-term and localized to within hundreds of feet of the dredging and disposal efforts. Impacts to fish habitat and sensitive life stages of fish species present while dredging will be minimized by utilizing the time of year restrictions noted in Table 7-1.

Intermittent, short-term impacts to fish include disturbance of fish throughout the water column within the localized area during dredging and disposal efforts. Due to their mobility, most fish would be expected to move out of an active dredging area or a dredged material burial area. The sediment plume associated with dredging and the plume following material placement would also have potential short-term water quality impacts that may also have indirect impacts on fish by temporarily altering certain finfish behaviors, such as migration, spawning, foraging, schooling, and predator evasion (O'Connor & Ehler, 1991). Increased turbidity has also been associated with potential gill abrasion and respiratory damage (Saila et al., 1972; Wilber & Clark, 2001).

Sediment characteristics and the life stage of species affect how sensitive species are to suspended sediment, with egg and larval stages tending to be the most sensitive (Berry et al., 2003; Wilber & Clark, 2001). During material placement, these impacts are limited both in duration and spatially due to the short time needed for dredged material to reach the bottom (Kraus, 1991; Dragos & Lewis, 1993; Dragos & Peven, 1994). Saila et al. (1972) also point out that "aquatic animals are able to tolerate high concentrations of suspended sediments for short periods." Since the tolerance level for suspended solids is high in shallow and mid-depth coastal waters, and fish and lobster may experience major changes in turbidity during storms, Saila et al. (1972) conclude that mortality due to elevated sediment concentrations in the water column resulting from dredged material placement is not likely.

As noted through this document, concentrations of suspended sediments and the duration needed to cause impacts to fish resources are expected to be short-term and localized and as such, effects to fish sources in the proposed project areas should be minimal.

7.6.2. Mammals

7.6.2.1. No Action Alternative

Under the No Action Alternative, mammal resources in the vicinity of the Providence FNP and Narragansett Bay would remain unchanged.

7.6.2.2. Preferred Alternative

Dredging and Placement of Material in Narragansett Bay

Harbor seals have the potential to be found in areas proposed for dredging and the dredged material placement areas. Harbor seals that wander into the FNP or Edgewood Shoals area during dredging activities should be able to avoid impact as they are highly mobile and could easily avoid the dredging and placement activities. No significant impacts to marine mammals (i.e., harbor seals) are expected as a result of the dredging or disposal activities.

Rhode Island Sound Disposal Site

Marine mammals at the RISDS should not be significantly affected by the proposed project. Impacts to marine mammals that may potentially enter the RISDS will be limited to the displacement of open water by the tugboats and disposal scows.

7.6.3. Birds

7.6.3.1. No Action Alternative

Under the No Action Alternative, bird resources in the vicinity of the Providence FNP and Narragansett Bay would remain unchanged.

7.6.3.2. Preferred Alternative

Narragansett Bay

As discussed in Section 4.6.3, a very large and diverse bird community exists in the Narragansett Bay area. USACE does not anticipate that avian species, including shorebirds, seabirds, and migratory birds, would be adversely (directly or indirectly) affected by the proposed project. The proposed project would cause only temporary impacts to the bird community as individuals avoid active construction areas due to noise and general activity. Since dredging would occur in open and deep water, impacts to the bird community are expected to be temporary and minor.

Rhode Island Sound Disposal Site

Impacts to birds at the RISDS are anticipated to be minimal. Although some birds may use this site to rest during seasonal migrations, no birds use this site for breeding. Noise effects from the barges and tugs used to carry the material to the disposal sites may temporarily displace some bird species, should any be present. However, birds would return to their use of the site following the disposal event. Material placement at RISDS is not expected to create foraging habitat that would attract birds to the area as the sediment plume is expected to be temporary and settle quickly enough that a forage base would not establish. No protective measures are expected to be needed.

7.6.4. Benthos

7.6.4.1. No Action Alternative

Under the No Action Alternative, benthic resources in the vicinity of the Providence FNP and Narragansett Bay would largely remain unchanged. With no action, shoaling is expected to continue and there may be a concomitant shift in the benthic community with sufficient changes in depth and sediment type.

7.6.4.2. Preferred Alternative

Dredging Impacts Narragansett Bay

Most shallow benthic habitats in estuarine systems are subject to deposition and resuspension events on daily or even tidal time scales (Oviatt & Nixon, 1975). Many organisms have behavioral or physiological responses to sediments that settle on or around them. Many organisms avoid the area of disturbances while others have a tolerance to attenuated light conditions or anaerobic conditions caused by partial or complete burial. Direct effects of sedimentation include smothering, toxicity (exposure to anaerobic sediment layers), reduced light intensity, and physical abrasion, whereas indirect effects include changes in habitat quality (Wilber et al., 2005).

Studies of burial of estuarine invertebrates found species specific responses. According to Hinchey et al. (in Berry et al., 2003), the responses varied as a function of motility, living position and inferred physiological tolerance of anoxic conditions while buried. The deposition of dissimilar sediments has a greater impact on organisms than sedimentation of like materials (Maurer et al., 1978, 1986). In the Providence FNP navigation channel, the benthic community already experiences and has adapted to sedimentation stress caused by resuspension of sediments due to natural processes (e.g., storms and tides) as well as anthropogenic influences (e.g., large vessel traffic). Monitoring of previous dredging activities in New Haven Harbor (New Haven, CT) and in Boston Harbor (Boston, Massachusetts) have shown that sediment plumes settle out predominantly in the dredge area (see Section 7.4) limiting the extent of additional stress to the system. The Boston and New Haven monitoring studies did however show that, to a limited extent, sediment plumes can extend outside of the navigation channels and can produce short-term increases in turbidity.

Turbidity impacts to benthos are dependent on the concentration and the duration of the suspended sediments (Clarke & Wilber, 2000; Suedel et al., 2015). Motile benthic organisms (e.g., lobster and crab) can generally avoid unsuitable conditions in the field and, under most dredging scenarios, encounter localized suspended sediment plumes for exposure durations of minutes to hours, unless the organism is attracted to the plume and follows its location. Although adult bivalve mollusks are silt-tolerant organisms (Sherk, 1972 in Clarke & Wilber, 2000), they can be affected by high suspended sediment concentrations. Quahogs (Pratt & Campbell, 1956 in Clarke & Wilber, 2000), and oysters (Kirby, 1994 in Clarke & Wilber, 2000), exposed to fine silty-clay sediments have exhibited reduced growth and survival, respectively. Suspended sediment concentrations required to elicit these responses and mortality, however, are extremely high, i.e., beyond the upper limits of concentrations reported for most estuarine systems under natural conditions, as well as typical concentrations associated with dredging operations. Sublethal effects, such as reduced pumping rates and growth, were evident for adult bivalves at concentrations that occur under natural conditions but may be of a short-term (i.e., hours to days) duration, for example, during a storm (Schubel, 1971; Turner & Miller, 1991 in Clarke & Wilber, 2000). The egg and larval stages of benthos (e.g., shellfish) are more sensitive to suspended sediment impacts than adults. Estimates of suspended sediment impacts to these pelagic, early life history stages must consider the local hydrodynamics of the dredging site, which strongly influence the likelihood of extended exposure to suspended sediment plumes (Clarke & Wilber, 2000; Suedel et al., 2015).

The benthic community in the federal navigation channel will be eliminated by direct removal through the dredging efforts. Once dredging is completed, the benthic community of the channel and side slope areas is expected to begin recolonization by recruitment from benthic species in other areas of Narragansett Bay. As the benthic community throughout the existing channel and side slopes is a mix of opportunistic early-successional stage benthic communities and mid-successional stage benthic communities, a return to a similar community following dredging is expected within approximately 1-3 years.

Impacts of Material Placement at All Sites in Narragansett Bay

For over 40 years, studies and monitoring efforts have been conducted in New England to understand the consequences of dredged material placement to benthic habitats and local food webs (Wolf et al., 2012; Fredette & French, 2004; Valente et al., 2007). The type and extent of impacts depend on the characteristics of both the dredged material and the habitat at the placement site (Bolam et al., 2006). Although short-term impacts and long-term changes in habitat due to sediment type and elevation of the seafloor have occurred at studied sites, there is no evidence of long-term effects on benthic processes or habitat conditions (Germano et al., 2011; Lopez et al., 2014).

One of the key biological impacts is the burial of benthic invertebrates where dredged material is deposited. Sediment type, sediment depth, burial duration, temperature, and adaptive features such as an organism's ability to burrow and to survive can affect the ability of organisms to migrate to normal depths of habitation. Benthic disturbance from dredged material placement at designated disposal sites has direct, immediate effects on sessile epifauna and infauna (Germano et al., (1994), (2011)). Sediment accumulations greater than 6 inches are expected to smother most benthic infauna (Lopez et al., 2014). Large decapod crustaceans (i.e., cancer crabs, shrimp species, lobster) are able to penetrate deeply into the sediment, which provides them with mechanisms that enable them to survive some burial. Other strong deposit feeders can withstand burial of 4 inches or more (Jackson & James, 1979; Bellchambers & Richardson, 1995), while 0.4 inch of sediment can kill attached epifaunal suspension feeders (Kranz, 1974). The greatest impacts from burial occur in the central mound area, where multiple deposits result in the thickest amounts of placed sediment (Germano et al., 1994). The burial on benthic invertebrate populations is typically a short-term impact, because benthic fauna rapidly recolonize the freshly placed, organically-rich sediment. Additional short-term impacts of placement may occur. Small surface-dwelling animals (e.g., some amphipod and polychaete species) may be dislodged and transported to the outer region of the deposit with water and sediment movement. The sediment plume may temporarily interfere with benthic feeding and respiration in the water column.

The physical nature of seafloor sediments defines the type of habitat that is available for benthic organisms to colonize, and thus the types of organisms and benthic community that can live and thrive on the placed dredged material. Potential long-term impacts may include changes in benthic community composition that result from potential alterations in sediment grain size and TOC as well as alterations in seafloor elevation.

Impacts of Material Placement at the Rhode Island Sound Disposal Site

Impacts to benthos at the RISDS are anticipated to be minimal. This site has been chosen as a federally approved disposal site due to favorable hydrodynamic, sedimentary, and biological conditions which serve to minimize the impacts of disposal of suitable dredged material (e.g., the site is depositional, and materials will not remain in the water column at levels above background for long periods). This area has been previously impacted by disposal activities and will be altered and recolonized repeatedly.

7.6.5. Shellfish and Lobster

7.6.5.1. No Action Alternative

Under the No Action Alternative, shellfish and lobster resources in the vicinity of the Providence FNP and Narragansett Bay would remain unchanged.

7.6.5.2. Preferred Alternative

Shellfish

Narragansett Bay

Narragansett Bay, including PIDS contain shellfish resources as noted in Section 4.6.7. Shellfish harvesting in these areas, including within the FNP, have been closed in the past because of contamination by pathogens from untreated sewage and contaminated stormwater, which flow through CSOs into the river (Boyd, 1991; RIDEM, 2024). Based on the results of previous studies correlating shellfish abundance and sediment type, sampling performed for the 2001 FEIS, and current RIDEM shellfish distribution data, no significant shellfish resources are expected to exist within the confines of the channel to be dredged. Based on the expected concentrations of suspended sediment plumes around dredging operations, the primary concern to quahogs in the upper Providence River would be operational induced mortalities as a result of sediment resuspension and a diminished brood stock. The expected increase in suspended sediments as a result of dredging, based upon previous monitoring at similar operations, would be well below those shown to cause acute impacts to adult shellfish or their larvae. Although feeding and growth rates may be slightly retarded for short periods of time, these effects are expected to be short lived, with few discernable long-term implications, as the sediment plumes would disperse and settle with the fluctuating tidal currents (USACE, 2001). Consequently, dredging of the channel would not significantly impact the overall shellfish populations or interrupt larval recruitment to the upper Narragansett Bay habitats. Dredging of the Rumstick

Neck Reach area will only occur from April 1 to April 30 to avoid and minimize impacts to this conditional shellfishing area.

The Edgewood Shoals area contains shellfish resources (see Section 4.6.5). Quahog (*Mercenaria mercenaria*) resources are abundant throughout the area proposed for the construction of the CAD cells, the access channel, and the area of PEB that will be filled with dredged material (Figure 7-1). As filter feeders, bivalves, like quahogs, are particularly susceptible to mechanical or abrasive action of suspended sediments (i.e., clogging of gills, irritation of tissues, etc.; Carnes, 1968 as cited in Stern et al., 1978). However, the response of organisms to suspended sediments is difficult to determine and may not be due to the actual concentrations of suspended solids, but to the number of particles in suspension, their densities, size distribution, shape, mineralogy, sorptive properties, or presence of organic matter and its form (Sherk, 1972, as reported by Stern and Stickle, 1978).

During construction operations in the upper Narragansett Bay/Edgewood Shoals area, the expected increases in suspended sediments and resultant resuspension during dredging operations in areas containing shellfish would be well below levels shown to cause acute impacts to adult shellfish (Sherk, 1972 in Clarke & Wilber, 2000). USACE based this understanding on modeling and previous monitoring efforts at similar operations. Although feeding and growth rates may be slightly reduced for short periods of time, these effects are expected to be short lived with little discernable long-term implications, as the sediment plume would be dispersed and settle with the fluctuating tidal currents. Suspended sediments at or near the dredge site would be at levels shown to be potentially detrimental to pre-adult life stages. Prior to ESN CAD cell construction, any relocation of shellfish resources will be determined in accordance with applicable federal law, regulation, and executive order.

The PIDS also has limited shellfish resources. PIDS was found to be devoid of commercially harvested shellfish resources (Table 4-7). Therefore, the placement of suitable dredged material in PIDS from CAD cell construction should not significantly affect any shellfish resources.

Rhode Island Sound Disposal Site (RISDS)

The RISDS has limited shellfish resources. RISDS is an approved disposal sites that accepts various types of dredged material from surrounding areas. Therefore, the placement of material in RISDS from CAD cell construction should not significantly affect any shellfish resources.

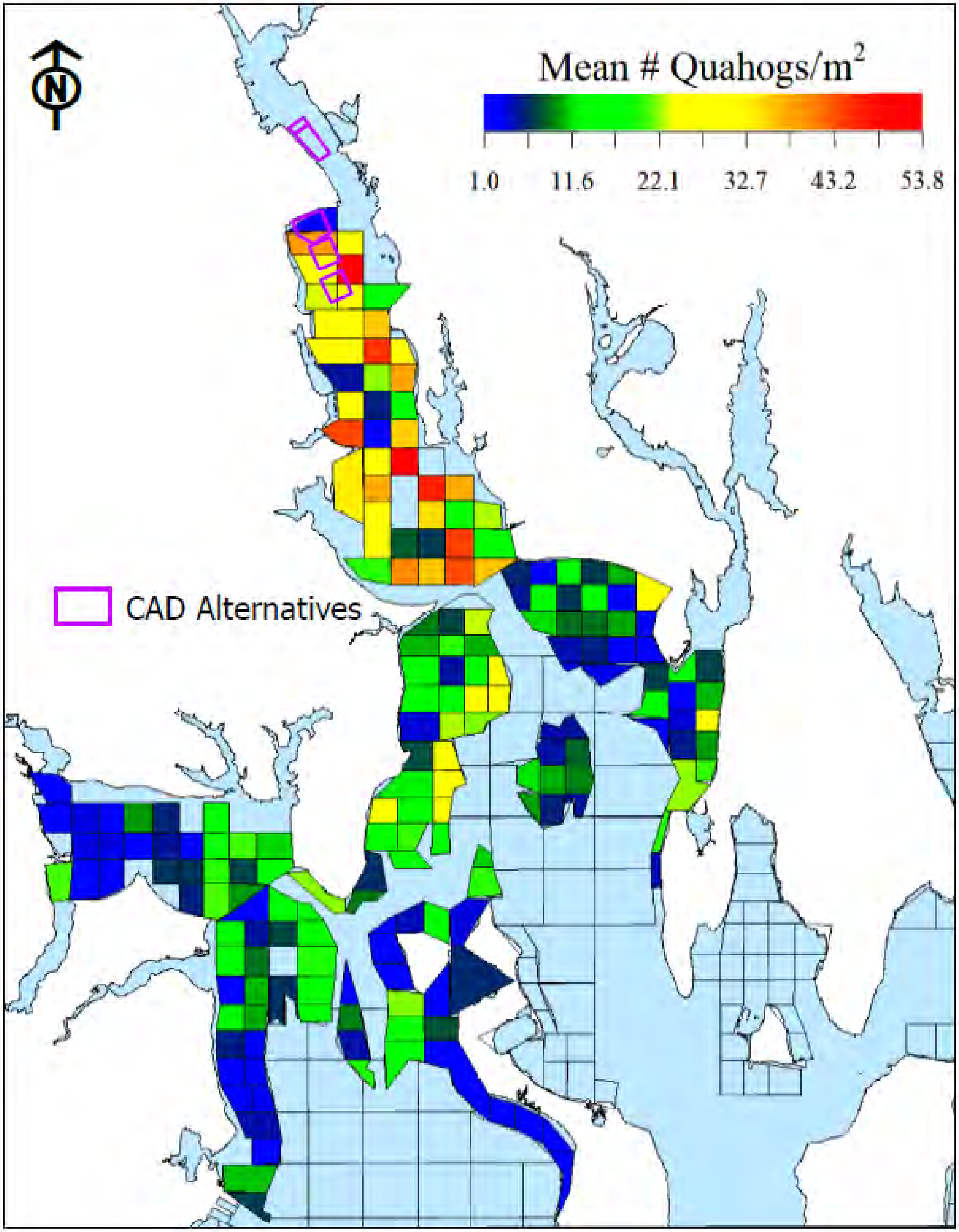


Figure 7-1. Confined Aquatic Disposal Cell Alternatives and 2021 Mean Quahog Density per Square Meter in Upper Narragansett Bay (RIDEM, 2022b).

Lobster

Providence River Federal Navigation Project and Edgewood Shoals

Lobster was not identified as a significant resource within the Providence FNP, Edgewood Shoals, or the Prudence Island Disposal Site. Therefore, impacts to lobster resources in these areas are expected to be minimal, e.g., the temporary unavailability of foraging habitat during dredge and placement operations.

Rhode Island Sound Disposal Site

During the placement operations and for at least several months after placement is complete at RISDS, lobsters would be limited in their use of up to 800 acres (3.2 square kilometers) for refuge and feeding until the sediments consolidate and the site is recolonized by benthic organisms. Based on substrate conditions, RISDS is similar in quality of lobster-refuge habitat to other potential placement sites, but this is not supported by the catch. Based on benthic resource conditions inferred from sediment profile sampling data, lobster-feeding habitat at RISDS is of moderate quality, with evidence of a mid-successional stage benthic community. Increased competition for resources would occur if lobsters temporarily moved from the site.

Once the dredged material placed at RISDS becomes consolidated and recolonized by benthic organisms, habitat quality for lobsters would be restored to the existing condition. The dredged material from the lower Providence River channel is similar in grain size distribution to sediments at RISDS, enhancing the likelihood that recovery of the benthic community and lobster food resources would occur.

A study of lobster abundance was conducted seven months after the last placement at RISDS. The objective of this study was to compare lobster abundance at RISDS to two other sites in Rhode Island Sound and to results of a similar survey in 1999 to examine whether placement impacted local lobster populations. There was an overall decrease in lobster abundance observed at all three sites in Rhode Island Sound between the 1999 and 2005 sampling events, consistent with a longer-term trend of decreasing lobster abundance throughout southern New England waters. Statistical comparisons indicated no significant changes in lobster abundance or size at RISDS between 1999 and 2005 that were unusually strong or anomalous compared to the changes observed at the other sites over the same time period. Thus, placement activities did not appear to have caused significant adverse impacts to lobster populations at RISDS compared to nearby areas of Rhode Island Sound (ENSR, 2008).

RISDS is an approved disposal sites that accepts various types of dredged material from surrounding areas. The site has been selected as a disposal site because of the fact that resources in the area are limited as compared to other sites in the vicinity. The placement of material from the creation of the CAD cells for this project should not significantly affect any lobster resources at the site.

7.7. Threatened and Endangered Species

7.7.1. No Action Alternative

Under the No Action Alternative, threatened and endangered species in the vicinity of the Providence FNP and Narragansett Bay would remain unchanged.

7.7.2. Preferred Alternative

USACE has made the determination that no threatened or endangered species are likely to be adversely affected by the proposed project. Impacts to each federally listed species are presented below.

7.7.2.1. Federally Listed Species

U.S. Fish and Wildlife Service Jurisdiction

The threatened or endangered species identified in the USFWS IPaC report included the northern long-eared (NLEB) and tricolored bats, the monarch butterfly, and the roseate tern. As there is no suitable habitat for either NLEB or tricolored bat, present anywhere within the project area, USACE used the Northern Long-eared Bat and Tricolored Bat Range-wide Determination Key in IPaC to determine the project will have no effect on these species (Appendix H). Similarly, as no suitable habitat exists for the monarch butterfly within the project area, USACE also made a no effect determination for this species. The roseate tern nests on beaches and islands, which will not be impacted by this project. As noted in Section 4.7, RIDEM records show there have been no nesting roseate terns in Rhode Island since the 1980s, and therefore, this species will not be disturbed. Therefore, USACE also made a no effect determination for the roseate tern using the Northeast Endangered Species Determination Key in IPaC (Appendix H).

National Marine Fisheries Service Jurisdiction

Based on the analysis of potential impacts, it is unlikely that significant adverse effects to the listed whales and sea turtles will result from dredging and placement of dredged material in Narragansett Bay (see Section 4.7.1 for a detailed list of species). The sediments from the Providence River navigation channel were tested and evaluated to assess their potential for adverse environmental impacts. These evaluations were guided by the requirements of MPRSA and CWA, Section 404(b)(1) guidelines. The evaluation included assessment of metal and organic contaminants, toxicity to marine organisms, and the potential for bioaccumulation (which is part of the assessment of human health and food-chain impacts) of metals and organics (including dioxins and furans). Sediment and water quality chemistry tests included evaluation of metals (i.e., antimony, arsenic, beryllium, cadmium, chromium, copper, gold, lead, mercury, nickel, selenium, silver, thallium, and zinc) and organic contaminants (i.e., pesticides, PCBs, PAHs, dioxins, furans, and semi-volatile compounds).

The sediment dredged from the FNP and placed in the CAD cells is generally of the same quality as existing conditions and there would be no significant increase to bioaccumulation risk.

Eventual placement of a cap of suitable dredged material on the CAD cells would limit bioaccumulation of any contaminants in the dredged material and would allow a stable benthic community to develop. Bioaccumulation potential is low, and the listed species are unlikely to obtain a significant portion of their food from the placement sites. The Edgewood Shoals area is a disturbed site with low benthic diversity and productivity. Although loggerhead and ridley turtles may occur in the area for a few months each summer; none of the turtles are likely to feed on benthic fauna in the action area. The endangered whales are only occasional visitors to the action area and are also unlikely to feed in the vicinity of the action area. They feed primarily on pelagic/planktonic prey that are unlikely to become contaminated with chemicals from the dredged material.

Disposal vessels transiting to the RISDS will not operate at speeds above 10 knots reducing the risk of a fatal vessel strike to any listed species. A NMFS-approved marine mammal/turtle observer will be present on-board all vessels transiting to the RISDS, and they and/or the captain will adhere to all reporting requirements agreed upon by the Corps and NMFS in the Programmatic Section 7 Consultation for open water and nearshore dredged material placement sites (NMFS-USACE, 2020). Additionally, all project vessels will follow NMFS regulations for visibility and when approaching right whales (50 CFR 222.32). Furthermore, dredged material will not be released if whales are within 1,500 feet or turtles are within 600 feet of the specified disposal point.

Although vessel traffic will increase during the period of the project, collisions between dredged material tugboats and barges and whales and sea turtles are unlikely. Whales can detect the presence of barges and tugs, and because of the slow speed at which barges and tugs operate, they will likely avoid them. Acoustic disturbance from the increased vessel traffic and dredged material placement operations may cause minor insignificant disturbance to the listed whales and sea turtles.

Adult and subadult Atlantic sturgeon and adult shortnose sturgeon may be present in the project areas opportunistically foraging or migrating. No permanent impact to these species' forage base is anticipated as a result of project activities due to the expectation of benthic recovery within several months following construction (Wilbur & Clarke, 2001, 2007). The Providence FNP is not connected to a spawning river for these species and is not a known overwintering site. Furthermore, adult and subadult Atlantic and shortnose sturgeons are mobile and will be capable of avoiding vessels as well as temporarily increased turbidity in the project areas.

Very little direct impact to whales and sea turtles is expected from the physical dumping of the dredged material from the barge. Turtles and whales in the vicinity of the placement site are likely to actively avoid the dredged material placement plume and forage in adjacent waters. Turtles that may be on the bottom as the dredged material descends, will likely escape burial by digging themselves out of bottom sediments. Indirect impacts of dredged material placement could be caused by alteration of zooplankton populations by the dredged material plume and burial or alteration of benthic communities. These effects are expected to be of short duration and are unlikely to have significant impacts on protected turtles and whales.

Based on the aforementioned sediment evaluation, regulations on vessel operation, existing data on whale, turtle, and sturgeon presence and behavior in and around the dredge and placement sites, and data on sediment plumes associated with placement, the potential effects of the proposed action on NMFS federally listed species when added to baseline conditions will be insignificant or discountable. USACE has determined the project may affect but is not likely to adversely affect these listed species.

7.7.2.2. State Listed Species

Coordination with RIDEM indicated that very few state endangered or threatened species are expected to be nest within half a mile of the dredge and placement areas (RIDEM, John Herbert, personal communication, 2022). Five species of special concern status were identified: three species of plants and two bird species with only the two bird species (common tern and oystercatcher) identified as possibly being affected by the proposed project (see Section 4.7).

RIDEM identified a breeding pair of American oystercatchers in 2022 at Watchemoket Rock in East Providence (John Herbert, RIDEM, personal communication, 2022). RIDEM also commented that common terns have nested on Watchemoket Rock, which is located 585 feet to the northeast and outside of the Fox Point Reach of the FNP (see Figure 3-1). A breeding TOY closure of April through September will be undertaken for these nesting species of state concern. When dredging this reach, activity will stay within the FNP and, therefore, no closer than 585 feet from the Watchemoket Rock.

7.8. Essential Fish Habitat

7.8.1. No Action Alternative

The No Action Alternative will have minor effects on the EFH and managed species of the Providence FNP. Naturally occurring storms have been documented to produce elevated turbidity levels in the estuarine systems like Narragansett Bay (Bohlen et al., 1996). Additionally, large storm events can mobilize sediments that cover benthic resources and affect the forage base for fish species. These impacts would continue to exist without the proposed action. Additionally, the typical noise environment of the FNP, which includes impacts from large commercial shipping vessels, tugboats, pilot boats, and a large recreational fleet, would continue to provide minor noise impacts to EFH in the harbor**.**

7.8.2. Preferred Alternative

Narragansett Bay and Rhode Island Sound

Impacts to EFH from the proposed maintenance project include temporary increases in turbidity from dredging and placement activities, the temporary loss of benthic organisms associated with the dredged material and impacts to eggs and larvae from turbidity from dredging and placement activities. Impacts will be minimized through the application of a dredging sequence that avoids sensitive areas during their most sensitive times of the year. See Table 7-1 for time of year dredging restrictions to be used for the proposed project.

In general, eggs and larvae are more susceptible to impacts than juveniles and adults, which can avoid dredging and placement related disturbance. Demersal species such as flounders are more susceptible to impacts than pelagic species since most dredging related disturbance occurs near the bottom. The EFH species with the most potential to be affected by dredging in the Providence River and upper Narragansett Bay are those with demersal eggs, namely, the winter flounder. Also impacted are those species with planktonic eggs and larvae suspended in the water column. These eggs and larvae may be physically damaged or killed by exposure to elevated concentrations of suspended solids. This project is not expected to significantly affect the habitat of any NMFS EFH managed species.

Juvenile and adult demersal and pelagic species are likely to find adjacent foraging habitat away from the from dredging or placement sediment plume. Small juvenile fish, particularly flounders and groundfish that reside on the bottom following metamorphosis from their larval form, will be more impacted than larger juveniles since they are less mobile. However, the Providence River and Edgewood Shoals provide poor benthic habitat, so it is unlikely that EFH species successfully use the habitat in these areas in high numbers.

HAPC for summer flounder (submerged aquatic vegetation) and juvenile cod (inshore 0-20 meters, complex rocky-bottom habitat) have the potential to occur in Narragansett Bay. However, the sediments in the direct footprints of the project areas to be affected are predominately unvegetated fine grained silts and sands and not considered HAPC for these species.

Coordination with the NMFS is ongoing to ensure that project impacts to EFH are avoided, minimized, or mitigated to the greatest extent practicable. Appendix H contains an EFH Assessment for the proposed project with species descriptions and a short summary of each life stage of EFH species that may be found in the project area.

Although project activities are likely to impact species present in the dredging and placement areas, the impacts will be minor, highly localized, and temporary. Dredging and placement activities will be sequenced to minimize impacts to fishery resources by adhering to sequenced dredging in various areas of the FNP.

The species present in these areas will return following the cessation of dredging. Physical parameters such as tides and currents are not expected to change because of the project. Any changes to water quality will be temporary and water quality will begin to return to pre-dredge conditions as soon as active dredging ceases. Prey species removed or buried by dredging and placement activities will also begin returning almost immediately following cessation of dredging.

Additionally, not all areas designated as EFH for the various species will incur impacts. Most species with designated EFH in the Providence River also have EFH in the larger Narragansett Bay, Mount Hope Bay, and portions of Rhode Island Sound. The effects of dredging and placement will be confined to limited areas of the Providence River, Narragansett Bay, and Rhode Island Sound. Therefore, the species at these locations will be able to sustain the population of their respective species in this geographic region.

7.9. Invasive Species

7.9.1. No Action Alternative

Under the No Action Alternative, invasive species distribution in the proposed project area would remain unchanged.

7.9.2. Preferred Alternative

Narragansett Bay and Rhode Island Sound Disposal Site

As mentioned in Section 4.9, the major known pathways for non-native species to enter the project area include stocking, aquarium releases, shipping, and bait releases. Commercial shipping, via the use of ballast water and from vessel fouling communities, is the only direct mechanism related to this project. The proposed maintenance dredging project should not result in an increase of vessels use the Providence FNP; therefore, invasive species effects are expected to be the same as the no action alternative. The proposed project is not anticipated to increase invasive species within the dredge site or any of the placement sites.

7.10. Cultural Resources

The Providence FNP has a long history of dredging from the 19th century to as recently as maintenance dredging in 2003-2005. Any cultural resources within the study area have most likely been disturbed or destroyed through this activity and the generally volatile nature of the area. Remnants of wharves, piers, derelict vessels, or associated features may be found in portions of the project area. Impacts for each alternative are discussed below.

<u>Area of Potential Effect</u>

The Area of Potential Effect (APE) for the Providence River FNP Dredged Material Management Plan includes the following areas as described above in the Executive Summary that will be subject to dredging and disposal activities as part of the DMMP:

- Providence River FNP
- Pawtuxet Cove FNP
- Bullocks Cove Point FNP
- Apponaug Cove FNP
- Edgewood Shoals North (ESN) and South (ESS) adjacent to the Providence River FNP where two large CAD cells consisting of over 5,000,000 cubic years of excavation are to be constructed; and
- Port Edgewood Basin, Fox Point Reach, PIDS, and RISDS for beneficial- uses of the excavated material.

7.10.1. No Action Alternative

Under the No Action Alternative, historic properties of the Providence River FNP, associated FNPs, and proposed disposal sites at Edgewood Shoals (North and South), Port Edgewood Basin, Fox Point Reach, PIDS and RISDS, if present, would not be impacted.

7.10.2. Preferred Alternative

Providence Federal Navigation Project and Associated FNPs (Bullocks Cove, Pawtuxet Cove, and Apponaug Cove)

Dredging of the Providence FNP to its authorized dimensions should have no impacts upon significant cultural resources. The channel has been maintained on a continuous basis since the late 19th century and as recently as 2005-2006. Any resources within these areas have most likely been disturbed or destroyed by the dredging and the active nature of the study area. Dredging to restore authorized dimensions only should have no effect upon historic properties or significant cultural resources.

The Federal channel has a long history of dredging from the 19th century to as recently as 2005-2006. Any cultural resources within the study area have most likely been disturbed or destroyed through this activity and the generally volatile nature of the area. Remnants of wharves, piers, derelict vessels, or associated features may be found in portions of the project area.

The Apponaug Cove FNP was last dredged in 1963, Bullocks Cove FNP in 2009, and Pawtuxet Cove FNP in 2006. For all the FNPs, previous maintenance dredging is likely to have disturbed or destroyed any historic properties that may have been present in these areas. Adjacent historic districts will not be affected by the proposed dredging.

Edgewood Shoals North (Fields Point) Confined Aquatic Disposal Cell with Beneficial Uses

This area also known as Fields Point is the site of the Providence sewage treatment plan, a smallpox hospital, a small fort (circa 1775) known as Fort Independence, a local park, and lastly, a naval shipyard built during World War II (1942-1945). No remnants of these resources are present, aside from structures associated with the wastewater treatment plan to the north. The area on the southern coast has been developed as the site of the waterfront campus of Johnson and Wales University.

USACE conducted a side scan sonar survey was conducted in 2022 of the ESN Basin and shoreline along Fields Point. Aside from remnants and ruins of a buried former pier, piles, and associated debris, no shipwrecks or submerged sites were identified. These results will be coordinated with the RI SHPO as part of NHPA compliance coordination. A previous study of the Fields Point area in 1982 determined that any sensitive archaeological areas have likely been "completely obliterated by recent cutting, filling, and construction" (Gallagher and Rubertone, 1982:12). Due to prior disturbance in this area, additional remote sensing investigations are not warranted, and we expect the RI SHPO to concur with this determination.

Edgewood Shoals South Confined Aquatic Disposal Cell

This site is proposed as the location of a new CAD cell south of Edgewood Shoals North. Soil samples and borings have been taken from the area. However, a remote sensing archaeological survey (side scan sonar, magnetometer, and sub-bottom profiler) will need to be performed during the Preconstruction Engineering and Design (PED) phase of the project to determine if historic properties are present on the surface or below the surface of the CAD cell.

Fox Point Reach Cell South Measure

As with the Edgewood Shoals South site, the Fox Point Reach South proposed CAD cell would also require a remote sensing archaeological survey to determine if historic properties are present during the PED phase with coordination of results with RI SHPO and other consulting parties. The Green Jacket Shoal site is located east of the Fox Point Reach on the East Providence shoreline. This site is eligible for listing on the National Register of Historic Places and consists of 29 wooden ships and six classes of vessels, as well as the remains of a pier for the Providence Dry Dock and Marine Railway Company at Bold Point, the last shipyard in Providence that built wooden merchant sailing vessels. This area is outside of the project APE and will not be impacted.

Prudence Island Disposal Site

Several shipwreck sites are noted southeast of Prudence Island from the NOAA AWOIS database (14106, 14108, 14110) and RI SHPO site files (2312). According to the SHPO files, this site was discovered by NOAA in 2004, and later studied during AUVfest 2008, a two-week event for autonomous underwater vehicles and technologist held in Narragansett Bay. Three areas were noted on side scan sonar images, one as a wreck, one as a barge, and the last as a granite seamount. The wreck and barge sites will be noted and, during SHPO coordination, USACE will propose an appropriate buffer (typically 50-foot) to avoid the sites during disposal activities.

The Narragansett Bay wreck sites believed to be the 18th century Revolutionary War-era vessels, H.M.S. Cerberus and Lark are located on the eastern shore of Narragansett Bay in the vicinity of the Portsmouth coastline and will not be impacted by the proposed disposal. These wreck sites were listed on the National Register of Historic Places in 1973.

RI Sound Disposal Site

The RISDS is a previously utilized site for the disposal of dredged material. Due to prior and extensive use, historic properties are not expected to be impacted by disposal at this location.

7.11. Socioeconomic Setting

7.11.1. No Action Alternative

Under the No Action Alternative, the socioeconomic characteristics of the surrounding communities would likely be negatively impacted if navigation in the Providence FNP were impaired leading to the Port of Providence losing commerce and job opportunities that stem from the commerce.

7.11.2. Preferred Alternative

Narragansett Bay

The analysis of the preferred alternative focuses on the areas surrounding the CAD cells located in Edgewood Shoals that may be affected during construction. Impacts on traffic, pollution, aesthetics, and other factors related to the construction may occur during construction. The construction of the first CAD cell will take approximately nine months and will start in May 2027.

Portions of the lands abutting the Providence FNP and Edgewood Shoals are commercially developed. Among these facilities are a Scotts Miracle Gro property, Univar Solutions Rhode Island (chemical distribution center), Rhode Island Edgewood Yacht Club, and many others. In addition, there are four critical infrastructure (CI) sites including a wastewater treatment plant, a Sprague Energy Corporation Terminal, and two Advanced Chemical Company buildings (precious metal refiner). Impacts on commercial developments will be temporary and minimal.

The communities adjacent to the construction site will likely experience temporary disturbances during each dredge cycle, including the first year of CAD cell construction in Edgewood Shoals followed by another year of continuous dredge operations along the 16.8-mile Providence FNP and hauling and placement activities in Edgewood Shoals activity. After the Providence FNP is dredged in each cycle, the particular CAD cell for each cycle would remain open for 20 years with occasional barge hauling and placement activity in Edgewood Shoals. The continuous use of excavation equipment and barges during the CAD cell construction and placement of dredged material may temporarily affect the aesthetics of the region for citizens residing in or visiting the area.

Rhode Island Sound Disposal Site

Vessels that utilize the area of the RISDS year-round will be able to navigate around the during placement activities, so no temporary impacts to boaters are expected. Sediment placement at the RISDS will be accomplished using a discrete disposal target, which will avoid and minimize impacts to lobster resources at the site, ensuring the local lobster fishery is unaffected by the project.

7.12. Hazardous, Toxic and Radioactive Waste

7.12.1. No Action Alternative

Under the No Action Alternative, the existing conditions noted in Section 4.12 would remain unchanged.

7.12.2. Preferred Alternative

The project is not anticipated to contribute any new hazardous, toxic, or radioactive waste material to Narragansett Bay, Providence FNP or to any of the placement sites.

7.13. Traffic and Transportation

7.13.1. No Action Alternative

Under the No-Action Alternative, conditions will continue to worsen over the 20-year period of analysis. Due to predicted future shoaling rates throughout the Providence FNP, the issues pertaining to the existing condition, described in Section 3, will continue to worsen if the channel is not dredged to the -40-foot MLLW depth recommended in the channel utilization analysis (Appendix B). Shoaling will continue and force Panamax and Handymax vessels, described in Section 4.13, to either increasingly rely on light-loading or to utilize other channels entirely. Further decreased access to the maneuvering area and turning basin in Fox Point Reach will force more vessels to get closer to ProvPort, Inc. and increase the risks to vessels and facilities. Inefficient deliveries to port will also increase as light loading to shallower draft ships becomes essential. The shoaled section of channel that was not dredged in 2005 will continue to force vessels of 600-foot length or greater are required to make smaller swings, rely on tugs more, and have longer wait times to navigate the channel.

7.13.2. Preferred Alternative

Narragansett Bay

In the preferred alternative, dredging will occur in 2028 and again in 2048 to return the entire Providence FNP, including all channel reaches and the maneuvering and turning basins, to the fully authorized depth of -40 feet below MLLW. These dredging cycles will resolve the transportation and navigation issues presently occurring as described under the existing conditions and expected to occur under the no-action alternative. With two complete cycles of maintenance dredging of Providence FNP, the navigation in this FNP will function without adverse impacts due to shoaling. During at least a 20-year period, vessels will no longer be forced to light-load or deal with depth uncertainty related to under keel clearance, and vessels will be able to use the turning basin and avoid proximity to ProvPort, Inc. Dredging of the shoaled sections of channel that were not dredged in 2005 will allow for larger vessel swings, reduce reliance on tugs, and will reduce wait times when navigating the channel. While shoaling will continue to occur over the 20-year period of analysis, these dredging events will allow vessels to traverse the channel safely and efficiently and will eliminate the transportation and navigation issues described in the no-action alternative above for the majority of the period between 2028 and 2068 (covering 20-year periods following each dredge cycle).

Increased construction equipment traffic will occur during each dredge cycle, including the first year of continuous excavation activities and barge use for hauling during the CAD cell construction in Edgewood Shoals followed by another year of continuous dredge operations along the 16.8-mile Providence FNP and hauling and placement activities in Edgewood Shoals activity. After the Providence FNP is dredged in each cycle, the particular CAD cell for each cycle would remain open for 20 years with occasional barge hauling and placement activity in Edgewood Shoals.

Rhode Island Sound Disposal Site

The proposed project would not impact traffic or transportation at the RISDS. Any vessels utilizing the area during placement activities would be able to readily move around and avoid the scow.

7.14. Noise

7.14.1. No Action Alternative

Under the No Action Alternative, the existing noise conditions noted in Section 4.14 would remain unchanged.

7.14.2. Preferred Alternative

Narragansett Bay and Rhode Island Sound Disposal Site

Impacts of Dredging Noise on Marine Life

Based on existing studies, the NMFS current thresholds for determining impacts to marine mammals is between 180 and 190 dB re 1 uPa (micro Pascal) for potential injury to cetaceans and pinnipeds respectively, and 160 dB re 1 uPa for behavioral disturbance/harassment from an impulsive noise source, and 120 dB re 1 uPa from a continuous source. Based on reviews by McQueen et al. (2018) and Southall et al. (2007) it is unlikely that underwater sound from conventional dredging operations can cause physical injury to fish, turtle, or marine mammal species. Some temporary loss of hearing could occur if fishes remain in the immediate vicinity of the dredge for lengthy durations, although the risk of this outcome is low (CEDA, 2011). Fish would likely respond to dredging by using avoidance techniques. Avoidance is defined as an effect that causes fish to not occupy an area that is periodically or infrequently occupied (CEDA, 2011). Dredging is likely to cause avoidance due to noise (and increased suspended sediments and other temporary water quality changes).

The NMFS criterion for physical injury to fish is 206 dB peak, regardless of fish size. However, dredging operations would likely cause the temporary displacement of fish species as a behavioral response to the noise. This is not likely to have an effect on populations of fish as they would be able to use areas outside of the navigation channel, CAD cell areas, and placement sites to traverse to and from spawning and feeding grounds.

The sediment within the project areas is predominantly silt/clay mixture. According to the Clarke et al. (2002), the peak amplitude for the bucket hitting the rocky, gravel, cobble bottom at Cook Inlet, Alaska was about 40 - 50 dB. Both Doug Clarke and Charles Dickerson, US Army Engineer Research and Development Center (ERDC), stated that this peak amplitude of the bucket hitting sand/silt/mud substrate would be significantly less than 120 dB. Since the substrate composition of the Providence River project areas are predominantly silt/clay material, it is reasonable to assume that the proposed dredging would have a lower sound level and should only have minimal impacts to marine life in the project area. Noise during placement activities is not expected to be excessive and will be temporary. Noise due to positioning and repositioning the dredge, raising and lowering spuds, and loading and hauling scows (70-76 decibels, Amerisafe Group, 2024) will be minimal and short-lived, and only during construction activities. Therefore, no significant impacts to the noise environment are expected at the placement sites.

Impacts of Dredging Noise on the Human Environment

Maintenance dredging and periodic new work dredging has occurred in Providence FNP for over 100 years. For maintenance dredging, the dredging equipment is usually present in the Harbor on a 10 to 12-month frequency every 20 years and that frequency is not expected to change with the proposed project. While there would be an increase in the ambient noise level during the dredging phase of the project, the source of noise is at a distance far enough away from any sensitive receptors that no impact is anticipated. Since dredging does not occur in one position for any extended period of time, there will be no disproportionate adverse impact on any communities adjacent to the harbor. Noise generated by this project would not be substantially different from other ambient noise levels of a typical commercial port.

7.15. Coastal Barrier Resources

7.15.1. No Action Alternative

Under the No Action Alternative, coastal barrier resources would remain unchanged.

7.15.2. Preferred Alternative

Narragansett Bay and Rhode Island Sound Disposal Site

As noted in Section 4.17, there is one CBRA unit complex (made up of 11 areas) located within the project area: Unit D02B. There is also one OPA located within Narragansett Bay: OPA D02BP. The proposed project will not affect Unit D02B or OPA D02BP. Additionally, per 16 U.S.C. § 3505(a)(2), the prohibition on Federal expenditures CBRA units does not apply to, “[t]he maintenance or construction of improvements of existing Federal navigation channels (including the Intracoastal Waterway) and related structures (such as jetties), including the disposal of dredge materials related to such maintenance or construction.” USACE submitted a consultation request to USFWS on May 13, 2025, seeking their concurrence on this exemption. Coordination with USFWS is ongoing. There are no CBRA units present in or near RISDS, so no impacts to these resources will occur due to placement at this site.

7.16. Recreation

7.16.1. No Action Alternative

Under the No Action Alternative, the existing recreation conditions noted in Section 4.18 would remain unchanged.

7.16.2. Preferred Alternative

Narragansett Bay and Rhode Island Sound

Minor impacts to recreational boating would occur within the dredging and placement sites during construction of the project. As a public safety measure, boating would be prohibited near the operating construction equipment and sediment placement locations. Recreational access to these areas would return to preconstruction conditions following completion of the project. Although short-term impacts could occur, no long-term adverse effects are anticipated. Commercial shipping would continue in the federal navigation channel. Information would be provided to the U.S. Coast Guard so they could issue a "Notice to Mariners" prior to initiation of construction and for each major change in the construction activities. This would alert public boaters of areas to avoid and the possibility of limited and restricted access. No significant adverse impacts to public safety are expected from the proposed project.

8. Preferred Plan*

Based on the formulation and evaluation of alternatives in Chapters 5, 6, and 7, the preferred plan is Alternative 2A, which meets the DMMP purpose and need to implement the least-cost, practicable and environmentally acceptable plan to maintain the Providence FNP, along with three adjacent shallow-draft FNPs (Bullocks Point Cove, Pawtuxet Cove, and Apponaug Cove) for a period of at least 20 years (through the year 2048), as well as to provide capacity needs for local non-federal dredging over the planning period and to incorporate BU. In Chapter 5, Alternative 2A was among eight action alternatives that were formulated to meet the practicality, acceptability, and completeness criteria used by the Study Team to qualify alternatives in addressing the purpose and need of the study. In Chapter 6, Alternate 2A was shown to be the least cost of the eight action alternatives, including incorporating cost-saving measures of BU. Then in Chapter 7, the environmental consequences of the preferred alternative were presented to further lay out the environmental acceptability of the preferred alternative. Now, in Chapter 8, the Preferred Plan, Alternative 2A will be described in detail, including details of Cycle-One and Cycle-Two dredged material placement facility construction and Providence FNP dredging implementation, project costs and implementation schedule, cost-sharing responsibilities, and real estate requirements.

8.1 Preferred Plan Overview

The Preferred Plan, Alternative 2A, involves excavation and dredging of a total of 11,200,000 CY of unconsolidated material in the Narragansett Bay, including the construction of two large CAD cells and two complete dredge maintenance cycles to address all maintenance dredging needs through at least the year 2048 for the Providence FNP and three adjacent shallow-draft FNPs, along with providing additional placement capacity for local needs through and beyond the year 2048. The preferred plan involves 4,800,000 CY of maintenance dredging over the twenty-year period in the Narragansett Bay area to address existing and predicted shoaling in the FNPs and to maintain the projects to authorized depths and widths, as economically warranted, with all material to be placed in the CAD cells. The preferred plan involves the construction of two CAD cells with access channels, ESN constructed in the year 2027, and ESS constructed in the year 2047, requiring excavation and placement of an additional 6,600,000 CY of unconsolidated materials. The two CAD cells and access channels are predicted to increase water circulation and flushing in the Edgewood Shoals embayment, thus providing marine ecosystem restoration benefits.

The alternative also involves the beneficial use of 2,700,000 CY of excavated material to cap and restore the two constructed CAD cells once completed. Beneficial uses of dredged material are integral to the preferred plan and are included in the Base Plan for cost-sharing purpose because all of the beneficial uses reduce the cost of the plan. Beneficial uses include the following measures: capping and restoring PEB in Cycle-One Capping and restoring the PIDS in Cycle-One, and capping and closing out five out of seven of the FPRN CAD cells in Cycle-One and capping the remaining two FPRN CAD cells in Cycle-Two, the placement areas also involve placement of unsuitable material from the Cycle-Two CAD cell construction into the Cycle-One CAD cell and placing suitable material from excavation of Cycle-Two CAD cell into the Cycle-One CAD cell as final capping material. Suitable material from Cycle-One CAD cell construction will also be placed in RISDS. Volumes of materials being excavated and placed to the various locations from the two CAD cells to be constructed are shown in Table 8-1.

Table 8-1. CAD Cell Construction Requirements for the Preferred Plan (Alternative 2A).

Placement To → / Placement From ↓			**Total Volume** (Note 1)	**Port Edgewood Basin**		**Fox Point Reach - North CAD Cap**		**Prudence Island Disposal Site Cap**		**Cycle One CAD Cell Starter Cell and Capping**		**Rhode Island Sound Disposal Site**	
				8-foot draft equipment		8-foot draft equipment		25-foot draft equipment		8-foot draft equipment		25-foot draft equipment	
				Volume (Note 1)	Haul Dist.	Volume (Note 1)	Haul Dist.	Volume (Note 1)	Haul Dist.	Volume (Note 1)	Haul Dist.	Volume (Note 1)	Haul Dist.
			CY	CY	Miles	CY	Miles	CY	Miles	CY	Miles	CY	Miles
Cycle One	**Edgewood Shoals North**	Main Cell - Unsuitable	37,000	37,000	0.2	0	n/a	0	n/a	n/a	n/a	0	n/a
		Access Channel - All Suitable	246,000	0	0.2	0	n/a	0	n/a	n/a	n/a	246,000	40.2
		Main Cell - Suitable	2,929,000	352,000	0.2	113,000	2.5	1,825,000	17.2	n/a	n/a	639,000	40.5
		Total	**3,212,000**	**389,000**		**113,000**		**1,825,000**		**0**		**885,000**	
Cycle Two	**Edgewood Shoals South**	Main Cell - Unsuitable	38,000	0	n/a	0	n/a	0	n/a	38,000	0.9	0	n/a
		Access Channel - All Suitable	95,000	0	n/a	0	n/a	0	n/a	0	n/a	95,000	39.4
		Main Cell - Suitable	2,824,000	0	n/a	128,000 (Note 2)	3.2	0	n/a	300,000 (Note 3)	1.1	2,346,000 (Note 2)	39.6
		Total	**2,957,000**	**0**		**128,000 (Note 2)**		**0**		**339,000 (Note 3)**		**2,442,000 (Note 2)**	

Note 1: Volumes are all unbulked (in-situ). Haul distances are all one-way.
Note 2: If remaining two FPRN CAD cells are still available for capping, then approximately 128,000 CY could be placed during Cycle-Two as clean capping material.
Note 3: Volumes preliminary estimates only and depend on final quantities during Cycle-Two.

This alternative would address two complete cycles of dredging needs, with dredging and placement of at least 2,400,000 CY of dredged material starting in the year 2028 accommodating federal and non-federal needs immediately, and then at least another 2,400,000 CY of dredged material that had accumulated from the years 2028 through 2048 in Providence FNP, along with accommodating the dredging needs of the three adjacent shallow-draft FNPs and the non-federal needs for up to another 20 years, through the year 2067.

For both dredge cycles, environmental restrictions would require timing of CAD cell construction and excavated material placement and maintenance dredging of the Providence FNP and placement of that dredged material. Table 8-2 shows the months available for operation by reach and dredged material placement location, along with approximate predicted operation durations per reach and haul distances between dredge or placement sites. Table 7-1 in Chapter

7, shows more details about the particular environmental restrictions and how they apply to the locations associated with the preferred plan.

Table 8-2. Construction Durations and Haul Distances with Restricted Months for Providence Federal Navigation Project by Reach for Construction Operations.

Refer to Table 7.1 in Chapter 7 for specific environmental restrictions.

Location	Restriction												Dredging Duration Needed		Haul Distances to CAD Cells	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	CAD Cell Construction Alternative (Year 1) (Months)	O&M (Year 2) With mobilization between reaches (Months)	Cycle One Edgewood Shoals North CAD Cell (Miles)	Cycle Two Edgewood Shoals South CAD Cell (Miles)
Fox Point Reach		X	X	X									2	3	2.17	2.82
Fuller Rock Reach		X	X	X	X	X	X	X	X				0	1	0.85	1.49
Sabin Point Reach						X	X						0	1	1.88	0.69
Bullock Point Reach		X	X			X	X						0	1	3.50	2.31
Conimicut Point Reach		X	X			X	X						0	1	5.28	4.09
Rumstick Neck Reach	X	X	X		X	X	X	X	X	X	X	X	0	1	7.22	6.04
Entrance Channel													0	1	8.30	7.12
Prudence Island Disposal Site													4	0	N/A	N/A
RI Sound Disposal Site													4	0	N/A	N/A
Edgewood Shoals		X	X	X									9 (Note 1)	9 (Note 1)	N/A	N/A
Total Time Duration Needed													9	9		

Legend:	
Construction and Placement Prohibited	X
Construction and Placement Allowed	

Note 1. The time period needed in Edgewood Shoals overlaps with other time periods.

Given the time durations needed for construction, the Providence FNP project construction schedule is shown in Table 8-3.

The following sections describe the two dredge styles in detail for the Preferred Alternative, Alternative 2A, and then describe cost-sharing requirements between the federal government and the Non-Federal Sponsor, and finally real estate requirements for the Preferred Alternative.

Table 8-3. Schedule of Design and Construction Activities by Fiscal Year and Quarter.

Providence FNP, RI Project Construction Schedule		
Construction Cycle	**Activity**	**Date Fiscal Year (Oct 1 – Sep 30) Quarter**
Decision Document	DMMP approved by NAD Commander	2025 Quarter 4
	Sign PPA and Obtain Federal and Non-Federal Funds	2026 Quarter 1
Cycle One	Start Design of CAD Cell and Providence FNP Dredging	2026 Quarter 1
	Mid-Point of Design	**2026 Quarter 3**
	Complete Design	2027 Quarter 1
	Advertise Project	2027 Quarter 1
	Award Project	2027 Quarter 2
	Contractor Notice to Proceed	2027 Quarter 2
	Mobilization CAD Cell Construction	2027 Quarter 2
	Mid-Point of CAD Cell Construction	**2027 Quarter 4**
	CAD Cell Construction Complete	2028 Quarter 2
	Mobilization Providence FNP Maintenance Dredging	2028 Quarter 2
	Mid-Point of Providence FNP Maintenance Dredging	**2028 Quarter 4**
	Providence FNP Maintenance Dredging Complete	2029 Quarter 2
Cycle Two	Start Design of CAD cell and Providence FNP Dredging	2046 Quarter 1
	Mid-Point of Design	**2046 Quarter 3**
	Complete Design	2047 Quarter 1
	Advertise Project	2047 Quarter 1
	Award Project	2047 Quarter 2
	Contractor Notice to Proceed	2047 Quarter 2
	Mobilization CAD Cell Construction	2047 Quarter 2
	Mid-Point of CAD Cell Construction	**2047 Quarter 4**
	CAD Cell Construction Complete	2048 Quarter 2
	Mobilization Providence FNP Maintenance Dredging	2048 Quarter 2
	Mid-Point of Providence FNP Maintenance Dredging	**2048 Quarter 4**
	Providence FNP Maintenance Dredging Complete	2049 Quarter 2

8.2 Preferred Plan – Dredge Cycle One:

For the Cycle-One dredging, the ESN CAD cell would be constructed in 2027 in the Edgewood Shoals embayment of the Providence River. The CAD cell location is a 51-acre area in the northern half of Edgewood Shoals, in an area currently approximately 6 to 15 feet below MLLW in depth (see Figure 5-1). The CAD cell would be located directly south and adjacent to the PEB. Feasibility-level drawings are provided in Appendix E. The CAD cell construction would require over 3,200,000 CY of excavation and placement of unconsolidated materials. The construction placement locations, volumes of placement, and haul distances from the ESN CAD cell to the placement locations are shown in Table 8-1. The placement durations and timing restrictions for the various Providence FNP reaches, CAD cell locations, and placement locations are shown in Table 8-2. The construction schedule is shown in Table 8-3.

The ESN CAD cell is sized to fit 2,400,000 CY of dredged materials from the Providence FNP to be dredged in 2028, three adjacent FNPs (between the years 2028 and 2047), and local non-federal dredging needs over a 20-year period (between the years 2028 and 2047), along with capacity to function as a starter cell for placement of unsuitable material generated from the Cycle-Two CAD cell construction. The dredging requirements of all of these sources are compiled in Table 8-4. This dredged material is predicted to bulk in volume upon excavation and placement by 15%, thus requiring a total CAD cell capacity design of 2,800,000 CY for placement of the unsuitable materials, as shown in Table 8-4. The CAD cell would also need to be capped with an additional three feet of clean material upon final closure and restoration, requiring approximately 300,000 CY of clean material. Additional capacity is predicted to be generated by future settlement and consolidation of the placed material, potentially providing additional space for placement of 170,000 CY more material.

The ESN CAD cell construction would require placement of both unsuitable material and suitable material in a variety of locations, as shown in detail in Table 8-1. Haul distances to the various placement sites are also shown in Table 8-1. A majority of the excavated material from the CAD cell construction would be beneficially used as cost-saving measures, totaling 2,327,000 CY, including filling and capping the PEB, capping and restoring five of the FPRN CAD cells, and capping and restoring the PIDS. An additional benefit is improved water circulation in Edgewood Shoals, which is generated by excavation of the ESN CAD cell and access channel. These beneficial-use sites are shown in Figure 4-1. The remaining 885,000 CY of excavated material, all suitable, would be placed in the RISDS, a designated open-water disposal area.

The ESN CAD cell would be a rectangular-shaped area with lateral dimensions of 1,600 feet north-south and 1,400 feet east-west, dredged at a 1V:5H slope to an elevation of -60 feet MLLW. A new access channel would be constructed between the CAD cell location and the Providence FNP channel to allow access to the ESN CAD cell by large dredging equipment and scows. The 1,955-foot-long access channel would be 280 feet wide at the surface footprint and dredged to a depth of -25 feet MLLW with 1V:5H sideslopes with an 100-foot bottom channel width. The access channel would not be made a part of the authorize FNP. The placement of the CAD cell and access channel could provide the deepened corridor necessary to provide better flushing and thus improved habitat condition in Edgewood Shoals. Therefore, this measure may result in a long-term positive environmental benefit. The access channel could have an alignment adjustment during design with similar excavation volume.

Table 8-4. Anticipated Dredged Material Placement and CAD Cell Construction Capacity Needs for Cycle-One Maintenance Dredging.

The Edgewood Shoals North CAD cell would be designed to contain the bulked quantities.

Dredging Volumes	
Providence River Complex Maintenance Dredging (Cycle One – Year 2028)	**Volume Needed to be Dredged (CY)**
Providence FNP Maintenance	
Entrance Reach (2020 shoaling volume)	33,411
Rumstick Neck Reach (2020 shoaling volume)	11,924
Conimicut Point Reach (2020 shoaling volume)	23,817
Bullock Point Reach (2020 shoaling volume)	114,952
Sabin Point Reach (2020 shoaling volume)	229,092
Fuller Rock Reach (2020 shoaling volume)	381,119
Fox Point Reach (2020 shoaling volume)	836,374
Total as of 2020 Survey	**1,630,689**
Providence FNP Shoaling through December 2026 (see Chapter 3)	384,000
Total Providence FNP Shoaling through December 2026	**2,015,000**
Other Shallow Draft FNPs, shoaling through Dec. 2026	
Bullock Point Cove	7,300
Pawtuxet Cove	34,300
Apponaug Cove	22,000
Total Shallow-Draft FNPs	**63,600**
Starter Cell allowance for Cycle 2 (from excavation of Edgewood Shoals South CAD Cell)	**38,000**
State Allowance total	**300,000**
Total All Sources of dredged volume to place in CAD Cell over 20 years	**2,416,600**
Rounded (nearest 100,000)	**2,400,000**
Capacity Needs in Edgewood Shoals North CAD Cell (Cycle One – Year 2028)	**Capacity Volume (CY)**
Total All Sources of dredged volume to be placed in placement facility over 20 years	**2,416,600**
15% Bulking Factor (during initial placement)	**362,490**
Total with Bulking (Unsuitable material capacity required in CAD cell for 20 years)	**2,779,090**
Rounded (nearest 100,000)	**2,800,000**
Final capping requirement of a 3-foot-thick layer of clean material during closure of the CAD cell after 20 years (preliminary estimate)	**300,000**
Total capacity requirements of CAD cell (rounded nearest 100,000)	**3,100,000**
Potential additional space generated over 20 years of settlement and consolidation prior to final capping (estimated 3,770 CY/acre) (Note 1) Acres = 51	**192,000**
Additional material capacity after 20 years due to settling (original volume to be excavated, assumed to be bulked 15% upon placement))	**170,000**

Note 1: Based on actual consolidation amounts at CAD cell 3AR in Fox Point Reach North.

The ESN CAD cell contains a 1,580-foot section of an existing old navigation channel to access the PEB. The old basin navigation channel contains 2 feet of overlying material not suitable for open-water placement. This unsuitable material would be dredged and placed in the PEB using shallow-draft scows since this area would be filled to -10 feet MLLW. The average haul distance from the ESN CAD cell to PEB is 0.2-mile one-way. The remainder of the material to be dredged from the ESN CAD cell is suitable for open-water placement. All of the material from the new access channel is also suitable for open-water placement.

The work would begin with dredging a total of 37,000 CY of unsuitable material from the existing old basin navigation channel that crosses the ESN CAD cell, and to haul and place this unsuitable material with shallow-draft scows in the PEB. This material would bulk (estimated 15%) during placement for a total placed volume of 43,000 CY. Once the unsuitable material has been removed, dredging of the underlying suitable materials would continue with the shallow-draft equipment to fill the PEB, which has a total capacity of 447,000 CY to -10 feet MLLW. The PEB would be filled to an elevation of -10 feet MLLW using approximately 300,000 CY of suitable material dredged from the ESN CAD cell construction, bulked 15% during placement to 400,000 CY, to cap the placed unsuitable material with at least a 3-foot cap of clean overlying material. Once the PEB was filled to -10 MLLW, the placed material would settle and consolidate 1 to 2 feet over a 5-year period, and basin would restore to a more funtional shallow marine habitat.

In 2027, the next step is dredging into the Edgewood Shoals from the Providence FNP channel to create the new access channel for the ESN CAD cell. This new channel construction would require dredging 246,000 CY of suitable material, which would be hauled on large scows for open-water placement in the RISDS (40.2-mile one-way haul distance). The RISDS is an EPA designated open-water dredged material placement site.

Next, the ESN CAD cell construction would be initiated and completed with large dredge and barge equipment on the ESN CAD cell in year 2027. The CAD cell would be dredged to -60 feet MLLW by removal of 2,929,000 CY of suitable material (bulked to 3,368,000 CY). The first 113,000 CY of this suitable dredged material (bulked to 130,000 CY) would be placed in five FPRN CAD cells (cell 1R, 3R, 4R, 6R, and 7R, as shown in Table 5-3), capping these five cells with at least three feet of clean material, up to -42 feet MLLW. The haul distance is approximately 2.5 miles one way. Next, 1,825,000 CY (bulked to 2,099,000 CY) of suitable material would be excavated and hauled to the PIDS to cap and restore the basin with at least three feet of clean material. The haul distance is approximately 17 miles, one way. Lastly, the remaining 885,000 CY of clean material (bulked to 1,018,000 CY) would be hauled to and placed in the RISDS, a haul distance of 41 miles, one way.

Once constructed, the ESN CAD cell would have a volume of 2,800,000 CY (-60 feet to -11 feet MLLW) for unsuitable material placement and could be capped at least three feet deep with approximately 300,000 CY (-11 feet to -8 feet MLLW) of suitable material. Thus, the CAD cell would provide enough capacity for the predicted 2,400,000 CY (2,800,000 CY with 15% bulking for consolidation) from the combined Narragansett Bay maintenance dredging requirements for the 20-year period, through the year 2047, including capacity as a starter cell for the Cycle-Two dredging cycle.

Following the ESN CAD cell construction, in 2028, the Providence FNP would be dredged of approximately 2,015,000 CY of unsuitable shoaled materials and placement of this material in the constructed ESN CAD cell. Haul distances for placement of dredged material from Providence FNP are shown in Table 8-1 and in Figure 8-1. The placement durations and timing restrictions for dredging the various Providence FNP reaches and placing the dredged material in the ESN CAD cell are shown in Table 8-2.

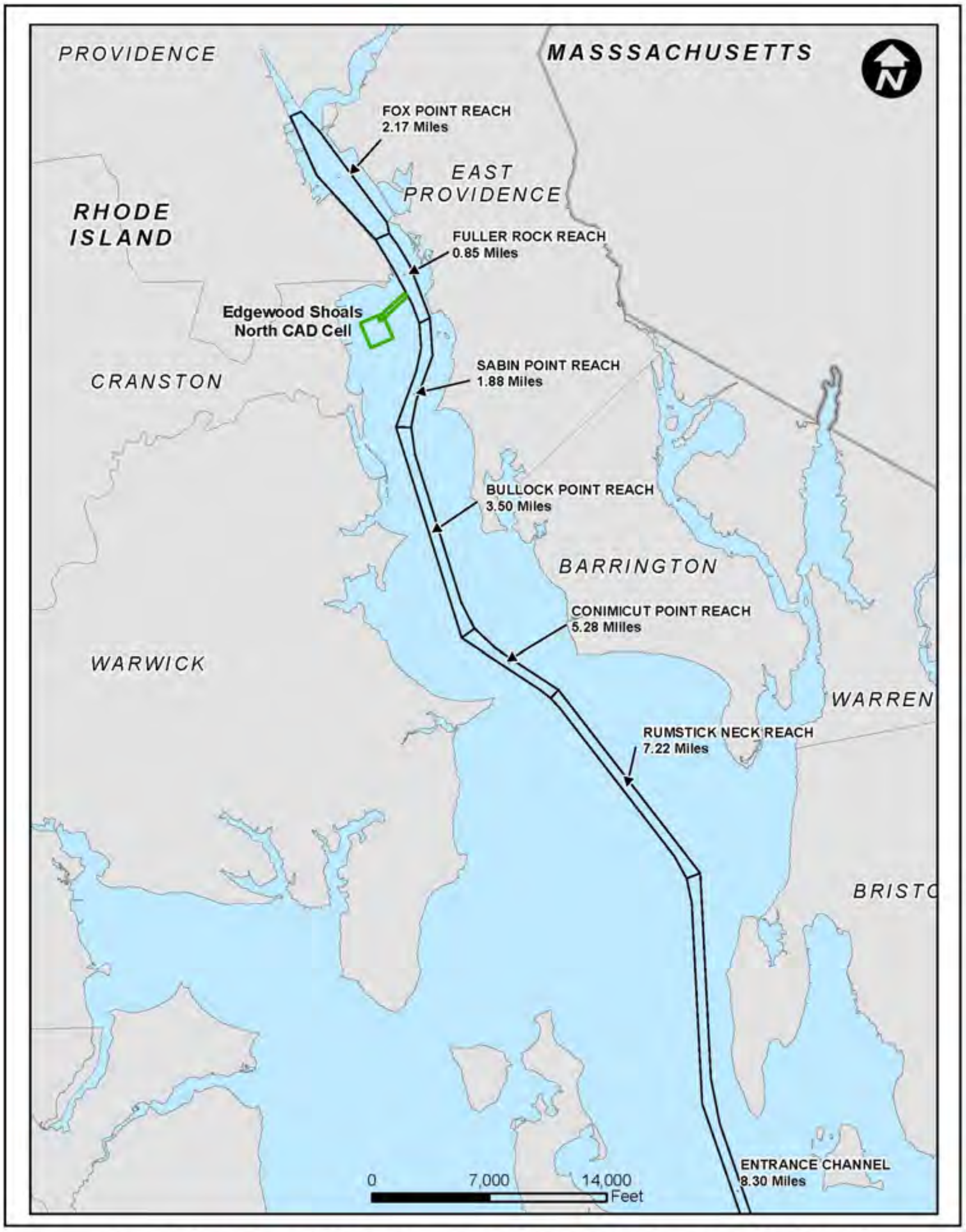


Figure 8-1. Edgewood Shoals North CAD Cell Measure – Haul Distances from Providence Federal Navigation Project Reaches.

The ESN CAD cell would remain open for 20 years (between the year 2028 and 2047), to receive 63,000 CY of additional unsuitable dredged material from nearby shallow-draft FNPs (Bullocks Cove, Pawtuxet Cove, and Apponaug Cove) as well as the allocated 300,000 CY of local non-federal dredged material and predicted 38,000 CY of unsuitable material from the Cycle-Two ESS CAD cell construction. Over the 20-year period, the material placed in the ESN CAD cell is expected to consolidate and settle, allowing for additional capacity of approximately 170,000 CY, as shown in Table 8-4, which can be used for unsuitable material along with final capping with suitable material. Once the ESN CAD cell has reached capacity, filled to no more than -11 feet below MLLW, in approximately 20 years, it would be capped and closed out with at least three feet of clean material, approximately 300,000 CY in volume, depending on the final condition of the ESN CAD cell and final capping needs.

8.3 Preferred Plan – Dredge Cycle Two

After maintenance dredging is completed during the Cycle-One, shoaling will continue in the Providence FNP, and the Study Team predicts that 1,900,000 CY of sediment in the Providence FNP will accumulate and need to be dredged to maintain the fully authorized FNP widths and depth as expected to continue to be economically warranted. All of this shoaled material is expected to be unsuitable for open-water placement; therefore, a second CAD cell (ESS CAD cell) would be constructed in Edgewood Shoals.

Over the next 20 years, the adjacent three FNPs (Bullocks Point Cove, Pawtuxet Cove, and Apponaug Cove FNPs) are expected to also accumulate shoaled materials, for a total estimated shoaled amount of 61,000 CY. Additionally, the Non-Federal Sponsor has requested another placement capacity allowance for local non-federal dredging needs of 300,000 CY anticipated to accumulate during the twenty-year period, between 2048 and 2067. All combined, the future dredging needs of the Providence River area add up to total expected placement needs of bulked unsuitable material of 2,400,000 CY (see Table 8-5).

For the Cycle-Two dredging, the ESS CAD cell would be constructed in the year 2047 in the Edgewood Shoals embayment of the Providence River. The ESS CAD cell location is a 50-acre area in the southern half of Edgewood Shoals, in an area currently approximately 8 to 15 feet below MLLW in depth (see Figure 5-1). The CAD cell would be located directly south of the proposed ESN CAD cell location. Feasibility-level drawings are provided in Appendix E. The ESS CAD cell construction would require 2,958,000 CY of excavation and placement of unconsolidated materials. The construction placement locations, volumes of placement, and haul distances from the ESS CAD cell to the placement locations are shown in Table 8-1. The placement durations and timing restrictions for the various Providence FNP reaches, CAD cell locations, and placement locations are shown in Table 8-2. The access channel could have an alignment adjustment during design with similar excavation volume.

The ESS CAD cell is sized to fit 2,400,000 CY of dredged materials from the Providence FNP, three adjacent FNPs, and local non-federal dredging needs over a 20-year period (between the years 2048 and 2067), along with capacity to function as a starter cell for placement of unsuitable material generated from a potential Cycle-Three CAD cell construction. The dredging requirements of all of these sources are compiled in Table 8-5. This dredged material is predicted to bulk in volume upon excavation and placement by 15%, thus requiring a total CAD cell capacity design of 2,800,000 CY for placement of the unsuitable materials, as shown in Table 8-5.

Table 8-5. Anticipated Dredged Material Placement and CAD Cell Construction Capacity Needs for Cycle-Two Maintenance Dredging.

The Edgewood Shoals South CAD cell would be designed to contain the bulked quantities.

Dredging Volumes	
Providence River Complex Maintenance Dredging (Cycle Two – Year 2048)	**Volume Needed to be Dredged (CYs)**
Providence FNP Maintenance	
Entrance Reach (2028 shoaling volume)	0
Rumstick Neck Reach (2028 shoaling volume)	0
Conimicut Point Reach (2028 shoaling volume)	0
Bullock Point Reach (2028 shoaling volume)	0
Sabin Point Reach (2028 shoaling volume)	0
Fuller Rock Reach (2028 shoaling volume)	0
Fox Point Reach (2028 shoaling volume)	0
Subtotal after 2028 Dredging Cycle Completed	**0**
Providence River Shoaling Jan 2027 to Dec 2046 (based on long-term shoaling rates between 1997-2020 to account for future uncertainty) (see Chapter 3)	1,900,000
Total Providence FNP Shoaling through December 2046	**1,900,000**
Other Shallow Draft FNPs, shoaling through Dec. 2046	
Bullock Point Cove	7,000
Pawtuxet Cove	44,000
Apponaug Cove	10,000
Total Shallow-Draft FNPs	**61,000**
Starter Cell allowance for future dredging and placement requirements (example: from construction of a potential CAD cell in Fox Point Reach South)	**150,000**
State Allowance total	**300,000**
Total All Sources of dredged volume to place in CAD Cell over 20 years	**2,410,000**
Rounded (nearest 100,000)	**2,400,000**
Capacity Needs in Edgewood Shoals South CAD Cell (Cycle Two – Year 2048)	**Capacity Volume (CY)**
Total All Sources of dredged volume to be placed in placement facility over 20 years	**2,410,000**
15% Bulking Factor (during initial placement)	**360,000**
Total with Bulking (Unsuitable material capacity required in CAD cell for 20 years)	**2,770,000**
Rounded (nearest 100,000)	**2,800,000**
Final capping requirement of a 3-foot-thick layer of clean material during closure of the CAD cell after 20 years (rounded)	**300,000**
Total capacity requirements of CAD cell	**3,100,000**
Potential additional space generated over 20 years of settlement and consolidation prior to final capping (estimated 3,770 CY/acre) (Note 1) Acres = 50	**190,000**
Additional material capacity after 20 years due to settling (original volume to be excavated, assumed to be bulked 15% upon placement))	**170,000**
Note 1: Based on actual consolidation amounts at CAD cell 3AR in Fox Point Reach North.	

The ESS CAD cell would also need to be capped with at least three feet of clean material upon final closure and restoration, requiring approximately 300,000 CY of clean material, depending on final closure needs. Additional capacity is predicted to be generated by future settlement and consolidation of the placed material, potentially providing additional space for placement of 170,000 CY more material.

The ESS CAD cell construction would require placement of both unsuitable material and suitable material in a variety of locations, as shown in detail in Table 8-1. Haul distances to the various placement sites are also shown in Table 8-1. Potential locations for BU to be excavated from the ESS CAD cell during construction are capping of the Cycle-One ESN CAD cell (ESN CAD cell) upon the completion of this ESN CAD cell use, in the year 2047, in which approximately between 250,000 to 300,000 CY could be placed as capping material, depending on the final consolidation and capacity needs for capping upon closure. An additional 128,000 CY of clean material could be used as BU to cap the final two FPRN CAD cells (cells 3AR and 5R, as shown in Table 5-3), in 2047. Other beneficial use sites will be studied over the next 20 years, and the remainder of the clean material to be excavated from the ESS CAD cell would be available for those potential future beneficial uses. Meanwhile, for cost estimating purposes, the remaining clean material (approximately 2,442,000 CY) would be assumed to be hauled and placed at the RISDS.

The ESS CAD cell would be a rectangular-shaped area with lateral dimensions of 1,600 feet north-south and 1,400 feet east-west, dredged at a 1V:5H slope to an elevation of -60 feet MLLW. A new access channel would be constructed between the CAD cell location and the Providence FNP channel to allow access to the CAD cell by large dredging equipment and scows. The 900-foot-long access channel would be 250 feet wide at the surface footprint and dredged to a depth of -25 feet MLLW with 1V:5H sideslopes, and an 100-foot channel bottom width. The access channel would not be made a part of the authorize federal navigation project.

The CAD cell contains a 1,560-foot section of an existing old navigation channel to access both this CAD cell location and the Cycle-One CAD cell, the ESN CAD cell. The old basin navigation channel contains 2 feet of overlying material not suitable for open-water placement. This unsuitable material would be dredged and placed in the ESN CAD cell prior to closing out that Cycle-One CAD cell, using shallow-draft scows since this area would be filled to -8 feet MLLW. The average haul distance from the CAD cell to ESN CAD cell is 0.25-mile one-way. The remainder of the material to be dredged from the CAD cell is suitable for open-water placement. All of the material from the new access channel is also suitable for open-water placement.

The work would begin with dredging a total of 38,000 CY of unsuitable material from the existing old basin navigation channel that crosses the CAD cell, and to haul and place this unsuitable material with shallow-draft scows in the PEB. This material would bulk (estimated 15%) during placement for a total placed volume of 44,000 CY. Once the unsuitable material has been removed, dredging of the underlying suitable materials would continue with the shallow-draft equipment to cap the Cycle-One CAD cell, the ESN CAD cell, which would require 250,000 CY to 300,000 CY to cap with at least three feet of clean material. Once the ESN CAD cell was capped, the placed material would settle and consolidate 1 to 2 feet over a 5-year period, and the closed CAD cell would restore to a funtional shallow marine habitat, while allowing tidal circulation through Edgwood Shoals via the constructed access channels and reduced elevation of the CAD cell footprint.

The next step would be in year 2047, excavating into the Edgewood Shoals from the Providence FNP channel to create the new access channel for the Cycle-Two CAD cell (ESS). This new channel construction would require dredging 95,000 CY of suitable material, which would be hauled on large scows for open-water placement in the RISDS (39-mile one-way haul distance).

Next, the CAD cell construction would be completed with large dredge and barge equipment on the CAD cell in year 2047. The CAD cell would be dredged to -60 ft MLLW by removal of the reaminder of the total of 2,824,000 CY of suitable material (bulked to 3,248,000 CY). First, at least 128,000 CY of clean dredged material could be hauled and placed on the final two CAD cells at the FPRN CAD cell site (cells 3AR and 5R) to place a three-foot cap and close out the entire site. The haul distance is approximately 3.2 miles one way. Finally, up to 2,473,000 CY of clean material (bulked to 2,844,000 CY) would be hauled to and placed in the RISDS, a haul distance of 40 miles, one way. Once constructed, the CAD cell would have a capacity of 2,739,000 CY (-60 feet to -11 feet MLLW) for unsuitable material placement and could be capped with between 250,000 and 300,000 CY (-11 feet to -8 feet MLLW) of suitable material.

The CAD cell would provide enough capacity for the predicted 2,400,000 CY (2,800,000 CY with 15% bulking) from the combined Providence River maintenance dredging. The dredged material from channel maintenance would be placed over a 15-year period into the CAD cell, and the material would consolidate during the 15-year time period, so the final CAD cell elevation would settle several feet lower than the -11 ft MLLW elevation, providing several additional feet of draft for final placement of a 3-foot cap of suitable material upon final capping, closure, and restoration of the CAD cell. The CAD cell closure would occur in the year 2067, when a future (Cycle-Three) placement facility may be constructed, and any clean material excavated during construction of that potential facility could be used to cap the Cycle-Two CAD cell.

Following the ESS CAD cell construction, in the year 2048, the Providence FNP would be dredged of predicted 21,900,000 CY of unsuitable shoaled materials and placement of this material in the constructed ESS CAD cell. Haul distances for placement of dredged material from Providence FNP are shown in Table 8-1 and in Figure 8-2. The placement durations and timing restrictions for dredging the various Providence FNP reaches and placing the dredged material in the ESS CAD cell are shown in Table 8-2.

The ESS CAD cell would remain open for 20 years (between the year 2048 and 2067, to receive 61,000 CY of additional unsuitable dredged material from nearby shallow-draft FNPs (Bullocks Cove, Pawtuxet Cove, and Apponaug Cove) as well as the allocated 300,000 CY of local non-federal dredged material. Over the 20-year period, the material placed in the CAD cell is expected to consolidate and settle, allowing for additional capacity of approximately 170,000 CY, as shown in Table 8-5, which can be used for unsuitable material along with final capping with suitable material. Once the CAD cell has reached capacity, filled to no more than -11 feet below MLLW, in approximately 20 years, it would be capped and closed out with three feet of clean material, approximately 300,000 CY in volume, depending on the final condition of the CAD cell and final capping needs.

Edgewood Shoals South CAD Cell Measure - Haul Distances from Providence FNP Reaches

Figure 8-2. Edgewood Shoals South CAD Cell Measure – Haul Distances from Providence Federal Navigation Project Reaches.

8.4 Preferred Plan – Total Project Costs

The Study Team conducted a detailed cost estimate of the Preferred Plan, with additions of contingencies, following level-3 cost estimating and using the CSRA to systematically go through aspects of the project, in compliance with ER 1110-2-1302. This more detailed computer-based simulation for risk analysis for the final preferred plan predicts possible outcomes of an uncertain events. The purpose of this more detailed risk analysis is to present the cost and schedule risks considered with a goal to bring project contingencies to a recommended 80% confidence level for budget and cost-sharing purposes. Details of the level-3 cost estimate and CSRA are shown in Appendix J.

The Preferred Plan (Alternative 2A) implementation first costs and financial costs, or fully funded costs, are summarized in Table 8-6. These costs reflect the placement plan referenced in Table 8-1. The table splits out the costs by Cycle-One and Cycle-Two, and further into activities from design through construction for each cycle. The table also shows the schedule of the mid-point dates of each activity for each cycle. The financial costs are the costs that will need to be cost-shared between the federal government and the local sponsor in accordance with 33 U.S.C § 2211 and ER 1105-2-100. The cost-sharing responsibilities are explained in detail in Section 8.5.

Table 8-6. Preferred Alternative – Alternative 2A Implementation Cost and Activity Dates by Design and Construction Activities and Maintenance Cycles.

Alternative 2A - With FNP and Local Needs Capacity ENN With BU (Cycle One) and ESS (Cycle Two)			Total Cost (FNP and Local)	
			First Cost (2026-Q1) ($)	**Financial (Fully Funded) Cost (Based on Activity Date) ($)**
Cycle	**Activity**	**Mid-Point Activity Date**		
Cycle One (ESN CAD Cell with BU)	CAD-Design Resources	2026-Q3	$1,701,000	$1,726,000
	Suitability Determination	2026-Q3	$0	$0
	CAD-Shellfish Relocation (if needed)	2026-Q3	$60,000	$63,000
	CAD-Construction	2027-Q4	$60,098,000	$62,874,000
	CAD-Constr. Resources	2027-Q4	$1,964,000	$2,072,000
	CAD-Subtotal		**$63,823,000**	**$66,735,000**
	O&M-Design Resources	2026-Q3	$738,000	$751,000
	O&M-Construction	2028-Q4	$26,085,000	$28,000,000
	O&M-Constr. Resources	2028-Q4	$853,000	$926,000
	O&M Subtotal		**$27,676,000**	**$29,677,000**
	Total Cycle One		**$91,499,000**	**$96,412,000**
Cycle Two (ESS CAD Cell)	CAD-Design Resources	2046-Q3	$2,010,000	$3,753,000
	Suitability Determination	2046-Q3	$350,000	$653,000
	CAD-Shellfish Relocation (if needed)	2046-Q3	$60,000	$116,000
	CAD-Construction	2047-Q4	$71,052,000	$124,205,000
	CAD-Constr. Resources	2047-Q4	$2,321,000	$4,501,000
	CAD-Subtotal		**$75,793,000**	**$133,228,000**
	O&M-Design Resources	2046-Q3	$752,000	$1,400,000
	O&M-Construction	2048-Q4	$26,514,000	$47,554,000
	O&M-Constr. Resources	2048-Q4	$866,000	$1,733,000
	O&M Subtotal		**$28,132,000**	**$50,687,000**
	Total Cycle Two		**$103,925,000**	**$183,915,000**
		CAD - Total	**$139,616,000**	**$199,963,000**
		O&M - Total	**$55,808,000**	**$80,364,000**

Total	$195,424,000	$280,327,000

8.5 Preferred Plan – Cost Sharing Requirements

Cost sharing is required by 33 U.S.C § 2211 and Section 101 of WRDA 1986, as amended, and is detailed in ER 1105-2-100. Cost sharing is required for construction of FNPs and for any additional improvements and facilities needed for the long-term maintenance, including CAD cells, which are considered general navigation features subject to cost sharing. The cost-share requirements for FNPs of various depths are shown in Table 2-3 in Chapter 2, Section 2.3.

Since the federal Base Plan includes the addition of measures providing for BU, and these beneficial-use measures actually reduced the design and construction cost of the Base Plan, then all costs will be cost-shared. Based on these cost-sharing requirements, the design and construction costs were split out by the proportionate amounts of space required for the various types of uses. All design and construction costs, through the implementation activities were cost-shared based on the percentage of capacity allocated for the various dredging sources.

Table 8-7 shows the cost-sharing responsibilities between the federal government and the Non-Federal Sponsor for Cycle-One maintenance implementation. Table 8-8 shows the cost-sharing responsibilities between the federal government and the Non-Federal Sponsor for Cycle-Two maintenance implementation. The tables show the percentages of capacity for the various dredged material sources for each maintenance cycle.

In Cycle-One, the Providence FNP, with 2,015,000 CY of dredging needs, accounts for 83.38% of the total capacity of 2,416,600 CY. The shallow-draft FNPs account for 2.63% of the total capacity. The starter cell capacity for the next placement facility for Providence FNP accounts for 1.57%, and the non-federal capacity accounts for 12.41%. Based on these percentages of capacity, the cost-sharing results for Cycle One are shown in Table 8-7. Costs are shown as financial costs, based on expected inflation up to the midpoint dates of when the funds are to be expended.

For Cycle-One maintenance, the total non-federal upfront cost is $22,634,000, with the first allocation of $607,000 to cover the design phase starting in the year 2026, and the second allocation of $22,027,000 for the construction phase, starting in the year 2027. The non-federal additional cost for Cycle-One is $5,845,000, to be paid over a 30-year period beginning after the start of implementation. The total non-federal responsibility for Cycle-One maintenance implementation is $28,479,000.

In Cycle-One, the federal cost for the design phase, including both CAD cell and O&M design in the year 2026 is $1,933,000. The federal cost for the construction phase of the CAD cell in the year 2027 is $42,919,000 and for the construction phase of O&M in the year 2028 is $28,926,000, for a total federal construction phase cost of $71,845,000.

In Cycle-Two, the Providence FNP, with 1,900,000 CY of dredging needs, accounts for 78.81% of the total capacity of 2,400,000 CY. The shallow-draft FNPs account for 2.53% of the total capacity. The starter cell capacity for the next placement facility for Providence FNP accounts for 6.22%, and the non-federal capacity accounts for 12.44%. Costs are shown as financial costs, based on expected inflation up to the midpoint dates of when the funds are to be expended.

Table 8-7. Preferred Plan: Cost Sharing for Cycle One Maintenance Dredging.

Providence River and Harbor Federal Navigation Project - Cost Sharing- Cycle One Cycle-One CAD Cell - Edgewood Shoals South Construction Providence River and Harbor Federal Navigation Project - Maintenance Dredging						
Activity		**Activity Date (Midpoint of activity performance) (Year and Quarter)**	**Financial Cost (Inflated to Activity Date) (Dollars)**			
CAD-Design Resources		2026-Q3	$1,726,000			
Suitability Determination		2026-Q3	$0			
CAD-Shellfish Relocation (if needed)		2026-Q3	$63,000			
CAD-Design Subtotal			**$1,789,000**			
CAD-Construction Work		2027-Q4	$62,874,000			
CAD-Construction Resources		2027-Q4	$2,072,000			
CAD-Construction Subtotal			**$64,946,000**			
Total CAD Cell Cost			**$66,735,000**			
O&M-Design Resources		2026-Q3	**$751,000**			
O&M-Design Subtotal			**$751,000**			
O&M-Construction Work		2028-Q4	**$28,000,000**			
O&M-Construction Resources		2028-Q4	**$926,000**			
O&M-Construction Subtotal			**$28,926,000**			
Total Providence FNP O&M Cost			**$29,677,000**			
Total Cycle-One Design and Construction Cost			**$96,412,000**			
Dredge Volumes	**CY**	**Percentage of Capacity**	**Up-Front Percentage**	**Post Construction Percentage**	**Non-Federal Up-Front Cost**	**Non-Federal Additional Cost**
Providence FNP	2,015,000	83.38%	25.00%	10.00%	$13,911,200	$5,564,500
Shallow-Draft FNPs	63,600	2.63%	10.00%	10.00%	$175,600	$175,600
Starter Cell Capacity	38,000	1.57%	25.00%	10.00%	$262,300	$104,900
Non-Federal Capacity	300,000	12.41%	100.00%		$8,284,600	$0
Totals	2,416,600	100.00%		**Non-Federal Costs Totals (rounded)**	**$22,634,000**	**$5,845,000**
Non-Federal CAD Cell Design Phase (rounded), 2026					**$607,000**	
Non-Federal CAD Cell Construction Phase (rounded), 2027					**$22,027,000**	
Non-Federal Additional Cost (rounded)						**$5,845,000**
Non-Federal Total Cost, Including Upfront and Additional Cost (rounded)						**$28,479,000**
Federal Cost for CAD Cell Design Phase (rounded), 2026						$1,182,000
Federal Cost for O&M Design Phase (rounded), 2026						$751,000
Federal Cost Design Phase - Total (rounded), 2026						$1,933,000
Federal Cost for CAD Cell Construction Phase (rounded), 2027						$42,919,000
Federal Cost for O&M Construction Phase - Providence FNP (rounded), 2028						$28,926,000
Total Federal Cost for CAD Cell Design and Construction						$44,101,000
Total Federal Cost for O&M Design and Construction						$29,677,000
Total Federal Cost (rounded)						**$73,778,000**
Total Non-Federal Cost (rounded)						**$28,479,000**
Total Cost (Total Design and Construction Cost plus NF Additional Cost)						**$102,257,000**

All costs are financial costs, inflated to the midpoint of when various activities are expected to be performed. The Cost-sharing is derived by proportionately splitting out all of the various costs, including mobilization and demobilization, excavation, PED, construction management, and other overhead costs throughout the design and construction of the CAD cell.

Maintenance dredging costs for the FNPs are entirely federal costs and not cost-shared.

Table 8-8. Preferred Plan: Cost Sharing for Cycle Two Maintenance Dredging.

Providence River and Harbor Federal Navigation Project - Cost Sharing- Cycle Two Cycle-Two CAD Cell - Edgewood Shoals South Construction Providence River and Harbor Federal Navigation Project - Maintenance Dredging						
Activity		**Activity Date (Midpoint of activity performance) (Year and Quarter)**	**Financial Cost (Inflated to Activity Date) (Dollars)**			
CAD-Design Resources		2046-Q3	$3,753,000			
Suitability Determination		2046-Q3	$653,000			
CAD-Shellfish Relocation (if needed)		2046-Q3	$116,000			
CAD-Design Subtotal			**$4,522,000**			
CAD-Construction Work		2047-Q4	$124,205,000			
CAD-Construction Resources		2047-Q4	$4,501,000			
Construction Subtotal			**$128,706,000**			
Total CAD Cell Cost			**$133,228,000**			
O&M-Design Resources		2046-Q3	**$1,400,000**			
O&M-Design Subtotal			**$1,400,000**			
O&M-Construction Work		2048-Q4	**$47,554,000**			
O&M-Construction Resources		2048-Q4	**$1,733,000**			
O&M-Construction Subtotal			**$49,287,000**			
Total Providence FNP O&M Cost			**$50,687,000**			
Total Cycle-One Design and Construction Cost			**$183,915,000**			
Dredge Volumes	**CY**	**Percentage of Capacity**	**Up-Front Percentage**	**Post Construction Percentage**	**Non-Federal Up-Front Cost**	**Non-Federal Additional Cost**
Providence FNP	1,900,000	78.81%	25.00%	10.00%	$26,247,700	$10,499,100
Shallow-Draft FNPs	61,000	2.53%	10.00%	10.00%	$337,100	$337,100
Starter Cell Capacity	150,000	6.22%	25.00%	10.00%	$2,072,200	$828,900
Non-Federal Capacity	300,000	12.44%	100.00%		$16,577,500	$0
Totals	2,411,000	100.00%		**Non-Federal Costs Totals (rounded)**	**$45,235,000**	**$11,665,000**
Non-Federal CAD Cell Design Phase (rounded), 2046					**$1,535,000**	
Non-Federal CAD Cell Construction Phase (rounded), 2047					**$43,700,000**	
Non-Federal Additional Cost (rounded)						**$11,665,000**
Non-Federal Total Cost, Including Upfront and Additional Cost (rounded)						**$56,900,000**
Federal Cost for CAD Cell Design Phase (rounded), 2046						$2,987,000
Federal Cost for O&M Design Phase (rounded), 2046						$1,400,000
Federal Cost Design Phase - Total (rounded), 2046						$4,387,000
Federal Cost for CAD Cell Construction Phase (rounded), 2047						$85,006,000
Federal Cost for O&M Construction Phase - Providence FNP (rounded), 2048						$49,287,000
Total Federal Cost for CAD Cell Design and Construction						$87,993,000
Total Federal Cost for O&M Design and Construction						$50,687,000
Total Federal Cost (rounded)						**$138,680,000**
Total Non-Federal Cost (rounded)						**$56,900,000**
Total Cost (Total Design and Construction Cost plus NF Additional Cost)						**$195,580,000**

All costs are financial costs, inflated to the midpoint of when various activities are expected to be performed. The Cost-sharing is derived by proportionately splitting out all of the various costs, including mobilization and demobilization, excavation, PED, construction management, and other overhead costs throughout the design and construction of the CAD cell.
Maintenance dredging costs for the FNPs are entirely federal costs, and not cost-shared.

For Cycle-Two maintenance, the total non-federal upfront cost is $45,235,000, with the first allocation of $1,535,000 to cover the design phase starting in the year 2046, and the second allocation of $43,700,000 for the construction phase, starting in the year 2047. The non-federal additional cost for Cycle-Two is $11,665,000, to be paid over a 30-year period beginning after the start of implementation. The total non-federal responsibility for Cycle-Two maintenance implementation is $56,900,000.

In Cycle-Two, the federal cost for the design phase, including both CAD cell and O&M design in the year 2046 is $4,387,000. The federal cost for the construction phase of the CAD cell in the year 2047 is $85,006,000 and for the construction phase of O&M in the year 2048 is $49,287,000, for a total federal construction phase cost of $134,293,000.

A PPA will need to be executed between the U.S. Government and the Non-Federal Sponsor, laying out the scope of work to be performed, financial cost-sharing responsibilities, estimated cost-shared financial costs, and schedules for the two maintenance cycles. This PPA will need to be executed prior to initiation of the implementation phase of this project. The particular amount of non-federal funds scheduled to be obligated and/or expended for each fiscal year will be requested from the Non-Federal Sponsor prior to beginning of each fiscal year in which work will be performed. Work will not commence until the appropriate amount of non-federal and federal funds are in place as needed.

8.6 Preferred Plan – Real Estate Requirements

The Study Team prepared a Real Estate Report for this DMMP, attached as Appendix L. There are no real estate acquisition requirements for the Preferred Plan. All work will be conducted in water, all equipment will be brought in by water, and no on-land staging or work areas are required. The project's purpose is to improve navigation. Therefore, navigation servitude applies and no real estate interests are required. Because navigation servitude applies, no land value estimates were required or developed.

9. Compliance with Applicable Laws and Policies*

Federal Statutes

1. American Indian Religious Freedom Act of 1978, 42 U.S.C. 1996.

Compliance: This project will not impede access by Native Americans to sacred sites, possession of sacred objects, and the freedom to worship through ceremonials and traditional rites.

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

Compliance: Public notice of the availability of this report to the EPA is required for compliance pursuant to Sections 176c and 309 of the CAA. A 30-day Public Notice will be published and coordination with the EPA will be performed. This maintenance dredging project is exempt from performing a conformity review based on 40 CFR 93.153.

3. Clean Water Act of 1977 (Federal Water Pollution Control Act Amendments of 1972) 33 U.S.C. 1251 et seq.

Compliance: A Section 404(b)(1) Evaluation and Compliance Review has been incorporated into this report. A State Water Quality Certification (WQC) pursuant to Section 401 of the CWA will be requested from the State of Rhode Island for the placement of material.

4. Coastal Zone Management Act of 1972, as amended, 16 U.S.C. 1451 et seq.

Compliance: A Coastal Zone Management Consistency Determination (CZMCD) was developed to demonstrate compliance with Rhode Island's coastal zone management policies. The CZMCD will be provided to the State of Rhode Island's Coastal Zone Management Program for their concurrence.

5. Endangered Species Act of 1973, as amended, 16 U.S.C. 1531 et seq.

Compliance: USACE has made the determination that the proposed project will have no effect on species managed by USFWS and it may affect, but is not likely to adversely affect, any threatened or endangered species managed by NMFS. Coordination with USFWS and NMFS is ongoing.

6. Federal Water Project Recreation Act, as amended, 16 U.S.C. 460l-12 et seq.

Compliance: Public notice of availability of the project report to the National Park Service (NPS) and Rhode Island Office of Statewide Planning relative to the Federal and State comprehensive outdoor recreation plans signifies compliance with this Act.

7. Fish and Wildlife Coordination Act, as amended, 16 U.S.C. 661 et seq.

Compliance: Coordination with the USFWS, NMFS, and State fish and wildlife agencies signifies compliance with the Fish and Wildlife Coordination Act. Coordination is ongoing.

8. Land and Water Conservation Fund Act of 1965, as amended, 54 U.S.C. 200301 et seq.

Compliance: Public notice of the availability of this report to the NPS and the Rhode Island Office of Statewide Planning relative to the Federal and State comprehensive outdoor recreation plans signifies compliance with this Act.

9. Marine Protection, Research, and Sanctuaries Act of 1971, as amended, 33 U.S.C. 1401 et seq.

Compliance: The project involves the transportation and disposal of dredged material in ocean waters pursuant to Sections 102 and 103 of the Act, respectively. No disposal of materials at the RISDS will occur unless it meets the requirements of MPRSA. Testing has found portions of the proposed dredged material to be suitable for disposal at RISDS and meets the requirements of the MPRSA. EPA concurred that the material designated to be placed at RISDS was suitable for open-water placement. EPA's concurrence for the project is in the suitability determination (Appendix F).

10. National Historic Preservation Act of 1966, as amended, 54 U.S.C. 300101 et seq.

Compliance: Coordination with the SHPO and Tribes will be conducted. Appendix A will contain the coordination correspondence when available for the final report.

11. Native American Graves Protection and Repatriation Act (NAGPRA), 25 U.S.C. 3001-3013, 18 U.S.C. 1170

Compliance: Regulations implementing NAGPRA will be followed if discovery of human remains and/or funerary items occur during implementation of this project. Not applicable as Federal property is not present in the APE.

12. Abandoned Shipwreck Act as amended, 43 U.S.C 2101-2106

Compliance: Regulations implementing this Act will be followed if shipwrecks are identified as part of this project with U.S. Government transferring title to the State on state-owned lands and retaining title on federal lands and in the case of U.S. military vessels.

13. National Environmental Policy Act of 1969, as amended, 42 U.S.C 4321 et seq.

Compliance: Preparation of an Environmental Assessment signifies partial compliance with NEPA. Full compliance shall be noted at the time the FONSI or Record of Decision is issued.

14. Rivers and Harbors Act of 1899, as amended, 33 U.S.C. 401 et seq.

Compliance: No requirements for projects or programs authorized by Congress. The proposed maintenance project is being conducted pursuant to the Congressionally approved- authority.

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

Compliance: Coordination with the NMFS and preparation of an EFH Assessment is ongoing. Coordination correspondence and the EFH Assessment will be in Appendix H.

16. Coastal Barrier Resources Act, as amended, 16 U.S.C. 3501 et seq.

Compliance: There is a CBRA multi-unit located adjacent to the project footprint, however, maintenance of the Providence FNP is exempt from Federal expenditure limitations that may otherwise be required by the CBRA since the FNP existed prior to mapping of the Coastal Barrier Resource System Unit on October 24, 1990 (as defined in Section 6(b) of CBRA). Therefore, this project is compliant with this Act.

17. Marine Mammal Protection Act of 1972, 16 U.S.C. 1361-1407.

Compliance: The project will not adversely impact marine mammals.

18. National Invasive Species Act, as amended, 16 U.S.C. 4701 et seq.

Compliance: The project will not introduce or disperse nonindigenous species into waters of the U.S. The contract specifications will require that all equipment be cleaned prior to mobilization to the project site.

Executive Orders (EO)

1. EO 11593, Protection and Enhancement of the Cultural Environment, 13 May 1971

Compliance: Coordination with the SHPO and Tribes will signify compliance.

2. EO 13007, Accommodation of Sacred Sites, 24 May 1996

Compliance: Access to and ceremonial use of Indian sacred sites by Indian religious practitioners will be allowed and accommodated. No adverse effects to the physical integrity of such sacred sites will occur.

3. EO 13045, Protection of Children from Environmental Health Risks and Safety Risks. 21 April 1997.

Compliance: The project will not create a disproportionate environmental health or safety risk for children.

4. EO 13175, Consultation and Coordination with Indian Tribal Governments, 6 November 2000.

Compliance: Consultation with Indian Tribal Governments, where applicable, and consistent with executive memoranda, DoD Indian policy, and USACE Tribal Policy Principles signifies compliance.

5. *EO 13061, and Amendments – Federal Support of Community Efforts Along American Heritage Rivers, 11 September 1997.*

Compliance: The project is not located along an American Heritage River.

6. EO 13112 - Invasive Species, 3 February 1999, as amended by Executive Order 13751, Safeguarding the Nation from the Impacts of Invasive Species, 8 December 2016.

Compliance: The project will not promote or cause the introduction or spread of invasive species.

7. EO 13186, Responsibilities of Federal Agencies to Protect Migratory Birds, 11 January 2001.

Compliance: The proposed project is not expected to incur any significant adverse effects to migratory birds.

Executive Memorandum

1. White House Memorandum, Government-to-Government Relations with Native American Tribal Governments, 29 April 1994.

Compliance: Consultation with Federally Recognized Indian Tribes signifies compliance. Appendix A contains the coordination correspondence.

10. Actions to Minimize Environmental Consequences*

Coordination with federal and state resource agencies is ongoing. To minimize adverse impacts to resources in Narragansett Bay (including the FNP, Edgewood Shoals, and PIDS) and RISDS, the following actions are being considered:

1. Dredge silt material from all reaches of the Narragansett Bay using an enclosed clamshell bucket dredge and prohibit scow overflow during operations.
2. Only dredge the Rumstick Neck Reach from April 1 to April 30 to avoid impacts to the conditional shellfishing area.
3. Avoid the quahog spawning areas during the spawning season by avoiding dredging between Sabin Point and Conimicut Point from June 1 through July.
4. Avoid dredging and disposal north of Fields Point (Fox Point and upper Fuller Rock Reaches) during the period when winter flounder larvae are most abundant in the water column (February 1 through April 30).
5. Avoid dredging between Bullock Point and 3,500 feet south of Conimicut Point during the winter flounder spawning (egg) period (February 1 through March 30).
6. When dredging the FNP near Watchemoket Rock (Fuller Rock Reach), maintain an approximately 585-foot buffer around Watchemoket Rock for nesting birds of state concern.
7. Allow non-federal dredging projects with unsuitable material to dispose their material in constructed CAD cells
8. Beneficially use suitable dredged material from CAD cell construction at PEB and PIDS.
9. Material placement at RISDS will adhere to the Group A conditions outlined in the Corps and NMFS Programmatic Section 7 Consultation for open water and nearshore dredged material placement sites as described in Section 7.7.3.

11. Agency Coordination and Public Involvement*

Throughout the dredged material management study, meetings were held to keep the public and stakeholders informed of the progress of the study. Additionally, regular meetings were held with the Non-Federal Sponsor. The DMMP and EA will be made available for public review and comment for a period of 30 days in spring 2025. All Federal, state, and local agencies, as well as non-governmental organizations and Tribes contacted for public review are listed in Table 11-1 below.

11.1. Stakeholder Involvement

USACE coordinated with the Non-Federal Sponsor and other stakeholders occurred regularly throughout the development of this DMMP via emails, letter exchange, teleconference, and on-site meetings. Stakeholder and Beneficial Use meetings were held as follows:

- June 28, 2019, at Save the Bay® in Providence, Rhode Island
- May 7, 2020 – Quahog Relocation Meeting – Edgewood Shoals CAD – USACE, & RIDEM
- December 15, 2021 — USACE, EPA, RIDEM, NOAA Fisheries, NOAA ESA, RI CRMC, RIDEM, RIDEM Div. of Marine Fisheries, and Save the Bay®(STB)
- August 12, 2022 – USACE, RIDEM, The Nature Conservancy, EPA, RI CRMC, NOAA, STB
- December 15, 2022 –Narragansett Bay National Estuarine Research Reserve, The Nature Conservancy, RI CRMC, NOAA NMFS, NOAA Fisheries, Save the Bay®, RIDEM Div. of Marine Fisheries, RIDEM Office of Water Resources, USFWS, EPA, USACE
- January 11, 2023 –RI CRMC and RIDEM. Planning Fishermen Outreach for Prudence Island Sampling/Beneficial Use.

USACE initiated coordination with local fisherman to discuss opportunities and concerns of potential uses of the clean material from CAD cell excavation via email on February 17, 2023, to contacts provided by the RIDEM Division of Marine Fisheries. Contacted groups include the Rhode Island Lobstermen's Association, the Rhode Island Saltwater Anglers Association, Fixed Trap and Mobile Gear fishermen.

11.2. Coordination with Federal, State, Regional, and Local Agencies, and Tribes

USACE coordinated with Federal, state, regional, and local agencies in conjunction with the preparation of the DMMP and EA. An interagency coordinated site visit was conducted on June 28, 2019. In accordance with Section 106 of the NHPA, USACE will coordinate with the Rhode Island SHPO and Tribes.

A public notice will be issued for this project in spring 2025. Refer to Appendix A for coordination documentation. The following agencies that have been contacted for this project include:

Table 11-1. Coordination with Federal, State, Regional and Local Agencies, and Tribes.

Federal Agencies
National Marine Fisheries Service
National Oceanic and Atmospheric Association
U.S. Coast Guard
U.S. Environmental Protection Agency, Region 1
U.S. Fish and Wildlife Service
State Agencies
Rhode Island Coastal Resources Management Council
Rhode Island Department of Environmental Management (RIDEM) Marine Fisheries, Dredging and Planning, & Marine Fisheries-Shellfish
Rhode Island State Historic Preservation Commission
Local Agencies
City of Providence
ProvPort
Tribes
Mashpee Wampanoag Tribe
Narragansett Indian Tribe
Wampanoag Tribe of Gay Head (Aquinnah)
Non-Profit Organizations
Narragansett Bay Commission
Rhode Island Natural Heritage Survey
Save the Bay®
The Nature Conservancy
Other
Brown University
Narragansett Bay National Estuarine Research Reserve
Edgewood Shoals Yacht Club
Providence River Channel Task Force
University of Rhode Island - Graduate School of Oceanography

11.3. Public Involvement

Public involvement included meetings with local harbor officials from Providence and surrounding areas. These officials expressed a need to dredge the entire area within the FNP channel including areas not dredged in the most recent federal maintenance dredging project in 2005. USACE included this input as a part of the alternatives evaluated during plan formulation that will result in including the areas not dredged in 2005.

USACE also held multiple meetings with local, state and federal agencies as noted in Table 11-1 above in 2021 through 2023 to solicit input on local and state dredging needs, potential placement sites for dredged material, and potential BU measures. The results of these meetings aided in the development of alternatives that integrated interagency input resulting in the successful identification of additional local and state dredging needs that were integrated into the design of the CAD cell alternatives, as well as three BU measures that will result in utilizing over 70% of the suitable dredging material for disposal at BU site locations.

Additional public involvement will occur during the public comment period. Once the comment period concludes, USACE will consolidate and address any comments received in the Final DMMP/EA.

12. Recommendation

Based on the formulation and evaluation of the dredged material management alternatives presented in Chapter 6 and environmental consequences of the preferred alternative compared to those of the No-Action Alternate in Chapter 7, Alternative 2A was selected as the recommended plan since the alternative meets the following decision criteria:

- The alternative provides the least-cost, environmentally acceptable, and practicable method, meeting the Federal Standard, for long-term management (through at least the year 2048) of all of the maintenance requirements for the Providence FNP to fully maintain the project as economically warranted for commercial navigation needs.
- The alternative provides for the least-cost placement capacity plan for long-term placement needs for maintenance dredging of the three associated shallow-draft FNPs (Pawtuxet Cove, Bullocks Point Cove, and Apponaug Cove) through the year 2048, and beyond to the year 2067.
- The alternative provides for the placement capacity for non-federal dredging needs as requested by the Non-Federal Sponsor through the year 2048, and beyond to the year 2067.
- The alternative can be implemented practicably, consistent with sound engineering practices.
- The alternative is environmentally acceptable, meeting all federal environmental standards, and providing beneficial use of dredged materials.
- The alternative provides for substantial beneficial uses of dredged material derived from the long-term management of the Providence FNP.

Alternative 2A fully meets the purpose and needs and objectives of the study and is recommended for implementation.

____
Date

____
Name
Colonel, U.S. Army
District Commander

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Providence River and Harbor Federal Navigation Project
Rhode Island Dredged Material Management Plan
and Environmental Assessment

Appendix A
Agency Coordination and Public Involvement

Providence River DMMP
Stakeholder's Meeting
June 28, 2019

Notes:

1. -Bullocks Cove and Pawtuxet Cove will be added for disposal in CAD cell whenever the need to maintain those projects arises and funding becomes available.
2. -State (CRMC) interested in cutting channel from Port Edgewood Basin toward the Federal Channel to further improve water circulation in the Edgewood Shoal area.
3. -Year zero CAD (receiving only Federal O&M material) will only be open short term (Edgewood Shoals). A Sate CAD cell (which would also have capacity for the Corps' year 10 dredging) would also need to be constructed in year 0 and would be left open. That CAD cell would probably not be in the Edgewood Shoal area as we are presuming there would be a restriction on leaving a CAD cell open in that area long term.
4. -State requires 300,000 cy additional CAD capacity every 10-year dredge cycle. The State is interested in having a CAD cell created to coincide with the channel referenced in Item 2 above. However there's bedrock in that area which will limit the CAD cell depth and capacity.
5. -Parent sediment dug for previous cycle was so variable that it was impossible to use for Beneficial Use. We expect the same for this round of CAD cell(s).
6. -Narragansett Bay Commission can monitor the area during and after construction to see if Edgewood Shoals work made a difference in water circulation.
7. -If we end up using Sabin Point CAD, the old turning basin at Edgewood Shoals would still get filled as part of that (and any other proposed) CAD cell alternative(s).
8. -Save the Bay and other stakeholders are working to open Sabin Point Beach. Concern was expressed that a CAD cell in that location might cause contamination to end up on that beach. Can we move the Sabin Point CAD cell a little to the north, further away from the beach?
9. -Others commented that it wouldn't make a difference to the beach since the material to be placed in the Sabin Point CAD would only be unsuitable material going on top of other unsuitable material. The CAD cell would eventually be "capped" with "cleaner" material than what is currently in the area (presumably representing an improvement).
10. -When are we reaching out to fisherman? I would like to have a better idea of our CAD cell alternatives so as to not invoke undue anxiety on the part of the fishing community. If we can eliminate some alternatives, then there should be less to deal with at that meeting.
11.

From: Walsh, Michael E CIV USARMY CENAE (US)
To: Laura Walsh at Work; Decelles, Elizabeth C CIV USARMY CENAE (US); Burnett, Adam W CIV USARMY CENAE (USA); Loyd, Richard B CIV USARMY CENAE (US)
Subject: Providence Harbor dredge: State"s Initial Comments
Date: Monday, July 8, 2019 7:31:51 AM

All,

Attached are the State's (CRMC) comments on the Providence River DMMP resulting from the Stakeholder's meeting we held on the 28th.

We need to meet and discuss their preferences.

I will schedule a meeting.

Mike Walsh

Navigation Project Manager

1-978-318-8586

From: Dan Goulet
Sent: Wednesday, July 3, 2019 8:41 AM
To: Walsh, Michael E CIV USARMY CENAE (US)
Cc: Jeff Willis
Subject: [Non-DoD Source] Providence Harbor dredge

Mike

Thank you so much for coming down and detailing all of the work you guys have done. You asked that we send along some of our concerns or preferences for the project.

The state would like to have all of the suitable material removed from the CAD cell construction to be used as fill in stillhouse cove to raise the elevation in keeping with the Kincade studies. If the entire cove can't be filled with the material it would be great if the entire area was permitted with sediment quality parameters so the state could continue the water quality restoration after this project is done or in the next years (year 10) the remaining area could be filled with the next Corps cad cell material.

The State would like to have our cell located and oriented in the shoal area between the main channel and the old basin so that it creates the channel that the Kincade study shows would allow for the full water quality benefits. We also ask that if this can be part of Corps restoration project to help with costs (so long as it does not delay the project) that you pass it along to the appropriate person.

While siting of the CAD cell will need to meet the Federal standard, our preference would be to have it in the federal channel and that the state caps it after the material has consolidated. We assume this will reduce the overall project cost and reduce our cost share.

If you have any questions or I have not been clear in our preferences please don't hesitate to call or email.

Dan

Danni Goulet, PE

Coastal Resources Management Council

4808 Tower Hill Road

Wakefield, RI 02879

401-783-3370

Fax 401-783-3767

RHODE ISLAND
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
DIVISION OF MARINE FISHERIES
Three Fort Wetherill Road
Jamestown, Rhode Island 02835

July 28, 2019

Department of the Army
US Army Corps of Engineers New England District
696 Virginia Road
Concord, MA 01742-2751

RE: Preliminary comments to consider when developing an Environmental Assessment (EA) and Dredged Material Management Plan (DMMP) for the proposed maintenance dredging of the Providence River Federal Navigation Project (FNP) in Providence, RI

Dear Mr. Walsh,

Thank you for coordinating a stakeholder meeting on June 28, 2019 at Save the Bay in Providence, Rhode Island (RI) to discuss aspects related to the development of an Environmental Assessment (EA) and Dredged Material Management Plan (DMMP) for the proposed maintenance dredging of the Providence River Federal Navigation Project (FNP) in Providence, RI. I appreciate the efforts that the ACOE has undertaken to assess the location for potential future Confined Aquatic Disposal (CAD) cells and options for potential beneficial reuse of dredged materials.

As requested, we are providing preliminary comments on aspects related to the EA and DMMP shown at the June 28, 2019 stakeholder meeting. We fully expect to have additional comments and questions as the development of the EA and DMMP continues. We hope these comments are the beginning of an on-going discussion and collaboration to incorporate RI Department of Environmental Management (DEM) Division of Marine Fisheries (DMF) feedback into the draft EA and DMMP.

At the June 28, 2019 Stakeholder meeting, three potential locations for CAD cell creation were shown (i.e., Edgewood Shoal CAD, URI Scenerio #3; Sabin Point Reach CAD; Rumstick Neck Reach CAD) and the filling of Port Edgewood Basin.

1) Of these three options, DMF believes the Rumstick Neck Reach CAD option is not viable and should be removed from consideration.
   a) This area is open to shellfishing and a large portion of quahog harvest stems from this area.
   b) Creating a CAD in this area would directly interfere with wild harvest opportunities and would strongly be opposed by the DMF and the commercial shellfish industry.

2) Considering that future potential CAD cells will be located lower in the Providence River, and possibly in areas outside of the federal navigation channel, DMF has concerns

regarding whether disposal of dredge spoils into the (new) CAD cells could affect surrounding habitat, including contamination of shellfish and finfish via resuspension of contaminated fines.

a) We suggest that for all remaining potential CAD areas, including those discussed at the June 28, 2019 Stakeholder meeting (i.e., Edgewood Shoal CAD, URI Scenerio #3; Sabin Point Reach CAD), as well as those yet to be identified, more information and analytical work is needed to determine, or predict, how disposal of future dredge spoils into the (new) CAD cells could affect surrounding habitat, including contamination of shellfish and finfish through resuspension of fines.

   i. The ACOE should be aware of the following:

      (a) For several years the DEM, in partnership with the RI Department of Health, has been evaluating portions of the lower Providence River for shellfishing, primarily between Gaspee and Conimicut Point. Portions of this area may be available for wild harvest of shellfish in coming years.

      (b) Improvements to stormwater management at Sabin Point Park have been underway, with the goal of improving water quality to a level that allows for swimming at this Sabin Point City Park.

   ii. Overall, DMF believes that additional analytical work and modeling will be needed to assess short- and long-term risk and potential impacts from contamination to areas down-river and down-bay for any of the current and future potential CAD cell locations.

3) We offer the following comments on the potential filing of the Edgewood basin and creation of the Edgewood Shoal CAD, URI Scenario #3:

   i. Although more information is needed, DMF is not opposed to the approach of increasing the elevation of the Edgewood Basin.

      (a) DMF will require more information to evaluate this request, including the spatial extent and current/proposed depth, as we well characteristics of sediment for disposal.

   ii. DMF is concerned that creation of a new CAD cell (shown as Edgewood Shoal CAD, URI Scenario #3 at the Stakeholder meeting) and increasing the elevation of the Edgewood Basin in the same dredging cycle may have potential cumulative impacts to shellfish and other marine resources.

      (a) Further information will be required, (see iii below) to more adequately evaluate this option.

      (b) An alternative approach may be to create a new CAD for the first dredging cycle in a location other than Edgewood Shoal area and use those spoils to increase the elevation of the Edgewood Basin. This approach may reduce cumulative impacts from dredging to a given area of reach of the Providence River; however, this does not consider outputs from the modeling scenarios conducted by URI.

   iii. For both options, DMF will require:

      (a) An evaluation of potential impacts to shellfish from dredging and filling, and a potential relocation plan will need to be developed.

      (b) Modeling scenarios and outputs conducted by URI will need to be shared and reviewed by DMF.

4) We offer the following comments on the potential Sabin Point Reach CAD:
   a) Overall, we understand that the location shown has not been ground-truthed and further ACOE work is needed to determine the exact location of this potential CAD cell.
   b) In general, locating future CAD cells within the FNC is likely a preferred option relative to other areas located not within the FNC.
   c) As mentioned in Comment 2.A.i and 2.A.ii, additional analytical work and modeling will be needed to assess short- and long-term risk and potential impacts from contamination to areas down-river and down-bay for any of the current and future potential CAD cell locations.

5) Some general, overarching comments to consider include:
   a) Locating future CAD cells within the Federal Navigation Channel may reduce impacts to marine resources and conflicts with other uses.
   b) As with the previous Providence River FNP dredging, DMF and ACOE will need to consider and/or develop:
      i. TOY restrictions and sequencing options, including tidal and weather restrictions, when developing the DMMP to minimize impacts to fish (i.e., winter flounder and other spawning finfish and anadromous species' spring and fall migrations) shellfish and other marine resources, and other potential existing uses;
      ii. Restrictions on dredging or dredge disposal based on tidal, weather, and other environmental factors;
      iii. A sampling design and monitoring system to track the movement of the sediment plume resulting from dredging and dredge disposal operations to ensure that only incidental fallback of dredge material results from the dredging activity, and monitoring physical attributes, including dissolved oxygen, turbidity, and total suspended solids at the dredge sites within the federal channel.

I welcome the opportunity to discuss these comments in more detail in the coming months, as well as provide further feedback as new EA and DMMP information becomes available. In the meantime, please let me know if you have any questions or need more information. Thank you again for coordinating the stakeholder meeting and the opportunity to work collaboratively in the development of these documents. DMF looks forward to working with you and the ACOE on this project.

Sincerely,

Eric Schneider
Principal Marine Biologist

Providence River & Harbor, Federal Navigation Project Dredged Material Management Plan DMMP

Stakeholder's Meeting

July 15, 2019

New England District
US Army Corp of Engineers

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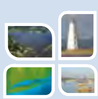

Presentation Agenda

- Project History
- Data Collection & Results
- Dredging Alternatives Analysis
- Unsuitable Dredged Material Placement Alternatives
- Suitable Dredged Material Placement Alternatives
- Discussion
- Questions / Comments

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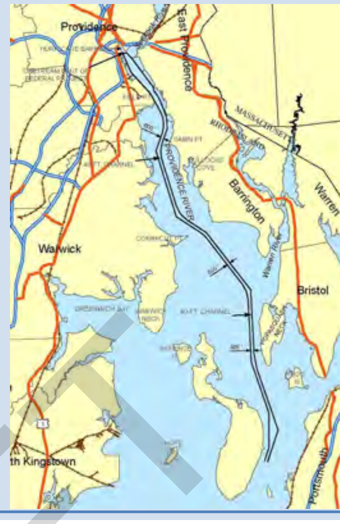
2

Providence River & Harbor, RI Project History

- Authorized by the Act of 30 August 1852, and modified numerous times since then.
- The existing FNP consists of a 16.8 mile long channel, 40 feet deep and generally 600 feet wide, from deep water in Narragansett Bay (just south of Prudence Island Light) to the head of navigation at the Seekonk River.
- Maintenance Dredging last performed between 2003-05: Total 3,821,349 CY
  - ❖ Maint. to RISDS: 2,637,053 CY
  - ❖ Maint. to CAD Cells: 1,184,341 CY
  - ❖ CAD material to RISDS: 1,737,190 CY
  - ❖ CAD material to upland: 52,030 CY
  - ❖ Extra CAD Space: 302,462 CY
- Non-Federal Sponsor: State of Rhode Island



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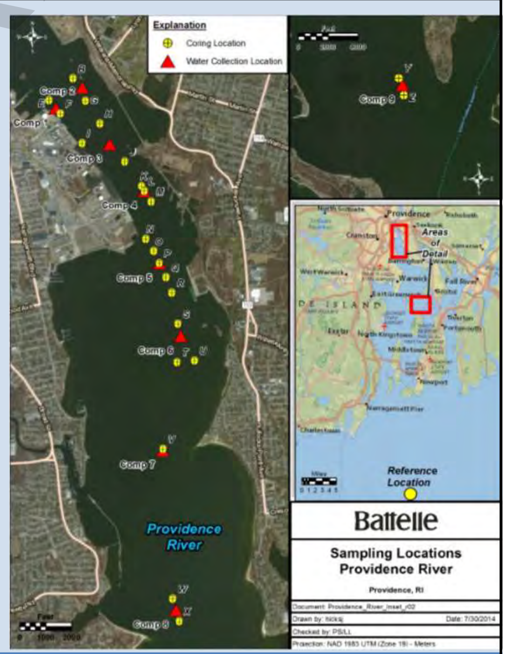
Data Collection & Results

- Most recent hydrographic survey data collected in May 2015 – May 2016
- Estimated Dredge Volumes:
  - – Required : 214,000 CY
  - – Overdepth: 722,000 CY
  - – **Extra Capacity: 300,000 CY**
  - – **Total : 1,236,000 CY**
- Dredged Sediments: 191 Samples collected at 22 different locations in 2014
- Bulk Chemistry / comparative Bioassay Analysis performed against RISDS, 10 Composites.
- Material primarily composed of organic silt and poorly graded fine to medium grained sand.
- Results of Suitability Determination revealed that nearly all of the material to be dredged is unsuitable for unconfined open water placement.



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Dredging Alternatives Analysis

No Action Alternative

- Evaluation prescribed by NEPA and the Council on Environmental Quality (CEQ)
- Serves as a baseline to compare all alternatives
- Channel conditions in the Providence River Channel would continue to deteriorate, risk of safety/groundings, restrictions on shipping to the Port of Providence would result in increased safety risks and negative economic impacts.

Less Than Authorized Dimensions

- Current and future predicted use of the Federal channel requires full project depth (40 feet deep MLLW) and width for safe navigation to/from the Port of Providence.
- Reduced dredging to less than authorized dimensions is not considered a viable option

Full Authorized Dimensions

- Removes all areas of shoaling for a total of ~950,000 CY of dredge material from the Federal project.
- Restores unrestricted navigation to the Port of Providence, and safety of navigation in the channel.
- Remove the need to wait on tide levels for the largest vessels using the channel.

Dredging Alternatives Analysis

- Dredged Material Management Plan
  - Consider the Future Without Project (No Action)
  - Formulate a range of action alternatives that meet project needs
  - Consider beneficial uses
  - Select the alternative that is:
    - ❑ Least-cost alternative that meets project objective
    - ❑ Environmentally acceptable
- Environmental Assessment
  - Evaluate existing conditions
  - Evaluate range of alternatives, including No Action
  - Public and agency coordination

Dredging Alternatives Analysis

1. Confined Aquatic Disposal (CAD) Cells
   - A. Beneath Channel, North of Fields Point
   - B. Beneath Channel, at Sabin Point Reach
   - C. Edgewood Shoal: URI Scenario #3

2. Upland Disposal Facilities
   - Several sites identified in last analysis (2001 FEIS). Only Central Landfill, Johnston, RI, is available, but limited.
   - Upland disposal tends to be significantly more expensive than CAD cell construction and disposal. Therefore, upland disposal would not qualify as the base plan.
   - Could take limited quantities for starting CAD Cell construction.

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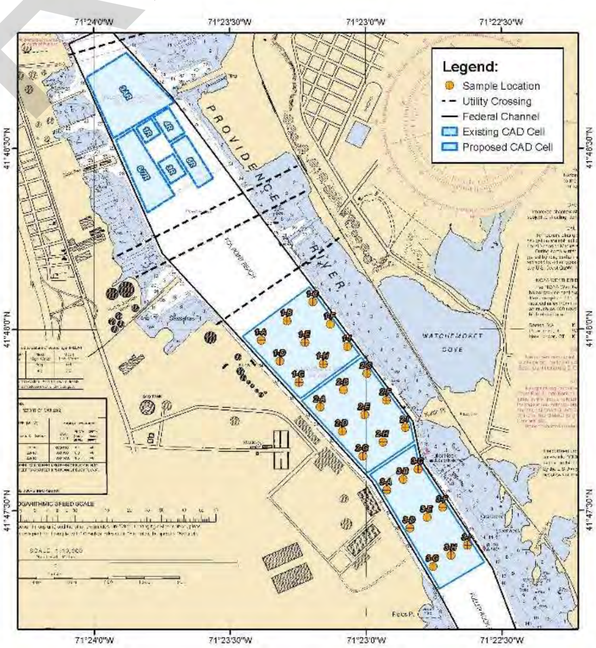
CAD North of Fields Point



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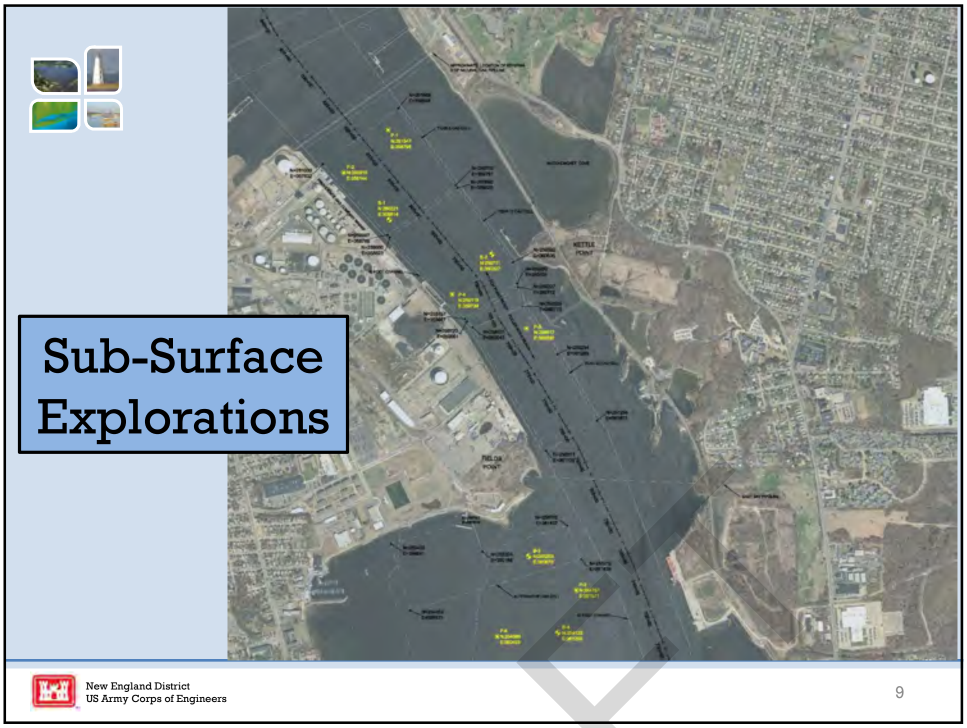
Sub-Surface Explorations
New England District
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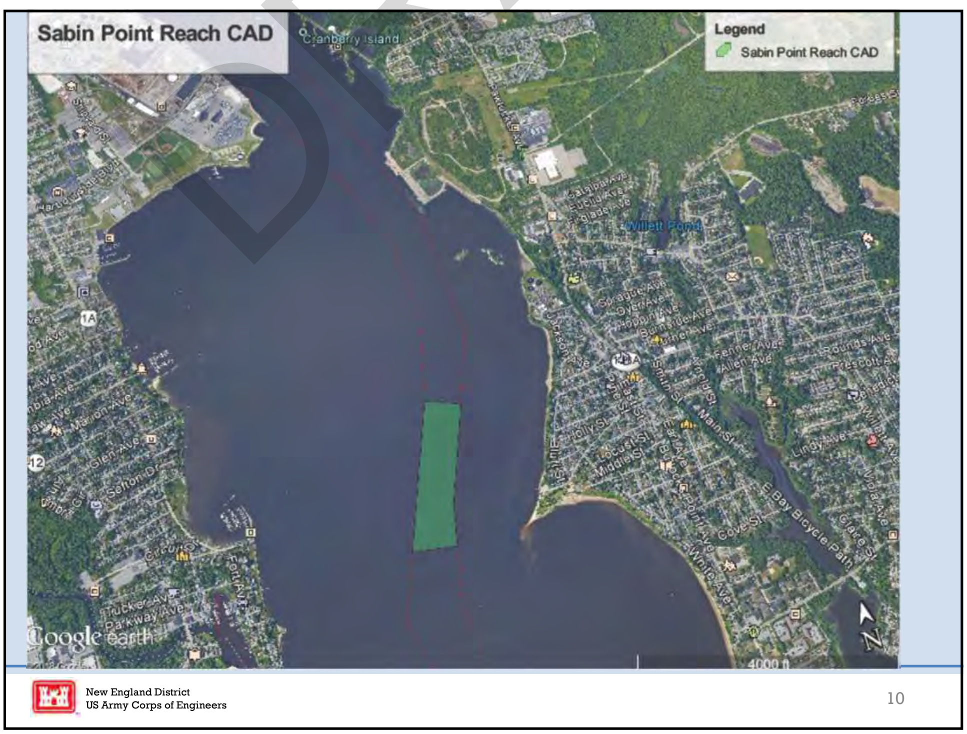
Sabin Point Reach CAD
Legend
Sabin Point Reach CAD
Cranberry Island
Willett Point
Google earth
4000 ft
New England District
US Army Corps of Engineers
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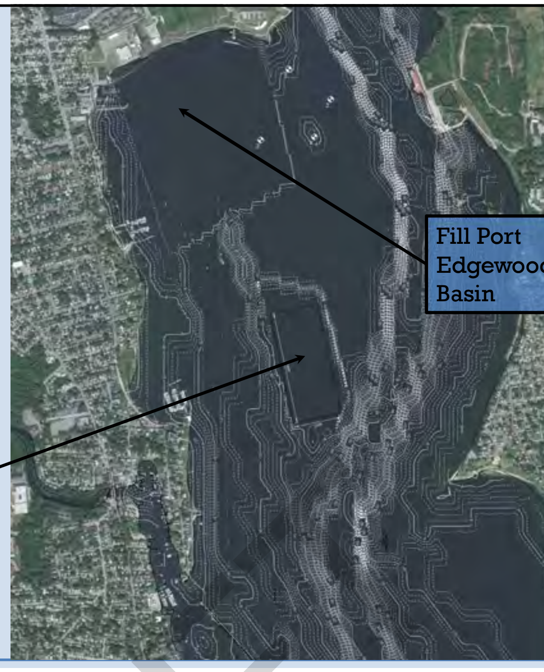
Edgewood Shoal CAD URI Scenario #3



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Potential Future CAD Locations

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Suitable Dredged Material Placement Alternatives

3. Beneficial Use / Habitat Restoration

A. Stillhouse Cove

-Fringe marsh quickly eroding/creek area expanding rapidly.

-Save the Bay identified this site for potential salt marsh enhancement utilizing suitable material from the FNP.

B. Fields Point

-There is a fringe salt marsh on Fields Point containing salt marsh, cordgrass marsh, and high marsh.

-Save the Bay identified this site for potential salt marsh enhancement utilizing suitable material from the FNP.

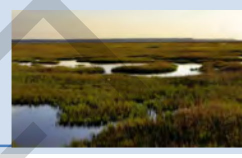
C. Blackstone and Ten Mile Rivers

-RI CRMC and TNC have identified creating salt marsh habitat between fish ladders on the Blackstone and Ten Mile Rivers as a project they would potentially like to use suitable dredged materials from the FNP.

D. Watchemocket Cove

-Low salt marsh creation with creeks and some high marsh

-Fully evaluated in USACE 2001 FEIS.



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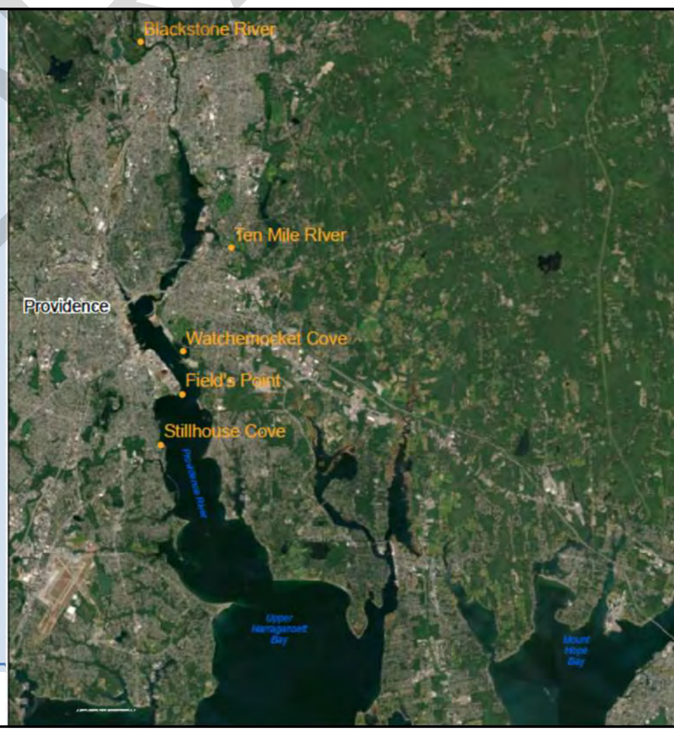
Beneficial Use / Habitat Restoration



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Identification of Base Plan for Suitable Materials

The “Federal Standard” requires all selected alternatives to represent the least cost, environmentally acceptable alternative. Based on the Federal Standard, the Base Plan for placement of Suitable Material dredged from the Navigation channel and from any constructed CAD cells is:

Open Water Placement at Rhode Island Sound Disposal Site

New England District
US Army Corps of Engineers

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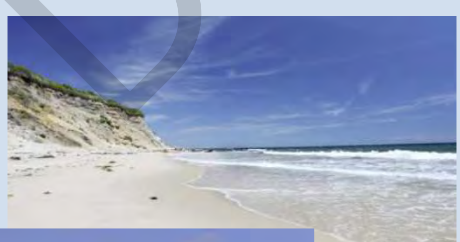
Questions / Comments



Mike Walsh
Navigation Project Manager
Michael.E.Walsh@usace.army.mil
Office: (978) 318-8586

New England District
US Army Corps of Engineers

New England District
US Army Corps of Engineers

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From: Timmermann, Timothy
To: Decelles, Elizabeth C CIV USARMY CENAE (US); Walsh, Michael E CIV USARMY CENAE (USA); Mackay, Joseph B CIV USARMY CENAE (USA)
Cc: LeClair, Jacqueline; Guza-Pabst, Olga; Colarusso, Phil; Lyons, Regina; Timmermann, Timothy
Subject: [Non-DoD Source] Providence River and Harbor Dredging
Date: Wednesday, August 21, 2019 12:10:59 PM

Elizabeth, Michael and Jay:

Thank you for hosting the recent discussion regarding the Providence River dredging project. It was helpful for us to learn more about the need for maintenance dredging in the Providence River. We appreciate the opportunity to ask questions and discuss your approach to the development of the project and the analysis of project impacts. As requested, we are writing to provide you with observations for your consideration as you work to determine the appropriate NEPA vehicle (EA or EIS) for the planned dredging and disposal activities. The scale and complexity of the project and the potential for impacts signals the need for a comprehensive analysis. Some of the key factors we considered are outlined below.

. All 1,236,000 cubic yards of material to be dredged is unsuitable for open water disposal. Toxicity testing in combination with STFate modeling show an unacceptable risk to organisms in the water column. Additionally, significant bioaccumulation of metals and PAHs were seen in testing resulting in an unacceptable hazard quotient based on EPA's risk assessment.

. The preferred dredged material disposal option is the development of new CAD cells within the Providence River. While the Corps' past work to consider alternatives provides a helpful starting point for the consideration CAD cell siting and development, the current effort requires an equally comprehensive analysis of alternatives, potential impacts, and mitigation. This work typically includes extensive interagency, public and stakeholder outreach and coordination.

. Previous maintenance dredging projects in the Providence River incorporated time of year restrictions and sequencing to avoid/minimize impacts. The current project does not include either measure. Both measures may be warranted given the results of water column toxicity tests. In addition, it is not clear whether the project will be consistent with RI DEM management requirements regarding time of year restrictions for dredging and CAD cell related work.

. More information could be provided to demonstrate whether the CAD cells used for the last major dredging project were effective at sequestering contaminated material and to explain how they continue to be managed. It would be reasonable for the environmental analysis to provide an overview of the status of the CAD cells used during the last round of dredging in the river including information as to how well these CAD cells performed, unexpected impacts, etc. Any specific reports that were prepared and filed with the Corps could be included in the analysis.

. It is not clear how water quality standards will be met in the Providence River in association with the disposal of the unsuitable dredged material in CAD cells. The tested material failed the water column toxicity test and had significant bioaccumulation of chemicals that exceeded EPA's non-carcinogenic hazard quotient. The tests suggest that there will be an impact in the water column during dredging and disposal.

. The source of unsuitable material remains unknown. CAD cell development siting and development is complicated, especially for large volumes of dredged material. It remains uncertain whether CAD cell disposal is sustainable in the long term. It would be reasonable for the dredged material management plan to explore whether management strategies can be implemented to reduce the quantity of unsuitable dredged material to be managed in the future.

. The winter flounder fishery has been closed to both commercial and recreational fishing for years. The Providence River represents spawning habitat for this species. Dredging during winter flounder spawning season will contribute additional impact to a stressed population. The analysis should explain whether any of the dredging or CAD cell development will occur in water depths considered winter flounder spawning habitat (<15 ft) and how impacts to this habitat will be addressed.

. Compliance with the Clean Water Act 404 (b) 1 Guidelines. The analysis should demonstrate how the project (the CAD cell disposal option) is the least environmentally damaging practicable alternative (LEDPA).

. The decision regarding whether an EA or EIS is appropriate should consider whether the work to analyze the previous dredging project over 21 years ago is still relevant. The exercise should determine what information is still relevant and where supplemental analysis will be necessary to fully understand the impacts of the proposed project.

. The scale and complexity of the project and the potential for impacts highlights the need for rigorous outreach targeting state and federal agencies, affected stakeholders, and the public.

. The need for a long-term dredged material management strategy for the Providence River cannot be understated. The current project is largely focused on addressing the immediate need for dredging of shoaled portions of the navigation channel. The need for this dredging is well documented. Because maintenance dredging on a similar scale is likely necessary on a recurring basis every ten years it would be prudent for the scope of the dredged material management plan and related environmental analysis to be broad enough to capture this need and establish a long-term solution and strategy for dredged material disposal within the Providence River.

Thanks for the opportunity to comment.

Timothy L. Timmermann, Director
Office of Environmental Review
EPA New England-Region 1
5 Post Office Square, Suite 100
Mail Code 06-3
Boston, MA 02109-3912

Email:
Telephone: 617-918-1025
E-Fax: 617-918-0025

CENAE-PDE 7 May 2020

MEMORANDUM FOR THE RECORD

SUBJECT: Shellfish Relocation in Edgewood Shoals, Providence River and Harbor Federal Navigation Maintenance Project

ATTENDEES: Michael Walsh, Elizabeth DeCelles (Corps), Eric Schneider (Principal Marine Biologist), Dennis Erkan (Shellfish Biologist), Ron Gagnon (Chief of Technical and Customer Assistance), Anna Gerber-Williams (Marine Biologist)(RIDEM)

CONTENT:

- Corps introduced Edgewood Shoal initial CAD cell layout, best location based on depth to bedrock, we want to minimize the footprint
- Grey box is a channel to cut over to the main FNP channel, using hydrodynamic modeling, this showed to help flush the gyre and facilitate recirculation, in addition to filling up this basin that goes anoxic
- Contaminated material will be buried here (in a CAD cell), clean material will go out to RISDS
- DEM: are there any concerns filling basin with marina or adjacent properties?
- Corps: we haven't started reaching out to those folks yet, we will be doing outreach and coordination. Right now we are working to find a suitable location for a CAD cell in this area.
- DEM: will this CAD cell be sufficient for the time 0 dredging or do we need additional capacity?
- Corps: Yes we will need additional capacity in future dredging cycles, but this CAD should be sufficient for this next dredge cycle.
- DEM: general process is taking the top layer, put that on the bottom of CAD and put cleaner sediment on top to cap and also cap current CAD cells. Remainder to go to RISDS.
- Corps: our experience with capping means we should wait a while for things to settle before attempting to "cap". The material used to fill the basin would be the same type that's there now.
- DEM: do you have an expected timeline or start of dredging yet?
- Corps: we are mostly impacted timeline wise by trying to find a CAD cell. Need more sampling and testing but can't get folks in the field now with COVID restrictions. Looking for CAD design by end of summer. Then do environmental coordination and have it finished maybe January 2021. A year from June for an approved EA. At least 3 years out from approval to dredge.
- DEM: so what can we provide to you in terms of what we were thinking on shellfish relocation?
- Corps: we have shellfish that would be directly impacted by a CAD cell in this area, We need to know: what are the resources that are there, what would the reasonable process to verify the extent of the resources, and how do we go about mitigating for that loss.

- DEM: mitigation would involve moving shellfish outside of the project footprint prior to dredging.
- Corps: A relocation program?
- DEM: wouldn’t have to move them far, just out of the footprint.
- Corps: that would be great. We would need to know locations.
- DEM: concerned with protecting brood stock to provide larvae
- Corps: How do you go about doing that? Picking up shellfish and giving them a new home? We need to specify that in a contract so we can get a cost associated with it.
- DEM: Not unique to this project, Quonset has done something similar, we can provide guidance on contracts to commercial fisherman or commercial dredge to harvest them and bring on deck to place in other locations. Commercial fishermen would be helpful for shallower areas. Works out well.
- Corps: What kind of dredging equipment would you use?
- DEM: hydraulic dredge designed to dig a shallow trench and then shellfish are scooped into the dredge. Some use water, some don’t. Scale will determine protocol for most effective project.
- Corps: we can differentiate the areas by depth to help.
- DEM: if you involve the shellfishermen, depending on days of effort per person, they would probably be able to give you a price. The owner of dredge would help with that cost estimate.
- DEM: do you need to send this out to bid or can you do a direct contract? We can provide some specifications.
- Corps: would like to put this on the same contractor dredging the CAD cell. DEM can put the process requirements in permit conditions. DEM will be able to work with us.
- Corps: We would like to include enough detail in our EA on the relocation effort.
- DEM: we can work with whatever the Corps needs and we have sources to help, scientific reports to justify means of effort.
- DEM: we should be able to do more survey work to find out more details of this area to help in planning stages.
- Corps: would it be prudent when we get closer to actual construction to then require an updated survey so that the contractor can be guided?
- DEM: that makes sense. We usually require 5 years for surveys pre-relocation. To define areas contractor should focus on.
- DEM: resources are patchy, so it’ll help to have a pre-survey to guide contractor.
- DEM: at this stage DEM volunteers to share the technical reports we have on this area and can continue to provide density data as soon as our new vessel is capable of surveying.
- DEM: the last dredge cycle no CAD cells were created?
- Corps: incorrect, there’s a series of CAD cells that were constructed in 2003-2005 that are almost full.
- DEM: when the last dredging was done was there relocation (of shellfish) work performed within the channel? No they were mostly adjacent to the channel and contracted a rocking-chair dredge from the Bay Campus that wasn’t very successful moving clams. Certain substrates have various abundances/densities.

- DEM: If we did some preliminary survey work and we knew there weren't a lot of resources in the channel, we wouldn't have to focus on them. But areas adjacent to channel (side slopes) may need relocation. Commercial shellfishing rig would be most appropriate to use.
- DEM: boxes on the shellfish density map are stations from years of survey work that demonstrate the trend of densities.
- DEM: are there other areas that would need shellfish relocation?
- Corps: We have two operations for dredging. 1 create CAD cell as disposal facility. Shellfish impacts here. Then (2) maintenance dredging of federal channel. Are you asking about within the channel and side slopes that would need to be relocated too?
- Corps: we can look at the EIS that was developed for the last dredging. What was done in the channel for that effort?
- Corps: Pawtuxet cove dredged material (a Federal project) would need to go into the CAD cell, as well as Seekonk River – potential for Corps to maintain channel up there as well. DMMP will cover those projects as well (for 20 years).
- DEM: does that mean the potential CAD in Edgewood shoals would suffice for year 0 and then we'd have to find other homes for the future dredging?
- Corps: Yes. The DMMP will say that the future placement locations will be CAD cells. We can identify potential locations for the future CAD cells and then finalize them once the specific dredging event gets nearer.
- Corps: If needed we would create 'starter cells' that do just that.
- Corps: one location (for a CAD cell) we looked at was further downstream in the channel but there are resources down there we would need to look at before we could pursue that area.
- DEM: if you have subsequent calls or go back with email, we appreciate working with you early to address impacts in a timely manner.
- Corps: Agreed. Are we good on this call for now?
- DEM: contact us with any more questions you may have.
- Corps: we appreciate it.

Prepared by:	Approved by:
Elizabeth DeCelles	Michael Walsh Project Manager Navigation Section

CENAE-PDE

January 3, 2022

MEETING NOTES

SUBJECT: Informational Meeting – Providence River and Harbor O&M Project

LOCATION: Webex

DATE OF MEETING: 12/15/21

ATTENDEES:

USACE: Michael Walsh, Erika Mark, Elizabeth Waterhouse, Grace Moses, Aaron Hopkins, Marc Paiva
NOAA: Roosevelt Mesa, Sabrina Pereira
RI DEM: Neal Personeus, Eric Schneider, David Borkman, Aaron Mello, Anna Gerber-Williams, Ron Gagnon, Patrick Barrett
EPA: Tim Timmermann, Steven Wolf
CRMC: Dan Goulet, Jeff Willis
SAVE THE BAY: Mike Jarbeau, James Boyd

NOTES

- Last time we dredged was 2003-2005
- 2021 latest survey, 1.1 mil cy maintenance (state 300k cy for regional dredge projects) plus addl 200k cy as starter cell for next dredge round, results of sed testing is all maintenance material is unsuitable for unconfined open water placement
- Much of the discussion surrounded the proposed Edgewood Shoals CAD (ES-CAD) alternative.
- Has URI adjusted and re-run their model (Scenario 9) with the current ES-CAD cell located further north?
    - No, we spoke to Prof. Kincaid about the modification but our ability to contract with URI is very limited. We will see what we can do to have them model the currently proposed ES-CAD configuration.
    - Are there other ways we could get the funding/Contracting in place for URI to do that modeling work, possibly as part of the state match?
    - It is possible. We need to discuss that with URI and CRMC.
- Has anyone run models to see if the flushing channel will remain open in out-years or will it require maintenance?
    - We are not planning on running any models for future conditions of the flushing channel after creation. The Corps does not consider that channel to be an authorized Federal navigation feature that we would be authorized to maintain in perpetuity. We do not

expect the channel to shoal in, but that is just our professional opinion. Others would need to take that effort on if maintaining the flushing channel were desired.

- We will be further defining the footprint of the ES-CAD cell and flushing channel after boring results are received.
- If apparent rock is encountered at shallow depths, will the drillers push through to try and find out if it's just a boulder or do they back off?
    - They roller bit into an obstruction to determine if it's bedrock or not.
- Would blasting be considered as part of the ES-CAD construction (to make it deeper) if they hit bedrock at a shallow depth?
    - Blasting is cost prohibitive for CAD construction. I bedrock is shallow we would either move or expand the ES-CAD footprint so we can obtain the volumetric capacity needed.
    - Did modeling show that -8 depth would be sufficient to curtail the anoxic conditions?
        - Essentially yes. URI scenario modeled 6'.
- Would Save the Bay operations be impacted? What about the adjacent marinas?
    - We need to coordinate with them to identify any risks of impacts, but early indications are that they could accommodate a depth of 8'.
- It is expected that the RI Yacht club and another marina in that area would not be impacted by an 8' depth (per Dan Goulet)
- Regarding the Channel CAD Cells (Channel-CAD) alternative, north of Fields Point, have the harbor pilots agreed to this area (adjacent to the shoreside dock facilities within upper river)?
    - There is one area that the Coast Guard and Pilots stated needed to be left available for emergency anchoring of ships in the upper river (the area between the two pipeline crossings). The proposed Channel-CAD alternative avoids that area.
- If there's a [beneficial use] project that needs a certain grain size, etc. would the contractors be able to separate the correct grain size material to obtain the material needed for the beneficial use? material or would we not be able to guarantee the sediment consistency?
    - It is possible, BUT likely very expensive. Adding to that cost is needed to double and triple handle the material as well as the challenge of needing to find a useable riverside site to process the material. Costs for beneficial use of material above the cost of open water disposal would likely need to be borne by non-Federal interests.
- We recognize that we need a shellfish survey of the ES-CAD area, and potential impacts to that resource could possibly require a shellfish transplant effort (DEM)
- With the ES-CAD cell, when the top three feet are placed and the ES-CAD cell is considered "closed," is that what has been modeled? What elevation should the final cap be implemented?

- Modeling did not track stages of construction and filling of the ES-CAD, only the final "closed" state. The model also did not attempt to predict movement of bottom sediments. The top of the ES-CAD cap is currently planned to be at elevation 8' below MLLW.
- It was noted that any CAD cell will be left open for several years (could be 10 or more) before "capped." We did not have URI model the stages of construction and filling of the ES-CAD, so it is not known if and to what degree any water circulation and quality benefits would be realized during those stages.
- During construction, will the new flushing channel create a passage for sediment to be flushed into main river? What about every time we dump in the ES-CAD?
    - There is minimum flow over the Edgewood Shoal, and increases in flows are expected to be minor. During the last dredging of the Providence River, movement of sediment associated with filling of the CAD cells was modeled and movement was not significant (in the river where currents are much higher than could ever be expected over the Edgewood Shoal).

- Is the expected capacity in ES-CAD the same as the Channel-CAD cells?
    - Yes, we will design the ES-CAD and the Channel-CAD alternatives to accommodate the volumes discussed earlier (approximately 1.8 MCY capacity).
- Is there a scenario where we build two CAD cells now, one for the first maintenance dredging cycle, and one for the next dredging cycle (approximately 15 years later)?
    - No, we would not likely receive funding to construct a CAD cell now that won't be needed so far in the future. There are too many other pressing needs nationally that are competing for scarce Federal dollars. Although the DMMP establishes a plan for this and the next dredging cycles, only the first dredge cycle would be funded at first
- What is the current project timeline?
    - We are updating our schedule now and it looks like the DMMP study should be finalized early 2023 and then a cost sharing agreement will be entered into to move forward to develop construction contract plans and specifications. Anticipating having a cost sharing agreement signed in the late spring or early summer of 2023, dredge construction would likely be in 2024.
- How long do you expect it will take to dig the ES-CAD cell?
    - There are a lot of variables, such as how difficult it is to dredge the parent material in the CAD cell(s), TOY restrictions, and how deep the final CAD cells are designed to. Without TOY restrictions construction of the CAD cell(s) would take maybe 9 months to a year.
- What is the DMMP process?

  - The current plan is that the DMMP and Environmental Assessment (EA) will be separate companion documents. When the Draft DMMP and EA are through with internal USACE reviews, then they would be released for public review and comment. Following that process the DMMP and EA would be finalized and approved.
- What is the purpose of this meeting?
  - This is for scoping. USACE is seeking comments, questions, concerns from the attendees to help make sure we understand and address the many and various concerns associated with the project. We ask that if anyone has comments or concerns to please make sure to email those to the USACE so we can make sure and capture those concerns accurately and address them during the NEPA process. That said, this meeting is an initial step in the process, and we welcome additional input from folks as we move forward.
- Will there be a request for URI to perform the analysis for the new CAD cell location?
  - USACE needs to have that conversation with them and identify a way to make it happen.

CONCLUSION AND FOLLOWUP ITEMS:

- Identify a means to engage with URI to model the currently proposed ES-CAD design.
- Send any written comments to Elizabeth Waterhouse at

Elizabeth Waterhouse
Environmental Resource Specialist
Environmental Branch
New England District
Corps of Engineers

Providence River & Harbor, Federal Navigation Project Dredged Material Management Plan DMMP

Stakeholder's Meeting

December 15, 2021

New England District
US Army Corp of Engineers

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Presentation Agenda

- Project History
- What's a DMMP?
- Data Collection & Results
- Disposal Alternatives Analysis
- Unsuitable Material Alternatives
- Suitable Material Alternatives
- Discussion
- Questions / Comments

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Providence River & Harbor, RI Project History

- Authorized by the Act of 30 August 1852, and modified numerous times since then.
- The existing FNP consists of a 16.8 mile long channel, 40 feet deep and generally 600 feet wide, from deep water in Narragansett Bay (just south of Prudence Island Light) to the head of navigation at the Seekonk River.
- Maintenance Dredging last performed between 2003-05: Total 3,821,349 CY
  - ❖ Maint. to RISDS: 2,637,053 CY
  - ❖ Maint. to CAD Cells: 1,184,341 CY
  - ❖ CAD material to RISDS: 1,737,190 CY
  - ❖ CAD material to upland: 52,030 CY
  - ❖ Extra CAD Space: 302,462 CY
- Non-Federal Sponsor: State of Rhode Island

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Dredged Material Management Plan DMMP

- Objective: To establish a plan to manage dredged materials for a minimum period of 20 years
- DMMP is required before entering into a cost sharing agreement with a Non-Federal Sponsor for the cost of a dredged material disposal facility
- Federal Base Plan: Least Cost, Environmentally Acceptable Alternative

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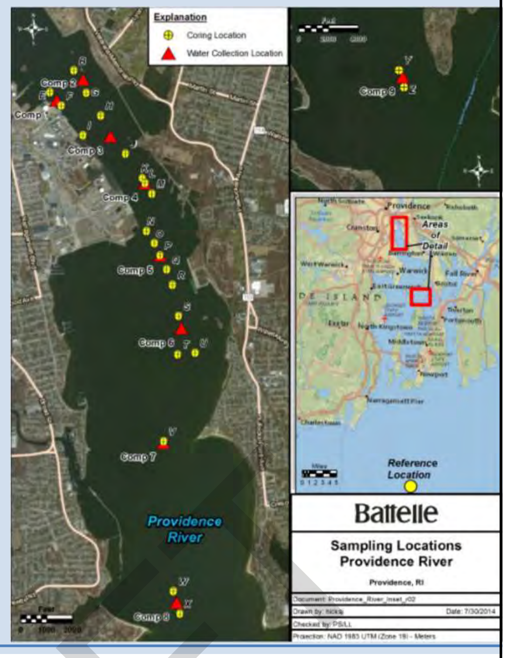
Data Collection & Results

- Most recent hydrographic survey data collected in Aug 2019 – Apr 2020
- Maintenance Dredge Volumes:
  - Required : 750,000 CY
  - Overdepth: 350,000 CY
  - **Total : 1,100,000 CY**
- Maintenance Dredged Sediments: 191 Samples collected at 22 different locations in 2014
- Bulk Chemistry / comparative Bioassay Analysis performed against RISDS, 10 Composites.
- Material primarily composed of organic silt and poorly graded fine to medium grained sand.
- Results of Suitability Determination revealed that nearly all of the maintenance material to be dredged is unsuitable for unconfined open water placement.



Disposal Alternatives Analysis Unsuitable Material

1. Confined Aquatic Disposal (CAD) Cells
   - A. Edgewood Shoal: URI Scenario #9
   - B. Beneath Channel, North of Fields Point

2. Upland Disposal Facilities
   - Several sites identified in last analysis (2001 FEIS). Only Central Landfill, Johnston, RI, is available, but limited.
   - Upland disposal tends to be significantly more expensive than CAD cell construction and disposal. Therefore, upland disposal would not qualify as the base plan.
   - Could take limited quantities for starting CAD Cell construction.

Required CAD Cell Capacity

CAD Capacity Need	Volume (CY)	Bulked Volume (15%)
Maintenance Material	1,100,000	1,265,000 CY
Add'l State Capacity	300,000	345,000 CY
Add'l Fed. Capacity	200,000	230,000 CY
Total Required Capacity	1.600,000	1,840,000 CY

- Each CAD Cell will be capped with 3 feet of suitable (clean) material when filling is completed, and the CAD Cell is closed.

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Edgewood Shoals Hydrodynamic Study

- 2017 – 2018 Contracted URI to use their model of the ES area to help determine if placement of a CAD Cell, along with bathymetric changes in the area, could improve water circulation and water quality over the shoal
- USACE and URI developed 9 Scenarios to model and evaluate
- Scenarios 3, 8, and 9 produced the greatest improvement to water circulation and quality
- Scenario 9 involves filling in of the Port Edgewood Basin and creation of an access/flushing channel

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Edgewood Shoal CAD URI Scenario #9

Construction Access / Flushing Channel

Fill Port Edgewood Basin

Edgewood Shoal CAD, to be Moved Northwest

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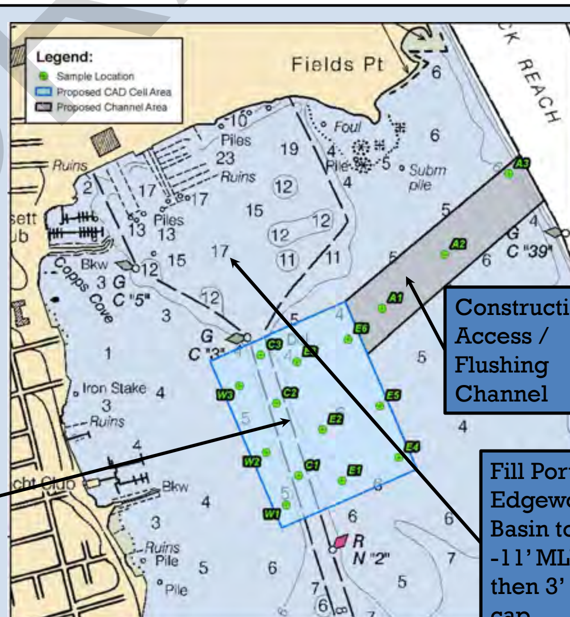
Edgewood Shoal CAD Current Design



Construction Access / Flushing Channel

Fill Port Edgewood Basin to El. -11' MLLW, then 3' cap.

Edgewood Shoal CAD

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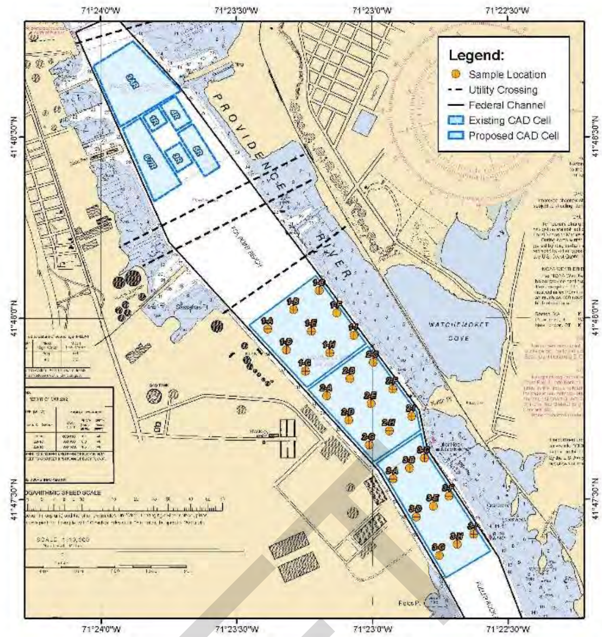
US Army Corps of Engineers

Channel CAD Cells North of Fields Point



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Possible Beneficial Use / Habitat Restoration

Require results of boring data to determine characteristics of CAD Parent material (for beneficial use)

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Identification of Base Plan for Suitable Materials

The "Federal Standard" requires all selected alternatives to represent the least cost, environmentally acceptable alternative. Based on the Federal Standard, the Base Plan for placement of Suitable Material dredged from the Navigation channel and from any constructed CAD cells is:

Open Water Placement at
Rhode Island Sound Disposal Site

New England District
US Army Corps of Engineers

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Questions / Comments

Erika Mark
Navigation Project Manager
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Office: (978) 318-8250

Written Comments to:
elizabeth.c.waterhouse@usace.army.mil

New England District
US Army Corps of Engineers

New England District
US Army Corps of Engineers

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DECEMBER 15, 2021 STAKEHOLDER MEETING - COMMENT

From: Gagnon, Ron (DEM)
To: Mark, Erika L CIV USARMY CENAE (USA); Waterhouse, Elizabeth C CIV USARMY CENAE (USA)
Cc: Walsh, Michael E CIV USARMY CENAE (USA); Horbert, Chuck (DEM); Personeus, Neal (DEM); Schneider, Eric (DEM); Dan Goulet
Subject: [Non-DoD Source] FW: Providence River DMMP - Edgewood Shoals Hydrodynamic Study
Date: Wednesday, December 29, 2021 2:08:26 PM
Attachments: image001.png

The Rhode Island Department of Environmental Management will require that the ACOE provide further analysis of the revised/proposed location of the Edgewood Shoals CAD Cell and any realignment of the Construction Access/Flushing Channel to support the results of the 2017-2018 URI Edgewood Shoals Hydrodynamic Study. In the presentation of December 15, 2020, the location of the CAD Cell was shifted northwest. The URI Hydrodynamic Study should be updated to account for this new CAD Cell location and confirm the results concerning water circulation and water quality improvements over the shoal.

Sincerely,

Ron Gagnon

Rhode Island Department of Environmental Management
235 Promenade Street | Room 260 | Providence, RI 02908

Ron Gagnon, P.E.
Administrator
Office of Customer & Technical Assistance
Tel: (401) 222-4700 ext. 2777500

Email:
Website: www.dem.ri.gov

CENAE-PDE

17 August 2022

MEMORANDUM FOR THE RECORD

SUBJECT: Beneficial Use Meeting for the Providence River and Harbor O&M Project (DMMP)

LOCATION: Webex

DATE OF MEETING: 12 August 2022

ATTENDEES:

- Caitlin Chaffee, Narragansett Bay National Estuarine Research Reserve
- Heather Kinney, The Nature Conservancy RI
- Jeff Willis, RI Coastal Resources Management Council
- Roosevelt Mesa, NOAAA NMFS
- Timothy Timmermann, EPA R1
- Sabrina Pereira, NOAA Fisheries
- Wenley Ferguson, Save The Bay, RI
- Eric Schneider, RI DEM Div. of Marine Fisheries
- Neal Personeus, RIDEM WQC
- Ronald Gagnon, RIDEM
- John Herbert, RI DEM Div. Fish & Wildlife
- John O'Brien, TNC
- Steve Wolf, EPA
- Elizabeth Waterhouse, USACE
- Adam Burnett, USACE
- Larry Oliver, USACE
- Grace Moses, USACE
- Scott Bucek, USACE
- Byron Rupp, USACE
- Chris Hatfield, USACE
- Erika Mark, USACE
- Jen Thalhauser, USACE
- John Kennelly, USACE
- Ben Loyd, USACE

REPORT:

USACE confirmed only one CAD cell would be needed for the first dredge cycle, likely Edgewood Shoals North. The Dredged Material Maintenance Plan (DMMP) also describes a plan for the next dredge cycle.

USACE stated that the filling of Port Edgewood Basin is being considered a Beneficial Use (BU) site because it would address low oxygen in that area. Approximately 400,000 CY of material would be necessary.

30,000 CY of unsuitable material would be placed in the Edgewood Shoals Basin first and then capped to bring elevation up to 10' MLLW. The remaining suitable material from CAD cell creation would go to RISDS or BU opportunities.

The proposed CAD cell would then be filled with O&M dredged material from Providence River FNP and other FNPs as well as non-federal projects over the next 15 years, and finally capped with clean material sometime after 15 years. There may be over 2 million CY of clean material potentially available for BU in addition to capping Port Edgewood Basin. The available clean material is primarily and generally characterized as silt.

Caitlin Chaffee identified that the Prudence Island Reserve boundary extends out to 15-foot depth contour. Dyer Island is a rookery site and has restrictions from DEM. There is also a significant SAV bed at the south end of Prudence Island.

In a possible BU measure, clean silt could be used as a cap at Prudence Island Disposal Site (PIDS), which has approximately 100’ depths. Steve Wolf mentioned that a method of placing silt as a cap was accomplished at the Mass Bay Industrial Waste site and the deposits were very accurately hitting the mark in depths similar to PIDS.

For the (PIDS) we would want to look at what’s effective to clean up the site and improve habitat. We do not currently know the extent or type of contamination there and it would need further testing if stakeholders are interested in this BU. We have no recent sediment data for PIDS.

Eric Schneider stated that Atlantic cod larvae have been detected near Prudence Island. They are likely using shallow, gravel bottom habitat, but unsure if they’d use the PIDS.

We do not currently know how much material would be necessary to improve habitat at PIDS. If this does become part of the preferred alternative, then disposals could occur at PIDS in time periods of rough weather, thus avoiding rough seas to RISDS . There are sensitive resources at PIDS/Prudence Island/Dyer Island that would need to be considered for time-of-year, tidal stages, etc. Contract specifications would need to address this.

There would be no “extra funds” available if PIDS became part of the preferred alternative and if there were cost savings compared to hauling the extra distance to RISDS.

We will evaluate various depth options for capping PIDS. First, we need to determine the current conditions and then look at varying depths for capping. It would take approximately 1.6M CY to place a 1-yard deep cap over PIDS. We want to make sure habitat functions are not disturbed.

The current project timeline estimates constructing the CAD cell in end of year 2023 into 2024. Dredging would occur the following year. However, this also depends on time of year restrictions.

If any stakeholder wants to pursue another authority for BU, then we’d need to get the study completed before mobilization, which is unlikely. There’s also potential to add another BU measure to the current project, but it would be 100% on the sponsor, and the plan would need to meet the current schedule.

Stillwell Cove is a small site near Edgewood Shoals but is likely unfeasible given costs. Another agency could pay 100% of costs above base plan.

Watchemoket Cove salt marsh enhancement site could be a multi-year project because of consolidation and could be a large, long-term commitment.

CONCLUSION AND FOLLOWUP ITEMS:

RI DEM Marine Fisheries (and other stakeholders): will respond to presentation and inquiries before Labor Day (Sep 2).

Elizabeth Waterhouse will obtain the Mass Bay Industrial Waste summary report Steve Wolf (EPA) mentioned and distribute as requested.

Elizabeth Waterhouse will send a link or file transfer to Wenley Ferguson for the 2001 FEIS that evaluated Watchemoket Cove as a BU site.

Partners and the State of RI will think carefully about BU opportunities and options. The biggest challenge will be funding as well as meeting the schedule.

Erika Mark (PM): schedule will be updated based on outcome of this meeting to add in additional investigations. Original schedule had draft EA and DMMP going out for review in the November timeframe, but this is now unlikely.

Elizabeth Waterhouse
Environmental Branch
New England District
U.S. Army Corps of Engineers

PROVIDENCE RIVER FEDERAL NAVIGATION PROJECT DREDGED MATERIAL MANAGEMENT PLAN (DMMP)

Beneficial Use Meeting
New England District
12 August 2022

Project Ecologist:
Elizabeth.C.Waterhouse@usace.army.mil

U.S.ARMY

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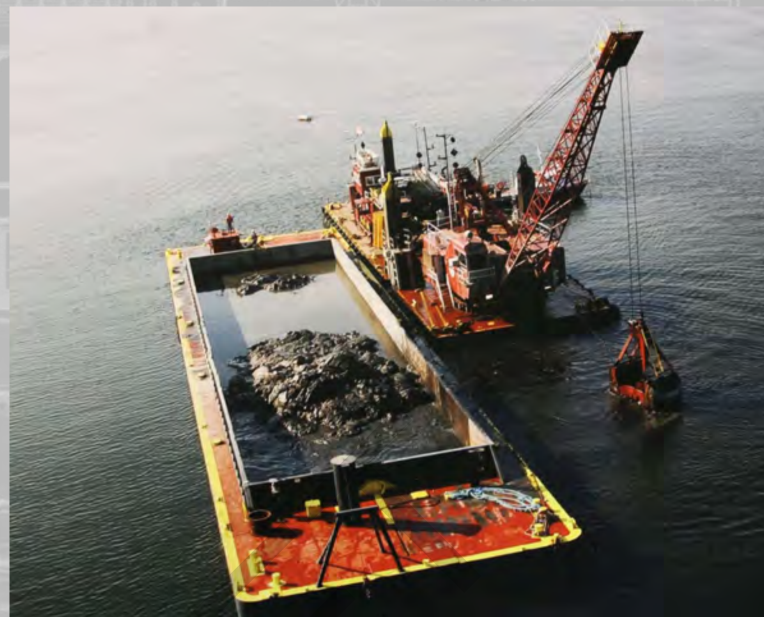

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PRESENTATION AGENDA

- Welcome/Introduction
  - ❖ *please add your name and affiliation in Webex chat*
- Operations and Maintenance Needs on the Providence River Federal Navigation Project
- Confined Aquatic Disposal (CAD) Cell Alternatives
- Beneficial Use Sediment Type and Alternatives
- Costs/Cost-Sharing
- Open Floor: Other Sites, Questions and Discussion

2

2

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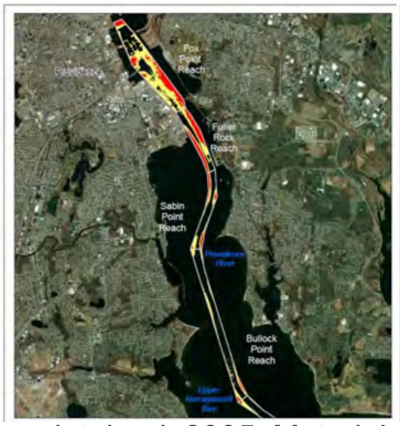
PROVIDENCE RIVER FEDERAL NAVIGATION PROJECT SURVEY (2020)



- Last maintained: 2005, Material placed in CAD cells in Fox Point Reach
- Existing Providence CAD cells also received material from small harbors: Bullocks Cove (twice), Pawtuxet, and Apponaug is in a five-year O&M plan
- Current Channel Material: All unsuitable for open water placement
- Current Channel Material Volume: 1.6 M CY (for placement in CAD)

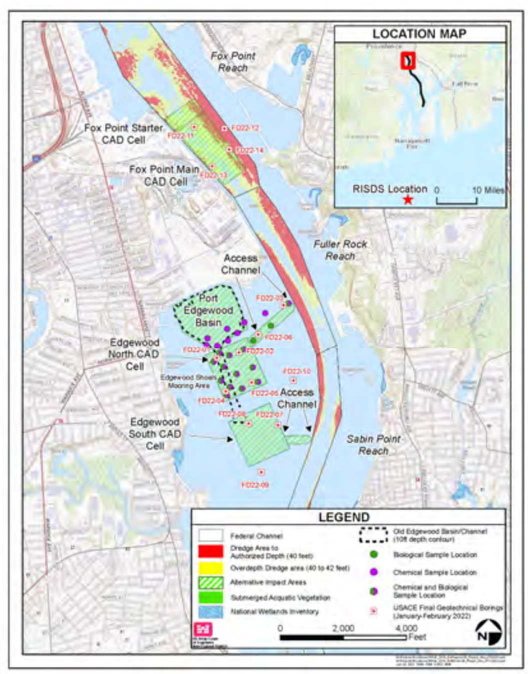
3

US Army Corps of Engineers

PLACEMENT ALTERNATIVES: CAD CELLS (UNSUITABLE MATERIAL)

1. Edgewood Shoals North*
2. Edgewood Shoals South
3. Fox Point Reach

**Likely base plan*



CAD Cell Alternative Impact Areas Providence DMMP

4

US Army Corps of Engineers

POSSIBLE DREDGED MATERIAL BENEFICIAL USE SITES: ~ 3M CY OF CLEAN SILT

Evaluated Sites from 2001 Final Environmental Impact Statement	2001 Estimated Non Federal Cost*	Current Status
Site 60, Green Jacket Shoal Salt Marsh	$32M	Concerns about historic resources and ship graveyard
Site 150, West of Watchemoket Cove Salt Marsh	$16M	No known change in status or availability
Site 149, Pomham Rocks - Salt Marsh Option	$9M	Not likely to be available due to new marine infrastructure in the area
Site 62, Bold Point - Park Expansion Option	$40M	Not available due to upgraded site condition
Site 159, Greene Island Expansion	$1M	Sand material only
Site 69a, Jamestown Bridge Reef Site - Reef Option	$226M	No longer available
Site 69b, Separation Zone Site - Reef Option (geotextile bag)		Would require designation from EPA - not feasible for this dredge cycle
*2022 Costs would increase from the 2001 estimate		

Recently Identified Beneficial Use Sites
Edgewood Shoals CAD, Port Basin Fill/ Flushing and Access Channel Cut (CRMC)
Field's Point (Save the Bay)
Stillhouse Cove (Save the Bay)
Prudence Island Disposal Site (USACE)

5

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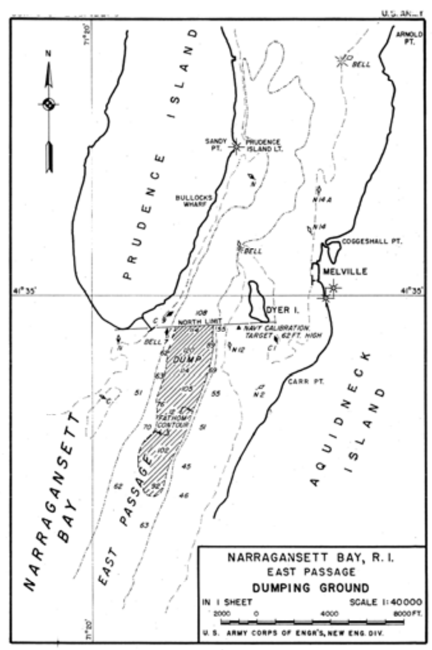
POSSIBLE DREDGED MATERIAL BENEFICIAL USE SITES: PRUDENCE ISLAND DISPOSAL SITE

- Material placed here for 1964 Pawtuxet Cove improvement project and left uncapped
- Located in approximately 100' of water
- 24 miles from CAD compared to 41 miles to RISDS (possible cost savings)
- Need to determine cap thickness



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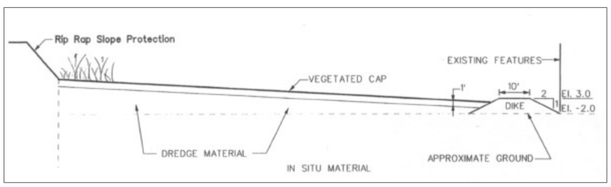
POSSIBLE DREDGED MATERIAL BENEFICIAL USE SITES: WEST OF WATCHEMOKET COVE

- Potential for salt marsh creation
- Site is currently a shallow subtidal area with water depths of 1 - 3 ft
- Low marsh or salt-marsh cordgrass marsh would be created



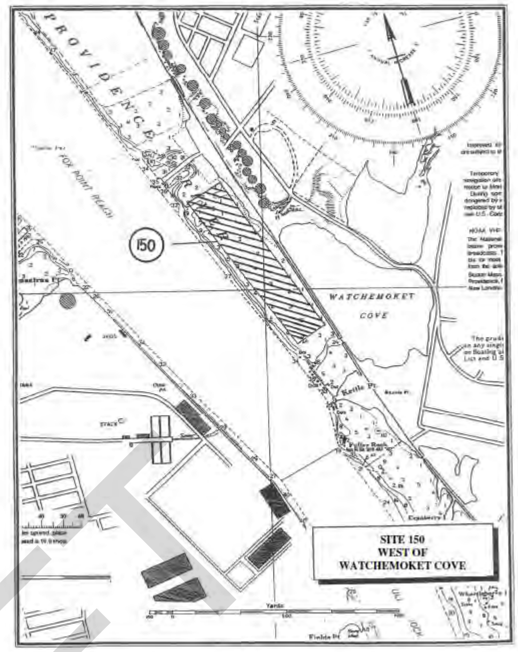


Figure 4.5.2-17. Site 150, West of Watchemoket Cove

7

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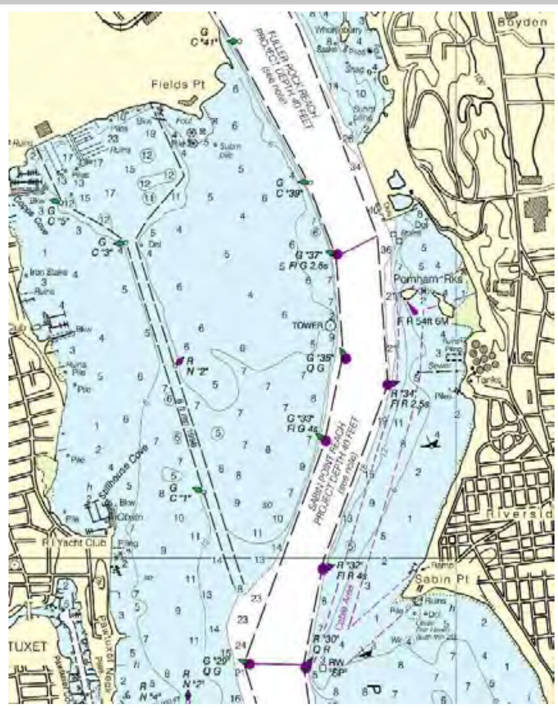
POSSIBLE DREDGED MATERIAL BENEFICIAL USE SITES: EDGEWOOD SHOALS

- Results from URI report indicated beneficial flushing would occur if we:
  - Fill and Cap Port Edgewood Basin
  - Dredge a “flushing”/access Channel to FNP
- Part of Base Plan



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8

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POSSIBLE DREDGED MATERIAL BENEFICIAL USE SITES: STILLHOUSE COVE

- Only silt available – no sand for barrier spit placement
- Potential for low and high marsh, fringe marsh placement

Imagery from Save the Bay

9

9

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COSTS AND COST-SHARING

- Base Plan (BP) – Federal Project
- If the Beneficial Use option is *less or equal cost* as BP, then it can be added to the BP
- If the Beneficial Use site is more costly than the BP, it would become a locally preferred plan and would have to be fully paid for by a non-federal sponsor or cost-sharing (e.g., Section 204)
- Use of Section 204 would require additional studies, reports, authorization and cost-sharing

10

10

OPEN FLOOR: OTHER SITES, QUESTIONS AND DISCUSSION


* Imagery from https://www.rimonitoring.org/saltmarshes

- *Please submit comments/ideas for beneficial use to Elizabeth.C.Waterhouse@usace.army.mil within 14 days for consideration in the DMMP*
- *Any questions regarding planning or plan formulation should be directed to Adam.W.Burnett@usace.army.mil*

11

From: Gagnon, Ron (DEM
Sent: Tuesday, September 6, 2022 10:51 AM
To: Waterhouse, Elizabeth C CIV USARMY CENAE (USA)
Cc: Schneider, Eric (DEM); Personeus, Neal (DEM)
Subject: [Non-DoD Source] FW: Providence River beneficial use comments

Follow Up Flag: Follow up
Flag Status: Flagged

Hello Elizabeth,

Sorry for the late response. Attached below are comments from the Division of Marine Fisheries. Please let us know if you have any questions or would like to discuss further.

Thanks,

Ron
Rhode Island Department of Environmental Management
235 Promenade Street | Room 260 | Providence, RI 02908

Ron Gagnon, P.E.
Administrator
Office of Customer & Technical Assistance
Tel: (401) 222-4700 ext. 2777500

Email:
Website: www.dem.ri.gov

The Division of Marine Fisheries (DMF) has discussed the four possible options presented during the US ACE, Providence River Dredging, Beneficial Use Meeting on August 12, 2022 (e.g., Prudence Island Disposal Site, West of Watchemoket Cove, Edgewood Shoals, and Stillhouse Cove). DMF is still evaluating these potential options; however, to assist US ACE with further scoping of the Providence River Dredging project DMF offers the following preliminary comments and questions on two options (e.g., Prudence Island Disposal Site, Edgewood Shoals). DMF will continue to seek information to further evaluate all four options and looks forward to continued discussions to identify the feasibility and scope of these options.

Prudence Island Disposal Site

- Data sources:
    - DMF is working with partners to determine if any fisheries data is available. At present, DMF does not have fisheries data to evaluate or contribute to the assessment and review; however, is still investigating whether there are research, commercial, and cooperative research projects or data sources for this site.
- Fisheries:

  - There are likely commercial and recreational fisheries occurring at and near this location. Communication with these stakeholders and users will be important to help inform potential options, conflicts, and best paths forward.
- General Comments:
  - At present, DMF does not have information that can be used to assess the habitat type or quality, fish or benthic communities, or fisheries occurring at this location (see below).
  - To better inform the assessment and exploration of this potential option DMF suggests information should be collected and considered to determine the spatial extent and level of contamination present, the composition and condition of the biological communities present, level and types of use occurring, and a cost-benefit of taking no action and beneficial use options. Data and information may include:
    - Original composition and spatial extent of material disposed at this location and whether these materials have been dispersed or sedimented over from natural processes.
    - Current sediment composition and characterization, including potential contaminates at depth, current water quality, and benthic substrate and infauna community present.
    - If contaminants are present, the potential health and environmental risks of no action.
    - The amount of material needed to address concerns and the cost-benefit to biological resources of taking action.

Edgewood Shoals

- General Comments:
  - Based on prior model runs as part of the US ACE Edgewood Shoals CAD Cell Evaluation conducted by URI, DMF believes that placement of spoils at Edgewood Shoals would likely reduce anoxic conditions and increase water quality at this location.
  - Shellfish surveys conducted by DMF found little to no shellfish in the Edgewood Shoals Beneficial Use Site, which is contrary to the high densities of shellfish found at the Edgewood Shoals potential CAD location.
    - DMF will provide additional comments and information on shellfish in a subsequent email.
  - Further discussion of the appropriate material for beneficial use (e.g., silt, sand, gravel), including the cap, for this location is warranted.

Eric Schneider

Principal Marine Fisheries Biologist

Rhode Island Department of Environmental Management
Division of Marine Fisheries
Fort Wetherill Marine Laboratory, 3 Fort Wetherill Road
Jamestown, Rhode Island 02835

Phone: 401.423-1933 |
Pronouns: He, him, his

CENAE-PD

3 January 2023

MEMORANDUM FOR THE RECORD

SUBJECT: Stakeholder Meeting – Providence River and Harbor Federal Navigation Project Operations and Maintenance Dredged Material Management Plan – Beneficial Use of Dredged Material from Proposed Confined Aquatic Disposal (CAD) Cell and Initial Results from Prudence Island Placement Site (PIPS)

LOCATION: Microsoft Teams

DATE OF MEETING: 15 December 2022, 1100-1200

ATTENDEES:

Caitlin Chaffee, Narragansett Bay National Estuarine Research Reserve (NBNERR)
Heather Kinney, The Nature Conservancy, RI
Jeff Willis, RI CRMC
Roosevelt Mesa, NOAA NMFS
Sabrina Pereira, NOAA Fisheries
Wenley Ferguson, Save The Bay, RI
Eric Schneider, RI DEM, Div. of Marine Fisheries
Neal Personeus, RI DEM, Office of Water Resources
Bart Wilson, USFWS
Dan Goulet, RI CRMC
Jeanie Brochi, USEPA
Julia Livermore, RI DEM
Michael Arguello, RI DEM
Mike Jarbeau, Save The Bay, RI
Patrick Barrett, RI DEM, Marine Fisheries
Phil Colarusso, USEPA
Elizabeth Waterhouse, USACE
Adam Burnett, USACE
Larry Oliver, USACE
Grace Moses, USACE
Chris Hatfield, USACE
Erika Mark, USACE
Jen Thalhauser, USACE
Ben Loyd, USACE
Aaron Hopkins, USACE

REPORT: Attendees discussed the following items.

- **Purpose of Meeting:** Fourth Stakeholder Meeting for Providence River and Harbor Federal Navigation Project (FNP) Operations and Maintenance (O&M) Dredged Material Management Plan (DMMP) to discuss Beneficial Use of Dredged Material options. Dredged Material available for beneficial use (BU) would be excavated during construction of the proposed Confined Aquatic Disposal (CAD) cell in the northern portion Edgewood Shoals. The material available for BU includes approximately 3,000,000 cubic yards (CY) of clean, underlying silty sediments.

- **Beneficial Use**: The current O&M base plan for suitable material from the proposed Edgewood Shoals CAD cell is disposal at the Rhode Island Sound Disposal Site (RISDS). As an alternative, portions of this material could be beneficially reused at other sites. If placement at one or more of these BU sites is more cost effective than hauling the material to RISDS, the alternative(s) would be added to the O&M base plan. Other BU alternatives that are more costly than placement at RISDS would not be considered as part of the O&M base plan but may be cost-shared with a sponsor. Non-federal funds for BU have not been identified at this point in time, and the previously discussed sites are not being added to the proposed action in the DMMP.

- **Prudence Island Placement Site (PIPS) Initial Testing Results:** USACE completed initial investigations at PIPS this fall to document the extent of contaminated sediments placed there in the 1950s. This effort involved a combined bathymetric and high resolution side scan sonar survey, collection of underwater video footage, and collection and analysis of sediment samples. Water depths within the survey footprint ranged from approximately 40 to 105 feet relative to mean lower low water (MLLW). Both the bathymetry and side scan sonar imagery documented a series of well-defined disposal features including mounds and impact craters that have persisted on the seabed since the 1950s. Multiple attempts were made to sample the top two feet of this material using a gravity corer, but only one deeper sample was recovered due to the unconsolidated nature of the sediments. Surficial sediment grabs consisting of the top 6 inches of sediment were collected from the 11 of the 12 planned stations. The surficial samples documented contaminant concentrations that corresponded with background levels for the area. A subsample collected from the lower half of the one gravity core contained increased concentrations of Polychlorinated biphenyls (PCBs) and post-industrial era metals, suggesting that contamination is present within the site at depth.

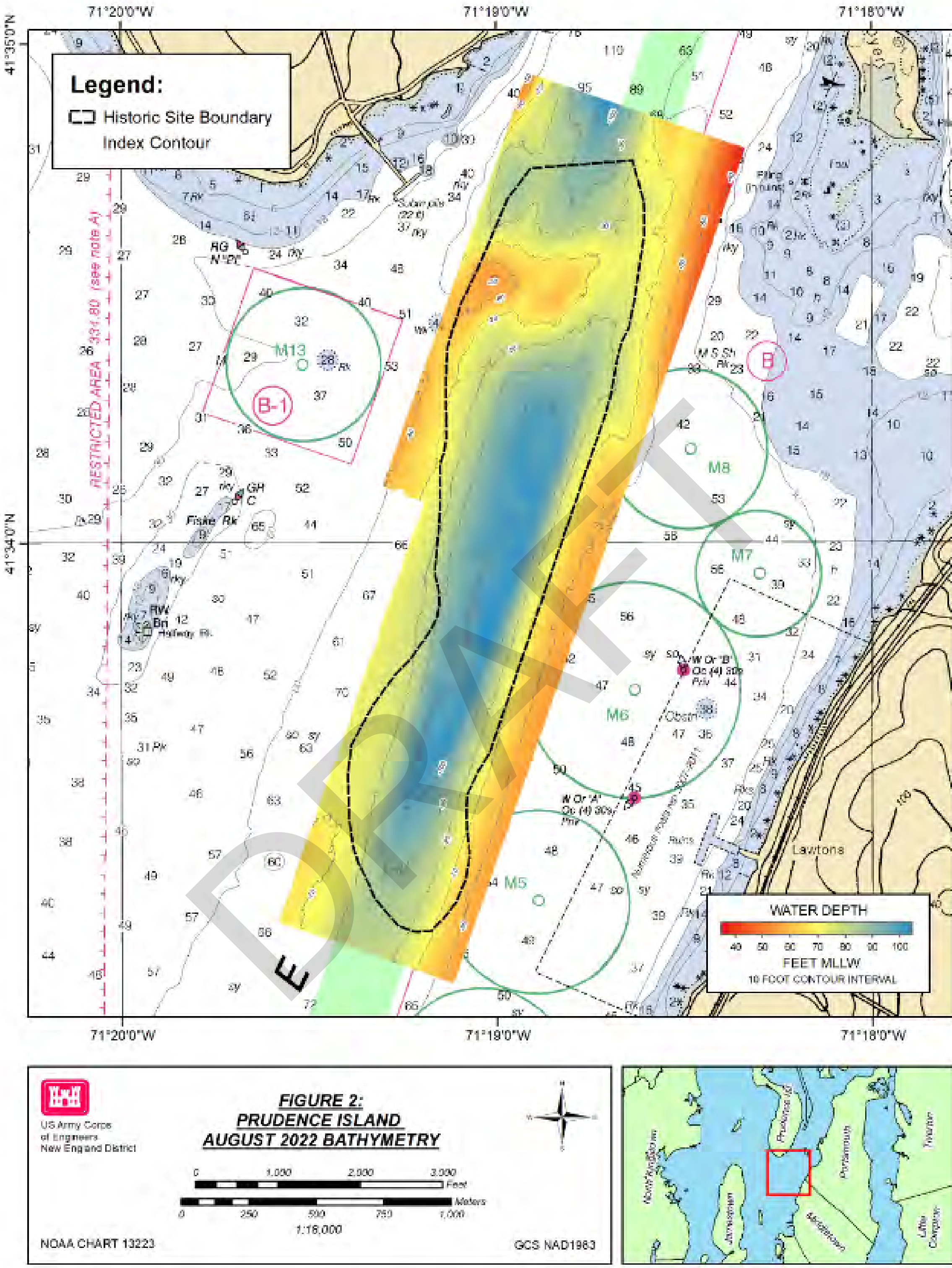
- **Future PIPS Sampling Efforts:** USACE intends to perform additional sampling and analysis of sediments within the proposed PIPS BU site to confirm the presence of contaminated sediments within the biologically active layer. Three foot vibracores will be collected from the fall 2022 stations and subsampled for chemical analysis. The change in sampling methodology should yield sufficient sediment recovery to meet the project objectives. This plan of action was agreed upon by all stakeholders in attendance. If there is evidence of contamination at within the biologically active layer, a 3 ft cap would be necessary to isolate it from the environment. No further use of the site would be allowed after the cap has been placed.

CONCLUSION AND FOLLOWUP ITEMS:

- Elizabeth Waterhouse to schedule a planning meeting with RI DEM Marine Fisheries and CRMC for setting up a stakeholder meeting for fishermen regarding PIPS testing and potential capping.
- USACE to proceed with additional sampling efforts at PIPS as described in this MFR.
- Further USACE testing at PIPS will yield results in mid-April, at which time another stakeholder meeting will be scheduled.

Elizabeth Waterhouse
Project Ecologist
U.S. Army Corps of Engineers
New England District

Participants reviewed a draft of these notes distributed on January 3, 2023.


Legend:
Historic Site Boundary
Index Contour
WATER DEPTH
40 50 60 70 80 90 100
FEET MLLW
10 FOOT CONTOUR INTERVAL
71°20'0"W
71°19'0"W
71°18'0"W
41°35'0"N
41°34'0"N
RESTRICTED AREA 334.80 (see note A)
M13
B-1
B
M8
M7
M6
M5
Fiske Rk
Lawtons
DRAFT
US Army Corps of Engineers New England District
FIGURE 2:
PRUDENCE ISLAND
AUGUST 2022 BATHYMETRY
1:16,000
NOAA CHART 13223
GCS NAD1983
North Kingstown
Jamestown
Prudence Isl
Portsmouth
Middletown
Tiverton
Little Compton

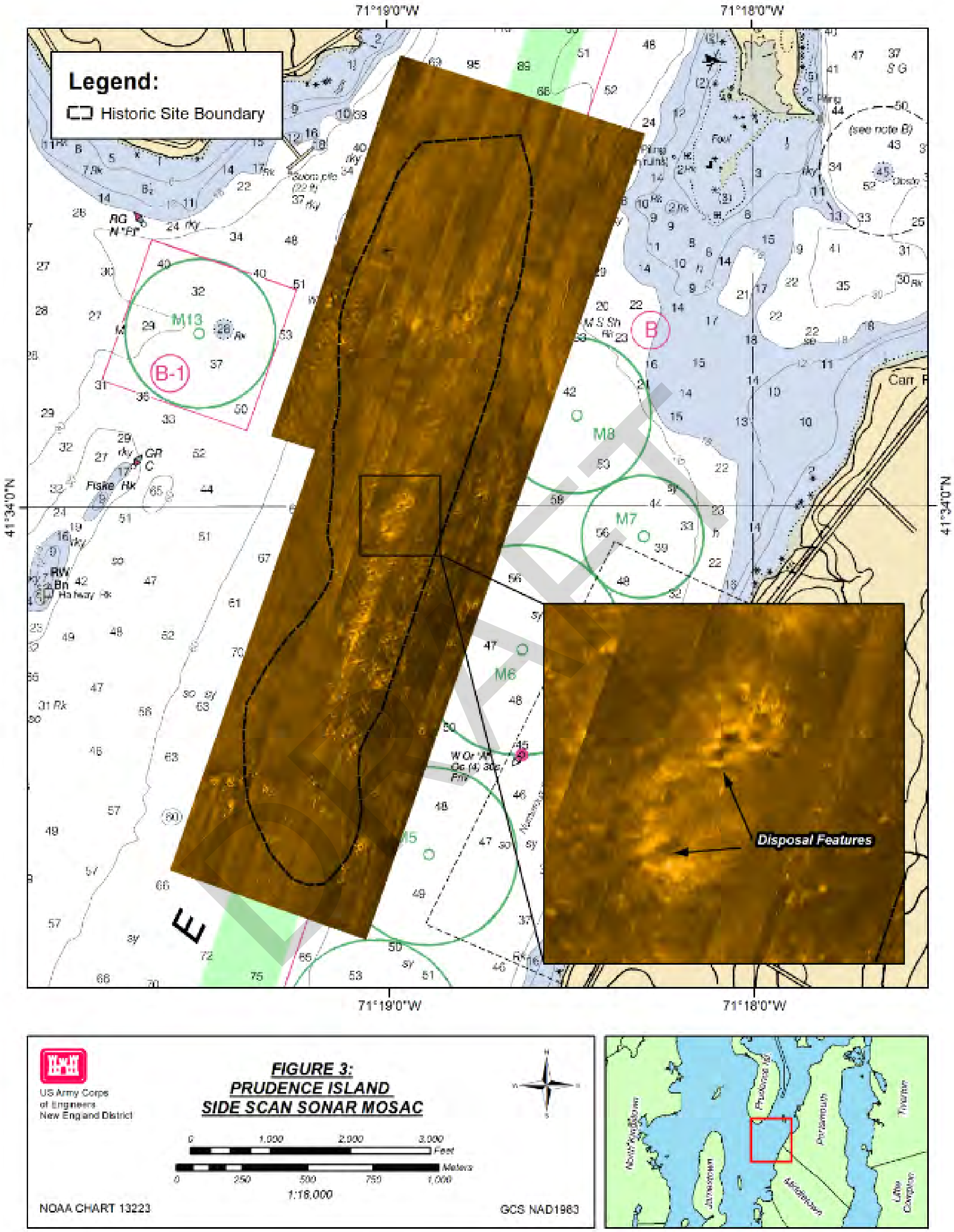


FIGURE 3:
PRUDENCE ISLAND
SIDE SCAN SONAR MOSAC

From: Waterhouse, Elizabeth C CIV USARMY CENAE (USA)
Sent: Friday, February 17, 2023 10:23 AM
To:

Cc: Oliver, Lawrence R CIV USARMY CENAE (USA); Schneider, Eric (DEM); Olszewski, Scott (DEM); Moses, Catherine Grace (Grace) CIV USARMY CENAE (USA); Dan Goulet
Subject: Providence River Dredging and Material Placement - Outreach Meeting

Follow Up Flag: Follow up
Flag Status: Flagged

Hello,

We obtained your contact information from Rhode Island DEM, Division of Marine Fisheries. I'm not sure if you've heard, but we're preparing to dredge the Providence River this year or next. Similar to the last time we dredged the river, we're planning to excavate a pit or confined aquatic disposal (CAD) cell in the upper river the dispose of the contaminated dredged sediment from the upper river. The excavation of the CAD cell will produce about 3 million cubic yards (cy) of clean sand and silt that will be available for beneficial uses, including the potential to cap a former dredged material disposal site in the upper bay. Preliminary sampling indicated that the site may contain contaminants that we could isolate with the clean sediment.

We would like to hold an informal meeting to discuss opportunities and concerns about potential uses of the clean material and gather input from local fishermen.

We could hold an online web-ex meeting, an in-person meeting, or a conference call within the next couple of weeks. Please let me know your thoughts on what may work best and we can make a plan to coordinate. Please also feel free to call my cell anytime 401-323-0509.

Thank you very much,

Elizabeth Waterhouse
Project Ecologist
U.S. Army Corps of Engineers
New England District
978-318-8943

Cc:
RILA - Gregory Mataronas
RILA - Lanny Dellinger
RILA - Alan Eagles
Fixed Trap - Kenneth Murgo
Mobile gear - Harry Whilden
RISA – Mike McGiveney

MARCH 2023 FACTS AND FIGURES FROM FISHERMANS OUTREACH

Project Description

- USACE is developing an Environmental Assessment and Dredged Material Management Plan (DMMP) for the Providence River Dredge Project (tentative schedule late 2024-2025)
- 608,000 cubic yards (CY) of shoaled material to be dredged from the channel is not suitable for open water disposal and needs to be placed in a Confined Aquatic Disposal (CAD) cell.
- The CAD cell will be located in Edgewood Shoals. In order to provide a passage for barges during maintenance dredging, a small access channel will be dredged to connect the federal channel to the CAD cell. Dredging of this connecting channel will also increase water quality of the area.
- 3 million CY of material will be dredged during the construction of the CAD cell, this material is suitable for open water disposal at the Rhode Island Sound Disposal Site (RISDS) or beneficial use if a need and sponsor is identified.
- One beneficial use already identified is capping of the existing Port Edgewood Basin.

Prudence Island Placement Site (PIPS)

- The Prudence Island Placement Site (PIPS) was used to dispose dredged material in the 1960s, before current testing and suitability requirements were in place. USACE completed initial sediment investigations at this location in 2022.
- Initial investigations in 2022 indicated that disposal features have persisted on the seabed since the 1960s. Limited samples were taken to determine the quality of surficial material at the PIPS and indicated that there may be legacy contamination just below a surficial layer.
- USACE is performing additional sampling and analysis of this area to confirm the initial results and determine the nature and depth of any legacy contamination.
- If it is determined that material in the biologically active layer is not supportive of a healthy ecosystem, USACE will place a 3 ft cap of suitable material from the CAD cell construction to isolate the existing contaminated material and provide a layer of clean material that will allow re-establishment of a healthy ecosystem.
- No further placement at the PIPS would be allowed after the cap has been placed.
- There would be no restrictions on fishing use post-placement.

Your Input and Concerns

- We are reaching out to local fishermen and stakeholders interested in or who use the PIPS area for fishing.
- We are looking to share information and obtain your input and any concerns for the potential beneficial use placement activity or any other aspect of the project.

Figure 1A. Providence River Federal National Project – Dredge (red) and Overdepth (yellow) Dredge Areas in the Upper River

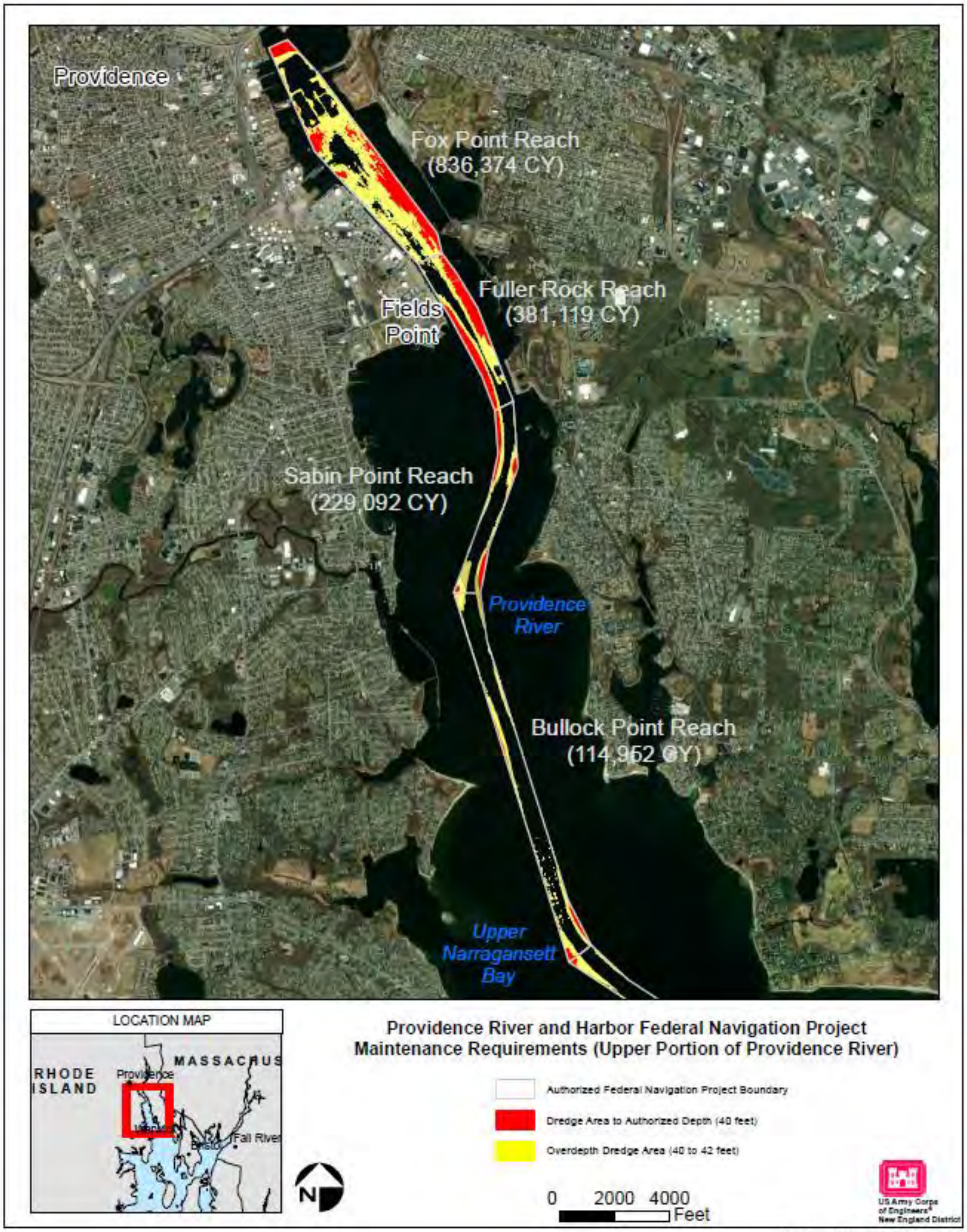


Figure 1B. Providence River Federal National Project – Dredge (red) and Overdepth (yellow) Dredge Areas in the Lower River

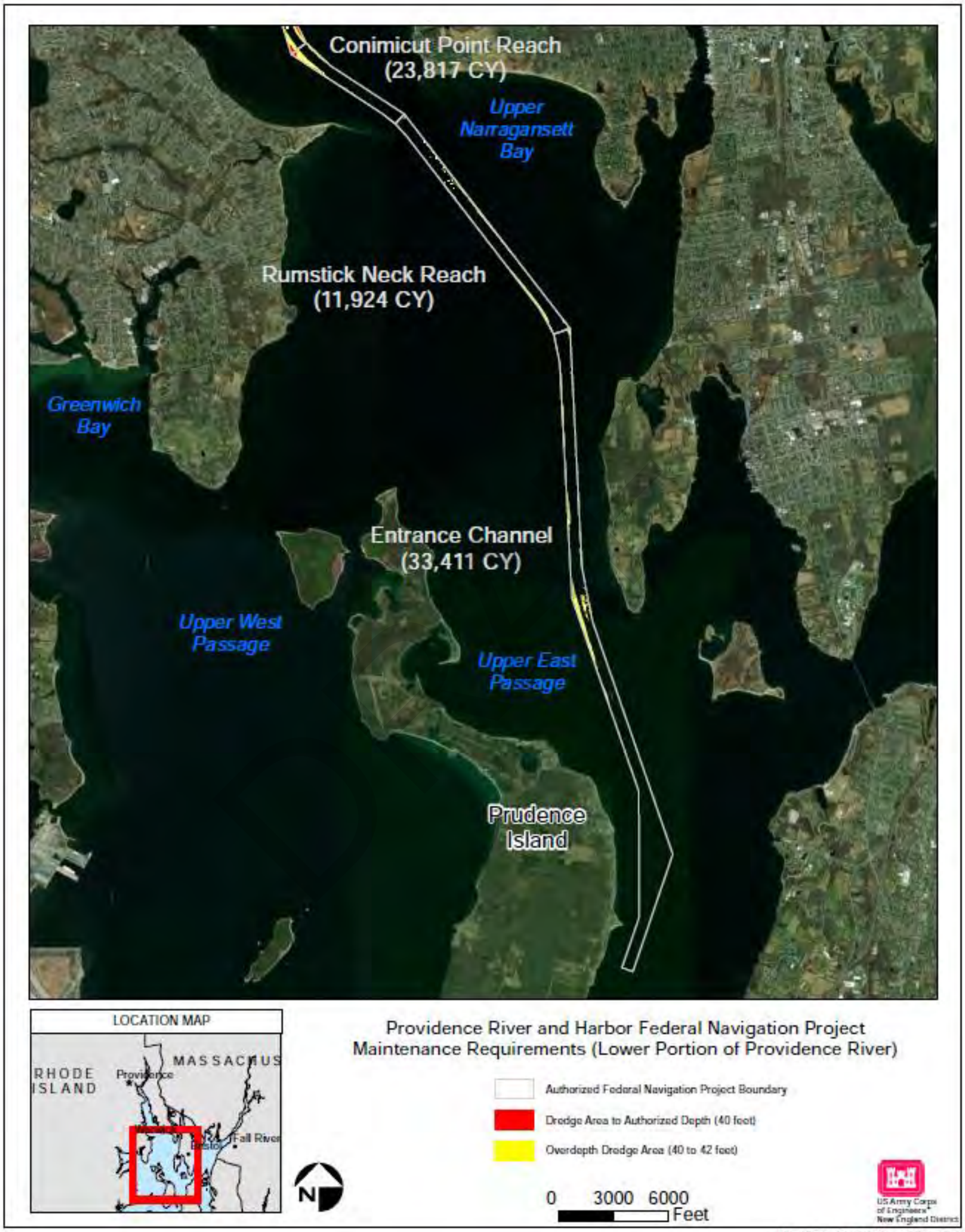


Figure 2. Edgewood Shoals Cad Cell (blue), Access Channel (grey), and Port Edgewood Basin (green)

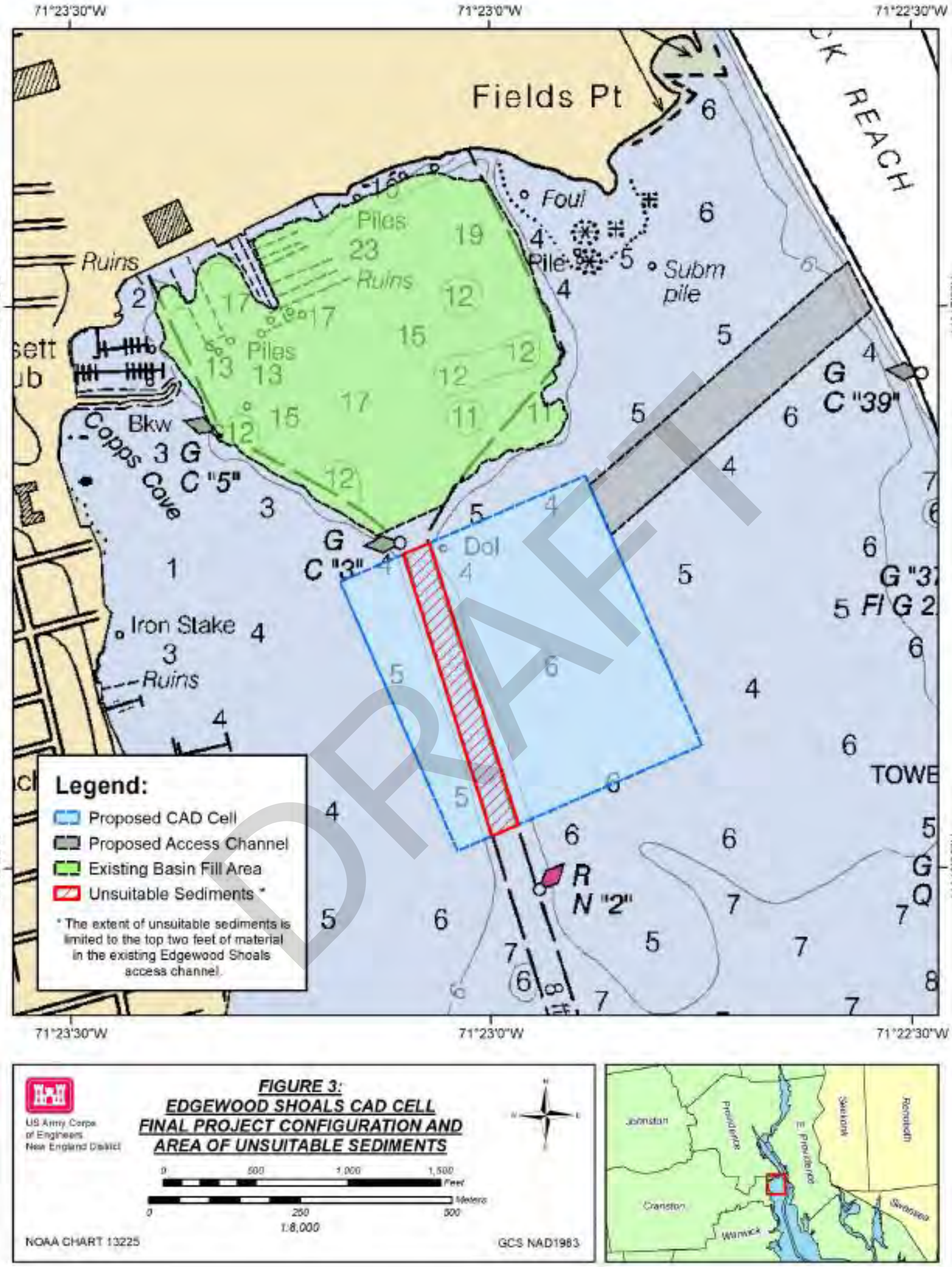


Figure 3. Sonar Image Showing the Approximate Prudence Island Placement Site and Historic Disposal Features Present in 2022

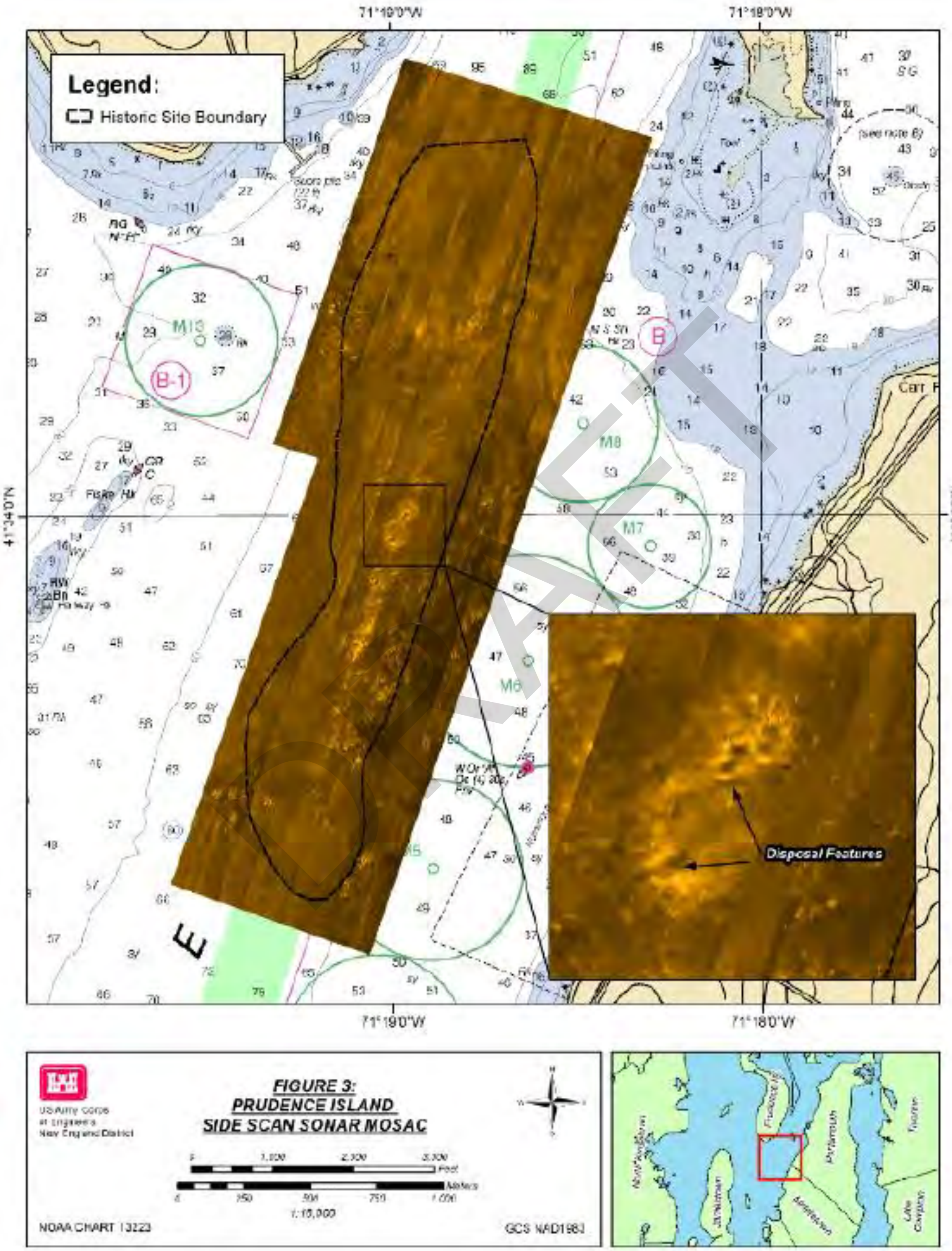


Figure 4. RIDEM Quahog Abundance Map in Narragansett Bay and Approximate CAD Cell Locations for the Current Action Areas (Edgewood Shoals CAD, Port Edgewood Basin) and Potential Future Dredge Cycles (Edgewood Shoals South and Fox Point CADs)

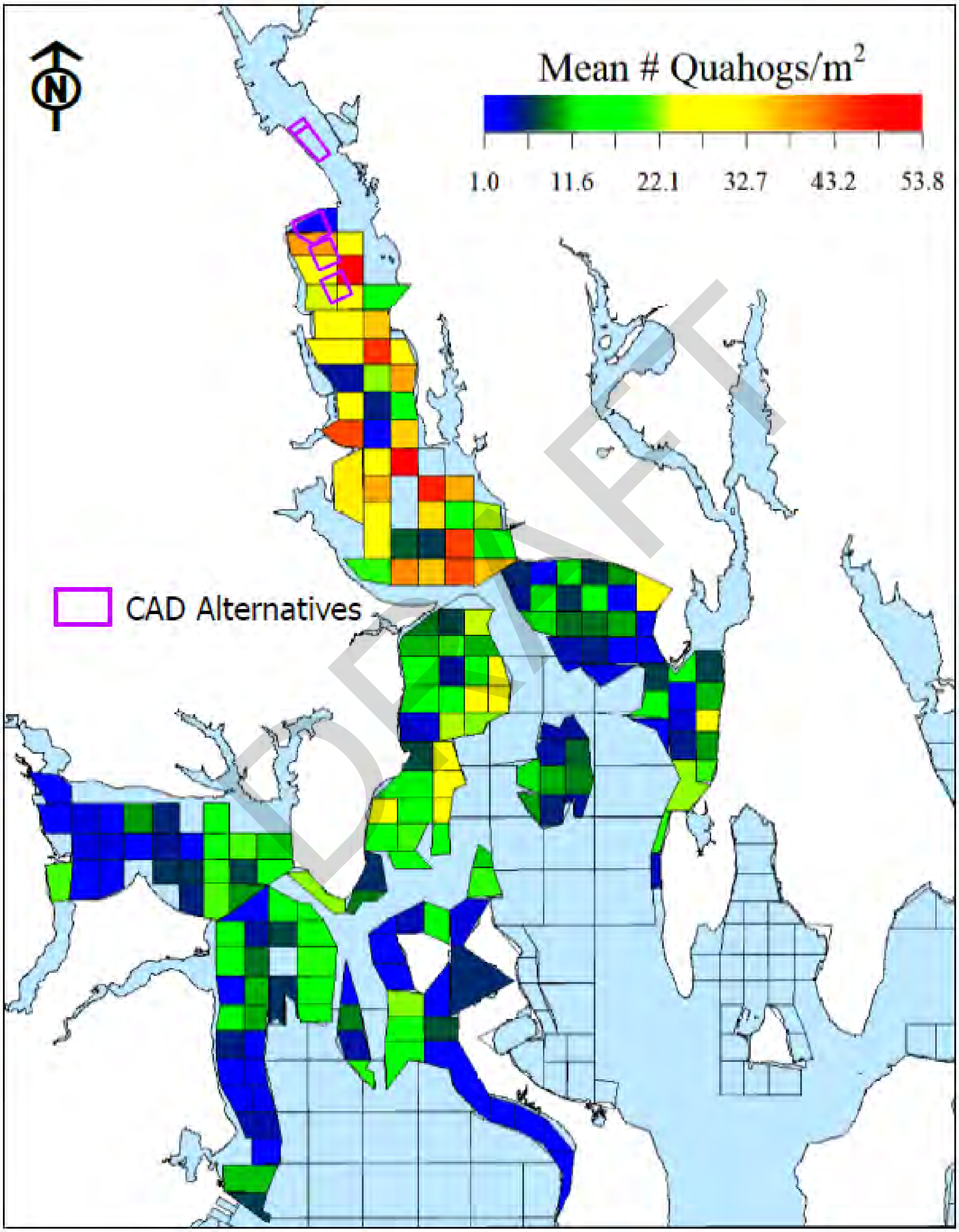
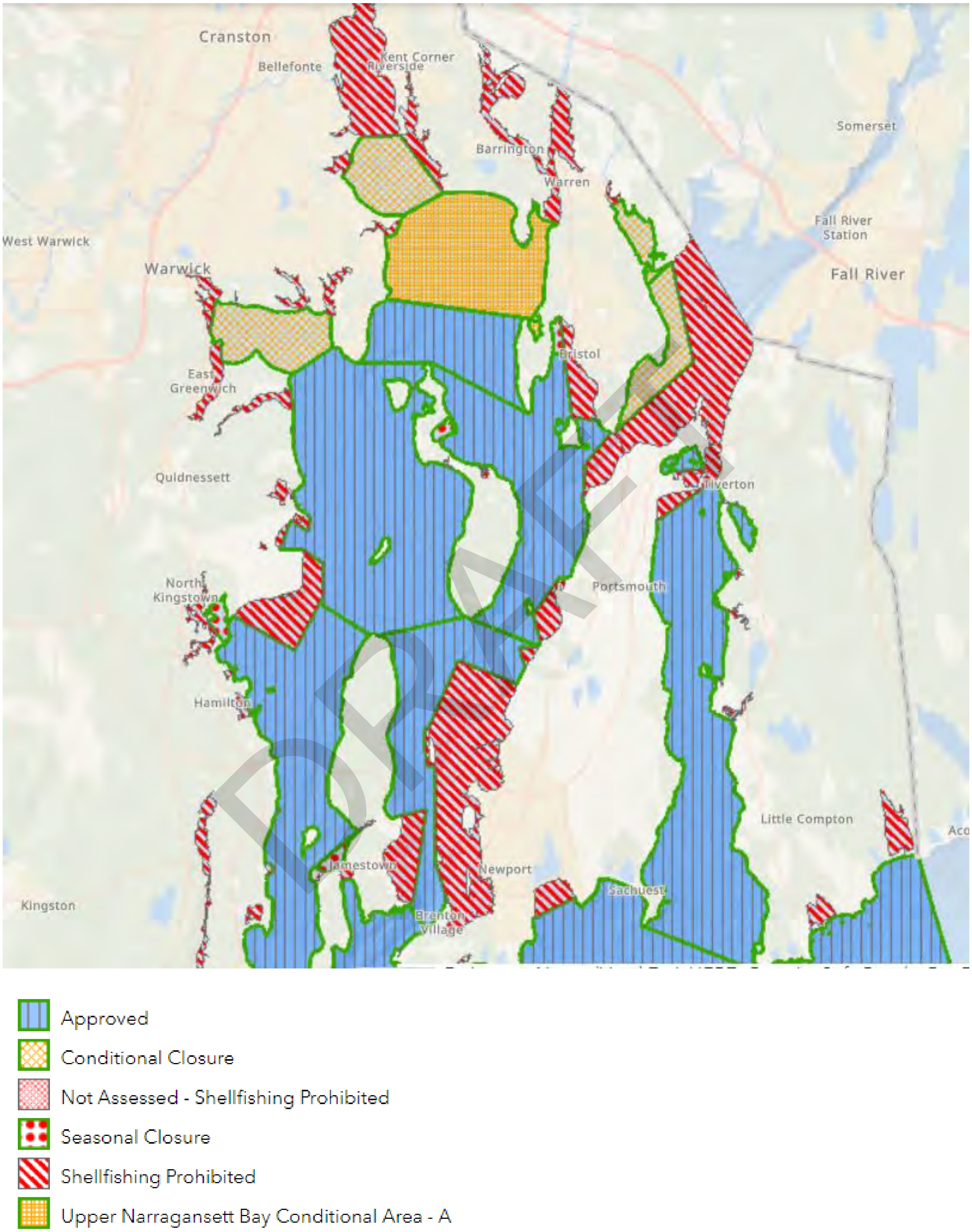


Figure 5. RIDEM Shellfish Harvest Restrictions Map (March 2023)



Providence River and Harbor Federal Navigation Project Rhode Island Dredged Material Management Plan and Environmental Assessment

Appendix B
Channel Utilization Report

Providence River and Harbor Federal Navigation Project
Providence, Rhode Island

Maintenance Dredging
Channel Utilization Assessment
Final
July 2024

Introduction

The purpose of this report is to determine the current usage of the authorized Providence River & Harbor Federal Navigation Project (FNP). The results can be used to help determine if current and reasonably foreseeable usage of the project warrants maintenance dredging to the authorized depth of -40 feet, Mean Lower Low Water (MLLW) for the full authorized dimensions along the 17-mile project. The U. S. Army Corps of Engineers (USACE) New England District is currently developing a Dredged Material Management Plan (DMMP) for the project. To restore the Providence River & Harbor FNP to authorized depths requires maintenance dredging of approximately 2.0 million cubic yards (CY) of material according to analysis of data from the USACE channel condition survey conducted in 2020. Initial chemical and biological testing of the dredged material has revealed that all of the 2.0 million CY of the dredged sediments is unsuitable for open water placement and would need to be placed at alternative placement sites. These alternatives may include placement in upland sites and/or construction of Confined Aquatic Disposal (CAD) cells.

The DMMP will also address additional capacity needed for placement of Non-Federal dredged material from the Providence River and Narragansett Bay. USACE has three shallow-draft FNPs accessed by the Providence FNP and has identified over 60,000 CY of material to dredge to authorized depths. The Non-Federal partner has identified an additional 300,000 CY of material that they expect to dredge throughout the 20-year period covered by the DMMP.

Methodology

Pursuant to ER 1105-2-100, this analysis examines past and present use of the navigation channel, including shipping volumes, the characteristics of vessels calling, and channel utilization over incremental depths.

A project that will continue to be economically viable is one where the existing channel depth is sufficiently utilized. This assessment examines the size of the vessels currently calling at the Port. Consideration is given to whether or not vessels are getting larger over time, and if larger vessels are calling more frequently. Another area of focus is the sailing draft of the existing fleet. This report examines how the fleet is using the channel depth currently provided and what changes in usage, if any, have occurred at various depths.

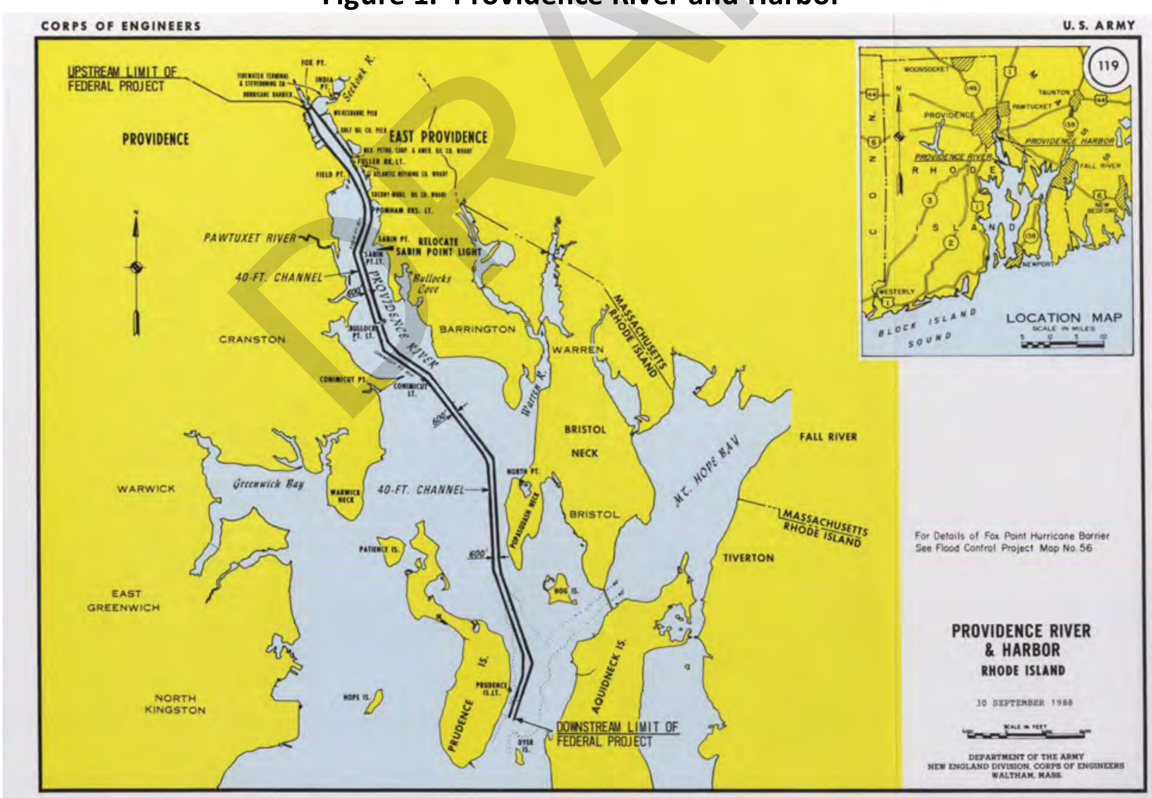
Finally, a channel utilization index is constructed, which shows the extent to which the channel is used at varying depths. The index is defined as the proportion of cargo tons moved at each channel depth relative to the proportion of vessel trips at each channel depth. This calculation reveals the intensity of usage for the channel, which can indicate efficiency.

Data are taken from the Waterborne Commerce Statistics Center (WCSC), with datasets on cargo tons delivered at each foot of channel depth and vessel trips at each foot of channel depth. These data, which cover the period from 2016-2020, the most recent years for which data were available, provide insight into the volume of cargo flowing in and out of the Harbor as well as the characteristics of the vessels.

Study Area

Providence is the capital of Rhode Island. With a population of 191,000 as of the 2010 census, it is the largest city in the state and the third largest in New England. Once a major manufacturing center, the city's economy is now based on producing services, particularly those in the education, healthcare, and finance sectors. The Port of Providence (Figure 1) is New England's second largest deep-water port and the anchor of the city's remaining industrial concerns. It is located in upper Narragansett Bay and in the Providence River, an 8-mile-long tidal river on the city's eastern side. USACE is responsible for dredging the entire 17 miles of federally authorized channel and turning basins.

Figure 1. Providence River and Harbor



Source: U.S. Army Corps of Engineers New England District

Project Description

The Providence River & Harbor FNP was originally adopted in 1852 and modified by 17 subsequent authorizations. The existing project was authorized by the River and Harbor Act of 1965. The FNP currently has an authorized depth of -40 feet MLLW and channel width of 600 feet, with wider bends and a 1,700-foot-wide harbor area at the upstream end. The total authorized channel length is approximately 17 miles long, extending from its upstream limit just downstream of the Providence (Fox Point) Hurricane Barrier to its downstream limit between Prudence Island and Aquidneck Island. A section of the channel and turning basin, along the east Providence shoreline and west of Watchemoket Cove in the Fox Point reach, was not dredged during the last dredging cycle in 2005. At that time, it was determined, in discussion with the pilots, that that portion of the project did not require the fully authorized depth and width necessary for maintaining safe and efficient navigation. This area of the project has continued to experience shoaling, and discussion with the executive director and the president of the Northeast Marine Pilots Association now indicates the area is problematic for the larger vessels to safely navigate. Maximum vessel size twenty years ago fell within the 50,000-60,000 dead weight ton (DWT) and 600-656-foot-length, with a few 60,000-80,000-DWT vessels at 656-800-foot-lengths. The number of calls by 60,000-80,000-DWT vessels has increased slightly since then and resulted in lightering and light-loading to navigate this section of the FNP.

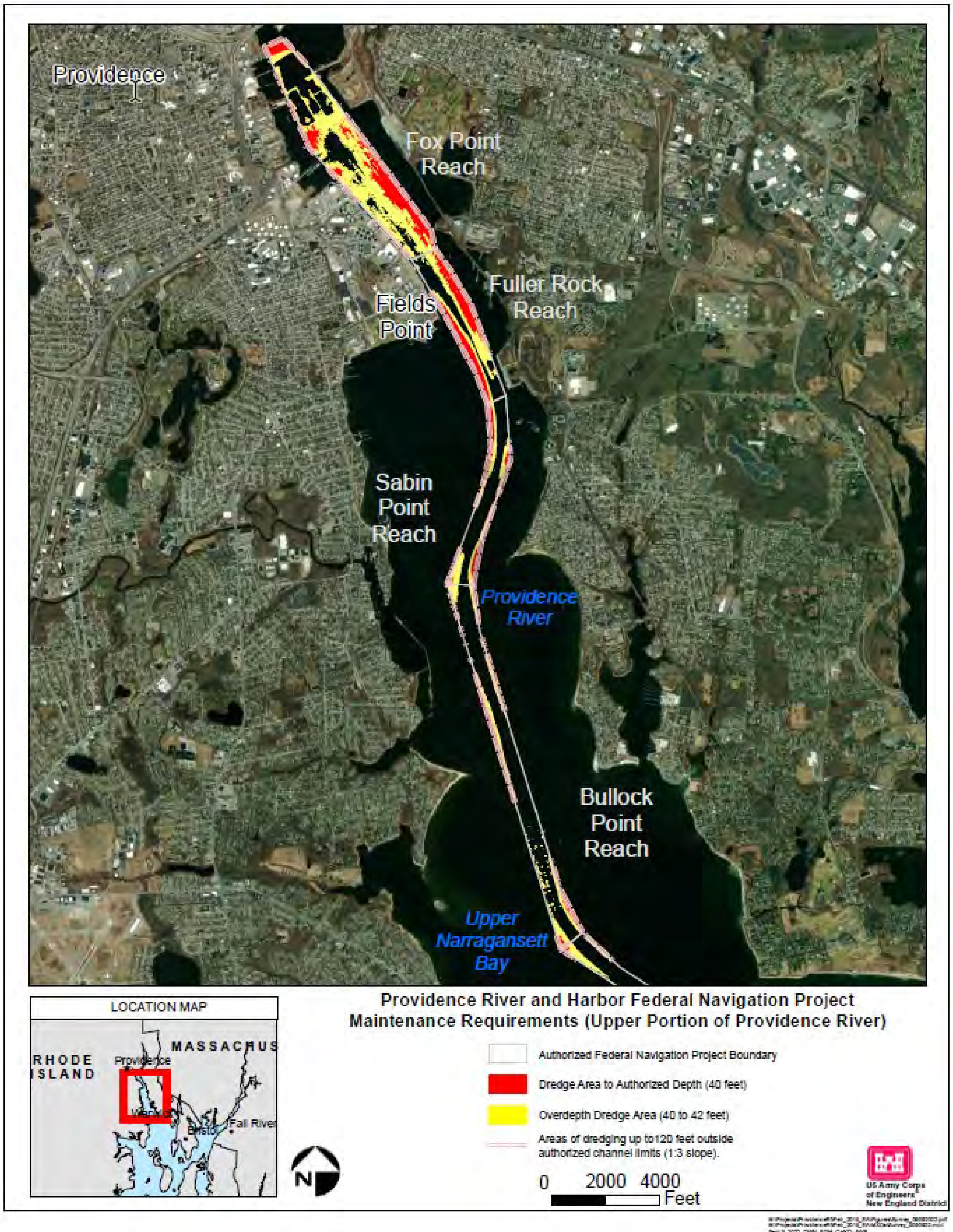
Current Harbor Conditions

The channel was last dredged to its authorized depth of -40 feet between the years 2003 and 2005. Shoaling has occurred over the intervening years, reducing the controlling depth to approximately 35 feet.

According to Port officials, Panamax and Handymax vessels, which can draft up to 46 feet and 40 feet, respectively, have been forced to lighter offshore using cranes and barges. This time-consuming process typically occurs in the Jamestown Anchorage south of Providence in Narragansett Bay, where the water reaches a depth of 110 feet. Some vessels, including tankers with 37-foot drafts or greater, require at least a 10% under keel clearance and must utilize the high tide in order to safely navigate the Federal channel and are typically offloading cargo quickly in order to avoid touching bottom. Additionally, larger vessels are currently expressing concern about depth uncertainty and needing soundings to get accurate readings for under keel clearance.

Figure 2, below, displays areas where shoaling has reduced limiting depth to 35 feet, particularly in the Fox Point reach and turning basin. This limiting depth does not encompass the entire channel, but shoaling has occurred in areas that limit turning and maneuvering room and disrupts channel operations for many larger vessels, including all vessels requiring depths of 35 feet or more. This has resulted in the lightering previously mentioned. Since vessels are avoiding the turning basin due to shoaling, they are getting closer to berthed vessels at Provport and posing risks to both vessels and wear and tear to facilities, resulting in additional safety concerns. Moored vessels are at risk of being jostled due to these close encounters. The alternative is to lighter with shallower draft ships that can travel closer to the shoaled in east side of the reach, resulting in inefficient deliveries to port. Due to the shoaled section of channel that was not dredged in 2005, vessels of 600-foot length or greater are required to make smaller swings, rely on tugs more, and have longer wait times to navigate the channel. These problems will continue to occur if the undredged section remains in its current state even if the remainder of the channel is dredged to the fully authorized depth. For this reason, the pilots association has requested this section be included in this next maintenance effort.

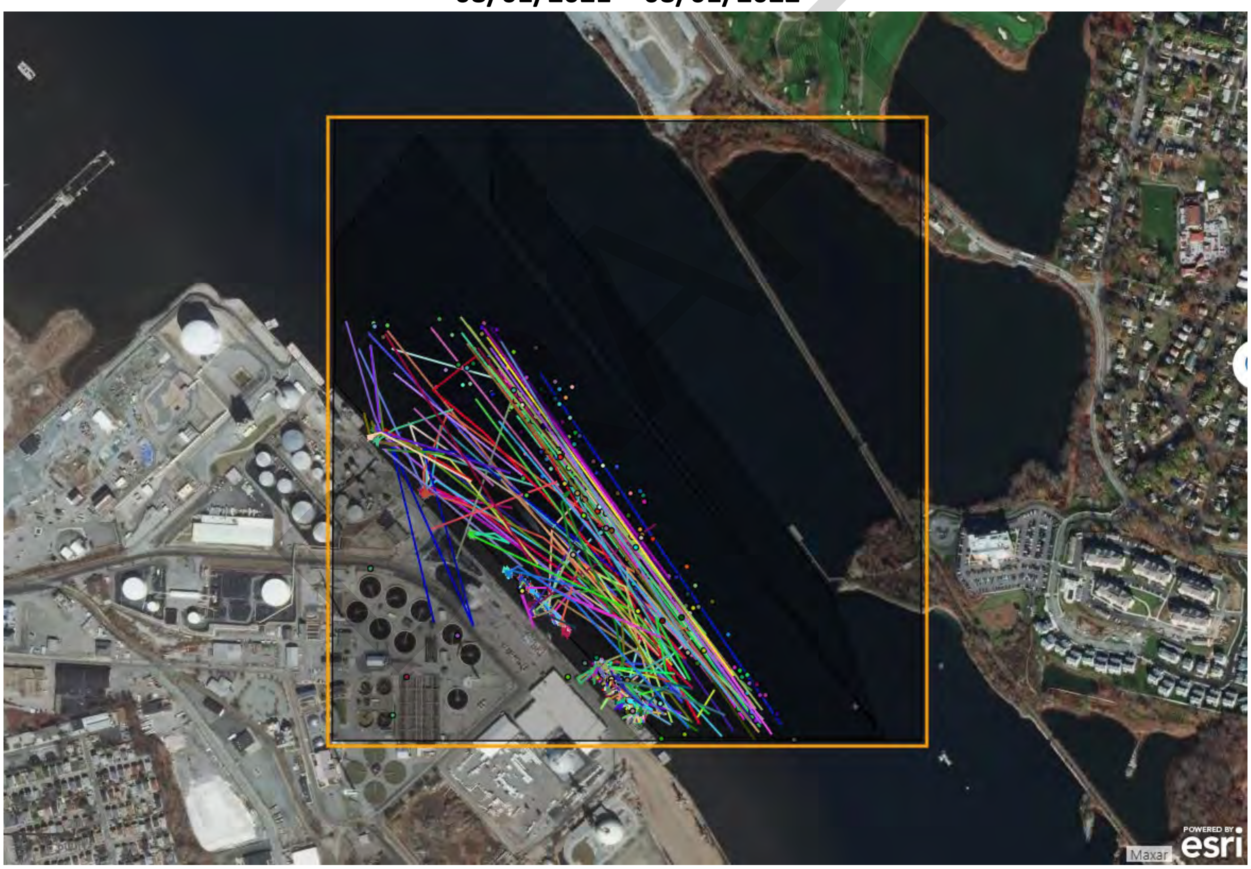
Figure 2. Providence River and Harbor Federal Navigation Project 2022 Dredging Needs Map



Source: U.S. Army Corps of Engineers New England District

Figure 3, below, displays vessel traffic of all vessels of 500-foot or greater length from August 1, 2021, to August 1, 2022, in the Fox Point reach from the Automatic Identification System Analysis Package (AISAP) Tool. Three vessels 700-foot length or greater have utilized the channel over the past year: the Golden Forward, a 751-foot length cargo vessel, the Grande Lagos, a 774-foot cargo vessel, and the Lan Hua Hai, an 833-foot-length cargo vessel. The assumption is that, following historic shipping trends, vessels calling on the port will only increase in size over the next 20 years and that Providence River and Harbor will see more vessels of 833-foot length or greater during this time. Pilots are getting inquiries for vessels of 140-foot beams, which translates to 830-foot lengths, but are unable to accommodate them because of the shoaled sections of channel in the Fox Point reach, including the section that was not dredged in the last cycle. These undredged conditions are limiting current and expected future utilization of the federal navigation project.

Figure 3. Providence River and Harbor Fox Point reach showing 500+-foot-long Vessel Traffic 08/01/2021 – 08/01/2022



Source: Automatic Identification System Analysis Package (AISAP) Tool, 2021-2022

Project Users

Providence Harbor hosts a number of important regional businesses, some of which rent space from the Port. Other terminals are located further upstream and are privately owned. All of these stakeholders rely on the Federal channel for their operations.

EUKOR Auto Carriers

EUKOR is a shipping company specializing in transporting automobiles and other rolling cargo. The South Korean-based company's Providence terminal exports 1,500 used automobiles a month to West Africa.

UNIVAR Terminal

Univar is a global chemical distribution company headquartered in Chicago. Its Providence terminal has an annual throughput of 50,000 tons and focuses on chlorine and wastewater treatment services.

Enterprise Products and Terminals

Enterprise Products Partners, headquartered in Houston, is one of the largest North American providers of midstream energy services to producers and consumers of natural gas, natural gas liquids, crude oil, refined products, and petrochemicals. The company's Providence terminal has an annual throughput of 180,000 tons and features a state-of-the-art vapor recovery system.

Lehigh Terminal

Lehigh Cement is an American company that produces, imports, and markets cements for the construction industry, with a strong customer base in New England. The company's Providence terminal has an annual throughput of 180,000 tons of bulk cement and a 50,000-ton dome to cover shipments waiting at the port for trucking.

Schnitzer Northeast

Schnitzer Steel is a steel manufacturing and scrap metal recycling company headquartered in Portland, Oregon. The company's Providence terminal exports 570,000 tons of scrap steel mainly to China, Turkey, and South Korea.

Washington Mills

Washington Mills is a Massachusetts-based company and one of the world's largest and oldest producers of abrasives and fused mineral products, which are used for making sandpaper and grinding wheels. The Providence terminal has an annual throughput of 80,000 tons.

New England Petroleum

New England Petroleum is a partnership between the Hudson Companies and Global Partners. The Providence terminal has 55.8-million gallons of annual throughput, and a new 16.5-million-gallon tank farm is under construction near the Port.

Morton Salt

Morton Salt, a Chicago-based subsidiary of German mining company K+S, is the largest producer and marketer of salt in North America. The company is the exclusive provider of road salt to the State of Rhode Island, and its terminal in Providence handles 300,000 tons of annual throughput.

Waterborne Commerce

In general, smaller vessels comprise the vast majority of trips to and from the Port, but deeper draft vessels bring in the majority of the cargo. Total volumes have remained steady in Providence River and Harbor in recent years. Table 1 below shows the total commodity tonnage through Providence River and Harbor from 2003 to 2020 (Latest available).

Table 1. Providence River and Harbor Total Waterborne Commerce 2003-2020 (short tons)

Year	Total Commodity Volume (short tons)
2003	9,200,000
2004	9,600,000
2005	10,000,000
2006	9,300,000
2007	9,200,000
2008	8,500,000
2009	6,900,000
2010	7,100,000
2011	7,600,000
2012	7,000,000
2013	7,800,000
2014	8,000,000
2015	8,000,000
2016	8,000,000
2017	8,500,000
2018	8,300,000
2019	8,200,000
2020	7,800,000

Source: Waterborne Commerce Statistics Center, USACE, 2021

Table 2 below displays a breakdown of Providence tonnage by commodity for the years 2016-2020. Quantities have held relatively constant over that period.

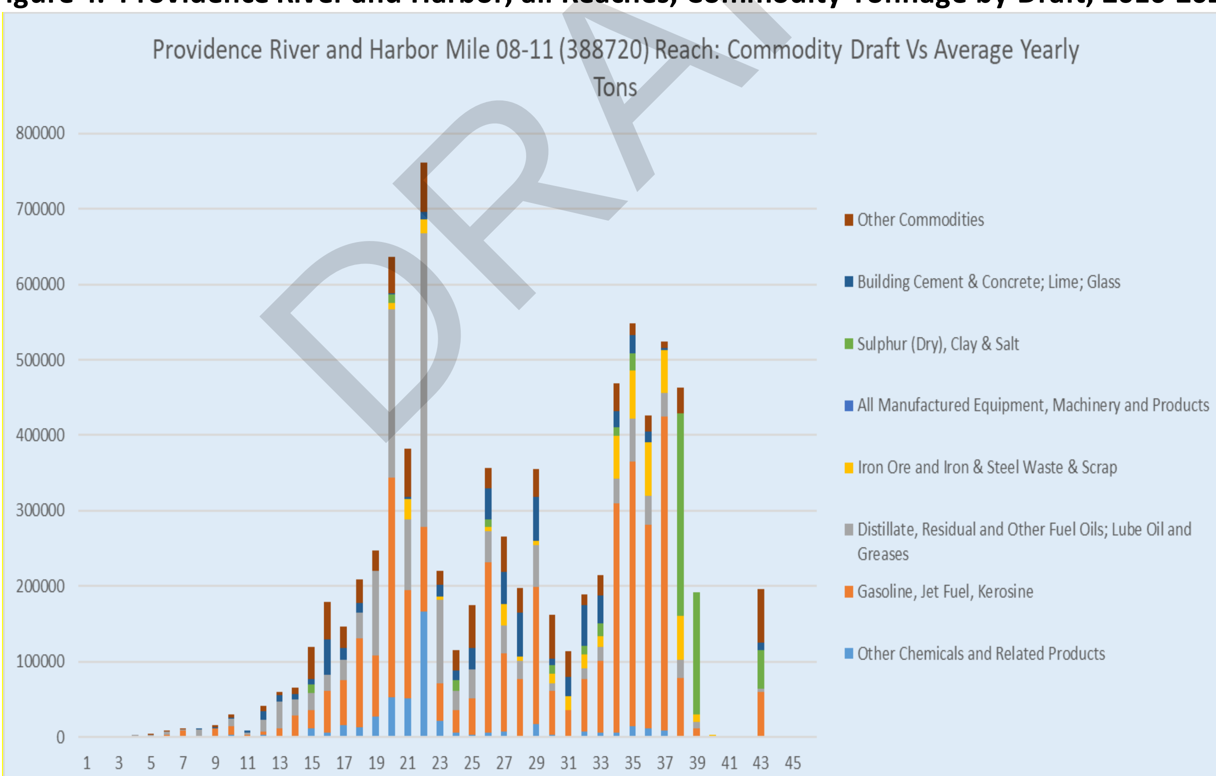
Table 2. Providence Harbor Commodity Composition, 2016 - 2020

Year	Commodity Volume (Short Tons)						
	Gasoline, Jet Fuel, Kerosine	Distillate, Residual and Other Fuel Oils; Lube Oil and Greases	Building Cement and Concrete; Lime; Glass	Iron Ore and Iron & Steel Waste & Scrap	Sulphur (Dry), Clay & Salt	Other Chemicals and Related Products	Other*
2016	3,553,953	2,112,079	590,229	589,875	397,307	399,183	389,408
2017	3,721,298	1,900,503	615,684	691,339	477,449	469,179	456,093
2018	3,459,071	2,022,190	569,084	571,809	724,619	384,445	528,550
2019	3,391,661	1,994,456	643,802	543,397	631,999	379,582	565,227
2020	2,928,911	2,144,241	616,617	-	828,302	385,768	-
Total	17,054,894	10,173,469	3,035,416	2,396,420	3,059,676	2,018,157	1,939,278

Source: Waterborne Commerce Statistics Center, USACE, 2021

Figure 4, below, displays the volume of tonnage moved through the Providence River and Harbor system from 2016-2020, by vessel draft in feet.

Figure 4. Providence River and Harbor, all Reaches, Commodity Tonnage by Draft, 2016-2020



Source: USACE Channel Portfolio Tool, data only available through 2020

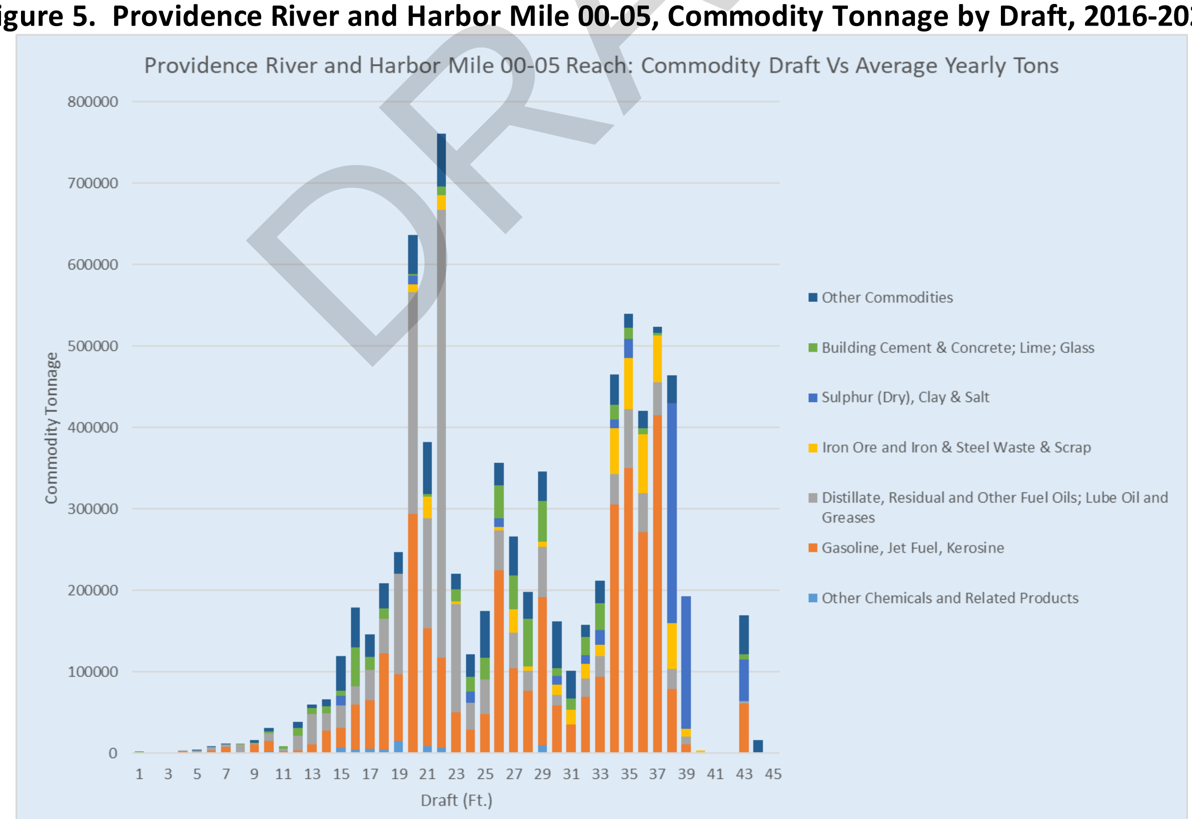
Channel Utilization Analysis

The purpose of the channel utilization analysis is to provide an assessment of the extent to which the navigations channels in Providence River and Harbor are used for commercial shipping. Because the main criterion for continued dredging is channel usage and the extent to which each foot of depth is being used to ship cargo, the analysis can be used to assess whether maintenance dredging to a certain depth is warranted.

The data described previously in this report form the basis for the channel utilization analysis. The analysis period consists of the years 2016 – 2020, the most recent years for which data were available. The utilization analysis is performed for each separable reach of channel in the harbor and displays the type and volume of tonnage moved at each increment of sailing draft. The reaches examined include Providence River and Harbor Mile 00-05 Reach, Providence River and Harbor Mile 06-07 Reach, Providence River and Harbor Mile 08-11 (388760) Reach, Providence River and Harbor Mile 08-11 (338740) Reach, and Providence River and Harbor Mile 08-11 (338720) Reach.

The data shown in the channel utilization graphs show the extent and efficiency of channel utilization for each channel reach. If a channel has higher tonnage values at deeper drafts, then the channel is being used more intensively, and therefore more efficiently, at deeper depths. The channel utilization analysis for the Providence River and Harbor Mile 00-05 is shown in Figure 5 below.

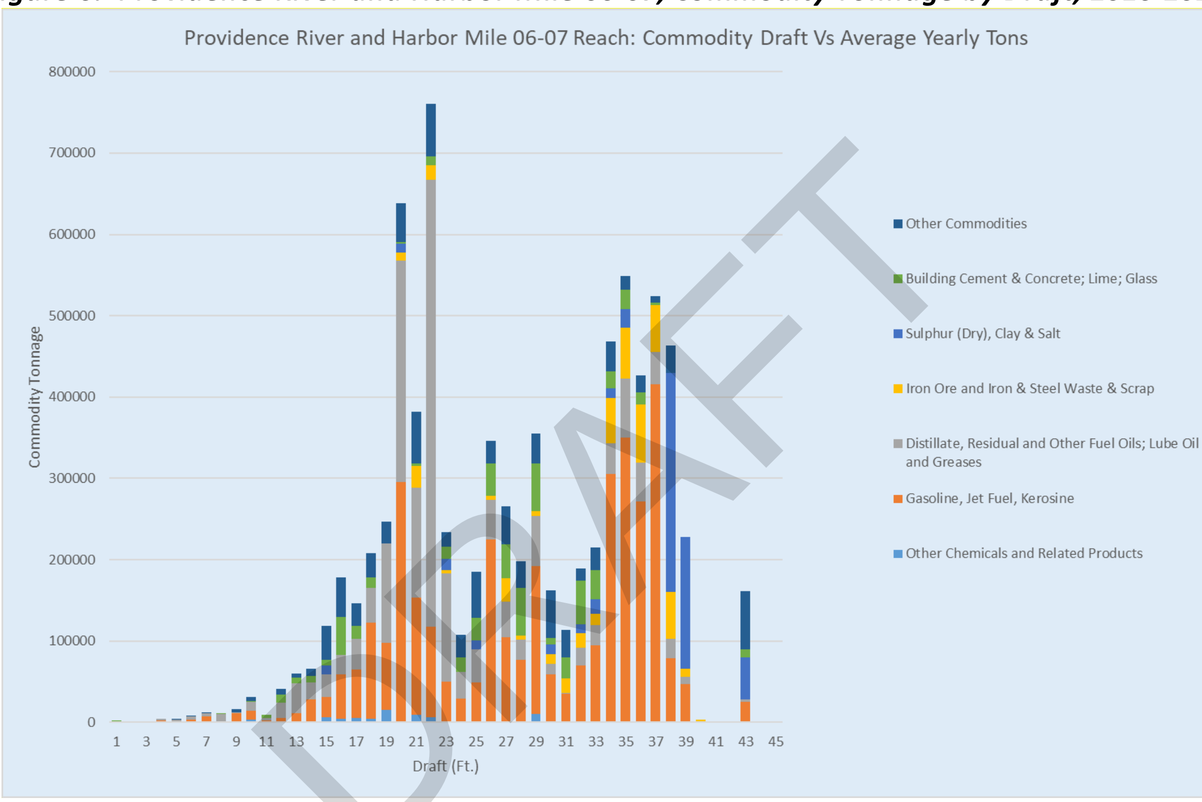
Figure 5. Providence River and Harbor Mile 00-05, Commodity Tonnage by Draft, 2016-2020



Source: USACE Channel Portfolio Tool, data only available through 2020

The channel utilization analysis for Providence River and Harbor Mile 06-07 is shown in Figure 6 below. The data show significant utilization of the channel to 44 feet of channel depth. Considering underkeel clearance requirements which are typically 10% of vessel draft, the data show that dredging to 48 feet is economically warranted. While this is deeper than the authorized channel depth of 40 feet, dredging the channel to the full authorized depth of 40 feet would allow largely unrestricted use of the channel for the majority of the fleet and would support more efficient operations.

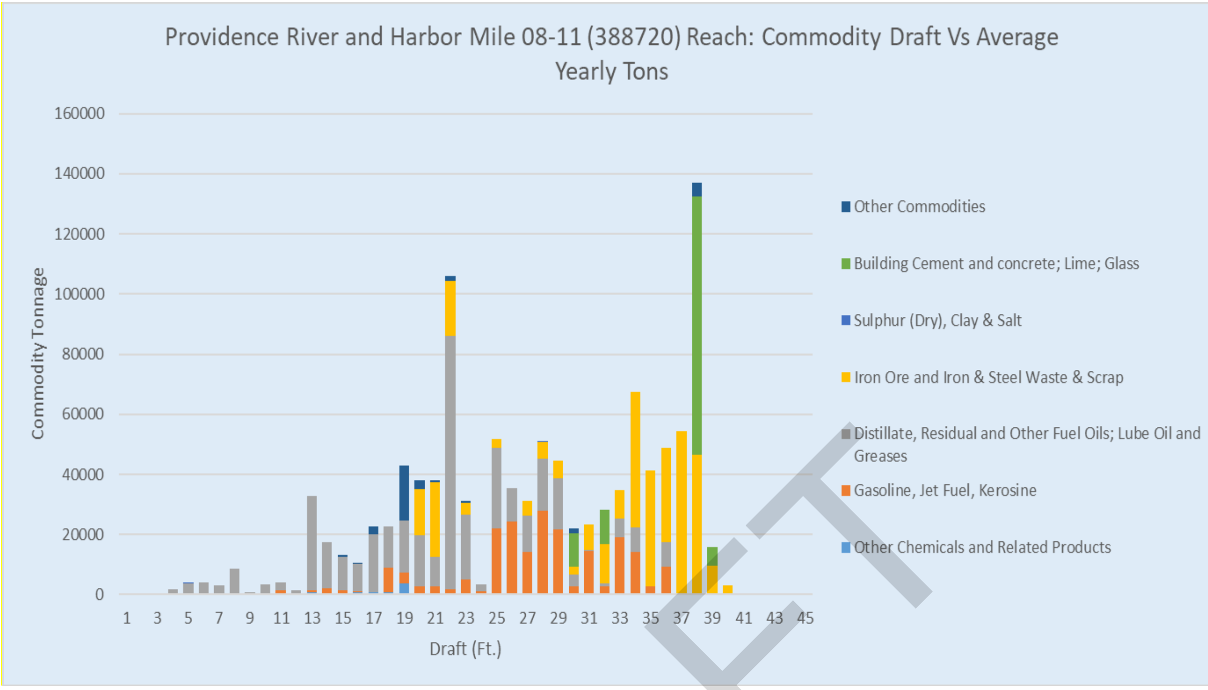
Figure 6. Providence River and Harbor Mile 06-07, Commodity Tonnage by Draft, 2016-2020



Source: USACE Channel Portfolio Tool, data only available through 2020

The channel utilization analysis for the Providence River and Harbor Mile 08-11 (388720) is shown in Figure 7, below. The analysis shows significant utilization of the channel to 39.5 feet of channel depth. Considering underkeel clearance requirements, the data support dredging to at least 44 feet of channel depth. This is also deeper than the authorized channel depth of 40 feet, so dredging the channel to the full authorized depth of 40 feet would also allow largely unrestricted use of the channel for the majority of the fleet and would support more efficient operations.

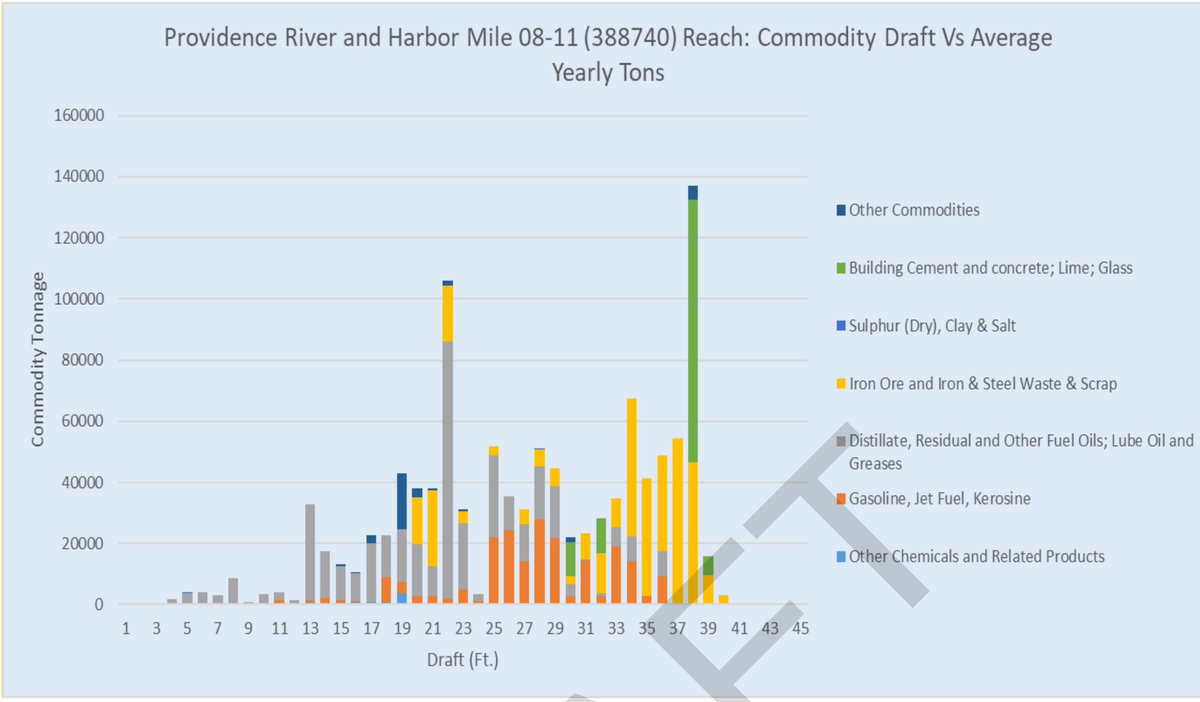
Figure 7. Providence River and Harbor Mile 08-11 (388720), Commodity Tonnage by Draft, 2016-2020



Source: USACE Channel Portfolio Tool, data only available through 2020

The channel utilization analysis for the Providence River and Harbor Mile 08-11 (388740) is shown in Figure 8, below. The analysis shows significant utilization of the channel to 39.5 feet of channel depth. Considering underkeel clearance requirements, the data support dredging to at least 44 feet of channel depth. This is also deeper than the authorized channel depth of 40 feet, so dredging the channel to the full authorized depth of 40 feet would also allow largely unrestricted use of the channel for the majority of the fleet and would support more efficient operations.

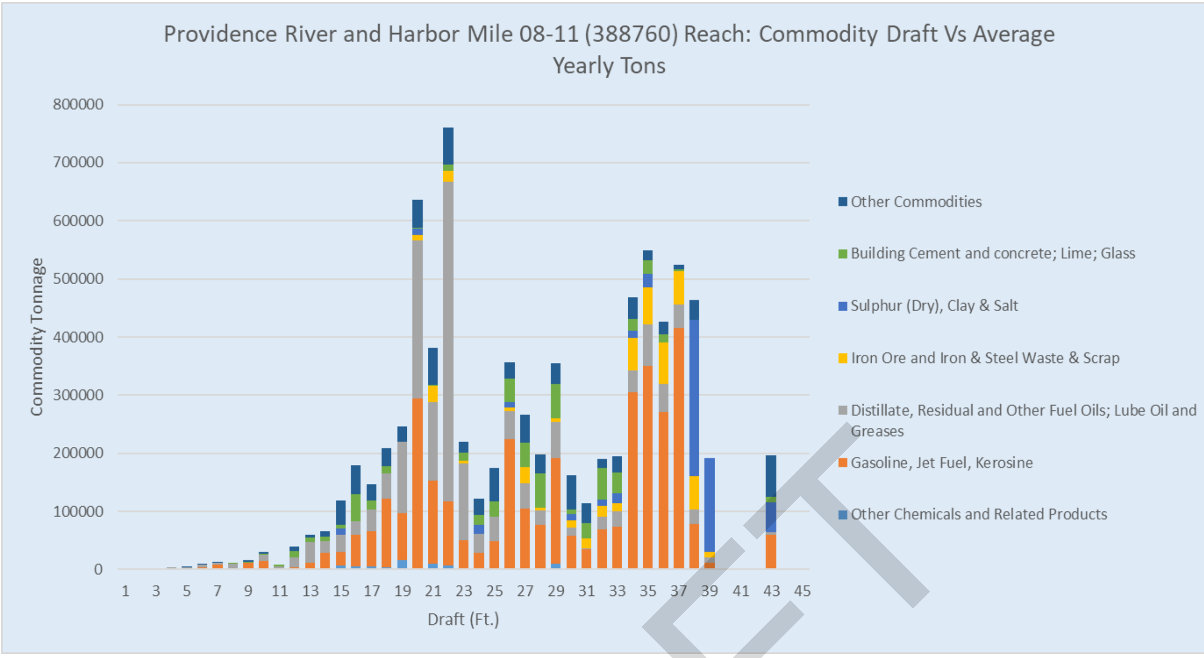
Figure 8. Providence River and Harbor Mile 08-11 (388740), Commodity Tonnage by Draft, 2016-2020



Source: USACE Channel Portfolio Tool, data only available through 2020

The channel utilization analysis for the Providence River and Harbor Mile 08-11 (388760) is shown in Figure 9, below. The analysis shows significant utilization of the channel to 44 feet of channel depth. Considering underkeel clearance requirements, the data support dredging to at least 48 feet of channel depth. While this is also deeper than the authorized channel depth of 40 feet, dredging the channel to the full authorized depth of 40 feet would allow largely unrestricted use of the channel for the majority of the fleet and would support more efficient operations.

Figure 9. Providence River and Harbor Mile 08-11 (388760), Commodity Tonnage by Draft, 2016-2020



Source: USACE Channel Portfolio Tool, data only available through 2020

Providence River and Harbor Federal Navigation Project
Rhode Island Dredged Material Management Plan
and Environmental Assessment

Appendix C
Providence River and Harbor Federal Navigation Project
Authorization History

Appendix C. Providence River & Harbor Federal Navigation Project, Rhode Island Project Authorization History

Act	Provisions	Specific Reference
Act of 30 August 1852	Removal of Rock in Providence River – Modified by Joint Resolution of January 20, 1853, to Include Dredging of 9-Foot Channel. Approved by Sec. Of War Jefferson Davis June 1, 1853	AR 1853, Appendix P, Pg 278
Act of 2 March 1867	Dredging Channel through Pawtuxet Bar	AR 1867 Appendix N, Pg 448
Act of 11 July 1870	Deepen & Widen Channel to 14 Feet up to Fox Point	AR 1870, Pg 449
Act of 15 July 1870	Removal of Bulkhead Rock to –16 feet	Senate Exec Doc. #105, 41st Congress, 2nd Session
Act of 3 March 1873	Widen 12-Foot Channel by Removal of Long Point Shoal on East Side of Harbor	House Exec. Doc. #107, 42nd Congress, 3rd Session
Act of 18 June 1878	Remove Bulkhead Rock to –18 Feet	AR 1875, Appendix AA-9, Pg 33
R&H Act of 18 June 1878	Deepen Channel to –23 Feet by 200 Feet from Gaspee Shoal to Fox Point, with Wider Cuts at Shallower Depths (-20 x 600, -18 x 725, -12 x 940 & -6 x 1,060 Feet) in Reaches above Fields Point to Fox Point	Senate Exec. Doc. #3445th Congress, 2nd Session, 1878
R&H Act of 2 August 1882	Complete the Stepped Depth Channel from 23 Feet at 200 Feet Wide up to 6 Feet at 1,060 Feet Wide and then Deepen 300-Foot Cut to –25 Feet from Deep Water up to Fox Point	Senate Exec. Doc. #14547th Congress, 1st Session, 1882
R&H Act of 5 July 1884	Removal of Boulders from the Providence River Channel at the Pawtuxet River Mouth	AR 1884, Appendix C-7, Pg 617
R&H Act of 5 August 1886	Removal of Green Jacket Shoal, between the Harbor Lines, to –25 Feet	Senate Exec. Doc. #42, 48th Congress, 2nd Session
R&H Act of 3 June 1896	Extend the 25-Foot Channel Seaward via the Western Passage at 400 Feet Wide	Senate Doc. #20354th Congress, 1st Session, 1896
R&H Act of 13 June 1902	Widen the 25-Foot Providence Anchorage Easterly between Long Bed Shoal and Green Jacket Shoal by Deepening and Incorporating Shallower Dredged Areas and Adjoining Areas (Incorporates the Green Jacket Shoal Project into the Providence Harbor Project)	House Doc. #10856th Congress, 1st Session, 8 Dec 1899

Act	Provisions	Specific Reference
R&H Act of 2 March 1907	Further Widen the 25-foot Anchorage Basin by 400 Feet Eastward between Kettle Point and Long Bed (also House Doc. #919, 60th Cong., 1st Session, 7 May 1908)	AR 1907, Appendix C-9, Pg 942
R&H Act of 25 June 1910	Straighten and widen the 25-Foot Channel to 600 Feet Wide from Kettle Point to Gaspe Point, Widened Further at the Turns, Expand the 25-Ft Anchorage West to the Harbor Line, Remove Sassafras Point & Lighthouse, Cut Off East Tip of Fields Point, Disposal in Bay North of Dyer Island and East of Prudence Island	House Doc. #606, 61st Congress, 2nd Session, 29 Jan 1910 & House Doc. #919, above
R&H Act of 4 March 1913	Deepen Channel to –30 Feet By 600 Feet Wide from Deep Water Near Ohio Ledge to Providence, and Deepen the Providence Anchorage Basin out to the Harbor Lines Between Fox Point and Fields Point	House Doc. #1369, 62nd Congress, 3rd Session, 8 Feb 1913
R&H Act of 4 March 1915	Established New Requirements for Non-Federal Cooperation for 30-Foot Project to Allow more Time for Construction of Local Terminals	House. Committee Doc. #9, 63rd Congress, 2nd Session, 4 Feb 1914
R&H Act of 26 Aug 1937	Deepen Channel to 35 Feet by 600 Feet Wide, and Widened in Basin above Fields Point to between 715 and 1,700 Feet Wide	House Doc. #173, 75th Congress, 1st Session, 1937
R&H Act of 1965	Deepen Channel and Basin to 40 Feet, Channel at 600 Feet Wide, Widened at Turns, Extended Seaward to East of Prudence Island, and Dredge 30-Foot by 150-Foot-Wide Channel along India Point to Mouth of Seekonk River	Senate Doc. #93, 88th Congress, 2nd Session, 18 Aug 1964
WRD Act of 17 Oct 1986	Deauthorizes Unconstructed 30-Foot Channel at India Point	House Report 99-1013, 99th Congress, 2nd Session

Providence River and Harbor Federal Navigation Project Rhode Island Dredged Material Management Plan and Environmental Assessment

Appendix D
Providence River and Harbor Federal Navigation Project Maintenance History

PROVIDENCE RIVER & HARBOR
DECISION DOCUMENT
FOR MAINTENANCE DREDGING AND
DREDGED MATERIAL PLACEMENT FACILITY CONSTRUCTION

APPENDIX D
PROJECT HISTORY

This appendix consists of the following table, which details the history of all work done by the Corps of Engineers for the Providence River and Harbor Federal Navigation Project. Both improvements and maintenance work are included. This information was derived from a review of records of Congressional documents, Corps planning reports, references in the Annual Reports of the Chief of Engineers and the Assistant Secretary of the Army for Civil Work and other materials on file at the New England District.

Work Done on Federal Navigation Project

Date	Action	Quantity
Jul - Sep 1853	Dredging 9-Foot Channel. In-river disposal	11,985 cy
May 1867	Remove Wreck of Schooner Mary Stewart from Channel	---
May - Sep 1867	Dredging Channel at Pawtucket Bar	65,984 cy
Sep - Oct 1870	Begin Dredging 14-Foot Channel but only to 12 Feet	18,201 cy
Oct 1870	Bulkhead Rock Removed to only –14 Feet	27 cy Rock
Sep - Nov 1872	Continue Dredging Channel to 12 Feet	35,019 cy
Jul - Sep 1873	Remove End of Long Point to –12 Feet	30,529 cy
Jan - Jun 1874	Remove Pilings from Long Point Dredge Area (Completes Modification of 1873)	---
Oct - Dec 1878	Begin Dredging 23-Foot Channel but to 20 Feet With Disposal at Gould Island in Lower Bay	72,314 cy
Sep 1879 - Jan 1881	Complete 20-Foot Lower Depth and Begin Deepening to 23 Feet at Pawtuxet Bar with Disposal at Halfway Rock	558,228 cy
Mar - Oct 1880	Removal of Bulkhead Rock to –20 Feet (795 Tons) Disposal along East Shore	361 cy Rock
Mar 1881 - Jul 1882	Continue Dredging 20-Foot Upper Channel and 23-Foot Pawtuxet Bar Channel (Completed to 200 Feet)	322,140 cy
Aug 1881 - Apr 1882	Continue Dredging Upper Stepped Channel Cuts at 20, 14 and 12 Feet	322,255 cy
Oct 1882 - Nov 1883	Begin Dredging 25-Foot by 300-Foot Wide Channel and Widen 20-Foot East Cut at Long Bed Point	720,028 cy
Oct 1884 - Jun 1885	Continue Dredging 25-Foot Channel below Fields Point with Disposal off Prudence Island	625,073 cy

Sep 1884	Removal of Boulders off Pawtuxet River Mouth (1000 Tons)	455 cy Rock
Apr 1887 - Oct 1887	Continue Dredging 25-Foot Channel at Gaspee Reach and Widen 20-Foot Basin above Fields Point	310,952 cy
Jul - Nov 1887	Begin Dredging Green Jacket Shoal Anchorage to 25 Feet	206,431 cy
Aug 1889 - Feb 1880	Continue Dredging Green Jacket Shoal to 25 Feet	147,520 cy
Aug 1889 - Feb 1980	Continue Dredging the 20-Foot and 18-Foot Widths of the Anchorage Basin below Fox Point	96,034 cy
Apr 1891 - Aug 1891	Continue Dredging the 18-Foot, 12-Foot and 6-Foot Widths of the Anchorage Basin below Fox Point	228,449 cy
Aug - Oct 1891	Continue Dredging Green Jacket Shoal to 25 Feet	125,104 cy
May 1893 - May 1894	Continue Dredging the 18-Foot, 12-Foot and 20-Foot Widths of the Anchorage Basin above Sassafras Point	351,963 cy
Jun 1894	Ledge Removal above Fields Point in Anchorage (900 sy)	900 cy Rock
Nov 1893 - Jan 1894	Continue Dredging Green Jacket Shoal to 25 Feet	65,272 cy
Jul - Aug 1895	Continue Dredging Green Jacket Shoal to 25 Feet	36,647 cy
Oct 1895 - Sep 1896	Maintenance Dredging of 25-Foot Channel at Fox Pt.	73,479 cy
Sep - Oct 1896	Continue Dredging Green Jacket Shoal to 25 Feet	39,951 cy
Apr 1897 - Jul 1899	Continue Dredging 25-Foot Channel between Sassafras and Conimicut Points	1,388,332 cy
Mar 1899 - Jan 1901	Continue Dredging the 25-Foot Channel below Conimicut Point to the Western Passage	526,735 cy
Apr 1901 - Sep 1902	Continue Dredging the 25-Foot Channel in the Western Passage – Completes Modification of 1896	1,365,537 cy
Apr 1903 - Sep 1903	Begin Dredging the Expanded 25-Foot Providence Anchorage	749,270 cy
Jul 1905 - Mar 1908	Continue Dredging the Expanded 25-Foot Providence Anchorage Basin	4,679,953 cy
Sep 1907 - Mar 1909	Begin Dredging 1907 Expansion of 25-Foot Providence Anchorage Basin to East at Kettle Point	687,285 cy
Nov 1907 - Nov 1908	Removal of Hard Material from 25-Foot Anchorage at Long Bed Shoal	382,237 cy + 54 cy Boulders
Dec 1908 - Feb 1909	Removal of Hard Material from 25-Foot Anchorage at Long Bed Shoal	64,954 cy + 6 cy Boulders
Jul - Sep 1909	Maintenance of 25-Foot Channel & Basin	20,285 cy
Mar 1911 - Mar 1913	Begin Widening the 25-Foot Approach Channel to 600 Feet Wide	2,378,687 cy
Jun - Sep 1911	Begin Widening the Anchorage Easterly at Long Bed	79,144 cy

Sep 1911 - Feb 1913	Begin Widening the 25-Ft Anchorage West to Harbor Line and Removal of Fields Point	1,832,155 + 33 cy Boulders
Mar 1913	Removal of Sassafras Point Lighthouse Foundation	---
Dec 1912 - May 1913	Maintenance Dredging of 25-Foot Channel and Basin between Fuller Rock Light and Fox Point	614,773
May 1913 - Jun 1915	Begin Dredging of 30-Foot Channel with US Hopper Dredges in Lower Reaches below Bullock Point	2,003,933
Dec 1913 - Jan 1914	Maintenance Dredging of 25-Foot Channel at Fox Point	22,082
Jul - Sep 1913	Continue Improvement Dredging to Widen 25-Foot Basin to West along Harbor Line +	142,860 19,117 cy Boulders
Aug 1914 - May 1916	Continue Improvement Dredging of the 30-Foot Channel above Bullocks Point	3,055,438 + 32 cy Boulders
May 1915 - Aug 1916	Continued Improvement Dredging to Widen 25-Foot Area along East Harbor Line above Kettle Point	553,998 + 94 cy Boulders
Jun 1915 - Dec 1915	Continue Dredging of 30-Foot Channel and Anchorage with US Hopper Dredges in Upper Reaches Field's Point	684,945
Apr 1916	Emergency Improvement Dredging of 30-Foot Access Between 30-Anchorage and New State Pier	36,505
Jan 1917 - Mar 1918	Continue Improvement Dredging of 30-Foot Providence Anchorage Basin Out to Harbor Lines above Fields Point Expanded to Reach Facilities Necessary to War Effort	624,017 + 40 cy Boulders
Aug 1918	Improvement Dredging of 30-Foot Coaling Station Access	284
Dec 1918	Continue Improvement Dredging of 30-Foot Anchorage Basin using Hired Plant	---
Apr 1920 - Sep 1920	Continue Improvement Dredging of 30-Foot Upper Harbor Anchorage Basin (65,579 actual + 70,000 estimated)	135,579
Sep 1920 - Jun 1921	Continue Improvement Dredging of 30-Foot Upper Harbor Anchorage Basin on West Side (All Estimated)	630,000
Oct 1922 - Sep 1923	Emergency Improvement Dredging of 30-Foot State Pier Access from Anchorage (50% Cost Share)	25,564 +16,571 cy Boulders
Aug 1923 - Jan 1925	Continued Improvement and Maintenance Dredging of 30-Foot Anchorage to West above Fields Point and East between Squantum & Fuller Rocks Lights (Estimated)	2,101,000
Mar 1925 - Sep 1925	Continued Improvement Dredging of 30-Foot Channel And Basin between Fuller Rock Light & Gulf Pier (Estimated)	1,500,000
Jun - Dec 1926	Maintenance Dredging of 30-Foot Channel between Squantum and Sabine Point Light (Estimated Quantity)	400,000
Sep - Oct 1927	Maintenance Dredging of 30-Foot Channel below Sabine Point by US Hopper Dredge	360,289
Oct 1930 - Jan 1932	Maintenance Dredging of 30-Foot Channel from Squantum up to Fox Point	1,014,472 + 14 cy Boulders

Apr 1932 - Jul 1932	Improvement Dredging to Remove Rocky Shoal South of Conimicut Point (Completes 30-Ft Project of 1913)	2,572 cy Boulders
Oct 1932 - Sep 1933	Removal of Submerged Obstruction from 30-Foot Basin	Unknown
Jul - Dec 1936	Maintenance Dredging of 30-Foot Channel by Hopper Dredge between Squantum and North Points	1,084,020 cy
July 1938 - Dec 1939	Improvement Dredging of 35-Foot Channel using 3 US Hopper Dredges	3,562,970 cy
Mar 1939 - Aug 1939	Improvement of 35-Foot Channel by US Lighter to Remove Rock below Conimicut Point	245 cy Boulders
May 1939 - Nov 1939	Improvement Dredging of 35-Foot Channel between Squantum and Sabine Point	1,720,212 cy
Jul 1939 - Sep 1939	Improvement Dredging of 35-Foot Channel between below Conimicut Point	23,350 cy + 4,307 cy Rock
Feb 1940 - Feb 1941	Improvement Dredging of 35-Foot Channel between Squantum and Fox Point	4,264,502 cy + 157 cy Boulders
Mar 1940	Improvement Dredging of 35-Ft Channel by US Hopper	68,335 cy
Oct 1940	Improvement of 35-Foot Channel – Rock Removal Opposite Pomham Light	2,521 cy + 1,664 cy Rock
Sep - Nov 1940	Improvement of 35-Foot Channel – Rocky Shoal Removal below Conimicut Point Light	69,532 cy + 230 cy Boulders
Mar 1941 - Jul 1941	Improvement Dredging of 35-Foot Channel to Widen Cut below Fields Point. Contract Terminated Due to War Priorities	519,703 cy
Mar - May 1941	Removal of Boulder Shoals from 35-Foot Channel at Fields Point and below Conimicut Point by US Lighter	365 cy Boulders + 12 cy Ledge
Feb 1943 - Jan 1944	Blasting and Removal of Ledge from 35-Foot Channel At Fields Point and below Conimicut Point	2,352 cy + 679 cy Ledge
Oct 1944 - Apr 1945	Maintenance Dredging of 35-Foot Channel and Basin between Sabin Point and Wilkesbarre Pier	474,646 cy
Oct 1945- Sep 1946	Removal of Rock Obstruction from Basin off Gulf Pier	Unknown
May - Jun 1946	Maintenance of 35-Foot Channel below Sabin Point by US Hopper	127,680 cy
Apr 1949 - Jan 1950	Maintenance of 35-Foot Channel from Sabin Point to Fox Point	1,117,207 cy
Jan - Mar 1950	Improvement Dredging to Widen the 35-Foot Channel In Reach below Fields Point (Completes 35-Ft Project)	501,410 cy
May - Aug 1951	Maintenance Dredging of 35-Foot Channel between Sabin Point and Fields Point	83,334 cy
Jul - Aug 1951	Maintenance Dredging of 35-Foot Channel between Pomham Light and Ohio Ledge (Seaward Entrance)	446,680 cy

Jan 1955	Maintenance Dredging of 35-Foot Channel between Sabin Point and Ohio Ledge (Seaward Entrance)	147,934
Sep - Nov 1955	Maintenance Dredging of 35-Foot Channel above Sabin Point Light	151,977
May - Oct 1960	Maintenance Dredging of 35-Foot Channel between Sabin Point and Fox Point	175,000
Sep 1963	Maintenance Dredging of 35-Foot Channel between North Point and Sabin Point	167,100
Sep 1967 - May 1968	Begin Improvement Dredging of 40-Foot Channel Disposal at Brenton Reef Disposal Site	2,440,000
Aug 1968 - Jun 1971	Continue Improvement Dredging of 40-Foot Channel Disposal at Brenton Reef Disposal Site	6,865,000 + 2,488 cy Boulders
Oct 1969 - Sep 1971	Maintenance Dredging of 35-Foot Channel and Basin in Conjunction with Improvement Dredging Disposal at Brenton Reef Disposal Site	665,000
Aug 1975 - Jun 1976	Improvement – Rock Removal from 40-Foot Channel (Completes 40-Foot Project of 1965) Disposal at Brenton Reef Disposal Site	90,000 cy Till 10,190,000 cy
Dec 2002 - Aug 2005	Maintenance Dredging of 40-Foot Channel and Basin excluding two areas in Fox Point Reach (excluded: portion of turning basin at northern end of reach and maneuvering width along southeastern edge of reach), including construction of a series of 7 CAD cells in Fox Point Reach North.	5,913,076 cy total dredged (3,821,394 cy of O&M dredging, with 2,637,053 cy ocean disposal, and : 1,184,341 cy CAD, and 2,091,682 cy of CAD cell construction)
Mar 2007 - Sep 2007	Rock Removal	464 cy rock

PROVIDENCE RIVER AND HARBOR
RHODE ISLAND
FEDERAL NAVIGATION PROJECT MAINTENANCE DREDGING

DREDGED MATERIAL MANAGEMENT PLAN

MAY 2025

APPENDIX E - ENGINEERING

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TABLE OF CONTENTS

FIGURES

1. STATEMENT OF PURPOSE

The purpose of the Engineering Appendix is to provide an overview of design assumptions and calculations where applicable, and to document the reasoning and decisions made during the planning phase of a project. It presents the basic rationale and assumptions, criteria, logic, and considerations developed in support and evaluation of the design.

2. PROJECT SUMMARY

a) PROJECT AUTHORIZATION. The Providence River & Harbor FNP was originally adopted in 1852 and modified by 17 subsequent authorizations. The 40-foot-deep channel feature of the existing project that is now being maintained was authorized by the River and Harbor Act of 1965. The FNP currently has an authorized depth of -40 feet MLLW and channel width of 600 feet, with wider bends and a 1,700-foot-wide harbor area at the upstream end. The total authorized channel length is approximately 16 miles long, extending from its upstream limit just downstream of the Providence (Fox Point) Hurricane Barrier to its downstream limit between Prudence Island and Aquidneck Island in the Eastern Passage of Narragansett Bay.

b) NON-FEDERAL SPONSOR. Rhode Island Coastal Resources Management Council

c) STUDY PURPOSE. To restore the Providence River & Harbor FNP to authorized dimensions requires maintenance dredging. The purpose of this DMMP is to determine the alternative placement sites for the dredged material over a twenty-year period as well as address the additional capacity identified by the state for placement of Non-Federal dredged material from the Providence River and Narragansett Bay.

3. DREDGING AND DISPOSAL

Based on extrapolation of existing shoal rates within the Providence FNP, the project will need to be dredged twice within the 20-year planning period covered by this DMMP. The first cycle is planned to be performed in 2027, and the second cycle is predicted to be needed in 2047. The Recommended Plan is selection of Alternative 1 for the first cycle of dredging and Alternative 2 for the second cycle of dredging.

For the first cycle of dredging, a total of approximately 2,100,000 cy of dredged material will be dredged from Providence River Channel FNP and connected shallow draft FNPs. A dredged material placement facility will be constructed in 2027 to contain the dredged material from the FNP as well as other dredged materials generated through the first 15 years of the 20-year DMMP planning period. A Confined Aquatic Disposal (CAD) cell is proposed to be constructed to contain the dredged material from the FNP and will also be designed and constructed to hold an additional estimated 300,000 CY generated over the first 15 years of the 20-year planning period by the non-federal sponsor of the project for a total dredged material quantity of approximately 2,400,000 CY. The entire capacity of the first CAD cell to be constructed is approximately 2,800,000 CY of dredged material, including a 15% bulking factor of the dredged material during placement. The CAD cell will also be constructed large enough to get capped with approximately 240,000 CY of clean material after about 15 years, when the CAD cell is expected to reach capacity. Refer to Section 5 for more detailed information.

Suitable dredge material from creation of the CAD cell will be beneficially used to the extent possible. Management of this material is as follows:

1) as beneficial-use fill and capping material in the Edgewood Basin just north of the CAD cell site
2) as beneficial-use capping material in the old Fox Point CAD cells (used during the 2003-2005 maintenance cycle of the Providence River FNP) in the northern end of Fox Point Reach in the Providence River FNP
3) as beneficial-use capping material in an abandoned subtidal dredged material disposal site in Narragansett Bay adjacent to Prudence Island, and
4) suitable material placed in ocean waters at the EPA designated Rhode Island Sound Disposal Site.

All four placement locations are in subtidal waters and one way haul distances are shown below.

Disposal/BU Location	**North CAD Cell**	**South CAD Cell**	**New Fox Point CAD cells**
Edgewood Basin	0.3 miles	0.8 miles	2.0 miles
Old Fox Point CAD Cells	1.6 miles	2.2 miles	1.1 miles
Prudence Island Disposal Site	17 miles	15.8 miles	17.6 miles
Rhode Island Sound Disposal Site	41.2 miles	40.0 miles	41.5 miles

After 20 years, a second dredge cycle of the Providence would be initiated. A second CAD cell would be constructed to accommodate predicted quantities of dredged material from the various sources. The study predicts that based on a continuation of shoaling in the Providence River and Harbor, that Providence FNP and adjacent shallow-draft FNPs will require approximately 2,100,000 CY dredging, and non-federal channels will need another 300,000 CY of dredging. The second CAD cell is possible at Edgewood Shoals South. The second CAD cell would need approximately 2,800,000 CY capacity, including a 15% bulking factor. The first CAD cell would remain open until the second CAD cell is constructed since it will be used as a starter cell for the second CAD cell, for 15 to 20 years, and finally be capped with clean material, possibly from the clean material from the second CAD cell.

Refer to Section 5 and 6 for more information on quantities.

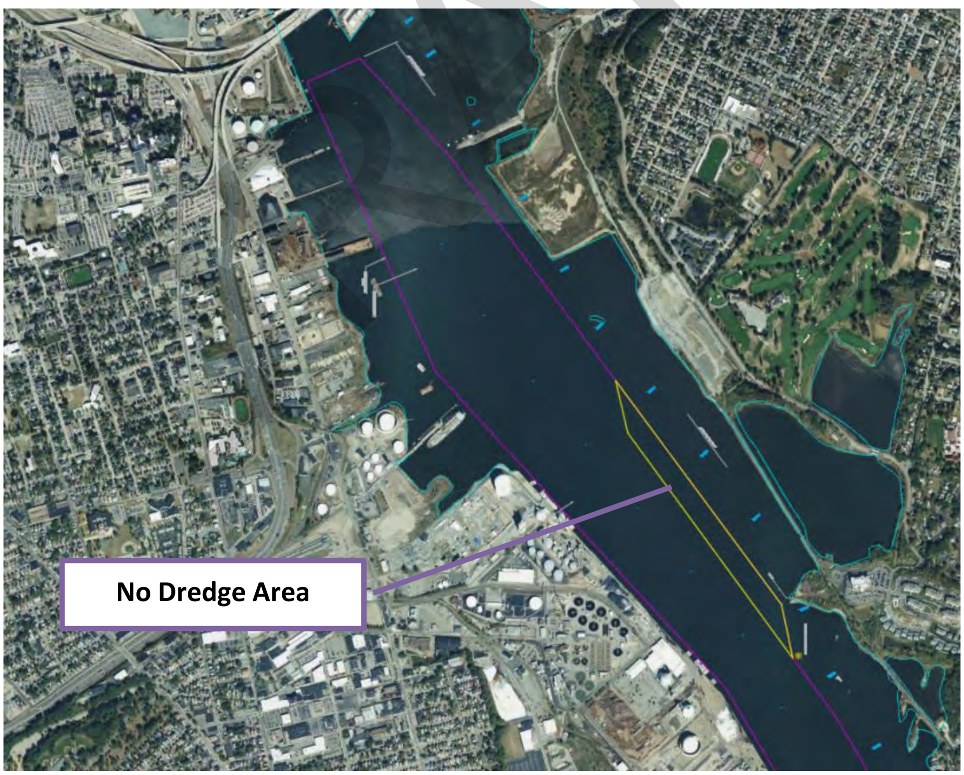
4. CHANNEL MANEUVERING ANALYSIS

Maneuvering area design calculations were performed specifically for the turning areas where the channel widens from the Fuller Rock Reach to the Fox Point Reach. Historically, a portion of the Federal Navigation Channel was not dredged along the eastern channel limit as turning and maneuvering were not needed in this location. The analysis was conducted in this area to determine if this area would be needed for ship maneuvering moving into the future. As channel traffic increases and becomes larger, the calculations result in the need for using this area for turning and maneuvering in the future. The analysis uses EM 1110-2-1613 "Hydraulic Design of Deep-Draft Navigation Projects" April 8, 1983 (USACE, 1983) and an analysis of the current and future vessels using the channel.

ANALYSIS RESULTS

I. INTRODUCTION

The purpose of this Turning Area Analysis is to determine if dredging the entire Federal Navigation Channel within the Providence River Fox Point Reach is warranted based on needed turning area dimensions by both current and future vessels. A section of Fox Point Reach was not dredged during prior maintenance dredging cycle in 2003. This "No Dredge Area" is along the east channel limit, beginning at the transition from Fuller Rock Reach to Fox Point Reach and extending 3,800 feet in length and 350 feet wide. Existing bathymetry surveys show sounds as shallow as -30 feet MLLW in the "No Dredge Area".



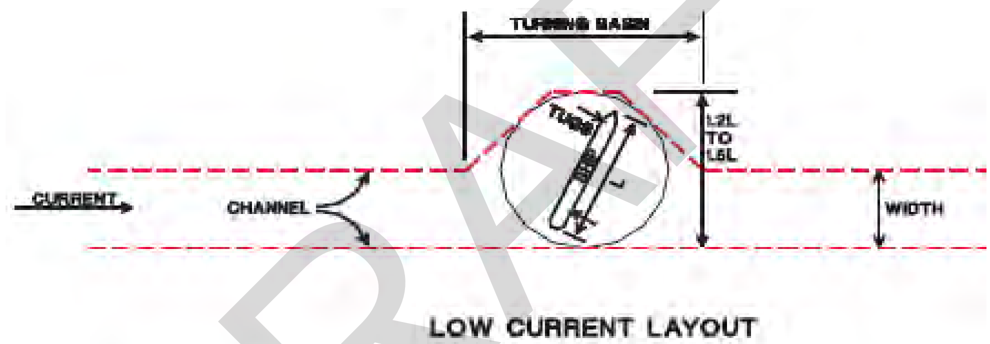
II. TURNING AREA ANALYSIS

Design Vessel:

One year of historical vessel tracking data was used to determine if the area adjacent to the shoaled section was being used to turn and reverse ship direction. The results showed that this area is used by many vessels including three vessels that were 700 feet or greater in length. The current largest class of bulk carriers using this section to reverse direction are 833 feet long salt ships. A verbal survey of pilots revealed that vessel sizes are expected to get larger and become a greater proportion of arrivals within this section of Fox Point Reach. A vessel length of 850 feet will be assumed for this Turning Area Analysis.

Turning Area

The Hydraulic Design of Deep-Draft Navigation Projects (EM 1110-2-1613) was referenced to calculate the recommended turning basin width. In normal operations, turning basins are used by the pilots in conjunction with two or more tugs to bring the ship about. Assuming a current of 1.5 knots, the turning basin multiplier is 1.5. With a vessel length of 850 feet, the turning basin diameter is estimated to be 1,275 feet and it should be noted that this diameter only accommodates one-way traffic.



CURRENT SPEED KNOTS	TURNING BASIN SIZE MULTIPLIER (*L)
0 < 1/2	1.2
1/2 < 1 1/2	1.5
> 1 1/2	SIMULATOR DESIGN

The "No Dredge Area" is approximately 3200 feet long running along a variable width of the FNP from Fullers Rock Reach northwesterly along the Fox Point Reach. The narrowest width in the existing conditions is approximately 900 feet near Fullers Rock Reach extending to 1200 feet at the end of the "No Dredge Area" in Fox Point Reach. Dredging the "No Dredge Area" during the next maintenance dredging operations would increase the overall width of the turning basin and channel to 1200 feet near Fullers Rock Reach extending to 1500 feet at the end of the "No Dredge Area" in Fox Point Reach.

III. CONCLUSION

The historic "No Dredge Area" along the east channel limit within Fox Point Reach needs to be dredged to required depth to accommodate current and future vessel demand. Pilots in the region expects vessels to get larger and become a greater proportion of arrivals. Dredging this section would provide the minimum required diameter of 1,275 feet for the majority of overall 3200 foot length to accommodate expected vessels lengths of 850 feet.

5. HYDROGRAPHIC SURVEY DATUM AND HORIZONTAL COORDINATES

The vertical datum references the plane of Mean Lower Low Water (MLLW) and is based on the 1983-2001 Tidal Epoch. Soundings are in feet and tenths. The horizontal coordinates are in US Survey Feet and are based on the Lambert Grid System for the state of Rhode Island, North American Datum of 1983 (NAD 83).

6. QUANTITY CALCULATIONS

DREDGE QUANTITIES

The quantities of dredged material to be removed from the channels were calculated using 3D models developed from existing soundings and design surfaces that represent the authorized and overdepth surfaces with side slopes of 3 horizontal to 1 vertical. The 3D model is an evaluation tool used in Autodesk AutoCAD Civil 3D to compute cut and fill volumes. Cut and fill volumes obtained from this tool are calculated between two triangulated surfaces, or Triangulated Irregular Networks (TIN), by projecting the triangles from an existing surface onto a design surface and then computing the volume of each of the resultant prismoids. The volume calculated using the triangle volume method is the exact mathematical volume between the two selected surfaces. The total volume of maintenance dredge material calculated includes a 2' payable over depth volume or "Dredging Tolerance" as defined in EM 1110-2-1613. The accuracy of the results of the 3D model is limited only by the accuracy of the TIN that are used.

The volume calculation methodology utilized hydrographic surveys by USACE in April 2020. The Providence River DMMP is intended to address the maintenance dredging of the authorized Providence River & Harbor Federal Navigation Project and several other sources of dredge material. These other sources include:

A. Three associated shallow draft FNPs that will also require maintenance in the same 20-year planning horizon for dredged material disposal. Those projects are Bullock Point Cove, Pawtuxet Cove and Apponaug Cove. Bullock Point and Pawtuxet Coves FNP maintenance materials were placed in the CAD cells constructed for Providence River in 2003-2005 after completion of the Providence River maintenance. The CAD cell placement was the Federal Base Plan for each of those projects. Quantities shown in Dredge Cycle #1 for these three shallow draft FNPs are derived from hydrographic surveys conducted by USACE in early 2023.

B. An allowance for the State of Rhode Island for disposal of unsuitable dredge material.

C. For Dredge Cycle #1, allowance is needed for approximately 38,300 CY bulked during placement to 44,000 CY of unsuitable material associated with the surface of the South

CAD Cell to be used for Dredge Cycle #2. This avoids needing a starter cell or some other means of unsuitable disposal associated with the creation of the South CAD Cell.

BENEFICIAL USE QUANTITIES

The volumes of the various beneficial use objectives are calculated using the same methodology as summarized above using the same hydrographic surveys by USACE in April 2020. Refer to Conceptual Drawings for more information.

FOX POINT CAD CELLS: The existing CAD cells need to be capped by a three-foot-thick layer of clean material to isolate the unsuitable dredged material from the environment and prevent re-exposure by erosion or prop wash. The CAD cells are designed to have a top elevation of the cap material no shallower than the –42-foot MLLW bottom elevation of the channel overdepth allowance. Unsuitable material can extend to -45-foot MLLW. Volumes shown are bulked quantities.

CAD cell	**Unsuitable Capacity (CY)**	**Suitable Capacity (CY)**	**Notes**
1R	5,100	9,000	Ready for filling and capping
2R	0	2,000	Capped
3R	13,600	12,600	Ready for filling and capping
4R	2,400	11,800	Ready for filling and capping
5R	53,400	25,400	Leaving Open - Available unsuitable capacity
6R	11,900	23,700	Ready for filling and capping
7R	12,400	27,700	Ready for filling and capping
3AR	208,300	103,000	Leaving Open - Available unsuitable capacity
Total	**307,100**	**215,200**	
Total Ready for filling and capping	**45,400**	**84800**	**Total available for Filing and Capping = 130,200 CY (113,200 unbulked capacity)**

EDGEWOOD BASIN: The Edgewood Basin is a former deepened port in support of various uses over the years and at one time supported US Navy uses. The basin is used for both the base plan dredge material disposal and beneficial use. In the base plan, unsuitable material currently on top of the North or South CAD cells would be placed in the basin and then capped with suitable material.

The basin generally ranges in depths from -8 ft to -18 ft MLLW with pockets as deep as -30 ft MLLW. There is an existing approximately 130-ft wide navigation channel with an approximte depths of -12 ft to -14 ft MLLW running north/south beginning from the Providence Federal Navigation Channel ending at the Edgewood Basin along the shore of what is currently referred to as Fields Point. The basin sediment is unsuitable material and is a stagnant and anoxic zone. The Edgewood Basin can be filled with unsuitable material and/or suitable material to a depth of -13-ft MLLW and would be capped with a 3 feet of suitable material cover to elevation -10 ft MLLW.

PRUDENCE ISLAND DISPOSAL SITE: The Prudence Island Disposal Site is a historical disposal site containing unsuitable materials adjacent to Prudence Island. The location ranges in depths from -40 ft to -105 ft MLLW. The site contains unsuitable material and the proposal is to cap the historic site with a 3 foot suitable material cover.

Beneficial Use Location	**Unsuitable Capacity (Cubic Yards)**	**Suitable Capacity**
Edgewood Basin	178,800	268,700
Fox Point CAD Cells	45,400	84,800
Prudence Island Disposal Site	N/A	1,825,000
Total – Beneficial Use	**224,200**	**2,178,500**

CAD CELLS

EDGEWOOD SHOALS NORTH: This alternative would include a Main CAD Cell within the northern half of Edgewood Shoals region of the Providence River. Edgewood Shoals is outside the FNP channel. Edgewood Shoals is shallow with depths ranging generally from -8-ft to -6-ft MLLW.

An access channel from the FNP to the CAD cell would be required to provide deep draft navigation access. The approximately 1955 ft long access channel is proposed at 100 ft wide and dredged to a depth of -25 MLLW with 1V:5H sideslopes resulting in 246,000 CY of suitable material.

The Main Cell would be dredged at a 1V:5H slope to a depth of -60 ft MLLW with approximate bottom dimensions of 1,057-ft by 912-ft. The Main Cell crosses 1,590-ft of an approximately 130-ft wide existing navigation channel containing 2 ft of Unsuitable Material. This 37,400 CY of Unsuitable Material (43,000 CY with bulking) would be dredged by shallow draft equipment since this area is at an average elevation of -7 ft MLLW. The Unsuitable Material would be disposed of in the existing Edgewood Basin disposal site.

The Main Cell would have a bulked capacity of 2,780,000 CY (-60 ft to -11 ft MLLW) for Unsuitable Material disposal and could be capped (3-foot-deep cap) with 240,000 CY (-11 ft to -8 ft MLLW) of Suitable Material. The Main Cell would provide enough capacity for the 2,417,150 CY (2,780,000 CY with 15% bulking for consolidation) from the Providence River maintenance dredging.

EDGEWOOD SHOALS SOUTH: This alternative would include a Main CAD Cell within the southern half of Edgewood Shoals region of the Providence River, which is outside of the FNP channel. An analysis was conducted for both the North and South CAD cells to determine which alternative would be more cost effective in the first dredge cycle. Therefore, the sizing and depths of the South CAD cell match the North. Dredge cycle #2 volume calculations are estimated roughly similar to the required volumes for dredge cycle #1. Actual shoal volumes will dictate actual required South CAD cell size during the PED phase for Dredge cycle #2.

The conceptual drawings illustrate the Edgewood Shoals South Cell at a 1V:5H slope to an elevation of -60 ft MLLW with approximate bottom dimensions of 1,059-ft by 910-ft providing storage capacity similar to that of the North CAD cell. Access to the cell is provided by a 900 foot long, 100 ft wide access channel dredged to a depth of -25 MLLW with 1V:5H sideslopes resulting in 95,000 CY of suitable material.

The Main Cell crosses 1,560-ft of an approximately 130-ft wide existing navigation channel containing 2-ft of Unsuitable Material. This 38,300 CY of Unsuitable Material (44,000 CY with bulking) would be dredged by shallow draft equipment since this area is at an average elevation of -7 ft MLLW. The Unsuitable Material would be disposed of in the existing Edgewood Shoals North CAD cell. The actual size of this cell would be reduced and finalized during PED phase of dredge cycle #2.

NEW FOX POINT CAD CELLS: This alternative would include a Starter and Main CAD Cell dredged within the Fox Point Reach of the Providence River Navigation Channel. The CAD Cells only partially span the channel width to not encroach into the area that was not dredged during the last Providence River maintenance dredging effort. The Fox Point Reach has an Unsuitable layer that would need to be placed in the Edgewood Basin and Starter CAD Cell. This Unsuitable layer ranges in thickness from 2-ft to 16-ft and has a maximum bottom depth of -52-ft MLLW. The approximate dimensions of the Starter and Main CAD Cells at the mudline are 500-ft by 1130-ft and 2240-ft by 1070-ft. The Starter Cell has a mudline area of 533,700 sq-ft and the Main Cell has a mudline area of 2,118,700 sq-ft. Both cells would be dredged at a 1V:3H slope to an elevation of -90 ft MLLW.

The Starter Cell requires a total of 578,300 CY be dredged, with a 141,400-CY-layer of Unsuitable Material (162,610 CY with 15% bulking upon placement) and 436,900 CY of suitable material (502,435 CY with 15% bulking). All the Unsuitable material would be disposed of in Edgewood Basin by shallow draft equipment. The Edgewood Basin has a total capacity of 447,500 CY. The basin can be filled with Unsuitable Material to a depth of -13-ft MLLW (a capacity of 178,800 CY or 205,620 bulked). The basin can then be capped with a 3-foot thickness of suitable material from the starter cell (-13 to -10 MLLW) totaling 268,700 CY. The remaining 168,200 CY of Suitable Material from the Starter Cell would be hauled and placed in the Rhode Island Sound Disposal Site. The Starter Cell would have a capacity of 521,700 CY (bulked) for Unsuitable Material (-90 ft to -45 ft MLLW) and could be capped (3-foot-thick cap) with 56,600 CY of Suitable Material (-45 ft to -42 ft MLLW). The Starter Cell would have enough capacity for the 446,800 CY (513,800 CY with 15% bulking for consolidation) of Unsuitable Material from the Main Cell construction.

The Main Cell has a 446,800 CY layer of Unsuitable Material that would be disposed of in the Starter Cell. The Starter Cell would be capped with 56,600 CY (-45 ft to -42 ft MLLW) of Suitable Material from the Main Cell with the remaining 2,521,500 CY of Suitable Material being disposed of at the Rhode Island Sound Disposal Site. The Main Cell would have a capacity of 2,736,700 CY for Unsuitable Material (-90 ft to -45 ft MLLW) and could be capped (3-foot-deep cap) with 229,900 CY of Suitable Material (-45 ft to -42 ft MLLW). The Main Cell would provide enough capacity for the 2,378,900 CY (2,736,700 CY with 15% bulking for consolidation) from the Providence River maintenance dredging. This calculation does not include allowance for unsuitable material over the Edgewood Shoals South CAD cell since the Edgewood Shoals North CAD cell is the recommended plan.

NEW FOX POINT CAD CELL VOLUMES

Material Type	Starter CAD Cell	Main CAD Cell
Unsuitable Disposal	513,800 CY	2,736,700 CY
Suitable Cap	56,600 CY	229,900 CY

SUMMARY - DREDGE CYCLE #1 (DEC 2026)

Providence River Complex Maintenance Dredging (Cycle 1 starting Dec 2026)	**Volume Needed to be Dredged (Cubic Yards)**
Providence River FNP Maintenance	
Entrance Reach (2020 shoaling volume)	33,411
Rumstick Neck Reach (2020 shoaling volume)	11,924
Conimicut Point Reach (2020 shoaling volume)	23,817
Bullock Point Reach (2020 shoaling volume)	114,952
Sabin Point Reach (2020 shoaling volume)	229,092
Fuller Rock Reach (2020 shoaling volume)	381,119
Fox Point Reach (2020 shoaling volume)	836,374
Total as of 2020 Survey	**1,630,689**
Providence River FNP Shoaling through Dec 2026	384,560
Total Providence FNP Shoaling through 2026	**2,015,249**
Other Shallow Draft FNPs	
Bullock Point Cove (2026 shoaling volume)*	7,300
Pawtuxet Cove (2026 shoaling volume)*	34,300
Apponaug Cove (2026 shoaling volume)*	22,000
Total Shallow-Draft FNPs	**63,600**
Allowance for Unsuitable for South CAD	**38,300**
State Allowance total	**300,000**
Total All Sources of dredged volume	**2,417,149**
15% Bulking Factor (during placement)	**362,572**
Total with Bulking (capacity required in CAD cell)	**2,779,721**
Rounded	**2,780,000**

* Assumes shoaling to 2026 plus contingency

SUMMARY - DREDGE CYCLE #2 (DEC 2047)

Providence River Complex Maintenance Dredging (Cycle 2 starting 2047)	Volume Needed to be Dredged (Cubic Yards)
Providence River FNP Maintenance	
Entrance Reach (2027 shoaling volume)*	0
Rumstick Neck Reach (2027 shoaling volume)*	0
Conimicut Point Reach (2027 shoaling volume)*	0
Bullock Point Reach (2027 shoaling volume)*	0
Sabin Point Reach (2027 shoaling volume)*	0
Fuller Rock Reach (2027 shoaling volume)*	0
Fox Point Reach (2027 shoaling volume)*	0
Total as of 2027 Survey*	**0**
Providence River Shoaling (Jan 2027-Dec 2046)	1,900,000
Total Providence FNP Shoaling through 2046	**1,900,000**
Other Shallow Draft FNPs	
Bullock Point Cove (20 year shoal rate)**	7,000
Pawtuxet Cove (20 year shoal rate)**	26,000
Apponaug Cove (20 year shoal rate)**	10,000
Total Shallow-Draft FNPs	**43,000**
Allowance for starter cell needs for future FNP dredging	**150,000**
State Allowance total	**300,000**
Total All Sources of dredged volume	**2,392,000**
15% Bulking Factor (during placement)	**358,800**
Total with Bulking (capacity required in CAD cell)	**2,750,800**
Rounded	**2,800,000**

* Assumed fully maintained after dredge operation in 2027

**Refer to Engineering Appendix for shoal rates

7. SHOALING RATES

Shoaling rate calculations are summarized in the following tables for the Providence River & Harbor Federal Navigation Project and the three associated shallow draft FNPs.

Based on the last condition survey, conducted in 2020, approximately 1,631,000 CY of shoaled material has accumulated in Providence FNP through the year 2020. The table below shows shoaled amounts and average shoaling rates by time period, along with projected average short-term and long-term shoal rates that may incur in the FNP.

Providence River FNP Historical Shoal Rates						
Start Date	**End Date**	**Difference (Months)**	**Start Volume (CY)**	**End Volume (CY)**	**Difference (CY)**	**Shoal Rate (CY/Month)**
Jun-71	Jun-99	336	0	3,899,100	3,899,100	11,604
June 2007	Nov 2015	101	890,349	1,438,133	547,784	5,424
Nov 2015	April 2020	53	1,438,133	1,630,690	192,557	3,633
Short-term average		154			740341	4,807
Long-term average		591			4,639,441	7,900

To estimate long-term shoaling rate into the distant future (from the year 2027 through 2047), the Study Team used a more conservative shoaling rate to account for uncertainties in future hydrologic and storm conditions in the watershed and coastal area. This more conservative shoaling rate pulled in data from the year 1971 through 2020, for an estimated shoaling rate of 7,900 CY per month (95,000 CY per year). Therefore, the estimated shoaling rate from the year 2027 through the end of 2046 is 1,900,000 CY, as shown in the table below.

Providence River Estimated Shoaling Volume					
Start Date	**End Date**	**Difference (Months)**	**Assumed Shoal Rate (CY/Month)**	**Estimate Shoaling Volume (CY)**	**Comments**
April 2020	Dec 2026	80	4,807	384,560	Based on short-term average shoal rate, due to low uncertainty with known hydrological conditions from 2020-2024
Jan 2027	Dec 2046	240	7,900	1,900,000	Based on long-term average shoal rate, due to high uncertainty of future events

Shallow Draft FNP Shoal Rates							
Location	**Start Date**	**End Date**	**Difference (Months)**	**Start Volume (CY)**	**End Volume (CY)**	**Difference (CY)**	**Shoal Rate (CY/Month)**
Bullock Point Cove	May 2020	Dec 2023	43	1,746	2,936	1,190	28
Pawtuxet Cove	Apr 2017	Mar 2023	71	17,461	25,144	7,683	108
Apponaug Cove	May 2015	Feb 2023	93	22,537	19,922	-2,615	-28
Estimated Shoaling Volume (Assumes initial dredge cycle in 2027)							
Location	**Start Date**	**End Date**	**Difference (Months)**	**Assumed Shoal Rate (CY/Month)**	**Estimate Shoaling Volume (CY)**	**Dredge cycle #2 Volume (CY)**	
Bullock Point Cove	Jan 2027	Dec 2046	240	28	6,720	7,000	
Pawtuxet Cove	Jan 2027	Dec 2046	240	108	25,920	26,000	
Apponaug Cove	Jan 2027	Dec 2046	240	-28	-6,720*	10,000 (Est)	

* Actual shoal rate is negative, so an estimated volume is used for Cycle #2

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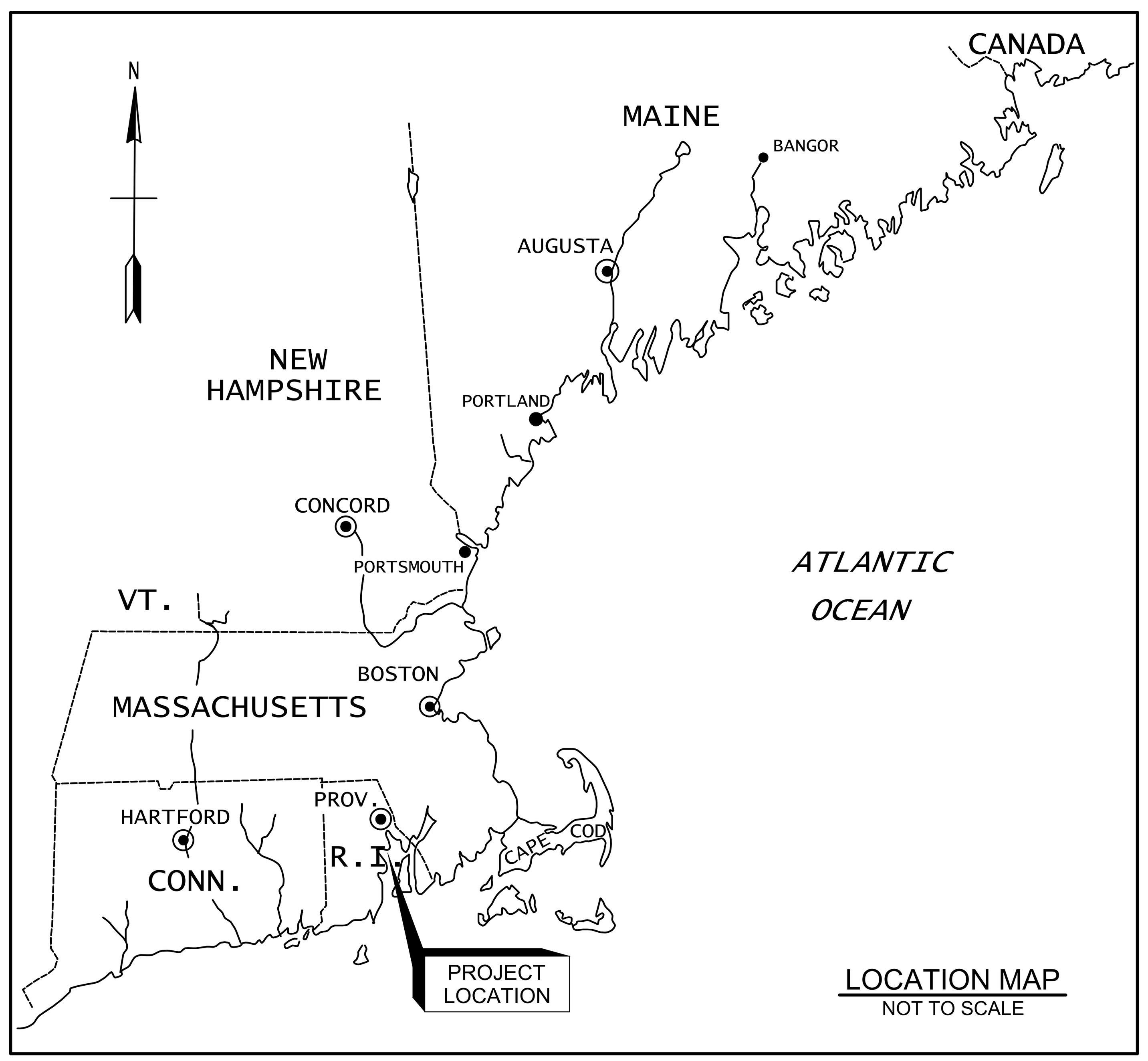
New England District

PROVIDENCE RIVER AND HARBOR
PROVIDENCE, RHODE ISLAND
DREDGED MATERIAL MANAGEMENT PLAN (DMMP)

INDEX TO DRAWINGS

SHEET NO.		DESIGN FILE	SHEET TITLE
1	G-001	PRO-DMMP-24_G-001.DWG	COVER SHEET AND INDEX
2	G-101	PRO-DMMP-24_G-101.DWG	GENERAL PLANS
3	C-101	PRO-DMMP-24_C-101.DWG	PLAN - PROPOSED SOUTH CAD CELL
4	C-102	PRO-DMMP-24_C-102.DWG	PLAN - PROPOSED NORTH CAD CELL AND EDGEWOOD SHOALS BASIN
5	C-103	PRO-DMMP-24_C-103.DWG	PLAN - EXISTING FOX POINT CAD CELLS
6	C-104	PRO-DMMP-24_C-104.DWG	PLAN - PRUDENCE ISLAND DISPOSAL SITE
7	C-301	PRO-DMMP-24_C-301.DWG	SECTIONS - PROPOSED SOUTH CAD CELL
8	C-302	PRO-DMMP-24_C-302.DWG	SECTIONS - PROPOSED NORTH CAD CELL



LOCATION MAP
NOT TO SCALE

SOLICITATION NO.:
CONTRACT NO.:
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SIGNATURES AFFIXED BELOW INDICATE OFFICIAL RECOMMENDATION AND APPROVAL OF ALL DRAWINGS IN THIS SET AS INDEXED ON THIS SHEET

APPROVED FOR TECHNICAL ADEQUACY BY:
TECHNICAL LEAD ENGINEER — DATE

REVIEWED BY:
CHIEF, GEOTECHNICAL/WATER RESOURCES BRANCH — DATE

REVIEWED BY:
CHIEF, GEO-ENVIRONMENTAL ENGINEERING BRANCH — DATE

APPROVAL RECOMMENDED BY:
CHIEF, DESIGN BRANCH — DATE

APPROVED BY:
CHIEF, ENGINEERING DIVISION — DATE

This project was designed by the U.S. Army Corps of Engineers. The initials or signatures and registration designations of individuals appear on these project documents, within the scope of their employment as required by ER 1110-1-8152.

US Army Corps of Engineers®

MARK	DESCRIPTION	DATE

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SIZE: ANSI D
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ISSUE DATE:
SOLICITATION NO.:
CONTRACT NO.:
DRAWING CODE: PRO-DMMP-24
SHEET 1 OF 8

U.S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DISTRICT
696 VIRGINIA ROAD
CONCORD, MA 01742-2751

PROVIDENCE RIVER AND HARBOR
PROVIDENCE, RHODE ISLAND
DREDGED MATERIAL MANAGEMENT PLAN (DMMP)

COVER SHEET AND INDEX

SHEET ID
G-001

PRELIMINARY - NOT FOR CONSTRUCTION

A1 GENERAL PLAN - PROVIDENCE RIVER AND HARBOR

SCALE: 1" = 5000'

0 5000' 10000'

A8 GENERAL PLAN - EDGEWOOD SHOALS

SCALE: 1" = 500'

0 500' 1000'

GENERAL NOTES

1. THE EXISTING CONDITIONS SHOWN ON THESE DRAWINGS REPRESENT THE RESULTS OF SURVEYS MADE ON THE DATES INDICATED, AND CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS EXISTING AT THAT TIME.
2. SOUNDINGS AND CONTOURS SHOWN REFERENCE THE PLANE OF MEAN LOWER LOW WATER (MLLW). SOUNDINGS ARE SHOWN AS DEPTHS BELOW THE REFERENCE PLANE OF MLLW.
3. AERIAL IMAGERY SHOWN IS FROM 2024 MICROSOFT CORPORATION.
4. COORDINATES SHOWN ARE IN U.S. FEET AND REFERENCE THE RHODE ISLAND STATE PLANE COORDINATE SYSTEM (NAD83).
5. UNLESS OTHERWISE NOTED, ALL TOPOGRAPHY INCLUDING SHORELINE, BRIDGES, PIERS, UTILITIES, ETC. IS LOCATED APPROXIMATE AND SHOULD BE USED AS A GENERAL REFERENCE ONLY.

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MARK	DESCRIPTION	DATE

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ISSUE DATE: | SOLICITATION NO.: | CONTRACT NO.: | DRAWING CODE: PRO-DMMP-24 | SHEET 2 OF 8

U.S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DISTRICT
696 VIRGINIA ROAD
CONCORD, MA 01742-2751

PROVIDENCE RIVER AND HARBOR
PROVIDENCE, RHODE ISLAND
DREDGED MATERIAL MANAGEMENT PLAN (DMMP)

GENERAL PLANS

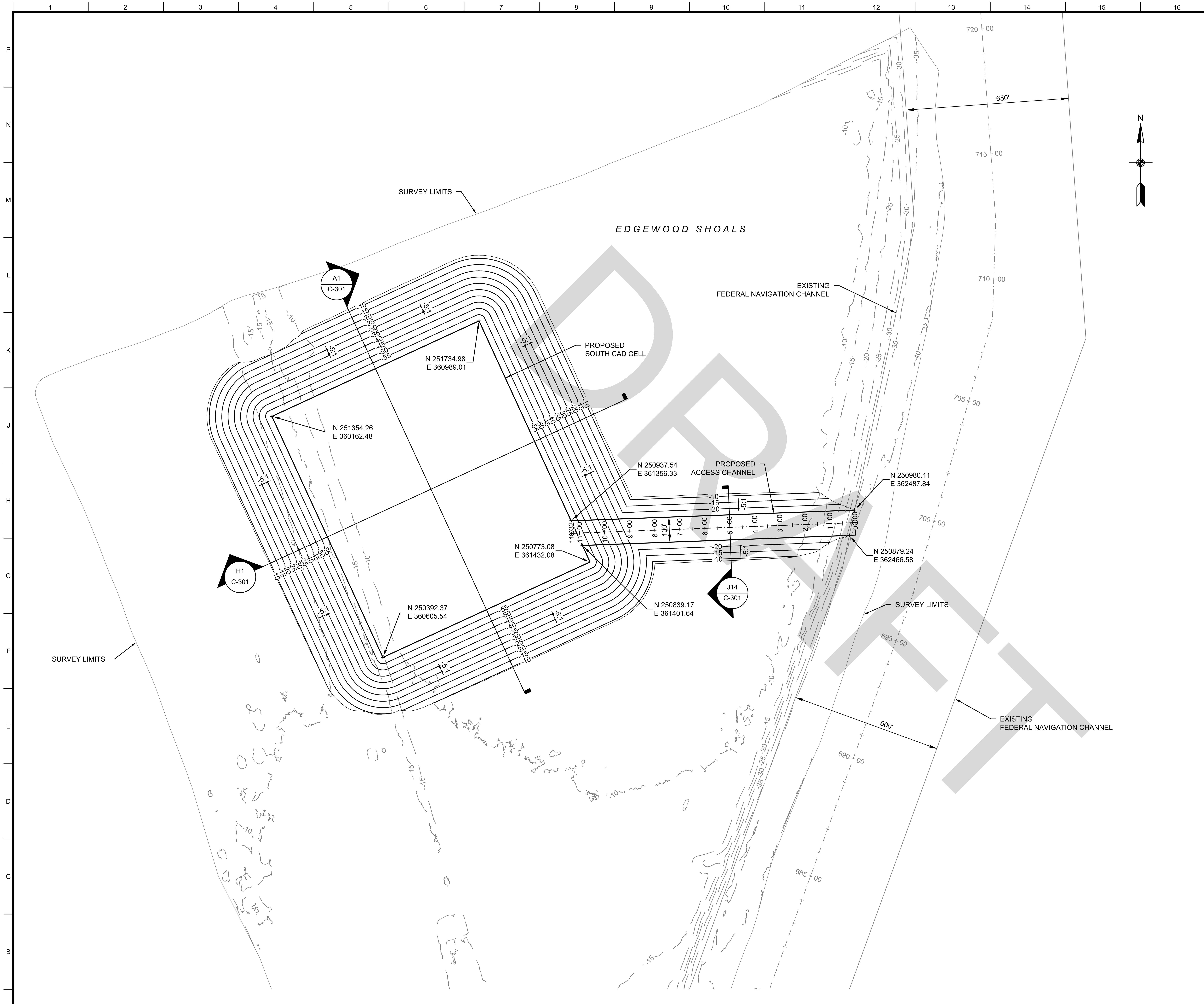
SHEET ID

G-101

PRELIMINARY - NOT FOR CONSTRUCTION

GENERAL SHEET NOTES

1. THE EXISTING CONDITION CONTOURS SHOWN ON THIS DRAWING ARE FROM U.S. ARMY CORPS OF ENGINEERS SURVEYS CONDUCTED DURING MAY 2022.



A1 PLAN - PROPOSED SOUTH CAD CELL

SCALE: 1" = 200'

0 200' 400'

US Army Corps of Engineers®

MARK	DESCRIPTION	DATE

DESIGNED BY:	ISSUE DATE:
DRAWN BY:	SOLICITATION NO.:
CHECKED BY:	CONTRACT NO.:
SUBMITTED BY:	DRAWING CODE: PRO-DMMP-24
SIZE: ANSI D	SCALE: 1" = 200'
	SHEET 3 OF 8

U.S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DISTRICT
696 VIRGINIA ROAD
CONCORD, MA 01742-2751

PROVIDENCE RIVER AND HARBOR
PROVIDENCE, RHODE ISLAND
DREDGED MATERIAL MANAGEMENT PLAN (DMMP)

PLAN - PROPOSED SOUTH CAD CELL

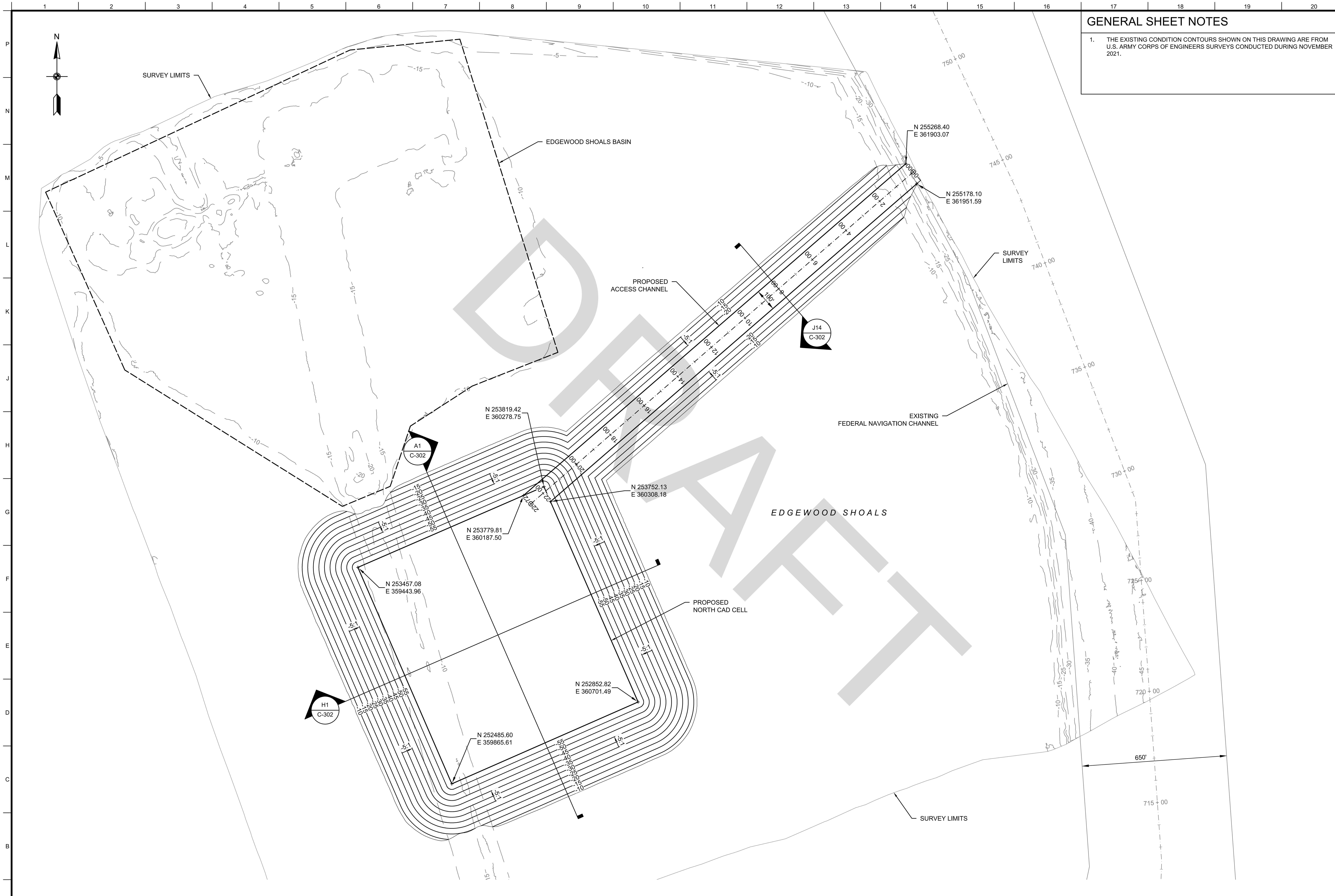
SHEET ID

C-101

PRELIMINARY - NOT FOR CONSTRUCTION

GENERAL SHEET NOTES

1. THE EXISTING CONDITION CONTOURS SHOWN ON THIS DRAWING ARE FROM U.S. ARMY CORPS OF ENGINEERS SURVEYS CONDUCTED DURING NOVEMBER 2021.



A1 PLAN - PROPOSED NORTH CAD CELL AND EDGEWOOD SHOALS BASIN

SCALE: 1" = 200'

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MARK	DESCRIPTION	DATE

DESIGNED BY:	DRAWN BY:	ISSUE DATE:
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SUBMITTED BY:		CONTRACT NO.:
SIZE: ANSI D	SCALE: 1" = 200'	DRAWING CODE: PRO-DMMP-24 SHEET 4 OF 8

U.S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DISTRICT
696 VIRGINIA ROAD
CONCORD, MA 01742-2751

PROVIDENCE RIVER AND HARBOR
PROVIDENCE, RHODE ISLAND
DREDGED MATERIAL MANAGEMENT PLAN (DMMP)

PLAN - PROPOSED NORTH CAD CELL AND EDGEWOOD SHOALS BASIN

SHEET ID

C-102

PRELIMINARY - NOT FOR CONSTRUCTION

DRAFT

PLAN - EXISTING FOX POINT CAD CELLS

A1 SCALE: 1"=200'

0 200' 400'

GENERAL SHEET NOTES

1. SOUNDINGS SHOWN ON THIS DRAWING ARE FROM A U.S. ARMY CORPS OF ENGINEERS CONDITION SURVEY CONDUCTED DURING 2019 AND 2020.

POINT #	NORTHING	EASTING	DESCRIPTION
1	264690.70	356301.81	CAD CELL 1R
2	264436.70	356460.81	CAD CELL 1R
3	264277.70	356205.81	CAD CELL 1R
4	264532.70	356047.80	CAD CELL 1R
5	264394.63	356486.64	CAD CELL 2R
6	264139.63	356645.64	CAD CELL 2R
7	263980.62	356391.64	CAD CELL 2R
8	264235.63	356232.64	CAD CELL 2R
9	264097.70	356672.82	CAD CELL 3R
10	263758.70	356884.83	CAD CELL 3R
11	263599.70	356630.83	CAD CELL 3R
12	263938.70	356418.82	CAD CELL 3R
13	264876.71	356598.81	CAD CELL 4R
14	264452.71	356863.82	CAD CELL 4R
15	264293.70	356608.82	CAD CELL 4R
16	264717.70	356343.81	CAD CELL 4R
17	264409.71	356889.82	CAD CELL 5R
18	263688.71	357339.84	CAD CELL 5R
19	263529.71	357085.84	CAD CELL 5R
20	264250.70	356635.82	CAD CELL 5R
21	264505.70	356004.80	CAD CELL 6R
22	263954.70	356348.82	CAD CELL 6R
23	263712.69	355962.81	CAD CELL 6R
24	264318.69	355705.80	CAD CELL 6R
25	263954.70	356348.82	CAD CELL 7R
26	263403.70	356693.83	CAD CELL 7R
27	263117.69	356235.83	CAD CELL 7R
28	263712.69	355962.81	CAD CELL 7R
29	265792.70	355896.78	CAD CELL 3AR
30	264964.71	356646.81	CAD CELL 3AR
31	264361.69	355682.80	CAD CELL 3AR
32	265375.69	355230.78	CAD CELL 3AR

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SIZE: ANSI D | SCALE: 1" = 200' | SHEET 5 OF 8

U.S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DISTRICT
696 VIRGINIA ROAD
CONCORD, MA 01742-2751

PROVIDENCE RIVER AND HARBOR
PROVIDENCE, RHODE ISLAND
DREDGED MATERIAL MANAGEMENT PLAN (DMMP)

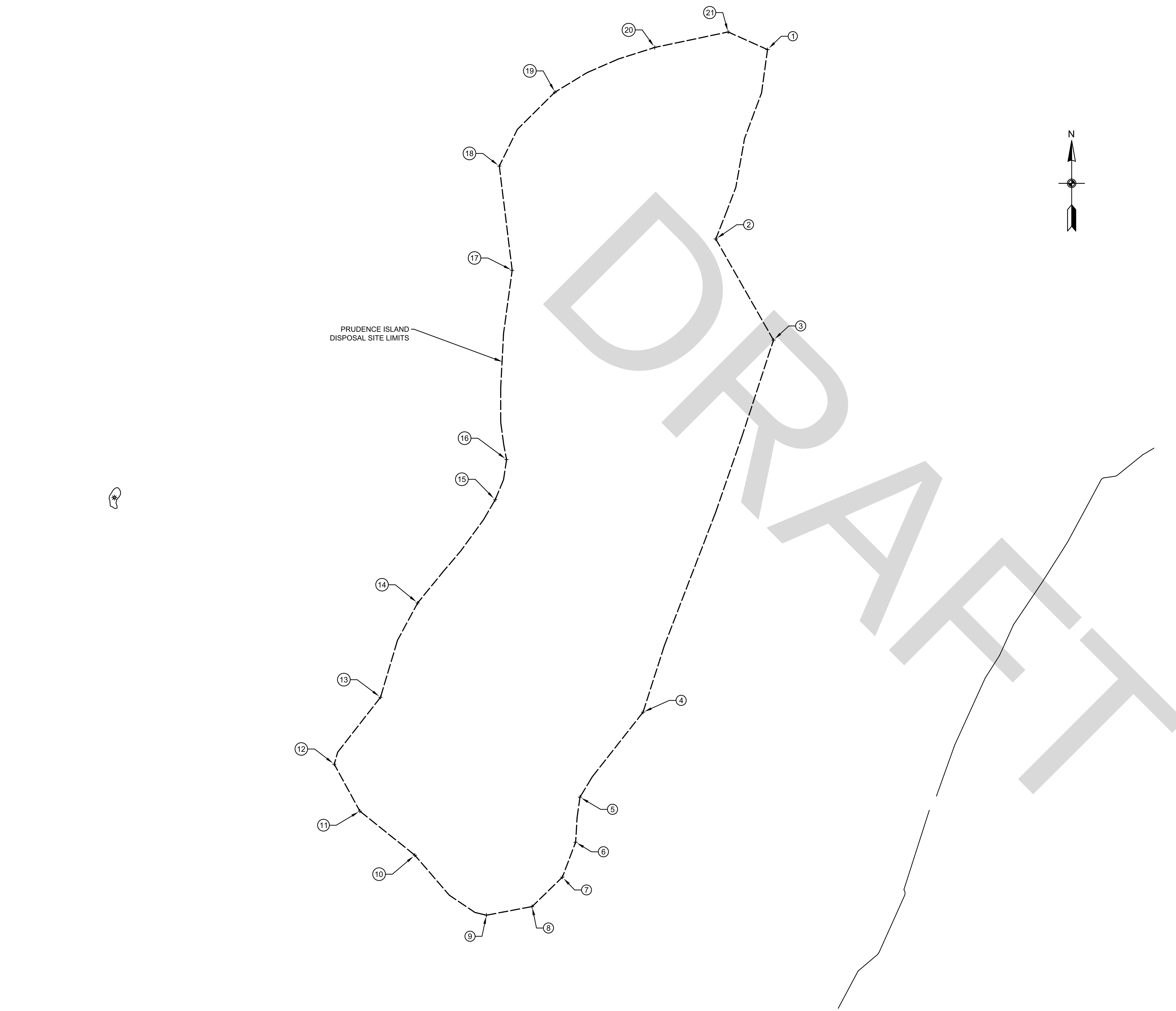
PLAN - EXISTING FOX POINT CAD CELLS

SHEET ID
C-103

PRELIMINARY - NOT FOR CONSTRUCTION

GENERAL SHEET NOTES

1.



POINT #	NORTHING	EASTING
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4	173158.56	378749.29
5	172385.99	378176.37
6	171976.90	378136.82
7	171659.32	378016.76
8	171392.08	377741.78
9	171313.63	377326.57
10	171858.86	376676.75
11	172259.63	376177.11
12	172685.65	375944.73
13	173293.89	376364.53
14	174150.89	376702.14
15	175088.82	377406.28
16	175453.42	377509.51
17	177173.42	377560.64
18	178120.37	377443.73
19	178792.24	377948.94
20	179198.49	378855.19
21	179339.12	379521.86

A1 PLAN - PRUDENCE ISLAND DISPOSAL SITE

SCALE: 1"=500'

0 200' 400'

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MARK | DESCRIPTION | DATE

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ISSUE DATE: | SOLICITATION NO.: | CONTRACT NO.: | DRAWING CODE: PRO-DMMP-24 | SHEET 6 OF 8

U.S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DISTRICT
696 VIRGINIA ROAD
CONCORD, MA 01742-2751

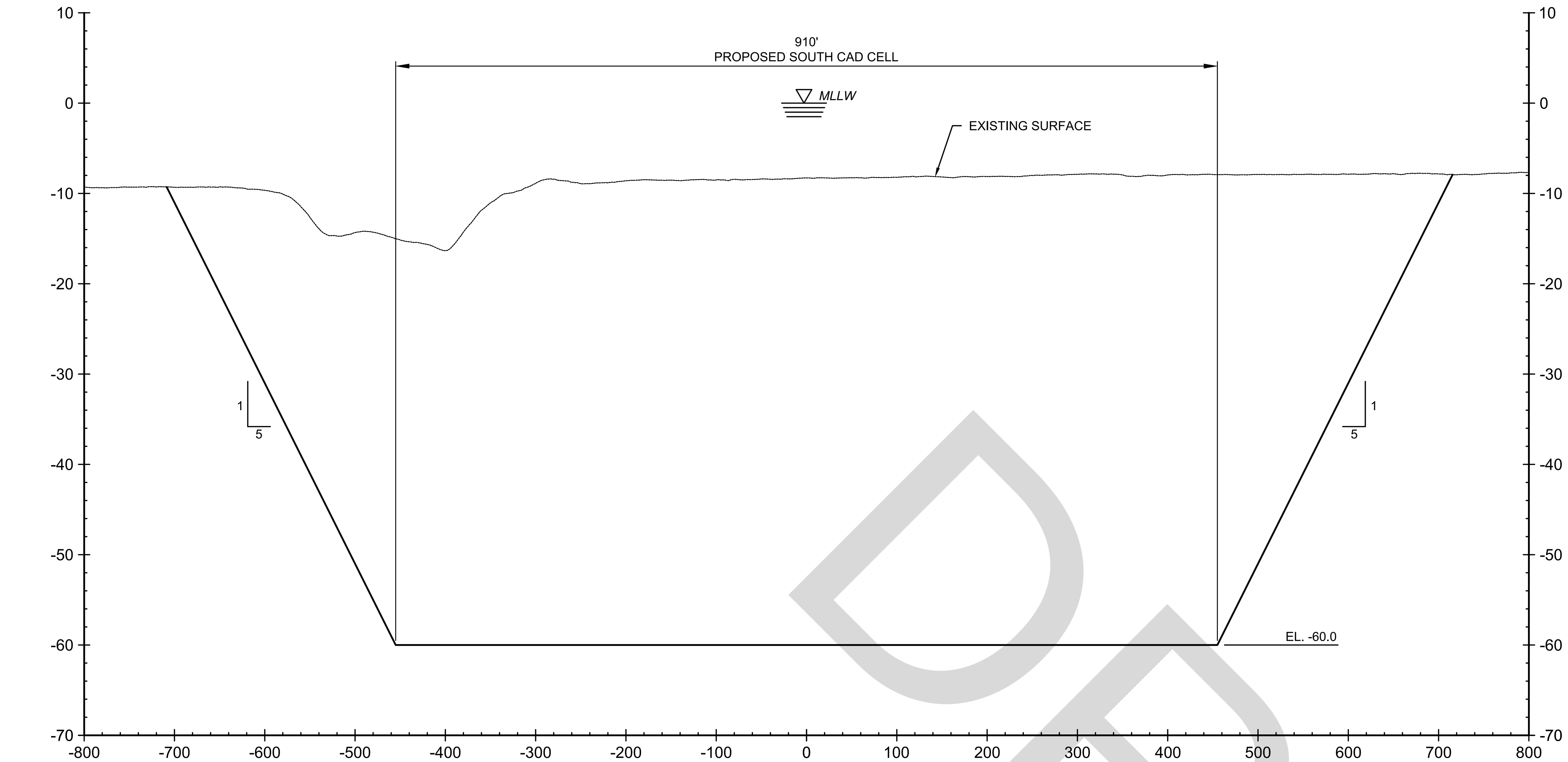
PROVIDENCE RIVER AND HARBOR
PROVIDENCE, RHODE ISLAND
DREDGED MATERIAL MANAGEMENT PLAN (DMMP)

PLAN - PRUDENCE ISLAND DISPOSAL SITE

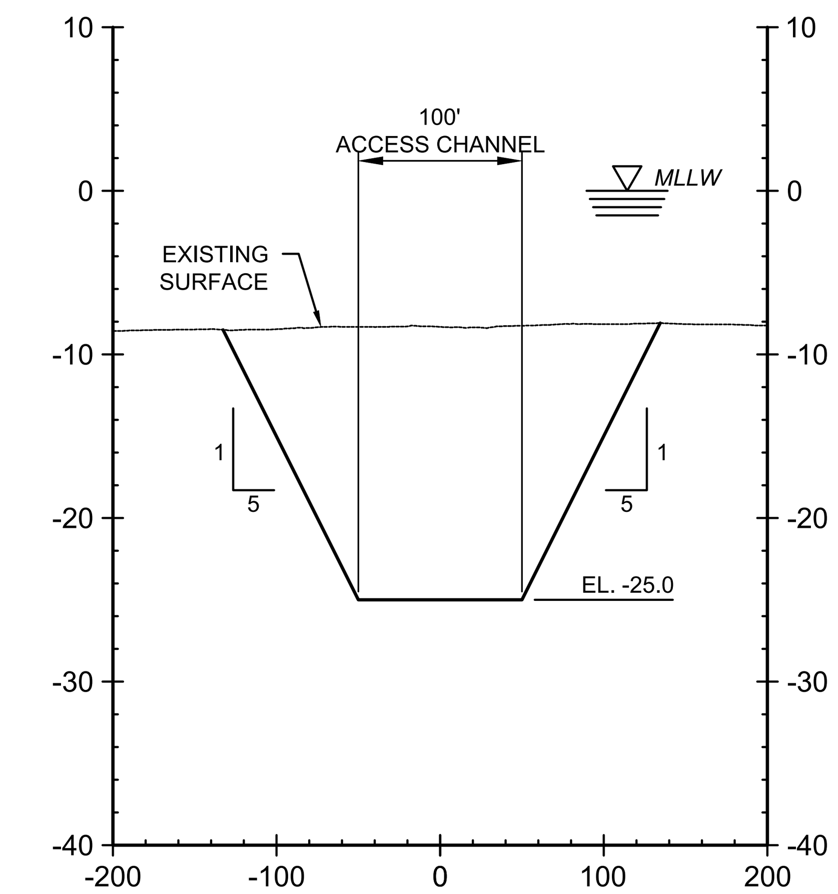
SHEET ID

C-104

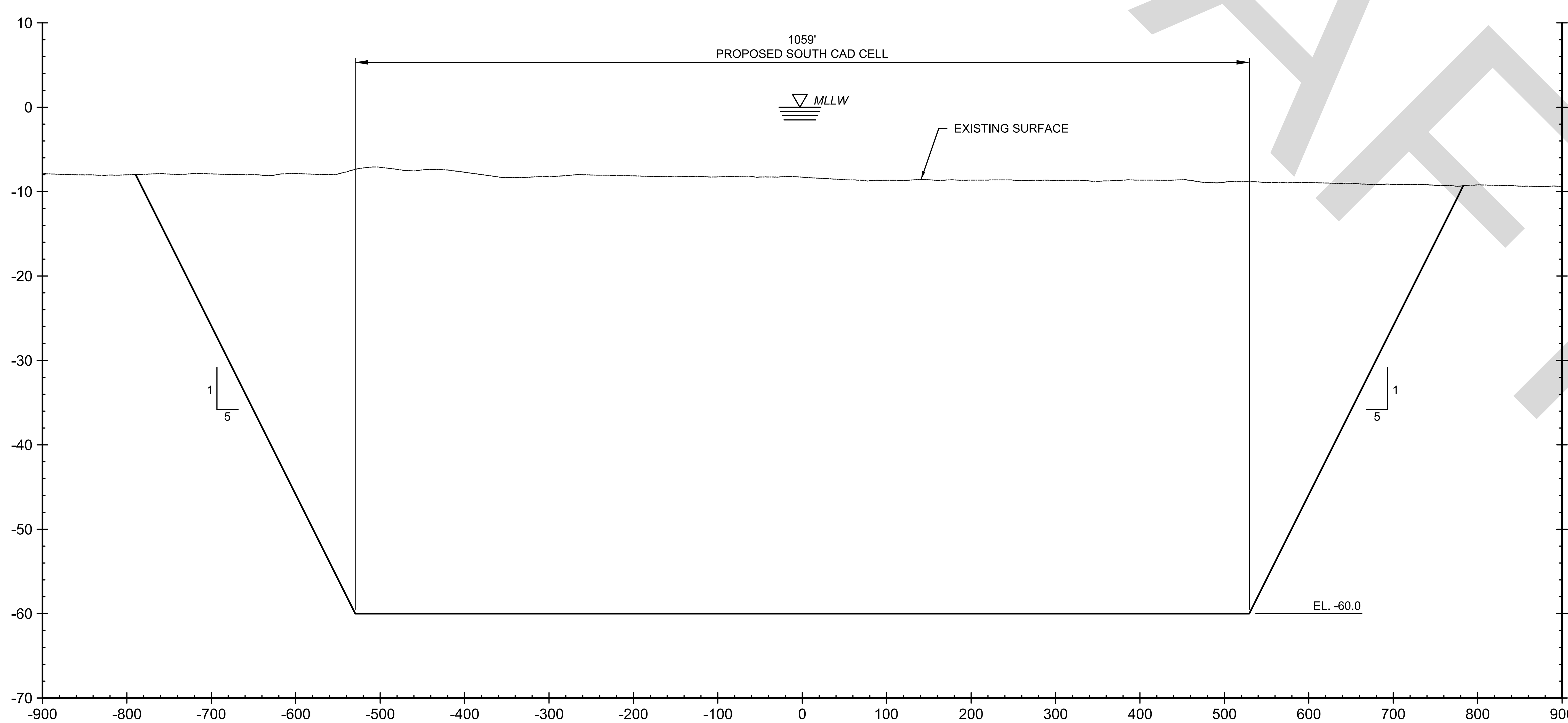
PRELIMINARY - NOT FOR CONSTRUCTION



H1 SECTION
SCALE: HOR. 1" = 100', VER. 1"=10'



J14 SECTION
SCALE: HOR. 1" = 100', VER. 1"=10'



A1 SECTION
SCALE: HOR. 1" = 100', VER. 1"=10'

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ISSUE DATE:
SOLICITATION NO.:
CONTRACT NO.:
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SHEET 7 OF 8

DESIGNED BY:
DRAWN BY:
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SUBMITTED BY:
SIZE: ANSI D
SCALE: 1" = 100'

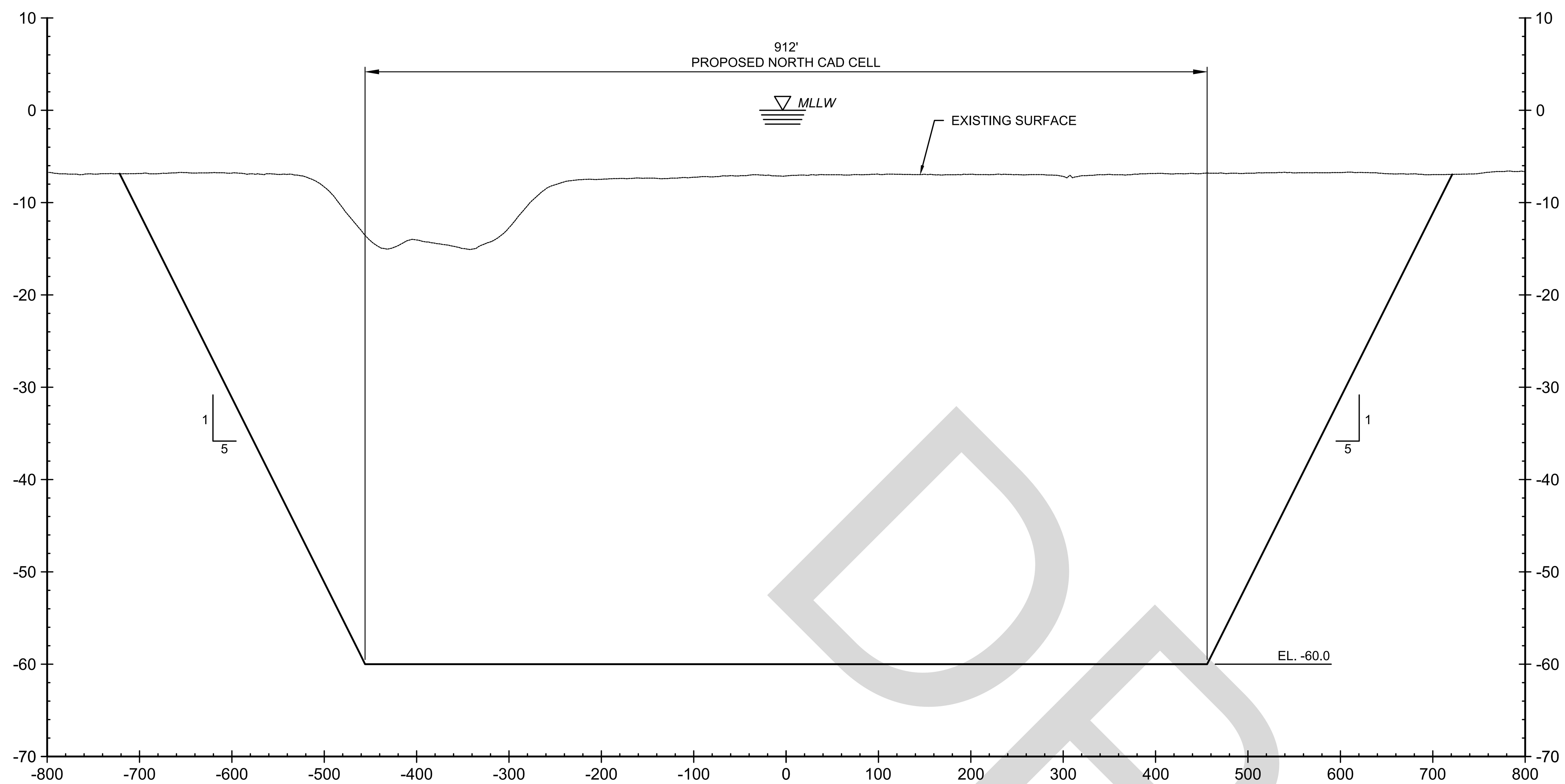
U.S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DISTRICT
696 VIRGINIA ROAD
CONCORD, MA 01742-2751

PROVIDENCE RIVER AND HARBOR
PROVIDENCE, RHODE ISLAND
DREDGED MATERIAL MANAGEMENT PLAN (DMMP)

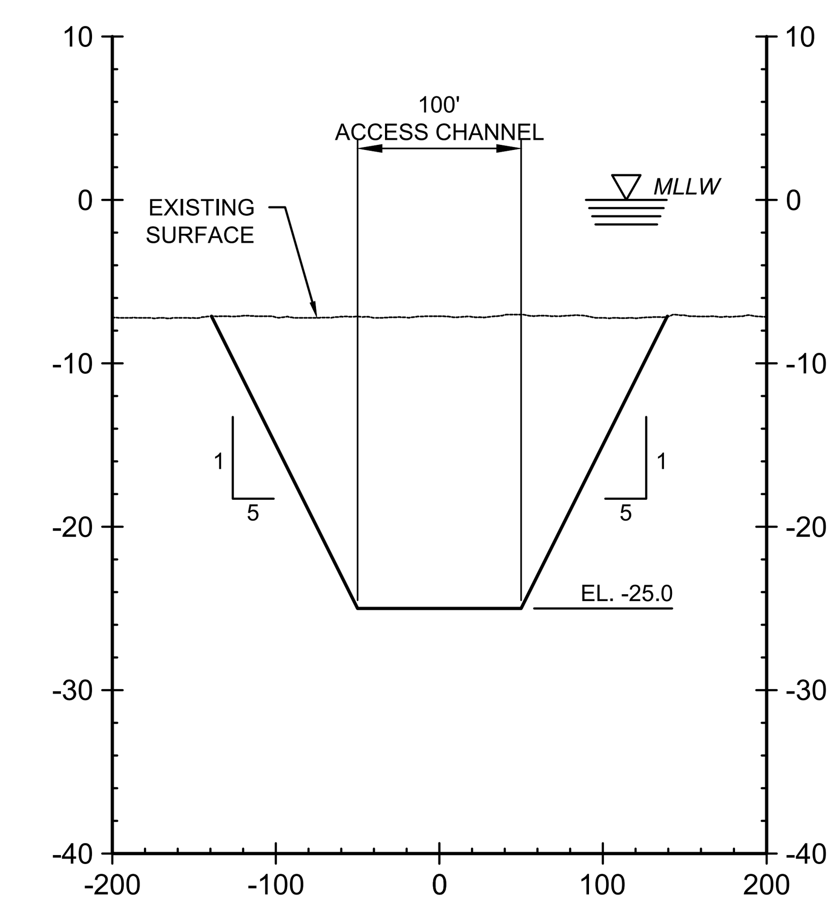
SECTIONS - PROPOSED SOUTH CAD CELL

SHEET ID
C-301

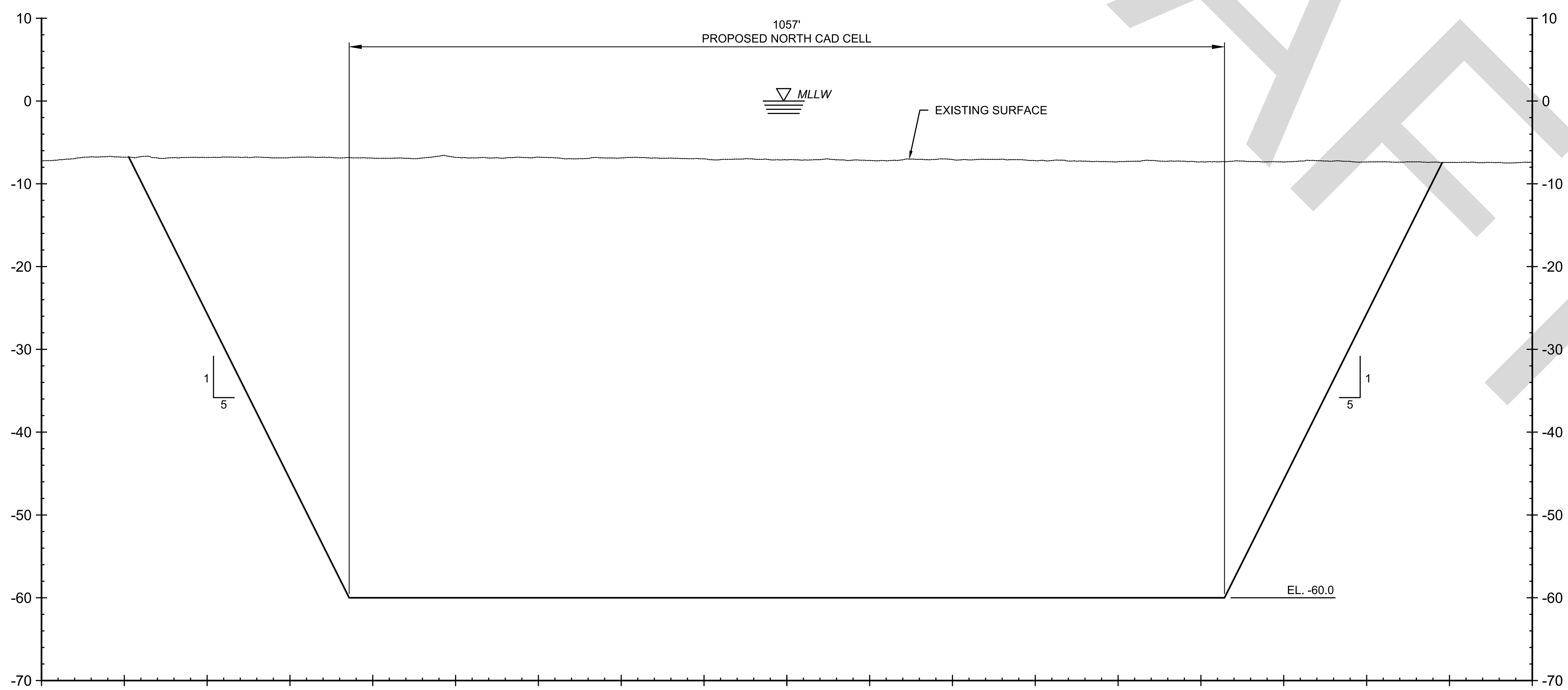
PRELIMINARY - NOT FOR CONSTRUCTION



H1 SECTION
SCALE: HOR. 1" = 100', VER. 1"=10'
0 100' 200'
0 10' 20'



J14 SECTION
SCALE: HOR. 1" = 100', VER. 1"=10'
0 100' 200'
0 10' 20'



A1 SECTION
SCALE: HOR. 1" = 100', VER. 1"=10'
0 100' 200'
0 10' 20'

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MARK	DESCRIPTION	DATE

ISSUE DATE:
SOLICITATION NO.:
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SHEET 8 OF 8

DESIGNED BY:
DRAWN BY:
CHECKED BY:
SUBMITTED BY:
SIZE: ANSI D
SCALE: 1" = 100'

U.S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DISTRICT
696 VIRGINIA ROAD
CONCORD, MA 01742-2751

PROVIDENCE RIVER AND HARBOR
PROVIDENCE, RHODE ISLAND
DREDGED MATERIAL MANAGEMENT PLAN (DMMP)

SECTIONS - PROPOSED NORTH CAD CELL

SHEET ID
C-302

PRELIMINARY - NOT FOR CONSTRUCTION

Providence River and Harbor Federal Navigation Project Rhode Island Dredged Material Management Plan and Environmental Assessment

Appendix F
Subsurface Scanning, Sediment Analysis, and Suitability Determinations

CENAE–PDE 20 October 2022

FINAL Suitability Determination in Support of the Providence River and Harbor DMMP, Providence, Rhode Island

1. **Summary:**
This document addresses the suitability of dredged material within the footprint of a proposed confined aquatic disposal (CAD) cell and access channel in the vicinity of Edgewood Shoals in Providence, RI for unconfined open water disposal at the Rhode Island Sound Disposal Site (RISDS) or confined disposal in the existing Edgewood Shoals basin. The New England District (NAE) of the U.S. Army Corps of Engineers (USACE) finds that sufficient data has been provided to satisfy the evaluation and testing requirements of Section 103 of the Marine Protection, Research and Sanctuaries Act (MPRSA) and Section 404 of the Clean Water Act (CWA). Based on an evaluation of the project site and the material proposed to be dredged, NAE finds the surficial two feet of sediment located within the historic access channel that connects the Edgewood Shoals basin to the Providence River Federal Navigation Project (FNP) to be unsuitable for unconfined open water placement at RISDS. However, this material meets the requirements for disposal into the existing basin provided that it is capped with clean sediments. The remaining sediments in the proposed project area are suitable for unconfined open water disposal as proposed.

2. **Project Description:**
NAE is currently preparing a dredged material management plan (DMMP) that will identify, evaluate, and compare management alternatives for material generated from the maintenance dredging of the Providence River FNP over the next 20-year period. This includes the management of 608,000 cubic yards of shoaled material which was found to be unsuitable for unconfined open water disposal based on chemical and biological testing performed in 2013 and 2014 (USACE, 2017). A potential alternative for this material, and additional unsuitable material that may be present in subsequent rounds of maintenance dredging, involves the construction of CAD cells in the vicinity of Edgewood Shoals and an access channel connecting the CAD cells to the FNP. In 2019, NAE conducted a series of sub-bottom profiler surveys to identify the optimal location for these project features based on subsurface strata. The project layout is presented in Figures 1, 2, and 3.

The Providence River currently has six CAD cells that were constructed in the upper harbor to accommodate unsuitable material from maintenance dredging of the FNP that took place in 2005 and subsequent non-Federal dredging projects around Providence Harbor. NAE recently estimated the remaining capacity of the existing CAD cells as approximately 300,000 cubic yards. The remaining capacity is not sufficient for the long term needs of the FNP and non-Federal dredging projects in the area.

NAE is proposing to dredge approximately 245,700 cubic yards (CY) of sand and silt from shoaled areas within the proposed 100 foot wide access channel connecting a proposed CAD cell to the Sabin Point Reach channel and 2,966,530 CY of sand and silt from an approximately 52 acre area for a proposed CAD cell in the vicinity of Edgewood Shoals (Figures 1 and 2). The proposed access channel will be mechanically dredged to a depth of -25 feet at Mean Lower Low Water (MLLW) and the CAD cell will be mechanically dredged to the project depth of -60 feet at MLLW. Suitable material from the proposed access channel and CAD cell will be placed at RISDS and unsuitable material will be placed into the existing approximately 64 acre Edgewood Shoals basin and capped with clean sediments.

3. **Conceptual Site Model:**

NAE reviewed historic testing data, previous environmental assessments, water quality data, adjacent land-use information, and interviewed local officials to develop a conceptual site model (CSM) for the proposed project area. This CSM was used to characterize the system and to identify potential sources of contamination, site-specific contaminants of concern, exposure pathways, and biological receptors.

The Providence River and Harbor are located in the northern portion of Narragansett Bay and constitute the principal commercial waterway in the state of Rhode Island. The Providence River is formed by the junction of the Woonasquatucket and Moshassuck Rivers, which originate in northern Rhode Island. From this confluence in the city of Providence the river flows south for one mile to the head of Providence Harbor at Fox Point, where it is joined by the Seekonk River. The FNP in the Providence River consists of a 16.8 mile long channel that is 40 feet deep at MLLW beginning at the head of Providence Harbor and following the river on a southerly course to deep water in Narragansett Bay near Prudence Island. The channel is generally 600 feet wide except for the Providence Harbor reach located between Fox Point and Fields Point (near the Providence-Cranston city line), where it has varying widths up to 1,700 ft.

Edgewood Shoals is a natural shallow area in the Providence River located between Fields Point and the mouth of the Pawtuxet River. The eastern edge of the shoal abuts the 40 foot FNP channel. A 13 foot channel and basin was dredged through the shoal in the early 1940s to provide access to a shipyard commissioned by the US Maritime Commission as part of the Nation's Emergency Shipbuilding Program. This existing channel has been allowed to shoal in over time and recent nautical charts (Figure 1) indicate a reported depth of 8 feet. The site of the former Fields Point Shipyard is currently occupied by a combined Navy, Marine Corps, and Army Reserve center and an educational facility run by Save the Bay. Land use along the western shoreline of Edgewood Shoals includes a mix of urban residential development and small marinas.

Water quality in the upper Providence River is dictated by tidal exchange with Narragansett Bay and freshwater inputs from the Woonasquatucket, Moshassuck, Seekonk, and Pawtuxet Rivers. Modeling performed by the University of Rhode Island (Medley, 2019) documented that the Edgewood Shoals area is a circulation-restricted zone where hydrodynamic exchange is limited due to the steep bathymetric gradient between the ~6 foot shoal and the adjacent 40 foot channel. The resulting lack of flushing is known to cause low dissolved oxygen levels during the summer months. The area is also subject to nutrient loading caused by a combination of overland runoff from adjacent urban areas and discharge from the nearby Fields Pond and East Providence wastewater treatment facilities.

The Rhode Island Department of Environmental Management (RIDEM) classifies the waters of the Providence River from the confluence of the Moshassuck and Woonasquatucket rivers to a line extending due east of Naushon Avenue in Warwick to the western terminus of beach Road in East Providence in Warwick as class SB1{a} (250-RICR-150-05-1). SB1 waters are designated for: primary and secondary contact recreational activities, fish and wildlife habitat, aquaculture use (other than shellfish for direct human consumption), navigation, and industrial cooling. The {a} qualifier denotes a partial use restriction due to impacts from CSOs.

The FNP in the Providence River was last dredged in 2005 when 3,800,000 cubic yards of shoaled material were mechanically removed to restore the project to its authorized dimensions. Approximately two thirds of this material was found to be suitable for unconfined open water placement. Due to elevated levels of metals and polychlorinated biphenyls (PCBs) the remainder of the material was placed in a series of CAD cells located in the FNP footprint at the head of Providence Harbor. Recent surveys indicate that sufficient shoaling has occurred since 2005 to warrant the next cycle of maintenance dredging. Testing performed in 2013 and 2014 found the existing shoaled material to be unsuitable for unconfined open water placement due to elevated concentrations of individual metals, polycyclic aromatic hydrocarbons (PAHs), PCBs, and pesticides (USACE, 2017).

There is no record of maintenance dredging in the existing Edgewood Shoals channel or basin since their construction in the 1940s. A review of NAE Regulatory permit requests from the adjacent private marinas found no sediment testing data on file.

There have been a number of historic releases of petroleum products into the Providence River from the terminal facilities located upstream of Edgewood Shoals. No recent releases have been reported in the immediate vicinity of the proposed project.

Following this tier one review of the site characteristics and the available historical data, the proposed project in the vicinity of Edgewood Shoals was given a **moderate** to **high** risk ranking according to the following matrix:

Rank	Guidelines
Low	Few or no sources of contamination. Data available to verify no significant potential for adverse biological effects.
Low-Moderate	Few or no sources of contamination but existing data is insufficient to confirm ranking.
Moderate	Contamination sources exist within the vicinity of the project with the potential to produce chemical concentrations that may cause adverse biological effects.
High	Known sources of contamination within the project area and historical data exists that has previously failed biological testing.

4. **Sampling, Testing, and Analysis:**
NAE prepared a sampling and analysis plan (SAP) for the project on 27 March 2020 to investigate the extent and depth of contaminants of concern (COCs) within a preliminary CAD cell footprint. All sampling and analysis followed the procedures outlined in the *Regional Implementation Manual for the Evaluation of Dredged Material Proposed for Disposal in New England Waters* (RIM) (EPA/USACE, 2004), the *Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S.– Testing Manual* (ITM) (EPA/USACE, 1998), and *Evaluation of Dredged Material Proposed for Ocean Disposal – Testing Manual* (Green Book) (EPA/USACE, 1991) as appropriate. The SAP called for 16 sediment cores to be collected in order to characterize the dredge footprint within the proposed access channel and CAD cell area (Figure 1). All cores were collected to a maximum depth of 12 feet below the water sediment interface or refusal. This range was selected to cover the first distinct change in subsurface strata observed in the 2019 sub-bottom data.

NAE collected sediment cores in August of 2020 (Table 1 and Figure 1). Based on the results of this sampling and testing effort, the project footprint was refined and shifted south to avoid high levels of COCs found within the existing Edgewood Shoals basin. NAE collected second round of sediment cores in April 2021 for bulk chemistry concurrently with sampling for elutriate and biological testing to further evaluate the material for the proposed disposal alternatives. Project area water and sediments were used to prepare elutriate samples for chemical analysis and water column toxicity testing. Project area sediments were also used to perform 10-day whole sediment toxicity testing and 28-day bioaccumulation testing.

TABLE 1:
2020-2021 SAMPLE LOCATIONS AND SUB-SAMPLE INTERVALS FOR BULK CHEMICAL ANALYSIS

Sample Location	Latitude	Longitude	Survey Depth (FT MLLW)	Sediment Core Length (FT)	Sample Intervals (FT Below Water/Sediment Interface)
2020 Sample Locations					
A	41.777046	-71.384517	-6.4	9.0	0-1.0/ 1.0-2.0/ 2.0-4.4/ 4.4-9.0
B	41.777277	-71.383794	-13.7	11.1	0-1.0/ 1.0-2.0/ 2.0-7.3/ 7.3-11.1
C	41.777604	-71.382700	-6.4	11.5	0-2.3/ 2.3-4.3/ 4.3-11.5
D	41.778173	-71.380835	-6.0	12.0	0-1.0/ 1.0-2.0/ 2.0-4.4/ 4.4-12.0
E	41.778664	-71.385377	-6.9	12.0	0-1.0/ 1.0-2.0/ 2.0-3.7/ 3.7-12.0
F	41.778946	-71.384514	-21.7	10.5	0-1.5/ 1.5-3.5/ 3.5-10.0/ 10.0-10.5
G	41.779245	-71.383524	-7.5	11.1	0-1.0/ 1.0-2.0/ 2.0-4.0/ 4.0-11.1
H	41.779786	-71.381859	-7.6	6.9	0-3.4/ 3.4-6.9
I	41.780129	-71.386195	-7.1	11.2	0-1.0/ 1.0-2.0/ 2.0-8.0/ 8.0-11.2
J	41.780538	-71.383668	-7.1	10.7	0-1.0/ 1.0-2.0/ 2.0-4.0/ 4.0-10.7
K	41.781187	-71.382588	-7.1	10.0	0-2.0/ 2.0-3.0/ 3.0-8.3/ 8.3-10.0
N	41.781719	-71.381382	-8.1	4.0	0-4.0
O	41.782921	-71.379349	-7.1	5.5	0-0.6/ 0.6-2.6/ 2.6-5.5
P	41.783792	-71.376646	-7.4	11.5	0-2.5/ 2.5-4.0/ 4.0-8.5/ 8.5-11.5
2021 Sample Locations					
C1	41.776484	-71.383463	-13.7	8.0	0-2.0/ 2.0-8.0
C3	41.779418	-71.384689	-13.7	8.0	0-2.5/ 2.5-8.0
E1	41.776352	-71.382066	-6.4	8.0	0-4.0 / 4.0-8.0
E4	41.776925	-71.380218	-6.0	8.0	0-4.0 / 4.0-8.0
W3	41.778664	-71.385377	-6.9	8.0	0-2.0/ 2.0-8.0

Physical and Chemical Analysis of Sediments

During the 2020 sampling effort individual cores from the proposed access channel and CAD cell area were subsampled vertically with one subsample taken from the surficial layer and additional samples collected based on lithology observed at depth. Each subsample was analyzed individually for grain size and bulk sediment chemistry. After the decision was made to alter the CAD cell and access channel footprints, additional samples were collected for bulk chemistry in April 2021 (Table 1 and Figure 1). These cores were subsampled vertically and analyzed individually in the same manner as the August 2020 sampling event.

Results of the bulk sediment chemistry analysis are presented in Appendix A with core logs and photos in Appendix B. Samples from the proposed CAD cell were primarily soft grey to black organic silt over firm sandy silt throughout the proposed project footprint. An increased fraction of coarse grained material corresponding to shell fragments was noted in the northern half of the project area. The three cores taken from the vicinity of the proposed access channel contained a mix of sandy silt and shell fragments.

To examine the sediment concentrations in an ecologically meaningful context, NAE screened the bulk sediment values with Sediment Quality Guidelines (SQGs). Applicable SQG screening values for marine and estuarine sediments are the National Oceanic and Atmospheric Administration (NOAA) effects-range low (ERL) and effects-range median (ERM). ERL/ERM values are empirically derived guidelines that identify contaminant levels that indicate when the potential for toxic effects are unlikely (ERL) and when an increased probability of toxic effects is evident (ERM).

Samples collected from the existing basin (F, L, and M) contained moderate to high levels of most analyzed COCs. These stations exhibited concentrations of metals, PAHs, total PCBs, and multiple pesticides above the ERL. In addition, some sample intervals from these stations contained total PCBs, total high molecular weight PAHs (HPAHs), total DDx (sum of 4,4'-DDD + 4,4'-DDE + 4,4'-DDT), and total chlordanes at concentrations above the ERM. As previously stated, due to the elevated concentrations found in the existing basin, the proposed footprint of the CAD cell and its access channel were shifted south to avoid this area (Figure 3).

Concentrations of COCs within the existing channel inside the CAD cell footprint (C1, B, and C3) were elevated in the surficial two feet with multiple exceedances of the ERL as well as several metals, total PCBs, and total chlordanes detected at concentrations greater than the ERM. Concentrations of COCs decreased significantly in the samples taken at depth within the existing channel, where only minor exceedances of the ERL were present.

Samples collected west of the existing channel in 2020 (A, E, and I) contained only arsenic at concentrations greater than the ERL. Sample W1, also located west of the existing channel, collected in 2021 contained multiple metals at concentrations greater than the ERL as well as mercury at a concentration greater than the ERM.

Samples located east of the existing channel (C, D, G, H, J, E1, and E4) largely contained arsenic at levels greater than the ERL. A subset of these samples also contained dieldrin and mercury at concentrations greater than the ERL.

Samples taken from the vicinity of the proposed access channel between the proposed CAD cell and Sabin Point Reach channel (K, N, O, and P) contained few exceedances of the ERL. A subset of these samples contained arsenic or mercury at concentrations greater than the ERL.

The transition to parent material at depth was interpreted through examination of the project sediment core logs and bulk sediment chemistry data. The surficial interval within cores from distinct portions of the project footprint (existing access channel, east bank, west bank, and ambient material in the vicinity of the proposed access channel) was selected for compositing and further analysis to determine suitability for open water placement under MPRSA. Similarly, the interval of underlying material within a subset of cores from each area was selected for compositing and further evaluation to represent parent material throughout the entire project area.

Biological Analysis of Sediments

Samples for biological testing were collected in April of 2021 with the second round of cores for bulk sediment chemistry. Five composite samples were collected according to the composting plan below (Table 2 and Figure 2) to determine the potential for the dredged sediment to cause adverse effects to the biological receptors identified in the CSM. Sediment toxicity was measured through a 10-day whole sediment acute toxicity test, human health risk was determined through a 28-day bioaccumulation test, and water column toxicity was determined through a suspended particulate phase test as described in the Green Book (EPA/USACE, 1991).

**TABLE 2:
2021 SAMPLE LOCATIONS AND COMPOSITING
FOR ELUTRIATE AND BIOLOGICAL TESTING**

Sample Location	Latitude	Longitude	Survey Depth (FT MLLW)	Sample Interval (FT Below Water/Sediment Interface)
Composite 1 - CAD Cell (Western Bank)				
W1	41.775774	-71.383865	-6.4	0-2.0
W2	41.777046	-71.384517	-6.4	0-2.0
W3	41.778664	-71.385377	-6.9	0-2.0
Composite 2 - CAD Cell (Existing Channel)				
C1	41.776484	-71.383463	-13.7	0-2.0
C2	41.777277	-71.383794	-13.7	0-2.0
C3	41.779418	-71.384689	-13.7	0-2.0
Composite 3 - CAD Cell (Eastern Bank)				
E1	41.776352	-71.382066	-6.4	0-4.0
E2	41.777604	-71.382700	-6.4	0-4.0
E3	41.779245	-71.383524	-7.5	0-4.0
E4	41.776925	-71.380218	-6.0	0-4.0
E5	41.778173	-71.380835	-6.0	0-4.0
E6	41.779786	-71.381859	-7.6	0-4.0
Composite 4 – Proposed Access Channel				
A1	41.780525	-71.380754	-7.1	0-2.0
A2	41.781832	-71.378722	-7.1	0-2.0
A3	41.783792	-71.376646	-7.4	0-2.0
Composite 5 - Underlying Material				
W3	41.778664	-71.385377	-6.9	2.0-8.0
C3	41.779418	-71.384689	-13.7	2.0-8.0
E4	41.776925	-71.380218	-6.0	4.0-8.0
A3	41.783792	-71.376646	-7.4	2.0-8.0

Evaluating Potential Effects to Benthic Organisms

Mean mortality in the control sample of the 10-day whole sediment acute toxicity test was less than 10% for the amphipod (*Leptocheirus plumulosus*) but was greater than 10% for the mysid (*Americamysis bahia*). The *L. plumulosus* tests were valid based on quality control criteria established in the testing protocol. The laboratory control for *A. bahia* failed to meet the test acceptability criterion of ≥90% survivability, however, the site composites all achieved survival equal to or higher than the RISDS reference data. Therefore, these data are valid for evaluation of the project.

Mean survivability for *A. bahia* ranged from 85% to 97% for the five composite samples and was not statistically different when compared to survivability in the RISDS reference sediment. The material proposed to be dredged is not considered acutely toxic to the mysids used in this assessment.

Mean survivability for *L. plumulosus* ranged from 58% to 91% for the five composite samples. The survivability was not statistically different when compared to survivability in the RISDS reference sediment in Composite 1. The survivability in Composites 2, 3, and 4 was statistically different from the survivability in the reference sediment but was within 20% of the reference value, and therefore within the acceptable range. The survivability in Composite 5 was also statistically different from the survivability in the reference sediment but was not within 20% of the reference value, and therefore not within the acceptable range. Based on these results, only the material to be dredged from the vicinity of Composites 1 through 4 is not acutely toxic to the amphipods used in this assessment.

Because the sediment chemistry results of the individual samples included in Composite 5 contained low or non-detect concentrations of COCs, and the 10-day test with the mysid shrimp showed no detrimental responses to Composite 5, a second sampling and testing effort was performed to re-run the Composite 5 10-day toxicity test for *L. plumulosus* and also to analyze the individual stations in Composite 5 for an extended analytical suite including organotins, simultaneously extracted metals (SEM), and acid volatile sulfides. Sediment cores were re-collected from the original sample locations and depth intervals in August 2021. Organotins (tetra-n-butyltin, tributyltin, dibutyltin, and monobutyltin) were not detected in these sediments. Cadmium, lead, nickel, and zinc were detected in all four SEM samples and copper was not detected in any of the SEM samples. AVS was detected in the C3 sample, but not in the remaining three samples. An SEM/AVS ratio of 0.73 was calculated for the C3 sample which indicates that the available sulfides in the sample are sufficient to bind to all of the divalent metals such that the metals would not be bioavailable to benthic invertebrates (EPA, 2007).

A second solid phase amphipod bioassay using *L. plumulosus* was initiated in September 2021 using these newly collected sediments and resulted in a mean survival of 98%, which is greater than the 95% mean survival in the RISDS reference sediment. These observations suggest that the results of the original Composite 5 *L. plumulosus* test was anomalous, likely due to laboratory culture issues, and the Composite 5 materials do not result in acute toxicity to amphipods. Further, expanded sediment chemistry analysis and tissue chemistry results did not identify any potential sources of toxicity that might have contributed to the adverse response observed in the original assay. Therefore, NAE determined that the material to be dredged is not considered acutely toxic to the amphipods used in this assessment for Composite 5.

Results from the 10-day whole sediment toxicity tests are summarized in Table 3.

TABLE 3:
MEAN SURVIVABILITY
10-DAY WHOLE SEDIMENT TOXICITY TEST

Organism	Lab Control	RISDS Reference	Comp 1	Comp 2	Comp 3	Comp 4	Comp 5	Comp 5 (re-test)
A. bahia	88%	92%	97%	92%	85%	97%	94%	---
L. plumulosus	96%	95%	91%	79%	83%	81%	58%	98%

Evaluating Potential Effects to Human Health

In order to assess the potential risk to human health through the exposure pathways identified in the CSM, a 28-day bioaccumulation test was performed with the clam *Macoma nasuta* and marine worm *Nereis virens* using sediments from the five composite samples. Results showed statistically significant increases of certain contaminants in tissue samples from clams exposed to project sediments when compared to samples from clams exposed to reference area sediments including chromium, copper, lead, mercury, several individual PAHs, PCB congeners, and two pesticides. Significant increases in worm tissue samples included chromium, copper, lead, nickel, several individual PAHs, and PCB congeners.

Based on these results the tissue burden data were analyzed with the EPA Bioaccumulation Evaluation Screening Tool (BEST) model to determine the toxicological significance of bioaccumulation from exposure to the dredged sediment. The BEST model includes an evaluation of the non-carcinogenic risk, carcinogenic risk, and any observed exceedances of Food and Drug Administration (FDA) thresholds to determine potential adverse impacts to human health from the consumption of lobster, fish, or shellfish exposed to project sediments. Consideration was also given to the number of contaminants that were statistically elevated in comparison to the reference tissue concentrations and to the magnitude of those concentrations in comparison to the reference tissue concentrations and comparable organisms living in the vicinity of the disposal site according to the factors outlined in the Ocean Testing Manual (EPA/USACE 1991).

Modeling based on the tissue contaminant loads measured in the proposed CAD cell and access channel found that all contaminants were below the EPA Hazard Quotient for non-carcinogenic risk of 1.0, below the EPA carcinogenic risk threshold (1 x 10^{-4}), and were also less than established FDA action levels for Composites 1, 3, 4, and 5. However, modeling based on the tissue contaminant loads measured in the clams exposed to the surficial two feet of sediments in the existing access channel found that the calculated risk in Composite 2 was above the EPA Hazard Quotient for non-carcinogenic risk and above the EPA carcinogenic risk threshold total lobster and lobster hepatopancreas, and above the EPA Hazard Quotient for non-carcinogenic risk for lobster muscle. Modeling based on the tissue contaminant loads measured in the worms exposed to sediments in the existing channel (Composite 2) found that the calculated risk in Composite 2 was also above the EPA Hazard Quotient for non-carcinogenic risk for total lobster and lobster hepatopancreas. Contaminants levels measured in tissue samples from Composite 2 were all less than established FDA action levels.

Based on this analysis there is an unacceptable risk to the receptors identified in the CSM through exposure to surficial sediments in the existing channel (Composite 2). However, there is no unacceptable risk to the receptors identified in the CSM from the bioaccumulation of contaminants through exposure to the dredged material from the surficial interval throughout the remainder of the proposed project area or from any project area sediments at depth. BEST model outputs and tissue data are provided in Appendix C.

<u>Evaluating Potential Effects to Fish and Marine Invertebrates</u>

The conceptual site model identified the uptake of contaminants from the water column during the placement of dredged material at RISDS or into the Edgewood Shoals basin as a primary exposure pathway for project sediments. The potential for water column toxicity was determined through a suspended particulate phase (SPP) toxicity test as described in the Green Book (EPA/USACE 1991) and ITM (EPA/USACE 1998).

The results from the suspended particulate phase toxicity test were used to determine the median lethal concentration (LC_{50}) for the three target species exposed to the sediment elutriates. The mysid, *Americamysis bahia,* and the minnow, *Menidia beryllina,* showed no adverse effects on survival after exposure to the elutriate from all five composites. The urchin, *Arbacia punctulata,* showed no adverse effects on survival after exposure to the elutriate from Composites 1, 3, and 4 but showed adverse effects on survival after exposure to the elutriate from Composites 2 and 5 with LC_{50} values of 22% and 27%, respectively (Table 4).

The level of ammonia in the pore water from Composite 2 was elevated. Elevated ammonia concentrations occur naturally in sediment and cause toxicity in the static environmental conditions of a laboratory suspended particulate phase test (Kennedy et al 2015). In open water conditions, such as the proposed placement area, ammonia is a non-persistent compound that dissipates rapidly and is not considered a contaminant of concern for dredged material evaluations (Kennedy et al 2015).

The limiting permissible concentration (LPC), after allowance for mixing, cannot exceed 0.01 of the LC_{50} concentration beyond the boundaries of the mixing zone as described in the Green Book (EPA/USACE 1991). In cases where ammonia is the driver for an observed response in a suspended particulate phase test EPA Region 1 and NAE have agreed to use an alternate application factor of 0.05 to determine the LPC for a project.

Following the protocol developed by NAE and EPA Region 1 to identify potential toxicity from ammonia, NAE directed the laboratory to rerun the suspended particulate phase toxicity tests for all three test organisms using ammonia mitigated elutriate for Composite 2. The urchin *Arbacia punctulata* showed no adverse effect on survival when exposed to the ammonia mitigated elutriate from Composite 2 with LC50 values of >100% (Table 4).

TABLE 4
LC50 VALUES IN SUSPENDED PHASE TOXICITY TEST

Composite	*A. Bahia* LC50 (%)	*M. beryllina* LC50 (%)	*A. Punctulata* LC50 (%)
Standard Elutriate Testing			
Composite 1	>100%	>100%	>100%
Composite 2	>100%	>100%	22%
Composite 3	>100%	>100%	>100%
Composite 4	>100%	>100%	>100%
Composite 5	>100%	>100%	27%
Ammonia Mitigated Testing			
Mitigated Composite 2	>100%	>100%	>100%

Based on this evaluation NAE identified unionized ammonia as the sole driver for the toxicity observed in the suspended particulate phase test for the urchin exposed to the unmitigated Composite 2 elutriate and applied the alternate application factor (0.05) to calculate the LPC for that composite. Elutriate chemistry concentrations and suspended particulate phase test unionized ammonia levels are presented in Appendix D.

To determine if the discharge of dredged material would meet the LPC, NAE utilized the Short-Term Fate (STFATE) numerical model to analyze the disposal cloud as it descends through the water column after release from a scow. Results of the STFATE evaluation using the lowest LPC (LC_{50} of 27% and an application factor of 0.01 for Composite 5) predicted that the water column would attain the LPC within four hours of disposal at RISDS.

Similarly, STFATE was also used to determine if the discharge of dredged material from the entire proposed CAD cell and access channel footprint including the existing access channel represented by Composite 2 would meet the LPC as it descends through the water column from a scow. Results of the STFATE evaluation using the Composite 2 LPC (LC_{50} of 22% and the alternate application factor of 0.05) predicted that the water column would attain the LPC within four hours of disposal into the Edgewood Shoals basin.

5. **Suitability Determination:**

Based on the results of biological testing and subsequent risk modeling, no significant adverse impacts through the exposure pathways identified in the conceptual site model were found for the proposed access channel or CAD cell area within Edgewood Shoals with the exception of the surficial two feet of sediment in the portion of the proposed CAD cell footprint that corresponds with the existing access channel. Based on the testing and evaluation requirements set forth in Section 103 of the MPRSA, the sediments to be dredged from the proposed access channel and the CAD cell, with the exception of the surficial two feet of sediment in the existing access channel, are considered suitable for unconfined open water disposal at RISDS. In addition, according to the testing and evaluation requirements set forth in Section 404 of the CWA, these sediments are suitable for placement into the existing Edgewood Shoals basin.

The surficial two feet of sediment located in the existing Edgewood Shoals access channel, consisting of approximately 37,450 CY, were found to be unsuitable for unconfined open water placement at RISDS under Section 103 of the MPRSA. However, these sediments can be effectively isolated under 40 CFR 230.72 of the CWA through disposal and containment in the existing Edgewood Shoals basin. The discharge of the dredged material meets the CWA criteria for water column effects during disposal into the CAD cell through the elutriate evaluation outlined at 40 CFR 230.61. This unsuitable material will be covered with a minimum of three feet of suitable material (approximately 410,050 CY) from the construction of the proposed CAD cell in order to isolate the unsuitable sediments from the environment and to increase the elevation of the existing basin.

This suitability determination was coordinated with EPA Region 1 and RIDEM. RIDEM concurred with the determination and EPA Region 1 conducted an individual evaluation of the project and documented their findings in a separate memo.

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USACE-New England District	USACE-New England District

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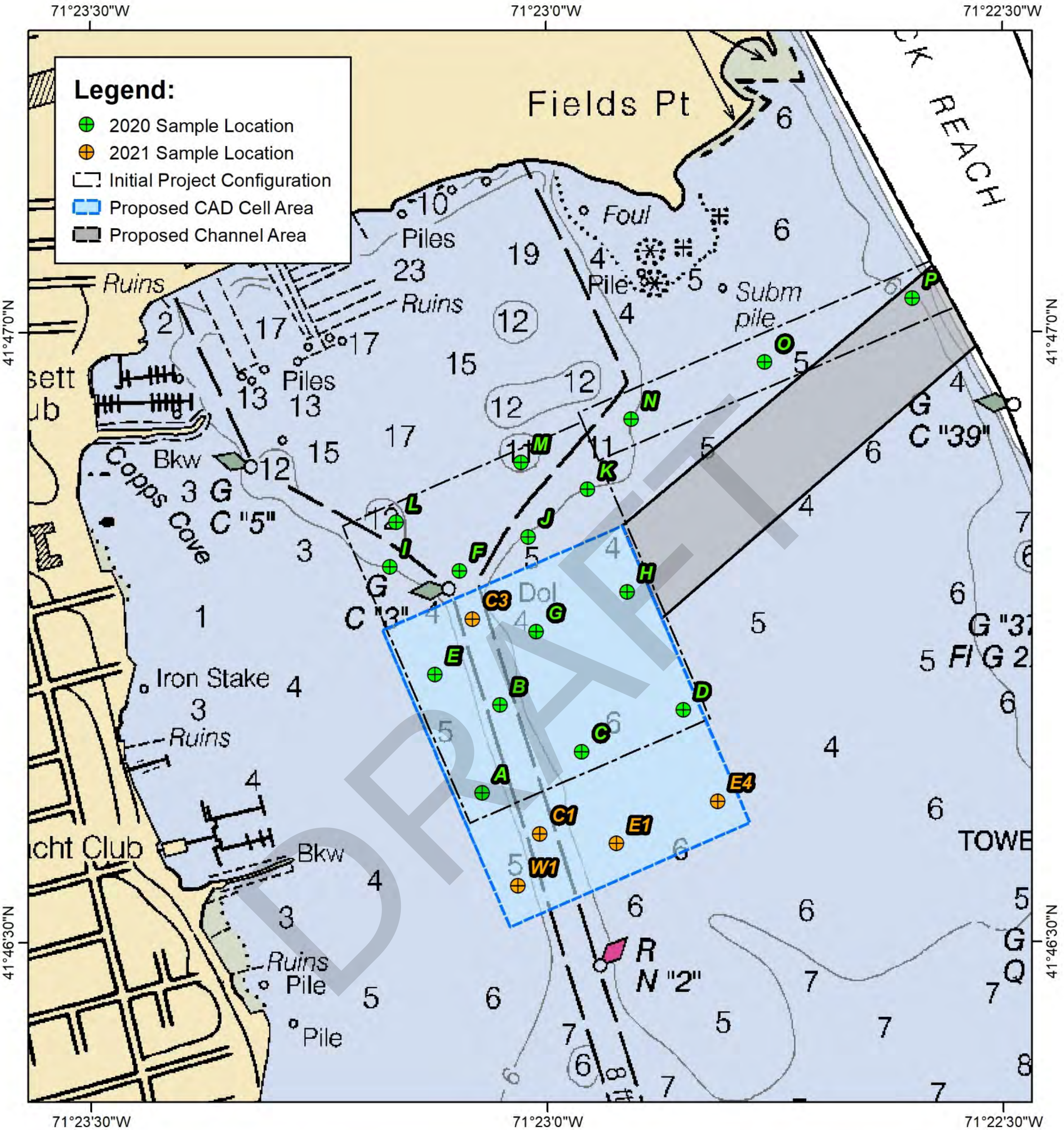


US Army Corps of Engineers New England District

FIGURE 1:
EDGEWOOD SHOALS CAD CELL
PROJECT OVERVIEW AND
AREA OF UNSUITABLE SEDIMENTS

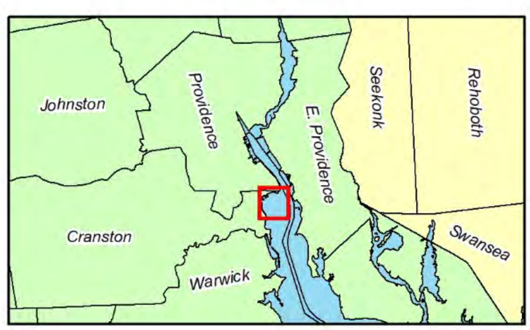
0 500 1,000 1,500 Feet

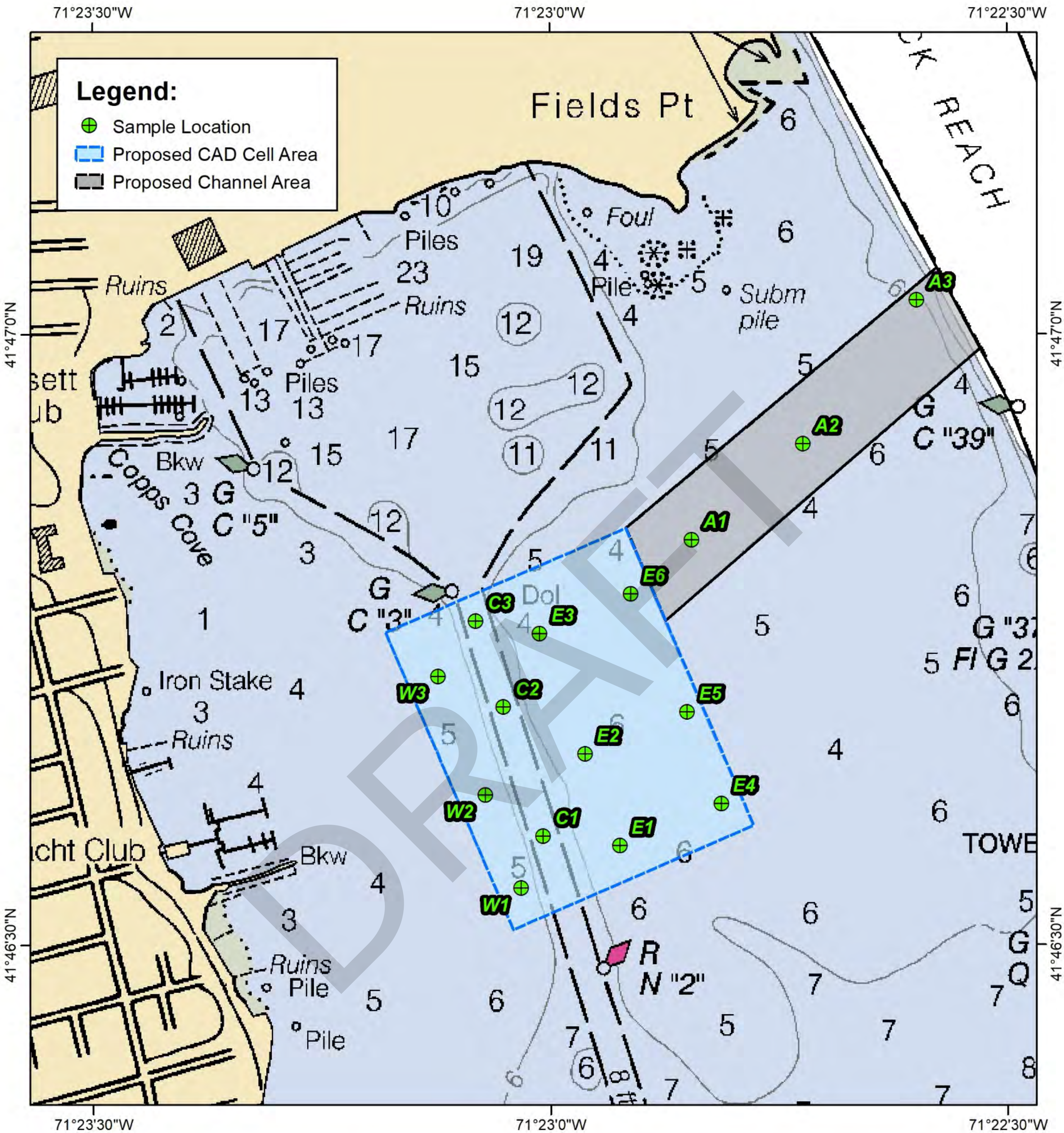
0 250 500 Meters

1:8,000

NOAA CHART 13225

GCS NAD1983





US Army Corps of Engineers New England District

FIGURE 2:
EDGEWOOD SHOALS CAD CELL
2021 BIOLOGICAL TESTING
SAMPLING LOCATIONS

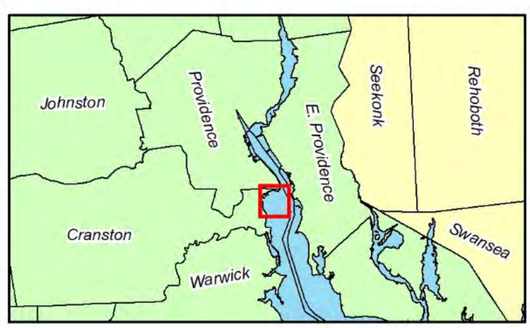
0 500 1,000 1,500 Feet

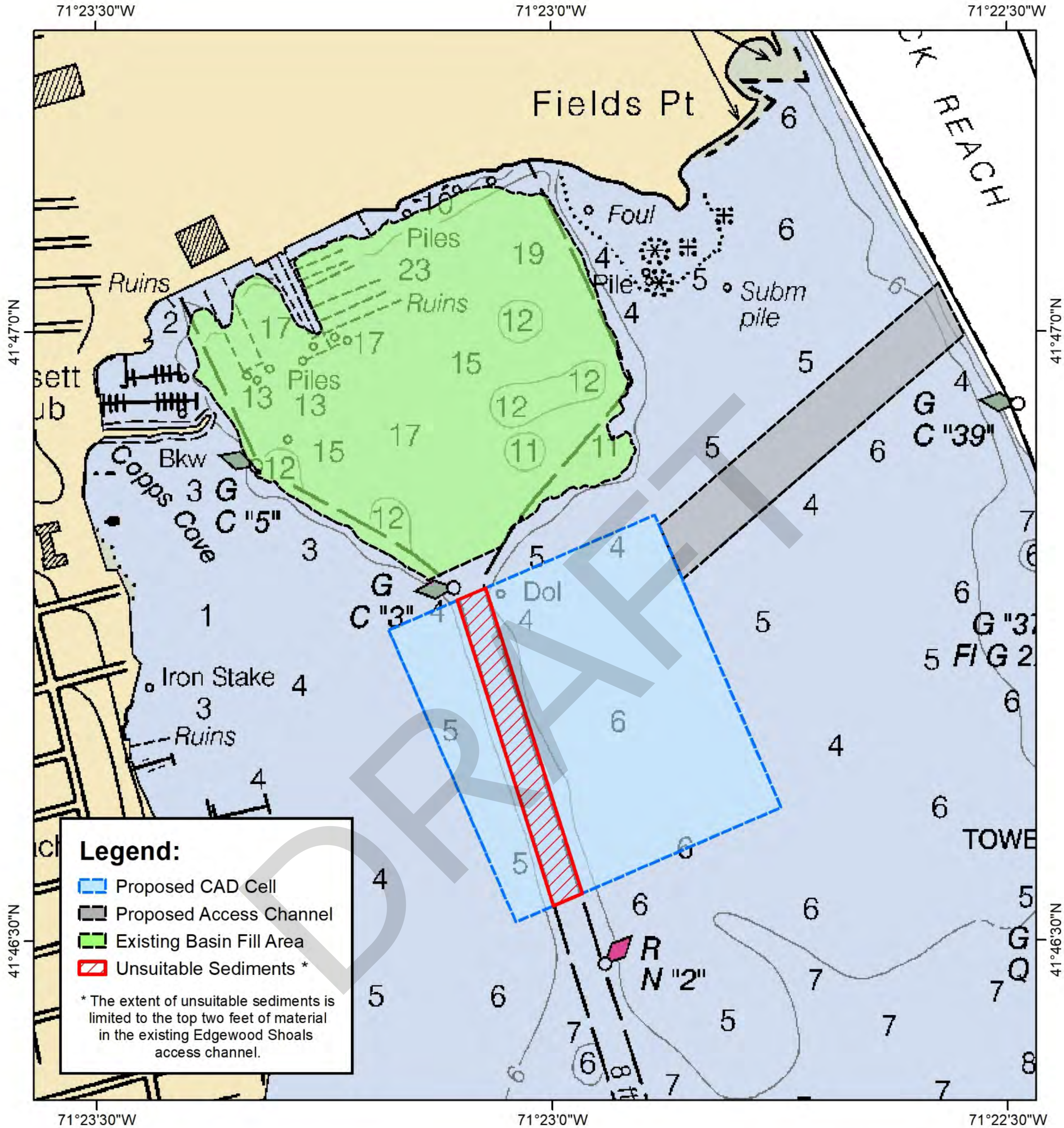
0 250 500 Meters

1:8,000

NOAA CHART 13225

GCS NAD1983





US Army Corps of Engineers New England District

FIGURE 3:
EDGEWOOD SHOALS CAD CELL
FINAL PROJECT CONFIGURATION AND AREA OF UNSUITABLE SEDIMENTS

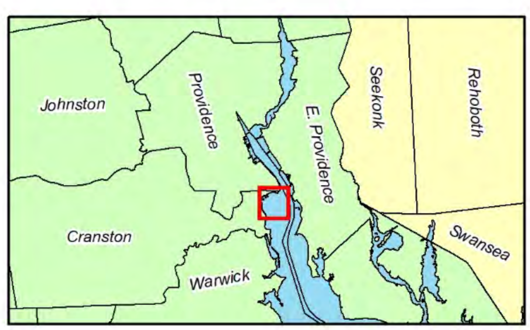
0 500 1,000 1,500 Feet

0 250 500 Meters

1:8,000

NOAA CHART 13225

GCS NAD1983



Appendix A

Bulk Sediment Chemistry Results

2020 and 2021 Bulk Chemistry and Grain Size Results

AREA:			CAD Cell (Western Bank)											
SAMPLE ID:			W1 0-2.0'		W1 2.0-8.0'		A 0-1		A 1-2		A 2-4.4		A 4.4-9	
ANALYTE	ERL	ERM	Conc	Q	Conc	Q	Conc	Q	Conc	Q	Conc	Q	Conc	Q
GRAIN SIZE ANALYSIS	(%)													
% Coarse Sand			-		-		8.4		8		4.9		11.7	
% Fine Sand			-		-		12.6		12.6		8.7		6.2	
% Medium Sand			-		-		15.8		14.1		12.3		11.8	
% Total Fines			-		-		62.7		64.1		73.4		67.7	
% Total Gravel			-		-		0.5		1.2		0.7		2.6	
GENERAL CHEMISTRY	(%)													
Moisture			53.1		50.8		51.9		49.4		49.8		48.7	
Solids, Total			46.9		49.2		48.1		50.6		50.2		51.3	
TOTAL ORGANIC CARBON	(%)													
Total Organic Carbon (Average)			2.24		2.1		1.98		2.13		1.95		2	
Total Organic Carbon (Rep1)			2.21		2.05		2.11		2		1.91		1.98	
Total Organic Carbon (Rep2)			2.26		2.16		1.84		2.27		1.99		2.03	
TOTAL METALS	(mg/kg)	(mg/kg)												
Arsenic, Total	8.2	70	13.9		6.16		10.8		8.32		8.4		10.9	
Cadmium, Total	1.2	9.6	1.1		0.18		0.369		0.275		0.242		0.302	
Chromium, Total	81	370	95.1		21.3		32		29.3		23.6		25.9	
Copper, Total	34	270	117		5.8		27		25.5		8.79		8.63	
Lead, Total	46.7	218	93.1		7.65		22.8		20.8		8.96		9.45	
Mercury, Total	0.15	0.71	0.792		0.015	J	0.061		0.052		0.004	J	0.02	U
Nickel, Total	20.9	51.6	13		12.2		13.8		12.1		14.7		16.9	
Silver, Total	1	3.7					0.397		0.436		0.072	J	0.057	J
Zinc, Total	150	410	84.6		36.2		53.4		49.7		47.9		53.6	
RIM PAHS/PCB CONGENERS BY GC/MS	(ug/kg)	(ug/kg)												
Acenaphthene	16	500	2.39	J	5.4	U	3.48	J	9.13	U	9.4	U	9.27	U
Acenaphthylene	44	640	18		0.79	J	14.1		6.23	J	9.4	U	9.27	U
Anthracene	85.3	1100	25		4.22	J	31.6		9.55		9.4	U	9.27	U
Fluorene	19	540	7.03		1.2	J	6.32	J	2.99	J	9.4	U	9.27	U
Naphthalene	160	2100	25.5		4.21	J	9.57	J	5.57	J	9.4	U	9.27	U
Phenanthrene	240	1500	54.8		27.7		54.1		20.2		2.01	J	9.27	U
Total LMW PAHs	*552*	*3160*	*133*		*38.6*		*119*		*45.4*		*5.35*		*4.27*	
Benz(a)anthracene			123		4.75	J	103		32.3		9.4	U	9.27	U
Benzo(a)pyrene	430	1600	139		5.4	U	104		35		9.4	U	9.27	U
Benzo(b)fluoranthene			168		5.4	U	103		37.6		9.4	U	9.27	U
Benzo(ghi)perylene			107		1.08	J	67.2		25.4		1.54	J	9.27	U
Benzo(k)fluoranthene			108		1.64	J	89		31.3		9.4	U	9.27	U
Chrysene	384	2800	96.3		4.23	J	83.2		30.8		9.4	U	9.27	U
Dibenz(a,h)anthracene			28.2		5.4	U	20		6.64	J	9.4	U	9.27	U
Fluoranthene	600	5100	147		3.49	J	163		50.2		2.69	J	9.27	U
Indeno(1,2,3-cd)Pyrene			95.4		5.4	U	84.9		35.1		8.79	J	9.27	U
Pyrene	665	2600	244		8.7		135		43.5		9.4	U	9.27	U
Total HMW PAHs	*1700*	*9600*	*1256*		*27.0*		*952*		*328*		*21.5*		*10.9*	
RIM PAHS/PCB CONGENERS BY GC/MS	(ug/kg)													
Cl2-BZ#8			0.204	J	0.54	U	1.04	U	0.913	U	0.94	U	0.927	U
Cl3-BZ#18			0.155	J	0.54	U	1.04	U	0.913	U	0.94	U	0.927	U
Cl3-BZ#28			0.359	J	0.54	U	1.04	U	0.913	U	0.94	U	0.927	U
Cl4-BZ#44			0.512	J	0.54	U	1.04	U	0.913	U	0.94	U	0.927	U
Cl4-BZ#49			0.408	J	0.54	U	0.406	J	0.913	U	0.94	U	0.927	U
Cl4-BZ#52			0.591		0.54	U	0.322	J	0.332	J	0.94	U	0.927	U
Cl4-BZ#66			0.501	J	0.54	U	0.479	J	0.235	J	0.94	U	0.927	U
Cl5-BZ#87			0.542	J	0.54	U	0.315	J	0.913	U	0.94	U	0.927	U
Cl5-BZ#101			1.33		0.54	U	0.966	J	0.648	J	0.94	U	0.927	U
Cl5-BZ#105			0.476	J	0.54	U	0.412	J	0.913	U	0.94	U	0.927	U
Cl5-BZ#118			0.957		0.54	U	0.671	J	0.913	U	0.94	U	0.927	U
Cl6-BZ#128			0.217	J	0.54	U	0.411	J	0.913	U	0.94	U	0.927	U
Cl6-BZ#138			1.62		0.54	U	1.53		0.77	J	0.94	U	0.927	U
Cl6-BZ#153			1.35		0.54	U	1.3		0.547	J	0.94	U	0.927	U
Cl7-BZ#170			0.432	J	0.54	U	0.54	J	0.913	U	0.94	U	0.927	U
Cl7-BZ#180			0.682		0.54	U	0.784	J	0.353	J	0.94	U	0.927	U
Cl7-BZ#183			0.289	J	0.54	U	0.401	J	0.913	U	0.94	U	0.927	U
Cl7-BZ#184			0.565	U	0.54	U	1.04	U	0.913	U	0.94	U	0.927	U
Cl7-BZ#187			0.681		0.54	U	0.666	J	0.24	J	0.94	U	0.927	U
Cl8-BZ#195			0.565	U	0.54	U	1.04	U	0.913	U	0.94	U	0.927	U
Cl9-BZ#206			0.513	J	0.54	U	0.388	J	0.913	U	0.94	U	0.927	U
Cl10-BZ#209			0.709		0.54	U	0.911	J	0.913	U	0.94	U	0.927	U
Total PCBs	*22.7*	*180*	*22.7*		*2.07*		*19.9*		*8.50*		*3.60*		*3.55*	
RIM ORGANOCHLORINE PESTICIDES	(ug/kg)													
4,4'-DDD	2	20	0.565	U	0.54	U	0.519	U	0.457	U	0.47	U	0.464	U
4,4'-DDE	2.2	27	0.565	U	0.54	U	0.519	U	0.457	U	0.47	U	0.464	U
4,4'-DDT	1	7	0.565	U	0.54	U	0.519	U	0.457	U	0.47	U	0.464	U
Total DDx	*1.58*	*46.1*	*0.062*		*0.060*		*0.057*		*0.050*		*0.051*		*0.051*	
Aldrin			0.565	U	0.54	U	0.519	U	0.457	U	0.47	U	0.464	U
Alpha-BHC			0.565	U	0.54	U	0.519	U	0.457	U	0.47	U	0.464	U
Beta-BHC			0.565	U	0.54	U	0.519	U	0.457	U	0.47	U	0.464	U
cis-Chlordane			0.565	U	0.54	U	0.519	U	0.457	U	0.47	U	0.464	U
cis-Nonachlor			0.565	U	0.54	U	0.519	U	0.457	U	0.47	U	0.464	U
Delta-BHC			0.565	U	0.54	U	0.519	U	0.457	U	0.47	U	0.464	U
Dieldrin	0.02	8	0.565	U	0.54	U	0.519	U	0.457	U	0.47	U	0.464	U
Endosulfan I			0.565	U	0.54	U	0.519	U	0.457	U	0.47	U	0.464	U
Endosulfan II			0.565	U	0.54	U	0.519	U	0.457	U	0.47	U	0.464	U
Endosulfan sulfate			0.565	U	0.54	U	0.519	U	0.457	U	0.47	U	0.464	U
Endrin			0.565	U	0.54	U	0.519	U	0.457	U	0.47	U	0.464	U
gamma-BHC			0.565	U	0.54	U	0.519	U	0.457	U	0.47	U	0.464	U
Heptachlor			0.565	U	0.54	U	0.519	U	0.457	U	0.47	U	0.464	U
Heptachlor epoxide			1.13	U	1.08	U	1.04	U	0.913	U	0.94	U	0.927	U
Hexachlorobenzene			1.13	U	1.08	U	1.04	U	0.913	U	0.94	U	0.927	U
Methoxychlor			0.565	U	0.54	U	0.519	U	0.457	U	0.47	U	0.464	U
Oxychlordane			1.13	U	1.08	U	1.04	U	0.913	U	0.94	U	0.927	U
Toxaphene			28.4	U	27.1	U	26.1	U	22.9	U	23.6	U	23.3	U
trans-Chlordane			0.565	U	0.54	U	0.519	U	0.457	U	0.47	U	0.464	U
trans-Nonachlor			0.565	U	0.54	U	0.519	U	0.457	U	0.47	U	0.464	U
Total Chlordanes	*0.5*	*6*	*0.234*		*0.223*		*0.215*		*0.189*		*0.195*		*0.193*	

AREA:	CAD Cell (Western Bank)															
SAMPLE ID:	E 0-1		E 1-2		E 2-3.7		E 3.7-12		I 0-1'		I 1-2'		I 2-8'		I 8-11.2'	
ANALYTE	Conc	Q	Conc	Q	Conc	Q	Conc	Q	Conc	Q	Conc	Q	Conc	Q	Conc	Q
GRAIN SIZE ANALYSIS																
% Coarse Sand	9.2		12.7		8		-		NA	U	NA	U	NA	U	NA	U
% Fine Sand	12.8		8.2		7.8		-		0.1		0.4		0.1		0.3	
% Medium Sand	19.2		17.5		12.4		-		1.8		3.6		2.3		2.1	
% Total Fines	57.7		58.9		70.5		-		3		3		3.5		2.9	
% Total Gravel	1.1		2.7		1.3		-		95.1		93		94.1		94.7	
GENERAL CHEMISTRY																
Moisture	50.9		51.2		49.5		46.8		48.7		50.4		54.1		45.3	
Solids, Total	49.1		48.8		50.5		53.2		51.3		49.6		45.9		54.7	
TOTAL ORGANIC CARBON																
Total Organic Carbon (Average)	2.03		1.88		1.85		1.9		1.89		2.08		1.89		1.76	
Total Organic Carbon (Rep1)	1.94		1.88		1.86		1.84		1.88		2.1		1.91		1.76	
Total Organic Carbon (Rep2)	2.12		1.88		1.85		1.96		1.9		2.05		1.88		1.76	
TOTAL METALS																
Arsenic, Total	8.84		8.46		8.4		9.13		8.44		9.45		7.32		9.03	
Cadmium, Total	0.238		0.221		0.231		0.312		0.335		0.29		0.223		0.235	
Chromium, Total	24.7		22.9		23.1		23.2		21.5		25		21.3		23.1	
Copper, Total	12.7		8.09		8.73		7.97		6.98		7.79		6.9		7.3	
Lead, Total	11.6		8.47		8.85		8.67		7.43		9.28		7.63		8.16	
Mercury, Total	0.009	J	0.02	U	0.007	J	0.019	U	0.004	J	0.018	U	0.005	J	0.003	J
Nickel, Total	14.1		14.5		14.4		15.6		13.8		15.4		13.2		14.8	
Silver, Total	0.148	J	0.056	J	0.065	J	0.053	J	0.05	J	0.058	J	0.048	J	0.05	J
Zinc, Total	47.7		46.2		47		48.1		43		50.1		43.9		48.2	
RIM PAHS/PCB CONGENERS BY GC/MS																
Acenaphthene	7.03	J	7.56	J	5.07	J	6.41	J	9.23	U	9.18	U	10.5	U	8.58	U
Acenaphthylene	4.12	J	4.36	J	2.22	J	3.55	J	9.23	U	9.18	U	10.5	U	8.58	U
Anthracene	2.48	J	9.58	U	9.89	U	9.2	U	9.23	U	9.18	U	10.5	U	8.58	U
Fluorene	1.19	J	9.58	U	9.89	U	9.2	U	9.23	U	9.18	U	10.5	U	8.58	U
Naphthalene	5.11	J	3.96	J	4.12	J	3.73	J	3.62	J	4.67	J	6.09	J	6.59	J
Phenanthrene	5.36	J	2.3	J	2.84	J	9.2	U	9.23	U	9.18	U	2.64	J	2.04	J
Total LMW PAHs	*25.3*		*19.3*		*15.4*		*15.7*		*7.10*		*8.13*		*11.6*		*11.0*	
Benz(a)anthracene	6.43	J	9.58	U	9.89	U	9.2	U	9.23	U	9.18	U	10.5	U	8.58	U
Benzo(a)pyrene	7.87	J	9.58	U	9.89	U	9.2	U	9.23	U	9.18	U	10.5	U	8.58	U
Benzo(b)fluoranthene	13.7		9.58	U	9.89	U	9.2	U	9.23	U	9.18	U	10.5	U	8.58	U
Benzo(ghi)perylene	8.87	J	2.08	J	2.39	J	9.2	U	9.23	U	9.18	U	10.5	U	8.58	U
Benzo(k)fluoranthene	7.32	J	1.48	J	1.73	J	9.2	U	9.23	U	9.18	U	10.5	U	8.58	U
Chrysene	6.24	J	9.58	U	9.89	U	9.2	U	9.23	U	9.18	U	10.5	U	8.58	U
Dibenz(a,h)anthracene	4.42	J	1.24	J	9.89	U	9.2	U	9.23	U	9.18	U	10.5	U	8.58	U
Fluoranthene	11.1		2.9	J	3.96	J	1.88	J	9.23	U	9.18	U	3.2	J	8.58	U
Indeno(1,2,3-cd)Pyrene	16.9		9.52	J	9.48	J	7.92	J	9.23	U	9.18	U	10.5	U	8.58	U
Pyrene	12.2		9.58	U	2.92	J	9.2	U	9.23	U	9.18	U	10.5	U	8.58	U
Total HMW PAHs	*95.1*		*24.5*		*27.3*		*18.6*		*10.9*		*10.8*		*14.5*		*10.1*	
RIM PAHS/PCB CONGENERS BY GC/MS																
Cl2-BZ#8	0.981	U	0.752	J	0.989	U	0.695	J	0.923	U	0.918	U	1.05	U	0.858	U
Cl3-BZ#18	0.981	U	0.958	U	0.989	U	0.92	U	0.923	U	0.918	U	1.05	U	0.858	U
Cl3-BZ#28	0.981	U	0.958	U	0.989	U	0.92	U	0.923	U	0.918	U	1.05	U	0.858	U
Cl4-BZ#44	0.981	U	0.958	U	0.989	U	0.92	U	0.923	U	0.918	U	1.05	U	0.858	U
Cl4-BZ#49	0.981	U	0.958	U	0.989	U	0.92	U	0.923	U	0.918	U	1.05	U	0.858	U
Cl4-BZ#52	0.291	J	0.958	U	0.183	J	0.92	U	0.923	U	0.918	U	1.05	U	0.858	U
Cl4-BZ#66	0.209	J	0.958	U	0.162	J	0.92	U	0.923	U	0.918	U	1.05	U	0.858	U
Cl5-BZ#87	0.981	U	0.958	U	0.164	J	0.92	U	0.923	U	0.918	U	1.05	U	0.858	U
Cl5-BZ#101	0.297	J	0.958	U	0.989	U	0.92	U	0.923	U	0.918	U	1.05	U	0.858	U
Cl5-BZ#105	0.212	J	0.958	U	0.989	U	0.92	U	0.923	U	0.918	U	1.05	U	0.858	U
Cl5-BZ#118	0.233	J	0.958	U	0.989	U	0.92	U	0.923	U	0.918	U	1.05	U	0.858	U
Cl6-BZ#128	0.981	U	0.958	U	0.989	U	0.92	U	0.923	U	0.918	U	1.05	U	0.858	U
Cl6-BZ#138	0.273	J	0.958	U	0.989	U	0.92	U	0.923	U	0.918	U	1.05	U	0.858	U
Cl6-BZ#153	0.981	U	0.958	U	0.989	U	0.92	U	0.923	U	0.918	U	1.05	U	0.858	U
Cl7-BZ#170	0.981	U	0.958	U	0.989	U	0.92	U	0.923	U	0.918	U	1.05	U	0.858	U
Cl7-BZ#180	0.981	U	0.958	U	0.989	U	0.92	U	0.923	U	0.918	U	1.05	U	0.858	U
Cl7-BZ#183	0.981	U	0.958	U	0.989	U	0.92	U	0.923	U	0.918	U	1.05	U	0.858	U
Cl7-BZ#184	0.981	U	0.958	U	0.989	U	0.92	U	0.923	U	0.918	U	1.05	U	0.858	U
Cl7-BZ#187	0.28	J	0.958	U	0.989	U	0.92	U	0.923	U	0.918	U	1.05	U	0.858	U
Cl8-BZ#195	0.981	U	0.958	U	0.989	U	0.92	U	0.923	U	0.918	U	1.05	U	0.858	U
Cl9-BZ#206	0.981	U	0.958	U	0.989	U	0.92	U	0.923	U	0.918	U	1.05	U	0.858	U
Cl10-BZ#209	0.981	U	0.958	U	0.989	U	0.92	U	0.923	U	0.918	U	1.05	U	0.858	U
Total PCBs	*6.05*		*4.98*		*4.18*		*4.73*		*3.53*		*3.51*		*4.01*		*3.28*	
RIM ORGANOCHLORINE PESTICIDES																
4,4'-DDD	0.49	U	0.479	U	0.494	U	0.46	U	0.462	U	0.459	U	0.523	U	0.429	U
4,4'-DDE	0.49	U	0.479	U	0.494	U	0.46	U	0.462	U	0.459	U	0.523	U	0.429	U
4,4'-DDT	0.49	U	0.479	U	0.494	U	0.46	U	0.462	U	0.459	U	0.523	U	0.429	U
Total DDx	*0.054*		*0.053*		*0.055*		*0.051*		*0.051*		*0.050*		*0.058*		*0.047*	
Aldrin	0.49	U	0.479	U	0.494	U	0.46	U	0.462	U	0.459	U	0.523	U	0.429	U
Alpha-BHC	0.49	U	0.479	U	0.494	U	0.46	U	0.462	U	0.459	U	0.523	U	0.429	U
Beta-BHC	0.49	U	0.479	U	0.494	U	0.46	U	0.462	U	0.459	U	0.523	U	0.429	U
cis-Chlordane	0.49	U	0.479	U	0.494	U	0.46	U	0.462	U	0.459	U	0.523	U	0.429	U
cis-Nonachlor	0.49	U	0.479	U	0.494	U	0.46	U	0.462	U	0.459	U	0.523	U	0.429	U
Delta-BHC	0.49	U	0.479	U	0.494	U	0.46	U	0.462	U	0.459	U	0.523	U	0.429	U
Dieldrin	0.49	U	0.479	U	0.494	U	0.46	U	0.462	U	0.459	U	0.523	U	0.429	U
Endosulfan I	0.49	U	0.479	U	0.494	U	0.46	U	0.462	U	0.459	U	0.523	U	0.429	U
Endosulfan II	0.49	U	0.479	U	0.494	U	0.46	U	0.462	U	0.459	U	0.523	U	0.429	U
Endosulfan sulfate	0.49	U	0.479	U	0.494	U	0.46	U	0.462	U	0.459	U	0.523	U	0.429	U
Endrin	0.49	U	0.479	U	0.494	U	0.46	U	0.462	U	0.459	U	0.523	U	0.429	U
gamma-BHC	0.49	U	0.479	U	0.494	U	0.46	U	0.462	U	0.459	U	0.523	U	0.429	U
Heptachlor	0.49	U	0.479	U	0.494	U	0.46	U	0.462	U	0.459	U	0.523	U	0.429	U
Heptachlor epoxide	0.981	U	0.958	U	0.989	U	0.92	U	0.923	U	0.918	U	1.05	U	0.858	U
Hexachlorobenzene	0.981	U	0.958	U	0.989	U	0.92	U	0.923	U	0.918	U	1.05	U	0.858	U
Methoxychlor	0.49	U	0.479	U	0.494	U	0.46	U	0.462	U	0.459	U	0.523	U	0.429	U
Oxychlordane	0.981	U	0.958	U	0.989	U	0.92	U	0.923	U	0.918	U	1.05	U	0.858	U
Toxaphene	24.6	U	24	U	24.8	U	23.1	U	23.2	U	23	U	26.3	U	21.5	U
trans-Chlordane	0.49	U	0.479	U	0.494	U	0.46	U	0.462	U	0.459	U	0.523	U	0.429	U
trans-Nonachlor	0.49	U	0.479	U	0.494	U	0.46	U	0.462	U	0.459	U	0.523	U	0.429	U
Total Chlordanes	*0.204*		*0.198*		*0.205*		*0.190*		*0.191*		*0.190*		*0.217*		*0.178*	

AREA:	CAD Cell (Existing Channel)															
SAMPLE ID:	C1 0-2.0'		C1 2.0-8.0'		B 0-1		B 1-2		B 2-7.3		B 7.3-11.1		C3 0-2.5'		C3 2.5-8.0'	
ANALYTE	Conc	Q	Conc	Q	Conc	Q	Conc	Q	Conc	Q	Conc	Q	Conc	Q	Conc	Q
GRAIN SIZE ANALYSIS																
% Coarse Sand	-		-		12.1		8.8		7.7		6		-		-	
% Fine Sand	-		-		15.6		9.5		7.1		39.6		-		-	
% Medium Sand	-		-		19.3		12.7		12.7		26.4		-		-	
% Total Fines	-		-		51.4		67.1		71.7		23.4		-		-	
% Total Gravel	-		-		1.6		1.9		0.8		4.6		-		-	
GENERAL CHEMISTRY																
Moisture	68.7		45.6		41		45.1		49.7		15.9		63.7		45.6	
Solids, Total	31.3		54.4		59		54.9		50.3		84.1		36.3		54.4	
TOTAL ORGANIC CARBON																
Total Organic Carbon (Average)	5.3		2.41		2.08		1.89		2.22		0.219		5.06		2	
Total Organic Carbon (Rep1)	5.31		2.44		2.22		1.86		2.13		0.221		5.1		2.04	
Total Organic Carbon (Rep2)	5.29		2.38		1.95		1.91		2.32		0.217		5.03		1.97	
TOTAL METALS																
Arsenic, Total	14.2		7.63		9.97		8.57		11.1		2.49		12.2		6.91	
Cadmium, Total	4.99		1.31		0.426		0.279		0.374		0.033	J	5.64		0.256	
Chromium, Total	332		82		36.8		26.8		30.4		5.35		357		23.7	
Copper, Total	922		187		36		15.9		19.6		4.83		994		10.8	
Lead, Total	300		67.9		25.3		13		17.1		3.16		265		9.83	
Mercury, Total	2.18		0.437		0.157		0.042		0.048		0.008	U	2.39		0.036	
Nickel, Total	65.8		16.6		13.3		14.3		16.2		5.89		45.7		13.5	
Silver, Total					0.456		0.188		0.299		0.117	U				
Zinc, Total	430		104		59.8		49.8		57		17.7		447		42.6	
RIM PAHS/PCB CONGENERS BY GC/MS																
Acenaphthene	49.4		17.6		5.02	J	2.15	J	2.94	J	5.83	U	39.2		4.78	U
Acenaphthylene	179		40.5		14.1		6.05	J	5.42	J	5.83	U	173		1.27	J
Anthracene	172		57.8		18.1		6.3	J	13.2		5.83	U	160		0.839	J
Fluorene	44.1		22.4		5.62	J	2.04	J	4.06	J	5.83	U	55.4		0.847	J
Naphthalene	131		35.5		11.8		4.38	J	7.61	J	5.83	U	128		5.65	
Phenanthrene	495		154		29.2		10.7		17.2		5.83	U	484		1.82	J
Total LMW PAHs	*1071*		*328*		*83.8*		*31.6*		*50.4*		*2.68*		*1040*		*10.9*	
Benz(a)anthracene	726		189		54.1		19.2		29.5		5.83	U	749		2.03	J
Benzo(a)pyrene	710		199		60.9		20.6		26.9		5.83	U	778		4.78	U
Benzo(b)fluoranthene	1010		245		68.5		26.2		31.7		5.83	U	1160		1.92	J
Benzo(ghi)perylene	672		167		48		16.6		19.8		5.83	U	696		1.62	J
Benzo(k)fluoranthene	579		159		54		17.8		24.5		5.83	U	545		1.51	J
Chrysene	569		134		45.1		16.2		24.7		5.83	U	578		1.5	J
Dibenz(a,h)anthracene	173		46.2		13.2		5.39	J	6.81	J	5.83	U	183		4.78	U
Fluoranthene	1200		246		74.7		29.3		50.3		5.83	U	1070		2.63	J
Indeno(1,2,3-cd)Pyrene	581		148		58.1		24.1		28.2		5.83	U	596		1.62	J
Pyrene	1340		342		88.2		34.2		49.2		5.83	U	1400		3.84	J
Total HMW PAHs	*7560*		*1875*		*565*		*210*		*292*		*6.86*		*7560*		*18.0*	
RIM PAHS/PCB CONGENERS BY GC/MS																
Cl2-BZ#8	0.847	U	0.48	U	0.793	U	0.869	U	0.918	U	0.583	U	0.71	U	0.478	U
Cl3-BZ#18	2.32		0.48	U	0.793	U	0.869	U	0.918	U	0.583	U	2.11		0.478	U
Cl3-BZ#28	5.88		0.48	U	0.793	U	0.869	U	0.918	U	0.583	U	2.36		0.478	U
Cl4-BZ#44	10.8		0.48	U	0.793	U	0.281	J	0.339	J	0.583	U	7.47		0.478	U
Cl4-BZ#49	7.56		0.48	U	0.793	U	0.272	J	0.918	U	0.583	U	4.26		0.478	U
Cl4-BZ#52	16.6		0.48	U	0.44	J	0.711	J	0.781	J	0.093	J	8.37		0.478	U
Cl4-BZ#66	13.4		0.48	U	0.266	J	0.275	J	0.293	J	0.583	U	6.67		0.478	U
Cl5-BZ#87	11		0.552		0.793	U	0.721	J	0.768	J	0.583	U	16.6		0.478	U
Cl5-BZ#101	35.8		0.632		0.551	J	1.8		1.47		0.583	U	39.1		0.478	U
Cl5-BZ#105	12.9		0.48	U	0.793	U	0.552	J	0.611	J	0.583	U	15.3		0.478	U
Cl5-BZ#118	29.3		0.993		0.44	J	1.25		1.06		0.583	U	36.2		0.478	U
Cl6-BZ#128	10.8		0.48	U	0.793	U	0.398	J	0.349	J	0.583	U	10		0.478	U
Cl6-BZ#138	42.4		0.862		0.551	J	1.51		1.42		0.583	U	42.8		0.478	U
Cl6-BZ#153	34.8		0.61		0.484	J	1.09		0.835	J	0.583	U	32.6		0.478	U
Cl7-BZ#170	10.9		0.48	U	0.793	U	0.493	J	0.458	J	0.583	U	9.2		0.478	U
Cl7-BZ#180	22.2		0.528		0.324	J	0.668	J	0.522	J	0.583	U	17		0.478	U
Cl7-BZ#183	5.58		0.262	J	0.793	U	0.131	J	0.918	U	0.583	U	4.66		0.478	U
Cl7-BZ#184	0.211	J	0.48	U	0.793	U	0.869	U	0.918	U	0.583	U	0.234	J	0.478	U
Cl7-BZ#187	17.6		0.78		0.391	J	0.297	J	0.296	J	0.583	U	13.1		0.478	U
Cl8-BZ#195	2.95		0.48	U	0.793	U	0.869	U	0.918	U	0.583	U	1.6		0.478	U
Cl9-BZ#206	14.8		10.5		4.09		1.71		1.26		0.583	U	10.8		0.478	U
Cl10-BZ#209	14.1		9.25		4.96		1.45		1.7		0.583	U	14.1		0.478	U
Total PCBs	*595*		*49.3*		*26.3*		*25.7*		*23.6*		*2.33*		*538*		*1.83*	
RIM ORGANOCHLORINE PESTICIDES																
4,4'-DDD	4.54		0.48	U	0.397	U	0.142	J	0.125	J	0.292	U	6.54		0.478	U
4,4'-DDE	26.6		0.48	U	0.397	U	0.394	JP	0.197	JP	0.292	U	27.2		0.478	U
4,4'-DDT	4.93	IP	0.48	U	0.397	U	0.066	JIP	0.049	JIP	0.292	U	4.86	IP	0.478	U
Total DDx	*36.1*		*0.053*		*0.044*		*0.602*		*0.371*		*0.032*		*38.6*		*0.053*	
Aldrin	0.424	U	0.48	U	0.397	U	0.434	U	0.459	U	0.292	U	0.355	U	0.478	U
Alpha-BHC	0.424	U	0.48	U	0.397	U	0.434	U	0.459	U	0.292	U	0.355	U	0.478	U
Beta-BHC	0.424	U	0.48	U	0.397	U	0.434	U	0.459	U	0.292	U	0.355	U	0.478	U
cis-Chlordane	4.37		0.48	U	0.397	U	0.434	U	0.459	U	0.292	U	2.24	P	0.478	U
cis-Nonachlor	15.7	P	0.48	U	0.397	U	0.434	U	0.459	U	0.292	U	3.54	IP	0.478	U
Delta-BHC	0.424	U	0.48	U	0.397	U	0.434	U	0.459	U	0.292	U	0.355	U	0.478	U
Dieldrin	10.5	IP	0.48	U	0.397	U	0.123	JIP	0.119	JIP	0.292	U	5.44	IP	0.478	U
Endosulfan I	0.424	U	0.48	U	0.397	U	0.434	U	0.459	U	0.292	U	0.355	U	0.478	U
Endosulfan II	0.424	U	0.48	U	0.397	U	0.434	U	0.459	U	0.292	U	0.355	U	0.478	U
Endosulfan sulfate	0.424	U	0.48	U	0.397	U	0.434	U	0.459	U	0.292	U	0.355	U	0.478	U
Endrin	0.424	U	0.48	U	0.397	U	0.434	U	0.459	U	0.292	U	0.355	U	0.478	U
gamma-BHC	0.424	U	0.48	U	0.397	U	0.434	U	0.459	U	0.292	U	0.355	U	0.478	U
Heptachlor	0.424	U	0.48	U	0.397	U	0.434	U	0.459	U	0.292	U	0.355	U	0.478	U
Heptachlor epoxide	0.847	U	0.959	U	0.793	U	0.869	U	0.918	U	0.583	U	0.71	U	0.957	U
Hexachlorobenzene	0.847	U	0.959	U	0.793	U	0.869	U	0.918	U	0.583	U	0.71	U	0.957	U
Methoxychlor	0.424	U	0.48	U	0.397	U	0.434	U	0.459	U	0.292	U	0.355	U	0.478	U
Oxychlordane	0.847	U	0.959	U	0.793	U	0.869	U	0.918	U	0.583	U	0.71	U	0.957	U
Toxaphene	21.3	U	24.1	U	19.9	U	21.8	U	23	U	14.6	U	17.8	U	24	U
trans-Chlordane	15.7	I	0.48	U	0.397	U	0.17	JIP	0.459	U	0.292	U	8.9	IP	0.478	U
trans-Nonachlor	5.51	P	0.48	U	0.397	U	0.434	U	0.459	U	0.292	U	3.86	P	0.478	U
Total Chlordanes	*21.4*		*0.199*		*0.164*		*0.180*		*0.190*		*0.120*		*7.52*		*0.198*	

Yellow indicates exceedance of the ERL
Green indicates an exceedance of the ERM
U: Compound was analyzed for but was not detected (non-detect)
J: Indicates an estimated value
I: The lower value for the two columns has been reported due to obvious interference
P: The RPD between the results for the two columns exceeds the method-specified criteria
Total PCBs were calculated using the NOAA 18 method
Half the MDL was used for U-qualified values to calculate summary values
Total Chlordane is a sum of alpha and gamma chlordane, cis and trans nonachlor,
and oxychlordane

2020 and 2021 Bulk Chemistry and Grain Size Results

AREA: CAD Cell (Eastern Bank)

SAMPLE ID:	ERL	ERM	E1 0-4.0'		E1 4.0-8.0'		E4 0-4.0'		E4 4.0-8.0'		C 0-2.3		C 2.3-4.3		C 4.3-11.5		D 0-1	
ANALYTE			Conc	Q	Conc	Q	Conc	Q	Conc	Q	Conc	Q	Conc	Q	Conc	Q	Conc	Q
GRAIN SIZE ANALYSIS	(%)																	
% Coarse Sand			-		-		-		-		6.4		6.6		6.3		9.3	
% Fine Sand			-		-		-		-		13.1		10.9		5.3		11.8	
% Medium Sand			-		-		-		-		13.1		11.8		8.7		15.3	
% Total Fines			-		-		-		-		66.1		70.5		78.7		62.5	
% Total Gravel			-		-		-		-		1.3		0.2		1		1.1	
GENERAL CHEMISTRY	(%)																	
Moisture			49.6		49.9		48.3		46		57.7		49.2		52.3		49.6	
Solids, Total			50.4		50.1		51.7		54		42.3		50.8		47.7		50.4	
TOTAL ORGANIC CARBON	(%)																	
Total Organic Carbon (Average)			1.92		2.02		1.96		1.9		1.94		2.04		1.92		2.09	
Total Organic Carbon (Rep1)			1.96		1.99		1.99		1.84		1.92		2.08		1.93		2.23	
Total Organic Carbon (Rep2)			1.87		2.06		1.92		1.97		1.96		2.01		1.9		1.96	
TOTAL METALS	(mg/kg)	(mg/kg)																
Arsenic, Total	8.2	70	14.6		9.08		6.76		6.2		8.26		9.12		9.59		9.67	
Cadmium, Total	1.2	9.6	0.255		0.296		0.263		0.182		0.253		0.289		0.24		0.328	
Chromium, Total	81	370	48.7		24.2		20.9		19.4		25.5		32.5		25.4		27.5	
Copper, Total	34	270	23.9		7.15		13.6		6.27		17.7		30.7		9.2		20.8	
Lead, Total	46.7	218	45		8.95		12.3		6.67		16.4		37.7		9.76		15.6	
Mercury, Total	0.15	0.71	0.148		0.02	J	0.051		0.019	J	0.043		0.083		0.004	J	0.035	
Nickel, Total	20.9	51.6	12.8		14.8		10.4		11.6		12.9		13.1		15.9		14.6	
Silver, Total	1	3.7									0.272		0.55		0.078	J	0.331	
Zinc, Total	150	410	48.3		44.5		36.5		35.6		46.2		51.6		50.6		52.2	
RIM PAHS/PCB CONGENERS BY GC/MS	(ug/kg)	(ug/kg)																
Acenaphthene	16	500	5.16	U	5.17	U	4.9	U	4.7	U	10.9	U	9.02	U	10.1	U	9.16	U
Acenaphthylene	44	640	5.87		0.87	J	2.32	J	4.7	U	5.01	J	6	J	10.1	U	7.02	J
Anthracene	85.3	1100	6.27		1.88	J	2.9	J	4.7	U	5.62	J	7.12	J	1.61	J	7.69	J
Fluorene	19	540	1.9	J	0.899	J	1.07	J	4.7	U	1.76	J	2.18	J	10.1	U	2.3	J
Naphthalene	160	2100	7.78		6.32		5.7		3.51	J	4.58	J	5.12	J	10.1	U	6.14	J
Phenanthrene	240	1500	14.4		2.81	J	6.05		1.43	J	11.8		14.4		3.48	J	16.2	
Total LMW PAHs	*552*	*3160*	*36.7*		*13.3*		*18.5*		*6.22*		*29.8*		*35.7*		*8.03*		*40.2*	
Benz(a)anthracene			31.6		4.7	J	7.9		4.7	U	18		22.3		5.14	J	25.4	
Benzo(a)pyrene	430	1600	34.4		3.62	J	11.2		4.7	U	26.6		32.7		4.63	J	36	
Benzo(b)fluoranthene			32.8		3.45	J	12.2		4.7	U	37.8		44.8		4.86	J	46.8	
Benzo(ghi)perylene			22.5		2.67	J	9.81		1.09	J	25.1		30.5		3.73	J	30.9	
Benzo(k)fluoranthene			30.1		3.43	J	9.32		0.978	J	23.9		28.6		4.71	J	29.2	
Chrysene	384	2800	23.6		3.22	J	6.77		4.7	U	20.2		27.7		4.18	J	26.5	
Dibenz(a,h)anthracene			6.56		0.706	J	2.35	J	4.7	U	6.09	J	7.45	J	1.26	J	7.32	J
Fluoranthene	600	5100	35.1		6.76		12.2		1.86	J	34.1		38.8		6.37	J	42	
Indeno(1,2,3-cd)Pyrene			21.8		2.56	J	8.62		4.7	U	34.7		38.6		11.5		40.6	
Pyrene	665	2600	53.5		8.06		20.1		1.56	J	35.6		42.6		6.63	J	48.3	
Total HMW PAHs	*1700*	*9600*	*292*		*39.2*		*100*		*9.31*		*262*		*314*		*53.0*		*333*	
RIM PAHS/PCB CONGENERS BY GC/MS	(ug/kg)																	
Cl2-BZ#8			0.516	U	0.517	U	0.49	U	0.47	U	1.09	U	0.902	U	1.01	U	0.916	U
Cl3-BZ#18			0.516	U	0.517	U	0.49	U	0.47	U	1.09	U	0.902	U	0.168	J	0.152	J
Cl3-BZ#28			0.516	U	0.517	U	0.49	U	0.47	U	1.09	U	0.234	J	1.01	U	0.916	U
Cl4-BZ#44			0.516	U	0.517	U	0.17	J	0.47	U	1.09	U	0.28	J	1.01	U	0.916	U
Cl4-BZ#49			0.516	U	0.517	U	0.49	U	0.47	U	1.09	U	0.295	J	1.01	U	0.279	J
Cl4-BZ#52			0.516	U	0.517	U	0.157	J	0.47	U	0.382	J	0.446	J	0.267	J	0.442	J
Cl4-BZ#66			0.516	U	0.517	U	0.086	J	0.47	U	0.266	J	0.396	J	0.147	J	0.398	J
Cl5-BZ#87			0.516	U	0.517	U	0.49	U	0.47	U	0.193	J	0.3	J	0.2	J	0.916	U
Cl5-BZ#101			0.516	U	0.517	U	0.221	J	0.47	U	0.662	J	0.895	J	0.254	J	0.788	J
Cl5-BZ#105			0.516	U	0.517	U	0.49	U	0.47	U	1.09	U	0.349	J	1.01	U	0.378	J
Cl5-BZ#118			0.516	U	0.517	U	0.218	J	0.47	U	0.636	J	0.642	J	1.01	U	0.821	J
Cl6-BZ#128			0.516	U	0.517	U	0.49	U	0.47	U	1.09	U	0.902	U	1.01	U	0.916	U
Cl6-BZ#138			0.516	U	0.517	U	0.292	J	0.47	U	0.806	J	1.21		1.01	U	1.18	
Cl6-BZ#153			0.516	U	0.517	U	0.259	J	0.47	U	0.73	J	0.994		1.01	U	0.999	
Cl7-BZ#170			0.516	U	0.517	U	0.49	U	0.47	U	1.09	U	0.902	U	1.01	U	0.495	J
Cl7-BZ#180			0.516	U	0.517	U	0.49	U	0.47	U	0.335	J	0.546	J	1.01	U	0.591	J
Cl7-BZ#183			0.516	U	0.517	U	0.49	U	0.47	U	1.09	U	0.902	U	1.01	U	0.916	U
Cl7-BZ#184			0.516	U	0.517	U	0.49	U	0.47	U	1.09	U	0.902	U	1.01	U	0.916	U
Cl7-BZ#187			0.516	U	0.517	U	0.49	U	0.47	U	1.09	U	0.484	J	1.01	U	0.582	J
Cl8-BZ#195			0.516	U	0.517	U	0.49	U	0.47	U	1.09	U	0.902	U	1.01	U	0.916	U
Cl9-BZ#206			0.516	U	0.517	U	0.49	U	0.47	U	1.09	U	0.604	J	1.01	U	0.594	J
Cl10-BZ#209			0.516	U	0.517	U	0.49	U	0.47	U	1.09	U	0.902	U	1.01	U	0.724	J
Total PCBs	*22.7*	*180*	*1.98*		*1.98*		*3.93*		*1.80*		*10.3*		*15.3*		*4.85*		*17.4*	
RIM ORGANOCHLORINE PESTICIDES	(ug/kg)																	
4,4'-DDD	2	20	0.516	U	0.517	U	0.49	U	0.47	U	0.545	U	0.451	U	0.504	U	0.458	U
4,4'-DDE	2.2	27	0.516	U	0.517	U	0.49	U	0.47	U	0.545	U	0.226	JP	0.504	U	0.328	J
4,4'-DDT	1	7	0.516	U	0.517	U	0.49	U	0.47	U	0.545	U	0.451	U	0.504	U	0.458	U
Total DDx	*1.58*	*46.1*	*0.057*		*0.057*		*0.054*		*0.051*		*0.060*		*0.266*		*0.056*		*0.368*	
Aldrin			0.516	U	0.517	U	0.49	U	0.47	U	0.545	U	0.451	U	0.504	U	0.458	U
Alpha-BHC			0.516	U	0.517	U	0.49	U	0.47	U	0.545	U	0.451	U	0.504	U	0.458	U
Beta-BHC			0.516	U	0.517	U	0.49	U	0.47	U	0.545	U	0.451	U	0.504	U	0.458	U
cis-Chlordane			0.516	U	0.517	U	0.49	U	0.47	U	0.545	U	0.451	U	0.504	U	0.458	U
cis-Nonachlor			0.516	U	0.517	U	0.49	U	0.47	U	0.545	U	0.451	U	0.504	U	0.458	U
Delta-BHC			0.516	U	0.517	U	0.49	U	0.47	U	0.545	U	0.451	U	0.504	U	0.458	U
Dieldrin	0.02	8	0.516	U	0.517	U	0.49	U	0.47	U	0.545	U	0.088	JIP	0.504	U	0.136	JIP
Endosulfan I			0.516	U	0.517	U	0.49	U	0.47	U	0.545	U	0.451	U	0.504	U	0.458	U
Endosulfan II			0.516	U	0.517	U	0.49	U	0.47	U	0.545	U	0.451	U	0.504	U	0.458	U
Endosulfan sulfate			0.516	U	0.517	U	0.49	U	0.47	U	0.545	U	0.451	U	0.504	U	0.458	U
Endrin			0.516	U	0.517	U	0.49	U	0.47	U	0.545	U	0.451	U	0.504	U	0.458	U
gamma-BHC			0.516	U	0.517	U	0.49	U	0.47	U	0.545	U	0.451	U	0.504	U	0.458	U
Heptachlor			0.516	U	0.517	U	0.49	U	0.47	U	0.545	U	0.451	U	0.504	U	0.458	U
Heptachlor epoxide			1.03	U	1.03	U	0.981	U	0.94	U	1.09	U	0.902	U	1.01	U	0.916	U
Hexachlorobenzene			1.03	U	1.03	U	0.981	U	0.94	U	1.09	U	0.902	U	1.01	U	0.916	U
Methoxychlor			0.516	U	0.517	U	0.49	U	0.47	U	0.545	U	0.451	U	0.504	U	0.458	U
Oxychlordane			1.03	U	1.03	U	0.981	U	0.94	U	1.09	U	0.902	U	1.01	U	0.916	U
Toxaphene			25.9	U	26	U	24.6	U	23.6	U	27.4	U	22.6	U	25.3	U	23	U
trans-Chlordane			0.516	U	0.517	U	0.49	U	0.47	U	0.545	U	0.451	U	0.504	U	0.458	U
trans-Nonachlor			0.516	U	0.517	U	0.49	U	0.47	U	0.545	U	0.451	U	0.504	U	0.458	U
Total Chlordanes	*0.5*	*6*	*0.214*		*0.215*		*0.204*		*0.194*		*0.226*		*0.187*		*0.209*		*0.190*	

SAMPLE ID:	D 1-2		D 2-4.4		D 4.4-12		G 0-1		G 1-2		G 2-4		G 4-11.1	
ANALYTE	Conc	Q	Conc	Q	Conc	Q	Conc	Q	Conc	Q	Conc	Q	Conc	Q
GRAIN SIZE ANALYSIS														
% Coarse Sand	6.2		10.1		9.6		-		11.8		12.5		14.3	
% Fine Sand	13.3		9.3		5.9		-		8.3		7.8		7	
% Medium Sand	13.5		16.4		12.3		-		14.4		16.2		21	
% Total Fines	66.5		63.7		71.7		-		63		61.7		55.5	
% Total Gravel	0.5		0.5		0.5		-		2.5		1.8		2.2	
GENERAL CHEMISTRY														
Moisture	47.6		47.9		49.6		53		51.2		51		46.1	
Solids, Total	52.4		52.1		50.4		47		48.8		49		53.9	
TOTAL ORGANIC CARBON														
Total Organic Carbon (Average)	1.97		2.03		2		1.76		1.76		1.82		1.73	
Total Organic Carbon (Rep1)	1.96		2.04		1.94		1.75		1.76		1.77		1.78	
Total Organic Carbon (Rep2)	1.98		2.03		2.06		1.78		1.76		1.87		1.68	
TOTAL METALS														
Arsenic, Total	8.51		8.9		9.34		10.4		10.6		8.7		8.3	
Cadmium, Total	0.307		0.251		0.21		0.346		0.254		0.254		0.212	
Chromium, Total	28.5		21.2		23.9		35.1		24.7		22.6		22.2	
Copper, Total	27.7		7.55		7.74		28.7		8.36		8.48		6.59	
Lead, Total	20.8		7.8		8.57		26.2		9.46		9.24		7.6	
Mercury, Total	0.042		0.018	U	0.019	U	0.026		0.006	J	0.01	J	0.002	J
Nickel, Total	13.3		13.7		15		12.8		14.3		13		13	
Silver, Total	0.5		0.053	J	0.052	J	0.519		0.074	J	0.087	J	0.05	J
Zinc, Total	54.5		44.2		47.6		58.6		47.3		44.6		43.3	
RIM PAHS/PCB CONGENERS BY GC/MS														
Acenaphthene	8.88	U	9.44	U	9.45	U	10	U	9.53	U	9.53	U	8.83	U
Acenaphthylene	4.48	J	9.44	U	9.45	U	2.44	J	9.53	U	9.53	U	8.83	U
Anthracene	4.46	J	9.44	U	9.45	U	3.14	J	9.53	U	1.57	J	8.83	U
Fluorene	1.41	J	9.44	U	9.45	U	1.31	J	9.53	U	9.53	U	8.83	U
Naphthalene	3.84	J	9.44	U	9.45	U	2.77	J	9.53	U	1.9	J	8.83	U
Phenanthrene	8.7	J	9.44	U	9.45	U	7.6	J	2.81	J	4.08	J	8.83	U
Total LMW PAHs	*23.7*		*4.34*		*4.34*		*18.2*		*6.19*		*9.54*		*4.06*	
Benz(a)anthracene	14.9		9.44	U	9.45	U	11.3		9.53	U	3.85	J	8.83	U
Benzo(a)pyrene	22.7		9.44	U	9.45	U	14.5		9.53	U	9.53	U	8.83	U
Benzo(b)fluoranthene	33.8		9.44	U	9.45	U	20.4		4.68	J	3.66	J	8.83	U
Benzo(ghi)perylene	21.9		9.44	U	9.45	U	13.4		9.53	U	3.91	J	8.83	U
Benzo(k)fluoranthene	19.3		9.44	U	9.45	U	13.6		3.32	J	3.32	J	8.83	U
Chrysene	16.1		9.44	U	9.45	U	11.5		2.87	J	3.15	J	8.83	U
Dibenz(a,h)anthracene	4.87	J	9.44	U	9.45	U	4.02	J	9.53	U	1.44	J	8.83	U
Fluoranthene	23.6		9.44	U	1.86	J	19.4		5.13	J	7.3	J	2.13	J
Indeno(1,2,3-cd)Pyrene	28.6		7.81	J	7.97	J	21.4		9.53	U	11.7		8.83	U
Pyrene	35.4		9.44	U	9.45	U	20.7		5.48	J	7.44	J	8.83	U
Total HMW PAHs	*221*		*17.7*		*18.9*		*150*		*27.0*		*47.9*		*11.7*	
RIM PAHS/PCB CONGENERS BY GC/MS														
Cl2-BZ#8	0.888	U	0.944	U	0.945	U	1	U	0.953	U	0.953	U	0.883	U
Cl3-BZ#18	0.888	U	0.944	U	0.945	U	1	U	0.953	U	0.266	J	0.883	U
Cl3-BZ#28	0.888	U	0.944	U	0.945	U	1	U	0.953	U	0.953	U	0.883	U
Cl4-BZ#44	0.888	U	0.944	U	0.945	U	1	U	0.953	U	0.953	U	0.883	U
Cl4-BZ#49	0.239	J	0.944	U	0.945	U	1	U	0.953	U	0.953	U	0.883	U
Cl4-BZ#52	0.388	J	0.944	U	0.945	U	1	U	0.953	U	0.25	J	0.883	U
Cl4-BZ#66	0.336	J	0.944	U	0.945	U	1	U	0.953	U	0.953	U	0.883	U
Cl5-BZ#87	0.252	J	0.944	U	0.945	U	1	U	0.953	U	0.4	J	0.883	U
Cl5-BZ#101	0.704	J	0.944	U	0.945	U	1	U	0.953	U	1.8		0.883	U
Cl5-BZ#105	0.188	J	0.944	U	0.945	U	1	U	0.953	U	0.953	U	0.883	U
Cl5-BZ#118	0.511	J	0.944	U	0.945	U	1	U	0.953	U	0.953	U	0.883	U
Cl6-BZ#128	0.888	U	0.944	U	0.945	U	1	U	0.953	U	0.953	U	0.883	U
Cl6-BZ#138	0.88	J	0.944	U	0.945	U	1	U	0.953	U	0.953	U	0.883	U
Cl6-BZ#153	0.824	J	0.944	U	0.945	U	1	U	0.953	U	0.953	U	0.883	U
Cl7-BZ#170	0.888	U	0.944	U	0.945	U	1	U	0.953	U	1.16		0.883	U
Cl7-BZ#180	0.564	J	0.944	U	0.945	U	1	U	0.953	U	0.953	U	0.883	U
Cl7-BZ#183	0.888	U	0.944	U	0.945	U	1	U	0.953	U	0.331	J	0.883	U
Cl7-BZ#184	0.888	U	0.944	U	0.945	U	1	U	0.953	U	0.953	U	0.883	U
Cl7-BZ#187	0.32	J	0.944	U	0.945	U	1	U	0.953	U	0.34	J	0.883	U
Cl8-BZ#195	0.888	U	0.944	U	0.945	U	1	U	0.953	U	0.953	U	0.883	U
Cl9-BZ#206	0.888	U	0.944	U	0.945	U	1	U	0.953	U	0.953	U	0.883	U
Cl10-BZ#209	0.888	U	0.944	U	0.945	U	1	U	0.953	U	0.953	U	0.883	U
Total PCBs	*11.2*		*3.61*		*3.61*		*3.84*		*3.65*		*10.5*		*3.38*	
RIM ORGANOCHLORINE PESTICIDES														
4,4'-DDD	0.309	J	0.472	U	0.472	U	0.501	U	0.476	U	0.476	U	0.441	U
4,4'-DDE	0.209	JP	0.472	U	0.472	U	0.501	U	0.476	U	0.476	U	0.441	U
4,4'-DDT	0.06	JIP	0.472	U	0.472	U	0.501	U	0.476	U	0.476	U	0.441	U
Total DDx	*0.578*		*0.052*		*0.052*		*0.055*		*0.053*		*0.053*		*0.049*	
Aldrin	0.444	U	0.472	U	0.472	U	0.501	U	0.476	U	0.476	U	0.441	U
Alpha-BHC	0.444	U	0.472	U	0.472	U	0.501	U	0.476	U	0.476	U	0.441	U
Beta-BHC	0.444	U	0.472	U	0.472	U	0.501	U	0.476	U	0.476	U	0.441	U
cis-Chlordane	0.444	U	0.472	U	0.472	U	0.501	U	0.476	U	0.476	U	0.441	U
cis-Nonachlor	0.444	U	0.472	U	0.472	U	0.501	U	0.476	U	0.476	U	0.441	U
Delta-BHC	0.444	U	0.472	U	0.472	U	0.501	U	0.476	U	0.476	U	0.441	U
Dieldrin	0.068	JIP	0.472	U	0.472	U	0.501	U	0.476	U	0.476	U	0.441	U
Endosulfan I	0.444	U	0.472	U	0.472	U	0.501	U	0.476	U	0.476	U	0.441	U
Endosulfan II	0.444	U	0.472	U	0.472	U	0.501	U	0.476	U	0.476	U	0.441	U
Endosulfan sulfate	0.444	U	0.472	U	0.472	U	0.501	U	0.476	U	0.476	U	0.441	U
Endrin	0.444	U	0.472	U	0.472	U	0.501	U	0.476	U	0.476	U	0.441	U
gamma-BHC	0.444	U	0.472	U	0.472	U	0.501	U	0.476	U	0.476	U	0.441	U
Heptachlor	0.444	U	0.472	U	0.472	U	0.501	U	0.476	U	0.476	U	0.441	U
Heptachlor epoxide	0.888	U	0.944	U	0.945	U	1	U	0.953	U	0.953	U	0.883	U
Hexachlorobenzene	0.888	U	0.944	U	0.945	U	1	U	0.953	U	0.953	U	0.883	U
Methoxychlor	0.444	U	0.472	U	0.472	U	0.501	U	0.476	U	0.476	U	0.441	U
Oxychlordane	0.888	U	0.944	U	0.945	U	1	U	0.953	U	0.953	U	0.883	U
Toxaphene	22.3	U	23.7	U	23.7	U	25.2	U	23.9	U	23.9	U	22.2	U
trans-Chlordane	0.444	U	0.472	U	0.472	U	0.501	U	0.476	U	0.476	U	0.441	U
trans-Nonachlor	0.444	U	0.472	U	0.472	U	0.501	U	0.476	U	0.476	U	0.441	U
Total Chlordanes	*0.184*		*0.195*		*0.196*		*0.207*		*0.198*		*0.198*		*0.183*	

SAMPLE ID:	H 0-3.4		H 3.4-6.9		J 0-1'		J 1-2'		J 2-4'		J 4-10.7'	
ANALYTE	Conc	Q	Conc	Q	Conc	Q	Conc	Q	Conc	Q	Conc	Q
GRAIN SIZE ANALYSIS												
% Coarse Sand	8.2		16		1.9		8.6		2.9		0.2	
% Fine Sand	10.6		8.6		4.8		3		3.6		1.7	
% Medium Sand	19.7		19.3		19.5		11.7		11.4		8.9	
% Total Fines	60.7		54.9		24		16.5		16.3		21.2	
% Total Gravel	0.8		1.2		49.8		60.2		65.8		68	
GENERAL CHEMISTRY												
Moisture	56.4		47.3		41		43.2		48.2		37.2	
Solids, Total	43.6		52.7		59		56.8		51.8		62.8	
TOTAL ORGANIC CARBON												
Total Organic Carbon (Average)	-		1.82		1.5		1.52		1.58		1.3	
Total Organic Carbon (Rep1)	-		1.84		1.5		1.57		1.44		1.49	
Total Organic Carbon (Rep2)	-		1.81		1.5		1.46		1.72		1.12	
TOTAL METALS												
Arsenic, Total	12.3		9.04		5.29		6.43		7.07		6.37	
Cadmium, Total	0.247		0.278		0.206		0.223		0.194		0.195	
Chromium, Total	49.2		25		17.4		17		18.5		16.1	
Copper, Total	28.6		7.94		14.1		6.25		5.96		5.59	
Lead, Total	43.2		8.98		11.4		6.58		6.56		6.02	
Mercury, Total	0.226		0.019	U	0.034		0.003	J	0.014	U	0.012	U
Nickel, Total	12.1		14.3		8.58		10.8		11.6		10.6	
Silver, Total	0.228		0.069	J	0.246		0.053	J	0.041	J	0.035	J
Zinc, Total	51.8		48.6		33.6		35.4		38.2		33.6	
RIM PAHS/PCB CONGENERS BY GC/MS												
Acenaphthene	3.25	J	9.18	U	8.3	U	8.22	U	9.16	U	7.32	U
Acenaphthylene	8.15	J	9.18	U	3.58	J	1.07	J	9.16	U	7.32	U
Anthracene	28.4		9.18	U	4.13	J	5.15	J	1.99	J	1.23	J
Fluorene	9.33	J	9.18	U	1.4	J	1.51	J	1.44	J	0.888	J
Naphthalene	17.9		9.18	U	10.6		7.19	J	7.21	J	5.07	J
Phenanthrene	48.5		9.18	U	10		10.2		3	J	2.12	J
Total LMW PAHs	*116*		*4.22*		*30.5*		*25.9*		*15.1*		*10.4*	
Benz(a)anthracene	90		9.18	U	18		16.2		9.16	U	7.32	U
Benzo(a)pyrene	93.2		9.18	U	19.4		15.4		9.16	U	7.32	U
Benzo(b)fluoranthene	95.5		9.18	U	24.7		15.9		9.16	U	7.32	U
Benzo(ghi)perylene	55.2		9.18	U	15.9		8.97		9.16	U	7.32	U
Benzo(k)fluoranthene	73.4		9.18	U	21.3		14		9.16	U	7.32	U
Chrysene	74.3		9.18	U	16.3		13.1		9.16	U	7.32	U
Dibenz(a,h)anthracene	16		9.18	U	4.93	J	2.79	J	9.16	U	7.32	U
Fluoranthene	125		9.18	U	27.2		15		2.15	J	7.32	U
Indeno(1,2,3-cd)Pyrene	70.2		9.18	U	22.8		16.2		9.16	U	7.32	U
Pyrene	130		9.18	U	29.3		10.7		9.16	U	7.32	U
Total HMW PAHs	*823*		*10.8*		*200*		*128*		*12.1*		*8.63*	
RIM PAHS/PCB CONGENERS BY GC/MS												
Cl2-BZ#8	1.1	U	0.918	U	0.83	U	0.822	U	0.351	J	0.163	J
Cl3-BZ#18	1.1	U	0.918	U	0.83	U	0.822	U	0.376	J	0.271	J
Cl3-BZ#28	1.1	U	0.918	U	0.83	U	0.822	U	0.3	J	0.196	J
Cl4-BZ#44	1.1	U	0.918	U	0.83	U	0.822	U	0.472	J	0.206	J
Cl4-BZ#49	1.1	U	0.918	U	0.83	U	0.822	U	0.343	J	0.732	U
Cl4-BZ#52	1.1	U	0.918	U	0.136	J	0.822	U	0.476	J	0.174	J
Cl4-BZ#66	1.1	U	0.918	U	0.155	J	0.822	U	0.316	J	0.117	J
Cl5-BZ#87	1.1	U	0.918	U	0.83	U	0.822	U	0.373	J	0.732	U
Cl5-BZ#101	1.1	U	0.918	U	0.471	J	0.822	U	0.392	J	0.732	U
Cl5-BZ#105	1.1	U	0.918	U	0.83	U	0.822	U	0.226	J	0.732	U
Cl5-BZ#118	1.1	U	0.918	U	0.263	J	0.822	U	0.287	J	0.732	U
Cl6-BZ#128	1.1	U	0.918	U	0.83	U	0.822	U	0.26	J	0.732	U
Cl6-BZ#138	1.1	U	0.918	U	0.459	J	0.822	U	0.175	J	0.732	U
Cl6-BZ#153	1.1	U	0.918	U	0.433	J	0.822	U	0.916	U	0.732	U
Cl7-BZ#170	1.1	U	0.918	U	0.83	U	0.822	U	0.916	U	0.732	U
Cl7-BZ#180	1.1	U	0.918	U	0.261	J	0.822	U	0.916	U	0.732	U
Cl7-BZ#183	1.1	U	0.918	U	0.83	U	0.822	U	0.916	U	0.732	U
Cl7-BZ#184	1.1	U	0.918	U	0.83	U	0.822	U	0.282	J	0.732	U
Cl7-BZ#187	1.1	U	0.918	U	0.164	J	0.822	U	0.916	U	0.732	U
Cl8-BZ#195	1.1	U	0.918	U	0.83	U	0.822	U	0.916	U	0.732	U
Cl9-BZ#206	1.1	U	0.918	U	0.83	U	0.822	U	0.916	U	0.732	U
Cl10-BZ#209	1.1	U	0.918	U	0.83	U	0.822	U	0.916	U	0.732	U
Total PCBs	*4.21*		*3.51*		*6.54*		*3.15*		*8.71*		*4.21*	
RIM ORGANOCHLORINE PESTICIDES												
4,4'-DDD	0.55	U	0.459	U	0.415	U	0.411	U	0.458	U	0.366	U
4,4'-DDE	0.55	U	0.459	U	0.079	J	0.411	U	0.458	U	0.366	U
4,4'-DDT	0.55	U	0.459	U	0.415	U	0.411	U	0.458	U	0.366	U
Total DDx	*0.060*		*0.050*		*0.115*		*0.046*		*0.050*		*0.041*	
Aldrin	0.55	U	0.459	U	0.415	U	0.411	U	0.458	U	0.366	U
Alpha-BHC	0.55	U	0.459	U	0.415	U	0.411	U	0.458	U	0.366	U
Beta-BHC	0.55	U	0.459	U	0.415	U	0.411	U	0.458	U	0.366	U
cis-Chlordane	0.55	U	0.459	U	0.415	U	0.411	U	0.458	U	0.366	U
cis-Nonachlor	0.55	U	0.459	U	0.415	U	0.411	U	0.458	U	0.366	U
Delta-BHC	0.55	U	0.459	U	0.415	U	0.411	U	0.458	U	0.366	U
Dieldrin	0.55	U	0.459	U	0.303	JP	0.411	U	0.458	U	0.366	U
Endosulfan I	0.55	U	0.459	U	0.415	U	0.411	U	0.458	U	0.366	U
Endosulfan II	0.55	U	0.459	U	0.415	U	0.411	U	0.458	U	0.366	U
Endosulfan sulfate	0.55	U	0.459	U	0.415	U	0.411	U	0.458	U	0.366	U
Endrin	0.55	U	0.459	U	0.415	U	0.411	U	0.458	U	0.366	U
gamma-BHC	0.55	U	0.459	U	0.415	U	0.411	U	0.458	U	0.366	U
Heptachlor	0.55	U	0.459	U	0.415	U	0.411	U	0.458	U	0.366	U
Heptachlor epoxide	1.1	U	0.918	U	0.83	U	0.822	U	0.916	U	0.732	U
Hexachlorobenzene	1.1	U	0.918	U	0.83	U	0.822	U	0.916	U	0.732	U
Methoxychlor	0.55	U	0.459	U	0.415	U	0.411	U	0.458	U	0.366	U
Oxychlordane	1.1	U	0.918	U	0.83	U	0.822	U	0.916	U	0.732	U
Toxaphene	27.6	U	23	U	20.8	U	20.6	U	23	U	18.4	U
trans-Chlordane	0.55	U	0.459	U	0.415	U	0.411	U	0.458	U	0.366	U
trans-Nonachlor	0.55	U	0.459	U	0.415	U	0.411	U	0.458	U	0.366	U
Total Chlordanes	*0.228*		*0.190*		*0.172*		*0.170*		*0.190*		*0.152*	

Yellow indicates exceedance of the ERL
Green indicates an exceedance of the ERM
U: Compound was analyzed for but was not detected (non-detect)
J: Indicates an estimated value
I: The lower value for the two columns has been reported due to obvious interference
P: The RPD between the results for the two columns exceeds the method-specified criteria
Total PCBs were calculated using the NOAA 18 method
Half the MDL was used for U-qualified values to calculate summary values
Total Chlordane is a sum of alpha and gamma chlordane, cis and trans nonachlor,
and oxychlordane

2020 and 2021 Bulk Chemistry and Grain Size Results

AREA:			Vicinity of Proposed Access Channel											
SAMPLE ID:	ERL	ERM	K 0-2'	K 2-3'	K 3-8.3'	K 8.3-10'	N 0-4'	O 0-0.6'	O 0.6-2.6'	O 2.6-5.5'	P 0-2.5	P 2.5-4.0'	P 4-8.5'	P 8.5-11.5'
ANALYTE			Conc Q	Conc Q	Conc Q	Conc Q	Conc Q	Conc Q	Conc Q	Conc Q	Conc Q	Conc Q	Conc Q	Conc Q
GRAIN SIZE ANALYSIS	(%)													
% Coarse Sand			NA U	NA U	NA U	NA U	1.6	3.3	NA U	0.8	4.7	0.1	NA U	1.1
% Fine Sand			0.3	0.6	1.1	NA U	2.1	4.1	0.7	2.1	1.7	0.6	0.3	2.2
% Medium Sand			5.7	3.2	4.6	0.2	9.8	12.7	6.1	16.9	9	2.2	3.1	9.1
% Total Fines			8.1	6.7	8.4	0.2	11.4	47.4	28.3	58.5	11.7	9.9	7.4	5.9
% Total Gravel			85.9	89.5	85.9	99.6	75.1	32.5	64.9	21.7	72.9	87.2	89.2	81.7
GENERAL CHEMISTRY	(%)													
Moisture			49	49.3	44.5	25.3	47	39.4	43.5	32.5	53	50	46.3	50.3
Solids, Total			51	50.7	55.5	74.7	53	60.6	56.5	67.5	47	50	53.7	49.7
TOTAL ORGANIC CARBON	(%)													
Total Organic Carbon (Average)			1.79	1.68	1.72	0.423	1.7	1.04	1.43	1.01	1.68	1.61	1.78	1.82
Total Organic Carbon (Rep1)			1.8	1.61	1.71	0.431	1.74	1.12	1.43	1.14	1.67	1.54	1.7	1.79
Total Organic Carbon (Rep2)			1.79	1.75	1.74	0.415	1.65	0.973	1.42	0.887	1.7	1.68	1.86	1.86
TOTAL METALS	(mg/kg)	(mg/kg)												
Arsenic, Total	8.2	70	12	8.88	7.75	3.51	8.78	6.56	5.36	3.4	8.19	6.02	6.82	1.71
Cadmium, Total	1.2	9.6	0.296	0.231	0.246	0.071	0.273	0.253	0.157	0.09	0.264	0.19	0.215	0.128
Chromium, Total	81	370	28.6	23.4	18.7	14.3	19.4	24.2	12.7	7.62	25.2	17.2	17.7	18.1
Copper, Total	34	270	9.83	8.16	6.55	9.98	6.84	20.2	4.34	2.87	14.4	5.96	5.86	0.632 J
Lead, Total	46.7	218	10.3	8.46	6.84	5.4	7.22	16.9	4.48	2.67	13.6	6.21	6.16	3.82
Mercury, Total	0.15	0.71	0.004 J	0.016 U	0.013 U	0.009 U	0.003 J	0.082	0.012 U	0.011 U	0.036	0.416	0.013 U	0.016 U
Nickel, Total	20.9	51.6	17.1	15	12.7	11.6	12.3	7.58	7.83	5.06	12.9	10.2	10.9	9.33
Silver, Total	1	3.7	0.078 J	0.061 J	0.044 J	0.035 J	0.049 J	0.297	0.036 J	0.019 J	0.193 J	0.051 J	0.041 J	0.196 U
Zinc, Total	150	410	53.9	45.9	38.8	28	41	36.2	24.9	16.6	47.6	35.2	37	35.2
RIM PAHS/PCB CONGENERS BY GC/MS	(ug/kg)	(ug/kg)												
Acenaphthene	16	500	3.69 J	3.05 J	8.81 U	2.12 J	9.02 U	4.47 J	8.14 U	7.33 U	9.81 U	9.79 U	8.66 U	9.36 U
Acenaphthylene	44	640	4.2 J	2.35 J	8.81 U	1.78 J	9.02 U	6.3 J	8.14 U	7.33 U	3.84 J	9.79 U	8.66 U	9.36 U
Anthracene	85.3	1100	8.98 U	9.49 U	8.81 U	6.48 U	9.02 U	14.4	8.14 U	7.33 U	7.05 J	9.79 U	8.66 U	9.36 U
Fluorene	19	540	1.59 J	1.71 J	8.81 U	0.936 J	9.02 U	3.63 J	8.14 U	7.33 U	1.66 J	9.79 U	8.66 U	9.36 U
Naphthalene	160	2100	8.5 J	9.29 J	8.81 U	5 J	5.34 J	12.6	5.82 J	3.47 J	6.49 J	3.56 J	7.59 J	13.7
Phenanthrene	240	1500	3.29 J	3.65 J	8.81 U	1.84 J	2.59 J	34.4	8.14 U	7.33 U	17.7	9.79 U	8.66 U	9.36 U
Total LMW PAHs	*552*	*3160*	*21.8*	*20.7*	*4.05*	*12.1*	*10.4*	*75.8*	*8.89*	*6.24*	*37.7*	*7.26*	*10.9*	*17.2*
Benz(a)anthracene			4.41 J	9.49 U	8.81 U	6.48 U	9.02 U	58.7	8.14 U	7.33 U	27.2	9.79 U	8.66 U	9.36 U
Benzo(a)pyrene	430	1600	8.98 U	9.49 U	8.81 U	6.48 U	9.02 U	60.8	8.14 U	7.33 U	29.2	9.79 U	8.66 U	9.36 U
Benzo(b)fluoranthene			3.09 J	9.49 U	8.81 U	6.48 U	3.33 J	58.7	8.14 U	7.33 U	34.4	9.79 U	8.66 U	9.36 U
Benzo(ghi)perylene			3.41 J	9.49 U	8.81 U	6.48 U	2.88 J	44.7	8.14 U	7.33 U	25.2	9.79 U	8.66 U	9.36 U
Benzo(k)fluoranthene			3.08 J	9.49 U	8.81 U	6.48 U	3.05 J	57	8.14 U	7.33 U	29.2	9.79 U	8.66 U	9.36 U
Chrysene	384	2800	2.6 J	9.49 U	8.81 U	6.48 U	2.12 J	51.4	8.14 U	7.33 U	24.9	9.79 U	8.66 U	9.36 U
Dibenz(a,h)anthracene			8.98 U	9.49 U	8.81 U	6.48 U	9.02 U	13	8.14 U	7.33 U	5.28 J	9.79 U	8.66 U	9.36 U
Fluoranthene	600	5100	4.16 J	2.65 J	8.81 U	1.62 J	4.17 J	86.9	8.14 U	7.33 U	52	1.93 J	8.66 U	9.36 U
Indeno(1,2,3-cd)Pyrene			9.83	9.49 U	8.81 U	6.48 U	9.37	49.9	8.14 U	7.33 U	29.8	9.79 U	8.66 U	9.36 U
Pyrene	665	2600	4.14 J	9.49 U	8.81 U	6.48 U	4.72 J	92.4	8.14 U	7.33 U	49.4	9.79 U	8.66 U	9.36 U
Total HMW PAHs	*1700*	*9600*	*37.3*	*12.9*	*10.4*	*8.64*	*33.3*	*574*	*9.58*	*8.63*	*307*	*12.5*	*10.2*	*11.0*
RIM PAHS/PCB CONGENERS BY GC/MS	(ug/kg)													
Cl2-BZ#8			0.898 U	0.949 U	0.881 U	0.648 U	0.902 U	0.751 U	0.814 U	0.733 U	0.981 U	0.979 U	0.866 U	0.936 U
Cl3-BZ#18			0.898 U	0.949 U	0.881 U	0.648 U	0.902 U	0.751 U	0.814 U	0.733 U	0.981 U	0.979 U	0.866 U	0.936 U
Cl3-BZ#28			0.898 U	0.949 U	0.881 U	0.648 U	0.902 U	0.751 U	0.814 U	0.733 U	0.981 U	0.979 U	0.866 U	0.936 U
Cl4-BZ#44			0.898 U	0.949 U	0.881 U	0.648 U	0.902 U	0.751 U	0.814 U	0.733 U	0.981 U	0.979 U	0.866 U	0.936 U
Cl4-BZ#49			0.898 U	0.949 U	0.881 U	0.648 U	0.902 U	0.751 U	0.814 U	0.733 U	0.981 U	0.979 U	0.866 U	0.936 U
Cl4-BZ#52			0.898 U	0.949 U	0.881 U	0.648 U	0.902 U	0.234 J	0.814 U	0.733 U	0.217 J	0.979 U	0.866 U	0.936 U
Cl4-BZ#66			0.898 U	0.949 U	0.881 U	0.648 U	0.902 U	0.147 J	0.814 U	0.733 U	0.208 J	0.979 U	0.866 U	0.936 U
Cl5-BZ#87			0.898 U	0.949 U	0.881 U	0.648 U	0.902 U	0.751 U	0.814 U	0.733 U	0.981 U	0.979 U	0.866 U	0.936 U
Cl5-BZ#101			0.898 U	0.949 U	0.881 U	0.648 U	0.902 U	0.605 J	0.814 U	0.733 U	0.473 J	0.979 U	0.866 U	0.936 U
Cl5-BZ#105			0.898 U	0.949 U	0.881 U	0.648 U	0.902 U	0.188 J	0.814 U	0.733 U	0.981 U	0.979 U	0.866 U	0.936 U
Cl5-BZ#118			0.898 U	0.949 U	0.881 U	0.648 U	0.902 U	0.448 J	0.814 U	0.733 U	0.4 J	0.979 U	0.866 U	0.936 U
Cl6-BZ#128			0.898 U	0.949 U	0.881 U	0.648 U	0.902 U	0.751 U	0.814 U	0.733 U	0.981 U	0.979 U	0.866 U	0.936 U
Cl6-BZ#138			0.898 U	0.949 U	0.881 U	0.648 U	0.902 U	0.778	0.814 U	0.733 U	0.398 J	0.979 U	0.866 U	0.936 U
Cl6-BZ#153			0.898 U	0.949 U	0.881 U	0.648 U	0.902 U	0.584 J	0.814 U	0.733 U	0.459 J	0.979 U	0.866 U	0.936 U
Cl7-BZ#170			0.898 U	0.949 U	0.881 U	0.648 U	0.902 U	0.751 U	0.814 U	0.733 U	0.981 U	0.979 U	0.866 U	0.936 U
Cl7-BZ#180			0.898 U	0.949 U	0.881 U	0.648 U	0.902 U	0.346 J	0.814 U	0.733 U	0.288 J	0.979 U	0.866 U	0.936 U
Cl7-BZ#183			0.898 U	0.949 U	0.881 U	0.648 U	0.902 U	0.127 J	0.814 U	0.733 U	0.981 U	0.979 U	0.866 U	0.936 U
Cl7-BZ#184			0.898 U	0.949 U	0.881 U	0.648 U	0.902 U	0.751 U	0.814 U	0.733 U	0.981 U	0.979 U	0.866 U	0.936 U
Cl7-BZ#187			0.898 U	0.949 U	0.881 U	0.648 U	0.902 U	0.246 J	0.814 U	0.733 U	0.981 U	0.979 U	0.866 U	0.936 U
Cl8-BZ#195			0.898 U	0.949 U	0.881 U	0.648 U	0.902 U	0.751 U	0.814 U	0.733 U	0.981 U	0.979 U	0.866 U	0.936 U
Cl9-BZ#206			0.898 U	0.949 U	0.881 U	0.648 U	0.902 U	0.751 U	0.814 U	0.733 U	0.981 U	0.979 U	0.866 U	0.936 U
Cl10-BZ#209			0.898 U	0.949 U	0.881 U	0.648 U	0.902 U	0.751 U	0.814 U	0.733 U	0.981 U	0.979 U	0.866 U	0.936 U
Total PCBs	*22.7*	*180*	*3.43*	*3.63*	*3.37*	*2.48*	*3.45*	*8.68*	*3.11*	*2.80*	*7.27*	*3.75*	*3.31*	*3.58*
RIM ORGANOCHLORINE PESTICIDES	(ug/kg)													
4,4'-DDD	2	20	0.449 U	0.475 U	0.441 U	0.324 U	0.451 U	0.376 U	0.407 U	0.366 U	0.49 U	0.49 U	0.433 U	0.468 U
4,4'-DDE	2.2	27	0.449 U	0.475 U	0.441 U	0.324 U	0.451 U	0.376 U	0.407 U	0.366 U	0.49 U	0.49 U	0.433 U	0.468 U
4,4'-DDT	1	7	0.449 U	0.475 U	0.441 U	0.324 U	0.451 U	0.376 U	0.407 U	0.366 U	0.49 U	0.49 U	0.433 U	0.468 U
Total DDx	*1.58*	*46.1*	*0.050*	*0.053*	*0.048*	*0.036*	*0.050*	*0.041*	*0.045*	*0.041*	*0.054*	*0.054*	*0.048*	*0.051*
Aldrin			0.449 U	0.475 U	0.441 U	0.324 U	0.451 U	0.376 U	0.407 U	0.366 U	0.49 U	0.49 U	0.433 U	0.468 U
Alpha-BHC			0.449 U	0.475 U	0.441 U	0.324 U	0.451 U	0.376 U	0.407 U	0.366 U	0.49 U	0.49 U	0.433 U	0.468 U
Beta-BHC			0.449 U	0.475 U	0.441 U	0.324 U	0.451 U	0.376 U	0.407 U	0.366 U	0.49 U	0.49 U	0.433 U	0.468 U
cis-Chlordane			0.449 U	0.475 U	0.441 U	0.324 U	0.451 U	0.376 U	0.407 U	0.366 U	0.49 U	0.49 U	0.433 U	0.468 U
cis-Nonachlor			0.449 U	0.475 U	0.441 U	0.324 U	0.451 U	0.376 U	0.407 U	0.366 U	0.49 U	0.49 U	0.433 U	0.468 U
Delta-BHC			0.449 U	0.475 U	0.441 U	0.324 U	0.451 U	0.376 U	0.407 U	0.366 U	0.49 U	0.49 U	0.433 U	0.468 U
Dieldrin	0.02	8	0.449 U	0.475 U	0.441 U	0.324 U	0.451 U	0.376 U	0.407 U	0.366 U	0.49 U	0.49 U	0.433 U	0.468 U
Endosulfan I			0.449 U	0.475 U	0.441 U	0.324 U	0.451 U	0.376 U	0.407 U	0.366 U	0.49 U	0.49 U	0.433 U	0.468 U
Endosulfan II			0.449 U	0.475 U	0.441 U	0.324 U	0.451 U	0.376 U	0.407 U	0.366 U	0.49 U	0.49 U	0.433 U	0.468 U
Endosulfan sulfate			0.449 U	0.475 U	0.441 U	0.324 U	0.451 U	0.376 U	0.407 U	0.366 U	0.49 U	0.49 U	0.433 U	0.468 U
Endrin			0.449 U	0.475 U	0.441 U	0.324 U	0.451 U	0.376 U	0.407 U	0.366 U	0.49 U	0.49 U	0.433 U	0.468 U
gamma-BHC			0.449 U	0.475 U	0.441 U	0.324 U	0.451 U	0.376 U	0.407 U	0.366 U	0.49 U	0.49 U	0.433 U	0.468 U
Heptachlor			0.449 U	0.475 U	0.441 U	0.324 U	0.451 U	0.376 U	0.407 U	0.366 U	0.49 U	0.49 U	0.433 U	0.468 U
Heptachlor epoxide			0.898 U	0.949 U	0.881 U	0.648 U	0.902 U	0.751 U	0.814 U	0.733 U	0.981 U	0.979 U	0.866 U	0.936 U
Hexachlorobenzene			0.898 U	0.949 U	0.881 U	0.648 U	0.902 U	0.751 U	0.814 U	0.733 U	0.981 U	0.979 U	0.866 U	0.936 U
Methoxychlor			0.449 U	0.475 U	0.441 U	0.324 U	0.451 U	0.376 U	0.407 U	0.366 U	0.49 U	0.49 U	0.433 U	0.468 U
Oxychlordane			0.898 U	0.949 U	0.881 U	0.648 U	0.902 U	0.751 U	0.814 U	0.733 U	0.981 U	0.979 U	0.866 U	0.936 U
Toxaphene			22.5 U	23.8 U	22.1 U	16.3 U	22.6 U	18.8 U	20.4 U	18.4 U	24.6 U	24.6 U	21.7 U	23.5 U
trans-Chlordane			0.449 U	0.475 U	0.441 U	0.324 U	0.451 U	0.376 U	0.407 U	0.366 U	0.49 U	0.49 U	0.433 U	0.468 U
trans-Nonachlor			0.449 U	0.475 U	0.441 U	0.324 U	0.451 U	0.376 U	0.407 U	0.366 U	0.49 U	0.49 U	0.433 U	0.468 U
Total Chlordanes	*0.5*	*6*	*0.186*	*0.196*	*0.183*	*0.134*	*0.187*	*0.155*	*0.169*	*0.152*	*0.204*	*0.203*	*0.179*	*0.194*

AREA:	Existing Basin										
SAMPLE ID:	F 0-1.5	F 1.5-3.5	F 10-10.5	F 3.5-10	L 0-1'	L 1-2.8'	L 2.8-3.8'	L 3.8-11.5'	M 0-5.3'	M 5.3-6.5'	M 6.5-9.5'
ANALYTE	Conc Q	Conc Q	Conc Q	Conc Q	Conc Q	Conc Q	Conc Q	Conc Q	Conc Q	Conc Q	Conc Q
GRAIN SIZE ANALYSIS											
% Coarse Sand	-	-	-	-	NA U	NA U	NA U	NA U	NA U	NA U	0.5
% Fine Sand	-	-	-	-	NA U	0.1	3	0.3	0.4	0.1	1
% Medium Sand	-	-	-	-	4.2	4.8	7.9	3.3	6.7	0.4	6.5
% Total Fines	-	-	-	-	3.4	3.1	4.6	3.2	5.8	1.5	16.5
% Total Gravel	-	-	-	-	92.4	92	84.5	93.2	87.1	98	75.5
GENERAL CHEMISTRY											
Moisture	71.3	50.5	42.6	42	59.8	70.4	45.7	48.7	71.7	56.5	39.6
Solids, Total	28.7	49.5	57.4	58	40.2	29.6	54.3	51.3	28.3	43.5	60.4
TOTAL ORGANIC CARBON											
Total Organic Carbon (Average)	4.71	1.98	3.02	2.03	4.61	5.32	1.79	1.82	5.53	2.88	1.63
Total Organic Carbon (Rep1)	4.69	2.04	2.88	1.99	4.54	5.26	1.77	1.82	5.46	2.83	1.65
Total Organic Carbon (Rep2)	4.73	1.92	3.16	2.06	4.68	5.37	1.82	1.82	5.59	2.92	1.62
TOTAL METALS											
Arsenic, Total	15.1	11.4	9.41	9.64	12.2	19.3	8.54	8.47	2.84	11.1	6.85
Cadmium, Total	3.93	1.68	0.09	0.197	1.44	6.18	0.579	0.224	1.01	5.34	0.894
Chromium, Total	242	57	16.7	25.9	133	382	43.5	24.2	54.2	120	34.4
Copper, Total	630	67.4	9.11	7.77	262	1050	83.8	10.3	154	265	39.6
Lead, Total	270	34.9	7.92	9.62	172	405	31.1	9.57	60	97.6	20.5
Mercury, Total	1.62	0.051	0.017 U	0.004 J	0.817	1.62	0.02	0.007 J	1.44	0.582	0.068
Nickel, Total	46.6	17.7	13.9	15.6	23.8	80	16.5	15	10.8	17.3	11.2
Silver, Total	13.2	2.18	0.035 J	0.052 J	5.12	20.9	1.41	0.119 J	3.19	9.38	0.812
Zinc, Total	364	101	36.2	51.4	201	547	72.4	48.6	87.6	215	59
RIM PAHS/PCB CONGENERS BY GC/MS											
Acenaphthene	48.4 J	14.1	8.1 U	5.52 J	28.4	66.6	8.72 J	4.71 J	121	82.4	5.76 J
Acenaphthylene	199	22.9	8.1 U	2.46 J	144	323	29.7	5.44 J	410	145	9.73
Anthracene	218	28.3	8.1 U	8.25 U	134	315	24.9	3.14 J	442	194	8.29
Fluorene	49.3 J	12.9	0.949 J	8.25 U	34.5	74.3	8.26 J	3.06 J	137	123	5.42 J
Naphthalene	132	23.4	8.1 U	3.7 J	107	195	21.4	11.5	270	191	12.6
Phenanthrene	406	56.1	2.4 J	8.25 U	348	761	59.7	8.24 J	1120	680	20.7
Total LMW PAHs	*1053*	*158*	*5.80*	*13.5*	*796*	*1735*	*153*	*36.1*	*2500*	*1415*	*62.5*
Benz(a)anthracene	648	84.3	8.1 U	8.25 U	622	1210	89.2	11.1	1840	731	28.4
Benzo(a)pyrene	898	80	8.1 U	8.25 U	692	1060	78.9	8.1 J	1250	449	20.3
Benzo(b)fluoranthene	1060	86	8.1 U	8.25 U	1060	1760	105	14.6	2090	765	33.5
Benzo(ghi)perylene	798	60.2	8.1 U	8.25 U	633	1000	75.2	8.45 J	1100	360	20.4
Benzo(k)fluoranthene	845	77.6	8.1 U	8.25 U	591	868	80.2	9.07 J	1050	334	24.4
Chrysene	684	82.1	8.1 U	8.25 U	495	775	64.6	8.11 J	1180	503	23.6
Dibenz(a,h)anthracene	196	19.9	8.1 U	8.25 U	176	306	22	9.38 U	330	144	6.9 J
Fluoranthene	1080	166	2.26 J	2.69 J	1080	2040	170	16.7	2790	1250	50.3
Indeno(1,2,3-cd)Pyrene	859	71	8.1 U	8.25 U	588	983	76.9	13.9	974	357	25.8
Pyrene	1190	126	8.1 U	8.25 U	1020	1640	140	13.7	2580	977	49.1
Total HMW PAHs	*8258*	*853*	*11.0*	*11.6*	*6957*	*11642*	*902*	*104*	*15184*	*5870*	*283*
RIM PAHS/PCB CONGENERS BY GC/MS											
Cl2-BZ#8	2.74 J	0.941 U	0.81 U	0.825 U	1.13 U	1.55 U	0.896 U	0.938 U	1.68 U	1.09 U	0.781 U
Cl3-BZ#18	4.97 J	0.941 U	0.81 U	0.825 U	1.13 U	2.34	0.464 J	0.938 U	3.73	1.09 U	0.781 U
Cl3-BZ#28	6.05 J	0.941 U	0.81 U	0.825 U	1.13 U	7.9	0.979	0.938 U	6.36	1.09 U	0.781 U
Cl4-BZ#44	13.4	0.371 J	0.81 U	0.825 U	3.17	12.3	1.75	0.294 J	17.1	3.99	0.781 U
Cl4-BZ#49	9.15	0.677 J	0.81 U	0.825 U	2.75	10.4	1.66	0.938 U	11.2	1.88	0.781 U
Cl4-BZ#52	14.5	0.824 J	0.81 U	0.825 U	3.79	14.1	3.3	0.24 J	43.3	3.26	0.33 J
Cl4-BZ#66	16.5	0.584 J	0.81 U	0.825 U	5.68	18	2.3	0.274 J	20.7	3.36	0.251 J
Cl5-BZ#87	21.3	0.631 J	0.81 U	0.825 U	3.61	12.2	3.64	0.938 U	37.4	4.59	0.781 U
Cl5-BZ#101	46.6	1.86	0.81 U	0.825 U	14.4	47.3	12.9	0.683 J	141	12.4	0.386 J
Cl5-BZ#105	17.8	0.557 J	0.81 U	0.825 U	5.36	12.3	4.78	0.938 U	36.8	4.26	0.781 U
Cl5-BZ#118	35	0.941	0.81 U	0.825 U	11.8	25.5	7.16	0.636 J	110	5.44	0.781 U
Cl6-BZ#128	16	0.941 U	0.81 U	0.825 U	3.34	13.4	1.84	0.938 U	68.2	1.09 U	0.781 U
Cl6-BZ#138	59	1.56	0.81 U	0.825 U	15	55	11.4	0.609 J	218	10.8	0.61 J
Cl6-BZ#153	42.5	1.4	0.81 U	0.825 U	12.9	40.6	7.61	0.567 J	89.1	8.95	0.355 J
Cl7-BZ#170	20.6	0.674 J	0.81 U	0.825 U	3.71	18.2	1.56	0.938 U	28.2	3.34	0.781 U
Cl7-BZ#180	23.5	1.03	0.81 U	0.825 U	6.55	23.1	3.35	0.938 U	35.8	8.22	0.781 U
Cl7-BZ#183	7.48	0.48 J	0.81 U	0.825 U	2.37	6.86	1.83	0.938 U	9.24	2.55	0.781 U
Cl7-BZ#184	6.8 U	0.941 U	0.81 U	0.825 U	1.13 U	1.55 U	0.896 U	0.938 U	1.68 U	1.09 U	0.781 U
Cl7-BZ#187	16.5	1.05	0.81 U	0.825 U	7.35	18.8	1.89	0.938 U	23.7	4.4	0.781 U
Cl8-BZ#195	5.03 J	0.941 U	0.81 U	0.825 U	1.13 U	1.55 U	0.896 U	0.938 U	1.68 U	1.09 U	0.781 U
Cl9-BZ#206	17.9	4.97	0.81 U	0.825 U	7.08	23.4	3.05	0.938 U	26.7	22.6	2.6
Cl10-BZ#209	18.5	6.84	0.81 U	0.825 U	8.12	35.5	4.03	0.938 U	48.7	43.1	2.7
Total PCBs	*754*	*46.4*	*3.10*	*3.16*	*217*	*736*	*137*	*8.75*	*1836*	*269*	*16.2*
RIM ORGANOCHLORINE PESTICIDES											
4,4'-DDD	0.851 U	0.471 U	0.405 U	0.412 U	0.567 U	1.99	0.508 IP	0.469 U	13.9 P	2.32	0.39 U
4,4'-DDE	16.9 I	0.471 U	0.405 U	0.412 U	0.567 U	20.6	4.36 P	0.469 U	31.5	2.8	0.39 U
4,4'-DDT	4.17 IP	0.471 U	0.405 U	0.412 U	0.567 U	2.4 IP	0.408 JIP	0.469 U	8.29 IP	0.592 IP	0.39 U
Total DDx	*21.1*	*0.052*	*0.045*	*0.046*	*0.063*	*25.0*	*5.28*	*0.051*	*53.7*	*5.71*	*0.043*
Aldrin	0.851 U	0.471 U	0.405 U	0.412 U	0.567 U	0.777 U	0.448 U	0.469 U	0.841 U	0.547 U	0.39 U
Alpha-BHC	0.851 U	0.471 U	0.405 U	0.412 U	0.567 U	0.777 U	0.448 U	0.469 U	0.841 U	0.547 U	0.39 U
Beta-BHC	0.851 U	0.471 U	0.405 U	0.412 U	0.567 U	0.777 U	0.448 U	0.469 U	0.841 U	0.547 U	0.39 U
cis-Chlordane	2.7	0.471 U	0.405 U	0.412 U	0.567 U	2.74	0.448 U	0.469 U	3.79	0.547 U	0.39 U
cis-Nonachlor	0.851 U	0.471 U	0.405 U	0.412 U	0.567 U	0.777 U	0.448 U	0.469 U	0.841 U	0.547 U	0.39 U
Delta-BHC	0.851 U	0.471 U	0.405 U	0.412 U	0.567 U	0.777 U	0.448 U	0.469 U	0.841 U	0.547 U	0.39 U
Dieldrin	7.56 IP	0.471 U	0.405 U	0.412 U	0.567 U	5.92 IP	1.58 IP	0.469 U	8.32 IP	2.81 IP	0.39 U
Endosulfan I	0.851 U	0.471 U	0.405 U	0.412 U	0.567 U	0.777 U	0.448 U	0.469 U	0.841 U	0.547 U	0.39 U
Endosulfan II	0.851 U	0.471 U	0.405 U	0.412 U	0.567 U	0.777 U	0.448 U	0.469 U	0.841 U	0.547 U	0.39 U
Endosulfan sulfate	0.851 U	0.471 U	0.405 U	0.412 U	0.567 U	0.777 U	0.448 U	0.469 U	0.841 U	0.547 U	0.39 U
Endrin	0.851 U	0.471 U	0.405 U	0.412 U	0.567 U	0.777 U	0.448 U	0.469 U	0.841 U	0.547 U	0.39 U
gamma-BHC	0.851 U	0.471 U	0.405 U	0.412 U	0.567 U	0.777 U	0.448 U	0.469 U	0.841 U	0.547 U	0.39 U
Heptachlor	0.851 U	0.471 U	0.405 U	0.412 U	0.567 U	0.777 U	0.448 U	0.469 U	0.841 U	0.547 U	0.39 U
Heptachlor epoxide	1.7 U	0.941 U	0.81 U	0.825 U	1.13 U	1.55 U	0.896 U	0.938 U	1.68 U	1.09 U	0.781 U
Hexachlorobenzene	1.7 U	0.941 U	0.81 U	0.825 U	1.13 U	1.55 U	0.896 U	0.938 U	1.68 U	1.09 U	0.781 U
Methoxychlor	0.851 U	0.471 U	0.405 U	0.412 U	0.567 U	0.777 U	0.448 U	0.469 U	0.841 U	0.547 U	0.39 U
Oxychlordane	1.7 U	0.941 U	0.81 U	0.825 U	1.13 U	1.55 U	0.896 U	0.938 U	1.68 U	1.09 U	0.781 U
Toxaphene	42.7 U	23.6 U	20.3 U	20.7 U	28.5 U	39 U	22.5 U	23.6 U	42.2 U	27.5 U	19.6 U
trans-Chlordane	9.38 IP	0.471 U	0.405 U	0.412 U	0.567 U	9.27 IP	1.09 IP	0.469 U	21.7 IP	0.547 U	0.39 U
trans-Nonachlor	5.64 P	0.471 U	0.405 U	0.412 U	0.567 U	3.18	0.448 U	0.469 U	8.03 P	0.547 U	0.39 U
Total Chlordanes	*5.96*	*0.195*	*0.168*	*0.171*	*0.235*	*3.48*	*0.186*	*0.194*	*8.35*	*0.227*	*0.161*

Yellow indicates exceedance of the ERL
Green indicates an exceedance of the ERM
U: Compound was analyzed for but was not detected (non-detect)
J: Indicates an estimated value
I: The lower value for the two columns has been reported due to obvious interference
P: The RPD between the results for the two columns exceeds the method-specified criteria
Total PCBs were calculated using the NOAA 18 method
Half the MDL was used for U-qualified values to calculate summary values
Total Chlordane is a sum of alpha and gamma chlordane, cis and trans nonachlor,
and oxychlordane

Appendix B

Core Logs and Photographs

PROJECT: Providence River-Edgewood Shoals DATE: 8/7/2020

SAMPLING PERSONNEL: RBL/TAR

SEA STATE: Calm WEATHER CODE: Sunny

LOCATION METHOD: DGPS

SAMPLE ID: A SAMPLER TYPE: VC

TIME: 11:25

SOUNDING: 11.2’ CORRECTED DEPTH: -4.8=6.4’

COORDINATES: N 41.777046 E -71.384517

PENETRATION/RECOVERY: 9.0/9.0’ NO. OF ATTEMPTS: 2

MATERIAL DESCRIPTION: Loose organic silt over gray sandy silt with shell

CORE PHOTO:	NOTES:
	Core taken refusal. • 0-0.9’ D. gray loose organic silt , clam shell fragments, wet • 0.9-4.4’ gray organic silt, non-plastic, soft, wet • 4.4-9.0’ gray non-plastic silt with layers of oyster and scallop shell, firmer, moist • Samples: 0-1.0’, 1.0-2.0’, 2.0-4.4’, 4.4-9’

PROJECT: Providence River-Edgewood Shoals DATE: 8/7/2020

SAMPLING PERSONNEL: RBL/TAR

SEA STATE: Calm WEATHER CODE: Sunny

LOCATION METHOD: DGPS

SAMPLE ID: B SAMPLER TYPE: VC

TIME: 11:53

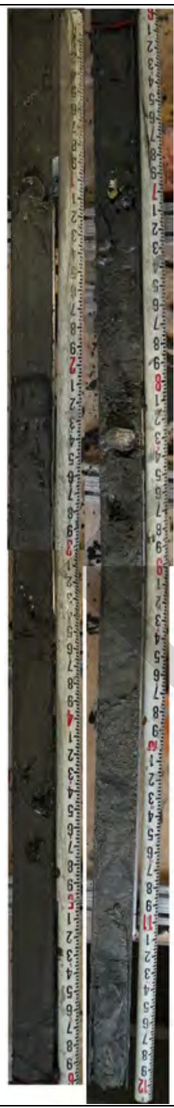
SOUNDING: 18.4’ CORRECTED DEPTH: -4.7=13.7’

COORDINATES: N 41.778243 E -71.384184

PENETRATION/RECOVERY: 12.0/12.0’ NO. OF ATTEMPTS: 1

MATERIAL DESCRIPTION: Gray silt with shell

CORE PHOTO:



NOTES:

- 0-7.3’ Gray non-plastic silt with scattered shell fragments
    - Top is soft, firmer with depth
    - Lens of D. gray silt at 2.1’
    - Sample 0-1.0’ petroleum odor
- 7.3-11.1’ gray poorly graded medium/fine sand with scattered shell fragments, very firm, moist
    - whole clam shells at 8.3’
- 11.2-12.0’ Mottled gray/dark gray sandy clay, non-plastic, very firm, dry

- Samples: 0.0-1.0’. 1.0-2.0’, 2.0-7.3’(MS/MSD/DUP-no GS), 7.3-11.1’

PROJECT: Providence River-Edgewood Shoals DATE: 8/7/2020

SAMPLING PERSONNEL: RBL/TAR

SEA STATE: Calm WEATHER CODE: Sunny

LOCATION METHOD: DGPS

SAMPLE ID: C SAMPLER TYPE: VC

TIME: 12:16

SOUNDING: 11.8’ CORRECTED DEPTH: -4.4=6.4’

COORDINATES: N 41.777604 E -71.382700

PENETRATION/RECOVERY: 12.0/11.5’ NO. OF ATTEMPTS: 1

MATERIAL DESCRIPTION: Gray silt with shell

CORE PHOTO:	NOTES:
	Driven to core head. • 0-2.3’ Loose organic silt and shell • 2.3-4.3 Gray organic silt with scattered shell, soft, wet • 4.3-11.5’ Gray non-plastic silt with scattered lenses of clam shell, firmer, moist • Samples: 0-2.3’, 2.3-4.3’, 4.3-11.5’’

PROJECT: Providence River-Edgewood Shoals DATE: 8/7/2020

SAMPLING PERSONNEL: RBL/TAR

SEA STATE: Calm WEATHER CODE: Sunny

LOCATION METHOD: DGPS

SAMPLE ID: D SAMPLER TYPE: VC

TIME: 12:44

SOUNDING: 11.1 CORRECTED DEPTH: -4.1=6.0’

COORDINATES: N 41.778173 E -71.380835

PENETRATION/RECOVERY: 12.0/12.0’ NO. OF ATTEMPTS: 1

MATERIAL DESCRIPTION: Organic silt over gray silt with shell

CORE PHOTO:

NOTES:

Driven to core head.

- 0-0.4 Dark gray organic silt and shell fragments, loose, soft, wet
- 0.4-4.4 Gray organic silt, soft wet
  - layer of dark gray OL and shell fragments from 1-1.2
  - Large 0.2” quahog from 2.0-2.2’
- 4.4-12.0 gray non plastic silt with few scattered shell fragments, then scallop shell rom 9.8-12.0, firm, moist

- Samples: 0-1’, 1-1’, 2-4.4’, 4.4-12’

PROJECT:	Providence River-Edgewood Shoals	DATE:	8/7/2020
SAMPLING PERSONNEL:	RBL/TAR		
SEA STATE:	Calm	WEATHER CODE:	Sunny
LOCATION METHOD:	DGPS		

SAMPLE ID:	E	SAMPLER TYPE:	VC
TIME:	13:03		
SOUNDING:	10.6’	CORRECTED DEPTH:	-3.7=6.9’
COORDINATES:	N 41.778664	E	-71.385377
PENETRATION/RECOVERY:	12.0’	NO. OF ATTEMPTS:	1
MATERIAL DESCRIPTION:	Organic silt over gray silt with shell		

CORE PHOTO:	NOTES:
	Driven to core head. • 0-0.3 Dark gray organic silt and clam shell fragments, loose, wet • 0.3-3.7 Gray non-plastic fines, high organic content, very soft, wet • 3.7-12.0 Gray non-plastic fines with scattered layers of scallop shell, firmer, moist • Samples: 0-1’, 1-2’, 2-3.7’, 3.7-12’

PROJECT: Providence River-Edgewood Shoals DATE: 8/7/2020

SAMPLING PERSONNEL: RBL/TAR

SEA STATE: WEATHER CODE:

LOCATION METHOD: DGPS

SAMPLE ID: F SAMPLER TYPE: VC

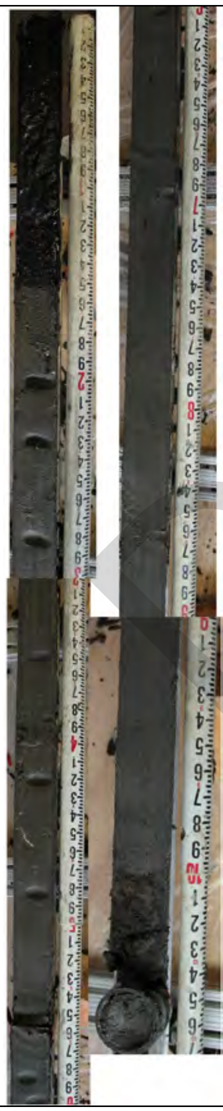
TIME: 13:22

SOUNDING: 25.1’ CORRECTED DEPTH: -3.4=21.7’

COORDINATES: N 41.7780074 E -71.384923

PENETRATION/RECOVERY: 10.5/10.5’ NO. OF ATTEMPTS: 1

MATERIAL DESCRIPTION: Organic silt over gray silt with shell, and brown to gray silty sand at depth

CORE PHOTO:	NOTES:
	Taken to refusal • 0-1.5 Black organic silt, loose, very wet • 1.5-10.0 Gray non-plastic silt with few scattered shell fragments, soft 1.5-3.5 then firm, moist • 10-10.5 Brown/gray silty sand with decomposing woody material • Samples: 0-1.5’, 1.5-3.5’, 3.5-10’ (MS/MSD/DUP, no GS) 10-10.5’

PROJECT: Providence River-Edgewood Shoals DATE: 8/7/2020

SAMPLING PERSONNEL: RBL/TAR

SEA STATE: Calm WEATHER CODE: Sunny

LOCATION METHOD: DGPS

SAMPLE ID: G SAMPLER TYPE: VC

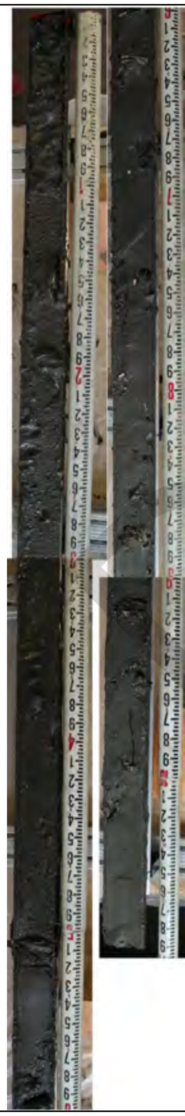
TIME: 13:43

SOUNDING: 10.4’ CORRECTED DEPTH: -2.9=7.5’

COORDINATES: N 41.779245 E -71.383524

PENETRATION/RECOVERY: 12.0/11.1’ NO. OF ATTEMPTS: 1

MATERIAL DESCRIPTION: Organic silt over gray silt with shell

CORE PHOTO:	NOTES:
	Driven to core head • 0-4.0 Gray organic silt with scattered oyster shell, loose/soft, wet, non-plastic, hydrogen sulfide odor • 4.0-11.1 gray non-plastic silt with scattered layers of scallop shell, firmer, moist • Samples: 0-1’, 1-2’, 2-4’, 4-11.1’

PROJECT: Providence River-Edgewood Shoals DATE: 8/7/2020

SAMPLING PERSONNEL: RBL/TAR

SEA STATE: Calm WEATHER CODE: Sunny

LOCATION METHOD: DGPS

SAMPLE ID: H SAMPLER TYPE: VC

TIME: 14:01

SOUNDING: 10.1’ CORRECTED DEPTH: -2.5=7.6’

COORDINATES: N 41.779786 E -71.381859

PENETRATION/RECOVERY: 6.9/6.9’ NO. OF ATTEMPTS: 3

MATERIAL DESCRIPTION: Organic silt over gray silt with shell

CORE PHOTO:	NOTES:
	Shallow refusal, multiple attempts with 1 bent core barrel • 0-3.4 Loose organic silt • 3.4-6.9 gray non-plastic silt • Samples: 0-3.4’, 3.4-6.9’

PROJECT: Providence River-Edgewood Shoals DATE: 8/20/20

SAMPLING PERSONNEL: RBL/TAR

SEA STATE: Calm WEATHER CODE: Sunny

LOCATION METHOD: DGPS

SAMPLE ID: I SAMPLER TYPE: Vibracore

TIME: 11:08

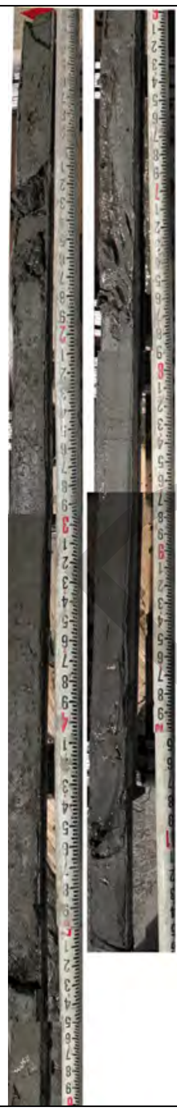
SOUNDING: 11.6’ CORRECTED DEPTH: -4.5=7.1’

COORDINATES: N 41.780129 E -71.386195

PENETRATION/RECOVERY: 12.0//11.2’ NO. OF ATTEMPTS: 1

MATERIAL DESCRIPTION: Grey sandy silt

CORE PHOTO:



NOTES:

Driven to core head.

- 0-8’: grey soft, wet silt with little sand, slightly firmer with depth
    - 5.2’: shell fragments
    - 5.8’: large shell fragments
- 8-11.2’: firm, moist, grey silt with some sand, very low plasticity, shell fragments throughout
    - 11.0’ several whole ~2” clam shells

- Sample Intervals:
    - 0-1’
    - 1-2’
    - 2-8’
    - 8-11.2’

PROJECT: Providence River-Edgewood Shoals DATE: 8/20/20

SAMPLING PERSONNEL: RBL/TAR

SEA STATE: Calm WEATHER CODE: Sunny

LOCATION METHOD: DGPS

SAMPLE ID: J SAMPLER TYPE: Vibracore

TIME: 11:31

SOUNDING: 11.1’ CORRECTED DEPTH: -4.0=7.1’

COORDINATES: N 41.780538 E -71.383668

PENETRATION/RECOVERY: 12.0//10.7’ NO. OF ATTEMPTS: 1

MATERIAL DESCRIPTION: Grey sandy silt

CORE PHOTO:

NOTES:

Driven to core head.

- 0-4’: grey soft wet silt with some sand
- 4-10.7’ grey firmer moist sandy silt, shell fragments throughout, non-plastic, slightly firmer with depth
    - 6-6.5’: slightly sandier
    - 8.6-9.4’: lens with larger shell fragments
    - 10.2’ large oyster and scallop shells

- Sample Intervals:
    - 0-1’
    - 1-2’
    - 2-4’
    - 4-10.7’

PROJECT: Providence River-Edgewood Shoals DATE: 8/20/20

SAMPLING PERSONNEL: RBL/TAR

SEA STATE: Calm WEATHER CODE: Sunny

LOCATION METHOD: DGPS

SAMPLE ID: K SAMPLER TYPE: Vibracore

TIME: 11:55

SOUNDING: 11.4’ CORRECTED DEPTH: -2.7=12.9'

COORDINATES: N 41.781187 E -71.382588

PENETRATION/RECOVERY: 10.0/10.0’ NO. OF ATTEMPTS: 1

MATERIAL DESCRIPTION: Grey sandy silt

CORE PHOTO:	NOTES:

	Shallow refusal, bottom of core is hard packed with grey fine sand and silt.
	
	• 0-3’: grey, soft, wet silt with little sand
	• 3-8.3’: grey firm silt with little sand, moist, very low plasticity, some shell fragments throughout
	    o 3.7’ shell fragments
	• 8.3-10’: grey, moist, sandy clay, low plasticity, very firm
	
	• Sample Intervals:
	    o 0-2’
	    o 2-3’
	    o 3-8.2’
	    o 8.2-10’

PROJECT: Providence River-Edgewood Shoals DATE: 8/20/20
SAMPLING PERSONNEL: RBL/TAR
SEA STATE: Calm WEATHER CODE: Sunny
LOCATION METHOD: DGPS

SAMPLE ID: L SAMPLER TYPE: Vibracore
TIME: 12:26
SOUNDING: 15.6’ CORRECTED DEPTH: -2.7=12.9’
COORDINATES: N 41.780739 E -71.386083
PENETRATION/RECOVERY: 12.0/11.5’ NO. OF ATTEMPTS: 2
MATERIAL DESCRIPTION: Black organic silt over grey silt

CORE PHOTO:	NOTES:
	Multiple attempts, the first core had shallow recovery because barrel clogged with a large clam shell, second core driven to core head. • 0-2.8: Black organic silt, wet, very soft • 2.8-11.5: moist, grey non-plastic silt with shell fragments throughout, firmer with depth • Sample Intervals o 0-1’ o 1-2.8’ o 2.8-3.8’ o 3.8-11.5’

PROJECT: Providence River-Edgewood Shoals DATE: 8/20/20

SAMPLING PERSONNEL: RBL/TAR

SEA STATE: Calm WEATHER CODE: Sunny

LOCATION METHOD: DGPS

SAMPLE ID: M SAMPLER TYPE: Vibracore

TIME: 13:00

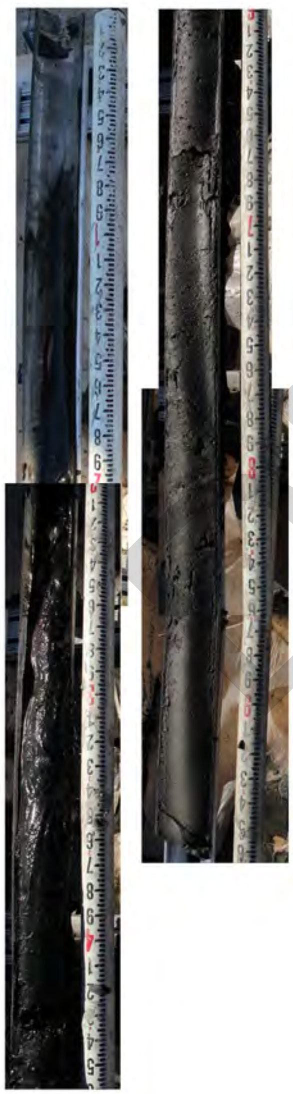
SOUNDING: 14.5’ CORRECTED DEPTH: -1.4’=13.1

COORDINATES: N 41.781553 E -71.383797

PENETRATION/RECOVERY: 9.8/9.8’ NO. OF ATTEMPTS: 4

MATERIAL DESCRIPTION: Black organic silt over grey sandy silt

CORE PHOTO:



NOTES:

Driven to refusal. Multiple attempts and one relocation due to poor penetration.

- 0-2: water with suspended silt
- 0-5.3’: black organic silt, very loose and wet, petroleum odor
- 5.3-6.5’: soft wet grey silt
- 6.5-9.5’: firmer grey sandy silt, moist, firmer with depth, small shell fragments

- Sample Interval
  - 0-2’
  - 2-5.3’
  - 5.3-6.5
  - 6.5-9.5

PROJECT: Providence River-Edgewood Shoals DATE: 8/20/20

SAMPLING PERSONNEL: RBL/TAR

SEA STATE: Calm WEATHER CODE: Sunny

LOCATION METHOD: DGPS

SAMPLE ID: N SAMPLER TYPE: Vibracore

TIME: 13:38

SOUNDING: 8.5 CORRECTED DEPTH: -0.4=8.1’

COORDINATES: N 41.782144 E -71.381785

PENETRATION/RECOVERY: 4.0/4.0’ NO. OF ATTEMPTS: 3

MATERIAL DESCRIPTION: Grey sandy silt

CORE PHOTO:	NOTES:

	Shallow refusal with multiple attempts.
	
	• 0-4’ soft, wet, grey sandy silt, firmer with depth
	    o 0-1.4’: large shells (clams, oysters) and coarser sand
	    o 1.1’ ~3 inch clam shell
	
	• Sample Intervals
	    o 0-4.0’

PROJECT: Providence River-Edgewood Shoals DATE: 8/20/20

SAMPLING PERSONNEL: RBL/TAR

SEA STATE: Calm WEATHER CODE: Sunny

LOCATION METHOD: DGPS

SAMPLE ID: O SAMPLER TYPE: Vibracore

TIME: 13:58

SOUNDING: 7.8’ CORRECTED DEPTH: -0=7.8’

COORDINATES: N 41.782921 E -71.379349

PENETRATION/RECOVERY: 5.5/5.5’ NO. OF ATTEMPTS: 2

MATERIAL DESCRIPTION: Grey sandy silt over silty fine sand

CORE PHOTO:

NOTES:

Shallow refusal, core barrel bent and cracked on first attempt

- 0-0.6: black, very loose, wet sandy silt with a lot of shell fragments and large whole shells,
- 0.6-2.6: soft, wet, grey sandy silt, some shell fragments
- 2.6-5.5’: grey, firm, moist, silty fine sand
- 3.2’: shell fragments
- 3.5-3.7’: lens of med-coarse sand

- Sample Intervals:
  - 0-0.6’
  - 0.6-2.6
  - 2.6-5.5

PROJECT: Providence River-Edgewood Shoals DATE: 8/20/20

SAMPLING PERSONNEL: RBL/TAR

SEA STATE: Calm WEATHER CODE: Sunny

LOCATION METHOD: DGPS

SAMPLE ID: P SAMPLER TYPE: Vibracore

TIME: 14:35

SOUNDING: 7.1’ CORRECTED DEPTH: +0.3=7.4’

COORDINATES: N 41.783792 E -71.376646

PENETRATION/RECOVERY: 12.0/11.5’ NO. OF ATTEMPTS: 1

MATERIAL DESCRIPTION: Grey sandy silt

CORE PHOTO:	NOTES:

	Driven to core head
	
	• 0-2.5’: extremely loose, wet grey silt with large (~2inch) mussel and clam shells
	• 2.5-4.0’: grey, soft, wet, sandy silt
	• 4.0-8.5’: firmer, wet, grey silt with some shell fragments, firmer with depth
	  o 6.8’: larger pieces of shell
	• 8.5-9.5’: moist grey sandy silt with more coarse shell fragments at bottom of core
	
	• Sample Intervals
	  o 0-2.5’
	  o 2.5-4.0’
	  o 4-8.5’
	  o 8.5-9.5’

Appendix C

Bioaccumulation and BEST Model Results

Table C-1 Tissue Analysis – Mean Wet Weight Chemical Concentrations and Statistical Findings for *M. nasuta* Tissue

Analyte	Native Tissue	2019 RISDS Reference	Composite 1 (W1-W3)	Composite 2 (C1-C3)	Composite 3 (E1-E6)	Composite 4 (A1-A3)	Composite 5 (W3,C3,E4,A3)
Total Metals (mg/kg wet weight))							
Arsenic	1.3	2.6	2.0 NS	1.8 NS	2.3 NS	1.7 NS	1.7 NS
Cadmium	0.023 b	0.034 b	0.030 bNS	0.037 bNS	0.033 bNS	0.025 bNS	0.025 bNS
Chromium	0.35 b	0.30 b	0.37 bNS	0.80 S	0.22 bNS	0.24 bNS	0.30 bNS
Copper	1.3	1.2	1.4 S	3.9 S	1.5 S	1.4 NS	1.8 S
Lead	0.25	0.22	0.21 NS	1.2 S	0.2 NS	0.24 NS	0.31 S
Mercury	0.002 a	0.0017 a	0.0019 ac	0.0031 abS	0.0020 ac	0.0020 ac	0.0019 ac
Nickel	0.25	0.61	0.42 NS	0.44 NS	0.40 NS	0.37 NS	0.40 NS
Zinc	8.6	13.4	10.2 NS	9.5 NS	11 NS	8.5 NS	9.0 NS
Polycyclic Aromatic Hydrocarbons (ug/kg)							
Acenaphthene	0.46 a	0.47 a	0.46 ac	0.56 abNS	0.45 ac	0.46 ac	0.46 ac
Acenaphthylene	0.29 a	0.29 a	0.29 ac	1.5 bS	0.28 ac	0.28 ac	0.38 abNS
Anthracene	0.31 a	0.31 a	0.31 ac	4.0 bS	0.30 ac	0.66 abNS	0.65 abS
Benzo(a)anthracene	0.58 a	0.58 a	0.58 ac	28 S	0.57 ac	1.7 aNS	3.8 bS
Benzo(a)pyrene	0.61 a	0.61 a	0.61 ac	22 S	0.59 ac	1.7 aNS	2.9 bS
Benzo(b)fluoranthene	0.80 a	0.81 a	0.80 ac	30 S	0.79 ac	1.8 aNS	4.1 bS
Benzo(k)fluoranthene	0.37 a	0.37 a	0.37 ac	21 S	0.36 ac	1.1 abNS	3.2 bS
Benzo(g,h,i)perylene	0.26 a	0.26 a	0.26 ac	0.25 ac	0.25 ac	0.26 ac	0.25 ac
Chrysene	0.56 a	0.57 a	0.56 ac	30 S	1.1 abS	1.3 abNS	3.7 bS
Dibenzo(a,h)anthracene	0.30 a	0.30 a	0.30 ac	0.29 ac	0.29 ac	0.30 ac	0.29 ac
Fluoranthene	2.0 b	2.1 b	1.49 bNS	52 S	1.3 abNS	3.3 bNS	6.2 S
Fluorene	1.2 b	0.26 a	1.12 bS	1.9 bS	0.83 bS	1.6 bS	1.1 bS
Indeno(1,2,3-c,d)pyrene	0.61 a	0.74 ab	0.61 aNS	0.59 aNS	0.59 aNS	0.60 aNS	0.60 aNS
Naphthalene	0.40 a	0.40 a	0.40 ac	1.1 bS	0.39 ac	0.64 abNS	0.39 ac
Phenanthrene	2.3 b	1.2 ab	2.1 bS	8.3 S	2.0 bS	3.8 bS	2.7 bS
Pyrene	0.96 ab	0.86 ab	1.3 abNS	79 S	2.1 bS	4.0 abS	11 S
Total LMW PAHs [1]	*5.0*	*2.9*	*4.6*	*17*	*4.3*	*7.4*	*5.7*
Total HMW PAHs [1]	*7.1*	*7.2*	*6.9*	*264*	*8.0*	*16*	*37*
Total PAHs [1]	*12*	*10*	*12*	*281*	*12*	*23*	*42*
Polychlorinated Biphenyl Congeners (ug/kg)							
PCB 8	0.048 a	0.048 a	0.048 ac	0.30 bS	0.047 ac	0.048 ac	0.047 ac
PCB 18	0.035 a	0.035 a	0.035 ac	0.69 S	0.034 ac	0.035 ac	0.034 ac
PCB 28	0.059 a	0.059 a	0.059 ac	1.3 S	0.058 ac	0.059 ac	0.058 ac
PCB 44	0.066 a	0.066 a	0.066 ac	0.85 S	0.064 ac	0.065 ac	0.22 bS
PCB 52	0.037 a	0.037 a	0.052 abNS	3.6 S	0.036 ac	0.036 ac	0.66 S
PCB 66	0.035 a	0.035 a	0.035 ac	1.8 S	0.034 ac	0.034 ac	0.27 bS
PCB 101	0.056 a	0.057 a	0.056 ac	6.8 S	0.055 ac	0.096 abNS	1.4 S
PCB 105	0.050 a	0.051 a	0.051 ac	1.9 S	0.049 ac	0.050 ac	0.45 bS
PCB 118	0.053 a	0.054 a	0.054 ac	4.4 S	0.052 ac	0.065 abNS	0.98 S
PCB 128	0.063 a	0.063 a	0.063 ac	1.0 S	0.062 ac	0.062 ac	0.31 bS
PCB 138	0.040 a	0.041 a	0.040 ac	4.3 S	0.040 ac	0.040 ac	1.0 S
PCB 153	0.084 a	0.084 a	0.084 ac	3.2 S	0.082 ac	0.083 ac	0.73 S
PCB 170	0.031 a	0.031 a	0.031 ac	0.48 bS	0.030 ac	0.031 ac	0.031 ac
PCB 180	0.032 a	0.032 a	0.032 ac	0.89 S	0.031 ac	0.031 ac	0.27 bS
PCB 187	0.045 a	0.046 a	0.045 ac	0.76 S	0.044 ac	0.045 ac	0.18 bS
PCB 195	0.059 a	0.060 a	0.059 ac	0.06 ac	0.058 ac	0.059 ac	0.058 ac
PCB 206	0.061 a	0.061 a	0.061 ac	0.31 bS	0.059 ac	0.060 ac	0.060 ac
PCB 209	0.070 a	0.070 a	0.070 ac	0.25 bS	0.068 ac	0.069 ac	0.068 ac
Total PCBs [1]	*1.8*	*1.9*	*1.9*	*65*	*1.8*	*1.9*	*14*
Pesticides (ug/kg)							
Aldrin	0.030 a	0.030 a	0.030 ac	0.029 ac	0.030 ac	0.030 ac	0.030 ac
cis-Chlordane	0.065 a	0.066 a	0.065 ac	0.063 ac	0.064 ac	0.065 ac	0.064 ac
trans-Chlordane	0.018 a	0.018 a	0.018 ac	0.018 ac	0.018 ac	0.018 ac	0.018 ac
cis-Nonachlor	0.088 a	0.0088 a	0.009 ac	0.0086 ac	0.0085 ac	0.009 ac	0.0087 ac
trans-Nonachlor	0.008 a	0.0081 a	0.008 ac	0.0077 ac	0.0080 ac	0.008 ac	0.0078 ac
Oxychlordane	0.037 a	0.038 a	0.038 ac	0.036 ac	0.037 ac	0.037 ac	0.037 ac
Total Chlordanes [1]	*0.14*	*0.14*	*0.14*	*0.13*	*0.13*	*0.14*	*0.14*
4,4'-DDT	0.012 a	0.012 a	0.012 ac	0.012 ac	0.012 ac	0.012 ac	0.012 ac
4,4'-DDD	0.009 a	0.0091 a	0.0091 ac	0.0087 ac	0.0088 ac	0.0091 ac	0.0088 ac
4,4'-DDE	0.0055 a	0.18 b	0.0055 aNS	3.4 S	0.0055 aNS	0.006 aNS	0.0054 aNS
Total DDT [1]	*0.026*	*0.20*	*0.026*	*3.4*	*0.026*	*0.026*	*0.026*
Dieldrin	0.018 a	0.018 a	0.018 ac	3.0 S	0.018 ac	0.018 ac	0.018 ac
alpha-Endosulfan	0.017 a	0.017 a	0.017 ac	0.016 ac	0.016 ac	0.017 ac	0.017 ac
beta-Endosulfan	0.0085 a	0.009 a	0.009 ac	0.008 ac	0.0085 ac	0.0086 ac	0.0083 ac
Endosulfans[1]	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Endrin	0.0098 a	0.010 a	0.010 ac	0.010 ac	0.010 ac	0.010 ac	0.010 ac
Heptachlor	0.019 a	0.019 a	0.019 ac	0.018 ac	0.018 ac	0.019 ac	0.019 ac
Heptachlor epoxide	0.039 a	0.039 a	0.039 ac	0.038 ac	0.038 ac	0.039 ac	0.038 ac
Hexachlorobenzene	0.16 a	0.16 a	0.163 ac	0.16 ac	0.159 ac	0.161 ac	0.16 ac
Lindane	0.027 a	0.027 a	0.027 ac	0.027 ac	0.027 ac	0.027 ac	0.027 ac
Methoxychlor	0.043 a	0.42 a	0.043 ac	0.042 ac	0.042 ac	0.043 ac	0.042 ac
Toxaphene	0.08 a	0.79 a	0.79 ac	0.76 ac	0.77 ac	0.78 ac	0.77 ac

Results for RISDS Reference and Composites are presented are the mean of five replicate samples. Native tissue results are presented as the mean of three replicates.

Mean concentrations are reported to 2 significant figures for organic compounds and metals ≤9.9 mg/kg, and to 3 significant figures for metals ≥10.0 mg/kg.

1 - Totals calculated for informational purposes only using 1/2 MDL for non-detected values. Statistical analysis not conducted on total values and qualifiers not applied.

Statistical qualifiers -

- a - Analyte not detected (below MDL) in at least one replicate; mean value was calculated using one-half the MDL for the non-detect.
- b - Analyte estimated (detected below RL but above MDL) in at least one replicate; mean value calculated using estimated value.
- c - Analyte was not detected in the target composite tissue replicates or in the historic reference tissue, therefore it was eliminated from further evaluation for the composite.

NS - Not Significant - mean tissue body burden was not statistically different from the associated reference site mean body burden. Statistical significance accepted at α=0.05.

S - Significant - mean tissue body burden was statistically different, greater than the associated reference site mean body burden. Statistical significance accepted at α=0.05

Table C-2 Tissue Analysis – Mean Wet Weight Chemical Concentrations and Statistical Findings for *N. virens* Tissue

Analyte	Native Tissue	2019 CLDS Reference	Composite 1 (W1-W3)	Composite 2 (C1-C3)	Composite 3 (E1-E6)	Composite 4 (A1-A3)	Composite 5 (W3,C3,E4,A3)
Total Metals (mg/kg wet weight)							
Arsenic	1.3	1.5	1.3 NS	1.1 NS	1.3 NS	1.3 NS	1.1 NS
Cadmium	0.023 b	0.030 b	0.027 bNS	0.033 bNS	0.025 bNS	0.025 bNS	0.025 bNS
Chromium	0.3 b	0.054 b	0.17 bS	0.24 bS	0.11 bS	0.14 bS	0.082 bS
Copper	1.6	1.1	1.8 S	3.1 S	1.4 NS	1.3 NS	1.2 NS
Lead	0.12	0.055	0.089 S	0.21 S	0.067 S	0.063 NS	0.069 S
Mercury	0.014 b	0.014 b	0.014 bNS	0.014 bNS	0.015 bNS	0.014 bNS	0.013 bNS
Nickel	0.30	0.13 b	0.21 S	0.22 S	0.16 S	0.18 S	0.12 NS
Zinc	6.0	25	6.6 NS	19 NS	5.2 NS	14 NS	7.8 NS
Polycyclic Aromatic Hydrocarbons (ug/kg wet weight)							
Acenaphthene	0.45 a	0.46 a	0.46 ac	0.70 abNS	0.47 ac	0.47 ac	0.47 ac
Acenaphthylene	0.28 a	0.28 a	0.28 ac	0.28 ac	0.29 ac	0.29 ac	0.29 ac
Anthracene	0.30 a	0.31 a	0.37 abNS	0.39 abNS	0.38 abNS	0.31 ac	0.31 ac
Benzo(a)anthracene	0.57 a	0.58 a	0.57 ac	1.9 bS	0.58 ac	0.58 ac	0.58 ac
Benzo(a)pyrene	0.59 a	0.61 a	0.60 ac	0.61 ac	0.61 ac	0.61 ac	0.61 ac
Benzo(b)fluoranthene	0.79 a	0.80 a	0.79 ac	0.80 ac	0.81 ac	0.81 ac	0.81 ac
Benzo(k)fluoranthene	0.36 a	0.37 a	0.36 ac	0.37 ac	0.37 ac	0.37 ac	0.37 ac
Benzo(g,h,i)perylene	0.25 a	0.26 a	0.26 ac	0.26 ac	0.26 ac	0.26 ac	0.26 ac
Chrysene	0.55 a	0.56 a	0.56 ac	2.5 bS	0.57 ac	0.57 ac	0.56 ac
Dibenzo(a,h)anthracene	0.29 a	0.30 a	0.30 ac	0.30 ac	0.30 ac	0.30 ac	0.30 ac
Fluoranthene	0.45 a	0.45 a	0.54 abNS	4.3 bS	0.46 ac	0.46 ac	0.94 abS
Fluorene	0.91 b	0.26 a	1.0 bS	1.1 bS	1.0 bS	1.0 bS	0.92 bS
Indeno(1,2,3-c,d)pyrene	0.59 a	0.60 a	0.60 ac	0.60 ac	0.61 ac	0.61 ac	0.61 ac
Naphthalene	1.20 b	0.40 a	0.39 ac	0.40 ac	0.40 ac	0.40 ac	0.40 ac
Phenanthrene	0.67 ab	0.62 ab	1.1 abS	1.3 abS	1.3 bS	0.63 abNS	0.62 abNS
Pyrene	0.66 a	0.67 a	0.66 ac	6.1 S	0.68 ac	0.68 ac	1.6 abS
Total LMW PAHs [1]	*3.8*	*2.3*	*3.6*	*4.1*	*3.8*	*3.1*	*3.0*
Total HMW PAHs [1]	*5.1*	*5.2*	*5.2*	*18*	*5.3*	*5.3*	*6.6*
Total PAHs [1]	*8.9*	*7.5*	*8.8*	*22*	*9.1*	*8.4*	*9.6*
Polychlorinated Biphenyl Congeners (ug/kg wet weight)							
PCB 8	0.047 a	0.048 a	0.058 abNS	0.078 abNS	0.048 ac	0.048 ac	0.048 ac
PCB 18	0.034 a	0.035 a	0.034 ac	0.28 abS	0.035 ac	0.035 ac	0.035 ac
PCB 28	0.058 a	0.059 a	0.058 ac	0.46 abNS	0.060 ac	0.060 ac	0.059 ac
PCB 44	0.064 a	0.066 a	0.082 abNS	0.33 bS	0.067 ac	0.066 ac	0.066 ac
PCB 52	0.036 a	0.11 ab	0.036 aNS	1.5 S	0.037 aNS	0.037 aNS	0.44 abS
PCB 66	0.034 a	0.034 a	0.060 abNS	0.33 bS	0.035 ac	0.035 ac	0.035 ac
PCB 101	0.20 b	0.056 a	0.19 abS	2.1 S	0.057 ac	0.057 ac	0.46 bS
PCB 105	0.049 a	0.050 a	0.050 ac	1.0 S	0.051 ac	0.051 ac	0.15 abS
PCB 118	0.052 a	0.053 a	0.053 ac	0.68 bS	0.054 ac	0.054 ac	0.21 abS
PCB 128	0.062 a	0.063 a	0.10 abNS	0.55 bS	0.064 ac	0.064 ac	0.063 ac
PCB 138	0.34 b	0.41 b	0.40 bNS	2.1 S	0.041 aNS	0.26 abNS	0.50 bS
PCB 153	0.43 b	0.50 b	0.61 S	1.9 S	0.085 aNS	0.30 abNS	0.61 S
PCB 170	0.030 a	0.031 a	0.072 abNS	0.37 abS	0.031 ac	0.031 ac	0.031 ac
PCB 180	0.23 b	0.031 a	0.28 abS	0.70 S	0.032 ac	0.16 abS	0.27 bS
PCB 187	0.27 b	0.087 ab	0.30 bS	0.70 bS	0.046 aNS	0.20 abS	0.22 abS
PCB 195	0.058 a	0.059 a	0.059 ac	0.059 ac	0.060 ac	0.060 ac	0.060 ac
PCB 206	0.059 a	0.060 a	0.060 ac	0.060 ac	0.061 ac	0.061 ac	0.061 ac
PCB 209	0.068 a	0.069 a	0.069 ac	0.069 ac	0.070 ac	0.070 ac	0.070 ac
Total PCBs [1]	*4.2*	*3.6*	*5.2*	*27*	*1.9*	*3.3*	*6.8*
Pesticides (ug/kg wet weight)							
Aldrin	0.030 a	0.030 a	0.030 ac	0.030 ac	0.031 ac	0.030 ac	0.030 ac
cis-Chlordane	0.064 a	0.065 a	0.064 ac	0.065 ac	0.066 ac	0.066 ac	0.065 ac
trans-Chlordane	0.018 a	0.018 a	0.018 ac	0.018 ac	0.019 ac	0.019 ac	0.018 ac
cis-Nonachlor	0.0085 a	0.009 a	0.009 ac	0.0088 ac	0.009 ac	0.0089 ac	0.0088 ac
trans-Nonachlor	0.0080 a	0.008 a	0.0080 ac	0.0080 ac	0.008 ac	0.0080 ac	0.0081 ac
Oxychlordane	0.037 a	0.037 a	0.037 ac	0.037 ac	0.038 ac	0.038 ac	0.037 ac
Total Chlordanes [1]	*0.13*	*0.14*	*0.14*	*0.14*	*0.14*	*0.14*	*0.14*
4,4'-DDT	0.012 a	0.012 a	0.012 ac	0.012 ac	0.012 ac	0.012 ac	0.012 ac
4,4'-DDD	0.0090 a	0.009 a	0.009 ac	0.0090 ac	0.009 ac	0.0091 ac	0.0091 ac
4,4'-DDE	0.0055 a	0.005 a	0.006 ac	0.0055 ac	0.006 ac	0.0054 ac	0.0055 ac
Total DDT [1]	*0.026*	*0.026*	*0.026*	*0.026*	*0.027*	*0.027*	*0.027*
Dieldrin	0.018 a	0.018 a	0.018 ac	0.018 ac	0.018 ac	0.018 ac	0.018 ac
alpha-Endosulfan	0.016 a	0.017 a	0.016 ac	0.017 ac	0.017 ac	0.017 ac	0.017 ac
beta-Endosulfan	0.0085 a	0.0085 a	0.0085 ac	0.0086 ac	0.009 ac	0.0086 ac	0.0086 ac
Endosulfans[1]	0.025	0.025	0.025	0.025	0.026	0.025	0.025
Endrin	0.0097 a	0.010 a	0.010 ac	0.010 ac	0.010 ac	0.010 ac	0.010 ac
Heptachlor	0.019 a	0.019 a	0.019 ac	0.019 ac	0.019 ac	0.019 ac	0.019 ac
Heptachlor epoxide	0.038 a	0.039 a	0.039 ac	0.039 ac	0.039 ac	0.039 ac	0.039 ac
Hexachlorobenzene	0.16 a	0.16 a	0.16 ac	0.16 ac	0.16 ac	0.16 ac	0.16 ac
Lindane	0.027 a	0.027 a	0.027 ac	0.027 ac	0.028 ac	0.028 ac	0.027 ac
Methoxychlor	0.042 a	0.42 a	0.043 ac	0.043 ac	0.043 ac	0.043 ac	0.043 ac
Toxaphene	0.77 a	0.78 a	0.78 ac	0.78 ac	0.79 ac	0.79 ac	0.79 ac

Results for RISDS Reference and Composites are presented are the mean of five replicate samples. Native tissue results are presented as the mean of three replicates.

Mean concentrations are reported to 2 significant figures for organic compounds and metals ≤9.9 mg/kg, and to 3 significant figures for metals ≥10.0 mg/kg.

1 - Totals calculated for informational purposes only using 1/2 MDL for non-detected values. Statistical analysis not conducted on total values and qualifiers not applied.

Statistical qualifiers -

- a - Analyte not detected (below MDL) in at least one replicate; mean value was calculated using one-half the MDL for the non-detect.
- b - Analyte estimated (detected below RL but above MDL) in at least one replicate; mean value calculated using estimated value.
- c - Analyte was not detected in the target composite tissue replicates or in the historic reference tissue, therefore it was eliminated from further evaluation for the composite.

NS - Not Significant - mean tissue body burden was not statistically different from the associated reference site mean body burden. Statistical significance accepted at α=0.05.

S - Significant - mean tissue body burden was statistically different, greater than the associated reference site mean body burden. Statistical significance accepted at α=0.05

Project name:	Edgewood Shoals 2021
Project number:	
Model filename:	EdgewoodShoals2021.best
Chemical filename:	Chemical_List_for_EPA_Reg1_template (in progress).xlsx

Table Of Contents

Selected Chemicals

Invertebrate Name Macoma nasuta

	Composite 1	Composite 2	Composite 3	Composite 4	Composite 5
101					
105					
118					
1234678 HpDD					
1234678-HpCDD					
1234678-HpCDF					
123478-HxCDD					
123478-HxCDF					
123478-HxDD					
1234789-HpCDF					
123678-HxCDD					
123678-HxCDF					
123678-HxDD					
12378 PeCDD					
12378-PeCDF					
123789-HxCDD					
123789-HxCDF					
123789-HxDD					
128					

	Composite 1	Composite 2	Composite 3	Composite 4	Composite 5
138					
153					
170					
18					
180					
187					
195					
206					
209					
234678-HxCDF					
23478-PeCDF					
2378 TCDD					
2378-TCDF					
28					
4,4'-DDD					
4,4'-DDE					
4,4'-DDT					
44					
52					
66					
8					
Acenaphthene					
Acenaphthylene		X			
Aldrin					
Aldrin+Dieldrin					
Anthracene		X			X
Arsenic	X				
Benzo(a)anthracene					X
Benzo(a)pyrene					X
Benzo(a)pyrene TEQ					
Benzo(b)fluoranthene					X
Benzo(g,h,i)perylene					
Benzo(k)fluoranthene					X
Cadmium					
Chlordane+Heptachlo					
Chromium		X			
Chrysene		X	X		
Copper		X	X		X

	Composite 1	Composite 2	Composite 3	Composite 4	Composite 5
DIOXINS/FURANS					
Dibenzo(a,h)					
Dieldrin		X			
Dioxin					
Endosulfans					
Endrin					
Fluoranthene		X			X
Fluorene	X	X	X	X	X
Heptachlor					
Heptachlor epoxide					
Heptachlor+Heptachlo					
Hexachlorobenzene					
Indeno(1,2,3-c,d)					
Lead		X			X
Lindane					
Lv - Phenanthrene					
METALS					
Mercury		X			
Methoxychlor					
Mirex					
Naphthalene		X	X		
Nickel					
OCDD					
OCDF					
Oxychlordane					
PAH Total		X		X	X
PAHS					
PCB 101					
PCB 105					
PCB 118					
PCB 128					
PCB 138					
PCB 153					
PCB 170					
PCB 18					
PCB 180					
PCB 187					
PCB 195					

	Composite 1	Composite 2	Composite 3	Composite 4	Composite 5
PCB 206					
PCB 209					
PCB 28					
PCB 44					
PCB 52					
PCB 66					
PCB 8					
PCB Congeners					
PCB-105					
PCB-114					
PCB-118					
PCB-123					
PCB-126					
PCB-156					
PCB-157					
PCB-167					
PCB-169					
PCB-189					
PCB-77					
PCB-81					
PESTICIDES					
Phenanthrene	X	X	X	X	X
Pyrene		X			X
Silver					
Total Chlordanes					
Total DDT					
Total PCBs		X			X
Toxaphene					
Zinc					
alpha-Endosulfan					
beta-Endosulfan					
bis (2-ethylhexyl)					
cis-Chlordane					
cis-Nonachlor					
trans-Chlordane					
trans-Nonachlor					

Selected Chemicals

Invertebrate Name Nereis virens

	Composite 1	Composite 2	Composite 3	Composite 4	Composite 5
101					
105					
118					
1234678 HpDD					
1234678-HpCDD					
1234678-HpCDF					
123478-HxCDD					
123478-HxCDF					
123478-HxDD					
1234789-HpCDF					
123678-HxCDD					
123678-HxCDF					
123678-HxDD					
12378 PeCDD					
12378-PeCDF					
123789-HxCDD					
123789-HxCDF					
123789-HxDD					
128					
138					
153					
170					
18					
180					
187					
195					
206					
209					
234678-HxCDF					
23478-PeCDF					
2378 TCDD					
2378-TCDF					
28					
4,4'-DDD					
4,4'-DDE					

	Composite 1	Composite 2	Composite 3	Composite 4	Composite 5
4,4'-DDT					
44					
52					
66					
8					
Acenaphthene					
Acenaphthylene					
Aldrin					
Aldrin+Dieldrin					
Anthracene					
Arsenic					
Benzo(a)anthracene		X			
Benzo(a)pyrene					
Benzo(a)pyrene TEQ					
Benzo(b)fluoranthene					
Benzo(g,h,i)perylene					
Benzo(k)fluoranthene					
Cadmium					
Chlordane+Heptachlo					
Chromium	X	X	X	X	X
Chrysene		X			
Copper	X	X			
DIOXINS/FURANS					
Dibenzo(a,h)					
Dieldrin					
Dioxin					
Endosulfans					
Endrin					
Fluoranthene		X			X
Fluorene	X	X	X	X	X
Heptachlor					
Heptachlor epoxide					
Heptachlor+Heptachlo					
Hexachlorobenzene					
Indeno(1,2,3-c,d)					
Lead	X	X	X		X
Lindane					
Lv - Phenanthrene					

	Composite 1	Composite 2	Composite 3	Composite 4	Composite 5
METALS					
Mercury					
Methoxychlor					
Mirex					
Naphthalene					
Nickel	X	X	X	X	
OCDD					
OCDF					
Oxychlordane					
PAH Total		X			
PAHS					
PCB 101					
PCB 105					
PCB 118					
PCB 128					
PCB 138					
PCB 153					
PCB 170					
PCB 18					
PCB 180					
PCB 187					
PCB 195					
PCB 206					
PCB 209					
PCB 28					
PCB 44					
PCB 52					
PCB 66					
PCB 8					
PCB Congeners					
PCB-105					
PCB-114					
PCB-118					
PCB-123					
PCB-126					
PCB-156					
PCB-157					
PCB-167					

	Composite 1	Composite 2	Composite 3	Composite 4	Composite 5
PCB-169					
PCB-189					
PCB-77					
PCB-81					
PESTICIDES					
Phenanthrene	X	X	X		
Pyrene					X
Silver					
Total Chlordanes					
Total DDT					
Total PCBs		X			X
Toxaphene					
Zinc					
alpha-Endosulfan					
beta-Endosulfan					
bis (2-ethylhexyl)					
cis-Chlordane					
cis-Nonachlor					
trans-Chlordane					
trans-Nonachlor					

Human Subreport

Human: Adult Angler

Total Estimated Risks From Organics(see EPA Table Xa)

Receptor: Adult Angler

Organism: Macoma nasuta

		Cancer Risk	Non-Cancer Risk
Composite 1 (W1,W2,W3)		Fish Fillet	
	Test	0	2.79E-6
	Reference	0	4.93E-7
		Total Lobster	
	Test	0	1.44E-5
	Reference	0	2.54E-6
		Lobster Muscle	
	Test	0	4.47E-6
	Reference	0	7.89E-7

		Cancer Risk	Non-Cancer Risk
		Macoma nasuta	
	Test	0	3.21E-6
	Reference	0	5.68E-7
		Nereis virens	
	Test	0	0
	Reference	0	0
		Lobster Hepatopancreas	
	Test	0	9.94E-6
	Reference	0	1.76E-6
Composite 2 (C1,C2,C3)		Fish Fillet	
	Test	3.67E-5	7.78E-1
	Reference	7.54E-7	1.81E-2
		Total Lobster	
	Test	1.89E-4	4.01E0
	Reference	3.89E-6	9.34E-2
		Lobster Muscle	
	Test	5.87E-5	1.24E0
	Reference	1.21E-6	2.9E-2
		Macoma nasuta	
	Test	3.82E-5	8.01E-1
	Reference	7.78E-7	1.86E-2
		Nereis virens	
	Test	0	0
	Reference	0	0
		Lobster Hepatopancreas	
	Test	1.31E-4	2.77E0
	Reference	2.68E-6	6.44E-2
Composite 3 (E1,E2,E3,		Fish Fillet	
	Test	2.13E-9	3.1E-6
	Reference	6.62E-10	2.01E-6
		Total Lobster	
	Test	1.1E-8	1.6E-5
	Reference	3.41E-9	1.04E-5
		Lobster Muscle	
	Test	3.41E-9	4.96E-6
	Reference	1.06E-9	3.21E-6

		Cancer Risk	Non-Cancer Risk
		Macoma nasuta	
	Test	2.32E-9	3.57E-6
	Reference	7.2E-10	2.32E-6
		Nereis virens	
	Test	0	0
	Reference	0	0
		Lobster Hepatopancreas	
	Test	7.58E-9	1.1E-5
	Reference	2.36E-9	7.15E-6
Composite 4 (A1,A2,A3)		Fish Fillet	
	Test	0	4.82E-6
	Reference	0	4.93E-7
		Total Lobster	
	Test	0	2.49E-5
	Reference	0	2.54E-6
		Lobster Muscle	
	Test	0	7.71E-6
	Reference	0	7.89E-7
		Macoma nasuta	
	Test	0	5.55E-6
	Reference	0	5.68E-7
		Nereis virens	
	Test	0	0
	Reference	0	0
		Lobster Hepatopancreas	
	Test	0	1.72E-5
	Reference	0	1.76E-6
Composite 5 (W3,C3,E4,		Fish Fillet	
	Test	1.27E-5	1.69E-1
	Reference	1.68E-6	1.81E-2
		Total Lobster	
	Test	6.57E-5	8.71E-1
	Reference	8.67E-6	9.32E-2
		Lobster Muscle	
	Test	2.04E-5	2.7E-1
	Reference	2.69E-6	2.89E-2

		Cancer Risk	Non-Cancer Risk
		Macoma nasuta	
	Test	1.32E-5	1.74E-1
	Reference	1.74E-6	1.86E-2
		Nereis virens	
	Test	0	0
	Reference	0	0
		Lobster Hepatopancreas	
	Test	4.53E-5	6.01E-1
	Reference	5.98E-6	6.43E-2

Total Estimated Risks From Organics(see EPA Table Xa)

Receptor: Adult Angler

Organism: Nereis virens

		Cancer Risk	Non-Cancer Risk
Composite 1 (W1,W2,W3)		Fish Fillet	
	Test	0	1.93E-6
	Reference	0	4.12E-7
		Total Lobster	
	Test	0	9.95E-6
	Reference	0	2.13E-6
		Lobster Muscle	
	Test	0	3.08E-6
	Reference	0	6.6E-7
		Macoma nasuta	
	Test	0	0
	Reference	0	0
		Nereis virens	
	Test	0	2.61E-6
	Reference	0	5.59E-7
		Lobster Hepatopancreas	
	Test	0	6.86E-6
	Reference	0	1.47E-6
Composite 2 (C1,C2,C3)		Fish Fillet	
	Test	1.15E-5	2.85E-1
	Reference	1.35E-6	3.26E-2
		Total Lobster	
	Test	5.96E-5	1.47E0
	Reference	6.94E-6	1.68E-1
		Lobster Muscle	
	Test	1.85E-5	4.56E-1
	Reference	2.15E-6	5.22E-2
		Macoma nasuta	
	Test	0	0
	Reference	0	0

		Cancer Risk	Non-Cancer Risk
		Nereis virens	
	Test	1.4E-5	3.45E-1
	Reference	1.63E-6	3.96E-2
		Lobster Hepatopancreas	
	Test	4.11E-5	1.01E0
	Reference	4.79E-6	1.16E-1
Composite 3 (E1,E2,E3,		Fish Fillet	
	Test	0	2.28E-6
	Reference	0	4.12E-7
		Total Lobster	
	Test	0	1.17E-5
	Reference	0	2.13E-6
		Lobster Muscle	
	Test	0	3.64E-6
	Reference	0	6.6E-7
		Macoma nasuta	
	Test	0	0
	Reference	0	0
		Nereis virens	
	Test	0	3.09E-6
	Reference	0	5.59E-7
		Lobster Hepatopancreas	
	Test	0	8.1E-6
	Reference	0	1.47E-6
Composite 4 (A1,A2,A3)		Fish Fillet	
	Test	0	1.96E-6
	Reference	0	4.12E-7
		Total Lobster	
	Test	0	1.01E-5
	Reference	0	2.13E-6
		Lobster Muscle	
	Test	0	3.14E-6
	Reference	0	6.6E-7
		Macoma nasuta	
	Test	0	0
	Reference	0	0

		Cancer Risk	Non-Cancer Risk
		Nereis virens	
	Test	0	2.66E-6
	Reference	0	5.59E-7
		Lobster Hepatopancreas	
	Test	0	6.98E-6
	Reference	0	1.47E-6
Composite 5 (W3,C3,E4,		Fish Fillet	
	Test	2.44E-6	6.1E-2
	Reference	1.31E-6	3.26E-2
		Total Lobster	
	Test	1.26E-5	3.15E-1
	Reference	6.73E-6	1.68E-1
		Lobster Muscle	
	Test	3.9E-6	9.75E-2
	Reference	2.09E-6	5.22E-2
		Macoma nasuta	
	Test	0	0
	Reference	0	0
		Nereis virens	
	Test	2.96E-6	7.39E-2
	Reference	1.58E-6	3.96E-2
		Lobster Hepatopancreas	
	Test	8.68E-6	2.17E-1
	Reference	4.65E-6	1.16E-1

Seafood Non-Cancer Risks (see EPA Table 6a, Columns F & G)

Receptor: Adult Angler

Organism: Macoma nasuta

			Non-Cancer Risk
Composite 1 (W1,W2,W3)	Arsenic	Test	5.77E-1
		Reference	7.51E-1
Composite 2 (C1,C2,C3)	Chromium	Test	2.28E-2
		Reference	8.58E-3
	Copper	Test	0
		Reference	0
	Lead	Test	0
		Reference	0
	Mercury	Test	2.66E-3
		Reference	1.44E-3
Composite 3 (E1,E2,E3,E4,E5,E6)	Copper	Test	0
		Reference	0
Composite 5 (W3,C3,E4,A3)	Copper	Test	0
		Reference	0
	Lead	Test	0
		Reference	0

Seafood Non-Cancer Risks (see EPA Table 6a, Columns F & G)

Receptor: Adult Angler

Organism: Nereis virens

			Non-Cancer Risk
Composite 1 (W1,W2,W3)	Chromium	Test	4.82E-3
		Reference	1.53E-3
	Copper	Test	0
		Reference	0
	Lead	Test	0
		Reference	0
	Nickel	Test	0
		Reference	0
Composite 2 (C1,C2,C3)	Chromium	Test	6.76E-3
		Reference	1.53E-3
	Copper	Test	0
		Reference	0
	Lead	Test	0
		Reference	0
	Nickel	Test	0
		Reference	0
Composite 3 (E1,E2,E3,E4,E5,E6)	Chromium	Test	3.03E-3
		Reference	1.53E-3
	Lead	Test	0
		Reference	0
	Nickel	Test	0
		Reference	0
Composite 4 (A1,A2,A3)	Chromium	Test	4.13E-3
		Reference	1.53E-3
	Nickel	Test	0
		Reference	0
Composite 5 (W3,C3,E4,A3)	Chromium	Test	2.35E-3
		Reference	1.53E-3
	Lead	Test	0
		Reference	0

FDA Action Limit/Tolerance (see EPA Table 3, Columns D & E)

Receptor: Adult Angler

Organism: Macoma nasuta

	Contaminant	FDA Action Level (mg/kg)	Steady State Corrected Mean Tissue Concentration (mg/kg)
Composite 1 (W1,W2,	Total PCBs	2E3	4.3E0
Composite 1 (W1,W2,	Mercury	1E0	1.9E-3
Composite 1 (W1,W2,	Total DDT	5E3	4.48E-2
Composite 1 (W1,W2,	Total Chlordanes	3E2	2.3E-1
Composite 2 (C1,C2,	Total PCBs	2E3	1.58E2
Composite 2 (C1,C2,	Mercury	1E0	3.1E-3
Composite 2 (C1,C2,	Total DDT	5E3	5.23E0
Composite 2 (C1,C2,	Total Chlordanes	3E2	2.23E-1
Composite 3 (E1,E2,E3,	Total PCBs	2E3	4.13E0
Composite 3 (E1,E2,E3,	Mercury	1E0	2E-3
Composite 3 (E1,E2,E3,	Total DDT	5E3	4.41E-2
Composite 3 (E1,E2,E3,	Total Chlordanes	3E2	2.25E-1
Composite 4 (A1,A2,A3)	Total PCBs	2E3	4.33E0
Composite 4 (A1,A2,A3)	Mercury	1E0	2E-3
Composite 4 (A1,A2,A3)	Total DDT	5E3	4.48E-2
Composite 4 (A1,A2,A3)	Total Chlordanes	3E2	2.28E-1
Composite 5 (W3,C3,	Total PCBs	2E3	3.04E1
Composite 5 (W3,C3,	Mercury	1E0	1.9E-3
Composite 5 (W3,C3,	Total DDT	5E3	4.41E-2
Composite 5 (W3,C3,	Total Chlordanes	3E2	2.26E-1

FDA Action Limit/Tolerance (see EPA Table 3, Columns D & E)

Receptor: Adult Angler

Organism: Nereis virens

	Contaminant	FDA Action Level (mg/kg)	Steady State Corrected Mean Tissue Concentration (mg/kg)
Composite 1 (W1,W2,	Total PCBs	2E3	1.14E1
Composite 1 (W1,W2,	Mercury	1E0	1.44E-2
Composite 1 (W1,W2,	Total DDT	5E3	4.44E-2
Composite 1 (W1,W2,	Total Chlordanes	3E2	2.27E-1
Composite 2 (C1,C2,	Total PCBs	2E3	5.91E1
Composite 2 (C1,C2,	Mercury	1E0	1.36E-2
Composite 2 (C1,C2,	Total DDT	5E3	4.46E-2
Composite 2 (C1,C2,	Total Chlordanes	3E2	2.28E-1
Composite 3 (E1,E2,E3,	Total PCBs	2E3	4.14E0
Composite 3 (E1,E2,E3,	Mercury	1E0	1.46E-2
Composite 3 (E1,E2,E3,	Total DDT	5E3	4.51E-2
Composite 3 (E1,E2,E3,	Total Chlordanes	3E2	2.31E-1
Composite 4 (A1,A2,A3)	Total PCBs	2E3	7.3E0
Composite 4 (A1,A2,A3)	Mercury	1E0	1.44E-2
Composite 4 (A1,A2,A3)	Total DDT	5E3	4.5E-2
Composite 4 (A1,A2,A3)	Total Chlordanes	3E2	2.31E-1
Composite 5 (W3,C3,	Total PCBs	2E3	1.5E1
Composite 5 (W3,C3,	Mercury	1E0	1.3E-2
Composite 5 (W3,C3,	Total DDT	5E3	4.53E-2
Composite 5 (W3,C3,	Total Chlordanes	3E2	2.3E-1

Ecological Effects Level (see EPA Table 8a.1, Columns D & E)

Receptor: Adult Angler

Organism: Macoma nasuta

	Contaminant	Ecological Effect Level (mg/kg)	Steady State Corrected Mean Tissue Concentration (mg/kg)
Composite 1 (W1,W2,	Anthracene	3.75E3	3.09E-1
Composite 1 (W1,W2,	Benzo(a)pyrene	8E3	1.22E0
Composite 1 (W1,W2,	PAH Total	1E4	1.15E1
Composite 1 (W1,W2,	Total PCBs	4E3	4.3E0
Composite 1 (W1,W2,	Aldrin	2.99E2	3.02E-2
Composite 1 (W1,W2,	Dieldrin	4.37E0	2.46E-2
Composite 1 (W1,W2,	Endosulfans	2.86E0	2.52E-2
Composite 1 (W1,W2,	Arsenic	1.26E1	2.02E0
Composite 1 (W1,W2,	Cadmium	3.03E0	3E-2
Composite 1 (W1,W2,	Chromium	1.18E1	3.68E-1
Composite 1 (W1,W2,	Copper	9.6E0	1.43E0
Composite 1 (W1,W2,	Lead	1.19E1	2.07E-1
Composite 1 (W1,W2,	Mercury	2E-1	1.9E-3
Composite 1 (W1,W2,	Nickel	3.8E0	4.18E-1
Composite 1 (W1,W2,	Zinc	1.52E3	1.02E1
Composite 1 (W1,W2,	Total DDT	3E3	4.48E-2
Composite 2 (C1,C2,	Anthracene	3.75E3	3.97E0
Composite 2 (C1,C2,	Benzo(a)pyrene	8E3	4.39E1
Composite 2 (C1,C2,	PAH Total	1E4	2.81E2
Composite 2 (C1,C2,	Total PCBs	4E3	1.58E2
Composite 2 (C1,C2,	Aldrin	2.99E2	2.94E-2
Composite 2 (C1,C2,	Dieldrin	4.37E0	4.09E0
Composite 2 (C1,C2,	Endosulfans	2.86E0	2.45E-2
Composite 2 (C1,C2,	Arsenic	1.26E1	1.84E0
Composite 2 (C1,C2,	Cadmium	3.03E0	3.74E-2
Composite 2 (C1,C2,	Chromium	1.18E1	7.98E-1
Composite 2 (C1,C2,	Copper	9.6E0	3.92E0
Composite 2 (C1,C2,	Lead	1.19E1	1.22E0
Composite 2 (C1,C2,	Mercury	2E-1	3.1E-3
Composite 2 (C1,C2,	Nickel	3.8E0	4.41E-1
Composite 2 (C1,C2,	Zinc	1.52E3	9.52E0
Composite 2 (C1,C2,	Total DDT	3E3	5.23E0
Composite 3 (E1,E2,E3,	Anthracene	3.75E3	3.02E-1
Composite 3 (E1,E2,E3,	Benzo(a)pyrene	8E3	1.19E0

	Contaminant	Ecological Effect Level (mg/kg)	Steady State Corrected Mean Tissue Concentration (mg/kg)
Composite 3 (E1,E2,E3,	PAH Total	1E4	1.22E1
Composite 3 (E1,E2,E3,	Total PCBs	4E3	4.13E0
Composite 3 (E1,E2,E3,	Aldrin	2.99E2	2.95E-2
Composite 3 (E1,E2,E3,	Dieldrin	4.37E0	2.4E-2
Composite 3 (E1,E2,E3,	Endosulfans	2.86E0	2.48E-2
Composite 3 (E1,E2,E3,	Arsenic	1.26E1	2.29E0
Composite 3 (E1,E2,E3,	Cadmium	3.03E0	3.28E-2
Composite 3 (E1,E2,E3,	Chromium	1.18E1	2.2E-1
Composite 3 (E1,E2,E3,	Copper	9.6E0	1.5E0
Composite 3 (E1,E2,E3,	Lead	1.19E1	2.37E-1
Composite 3 (E1,E2,E3,	Mercury	2E-1	2E-3
Composite 3 (E1,E2,E3,	Nickel	3.8E0	3.97E-1
Composite 3 (E1,E2,E3,	Zinc	1.52E3	1.08E1
Composite 3 (E1,E2,E3,	Total DDT	3E3	4.41E-2
Composite 4 (A1,A2,A3)	Anthracene	3.75E3	6.56E-1
Composite 4 (A1,A2,A3)	Benzo(a)pyrene	8E3	3.44E0
Composite 4 (A1,A2,A3)	PAH Total	1E4	2.35E1
Composite 4 (A1,A2,A3)	Total PCBs	4E3	4.33E0
Composite 4 (A1,A2,A3)	Aldrin	2.99E2	2.99E-2
Composite 4 (A1,A2,A3)	Dieldrin	4.37E0	2.43E-2
Composite 4 (A1,A2,A3)	Endosulfans	2.86E0	2.51E-2
Composite 4 (A1,A2,A3)	Arsenic	1.26E1	1.7E0
Composite 4 (A1,A2,A3)	Cadmium	3.03E0	2.5E-2
Composite 4 (A1,A2,A3)	Chromium	1.18E1	2.41E-1
Composite 4 (A1,A2,A3)	Copper	9.6E0	1.42E0
Composite 4 (A1,A2,A3)	Lead	1.19E1	2.4E-1
Composite 4 (A1,A2,A3)	Mercury	2E-1	2E-3
Composite 4 (A1,A2,A3)	Nickel	3.8E0	3.67E-1
Composite 4 (A1,A2,A3)	Zinc	1.52E3	8.51E0
Composite 4 (A1,A2,A3)	Total DDT	3E3	4.48E-2
Composite 5 (W3,C3,	Anthracene	3.75E3	6.53E-1
Composite 5 (W3,C3,	Benzo(a)pyrene	8E3	5.9E0
Composite 5 (W3,C3,	PAH Total	1E4	4.22E1
Composite 5 (W3,C3,	Total PCBs	4E3	3.04E1
Composite 5 (W3,C3,	Aldrin	2.99E2	2.97E-2
Composite 5 (W3,C3,	Dieldrin	4.37E0	2.43E-2
Composite 5 (W3,C3,	Endosulfans	2.86E0	2.48E-2

	Contaminant	Ecological Effect Level (mg/kg)	Steady State Corrected Mean Tissue Concentration (mg/kg)
Composite 5 (W3,C3,	Arsenic	1.26E1	1.69E0
Composite 5 (W3,C3,	Cadmium	3.03E0	2.54E-2
Composite 5 (W3,C3,	Chromium	1.18E1	3E-1
Composite 5 (W3,C3,	Copper	9.6E0	1.78E0
Composite 5 (W3,C3,	Lead	1.19E1	3.09E-1
Composite 5 (W3,C3,	Mercury	2E-1	1.9E-3
Composite 5 (W3,C3,	Nickel	3.8E0	4.03E-1
Composite 5 (W3,C3,	Zinc	1.52E3	9.01E0
Composite 5 (W3,C3,	Total DDT	3E3	4.41E-2

Ecological Effects Level (see EPA Table 8a.1, Columns D & E)

Receptor: Adult Angler

Organism: Nereis virens

	Contaminant	Ecological Effect Level (mg/kg)	Steady State Corrected Mean Tissue Concentration (mg/kg)
Composite 1 (W1,W2,	Anthracene	3.75E3	3.74E-1
Composite 1 (W1,W2,	Benzo(a)pyrene	8E3	1.2E0
Composite 1 (W1,W2,	PAH Total	1E4	8.82E0
Composite 1 (W1,W2,	Total PCBs	4E3	1.14E1
Composite 1 (W1,W2,	Aldrin	2.99E2	2.98E-2
Composite 1 (W1,W2,	Dieldrin	4.37E0	2.42E-2
Composite 1 (W1,W2,	Endosulfans	2.86E0	2.49E-2
Composite 1 (W1,W2,	Arsenic	1.26E1	1.32E0
Composite 1 (W1,W2,	Cadmium	3.03E0	2.68E-2
Composite 1 (W1,W2,	Chromium	1.18E1	1.69E-1
Composite 1 (W1,W2,	Copper	9.6E0	1.79E0
Composite 1 (W1,W2,	Lead	1.19E1	8.86E-2
Composite 1 (W1,W2,	Mercury	2E-1	1.44E-2
Composite 1 (W1,W2,	Nickel	3.8E0	2.1E-1
Composite 1 (W1,W2,	Zinc	1.52E3	6.64E0
Composite 1 (W1,W2,	Total DDT	3E3	4.44E-2
Composite 2 (C1,C2,	Anthracene	3.75E3	3.86E-1
Composite 2 (C1,C2,	Benzo(a)pyrene	8E3	1.21E0
Composite 2 (C1,C2,	PAH Total	1E4	2.18E1
Composite 2 (C1,C2,	Total PCBs	4E3	5.91E1
Composite 2 (C1,C2,	Aldrin	2.99E2	3E-2
Composite 2 (C1,C2,	Dieldrin	4.37E0	2.44E-2
Composite 2 (C1,C2,	Endosulfans	2.86E0	2.51E-2
Composite 2 (C1,C2,	Arsenic	1.26E1	1.11E0
Composite 2 (C1,C2,	Cadmium	3.03E0	3.26E-2
Composite 2 (C1,C2,	Chromium	1.18E1	2.37E-1
Composite 2 (C1,C2,	Copper	9.6E0	3.13E0
Composite 2 (C1,C2,	Lead	1.19E1	2.06E-1
Composite 2 (C1,C2,	Mercury	2E-1	1.36E-2
Composite 2 (C1,C2,	Nickel	3.8E0	2.2E-1
Composite 2 (C1,C2,	Zinc	1.52E3	1.9E1
Composite 2 (C1,C2,	Total DDT	3E3	4.46E-2
Composite 3 (E1,E2,E3,	Anthracene	3.75E3	3.78E-1
Composite 3 (E1,E2,E3,	Benzo(a)pyrene	8E3	1.23E0

	Contaminant	Ecological Effect Level (mg/kg)	Steady State Corrected Mean Tissue Concentration (mg/kg)
Composite 3 (E1,E2,E3,	PAH Total	1E4	9.1E0
Composite 3 (E1,E2,E3,	Total PCBs	4E3	4.14E0
Composite 3 (E1,E2,E3,	Aldrin	2.99E2	3.05E-2
Composite 3 (E1,E2,E3,	Dieldrin	4.37E0	2.47E-2
Composite 3 (E1,E2,E3,	Endosulfans	2.86E0	2.55E-2
Composite 3 (E1,E2,E3,	Arsenic	1.26E1	1.26E0
Composite 3 (E1,E2,E3,	Cadmium	3.03E0	2.54E-2
Composite 3 (E1,E2,E3,	Chromium	1.18E1	1.06E-1
Composite 3 (E1,E2,E3,	Copper	9.6E0	1.35E0
Composite 3 (E1,E2,E3,	Lead	1.19E1	6.74E-2
Composite 3 (E1,E2,E3,	Mercury	2E-1	1.46E-2
Composite 3 (E1,E2,E3,	Nickel	3.8E0	1.61E-1
Composite 3 (E1,E2,E3,	Zinc	1.52E3	5.21E0
Composite 3 (E1,E2,E3,	Total DDT	3E3	4.51E-2
Composite 4 (A1,A2,A3)	Anthracene	3.75E3	3.12E-1
Composite 4 (A1,A2,A3)	Benzo(a)pyrene	8E3	1.23E0
Composite 4 (A1,A2,A3)	PAH Total	1E4	8.38E0
Composite 4 (A1,A2,A3)	Total PCBs	4E3	7.3E0
Composite 4 (A1,A2,A3)	Aldrin	2.99E2	3.04E-2
Composite 4 (A1,A2,A3)	Dieldrin	4.37E0	2.48E-2
Composite 4 (A1,A2,A3)	Endosulfans	2.86E0	2.54E-2
Composite 4 (A1,A2,A3)	Arsenic	1.26E1	1.25E0
Composite 4 (A1,A2,A3)	Cadmium	3.03E0	2.54E-2
Composite 4 (A1,A2,A3)	Chromium	1.18E1	1.45E-1
Composite 4 (A1,A2,A3)	Copper	9.6E0	1.25E0
Composite 4 (A1,A2,A3)	Lead	1.19E1	6.32E-2
Composite 4 (A1,A2,A3)	Mercury	2E-1	1.44E-2
Composite 4 (A1,A2,A3)	Nickel	3.8E0	1.79E-1
Composite 4 (A1,A2,A3)	Zinc	1.52E3	1.37E1
Composite 4 (A1,A2,A3)	Total DDT	3E3	4.5E-2
Composite 5 (W3,C3,	Anthracene	3.75E3	3.1E-1
Composite 5 (W3,C3,	Benzo(a)pyrene	8E3	1.22E0
Composite 5 (W3,C3,	PAH Total	1E4	9.6E0
Composite 5 (W3,C3,	Total PCBs	4E3	1.5E1
Composite 5 (W3,C3,	Aldrin	2.99E2	3.03E-2
Composite 5 (W3,C3,	Dieldrin	4.37E0	2.47E-2
Composite 5 (W3,C3,	Endosulfans	2.86E0	2.53E-2

	Contaminant	Ecological Effect Level (mg/kg)	Steady State Corrected Mean Tissue Concentration (mg/kg)
Composite 5 (W3,C3,	Arsenic	1.26E1	1.1E0
Composite 5 (W3,C3,	Cadmium	3.03E0	2.48E-2
Composite 5 (W3,C3,	Chromium	1.18E1	8.22E-2
Composite 5 (W3,C3,	Copper	9.6E0	1.18E0
Composite 5 (W3,C3,	Lead	1.19E1	6.92E-2
Composite 5 (W3,C3,	Mercury	2E-1	1.3E-2
Composite 5 (W3,C3,	Nickel	3.8E0	1.25E-1
Composite 5 (W3,C3,	Zinc	1.52E3	7.77E0
Composite 5 (W3,C3,	Total DDT	3E3	4.53E-2

FDA Level of Concern (see EPA Table 7a, Columns B & D)

Receptor: Adult Angler

Organism: Macoma nasuta

	Contaminant	FDA Level of Concern(mg/kg)	Steady State Corrected Mean Tissue Concentration (mg/kg)
Composite 1 (W1,W2,	Arsenic	8.6E1	2.02E0
Composite 1 (W1,W2,	Cadmium	3.7E0	3E-2
Composite 1 (W1,W2,	Chromium	1.3E1	3.68E-1
Composite 1 (W1,W2,	Lead	1.7E0	2.07E-1
Composite 1 (W1,W2,	Nickel	8E1	4.18E-1
Composite 2 (C1,C2,	Arsenic	8.6E1	1.84E0
Composite 2 (C1,C2,	Cadmium	3.7E0	3.74E-2
Composite 2 (C1,C2,	Chromium	1.3E1	7.98E-1
Composite 2 (C1,C2,	Lead	1.7E0	1.22E0
Composite 2 (C1,C2,	Nickel	8E1	4.41E-1
Composite 3 (E1,E2,E3,	Arsenic	8.6E1	2.29E0
Composite 3 (E1,E2,E3,	Cadmium	3.7E0	3.28E-2
Composite 3 (E1,E2,E3,	Chromium	1.3E1	2.2E-1
Composite 3 (E1,E2,E3,	Lead	1.7E0	2.37E-1
Composite 3 (E1,E2,E3,	Nickel	8E1	3.97E-1
Composite 4 (A1,A2,A3)	Arsenic	8.6E1	1.7E0
Composite 4 (A1,A2,A3)	Cadmium	3.7E0	2.5E-2
Composite 4 (A1,A2,A3)	Chromium	1.3E1	2.41E-1
Composite 4 (A1,A2,A3)	Lead	1.7E0	2.4E-1
Composite 4 (A1,A2,A3)	Nickel	8E1	3.67E-1
Composite 5 (W3,C3,	Arsenic	8.6E1	1.69E0
Composite 5 (W3,C3,	Cadmium	3.7E0	2.54E-2
Composite 5 (W3,C3,	Chromium	1.3E1	3E-1
Composite 5 (W3,C3,	Lead	1.7E0	3.09E-1
Composite 5 (W3,C3,	Nickel	8E1	4.03E-1

FDA Level of Concern (see EPA Table 7a, Columns B & D)

Receptor: Adult Angler

Organism: Nereis virens

	Contaminant	FDA Level of Concern(mg/kg)	Steady State Corrected Mean Tissue Concentration (mg/kg)
Composite 1 (W1,W2,	Arsenic	8.6E1	1.32E0
Composite 1 (W1,W2,	Cadmium	3.7E0	2.68E-2
Composite 1 (W1,W2,	Chromium	1.3E1	1.69E-1
Composite 1 (W1,W2,	Lead	1.7E0	8.86E-2
Composite 1 (W1,W2,	Nickel	8E1	2.1E-1
Composite 2 (C1,C2,	Arsenic	8.6E1	1.11E0
Composite 2 (C1,C2,	Cadmium	3.7E0	3.26E-2
Composite 2 (C1,C2,	Chromium	1.3E1	2.37E-1
Composite 2 (C1,C2,	Lead	1.7E0	2.06E-1
Composite 2 (C1,C2,	Nickel	8E1	2.2E-1
Composite 3 (E1,E2,E3,	Arsenic	8.6E1	1.26E0
Composite 3 (E1,E2,E3,	Cadmium	3.7E0	2.54E-2
Composite 3 (E1,E2,E3,	Chromium	1.3E1	1.06E-1
Composite 3 (E1,E2,E3,	Lead	1.7E0	6.74E-2
Composite 3 (E1,E2,E3,	Nickel	8E1	1.61E-1
Composite 4 (A1,A2,A3)	Arsenic	8.6E1	1.25E0
Composite 4 (A1,A2,A3)	Cadmium	3.7E0	2.54E-2
Composite 4 (A1,A2,A3)	Chromium	1.3E1	1.45E-1
Composite 4 (A1,A2,A3)	Lead	1.7E0	6.32E-2
Composite 4 (A1,A2,A3)	Nickel	8E1	1.79E-1
Composite 5 (W3,C3,	Arsenic	8.6E1	1.1E0
Composite 5 (W3,C3,	Cadmium	3.7E0	2.48E-2
Composite 5 (W3,C3,	Chromium	1.3E1	8.22E-2
Composite 5 (W3,C3,	Lead	1.7E0	6.92E-2
Composite 5 (W3,C3,	Nickel	8E1	1.25E-1

Software version: BEST 4.0

Last date: 09/24/2021

User name: RBL

Appendix D

Elutriate Chemistry and Ammonia Data

Table D-1 Seawater and Elutriate Chemistry Results

Analyte		Lab Seawater		Dredge Site Water		Composite 1 Elutriate		Composite 2 Elutriate		Composite 3 Elutriate		Composite 4 Elutriate		Composite 5 Elutriate	
Metals (mg/L)															
Arsenic		0.00085		0.00058		0.030		0.0038		0.030		0.025		0.013	
Cadmium		0.000028		0.000036		0.000020	U	0.000022	J	0.000020	U	0.000020	U	0.000014	J
Chromium		0.00020	J	0.00023		0.00033		0.0053		0.00026		0.00030		0.00060	
Chromium, Hexavalent		0.010	U	0.010	UJ	0.010	U	0.0077	J	0.010	U	0.010	UJ	0.010	UJ
Copper		0.00037		0.00084		0.00025		0.0029		0.00029		0.00030		0.00042	
Lead		0.000050	U	0.000050	U	0.000059		0.00067		0.000033	J	0.000050	U	0.000069	
Mercury		0.00020	U	0.00020	U	0.00020	U	0.00020	U	0.00020	U	0.00020	U	0.00020	U
Nickel		0.00034		0.00087		0.00047		0.0020		0.00047		0.00046		0.00058	
Selenium		0.0010	U	0.0010	U	0.0010	U	0.0010	U	0.0010	U	0.0010	U	0.0010	U
Silver		0.00040	U	0.00040	U	0.00040	U	0.00040	U	0.00040	U	0.00040	U	0.00040	U
Zinc		0.0038		0.0020		0.00042	J	0.0018		0.00042	J	0.00067		0.00059	J
Organochlorine Pesticides (ug/L)															
4,4-DDT		0.00048	U	0.00047	U	0.00047	U	0.00047	U	0.00048	U	0.00047	U	0.00047	U
Aldrin		0.00096	U	0.00094	UJ	0.00095	UJ	0.00094	UJ	0.00096	U	0.00094	UJ	0.00094	UJ
Chloropyrifos		0.00096	U	0.00094	U	0.00095	U	0.00094	U	0.00096	U	0.00094	U	0.00094	U
cis-Chlordane		0.00048	U	0.00047	U	0.00047	U	0.00047	U	0.00048	U	0.00047	U	0.00047	U
Dieldrin		0.00048	U	0.00047	U	0.00047	U	0.00391	J	0.00048	U	0.00047	U	0.00054	J
Endosulfan I		0.00048	U	0.00047	U	0.00047	U	0.00047	U	0.00048	U	0.00047	U	0.00047	U
Endosulfan II		0.00048	U	0.00047	U	0.00047	U	0.00047	U	0.00048	U	0.00047	U	0.00047	U
Endrin		0.00048	U	0.00047	U	0.00047	U	0.00047	U	0.00048	U	0.00047	U	0.00047	U
gamma-BHC (Lindane)		0.00048	U	0.00047	U	0.00047	U	0.00047	U	0.00048	U	0.00047	U	0.00047	U
Heptachlor		0.00048	U	0.00047	UJ	0.00047	UJ	0.00047	UJ	0.00048	U	0.00047	UJ	0.00047	UJ
Heptachlor epoxide		0.00048	U	0.00047	U	0.00047	U	0.00047	U	0.00048	U	0.00047	U	0.00047	U
Toxaphene		0.024	U	0.024	U	0.024	U	0.024	U	0.024	U	0.024	U	0.024	U
trans-Chlordane		0.00048	U	0.00047	U	0.00047	U	0.00047	U	0.00048	U	0.00047	U	0.00047	U
Oxychlordane		0.00048	U	0.00047	U	0.00047	U	0.00047	U	0.00048	U	0.00047	U	0.00047	U
Pentachlorophenol (ug/L)															
Pentachlorophenol		1.89	UJ	1.89	U	1.89	U	1.89	U	1.89	U	1.89	U	1.89	U
Polychlorinated Biphenyl Congeners (ug/L)															
PCB 8		0.00096	U	0.00094	U	0.0010	U	0.00094	U	0.00096	U	0.00094	U	0.00094	U
PCB 18		0.00096	U	0.00094	U	0.0010	UJ	0.00061	J	0.00096	U	0.00094	U	0.00072	J
PCB 28		0.00096	U	0.00094	U	0.0010	U	0.0010	J	0.00096	U	0.00094	U	0.00058	J
PCB 44		0.00096	U	0.00094	U	0.0010	U	0.0016		0.00096	U	0.00094	U	0.00038	J
PCB 49	x	0.00096	U	0.00094	U	0.0010	U	0.0013	J	0.00096	U	0.00094	U	0.00027	J
PCB 52		0.00096	U	0.00094	U	0.00067	J	0.0029		0.00096	U	0.00094	U	0.00062	J
PCB 66		0.00096	U	0.00094	U	0.0010	U	0.0015		0.00096	U	0.00094	U	0.00051	J
PCB 87	x	0.00096	U	0.00094	U	0.0010	U	0.0033		0.00096	U	0.00094	U	0.00094	U
PCB 101		0.00096	U	0.00094	U	0.0010	U	0.0065		0.00096	U	0.00094	U	0.0013	J
PCB 105		0.00096	U	0.00094	U	0.0010	U	0.0031		0.00096	U	0.00094	U	0.00042	J
PCB 118		0.00096	U	0.00094	U	0.0010	U	0.0055		0.00096	U	0.00094	U	0.0011	J
PCB 128		0.00096	U	0.00094	U	0.0010	U	0.0016		0.00096	U	0.00094	U	0.00085	J
PCB 138		0.00096	U	0.00094	U	0.0010	U	0.0075		0.00096	U	0.00094	U	0.0013	J
PCB 153		0.00096	U	0.00094	U	0.0010	U	0.0054		0.00096	U	0.00094	U	0.00085	J
PCB 170		0.00096	U	0.00094	U	0.0010	U	0.0018		0.00096	U	0.00094	U	0.00081	J
PCB 180		0.00096	U	0.00094	U	0.0010	U	0.0029		0.00096	U	0.00094	U	0.00064	J
PCB 183	x	0.00096	U	0.00094	U	0.0010	U	0.00084	J	0.00096	U	0.00094	U	0.00073	J
PCB 184	x	0.00096	U	0.00094	U	0.0010	U	0.00094	U	0.00096	U	0.00094	U	0.00070	J
PCB 187		0.00096	U	0.00094	U	0.0010	U	0.0017		0.00096	U	0.00094	U	0.00078	J
PCB 195		0.00096	U	0.00094	U	0.0010	U	0.00094	U	0.00096	U	0.00094	U	0.00094	U
PCB 206		0.00096	U	0.00094	U	0.0010	U	0.0024		0.00096	U	0.00094	U	0.0010	
PCB 209		0.00096	U	0.00094	U	0.0010	U	0.0028		0.00096	U	0.00094	U	0.00095	J
Total PCBs		*0.0023*	*U*	*0.0022*	*U*	*0.0023*	*J*	*0.098*		*0.0023*	*U*	*0.0022*	*U*	*0.018*	*J*

Results presented are the mean of three replicate samples.
One-half of the sample-specific method detection limit (MDL) is used to represent non-detects in calculation of Total PCBs.
Total Polychlorinated Biphenyls (PCBs) calculated as the sum of the 18 NOAA congeners multiplied by 2.

J - Estimated value reported in at least one replicate.
mg/L - Milligram per liter.
NA - Not analyzed.
U - Not detected above the laboratory reporting limit (RL) in all replicates.
ug/L - Microgram per liter.
UJ - Analyte was analyzed for but not detected in at least one replicate. The sample RL is an estimated value.
x - Congener is not one of the 18 NOAA congeners included in Total PCBs.

Table D-2 Suspended Particulate Phase Testing – Water Quality Data Summary - Unmitigated

	Temperature (°C)		pH (SU)		Salinity (‰)		Ammonia (mg/L) Start		Ammonia (mg/L) End	
Sample ID	**Start**	**End**	**Start**	**End**	**Start**	**End**	**Total**	**Unionized**	**Total**	**Unionized**
A. bahia [a]										
Standard Elutriate Testing										
Laboratory Control	20	20	7.96	7.68	30.1	32.2	<0.015	<0.0004	0.083	0.0013
Composite 1	20	20	7.94	7.78	29.2	32.7	3.28	0.0936	3.55	0.0694
Composite 2	20	20	7.86	8.06	28.5	32.1	13.3	0.3186	5.75	0.2111
Composite 3	21	20	7.88	7.77	30.1	32.9	2.22	0.0593	3.14	0.0599
Composite 4	20	20	7.86	7.90	29.4	33.4	3.22	0.0767	3.08	0.0786
Composite 5	21	20	7.87	8.04	27.7	30.9	8.06	0.2133	4.31	0.1524
M. beryllina [a]										
Standard Elutriate Testing										
Laboratory Control	20	20	7.96	7.74	30.1	32.6	<0.015	<0.0004	0.057	0.0010
Composite 1	20	20	7.94	7.92	29.2	32.0	3.28	0.0936	2.94	0.0790
Composite 2	20	20	7.86	8.11	28.5	31.4	13.3	0.3186	4.36	0.1795
Composite 3	21	20	7.88	7.81	30.1	31.8	2.22	0.0593	2.97	0.0624
Composite 4	20	20	7.86	7.89	29.4	32.2	3.22	0.0767	3.06	0.0768
Composite 5	21	20	7.87	8.03	27.7	30.3	8.06	0.2133	3.99	0.1384
A. punctulate [a]										
Standard Elutriate Testing										
Laboratory Control	20	21	7.96	7.97	30.1	30.1	<0.015	<0.0004	<0.015	<0.0005
Composite 1	20	21	7.94	8.11	29.2	28.9	3.28	0.0936	3.07	0.1376
Composite 2[b]	20	21	7.86	8.32	28.5	29.0	13.3	0.3186	13.4	0.9470
Composite 3	21	21	7.88	8.08	30.1	29.6	2.22	0.0593	2.07	0.0865
Composite 4	20	21	7.86	8.11	29.4	29.7	3.22	0.0767	2.99	0.1334
Composite 5[b]	21	21	7.87	8.26	27.7	28.0	8.06	0.2133	6.98	0.4359

[a] Sample data are from 100% test concentration. Results from dilutions are reported in Appendix C.1.
[b] There were no surviving organisms at assay end in the 100% test solution.

Table D-3 Suspended Particulate Phase Testing –Water Quality Data Summary - Mitigated

Sample ID	Temperature (°C)		pH (SU)		Salinity (‰)		Ammonia (mg/L) Start		Ammonia (mg/L) End	
	Start	End	Start	End	Start	End	Total	Unionized	Total	Unionized
A. bahia [a]										
Laboratory Control	22	20	7.93	7.58	31.0	31.8	<0.015	<0.0005	1.78	0.0222
Mit Composite 2	22	20	7.91	7.63	30.0	32.8	1.4	0.0430	2.52	0.0350
M. beryllina [a]										
Laboratory Control	22	20	7.93	7.75	31.0	32.0	<0.015	<0.0005	1.55	0.0284
Mit Composite 2	22	20	7.91	7.72	30.0	32.3	1.4	0.0430	2.34	0.0400
A. punctulate [a]										
Laboratory Control	22	21	7.93	7.95	31.0	30.9	<0.015	<0.0005	0.147	0.0046
Mit Composite 2	22	22	7.91	7.99	30.0	30.1	1.4	0.0403	1.29	0.0473

[a] Sample data are from 100% test concentration. Results from dilutions are reported in Appendix C.1.

CENAE–RDP 18 July 2017

MEMORANDUM THRU:

Ruth M. Ladd, Chief, Policy Analysis and Technical Support Branch LADD.RUTH.M.1228556242 Digitally signed by LADD.RUTH.M.1228556242 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=LADD.RUTH.M.1228556242 Date: 2017.07.20 14:46:12 -04'00'

FOR: William M. Kavanaugh, Project Manager, CENAE-PPMD

SUBJECT: Suitability Determination for the Providence River Maintenance Dredging Federal Navigation Project

1. **References Cited**

a. US EPA Region I/USACE-NAE. 2014. Reference Memorandum for Evaluating Testing and Non-Testing Requirements of 40 C.F.R 227.6 and 227.27 Federal Navigation Dredging or Non-Federal Dredging Projects, for Open Ocean Disposal at the Rhode Island Sound Disposal Site (RISDS).

b. USEPA Region I/USACE-NAE. 2004. Regional Implementation Manual for the Evaluation of Dredged Material Proposed for Disposal in New England Waters. Environmental Protection Agency, Region 1, Boston, MA/US Army Corps of Engineers, New England District, Concord, MA. 54 pp.

c. USACE-NAE. 2015. Environmental Assessment/Finding of No Significant Impact, Providence River Federal Navigation Project Maintenance Dredging, US Army Corps of Engineers (USACE), New England District, Concord, MA.

2. **Summary**

This memorandum addresses compliance with the regulatory evaluation and testing requirements of the Marine Protection, Research and Sanctuaries Act (MPRSA, or Ocean Dumping Act) regulations at 40 CFR 227 as well as the issues outlined in the Rhode Island Sound Disposal Site (RISDS) Reference Memo (USEPA Region 1/USACE-NAE 2014) for unconfined open water disposal at an ocean disposal site.

Based upon this review, some of the proposed dredged material (from the Providence River Federal Navigation Project represented by composite samples COMP1 to COMP8) is not suitable for unrestricted ocean disposal at RISDS. This unsuitability is based on reduced survival rates observed in the elutriate bioassays and the increased calculated risks from the tissue bioaccumulation in the sediments represented by these composite samples. However, the balance of the proposed dredged material from the Providence River Federal Navigation Project (represented by composite sample COMP9) is suitable for unrestricted ocean disposal at RISDS.

Detailed information pertaining to the regulatory issues associated with the evaluation of this project as well as the technical background of the analytical tests summarized herein is found in the RISDS Reference Memo (EPA/USACE-NAE 2014). A copy of this memo can be obtained upon request from the EPA or USACE.

3. **Project Description**

The New England District (NAE) of the United States Army Corps of Engineers (USACE) is currently proposing to dredge an area of approximately 205 acres from shoaled areas within the 40 foot channel. This would produce a volume of approximately 548,000 cubic yards of sand and silt. This material is proposed to be mechanically dredged and disposed of at Rhode Island Sound Disposal Site (RISDS).

Project History: The Providence River is a tidal river formed by the junction of the Woonasquatucket and Moshassuck Rivers. From this confluence in the City of Providence, Rhode Island, the river flows southerly for 8 miles before emptying into Narragansett Bay. The Federal Navigation Project (FNP) in the Providence River is a 16.8 mile long channel that begins near the head of Providence Harbor and follows the Providence River on a southerly course to deep water near Prudence Island. The upper 2.5 miles comprise the main harbor of the port of Providence. The channel is generally 600 feet wide except for a length between Fields Point (near the Providence-Cranston city line) and Fox Point, where it has varying widths of up to 1,700 ft. The channel has an authorized depth of 40 feet (MLLW).

4. **Sampling Plan:**

A sampling plan (SAP) was developed by Ben Loyd of NAE and approved by the Marine Analysis Section (MAS) for the analysis of physical, biological and chemical characteristics of the sediment proposed to be dredged. This sampling plan was written in accordance with the USEPA Region 1/USACE-NAE Regional Implementation Manual guidelines (USEPA Region 1/USACE-NAE. 2004). The plan called for 191 cores to be taken from the project area. Nine composites were to be created from these cores. The federal agencies concurred with this plan. This determination evaluates the results of that biological testing.

a. Compositing plan

The sediment cores were composited according to the procedures outlined in the SAP (Battelle, 2014a) to create the nine harbor sediment composites and one reference site composite (Table 1). Five of the nine river composites were created based on the compositing scheme outlined in the SAP; however, it was determined during field sampling that Composites 1, 2, 4 and 5 should be adjusted based on site location, with a utility crossing additionally affecting Composite 1. The changes made are documented in Table 2-1 and Attachment A, and summarized as follows:

- Station G was moved from Composite 2 to Composite 1
- Station F was moved from Composite 1 to Composite 2
- Station C was dropped due to a utility crossing
- Station L was moved from Composite 5 to Composite 4

- Station N was moved from Composite 4 to Composite 5.

Table 1. Cross-reference for Station ID, Individual Sample ID, and Composite ID

Station ID	Sediment Sample ID	NAE Composite Designation
B	B1, B2,B3, B3, B4, B4, B5, B5, B6, B6, B6, B7, B7	COMP1
G	G1, G1, G2, G3, G3, G4, G4, G5, G5, G6, G6	
E	E1, E2, E2, E3, E3, E4, E4, E5, E5, E6, E6	COMP2
F	F1, F2, F2, F3, F3, F4, F4, F5, F5, F6, E6	
H	H1, H2, H2, H3, H3, H4, H4, H5, H5, H6, H6	COMP3
I	I1, I2, I3, I3, I5, I5, I6, I6	
J	J1, J2, J2, J3, J3, J4, J4, J5, J5	
K	K1, K2, K2, K3, K3, K4, K4, K5, K5	COMP4
L	L1, L2, L2, L3, L3, L4, L4, L5, L5	
M	M1, M2, M2, M3, M4, M4, M5, M5	
N	N1, N2, N3	COMP5
O	O1 ,O2, O3	
P	P1, P2, P3	
Q	Q1, Q2, Q3	
R	R1, R2 R3	
S	S1, S2, S3, S4. S5	COMP6
T	T1,T2, T2, T3, T3, T4, T4	
U	U1, U2, U3, U4, U5	
V	V1, V2, V3,V4, V5, V6,V7, V8, V9, V10, V11, V12, V13, V14	COMP7
W	W1, W2, W2, W5, W5, W6, W7, W7, W8, W8, W9, W9, W10, W10	COMP8
X	X1,X2, X3, X4, X4, X4, X5, X5, X6, X6, X8, X8, X9, X9	
Y	Y1, Y2, Y2, Y3, Y5, Y7, Y8, Y9, Y10, Y11, Y13	COMP9

Z	Z1, Z2, Z2, Z3, Z3, Z4, Z4, S5, S7, S8, S9	
RISDS	Grabs 1-19	COMP10

b. Preliminary evaluation of the 10-day toxicity test

A 10-day bioassay test was conducted on the nine composite samples using two test animals: an amphipod (*Leptocheirus plumulosus)*, and a mysid shrimp (*Americamysis bahia*). As the results indicated no toxic response, the suspended particulate and the bioaccumulations tests were conducted to completion.

c. Determining contaminants of concern

The composites were then analyzed for bulk sediment chemistry according to the contaminants outlined in the sampling plan for this project. The contaminants of concern were identified as the compounds found to be elevated in the project core samples relative to the RISDS reference site values. The contaminants of concern are all metals, PAHs, pesticides and PCBs. These contaminants of concern were subsequently employed in the bioaccumulation tests.

4. **Testing Results**

a. 10-day bioassay and elutriate results

Amphipod results: In the amphipod 10-day bioassay test, performed on *Leptocheirus plumulosus*, nine composites were analyzed for an acute response. The mean survivorship for the amphipods exposed to sediment from the control site was 93% with a mortality of 7%. As the mortality in the control was less than 20%, this test was valid. The mean survivorship for the amphipods exposed to sediment from the RISDS reference site was 90% with a mortality of 10%.

The mean survivorship for the amphipods exposed to sediment is presented in Table 2. Review of survival data documents a survival range of 85 to 94% for amphipods exposed to the project site composite sediments. The statistical analysis showed that the survival rates of the amphipods exposed to any of the project sediments, with the exception of COMP3, were not statistically reduced, compared to survival rates for amphipods exposed to sediments from the RISDS reference sediment. In the case of COMP3, it was only significantly different when a statistical outlier was not excluded from the analysis. This outlier was removed for the final analysis. In addition, the difference in survival was less than 20% different from that of the RISDS. As a result, COMP3 is considered to not have a significantly negative impact on the survival of amphipods.

There was no statistically significant difference between the survivorships of the amphipods exposed to the reference sediment and the amphipods exposed to the sediments represented by either composite. Therefore, the materials proposed to be dredged are not considered acutely toxic to the amphipods used in the testing.

Table 2. Summary of Survival Data: *L. plumulosus* 10-Day Solid Phase Evaluation (May 2014)

Day 10 Portion Survived Summary - Mean Amphipod Survival					
Sample ID	**Reps**	**Mean**	**Minimum**	**Maximum**	**CV**
Laboratory Control	5	93%	90%	100%	5%
RISDS Reference	5	90%	85%	95%	4%
COMP1	5	87%	85%	90%	3%
COMP2	5	85%	60%	100%	18%
COMP3	5	86%	80%	100%	10%
COMP4	5	90%	85%	100%	7%
COMP5	5	94%	90%	100%	4%
COMP6	5	93%	85%	100%	6%
COMP7	5	93%	85%	100%	6%
COMP8	5	94%	85%	100%	7%
COMP9	5	90%	75%	100%	13%
Day 10 Survival Statistical Analysis		**Statistically Significant Difference, "<" as Compared to:**		**Difference in Survival as Compared to RISDS (-001)**	
Sample ID	**Mean**	RISDS (-001)		<20%	
RISDS Reference	90%	-		-	
COMP1	87%	No		Yes	3%
COMP2	85%	No		Yes	5%
COMP3	86%	No/Yes*		Yes	4%
COMP4	90%	No		Yes	0%
COMP5	94%	No		Yes	-4%
COMP6	93%	No		Yes	-3%
COMP7	93%	No		Yes	-3%
COMP8	94%	No		Yes	-4%
COMP9	90%	No		Yes	0%

*The analysis was conducted with the exclusion of an outlier

Mysid results: In the mysid 10-day bioassay test, performed on *Americamysis bahia*, nine composites were analyzed for an acute response. The mean survivorship for the mysids exposed to sediment from the control site was 100% with a mortality of 0%. As the mortality in the control was not more than 10%, this test was valid. The mean survivorship for the mysids exposed to sediment from the reference site was 97% with a mortality of 3%.

The mean survivorship for the mysids is presented in Table 3. Review of survival data documents a survival range of 89 to 99% for mysids exposed to the project site composite sediments. The statistical analysis showed that survival rates of mysids exposed to project sediments, with the exception of COMP4, were not statistically reduced compared to survival rates for mysids exposed to sediments from the RISDS reference sediment. In the case of COMP4, the difference in survival was less than 20% different from that of the RISDS. Statistical analysis indicates that there is no significant difference between the survivorships of the mysids exposed to the reference sediment and the mysids exposed to the COMP4 sediments. As a result, COMP4 is considered to not have a significantly negative impact on the survival of mysids.

In conclusion, based on the results of tests on these two species, the materials proposed to be dredged are not likely to be acutely toxic to benthic organisms.

Table 3. Summary of Survival Data: *A. bahia* 10-Day Solid Phase Evaluation (May 2014)

Day 10 Portion Survived Summary - Mean Mysid Survival					
Sample ID	**Reps**	**Mean**	**Minimum**	**Maximum**	**CV**
Laboratory Control	5	100%	100%	100%	0%
RISDS Reference	5	97%	90%	100%	5%
COMP1	5	94%	85%	100%	7%
COMP2	5	97%	90%	100%	5%
COMP3	5	93%	85%	100%	6%
COMP4	5	89%	85%	95%	6%
COMP5	5	100%	100%	100%	0%
COMP6	5	93%	85%	100%	6%
COMP7	5	92%	85%	100%	8%
COMP8	5	99%	95%	100%	2%
COMP9	5	99%	95%	100%	2%
Day 10 Survival Statistical Analysis		**Statistically Significant Difference, "<" as Compared to:**		**Difference in Survival as Compared to RISDS (-001)**	
Sample ID	**Mean**	RISDS (-001)		<20%	
RISDS Reference	97%	-		-	-
COMP1	94%	No		Yes	3%
COMP2	97%	No		Yes	0%
COMP3	93%	No		Yes	4%
COMP4	89%	Yes		Yes	8%
COMP5	100%	No		Yes	-3%
COMP6	93%	No		Yes	4%

COMP7	92%	No	Yes	5%
COMP8	99%	No	Yes	-2%
COMP9	99%	No	Yes	-2%

b. Water Column Toxicity Tests

The Suspended Phase Acute Toxicity Test results are presented in Table 4. Several composites had reduced LC_{50} values of note.

The mysid shrimp (*Americamysis bahia*) showed a LC_{50} of >100% when exposed to elutriate from six composite sediment samples (COMP1 through COMP4, COMP6, and COMP9). The other three composites had LC_{50} values ranging from 68% to 79%.

The inland silverside minnow (*Menidia beryllina*) showed reduced LC_{50} values in eight composite sediment samples (COMP1 through COMP8). These reduced LC_{50} values ranged between 7% and 72%. The test animals showed a LC_{50} of >100% when exposed to elutriate from composite sediment sample COMP9.

The sea urchin larvae (*Arbacia punctulata*) showed reduced LC_{50} values in eight composite sediment samples (COMP1 through COMP8). These reduced LC_{50} values ranged between 13% and 73%. The test animals had an LC_{50} of >100% when exposed to sediments from the COMP9 sediment.

Since each of the test animals had reduced LC_{50} values, an STFATE water quality evaluation was performed. All models were run using a 3000 cu. yds. disposal volume and based on prior experience with the model, disposal volumes larger than this (e.g., 4000 cu. yds.) should also be acceptable.

Table 4. Summary of Endpoints and Adverse Effects Suspended Particulate Phase Evaluation (April 2014)

Sample ID	*Americamysis bahia*	*Menidia beryllina*	*Arbacia punctulata*	
	LC-50 Endpoint (Survival)	LC-50 Endpoint (Survival)	LC-50 Endpoint (Survival)	EC-50 Endpoint (Development)
COMP1	>100%	72%	73%	3%
COMP2	>100%	71%	78%	3%
COMP3	>100%	71%	13%	3%
COMP4	>100%	71%	19%	5%
COMP5	79%	68%	33%	3%
COMP6	>100%	68%	32%	15%
COMP7	71%	59%	28%	2%
COMP8	68%	7%	66%	4%
COMP9	>100%	>100%	>100%	59%

b. STFATE Water Quality Evaluation

In three composite samples (COMP1, COMP2 and COMP9), there was rapid dilution of the water fraction such that the lowest LC_{50} found in each composite was diluted to below the 1/100th value within four hours following sediment disposal. This rapid dilution supports the conclusion that there should not be unacceptable adverse effects from the disposal of these sediments at the RISDS.

For the other six composite samples (COMP3, through COMP8), there is insufficient dilution of the water fraction to cause the greatest LC_{50} found in each sample to be diluted to below the 1/100th value within four hours following sediment disposal. These results support the conclusion that there will be unacceptable adverse effects from the disposal of these sediments at the RISDS. All models were run using a 3000 cu. yds. disposal volume and based on prior experience with the model, disposal volumes larger than this (e.g., 4000 cu. yds.) should also be acceptable.

c. Bioaccumulation results

A set of 28-day bioaccumulation tests were conducted on all composite samples. Two species were used in the tests: the bivalve, *Macoma nasuta*, and the polychaete, *Nereis virens*. Both *M. nasuta* and *N. virens* significantly accumulated contaminants from the composite sediment samples replicates at a level greater than the tissue bioaccumulation levels observed in the reference site sediment samples. *M. nasuta* showed significant tissue bioaccumulation of copper, zinc and all PAHs but acenaphthene. Significant bioaccumulation occurred for the following pesticides: dieldrin, hexachlorobenzene, cis- and trans-Nonachlor, 4,4'-DDD and 4,4'-DDE.

N. virens showed significant tissue bioaccumulation in the project composite samples for a number of PAHs: acenaphthene, fluoranthene, fluorene, pyrene, anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene and benzo(g,h,i)perylene. Significant tissue bioaccumulation occurred for selected pesticides as well: dieldrin, cis- and trans-Chlordane, cis- and trans-Nonachlor, benzo(a)anthracene, chrysene, phenanthrene, and 4,4'-DDD. No significant tissue bioaccumulation occurred in any test animal for any PCB congener.

Because of the presence of significant bioaccumulation, the EPA ran a risk-assessment model of the bioaccumulation results. For these compounds, the toxicological significance of bioaccumulation from the sediment into benthic organisms was evaluated.

The risk assessment includes the evaluation of the carcinogenic risk, noncarcinogenic risk, and any observed exceedences of FDA Action Levels of Concern. All contaminants are assessed using trophic transfer levels for lobster, fish, and shellfish. For the carcinogenic risk assessment, all samples for all contaminants were within the EPA established range of 1×10^{-4}-1×10^{-6} and therefore, posed acceptable risks (see Appendix: Tables 1 and 2 – Note for this table composite samples COMP1 through COMP9 are designated by Sample names Composite A through Composite I).

For the non-carcinogenic risk assessment, eight composites (COMP1 to COMP8) had selected contaminants with estimated lobster risks that were larger than the EPA established hazard quotient ratio of 1. In COMP2, the estimated fish and molluscan shellfish risk were also greater than 1. Therefore, these materials pose an <u>unacceptable</u> non-carcinogenic risk if disposed of in open water.

In one composite sample (COMP9) all contaminants were less than the EPA established hazard quotient ration of 1, therefore, these materials will not pose an unacceptable non-carcinogenic risk if disposed of in open water. There were no exceedences of the FDA Action Levels.

Because of significant bioaccumulation in both sets of test animals, the EPA has determined that the material from eight composites (COMP1 to COMP8) is not suitable for open water disposal as proposed. However, the material from composite sample COMP9 is suitable for open water disposal as proposed.

5. If you have any questions or want further details on the procedure of project evaluation, please contact me at (978) 318-8336 or charles.n.farris@usace.army.mil.

Charles N Farris
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CHARLES N. FARRIS
Project Manager,
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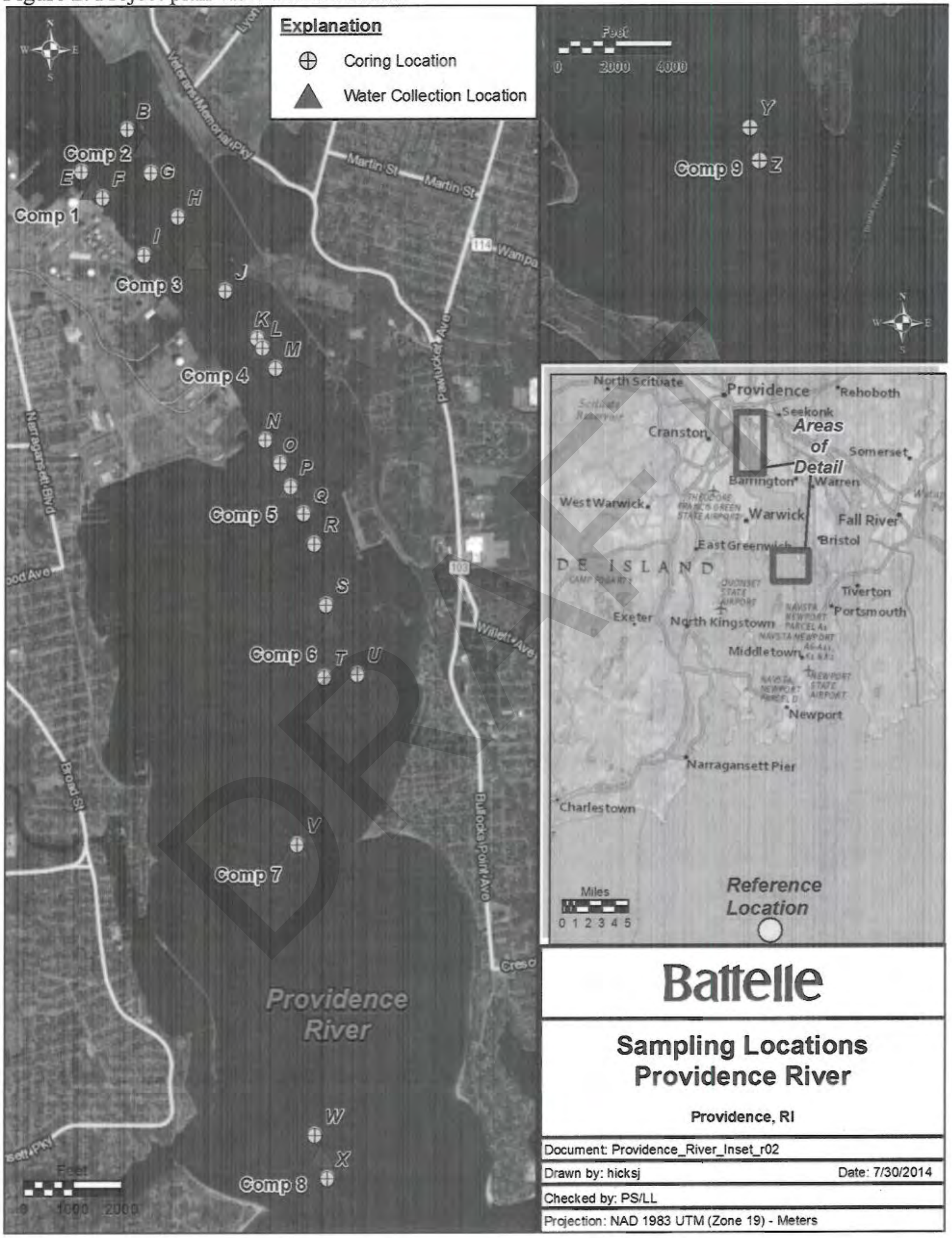
Regina Lyons, Manager Ocean and Coastal Protection Unit EPA Region 1 – New England	Jennifer L. McCarthy, Chief Regulatory Division New England District U.S. Army Corps of Engineers
Concur X	Concur X
Do not concur	Do not concur
Date 7/21/17	Date

Figure 2. Project plan view and elevations



APPENDIX

Table X-a Risk Summary of all Composites
Project Site: Providence River FNP
Project Number:
Organism: Macoma nasuta

	Column A	Column B	Column C	Column D	Column E	Column F
	CARCINOGENIC RISK			NON-CARCINOGENIC RISK		
Sampling Point	Total Estimated Lobster Risk	Total Estimated Fish Risk	Total Estimated Molluscan Shellfish Risk	Total Estimated Lobster Risk	Total Estimated Fish Risk	Total Estimated Molluscan Shellfish Risk
Composite A Reference (Reference)	3.51E-04 1.51E-05	6.80E-05 2.93E-06	7.10E-05 3.05E-06	2.63E+00 1.98E-01	5.10E-01 3.83E-02	5.25E-01 3.95E-02
Composite B Reference (Reference)	6.33E-04 1.51E-05	1.23E-04 2.93E-06	1.29E-04 3.05E-06	5.33E+00 1.98E-01	1.03E+00 3.83E-02	1.07E+00 3.95E-02
Composite C Reference (Reference)	4.75E-04 1.51E-05	9.20E-05 2.93E-06	9.62E-05 3.05E-06	4.29E+00 1.98E-01	8.31E-01 3.83E-02	8.56E-01 3.95E-02
Composite D Reference (Reference)	2.84E-04 1.51E-05	5.51E-05 2.93E-06	5.75E-05 3.05E-06	2.66E+00 1.98E-01	5.16E-01 3.83E-02	5.32E-01 3.95E-02
Composite E Reference (Reference)	1.52E-04 1.51E-05	2.94E-05 2.93E-06	3.06E-05 3.05E-06	1.55E+00 1.98E-01	3.00E-01 3.83E-02	3.09E-01 3.95E-02
Composite F Reference (Reference)	1.73E-04 1.51E-05	3.35E-05 2.93E-06	3.48E-05 3.05E-06	1.59E+00 1.98E-01	3.09E-01 3.83E-02	3.18E-01 3.95E-02
Composite G Reference (Reference)	1.14E-04 1.43E-05	2.21E-05 2.78E-06	2.29E-05 2.88E-06	1.34E+00 1.97E-01	2.59E-01 3.82E-02	2.67E-01 3.93E-02
Composite H Reference (Reference)	9.24E-05 1.43E-05	1.79E-05 2.78E-06	1.86E-05 2.88E-06	1.06E+00 1.97E-01	2.05E-01 3.82E-02	2.11E-01 3.93E-02
Composite I Reference (Reference)	8.73E-05 1.43E-05	1.69E-05 2.78E-06	1.76E-05 2.88E-06	6.20E-01 1.97E-01	1.20E-01 3.82E-02	1.24E-01 3.93E-02

Table X-b Risk Summary of all Composites
Project Site: Providence River FNP
Project Number:
Organism: Nereis virens

	Column A	Column B	Column C	Column D	Column E	Column F
	CARCINOGENIC RISK			NON-CARCINOGENIC RISK		
Sampling Point	Total Estimated Lobster Risk	Total Estimated Fish Risk	Total Estimated Molluscan Shellfish Risk	Total Estimated Lobster Risk	Total Estimated Fish Risk	Total Estimated Molluscan Shellfish Risk
Composite A	1.12E-04	2.16E-05	2.67E-05	1.90E+00	3.68E-01	4.47E-01
Reference (Reference)	1.92E-05	3.72E-06	4.54E-06	3.96E-01	7.66E-02	9.30E-02
Composite B	2.17E-04	4.21E-05	5.25E-05	3.03E+00	5.87E-01	7.14E-01
Reference (Reference)	1.92E-05	3.72E-06	4.54E-06	3.96E-01	7.67E-02	9.30E-02
Composite C	1.27E-04	2.46E-05	3.03E-05	2.26E+00	4.39E-01	5.32E-01
Reference (Reference)	1.92E-05	3.72E-06	4.54E-06	3.96E-01	7.66E-02	9.30E-02
Composite D	7.36E-05	1.43E-05	1.75E-05	1.36E+00	2.64E-01	3.20E-01
Reference (Reference)	1.92E-05	3.72E-06	4.54E-06	3.96E-01	7.66E-02	9.30E-02
Composite E	4.91E-05	9.51E-06	1.16E-05	9.74E-01	1.89E-01	2.29E-01
Reference (Reference)	1.92E-05	3.72E-06	4.54E-06	3.96E-01	7.66E-02	9.30E-02
Composite F	4.41E-05	8.55E-06	1.05E-05	8.83E-01	1.71E-01	2.08E-01
Reference (Reference)	1.92E-05	3.72E-06	4.54E-06	3.96E-01	7.66E-02	9.30E-02
Composite G	3.37E-05	6.54E-06	7.94E-06	7.75E-01	1.50E-01	1.82E-01
Reference (Reference)	1.79E-05	3.46E-06	4.21E-06	3.94E-01	7.63E-02	9.25E-02
Composite H	3.18E-05	6.16E-06	7.48E-06	7.38E-01	1.43E-01	1.73E-01
Reference (Reference)	1.79E-05	3.46E-06	4.21E-06	3.94E-01	7.63E-02	9.25E-02
Composite I	2.49E-05	4.83E-06	5.86E-06	5.55E-01	1.08E-01	1.30E-01
Reference (Reference)	1.78E-05	3.45E-06	4.19E-06	3.93E-01	7.62E-02	9.24E-02

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I
5 POST OFFICE SQUARE SUITE 100
BOSTON, MASSACHUSETTS 02109-3912

October 25, 2022

Mr. Lawrence Oliver
U.S. Army Corps of Engineers
New England District
696 Virginia Road, Concord, MA
01742-2751

Re: EPA Concurrence with the MPRSA Section 103(c) and CWA Section 404 Evaluation of the Final Suitability Determination in support of the Providence River and Harbor Dredged Material Management Plan

Dear Mr. Oliver,

I am writing in response to Aaron Hopkins' transmittal of the Final Suitability Determination (SD) on October 20, 2022, for the above referenced project. The EPA Ocean Dumping Program has reviewed the evaluation and testing requirements for the proposed dredged material disposal pursuant to both Section 103(c) of the Marine Protection Research and Sanctuaries Act (MPRSA) and Section 404 of the Clean Water Act (CWA).

Project Summary: The New England District Corps of Engineers (NAE) is currently preparing a dredged material management plan (DMMP) that will identify, evaluate, and compare management alternatives for material generated from the maintenance dredging of the Providence River FNP over the next 20-year period. This includes the management of approximately 608,000 cubic yards (CY) of shoaled material which was found to be unsuitable for unconfined open water disposal based on chemical and biological testing performed by NAE in 2013-14. The existing six confined aquatic disposal (CAD) cells in the upper portion of the harbor do not have sufficient capacity for the expected longer-term management of the FNP. A potential alternative for disposal of the current 608,000 CY of unsuitable material, and additional unsuitable material that may be identified in subsequent rounds of maintenance dredging, involves the construction of a new CAD cell in the vicinity of Edgewood Shoals and an access channel connecting the CAD cell to the FNP.

NAE's October 20, 2022, Final SD addresses the proposed construction of an Edgewood Shoals CAD cell that would involve dredging approximately 245,700 CY of sand and silt from shoaled areas within the proposed 100-foot wide access channel connecting the proposed CAD cell to the Sabin Point Reach channel and approximately 2,966,530 CY of sand and silt from an approximately 52 acre area for the proposed CAD cell. The proposed access channel will be mechanically dredged to a depth of -25 feet at Mean Lower Low Water (MLLW), and the CAD cell will be mechanically dredged to an estimated depth of -60 feet at MLLW. The October 20, 2022, Final SD evaluated the suitability of material dredged from the proposed access channel and CAD cell to be placed at the Rhode Island Sound Disposal Site (RISDS) and also determined if material unsuitable for disposal at RISDS could be disposed into the existing approximately 64-acre Edgewood Shoals basin and capped with clean sediments to beneficially increase the bottom elevation within the basin and improve water quality.

EPA has completed an evaluation of the project in accordance with both MPRSA 103(c) and CWA Section 404. This included a review of the physical, chemical, and biological testing data collected from the 16 locations across the dredging footprint as well as the physical setting and potential sources of contamination. Based on this evaluation, EPA concurs with the findings of NAE's October 20, 2022, Final SD that the surficial 2 ft of sediment within the historic access channel that crosses the CAD footprint (approximately 37,450 CY) is unsuitable for disposal at RISDS under Section 103 of MPRSA. However, further evaluation demonstrated that this material can be effectively isolated under 40 CFR §230.72 of the CWA through disposal and containment in the existing Edgewood Shoals basin. The deeper material beneath the historic access channel footprint (beneath the 2-ft surficial layer) as well as all the sediment within the remainder of the footprint of the proposed CAD cell and the proposed new access channel (together totaling approximately 3,174,780 CY) are considered suitable for disposal at RISDS under Section 103 of MPRSA.

We do have several items of note related to this project,

- The analysis of alternatives to open water disposal should take into consideration the very large volume of suitable material expected to be generated from this project and fully evaluate all potential beneficial uses of the material.
- Although the capping of unsuitable material within the Edgewood Shoals basin is allowed under 40 CFR §230.72, the expected low strength and high-water content of the unsuitable dredged material coupled with the large expanse of the targeted placement area will require significant planning of operational controls to limit any impacts to water quality during placement, consolidation, and capping phases.
- As any disposal of material from this project at RISDS will be governed by Section 103 of MPRSA, formal concurrence by EPA on the contract/specifications for the work is required.

If you have additional questions, please contact Steve Wolf (wolf.steven@epa.gov) or Alexa Sterling (sterling.alex@epa.gov).

Sincerely,

REGINA LYONS Digitally signed by REGINA LYONS
Date: 2022.10.25 08:56:15 -04'00'

Regina Lyons, Chief
National Estuary Program and Marine Protection Section

cc: Aaron Hopkins, USACE NAE
Steve Wolf, USEPA
Alexa Sterling, USEPA

PROVIDENCE RIVER AND HARBOR
RHODE ISLAND
FEDERAL NAVIGATION PROJECT
MAINTENANCE DREDGING

DREDGED MATERIAL MANAGEMENT PLAN

MAY 2025

APPENDIX G – SUBSURFACE SITE CHARACTERIZATION

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1. STATEMENT OF PURPOSE

The purpose of this Subsurface Site Characterization Appendix is to provide an overview of regional geology and description of the local subsurface material types in the Federal Navigation Project (FNP). The subsurface conditions of Providence Harbor were evaluated using three site investigations between 2018 and 2021. Data from these investigations were used in the design of proposed Confined Aquatic Disposal (CAD) cell(s).

2. PROJECT SUMMARY

The Providence River & Harbor FNP was originally adopted in 1852 and modified by 17 subsequent authorizations. The 40-foot-deep channel feature of the existing project that is now being maintained was authorized by the River and Harbor Act of 1965. The FNP currently has an authorized depth of -40 feet MLLW and channel width of 600 feet, with wider bends and a 1,700-foot-wide harbor area at the upstream end. The total authorized channel length is approximately 16 miles long, extending from its upstream limit just downstream of the Providence (Fox Point) Hurricane Barrier to its downstream limit between Prudence Island and Aquidneck Island in the Eastern Passage of Narragansett Bay.

3. DREDGING AND DISPOSAL

Based on extrapolation of existing shoal rates within the Providence FNP, the project will need to be dredged twice within the 20-year planning period covered by this DMMP. The first cycle is planned to be performed in 2027, and the second cycle is predicted to be needed in 2047. For the first cycle of dredging, a total of approximately 2,100,000 cy of dredged material will be dredged from Providence River Channel FNP and connected shallow draft FNPs. A dredged material placement facility will be constructed in 2027 to contain the dredged material from the FNP as well as other dredged materials generated through the first 15 years of the 20-year DMMP planning period. A Confined Aquatic Disposal (CAD) cell is proposed to be constructed to contain the dredged material from the FNP and will also be designed and constructed to hold an additional estimated 300,000 CY generated over the first 15 years of the 20-year planning period by the non-federal sponsor of the project for a total dredged material quantity of approximately 2,400,000 CY. The entire capacity of the first CAD cell to be constructed is approximately 2,800,000 CY of dredged material, including a 15% bulking factor of the dredged material during placement. The CAD cell will also be constructed large enough to get capped with approximately 240,000 CY of clean material after about 15 years, when the CAD cell is expected to reach capacity.

After 20 years, a second dredge cycle of the Providence would be initiated. A second CAD cell would be constructed to accommodate predicted quantities of dredged material from the various sources. The study predicts that based on a continuation of shoaling in the Providence River and Harbor, that Providence FNP and adjacent shallow-draft FNPs will require approximately 1,213,000 CY of dredging, and non-federal channels will need another 300,000 CY of dredging. The second CAD cell is possible at Edgewood Shoals South. The second CAD cell would need approximately 1,740,000 CY capacity, including a 15% bulking factor. This second CAD cell would then remain open until the second CAD cell is constructed since it will be used as a starter cell for the second CAD cell, for 15 to 20 years, and finally be capped with clean material, possibly from the clean material from the second CAD cell.

4. GEOLOGICAL INFORMATION

The Providence River FNP consists of a 16.8-mile-long north-south running navigation channel that separates Providence and East Providence. The channel is authorized to a depth of El. -40 feet mean lower low water (MLLW) and varies in width from 600 feet to 1,700 feet. The Federal channel extends from deep water in Narragansett Bay to the head of navigation near Fox Point in Providence. North of Field’s Point the River is primarily a shipping channel and is narrow and deep, while south of Field’s Point the River is substantially wider with a variable shallow and deep mudline.

Providence River and Seekonk River are estuaries at the head of Narraganset Bay. The courses these rivers take was shaped by drainage of glacial meltwater during the retreat of the Laurentide ice sheet. The Providence outwash plane dominates most of the topography in this area creating a low-lying landscape apart from some hills to the west. Preglacial physiography included multiple cycles of uplift and erosion. The advance of the ice sheet during the Pleistocene preferentially eroded the softer sedimentary rocks in the Narraganset basin. Harder, more resistant crystalline rocks remain that surround the basin. Glacial deposits dominate the landscape as it appears today.

I. REGIONAL AND BEDROCK GEOLOGY

Providence Harbor and the surrounding land masses are part of the Avalon Terrane, which is made up of a Proterozoic basement that consists of metavolcanic and metasedimentary rocks. These basement rocks underwent emplacement of various plutons in the late Proterozoic through the Carboniferous. During the Carboniferous, clastic, nonmarine sedimentary rocks were deposited. Some of these rich and organics and are considered coal bearing. The Alleghanian orogeny resulted in compressive deformation of these rocks during the Permian, causing shearing along the Hope Valley Shear Zone within the Esmond-Dedham subterrane. This shear zone bounds Providence Harbor, and several border faults exist within Narraganset bay due to this shearing (Figure 1).

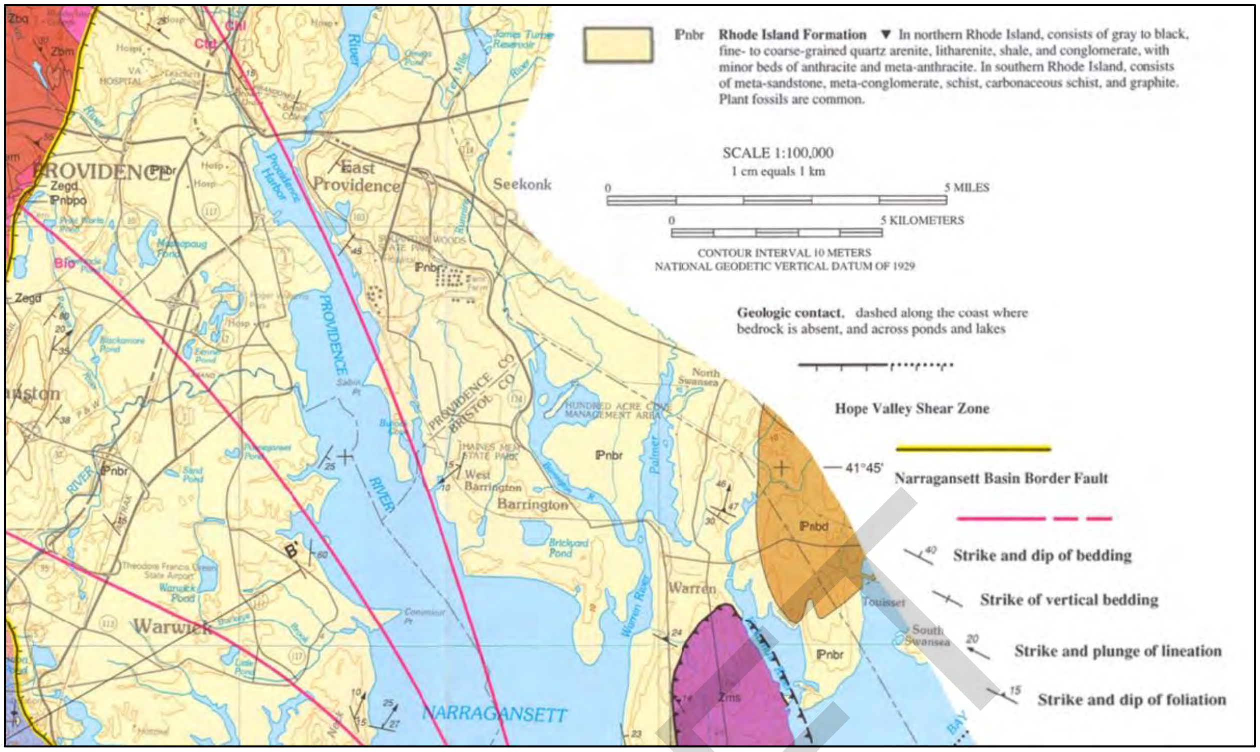

Figure 1. Excerpt from Bedrock geologic map of Rhode Island: Rhode Island Geological Survey, showing High Valley Shear Zone (yellow) and Naragansett Basin Border Faults (pink) (Hermes, et al., 1994).

The primary rock type observed in Narraganset Bay is the Rhode Island Formation. This unit consists of Pennsylvanian sedmentary rocks deposited that were subsequently metamorphosed during Triassic to Jurassic regional uplift. In southern Rhode Island, these sedimentary rocks include meta-sandstone, meta-conglomerate, schist, carbonaceous schist, and graphite. Plant fossils are commonly found in these rock types (Hermes, et al., 1994).

II. SURFICIAL GEOLOGY

Surficial geology in the Providence region is predominantly of glacial origin. A relatively thin layer of till mantles most of the bedrock, which is overlain by various types of glacial outwash. In the lower lying areas of Narraganset basin, there are deposits of stratified drift, e.g. kames, kame terraces, and outwash plains, which tend to grade into each other rather than forming distinct boundaries between morphologies.

The glacial geology of the Bristol (Narraganset Bay) and Providence (Providence River) quadrangles was mapped in 1950 and 1952 by J. Hiram Smith (Figures 2 and 3). The predominant units are as follows:

Qop deposits – outwash plains: mostly moderately to well-sorted sand and local deposits of coarse gravel

Qkt deposits – kame terraces: sand and gravel deposited by glacial meltwater streams between ice in the valley and the valley wall

Qic deposits – ice channel deposits: smaller ridges of sand and gravel e.g. eskers

Qk deposits – kames: irregularly shaped mounds of sand and gravel

Qgm – ground moraine: relatively thin layer of till on bedrock

Qsu – undifferentiated sand and gravel

The soil to the west of Providence River consists predominantly of outwash plain deposits. Several kame terrace deposits are mapped in Fields Point. The Fox Point area and most of Bristol and the islands in Narraganset bay are ground moraine, or basal till, deposits flanked by kame terraces (Figure 2 and Figure 3).

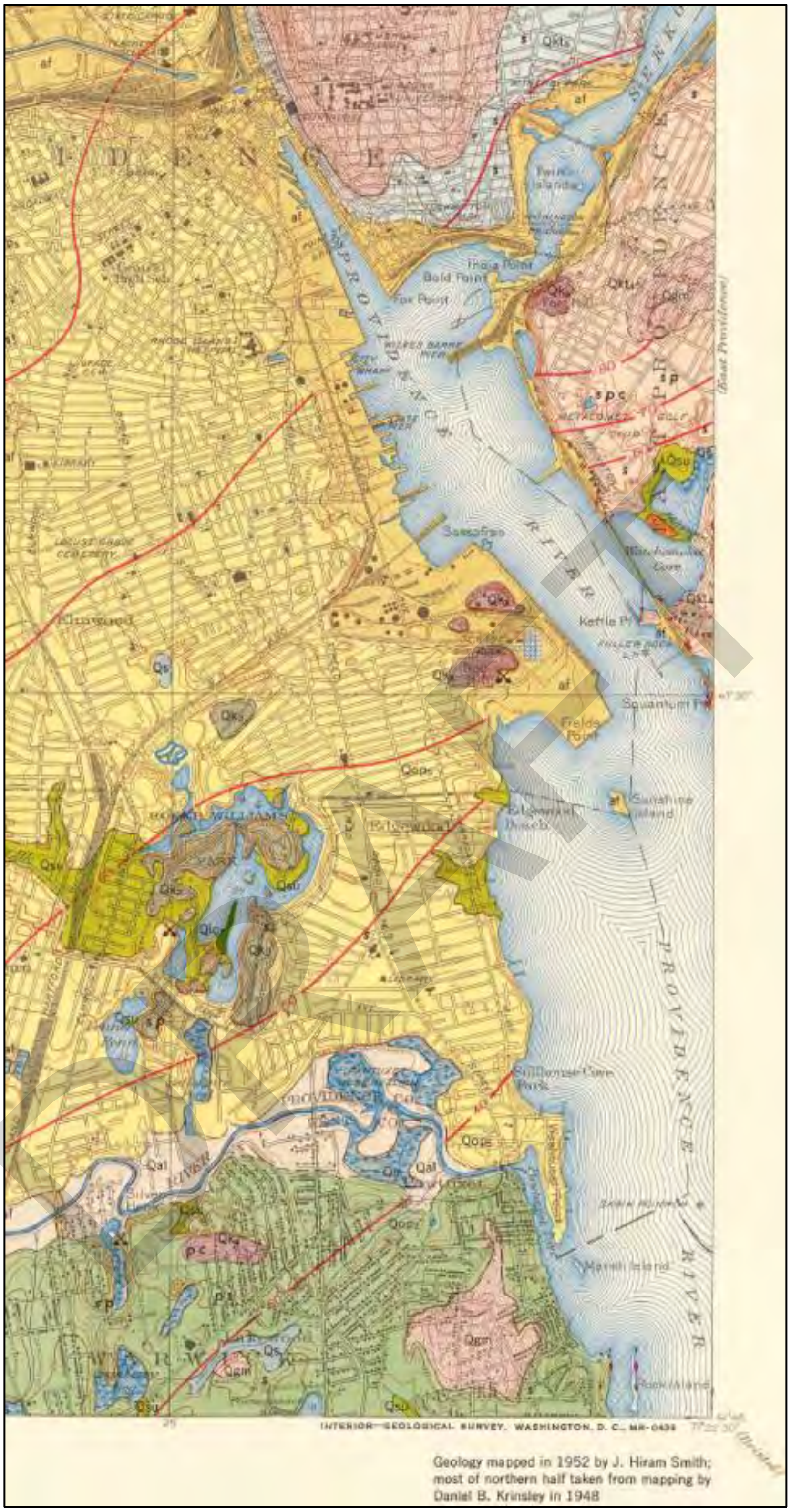

Figure 2. Excerpt from Surficial geology of the Providence quadrangle (Smith, 1956).

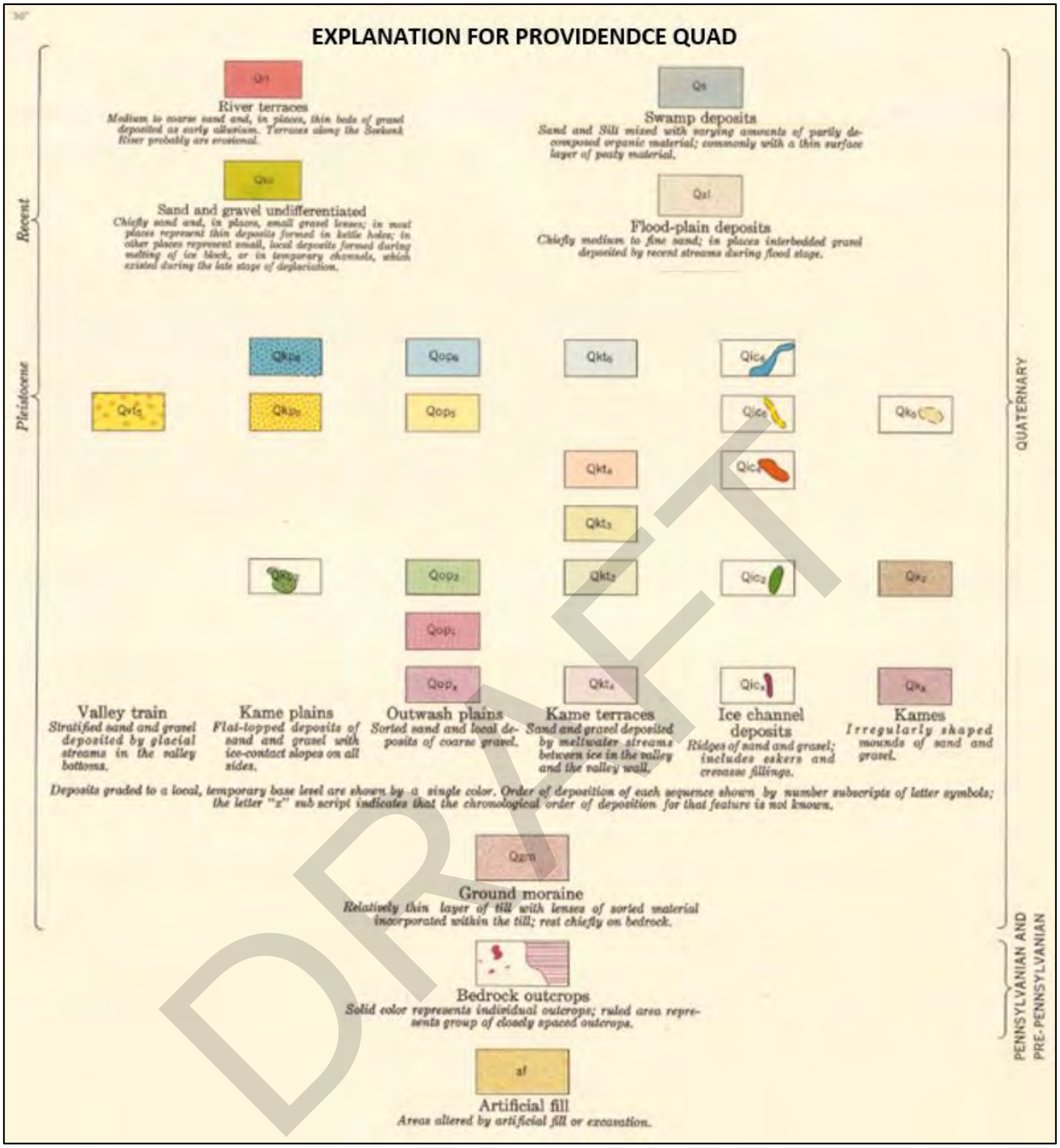

Figure 2. Legend for Surficial geology of the Providence quadrangle (Smith, 1956).

Figure 3. Excerpt from Surficial geology of the Bristol quadrangle and vicinity (Smith, 1955).

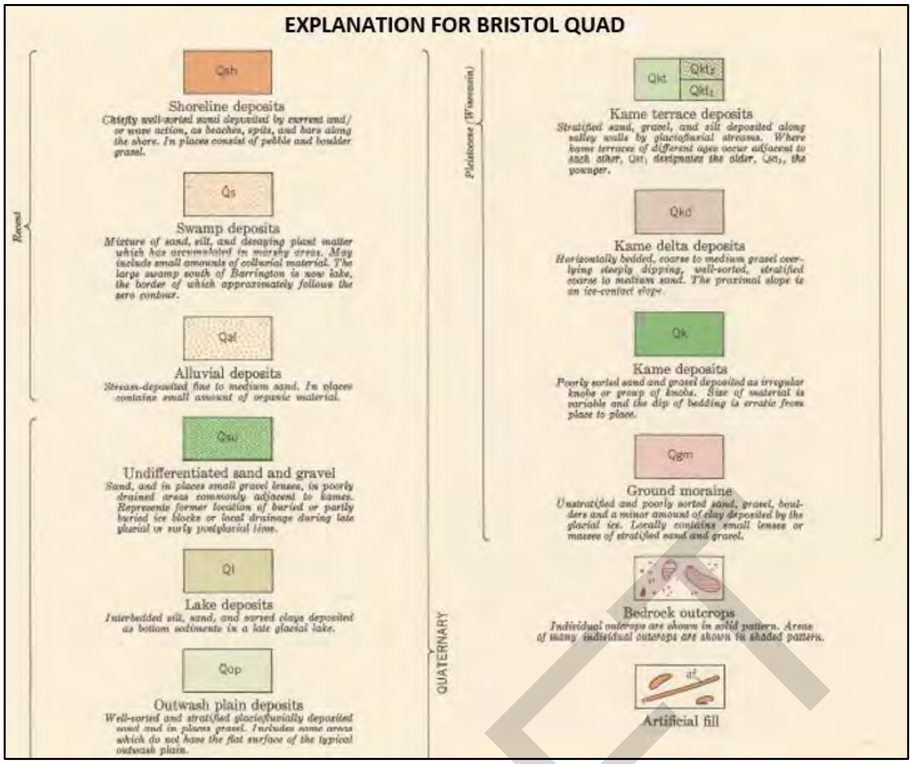

Figure 3. Legend for Surficial geology of the Bristol quadrangle and vicinity (Smith, 1955).

Modern alluvial and marine deposits are continuously deposited as part of the sediment load of the Providence River. Alluvium tends to be well sorted, but the grain size varies from place to place in the harbor due to drift in the stream path and changes in water level over time. The best characterization of these recent sediments within the FNP is in Section 5, Previous Subsurface Investigations.

5. PREVIOUS SUBSURFACE INVESTIGATIONS

GZA SUBSURFACE INVESTIGATION 2018

GZA's services were provided in response to US Army Corps of Engineers (USACE) Request for Proposal (RFP), dated June 21, 2017, Delivery Order/Call No. W912WJ17F0126 under Contract Number W912WJ-16-D-0003, between GZA and the United States Army Corps of Engineers New England District (District), dated September 6, 2017. GZA performed a subsurface exploration, laboratory testing, and interpretation of results compiled in a report of explorations. The objective of the assignment was to conduct marine subsurface drilling investigations in specific areas of the Providence River within the Federal Navigation Project (FNP) north of Fields Point and outside the FNP south of Fields Point to assess bottom conditions for the construction of Confined Aquatic Disposal (CAD) cells. The project consisted of performing four (4) borings and six (6) probes, an evaluation of sediment and overburden soils, and execution of a geotechnical laboratory testing program to identify material properties. The investigation aimed to identify the presence, frequency, and consistency of dense soils and bedrock that could affect potential CAD cell locations and/or require alternative dredging approaches e.g. mechanical rock removal or underwater blasting.

Borings were drilled using drive and wash drilling techniques with 4-inch casing. Split-spoon sampling was conducted at 10-foot intervals using a 3-inch-outside-diameter, 24-inch-long split-spoon sampler. Refusal of the sampling spoon for the purposes of this project was defined as 100 blows per 1 inch of penetration, or bouncing refusal, and verified by advancing the roller bit 3-feet beyond observed refusal. Probes were drilled using drive and wash drilling techniques with 4-inch casing and a 3-inch or 4-inch rollerbit. Typical probe drilling consisted of driving casing from mudline to casing blow count refusal, then advancing the rollerbit to target elevation or rollerbit refusal criteria. Probe refusal was defined as rollerbit drilling 3-feet into the refusal material. Bedrock was not cored during this investigation; however, bedrock was inferred by observing rollerbit effort, penetration time, and boring wash-water.

Visual classification of the soil samples was performed in accordance with Visual-Manual Procedures (ASTM D2488) and the Unified Soil Classification System (USCS). Probe data was recorded on the same log as the boring logs and included location, depth, drilling effort, and wash-water description. Soil samples were chosen to represent the varying lithology encountered and classified in accordance with ASTM D-2487. Soil samples were analyzed for grain size and Atterberg limit analysis in accordance with ASTM D-6913 and D-4318, respectively.

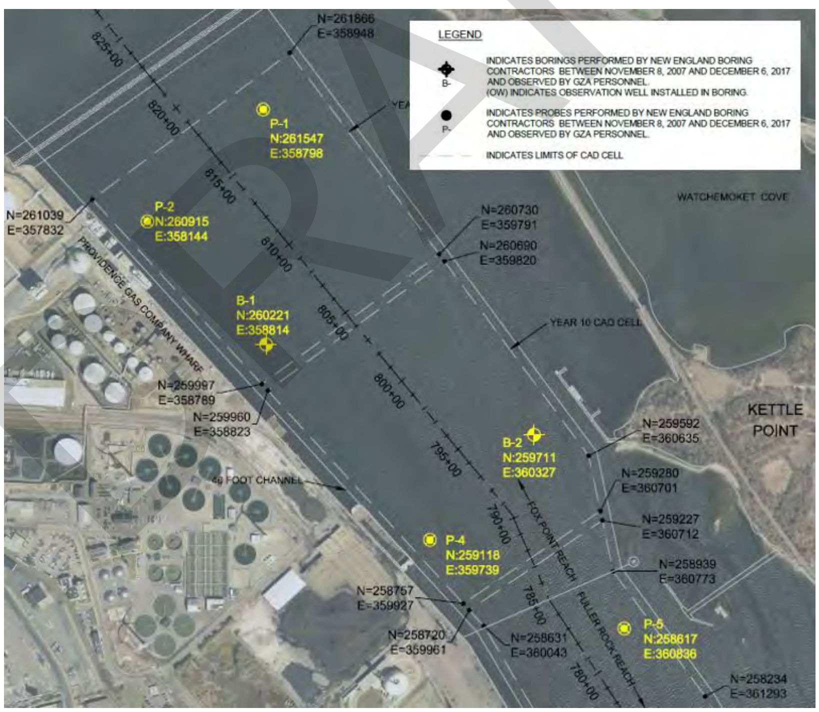

Figure 4. Excerpt from the exploration location plan (USACE, 2018).

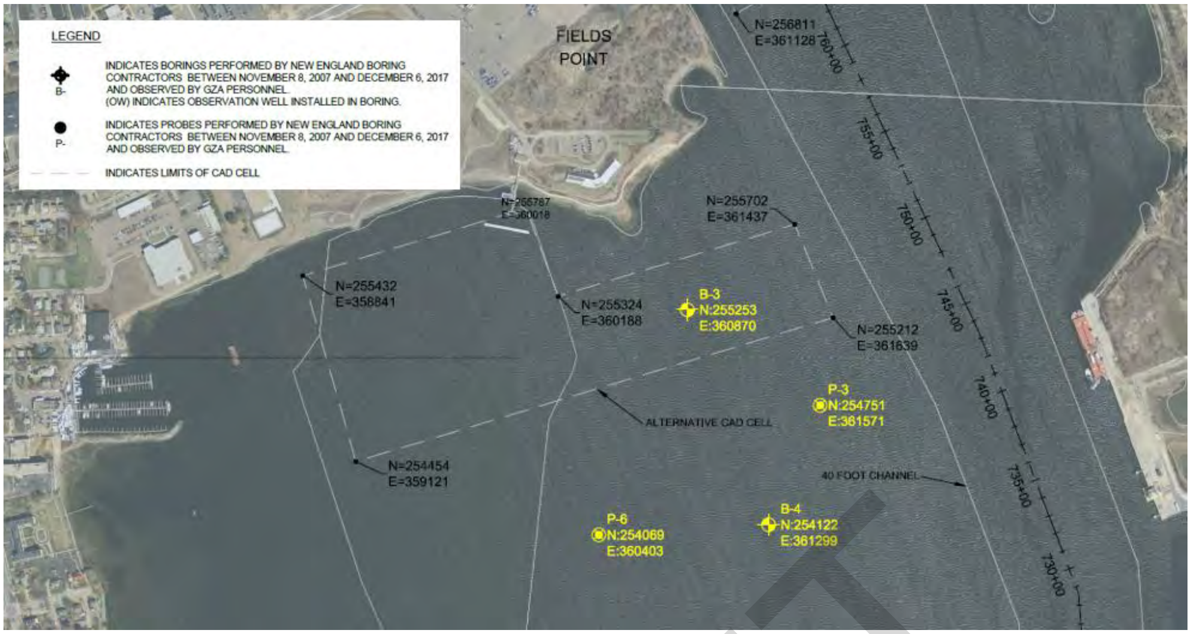

Figure 5. Excerpt from the exploration location plan (USACE, 2018).

The borings and probes were advanced to approximately El. -60 to -110 feet MLLW. The following material types were encountered during the subsurface investigation:

River Sediment: Approximately 7 to 36 feet of river sediment was encountered in all borings. The river sediment generally consisted of very loose, high plasticity black organic silt with shells and vegetative fibers at the surface changing to gray silt and shells at greater depths.

Glaciofluvial/Glaciomarine Outwash: All borings encountered a medium dense to very dense silt/sand/gravel deposit beneath the river sediment that ranged from approximately 2 to 42 feet thick. This stratum was interpreted as glaciofluvial/glaciomarine outwash and consisted of non-plastic stratified silt with clay and fine sand layers in some portions of the site and gravelly fine to coarse sand and sandy gravel in other portions of the site.

Glacial Till: Approximately 8 to 44 feet of dense to very dense silty gravel/sand stratum was encountered in three of the four borings, which was interpreted to be glacial till. This stratum was described as a poorly sorted mixture of silt, fine to coarse sand, clay, cobbles and boulders, typically not stratified.

Weathered Bedrock: Bedrock was not encountered everywhere but was inferred in one boring and three probes by advancing into the material with the rollerbit and observing effort, time, and wash-water. Weathered bedrock was inferred at approximately El. -106 feet MLLW in Fox Point Reach and between El. -53 and -95 feet MLLW in the area south of Fields Point.

2019 USACE SUB-BOTTOM PROFILER SURVEY

In 2019 USACE NAE's Environmental Resources and Marine Programs Section performed a marine seismic reflection survey in order to identify potential CAD cell locations for further geophysical investigation. USACE NAE used a Compressed High Intensity Radar Pulse (CHIRP) sub-bottom profiler to survey the Edgewood Shoals area and a portion of the channel between stations 700+00 and 715+00. The output was a digital terrain model of the interpreted top of rock surface as well as a 3D model of the sub-bottom profiles in Fields Point Reach and Sabin Point Reach.

The sub-bottom data were not calibrated for speed of sound through various sediment layers, but the survey provided the screening-level criteria needed to confirm these two sites as potential options for future CAD cell construction. An excerpt from the 3D model is shown in Figure 6.

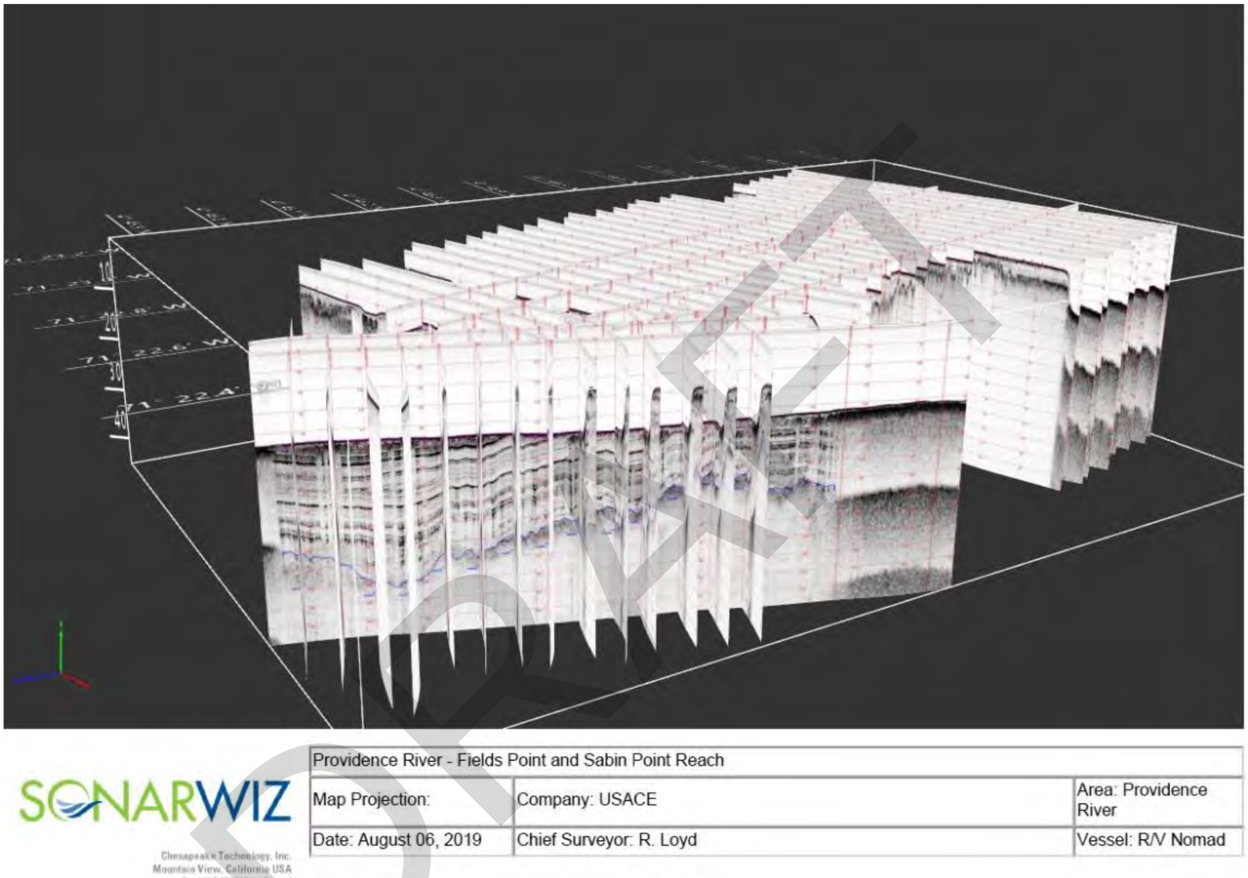

Figure 6. Excerpt from a 3D model produced by NAE ERS indicating approximate top of rock surface in blue.

GEI SUBSURFACE INVESTIGATION 2021

USACE NAE authorized GEI to perform a marine subsurface exploration program on December 13, 2021, by a signed USACE Contract W912WJ-21-D-0001 and task order number W912WJ22F0002, dated December 8, 2021, between GEI and USACE-NAE. The intent of the exploration results was to support the design and construction of CAD cells as part of the Providence River DMMP. The marine subsurface exploration program included ten (10) borings in the Edgewood Shoals area and four (4) borings in the Fox Point Reach area of the FNP.

The borings were advanced through the moon well on the centerline of the barge using 4-inch minimum diameter driven flush joint steel casing and rotary wash drilling techniques (ASTM D5783). Standard Penetration Tests (SPTs) were performed in general accordance with ASTM Standard D1586. All soil samples were classified using the Unified Soil Classification System as defined in ASTM Standards D2487 and D2488. Soil samples for laboratory analysis were selected to represent the varying lithology encountered during the subsurface explorations. Laboratory analysis included grain size distribution (ASTM D6913), size distribution tests including hydrometer (ASTM D7928), Atterberg limits (ASTM D4318), and organic content (ASTM D2974).

Borings in the Edgewood Shoals area were advanced to El. -60’ MLLW. The water column in the Edgewood Shoals area ranges from about 10 to 16-feet deep, therefore the borings extended approximately 50 feet into the sediment. Borings in the Fox Point Reach area were advanced to El. -100’ MLLW. The water column in the Fox Point Reach area ranges from about 28 to 38 feet deep, therefore the borings extended approximately 60 feet into the sediment. The following material types were encountered:

River Bottom Sediment: An approximately 5- to 52-foot-thick layer of river bottom sediment was encountered below mudline in all borings. The upper portions of the river bottom sediment consisted of very soft, black, highly plastic organic silt and organic clay with shells and vegetative fibers. Strong marine-like, organic odor was observed in the soil samples collected in the upper 15 feet of this layer. At greater depths, the sediment transitioned to stiff to very soft, gray, low to medium plasticity silt to organic silt and organic clay with some peat fibers and shell fragments.

The consistency of the stratum ranged from very soft (Weight of Casing (WOC), Weight of Rod (WOR), and Weight of Hammer (WOH)) and less than two blows per foot material to stiff. In the Edgewood Shoals area, most of the soil at and above El. -60 feet MLLW was observed to be river bottom sediment.

Glaciomarine Outwash: A layer of glaciomarine outwash was encountered below the river bottom sediment in almost all the borings, and 12 borings were terminated in this layer. The thickness of the stratum ranged from 0.5 to 46 feet. This layer consisted generally of silty sand to widely graded sand with varying amounts of low-plasticity silt and gravel. Stratified, medium-plastic clay and silt with fine sand layers was also observed.

Glacial Till: Glacial Till was encountered below the glaciomarine outwash in two of the borings in the Fox Point Reach area. The glacial till ranged from 0.3 to 22 feet thick. The SPT N-values in the Glacial Till ranged from 25 to 100 blows for less than 6 inches of penetration indicating a medium dense to very dense soil. The glacial till layer consisted of gray, unstratified narrowly graded gravel and silty sand with varying amounts of fine to coarse sand and non-plastic silt. The stratum was well-cemented. Boulders were encountered in at least one of the borings in this unit.

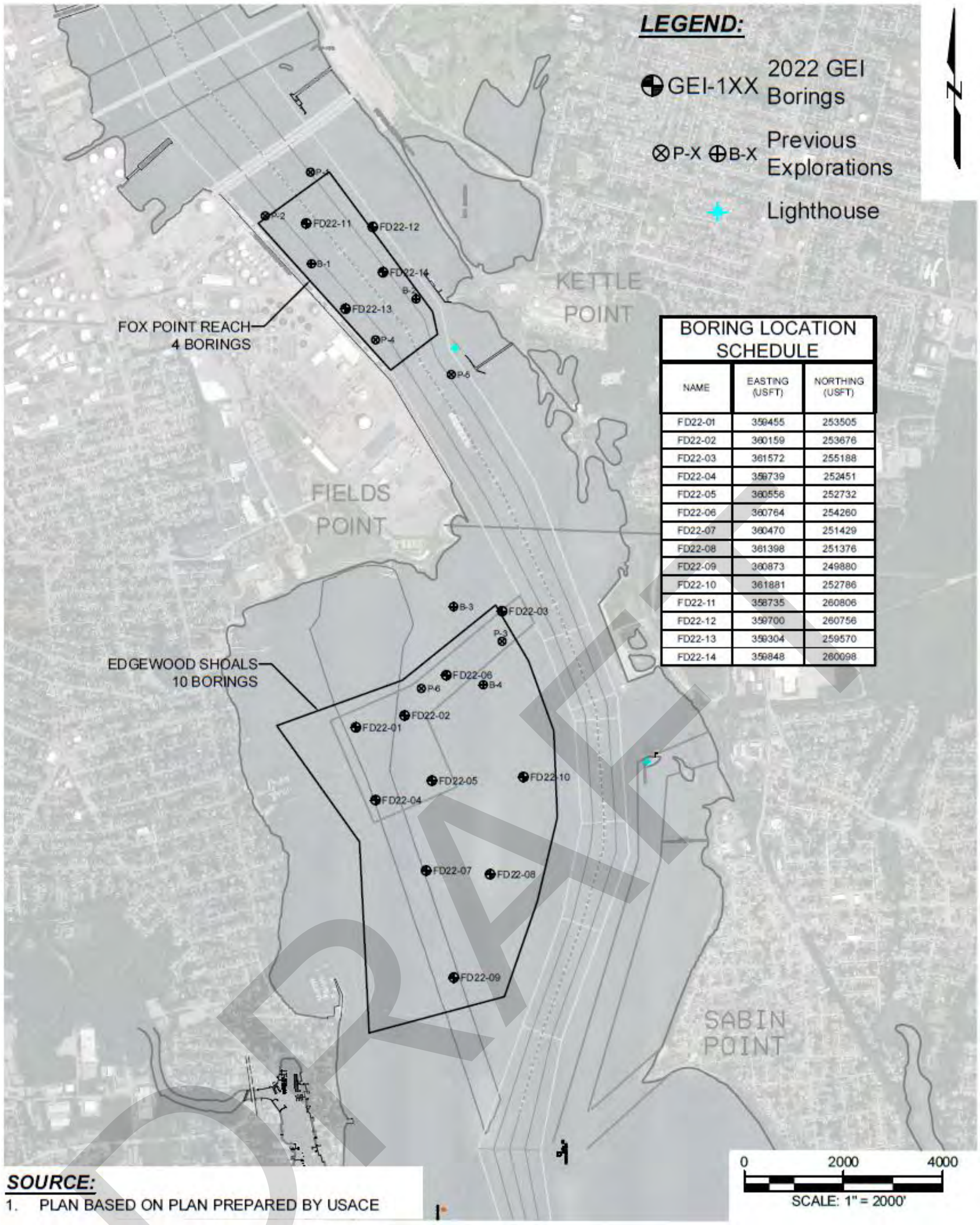

Figure 7. Excerpt from boring location plan (USACE, 2022).

6. SUBSURFACE CONDITIONS IN CAD CELL AREAS

This DMMP outlines three alternatives for CAD cell locations: Edgewood Shoals North (Alternative 1), Edgewood Shoals South (Alternative 2), and a main and starter CAD cells in Fox Point (Alternative 3). These CAD cell alternatives are detailed in the Engineering Appendix. The recommended plan in the Edgewood Shoals North CAD Cell and Beneficial Uses Alternative, which is Alternative 3 in the DMMP (See Section 7.1 in the main report). This plan recommends placement of dredged material from the Providence FNP for the first dredge cycle in one large CAD cell to be constructed within the northern central Edgewood Shoals embayment of the Providence River. Suitable materials excavated from the CAD cell construction would be beneficially used to cap Prudence Island Disposal Site with 3 feet of suitable material. Other sources of dredged material would also be placed in the CAD cell over 15 years until the CAD cell is full and then finally capped. The CAD cell would be a rectangular-shaped area covering 50.7 acres (2,212,000 square feet), with lateral dimensions of 1,580 ft north-south and 1,400 ft east-west, dredged at a 1V:5H slope to an elevation of -60 ft MLLW. The vertical design grade of the slope is based on a slope stability analysis performed by NAE in 2022.

Previous subsurface investigations have described the following sediment types within the proposed CAD cell areas:

<u>River Bottom Sediment</u>: Recent (Holocene) river bottom sediment is pervasive throughout the FNP in varying thickness. The upper portions of this unit consist of very soft, black, organic silt and organic clay with shells and vegetative fibers with a strong marine-like, organic odor (OL to OH). At greater depths, this sediment transitions to a very soft to stiff, gray, low to medium plasticity silt to organic silt and organic clay with some peat fibers and shell fragments.

In the channel (Fox Point Reach area), this layer is relatively thinner due to previous dredging of the harbor to the authorized depth of El. -40 feet MLLW. Organic silt in the Fox Point Reach is about 5 to 16 feet thick, thickening towards the east. It is encountered from the and terminates from El -45 to -57 feet MLLW (Figure 8).

Figure 8. Organic river bottom sediment (typical) in Fox Point Reach. Sample S1 from depth 0 to 2 feet below ground surface (BGS) in boring FD22-11 (USACE 2022).

In the Edgewood Shoals area, most soil at or above El. -60 feet MLLW is river bottom sediment. Organic silt and clay (OL and OH) ranges in thickness. Inorganic silt and clay (ML and CL) are encountered below Organic silt and clay in most of the Edgewood Shoals area to the final depth of subsurface explorations at El. -60' MLLW. This unit is very loose; most standard penetration tests resulted in self-weight penetration (weight or rod or weight of hammer).

Figure 9. Organic river bottom sediment (typical) in Edgewood Shoals. Sample S1 from 0 to 2 feet BGS in FD22-02 (USACE 2022).

Figure 10. Inorganic river bottom sediment (typical) in Edgewood Shoals. Sample S8 from 16 to 18 feet BGS in boring FD22-02 (USACE 2022).

Glaciomarine Outwash: A layer of glaciomarine outwash is encountered below the river bottom sediment throughout the FNP. The thickness of this layer has not been fully characterized since many borings terminated in this unit. Historical surficial geology mapping efforts did not include characterization of marine sediments in Providence Harbor. The glaciomarine outwash unit consists generally of silty sand to widely graded sand with varying amounts of silt and gravel (SM, SW-SM, GW, SP-SM). Stratified clay and silt with fine sand layers was also observed (ML). The thickness of this stratum within the FNP ranges from 0.5 to deeper than the full authorized channel depth.

Figure 11. Glaciomarine outwash (typical) in Edgewood Shoals. Sample S14 from 38 to 40 feet BGS in boring FD22-05 (USACE 2022).

Figure 12. Glaciomarine outwash (typical) in Fox Point Reach. Sample S6 from 50 to 52

feet BGS in boring B-2 (USACE 2018). Note the stratification in the clay (red arrow).

Figure 13. Glaciomarine outwash (typical) in Fox Point Reach. Sample S6 from 19 to 21 feet BGS in boring FD22-12 (USACE 2022).

<u>Glacial Till</u>: Glacial Till was encountered below the glaciomarine outwash in only a few borings. The till consists of dense to very dense gray, unstratified narrowly graded gravel and silty sand with varying amounts of sand and silt. The stratum was well-cemented, and boulders and cobbles were encountered.

In the Fox Point Reach the top of glacial till was encountered in one boring at El. -99' MLLW on the western side of the channel and in one boring at El. -78 feet MLLW. In Edgewood Shoals glacial till was encountered in the northeastern portion of the shoals 18 to 38 feet below the mudline in B-3, B-4 and FD22-06, or between El. -18 and -45 feet MLLW.

Figure 14. Glacial till (typical) in Edgewood Shoals. Sample S13 from 36 to 38 feet BGS in boring FD22-06 (USACE 2022).

Bedrock: Bedrock was inferred in one boring (B-4) in Edgewood Shoals at El. -57 feet MLLW. Bedrock was also inferred in two probes in Edgewood Shoals, P-3 and P-6, at El. -100 to -72 feet MLLW, respectively. Weathered bedrock was inferred in one probe, P-4 in Fox Point Reach at approximate elevation of -106 feet MLLW.

7. REFERENCES

Hermes, O.D., Gromet, L.P., Murray, D.P., Hamidzada, N.A., Skehan, J.W., and Mosher, S., 1994, Bedrock geologic map of Rhode Island: Rhode Island Geological Survey, Rhode Island Map Series Map 1, scale 1:100,000

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USACE, 2018, Sediment Testing and Data Report, Providence River DMMP Subsurface Investigation, Providence, Rhode Island, Prepared by GZA GeoEnvironmental, Inc.

Providence River and Harbor Federal Navigation Project Rhode Island Dredged Material Management Plan and Environmental Assessment

Appendix H

Environmental Appendix (IPAC analysis, EFH Assessment, CZMCD, Benthic Report, CWA Section 404(b)(1) Checklist)

IPAC analysis

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Ecological Services Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5094
Phone: (603) 223-2541 Fax: (603) 223-0104

In Reply Refer To: 05/13/2025 13:46:30 UTC
Project Code: 2025-0094639
Project Name: Providence DMMP

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

Updated 4/12/2023 - Please review this letter each time you request an Official Species List, we will continue to update it with additional information and links to websites may change.

About Official Species Lists

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Federal and non-Federal project proponents have responsibilities under the Act to consider effects on listed species.

The enclosed species list identifies threatened, endangered, proposed, and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. The Service recommends that verification be completed by visiting the IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested by returning to an existing project's page in IPaC.

Endangered Species Act Project Review

Please visit the "**New England Field Office Endangered Species Project Review and Consultation**" website for step-by-step instructions on how to consider effects on listed species and prepare and submit a project review package if necessary:

https://www.fws.gov/office/new-england-ecological-services/endangered-species-project-review

NOTE Please do not use the **Consultation Package Builder** tool in IPaC except in specific situations following coordination with our office. Please follow the project review guidance on our website instead and reference your **Project Code** in all correspondence.

Northern Long-eared Bat - (**Updated 4/12/2023**) The Service published a final rule to reclassify the northern long-eared bat (NLEB) as endangered on November 30, 2022. The final rule went into effect on March 31, 2023. You may utilize the **Northern Long-eared Bat Rangewide Determination Key** available in IPaC. More information about this Determination Key and the Interim Consultation Framework are available on the northern long-eared bat species page:

https://www.fws.gov/species/northern-long-eared-bat-myotis-septentrionalis

For projects that previously utilized the 4(d) Determination Key, the change in the species' status may trigger the need to re-initiate consultation for any actions that are not completed and for which the Federal action agency retains discretion once the new listing determination becomes effective. If your project was not completed by March 31, 2023, and may result in incidental take of NLEB, please reach out to our office at newengland@fws.gov to see if reinitiation is necessary.

Additional Info About Section 7 of the Act
Under section 7(a)(2) of the Act and its implementing regulations (50 CFR 402 et seq.), Federal agencies are required to determine whether projects may affect threatened and endangered species and/or designated critical habitat. If a Federal agency, or its non-Federal representative, determines that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Federal agency also may need to consider proposed species and proposed critical habitat in the consultation. 50 CFR 402.14(c)(1) specifies the information required for consultation under the Act regardless of the format of the evaluation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

https://www.fws.gov/service/section-7-consultations

In addition to consultation requirements under Section 7(a)(2) of the ESA, please note that under sections 7(a)(1) of the Act and its implementing regulations (50 CFR 402 et seq.), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species. Please contact NEFO if you would like more information.

Candidate species that appear on the enclosed species list have no current protections under the ESA. The species' occurrence on an official species list does not convey a requirement to consider impacts to this species as you would a proposed, threatened, or endangered species. The ESA does not provide for interagency consultations on candidate species under section 7, however, the Service recommends that all project proponents incorporate measures into projects to benefit candidate species and their habitats wherever possible.

Migratory Birds

In addition to responsibilities to protect threatened and endangered species under the Endangered Species Act (ESA), there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts see:

https://www.fws.gov/program/migratory-bird-permit

https://www.fws.gov/library/collections/bald-and-golden-eagle-management

Please feel free to contact us at **newengland@fws.gov** with your **Project Code** in the subject line if you need more information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat.

Attachment(s): Official Species List

Attachment(s):

- Official Species List
- Coastal Barriers

OFFICIAL SPECIES LIST

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

New England Ecological Services Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5094
(603) 223-2541

PROJECT SUMMARY

Project Code: 2025-0094639

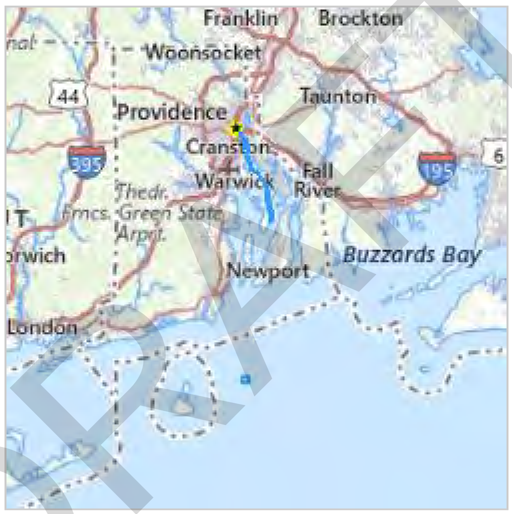
Project Name: Providence DMMP

Project Type: Disposal Dredge Material

Project Description: Dredged Material Management Plan for Providence, RI for immediate and future dredging needs. The DMMP presents a plan for the Providence River and Harbor FNP (Providence FNP) along with three adjacent shallow-draft FNPs (Pawtuxet Cove, Bullocks Point Cove, and Apponaug Cove) all located in the Providence River Estuary in southern Rhode Island.

Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@41.2267958,-71.38029070287723,14z



Counties: Rhode Island

ENDANGERED SPECIES ACT SPECIES

There is a total of 4 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

MAMMALS

NAME	STATUS
Northern Long-eared Bat *Myotis septentrionalis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9045	Endangered
Tricolored Bat *Perimyotis subflavus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/10515	Proposed Endangered

BIRDS

NAME	STATUS
Roseate Tern *Sterna dougallii dougallii* Population: Northeast U.S. nesting population No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/2083	Endangered

INSECTS

NAME	STATUS
Monarch Butterfly *Danaus plexippus* There is **proposed** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/9743	Proposed Threatened

CRITICAL HABITATS

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

YOU ARE STILL REQUIRED TO DETERMINE IF YOUR PROJECT(S) MAY HAVE EFFECTS ON ALL ABOVE LISTED SPECIES.

COASTAL BARRIERS

Projects within the John H. Chafee Coastal Barrier Resources System (CBRS) may be subject to the restrictions on Federal expenditures and financial assistance and the consultation requirements of the Coastal Barrier Resources Act (CBRA) (16 U.S.C. 3501 et seq.). For more information, please contact the local Ecological Services Field Office or visit the CBRA Consultations website. The CBRA website provides tools such as a flow chart to help determine whether consultation is required and a template to facilitate the consultation process.

SYSTEM UNIT (SU)

Most new Federal expenditures and financial assistance, including Federal flood insurance, are prohibited within System Units. ***Federally-funded projects within System Units require consultation with the Service.*** *Consultation is not required for projects using private, state, or local funds.*

UNIT	NAME	TYPE	SYSTEM UNIT ESTABLISHMENT DATE	FLOOD INSURANCE PROHIBITION DATE
D02B	Prudence Island	SU	11/16/1990	11/16/1990

IPAC USER CONTACT INFORMATION

Agency:	Army Corps of Engineers
Name:	Christine San Antonio
Address:	696 Virginia Road
City:	Concord
State:	MA
Zip:	01742
Email	christine.sanantonio@usace.army.mil
Phone:	9783188621

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Ecological Services Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5094
Phone: (603) 223-2541 Fax: (603) 223-0104

In Reply Refer To: 05/09/2025 19:06:53 UTC
Project code: 2025-0094639
Project Name: Providence DMMP

Federal Nexus: yes
Federal Action Agency (if applicable): Army Corps of Engineers

Subject: Record of project representative's no effect determination for 'Providence DMMP'

Dear Christine San Antonio:

This letter records your determination using the Information for Planning and Consultation (IPaC) system provided to the U.S. Fish and Wildlife Service (Service) on May 09, 2025, for 'Providence DMMP' (here forward, Project). This project has been assigned Project Code 2025-0094639 and all future correspondence should clearly reference this number. **Please carefully review this letter.**

Ensuring Accurate Determinations When Using IPaC

The Service developed the IPaC system and associated species' determination keys in accordance with the Endangered Species Act of 1973 (ESA; 87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.) and based on a standing analysis. All information submitted by the Project proponent into IPaC must accurately represent the full scope and details of the Project.

Failure to accurately represent or implement the Project as detailed in IPaC or the **Northern Long-eared Bat and Tricolored Bat Range-wide Determination Key (Dkey)**, invalidates this letter. ***Answers to certain questions in the DKey commit the project proponent to implementation of conservation measures that must be followed for the ESA determination to remain valid.***

Determination for the Northern Long-Eared Bat and/or Tricolored Bat

Based upon your IPaC submission and a standing analysis, your project has reached the following effect determinations:

Species	Listing Status	Determination
Northern Long-eared Bat (*Myotis septentrionalis*)	Endangered	No effect

Tricolored Bat (*Perimyotis subflavus*)	Proposed Endangered	No effect

Federal agencies must consult with U.S. Fish and Wildlife Service under section 7(a)(2) of the Endangered Species Act (ESA) when an action *may affect* a listed species. Tricolored bat is proposed for listing as endangered under the ESA, but not yet listed. For actions that may affect a proposed species, agencies cannot consult, but they can *confer* under the authority of section 7(a)(4) of the ESA. Such conferences can follow the procedures for a consultation and be adopted as such if and when the proposed species is listed. Should the tricolored bat be listed, agencies must review projects that are not yet complete, or projects with ongoing effects within the tricolored bat range that previously received a NE or NLAA determination from the key to confirm that the determination is still accurate.

To make a no effect determination, the full scope of the proposed project implementation (action) should not have any effects (either positive or negative), to a federally listed species or designated critical habitat. Effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action. (See § 402.17).

Under Section 7 of the ESA, if a federal action agency makes a no effect determination, no consultation with the Service is required (ESA §7). If a proposed Federal action may affect a listed species or designated critical habitat, formal consultation is required except when the Service concurs, in writing, that a proposed action "is not likely to adversely affect" listed species or designated critical habitat [50 CFR §402.02, 50 CFR§402.13].

Other Species and Critical Habitat that May be Present in the Action Area

The IPaC-assisted determination key for the northern long-eared bat and tricolored bat does not apply to the following ESA-protected species and/or critical habitat that also may occur in your Action area:

- Monarch Butterfly *Danaus plexippus* Proposed Threatened
- Roseate Tern *Sterna dougallii dougallii* Endangered

You may coordinate with our Office to determine whether the Action may affect the animal species listed above and, if so, how they may be affected.

Next Steps

If there are no updates on listed species, no further consultation/coordination for this project is required with respect to the species covered by this key. However, the Service recommends that project proponents re-evaluate the Project in IPaC if: 1) the scope, timing, duration, or location of the Project changes (includes any project changes or amendments); 2) new information reveals the Project may impact (positively or negatively) federally listed species or designated critical habitat; or 3) a new species is listed, or critical habitat designated. If any of the above conditions occurs, additional coordination with the Service should take place to ensure compliance with the Act.

If you have any questions regarding this letter or need further assistance, please contact the New England Ecological Services Field Office and reference Project Code 2025-0094639 associated with this Project.

Action Description

You provided to IPaC the following name and description for the subject Action.

1. Name

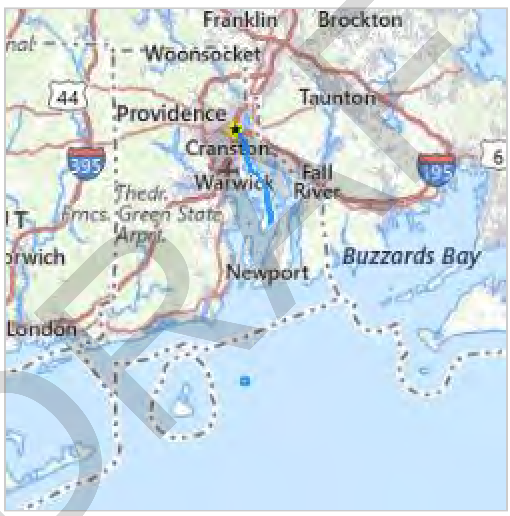
Providence DMMP

2. Description

The following description was provided for the project 'Providence DMMP':

> Dredged Material Management Plan for Providence, RI for immediate and future dredging needs. The DMMP presents a plan for the Providence River and Harbor FNP (Providence FNP) along with three adjacent shallow-draft FNPs (Pawtuxet Cove, Bullocks Point Cove, and Apponaug Cove) all located in the Providence River Estuary in southern Rhode Island.

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@41.2267958,-71.38029070287723,14z



DETERMINATION KEY RESULT

Based on the information you provided, you have determined that the Proposed Action will have no effect on the species covered by this determination key. Therefore, no consultation with the U.S. Fish and Wildlife Service pursuant to Section 7(a)(2) of the Endangered Species Act of 1973 (87 Stat. 884, as amended 16 U.S.C. 1531 *et seq.*) is required for those species.

QUALIFICATION INTERVIEW

1. Does the proposed project include, or is it reasonably certain to cause, intentional take of listed bats or any other listed species?

   Note: Intentional take is defined as take that is the intended result of a project. Intentional take could refer to research, direct species management, surveys, and/or studies that include intentional handling/encountering, harassment, collection, or capturing of any individual of a federally listed threatened, endangered or proposed species?

   No
2. Is the action area wholly within Zone 2 of the year-round active area for northern long-eared bat and/or tricolored bat?

   Automatically answered
   No
3. Does the action area intersect Zone 1 of the year-round active area for northern long-eared bat and/or tricolored bat?

   Automatically answered
   No
4. Does any component of the action involve leasing, construction or operation of wind turbines? Answer 'yes' if the activities considered are conducted with the intention of gathering survey information to inform the leasing, construction, or operation of wind turbines.

   Note: For federal actions, answer ‘yes’ if the construction or operation of wind power facilities is either (1) part of the federal action or (2) would not occur but for a federal agency action (federal permit, funding, etc.).

   No
5. Is the proposed action authorized, permitted, licensed, funded, or being carried out by a Federal agency in whole or in part?

   Yes
6. Is the Federal Highway Administration (FHWA), Federal Railroad Administration (FRA), or Federal Transit Administration (FTA) funding or authorizing the proposed action, in whole or in part?

   No

7. Are you an employee of the federal action agency or have you been officially designated in writing by the agency as its designated non-federal representative for the purposes of Endangered Species Act Section 7 informal consultation per 50 CFR § 402.08?

   Note: This key may be used for federal actions and for non-federal actions to facilitate section 7 consultation and to help determine whether an incidental take permit may be needed, respectively. This question is for information purposes only.

   Yes

8. Is the lead federal action agency the Environmental Protection Agency (EPA) or Federal Communications Commission (FCC)? Is the Environmental Protection Agency (EPA) or Federal Communications Commission (FCC) funding or authorizing the proposed action, in whole or in part?

   No

9. Is the lead federal action agency the Federal Energy Regulatory Commission (FERC)?

   No

10. [Semantic] Is the action area located within 0.5 miles of a known bat hibernaculum?

    Note: The map queried for this question contains proprietary information and cannot be displayed. If you need additional information, please contact your State wildlife agency.

    Automatically answered
    No

11. Does the action area contain any winter roosts or caves (or associated sinkholes, fissures, or other karst features), mines, rocky outcroppings, or tunnels that could provide habitat for hibernating bats?

    No

12. Does the action area contain (1) talus or (2) anthropogenic or naturally formed rock shelters or crevices in rocky outcrops, rock faces or cliffs?

    No

13. Will the action cause effects to a bridge?

    Note: Covered bridges should be considered as bridges in this question.

    No

14. Will the action result in effects to a culvert or tunnel at any time of year?

    No

15. Are trees present within 1000 feet of the action area?

    Note: If there are trees within the action area that are of a sufficient size to be potential roosts for bats answer "Yes". If unsure, additional information defining suitable summer habitat for the northern long-eared bat and tricolored bat can be found in Appendix A of the USFWS' Range-wide Indiana Bat and Northern long-eared bat Survey Guidelines at: [https://www.fws.gov/media/range-wide-indiana-bat-and-northern-long-eared-bat-survey-guidelines.](https://www.fws.gov/media/range-wide-indiana-bat-and-northern-long-eared-bat-survey-guidelines)

    Yes

16. Does the action include the intentional exclusion of bats from a building or structure?

    Note: Exclusion is conducted to deny bats' entry or reentry into a building. To be effective and to avoid harming bats, it should be done according to established standards. If your action includes bat exclusion and you are unsure whether northern long-eared bats or tricolored bats are present, answer "Yes." Answer "No" if there are no signs of bat use in the building/structure. If unsure, contact your local Ecological Services Field Office to help assess whether northern long-eared bats or tricolored bats may be present. Contact a Nuisance Wildlife Control Operator (NWCO) for help in how to exclude bats from a structure safely without causing harm to the bats (to find a NWCO certified in bat standards, search the Internet using the search term "National Wildlife Control Operators Association bats"). Also see the White-Nose Syndrome Response Team's guide for bat control in structures.

    No

17. Does the action involve removal, modification, or maintenance of a human-made structure (barn, house, or other building) **known or suspected to contain roosting bats?**

    No

18. Will the action cause construction of one or more new roads open to the public?

    For federal actions, answer 'yes' when the construction or operation of these facilities is either (1) part of the federal action or (2) would not occur but for an action taken by a federal agency (federal permit, funding, etc.).

    No

19. Will the action include or cause any construction or other activity that is reasonably certain to increase average night-time traffic permanently or temporarily on one or more existing roads? **Note:** For federal actions, answer 'yes' when the construction or operation of these facilities is either (1) part of the federal action or (2) would not occur but for an action taken by a federal agency (federal permit, funding, etc.). .

    No

20. Will the action include or cause any construction or other activity that is reasonably certain to increase the number of travel lanes on an existing thoroughfare?

    For federal actions, answer 'yes' when the construction or operation of these facilities is either (1) part of the federal action or (2) would not occur but for an action taken by a federal agency (federal permit, funding, etc.).

    No

21. Will the proposed Action involve the creation of a new water-borne contaminant source (e.g., leachate pond, pits containing chemicals that are not NSF/ANSI 60 compliant)?

    Note: For information regarding NSF/ANSI 60 please visit https://www.nsf.org/knowledge-library/nsf-ansi-standard-60-drinking-water-treatment-chemicals-health-effects

    No
22. Will the proposed action involve the creation of a new point source discharge from a facility other than a water treatment plant or storm water system?

    No
23. Will the action include drilling or blasting?

    No
24. Will the action involve military training (e.g., smoke operations, obscurant operations, exploding munitions, artillery fire, range use, helicopter or fixed wing aircraft use)?

    No
25. Will the proposed action involve the use of herbicides or other pesticides other than herbicides (e.g., fungicides, insecticides, or rodenticides)?

    No
26. Will the action include or cause activities that are reasonably certain to cause chronic or intense nighttime noise (above current levels of ambient noise in the area) in suitable summer habitat for the northern long-eared bat or tricolored bat during the active season?

    Chronic noise is noise that is continuous or occurs repeatedly again and again for a long time. Sources of chronic or intense noise that could cause adverse effects to bats may include, but are not limited to: road traffic; trains; aircraft; industrial activities; gas compressor stations; loud music; crowds; oil and gas extraction; construction; and mining.

    Note: Additional information defining suitable summer habitat for the northern long-eared bat and tricolored bat can be found in Appendix A of the USFWS' Range-wide Indiana Bat and Northern long-eared bat Survey Guidelines at: https://www.fws.gov/media/range-wide-indiana-bat-and-northern-long-eared-bat-survey-guidelines.

    No
27. Does the action include, or is it reasonably certain to cause, the use of permanent or temporary artificial lighting within 1000 feet of suitable northern long-eared bat or tricolored bat roosting habitat?

    Note: Additional information defining suitable summer habitat for the northern long-eared bat and tricolored bat can be found in Appendix A of the USFWS' Range-wide Indiana Bat and Northern long-eared bat Survey Guidelines at: https://www.fws.gov/media/range-wide-indiana-bat-and-northern-long-eared-bat-survey-guidelines.

    No

28. Will the action include tree cutting or other means of knocking down or bringing down trees, tree topping, or tree trimming?

    No

29. Will the proposed action result in the use of prescribed fire?

    Note: If the prescribed fire action includes other activities than application of fire (e.g., tree cutting, fire line preparation) please consider impacts from those activities within the previous representative questions in the key. This set of questions only considers impacts from flame and smoke.

    No

30. Does the action area intersect the northern long-eared bat species list area?

    Automatically answered
    Yes

31. [Semantic] Is the action area located within 0.25 miles of a culvert that is known to be occupied by northern long-eared or tricolored bats?

    Automatically answered
    No

32. [Semantic] Is the action area located within 150 feet of a documented northern long-eared bat roost site?

    Note: The map queried for this question contains proprietary information and cannot be displayed. If you need additional information, please contact your State wildlife agency.

    Automatically answered
    No

33. Is suitable summer habitat for the northern long-eared bat present within 1000 feet of project activities?
    If unsure, answer "Yes."

    Note: Additional information defining suitable summer habitat for the northern long-eared bat and tricolored bat can be found in Appendix A of the USFWS' Range-wide Indiana Bat and Northern long-eared bat Survey Guidelines at: [https://www.fws.gov/media/range-wide-indiana-bat-and-northern-long-eared-bat-survey-guidelines.](https://www.fws.gov/media/range-wide-indiana-bat-and-northern-long-eared-bat-survey-guidelines)

    Yes

34. Has a presence/probable absence summer bat survey targeting the northern long-eared bat following the Service's Range-wide Indiana Bat and Northern Long-Eared Bat Survey Guidelines been conducted within the project area?

    No

35. Does the action area intersect the tricolored bat species list area?

    Automatically answered
    Yes

36. [Semantic] Is the action area located within 0.25 miles of a culvert that is known to be occupied by northern long-eared or tricolored bats?

    Note: The map queried for this question contains proprietary information and cannot be displayed. If you need additional information, please contact your State wildlife agency.

    Automatically answered
    No

37. Is suitable summer habitat for the tricolored bat present within 1000 feet of project activities?
    (If unsure, answer ""Yes."")

    Note: If there are trees within the action area that may provide potential roosts for tricolored bats (e.g., clusters of leaves in live and dead deciduous trees, Spanish moss (Tillandsia usneoides), clusters of dead pine needles of large live pines) answer ""Yes."" For a complete definition of suitable summer habitat for the tricolored bat, please see Appendix A in the Service's Range-wide Indiana Bat and Northern long-eared Bat Survey Guidelines.

    Yes

38. Do you have any documents that you want to include with this submission?
    No

PROJECT QUESTIONNAIRE

IPAC USER CONTACT INFORMATION

Agency: Army Corps of Engineers
Name: Christine San Antonio
Address: 696 Virginia Road
City: Concord
State: MA
Zip: 01742
Email christine.sanantonio@usace.army.mil
Phone: 9783188621

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Ecological Services Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5094
Phone: (603) 223-2541 Fax: (603) 223-0104

In Reply Refer To: 05/13/2025 14:32:50 UTC
Project code: 2025-0094639
Project Name: Providence DMMP

Federal Nexus: yes
Federal Action Agency (if applicable): Army Corps of Engineers

Subject: Federal agency coordination under the Endangered Species Act, Section 7 for 'Providence DMMP'

Dear Christine San Antonio:

This letter records your determination using the Information for Planning and Consultation (IPaC) system provided to the U.S. Fish and Wildlife Service (Service) on May 13, 2025, for “Providence DMMP” (here forward, Project). This project has been assigned Project Code 2025-0094639 and all future correspondence should clearly reference this number.

The Service developed the IPaC system and associated species’ determination keys in accordance with the Endangered Species Act of 1973 (ESA; 87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.) and based on a standing analysis. All information submitted by the Project proponent into the IPaC must accurately represent the full scope and details of the Project. Failure to accurately represent or implement the Project as detailed in IPaC or the Northeast Determination Key (DKey), invalidates this letter. ***<u>Answers to certain questions in the DKey commit the project proponent to implementation of conservation measures that must be followed for the ESA determination to remain valid.</u>***

To make a no effect determination, the full scope of the proposed project implementation (action) should not have any effects (either positive or negative effect(s)), to a federally listed species or designated critical habitat. Effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action. (See § 402.17). Under Section 7 of the ESA, if a federal action agency makes a no effect determination, no further consultation with, or concurrence from, the Service is required (ESA §7). If a proposed Federal action may affect a listed species or designated critical habitat, formal consultation is required (except when the Service concurs, in writing, that a proposed action "is not likely to adversely affect" listed species or designated critical habitat [50 CFR §402.02, 50 CFR§402.13]).

The IPaC results indicated the following species is (are) potentially present in your project area and, based on your responses to the Service's Northeast DKey, you determined the proposed Project will have the following effect determinations:

Species	**Listing Status**	**Determination**
Roseate Tern (*Sterna dougallii dougallii*)	Endangered	No effect

Conclusion If there are no updates on listed species, no further consultation/coordination for this project is required for the species identified above. However, the Service recommends that project proponents re-evaluate the Project in IPaC if: 1) the scope, timing, duration, or location of the Project changes (includes any project changes or amendments); 2) new information reveals the Project may impact (positively or negatively) federally listed species or designated critical habitat; or 3) a new species is listed, or critical habitat designated. If any of the above conditions occurs, additional consultation with the Service should take place before project implements any changes which are final or commits additional resources.

In addition to the species listed above, the following species and/or critical habitats may also occur in your project area and are not covered by this conclusion:

- Monarch Butterfly *Danaus plexippus* Proposed Threatened
- Northern Long-eared Bat *Myotis septentrionalis* Endangered
- Tricolored Bat *Perimyotis subflavus* Proposed Endangered

To complete consultation for species that have reached a “May Affect” determination and/or species may occur in your project area and are not covered by this conclusion, please visit the “New England Field Office Endangered Species Project Review and Consultation” website for step-by-step instructions on how to consider effects on these listed species and/or critical habitats, avoid and minimize potential adverse effects, and prepare and submit a project review package if necessary: https://www.fws.gov/office/new-england-ecological-services/endangered-species-project-review

Please Note: If the Action may impact bald or golden eagles, additional coordination with the Service under the Bald and Golden Eagle Protection Act (BGEPA) (54 Stat. 250, as amended, 16 U.S.C. 668a-d) by the prospective permittee may be required. Please contact the Migratory Birds Permit Office, (413) 253-8643, or PermitsR5MB@fws.gov, with any questions regarding potential impacts to Eagles.

If you have any questions regarding this letter or need further assistance, please contact the New England Ecological Services Field Office and reference the Project Code associated with this Project.

Action Description

You provided to IPaC the following name and description for the subject Action.

1. Name

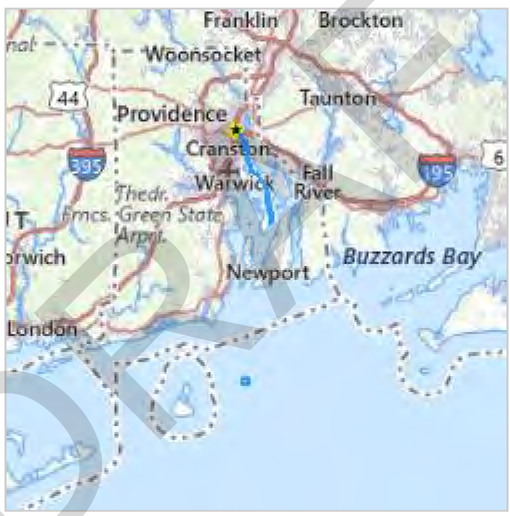
Providence DMMP

2. Description

The following description was provided for the project 'Providence DMMP':

> Dredged Material Management Plan for Providence, RI for immediate and future dredging needs. The DMMP presents a plan for the Providence River and Harbor FNP (Providence FNP) along with three adjacent shallow-draft FNPs (Pawtuxet Cove, Bullocks Point Cove, and Apponaug Cove) all located in the Providence River Estuary in southern Rhode Island.

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@41.2267958,-71.38029070287723,14z



QUALIFICATION INTERVIEW

1. As a representative of this project, do you agree that all items submitted represent the complete scope of the project details and you will answer questions truthfully?

   Yes

2. Does the proposed project include, or is it reasonably certain to cause, intentional take of listed species?

   Note: This question could refer to research, direct species management, surveys, and/or studies that include intentional handling/encountering, harassment, collection, or capturing of any individual of a federally listed threatened, endangered, or proposed species.

   No

3. Is the action authorized, permitted, licensed, funded, or being carried out by a Federal agency in whole or in part?

   Yes

4. Is the Federal Highway Administration (FHWA), Federal Railroad Administration (FRA), or Federal Transit Administration (FTA) the lead agency for this project?

   No

5. Are you including in this analysis all impacts to federally listed species that may result from the entirety of the project (not just the activities under federal jurisdiction)?

   Note: If there are project activities that will impact listed species that are considered to be outside of the jurisdiction of the federal action agency submitting this key, contact your local Ecological Services Field Office to determine whether it is appropriate to use this key. If your Ecological Services Field Office agrees that impacts to listed species that are outside the federal action agency's jurisdiction will be addressed through a separate process, you can answer yes to this question and continue through the key.

   Yes

6. Are you the lead federal action agency or designated non-federal representative requesting concurrence on behalf of the lead Federal Action Agency?

   Yes

7. Is the lead federal action agency the Environmental Protection Agency (EPA) or Federal Communications Commission (FCC)?

   No

8. Is the lead federal action agency the Federal Energy Regulatory Commission (FERC)?

   No

9. Is the lead federal action agency the Natural Resources Conservation Service?

   No

10. Will the proposed project involve the use of herbicide where listed species are present?

    No

11. Are there any caves or anthropogenic features suitable for hibernating or roosting bats within the area expected to be impacted by the project?

    No

12. Does any component of the project associated with this action include activities or structures that may pose a collision risk to **birds** (e.g., plane-based surveys, land-based or offshore wind turbines, communication towers, high voltage transmission lines, any type of towers with or without guy wires)?

    Note: For federal actions, answer ‘yes’ if the construction or operation of wind power facilities is either (1) part of the federal action or (2) would not occur but for a federal agency action (federal permit, funding, etc.).

    No

13. Does any component of the project associated with this action include activities or structures that may pose a collision risk to **bats** (e.g., plane-based surveys, land-based or offshore wind turbines)?

    Note: For federal actions, answer ‘yes’ if the construction or operation of wind power facilities is either (1) part of the federal action or (2) would not occur but for a federal agency action (federal permit, funding, etc.).

    No

14. Will the proposed project result in permanent changes to water quantity in a stream or temporary changes that would be sufficient to result in impacts to listed species?

    For example, will the proposed project include any activities that would alter stream flow, such as water withdrawal, hydropower energy production, impoundments, intake structures, diversion structures, and/or turbines? Projects that include temporary and limited water reductions that will not displace listed species or appreciably change water availability for listed species (e.g. listed species will experience no changes to feeding, breeding or sheltering) can answer "No". Note: This question refers only to the amount of water present in a stream, other water quality factors, including sedimentation and turbidity, will be addressed in following questions.

    No

15. Will the proposed project affect wetlands where listed species are present?

    This includes, for example, project activities within wetlands, project activities within 300 feet of wetlands that may have impacts on wetlands, water withdrawals and/or discharge of contaminants (even with a NPDES).

    No

16. Will the proposed project activities (including upland project activities) occur within 0.125 miles of the water's edge of a stream or tributary of a stream where listed species may be present?

    Yes

17. Will the proposed project directly affect a streambed (below ordinary high water mark (OHWM)) of the stream or tributary where listed species may be present?

    Yes

18. Will the proposed project bore underneath (directional bore or horizontal directional drill) a stream where listed species may be present?

    No

19. Will the proposed project involve a new point source discharge into a stream or change an existing point source discharge (e.g., outfalls; leachate ponds) where listed species may be present?

    No

20. Will the proposed project involve the removal of excess sediment or debris, dredging or in-stream gravel mining where listed species may be present?

    Yes

21. Will the proposed project involve the creation of a new water-borne contaminant source where listed species may be present?

    Note New water-borne contaminant sources occur through improper storage, usage, or creation of chemicals. For example: leachate ponds and pits containing chemicals that are not NSF/ANSI 60 compliant have contaminated waterways. Sedimentation will be addressed in a separate question.

    No

22. Will the proposed project involve perennial stream loss, in a stream of tributary of a stream where listed species may be present, that would require an individual permit under 404 of the Clean Water Act?

    No

23. Will the proposed project involve blasting where listed species may be present?

    No

24. Will the proposed project include activities that could negatively affect fish movement temporarily or permanently (including fish stocking, harvesting, or creation of barriers to fish passage).

    No

25. Will the proposed project involve earth moving that could cause erosion and sedimentation, and/or contamination along a stream or tributary of a stream where listed species may be present?

    Note: Answer "Yes" to this question if erosion and sediment control measures will be used to protect the stream.

    No

26. Will the proposed project impact streams or tributaries of streams where listed species may be present through activities such as, but not limited to, valley fills, large-scale vegetation removal, and/or change in site topography?

    No

27. Will the proposed project involve vegetation removal within 200 feet of a perennial stream bank where aquatic listed species may be present?

    No

28. Will erosion and sedimentation control Best Management Practices (BMPs) associated with applicable state and/or Federal permits, be applied to the project? If BMPs have been provided by and/or coordinated with and approved by the appropriate Ecological Services Field Office, answer "Yes" to this question.

    No

29. Is the project being funded, lead, or managed in whole or in part by U.S Fish and Wildlife Restoration and Recovery Program (e.g., Partners, Coastal, Fisheries, Wildlife and Sport Fish Restoration, Refuges)?

    No

30. Will the proposed project result in changes to beach dynamics that may modify formation of habitat over time?

    Note: Examples of projects that result in changes to beach dynamics include 1) construction of offshore breakwaters and groins; 2) mining of sand from an updrift ebb tidal delta; 3) removing or adding beach sands; and 4) projects that stabilize dunes (including placement of sand fences or planting vegetation).

    No

31. [Hidden Semantic] Is the project area located within the roseate tern AOI?

    Automatically answered
    Yes

32. If you have determined that the roseate tern is unlikely to occur within your project's action area or that your project is unlikely to have any potential effects on the roseate tern, you may wish to make a "no effect" determination for the roseate tern. Additional guidance on how to make this decision can be found in the project review section of your local Ecological Services Field Office's website. CBFO: https://www.fws.gov/office/chesapeake-bay-ecological-services/project-review ; MEFO: https://www.fws.gov/office/maine-ecological-services ; NJFO: https://www.fws.gov/office/new-jersey-ecological-services/new-jersey-field-office-project-review-guide ; NEFO: https://www.fws.gov/office/new-england-ecological-services/endangered-species-project-review#Step5 ; WVFO: https://www.fws.gov/office/west-virginia-ecological-services/project-planning. If you are unsure, answer "No" and continue through the key.

    Would you like to make a no effect determination for the roseate tern?

    No

33. Is this an aquaculture project?

    No

34. Is this a coastal project that has an action area that is less than one-half acre?

    Note: These projects may include marker buoys, moorings, navigational structures, docks, piers, floats, boat ramps, private dredging, boat houses, lobster pound, or shoreline work.

    No

35. Will project activities be conducted during the time of year when roseate terns are likely to be present?

    Note: roseate terns a likely to be present in Maine May 1 through Sept. 1; and in Connecticut, Massachusetts, New Hampshire, and Rhode Island April 15 through Oct. 15.

    Yes

36. Will the proposed project affect suitable habitat for roseate terns nesting (barrier islands with dense vegetation or rocks to serve as shelter)?

    No

37. Will the proposed project affect suitable habitat for roseate terns foraging (nearshore shallow waters, shoals and shoals in offshore waters)?

    No

38. Will the proposed project affect suitable habitat for roseate terns roosting (rocky habitat on coastal islands)?

    No

39. Will the proposed project affect suitable habitat for roseate terns staging (sandy barrier beaches, often on distal tips, primarily in NY and NE)?

    No

40. Will the proposed project involve ground disturbance (e.g., vehicles, tracked equipment, excavating, grading, placing fill material, etc.) in roseate tern foraging, nesting, roosting or staging habitat while terns are likely to be present (April1 - September 30)?

    No

41. Does the action area include suitable habitat for migrating roseate terns (sandy beaches, coastal islands)?

    No

42. [Semantic] Does the project intersect the Virginia big-eared bat critical habitat?

    Automatically answered
    No

43. [Semantic] Does the project intersect the Indiana bat critical habitat?

    Automatically answered
    No

44. [Semantic] Does the project intersect the candy darter critical habitat?

    Automatically answered
    No

45. [Semantic] Does the project intersect the diamond darter critical habitat?

    Automatically answered

    No

46. [Semantic] Does the project intersect the Big Sandy crayfish critical habitat?

    Automatically answered

    No

47. [Hidden Semantic] Does the project intersect the Guyandotte River crayfish critical habitat?

    Automatically answered

    No

48. Do you have any other documents that you want to include with this submission?

    No

PROJECT QUESTIONNAIRE

1. Approximately how many acres of trees would the proposed project remove?

   0

2. Approximately how many total acres of disturbance are within the disturbance/ construction limits of the proposed project?

   0

3. Briefly describe the habitat within the construction/disturbance limits of the project site.

   Providence River FNP, CAD Cells, and RISDS - below MLLW

IPAC USER CONTACT INFORMATION

Agency: Army Corps of Engineers
Name: Christine San Antonio
Address: 696 Virginia Road
City: Concord
State: MA
Zip: 01742
Email christine.sanantonio@usace.army.mil
Phone: 9783188621

EFH Assessment

ESSENTIAL FISH HABITAT ASSESSMENT FOR MAINTENANCE DREDGING OF THE PROVIDENCE RIVER AND HARBOR FEDERAL NAVIGATION PROJECT

May 2025

Prepared by

U.S. Army Corps of Engineers
New England District
696 Virginia Road
Concord, Massachusetts 01742

Table of Contents

1. General Project Information

Date Prepared:	May 2025
Project/ Application Number:	N/A
Project Name:	Providence River and Harbor Maintenance Dredging
Project Applicant:	U.S. Army Corps of Engineers, New England District
Federal Action Agency:	U.S. Army Corps of Engineers, New England District
Fast-41:	No
Action Agency Contact Name:	Matthew Mroczka
Contact Phone:	978-318-8537
Contact Email:	matthew.e.mroczka@usace.army.mil : U.S. Army Corps of Engineers New England District 696 Virginia Road Concord, Massachusetts 01742-2751

2. Project Description

Location (Approximate - WGS 84): Narragansett Bay: 41.6000/-71.3500
Rhode Island Sound Disposal Site:
41.238918/-71.369543

Body of Water (HUC-12): Narragansett Bay – Frontal Rhode Island Sound (0109000409)

Project Purpose:

The purpose of dredging the Providence River and Harbor Federal Navigation Project (FNP) is to restore and maintain the projects navigation efficiency and safety for the for deep draft vessel traffic entering and leaving the Port of Providence. Navigation in the Providence FNP along with three adjacent shallow-draft Federal Navigation Projects (FNPs), Pawtuxet Cove, Bullocks Point Cove, and Apponaug Cove is required to be maintained by USACE by periodic dredging of the channel and facilities in order to meet channel utilization requirements. Recent utilization analysis and engineering specifications for existing and expected commercial vessel use in the Providence FNP show that dredging is required to full congressionally authorized depths of -40 feet MLLW, along with full channel and turning basin dimensions. The Providence FNP constitutes the principal commercial waterway in Rhode Island, providing navigation to the Port of Providence (Figure 1). Deep-draft traffic in the FNP Channel consists mainly of tankers, barges, and general cargo vessels, typically with drafts in excess of 39 ft fully loaded.

The last significant dredging in the Federal Navigation Channel was completed in 2005, in which 4.3-million cy of sediment was dredged to remove shoaling and maintain the channel back to the authorized depth of -40 feet MLLW. The full width of turning basin was not dredged.

Sedimentation in the channel over the last 18 years has resulted in significant reductions in channel water depth and channel width. A current condition survey (conducted in 2020) of the Providence FNP shows that shoaling up to several feet deep has occurred in many locations of FNP (Figures 2 and 3), resulting in the shallowing and narrowing of the projects dimensions. To bring the FNP back to federally authorized dimensions, over 2,000,000 cubic yards (cy) of shoaled material will need to be dredged and placed in several suitable placement locations. The remaining open capacity of the existing dredged material disposal sites cannot accommodate this quantity (2,000,000 cy) of dredged material from this maintenance dredging and from future periodic maintenance dredging’s that will take place over the next 20 years.

A Dredged Material Management Plan (DMMP) which identifies multiple placement locations for the dredged material, has been developed. The recent channel utilization analysis provides evidence that the proposed O&M dredging of the FNP will eliminate the existing safety hazards associated with the shoaling of the channel and result in cost efficiencies for shippers to the port. Without dredging, navigation conditions in the channel will continue to deteriorate, resulting in greater restricted access for large vessels entering the Port of Providence. Eventually, this loss of access will result in decreasing the ports economic value to the region.

Project Description:

The proposed project involves two complete maintenance dredging cycles of the Providence River and Harbor Federal Navigation project (Providence FNP). Cycle-One is expected to be constructed in 2027-2028 and Cycle-Two is expected to be constructed in 2047-2048. Each dredging cycle will require the construction of a confined aquatic disposal (CAD) cell to accommodate unsuitable dredged material generated from the maintenance dredging of the Providence FNP as well as three adjacent shallow-draft federal navigation projects (FNPs) (Bullocks Cove, Pawtuxet Cove, and Apponaug Cove) and additional unsuitable dredged material from local non-federal sources.

The two CAD cells will each require an access channel, and the CAD cells will be located in the Edgewood Shoals area of Narragansett Bay adjacent to the Fuller Rock Reach of the Providence FNP (Figure 4). For Cycle One, the Edgewood Shoals North (ESN) CAD cell will be constructed in 2027, sized to account for placement of 2,015,000 cy of unsuitable material from Providence FNP, 63,000 cy of unsuitable material from the three adjacent FNPs, and placement of an additional 300,000 cy unsuitable material from non-federal dredging sources. The ESN CAD cell will also be sized to accommodate future starter cell materials from a Cycle-Two CAD cell and to accommodate a final three-foot cap of suitable material for restoration and closeout. The ESN CAD cell construction will cover a 50-acre area and generate approximately 37,000 cy of unsuitable material and 3,200,000 cy of suitable dredged material. Approximately 389,000 cy of material (37,000 cy unsuitable, capped by 352,000 cy suitable) from ESN CAD cell will be placed for beneficial use in the adjacent Port Edgewood Basin, a former Department of Defense navigation port (Figure 4).

Material placed at Port Edgewood Basin will cover existing unsuitable sediments in the basin as well as change the bathymetry to help alleviate water circulation and water quality issues in the basin. Approximately 1,825,000 cy of suitable material from the ESN CAD cell will be placed beneficially at the previously used Prudence Island Disposal Site to cover dredged material mounds at the site that contain unsuitable material (Figure 5). Additionally, approximately 113,000 cy of suitable material will be used to cap and restore bottom bathymetry at five current CAD cells in the north end of Fox Point Reach of the FNP, which were constructed for the former maintenance dredging activity back in the year 2005 (Figure 6). The remaining 885,000 cy of suitable material from the ESN CAD cell will be placed at the Rhode Island Sound Disposal Site (RISDS) (Figure 7). Following the construction of the ESN CAD cell, the Providence FNP will be dredged in the year 2028. The ESN CAD cell will remain open for approximately 20 years for placement of additional federal and non-federal dredging placement needs, and then be capped with clean material excavated from the Cycle-Two CAD cell and be closed out in the year 2047.

Maintenance dredging Cycle Two is expected to be implemented in 2047-2048. Based upon shoaling rate calculations, approximately 1,900,000 cy will be required to be removed from the Providence FNP during Cycle Two. For the second cycle, a second CAD cell, Edgewood Shoals South (ESS) CAD cell, will be constructed in a fifty-acre area in the southern half of the Edgewood Shoals area (Figure 4). The ESS CAD cell will be large enough to accommodate all of the predicted dredging needs of the Providence FNP along with 61,000 cy predicted to be dredged from the three adjacent FNPs, and additional capacity to place 300,000 cy of non-federal dredging needs and have capacity for future starter cell placement requirements and final for capping with three feet of clean material. The ESS CAD cell will remain open for approximately 20 years, and then be capped and closed out. The construction of the ESS CAD cell will generate approximately 3,000,000 cy of dredged material. Approximately 38,000 cy of unsuitable material from the ESS CAD cell will be placed in the Cycle-One (ESN) CAD cell, followed by capping and closure of the ESN CAD cell with approximately 350,000 cy of suitable material from the ESS CAD cell construction. Additionally, approximately 130,000 cy of suitable material could be placed to cap and close out the remaining two open CAD cells at the Fox Point Reach site (Figure 6). The remaining suitable material will be placed at the RISDS if no additional beneficial use alternatives can be found in 2047-2048. Following the construction of the ESS CAD cell, the Providence FNP will be dredged in the year 2048. The ESS CAD cell will remain open for approximately 20 years for placement of additional federal and non-federal dredging placement needs, and then be capped and closed out in the year 2067.

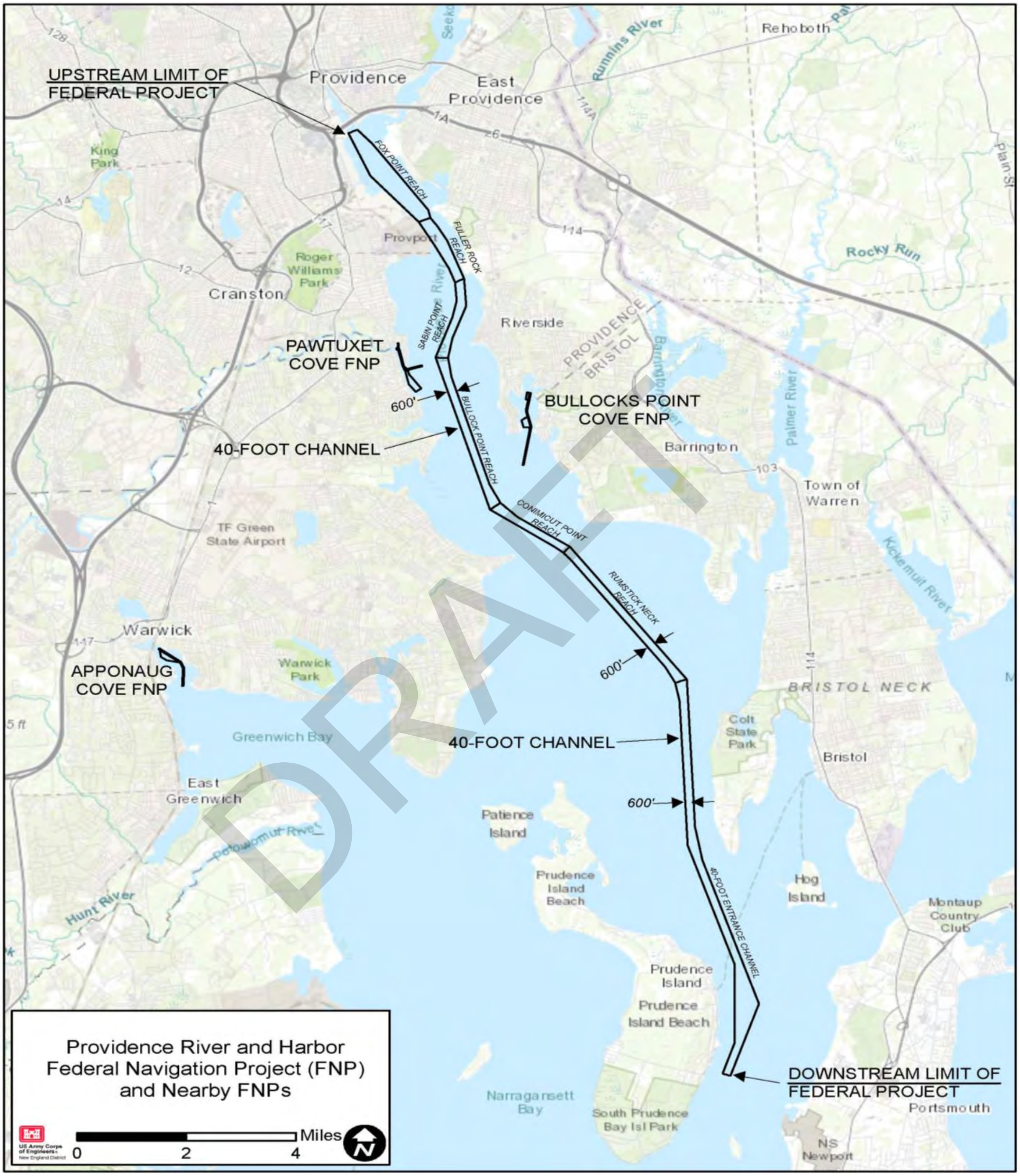


Figure 2. Providence River and Harbor Federal Navigation Project Features and Nearby Federal Navigation Projects.

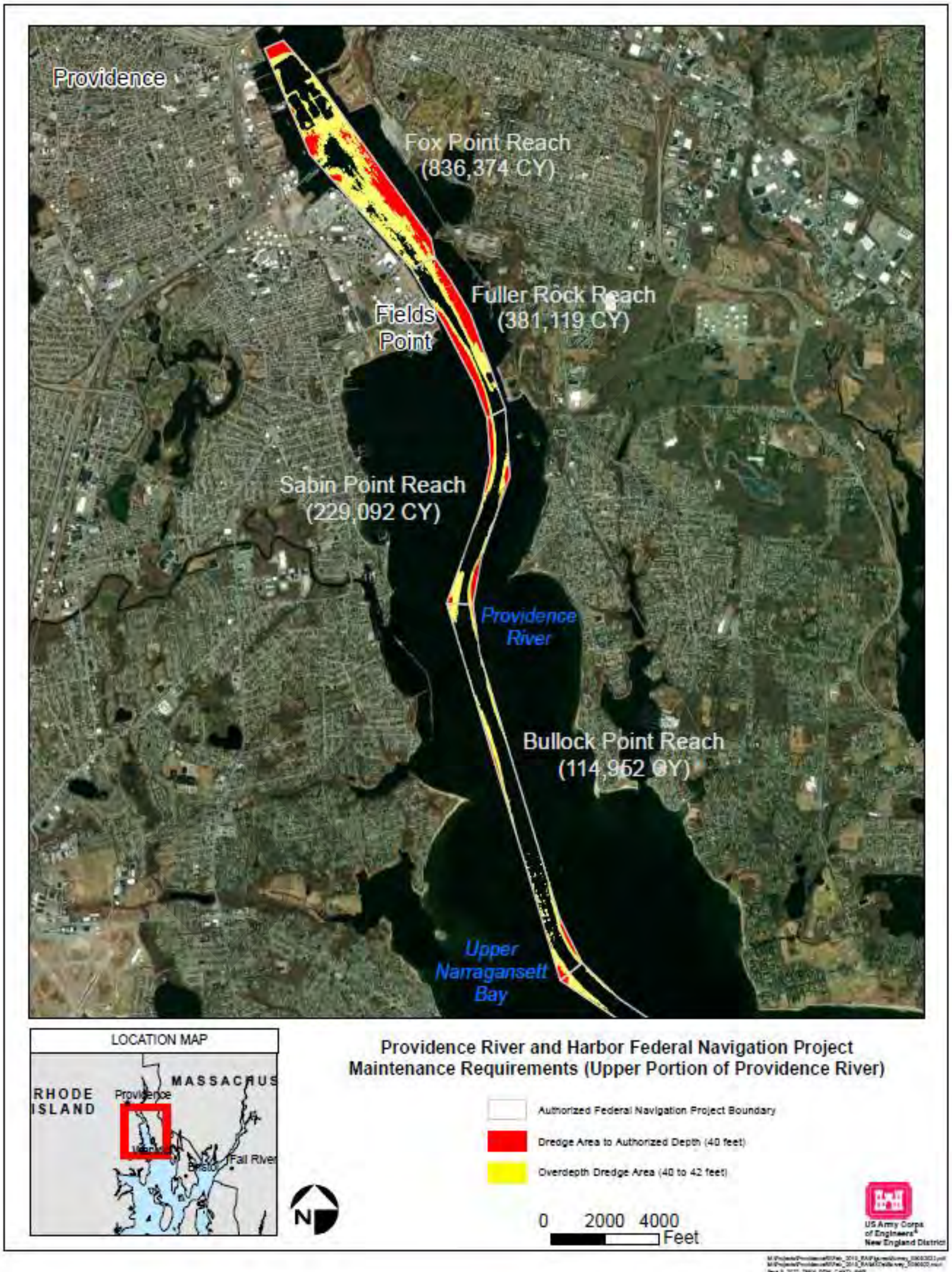


Figure 2. Shoaled areas of Providence River and Harbor FNP (northern reaches).

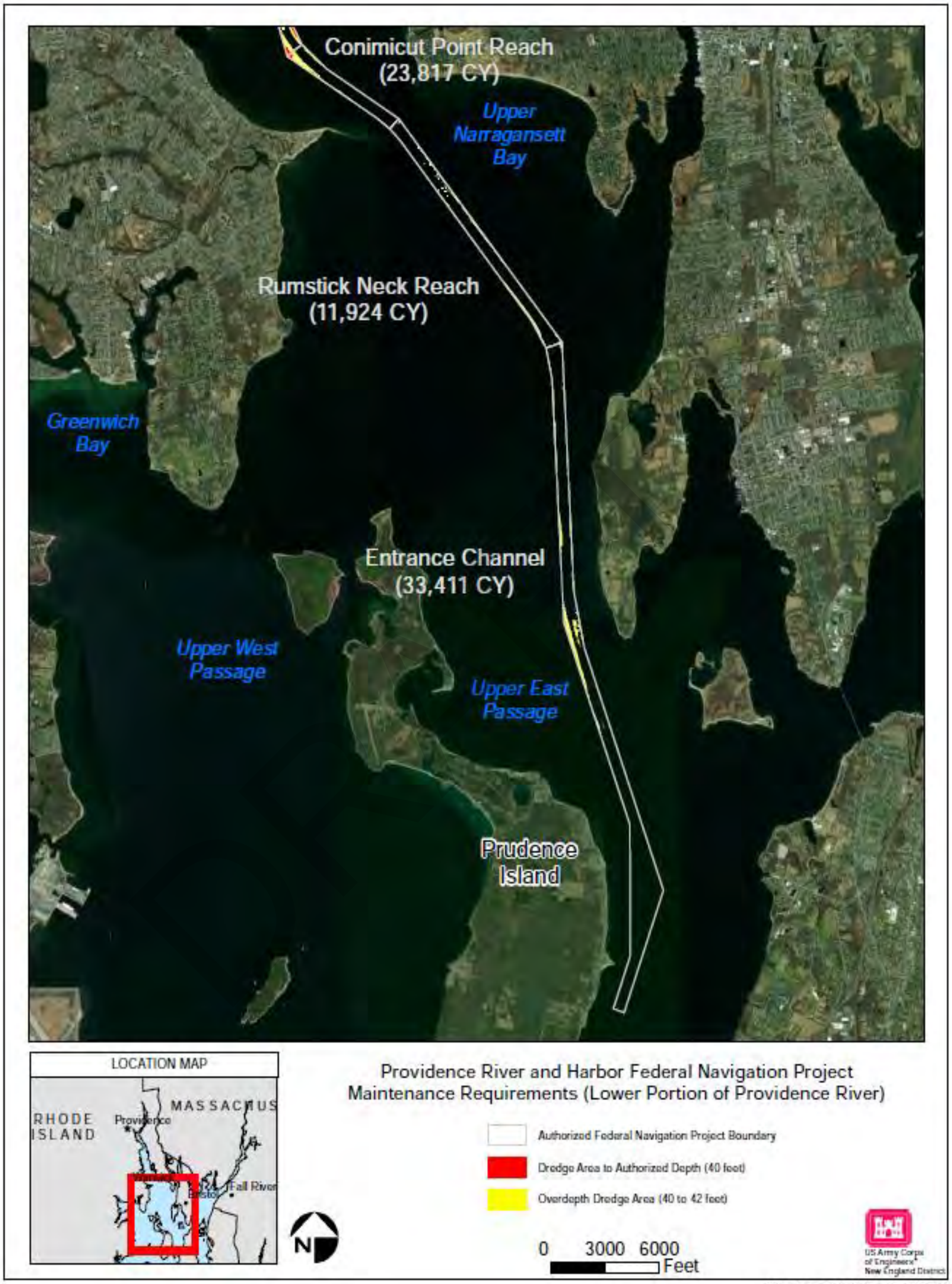
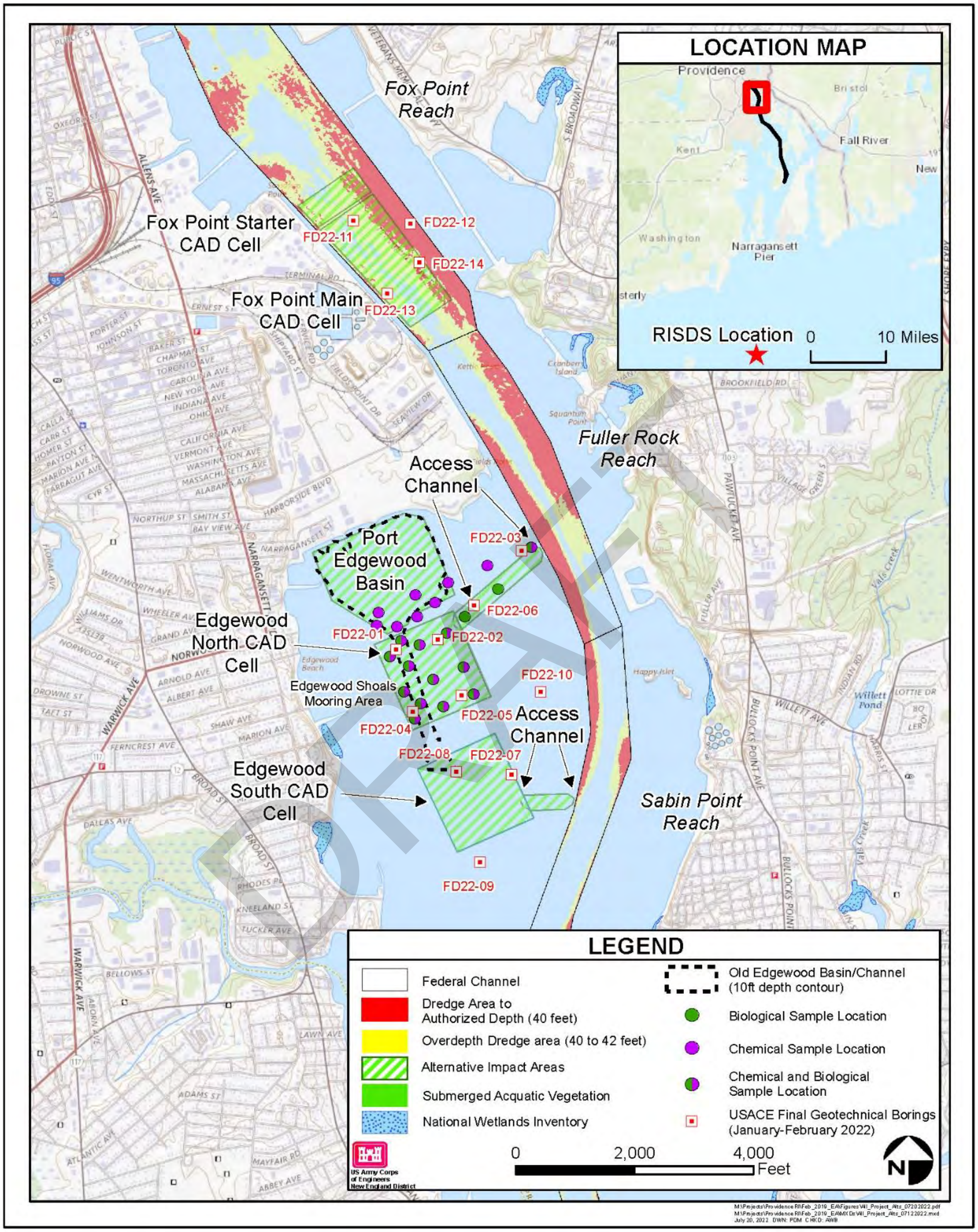


Figure 3. Shoaled areas of Providence River and Harbor FNP (southern reaches).



CAD Cell Alternative Impact Areas Providence DMMP

Figure 4. Edgewood Shoals North CAD cell, Edgewood Shoals South CAD cell, access channels, and Port Edgewood Basin.

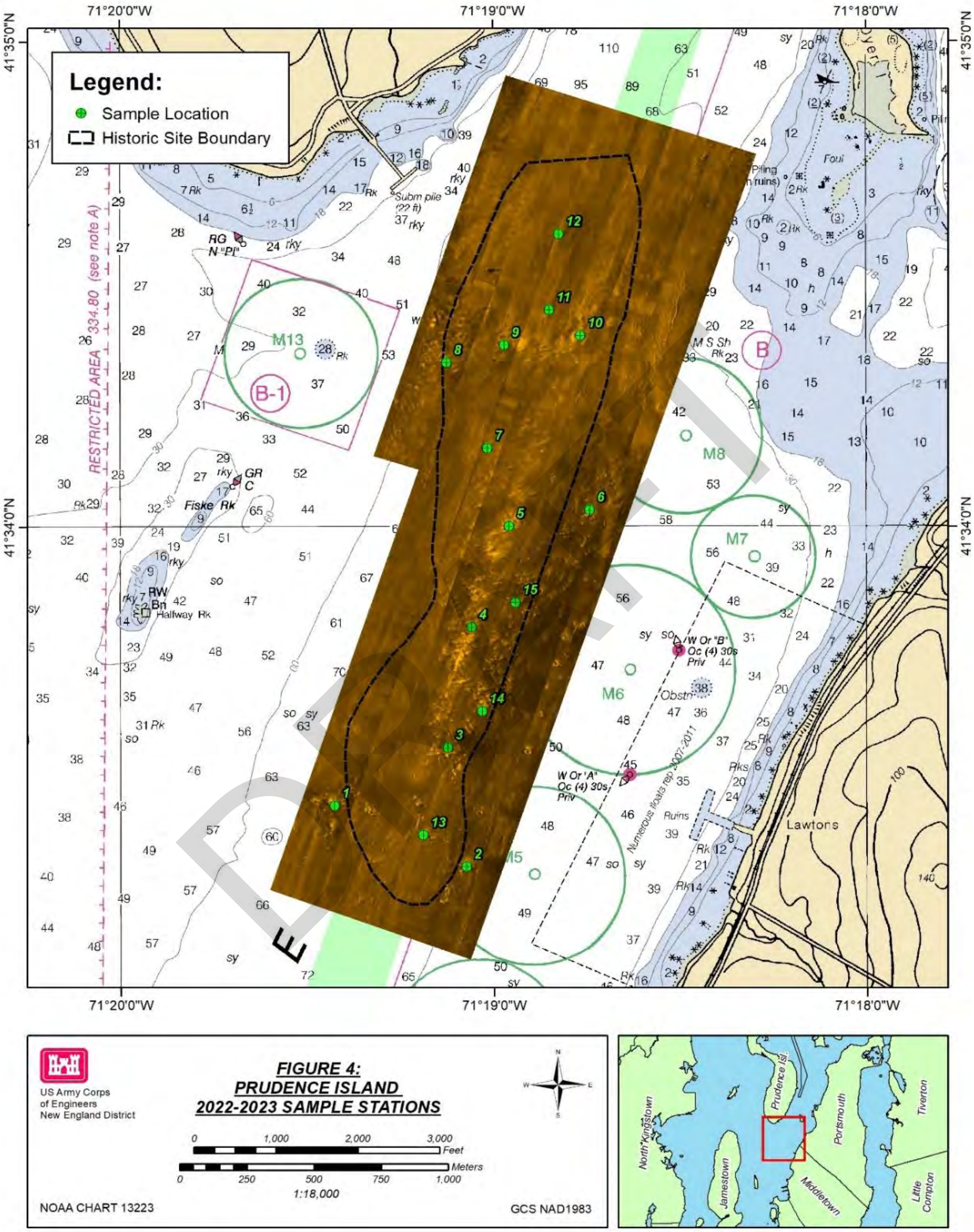


Figure 5. Prudence Island Disposal Site Side Scan Sonar Image.

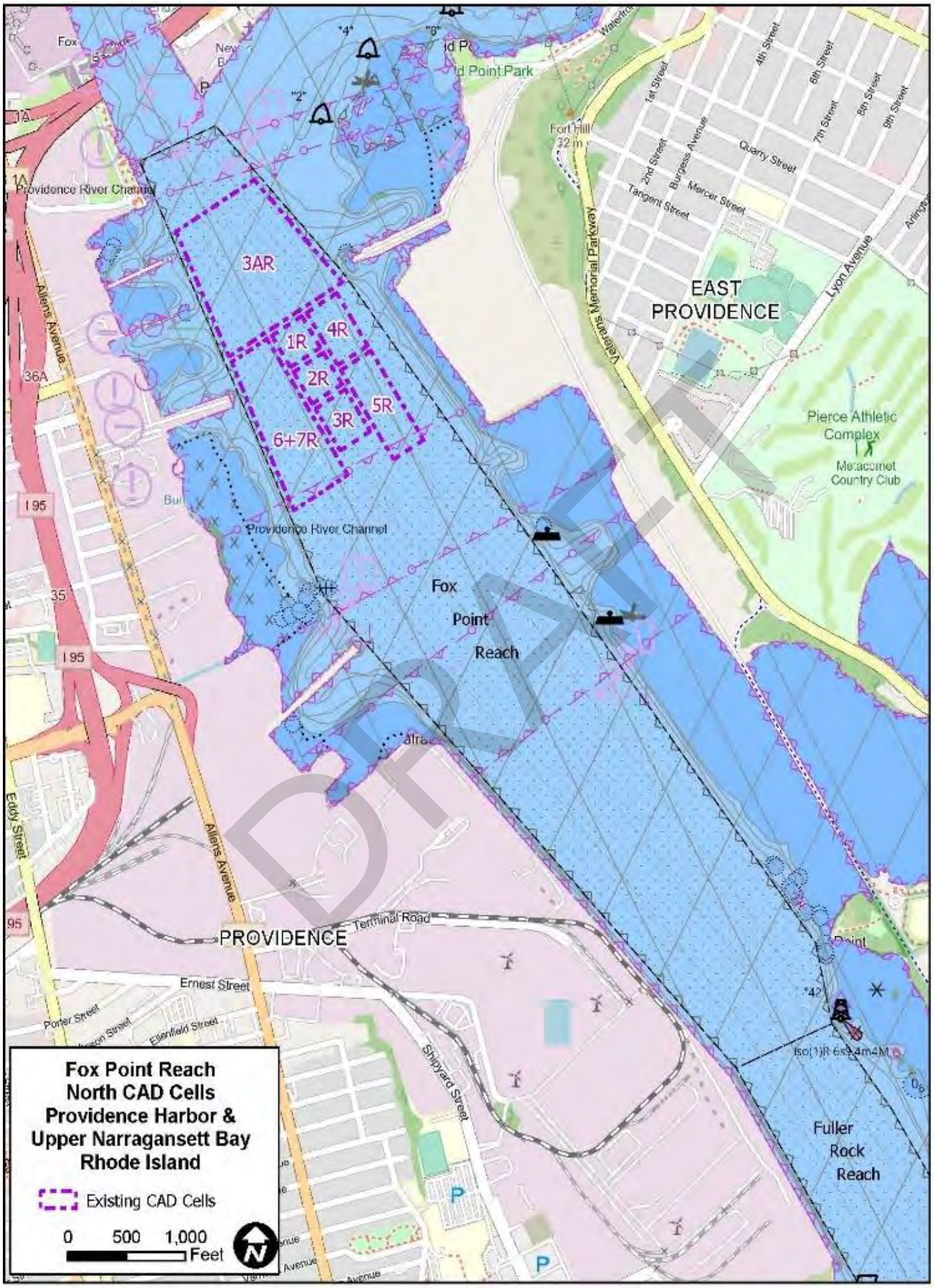
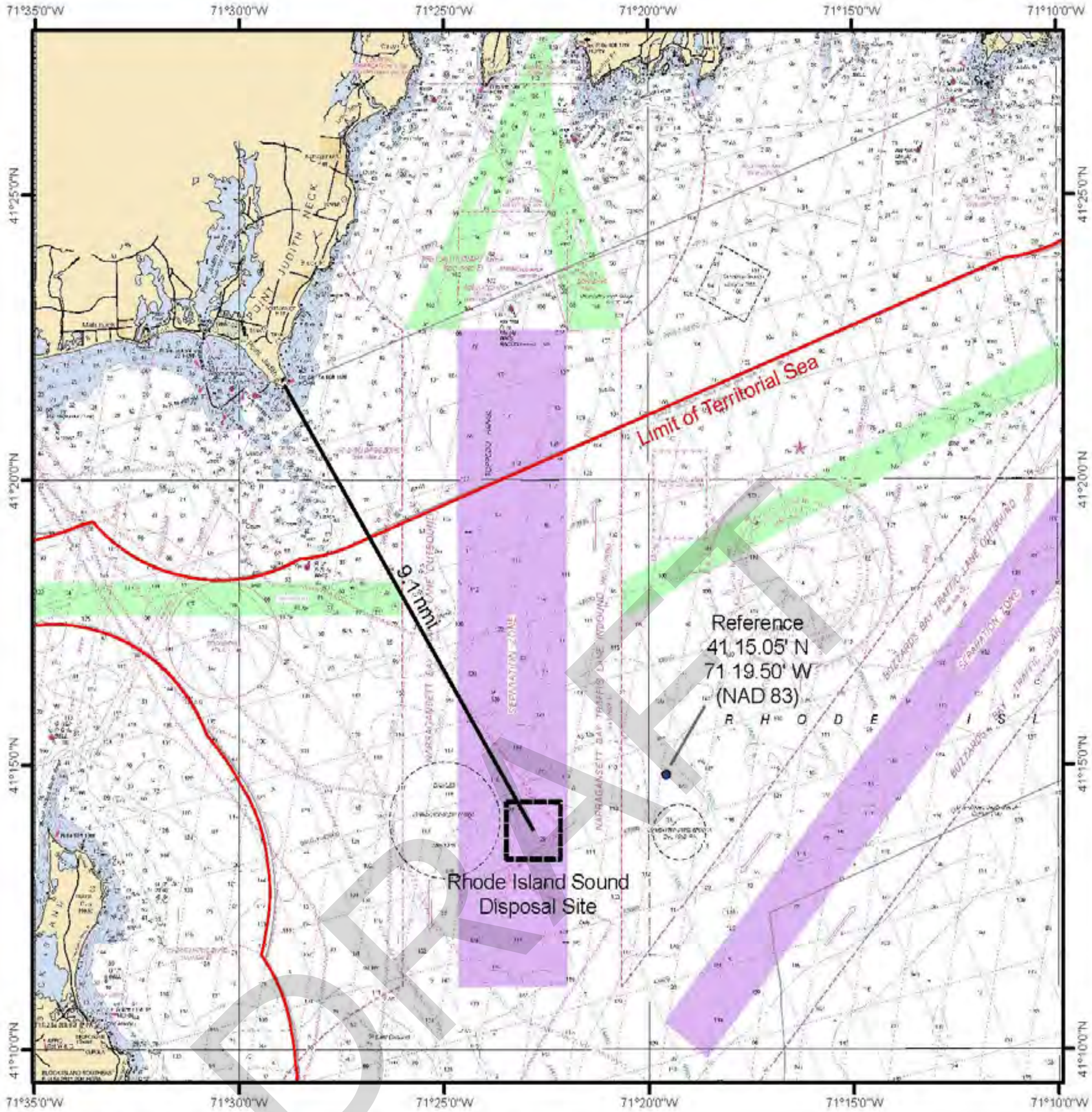


Figure 6. Fox Point Reach North Confined Aquatic Disposal Cells Location.



RHODE ISLAND SOUND DISPOSAL SITE

Description: The Rhode Island Sound Disposal Site (RISDS) was designated in December 2004. This 3.24 km^2 (1 nautical mi^2) site is centered at 41° 13.850' N, 71° 22.817' W (NAD 83). It is located approximately 9.1 nmi (16.8 km) south-southeast of Point Judith, Rhode Island, and approximately 11.3 nmi (21 km) south of the entrance to Narragansett Bay. It is situated within the Separation Zone for the Narragansett Bay Inbound and Outbound Traffic Lanes and lies within a topographic depression, with water depths from 36 to 39 m. The authorized disposal point (within the overall disposal area) is specified for each dredging project in other project documents.

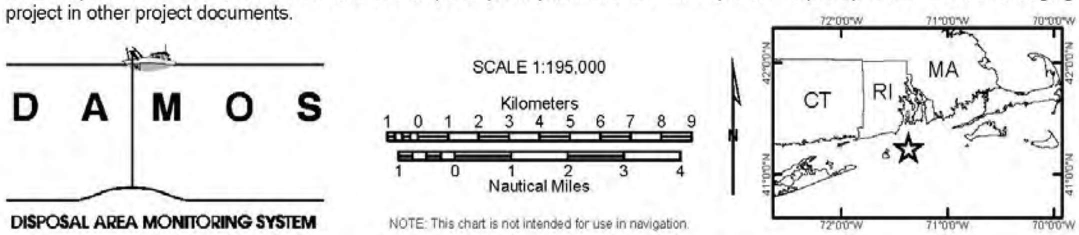


Figure 7. Rhode Island Sound Disposal Site Location

Anticipated Duration of In-Water Work including planned Start/End Dates, and any seasonal restrictions proposed to be included in the schedule:

The anticipated work to perform dredging within the FNP reaches and the CAD cells in Edgewood Shoals areas will use the time of year restrictions stated below in Table 1.

Table 1. Construction Durations and Haul Distances with Restricted Months for Providence Federal Navigation Project by Reach for Construction Operations.

Location	Restriction												Dredging Duration Needed		Haul Distances to CAD cells	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	CAD Cell Construction Alternative (Year 1) (Months)	O&M (Year 2) With mobilization between reaches (Months)	Cycle One Edgewood Shoals North CAD cell (Miles)	Cycle Two Edgewood Shoals South CAD cell (Miles)
Fox Point Reach		X	X	X									2	3	2.17	2.82
Fuller Rock Reach		X	X	X	X	X	X	X	X				0	1	0.85	1.49
Sabin Point Reach						X	X						0	1	1.88	0.69
Bullock Point Reach		X	X			X	X						0	1	3.50	2.31
Conimicut Point Reach		X	X			X	X						0	1	5.28	4.09
Rumstick Neck Reach	X	X	X		X	X	X	X	X	X	X	X	0	1	7.22	6.04
Entrance Channel													0	1	8.30	7.12
Prudence Island Basin													4	0	N/A	N/A
RI Sound Disposal Site													4	0	N/A	N/A
Edgewood Shoals		X	X	X									9 (Note 1)	9 (Note 1)	N/A	N/A
Total Time Duration Needed													9	9		

Legend:		
	Construction and Placement Prohibited	X
	Construction and Placement Allowed	

Note 1. The time period needed in Edgewood Shoals overlaps with other time periods.

3. Site Description

Is the project in designated EFH? Yes

Is the project in designated HAPC? Yes

Does the project contain any Special Aquatic Sites? No

Is this coordination under FWCA only? No

Total area of impact to EFH:

According to the latest bathymetry survey conducted by USACE in 2020, the total shoaled areas to be dredged (allowed plus overdepth) within the FNP is 373 acres. The area to be dredged at the Edgewood Shoals North CAD is 22 acres, and the access channel is 5 acres, for a total dredge area of 400 acres.

The placement areas (Port Edgewood Basin, Edgewood Shoals North CAD, RISDS and PIDS) are 65 acres, 22 acres, 140 acres, and 377 acres respectively, for a total placement area of 604 acres.

Therefore, the maximum total area of impact to EFH is 1,004 acres.

Total area of impact to HAPC:

The Providence River FNP, Edgewood Shoals Basin, Edgewood Shoals North CAD cell, and access channel fall within the Inshore 20m Juvenile Cod and summer flounder HAPC. Therefore, the maximum total area of potential impact to HAPC is 465 acres.

Current range of water depths:

The FNP in the Providence River consists of a 16.8-mile-long channel that is 40 feet deep at MLLW beginning at the head of Providence Harbor and following the river on a southerly course to deep water in Narragansett Bay near Prudence Island. The channel is generally 600 feet wide except for the Providence Harbor reach located between Fox Point and Fields Point (near the Providence-Cranston city line), where it has varying widths up to 1,700 ft.

Edgewood Shoals is a natural shallow area in the Providence River located between Fields Point and the mouth of the Pawtuxet River. The eastern edge of the shoal abuts the 40-foot FNP channel. A 13-foot channel and basin was dredged through the shoal in the early 1940s to provide access to a shipyard commissioned by the U.S. Maritime Commission as part of the Nation’s Emergency Shipbuilding Program. This existing channel has been allowed to shoal in and recent nautical charts indicate a reported depth of 8 feet (USACE, 2021a).

The ambient seafloor at RISDS is approximately 37 m (121 ft) deep. A berm was observed in 2020 sampling efforts along the western side of the site, curling northeast to connect to a large mound centered along the northern edge of the site. The berm was approximately 1.6 km (1 mile) in length, varied in width, and rose 1 to 2 m (3 to 6 ft) above the seafloor. RISDS seafloor features, including the berm and individual mounds were formed by dredged material placement. For more detailed information, please see DAMOS Monitoring Survey at the Rhode Island Sound Disposal Site May/June 2020 (USACE, 2021b).

Salinity range:

The concentration of salts in estuarine water reflects the volume of freshwater that is mixing with the saltwater that moves into Narragansett Bay from the ocean. The flows of freshwater from surface runoff, rivers, and wastewater discharges can carry pollutants into the Bay. Stations near the rivers that flow into upper Narragansett Bay tend to report lower salinity than those in lower Narragansett Bay. The mixing of freshwater inputs with seawater results in salinities in Narragansett Bay that range between 24 ppt in the Providence River and 32 ppt at the mouth of the Bay (Kremer and Nixon, 1978; Raposa, 2016).

Water temperature range:

In Narragansett Bay and the FNP, the warmest water temperature is in August with an average around 70°F / 21.1°C. The coldest month is February with an average water temperature of 37.9°F / 3.3°C (seatemperature.org, 2022a). For Rhode Island Sound (the ocean off of Newport, RI), temperatures range from 36°F / 2°C to 70°F / 21°C (seatemperature.org, 2022b).

4. Habitat Types

Substrate Volumes

Table 2. Substrate Volumes to be Dredged and Placed

Habitat Location	Habitat Type	Approx. Total Impacts (cy)	Temporary Impacts (cy)	Approx. Permanent Impacts (cy)
DREDGE				
Estuarine (dredged from FNP)	Substrate (silt)	2M	0	2M
Estuarine (dredged from Edgewood Shoals North CAD)	Substrate (silt)	3M	0	3M
Estuarine (dredged from access channel)	Substrate (silt)	250k	0	250k
PLACEMENT				
Estuarine (placed in Port Edgewood Basin)	Substrate (silt)	400k	0	400k
Estuarine (placed in Edgewood Shoals North CAD)	Substrate (silt)	2.6M	0	2.6M
Marine (placed at RISDS)	Substrate (silt)	2.8M	0	2.8M
Estuarine (Placed at PIDS)	Substrate (silt)	1.8M	0	1.8M

Submerged Aquatic Vegetation (SAV)

SAV Present? No

Details:

No SAV present within any of the project areas.

Sediment Characteristics

General Description of the Sediment Composition for the Providence River FNP:

In 2013, sediment samples from 24 individual stations in the Providence River were analyzed for grain size, total solids, and percent moisture (Table 3). Sediment samples were collected to project depth (authorized depth plus two feet of overdepth) or refusal from 24 stations using an SDI VibeCore-D electric vibracorer.

Water depths at the sample stations ranged from 37.5 to 39.2 feet MLLW. Sediments collected throughout the FNP consisted of poorly graded medium to fine sand with silt. Samples collected and analyzed for sediment grain size indicated that these sediments contain between and between 66% and 97% coarse grained material (cobble, gravel, sand) and between 3 and 34% fines (*i.e.*, silt and clay). A noticeable petroleum odor was observed in sediments from multiple stations in the upper portion of the FNP (B, G, E, F, J, N, O, P, Q, R). In addition, sediments collected from station V smelled strongly of sewage (USACE, 2013).

Table 3. Summary of Grain Size and Moisture Content Results for Providence River FNP

Sample ID	% Cobble	% Gravel	% Coarse Sand	% Medium Sand	% Fine Sand	% Total Fines	% Moisture
B	0.1(U)	2.19	12.5	36.6	33.6	15.1	66.4
D	0.1(U)	2.44	8.45	31.3	36.9	20.9	62.4
E	0.1(U)	0.1(U)	1.52	34.1	38.3	26.1	67.3
F	0.1(U)	0.1(U)	2.8	41.1	51.6	4.45	70.8
G	0.1(U)	2.58	16.3	49.4	28.8	2.88	68.2
H	0.1(U)	0.46	7.28	43.6	27.4	21.3	69.4
I	0.1(U)	0.91	5.21	47.3	36.2	10.4	63.8
J	0.1(U)	0.99	11.1	46.2	37.4	4.29	67.1
K	0.1(U)	0.1(U)	7.57	43.6	34.3	14.5	68.4
L	0.1(U)	0.32	10.4	45.1	30.9	13.3	66.5
M	0.1(U)	0.1(U)	3.5	42.9	33.7	19.9	66.1
N	0.1(U)	0.46	9.59	41.5	28	20.5	65.4
O	0.1(U)	0.1(U)	2.52	40.8	29.8	27	69.6
P	0.1(U)	0.1(U)	1.9	34.7	29.3	34.1	63.8
Q	0.1(U)	2.46	12.8	43.2	23.1	18.4	63.9
R	0.1(U)	0.1(U)	9.45	43.6	27.3	19.6	66.5
S	0.1(U)	3.71	14.6	40.3	24.1	17.4	65.1
T	0.1(U)	0.62	11	39.2	28.8	20.4	65.2
U	0.1(U)	5.7	22.2	42.8	24.2	5.09	63.3
V	0.1(U)	0.1(U)	8.48	45.8	42.8	2.87	67.6
W	0.1(U)	1.03	19.9	42.8	27.2	9.11	61.2
X	0.1(U)	1.6	20.3	39.7	24.3	14.1	64.7
Y	0.1(U)	5.18	18	35.4	28.1	13.3	42.9
Z	0.1(U)	6.11	16.4	35.6	23.6	18.3	44.2

General Description of the Sediment Composition for Edgewood Shoals:

Table 4. Summary of Grain Size and Moisture Content Results for Edgewood Shoals

Substrate Type:	Present at Site?	Approx. percentage of Total Substrate at Site:
Silt/Mud (<0.063mm)	Yes	51%
Sand (0.063-2mm)	Yes	35%
Granule/ Pebble (2-64mm)	Yes	14%
Cobble (64-256mm)	No	0%
Rocky: Boulder (>4096mm)	No	0%
Rocky: Coral	No	0%
Bedrock	No	0%

General Description of the Sediment Composition for RISDS:

Rhode Island Sound is a complex area including depositional and non-depositional environments, which dictate the structure, stability, and nature of the benthic community. Some areas may reflect a combination of erosional and depositional processes (textural patchiness; Knebel et al., 1982), which provides a variety of substrate types for benthic habitat. The bottom types in Rhode Island Sound range from silty sand (unconsolidated/depositional), to sand-rippled (reworked/sorted sediments), to hard stone and rock cobble (erosional/high energy/ non-depositional).

Sediments at the RISDS are mainly comprised of fine sands (45 percent to 96 percent sand), with some areas of coarse material such as cobbles or pebbles (USACE, 2004). Concentrations of TOC (Total Organic Carbon) were relatively low (<0.8 percent) in surface sediments and were strongly correlated with grain size. Concentrations of organic contaminants (i.e., total PAH - polycyclic aromatic hydrocarbons) and most metals correlated well with TOC but not with grain size. For example, lower chemical concentrations were found in sediments with low TOC and higher chemical concentrations were found in sediments with higher TOC. However, sediments contained slightly higher chemical concentrations than expected for sediments with small amounts of fine material (<15 percent fines; USACE, 2004).

General Description of the Sediment Composition for PIDS:

Placement of clean material from the construction of the Edgewood Shoals CAD cell at PIDS will cover the historic unsuitable dredged material and improve sediment quality at the site by sequestering the elevated metals and organic compounds in the existing material from the environment. The PIDS restoration effort will isolate the contaminated sediment from the biologically active zone and improve benthic habitat quality for this portion of Narragansett Bay. The material to be placed at PIDS is predominately silt, which is similar to existing conditions at the site. Therefore, the surficial sediments at PIDS will remain silt following dredged material placement.

Anadromous Fish Migratory or Spawning Habitat

In addition to the various species that use the Providence River as spawning and nursery habitat, several anadromous fish runs are located in the Providence River/Upper Bay system. These populations are believed to be self-sustaining RIDEM, personal communication, as reported in USACE, 2001. River herring (*Alosa aestivalis* and *A. psuedoharengus*) spawn at the base of the Omega Pond dam in the Ten Mile River system and Woonasquatucket River. River herring have historically been stocked in Brickyard Pond and Echo Lake in the Mussachuck Creek system. Spring Green Brook and Old Mill Creek (particularly Buckeye Brook and Warwick Pond) also appear to support self-sustaining populations of river herring. Both American shad (*Alosa sapidissima*) and river herring have been reported in the Warren River (USACE, 2001). The Blackstone River also serves as a spawning location (USACE, 2001). These locations are not within the dredge or placement areas and no impact to EFH, or spawning habitat is anticipated.

5. EFH and HAPC Designations

The following table provides a summary of Essential Fish Habitat Designations in the Providence River, Upper Narragansett Bay, Edgewood Shoals, Prudence Island and RISDS. The source of information included is the National Marine Fisheries Service (NMFS) EFH Mapper.

Table 5. Species and their respective life stages having designated Essential Fish Habitat in the:

(P) Providence River FNP including Edgewood Shoals Disposal Sites (ESDS)
(N) Narragansett Bay including Prudence Island Disposal Site (PIDS)
(R) Rhode Island Sound Disposal Site (RISDS).

Species	**Eggs**	**Larvae**	**Juveniles**	**Adults**
Albacore Tuna (*Thunnus alalunga)*			R	R
Atlantic Butterfish (*Peprilus triacanthus)*	P, N	P, N, R	P, N, R	P, N, R
Atlantic Cod (*Gadus morhua)*	P, N, R	P, N, R	P, N, R	R
Atlantic Herring (*Clupea harengus)*		P, N	P, N, R	P, N
Atlantic Mackerel (*Scomber scrombrus)*	P, N, R	P, N, R	P, N	P, N
Atlantic Sea Scallop *(Placopecten magellanicus)*	R	R	R	R
Basking Shark (*Cetorhinus maximus)*			R	R
Black Sea Bass (*Centropristis striatus)*			P, N, R	P, N, R
Bluefin Tuna (*Thunnus thunnus)*			R	R
Bluefish (*Pomatomus saltatrix)*		R	P, N, R	P, N, R
Common Thresher Shark (*Alopias vulpinus)*			R	R
Haddock *(Melanogrammus aeglefinus)*		R		

Little Skate (*Leucoraja erinacea)*			P, N, R	P, N, R
Longfin Inshore Squid (*Doryteuthis pealeii)*	R		P, N	P, N
Monkfish (*Lophius americanus)*	R	R		
Ocean Pout (*Zoarces americanus)*	N, R		R	N, R
Pollock (*Pollachius virens*)			P, N, R	
Red Hake (*Urophycis chuss)*	P, N, R	P, N, R	P, N, R	P, N
Sand Tiger Shark (*Carcharias taurus)*			P, N, R	
Sandbar Shark *(Carcharhinus plumbeus)*			R	R
Scup (*Stenotomus chrysops)*	P, N	P, N	P, N, R	P, N, R
Shortfin Mako Shark *(Isurus oxyrinchus)*			R	R
Silver Hake (*Merluccius bilinearis)*	P, N, R	P, N, R		R
Skipjack Tuna (*Katsuwonus pelamis)*				R
Smooth Dogfish (*Mustelus canis)*			R	R
Spiny Dogfish (*Squalus acanthias)*			R	R
Summer Flounder (*Paralichthys dentatus)*	R	P, N, R	P, N	P, N, R
White Hake (*Urophycis tenuis)*		R	R	
White Shark (*Carcharodon carcharias)*			P, N, R	R
Windowpane Flounder (*Scophthalmus aquosus)*	P, N, R	P, N, R	P, N, R	P, N, R
Winter Flounder (*Pseudopleuronectes americanus)*	P, N	P, N, R	P, N, R	P, N, R
Winter Skate (*Leucoraja ocellata)*			P, N, R	P, N, R
Witch Flounder *(Glyptocephalus cynoglossus)*		R		
Yellowfin Tuna (*Thunnus albacares)*			N, R	
Yellowtail Flounder (*Limanda ferruginea)*	R	R	R	R

6. Habitat Areas of Particular Concern (HAPCs)

Select all that apply	HAPC Designation	Select all that apply	HAPC Designation
X	Summer flounder: SAV		Alvin & Atlantis Canyons
	Sandbar shark		Baltimore Canyon
	Sand Tiger Shark (Delaware Bay)		Bear Seamount
	Sand Tiger Shark (Plymouth-Duxbury-Kingston Bay)		Heezen Canyon
X	Inshore 20m Juvenile Cod		Hudson Canyon
	Great South Channel Juvenile Cod		Hydrographer Canyon
	Northern Edge Juvenile Cod		Jeffreys & Stellwagen
	Lydonia Canyon		Lydonia, Gilbert & Oceanographer Canyons
	Norfolk Canyon (Mid-Atlantic)		Norfolk Canyon (New England)
	Oceanographer Canyon		Retriever Seamount
	Veatch Canyon (Mid-Atlantic)		Toms, Middle Toms & Hendrickson Canyons

Select all that apply	HAPC Designation	Select all that apply	HAPC Designation
	Veatch Canyon (New England)		Washington Canyon
	Cashes Ledge		Wilmington Canyon
	Atlantic Salmon		

The Providence River FNP and Narragansett Bay are located within the HAPC for Atlantic cod juveniles (inshore, 20 m). The HAPC for Atlantic cod juvenile recognizes the importance of structurally complex rocky-bottom habitat in inshore areas. These habitats contain emergent epifauna and benthic invertebrates that provide prey for Atlantic cod, the structural complexity is used as refuge areas from predators. The Providence River FNP and Edgewood Shoals do not contain any complex rocky habitat preferred by Atlantic cod juveniles. Consequently, there will be no significant impact to the HAPC for Atlantic cod.

The Providence River FNP and Narragansett Bay fall within the regional HAPC for summer flounder. Summer flounder HAPC consists of areas with Submerged Aquatic Vegetation (SAV). However, as there is no SAV present within or adjacent to the dredge or placement areas, there will be no impact to the HAPC for summer flounder.

Activity Details

Select all that apply	Project Type/Category
	Agriculture
	Aquaculture
	Bank/shoreline stabilization (e.g., living shoreline, groin, breakwater, bulkhead)
	Beach renourishment
X	Dredging/excavation
	Energy development/use e.g., hydropower, oil and gas, pipeline, transmission line, tidal or wave power, wind
	Fill
	Forestry
	Infrastructure/transportation (e.g., culvert construction, bridge repair, highway, port, railroad)
	Intake/outfall
	Military (e.g., acoustic testing, training exercises)
	Mining (e.g., sand, gravel)
X	Overboard dredged material placement
	Piers, ramps, floats, and other structures
	Restoration or fish/wildlife enhancement (e.g., fish passage, wetlands, mitigation bank/ILF creation)

Select all that apply	Project Type/Category
	Survey (e.g., geotechnical, geophysical, habitat, fisheries)
	Water quality (e.g., storm water drainage, NPDES, TMDL, wastewater, sediment remediation)
X	Other: Beneficial use of dredged material

7. Effects Evaluation

Potential Stressors

Select all that apply	Potential Stressors Caused by the Activity
	Underwater noise
X	Water quality/turbidity/contaminant release
X	Vessel traffic/barge grounding
X	Impingement/entrainment
	Prevent fish passage/spawning
X	Benthic community disturbance
X	Impacts to prey species

Select all that apply		Potential Stressors Caused by the Activity
Temp	Perm	
X	X	Water depth change
		Tidal flow change
X	X	Fill
		Habitat type conversion

Project Impacts and Mitigation

Project Impacts to EFH by Species

Key to abbreviations of project sites with designated Essential Fish Habitat

Providence River FNP
Edgewood Shoals Disposal Sites (ESDS)
Narragansett Bay
Prudence Island Disposal Site (PIDS)
Rhode Island Sound Disposal Site (RISDS)

Albacore tuna (*Thunnus alalunga*)

EFH for juvenile and adult albacore tuna is designated at Rhode Island Sound Disposal Site (RISDS) only. Albacore tuna are highly migratory, fast-moving species that would likely be in the project area as transient residents in the summer months only. They feed near the top of the food chain on fish, squid, and pelagic crustaceans (NOAA, 2017).

Effects. Because of their rarity in the area, their highly migratory nature, and the fact that there will be no impacts to their prey items we anticipate no effects to albacore tuna EFH from this project.

Atlantic butterfish *(Peprilus triacanthus)*

EFH for Atlantic butterfish eggs, larvae, juveniles, and adults is designated at Providence River FNP, ESDS, Narragansett Bay, and PIDS and for larvae and juveniles only at RISDS.

Butterfish are short-lived and grow rapidly. Spawning occurs during June and July. They are semi-pelagic and form loose schools that feed upon small invertebrates. They have a high natural mortality rate and are preyed upon by many species of fish, marine mammals, and seabirds. Few live to more than 3 years of age, and most are sexually mature at age 1.

In Rhode Island Sound, butterfish eggs are found from June to August. Butterfish have a seasonal inshore-offshore migration dependent on water temperature. In summer, they move north and inshore to feed on planktonic fish, squid, crustaceans, and jellyfish and are typically found at depths between 70 and 180 feet deep, however, they do occasionally venture inshore to shallow flats or sheltered bays and estuaries. In the winter, they move south and offshore in deep water at depths typically greater than 650 feet (NMFS and NEFMC, 2017).

EFH for Atlantic butterfish eggs includes pelagic habitats in inshore estuaries and embayment’s from Massachusetts Bay to the south shore of Long Island, New York, in

Chesapeake Bay, and on the Continental Shelf and slope, primarily from Georges Bank to Cape Hatteras, North Carolina. EFH for Atlantic butterfish eggs is generally found over bottom depths of 1,500 meters or less where average temperatures in the upper 200 meters of the water column are 6.5-21.5°C (NMFS and NEFMC, 2017).

EFH for Atlantic butterfish larvae includes pelagic habitats in inshore estuaries and embayment's in Boston harbor, from the south shore of Cape Cod to the Hudson River, and in Delaware and Chesapeake bays, and on the Continental Shelf from the Great South Channel (western Georges Bank) to Cape Hatteras, North Carolina. EFH for Atlantic butterfish larvae is generally found over bottom depths between 41 and 350 meters where average temperatures in the upper 200 meters of the water column are 8.5-21.5°C. NOAA has designated EFH for this life stage in the Study Area (NMFS and NEFMC 2017).

Effects. Butterfish eggs and larvae were found in ichthyoplankton samples in northern Rhode Island Sound by Bourne and Govoni (1988) and Keller et al., (1999). Juvenile and adult butterfish have been observed in NMFS trawls in Rhode Island Sound near RISDS. Since butterfish adults are present and are likely to spawn there, eggs and larvae are also likely to be present in the area. Eggs and larvae of the butterfish may be impacted by disposal of dredged material if they are present in the water column during the time of disposal. The act of dredging is not a continuous 24 hour per day activity. There are many stops that would allow turbidity to clear. Crew changes, break downs, repositioning of the dredge and scows and exchanging full scows for empty ones all provide breaks in the active dredging and disposal process that would allow for any turbidity to dissipate. Impacts from the dredging and disposal operations to butterfish EFH are expected to be minimal. Butterfish EFH at the project areas will not change. Juvenile and adult butterfish are likely to move from the project area during active dredging and disposal activities. They would most likely return once project activities have concluded, resulting in only minimal impacts.

<u>Atlantic Cod *(Gadus morhua)*</u>

EFH has been designated for Atlantic cod eggs, larvae, and juveniles at Providence River FNP and ESDS and Narragansett Bay and (PIDS). EFH for adults at RISDS only.

Atlantic cod can live more than 20 years. They can grow up to 51 inches and 77 pounds. They are capable of reproducing at 2 to 3 years old, when they are between 12 and 16 inches long. Cod spawn near the ocean floor from winter to early spring. Larger females can produce 3 to 9 million eggs when they spawn. They are top predators in the bottom ocean community, feeding on a variety of invertebrates and fish (NMFS and NEFMC, 2017).

EFH for cod eggs includes the surface waters over the continental shelf where water temperatures are below 12ºC, salinities are around 32-33 ppt., and water depths are less than 110 meters (361 ft). Cod eggs are most often observed in the fall with peaks in winter and spring, while larvae are most abundant in spring. EFH for cod larvae in include the pelagic waters over the continental shelf in waters below 10ºC, salinities around 32-33 ppt., and water depths between 30 and 70 meters (98 and 230 ft) (NMFS and NEFMC, 2017).

EFH for juvenile Atlantic cod includes bottom habitats with substrates of cobble or gravel. Generally, juveniles are found where water temperatures are below 20ºC, salinities range from 30 to 35 ppt, and water depths are between 25 and 75 meters. EFH for adult Atlantic cod includes bottom habitats with a substrate of rocks, pebble, or gravel. Adults are found at oceanic salinities, depths ranging from 10 to 150 meters, and water temperatures below 10ºC (NMFS and NEFMC, 2017).

Effects. Impacts to Atlantic cod eggs and larvae EFH will be minimal as their EFH is pelagic. Atlantic cod eggs and larvae may be impacted during disposal of dredge material if eggs and larvae are in the water column over the disposal site during the disposal operation. Eggs and larvae near the surface are less likely to be impacted than eggs and larvae deeper in the water column. Juvenile and adult cod have a very low likelihood of occurrence considering that juvenile and adult cod prefer substrates of rocks, pebble, and gravel. The substrates at these project sites are silt/sand, therefore, few juveniles and adults should be present and minimal impact to their EFH from dredging or disposal of dredged material is expected Those present are likely to actively move away. Because adult cod appear to be unlikely in this region, the presence of eggs and larvae may also be low resulting in minimal potential for effects for this species.

Atlantic Herring *(Clupea harengus)*

EFH has been designated for Atlantic sea herring larvae, juveniles, and adults in Providence River FNP, ESDS, Narragansett Bay and PIDS and EFH for juveniles only in RISDS. Atlantic herring are one of nearly 200 herring species in the family Clupeidae. They grow quickly, up to 14 inches. They can live up to 15 years. They can reproduce when they reach age 4. Atlantic herring migrate in schools to areas where they feed, spawn, and spend the winter. They spawn from October through November in the southern Gulf of Maine, Georges Bank, and Nantucket Shoals. Female herring can produce 30,000 to 200,000 eggs. They deposit their eggs on rock, gravel, or sand ocean bottom. Schools of herring can produce so many eggs that they cover the ocean bottom in a dense carpet of eggs several centimeters thick. The eggs usually hatch in 7 to 10 days, depending on temperature. By late spring, larvae grow into juvenile herring, which form large schools in coastal waters during the summer. Atlantic herring is an important species in the food web of the northwest Atlantic Ocean. A variety of bottom-dwelling fish such as winter flounder, cod, haddock, and red hake feed on herring eggs. Juvenile herring are heavily preyed upon due to their abundance and small size. A number of fish, sharks, skates, marine mammals, and seabirds prey on herring. Atlantic herring feed on zooplankton (tiny floating animals), krill, and fish larvae (NMFS and NEFMC, 2017).

EFH for Atlantic herring eggs and larvae are inshore and offshore benthic habitats in the Gulf of Maine and on Georges Bank and Nantucket Shoals in depths of 5 to 90 meters on coarse sand, pebbles, cobbles, and boulders and/or macroalgae. Eggs adhere to the bottom, often in areas with strong bottom currents, forming egg “beds” that may be many layers deep. Atlantic herring have a very long larval stage, lasting 4-8 months, and are transported long distances to inshore and estuarine waters where they metamorphose into early-stage juveniles in the spring (NMFS and NEFMC, 2017).

EFH for Atlantic herring juveniles and adults are intertidal and sub-tidal pelagic habitats to 300 meters throughout the region. Young-of-the-year juveniles can tolerate low salinities, but older juveniles avoid brackish water. One and two-year old juveniles form large schools and make limited seasonal inshore-offshore migrations. Older juveniles are usually found in water temperatures of 3 to 15°C in the northern part of their range and as high as 22°C in the Mid-Atlantic. Adults make extensive seasonal migrations between summer and fall spawning grounds on Georges Bank and the Gulf of Maine and overwintering areas in southern New England and the Mid-Atlantic region. They seldom migrate beyond a depth of about 100 meters unless they are preparing to spawn. They generally avoid water temperatures above 10°C and low salinities. Spawning takes place on the bottom, generally in depths of 5 to 90 meters on a variety of substrates (NMFS and NEFMC, 2017).

EFH for Atlantic herring adults are sub-tidal pelagic habitats with maximum depths of 300 meters throughout the region.

Effects. Because the Atlantic sea herring is a pelagic fish, EFH impacts due to dredging activities will be limited to effects on larvae and small juveniles floating in the plankton in the vicinity of the turbidity plume during dredging and disposal activities. The act of actively dredging is not a continuous 24 hour per day activity. There are many stops that would allow turbidity to clear. Crew changes, break downs, repositioning of the dredge and scows and exchanging full scows for empty ones all provide breaks in the active dredging and disposal process that would allow for any turbidity to dissipate. Larger juveniles and adult herring are likely to move out of the area. Impacts to Atlantic sea herring EFH in the project areas are expected to be minimal.

Atlantic Mackerel *(Scomber scrombrus)*

EFH has been designated for Atlantic mackerel eggs, larvae, juveniles, and adults in Providence River FNP, ESDS, Narragansett Bay, PIDS and for eggs and larvae only in RISDS.

There are two major spawning groups of Atlantic mackerel in the western Atlantic. The southern group spawns primarily in the Mid-Atlantic Bight from April to May and the northern group spawns in the Gulf of St. Lawrence in June and July. Both groups typically spawn 10 to 30 miles offshore. Depending on their size, females can spawn between 285,000 and almost 2 million eggs. They release their eggs in batches, between five and seven times throughout the spawning season. Eggs generally float in the surface water and hatch in 4 to 7 ½ days, depending on water temperature. Atlantic mackerel grow fast, up to 16 ½ inches and 2.2 pounds. They can live up to 20 years and are able to reproduce by the time they reach age 2 to 3. Atlantic mackerel feed heavily on crustaceans such as copepods, krill, and shrimp. They also eat squid, as well as some fish and ascidians (sac-like marine invertebrate filter feeders). Several species of fish and marine mammals eat Atlantic mackerel (NMFS and NEFMC, 2017).

EFH for Atlantic mackerel eggs and larvae is pelagic habitats in inshore estuaries and embayment's from Great Bay, New Hampshire to the south shore of Long Island, New York, inshore and offshore waters of the Gulf of Maine, and on the continental shelf from Georges Bank to Cape Hatteras, North Carolina. EFH for Atlantic mackerel eggs and larvae is generally found over bottom depths of 100 meters or less with average water temperatures of 5.5-12.5°C (NMFS and NEFMC, 2017).

EFH for juvenile and adult Atlantic mackerel is pelagic habitats in inshore estuaries and embayment's from Passamaquoddy Bay and Penobscot Bay, Maine to the Hudson River, in the Gulf of Maine, and on the continental shelf from Georges Bank to Cape Hatteras, North Carolina. EFH for juvenile and adult Atlantic mackerel is generally found over bottom depths less than 170 meters and in water temperatures of 5 to 20°C. Juvenile Atlantic mackerel feed primarily on small crustaceans, larval fish, and other pelagic organisms while Adult Atlantic mackerel are opportunistic predators feeding primarily on a wider range and larger individuals of pelagic crustaceans than juveniles, but also on fish and squid (NMFS and NEFMC, 2017).

Effects. Because the Atlantic mackerel is a fast-swimming pelagic fish, impacts to EFH due to dredging activities would be limited to effects on eggs and larvae floating in the water column in the vicinity of the turbidity plume during dredging or disposal activities. The act of dredging is not a continuous 24 hour per day activity. There are many stops that would allow turbidity to clear. Crew changes, break downs, repositioning of the dredge and scows and exchanging full scows for empty ones all provide breaks in the active dredging and disposal process that would allow for any turbidity to dissipate. Impacts to Atlantic mackerel eggs or larvae are expected to be minimal. Any juvenile and adult mackerels in the area are likely to leave. Although Bourne and Govoni (1988) found Atlantic mackerel eggs and larvae at their sampling stations in northern Rhode Island Sound, Atlantic mackerel were not highlighted as abundant by Keller et al. (1999).

Atlantic Sea Scallop *(Placopecten magellanicus)*

EFH is designated for all four Atlantic sea scallop life stages at RISDS.

Atlantic sea scallops can live up to 20 years. They grow quickly for the first few years of their life. The largest scallop ever reported was about 9 inches in shell height, but they typically don't grow larger than 6 inches. Sea scallops can reproduce by age 2, but don't produce many eggs or sperm until they are about 4 years old. They are very fertile; a female sea scallop can produce hundreds of millions of eggs per year. For this reason, scallops may respond more rapidly to management actions than species that reproduce slowly and in small numbers. Sea scallops usually spawn in late summer or early fall. They also may spawn in the spring, especially in the Mid-Atlantic Bight. After hatching, scallop larvae remain in the water column for 4 to 6 weeks before settling on the ocean floor. Sea scallops feed by filtering phytoplankton or other small organisms out of the water column, which can help to improve water quality by removing suspended materials. Many kinds of pelagic fish and invertebrates eat scallop larvae. Cod, wolffish, eel pout, flounder, crabs, lobster, sea turtles, and sea stars feed on juvenile and adult scallops. Using its adductor muscle to snap its top and bottom shells open and shut, a sea scallop can propel itself through the water. This helps them escape predators, such as sea stars, that other bivalves like mussels, clams, and oysters can't avoid (NMFS and NEFMC, 2017).

EFH for Atlantic sea scallop eggs are benthic habitats in inshore areas and on the continental shelf, in the vicinity of adult scallops. Eggs are heavier than seawater and remain on the seafloor until they develop into the first free-swimming larval stage (NMFS and NEFMC, 2017).

EFH for Atlantic sea scallop larvae are benthic and water column habitats in inshore and offshore areas throughout the region. Any hard surface can provide an essential habitat for settling pelagic larvae ("spat"), including shells, pebbles, and gravel. They also attach to macroalgae and other benthic organisms such as hydroids. Spat attached to sedentary branching organisms, or any hard surface have greater survival rates; spat that settle on shifting sand do not survive (NMFS and NEFMC, 2017).

EFH for Atlantic sea scallop juveniles and adults are benthic habitats in the Gulf of Maine, on Georges Bank, and in the Mid-Atlantic in depths of 18 to 110 meters. Juveniles (5-12 mm shell height) leave the original substrate on which they settle and attach themselves by byssal threads to shells, gravel, and small rocks, preferring gravel. As they grow older, they lose their byssal attachment. Juvenile scallops are relatively active and swim to escape predation. While swimming, they can be carried long distances by currents. On Georges Bank, age 1 juveniles are less dispersed than older juveniles and adults and are mainly associated with gravel-pebble deposits. Essential habitats for older juvenile scallops are gravel and sand. Adults are also found in shallower water and as deep as 180 meters in the Gulf of Maine. In the Mid-Atlantic they are found primarily between 45 and 75 meters and on Georges Bank they are more abundant between 60 and 90 meters. They often occur in aggregations called beds which may be sporadic or permanent, depending on how suitable the habitat conditions are (temperature, food availability, and substrate) and whether oceanographic features (fronts, currents) keep larval stages in the vicinity of the spawning population. Bottom currents stronger than 25 cm/sec inhibit feeding. Growth of adult scallops is optimal between 10 and 15°C and they prefer full strength seawater (NMFS and NEFMC, 2017).

Effects The proposed dredge areas are shallow and not considered EFH for any Atlantic sea scallop life stage. The placement site RISDS is EFH habitat for all life stages of Atlantic sea scallop. However, the bottom substrates at RISDS are mainly muds, not ideal scallop habitat. Placement of material at RISDS will temporarily disturb benthic resources. However, monitoring has shown that benthic recovery at placement sites can be expected (USACE, 2021b). The impacts of material placement at RISDS are not anticipated to significantly affect sea scallop EFH.

<u>Basking Shark (*Cetorhinus maximus*)</u>.

EFH is designated for juvenile and adult basking shark at RISDS only. These sharks are highly migratory species that would be present in Rhode Island Sound during the summer months only. Basking sharks are filter feeders.

***Effects*.** Based on this species diet and time of year it will be in the project area, no effects to its EFH are anticipated.

<u>Black Sea Bass (*Centropristis striata*)</u>

EFH is designated for juvenile and adult black sea bass at all project locations.

Black sea bass grow slowly, up to 2 feet and 9 pounds. They can reproduce when they reach 1 to 3 years old. They are protogynous hermaphrodites—most black sea bass start out as females, and as they mature and grow, they become males. Researchers aren’t sure why this happens, but one hypothesis suggests the relative scarcity of males in a spawning group may be the stimulus for a female to switch sex. Black sea bass spawn in coastal areas from January through July. Males gather a group of females to mate with and aggressively defend their territory. Depending on their size, females can produce between 30,000 and 500,000 eggs in a spawning season. Females can live up to 8 years; males live up to 12. Black sea bass are associated with structured hard bottom communities such as shellfish beds, pilings, wharves, or wrecks, offshore banks, ledges, and rocky or reef communities. Black sea bass eat whatever prey is available, but they especially like crabs, shrimp, worms, small fish, and clams. Little skate, spiny dogfish, monkfish, spotted hake, and summer flounder all feed on black sea bass (NMFS and NEFMC, 2017).

Black sea bass EFH for juveniles and adults in Rhode Island Sound includes demersal waters over the continental shelf. Generally, juveniles are found in waters warmer than 6ºC with salinities greater than 18 ppt. Additionally, juveniles and adults both inshore and offshore are found in association with rough bottom, shellfish and eelgrass beds, and natural and man-made structures in sandy areas. (NMFS and NEFMC, 2017).

Effects. Impacts to juvenile and adult black sea bass due to dredging activities in project areas will be minor, as juveniles and adults are likely to actively avoid areas where dredging is occurring and disturbances from dredging would not affect their preferred habitats (i.e., structured/hard substrates). Impacts to juveniles and adults in Rhode Island Sound due to dredged material disposal activities are also likely to be minimal since the substrate is mostly silt and sand, rather than the preferred structured bottom. Minimal impacts from dredging and disposal of dredged material are expected.

Bluefin Tuna (*Thunnus thynnus*)

EFH is designated for juvenile and adults at RISDS only.

The bluefin tuna is distributed in many regions including the warmer parts of the Atlantic, Pacific, and Indian oceans, as well as the Mediterranean Sea. In the western Atlantic, the bluefin tuna ranges from Labrador south along the U.S. coast into the Gulf of Mexico and the Caribbean and from Venezuela to Brazil. Bluefin tuna are a strong swift swimming migratory pelagic species. They school by size and are common in the Gulf Stream. In July through October, bluefin tuna will congregate on the continental shelf off New England. Spawning is believed to occur in May and June in the Straits of Florida and does not appear to occur north of this along the U.S. coast. Bluefin tuna eggs and larvae are pelagic and drift in the currents. Small juveniles arrive to feed in the northwestern Atlantic (Virginia to Cape Cod) in mid-June to July and will spend the winter above the 36ºN in offshore waters warmer than 16 to 17ºC (NMFS and NEFMC, 2017).

EFH for juveniles and adults includes pelagic waters from 50 m (164 ft) to the Exclusive Economic Zone (EEZ) boundary and from Northern Maine to the central Gulf of Mexico (NMFS and NEFMC, 2017).

Effects. Impacts to bluefin tuna EFH will be minimal as their EFH is pelagic and wide ranging. If bluefin tuna are present at RISDS they will actively move from the area.

Bluefish (*Pomatomus saltatrix*)

EFH has been designated for juvenile and adult bluefish at all project locations and for larvae only at RISDS. Bluefish are distributed in the northwest Atlantic along the coast from Maine to Florida. Bluefish are a migratory pelagic species which migrates north in the spring and south in the fall. The species forms large schools, often as large as 6 to 8 km (4 to 5 miles) long. Bluefish are found at least 148 km (92 miles) offshore at depths to 100 meters (328 ft) but will occasionally move into brackish portions of rivers. They are voracious predators that feed on a wide variety of fish and invertebrates. Bluefish spawn during the summer months in the Mid Atlantic Bight region. Spawning generally occurs over the outer half of the continental shelf in water temperatures between 18 and 26ºC and salinities ranging from 27 to 35 ppt. Eggs are pelagic and float at the surface. Larvae are also pelagic and are generally found offshore in water temperatures around 21ºC. Juvenile bluefish are found both inshore and offshore. Inshore, juveniles can be found along beaches, inlets, estuaries, creeks, rivers, clear and turbid water over bottoms of sand and gravel. They may also move considerable distances upstream in estuaries (NMFS and NEFMC, 2017).

Juvenile and adult bluefish EFH is found from Cape Hatteras to Cape Cod Bay, Massachusetts in pelagic waters over the continental shelf from the coast out to the limits of the EEZ (NMFS and NEFMC, 2017).

Effects. Impacts from the dredging and disposal operations to bluefish EFH are expected to be minimal. The physical and chemical characteristics of bluefish EFH at the project areas will not change. Juvenile and adult bluefish will actively avoid those areas where dredging is occurring. Impacts to bluefish larvae may occur during disposal at RISDS if larvae are in the water column at the time of the disposal. Impacts to juveniles and adults due to disposal activities are not expected since juveniles and adults will actively avoid the area during disposal.

Haddock (*Melanogrammus aeglefinus*)

EFH has been described for Haddock larvae only at RISDS. Haddock are a demersal species distributed in the western Atlantic from Greenland to Cape Hatteras, North Carolina. Adult haddock are generally more common in water depths from 45 to 135 meters (148 to 443 ft) and temperatures ranging from 2 to 10ºC. They are found in bottom habitats with substrates of sand, rock, pebbles, gravel, or broken shell. Spawning occurs between January and June, peaking during March and April. Eggs are pelagic and are generally concentrated within the upper 10 meters (33 ft) of the water column. Larvae are also pelagic and are typically oceanic although they may be found in estuaries. Juveniles are found initially in the water column but will descend to the bottom as they get older. Juvenile haddock tend to remain in more shallow water on banks and shoals, moving to deeper areas as adults (NMFS and NEFMC, 2017).

EFH for haddock larvae in RISDS includes surface waters where water depths are 30 to 90 meters (98 to 295 ft). In general, haddock larvae are most often observed when water temperatures are below 14ºC, and salinities range from 34 to 36 ppt (NMFS and NEFMC, 2017).

Effects. No juvenile or adult haddock EFH were reported in Rhode Island Sound near the disposal site. Therefore, it is unlikely that haddock larvae would be present in large numbers. The impact to haddock larvae from disposal of dredged material at RISDS is expected to be minimal to non-existent.

Little Skate (*Leucoraja erinacea*)

EFH has been described for little skate juveniles and adults at all project areas. This species ranges from Nova Scotia, Canada to Cape Hatteras. The little skate is most abundant in the northern section of the Mid-Atlantic Bight (MAB) and on the northeastern part of Georges Bank. Little skate exhibit seasonal movements. Adult and juvenile little skate move inshore during spring and autumn, and offshore in mid to late summer, and midwinter. They also move north and south with seasonal temperature changes along the southern fringe of their range. They may leave some estuaries for deeper water during warmer months. Little skates are common on sandy or gravelly substrates but may occur on mud as well. They tend to bury themselves in depressions during the day and become active at night (NMFS and NEFMC, 2017).

EFH for juvenile and adult little skate ranges from intertidal and sub-tidal benthic habitats in coastal waters of the Gulf of Maine and in the Mid-Atlantic region as far south as Delaware Bay, and on Georges Bank, extending to a maximum depth of 100 meters. EFH for juvenile and adult little skates occurs on sand and gravel substrates, but they are also found on mud (NMFS and NEFMC, 2017).

Effects**.** EFH for juvenile and adult skates will only have minor impacts. Little skate prefer harder bottoms than the project areas provide so the majority of their EFH will remain unimpacted. During the project soft bottom areas will be disturbed temporarily during dredge and disposal activities but will regrow their benthic invertebrate communities quickly. As both life stages of this species are motile, they can leave or avoid project areas during periods of disturbance. No significant impacts to little skate and their associated EFH are expected.

Longfin Inshore Squid (*Doryteuthis pealeii*)

EFH has been described for juveniles and adults at Providence River FNP, ESDS, Narragansett Bay, and PIDS. EFH for eggs has been described at RISDS only.

The longfin inshore squid EFH can be found between Newfoundland to the Gulf of Venezuela dispersed in continental shelf and slope waters. Spawning occurs year-round with peaks occurring from the spring to summer near Georges Bank at shallow coastal areas. The eggs attach to fixed objects like rocks, small boulders, and aquatic vegetation in masses, or fall as clusters on sand or mud bottoms in shallow waters less than 50 m in depth. Unlike the eggs, juveniles remain near surface waters at a depth of 10 m or less, until reaching 45 mm in length where they transition to a more demersal lifestyle at depths between 50 and 100 m, looking and migrating like adults. Adults often migrate offshore to the shelf edge and slope at around 400 m for the winter and inshore at 180 m for the summer. Additionally, as adults these animals make a diel vertical migration into the water column at night (Jacobson, 2005; Northeast Fisheries Science Center, 2011; (NMFS and NEFMC, 2017).

Effects. Juvenile and adult life stages of this species may occur with the project area during summer months as they often inhabit waters within the range that dredging, and disposal activities will occur. Squids are highly mobile and would leave the area if disturbed by dredging or disposal activities. Impacts to eggs at RISDS may occur during disposal operations if the eggs are located under the disposal plume. These squids prefer to attach their eggs to nearly any structure. RISDS is nearly devoid of structure, which is one of the reasons it was chosen as a disposal site. Therefore, impacts to squid eggs and EFH from the disposal of dredged material at RISDS is expected to be minimal.

Monkfish (*Lophius americanus*)

EFH has been designated for eggs and larvae of monkfish at RISDS. Monkfish, also known as goosefish, are distributed in the northwest Atlantic from the Gulf of St. Lawrence to Cape Hatteras, North Carolina. Adult monkfish are found in bottom habitats with various substrates including hard sand, sand-shell mix, mud, gravel, and algae covered rocks along the continental shelf in waters from 70 to 100 meters (230 to 328 ft) in depth but may also be found at depths of 800 meters (2625 ft). Spawning occurs in these habitats at water depths of 25 to 200 meters (82 to 656 ft), water temperatures below 13ºC, and salinities ranging from 29.9 to 36.7 ppt. Eggs are shed in a continuous ribbon-like sheet of gelatinous mucus which can be as large as 12 meters (39 ft) long and 1.5 meters (5 ft) wide. These egg “veils” float in the water column, generally close to the surface. Larvae and juveniles spend several months in a pelagic phase before juveniles settle to the bottom (NMFS and NEFMC, 2017).

EFH for monkfish eggs in Rhode Island Sound includes surface waters with temperatures below 18ºC in depths from 15 to 1000 meters. The egg veils are most common from March through September. EFH for monkfish larvae includes pelagic waters below 15ºC in depths from 25 to 1000 meters (82 to 3280 ft). Like eggs, larvae are most common from March through September (NMFS and NEFMC, 2017).

Effects. No information was obtained regarding the presence of monkfish larvae near the disposal site in Rhode Island Sound. Juvenile/adult monkfish were observed in NMFS trawls in Rhode Island Sound near the disposal site. Bourne and Govoni (1988) reported that monkfish larvae were present in surveys of Narragansett Bay and northern Rhode Island Sound, but not at high densities. The more recent survey by Keller et al. (1999) found no monkfish eggs or larvae in northern Rhode Island Sound. Based on this information, it is unlikely that monkfish larvae will be present in large numbers at the disposal site in Rhode Island Sound and impacts from disposal of dredged material are expected to be minimal.

Ocean Pout (*Macrozoarces americanus*)

EFH has been designated for eggs and adults in Narragansett Bay, PIDS and RISDS. EFH has been designated for juveniles at RISDS only.

Juvenile and adult ocean pout are demersal eel-like fish that are distributed in the northwest Atlantic from Labrador to Delaware. This species does not make extensive migrations but does move to different habitats when seasons change. During winter and spring, ocean pout are commonly found feeding in areas over bottom substrates of sand and sand-gravel. Feeding ceases in summer and ocean pout move to rocky areas where they spawn. Spawning occurs in September and October. Demersal eggs are guarded by adult fish until eggs hatch (NMFS and NEFMC, 2017).

EFH for ocean pout eggs includes hard bottom sheltered nests, holes, or crevices. Generally, ocean pout eggs are found in water temperatures below 10ºC, salinities ranging from 32 to 34 ppt, and water depths less than 50 meters (164 ft). EFH for juvenile ocean pout includes smooth bottom habitats near rocks or algae. Juveniles are most often found in waters with salinities greater than 25 ppt, temperatures below 14ºC, and depths less than 80 meters (262 ft). EFH for adult ocean pout includes bottom habitats in water depths less than 110 meters (361 ft) with water temperatures less than 15ºC and salinities ranging from 32 to 34 ppt. Spawning adults are found on hard bottom substrates, including artificial reefs, shipwrecks etc. in water temperatures less than 10ºC, depths less than 50 meters (164 ft) and salinities ranging from 32 to 34 ppt. Spawning occurs from late summer through early winter with peaks in September and October (NMFS and NEFMC, 2017).

Effects. No information was obtained regarding the presence of ocean pout eggs and larvae near RISDS. No ocean pout eggs and larvae were found in ichthyoplankton surveys by Bourne and Govoni (1988) or Keller et al. (1999) that included northern Rhode Island Sound. Juvenile and adult ocean pout were observed in NMFS trawls in Rhode Island Sound near the disposal site. However, because eggs and larvae are demersal and prefer rocky crevices or holes in the benthic substrate, and juvenile and adults prefer sand and sand-gravel substrates, they are not likely to be abundant, or even common, in the disposal areas. Those juvenile and adult ocean pout that are present are likely to move from the area while dredged material is being disposed, resulting in only minimal impacts to the juvenile and adult EFH.

Pollock (*Pollachius virens)*

Pollock EFH for juveniles is designated for all project areas. Pollock spawn from November to February, peaking in December over hard, stony, or rocky bottom. No consistently present hard bottom exists at any of the project locations, thus egg and larvae EFH will not likely be impacted by dredging and disposal. EFH for juvenile pollock consists of rocky bottom habitats with attached macroalgae (rockweed and kelp) that provide refuge from predators. Shallow water eelgrass beds are also essential habitats for young-of-the year pollock. Essential habitats for adult pollock are the tops and edges of offshore banks and shoals with mixed rocky substrates, often with attached macro algae (NMFS and NEFMC, 2017).

Effects. Given these habitat requirements, dredge and disposal areas are unlikely to provide EFH for juvenile pollock. Eelgrass beds are not present in the project area. therefore, no impacts to juvenile pollock EFH will occur.

Red Hake (*Urophycis chuss*)

EFH has been described for red hake eggs, larvae, and juveniles for all project areas. EFH for adult red Hake has been described for the Providence River, ESDS, Narragansett Bay, and the PIDS.

The red hake is distributed in the northwest Atlantic from the Gulf of St. Lawrence to North Carolina. This species undergoes extensive seasonal migrations, moving into shallow waters in the spring and summer to spawn and moving offshore to overwinter in deeper waters of the outer continental shelf and slope, particularly the area south and southwest of Georges Bank. Spawning occurs from May through November, with Southern New England a primary spawning area. Red hake spawn in coastal waters over the continental shelf in water 46.8 to 108 meters (154 to 354 ft) in depth and temperatures between 5 and 10ºC. Red hake eggs are pelagic, and float in plankton. Larvae also drift at the surface in the plankton often under eelgrass and rockweed. Young juvenile red hake are found initially at the surface, but as they grow (approximately 27 – 49 mm length) they descend to the bottom and are often found in the mantle cavity of shellfish (*i.e.*, scallops) under sponges, or in other benthic litter. Juveniles will remain in the vicinity of shellfish beds for 2 years if temperatures remain above 4ºC. If temperatures fall below 4ºC, juveniles will migrate to warmer, deeper water. Adult red hake stay close to objects on the bottom (*i.e*., shellfish beds) and can be found over soft mud or silt substrates and less frequently over sand and shell, and never rocky bottoms (NMFS and NEFMC, 2017).

EFH for red hake eggs in the project area are its surface waters. Red hake eggs are generally found in sea surface temperatures below 10ºC, and salinities less than 25 ppt. Red hake eggs are most often observed from May through November with peaks in June and July. EFH for red hake larvae in the Providence River, Narragansett Bay, and Rhode Island Sound includes surface waters with temperatures below 19ºC, salinities greater than 0.5 ppt, and water depths less than 200 meters (656 ft). Red hake larvae are most often observed from May through December with peaks in September and October. EFH for red hake juveniles in the Providence River, Narragansett Bay, and Rhode Island Sound includes bottom habitats with substrates of shell fragments, particularly areas containing live scallops. Juvenile red hake are generally found in water temperatures below 16ºC, salinities of 31 to 33 ppt, and water depths less than 100 meters (328 ft). EFH for adult red hake includes bottom habitats in depressions with substrates of sand and mud. Red hake adults generally occur in water temperatures below 12ºC, salinities of 33 to 34 ppt, and water depths of 10 to 130 meters (33 to 427 ft). Adults spawn in the same types of bottom habitats (depressions with sand and mud substrates) in waters less than 100 meters (328 ft) in depth, and when water temperatures are below 10ºC, and salinities are less than 25 ppt. Adult red hake are most often observed spawning from May through November with peaks in June and July (NMFS and NEFMC, 2017).

Effects. Red hake eggs were collected in recent ichthyoplankton surveys from the Providence River (MRI Inc., 1998) and eggs and larvae were collected in ichthyoplankton surveys from Narragansett Bay in December 1989 through November 1990 (Keller *et al*., 1999). Impacts to red hake egg and larvae EFH are likely to occur if eggs and larvae are present in the water column during dredging or disposal activities. Those eggs and larvae deeper in the water column are likely to be more heavily impacted than eggs and larvae closer to the surface. Impacts to juvenile EFH will be minor since most of the bottom habitat in the project areas are mud that is devoid of structure which juveniles prefer. Adult EFH will remain mostly unchanged since adults prefer demersal mud and sand habitats. Adults and larger juveniles are mobile and would likely move from the area when disturbed.

<u>Sand Tiger Shark (*Carcharias taurus*)</u>

EFH has been designated for sand tiger shark neonates/early juveniles in all project sites. The sand tiger shark is often found in tropical and warm temperate waters worldwide in very shallow waters ranging in temperatures from 19 to 25 °C, in salinities from 23 to 30 ppt, and in depth from 2.8 to 7.0 meters. The mating period of this species extends from late winter to early spring off Florida, and during autumn off North Carolina. Juveniles have been known to occur between Cape Cod and Cape Hatteras with extensive use of Delaware Bay by all life stages of sand tigers. Juveniles have also been shown to migrate extensively during the seasons, inhabiting waters in Maine to Delaware Bay during the summer and Cape Hatteras to central Florida during the winter (NMFS and NEFMC, 2017).

Effects. Impacts to the sand tiger shark EFH from dredging and dredged material disposal activities in the project areas are likely to be minimal. Because of the shark's mobility, it will likely avoid locations where dredging and dredged material disposal activities are being conducted.

<u>Sandbar Shark *(Carcharhinus plumbeus)*</u>

EFH has been designated for juveniles and adult sandbar sharks at RISDS only. The sandbar shark is a coastal pelagic shark. Juvenile sandbar sharks are found offshore in all coastal and pelagic waters north of 40ºN and west of 70ºW. Adults are found in shallow coastal areas from the coast out to 50 m (164 ft) (NMFS and NEFMC, 2017).

Effects. Impacts to the sandbar shark EFH from dredging and dredged material disposal activities in Rhode Island Sound are unlikely. The shark has a wide range of EFH habitats to rely on in the area. Because of the shark's high mobility, it will likely avoid locations where dredging and dredged material disposal activities are being conducted.

<u>Scup (*Stenotomus chrysops*)</u>

EFH has been designated for scup eggs, larvae, juveniles, and adults at the Providence River FNP, ESDS, Narragansett Bay, and PIDS. EFH has been designated for scup juveniles and adults only at RISDS. Scup are distributed in the northwest Atlantic throughout the Mid-Atlantic Bight from Cape Cod, Massachusetts to Cape Hatteras, North Carolina. Scup make seasonal inshore-offshore migrations, moving inshore during spring and summer and offshore to overwinter in waters ranging from 70 to 180 meters (230 to 590 ft) in depth. While inshore, scup are generally found over rocky bottoms schooling at depths between 1.8 and 36 meters (6 and 118 ft). Spawning occurs during the summer months. Scup eggs and larvae are pelagic and drift with currents. Scup eggs and larvae are found in waters between 12 and 23ºC and salinities greater than 15 ppt. Eggs are most often found from May through August and larvae are most abundant from May through September. Juvenile scup are often found in association with various sands, mud, mussel, and eelgrass bed type substrates in water temperatures greater than 7ºC. Juveniles and adults are found in the Providence River and Narragansett Bay and Rhode Island Sound in the spring and summer and move offshore in the winter (NMFS and NEFMC, 2017).

Effects. Scup eggs were collected in ichthyoplankton surveys from the Providence River (MRI Inc., 1998), and eggs and larvae were collected ichthyoplankton surveys from Narragansett Bay in December 1989 through November 1990 (Keller *et al*., 1999). There will likely be minimal impacts to eggs and larvae EFH during dredging and disposal activities since eggs and larvae are pelagic. Impacts may occur if eggs and larvae are present in the water column during dredging or disposal activities. Those eggs and larvae deeper in the water column are likely to be more heavily impacted than eggs and larvae closer to the surface. Juvenile and adult EFH's are not likely to be impacted in the vicinity of dredging or disposal areas since their EFH consists of rockier habitats which are not found in project areas. Any juvenile or adult scup, if present, would likely move out of the area if disturbed.

Shortfin Mako Shark *(Isurus oxyrinchus)*

EFH has been designated for juvenile shortfin mako sharks at RISDS. Shortfin mako sharks are pelagic and are more common in tropical and warm temperate waters, although stray individuals may visit Southern New England waters during summer months (NMFS and NEFMC, 2017).

Effects. Impacts to juvenile shortfin makos pelagic EFH from dredged material disposal activities in Rhode Island Sound are unlikely. Because of the shark's high mobility, it will likely avoid locations where dredged material disposal activities are being conducted.

Silver Hake (*Merluccius bilinearis*)

EFH has been designated for eggs and larvae at all project areas and for adults only in Narragansett Bay.

Silver hake are distributed in the northwest Atlantic from Newfoundland to South Carolina. This species is both a benthic and pelagic species, generally resting near the bottom by day and observed up in the water column at night. Adult benthic habitat includes bottoms of all substrate types. Silver hake are strong, swift swimmers and important predators. Their vertical movements are primarily governed by pursuit of prey. Whiting also make inshore-offshore migrations, moving inshore to more shallow water in the spring and moving offshore in autumn to overwinter in waters 200 meters (656 ft) in depth over the continental shelf and slope. Spawning generally occurs along the continental shelf in waters 30 to 325 meters (98 to 1066 ft) in depth during the late spring and early summer (May and June in Southern New England waters) in water temperatures below 13ºC (55ºF). Whiting egg and larval stages are pelagic and float at the surface and are carried by currents (NMFS and NEFMC, 2017).

EFH for silver hake eggs and larvae includes surface waters in temperatures below 20ºC (68ºF) and water depths between 50 and 150 meters (164 to 492 ft). Eggs are present all year, but peaks are seen from June through October. Peaks in larval abundance are seen in July through October. EFH for adult silver hake includes bottoms of all substrate types (NMFS and NEFMC, 2017).

Effects. Whiting eggs and larvae were present in ichthyoplankton surveys that included northern Rhode Island Sound (Bourne and Govoni, 1988; Keller et al., 1999). Therefore, eggs and larvae may be present near RISDS. Eggs and larvae may be impacted during disposal operations if they are present in the water column. No impacts to adult EFH are expected.

Skipjack Tuna (*Katsuwonus pelamis*)

EFH has been designated for adult skipjack tuna at RISDS. Skipjack tuna spawn opportunistically in equatorial waters throughout the year and in subtropical waters from spring to early fall (Collette and Nauen 1983). The maximum size of skipjack tuna is reported at 108 cm FL and a weight of 34.5 kg. Size at sexual maturity is 45 cm (18 inches) for males and 42 cm for females. This size is believed to correspond to about 1 to 1.5 years of age, although significant variability in interannual growth rates makes size-to-age relationships difficult to estimate (Collette and Nauen, 1983).

Effects. Skipjack tuna are infrequent summer visitors to the project area. No impacts to adult skipjack tuna EFH are expected.

Smooth Dogfish (*Mustelus canis*)

EFH has been designated for juveniles and adults at RISDS. Smooth dogfish are found in the Atlantic Ocean from Massachusetts to northern Argentina. As these animals are demersal, they primarily inhabit continental shelf and inshore waters at a depth of 200 m. Smooth dogfish are temperature dependent and often migrate between North Carolina and the Chesapeake Bay in the winter and move along bottom waters of the coast in the spring. Additionally, marsh creeks are likely important habitats for newborns during June and July while estuaries within the Mid-Atlantic Bight are known to be critical nursery habitats for the YOY life stage (NMFS and NEFMC, 2017).

Effects. Impacts to juvenile and adult smooth dogfish EFH from dredged material disposal activities in Rhode Island Sound are unlikely. Because of the shark's pelagic nature and high mobility, it will likely avoid locations where dredged material disposal activities are being conducted.

Spiny dogfish (*Squalus acanthias*)

EFH has been designated for juvenile and adult spiny dogfish at RISDS. The spiny dogfish is distributed in the northwestern Atlantic from Labrador to Florida. Spiny dogfish are a schooling species and will school by size when younger and by sex as adults. This species is generally found in temperatures between 3 and 28ºC and water depths from 10 to 390 meters (33 to 1280 ft) for juveniles and 450 meters (1476 ft) for adults. They feed on fish and crustaceans but tend to target the most abundant prey species in the area. Spiny dogfish movements are governed by the movements of their prey. They are generally found in coastal waters during spring and autumn, and during summer will migrate to the edge of continental shelf and to the Gulf of Maine-Georges Bank region. EFH for both juveniles and adults in Rhode Island Sound includes the pelagic waters out to the continental shelf (NMFS and NEFMC, 2017).

Effects. Impacts to juvenile and adult spiny dogfish EFH from dredged material disposal activities in Rhode Island Sound are unlikely. Because of the shark's pelagic nature and high mobility, it will likely avoid locations where dredged material disposal activities are being conducted.

<u>Summer Flounder (*Paralichthys dentatus*)</u>

EFH has been designated for summer flounder larvae and adults at all project sites, for juveniles at the Providence River FNP, ESDS, Narragansett Bay, and PIDS and for eggs at RISDS only (NMFS and NEFMC, 2017).

The summer flounder is a demersal species that is distributed in the northwest Atlantic from the Gulf of Maine to South Carolina. The summer flounder is a "left-eyed" flounder that is found over sand, mud, grass, around pilings, in tidal channels and salt ponds. The species is concentrated in bays and estuaries from spring to early autumn, and in early autumn, will migrate offshore to the outer continental shelf. Spawning occurs during the offshore migration in autumn and early winter. Summer flounder eggs are pelagic and float near the surface, drifting with currents. Eggs are most common within 14.5 km (9 miles) of the shore at water depths of 10 to 110 meters (33 to 361 ft). Larvae are partially benthic and may drop down to the substrate when not actively swimming. Early larvae will concentrate at depths of 22 to 57 meters (72 to 187 ft) at distances 22 to 83 km (14 to 52 miles) offshore. As larvae mature, they will move inshore with the currents, leaving post larvae and juveniles to settle on the bottom in bays and estuaries. Juvenile summer flounder tend to use various habitats (seagrass beds, mudflats, salt marsh creeks and open bay areas) in estuaries and bays as nursery areas. They are found in many of these habitats when water temperatures are greater than 3ºC and salinities range between 10 and 30 ppt. Adult summer flounder are common in inshore habitats during the warmer months. They move offshore to depths of 150 meters (492 ft) during colder months (NMFS and NEFMC, 2017).

Effects. Summer flounder larvae were collected in ichthyoplankton surveys from the Providence River (MRI Inc., 2000; 1999; 1993) and in ichthyoplankton surveys from Narragansett Bay in December 1989 through November 1990 (Keller *et al*., 1999). Impacts to egg and larval EFH during dredging and disposal activities will be minimal as they are mainly pelagic. Impacts from dredged material at RISDS could occur if eggs and larvae are in the water column over the disposal site during disposal. Because eggs float and larvae are partially benthic, larvae at the surface are likely to be less impacted by turbidity than larvae deeper in the water column. Impacts to adult and juvenile summer flounder EFH in all project areas will likely be minimal, as they are able to make use of many different bottom substrates and would likely move from the area if disturbed.

<u>White Hake (*Urophycis tenuis*)</u>

EFH for white hake larvae and juveniles is designated at RISDS only. White hake spawning takes place primarily offshore in deep waters along the continental slope off southern Georges Bank and the Middle Atlantic Bight. Larvae remain offshore and juveniles migrate inshore. Juvenile white hake are distributed over the project area in May-June (NMFS and NEFMC, 2017).

White hake EFH occurs from the Gulf of St. Lawrence to the Middle Atlantic Bight and from estuaries across the continental shelf to the submarine canyons along the upper continental slope and the deep, muddy basins in the Gulf of Maine. The eggs, larvae, and early juveniles are pelagic; older juveniles and adults are demersal (NMFS and NEFMC, 2017).

Effects. Larval white hake EFH should not be impacted as larvae tend to remain offshore and away from the project site to develop. Although dredging and disposal will remove or bury some benthic prey items, most juvenile white hake EFH will remain unaffected. Juvenile white hake will be able to use surrounding habitats for foraging while the affected areas recover.

<u>White Shark (*Carcharodon carcharias*)</u>

White sharks have juvenile EFH designated at all project locations. White sharks are highly migratory species that would be present in the project areas during the summer months only. Juvenile white sharks are top predators feeding on bony fishes, small sharks, and rays (NOAA, 2017).

Effects. Impacts to juvenile white shark EFH from dredged material disposal activities in Rhode Island Sound are unlikely. Because of the shark's high mobility, it will likely avoid locations where dredged material disposal activities are being conducted.

<u>Windowpane Flounder (*Scophthalmus aquosus*)</u>

EFH has been designated for windowpane flounder eggs, larvae, juveniles, and adults at all project sites. Windowpane flounder is a demersal species that is distributed in the northwest Atlantic along the continental shelf from the Gulf of St. Lawrence to Florida and is particularly common in large estuaries in waters less than 56 meters (184 ft). The windowpane flounder is a "left-eyed" flounder that is found over sand, mixtures of sandy silt or mud. No seasonal migration is evident in New England waters. Spawning occurs from April through December with peaks from May through October in waters below 21ºC and salinities between 5.5 and 36 ppt. Eggs and larvae are pelagic and float near the surface, drifting with currents. Juveniles are most often observed in the sublittoral zones generally in water depths of 6 to 14 meters (20 to 46 ft) (NMFS and NEFMC, 2017).

Windowpane flounder EFH includes inshore and offshore surface waters less than 70 meters (230 ft) in depth. Windowpane flounder eggs and larvae are most often found in surface waters where temperatures are below 20ºC. Juveniles are found in bottom habitats in water depths ranging from 1 to 100 meters (3 to 328 ft) and 1 to 75 meters (3 to 246 ft) for adults. Juveniles that settle in shallow inshore waters move to deeper offshore waters as they grow. Adults occur primarily on soft substrates (mud and sand) off Southern New England and Mid-Atlantic Bight (NEFMC and NMFS, 2017).

Effects. Windowpane flounder eggs and larvae were collected in ichthyoplankton surveys from the Providence River (MRI Inc., 2000; 1999; 1998; 1997; 1996; 1995; 1994; 1993) and in ichthyoplankton surveys from Narragansett Bay in December 1989 through November 1990 (Keller *et al*., 1999). Impacts to eggs and larvae that happen to be in the water column during dredging and disposal activities are likely to occur. Those eggs and larvae at the surface (where windowpane larvae are known to be present) are likely to be less impacted than larvae deeper in the water column. Impacts to juveniles and adult windowpane flounder EFH will likely be minimal, as individuals are likely to move from the dredge or disposal area to adjacent habitats.

<u>Winter Flounder (*Pseudopleuronectes americanus*)</u>

EFH has been described for winter flounder eggs, larvae, juveniles, and adults in the Providence River FNP, ESDS, Narragansett Bay, and PIDS and for larvae, juveniles, and adults at RISDS. In the Western Atlantic, the winter flounder *Pleuronectes americanus*, ranges from Labrador to Georgia. Like other flounders, winter flounder are a demersal species, common on muddy sand with patches of eelgrass, sand, clay and even gravel/cobble from the shoreline to 128 meters (420 ft). Their movements are generally localized, undertaking small scale migrations into estuaries, embayment's, and saltwater ponds in the winter to spawn, and moving to deeper water in summer. Winter flounder avoid waters cooler than 0ºC and warmer than 14- 15ºC. Adult winter flounder utilize a variety of substrates and prefer temperatures of 12-15 ˚C, and salinities above 22 ppt, although they have been shown to survive at salinities as low as 15 ppt. Mature adults are found in very shallow waters during the spawning season (NEFMC and NMFS, 2017). Spawning occurs over bottom habitats with substrates of sand, muddy sand, mud, or gravel in water temperatures less than 15ºC, and salinities between 5.5 and 36 ppt. Spawning in inshore areas occurs in water depths less than 6 meters, while spawning offshore can occur in waters as deep as 80 meters. Adult winter flounder are most often observed spawning from February through June. Adults also tend to return to the same spawning locations year after year and discrete local groups exist (Gulf of Maine, Georges Bank, Southern New England-Middle Atlantic). Winter flounder eggs are not buoyant but sink and stick together in clusters on the bottom. Newly hatched larvae remain near bottom (generally found at depths less than 37 meters (121 ft). The larvae are unlike other flatfishes in that even though they are pelagic, they are not completely at the mercy of tides or currents. Winter flounder larvae will alternatively swim upward and then sink to lie on the bottom as opposed to remaining constantly adrift at the surface. Juveniles tend to stay in inshore areas for 2 or more years but will move to avoid temperature extremes.

EFH for winter flounder eggs are found where water temperatures are less than 10ºC, salinities are between 10 and 30 ppt, and water depths are less than 5 meters (16 ft). EFH for winter flounder larvae are found in pelagic and bottom waters where temperatures are less than 15ºC, salinities range between 4 and 30 ppt, and water depths are less than 5 meters (16 ft). EFH for winter flounder young-of-year juveniles includes bottom habitats with a substrate of mud or fine-grained sand. Young-of-year winter flounder are generally found in water temperatures below 28ºC, salinities between 5 and 33 ppt, and in water depths of 0.1 to 10 meters (0.3 to 33 ft). EFH for older juveniles also includes bottom habitats with a mud or fine-grained sand. Older juveniles are generally found in water temperatures below 25ºC, salinities between 10 and 30 ppt, and water depths of 1 to 50 meters (3 to 164 ft). EFH for adult winter flounder includes bottom habitats with a substrate of mud, sand, or gravel. Adult winter flounder are generally found in water temperatures below 25ºC, salinities between 15 and 33 ppt, and water depths of 1 to 100 meters (3 to 328 ft).

Effects. Winter flounder eggs and larvae were collected in ichthyoplankton surveys from the Providence River (MRI Inc., 2000; 1999; 1998; 1997; 1996; 1995; 1994; 1993) and in ichthyoplankton surveys from Narragansett Bay in December 1989 through November 1990 (Keller *et al*., 1999). Impacts to egg EFH in the vicinity of the Providence River dredging operations are likely to be minimal because most of the upper river in the vicinity of Fox Point and Upper Fuller Rock Reaches is deeper than 5 meters (16 ft) where most winter flounder eggs are deposited. The shallow areas adjacent to the upper reaches of the channel where most of the dredging will be conducted have degraded habitats because of contamination. Impacts to larvae may occur if larvae are common near the bottom and in the water column near dredging or disposal operations. Impacts to larvae during disposal of dredged material at RISDS will occur if larvae are present at the disposal site during disposal. Juvenile and adult winter flounder are likely to experience minimal impacts during disposal operations because they are likely to move to avoid the disposal plume.

Winter Skate (*Leucoraja ocellata*)

EFH has been described for winter skate juveniles and adults at all project locations. Winter skates are found over a wide range extending from southern New England and the Mid-Atlantic Bight (MAB) to North Carolina. They exhibit seasonal movements by moving offshore in the summer and near shore in the autumn. Winter skates are most active at night and remain buried in depressions during the day. Juveniles and Adults can be found at depths ranging from the shoreline to 90 meters (NEFMC and NMFS, 2017).

Winter skate EFH is sand and gravel bottoms although they have been documented in areas with mud bottoms in 3 to 111 meters and temperatures of 0 to 20ºC (NMFS and NEFMC, 2017).

Effects. Both juveniles and adult skates may occur within the project areas during those periods in which they are expected to move inshore. As both life stages of this species are motile and can avoid the area during periods of disturbance due to construction by moving to adjacent undisturbed areas. Therefore, no significant impacts to winter skates and their associated EFH are expected due to the proposed project. This project is not expected to permanently change the bottom substrate. Benthos will be affected temporarily until benthic communities recover in approximately 6-18 months post-construction.

Witch Flounder *(Glyptocephalus cynoglossus*)

Witch flounder larval EFH is designated at RISDS only. The witch flounder is a demersal species that is distributed throughout the Gulf of Maine and deeper waters along Georges Bank, and along the edge of the continental shelf south to Cape Hatteras, North Carolina. Witch flounder are sedentary and are more common in water depths greater than 90 meters; most are caught between 110 and 275 meters (361 and 902 ft). Witch flounder are found on substrates of mud, clay, mud/clay mixed with sand, and smooth ground between rocky patches. They spawn in late spring and summer, peaking in May and June. The eggs are pelagic and drift in the plankton. Witch flounder eggs and larvae are most often observed during the months of March through October and March through November, respectively. Larval abundance peaks in May through July. Larvae are also pelagic and are commonly found over depths of 28 to 250 meters (92 to 820 ft) (NEFMC and NMFS, 2017).

EFH has been designated for witch flounder larvae in Rhode Island Sound. EFH for larvae in Rhode Island Sound includes surface waters to 250 meters (820 ft) in depth with oceanic salinities and surface water temperatures below 13ºC.

Effects. Impacts to witch flounder larvae during disposal of dredged material at RISDS will occur if larvae are in the water column over the disposal site during disposal. Larvae at the surface are less likely to be impacted than larvae deeper in the water column. Because the adults of this species appear to be absent from this region, the presence of larvae may also be low resulting in minimal effects.

Yellowfin Tuna (*Thunnus albacares)*

EFH has been described for juvenile yellowfin tuna at RISDS and Narragansett Bay. Yellowfin tuna sexual maturity is reached at about three years of age, 110 cm fork length (FL), and a weight of 25 kg. Spawning occurs throughout the year in the core areas of the species distribution (between 15° N lat. and 15° S lat.) and in the Gulf of Mexico and the Caribbean, occurring from May through November. Yellowfin tunas are believed to be serial spawners, and larval distribution appears to be limited to water temperatures above 24 °C, and salinity greater than 33 ppt (Richards and Simmons, 1971). Yellowfins are characteristically large, fast growing, and short-lived (Juan-Jorda et al., 2013). The maximum size of yellowfin tuna is over 200 cm FL (Collette and Nauen, 1983).

Effects. Juvenile yellowfin tuna may be infrequent summer visitors to RISDS and Narragansett Bay. Because of their rarity in the area, their highly migratory nature, and the fact that there will be no impacts to their EFH or prey items we anticipate no effects to yellowfin tuna EFH from this project.

Yellowtail Flounder (*Pleuronectes ferruginea*)

EFH has been designated for eggs, larvae, juveniles, and adult yellowtail flounder at RISDS only. Yellowtail flounder are a demersal species that is distributed along the northwestern Atlantic from Labrador to the Chesapeake Bay. Yellowtail flounder are a “right-eyed” species and are relatively sedentary, preferring bottoms of sand or sand and mud in waters from 30 to 90 meters (98 to 295 ft) in depth. Discrete stocks have been identified off Southern New England, Georges Bank, Cape Cod, and in the Middle Atlantic. Yellowtail flounder spawn in spring and summer with peaks observed in May.

EFH for yellowtail flounder eggs and larvae in Rhode Island Sound includes surface waters over the continental shelf where sea surface temperatures are below 15ºC, salinities are around 32.4 to 33.5 ppt., and water depths range from 30 to 90 meters (98 to 295 ft). Yellowtail flounder eggs and larvae are most often observed from March through July with peaks from April through June. EFH for juvenile and adult yellowtail flounder in Rhode Island Sound includes bottom habitats with substrates of sand or sand and mud. Juveniles and adults are most often observed in waters 20 to 50 meters (66 to 164 ft) in depth, at water temperatures below 15ºC, and salinities around 32.4 to 33.5 ppt. Spawning adult yellowtail flounder are found in the same bottom habitats but may be seen at depths ranging from 10 to 125 meters (33 to 410 ft). Spawning occurs at water temperatures below 17ºC and salinities of 32.4 to 33.5 ppt (NEFMC and NMFS, 2017).

Effects. Impacts to yellowtail flounder eggs and larvae during disposal of dredged material in Rhode Island Sound may occur if eggs and larvae are in the water column during disposal. Those eggs and larvae at the surface are less likely to be impacted than eggs and larvae deeper in the water column. Any juvenile or adult yellowtail flounder that happen to be present in the disposal area are likely to actively move away. Minimal impacts to yellowtail flounder EFH are expected.

Project Impacts Summary

The dredging of the Providence River and Harbor Federal Navigation Project and the associated placement of dredged material may adversely affect but is not likely to have significant effects or long-term lasting effects on the “spawning, breeding, feeding, or growth to maturity” of the majority of managed species that have EFH within the project area.

Dredging Sites

The dredging activities conducted for the project are likely to have some temporary impacts on EFH species in the Providence River, Narragansett Bay and Edgewood Shoals, but impacts will be minimized through the application of a dredging sequence that avoids sensitive areas during the most sensitive times of the year. In general, eggs and larvae are more susceptible to impacts than juveniles and adults, which are mobile and can find adjacent foraging habitat. Demersal species such as flounders are more susceptible to impacts than pelagic species since most dredging related disturbance occurs near the bottom. The EFH species with the most potential to be affected by dredging in the Providence River, Edgewood Shoals and upper Narragansett Bay are those with demersal eggs (one species: winter flounder) and those with planktonic eggs and larvae suspended in the water column. These eggs and larvae may be physically damaged or killed from exposure to elevated concentrations of suspended solids.

Juvenile and adult demersal and pelagic species are likely to actively avoid the sediment plume that results from dredging and find adjacent foraging opportunities. Small juvenile fish, particularly flounders and groundfish that reside on the bottom following metamorphosis from their larval form, will be more heavily affected than larger juveniles due to their mobility. However, the FNP and Edgewood Shoals provide poor benthic habitat, so it is unlikely that these species successfully use the channel habitat in high numbers.

Impacts to EFH and fish species can be minimized by using the appropriate dredging equipment and sequencing dredging activities to avoid key areas at sensitive times. The dredging will be sequenced to minimize impacts to fishery resources by adhering to the following priorities as much as possible without interrupting the progress of dredging.

Placement Sites

Placement activities conducted for the project are also likely to have some temporary impacts on the EFH species present at the proposed placement sites during placement and until the benthic habitat at the placement site recovers. Demersal species such as flounders will experience greater impacts than pelagic species, and eggs and larvae will experience greater impacts than juveniles and adults. The species with the most potential to be adversely affected by placement would be those that have demersal eggs and larvae. Demersal eggs and larvae are likely to be buried as dredged material is dumped at the placement site. Species that have planktonic eggs and larvae in the water column may also be seriously damaged or killed as they encounter the mass of material released from the scow.

Juveniles and adults of demersal species may be buried if they do not quickly move from the area when placement begins. Smaller juveniles are more likely to be buried than larger juveniles or adults. Pelagic juveniles and adults will likely experience minimal impacts as they are able to find adjacent foraging habitat as placement begins.

Small pelagic juveniles, however, may be damaged or killed if they are not able to escape the rapidly descending sediment particles during the placement activities.

Conclusions

Although project activities are likely to impact EFH and species present in the dredging and placement areas, the impacts will be temporary. The species present in these areas will return following project completion. Physical parameters such as tides and currents are not expected to change because of the project. Any changes to water quality (temperature, salinity, TSS, DO) will be temporary and water quality will return to pre-project conditions when the project is complete. Prey species eliminated during dredging and placement activities will also return following project completion. The filling of Port Edgewood Basin and dredging of an access channel to the FNP will improve flushing and water quality conditions in the aera and potentially the greater Narragansett Bay.

Additionally, not all areas designated as EFH for the various species will incur impacts. Most species with designated EFH in the Providence River and Edgewood Shoals also have EFH in the larger Narragansett Bay and portions of Rhode Island Sound. The effects of dredging and placement will be confined to limited areas of the Providence River, Edgewood Shoals, Narragansett Bay, and Rhode Island Sound. Therefore, these species will be able to sustain the population of their respective species in this geographic region.

Avoidance, Minimization, and Mitigation

Specific measures taken to avoid and minimize impacts to EFH:

This project will be performed within various project windows in different reaches of Narragansett Bay to minimize impacts to EFH (Table 1). The timing of this maintenance dredging is specifically set to avoid impacts to EFH. Furthermore, winter spawning species such as the winter flounder (whose EFH can be affected by dredging operations) spawn demersal eggs in late winter/early spring. The timing of maintenance dredging is specifically set to avoid impacts to winter flounder EFH.

Dredged material will be placed in areas with similar sediment composition. For example, silty sediments from the FNP will be placed at RISDS and Edgewood Shoals, where both have silty sediment currently. The placement of dredged material at these locations is specifically to avoid the conversion or loss of EFH. Any EFH impacts at the dredge or placement sites will be temporary.

Is compensatory mitigation proposed?

No compensatory mitigation proposed.

Compensatory mitigation details:

No significant adverse effects to any species' EFH is expected as a result of this project. Therefore, no compensatory mitigation is proposed.

8. Federal Agency Determination

Federal Action Agency's EFH determination	
	There is no adverse effect on EFH or EFH is not designated at the project site. EFH Consultation is not required. This is a FWCA only request.
X	The adverse effect on EFH is not substantial. This means that the adverse effects are no more than minimal, temporary, or can be alleviated with minor project modifications or conservation recommendations. This is a request for an abbreviated EFH consultation.
	The adverse effect on EFH is substantial. This is a request for an expanded EFH consultation.

9. Fish and Wildlife Coordination Act

Fish and Wildlife Coordination Act Resources

Species known to occur at site	**Habitat impact type**
alewife	Project window is outside of potential spawning run.
American eel	Temporary increase in turbidity during spawning run.
American shad	Project window is outside of potential spawning run.
Atlantic menhaden	Potential turbidity in dredge and placement areas.
blue crab	N/A
blue mussel	N/A
blueback herring	Project window is outside of potential spawning run.
Eastern oyster	N/A
horseshoe crab	N/A
quahog	Potential entrainment in dredge areas and burial in placement areas. Quahog relocation to take place within CAD footprint prior to construction
soft-shell clams	Potential entrainment in dredge areas and burial in placement areas.
striped bass	Potential turbidity in dredge and placement areas.
other species:	

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TEMPLATE FOR INTERAGENCY CBRA CONSULTATIONS

Overview and Instructions:

The Coastal Barrier Resources Act (CBRA) (16 U.S.C. 3501 et seq.) encourages the conservation of hurricane prone and biologically rich coastal barriers. No new expenditures or financial assistance may be made available under authority of any federal law for any purpose within the System Units of the John H. Chafee Coastal Barrier Resources System (CBRS) including: construction or purchase of roads, structures, facilities, or related infrastructure; most projects to prevent the erosion of or otherwise stabilize any inlet, shoreline, or inshore area; and any loans, grants, and other financial assistance (e.g., flood insurance and easements). However, the appropriate federal officer, after consultation with the U.S. Fish and Wildlife Service (Service), may make federal expenditures and financial assistance available within System Units for activities that meet one of CBRA's exceptions (16 U.S.C. 3505). CBRA imposes no restrictions on actions and projects within the CBRS that are carried out with state, local, or private funding. Any response from the Service to a CBRA consultation request is in the form of an opinion only. The Service has not been granted veto power. **The responsibility for complying with CBRA and the final decision regarding the expenditure of funds for a particular action or project rests with the federal action agency.**

There are two types of units within the CBRS, System Units and Otherwise Protected Areas (OPAs). OPAs are denoted with a "P" at the end of the unit number (e.g., "FL-64P"). Most new federal expenditures and financial assistance, including flood insurance, that affect System Units are prohibited. The only federal spending prohibition within OPAs is on flood insurance; other federal expenditures are permitted. **Consultation with the Service is not needed if the proposed action or project is located within an OPA.** However, agencies providing disaster assistance that is contingent upon a requirement to purchase flood insurance after the fact are advised to disclose the OPA designation and information on the restrictions on federal flood insurance to the recipient prior to the commitments of funds.

The Service has developed the attached template to help facilitate the CBRA consultation process. This form, and any additional documentation, may be submitted by the action agency to the appropriate Ecological Services Field Office to fulfill CBRA's consultation requirement.

Guidance for Uncommon Situations:

Special Exceptions for Certain Shoreline Stabilization

CBRA (16 U.S.C. 3504(a)(3)) allows for "the carrying out of any project to prevent the erosion of, or to otherwise stabilize, any inlet, shoreline, or inshore area" in the following two situations *without* consultation with the Service:

1) In **Louisiana Units S01 through S08 and LA-07** for purposes other than encouraging development, and
2) In all units, in cases **where an emergency threatens life, land, and property immediately adjacent to that unit**.

In either of these cases, consultation by any means (including this template) is not required. However, the Service appreciates a notification of the project/activity occurring under this exemption. Notification may be emailed to cbra@fws.gov.

Projects in Willacy or Cameron Counties, Texas affecting South Padre Island

CBRA's limitations on federal expenditures of financial assistance do not apply to services or facilities and related infrastructure located outside the boundaries of **South Padre Island Unit T11** which relate to any activity within that unit (except with respect to federal flood insurance or assistance provided by the Department of Housing and Urban Development, which may still be prohibited outside of Unit T11). For guidance regarding projects that may fall into this category, please see 16 U.S.C. 3505(d) and contact cbra@fws.gov and the Texas Coastal Ecological Services Field Office for assistance.

Additional Resources:

CBRS Mapper and GIS data: *https://www.fws.gov/cbra/maps-and-data*

CBRA consultation resources: *https://www.fws.gov/service/coastal-barrier-resources-act-project-consultation*

CBRS in/out property determinations (for projects very close to a CBRS boundary): *https://www.fws.gov/service/coastal-barrier-resources-system-property-documentation*

May 12, 2025

Christine San Antonio
Marine Biologist
Environmental Branch
New England District
U.S. Army Corps of Engineers
696 Virginia Road
Concord, MA 01742

The U.S. Army Corps of Engineers (USACE) requests a consultation with the U.S. Fish and Wildlife Service (Service) under the Coastal Barrier Resources Act (CBRA) (16 U.S.C. 3501 et seq.) for the proposed Providence River and Harbor Federal Navigation Project Rhode Island Dredged Material Management Plan and Environmental Assessment. This project/action is cost shared between the U.S. Army Corps of Engineers (72%) and the non-federal sponsor, Rhode Island Coastal Resources Management Council (28%).

Project Location
Insert project location. The CBRS Mapper can be used to identify the CBRS unit number(s) at: https://www.fws.gov/program/coastal-barrier-resources-act/maps-and-data.

The action or project is located in Providence, Rhode Island within (or partially within) Unit(s) D02B of the Coastal Barrier Resources System (CBRS).

Description of the Proposed Action or Project
Provide a brief description of the action or project.

U.S. Army Corps of Engineers (USACE) proactively identifies and evaluates a suite of dredged sediment management options to address immediate and future dredging needs of an existing Federal Navigation Project (FNP) to provide continued operations and maintenance of the project for its navigation purpose to the maximum scale and extent, within project authorization, for which continued maintenance is warranted in terms of vessel traffic and related factors.

USACE policy for dredged material management of FNPs is based on meeting the Base as defined in U.S. Code of Federal Regulations (33 CFR 335.7). The Federal Standard requires that USACE accomplish the management of dredged material associated with the construction or maintenance dredging of navigation projects in the least costly manner, consistent with sound engineering practices (practicable), and environmentally acceptable manner. Environmental acceptability includes meeting all federal environmental standards including the environmental standards established by Section 404 of the Clean Water Act (CWA) of 1972 or Section 103 of the Marine Protection, Research and Sanctuaries Act (MPRSA) of 1972, as amended. In cases where there is insufficient placement capacity to accommodate the warranted maintenance dredging over a period of at least 20 years, then a dredged material management study must be performed, which includes the preparation of a Dredged Material Management Plan (DMMP) (Engineer Regulation (ER) 1105-2-100).

This DMMP presents a plan for the Providence River and Harbor FNP (Providence FNP) along with three adjacent shallow-draft FNPs (Pawtuxet Cove, Bullocks Point Cove, and Apponaug Cove) all located in the Providence River Estuary in southern Rhode Island.

<u>Applicable Exception(s) under 16 U.S.C. 3505(a)</u>
Identify the appropriate exception(s) for the action or project under CBRA (16 U.S.C. 3505(a)).

General Exceptions

☐ 16 U.S.C. 3505(a)(1): Any use or facility necessary for the **exploration, extraction, or transportation of energy resources** which can be carried out only on, in, or adjacent to a coastal water area because the use or facility requires access to the coastal water body.

☒ 16 U.S.C. 3505(a)(2): The **maintenance or construction of improvements of existing federal navigation channels** (including the Intracoastal Waterway) and related structures (such as jetties), including the disposal of dredge materials related to such maintenance or construction. *A federal navigation channel or a related structure is an existing channel or structure, respectively, if it was authorized before the date on which the relevant System Unit or portion of the System Unit was included within the CBRS (16 U.S.C. 3505(b)).*

☐ 16 U.S.C. 3505(a)(3): The maintenance, replacement, reconstruction, or repair, but not the expansion, of **publicly owned or publicly operated roads, structures, or facilities that are essential links** in a larger network or system. *While this exception generally prohibits expansions, there is a special provision in CBRA that allows for the expansion of highways in Michigan under this exception (see 16 U.S.C. 3505(c)).*

☐ 16 U.S.C. 3505(a)(4): **Military activities** essential to national security.

☐ 16 U.S.C. 3505(a)(5): The construction, operation, maintenance, and rehabilitation of **Coast Guard facilities** and access thereto.

Specific Exceptions

The exceptions below may apply only if the project or action is also consistent with the purposes of CBRA, which are:

- *to minimize the loss of human life;*
- *minimize wasteful expenditure of federal revenues; and*
- *minimize damage to fish, wildlife, and other natural resources associated with coastal barriers*

by restricting future federal expenditures and financial assistance which have the effect of encouraging development; and by considering the means and measures by which the long-term conservation of these fish, wildlife, and other natural resources may be achieved.

Therefore, **if selecting any of the exceptions below, it is necessary to describe how the proposed action or project is consistent with these purposes**.

☐ 16 U.S.C. 3505(a)(6)(A): **Projects for the study, management, protection, and enhancement of fish and wildlife resources and habitats**, including acquisition of fish and wildlife habitats, and related lands, stabilization projects for fish and wildlife habitats, and recreational projects.

☐ 16 U.S.C. 3505(a)(6)(B): Establishment, operation, and maintenance of **air and water navigation aids** and devices, and for access thereto.

☐ 16 U.S.C. 3505(a)(6)(C): Projects under chapter 2003 of title 54 and the **Coastal Zone Management Act** of 1972 (16 U.S.C. 1451 et seq.). *Chapter 2003 of title 54 refers to expenditures under the **Land and Water Conservation Fund**. For additional information on the use of this exception for projects under the CZMA, please see this [fact sheet].*

☐ 16 U.S.C. 3505(a)(6)(D): **Scientific research**, including aeronautical, atmospheric, space, geologic, marine, fish and wildlife, and other research, development, and applications.

☐ 16 U.S.C. 3505(a)(6)(E): Assistance for **emergency actions essential to the saving of lives and the protection of property and the public health and safety**, if such actions are performed pursuant to sections 5170a, 5170b, and 5192 of title 42 **and are limited to actions that are necessary to alleviate the emergency.**

☐ 16 U.S.C. 3505(a)(6)(F): Maintenance, replacement, reconstruction, or repair, but not the expansion (except with respect to United States route 1 in the Florida Keys), of **publicly owned or publicly operated roads, structures, and facilities.** *Please note that for this exception, FEMA regulations (44 CFR Part 206.347(c)(5)) indicate that "no such facility may be repaired, reconstructed, or replaced unless it is an 'existing facility'" (i.e., one that was constructed prior to its inclusion in the CBRS and has not been substantially improved or expanded since).*

☐ 16 U.S.C. 3505(a)(6)(G): **Nonstructural projects for shoreline stabilization** that are designed to mimic, enhance, or restore a natural stabilization system. *For additional information on the use of this exception, please see this [Frequently Asked Questions] document.*

Justification for Exception(s)

*Briefly explain how the proposed action or project meets the exception(s) under CBRA identified above. **If the exception(s) cited above is under 16 U.S.C. 3505(a)(6), the justification must also include an explanation of how the proposed action or project is consistent with the purposes of CBRA (see above).***

Maintenance of the Providence River and Harbor FNP is exempt from Federal expenditure limitations that may otherwise be required by the CBRA since the FNP existed prior to mapping of the Coastal Barrier Resource System Unit on October 24, 1990, and meets the definition of maintenance or construction of improvements of existing federal navigation channels as per 16 U.S.C. 3505(a)(2).

Contact Information
Include contact information and where the response should be sent.

Christine San Antonio
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christine.sanantonio@usace.army.mil

U.S. Fish and Wildlife Service Response

Below is the Service's response to USACE's request for a consultation under CBRA for Providence River and Harbor Federal Navigation Project Rhode Island Dredged Material Management Plan and Environmental Assessment. This response represents the Service's opinion. **The final decision regarding the expenditure of funds for this action or project rests with the federal action agency.** USACE has fulfilled its obligation to consult with the Service under CBRA for this particular action or project within the CBRS. Please note that any new commitment of federal funds associated with this action or project, or change in the project design and/or scope, is subject to CBRA's consultation requirement.

The Service has reviewed the information provided by USACE, and believes the referenced action/project is:

- ☐ Not located within a System Unit of the CBRS and CBRA does not apply (except with respect to the restrictions on federal flood insurance)
- ☐ Located within a System Unit of the CBRS and meets the exception(s) to CBRA selected above
- ☐ Located within a System Unit of the CBRS and meets different exception(s) than the one(s) selected above (see additional information/comments below)
- ☐ Located within a System Unit of the CBRS and does not meet an exception to CBRA (see additional information/comments below)

Additional Information/Comments
Include any additional information/comments.

This response does not constitute consultation for any project pursuant to section 7 of the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.) or comments afforded by the Fish and Wildlife Coordination Act (48 Stat. 401; 16 U.S.C. 661 et seq.); nor does it preclude comment on any forthcoming environmental documents pursuant to the National Environmental Policy Act (83 Stat. 852; 42 U.S.C. 4321 et seq.).

SERVICE FIELD OFFICE SIGNATORY AND TITLE DATE

CWA Section 404(b)(1) Checklist

NEW ENGLAND DISTRICT
U.S. ARMY CORPS OF ENGINEERS, CONCORD, MA
CLEAN WATER ACT SECTION 404 (b)(1) EVALUATION

PROJECT: Maintenance Dredging of the Providence River and Harbor Federal Navigation Project, Providence, Rhode Island.

PROJECT MANAGER: Sam Bell PHONE NO. (978) 318-8727
COMPLETED BY: Todd Randall PHONE NO. (978) 318-8318

PROJECT DESCRIPTION:

The U.S. Army Corps of Engineers (USACE), New England District proposes maintenance dredging of the Providence River and Harbor Federal Navigation Project (Providence FNP) in Providence, Rhode Island. Hydrographic surveys identified shoaling of the FNP channel, which creates shallow conditions that increase the risk of vessel groundings within the FNP. A mechanical bucket dredge will remove the shoaled material to authorized depths, plus two feet of allowable over depth. USACE has completed a Dredged Material Management Plan (DMMP) for maintenance dredging and placement of dredged material from the 16-mile-long Providence FNP. An Environmental Assessment (EA) for this project has also been prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, as amended. This evaluation of the Clean Water Act Section 404(b)(1) guidelines is being performed for the placement of sediments associated with the project.

The FNP for Providence River and Harbor was originally adopted in 1852 and was modified by 17 subsequent authorizations through and including the Water Resources Development Act (WRDA) of 1986, which deauthorized the India Point channel. The existing project was authorized by the River and Harbor Act of 1965, in accordance with reports printed in Senate Document #93, 88th Congress, 2d Session, dated August 18, 1964. That project authorized deepening the main channel and turning basin in the Providence River to 40 feet. The complete list of authorizations is included in the DMMP.

The proposed project involves two complete maintenance dredging cycles of the Providence River and Harbor Federal Navigation project (Providence FNP). Cycle-One is expected to be constructed in 2027-2028 and Cycle-Two is expected to be constructed in 2047-2048. Each dredging cycle will require the construction of a confined aquatic disposal (CAD) cell to accommodate unsuitable dredged material generated from the maintenance dredging of the Providence FNP as well as three adjacent shallow-draft federal navigation projects (FNPs) (Bullocks Cove, Pawtuxet Cove, and Apponaug Cove) and additional unsuitable dredged material from local non-federal sources.

The two CAD cells will each require an access channel, and the CAD cells will be located in the Edgewood Shoals area of Narragansett Bay adjacent to the Fuller Rock Reach of the Providence FNP. For Cycle One, the Edgewood Shoals North (ESN) CAD cell will be constructed in 2027, sized to account for placement of 2,015,000 CY of unsuitable material from Providence FNP, 63,000 CY of unsuitable material from the three adjacent FNPs, and placement of an additional 300,000 CY unsuitable material from non-federal dredging sources. The ESN CAD cell will also be sized to accommodate future starter cell materials from a Cycle-Two CAD cell and to accommodate a final three-foot cap of suitable material for restoration and closeout. The ESN CAD cell construction will cover a 50-acre area and generate approximately 37,000 CY of unsuitable material and 3,200,000 CY of suitable dredged material. Approximately 389,000 CY of material (37,000 CY unsuitable, capped by 352,000 CY suitable) from ESN CAD cell will be placed for beneficial use in the adjacent Port Edgewood Basin, a former Department of Defense navigation port. Material placed at Port Edgewood Basin will cover existing unsuitable sediments in the basin as well as change the bathymetry to help alleviate water circulation and water quality issues in the basin. Approximately 1,825,000 CY of suitable material from ESN CAD cell will be placed beneficially at the previously used Prudence Island Disposal Site to cover dredged material mounds at the site that contain unsuitable material. Additionally, approximately 113,000 CY of suitable material will be used to cap and restore bottom bathymetry at five current CAD cells in the Fox Point Reach of the FNP that were constructed for the former maintenance dredging activity back in the year 2005. The remaining 885,000 CY of suitable material from the ESN CAD cell will be placed at the Rhode Island Sound Disposal Site (RISDS). Following the construction of the ESN CAD cell, the Providence FNP will be dredged in the year 2028. The ESN CAD cell will remain open for approximately 20 years for placement of additional federal and non-federal dredging placement needs, and then be capped with clean material excavated from the Cycle-Two CAD cell and be closed out in the year 2047.

Maintenance dredging Cycle Two is expected to be implemented in 2047-2048. Based upon shoaling rate calculations, approximately 1,900,000 CY will be required to be removed from the Providence FNP during cycle two. For the second cycle, a second CAD cell, Edgewood Shoals South (ESS) CAD cell, will be constructed in a fifty-acre area in the southern half of the Edgewood Shoals area. The ESS CAD cell will be large enough to accommodate all of the predicted dredging needs of the Providence FNP along with 61,000 CY predicted to be dredged from the three adjacent FNPs, additional capacity to place 300,000 of non-federal dredging needs, and capacity for and future starter cell placement requirements and final capping with three feet of clean material. The ESS CAD cell will remain open for approximately 20 years, and then be capped and closed out. The construction of the ESS CAD cell will generate approximately 3,000,000 CY of dredged material. Approximately 38,000 CY of unsuitable material from the ESS CAD cell will be placed in the Cycle-One (ESN) CAD cell, followed by capping and closure of the ESN CAD cell with approximately 350,000 CY of suitable material from the ESS CAD cell construction. Additionally, approximately 130,000 CY of suitable material could be placed to cap and close out the remaining two open CAD cells at the Fox Point Reach site. The remaining suitable material will be placed at the RISDS if no additional beneficial use alternatives can be found in 2047-2048. Following the construction of the ESS CAD cell, the Providence FNP will be dredged in the year 2048. The ESN CAD cell will remain open for approximately 20 years for placement of additional federal and non-federal dredging placement needs, and then be capped and closed out in the year 2067.

NEW ENGLAND DISTRICT
U.S. ARMY CORPS OF ENGINEERS
Evaluation of Clean Water Act Section 404(b)(1) Guidelines

PROJECT: Providence River and Harbor Federal Navigation Project, Providence, Rhode Island

1. Review of Compliance (Section 230.10(a)-(d)).

	YES	NO
a. The discharge represents the least environmentally damaging practicable alternative and if in a special aquatic site, the activity associated with the discharge must have direct access or proximity to or be in the aquatic ecosystem to fulfill its basic purpose.	X	
b. The activity does not appear to: 1) violate applicable state water quality standards or effluent standards prohibited under Section 307 of the CWA; 2) jeopardize the existence of Federally listed threatened and endangered species or their habitat; and 3) violate requirements of any Federally designated marine sanctuary.	X	
c. The activity will not cause or contribute to significant degradation of waters of the U.S. including adverse effects on human health, life stages of organisms dependent on the aquatic ecosystem, ecosystem diversity, productivity and stability, and recreational, aesthetic, and economic values.	X	
d. Appropriate and practicable steps have been taken to minimize potential adverse impacts of the discharge on the aquatic ecosystem.	X	

2. Technical Evaluation Factors (Subparts C-F).

	N/A	Not Significant	Significant
a. Potential Impacts on Physical and Chemical Characteristics of the Aquatic Ecosystem (Subpart C)			
1) Substrate		X	
2) Suspended particulates/turbidity		X	
3) Water column impacts		X	
4) Current patterns and water circulation		X	
5) Normal water fluctuations		X	
6) Salinity gradients		X	
b. Potential Impacts on Biological Characteristics of the Aquatic Ecosystem (Subpart D)			

	N/A	Not Significant	Significant
1) Threatened and endangered species		X	
2) Fish, crustaceans, mollusks, and other organisms in the aquatic food web		X	
3) Other wildlife (mammals, birds, reptiles, and amphibians)		X	
c. Potential Impacts on Special Aquatic Sites (Subpart E).			
1) Sanctuaries and refuges	X		
2) Wetlands		X	
3) Mud flats		X	
4) Vegetated shallows		X	
5) Coral reefs	X		
6) Riffle and pool complexes	X		
d. Potential Effects on Human Use Characteristics (Subpart F).			
1) Municipal and private water supplies	X		
2) Recreational and commercial fisheries		X	
3) Water-related recreation		X	
4) Aesthetics impacts		X	
5) Parks, national and historic monuments, national seashores, wilderness areas, research sites and similar preserves		X	

3. <u>Evaluation and Testing (Subpart G).</u>

a. The following information has been considered in evaluating the biological availability of possible contaminants in dredged or fill material. (Check only those appropriate.)	
1) Physical characteristics	X
2) Hydrography in relation to known or anticipated sources of contaminants	X

	3) Results from previous testing of the material or similar material in the vicinity of the project	X
	4) Known, significant sources of persistent pesticides from land runoff or percolation	X
	5) Spill records for petroleum products or designated hazardous substances (Section 311 of CWA)	X
	6) Public records of significant introduction of contaminants from industries, municipalities, or other sources.	X
	7) Known existence of substantial material deposits of substances which could be released in harmful quantities to the aquatic environment by man-induced discharge activities	X
	8) Other sources (specify)	X
List appropriate references. See USACE Environmental Assessment for the Maintenance Dredging of the Providence River and Harbor Federal Navigation Project, Sections 2.5, 4.2, 4.12, Appendix F		

	YES	NO
b. An evaluation of the appropriate information in 3a above indicates that there is reason to believe the proposed dredged material is not a carrier of contaminants or that levels of contaminants are substantively similar at extraction and disposal sites and not likely to require constraints.	X	

4. Disposal Site Delineation (Section 230.11(f)).

a. The following information has been considered in evaluating the biological availability of possible contaminants in dredged or fill material. (*Check only those appropriate.*)		
	1) Depth of water at disposal site	X
	2) Current velocity, direction, variability at disposal site	X
	3) Degree of turbulence	
	4) Water column stratification	X
	5) Discharge vessel speed and direction	X
	6) Rate of discharge	X
	7) Dredged material characteristics (constituents, amount, and type of material, settling velocities)	X

	8) Number of discharges per unit of time	X
	9) Other factors affecting rates and patterns of mixing (specify)	
List appropriate references. See USACE Environmental Assessment for the Maintenance Dredging of the Providence River and Harbor Federal Navigation Project, Sections 2.5, 3.0, and Appendix F		

	YES	NO
b. An evaluation of the appropriate information factors in 4a above indicated that the disposal sites and/or size of mixing zone are acceptable.	X	

5. Actions to Minimize Adverse Effects (Subpart H).

	YES	NO
All appropriate and practicable steps have been taken, through application of recommendation of Section 230.70-230.77 to ensure minimal adverse effects of the proposed discharge.	X	

List actions taken.
1. The designated tow vessel will be directed to place dredged material at specific coordinates within the designated placement sites to ensure discharge occurs in the areas assessed for effects.

6. Factual Determination (Section 230.11).

A review of appropriate information, as identified in Items 2 – 5 above, indicates there is minimal potential for short or long term environmental effects of the proposed discharge as related to:		
	YES	**NO**
a. Physical substrate at the disposal site (review Sections 2a, 3, 4, and 5 above)	X	
b. Water circulation fluctuation and salinity (review Sections 2a, 3, 4, and 5)	X	
c. Suspended particulates/turbidity (review Sections 2a, 3, 4 and 5)	X	
d. Contaminant availability (review Sections 2a, 3, and 4)	X	
e. Aquatic ecosystem structure, function, and organisms (review Sections 2b and 2c, 3, and 5)	X	
f. Proposed disposal site (review Sections 2, 4, and 5)	X	

g.	Cumulative effects on the aquatic ecosystem	X	
h.	Secondary effects on the aquatic ecosystem	X	

7. Findings of Compliance or Non-compliance

	YES	NO
The proposed disposal site for discharge of dredged or fill material complies with the Section 404(b)(1) guidelines.	X	

______________________ ______________________________

Date

Justin R. Pabis, P.E.
Colonel, U.S. Army Corps of Engineers
District Engineer

RICR Section 1.3.1 In Tidal and Coastal Pond Waters, on Shoreline Features and Their Contiguous Areas (formerly § 300)

A. Category B Requirements (formerly § 300.1)

1. The requirements herein for a Category B Assent are necessary data and information for the purposes of federal consistency reviews. All persons applying for a Category B Assent are required to:

a. Demonstrate the need for the proposed activity or alteration;

Maintenance dredging of the Providence River and Harbor Federal Navigation Project (FNP) is required to maintain safe navigation in the FNP. This navigation feature and the access it provides to commercial goods and services in Rhode Island is an important element of the state's economy.

The proposed project involves two complete maintenance dredging cycles of the Providence River and Harbor Federal Navigation Project (FNP). Cycle-One is expected to be constructed in 2027-2028 and Cycle-Two is expected to be constructed in 2047-2048. Each dredging cycle will require the construction of a confined aquatic disposal (CAD) cell to accommodate unsuitable dredged material generated from the maintenance dredging of the Providence River and Harbor FNP as well as three adjacent shallow-draft FNPs (Bullocks Cove, Pawtuxet Cove, and Apponaug Cove). Each maintenance dredging cycle is anticipated to generate approximately 1,900,000 cubic yards (CY) of unsuitable material from the Providence River and Harbor FNP and approximately 60,000 CY from the adjacent FNPs.

An access channel and two CAD cells (one for each dredging cycle) will be constructed in the Edgewood Shoals area of Narragansett Bay adjacent to the Fuller Rock Reach of the Providence River. The access channel and Edgewood Shoals North (ESN) CAD cell will be constructed in 2027 and will generate approximately 3,200,000 CY of suitable dredged material. The CAD cell is being sized to for account for 2,079,000 CY of federal dredging needs plus the placement of an additional 300,000 CY of non-federal dredging needs. Approximately 389,000 CY of material (37,000 CY unsuitable, capped by 352,000 CY suitable) from ESN CAD cell will be placed for beneficial use in the adjacent Port Edgewood Basin, a former Department of Defense river basin. Material placed at Port Edgewood Basin will cover existing unsuitable sediments in the basin as well as change the bathymetry to help alleviate water circulation and water quality issues in the basin. Approximately 1,825,000 CY of suitable material from ESN CAD cell will be placed beneficially at the previously used Prudence Island Disposal Site (PIDS) to cover dredged material mounds at the site that contain unsuitable material. Additionally, approximately 113,000 CY of suitable material will be used to cap and restore river bottom bathymetry at five CAD cells in the Fox Point Reach of the FNP that were built in the last maintenance dredging effort.

The remaining 885,000 CY of suitable material from the ESN CAD cell will be placed at the Rhode Island Sound Disposal Site (RISDS).

Maintenance dredging cycle two is expected to be constructed in 2047-2048. Based upon shoaling rate calculations, approximately 2,000,000 CY will be required to be removed from the Providence FNP and adjacent FNPs during cycle two. For the second cycle, a second CAD cell, Edgewood Shoals South (ESS), would be constructed in the Edgewood Shoals area. The construction of the ESS CAD cell would generate approximately 3,000,000 CY of dredged material. Approximately 38,000 CY of unsuitable material from the ESS CAD cell would be placed in the Cycle-One (ESN) CAD cell, followed by capping and closure of the ESN CAD cell with approximately 350,000 CY of suitable material. Additionally, approximately 200,000 CY of suitable material could be placed to cap and close out the remaining two open CAD cells at the Fox Point Reach North site. The remaining suitable material would be placed at the RISDS if no beneficial use alternatives can be found in 2047-2048.

b. Demonstrate that all applicable local zoning ordinances, building codes, flood hazard standards, and all safety codes, fire codes, and environmental requirements have or will be met; local approvals are required for activities as specifically prescribed for nontidal portions of a project in §§ 1.3.1(B), (C), (F), (H), (I), (K), (M), (O) and (Q) of this Part; for projects on state land, the state building official, for the purposes of this section, is the building official;

The National Environmental Policy Act requires that an Environmental Assessment (EA) be prepared for the proposed work. A copy of the Draft EA is enclosed. The Draft EA demonstrates that all the environmental requirements that the proposed project is subject to have been met.

c. Describe the boundaries of the coastal waters and land area that is anticipated to be affected;

The proposed maintenance dredging project will require the construction of CAD cells to accommodate unsuitable dredged material. Suitable material from the construction of the CAD cell will be used beneficially to restore bottom habitats in Port Edgewood Basin, cap the historic Prudence Island Disposal Site, and the capping of existing CAD cells in the Fox Point Reach of the Providence River. The Draft DMMP/EA as well as Attachments 1 and 2 to this package depict the proposed dredge areas as well as the proposed placement sites.

d. Demonstrate that the alteration or activity will not result in significant impacts on erosion and/or deposition processes along the shore and in tidal waters;

The proposed project is not anticipated to adversely impact erosion or deposition. Section 7 of the Draft DMMP/EA for the proposed project details the anticipated project effects.

e. Demonstrate that the alteration or activity will not result in significant impacts on the abundance and diversity of plant and animal life;

A complete analysis of the environmental consequences of the project on resources within the proposed project area are documented in Section 7 of the attached Draft DMMP/EA. No significant impacts are anticipated. Therefore, the proposed project is consistent with this policy.

f. Demonstrate that the alteration will not unreasonably interfere with, impair, or significantly impact existing public access to, or use of, tidal waters and/or the shore;

A complete analysis of the consequences of the project on public access within the proposed project area are documented in Section 7 of the attached Draft DMMP/EA. No significant impacts are anticipated. Therefore, the proposed project is consistent with this policy.

g. Demonstrate that the alteration will not result in significant impacts to water circulation, flushing, turbidity, and sedimentation;

A complete analysis of the consequences of the project on physical processes within the proposed project area are documented in Section 7 of the attached Draft DMMP/EA. No significant impacts are anticipated. Therefore, the proposed project is consistent with this policy.

h. Demonstrate that there will be no significant deterioration in the quality of the water in the immediate vicinity as defined by DEM;

A complete analysis of the consequences of the project on water quality within the proposed project area are documented in Section 7 of the attached Draft DMMP/EA. No significant impacts are anticipated. Therefore, the proposed project is consistent with this policy.

i. Demonstrate that the alteration or activity will not result in significant impacts to areas of historic and archaeological significance;

A complete analysis of the consequences of the project on historical and archaeological resources within the proposed project area are documented in Section 7 of the attached Draft DMMP/EA. No significant impacts are anticipated. Therefore, the proposed project is consistent with this policy.

j. Demonstrate that the alteration or activity will not result in significant conflicts with water dependent uses and activities such as recreational boating, fishing, swimming, navigation, and commerce, and;

A complete analysis of the consequences of the project on water dependent uses within the proposed project area are documented in Section 7 of the attached Draft DMMP/EA. No significant impacts are anticipated. Therefore, the proposed project is consistent with this policy.

k. Demonstrate that measures have been taken to minimize any adverse scenic impact (see

§ 1.3.5 of this Part).

The construction of the proposed project will take place over a period of two years. During construction, dredging equipment will be present and visible to the public. However, following construction, dredging equipment will leave. Therefore, no long term adverse scenic impacts are expected.

2. Each topic shall be addressed in writing and include detailed site plans and a locus map for the proposed project.

A Draft EA is included with this request for concurrence and contains maps and plans of the proposed project.

3. Additional requirements are listed for specific Category B activities and alterations in the sections that follow.

RICR Section 1.3.1(I) is applicable to this project and compliance with its policies are noted below.

RICR Section 1.3.1(I) Dredging and dredged material disposal (formerly § 300.9)

1. Policies

a. The Council shall support necessary maintenance dredging activities in Type 2, 3, 4, 5, and 6 waters, provided environmentally sound disposal locations and procedures are identified.

The project involves maintenance dredging of the Providence River and Harbor Federal Navigation Project. The material to be dredged from the FNP consists of unsuitable sandy silt that will be placed in confined aquatic disposal cells for containment. The majority of suitable sediments dredged from the CAD cell will be used beneficially to restore bottom habitats in Port Edgewood Basin, cap the historic Prudence Island Disposal Site, and the capping of existing CAD cells in the Fox Point Reach of the Providence River. Therefore, the proposed project is consistent with this policy.

b. Where beneficial re-use options as set forth in R.I. Gen. Laws § 46-6.1-3 are not practical, the Council favors offshore open-water disposal for large volumes of dredged materials, providing that environmental impacts are minimized.

The majority of suitable sediments dredged from the proposed project will be used beneficially to restore bottom habitats in Port Edgewood Basin, the historic Prudence Island Disposal Site, and the capping of existing CAD cells in the Fox Point Reach of the Providence River. Any volume of suitable material remaining will be placed at the Rhode Island Sound Disposal Site. Therefore, the proposed project is consistent with this policy.

c. The Council encourages the use of innovative nearshore methods of dredged materials disposal, particularly when small volumes of material must be disposed. These options include but are not limited to the creation of wetlands, shellfish habitat, and beach nourishment in suitable areas.

USACE also encourages beneficial use alternatives where possible. The proposed project will place dredged material beneficially in Port Edgewood Basin to cap unsuitable sediments and to change the bathymetry in Edgewood Shoals to eliminate water quality issues. Material will also be used to cap the previously used Prudence Island Disposal Site and to cap confined aquatic disposal cells in the Fox Point Reach of the Providence River. Therefore, the proposed project is consistent with this policy.

d. For disposal of dredged material resulting from maintenance dredging operations, a Category A Review may be permitted provided the Executive Director determines that the disposal is conducted consistent with the RIDEM's dredging regulations and that the disposal is at an approved disposal facility, or at an approved federal disposal facility. Category A reviews may also be permitted when:

(1) the upland disposal volume is not greater than 10,000 cubic yards (see § 1.3.1(B) of this Part);

(2) the proposal complies with all applicable local zoning ordinances;

(3) applicable soil erosion and sediment controls are employed (see § 1.3.1(B) of this Part); and

(4) the proposal meets the standards of § 1.1.6(E) of this Part.

The proposed work involves dredging volumes greater than 10,000 CY. Therefore, this policy is not applicable.

e. For beach replenishment, a Category A review may be permitted for the placement of clean sands provided the Executive Director determines that the placement of the materials shall be for beach replenishment only, and the proposal meets the standards of §§1.1.4(E) and 1.3.1(I) of this Part as applicable.

The proposed work involves placing dredged material in the subtidal nearshore environment. Therefore, this policy is not applicable.

f. The Council utilizes and follows the prescribed processes outlined in the Army Corps regulations and manuals for both upland and in-water dredged material disposal.

The project involves maintenance dredging of the Providence River and Harbor Federal Navigation Project. The material to be dredged from the FNP consists of unsuitable sandy silt that will be placed in confined aquatic disposal cells for containment. The majority of suitable sediments dredged from the CAD cell will be used beneficially to restore bottom habitats in Port Edgewood Basin, cap the historic Prudence Island Disposal Site, and the capping of existing CAD cells in the Fox Point Reach of the Providence River. Therefore, the proposed project is consistent with this policy.

g. The Council may require performance assurance bonds for projects that utilize in-water disposal or transit federal channels with loaded scows.

USACE and RI CRMC are project partners on the proposed project. The proposed project is consistent with this policy.

Providence River and Harbor Federal Navigation Project Rhode Island Dredged Material Management Plan and Environmental Assessment

Appendix I
Coastal Engineering and Infrastructure Resilience

Contents

1. INTRODUCTION

This appendix presents the results of the Hydraulic, Hydrology and Coastal (HH&C) engineering evaluation and analysis for the Providence River and Harbor Federal Navigation Project (FNP) Dredged Material Management Plan (DMMP). This report will discuss the existing hydrologic information relevant to the project, summarize hydrodynamic modeling conducted in support of the study, and assess the project's risk to changing conditions.

2. PROJECT AREA

The Providence River and Harbor FNP is located in the upper reaches of Narragansett Bay and is generally oriented south to north starting in Portsmouth, Rhode Island and terminating at the head of Narragansett Bay between Providence and East Providence, Rhode Island at the confluence of the Providence and Seekonk Rivers (Figure 1).

Providence FNP is Rhode Island's largest port with terminals located on both the east and west sides of the FNP. Active facilities that were identified by the harbor pilots are highlighted in Figure 2. The port primarily receives liquid petroleum products but also moves cement, salt, asphalt, chemicals, scrap metal, steel, and iron.

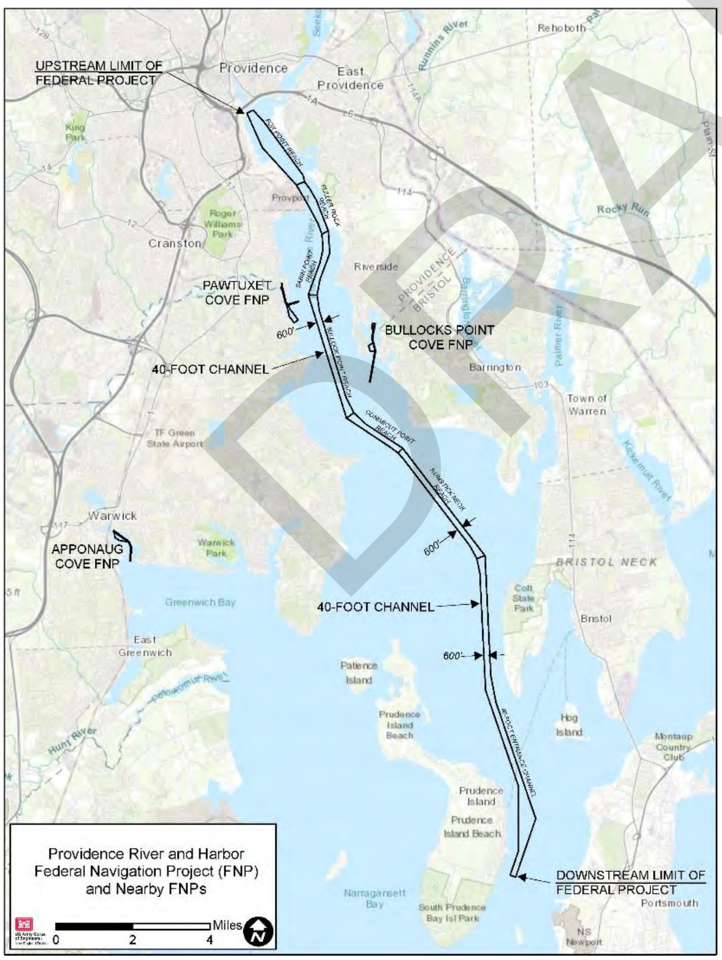

Figure 1. Providence River and Harbor FNP Map

Figure 2. Active terminals using the Providence FNP.

3. TIDES

Daily tidal fluctuations within the project area are semi-diurnal, with a full tidal period that averages 12 hours and 25 minutes; therefore, there are nearly two full tidal cycles per day. Tidal range generally increases from south to north within the project area and within Narragansett Bay. For instance, the mean tide range at Newport is 3.46, whereas the mean tide range at Providence is 4.42 feet. Relevant tidal datums for Providence are provided in Table 1.

Table 1. NOAA tidal gage datum relationships (Station 8454000, Providence, Rhode Island)

Datum[1]	**Feet (NAVD88)**
Mean Higher High Water (MHHW)	2.37
Mean High Water (MHW)	2.12
NAVD88	0.00
Mean Sea Level (MSL)	-0.22
Mean Low Water (MLW)	-2.29
Mean Lower Low Water (MLLW)	-2.47
Great Diurnal Range (GT)[2]	4.84
Mean Range of Tide (MN)[3]	4.42

Notes: [1] Tidal datums based on 1983-2001 tidal epoch

[2] Great Diurnal Range (GT) = MHHW-MLLW

[3] Mean Tidal Range (MN) = MHW-MLW

The average seasonal cycle of mean sea level, shown in Figure 3, is caused by regular fluctuations in coastal temperatures, salinities, winds, atmospheric pressures, and ocean currents. On average there is a 0.4-foot (0.12 m) difference in sea level from July (highest) to February (lowest).

Interannual (2 or more years) variations in sea level, shown in Figure 4, are caused by irregular fluctuations in coastal ocean temperatures, salinities, winds, atmospheric pressures, and ocean currents (El Nino). Figure 4 shows the historic interannual variation of monthly mean sea level and the 5-month running average. The average seasonal cycle and linear sea level trend have been removed.

Seasonal and interannual variations in sea level can contribute to fluctuations in water levels within the project area.

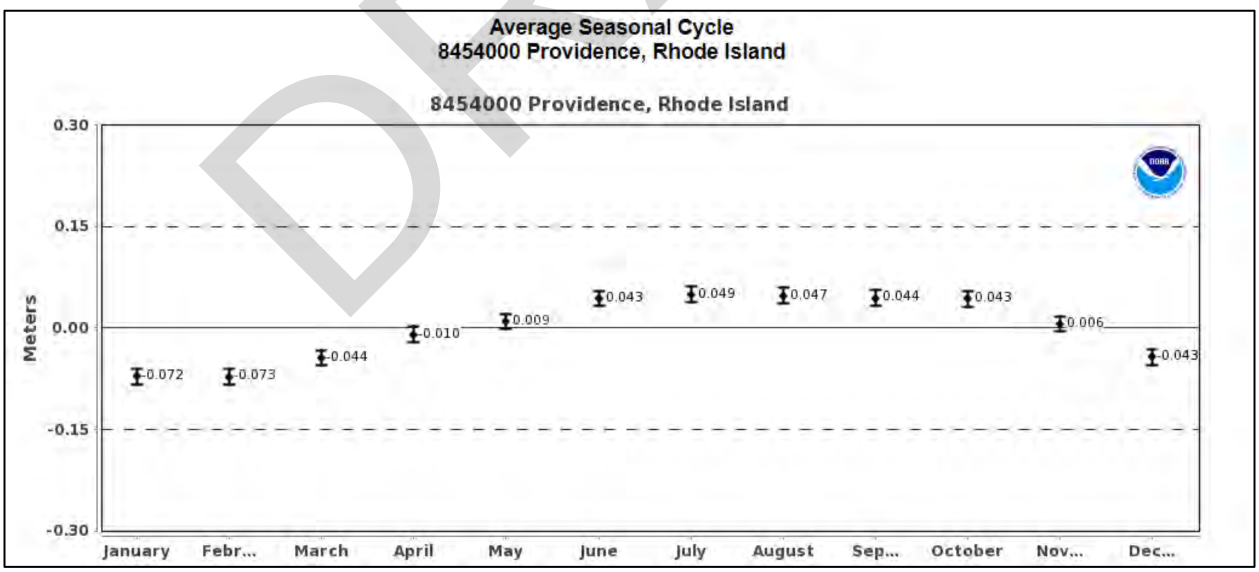

Figure 3. Average seasonal cycle of mean sea level at Providence, RI

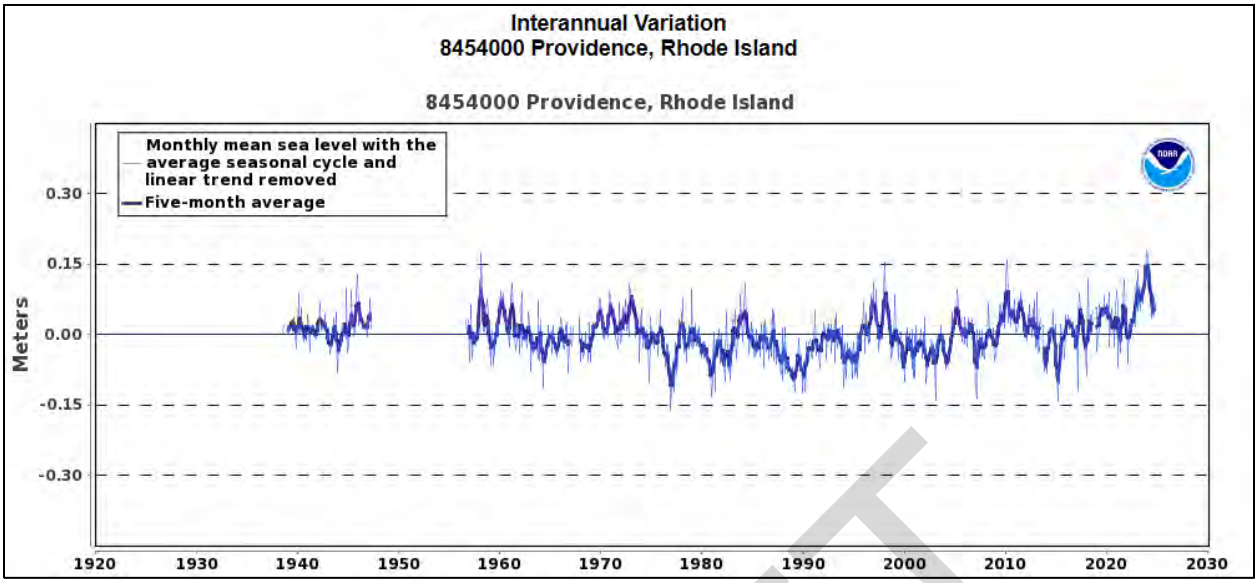

Figure 4. Interannual variation of sea level at Providence, RI

4. HYDRODYNAMIC MODELING

In support of the DMMP, USACE contracted the University of Rhode Island's Graduate School of Oceanography (URI) to evaluate the effects of potential Confined Aquatic Disposal (CAD) cell placements in the vicinity of Edgewood Shoals on circulation south of Fields Point using numerical modeling.

4.1. Background

Edgewood Shoals (Figure 5) is a shallow area of the Providence River that is known for intermittent hypoxia due to weak hydrodynamic exchange with the rest of Narragansett Bay. It is situated to the west of the Providence FNP and south of Fields Point. The Providence FNP, at -40 feet MLLW, controls much of upper Narragansett Bay's circulation, providing a major source for lower temperature and higher salinity water from the lower bay and Rhode Island Sound. Due to the steep gradient between the Shoals and the FNP, and the added influence of man-made Fields Point, Edgewood Shoals has shown to be incapable of proper hydrodynamic exchange with the main estuary. Results from previous observational surveys (2005) indicated high velocities of flow are present in the main channel, with a sharp decrease in the flow over the Shoals, as well as areas over the Shoals where flow reverses. Figure 6 illustrates the circulation pattern of an ebb tide (right) and an image of a tilt current meter (left), a system of which were deployed in 2010 for current measurement.

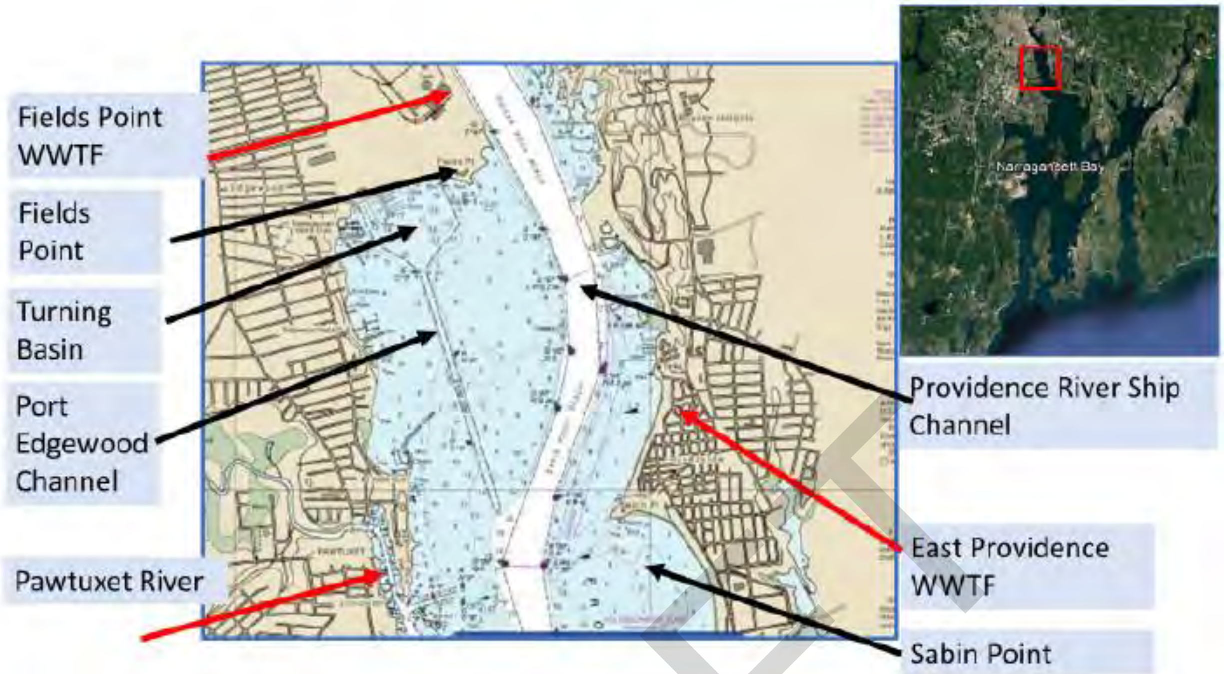

Figure 5. NOAA OCS Chart #13224 outlining major features of Edgewood Shoals. Geographic and bathymetric features are indicated with black arrows while the wastewater treatment facilities and river outfall are indicated with red arrows.

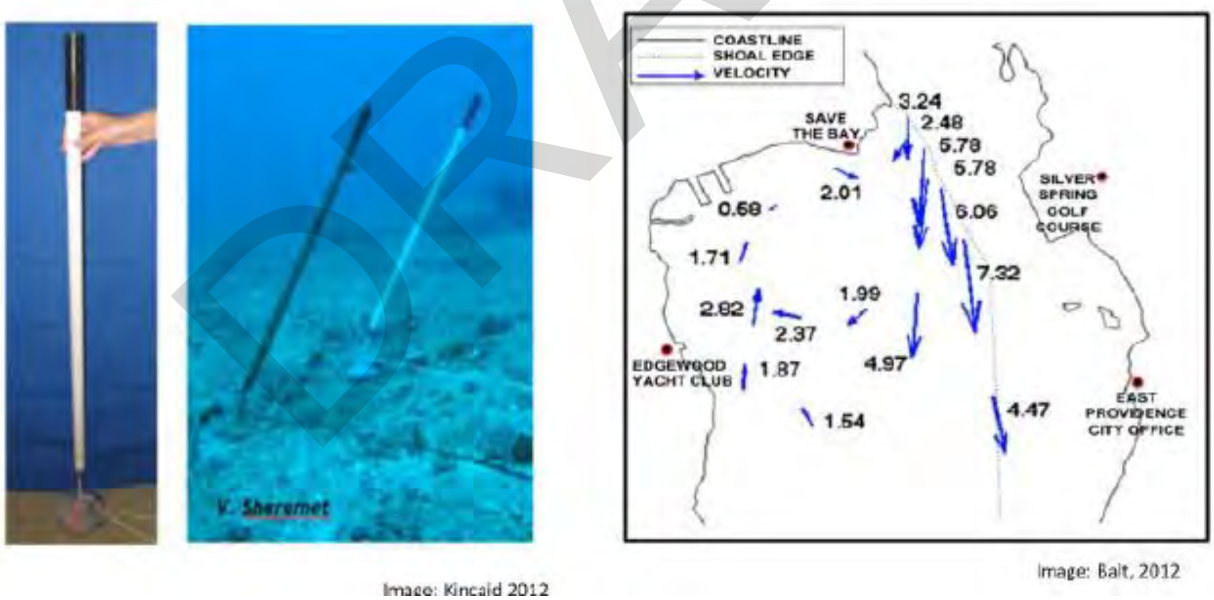

Figure 6. Current tilt meter (left) and circulation pattern of ebb tide (right) at Edgewood Shoals.

4.2. Model

URI used their existing Narragansett Bay ROMS (NB-ROMS) model to examine the hydrodynamics of Narragansett Bay. ROMS is a 3-dimensional, terrain following, free-surface numerical model that solves the Reynolds-averaged Navier-Stokes equations (RANS), as well as the equations for the conservation of energy and scalars using simplifying assumptions. The model uses a curvilinear grid structure for the step-wise solutions to the RANS and conservation equations. The current version of NB-ROMS has a grid resolution of the Providence River to <40m. The model source code includes modules for sea-ice, biological and chemical transport, and suspended sediment analysis, and can be mutually coupled with wave (SWAN) and wind (WRF) models. The model skill for temperature, salinity and water levels are on the order of >0.8 on the Willmott Skill scale (Willmott, 1981) where 1.0 indicates perfect correspondence between model results and natural conditions (Kincaid, 2012).

The model is forced by freshwater point sources (rivers and wastewater treatment facilities), seven tidal harmonic constituents (M2, M4, M6, S2, N2, O1, K1) and surface atmospheric forcing fields. A correction factor is applied to account for groundwater discharge rates throughout the basin. Winds are applied at the surface of the entire grid, with data for 2010 collected at T.F. Green Airport in Warwick, RI. Atmospheric forcing parameters for summer of 2010, namely long-wave and short-wave radiation, relative humidity, air temperature and pressure, and precipitation are applied at the surface in a bulk forcing format.

4.3. Alternative Development

Nine bathymetric alternatives, or dredging scenarios, were applied in the model by altering the depths of the Edgewood Shoals region of the NB-ROMS grid. The matrix of measures comprising each alternative is provided in Table 2. Measures include dredging small channels for access on-to and off-of the shoal (access channels), a modeled "depression" in the bathymetry for a potential CAD cell (referred to as "modeled CAD cell"), and finally, filling of the existing bathymetry with clean, or suitable material (fill). These measures correspond as follows to the Initial Measures listed in Table 5-1 of the DMMP-EA:

- Fill (Turning Basin) is equivalent to Measure ID P-10
- Dredge E-W Access Channel is a byproduct Measure ID P-4
- Modeled CAD Cell is equivalent to Measure ID P-5
- Deepen Port Edgewood Channel and Grade Shoal to Ship Channel Depth were not developed into measures

Table 2. Matrix of measures included in each of the 9 dredging scenarios.

Model Run	Fill (Turning Basin)	Deepen Port Edgewood Channel	Dredge E-W access channel	Grade shoal to Ship Channel Depth	Modeled CAD Cell
Scenario 1			✖		
Scenario 2		✖	✖		
Scenario 3	✖				✖
Scenario 4				✖	
Scenario 5			✖		
Scenario 6					✖
Scenario 7			✖		
Scenario 8	✖				
Scenario 9	✖		✖		✖

Scenario 1 most closely resembles the Edgewood Shoals North CAD cell measure (P-4) while Scenario 6 is most similar to the Edgewood Shoals South CAD cell measure (P-5). Combined with the Filling of the Turning Basin (P-10), Scenario 9 is equivalent to Alternative 2A.

4.4. Results

The scenarios were evaluated using numerical dye tracers and Lagrangian drifter floats. The tracer analysis area, shown in Figure 7, was chosen based on the location of the Port Edgewood Turning Basin which experiences chronic low dissolved oxygen during summer months. Surface and bottom concentrations were recorded over three day long model runs for all scenarios. Dye concentrations fluctuate due to tidal flows. Since surface water has greater tidal velocities than bottom water, overall, the concentration of dyes in the surface water fluctuate at a greater frequency than concentrations of dye in the bottom water. The overall trend of dye concentration is towards zero, or completely flushed, but never fully reaches a value of zero. Dye concentration results are shown over three days in Figure 8 while the change in dye concentration for the first 24 hours between the existing condition (reference case) and the scenarios for both surface and bottom dye is presented in Figure 9.

Surface dye concentrations are most reduced in Scenarios 2, 5, and 9.

Figure 7. Edgewood Shoals Turning Basin analysis box.

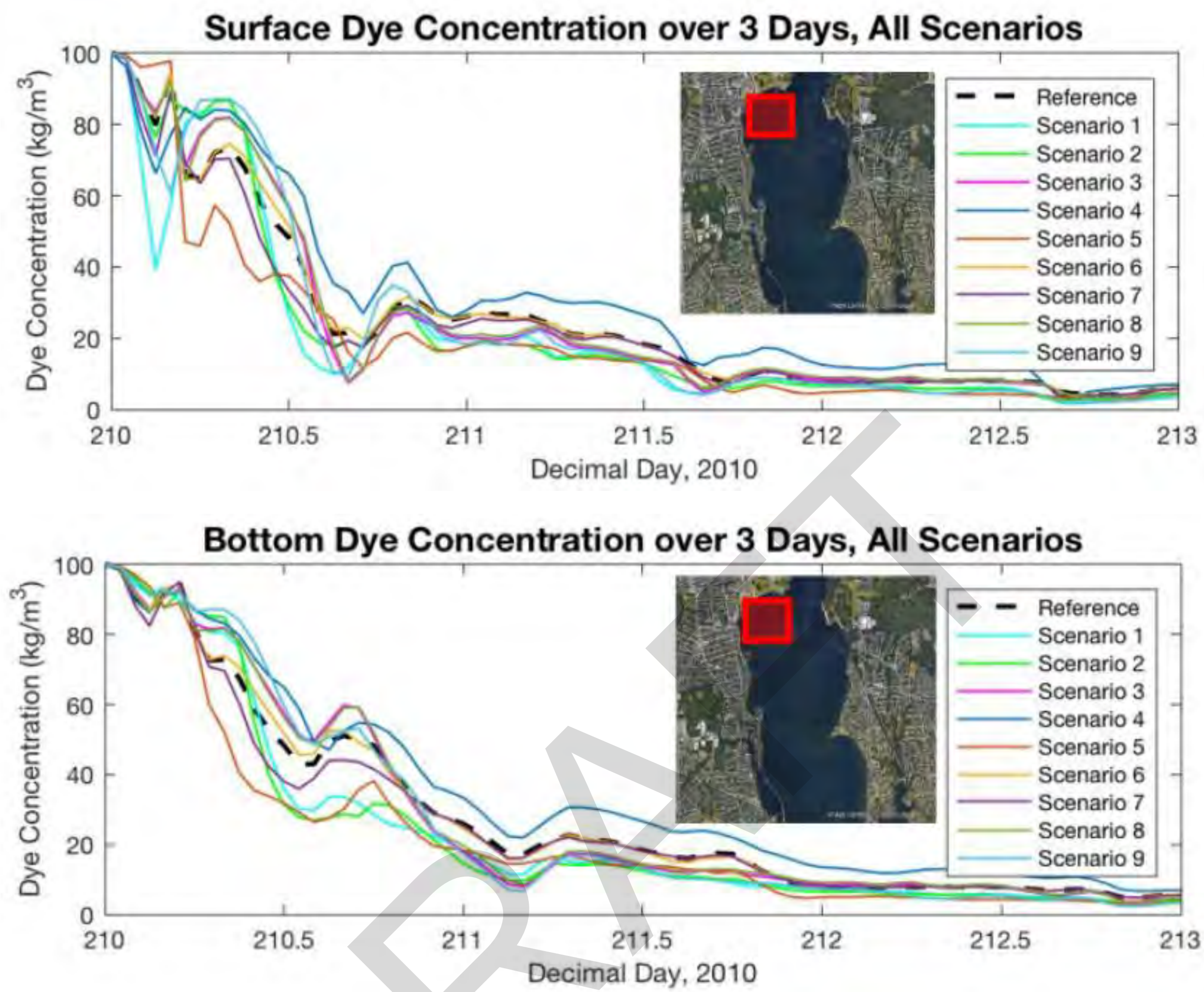

Figure 8. Numerical tracer (dye) results over the three day model run in the surface water (top) and bottom water (bottom) of the Edgewood Shoals Turning Basin analysis box.

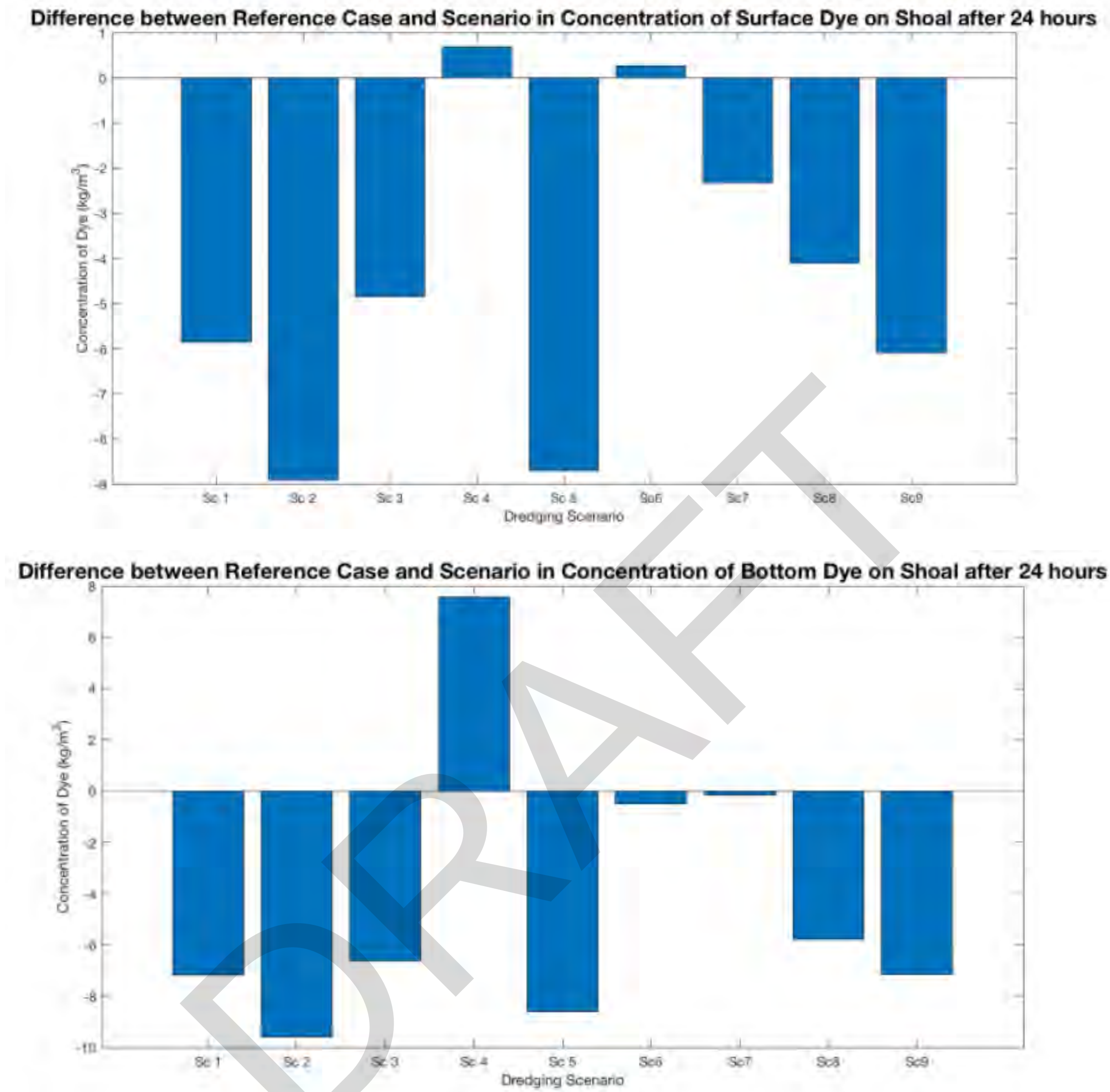

Figure 9. Numerical tracer (dye) results after 24 hours of the model run in the surface water (top) and bottom water (bottom) of the Edgewood Shoals Turning Basin analysis box.

Profiles of temperature and salinity were also used to compare the modeled scenarios (Figures 10 and 11). Scenarios 1, 2, and 5 see an increase in salinity by roughly 1.5 PSU (Practical Salinity Units) from the existing condition. In the temperature analysis, there is a temperature drop of roughly 0.2 degrees C in scenarios 2 and 5, and a 0.1 degree C decrease in temperature in scenario 1. Results from Scenario 9 were comparable to Scenarios 1, 2, and 5, although its temperature and salinity profiles were only provided to about 2m depth.

The dye and float results both indicate that scenarios 1, 2, 5, and 9 are more efficient in removing dye from the shoal than the reference case. This shows the importance of the east-west pathway that is created by building an access channel between the main shipping channel and the shoal. The creation of this east-west channel is part of the Edgewood Shoals North CAD cell measure. Scenario 6, which is most similar to the Edgewood Shoals South CAD cell measure shows neither significant increases, or decreases in circulation when it is constructed alone. However, when the Edgewood Shoals South CAD cell is combined with the east-west channel and filling of the turning basin, as is the case in Scenario 9 (Alternative 2A), environmental benefits are also realized.

Additional hydrodynamic modeling results and discussion of each alternative's effect on circulation are documented in the attached hydrodynamic modeling report.

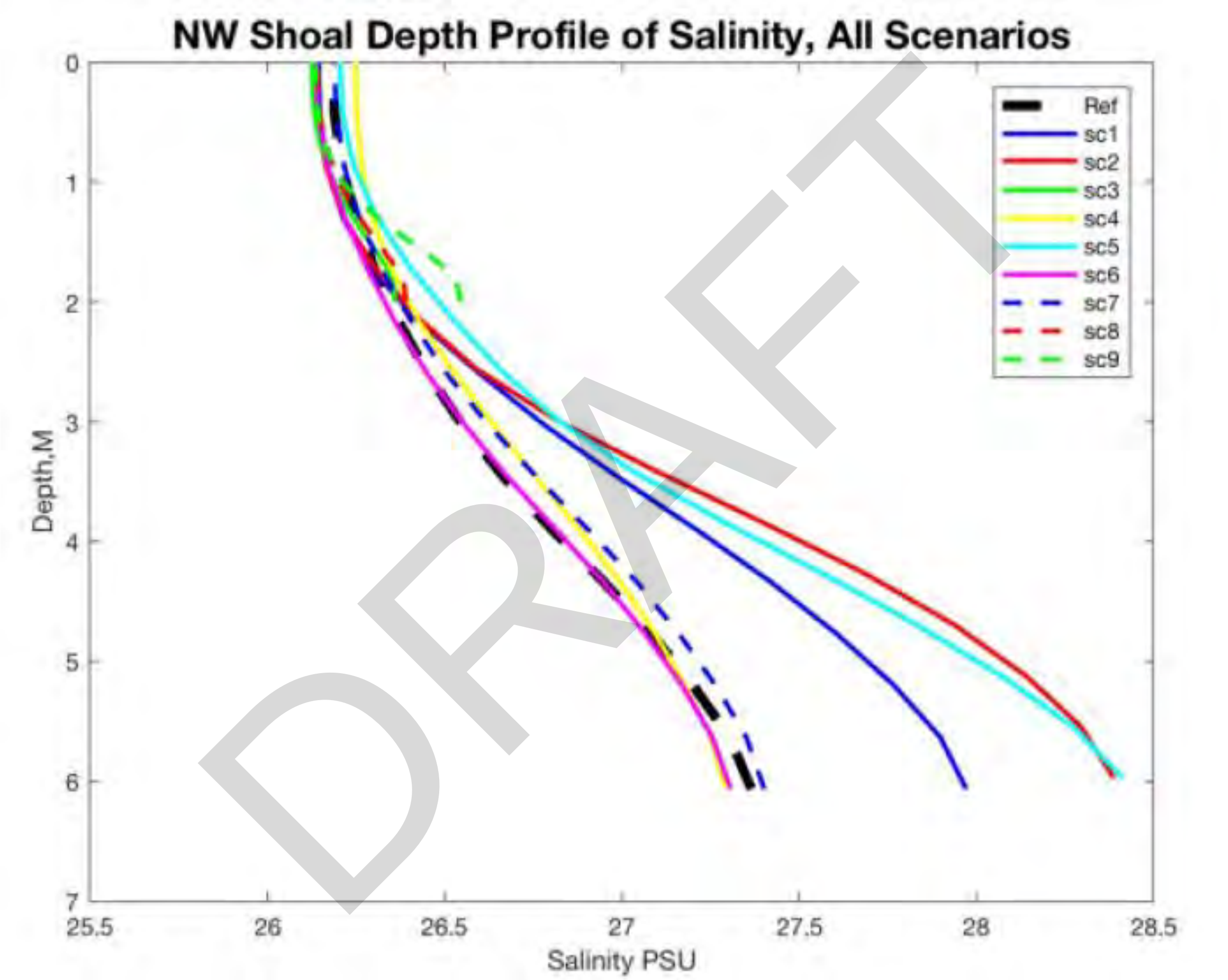

Figure 10. Modeled output of vertical profiles of salinity in the Edgewood Shoals Turning Basin for each scenario.

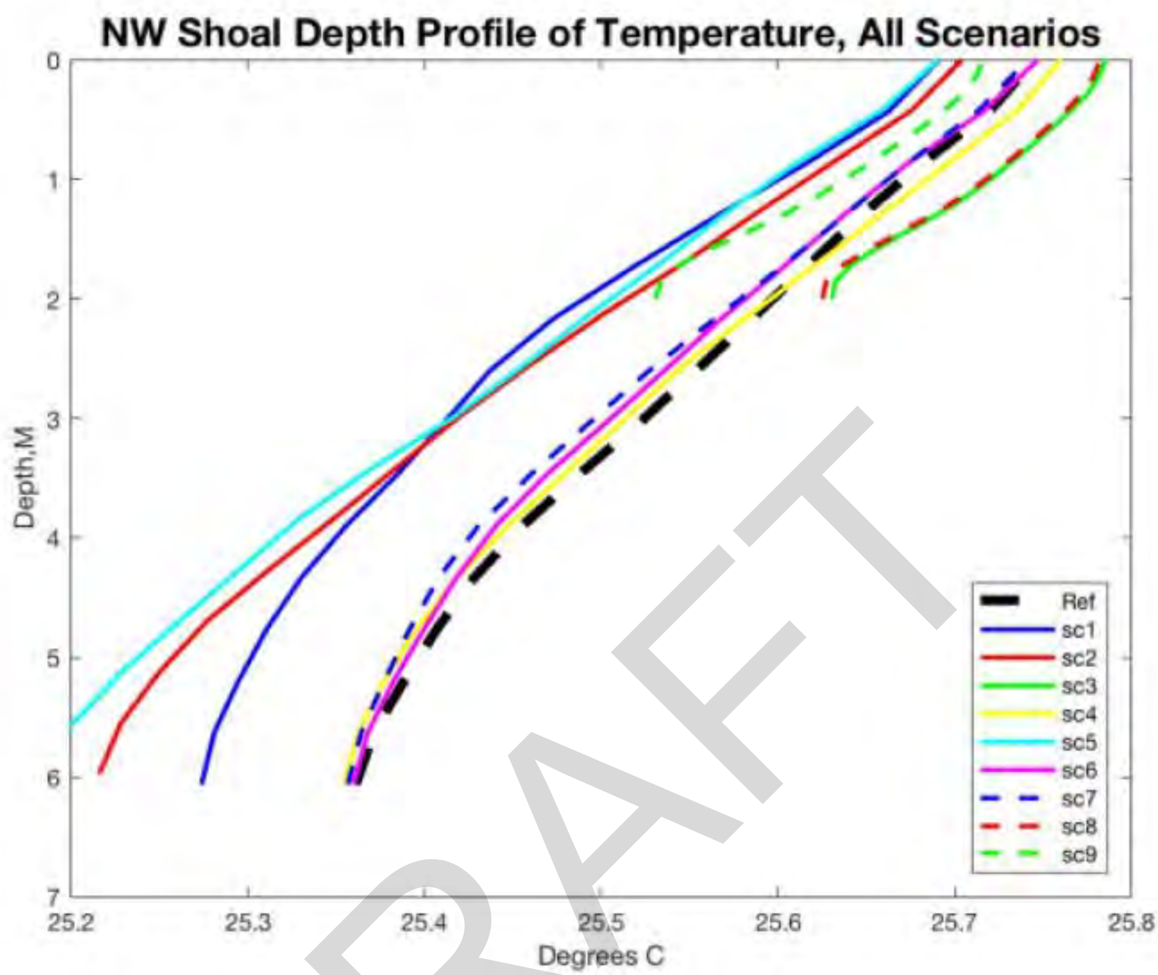

Figure 11. Modeled output of vertical profiles of temperature in the Edgewood Shoals Turning Basin for each scenario.

5. SEA LEVEL CHANGE

5.1. Background on Sea Level Change

Global sea level change (SLC) is often caused by the global change in the volume of water in the world's oceans in response to three climatological processes: 1) ocean mass change associated with long-term forcing of the ice ages ultimately caused by small variations in the orbit of the earth around the sun; 2) density changes from total salinity; and most recently, 3) changes in the heat content of the world's oceans, which recent literature suggests may be accelerating due to global warming. Global SLC can also be caused by basin changes through such processes as seafloor spreading. Global sea level, also sometimes referred to as global mean sea level, is the average height of all the world's oceans.

Relative (local) SLC is the local change in sea level relative to the elevation of the land at a specific point on the coast. Relative SLC is a combination of both global and local SLC caused by changes in estuarine and shelf hydrodynamics, regional oceanographic circulation patterns (often caused by changes in regional atmospheric patterns), hydrologic cycles (river flow), and local and/or regional vertical land motion (subsidence or uplift).

5.2. USACE Guidance

In accordance with ER 1100-2-8162, potential effects of relative sea level change (RSLC) were analyzed over a 50-year economic period of analysis and a 100-year planning horizon. USACE guidance states "the period of analysis shall be the time required for implementation of the lesser of: (1) the period of time over which any alternative plan would have significant beneficial or adverse effects, (2) a period not to exceed 50 years" (ER 1105-2-100). However, because infrastructure often stays in place well beyond the economic period of analysis, a 100-year adaptation planning horizon is used to address robustness and resilience in the time of service of the project that can extend past its original design life. Research by climate science experts predict continued or accelerated climate change for the 21st century and possibly beyond, which would cause a continued or accelerated rise in global mean sea level. ER 1100-2-8162 states that planning studies will formulate alternatives over a range of possible future rates of SLC and consider how sensitive and adaptable the alternatives are to SLC.

ER 1100-2-8162 requires planning studies and engineering designs to consider three future sea level change scenarios: low, intermediate, and high. The historic rate of SLC represents the low rate. The intermediate rate of SLC is estimated using the modified National Research Council (NRC) Curve I. The high rate of SLC is estimated using the modified NRC Curve III. The high rate exceeds the upper bounds of IPCC estimates from both 2001 and 2007 to accommodate the potential rapid loss of ice from Antarctica and Greenland but is within the range of values published in peer-reviewed articles since that time.

5.3. Historical Sea Level Change

Historical RSLC for this study (2.43 mm/yr or 0.00797 ft/yr for the years 1938-2021) is based on NOAA tidal records at Providence, RI. The historical record of relative mean sea level for Providence is shown in Figure 12.

The USACE Sea Level Analysis Tool (SLAT) was also used to visualize historic SLC relative to the three USACE sea level change curves. The SLAT presents several metrics for measuring sea level change: the monthly mean sea level (light blue), the 5-year moving average (orange), and the 19-year moving average (dark blue). Figure 13 and Figure 14 show historical RSLC at Providence for the gage's full record (1938-2021) and from 1983-2021, respectively. It is apparent that over long timescales (19 years) mean sea level is steadily increasing. However, over shorter time scales mean sea level may increase or decrease. The monthly mean sea level (light blue), for instance, goes up and down every year capturing the seasonal cycle in mean sea level. The 5-year moving average (orange) captures the interannual variation (2 or more years).

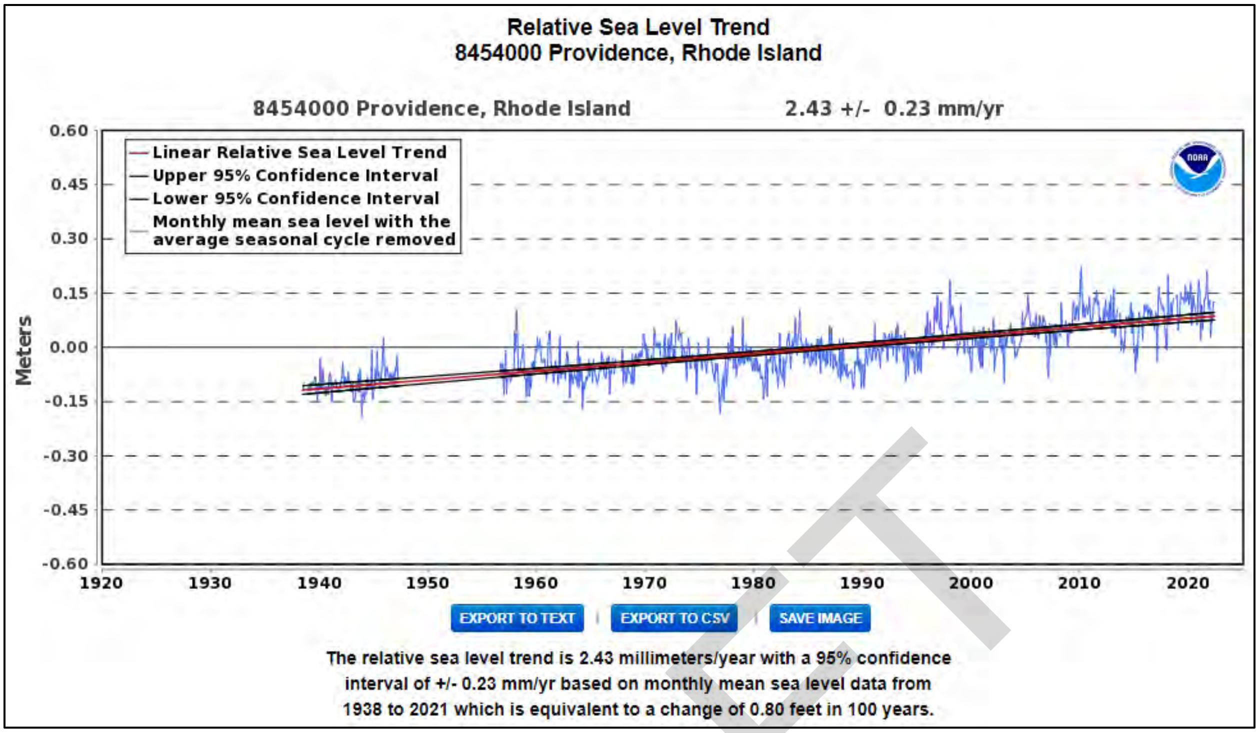

Figure 12: Historical RSLC at Providence, RI NOAA tide gage

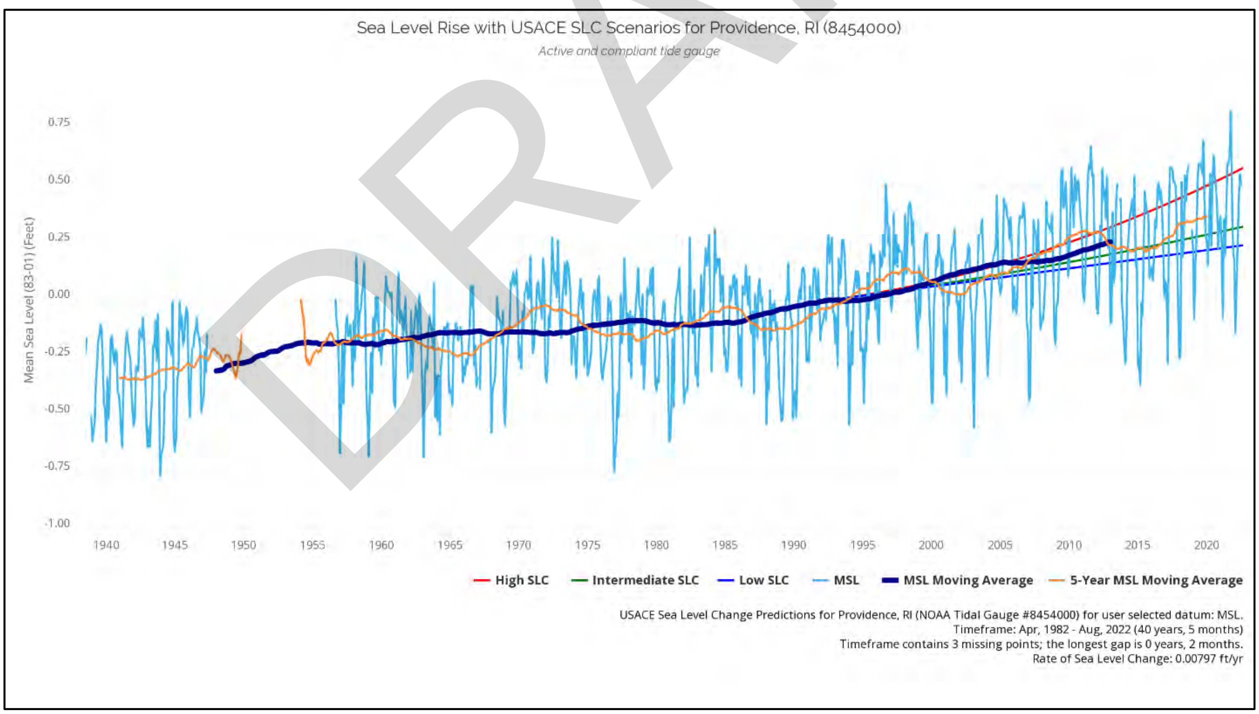

Figure 13: Historical (1938-2021) RSLC at Providence, RI

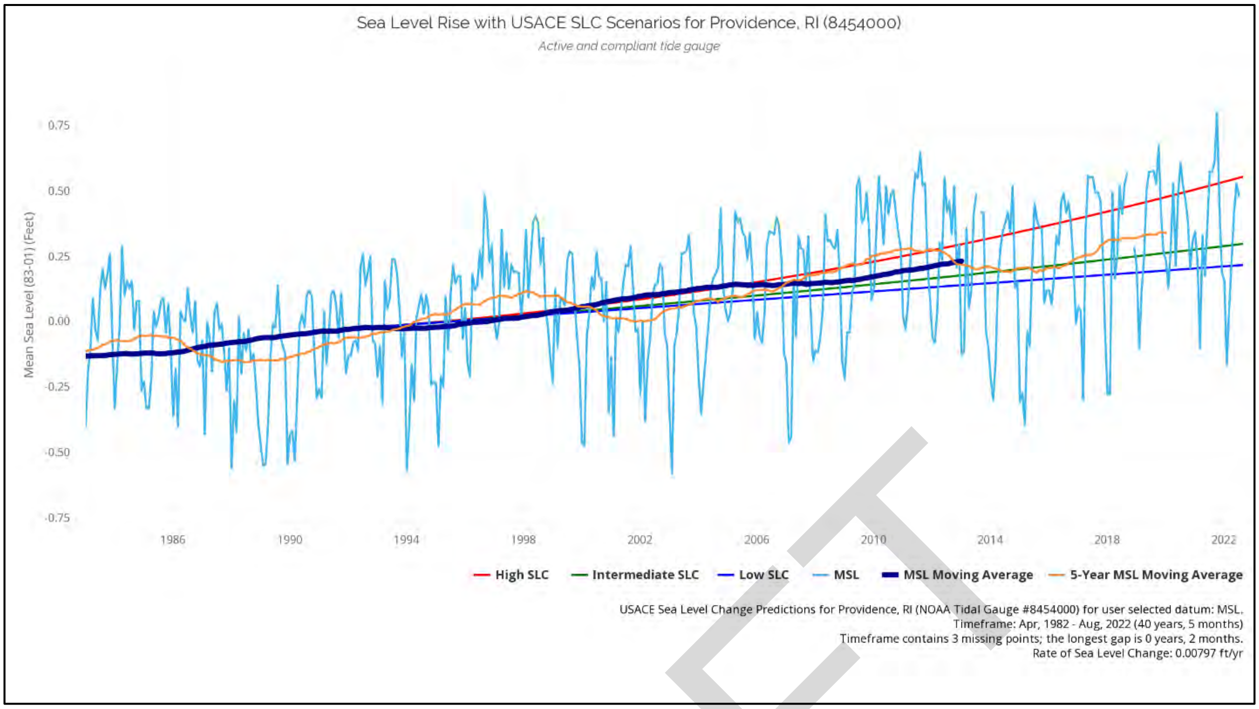

Figure 14: Historical (1983-2021) RSLC at Providence, RI

5.4. USACE SLC Scenarios

USACE low, intermediate, and high SLC scenarios over the 100-year planning horizon at Providence, RI are presented in Table 3 and Figure 15. Water level elevations at year 2027 are expected to be between 0.3 and 0.7 feet higher than the current National Tidal Datum Epoch (NTDE). Water levels are projected to be between 0.4 and 1.5 feet higher than the current NTDE in 2047, and 1.1 to 7.6 feet higher in 2125.

Table 3: USACE Sea Level Change Scenarios for Providence, RI

Providence, RI			
Year	**Low**	**Intermediate**	**High**
1992	0	0	0
2025	0.26	0.36	0.67
2027	0.28	0.38	0.72
2045	0.42	0.67	1.46
2047	0.43	0.7	1.54
2065	0.58	1.06	2.56
2085	0.74	1.51	3.95
2105	0.90	2.04	5.63
2125	1.06	2.63	7.62

All values are in feet relative to MSL, 1992

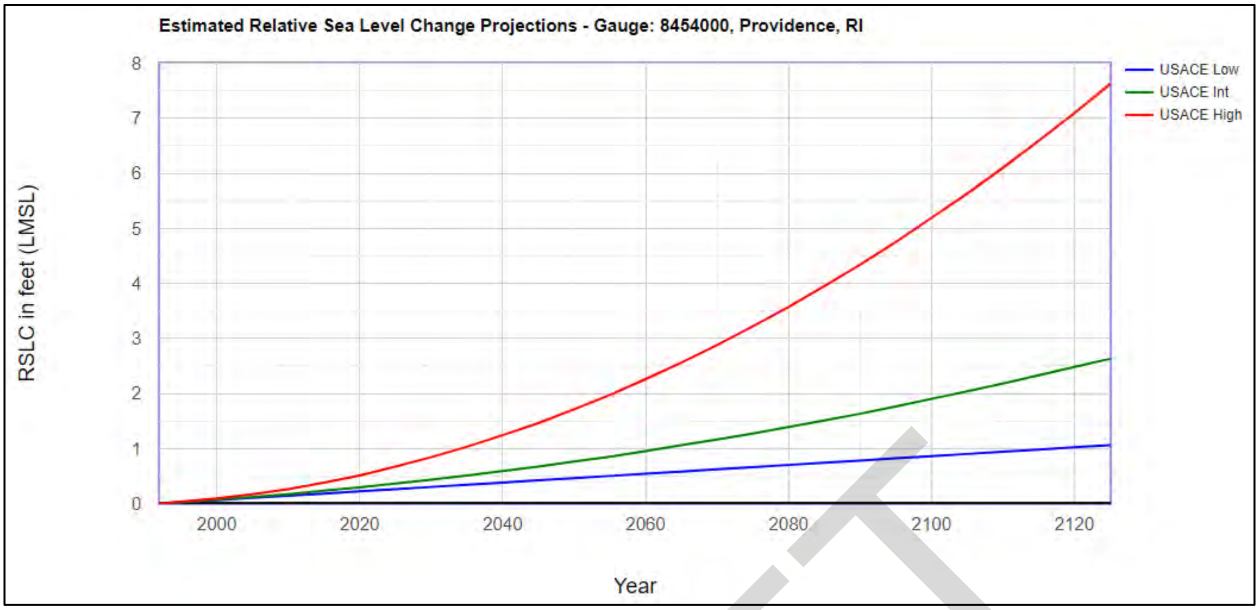

Figure 15: USACE Sea Level Change Scenarios for Providence, RI

5.5. SLC Impacts on Providence River

While sea level projections were provided over the 100-year planning adaptation horizon, the focus for this DMMP is to insure full navigational capacity over the next 20 years. Therefore, the following sea level change analysis evaluates impacts to the FNP over the next 20 years through 2047. In general, sea level change will increase the navigable depth of the channel over time, potentially reducing the amount of maintenance dredging required to maintain the authorized channel depth. However, sea level change may impact local service facilities (LSF) and affect port operations as bulkheads will have less freeboard and be more vulnerable to flooding.

Port Facilities

Potential risks associated with sea level change and inundation of the local service facilities (LSF), including the piers and utilities serving the berthing areas, were examined. Impacts to the LSF were assessed using the tidal datums at Providence and statistical water levels, also from NOAA Station 8454000, combined with the predicted sea level change scenarios. The Mean Higher High Water (MHHW) level and the 99% annual exceedance probability (AEP; or 1-year annual recurrence interval) of the measured water level were added to each sea level change scenario. If sea level change coupled with the MHHW and the 99% AEP water level exceeded the deck height of the terminals on the waterway, it was assumed to be in a condition that would affect regular port operation and require structural modifications.

The 99% AEP event was selected to be representative of a storm which would hinder port operations or impede navigation of the channel. It was expected that any greater storm would also affect port operation and channel navigability.

The deck height of each terminal, derived from 2022 RI Statewide USGS LiDAR (Figure 16), is given in Table 4 relative to the predicted water levels. For all SLC scenarios, the terminal deck elevations are presently high enough to avoid inundation at MHHW and the 99% AEP event through 2047. This indicates there is a low risk to the LSF at the project over the 20-year DMMP period of analysis.

However, the terminals may want to begin considering adaptation measures to insure their continued operation farther into the future. The lowest deck elevation at Terminal E is projected to be inundated by the 99% AEP event and MHHW as soon as 2056 and 2081, respectively. At some point local service facilities will become inaccessible if improvements are not made.

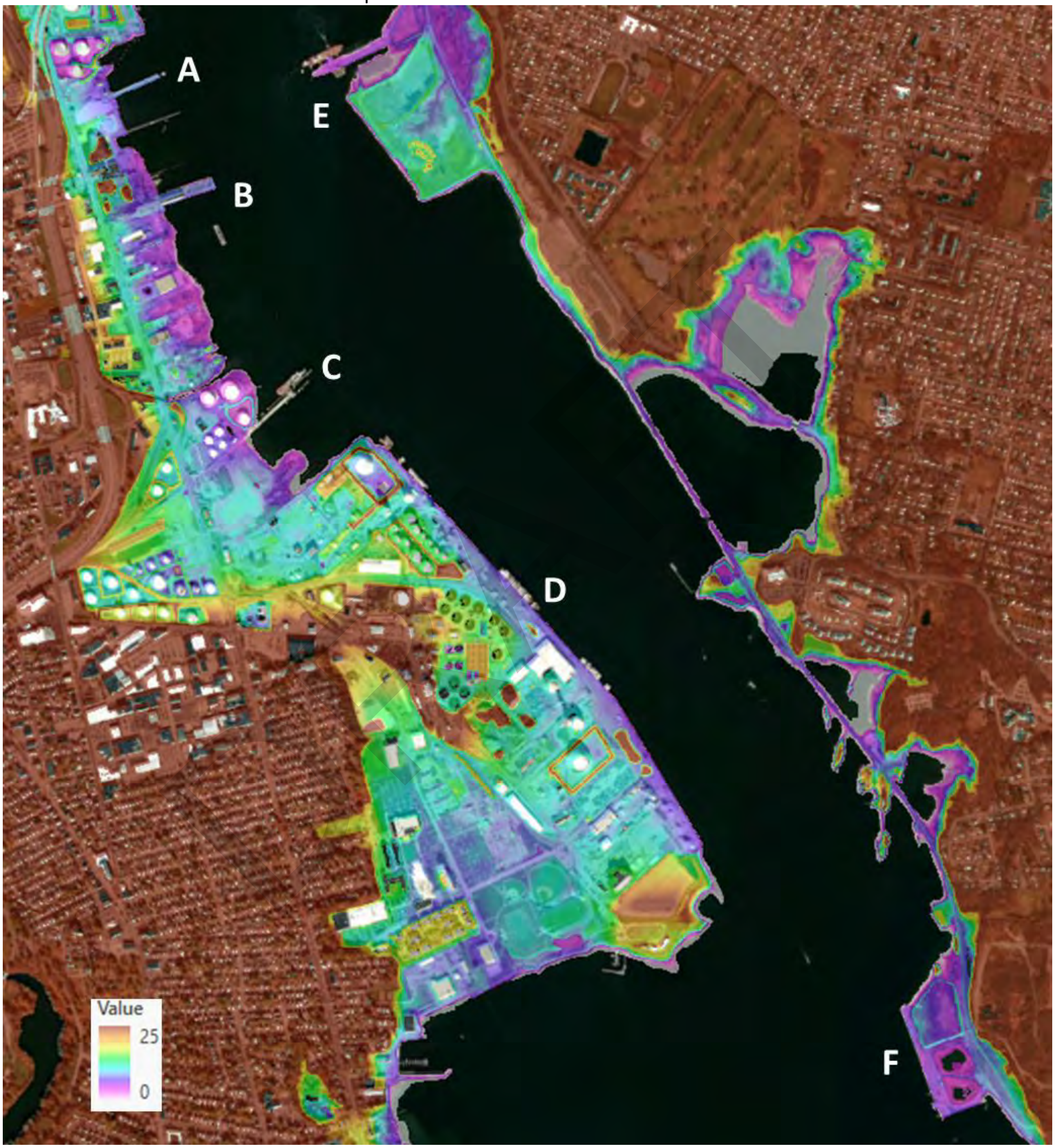

Figure 16. LiDAR coverage of the Providence FNP local service facilities. Elevations in feet, NAVD88.

Table 4. Terminal Deck Elevations and Projected Water Surface Elevations

Terminal	Deck Elevation (ft, NAVD88)	2047 Low/Int./High MHHW (ft, NAVD88)	2047 Low/Int./High 99% AEP (ft, NAVD88)
A	9.3	2.8 / 3.1 / 3.9	4.4 / 4.7 / 5.5
B	8.6		
C	6.5*		
D	8.5		
E	6		
F	6.5		

* Pier elevation unavailable. Elevation from lowest onshore facility.

Vertical Clearance

Vessels approaching the Providence FNP transit Narragansett Bay's East Passage, passing under the Claiborne Pell Bridge (Newport Bridge) which connects Jamestown (Conanicut Island) to Newport (Aquidneck Island). Presently, the vertical clearance under the Pell Bridge is 194 feet at MHW. Horizontal clearance under the center span is 1500 feet. With sea level change, vertical clearance will be reduced 0.4 to 1.5 feet through 2047. Although air drafts of vessels calling on Providence were not gathered for this analysis, it is assumed substantial vertical clearance will remain available for vessel passage beneath the Newport Bridge across the tidal cycle well past 2047. The bridge was designed to accommodate Forrestal-class aircraft carriers formerly headed to Naval Station Newport, also located north of the bridge.

DMMP Alternatives

All of the retained alternatives involve sub-tidal placement of dredged material. As sea levels rise, depths above the placement sites will increase, affecting each equally. Therefore, sea level change has no impact on the selection of the retained alternatives and will not affect their feasibility or performance.

In addition to sea level change, there are uncertainties regarding future temperature, rainfall, and streamflow predictions. As a result, it was assumed that historic sedimentation rates, both near-term and long-term, were assumed to be representative of the range of future shoaling rates.

6. CONCLUSION

This appendix summarized the Hydraulic, Hydrology and Coastal (HH&C) engineering evaluation and analysis that was conducted for the Providence River and Harbor FNP DMMP. The URI NB-ROMS model was used to evaluate if bathymetric modifications to the Edgewood Shoals area, including the construction of channels and CAD cells, could provide improvements to surface and bottom water circulation. The preferred alternative, Alternative 2A, was modeled as Scenario 9 and showed that it would result in environmental benefits such as increased flushing and salinity, and decreased temperature in the Edgewood Shoals area. An infrastructure resilience assessment was also conducted to investigate how a changing climate is projected to affect the FNP and DMMP. While no facilities are impacted within the 20-year DMMP period of analysis, sea level change will begin impacting local service facilities in the future under the high sea level change scenario.

Because all DMMP alternatives were sub-tidal, sea level change did not impact the selection of the retained alternatives.

Providence River & Harbor Dredged Material Management Plan (DMMP) Hydrodynamic Modeling Using the ROMS Model Applied to Narragansett Bay

A Final Report prepared for the completion of Task 3.2 of the Performance Work Statement for Project: "Hydrodynamic Modeling and Analysis Services" US Army Corps of Engineers New England District

G.E. Medley[1]

1. INTRODUCTION:

The Providence River & Harbor Federal Navigation Project (FNP) was originally established by Congress through the Act of 30 August 1852. The existing FNP consists of a 16.5-mile-long channel, 40 feet deep and generally 600 feet wide, from deep water in Narragansett Bay (just south of Prudence Island Light) to the upstream project limit at Fox Point. Congress has also authorized the United States Army Corps of Engineers to conduct periodic maintenance dredging of the FNP to keep the channel open for shipping and commercial navigation.

In September, 2017, a proposal was written to the United States Army Corps of Engineers (USACE) New England District to conduct hydrodynamic modeling work as part of their dredged material management study (Study) which will result in a final Dredged Material Management Plan (DMMP). The Study seeks to identify and evaluate various dredged material disposal alternatives with the goal of identifying the least costly, environmentally acceptable alternative for dredged material management. Alternatives being considered in the Study will include construction of a Confined Aquatic Disposal (CAD) Cell in a shallow area of the Providence River known as Edgewood Shoals (Figure 3a, 3b). Edgewood Shoals is known for intermittent hypoxia due to weak hydrodynamic exchange with the rest of Narragansett Bay. The DMMP drafted by the USACE will include potential bathymetric modifications of the shoal commensurate with a CAD cell constructed in the Edgewood Shoals area. Those bathymetric modifications are further described as "dredging scenarios", for the purpose of CAD cell placement. This project involves the testing of nine different potential dredging scenarios using the Regional Ocean Modeling System (ROMS) model applied to Edgewood Shoals. The goal of this report is to analyze each dredging scenario and provide to USACE data necessary to select the dredging scenario that provides the greatest potential for environmental improvement while

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coinciding with a CAD cell alternative that is allowed under the USACE's construction authority. Environmental benefit for each dredging scenario is determined qualitatively and quantitatively through the use of numerical tracers that identify the key flushing and exchange patterns between the shallow shoal and the main channel of the Providence River.

The Providence River and Harbor Dredged Material Management Plan

Dredging has occurred in the Providence River since 1853. Over 150 years of dredging projects have resulted in 56.5 million cubic yards of material removed from the bottom of the Federal channel (USACE, 2002). The Providence River Ship Channel is the main passageway through Narragansett Bay into the Port of Providence, and is maintained from Fox Point in Providence, South to the east passage off of Prudence Island (Figure 1). The channel is separated into 5 Reaches for the purpose of management: Fox Point Reach, Fuller Rock Reach, Sabin Point Reach, Conimicut Point Reach, and Rumstick Neck Reach. The congressionally authorized channel depth, for the Providence River FNP, is 40 feet, or 12.2 meters below MLLW (mean lower-low water). Based on hydrographic surveys taken from 1977 to 1999, the average shoaling rate of the Providence River Ship Channel was determined to be roughly 140,000 cubic yards of material per year. The fastest rates occur in the upper Reaches of Fox Point, Sabin Point, and Fuller Rock, where the shoaling rate typically exceeds 4 inches of deposition per year (USACE, 2002). Commerce into the Port of Providence consists mostly of liquid petroleum products, with smaller amounts of salt, cement, steel, and asphalt being shipped up the bay intermittently (USACE, 2002). Failure to provide adequate depths for steadily-increasing drafts of vessels that ship these materials was determined detrimental to the State of Rhode Island's commercial efforts.

Dredging work for the previous Providence River and Harbor Dredging Cycle began in April 2003 and ended in July of 2005. Due to heavy shoaling in the Ship Channel, the US Coast Guard placed restrictions on vessels traveling up Narragansett Bay to maximum drafts of 35 feet and one-way traffic of larger vessels. Before 2003, the last dredging project was completed in 1976. During this time period, 0.9 million cubic meters of dredged material was determined to be unsuitable for open water disposal and was placed into Confined Aquatic Disposal (CAD) cells, located beneath the footprint of the Providence River Ship Channel immediately south of the Fox Point Hurricane Barrier (Figure 2) (USACE, 2005). The deepest of these cells was 90 feet. 1.5 million cubic meters of additional material was dredged in order to create these CAD cells. This material, below a certain depth, was determine suitable for open water disposal. Unsuitable material was placed into the CAD Cells (USACE, 2005).

Image: USACE,2005

Figure 1: Image of the maintained Providence River Ship Channel in Narragansett Bay. Image obtained from the 2005 Disposal Area Monitoring (DAMOS).

Figure 2: Satellite image of the upper Providence River, outlining the boundaries of the Upper River CAD Cells built for the 2003-2005 maintenance dredging project. Image obtained from the 2005 Disposal Area Monitoring (DAMOS).

2. STUDY AREA:

Edgewood Shoals (Figure 3a, 3b) is a relatively shallow shoal of the Providence River in Narragansett Bay to the west of the main Providence River shipping channel, and to the south of Fields Point. One of the main features of the Providence River is a 10-12-meter-deep federal shipping channel that runs from south of Prudence Island to the Fox Point area of the Providence river. This feature controls much of the upper estuary's circulation and provides a major source for lower-bay and Rhode Island Sound-sourced water, which is consistently cooler with a higher salinity. A steep bathymetric gradient separates the main body of the channel from the shallow shelf of the shoal. Due to this steep gradient and the added influence of Field's Point, a man-made shoreline, Edgewood Shoals is shown through data and numerical modeling that it is incapable of proper hydrodynamic exchange with the main estuary.

Figure 3 (a.) A nautical chart (NOAA OCS Chart # 13224) outlining major features of Edgewood Shoals. Marked with orange stars are locations on the shores of the shoal, and marked with black arrows is the location of the maintained Providence River Ship channel. (b.) A satellite image of Narragansett Bay with a red box outlining the location of Edgewood Shoals.

The section of the bay that comprises Edgewood Shoals is subject to significant anthropogenic pressures, including bacterial contamination, pollution from heavy metals and excessive nutrient loading. This nutrient loading is sourced from a combination of land-surface runoff, wastewater treatment facility discharge, and the discharge contribution of local tributaries (Deacutis, 2008). The shores of Edgewood Shoals are composed of the cities of East Providence (East shore), Providence (North Shore) and the cities of Cranston (West Shore) and Warwick to the south and west. In addition to runoff from these cities, the shoreline of Edgewood Shoals harbors two Waste Water Treatment Facilities in the cities of East Providence and Providence, Fields Point WWTF and the East Providence WWTF, and takes on runoff from the Pawtuxet River (Figure 4), which is composed of surface runoff as well as the discharge of three more WWTF's, The City of Warwick WWTF, City of Cranston WWTF and Town of West Warwick WWTF.

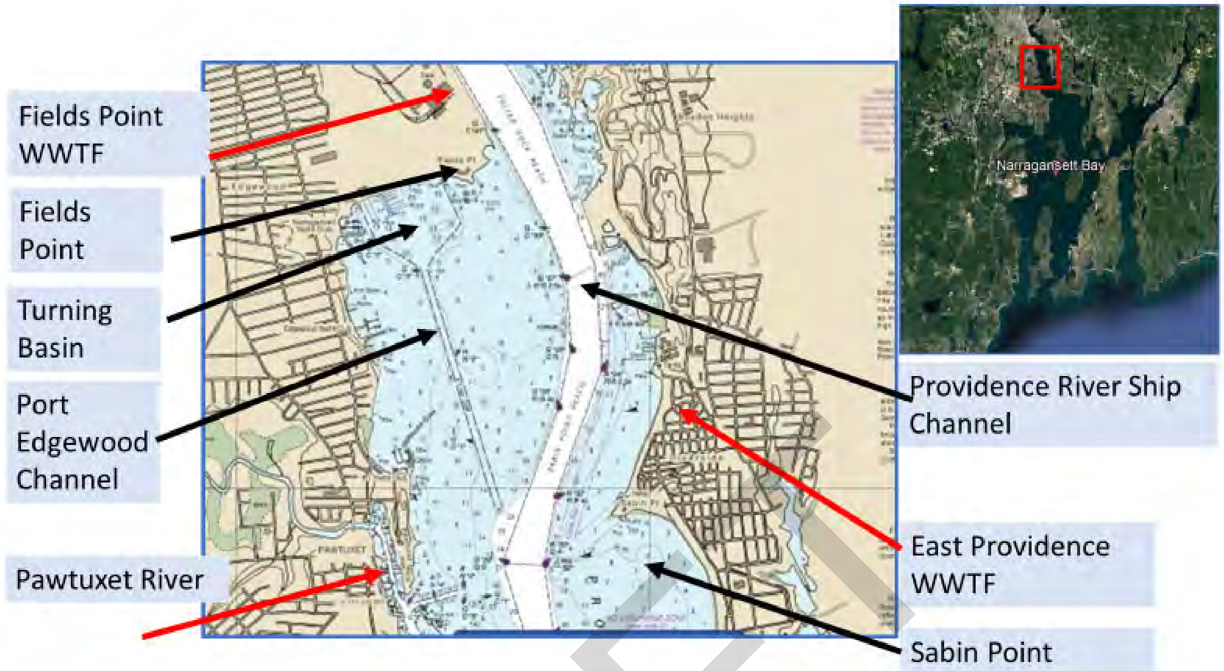

Figure 4: A nautical chart (NOAA OCS Chart # 13224) outlining major features of Edgewood Shoals., with arrows outlining major features on the Shoal. Geographic and bathymetric features are outlined with black lines while the wastewater treatment facilities and river outfall are outlined with red arrows.

Circulation on Edgewood Shoals: Previous Studies

Circulation in the Providence River Estuary has been studied previously by Graduate School of Oceanography students Deanna Bergondo (2005), Justin Rogers (2008), Nicole LaSota (2009) and Christelle Balt (2012). Acoustic Doppler Current Profiler (ADCP) and Tilt Current Meter (TCM) studies in 2005 and 2010, respectively, provide a spatially and temporally detailed observational foundation for tidal and residual circulation patterns throughout the Providence River. This includes detailed coverage for Edgewood Shoals. Additionally, scaled analog model studies of Edgewood Shoals were completed by Graduate School of Oceanography researchers at Australian National University in Canberra, ACT. The combination of moored and underway ADCP deployments (Kincaid, 2001; Kincaid and Bergondo, 2005), a network of 22 TCM's (Kincaid, 2012) and a Regional Ocean Modeling System (ROMS) parameter validation study (Rogers, 2008; Kincaid, 2012) characterize hydrodynamic patterns in this region for both instantaneous and residual water movement. Residual current patterns observed in both numerical and laboratory models include a strong net southward flow in the surface water of the

Providence River Ship Channel, a northward deep return flow in the bottom and eastern edge of the Ship Channel, and the formation of a persistent clockwise gyre on Edgewood Shoals.

Dispersion Studies on Edgewood Shoals and the Providence River Using an ADCP (July 2005-October 2005)

Three moored Acoustic Doppler Current Profiler's (ADCP) were deployed in the summer of 2005 to collect observational data for four months in the Providence River and Edgewood Shoals. Additionally, three underway ADCP surveys were completed during the same time-frame over one tidal cycle to capture the spatial velocity structure of the water column. This work was funded by the Narragansett Bay Commission and was completed by URI Graduate School of Oceanography researchers. RD- Instruments Workhorse ADCP's were used during this deployment. Acoustic Doppler Profilers emit a pulse of sound that will return to the transducer after interacting with particulates in the water column. The doppler shift in the returned pulses determine the velocity components of the water column (C. Kincaid, pers. comm. August 2017). The purpose of the surveys and modeling work completed for the Narragansett Bay Commission in 2005 was to compile new observational data, combined with numerical modeling using the then-current version of the Narragansett Bay ROMS model to support existing models for transport in the upper regions of the Bay.

The results from these observational surveys indicated that there are high velocities of flow present in the main channel just off of Edgewood Shoals, with a sharp decrease in the flow over the Shoals, including areas where the flow reverses. In this case, the model results were relatively consistent with the field observations as well as the ADCP data (Bergondo and Kincaid, 2005). Figure 3 is a sample of the observational data collected during the underway ADCP survey in July of 2005. In these data, collected over one complete tidal cycle, there is a continuous trend of northward flow on the western side of the shoal, and southward flow on the eastern side of the shoal. Additionally, deep, fast moving return flow is observed during flood and ebb tides. Figure 3 also captures the steep bathymetric gradient that occurs between the shallow shoal of 2 meters and the maintained Providence River Shipping Channel of roughly 12 meters.

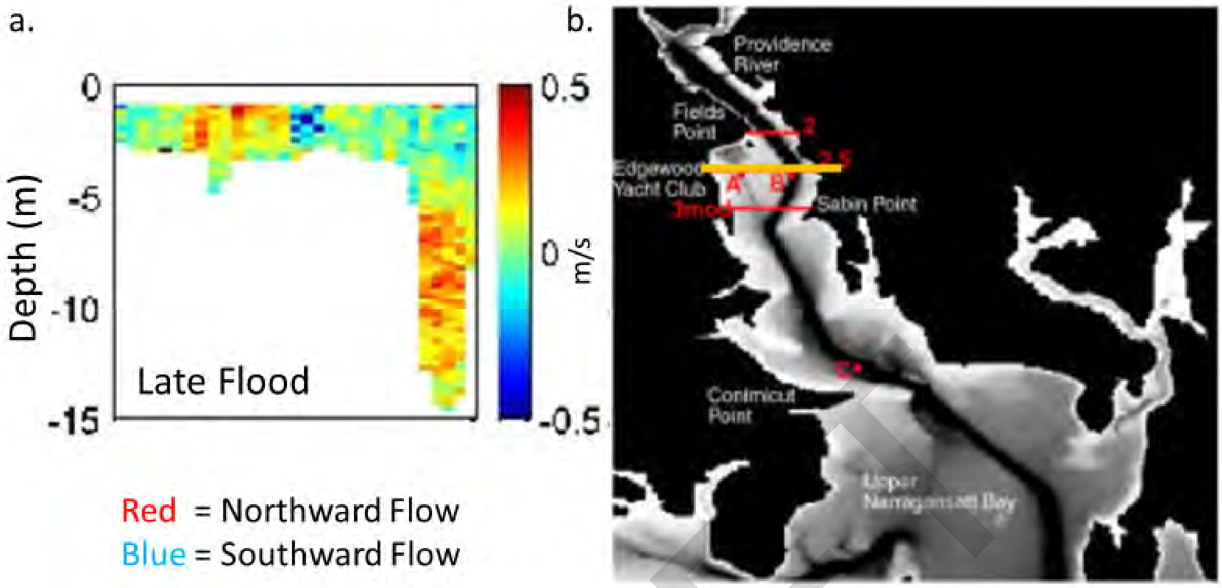

Figure 5: A sample of the observational data collected from the second underway ADCP survey completed in July, 2005. (a.) Instantaneous observed velocities (m/s) on Edgewood Shoals and the ship channel for a single transect, during the late flood tide. (b.) This transect (marked in yellow on the map) crosses Edgewood Shoals. (Image from Bergondo and Kincaid 2005)

Study: Tilt Current Meter Deployment on Edgewood Shoals, Spring 2010

The Edgewood Shoals area is well-known for its lack of tidal flushing that coincides with the adjacent deep channel. In March of 2010, a network of 21 Tilt Current Meters was deployed in Edgewood Shoals by GSO MS Student C. Balt as part of a project funded by the Narragansett Bay Commission (Balt, 2011), (locations of TCM's are in Figure 6). A Seahorse Tilt Current Meter (TCM) (Manning and Sheremet, 2009) (Figure 7a) is an instrument that consists of a solid, grounding base that is connected by a soft membrane to a buoyant PVC pipe. The connecting membrane allows the pipe to tilt in the direction of the flow of water. An accelerometer sensor is connected to the top of the PVC pipe and records the angle of that tilt. The meters are calibrated in a laboratory setting that enables users to determine the coefficients necessary for converting the PVC pipe direction of tilt and tilt angles to N-S, E-W velocity components and their magnitudes, respectively.

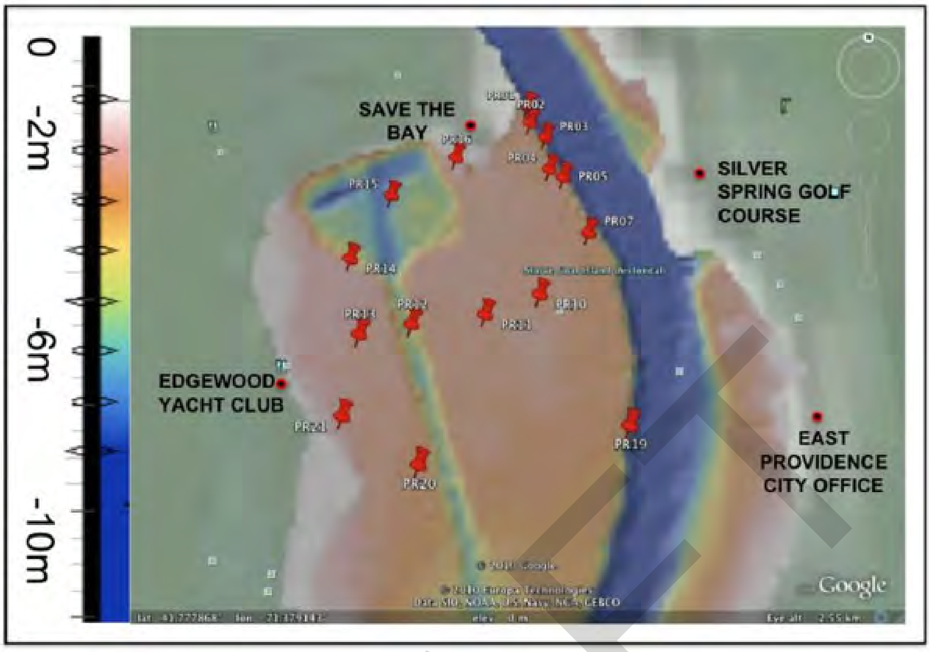

Figure 6: Locations of the Tilt Current Meters (red pins) that were recovered with usable data after the Spring of 2010 Deployment. Marked on this figure are the locations of the East Providence City Offices, Save the Bay, Edgewood Yacht Club, and the Silver Spring Golf Course. (Image: Balt 2012)

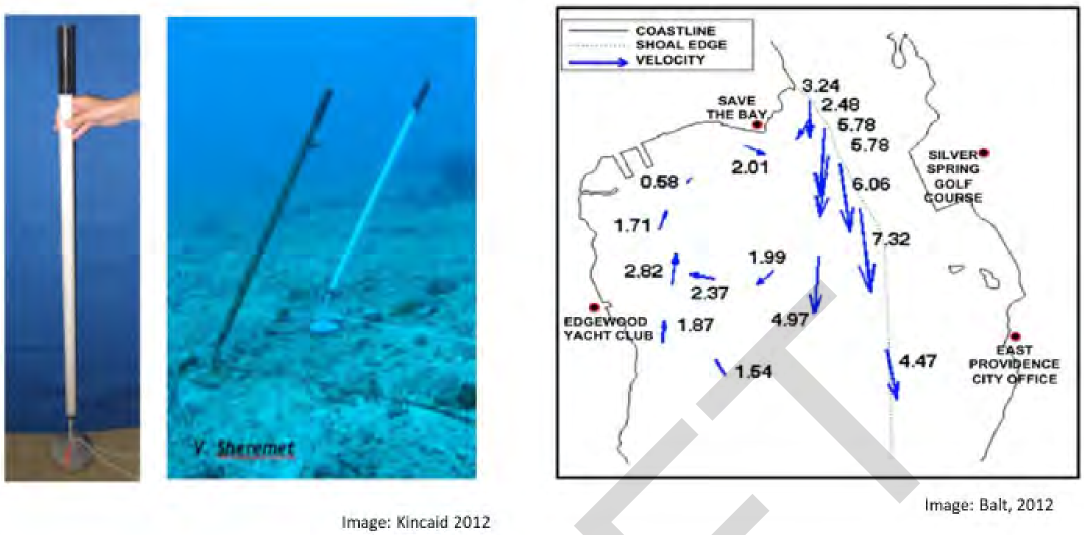

Figure 7 (a.) An image of a tilt current meter designed by URI marine research associate V. Sheremet. (b.) An image of the net residual circulation patters on Edgewood Shoals from the observational data collected during the Spring of 2010 (Balt, 2012).

The network of 21 TCM's (Figure 6, 7a, 7b) was deployed on March 8, 2010 for 52 days and were taken out of the water on April 30, 2010. A variety of conditions were observed during the deployment. Between decimal days 85-105 a record-breaking high run-off event occurred, strong easterly and westerly wind events occurred, as well as northerly and southerly wind events. When considering exchange between the main Providence River channel and Edgewood Shoals, careful consideration of the E/W flow components on the edge of the shoal is essential. On decimal day 88, a strong south-southwest wind event enhanced the east-west velocity components of the TCM's on the edge of the shoal, indicating an increase in off-shoal exchange. This also caused a breakdown of the gyre-like flow on the shoal. Nevertheless, when the wind reverted back to a north-northwesterly wind direction, the gyre re-formed.

In fluid dynamics, a theoretical circulation gyre can be caused by the influence of a jet that meets a sudden, abrupt increase of the cross-sectional area of the available channel space (Kincaid, 2012). It is observed that the Providence River is narrow to the north of Field's Point, and widens sharply just to the south of Field's point creating the Shoals. This pattern was observed in scaled laboratory based experiments of the Providence River as it widens into the shoals, performed at the Geophysical Fluid Dynamics Laboratory at Australia National University (Kincaid pers. Comm 2017,; Balt, 2011). In this laboratory setup, runoff and tides were the only forces applied to constant-density water.

Study: Numerical Dye Simulations of WWTF Discharge

Numerical dye simulations in ROMS (Kincaid, 2012; 2014) on Edgewood Shoals indicated a level of retention of river and wastewater treatment facility discharge on the shallow shoal. This pattern of recirculation and retention is caused by the combination of a man-made shoreline and a steep bathymetric gradient between the shallow shoal and the deep federal shipping channel. This study tracked the relative accumulation of distinct numerical dyes on Edgewood Shoals from all local river and Waste Water Treatment Facility (WWTF) sources for a range of hypothetical environmental forcing conditions. Modeled observations using numerical dye tracers indicate that Edgewood Shoals is primarily composed of water sources from the following Rivers and Wastewater Treatment facilities: Blackstone, Ten Mile, Woonosquatucket, Pawtuxet and Moshassock Rivers, and the Bucklin Point, Fields Point and East Providence WWTF's. These modeled results were compiled using a coarse grid version of the NB-ROMS model.

No study has yet to track the flushing of water and exchange flows on Edgewood Shoals under real environmental forcing parameters for Summer, 2010. The current study focuses on how the recirculation pattern retains water on the shoal when the water column is thermally and salinity stratified, and how changes to the bathymetry may influence the flushing dynamics.

Circulation Dynamics and Dissolved Oxygen:

It has been well-established that the physical processes of an estuary or sub-estuary have a direct link to the water quality (Stram et al., 2005 (Rio Chone Estuary); Stanley and Nixon 1992 (Pamlico Estuary); Yin et al., 2005 (Pearl River Estuary); Zhu et al. 2015 (Tampa Bay Estuary); Biocort, 1992 (Chesapeake Bay Estuary). Dissolved oxygen (DO) depletion, also known as hypoxia, occurs when large blooms of photosynthetic microalgae increase the demand for oxygen in a body of water. The bloom itself is not the cause of the decreased oxygen, but the respiration that occurs beneath the bloom in the subsurface water that causes oxygen levels to plummet. Causes behind these isolated blooms are a combination of nitrogen loading from anthropogenic sources (Saarman et al. 2008), and weak physical lateral movement of bottom water in an estuary or sub-estuary with the main body of the estuary. Retained nutrients within a sub-estuary can influence the intensity of blooms (Abdelrhman, 2005).

Dissolved Oxygen Dynamics on Edgewood Shoals, Providence River

Episodic phytoplankton blooms occur regularly in the Providence River and are often followed by a sharp decrease in dissolved oxygen in the water column (Bergondo et al. 2005), leading to hypoxic events in the Upper Bay region. Bergondo (2004), Abdelrhman (2005) and Deacutis (2008) note that an increase in hydrodynamic exchange in sub-estuaries of Narragansett Bay will decrease the likelihood of harmful blooms that eventually lead to hypoxic conditions, therefore improving the ecological health of the system as a whole.

It is believed that there is a direct link between the circulation pattern on Edgewood Shoals and high probability of low-oxygen events that occur there. Between 2005 and 2014, dissolved oxygen surveys were performed at 77 locations throughout the Upper Bay region and the Providence River (http://www.geo.brown.edu/georesearch/insomniacs). Data from the Edgewood Shoals locations in these surveys indicated dissolved oxygen levels that were borderline hypoxic to acute hypoxic (DO levels of 2.3 mg/l or less) in 2006, 2008, 2009, 2010, 2012 and 2013 during the months of July and August. Low dissolved oxygen in the water column halts subsurface marine ecosystem development and has large impacts on fisheries (Deacutis, 2008). The circulation pattern leading to a highly stratified water column on Edgewood Shoals is to blame for the higher probability of low-oxygen events. If the system can be altered in such a way to allow for a higher rate of water exchange, the health of the ecosystem in this section of the Providence River will increase significantly.

Impacts of Dredging on Estuarine Circulation

Zhu et al. (2014) showed that widening and deepening the main shipping channel in Tampa Bay, FL will increase the tidal range, and decrease the tidal phase from the mouth to the head of the bay. More importantly, it was discovered that widening and deepening channels will cause an upward shift in non-tidal, or residual circulation (Goodwin, 1987). The impacts of dredging on estuarine circulation have been heavily studied in Tampa Bay, FL in reference to maintenance dredging projects for their shipping lanes. Goodwin (1987) finds that with deepening and widening of channels in shallow areas, increasingly rapid transfer of dissolved chemical constituents is seen. Additionally, increased salinity in upper reaches of Tampa Bay have been used as a metric for increased tidal flushing. Tidal "pumping" is described as discrepancies between flood and ebb tidal patterns, which is heavily affected by irregular bottom topography in shallow, partially to well-mixed estuaries. Circulation restrictions reduce the potential transport of dissolved constituents. Circulation restrictions are described as shallow zones on the edges of deep, maintained zones. The creation of deeper zones has the potential to increase the number of circulation restrictions in an estuary (Goodwin, 1987).

3. **METHODS**

ROMS (Shchepetkin and McWilliams 2003, 2005) is a 3-dimensional, terrain-following, free-surface numerical model that solves the Reynolds-averaged Navier-Stokes equations (RANS), as well as the equations for the conservation of energy and scalars using simplifying assumptions (Haidvogel et al. 2008, Shchepetkin and McWilliams, 2003). The model uses a curvilinear, Arakawa-C grid structure (Arakawa and Lamb, 1977) for the step-wise solutions to the RANS and conservation equations. Curvilinear grid structure enables the horizontal resolution to concentrate in specific areas, in this case the Providence River Estuary. Horizontal coordinates used in this model are cartesian, with vertically-stretched sigma coordinates in the vertical direction. The source code includes modules for sea-ice, biological and chemical transport (NPZD - Nitrogen, Phosphorus, Zooplankton and Detritus), and suspended sediment analysis, and can be mutually coupled with wave (SWAN) and wind (WRF) models. ROMS contains various vertical mixing schemes as well as bottom boundary layer parameterizations and can be programmed to represent the hydrodynamics of any regional coastal system in the world (Haidvogel et al. 2008).

The Narragansett Bay ROMS (NB-ROMS) model has evolved through several efforts to improve and modify the model to properly exhibit the hydrodynamics of Narragansett Bay. Improvement stages were run, coupled with targeted, real-time observational data sets consisting of current velocities profiles and hydrographic properties such as salinity and temperature. There have been three generations of ROMS models, modified to specifically apply to Narragansett Bay (Rogers 2008; Lasota 2009; Kincaid 2012). The first edition of the model was designed to only exhibit the processes of the upper bay (Rogers, 2008). However, it was determined that this version of the model had a domain boundary that was too close to the area of study, impacting the results in a negative way. The second generation of the Narragansett Bay hydrodynamic model used ROMS again, and increased the model domain by extending the southern boundary to the edge of Rhode Island Sound (Lasota, 2009). Nevertheless, it was determined that the grid resolution (>130 m) in the Providence River was too coarse to properly represent chemical and biological transport. The current version of the NB-ROMS model is known as the Full Bay ROMS model, and has increased the grid resolution of the Providence River to <40m (Kincaid, 2012). Additionally, it was determined that the first and second generations of the NB-ROMS model did not perform when it came to properly simulating residual flows. Residual, or subtidal flows are instrumental in numerically describing long-term chemical and biological transport in the Bay (Kincaid, 2012). The NB-ROMS model is a version of the ROMS model that was verified for Narragansett Bay waters as a component of the NOAA Coastal Hypoxia Research Project (NA05N054781201) (Bergondo 2005, Balt 2014). The model domain was extended in the most recent version to include a southern boundary that extends into Rhode Island Sound (figure 9). It consists of 15 sigma layers in the vertical, and less than 40-meter grid resolution in parts of the Providence River in the horizontal. The model skill for temperature, salinity and water levels in the Full Bay ROMS model are on the order of >0.8 on the Willmott Skill scale (Willmott, 1981) where 1.0 indicates perfect correspondence between model results and natural conditions (Kincaid, 2012). The Full Bay NB-ROMS model is the version that will be used for this project.

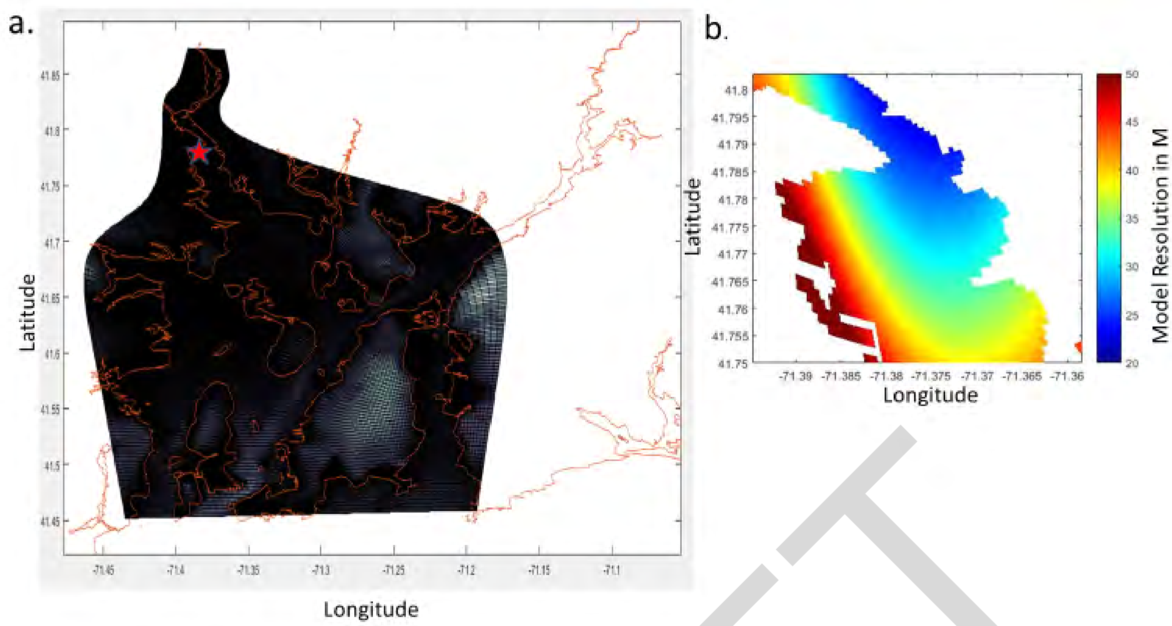

Figure 8 (a.) NB-ROMS Model Domain: The NB-ROMS Model domain, with Edgewood Shoals marked with a red star. The southern boundary consists of the mouth of Narragansett Bay at the Sakonnet River, East Passage and West Passage. The highest grid resolution is in the Providence and Seekonk Rivers to the north, and the lowest resolution is in Mount Hope Bay to the east. All boundaries are closed except for the southern boundary. (b.) NB-ROMS domain zoomed in on Edgewood Shoals. Model resolution increases to 35-meter grid cells in the Edgewood Shoals region.

Numerical Model Forcing:

The NB-ROMS model is forced by freshwater point sources (rivers), seven tidal harmonic constituents (M2, M4, M6, S2, N2, O1, K1) and surface atmospheric forcing fields. This section includes the development of all ROMS model initial condition files, boundary forcing files, atmospheric forcing files, and most notably for this project, new grid files containing altered bathymetry for each dredging scenario. Alterations to the Narragansett Bay grid will be performed in MATLAB and the new files will be saved to netCDF format.

The numerical model is forced by freshwater inputs from the USGS discharge gauges at the following rivers and wastewater treatment facilities (WWTF's): Blackstone, Palmer, Moshassock, Seekonk, Pawtuxet, Taunton, Hunt, Green, Harding Brook, Muskerchug, Woonasquatucket and 10-Mile rivers, and the Fields Point, Bucklin Point and East Providence WWTF's. A correction factor is applied to account for groundwater discharge rates throughout the basin. Winds are applied at the surface of the entire grid, with data for 2010 collected at T.F. Green Airport in Warwick, RI. Atmospheric forcing parameters for summer of 2010, namely long-wave and short-wave radiation, relative humidity, air temperature and pressure and precipitation are applied at the surface in a bulk forcing format.

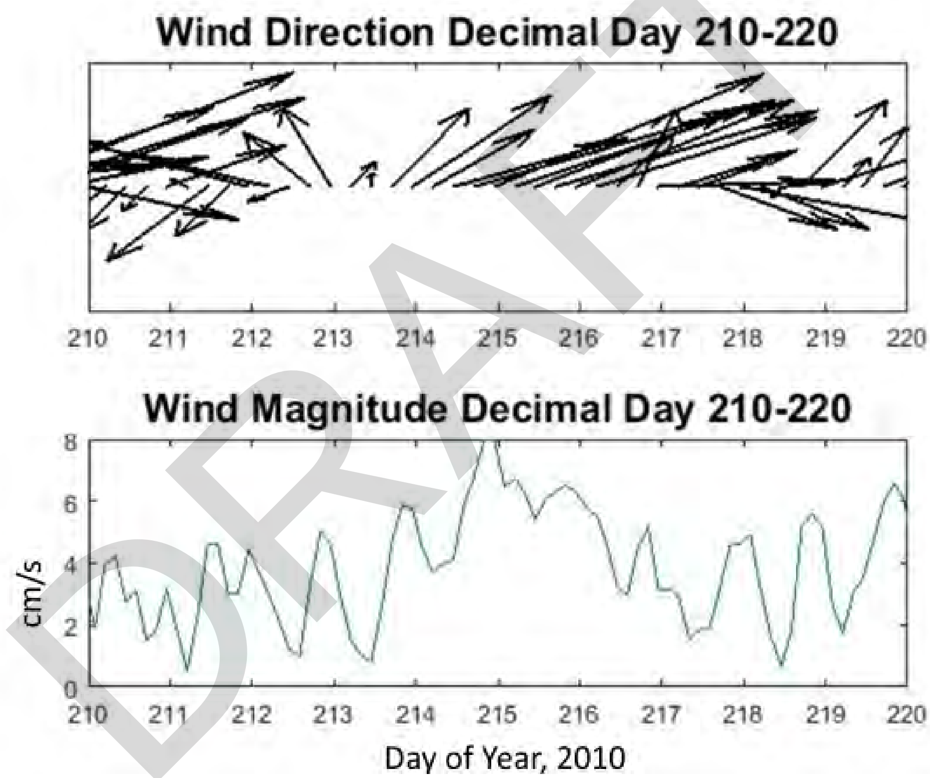

Figure 9. Wind direction and magnitude used to force the numerical model. Winds are collected from observational data and are applied uniformly to the model. Wind direction arrows are scaled to relative strength, but however cannot be used as an indicator of magnitude. Magnitudes (lower plot) are indicated in cm/s. One significant wind event occurs on decimal day 215 during this model run.

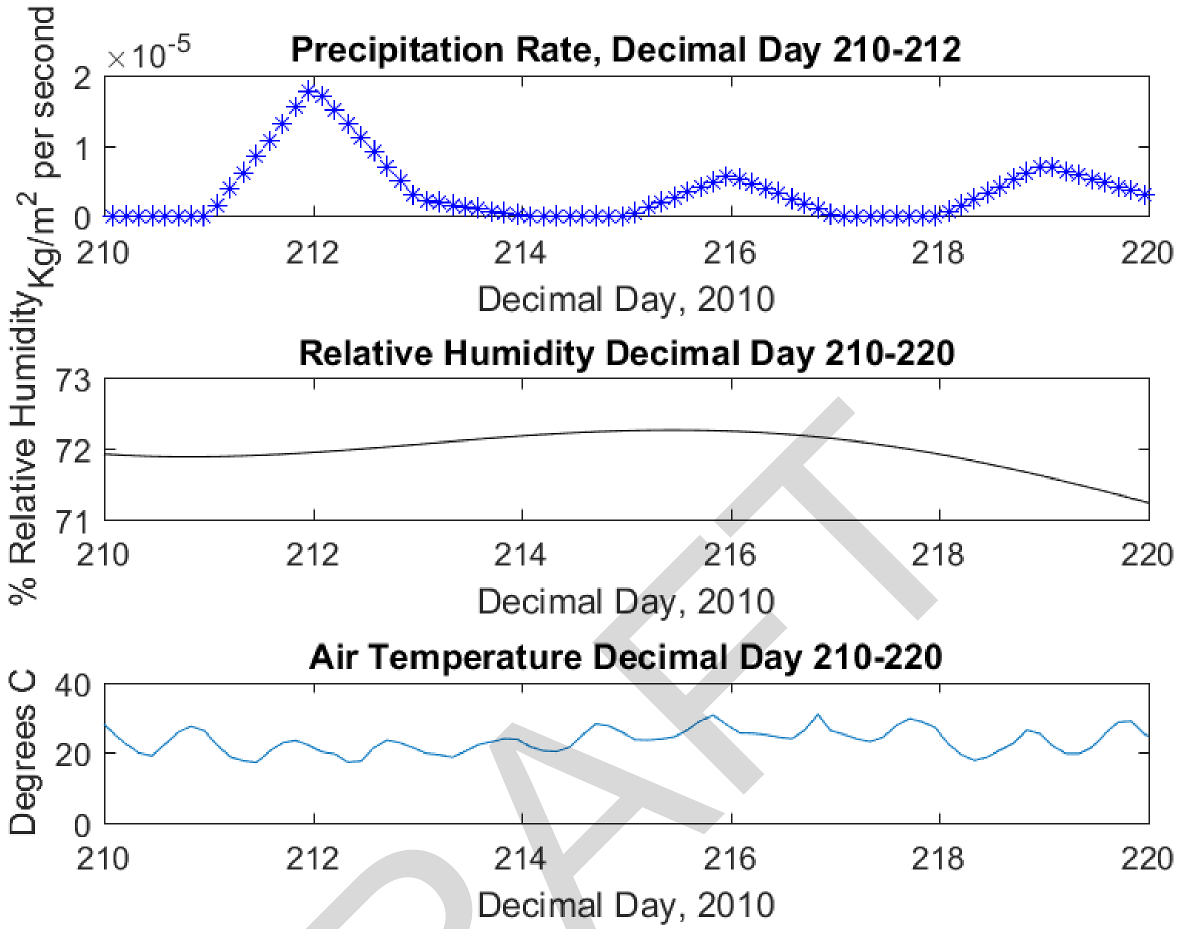

Figure 10: Precipitation rate, relative humidity and air temperature applied as forcing to the 10-day model run for Summer, 2010. One significant precipitation event occurs on decimal day 212. Air temperature is measured in degrees Celcius, relative humidity is presented as a percentage, and precipitation rate is noted as a flux.

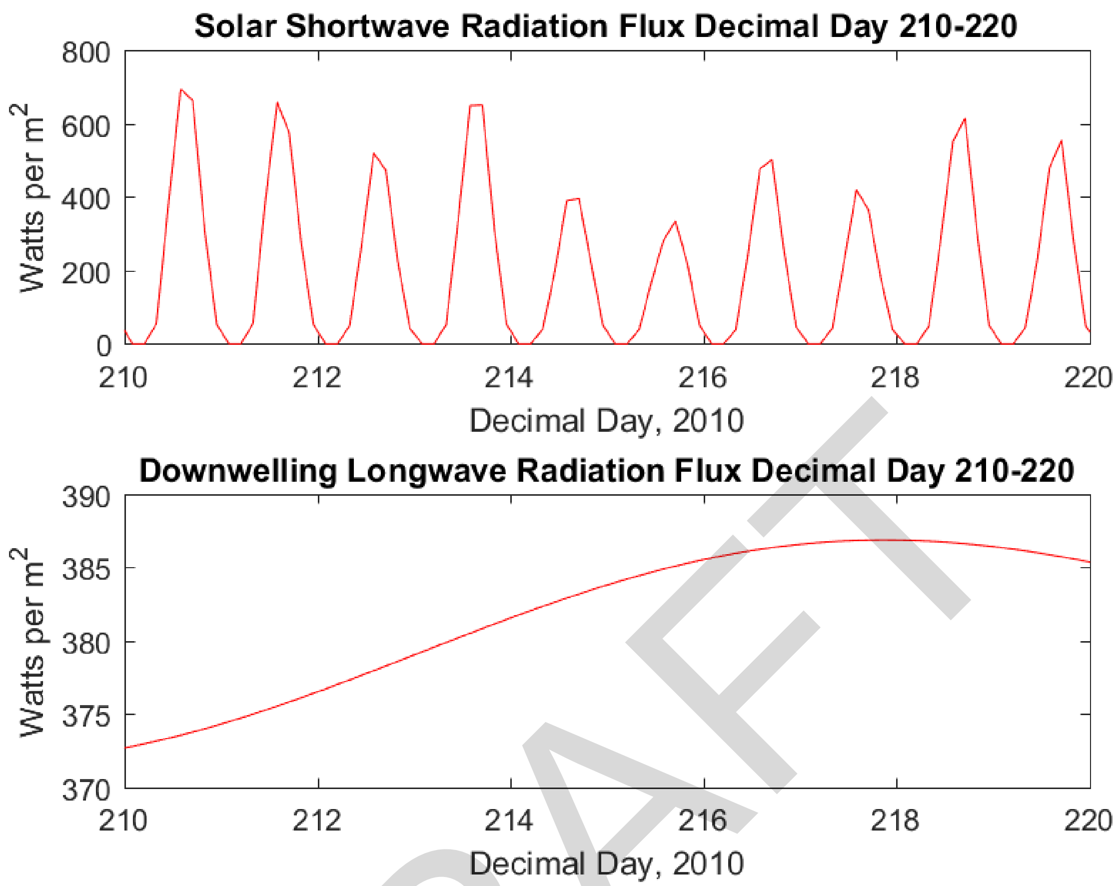

Figure 11: Short-wave and long-wave radiation (solar) fluxes applied as forcing to the 10-day model run for Summer, 2010.

Model Boundary Conditions:

Boundary conditions are set as follows: the only open boundary is to the south, with closed conditions to the north, east, and west. The boundary condition for free-surface velocity uses the Chapman (1985) method. The 2-dimensional U- and V-momentum components are applied at the boundary using the Flather (1976) method. The 3-dimensional U- and V-momentum components and mixing turbulent kinetic energy are applied at the boundary using the Radiation method. Temperature and Salinity are applied at the open boundary using a Radiation method with nudging, which allows water to leave the domain as well as enter at the boundary based on hydrographic data collected at the mouth of Narragansett Bay. Radiation with nudging has been proven effective in active/passive radiation conditions (Haidvogel et al, 2008). Nested at the open boundary at the mouth of the East Passage, West Passage and Sakonnet River are values for water velocity, temperature and salinity that have been calculated from the Rhode Island Sound ROMS model (ROMS-RIS). ROMS-RIS is forced at its open boundaries from the ROMS-ESPRESSO model for the Middle Atlantic Bight. Tides are interpreted as water levels at the open boundaries, using tidal harmonics from the Advanced Circulation Model for Oceanic, Coastal and Estuarine Waters (ADCIRC) for the East Coast of the United States.

Initial conditions:

Initial conditions are set to existing conditions for Summer 2010. Conditions for the 30-day model spin-up period will be applied from a ROMS restart file containing spun-up summer-like conditions. The model was spun-up from decimal day 180 to decimal day 210. Experimental runs were started on decimal day 210 from the restart file containing the spun-up initial conditions for late July, 2010. This time period was chosen because it overlaps with a mid-summer neap tide (figure 12) during a period of low wind, allowing for strongly stratified water column to have developed in the Providence River.

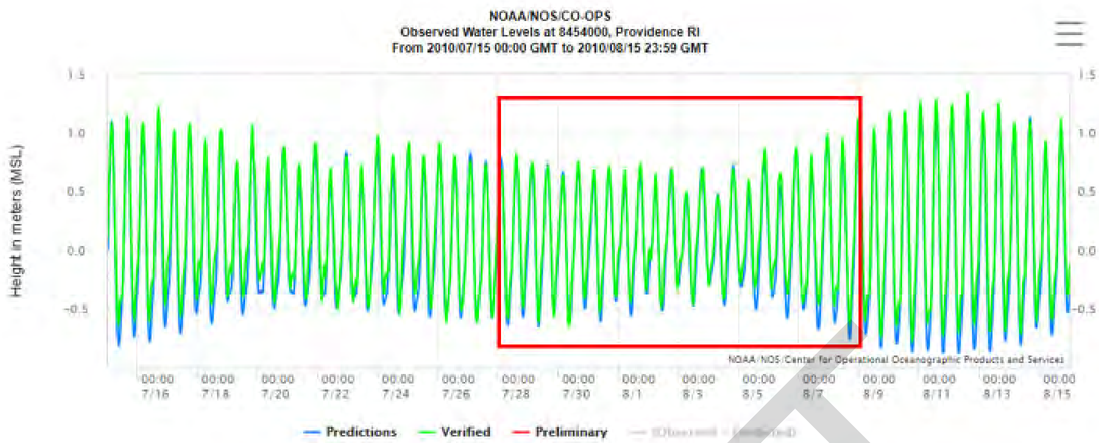

Figure 12: Water levels from NOAA PORTS in Providence, RI for late July-Early August of 2010. The red box marks the time period chosen for the modeling for this project. A neap tide is observed during this 10 -day modeling period from decimal day 220-220 (July 28-August 9, 2010).

Grid Generation:

The alterations made to the NB-ROMS existing model for this project are as follows: alteration of bathymetry files to create 9 bathymetric alternatives, or dredging scenarios, the addition of environmental forcing files using real-time data from Summer, 2010, and the addition of station files to receive data output from a series of locations in Edgewood shoals.

The NB-ROMS grid is a 175 (East-West) by 350 (North-South) node curvilinear grid with 15 terrain-following sigma layers in the vertical. The grid is comprised of all of Narragansett Bay with the boundary set at the mouths of the East Passage, the West Passage and the Sakonnet River in a roughly east-west orientation. This boundary was determined to be far enough South in Narragansett Bay as to not affect the study area. The new bathymetric grid files will be created using a MATLAB script that allowed the user to make changes to the already-existing grid file by creating and loading a series of depth planes to interpolate onto the existing grid. Each plane was created by a given a series of end-points (latitude, longitude, and point depth) that corresponded with points on the existing grid and determined the boundary of the plane. The depths within the boundaries of the plane will be interpolated linearly onto the existing grid based on the depths at the end-points. The complexity of the shape of the channel was determined by the overlapping of multiple interpolation planes of different depth values. Once the new depths had been interpolated onto the existing grid, the grid was smoothed using LP Bathymetry (Sikirić et al., 2009), using the linear programming capabilities of LP_Solve (Berkelaar et al., 2005) to smooth.

Bathymetry in the 175x350 NB-ROMS grid used in this project comes from two sources. For modeling purposes in the Providence River, care was taken to use the most recent subsurface map of the area. Bathymetry from a depth survey completed by the USACE in May of 2017, as well as NOAA Coastal Relief bathymetry was interpolated on to the existing bathymetric grid from, obtained from the National Geophysical Data Center (NGDC) in 2014 for everything north of Ohio Ledge. This new bathymetry was then selectively smoothed, to ensure that the depths of both the Port Edgewood Channel and Providence River Ship channel were preserved to the greatest extent possible while still maintaining model stability. Increased detail on the shoal was obtained by the USACE (2017) survey.

4. RESULTS OF SCENARIO DESIGN:

Dredging Scenarios

Bathymetric Alternatives, or Dredging Scenarios, were designed as follows: Confined Aquatic Disposal cells placed on Edgewood Shoals will need additional channels dredged from the Providence River Ship Channel in order to facilitate dredging/disposal equipment mobility. Locations for potential Cells, as well as access channels were determined based on a series of analyses for contamination depth. The goal is a roughly 10,000 square meter cell with a depth of 20-25 meters (60-75 feet). Issues with obtaining maximum preferred depth will be compensated with lateral surface area. Filling deeper areas with clean, subsurface material is encouraged in dredging scenario design. Any design that is deemed unsuitable to fit the needs of the USACE but provides maximum flushing benefit will still be included in this analysis.

Bathymetric alternatives (“dredging scenarios”), were built in MATLAB by altering depths in the Edgewood Shoals region of the NB-ROMS grid. In this report, nine of the dredging scenarios will be introduced and hydrodynamic results from the ROMS model will be analyzed for each. The “Reference Case” (Figure 14) in this report refers to the existing bathymetric features on the shoal, referencing to depth soundings collected in May, 2017 (USACE, 2017).

The following scenarios are a combination of the following: dredging small channels for access on-to and off-of the shoal (further referred to as “access channels”), a modeled “depression” in the bathymetry for a potential CAD cell (further referred to as “modeled CAD cell”), and finally, filling of the existing bathymetry with clean, or suitable material (further referred to as “fill”).

Model Run	Fill (Turning Basin)	Deepen Port Edgewood Channel	Dredge E-W access channel	Grade shoal to Ship Channel Depth	Modeled CAD Cell
Scenario 1			✖		
Scenario 2		✖	✖		
Scenario 3	✖				✖
Scenario 4				✖	
Scenario 5			✖		
Scenario 6					✖
Scenario 7			✖		
Scenario 8	✖				
Scenario 9	✖		✖		✖

Table 1: Method behind each of the dredging scenarios, labeled 1-9.

Figures 13-22, as well as Table 1 provide detail on the 9 dredging scenarios designed. Scenarios 1, 2, and 9 feature an access channel running parallel to Fields Point, connecting the Port Edgewood Turning Basin to the Providence River Ship Channel at a depth of 6 meters near the Port Edgewood Turning Basin, deepening to 11 meters at the shoal break at the Providence River Ship Channel. Scenarios 2 and 5 feature an access channel that consists of deepening of the existing Port Edgewood Channel to a maximum depth of 5 meters at the Port Edgewood Turning Basin and 8 meters at the shoal break connecting to the Providence River Ship Channel.

Scenarios 3, 8 and 9 apply fill to the Port Edgewood Turning basin, filling to a minimum depth of 2 meters. Scenarios 3, 6 and 9 feature a modeled CAD cell location in the southwest section of Edgewood Shoals. Scenario 4 grades the eastern 1/3 of the shoal to the existing depth of the Providence River Ship Channel. Scenario 7 adds a small access channel to the section of shoal just to the south of Fields Point.

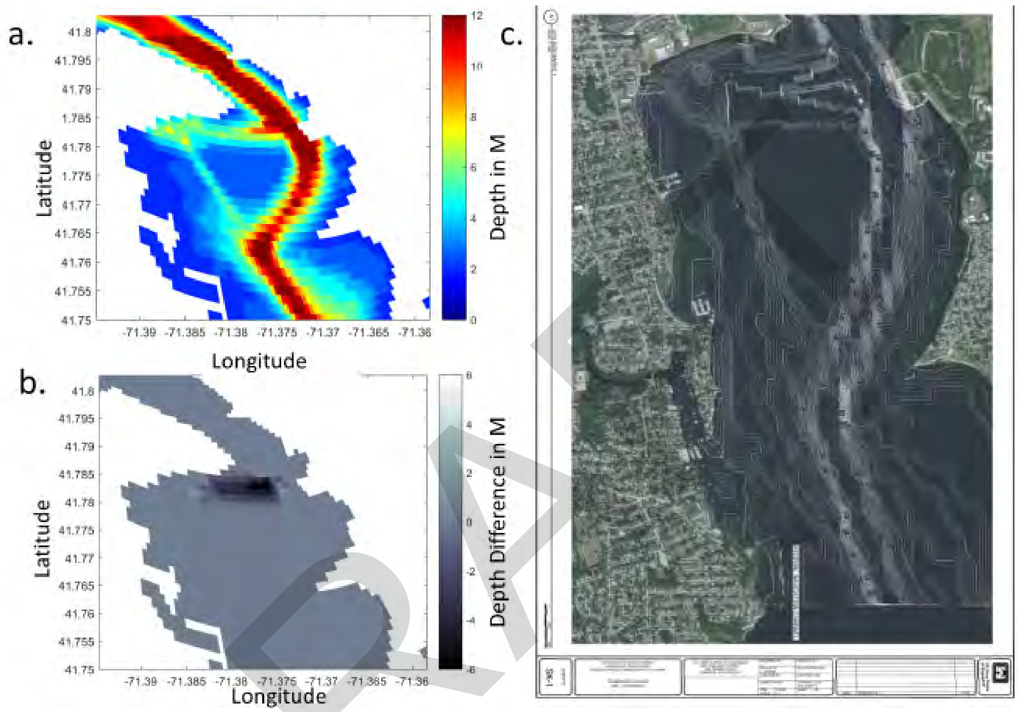

Figure 13 (a.) Dredging Scenario 1 map of depths. Scenario 1 deepens the northeast section of the shoal by providing an access channel where it does not currently exist. (b.) A map of the depth difference between the Reference Case (existing bathymetry) and the dredging case. (c.) A depth contour plot of URI Scenario 1 overlain on a satellite image of Edgewood Shoals (Image: USACE 2018).

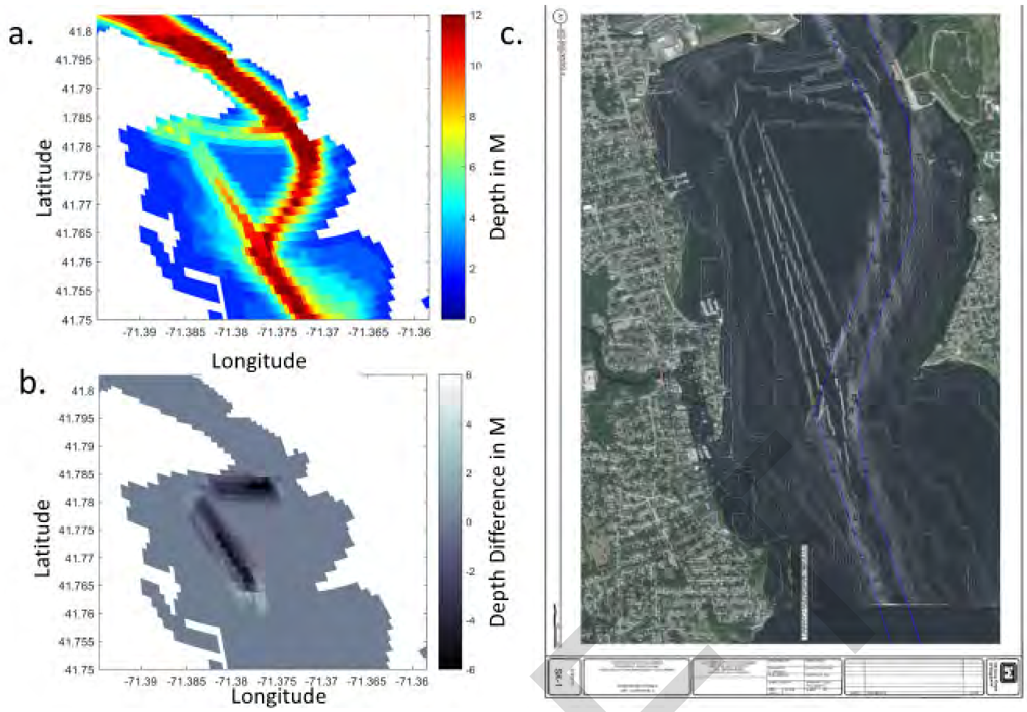

Figure 14 (a.) Dredging Scenario 2 map of depths. Scenario 2 deepens the northeast section of the shoal by providing an access channel where it does not currently exist. Additionally, this scenario deepens the existing Port Edgewood Channel by 2 meters. (b.) A map of the depth difference between the Reference Case (existing bathymetry) and the dredging case. (c.) A depth contour plot of URI Scenario 2 overlain on a satellite image of Edgewood Shoals (Image: USACE 2018).

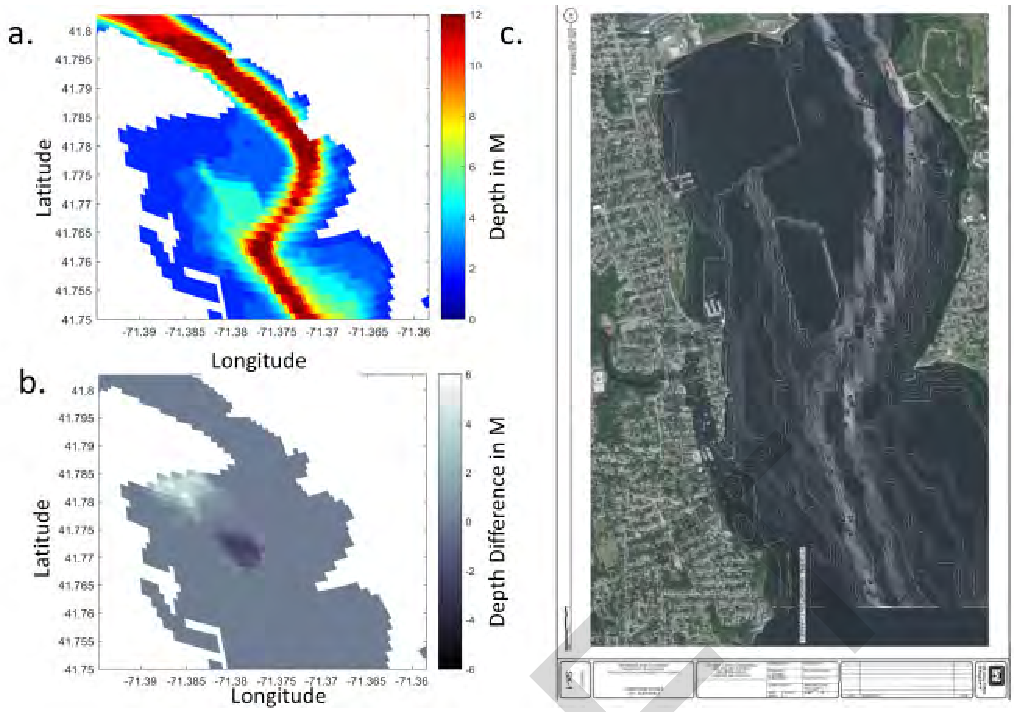

Figure 15 (a.) Dredging Scenario 3 map of depths. Scenario 3 adds a Modeled CAD Cell in the Southeast section of the Shoal, as well as fills in the Turning Basin to an ambient depth of 2 meters. (b.) A map of the depth difference between the Reference Case (existing bathymetry) and the dredging case. (c.) A depth contour plot of URI Scenario 3 overlain on a satellite image of Edgewood Shoals (Image: USACE 2018).

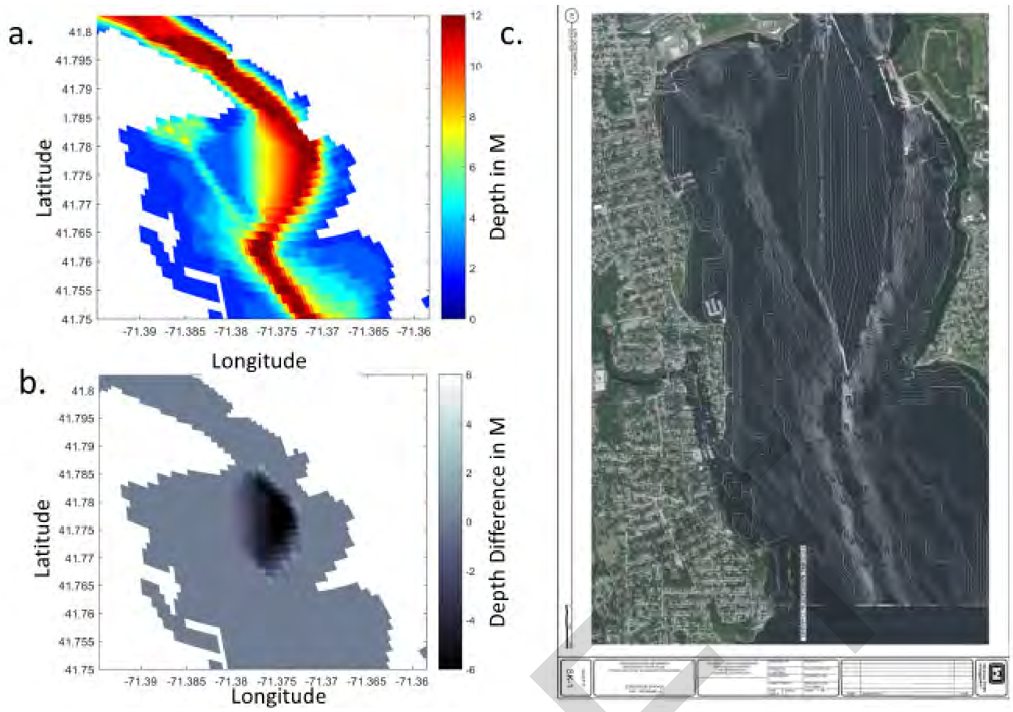

Figure 16 (a.) Dredging Scenario 4 map of depths. Scenario 4 grades the shoal to the depth of the channel, shallowing the slope of the Shoal-Channel interface. (b.) A map of the depth difference between the Reference Case (existing bathymetry) and the dredging case. (c.) A depth contour plot of URI Scenario 4 overlain on a satellite image of Edgewood Shoals (Image: USACE 2018).

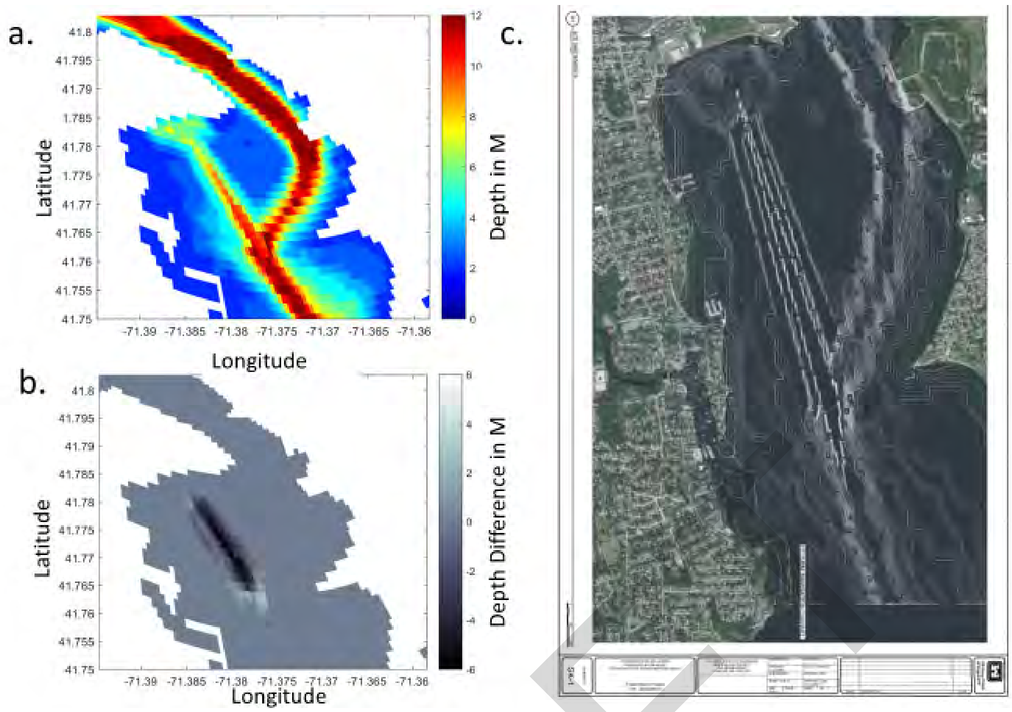

Figure 17 (a.) Dredging Scenario 5 map of depths. Scenario 5 deepens the existing Port Edgewood channel by an additional 2 meters. (b.) A map of the depth difference between the Reference Case (existing bathymetry) and the dredging case. (c.) A depth contour plot of URI Scenario 5 overlain on a satellite image of Edgewood Shoals (Image: USACE 2018).

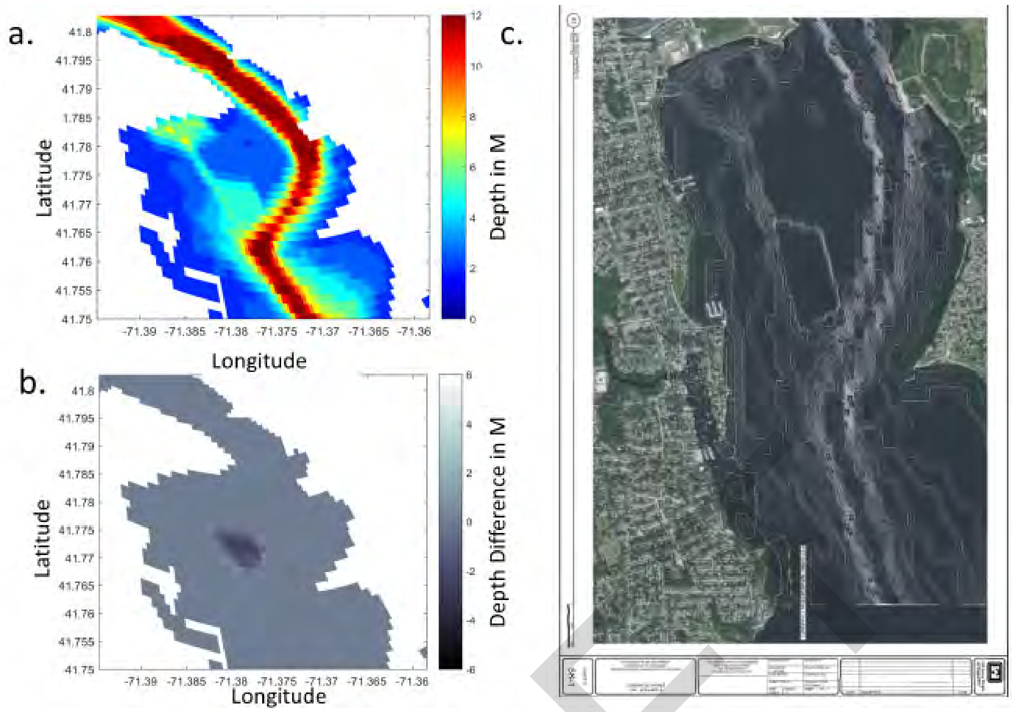

Figure 18 (a.) Dredging Scenario 6 map of depths. Scenario 6 adds a Modeled CAD Cell in the Southeast section of the Shoal. (b.) A map of the depth difference between the Reference Case (existing bathymetry) and the dredging case. (c.) A depth contour plot of URI Scenario 6 overlain on a satellite image of Edgewood Shoals (Image: USACE 2018).

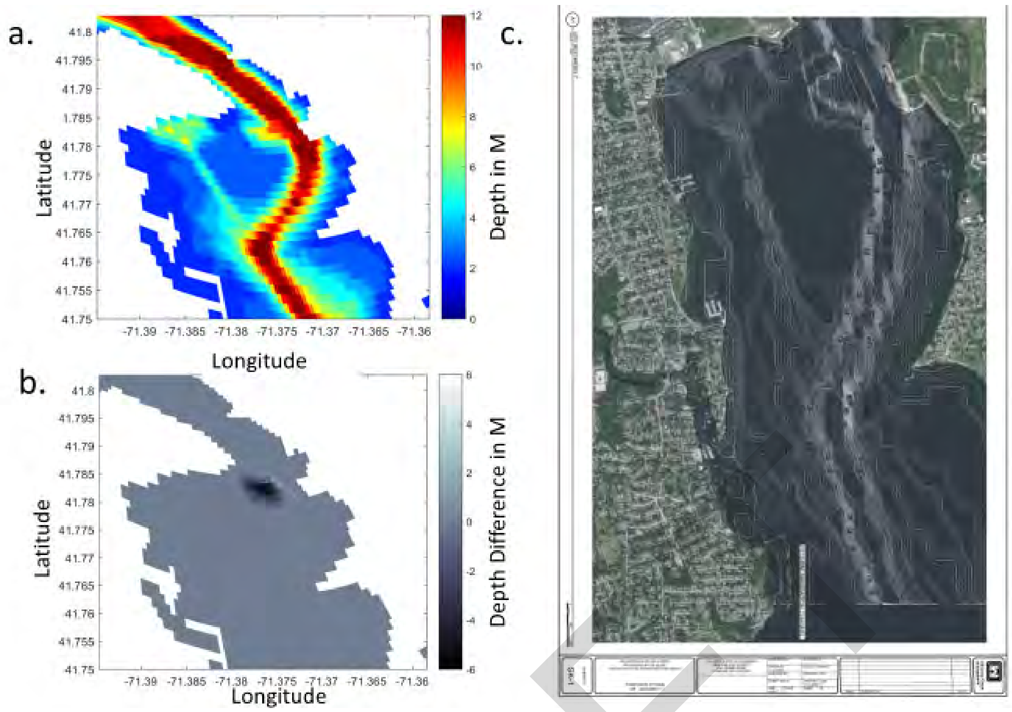

Figure 19 (a.) Dredging Scenario 7 map of depths. Scenario 7 adds a short access channel in the eastern section of the Shoal. (b.) A map of the depth difference between the Reference Case (existing bathymetry) and the dredging case. (c.) A depth contour plot of URI Scenario 7 overlain on a satellite image of Edgewood Shoals (Image: USACE 2018).

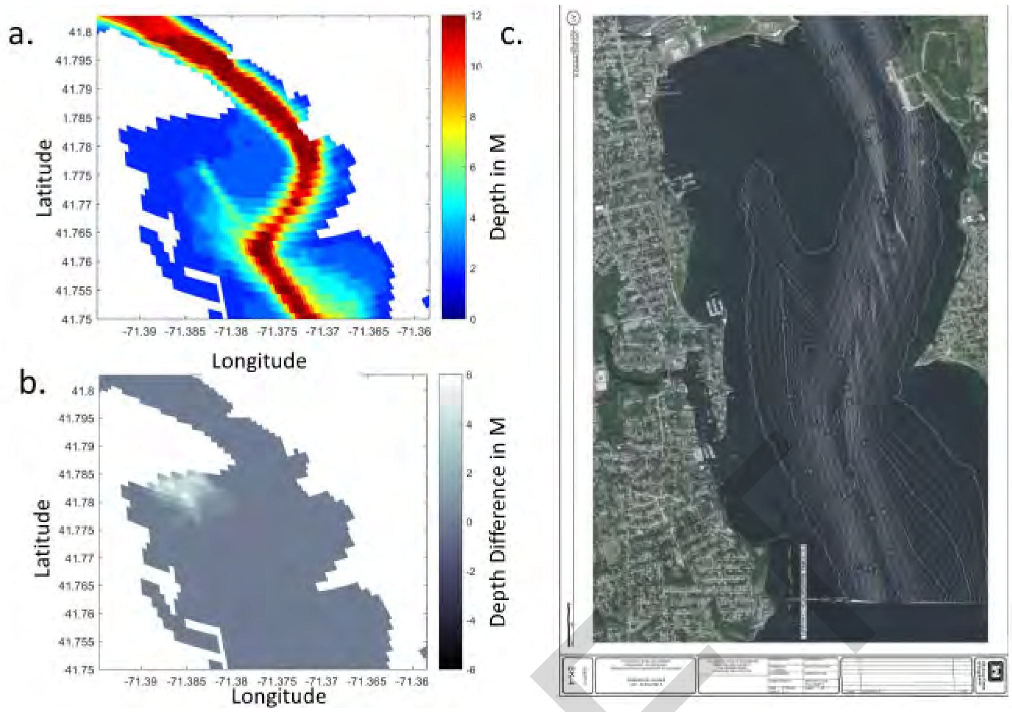

Figure 20 (a.) Dredging Scenario 8 map of depths. Scenario 8 fills in the Port Edgewood Turning Basin to an ambient depth of 2 meters. (b.) A map of the depth difference between the Reference Case (existing bathymetry) and the dredging case. (c.) A depth contour plot of URI Scenario 8 overlain on a satellite image of Edgewood Shoals (Image: USACE 2018).

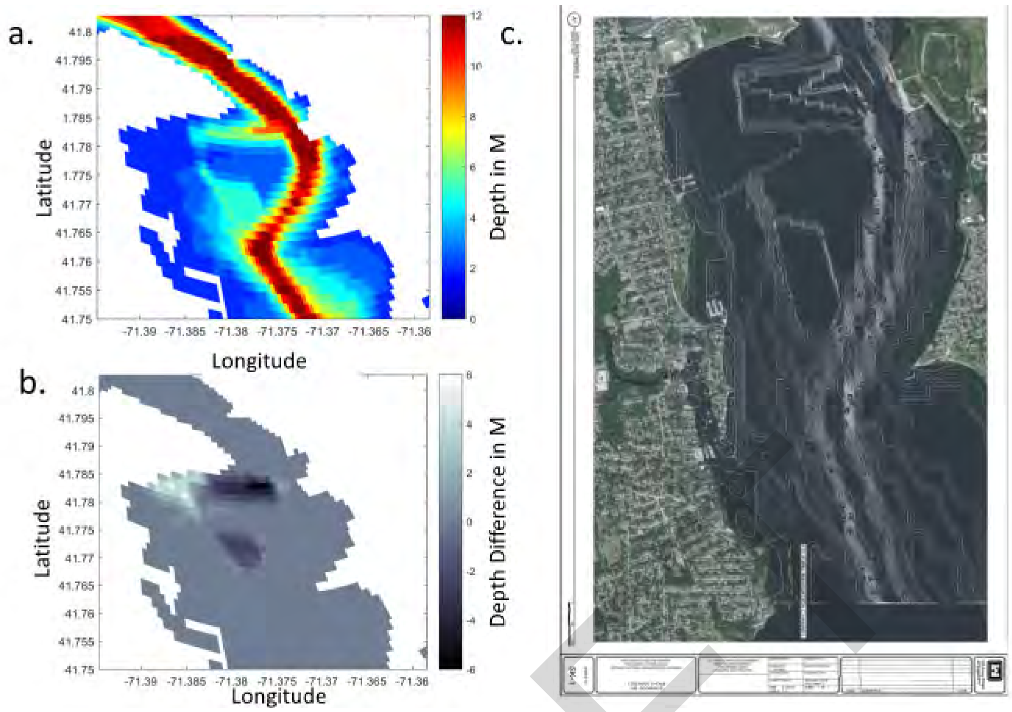

Figure 21 (a.) Dredging Scenario 9 map of depths. Scenario 9 fills in the Port Edgewood Turning Basin to an ambient depth of 2 meters. (b.) A map of the depth difference between the Reference Case (existing bathymetry) and the dredging case. (c.) A depth contour plot of URI Scenario 9 overlain on a satellite image of Edgewood Shoals (Image: USACE 2018).

5. ROMS EXPERIMENTAL DESIGN

The research aim is to model a time period when the system is portraying weak circulation. ROMS was run for a 10-day period of summer 2010, from decimal day 210-220 (July 28th-August 9th, 2010), using realistic wind, tide, precipitation, river runoff and wastewater treatment discharge forcing files for that time period. Decimal day 210-220 in 2010 was chosen due to its time in the tidal cycle (neap tide) and due to data indicating low dissolved oxygen levels on Edgewood Shoals. These combine to indicate a time period of weak circulation on the shoal.

The horizontal grid spacing is less than 40 meters on Edgewood Shoals, with varying resolution in the vertical due to the terrain-following capabilities of the sigma coordinate system. Forcing files and run parameters remain constant over the course of experimental runs, the only variable being changed in each run was the grid file containing the bathymetries of each test scenario. New station files (output information locations) will be created in order to adequately capture the conditions of temperature, salinity and, most important to this project, magnitude and direction of flow on-to and off-of Edgewood Shoals.

ROMS run results are driven primarily by environmental forcing conditions, which for this project will be close approximations of data collected in the Summer of 2010. Forcing parameters for this project include wind forcing (magnitude and direction), tidal forcing (amplitudes, oscillations), and seasonal density conditions. Seasonal density conditions are primarily driven by temperature fluctuations and freshwater inputs (river discharge, precipitation, surface runoff). In the case of this project, river discharge and runoff values are obtained from the U.S. Geological Survey, rainfall amounts from T.F. Green Airport in Warwick RI, and tides, barometric pressure, winds (direction and magnitude) and air temperature are obtained from NOAA PORTS (Physical Oceanographic Real Time System).

To represent the movement of specific parcels of water, drifters (figure 22) are used as part of the input into the model. Drifters will be released (initialized) in the model at the first time-step, at the beginning of a flood tide cycle. 975 modeled drifters will be released in a designated box on Edgewood Shoal. 325 modeled drifters each will be released at the surface, middle and bottom of the water column of the Shoal. Drifters will then be tracked at each time-step from decimal day 210 to decimal day 220 in summer, 2010. The movement of the drifters through time simulates the movement of specific parcels of water.

To characterize chemical and biological components in the water which diffusion properties characterize exchange, passive numerical dyes are released in the model (figure 22). This method is similar to the ecological box model work using ROMS of Kremer et al. (2010) in which numerical dyes were released in the Providence River and tracked for 24 hours.
Dyes and floats were placed strategically into initial fields, in order to trace the highly impacted water in the Turning Basin on Edgewood Shoals. These fields were placed as close approximations to the hypoxic conditions from the observational data sets collected as part of the Insomniac Cruises (1999-2013) (NBEP, 2013).

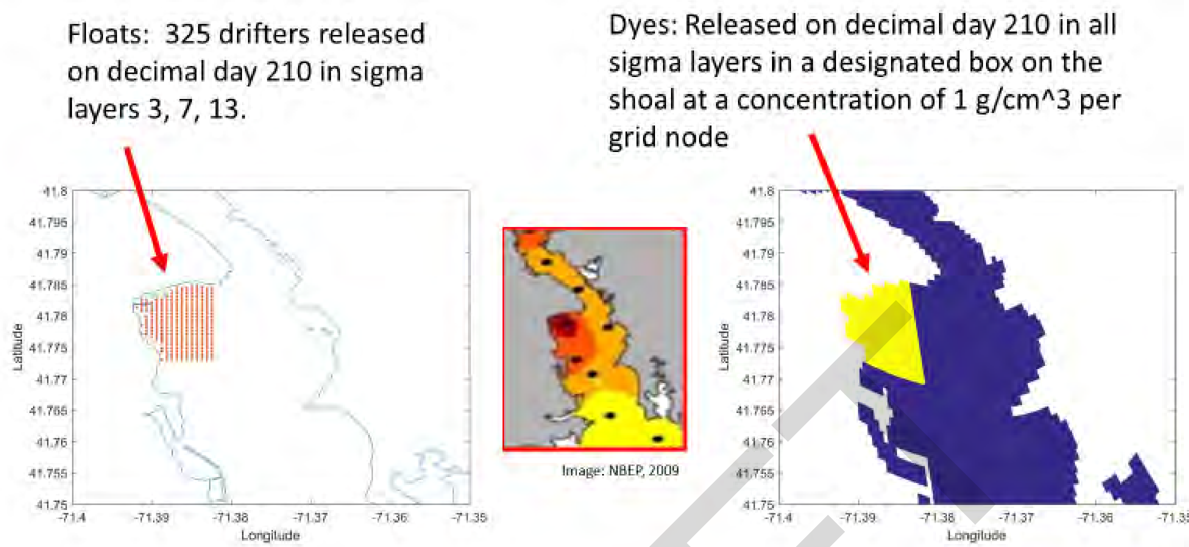

Figure 22: Numerical dye initial field, float initial positions. These numerical tracers were placed strategically in order to track the highly impacted water in the turning basin on Edgewood Shoals.

Stations for Model Output:

Locations for output of ROMS modeled temperature, salinity, water levels and water velocities were chosen based on sites of previous hydrographic data collection by URI, Narragansett Bay Commission, and the Rhode Island Department of Environmental Management (RI-DEM). NOAA Ports Stations at Newport, Providence, Quonset and Conimicut Point were also included as locations for model output. Locations for model output were placed at a high concentration in areas of interest on Edgewood Shoals – including the Port Edgewood Turning Basin, the Port Edgewood Channel, and at the edge of the shoal break. Figures 23 and 24 note the locations in Narragansett Bay and Edgewood Shoals chosen for model output.

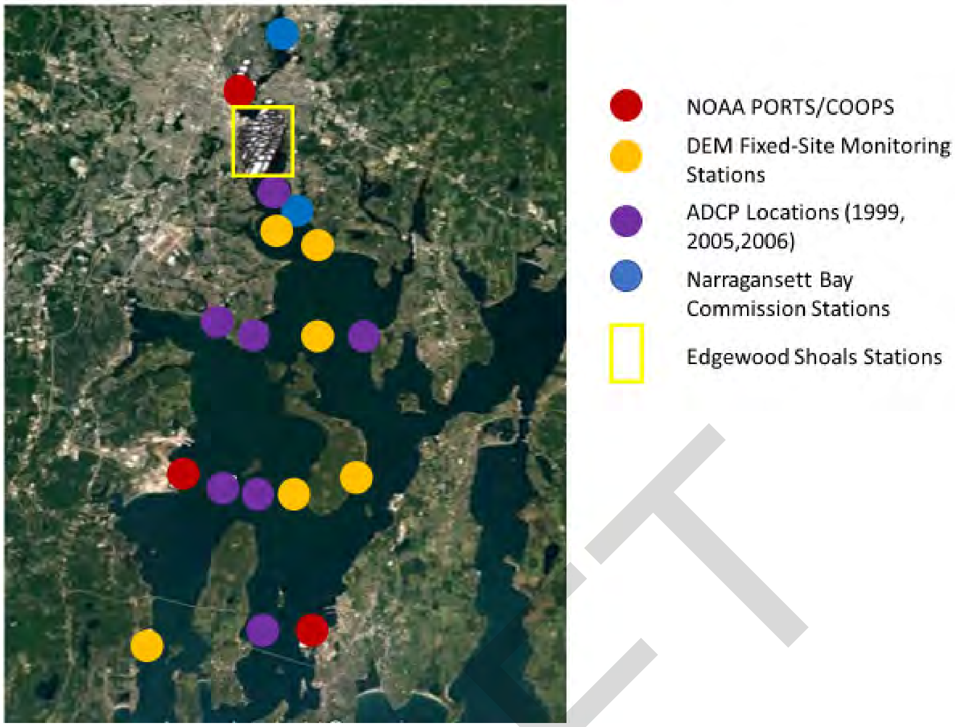

Figure 23: Virtual stations created for locations of ROMS model output throughout Narragansett Bay. Station locations were chosen based on locations of observational data collected by URI researchers, NOAA PORTS, DEM and the Narragansett Bay Commission.

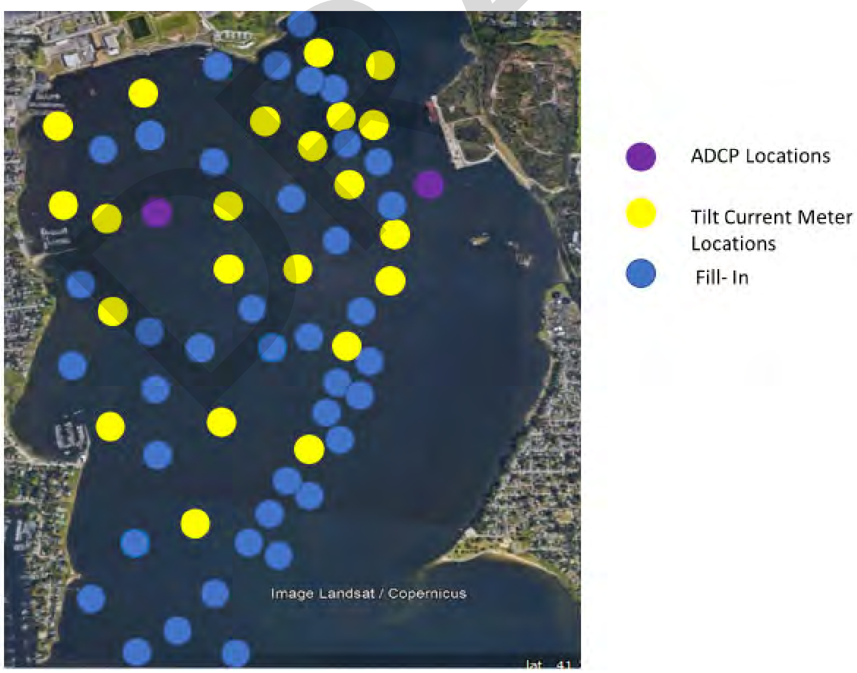

Figure 24: Virtual stations created for locations of ROMS model output throughout Narragansett Bay, zoomed in on Edgewood Shoals. Station locations were chosen based on locations of

observational data collected by URI researchers, NOAA PORTS, DEM and the Narragansett Bay Commission.

6. RESULTS OF MODEL RUNS:

The Reference Case

All differences between Dredging Scenario modeled cases will be described as differences from the Reference Case, which features the existing bathymetry on Edgewood Shoals, and the Providence River Ship Channel at a uniform controlling depth of 12 meters. The ROMS Model was run for 40 days (day of year 180-220), with the target analysis time being from decimal day 210-220 (results for entire 40-day model runs are available in appendix A). The analysis period for the reference case used in this study is a 10-day modeled simulation of summer conditions for July and August, 2010. During the 40-day model run, the minimum air temperature used to force the model during this time-period is 19 degrees C and the maximum air temperature used to force the model during this time-period is 27 degrees C. Modeled water temperatures for the target analysis time-period at the surface run between 25.6 degrees C and 25.8 degrees C, and at the bottom fluctuate between 25.1 degrees C and 25.3 degrees C. The maximum wind speed for the analysis time-period is on decimal day 215 (August 3rd) at 7 m/s (13.6 knots) from the south-southwest. Minimum wind speeds are light (<.1 m/s) with variable directions. Runoff from the Blackstone, Moshassuck, Pawtuxet and Seekonk remain fairly steady throughout the model run, with one relatively light precipitation event occurring on decimal day 217-218 (August 5th-6th) with maximum runoff from the Moshassuck, Blackstone, Pawtuxet reaching 2.8, 12.7, and 4.2 cubic meters per second, respectively.

The 40-day model was run during one spring cycle and two neap cycles. Results in this report will be taken from the second neap tide cycle, occurring from decimal day 210 to decimal day 220. This time period has a tidal range of 0.8 meters. Tidal, or instantaneous velocities in the bottom water of the shoal span from <0.1 m/s on the inner shoal (Turning Basin), and generally increase with distance moving towards the shipping channel. The maximum tidal velocities in the bottom water the Shoal during this model run are 0.22 m/s in the southwest section of the shoal. Bottom water tidal and residual velocities will be the focus of this results and discussion section, as these are the velocities responsible for average movement of chemical constituents on-to and off-of Edgewood Shoals. The residual, or nontidal velocity in the northeast section of the shoal reach a maximum 0.04 m/s in the eastward direction, and a maximum 0.04 m/s in the southward direction (figure 25). In the northwest section of the shoal (figure 26), the Reference Case has a northward residual velocity spike to 0.06 m/s on decimal day 218 (August 6), but for the most part remains below 0.02 m/s in the northward direction, and below 0.001 m/s in the eastward direction, which follows closely with residual flows from the Tilt Current Meter deployments in 2010 (Balt, 2011). The southwest section of the shoal (figure 27) has a southward spike to 0.06 m/s on decimal day 214.7 (August 2nd), with a maximum northward residual velocity of 0.04 m/s. The southeast section of the shoal (figure 28) has a maximum northward residual velocity at 0.045 m/s and a minimum of just above zero on decimal day 211 (July 30th).

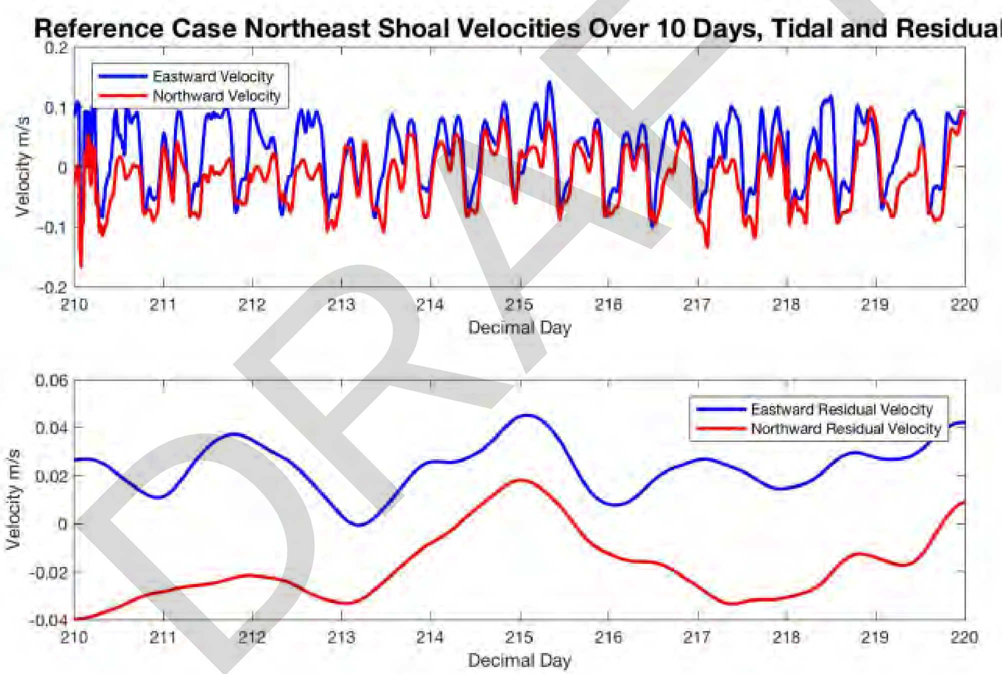

Figure 25: The bottom water modeled tidal and residual (33-hour low-pass filtered) velocities for the northeast section of Edgewood Shoals in the Reference Case, from decimal day 210-220. The red lines indicate the northward velocities while the blue lines indicate eastward velocity.

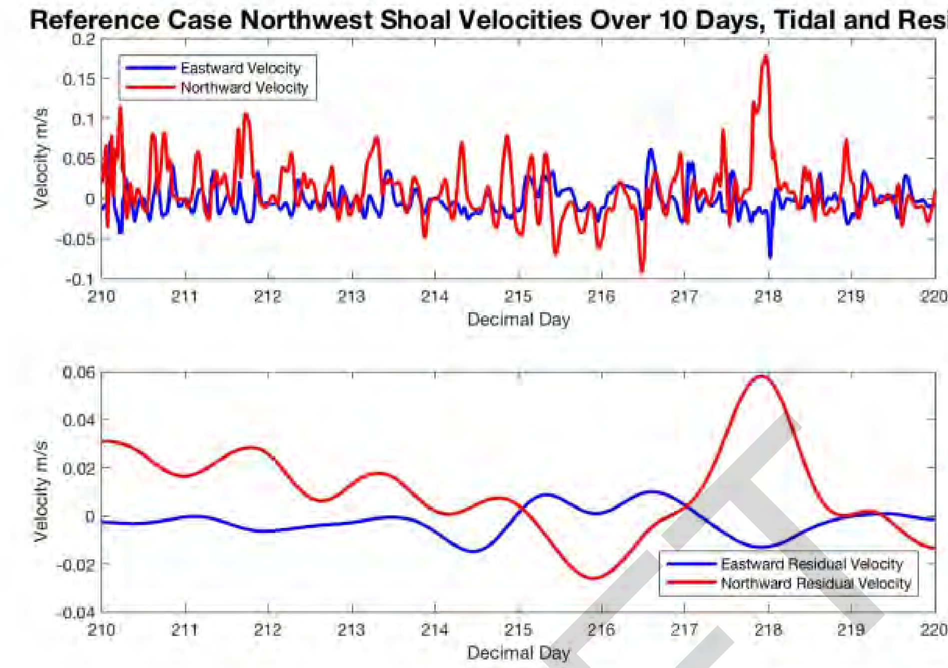

Figure 26: The bottom water modeled tidal and residual (33-hour low-pass filtered) velocities for the northwest section of Edgewood Shoals in the Reference Case, from decimal day 210-220. The red lines indicate the northward velocities while the blue lines indicate eastward velocity.

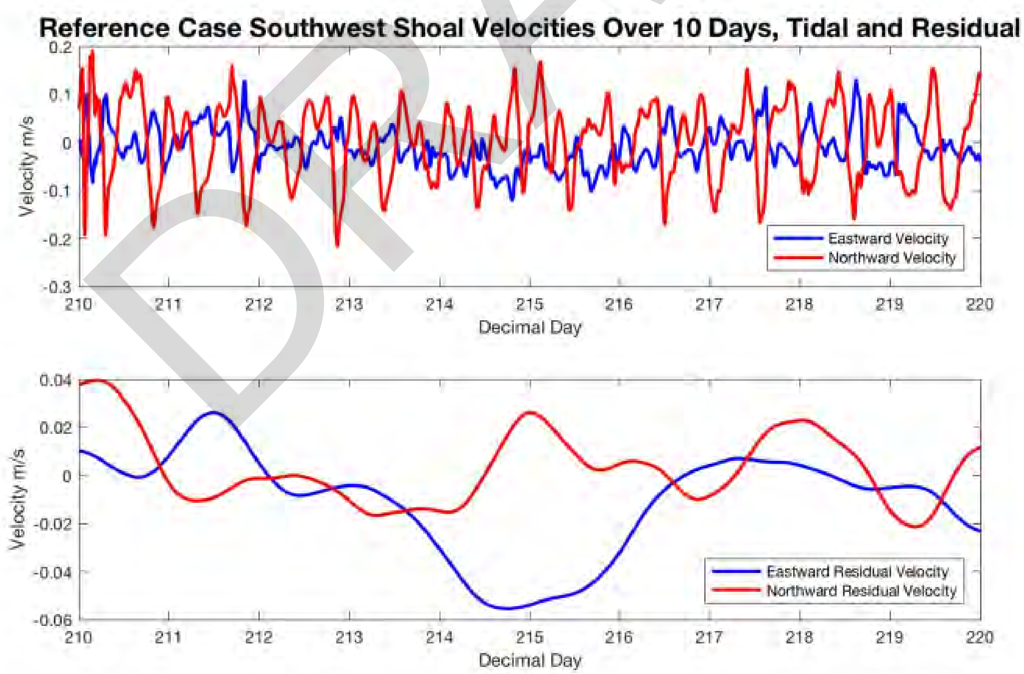

Figure 27: The bottom water modeled tidal and residual (33-hour low-pass filtered) velocities for the southwest section of Edgewood Shoals in the Reference Case, from decimal day 210-220. The red lines indicate the northward velocities while the blue lines indicate eastward velocity.

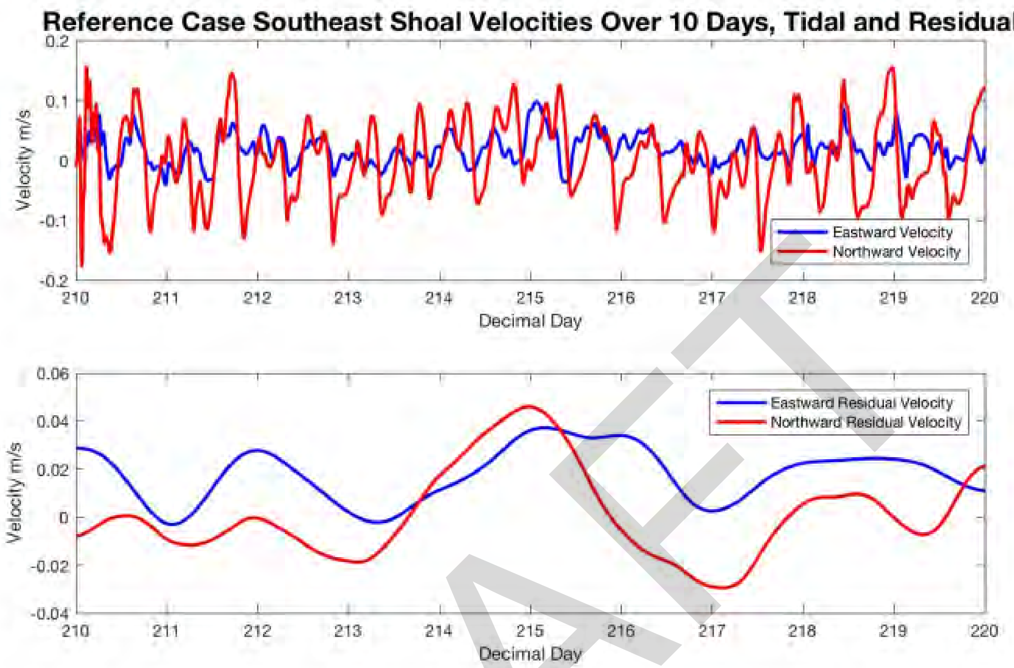

Figure 28: The bottom water modeled tidal and residual (33-hour low-pass filtered) velocities for the southeast section of Edgewood Shoals in the Reference Case, from decimal day 210-220. The red lines indicate the northward velocities while the blue lines indicate eastward velocity.

When compared to the velocities in the Providence River Ship Channel (figure 29), Edgewood Shoal velocities are roughly half of the water speeds of the deeper Ship Channel. The Ship Channel bottom water experiences net northward residual flow, reaching 0.1 m/s on decimal day 210 (July 29th). Eastward velocity hovers around zero, indicating that the flow is heavily north-south dominated, which matches observations from the 2005 ADCP transects (Kincaid, 2012). Tidal velocities in the bottom water of the Ship Channel reach 0.3 m/s to in the northward direction, and reach a maximum of 0.2 m/s in the southward direction.

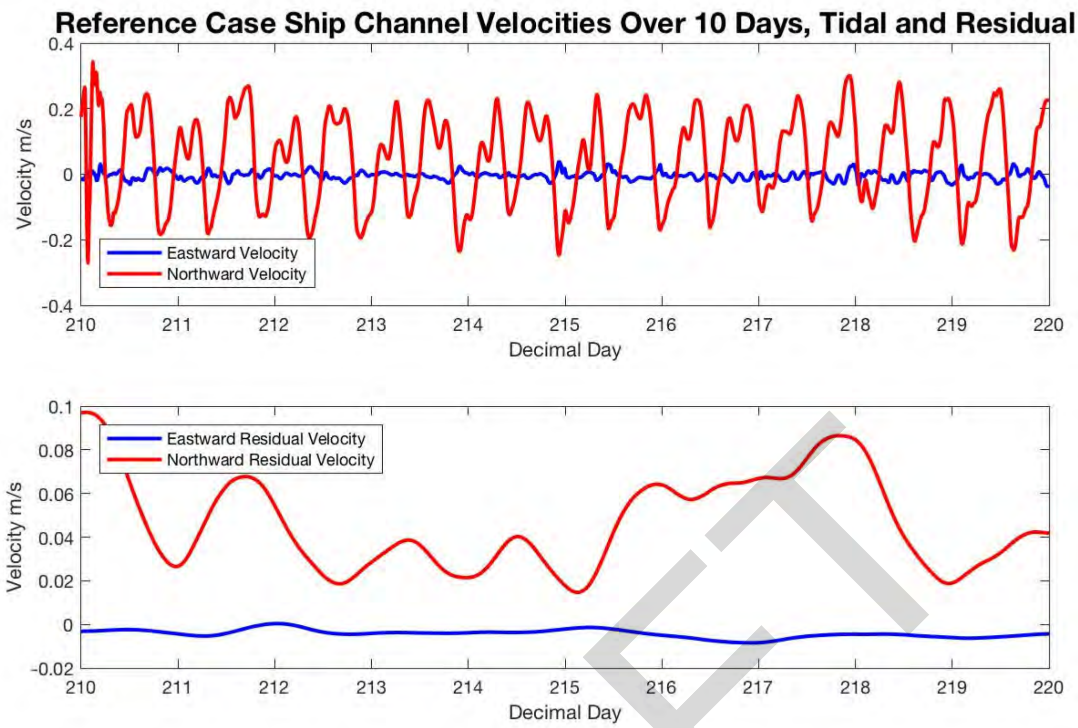

Figure 29: The modeled tidal and residual (33-hour low-pass filtered) velocities for the bottom water of the Providence River Ship Channel in the Reference Case, from decimal day 210-220. The red lines indicate the northward velocities while the blue lines indicate eastward velocity.

Numerical Tracer (Dye) Analysis:

Numerical tracer concentration was analyzed in a designated box on Edgewood Shoal (figure 30), with boundaries set as 41.7858 to 41.7800 degrees latitude and -71.3824 to -71.3919 degrees longitude. This area was chosen based on data from Narragansett Bay Estuary Program indicating low dissolved oxygen levels in the Turning Basin region of Edgewood Shoals. To directly compare numerical passive tracer results to drifter results, the same area is used for both passive dye tracer concentrations, as well as lagrangian drifter counts.

Surface and bottom water dyes were both set at 100 kg/m^3 as an initial concentration. Over time, the dyes were allowed to flow freely throughout the shoal, following key circulation patterns. Figure 31 is a 3-day time-series of the total concentration of surface dye in the analysis box. Figure 32 is a 3-day time-series of the concentration of bottom water dye in the analysis box. Three days was chosen as a time window, because the dye concentration drops off significantly after 3 days and the results flat-line. Dye concentrations fluctuate due to tidal flows. Since surface water has greater tidal velocities than the bottom water, overall, the concentration of dyes in the surface water fluctuate at a greater frequency then concentrations of dye in the bottom water. The overall trend of dye is towards zero concentration, or completely flushed, but never reaches a value of zero.

Figure 30: Pre-set area for analysis of dye concentration at the Turning Basin. This pre-determined location was chosen based on the location of the Port Edgewood Turning Basin, which experiences chronic low dissolved oxygen during summer months (NBEP, 2003).

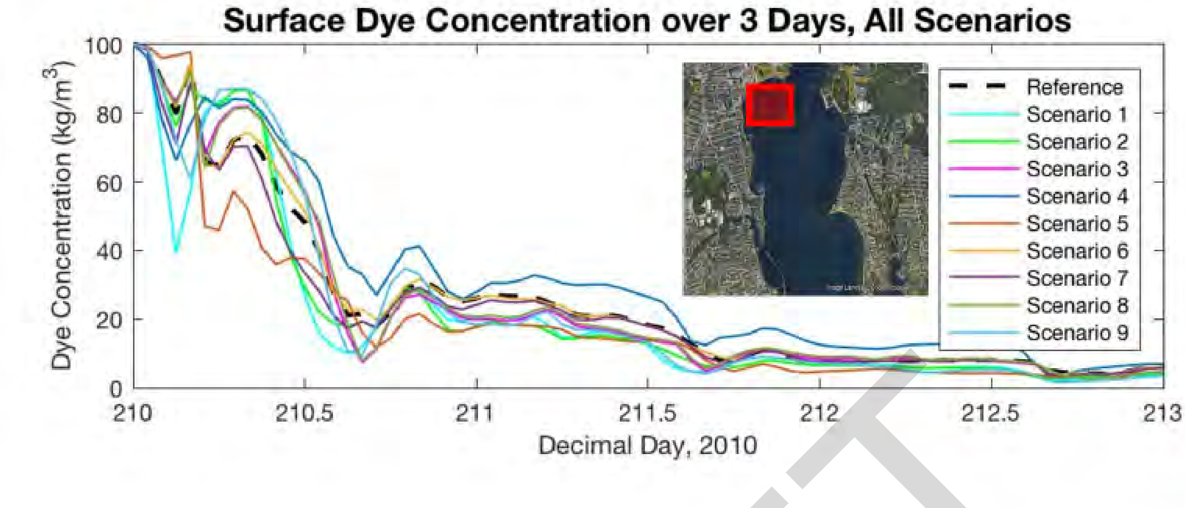

Figure 31: Numerical tracer (dye) results over three days of the model run in the surface water in a pre-designated analysis box on Edgewood Shoals, for each scenario. The reference case is noted with a black dotted line. Dredging scenario 1 is noted in cyan, scenario 2 in green, scenario 3 in magenta, scenario 4 in dark blue, scenario 5 in red, scenario 6 in yellow, scenario 7 in purple, scenario 8 in olive green and scenario 9 in light blue.

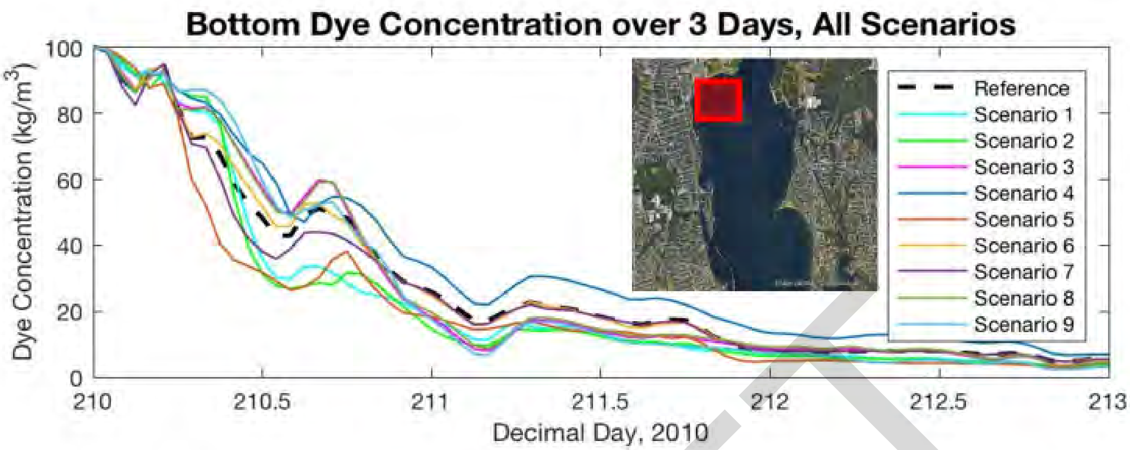

Figure 32: Numerical tracer (dye) results over three days of the model run in the bottom water in a pre-designated analysis box on Edgewood Shoals, for each scenario. The reference case is noted with a black dotted line. Dredging scenario 1 is noted in cyan, scenario 2 in green, scenario 3 in magenta, scenario 4 in dark blue, scenario 5 in red, scenario 6 in yellow, scenario 7 in purple, scenario 8 in olive green and scenario 9 in light blue.

In the bottom water is where concerns lie about chronic low dissolved oxygen. Looking at the bottom water numerical tracer concentration in figure 32, the first scenario to show an increased rate of dye dispersal in the bottom water is Scenario 5, dropping to below 40% of the original dye concentration after 12 hours of model run. Variation is seen throughout time due to tidal fluctuation of dye into and out of the analysis box. After one day, scenario 4 and the reference have retained the most amount of dye, and continue that pattern well into 36 and 48 hours of the analysis period. After three days of the run, all of the scenarios drop to an ambient background level of numerical tracer.

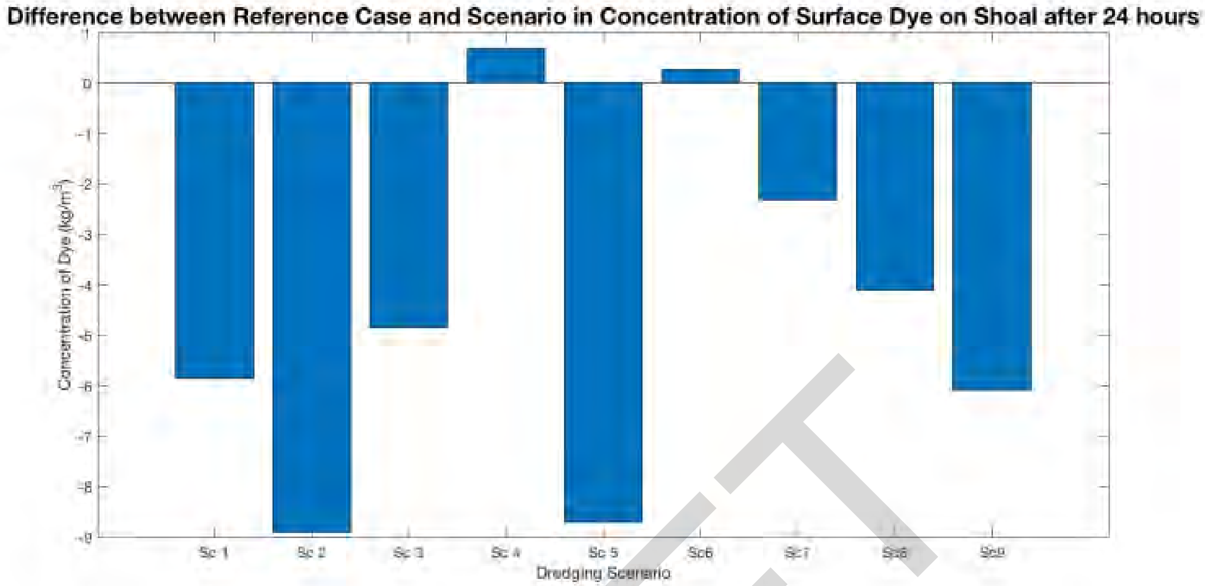

Figure 33: Numerical tracer (dye) results after 24 hours of the model run in the surface water in a pre-designated analysis box at the Turning Basin, for each scenario subtracted from the reference case. Note that positive values indicate that the scenario run has a higher concentration of dye in the analysis box than the reference case, while negative values indicate that the concentration of dye in the analysis box at the Turning Basin is less than that of the reference case.

When viewing these results as a difference between each scenario and the reference case, scenarios 2 and 5 have the largest differences in surface dye concentration from the reference after 24 hours (Figure 33). Scenarios 4 and 6 have a slightly higher concentration than the reference, indicated by a positive value. This indicates that dye is being retained in the analysis box at a higher level than that of the reference case. Overall, the surface water is more efficient at numerical tracer dispersal due to higher water velocities in the surface water.

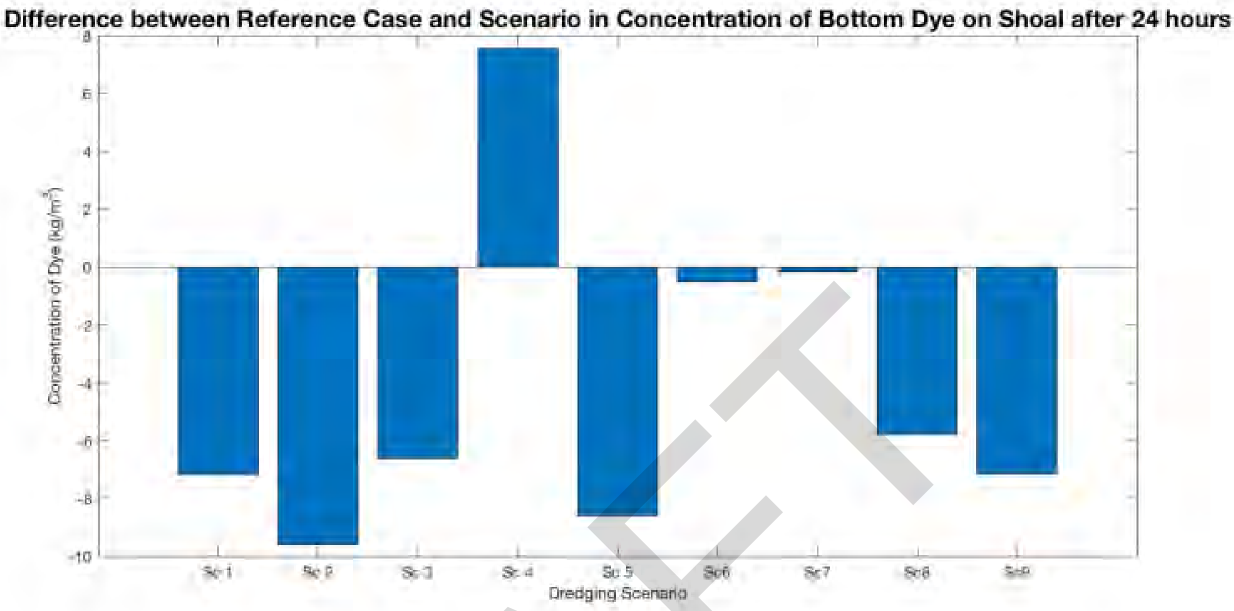

Figure 34: Numerical tracer (dye) results after 24 hours of the model run in the bottom water in a pre-designated analysis box at the Turning Basin, for each scenario subtracted from the reference case. Note that positive values indicate that the scenario run has a higher concentration of dye in the analysis box than the reference case, while negative values indicate that the concentration of dye in the analysis box at the Turning Basin less than that of the reference case.

In the bottom water (figure 34), the largest differences between the reference case and the dredging scenario cases occurs in scenarios 2, 5 and 4. Scenario 2 has roughly 10% less dye at the Turning Basin analysis box than the reference case, whereas scenario 5 has roughly 8% less dye. Scenario 4 has 8% more dye in the analysis box than the reference case, indicating retention of dye at the Turning Basin in comparison with the reference case. Scenarios 6 and 7 have the smallest differences in concentration with the reference case.

Lagrangian Drifter Analysis (Floats)

975 floats started in the analysis box at the Turning Basin, and were released to flow with the tidal and residual flows for 10 days. Figure 35 is a time-series of the number of floats in the analysis box in the Turning Basin of the shoal over the course of three days of model runs. After 3 days, the level of floats flatlines and eventually moves towards zero. Scenario 4 retains the

highest number of floats throughout time, whereas Scenarios 1, 2, 5 and 9 are the most efficient at removing floats from the shoal. In Scenario 1, the floats in the analysis box increase at a high rate, then decrease over time.

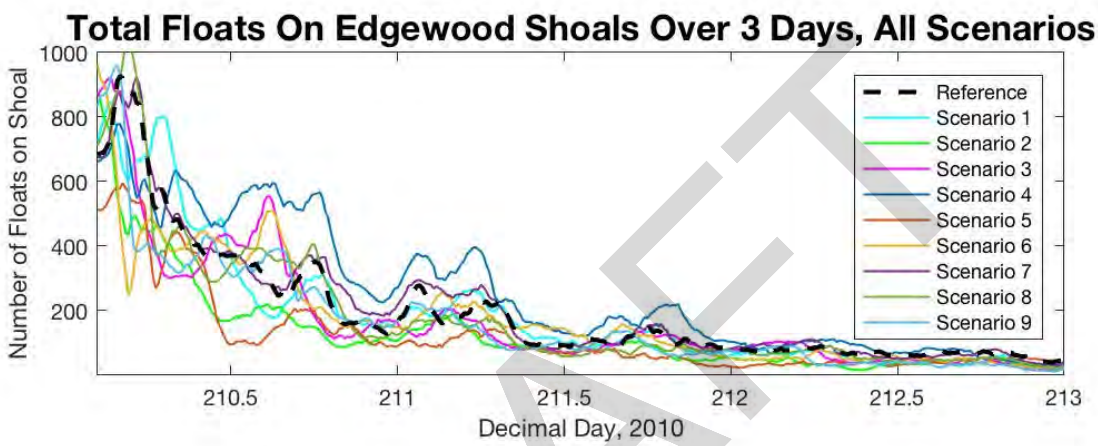

Figure 35: Lagrangian drifter (floats) counts over three days of the model run in the entire water column in a pre-designated analysis box at the Turning Basin, or each scenario. The reference case is noted with a black dotted line. Dredging scenario 1 is noted in cyan, scenario 2 in green, scenario 3 in magenta, scenario 4 in dark blue, scenario 5 in red, scenario 6 in yellow, scenario 7 in purple, scenario 8 in olive green and scenario 9 in light blue.

Profiles of Temperature and Salinity:

In the reference case, and in real-time, Edgewood Shoals is both thermally and salinity stratified under normal summer conditions. In the model, normal summer conditions are paired with light winds and low surface run-off, indicating the presence of a moderately stratified water column. Vertical profiles of salinity and temperature for the Turning Basin (northwest section of the shoal) are provided in figures 36 and 37.

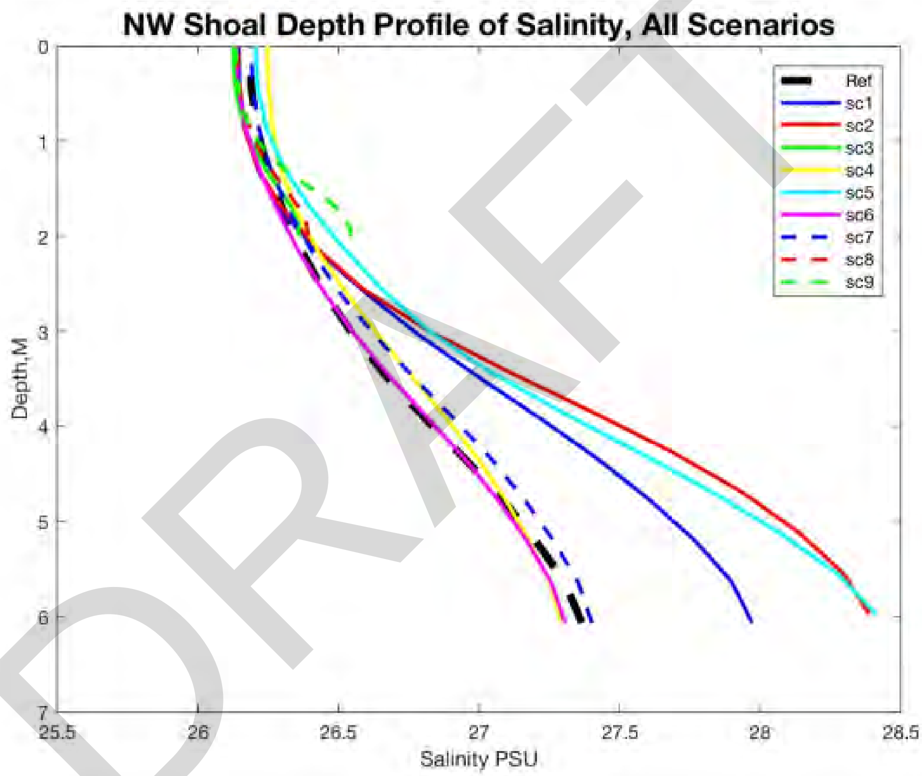

Figure 36: Modeled output of vertical profiles of salinity in the Turning Basin, for each dredged scenario. Note that scenarios 3, 6 and 9 feature shallower depths because the design fills in the Turning Basin.

In terms of salinity, three of the scenarios see a slight increase in the salinity of the bottom water Turning Basin. Scenarios 1, 2 and 5 see an increase in salinity by roughly 1.5 PSU (Practical Salinity Units) from the Reference case

In the vertical profile of temperature analysis, the profiles in the southwest and southeast sections of the shoal remain relatively constant between scenarios. In the northwest section of the shoal, there is a temperature drop of roughly 0.2 degrees C in scenarios 2 and 5, with a 0.1 degrees C decrease in temperature in scenario 1. In the northeastern section of the shoal, scenario 5 shows the only change in temperature from the reference.

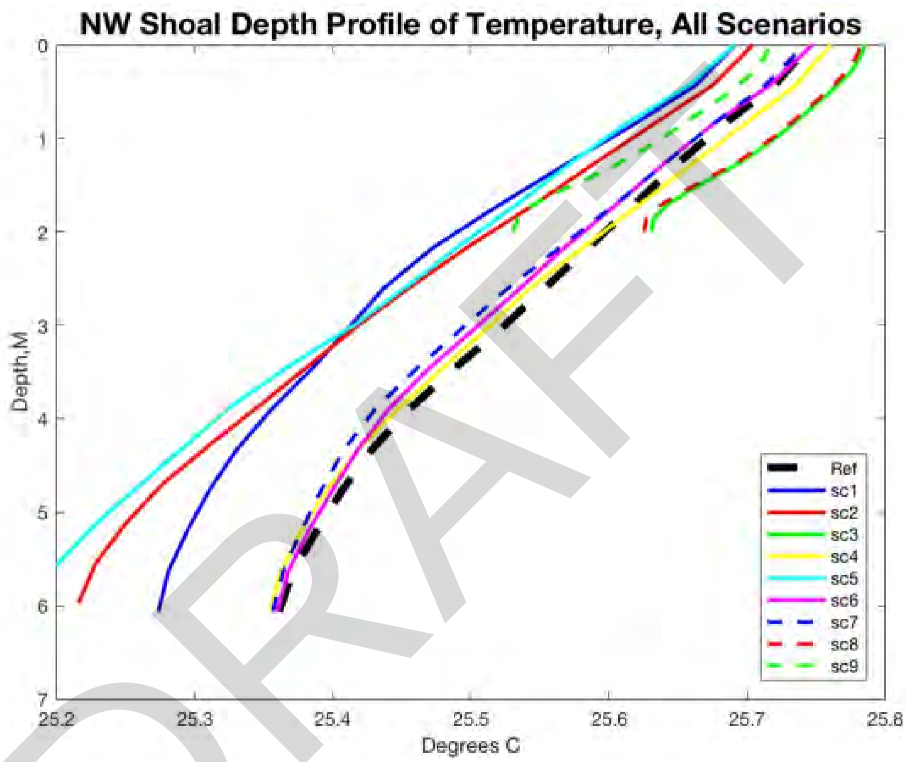

Figure 37: Modeled output of vertical profiles of temperature in the Turning Basin (in the northwest section of the Shoal), for each dredged scenario. Note that scenarios 3, 6 and 9 feature shallower depths because the design fills in the Turning Basin.

Temperature and Salinity from Modeled Stations:

Temperature on the shoal decreases in all scenarios except Scenarios 3, 8 and 9, where there is a temperature increase of 0.25, 0.22, and 0.15 °C, respectively, in the northwest zone of the shoal. This temperature increase also coincides with a salinity decrease by 0.9, 0.8 and 0.6 PSU, respectively. Scenario 5 also alters the temperature and salinity of the northwest section of the shoal by decreasing bottom water temperature and increasing the salinity. Scenarios 1, 2 and 9 cause a relatively large decrease in temperature in the northeast zone of the shoal, which coincides with 1.1, 1.2 and 1.05 PSU increase in salinity, respectively. Scenarios 3 and 6 cause a 0.5 PSU increase in salinity in the southeastern zone of the shoal, which is coupled with a 0.1-°C drop in temperature.

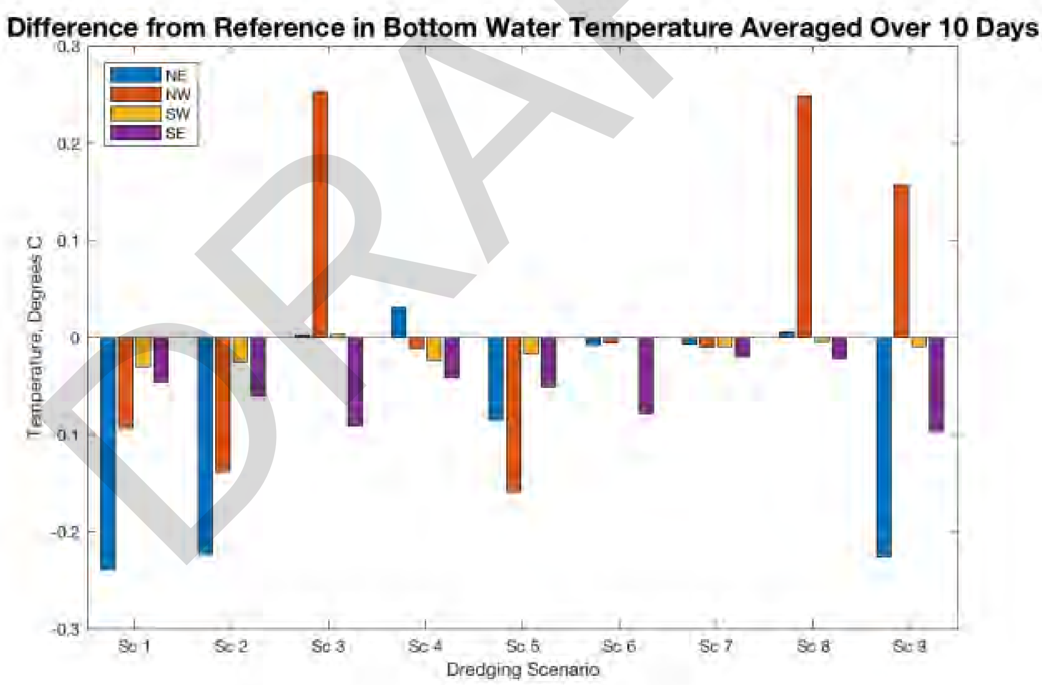

Figure 38: Difference in modeled bottom water temperature between each scenario and the reference. The northeastern zone of the shoal is in blue, the northwestern zone in red, the southwest zone in orange and the southeast zone of the shoal in purple.

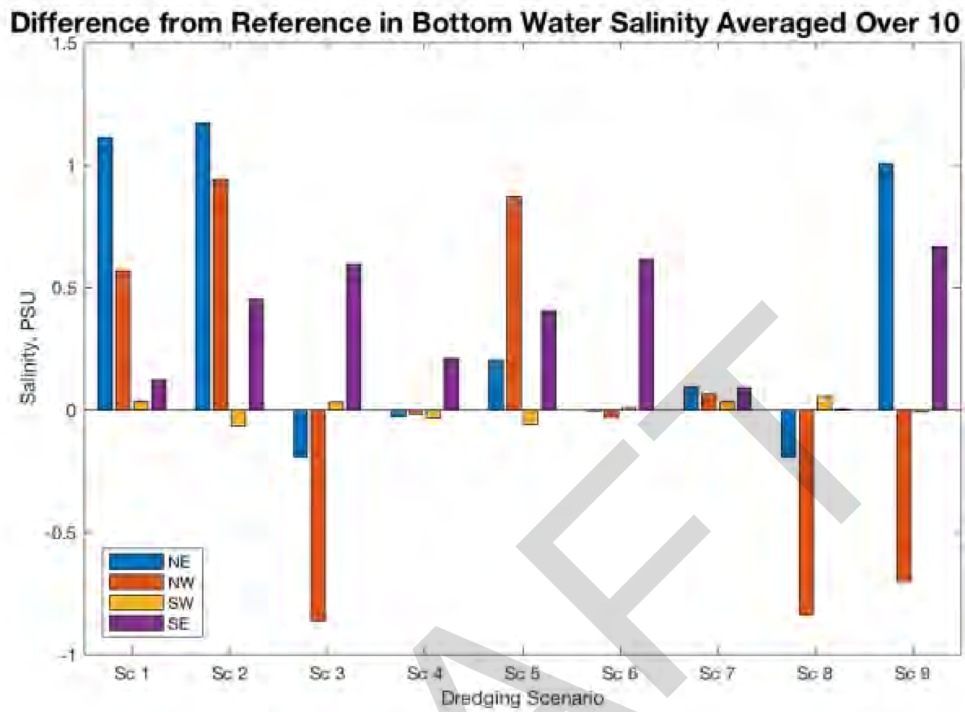

Figure 39: Difference in modeled bottom water salinity between each scenario and the reference. The northeastern zone of the shoal is in blue, the northwestern zone in red, the southwest zone in orange and the southeast zone of the shoal in purple.

7. **DISCUSSION OF RESULTS**:

Edgewood Shoals is considered to be a circulation restricted zone. A circulation restricted zone features two distinct, location-based flow regimes in a similar region, which allows one of the regions to be disconnected from the main region of flow. In the case of Edgewood Shoals, a steep bathymetric gradient between Edgewood Shoals and the maintained Providence River Ship Channel acts as a barrier for water to move in an east-west direction to flush during an entire tidal cycle, which inhibits the flushing capacity on a residual, or non-tidal scale.

There are two exit pathways considered on Edgewood Shoals when designing dredged scenarios to increase flushing. The first exit pathway is via the northeast section of the shoal, just to the south of Fields Point. The second exit pathway is through the Port Edgewood Channel.

The exit pathways are naturally utilized by the Shoal during two short periods of each tidal cycle. During the slack before ebb, water moves from the Turning Basin towards the Ship Channel. If a scenario can be created that enhances the pre-existing conduit for water exiting the Shoal in the northeast section to the south of Fields Point, the flushing dynamics of the Turning Basin can be improved.

Scenarios 1, 2 and 9 (Table 1) enhance the first exit pathway, by creating an east-west oriented channel to the south of Fields Point. Scenarios 1, 2, and 9 cause an increasingly westward residual velocity of water, with the bottom water moving eastward at the same magnitude as the reference (figure 35). When this pathway is dredged, water to exchange on-to and off-of the shoal in the area just to the south of Fields Point. What is believed to be happening is that the surface water is pushed around the corner of Fields Point from the main Ship Channel, while bottom water is being flushed in the net-eastward direction into the Ship Channel through the new channel of these scenarios. Dye results indicate that scenarios 1, 2 and 9 are more efficient in removing dye from the shoal than the reference case, and the other scenarios, except for Scenario 5. Similar to the numerical dye tracer results, Scenarios 1, 2, and 9 are the most efficient at removing floats from the shoal. The matching result indicates that the exit pathway to the northeast is a dominant flushing characteristic of Edgewood Shoals.

If the only exit pathway for chemical constituents leaving Edgewood Shoal is enhanced by dredging a channel connecting the Turning Basin to the Ship Channel with an east-west orientation, this does not explain why Scenario 5, which deepens the Port Edgewood Channel, causes a high rate of dye removal from the Shoal. Scenario 5 deepens the Port Edgewood Channel to a depth of roughly 5 meters, and keeps the Turning Basin intact. This indicates that another main entrance/exit pathway for chemical constituents onto the shoal is through the Port Edgewood Channel. Since exchange is classified in this area as the east-west flow of water onto and off of the shoal, a significant increase in the eastward or westward velocities in the northwest zone of the shoal indicate that water is either moving eastward off of the shoal into the Ship Channel, where it is transported down-bay, or that water is jumping the shoal break and is making its way onto the shoal in a westward motion. It is assumed that a northward-southward increase in velocities will not have this same effect due to the orientation of the shoal in the vicinity of the Ship Channel.

One of the most important zones on the shoal is the northwest section of the Shoal, or the area that makes up the Port Edgewood Turning Basin. This formerly maintained area is susceptible to low dissolved oxygen counts in the summer, indicating bottom water that remains fairly stagnant over long periods of time. Observational studies have indicated that this area of the shoal exhibits low tidal and residual flows during both spring and neap tide periods, and will only increase instantaneous velocities under certain conditions. In this study, one of the important factors taken into account is choosing a dredging scenario that will allow the Turning Basin, or the northwest region of the shoal, to increase instantaneous and residual velocities in order to flush this impacted region.

Temperature and salinity can be used as tracers of water masses comprising the Shoal and the Ship Channel. Edgewood Shoal is, during the model run, slightly warmer and has a lower salinity than the Ship Channel. An increase in salinity coupled with a decrease in temperature is an indication of the Ship Channel water mass moving onto Edgewood Shoals. Scenario 5 alters the temperature and salinity of the northwest region of the shoal by decreasing bottom water temperature. Since Scenario 5 deepens the Port Edgewood Channel, it is further evidence supporting the function of the Port Edgewood Channel as a conduit for saltier, cooler lower bay water onto and off-of the Edgewood Shoals. Scenarios 1, 2 and 9 cause a relatively large decrease in temperature in the northeast section of the shoal, which coincides with 1.1, 1.2 and 1.05 PSU increase in salinity, respectively. Scenarios 1, 2 and 9 have a similar feature in that they create a connecting channel between the Providence River Ship Channel and the Port Edgewood Turning Basin. The dredging of this channel is allowing cooler, saltier water in the form of Providence River Ship Channel bottom water to make its way onto the shoal.

Due to issues with model resolution on the shoal, it is believed that dye flux off of the shoal is artificially fast. When comparing the results to flushing in real-time, low velocities in the Turning Basin region of the Shoal experience low tidal and residual velocities in the bottom water, indicating a relatively stagnant water column during periods of neap tides and low winds. Artificially fast flushing rates can be attributed to artificially high tidal and residual modeled velocities. However, tidal and residual velocities on the shoal during the modeled period match observational data in both neap tide periods and spring tide periods and are within a range of error of 1 cm/s in many areas of the Shoal. It is possible that the grid resolution in this area is creating artificial diffusion between grid cells, however further investigation coupled with a higher-resolution NB-ROMS grid is necessary to fully understand the exchange between grid cells on a diffusive scale.

Scenarios 3, 6 and 9: Placement of a Modeled CAD Cell

The Army Corps' purpose in undertaking this study is to identify opportunities for placement of a CAD cell in the Edgewood Shoals that could include bathymetric modifications to the shoal such that improvements would result in increased water circulation therefore improved water quality. Three of the nine scenarios that were modeled (Scenarios 3, 6, and 9 in Table 1) included placement of a CAD cell at the southeastern section of the shoal. Each of these three scenarios included variations of additional bathymetric modifications which resulted in differing degrees of improvement to the water circulation and water quality in the Turning Basin on Edgewood Shoal.

According to the numerical dye results, the addition of a CAD cell in the southwest section of the shoal (Scenario 6, Table 1) neither significantly increases, or decreases, the retention of water parcels in the bottom water of the Turning Basin. Surface dye analysis indicates a 0.5% increase of numerical dye, or 5 kg/m^3, out of the initial starting condition of 100 kg/m^3. In the bottom water, there is a 0.4% decrease in numerical dye. This result is the closest value of dye to the reference of all scenarios tested, indicating the least amount of change to the circulation dynamics of the Shoal. Scenario 3, (Table 1) which fills in the Port Edgewood Turning Basin to an ambient depth of 2 meters as well as places a CAD cell in the southwest section of the shoal, decreases the amount of numerical dye in the bottom water of the Edgewood Shoals Turning Basin by 7% and decreases the amount of numerical dye in the surface water by 4.5%. Further studies on the sensitivity of the depth of the Turning Basin must be completed in order to determine if there is a specific depth that should be considered for the Basin in order to allow for flushing of this system. Scenario 9 (Table 1), which fills in the Turning Basin, adds a CAD cell in the southwest section of the Shoal, and finally dredges an east-west oriented channel just to the south of Fields Point, also decreases the amount of numerical dye retained in the bottom water of the Turning Basin by 7.5%, and decreases the amount of numerical dye retained in the surface water of the Turning Basin by 6.5% .

CONCLUSIONS:

The DMMP for the next maintenance dredging cycle of the Providence River and Harbor FNP includes the potential to construct a Confined Aquatic Disposal (CAD) Cell in a shallow area of the Providence River known as Edgewood Shoals. This report outlines bathymetric modifications of the shoal, or dredging scenarios, for the purpose of CAD cell placement and access. 9 Scenarios were built and run for 10 days during the summer of 2010 using a free-surface, 3-dimensional hydrodynamic model called ROMS (The Regional Ocean Modeling System) that has been configured for Narragansett Bay. Environmental benefit for each dredging scenario is determined through analysis of flow structure on the shoal, as well as the comparison of the retention of lagrangian drifters and numerical passive tracers (dyes) in the highly impacted section of the shoal known as the Port Edgewood Turning Basin

From this analysis, it appears that the most effective way to force exchange between the Edgewood Shoals and the Providence River Ship Channel is an east-west channel to act as a conduit for flow between the Ship Channel and the bottom water of the Turning Basin. This involves a large amount of dredging in an area where it may not be possible to reach the depth of the suggested scenarios. However, it is also evident that decreasing the depth of the Turning Basin to an ambient depth of 2 meters (Scenarios 3, 8 and 9) increase the vertical mixing of the water column, encouraging the breakdown of the stratified water column, which may cause a decrease in the low dissolved oxygen events which occur on the Shoal. This result is significant, because of the preference for filling with clean material versus dredging additional unsuitable material. When both filling and access channel dredging designs are combined, in Scenario 9, the effect of mixing the water column in the Turning Basin and enhancing a natural flushing pathway cause the most efficient flushing.

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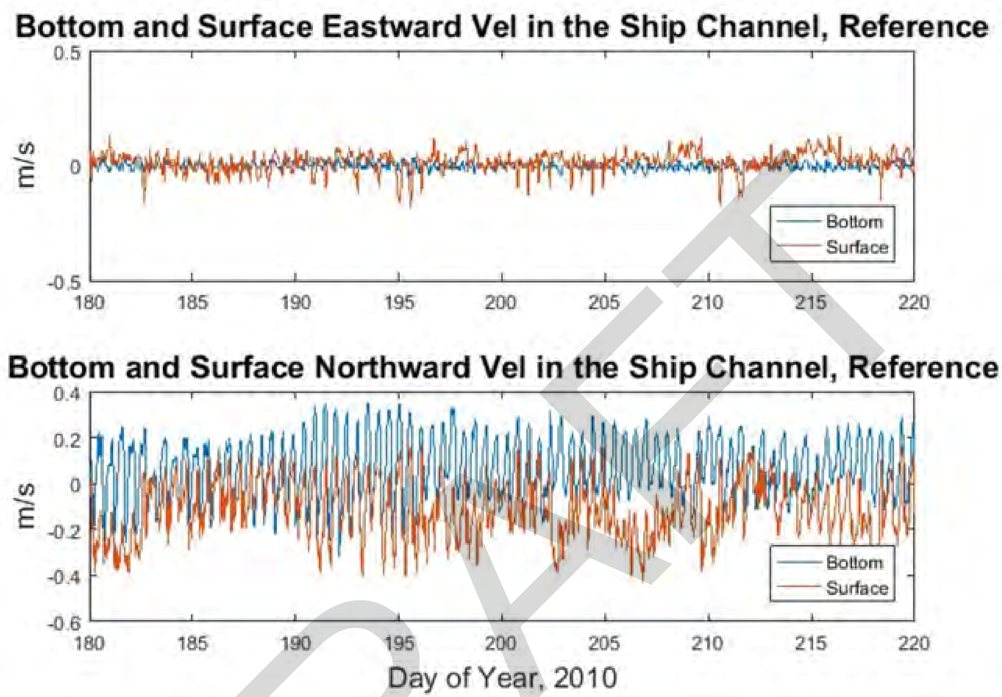
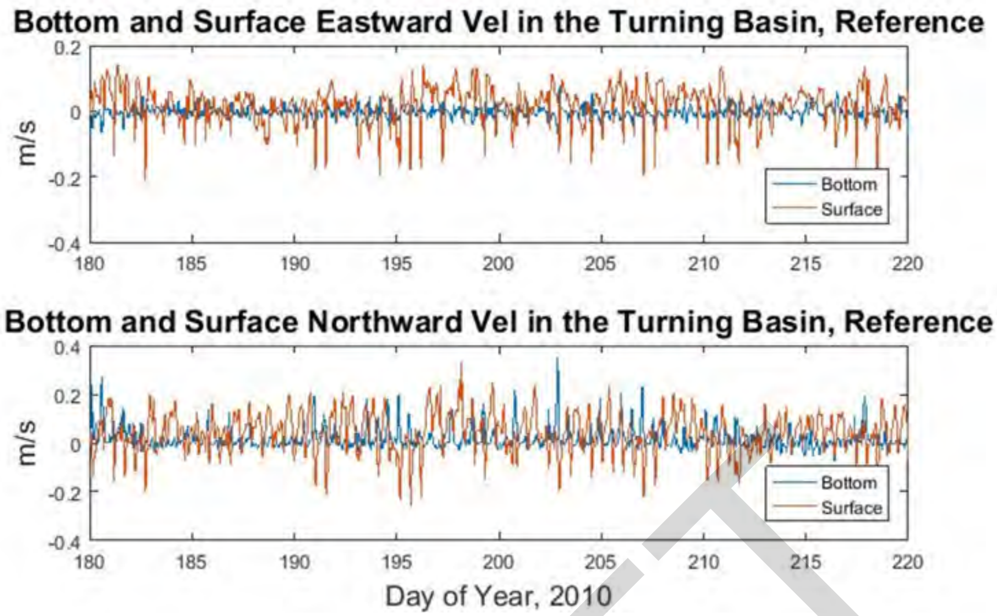
9. APPENDIX

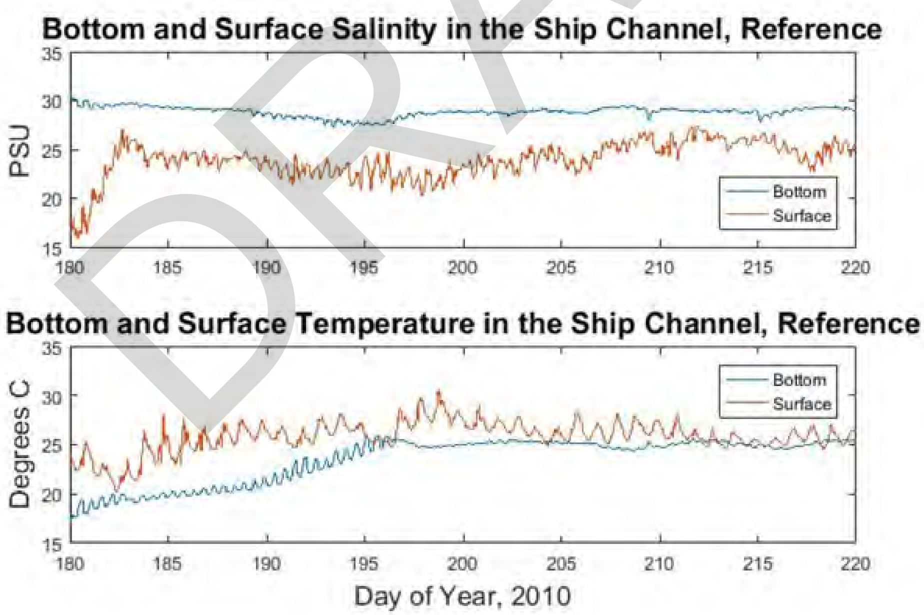
Appendix A: Additional Figures: Modeled Results from Spring and Neap Periods (40-day model runs)



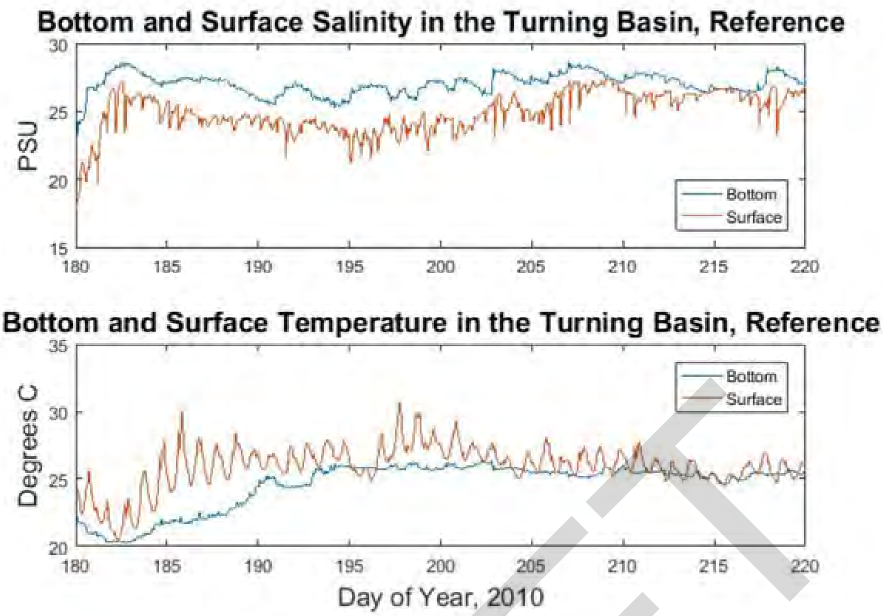
A1. Bottom and surface modeled eastward and northward tidal velocities in the Ship Channel, for the Reference Case (featuring the existing bathymetry on Edgewood Shoals). Blue represents the tidal velocities in the surface water, whereas red indicates the tidal velocities in the bottom water of the Ship Channel.



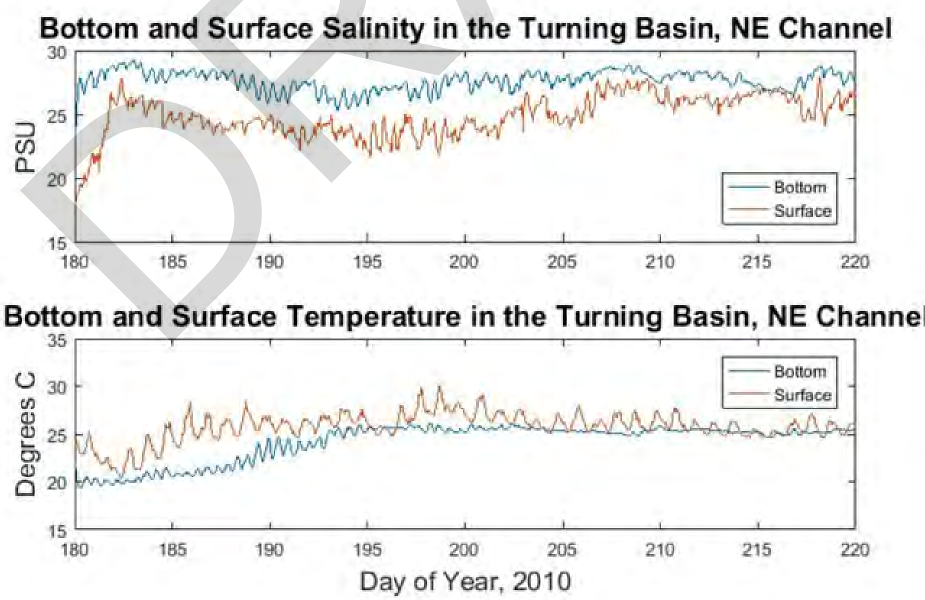
A2. Bottom and surface modeled eastward and northward tidal velocities in the Turning Basin on Edgewood Shoals, for the Reference Case (featuring the existing bathymetry on Edgewood Shoals). Blue represents the tidal velocities in the surface water, whereas red indicates the tidal velocities in the bottom water of the Turning Basin.



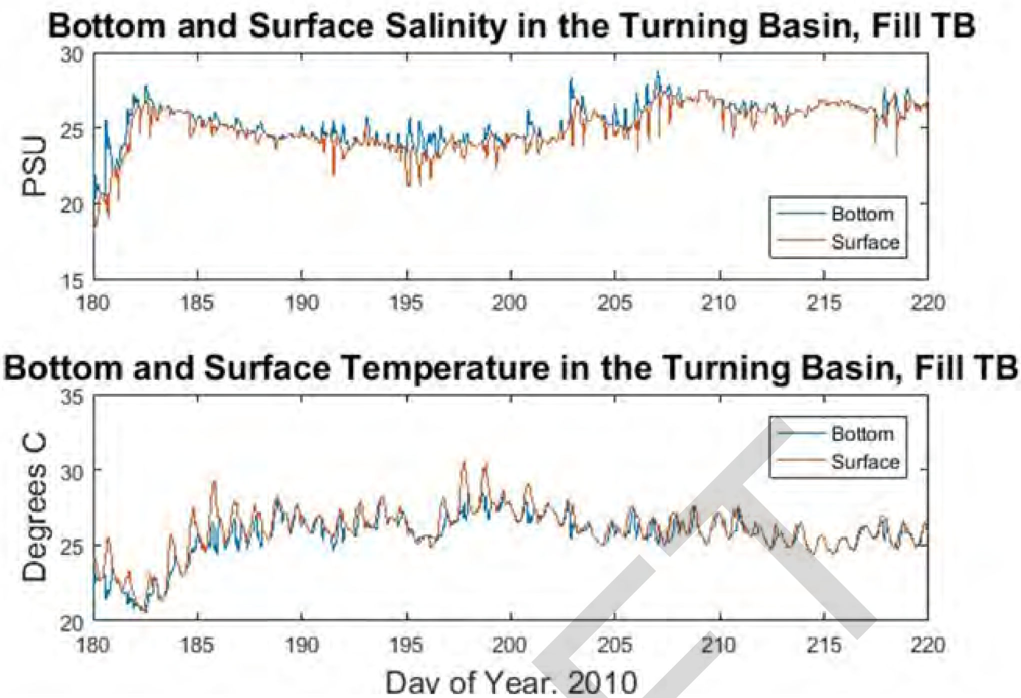
A3. Bottom and Surface salinity and temperature in the Ship Channel for the Reference Case. Blue signifies a bottom water result, whereas red signifies a surface water result. Note that the stratification in the Ship Channel is present throughout most of the model run.



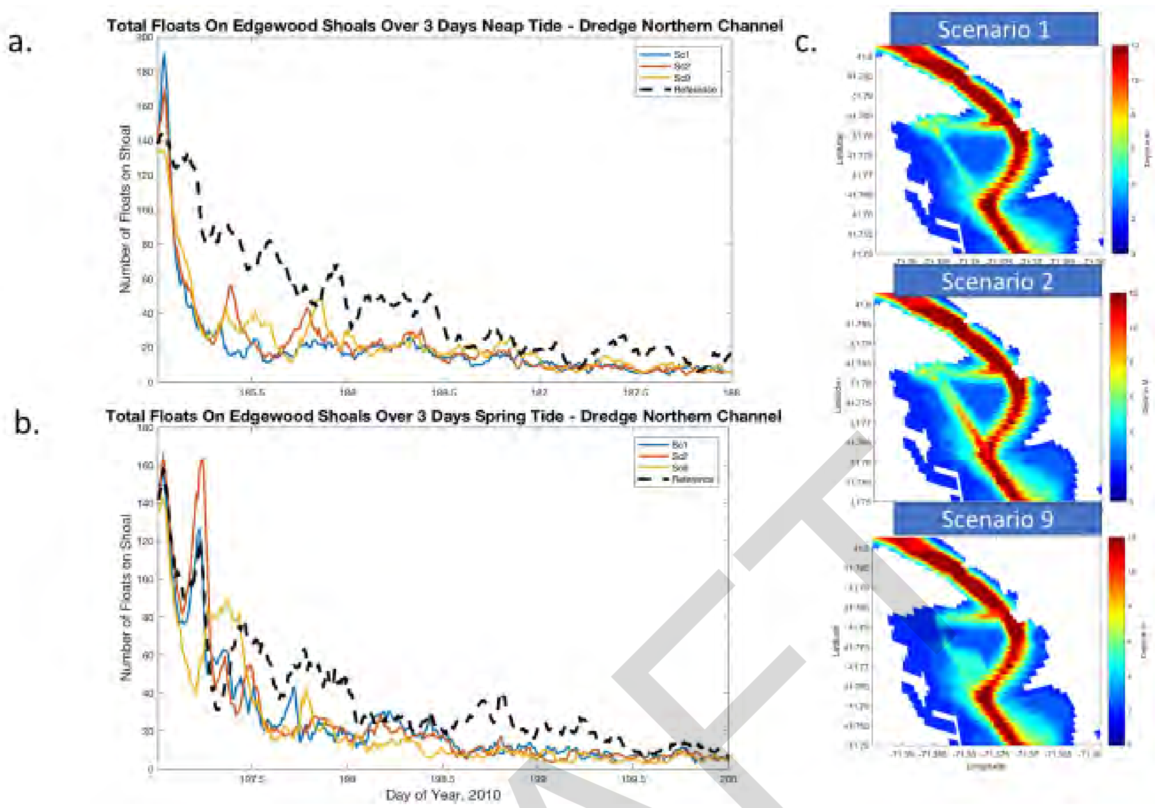
A4. Bottom and Surface salinity and temperature in the Turning Basin in the Reference Case. Blue signifies a bottom water result, whereas red signifies a surface water result. Note that the stratification in the Turning Basin is present throughout most of the model run.



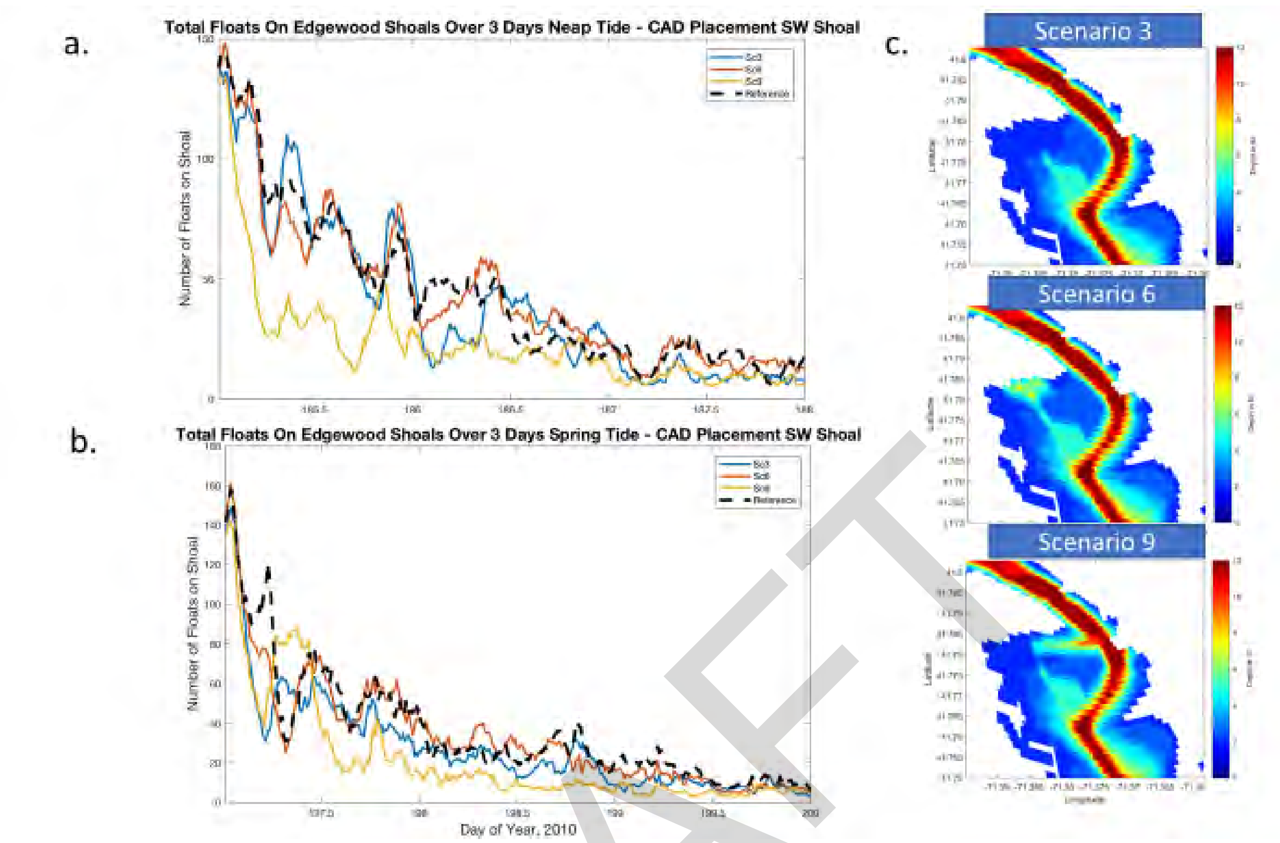
A5. Bottom and Surface salinity and temperature in the Turning Basin after the addition of an east-west oriented channel just to the south of Fields Point. This dredged design is featured in Scenarios 1, 2 and 9 (Table 1 in main report).



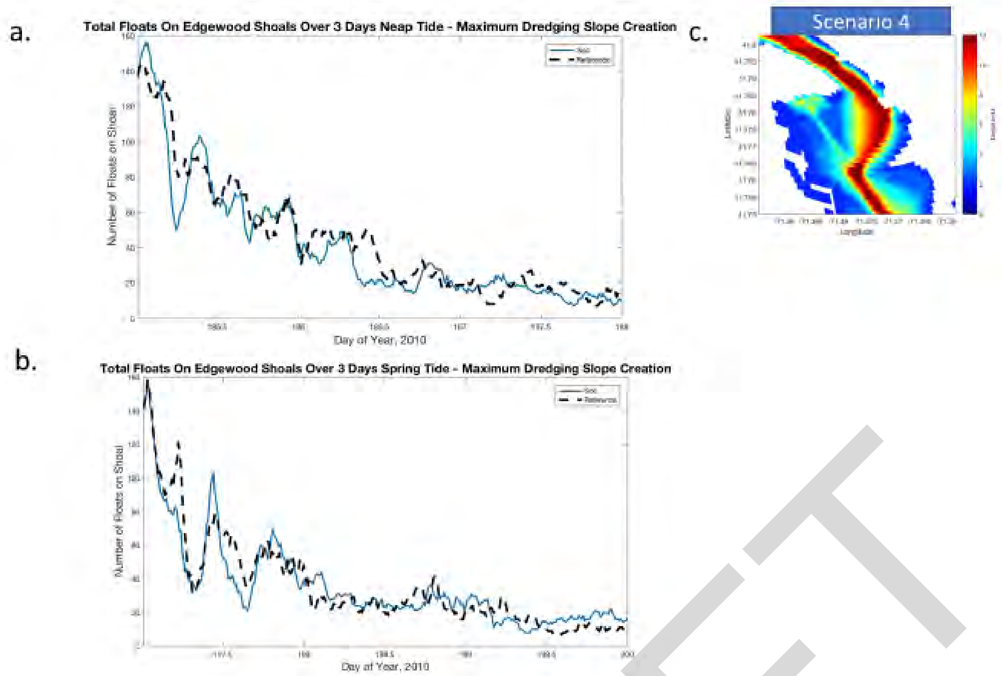
A6. Bottom and Surface salinity and temperature in the Turning Basin after filling in the Port Edgewood Turning Basin. This dredged design is featured in Scenarios 3, 8 and 9 (Table 1 in main report). Blue signifies a bottom water result, whereas red signifies a surface water result. Note that the stratification in the Turning Basin is almost non-existent after filling in the Turning Basin to an ambient depth of 2 meters.



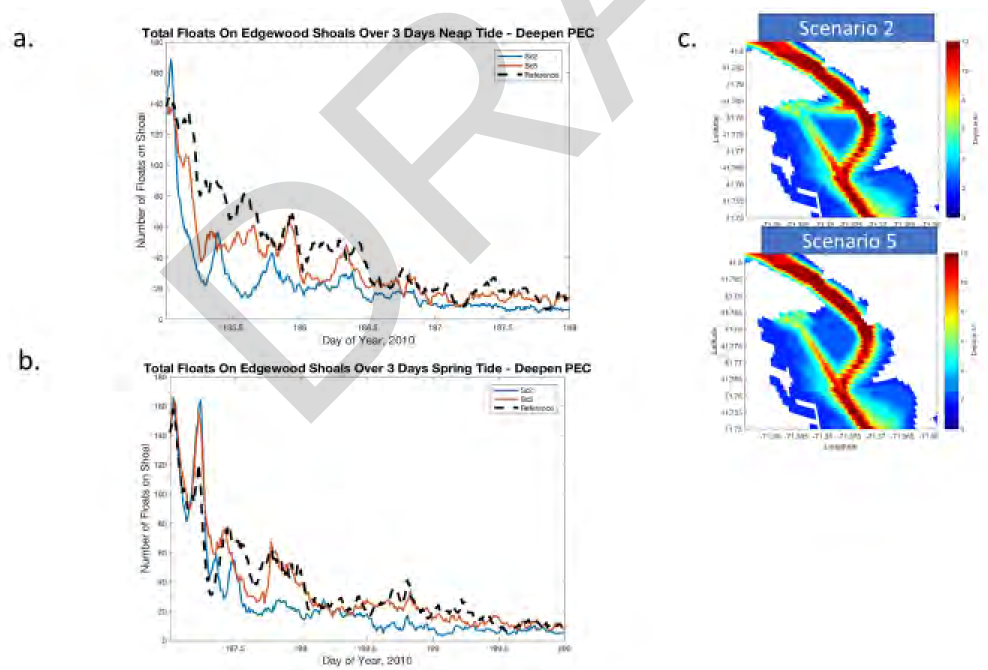
A7. Drifter (float) results for an (a.) neap tide and (b.) spring tide for the reference case versus all scenarios that dredge an east-west oriented channel just to the south of Fields Point (Table 1, main report). Scenario 1 is indicated in blue in the time-series, Scenario 2 in red, and Scenario 9 in yellow.



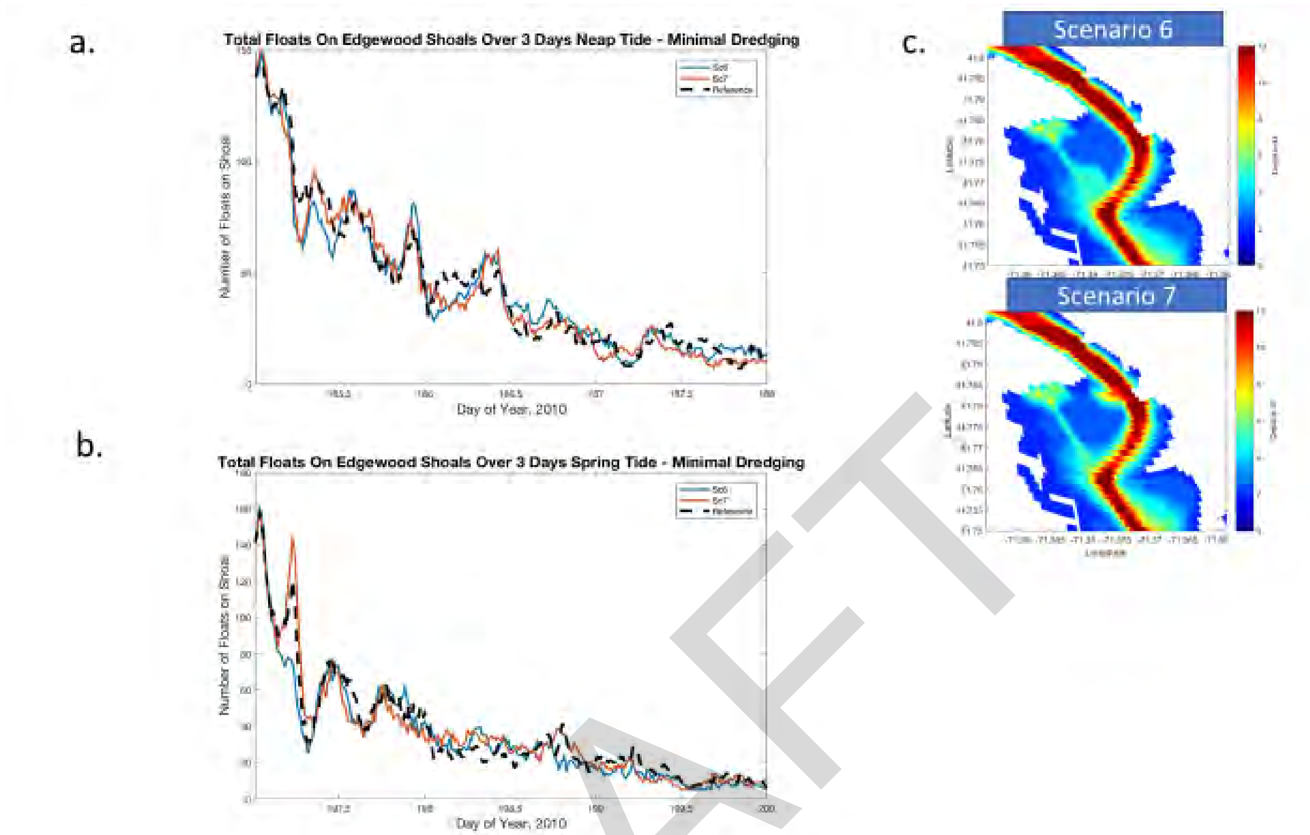
A8. Drifter (float) results for an (a.) neap tide and (b.) spring tide for the reference case versus all scenarios that place a modeled CAD cell in the southwest section of the Shoal (Table 1, main report). Scenario 3 is indicated in blue in the time-series, Scenario 6 in red, and Scenario 9 in yellow.



A8. Drifter (float) results for an (a.) neap tide and (b.) spring tide for the reference case versus all scenarios that place a modeled CAD cell in the southwest section of the Shoal (Table 1, main report). Scenario 3 is indicated in blue in the time-series, Scenario 6 in red, and Scenario 9 in yellow.

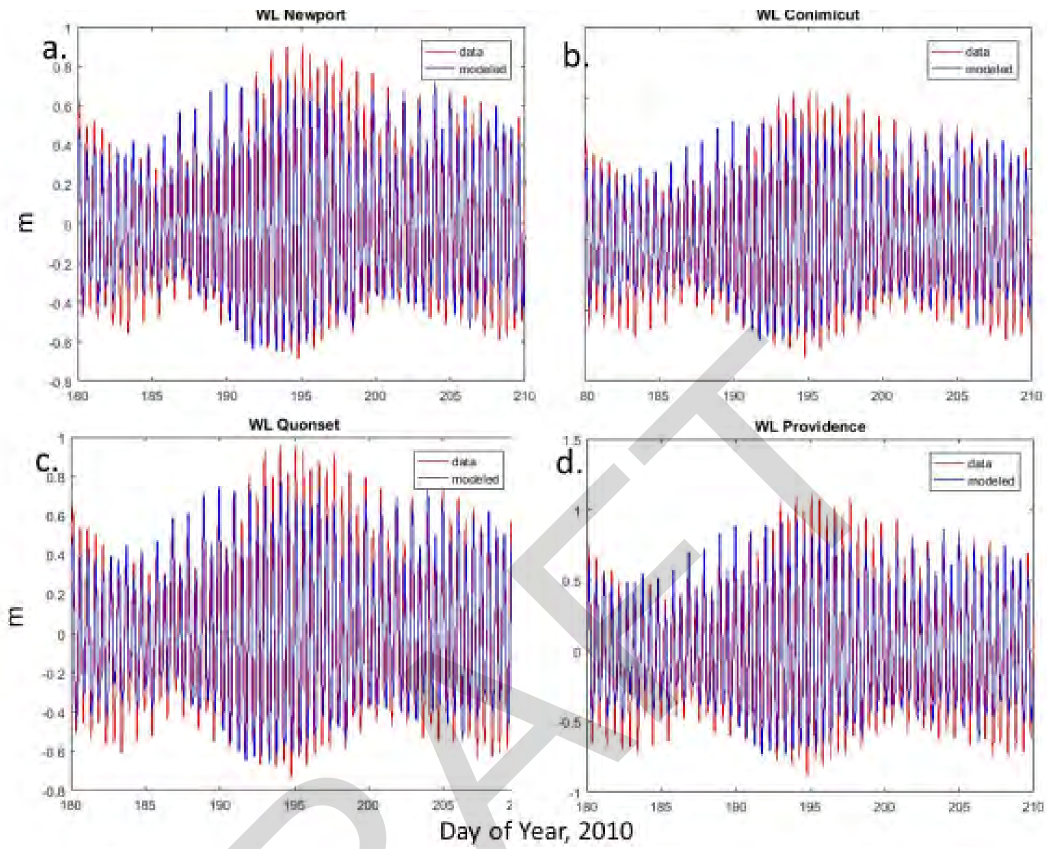


A8. Drifter (float) results for an (a.) neap tide and (b.) spring tide for the reference case versus all scenarios that place a modeled CAD cell in the southwest section of the Shoal (Table 1, main report). Scenario 3 is indicated in blue in the time-series, Scenario 6 in red, and Scenario 9 in yellow.

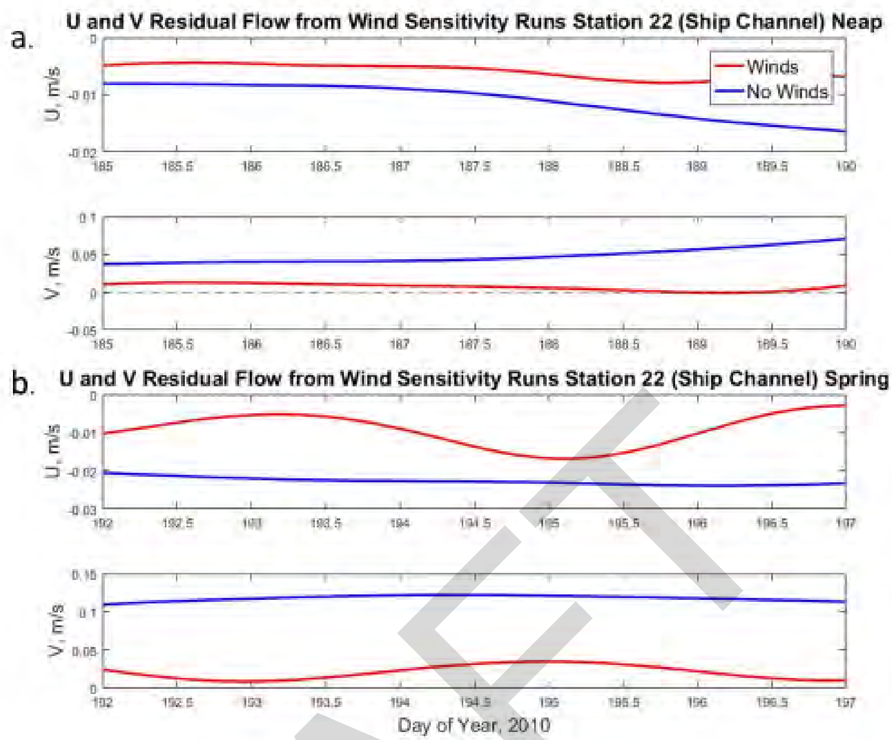


A8. Drifter (float) results for an (a.) neap tide and (b.) spring tide for the reference case versus all scenarios that place a modeled CAD cell in the southwest section of the Shoal (Table 1, main report). Scenario 3 is indicated in blue in the time-series, Scenario 6 in red, and Scenario 9 in yellow.

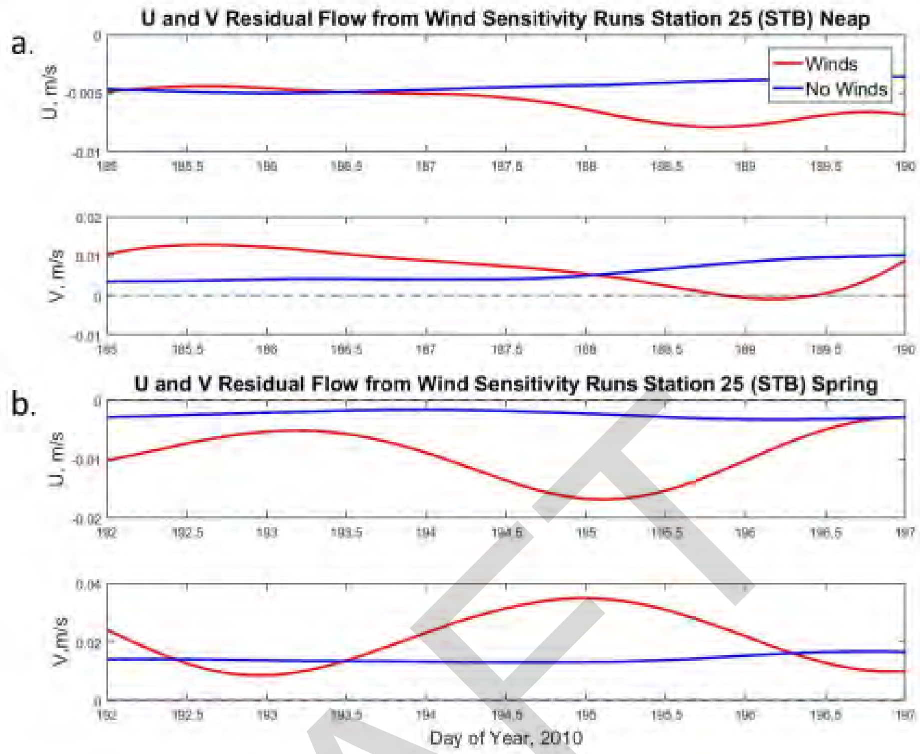
Appendix B: Model Verification



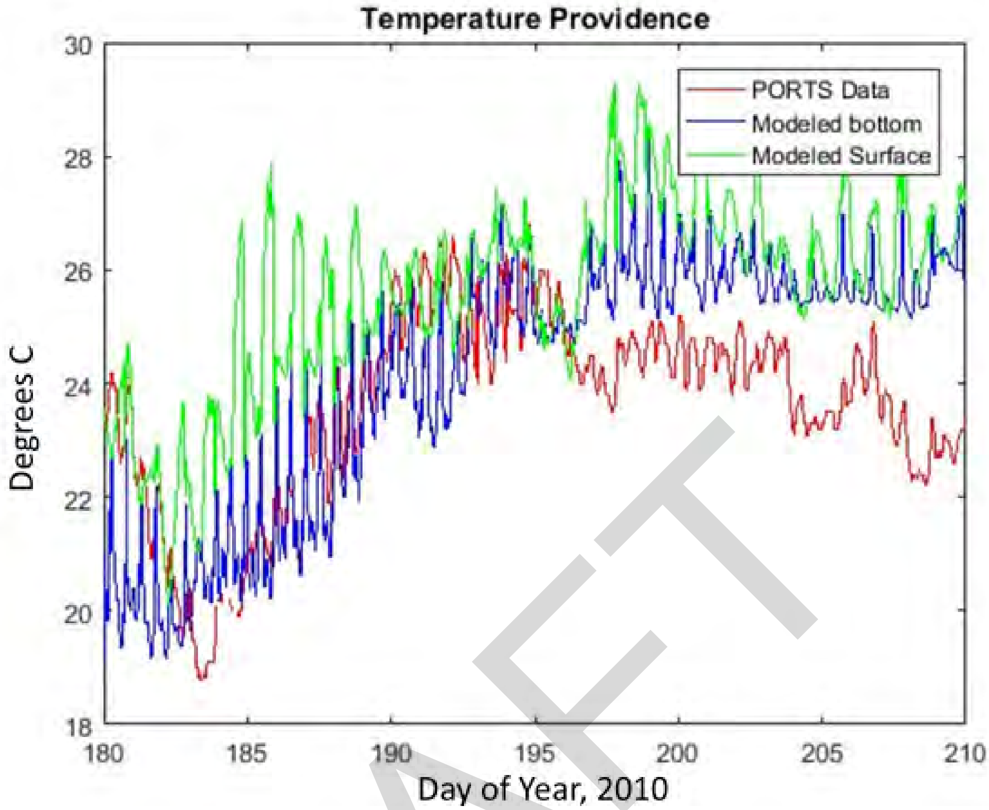
B1. Modeled water levels in the NB-ROMS model (blue) versus recorded water levels (red) at NOAA PORTS stations at (a.) Newport, (b.) Conimicut (c.) Quonset and (d.) Providence.



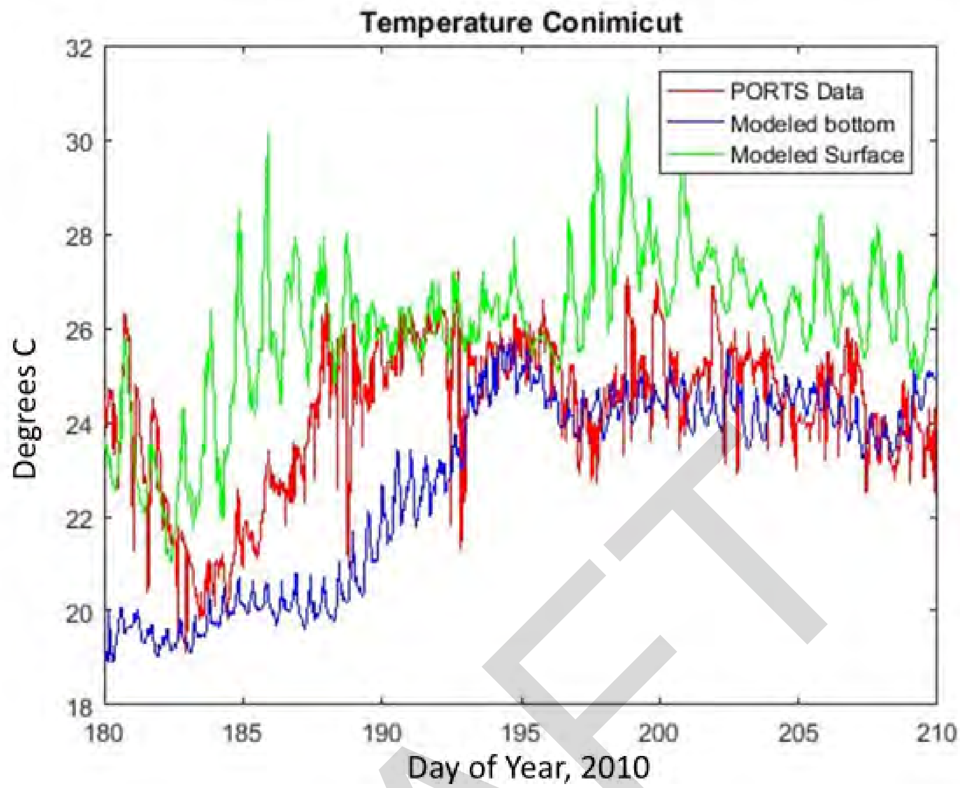
B2. Results of wind sensitivity analysis, for a modeled station in the Ship Channel during a spring tide. Blue indicates the run that was completed without winds forcing the model, and red indicates the model run that was completed with observed winds from T.F. Green Airport, uniformly applied to the entire model domain.



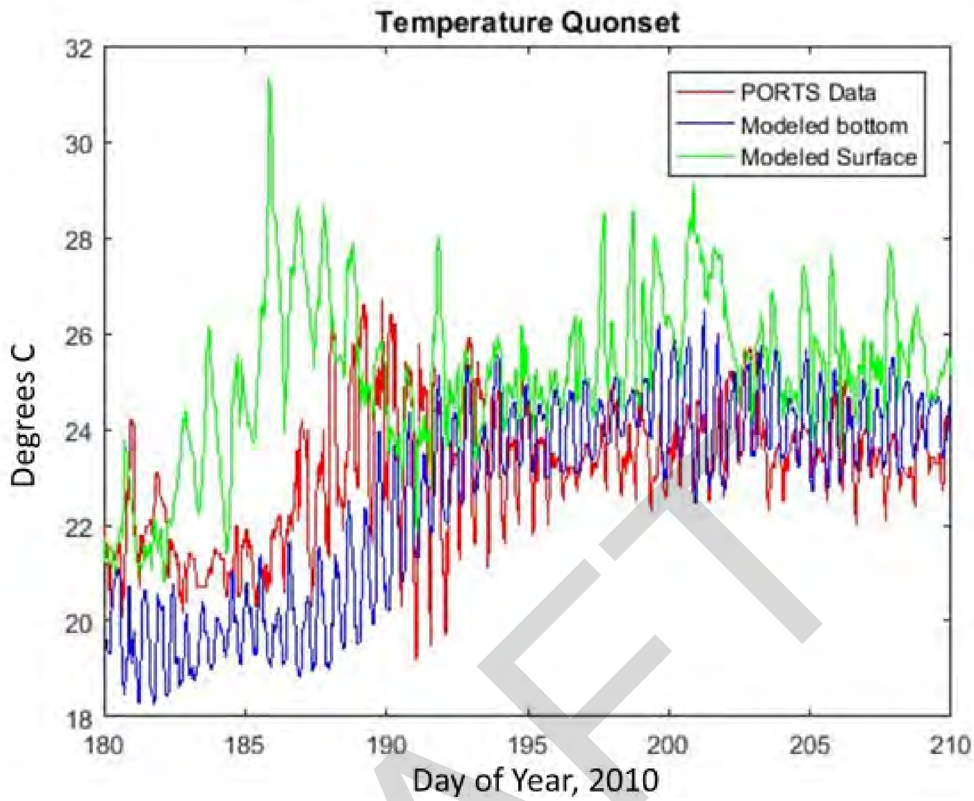
B3. Results of wind sensitivity analysis, for a modeled station at Save the Bay dock during a spring tide. Blue indicates water velocity (eastward and northward) from the run that was completed without winds forcing the model, and red indicates the water velocity (eastward and northward) from the model run that was completed with observed winds from T.F. Green Airport, uniformly applied to the entire model domain.



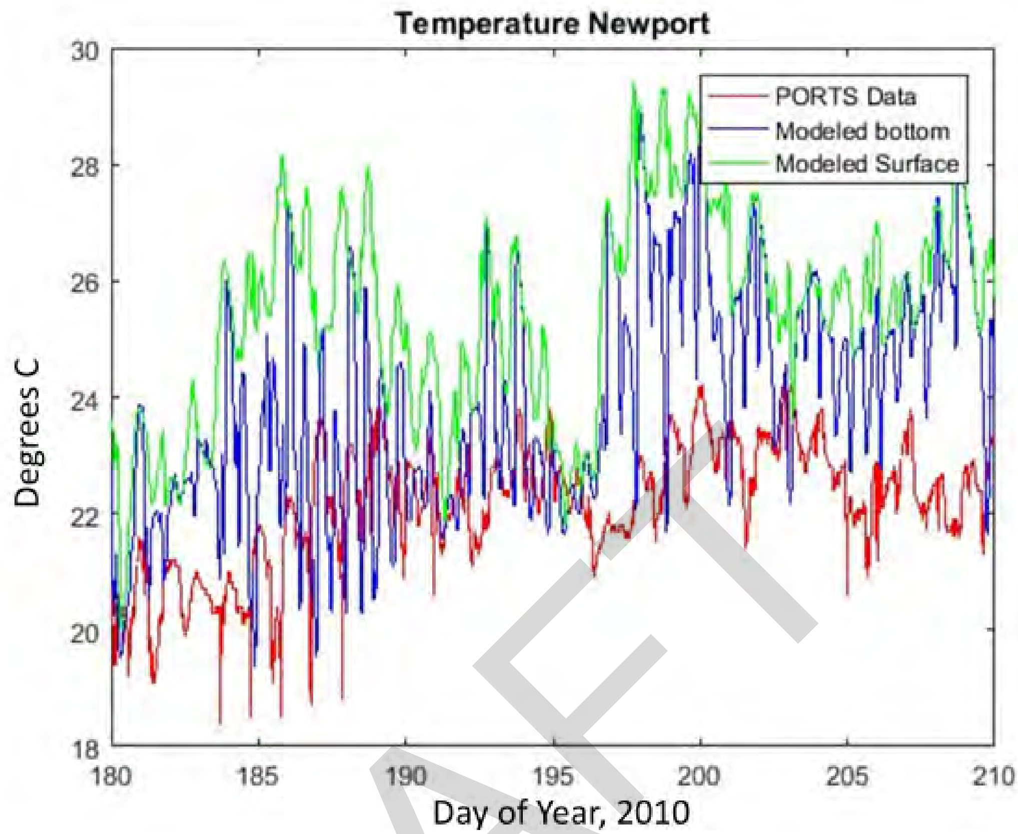
B4. Model verification for temperature at the NOAA Ports Station in Providence, RI. Red indicates the PORTS data, whereas blue and green are output temperatures at the same location in the NB-ROMS model at the bottom, and surface, respectively.



B5. Model verification for temperature at the NOAA Ports Station at Conimicut Light, in Warwick, RI. Red indicates the PORTS data, whereas blue and green are output temperatures at the same location in the NB-ROMS model at the bottom, and surface, respectively.



B6. Model verification for temperature at the NOAA Ports Station at Quonset, RI. Red indicates the PORTS data, whereas blue and green are output temperatures at the same location in the NB-ROMS model at the bottom, and surface, respectively.



B7. Model verification for temperature at the NOAA Ports Station at Goat Island, in Newport, RI. Red indicates the PORTS data, whereas blue and green are output temperatures at the same location in the NB-ROMS model at the bottom, and surface, respectively.

Providence River and Harbor Federal Navigation Project Rhode Island Dredged Material Management Plan and Environmental Assessment

Appendix J
Design and Construction Cost Estimates

1. Draft Design Maturity Memorandum
2. Draft ARA
3. TPCS Worksheets

Design Maturity Determination for Cost Certification – Version 3, Revised 12 Sept 2024

Date: 3/27/25
P2 Designation/Project Name: 107660 / Providence River DMMP

The Chief of Engineering is responsible for the technical content and engineering sufficiency for all engineering products produced by the command. As such, I have performed the Management Control Evaluation per Engineer Regulation (ER) 1110-2-1150, Engineering and Design for Civil Works Projects, Appendix H, Internal Management Control Review Checklist.

The current design DOES NOT require HQ approval (i.e., engineering waivers), requiring a deviation from mandatory requirements and mandatory standards, as defined in ERs, Engineering Manuals, Engineering Technical letters, and Engineering Circulars.

The current hydrology and hydraulics modeling is at 100 % design maturity, per reference (h) below.

The current geotechnical data and subsurface investigations are at 100 % design maturity, per reference (h) below. Subsurface investigations shall also include investigations of potential borrow and spoil areas.

The current survey data is at 75 % design maturity, per reference (h) below.

Other major technical and/or scope assumptions and risks include the following, which will be refined as the design progresses.

Given the consistent results from the geotechnical borings we do not anticipate the need for any additional borin

The aggregate for all features is 50 % design maturity. Therefore, per Engineer Regulation 1110-2-1302, Civil Works Cost Engineering, I certify that the design deliverables used to generate the cost products for this project and the estimate meet the requirements for a CLASS 3 estimate, as per reference (a) below. Design risks, impacts and remaining efforts are summarized on page 2.

The total project baseline schedule for this project is 48 months. This schedule was coordinated with the Project Manager, Project Delivery Team, and Non-Federal Sponsor, and takes into consideration the project constraints, including district execution capacity, capability of providing real estate in a timely fashion, and cost-share budget requirements, along with the market conditions, including industry capability to execute the project.

Considering risks and assumptions noted above, along with all other concerns documented in the Risk Register, the Cost and Schedule Risk Analysis has developed a contingency of ____% at the 80 % confidence level for the defined project scope.

Chief of Engineering

David Margolis
Printed Name

Signature

Design Maturity Determination for Cost Certification, Remaining Work

If an engineering waiver is required, list the risks and remaining design work needed to mitigate this issue in the current design. Identify remaining effort to complete the design required for 100% design.

N/A

Identify remaining effort to complete geotechnical design effort required for 100% design. List the risks and cost and schedule impacts needed to mitigate this issue in the current design.

No additional geotechnical investigation is required for this project.

Identify remaining effort required to complete H&H required for 100% design. List the risks and cost and schedule impacts needed to mitigate this issue in the current design.

No additional H&H modeling is required for this project.

Identify remaining effort needed to complete survey data required for 100% design. List the risks and cost and schedule impacts needed to mitigate this issue in the current design.

Updated contract survey for the maintenance dredging of the Providence River FNP will be conducted this FY. The study has capture historical shoal rates and based the cad cell sizing on the most recent survey data available. Survey for this study is approximately 5 years old. The engineering appendix covers detailed shoaling rate calculations through 2026, which is the date of the initial maintenance cycle

If the project is anticipated to be executed in parts, provide a design assessment (percent complete) of each part/phase below.

Phase 1 - Edgewood Shoals North Cad cell with Providence River FNP maintenance dredging in CY27 is 50% design complete.

Phase 2 Edgewood Shoals South Cad cell with Providence River FNP maintenance dredging in CY47 is 50% design complete.

References:

a. ER 1110-2-1302 – Civil Works Cost Engineering
b. CECW-EC memorandum dated 05-June-2023MFR, Guidance on Cost Engineering Products update for Civil Works Projects in accordance with Engineer Regulation 1110-2-1302 – Civil Works Cost Engineering
c. ER 1165-2-217 – Civil Works Review Policy
d. ER 1110-2-1150 – Engineering and Design for Civil Works Projects
e. ER 1110-345-700 – Design Analysis, Drawings and Specifications
f. EM 5-1-11 – Project Delivery Business Process (PDBP)
g. Engineering and Construction Bulletin (ECB) 2023-9 – Civil Works Design Milestone Checklists

Design Maturity Determination for Cost Certification – Instructions

Paragraph 1 – Design Date: Use the drop-down menu to populate the date of the design.

Paragraph 1 – Project Information: Enter the P2 Project number and Project name.

Paragraph 3 – Engineering Waivers: Use the drop-down menu to populate this field with either "Does," or "Does not." If an engineering waiver is needed, or anticipated to be needed, provide the specific waiver required for the Project. A waiver is any deviation from current mandatory standards, as indicated.

Paragraph 4 – Hydrology and Hydraulics: Populate this field with the % design maturity.

Paragraph 5 – Geotechnical Information: Populate this field with the % design maturity.

Paragraph 6 – Survey Data: Populate this field with the % design maturity.

Paragraph 7 – Other Technical Assumptions and/or Scope: Enter any other major technical assumptions or scope assumptions here. Only include assumptions that pertain to design. Template discussion fields are provided as a courtesy. Please include additional pages as necessary.

Paragraph 8 – Signature: Print the name and provide the title and signature for the District's Chief of Engineering. This authority cannot be delegated; however, the Deputy Chief of Engineering and Design may sign the form in the absence of the Chief of Engineering. All fillable fields must be populated (use N/A if not applicable) in order for the document to be signed.

Page 2 – Remaining Work: Identify the current baseline design assumptions and the remaining design effort and risks to complete 100% design for the authorized project. If the project is to be broken into parts or phases, provide details on the aggregate design level of each phase and anticipated timeline for completion.

Instructions:

General notes: **Blue** text indicates items to be populated by the user.
Black text indicates items not to be altered by the user.

Input & Results Worksheet:

1. Per ER 1110-1-1300, 26 Mar 93, Section 9.d.(3): "…The cost engineer has the responsibility for application of contingencies to properly weight the uncertainties associated with each major construction cost item or feature in coordination with input with other members of the project development team." Therefore, the cost engineer shall be responsible for developing this worksheet.

2. Enter the **Project Name** in cell C2.

3. Select the **Project Development Stage** in cell C3. (Selected CAP is still at alternative stage).

4. Select the **Risk Category** in cell C4.
   Low Risk: Simple-No life safety
   Moderate Risk: Typical-Possible life safety
   High Risk: Complex Project or Life Safety (flood protection)

5. Enter the **Total Construction Contract Cost** in cell D6. Note this does not include 01 Lands and Damages, 30 Planning, Engineering and Design or 31 Construction Management.

6. Create the **Feature of Work** list based on appropriately selected items from the estimate's Work Breakdown Structure (WBS).
   Note the 01 Lands and Damages cost and contingency shall be provided by Real Estate.
There can be different construction elements with differing risks w/in the same WBS element.
   Item 12 (Remaining Items) in the list accounts for all WBS items not specifically selected for analysis. This value is

7. Select the appropriate **CWWBS** number and description from the pull down menu in column B.
   Note that there is no pull down tab for the Remaining Items since it likely includes items from multiple CWWBS items.
   There can be different construction elements with differing risks w/in the same WBS element.
Note that Planning, Engineering, & Design and Construction Management can not be changed.

8. Enter the corresponding Estimated **Cost** for the chosen **Feature of Work** Items.

PDT Involvement Worksheet:

1. Fill in the appropriate team members names and office. The list is an example and is subject to change per project.

2. Input meeting date.

Risk Register Worksheet:

The Risk Register lists each Risk Element in the blue row. Each **Feature of Work** will be listed for each Risk Element in column B:D.
A number in column A is designated to reflect each **Risk Element.**

1. Describe the PDT Concerns for each **Feature of Work** for each Risk Element (what can go wrong?) in Column E.

2. Enter the PDT Discussions & Conclusions for each **Feature of Work** for each Risk Element in column F.

3. Select the **Impact** for the pull down menu in column G.

4. Select the **Likelihood** from the pull down menu in column H.

WBS Risk Matrix Worksheet:

No action is needed on this worksheet. All values self-populate. The WBS Risk Matrix serves as a Report summary.

CWWBS Worksheet:

This worksheet is for reference only (hidden from view).

Input & Results Worksheet:

1. Return to this worksheet to see the calculated results.
   No other input is needed on this sheet. All calculations occur from input values from other worksheets.

2. The **Total Weighted Construction Contingency** will be located in cell F29. This is the value to apply to the entire Construction Contract Cost.

3. The contingency rates for the 30 and 31 accounts are located in cell F30 and F31 respectively. You can choose to use the same % value of the constructio

Abbreviated Risk Analysis

Providence River DMMP

Feasibility (Alternatives)

Meeting Date: 27-Mar-25

PDT Members

Note: PDT involvement is commensurate with project size and involvement.

Represents	Name
Project Management:	Sam Bell
Planner:	Adam Burnett
Study Manager:	Adam Burnett
Contracting:	n/a
Real Estate:	Bill Mehr
Relocations:	n/a
OTHER:	n/a
Engineering & Design:	Lee Thibodeau
Technical Lead:	n/a
Geotech:	Gina Romano
H&H	Lisa Winter
Civil:	Lee Thibodeau
Structural:	n/a
Mechanical:	n/a
Electrical:	n/a
Cost Engineering:	Dan Palmer
Construction:	n/a
Operations:	n/a
Environmental:	Todd Randall
VE	n/a
DOT & PF Sponsor	n/a
DOT & PF Sponsor	n/a
OTHER:	n/a
OTHER:	n/a
OTHER:	n/a
	n/a

	Term	Definition
Terminology	Risk Analysis ER 1110-2-1302, 15 Sep 08, page 19	a. Cost risk analysis is the process of identifying and measuring the cost impact of project uncertainties on the estimated TPC. It shall be accomplished as a joint analysis between the cost engineer and the designers or appropriate PDT members that have specific knowledge and expertise on all possible project risks. (1) PDTs are required to prepare a formal cost risk analysis for all decision documents requiring Congressional authorization for projects exceeding $40 million (TPC)(see appendix B). Where cost risk analysis is required, it is anticipated that the cost risk analysis will be performed once the recommended plan is identified prior to the alternative formulation briefing milestone.
	Typical Risk Elements	Factors that can introduce risk to items listed in the Selected Work Breakdown Structure Items. The ones listed are the most typical for Civil Works Projects. These Risk Elements should be reviewed and established for each project.
	Potential Risk Areas	These are items from the estimate's Work Breakdown Structure, either broad or detailed, that are believed to contain some risk. The cost estimator defines the Work Breakdown Structure. It is recommended that the PDT select the appropriate Selected Work Breakdown Structure Items and considers all Features. Focus should be placed on the items with the significant risks. Appropriately identifying the Selected Work Breakdown Structure Items will lead to a more confident development of contingency.

	Risk Element	Typical Concerns	Max Potential Cost Growth
Typical Risk Elements	Project Management & Scope Growth	• Potential for scope growth, added features? • Project accomplishes intent? • Funding Difficulties? • Sufficent Staffing/Support?	75%
	Acquisition Strategy	• Contracting plan firmly established? • 8a or small business likely? • Requirement for subcontracting? • Accelerated schedule or harsh weather schedule? • High-risk acquisition limits competition, design/build? • Limited bid competition anticipated? • Bid schedule developed to reduce quantity risks?	30%
	Construction Elements	• Accelerated schedule or harsh weather schedule? • High risk or complex construction elements, site access, in-water? • Water care and diversion plan? • Unique construction methods? • Special mobilization? • Special equipment or subcontractors needed? • Potential for construction modification and claims?	25%
	Specialty Construction or Fabrication	• Atypical construction elements, unusual material or equipment manufactured or installed? • Confidence in constructibility or methodology? • One of a kind and confidence in fabrication and installation? • Ability to reasonably transport? • Risk of specialty equipment functioning first time? Testing?	65%
	Technical Design & Quantities	• Level of confidence based on design and assumptions? • Possibility for increased quantities due to loss, waste, or subsidence? • Appropriate methods applied to calculate quantities? • Sufficient investigations to develop quantities? • Quality control check applied?	30%
	Cost Estimate Assumptions	• Reliability and number of key quotes? • Assumptions related to prime and subcontractor markups/assignments? • Assumptions regarding crew, productivity, overtime? • Site accessibility, transport delays, congestion? • Overuse of Cost Book, lump sum, allowances? • Lack confidence on critical cost items?	35%
	External Project Risks	• Potential for severe adverse weather? • Political influences, lack of support, obstacles? • Unanticipated inflations in fuel, key materials? • Potential for market volatility impacting competition, pricing? • Funding Constraints	40%

Abbreviated Risk Analysis

Project (less than $40M): **Providence River DMMP**
Project Development Stage/Alternative: **Feasibility (Alternatives)**
Risk Category: **Moderate Risk: Typical Project Construction Type**

Alternative: **ESN/Providence FNP Locations**
Meeting Date: **2025-03-27**

Total Estimated Construction Contract Cost = $ 64,118,000

	CWWBS	Feature of Work	Estimated Cost		% Contingency	$ Contingency	Total
	01 LANDS AND DAMAGES	Real Estate	$ -		0%	$ -	$ -
1	12 NAVIGATION, PORTS AND HARBORS	Edgewood Shoals North CAD Cell	$ 44,711,000		30%	$ 13,533,950	$ 58,244,950
2	12 NAVIGATION, PORTS AND HARBORS	Providence FNP Locations	$ 19,407,000		30%	$ 5,874,468	$ 25,281,468
3			$ -		0%	$ -	$ -
4			$ -		0%	$ -	$ -
5			$ -		0%	$ -	$ -
6			$ -		0%	$ -	$ -
7			$ -		0%	$ -	$ -
8			$ -		0%	$ -	$ -
9			$ -		0%	$ -	$ -
10			$ -		0%	$ -	$ -
11			$ -		0%	$ -	$ -
12	All Other	Remaining Construction Items	$ -	0.0%	0%	$ -	$ -
13	30 PLANNING, ENGINEERING, AND DESIGN	Planning, Engineering, & Design	$ 2,613,000		20%	$ 515,153	$ 3,128,153
14	31 CONSTRUCTION MANAGEMENT	Construction Management	$ 1,603,000		26%	$ 410,166	$ 2,013,166
XX	FIXED DOLLAR RISK ADD (EQUALLY DISPERSED TO ALL, MUST INCLUDE JUSTIFICATION SEE BELOW)					$ -	

Totals				
Real Estate	$ -	0%	$ -	$ -
Total Construction Estimate	$ 64,118,000	30%	$ 19,408,418	$ 83,526,418
Total Planning, Engineering & Design	$ 2,613,000	20%	$ 515,153	$ 3,128,153
Total Construction Management	$ 1,603,000	26%	$ 410,166	$ 2,013,166
Total Excluding Real Estate	**$ 68,334,000**	**30%**	**$ 20,333,738**	**$ 88,667,738**

	Base	50%	80%
Confidence Level Range Estimate ($000's)	$68,334k	$80,534k	$88,668k

* 50% based on base is at 5% CL.

Fixed Dollar Risk Add: (Allows for additional risk to be added to the risk analsyis. Must include justification. Does not allocate to Real Estate.	

Providence River DMMP ESN/Providence FNP Locations

Feasibility (Alternatives)

Abbreviated Risk Analysis

Meeting Date: 27-Mar-25

Risk Level

	Negligible	Marginal	Moderate	Significant	Critical
Very Likely	2	3	4	5	5
Likely	1	2	3	4	5
Possible	0	1	2	3	4
Unlikely	0	0	1	2	3

Risk Register

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level	30% Line Item Magnitude ($000)
	Project Management & Scope Growth					Maximum Project Growth	75%	
Yes	PS-1	Edgewood Shoals North CAD Cell	Potential for scope growth such as bigger CAD cell for additional USACE FNP material placement needs.	There is a potential for minor additional CAD cell capacity if an updated condition survey shows more material than predicted. However, the existing plan already accounts for future predicted shoaling. Therefore, the likelihood of potential scope growth is unlikely and the impact would be marginal.	Marginal	Unlikely	0	$44,711k
Yes	PS-2	Providence FNP Locations	Potential for scope growth such as additional USACE FNP disposal slated for the CAD Cell.	The CAD cell is for disposal of unsuitable material. The current scope of FNPs containing unsuitable material that would use this disposal location are known and additional sites are not anticipated. The likelihood of additional FNPs requiring disposal at the CAD Cell is unlikely and the impact is expected to be marginal.	Marginal	Unlikely	0	$19,407k
Yes	PS-12	Remaining Construction Items	N/A	N/A	Negligible	Unlikely	0	$k
Yes	PS-13	Planning, Engineering, & Design	Potential for scope growth such as bigger CAD cell for additional state disposal or other USACE FNP location disposal. Potential for scope growth such as additional USACE FNP location disposal.	Additional CAD Cell capacity would not be as significant to the design cost as additional FNPs being added to the project. Overall, the likelihood of this risk is possible and the impact is moderate.	Moderate	Possible	2	$2,613k
Yes	PS-14	Construction Management	Potential for scope growth such as bigger CAD cell for additional state disposal or other USACE FNP location disposal. Potential for scope growth such as additional USACE FNP location disposal.	Additional CAD Cell capacity and/or additional FNPs being added to the project would directly affect CM as this would require additional construction duration which directly affects the CM cost. Overall, the likelihood of this risk is possible and the impact is moderate.	Moderate	Possible	2	$1,603k
	Acquisition Strategy					Maximum Project Growth	30%	
Yes	AS-1	Edgewood Shoals North CAD Cell	Unknown contracting plan. Limited competition possible.	The estimate currently assumes all dredging will be done by a large dredge contractor. It is possible for limited competition, which could have a moderate impact on bid prices.	Moderate	Possible	2	$44,711k
Yes	AS-2	Providence FNP Locations	Unknown contracting plan. Limited competition possible.	The estimate currently assumes all dredging will be done by a large dredge contractor. It's possible if the work is broken up, the contracts could be small business set-asides, which could have moderate impact to the cost of the projects.	Moderate	Possible	2	$19,407k
Yes	AS-12	Remaining Construction Items	N/A	N/A	Negligible	Unlikely	0	$k
Yes	AS-13	Planning, Engineering, & Design	No concern.	It is unlikely any part of this project would go through any kind of best value process. No risk modeled.	Negligible	Unlikely	0	$2,613k
Yes	AS-14	Construction Management	Extended construction duration with small business contract(s).	There's a risk the durations could be extended with small business procurement on the FNP. This is possible but the impact is expected to be marginal given the unknown of the FNP being separated.	Marginal	Possible	1	$1,603k

	Construction Elements					Maximum Project Growth	**25%**	
Yes	CON-1	Edgewood Shoals North CAD Cell	Accelerated schedule somewhat required due to environmental restrictions.	For CAD Cell creation, the cost estimate is assuming two dredges will excavate. Current duration is less than 6 months and the limiting factor is the number of scows (currently assumed to be 5 on the project). If necessary, the contractor could mobilize additional scows to lessen duration; however, 5 scows are hitting the max typically seen on larger dredging projects such as this. Additional scows would increase operating cost but shorten schedule; assume this is a draw; no risk modeled.	Marginal	Possible	**1**	$44,711k
Yes	CE-2	Providence FNP Locations	Accelerated schedule somewhat required due to environmental restrictions.	The schedule for the FNPs is well within the environmental windows. Risk not modeled.	Marginal	Possible	**1**	$19,407k
Yes	CE-12	Remaining Construction Items	Accelerated schedule somewhat required due to environmental restrictions.	The schedule for the FNPs is well within the environmental windows. Risk not modeled.	Negligible	Unlikely	**0**	$k
Yes	CE-13	Planning, Engineering, & Design	No concern.	Construction elements might affect PED as far as EDC but this is such a small fraction of the PED costs, it is unnecessary to model.	Negligible	Unlikely	**0**	$2,613k
Yes	CE-14	Construction Management	No concern.	No risk is modeled for any construction elements for this risk category; risk not modeled.	Negligible	Unlikely	**0**	$1,603k
	Specialty Construction or Fabrication					Maximum Project Growth	**65%**	
Yes	SC-1	Edgewood Shoals North CAD Cell	No concern.	No specialty construction/equipment/fabrication necessary for this project.	Negligible	Unlikely	**0**	$44,711k
Yes	SC-2	Providence FNP Locations	No concern.	No specialty construction/equipment/fabrication necessary for this project.	Negligible	Unlikely	**0**	$19,407k
Yes	SC-12	Remaining Construction Items	No concern.	No specialty construction/equipment/fabrication necessary for this project.	Negligible	Unlikely	**0**	$k
Yes	SC-13	Planning, Engineering, & Design	No concern.	No specialty construction/equipment/fabrication necessary for this project.	Negligible	Unlikely	**0**	$2,613k
Yes	SC-14	Construction Management	No concern.	No specialty construction/equipment/fabrication necessary for this project.	Negligible	Unlikely	**0**	$1,603k
	Technical Design & Quantities					Maximum Project Growth	**30%**	
Yes	T-1	Edgewood Shoals North CAD Cell	Risk of change in design and quantities.	The design of the CAD Cell is preliminary but based on accurate bathymetric data, including a survey conducted in 2021. There is marginal likelihood of the design changing much during PED compared to what has been done for the DMMP study. A suitability determination has been completed on the ESN CAD Cell location as well as on the FPRS CAD cell site. The conditions are very similar between the ESN and ESS, so unlikely to have much variation, though a suitability determination will be needed for ESS site - so ESS is not available for cycle-one dredging. All sites will need additional suitability determinations during cycle 2. On the ESN site, all the material is suitable for disposal at RISDS, except a small amount in an old channel. On the FPRS site, an 8-foot layer is unsuitable, so needs two starter cells. For cycle one, there is adequate capacity in PEB site for unsuitable material, with excess capacity in the event during design that more unsuitable material is determined. It is possible for the design and quantities to change very little from what has been calculated now for the feasibility study and what is calculated during PED and actually removed/disposed of during construction. Because the bathymetry data is accurate, with minimal additional shoaling expected, the impact is expected to be marginal.	Marginal	Possible	**1**	$44,711k

Yes	T-2	Providence FNP Locations	Risk of change in design and quantities.	The design of the FNP is preliminary but based on a condition survey in 2020, along with predicted shoaling rates averaged from several past condition surveys. According to Civil Design, there is marginal likelihood of the design changing much during PED compared to what has been done for the DMMP study. It is possible for the design and quantities to change a small amount from what has been calculated now for the feasibility study and what is calculated during PED and actually removed/disposed of during construction. In Cycle 2, there will be capacity designed in to the cycle-1 CAD cell for placement of various amounts of unsuitable material excavated during the cycle-2 CAD cell construction. Because the survey data is based on a series of condition surveys, the impact is expected to be marginal.	Marginal	Possible	1	$19,407k
No	T-11	0			Negligible	Unlikely	N/A	$k
Yes	T-12	Remaining Construction Items	N/A	N/A	Marginal	Unlikely	0	$k
Yes	T-13	Planning, Engineering, & Design	No concern.	Risk not modeled.	Negligible	Unlikely	0	$2,613k
Yes	T-14	Construction Management	Risk of change in design and quantities.	Any additional quantities or alteration in design will directly affect the CM costs. The likelihood is likely and the impact is marginal to match the construction features of work.	Marginal	Likely	2	$1,603k
	Cost Estimate Assumptions				**Maximum Project Growth**		**35%**	
Yes	EST-1	Edgewood Shoals North CAD Cell	There is always a risk that the equipment, crew, and productivities/inputs utilized in the CEDEPs and MII cost estimate will differ from what the contractors use during the bidding process.	The likelihood of our assumptions being different from the contractors is likely, however we anticipate the impact to be marginal.	Marginal	Likely	2	$44,711k
Yes	EST-2	Providence FNP Locations	There is always a risk that the equipment, crew, and productivities/inputs utilized in the CEDEPs and MII cost estimate will differ from what the contractors use during the bidding process.	The likelihood of our assumptions being different from the contractors is likely, however we anticipate the impact to be marginal.	Marginal	Likely	2	$19,407k
Yes	EST-12	Remaining Construction Items	N/A	N/A	Marginal	Likely	2	$k
Yes	EST-13	Planning, Engineering, & Design	The PED costs have been corroborated with relevant members of the PDT and are anticipated to be sufficient for PED.	Risk not modeled.	Negligible	Unlikely	0	$2,613k
Yes	EST-14	Construction Management	The CM costs have been corroborated with relevant members of the PDT and are anticipated to be sufficient for construction	Risk not modeled.	Negligible	Unlikely	0	$1,603k
	External Project Risks				**Maximum Project Growth**		**40%**	
Yes	EX-1	Edgewood Shoals North CAD Cell	Increase in fuel prices. Delays in project schedule.	If fuel prices rise again just before or during construction, they are not anticipated to rise significantly above the price in the estimate now. Anticipate minimal delays to project schedule due to funding issues, delays during PED/solicitation, etc. are possible to differ from the projected schedule. The impact is expected to be moderate.	Moderate	Possible	2	$44,711k

Yes	EX-2	Providence FNP Locations	Increase in fuel prices. Delays in project schedule.	See above.	Moderate	Possible	**2**	$19,407k
Yes	EX-12	Remaining Construction Items	N/A	N/A	Negligible	Possible	**0**	$k
Yes	EX-13	Planning, Engineering, & Design	Delays in project schedule.	Delays to project schedule due to funding issues, delays during PED/solicitation, etc. are possible to differ from the assumed schedule. The impact is expected to be marginal depending on the length of the delay.	Marginal	Possible	**1**	$2,613k
Yes	EX-14	Construction Management	Delays in project schedule.	See above.	Marginal	Possible	**1**	$1,603k

Providence River DMMP ESN/Providence FNP Locations
Feasibility (Alternatives)
Abbreviated Risk Analysis

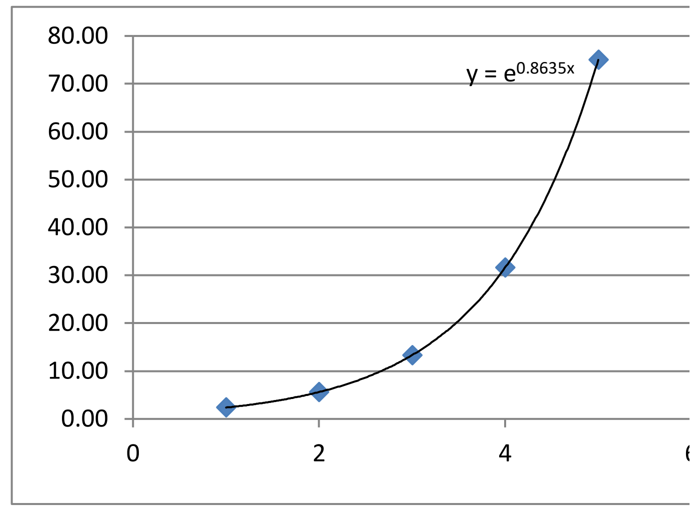
Risk Evaluation

WBS	Potential Risk Areas	Project Management & Scope Growth	Acquisition Strategy	Construction Elements	Specialty Construction or Fabrication	Technical Design & Quantities	Cost Estimate Assumptions	External Project Risks	Cost in Thousands
01 LANDS AND DAMAGES	**Real Estate**								$0
12 NAVIGATION, PORTS AND HARBORS	**Edgewood Shoals North CAD Cell**	0	2	1	0	1	2	2	$44,711
12 NAVIGATION, PORTS AND HARBORS	Providence FNP Locations	0	2	1	0	1	2	2	$19,407
0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
0	**0**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
0	**0**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
0	**0**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
0	**0**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
0	**0**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
All Other	Remaining Construction Items	0	0	0	0	0	2	0	$0
30 PLANNING, ENGINEERING, AND DESIGN	Planning, Engineering, & Design	2	0	0	0	0	0	1	$2,613
31 CONSTRUCTION MANAGEMENT	Construction Management	2	1	0	0	2	0	1	$1,603
									$68,334
Risk		$ 237	$ 7,214	$ 6,004	$ -	$ 1,328	$ 2,658	$ 2,892	**$20,334**
Fixed Dollar Risk Allocation		$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$0**
	Risk	$ 237	$ 7,214	$ 6,004	$ -	$ 1,328	$ 2,658	$ 2,892	**$20,334**
								Total	**$88,668**

Project Scope Growth Max Potenital Cost Growth 75 %

x	y	
0	0	0.00%
1	2.37	2.37%
2	5.62	5.62%
3	13.34	13.34%
4	31.63	31.63%
5	75.00	75.00%

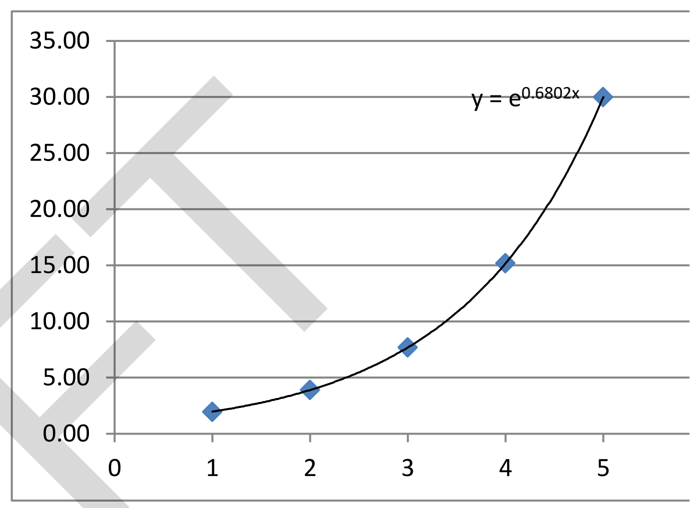
y	=	a^x	
a	=	y^(1/x)	
a	=		2.37144061



Acquisition Strategy Max Potenital Cost Growth 30 %

x	y	
0	5	5.00%
1	1.97	6.97%
2	3.90	10.87%
3	7.70	18.57%
4	15.19	33.76%
5	30.00	63.76%

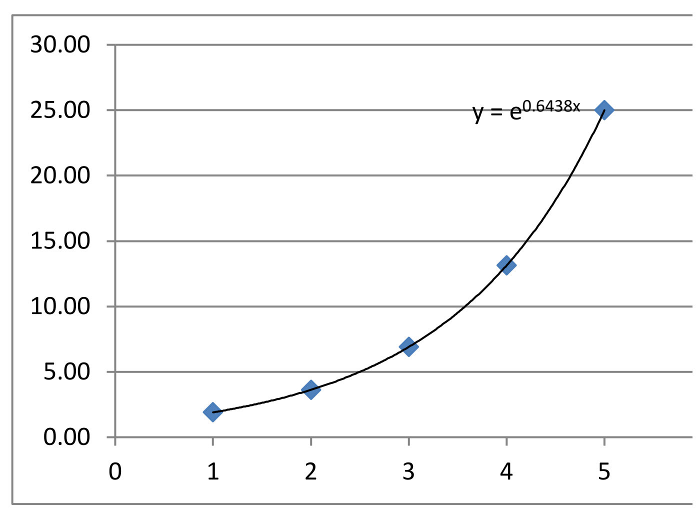
y	=	a^x	
a	=	y^(1/x)	
a	=		1.974350486



Construction Elements Max Potenital Cost Growth 25 %

x	y	
0	7	7.00%
1	1.90	8.90%
2	3.62	10.62%
3	6.90	13.90%
4	13.13	20.13%
5	25.00	32.00%

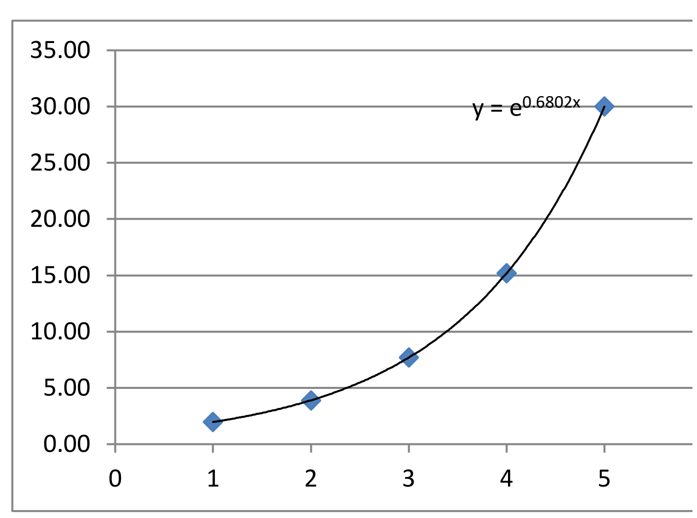
y	=	a^x	
a	=	y^(1/x)	
a	=		1.903653939



Quantities Max Potenital Cost Growth 30 %

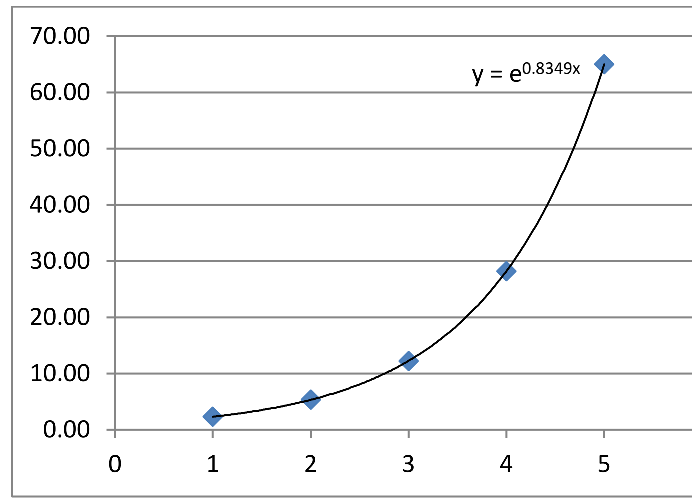
x	y	
0	0	0.00%
1	1.97	1.97%
2	3.90	3.90%
3	7.70	7.70%
4	15.19	15.19%
5	30.00	30.00%

y	=	a^x	
a	=	y^(1/x)	
a	=		1.974350486



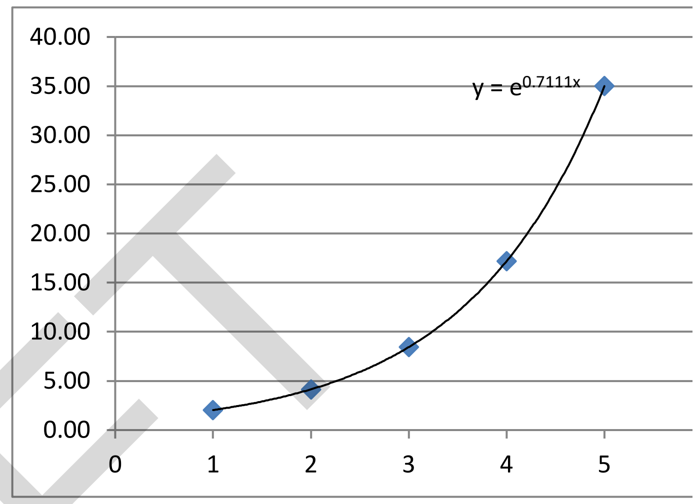
Special Construction or Fabrication	Max Potenital Cost Growth	65 %	
	x	y	
	0	0	0.00%
	1	2.30	2.30%
	2	5.31	5.31%
	3	12.24	12.24%
	4	28.21	28.21%
	5	65.00	65.00%

y	=	a^x	
a	=	y^(1/x)	
a	=		2.30453162



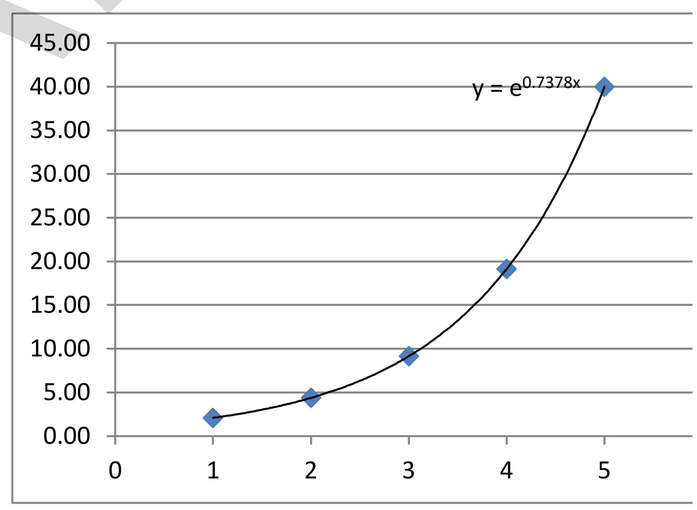
Cost Est Assumptions	Max Potenital Cost Growth	35 %	
	x	y	
	0	0	0.00%
	1	2.04	2.04%
	2	4.15	4.15%
	3	8.44	8.44%
	4	17.19	17.19%
	5	35.00	35.00%

y	=	a^x	
a	=	y^(1/x)	
a	=		2.036168005
95			



External Risks	Max Potenital Cost Growth	40 %	
	x	y	
	0	0	0.00%
	1	2.09	2.09%
	2	4.37	4.37%
	3	9.15	9.15%
	4	19.13	19.13%
	5	40.00	40.00%

y	=	a^x	
a	=	y^(1/x)	
a	=		2.091279105



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Providence River DMMP
Feasibility (Alternatives)
Abbreviated Risk Analysis

	Project Management & Scope Growth		Acquisition Strategy		Construction Elements		Technical Design & Quantities		Specialty Construction or Fabrication		Cost Estimate Assumptions		External Project Risks		Σ	Σ of $
	75%		30%		25%		30%		65%		35%		40%		300%	
Edgewood Shoals North CAD Cell	0.00%	$ -	10.87%	$ 4,861,163	8.90%	$ 3,980,913	1.97%	$ 882,752	0.00%	$ -	4.15%	$ 1,853,709	4.37%	$ 1,955,412		$ 13,533,950
Providence FNP Locations	0.00%	$ -	10.87%	$ 2,110,009	8.90%	$ 1,727,932	1.97%	$ 383,162	0.00%	$ -	4.15%	$ 804,610	4.37%	$ 848,755		$ 5,874,468
0	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -		$ -
0	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -		$ -
0	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -		$ -
0	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -		$ -
0	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -		$ -
0	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -		$ -
0	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -		$ -
0	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -		$ -
0	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -	FALSE	$ -		$ -
Remaining Construction Items	0.00%	$ -	5.00%	$ -	7.00%	$ -	0.00%	$ -	0.00%	$ -	4.15%	$ -	0.00%	$ -		$ -
Planning, Engineering, & Design	5.62%	$ 146,948	5.00%	$ 130,650	7.00%	$ 182,910	0.00%	$ -	0.00%	$ -	0.00%	$ -	2.09%	$ 54,645		$ 515,153
Construction Management	5.62%	$ 90,148	6.97%	$ 111,799	7.00%	$ 112,210	3.90%	$ 62,486	0.00%	$ -	0.00%	$ -	2.09%	$ 33,523		$ 410,166
		$ 237,096.48		$ 7,213,620.89		$ 6,003,964.83		$ 1,328,399.94		$ -		$ 2,658,319.55		$ 2,892,335.91	$ 20,333,737.60	$ 19,408,418
		$ 64,118,000.00		$ 64,118,000.00		$ 64,118,000.00		$ 64,118,000.00		$ 64,118,000.00		$ 64,118,000.00		$ 64,118,000.00	$ 64,118,000.00	$ 64,118,000.00
		0.37%		11.25%		9.36%		2.07%		0.00%		4.15%		4.51%	31.71%	30.27%

****** TOTAL PROJECT COST SUMMARY ******

PROJECT: **Providence River DMMP**
PROJECT NO: n/a
LOCATION: Providence River DMMP

DISTRICT: NAE **PREPARED: 12/16/2024**
POC: CHIEF, COST ENGINEERING, Chris Tilley (Acting)

This Estimate reflects the scope and schedule in report; Misc info from PDT

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
Construct Edgewood Shoals North CAD Cell (w/BU's)						Program Year (Budget EC): 2026; Effective Price Level Date: 1 OCT 25									
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	**TOTAL ($K)**	Spent Thru 1-Oct-24 ($K)	**TOTAL FIRST COST ($K)**	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*		*K*	*L*	*M*	*N*	*O*
12	Construct Edgewood Shoals North CAD Cell (w/BU's)	$44,711	$13,413	30.0%	$58,125	3.4%	$46,229	$13,869	$60,098	$0	$60,098	4.6%	$48,365	$14,509	$62,874
12	Providence River FNP Maintenance Dredging	$19,407	$5,822	30.0%	$25,229	3.4%	$20,066	$6,020	$26,085	$0	$26,085	7.3%	$21,538	$6,462	$28,000
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	CONSTRUCTION ESTIMATE TOTALS:	$64,118	$19,235		$83,353	3.4%	$66,295	$19,888	$86,183	$0	$86,183	5.4%	$69,903	$20,971	$90,874
01	LANDS AND DAMAGES	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN	$2,613	$523	20.0%	$3,136	3.1%	$2,694	$539	$3,233	$0	$3,233	2.7%	$2,768	$554	$3,321
31	CONSTRUCTION MANAGEMENT	$1,603	$417	26.0%	$2,020	3.1%	$1,653	$430	$2,082	$0	$2,082	6.5%	$1,760	$458	$2,217
	PROJECT COST TOTALS:	$68,334	$20,175	29.5%	$88,509		$70,642	$20,857	**$91,499**	$0	**$91,499**	5.4%	$74,431	$21,982	$96,413

CHIEF, COST ENGINEERING, Chris Tilley (Acting)

PROJECT MANAGER, Sam Bell

CHIEF, REAL ESTATE, xxx

CHIEF, PLANNING, xxx

CHIEF, ENGINEERING, xxx

CHIEF, OPERATIONS, xxx

CHIEF, CONSTRUCTION, xxx

CHIEF, CONTRACTING,xxx

CHIEF, PM-PB, xxxx

CHIEF, DPM, xxx

ESTIMATED TOTAL PROJECT COST: **$96,413**

**** TOTAL PROJECT COST SUMMARY ****

**** CONTRACT COST SUMMARY ****

PROJECT: Providence River DMMP
LOCATION: Providence River DMMP
This Estimate reflects the scope and schedule in report; Misc info from PDT

DISTRICT: NAE
POC: CHIEF, COST ENGINEERING, Chris Tilley (Acting)
PREPARED: 12/16/2024

<> Dredging to Create New Edgewood Shoals North CAD Cell (3,212,230 cy) with Disposal to Various Locations INCLUDING the Beneficial Use Locations*
* PDT confirms original 2022 ARA is still current and the same contingecy can be used, and PED and CM was revised from 5% to 4%, and 3% to 2.5% per PDT.

Estimate Prepared: **4-Oct-24**
Effective Price Level: 1-Oct-24

Program Year (Budget EC): 2026
Effective Price Level Date: 1 OCT 25

Civil Works Work Breakdown Structure			ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
WBS NUMBER		Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	RISK BASED CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A		*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*P*	*L*	*M*	*N*	*O*
		PHASE 1 or CONTRACT 1													
12		Construct Edgewood Shoals North CAD Cell (w/BU's)	$44,711	$13,413	30.0%	$58,125	3.4%	$46,229	$13,869	$60,098	2027Q4	4.6%	$48,365	$14,509	$62,874
		#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
		#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
		#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
		#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
		#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
		#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
		#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
		CONSTRUCTION ESTIMATE TOTALS:	$44,711	$13,413	30.0%	**$58,125**		$46,229	$13,869	$60,098			$48,365	$14,509	$62,874
01		LANDS AND DAMAGES	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
30		PLANNING, ENGINEERING & DESIGN													
	0.5%	Project Management	$201	$40	20.0%	$241	3.1%	$207	$41	$249	2026Q3	1.5%	$211	$42	$253
	0.2%	Planning & Environmental Compliance	$78	$16	20.0%	$94	3.1%	$81	$16	$97	2026Q3	1.5%	$82	$16	$98
	1.9%	Engineering & Design	$850	$170	20.0%	$1,019	3.1%	$876	$175	$1,051	2026Q3	1.5%	$889	$178	$1,067
	0.2%	Reviews, ATRs, IEPRs, VE	$67	$13	20.0%	$80	3.1%	$69	$14	$83	2026Q3	1.5%	$70	$14	$84
	0.2%	Life Cycle Updates (cost, schedule, risks)	$67	$13	20.0%	$80	3.1%	$69	$14	$83	2026Q3	1.5%	$70	$14	$84
	0.2%	Contracting & Reprographics	$67	$13	20.0%	$80	3.1%	$69	$14	$83	2026Q3	1.5%	$70	$14	$84
	0.6%	Engineering During Construction	$257	$51	20.0%	$309	3.1%	$265	$53	$318	2027Q4	5.5%	$280	$56	$336
	0.4%	Planning During Construction	$156	$31	20.0%	$188	3.1%	$161	$32	$194	2027Q4	5.5%	$170	$34	$204
	0.0%	Adaptive Mgmt & Monit (Shellfish Relocation)	$49	$10	20.0%	$58	3.1%	$50	$10	$60	2027Q4	5.5%	$53	$11	$63
	0.1%	Project Operations	$45	$9	20.0%	$54	3.1%	$46	$9	$55	2026Q3	1.5%	$47	$9	$56
		Real Estate (All Federal Labor)	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	4.0%	**total**													
31		CONSTRUCTION MANAGEMENT													
	1.6%	Construction Management	$693	$180	26.0%	$873	3.1%	$715	$186	$900	2027Q4	5.5%	$754	$196	$950
	0.7%	Project Operation:	$291	$76	26.0%	$366	3.1%	$300	$78	$378	2027Q4	5.5%	$316	$82	$398
	0.3%	Project Management	$134	$35	26.0%	$169	3.1%	$138	$36	$174	2027Q4	5.5%	$146	$38	$184
	2.5%	**total**													
		CONTRACT COST TOTALS:	$47,666	$14,071		$61,737		$49,275	$14,547	**$63,823**			$51,522	$15,214	**$66,736**

**** TOTAL PROJECT COST SUMMARY ****

**** CONTRACT COST SUMMARY ****

PROJECT: Providence River DMMP
LOCATION: Providence River DMMP
This Estimate reflects the scope and schedule in report; Misc info from PDT

DISTRICT: NAE PREPARED: 12/16/2024
POC: CHIEF, COST ENGINEERING, Chris Tilley (Acting)

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
<> Maintenance Dredge FNP with Disposal to Edgewood Shoals North CAD Cell.* * PDT confirms original 2022 ARA is still current and the same contingecy can be used, and PED and CM was revised from 5% to 4%, and 3% to 2.5% per PDT.		Estimate Prepared:			**4-Oct-24**	Program Year (Budget EC):		2026						
		Effective Price Level:			1-Oct-24	Effective Price Level Date:		1 OCT 25						
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*P*	*L*	*M*	*N*	*O*
	PHASE 2 or CONTRACT 2													
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
12	Providence River FNP Maintenance Dredging	$19,407	$5,822	30.0%	$25,229	3.4%	$20,066	$6,020	$26,085	2028Q4	7.3%	$21,538	$6,462	$28,000
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	CONSTRUCTION ESTIMATE TOTALS:	$19,407	$5,822	30.0%	**$25,229**		$20,066	$6,020	$26,085			$21,538	$6,462	$28,000
01	LANDS AND DAMAGES	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN													
0.5%	Project Management	$87	$17	20.0%	$105	3.1%	$90	$18	$108	2026Q3	1.5%	$91	$18	$110
0.2%	Planning & Environmental Compliance	$34	$7	20.0%	$41	3.1%	$35	$7	$42	2026Q3	1.5%	$36	$7	$43
1.9%	Engineering & Design	$369	$74	20.0%	$442	3.1%	$380	$76	$456	2026Q3	1.5%	$386	$77	$463
0.2%	Reviews, ATRs, IEPRs, VE	$29	$6	20.0%	$35	3.1%	$30	$6	$36	2026Q3	1.5%	$30	$6	$37
0.2%	Life Cycle Updates (cost, schedule, risks)	$29	$6	20.0%	$35	3.1%	$30	$6	$36	2026Q3	1.5%	$30	$6	$37
0.2%	Contracting & Reprographics	$29	$6	20.0%	$35	3.1%	$30	$6	$36	2026Q3	1.5%	$30	$6	$37
0.6%	Engineering During Construction	$112	$22	20.0%	$134	3.1%	$115	$23	$138	2028Q4	8.8%	$125	$25	$150
0.4%	Planning During Construction	$68	$14	20.0%	$82	3.1%	$70	$14	$84	2028Q4	8.8%	$76	$15	$91
0.0%	Adaptive Management & Monitoring	$0	$0	20.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.1%	Project Operations	$19	$4	20.0%	$23	3.1%	$20	$4	$24	2026Q3	1.5%	$20	$4	$24
	Real Estate (All Federal Labor)	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
4.0%	**total**													
31	CONSTRUCTION MANAGEMENT													
1.6%	Construction Management	$301	$78	26.0%	$379	3.1%	$310	$81	$391	2028Q4	8.8%	$337	$88	$425
0.7%	Project Operation:	$126	$33	26.0%	$159	3.1%	$130	$34	$164	2028Q4	8.8%	$141	$37	$178
0.3%	Project Management	$58	$15	26.0%	$73	3.1%	$60	$16	$76	2028Q4	8.8%	$65	$17	$82
2.5%	**total**													
	CONTRACT COST TOTALS:	$20,668	$6,103		$26,772		$21,366	$6,310	**$27,676**			$22,909	$6,768	**$29,677**

****** TOTAL PROJECT COST SUMMARY ******

PROJECT: **Providence River DMMP**
PROJECT NO: n/a
LOCATION: Providence River DMMP

DISTRICT: NAE
POC: CHIEF, COST ENGINEERING, Chris Tilley (Acting)

PREPARED: 12/16/2024

This Estimate reflects the scope and schedule in report; Misc info by PDT

Civil Works Work Breakdown Structure		**ESTIMATED COST**				**PROJECT FIRST COST (Constant Dollar Basis)**						**TOTAL PROJECT COST (FULLY FUNDED)**			
Construct Edgewood Shoals North CAD Cell						Program Year (Budget EC): 2026 Effective Price Level Date: 1 OCT 25									
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	**TOTAL ($K)**	Spent Thru: **1-Oct-24** ($K)	**TOTAL FIRST COST** ($K)	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***I***	***J***		***K***	***L***	***M***	***N***	***O***
12	Construct Edgewood Shoals North CAD Cell	$55,009	$16,503	30.0%	$71,511	3.4%	$56,876	$17,063	$73,939	$0	$73,939	4.6%	$59,504	$17,851	$77,355
12	Providence River FNP Maintenance Dredging	$19,407	$5,822	30.0%	$25,229	3.4%	$20,066	$6,020	$26,085	$0	$26,085	7.3%	$21,538	$6,462	$28,000
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	CONSTRUCTION ESTIMATE TOTALS:	$74,416	$22,325		$96,740	3.4%	$76,942	$23,083	$100,025	$0	$100,025	5.3%	$81,043	$24,313	$105,355
01	LANDS AND DAMAGES	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN	$3,025	$605	20.0%	$3,630	3.1%	$3,119	$624	$3,743	$0	$3,743	2.7%	$3,203	$641	$3,844
31	CONSTRUCTION MANAGEMENT	$1,860	$484	26.0%	$2,344	3.1%	$1,918	$499	$2,417	$0	$2,417	6.3%	$2,040	$530	$2,570
	PROJECT COST TOTALS:	$79,301	$23,413	29.5%	$102,715		$81,979	$24,205	**$106,184**	$0	**$106,184**	5.3%	$86,285	$25,484	$111,769

________________________ **CHIEF, COST ENGINEERING, Chris Tilley (Acting)**

ESTIMATED TOTAL PROJECT COST: $111,769

________________________ **PROJECT MANAGER, Sam Bell**

________________________ **CHIEF, REAL ESTATE, xxx**

________________________ **CHIEF, PLANNING, xxx**

________________________ **CHIEF, ENGINEERING, xxx**

________________________ **CHIEF, OPERATIONS, xxx**

________________________ **CHIEF, CONSTRUCTION, xxx**

________________________ **CHIEF, CONTRACTING,xxx**

________________________ **CHIEF, PM-PB, xxxx**

________________________ **CHIEF, DPM, xxx**

**** TOTAL PROJECT COST SUMMARY ****

**** CONTRACT COST SUMMARY ****

PROJECT: Providence River DMMP
LOCATION: Providence River DMMP
This Estimate reflects the scope and schedule in report; Misc info by PDT

DISTRICT: NAE
POC: CHIEF, COST ENGINEERING, Chris Tilley (Acting)
PREPARED: 12/16/2024

<> Dredging to Create New Edgewood Shoals North CAD Cell (3,212,230 cy) with Disposal to Various Locations NOT Including the Beneficial Use Locations*
* PDT confirms original 2022 ARA is still current and the same contingecy can be used, and PED and CM was revised from 5% to 4%, and 3% to 2.5% per PDT.

ESTIMATED COST: Estimate Prepared: **4-Oct-24**; Effective Price Level: 1-Oct-24

PROJECT FIRST COST (Constant Dollar Basis): Program Year (Budget EC): 2026; Effective Price Level Date: 1 OCT 25

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	RISK BASED CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*P*	*L*	*M*	*N*	*O*
	PHASE 1 or CONTRACT 1													
12	Construct Edgewood Shoals North CAD Cell	$55,009	$16,503	30.0%	$71,511	3.4%	$56,876	$17,063	$73,939	2027Q4	4.6%	$59,504	$17,851	$77,355
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	CONSTRUCTION ESTIMATE TOTALS:	$55,009	$16,503	30.0%	**$71,511**		$56,876	$17,063	$73,939			$59,504	$17,851	$77,355
01	LANDS AND DAMAGES	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN													
0.5%	Project Management	$248	$50	20.0%	$297	3.1%	$255	$51	$306	2026Q3	1.5%	$259	$52	$311
0.2%	Planning & Environmental Compliance	$96	$19	20.0%	$116	3.1%	$99	$20	$119	2026Q3	1.5%	$101	$20	$121
1.9%	Engineering & Design	$1,045	$209	20.0%	$1,254	3.1%	$1,078	$216	$1,293	2026Q3	1.5%	$1,094	$219	$1,313
0.2%	Reviews, ATRs, IEPRs, VE	$83	$17	20.0%	$99	3.1%	$85	$17	$102	2026Q3	1.5%	$86	$17	$104
0.2%	Life Cycle Updates (cost, schedule, risks)	$83	$17	20.0%	$99	3.1%	$85	$17	$102	2026Q3	1.5%	$86	$17	$104
0.2%	Contracting & Reprographics	$83	$17	20.0%	$99	3.1%	$85	$17	$102	2026Q3	1.5%	$86	$17	$104
0.6%	Engineering During Construction	$316	$63	20.0%	$380	3.1%	$326	$65	$391	2027Q4	5.5%	$344	$69	$413
0.4%	Planning During Construction	$193	$39	20.0%	$231	3.1%	$198	$40	$238	2027Q4	5.5%	$209	$42	$251
0.0%	Adaptive Mgmt & Monit (Shellfish Relocation)	$49	$10	20.0%	$58	3.1%	$50	$10	$60	2027Q4	5.5%	$53	$11	$63
0.1%	Project Operations	$55	$11	20.0%	$66	3.1%	$57	$11	$68	2026Q3	1.5%	$58	$12	$69
	Real Estate (All Federal Labor)	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
4.0%	**total**													
31	CONSTRUCTION MANAGEMENT													
1.6%	Construction Management	$853	$222	26.0%	$1,074	3.1%	$879	$229	$1,108	2027Q4	5.5%	$927	$241	$1,168
0.7%	Project Operation:	$358	$93	26.0%	$451	3.1%	$369	$96	$464	2027Q4	5.5%	$389	$101	$490
0.3%	Project Management	$165	$43	26.0%	$208	3.1%	$170	$44	$214	2027Q4	5.5%	$179	$47	$226
2.5%	**total**													
	CONTRACT COST TOTALS:	$58,633	$17,310		$75,943		$60,613	$17,895	**$78,508**			$63,377	$18,715	**$82,092**

**** TOTAL PROJECT COST SUMMARY ****

**** CONTRACT COST SUMMARY ****

PROJECT: Providence River DMMP
LOCATION: Providence River DMMP
This Estimate reflects the scope and schedule in report; Misc info by PDT

DISTRICT: NAE
POC: CHIEF, COST ENGINEERING, Chris Tilley (Acting)
PREPARED: 12/16/2024

<> Maintenance Dredge FNP with Disposal to Edgewood Shoals North CAD Cell.*
* PDT confirms original 2022 ARA is still current and the same contingecy can be used, and PED and CM was revised from 5% to 4%, and 3% to 2.5% per PDT.

ESTIMATED COST: Estimate Prepared: **4-Oct-24**; Effective Price Level: 1-Oct-24

PROJECT FIRST COST (Constant Dollar Basis): Program Year (Budget EC): 2026; Effective Price Level Date: 1 OCT 25

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*P*	*L*	*M*	*N*	*O*
	PHASE 2 or CONTRACT 2													
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
12	Providence River FNP Maintenance Dredging	$19,407	$5,822	30.0%	$25,229	3.4%	$20,066	$6,020	$26,085	2028Q4	7.3%	$21,538	$6,462	$28,000
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	CONSTRUCTION ESTIMATE TOTALS:	$19,407	$5,822	30.0%	**$25,229**		$20,066	$6,020	$26,085			$21,538	$6,462	$28,000
01	LANDS AND DAMAGES	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN													
0.5%	Project Management	$87	$17	20.0%	$105	3.1%	$90	$18	$108	2026Q3	1.5%	$91	$18	$110
0.2%	Planning & Environmental Compliance	$34	$7	20.0%	$41	3.1%	$35	$7	$42	2026Q3	1.5%	$36	$7	$43
1.9%	Engineering & Design	$369	$74	20.0%	$442	3.1%	$380	$76	$456	2026Q3	1.5%	$386	$77	$463
0.2%	Reviews, ATRs, IEPRs, VE	$29	$6	20.0%	$35	3.1%	$30	$6	$36	2026Q3	1.5%	$30	$6	$37
0.2%	Life Cycle Updates (cost, schedule, risks)	$29	$6	20.0%	$35	3.1%	$30	$6	$36	2026Q3	1.5%	$30	$6	$37
0.2%	Contracting & Reprographics	$29	$6	20.0%	$35	3.1%	$30	$6	$36	2026Q3	1.5%	$30	$6	$37
0.6%	Engineering During Construction	$112	$22	20.0%	$134	3.1%	$115	$23	$138	2028Q4	8.8%	$125	$25	$150
0.4%	Planning During Construction	$68	$14	20.0%	$82	3.1%	$70	$14	$84	2028Q4	8.8%	$76	$15	$91
0.0%	Adaptive Management & Monitoring	$0	$0	20.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.1%	Project Operations	$19	$4	20.0%	$23	3.1%	$20	$4	$24	2026Q3	1.5%	$20	$4	$24
	Real Estate (All Federal Labor)	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
4.0%	**total**													
31	CONSTRUCTION MANAGEMENT													
1.6%	Construction Management	$301	$78	26.0%	$379	3.1%	$310	$81	$391	2028Q4	8.8%	$337	$88	$425
0.7%	Project Operation:	$126	$33	26.0%	$159	3.1%	$130	$34	$164	2028Q4	8.8%	$141	$37	$178
0.3%	Project Management	$58	$15	26.0%	$73	3.1%	$60	$16	$76	2028Q4	8.8%	$65	$17	$82
2.5%	**total**													
	CONTRACT COST TOTALS:	$20,668	$6,103		$26,772		$21,366	$6,310	**$27,676**			$22,909	$6,768	**$29,677**

**** TOTAL PROJECT COST SUMMARY ****

PROJECT: Providence River DMMP
PROJECT I n/a
LOCATION: Providence River DMMP

DISTRICT: NAE **PREPARED: 12/16/2024**
POC: CHIEF, COST ENGINEERING, Chris Tilley (Acting)

This Estimate reflects the scope and schedule in report; Misc info from PDT

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
Construct Edgewood Shoals South CAD Cell (w/BU's)						Program Year (Budget EC): 2026 Effective Price Level Date: 1 OCT 25									
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Spent Thru: 1-Oct-24 ($K)	TOTAL FIRST COST ($K)	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	B	C	D	E	F	G	H	I	J		K	L	M	N	O
12	Construct Edgewood Shoals South CAD Cell (w/BU's)	$41,734	$12,520	30.0%	$54,254	3.4%	$43,151	$12,945	$56,096	$0	$56,096	4.6%	$45,144	$13,543	$58,688
12	Providence River FNP Maintenance Dredging	$19,726	$5,918	30.0%	$25,643	3.4%	$20,395	$6,119	$26,514	$0	$26,514	7.3%	$21,892	$6,568	$28,460
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	CONSTRUCTION ESTIMATE TOTALS:	$61,460	$18,438		$79,898	3.4%	$63,546	$19,064	$82,610	$0	$82,610	5.5%	$67,037	$20,111	$87,148
01	LANDS AND DAMAGES	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN	$2,507	$501	20.0%	$3,008	3.1%	$2,585	$517	$3,102	$0	$3,102	2.7%	$2,656	$531	$3,187
31	CONSTRUCTION MANAGEMENT	$1,536	$399	26.0%	$1,936	3.1%	$1,584	$412	$1,996	$0	$1,996	6.5%	$1,688	$439	$2,127
	PROJECT COST TOTALS:	$65,503	$19,339	29.5%	$84,842		$67,715	$19,993	**$87,708**	$0	**$87,708**	5.4%	$71,380	$21,081	$92,461

_______________ **CHIEF, COST ENGINEERING, Chris Tilley (Acting)**

ESTIMATED TOTAL PROJECT COST: $92,461

_______________ **PROJECT MANAGER, Sam Bell**

_______________ **CHIEF, REAL ESTATE, xxx**

_______________ **CHIEF, PLANNING, xxx**

_______________ **CHIEF, ENGINEERING, xxx**

_______________ **CHIEF, OPERATIONS, xxx**

_______________ **CHIEF, CONSTRUCTION, xxx**

_______________ **CHIEF, CONTRACTING,xxx**

_______________ **CHIEF, PM-PB, xxxx**

_______________ **CHIEF, DPM, xxx**

**** TOTAL PROJECT COST SUMMARY ****

**** CONTRACT COST SUMMARY ****

PROJECT: Providence River DMMP
LOCATION: Providence River DMMP
This Estimate reflects the scope and schedule in report; Misc info from PDT

DISTRICT: NAE PREPARED: 12/16/2024
POC: CHIEF, COST ENGINEERING, Chris Tilley (Acting)

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
<> Dredging to Create New Edgewood Shoals South CAD Cell (2,957,580 cy) with Disposal to Various Locations INCLUDING the Beneficial Use Locations* * PDT revised contingency from original 2022 ARA at 34% CAD Cell Construction to 30% contingecy , as well as PED and CM was revised from 5% to 4%, and 3% to 2.5% per PDT.		Estimate Prepared:			**4-Oct-24**	Program Year (Budget EC):			2026					
		Effective Price Level:			1-Oct-24	Effective Price Level Date:			1 OCT 25					
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	RISK BASED CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*P*	*L*	*M*	*N*	*O*
	PHASE 1 or CONTRACT 1													
12	Construct Edgewood Shoals South CAD Cell (w/BU's)	$41,734	$12,520	30.0%	$54,254	3.4%	$43,151	$12,945	$56,096	2027Q4	4.6%	$45,144	$13,543	$58,688
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	CONSTRUCTION ESTIMATE TOTALS:	$41,734	$12,520	30.0%	**$54,254**		$43,151	$12,945	$56,096			$45,144	$13,543	$58,688
01	LANDS AND DAMAGES	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN													
0.5%	Project Management	$188	$38	20.0%	$225	3.1%	$194	$39	$232	2026Q3	1.5%	$197	$39	$236
0.2%	Planning & Environmental Compliance	$73	$15	20.0%	$88	3.1%	$75	$15	$90	2026Q3	1.5%	$76	$15	$92
1.9%	Engineering & Design	$793	$159	20.0%	$952	3.1%	$818	$164	$981	2026Q3	1.5%	$830	$166	$996
0.2%	Reviews, ATRs, IEPRs, VE	$63	$13	20.0%	$75	3.1%	$65	$13	$77	2026Q3	1.5%	$66	$13	$79
0.2%	Life Cycle Updates (cost, schedule, risks)	$63	$13	20.0%	$75	3.1%	$65	$13	$77	2026Q3	1.5%	$66	$13	$79
0.2%	Contracting & Reprographics	$63	$13	20.0%	$75	3.1%	$65	$13	$77	2026Q3	1.5%	$66	$13	$79
0.6%	Engineering During Construction	$240	$48	20.0%	$288	3.1%	$247	$49	$297	2027Q4	5.5%	$261	$52	$313
0.4%	Planning During Construction	$146	$29	20.0%	$175	3.1%	$151	$30	$181	2027Q4	5.5%	$159	$32	$191
0.0%	Adaptive Mgmt & Monit (Shellfish Relocation)	$49	$10	20.0%	$58	3.1%	$50	$10	$60	2027Q4	5.5%	$53	$11	$63
0.1%	Project Operations	$42	$8	20.0%	$50	3.1%	$43	$9	$52	2026Q3	1.5%	$44	$9	$52
	Real Estate (All Federal Labor)	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
4.0%	**total**													
31	CONSTRUCTION MANAGEMENT													
1.6%	Construction Management	$647	$168	26.0%	$815	3.1%	$667	$173	$840	2027Q4	5.5%	$704	$183	$886
0.7%	Project Operation:	$271	$71	26.0%	$342	3.1%	$280	$73	$352	2027Q4	5.5%	$295	$77	$372
0.3%	Project Management	$125	$33	26.0%	$158	3.1%	$129	$34	$163	2027Q4	5.5%	$136	$35	$172
2.5%	**total**													
	CONTRACT COST TOTALS:	$44,495	$13,135		$57,630		$45,998	$13,579	**$59,577**			$48,095	$14,202	**$62,297**

**** TOTAL PROJECT COST SUMMARY ****

**** CONTRACT COST SUMMARY ****

PROJECT: Providence River DMMP
LOCATION: Providence River DMMP
This Estimate reflects the scope and schedule in report; Misc info from PDT

DISTRICT: NAE
POC: CHIEF, COST ENGINEERING, Chris Tilley (Acting)
PREPARED: 12/16/2024

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
<> Maintenance Dredge FNP with Disposal to Edgewood Shoals South CAD Cell.* * PDT confirms original 2022 ARA is still current and the same contingecy can be used, and PED and CM was revised from 5% to 4%, and 3% to 2.5% per PDT.		Estimate Prepared:			4-Oct-24	Program Year (Budget EC):			2026					
		Effective Price Level:			1-Oct-24	Effective Price Level Date:			1 OCT 25					
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*P*	*L*	*M*	*N*	*O*
	PHASE 2 or CONTRACT 2													
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
12	Providence River FNP Maintenance Dredging	$19,726	$5,918	30.0%	$25,643	3.4%	$20,395	$6,119	$26,514	2028Q4	7.3%	$21,892	$6,568	$28,460
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	CONSTRUCTION ESTIMATE TOTALS:	$19,726	$5,918	30.0%	**$25,643**		$20,395	$6,119	$26,514			$21,892	$6,568	$28,460
01	LANDS AND DAMAGES	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN													
0.5%	Project Management	$89	$18	20.0%	$107	3.1%	$92	$18	$110	2026Q3	1.5%	$93	$19	$112
0.2%	Planning & Environmental Compliance	$35	$7	20.0%	$41	3.1%	$36	$7	$43	2026Q3	1.5%	$36	$7	$43
1.9%	Engineering & Design	$375	$75	20.0%	$450	3.1%	$386	$77	$464	2026Q3	1.5%	$392	$78	$471
0.2%	Reviews, ATRs, IEPRs, VE	$30	$6	20.0%	$36	3.1%	$31	$6	$37	2026Q3	1.5%	$31	$6	$37
0.2%	Life Cycle Updates (cost, schedule, risks)	$30	$6	20.0%	$36	3.1%	$31	$6	$37	2026Q3	1.5%	$31	$6	$37
0.2%	Contracting & Reprographics	$30	$6	20.0%	$36	3.1%	$31	$6	$37	2026Q3	1.5%	$31	$6	$37
0.6%	Engineering During Construction	$113	$23	20.0%	$136	3.1%	$117	$23	$140	2028Q4	8.8%	$127	$25	$153
0.4%	Planning During Construction	$69	$14	20.0%	$83	3.1%	$71	$14	$85	2028Q4	8.8%	$77	$15	$93
0.0%	Adaptive Management & Monitoring	$0	$0	20.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.1%	Project Operations	$20	$4	20.0%	$24	3.1%	$20	$4	$24	2026Q3	1.5%	$21	$4	$25
	Real Estate (All Federal Labor)	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
4.0%	**total**													
31	CONSTRUCTION MANAGEMENT													
1.6%	Construction Management	$306	$79	26.0%	$385	3.1%	$315	$82	$397	2028Q4	8.8%	$343	$89	$432
0.7%	Project Operation:	$128	$33	26.0%	$162	3.1%	$132	$34	$167	2028Q4	8.8%	$144	$37	$181
0.3%	Project Management	$59	$15	26.0%	$75	3.1%	$61	$16	$77	2028Q4	8.8%	$66	$17	$84
2.5%	**total**													
	CONTRACT COST TOTALS:	$21,008	$6,204		$27,212		$21,717	$6,414	**$28,131**			$23,285	$6,879	**$30,164**

****** TOTAL PROJECT COST SUMMARY ******

PROJECT: **Providence River DMMP**
PROJECT NO: n/a
LOCATION: Providence River DMMP

DISTRICT: NAE
POC: CHIEF, COST ENGINEERING, Chris Tilley (Acting)

PREPARED: 12/16/2024

This Estimate reflects the scope and schedule in report; Misc info by PDT

Civil Works Work Breakdown Structure		**ESTIMATED COST**				**PROJECT FIRST COST (Constant Dollar Basis)**						**TOTAL PROJECT COST (FULLY FUNDED)**			
Construct Edgewood Shoals South CAD Cell						Program Year (Budget EC): 2026 Effective Price Level Date: 1 OCT 25									
WBS NUMBER *A*	Civil Works Feature & Sub-Feature Description *B*	COST ($K) *C*	CNTG ($K) *D*	CNTG (%) *E*	TOTAL ($K) *F*	ESC (%) *G*	COST ($K) *H*	CNTG ($K) *I*	**TOTAL ($K)** *J*	Spent Thru: **1-Oct-24** ($K)	**TOTAL FIRST COST** ($K) *K*	INFLATED (%) *L*	COST ($K) *M*	CNTG ($K) *N*	FULL ($K) *O*
12	Construct Edgewood Shoals South CAD Cell	$52,861	$15,858	30.0%	$68,719	3.4%	$54,656	$16,397	$71,052	$0	$71,052	4.6%	$57,181	$17,154	$74,335
12	Providence River FNP Maintenance Dredging	$19,726	$5,918	30.0%	$25,643	3.4%	$20,395	$6,119	$26,514	$0	$26,514	7.3%	$21,892	$6,568	$28,460
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	CONSTRUCTION ESTIMATE TOTALS:	$72,587	$21,776		$94,363	3.4%	$75,051	$22,515	$97,566	$0	$97,566	5.4%	$79,073	$23,722	$102,795
01	LANDS AND DAMAGES	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN	$2,952	$590	20.0%	$3,542	3.1%	$3,043	$609	$3,652	$0	$3,652	2.7%	$3,126	$625	$3,751
31	CONSTRUCTION MANAGEMENT	$1,815	$472	26.0%	$2,286	3.1%	$1,871	$486	$2,357	$0	$2,357	6.4%	$1,990	$517	$2,508
	PROJECT COST TOTALS:	$77,353	$22,838	29.5%	$100,192		$79,965	$23,610	**$103,576**	$0	**$103,576**	5.3%	$84,189	$24,865	$109,054

ESTIMATED TOTAL PROJECT COST: $109,054

____________________ **CHIEF, COST ENGINEERING, Chris Tilley (Acting)**

____________________ **PROJECT MANAGER, Sam Bell**

____________________ **CHIEF, REAL ESTATE, xxx**

____________________ **CHIEF, PLANNING, xxx**

____________________ **CHIEF, ENGINEERING, xxx**

____________________ **CHIEF, OPERATIONS, xxx**

____________________ **CHIEF, CONSTRUCTION, xxx**

____________________ **CHIEF, CONTRACTING,xxx**

____________________ **CHIEF, PM-PB, xxxx**

____________________ **CHIEF, DPM, xxx**

**** TOTAL PROJECT COST SUMMARY ****

**** CONTRACT COST SUMMARY ****

PROJECT: Providence River DMMP
LOCATION: Providence River DMMP
This Estimate reflects the scope and schedule in report; Misc info by PDT

DISTRICT: NAE
POC: CHIEF, COST ENGINEERING, Chris Tilley (Acting)
PREPARED: 12/16/2024

<> Dredging to Create New Edgewood Shoals South CAD Cell (2,957,580 cy) with Disposal to Various Locations NOT Including the Beneficial Use Locations*
* PDT revised contingency from original 2022 ARA at 34% CAD Cell Construction to 30% contingecy , as well as PED and CM was revised from 5% to 4%, and 3% to 2.5% per PDT.

ESTIMATED COST: Estimate Prepared: **4-Oct-24**; Effective Price Level: 1-Oct-24

PROJECT FIRST COST (Constant Dollar Basis): Program Year (Budget EC): 2026; Effective Price Level Date: 1 OCT 25

Civil Works Work Breakdown Structure			ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
WBS NUMBER		Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	RISK BASED CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A		*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*P*	*L*	*M*	*N*	*O*
		PHASE 1 or CONTRACT 1													
12		Construct Edgewood Shoals South CAD Cell	$52,861	$15,858	30.0%	$68,719	3.4%	$54,656	$16,397	$71,052	2027Q4	4.6%	$57,181	$17,154	$74,335
		#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
		#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
		#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
		#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
		#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
		#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
		#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
		CONSTRUCTION ESTIMATE TOTALS:	$52,861	$15,858	30.0%	**$68,719**		$54,656	$16,397	$71,052			$57,181	$17,154	$74,335
01		LANDS AND DAMAGES	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
30		PLANNING, ENGINEERING & DESIGN													
	0.5%	Project Management	$238	$48	20.0%	$285	3.1%	$245	$49	$294	2026Q3	1.5%	$249	$50	$299
	0.2%	Planning & Environmental Compliance	$93	$19	20.0%	$111	3.1%	$95	$19	$114	2026Q3	1.5%	$97	$19	$116
	1.9%	Engineering & Design	$1,004	$201	20.0%	$1,205	3.1%	$1,035	$207	$1,243	2026Q3	1.5%	$1,051	$210	$1,262
	0.2%	Reviews, ATRs, IEPRs, VE	$79	$16	20.0%	$95	3.1%	$82	$16	$98	2026Q3	1.5%	$83	$17	$100
	0.2%	Life Cycle Updates (cost, schedule, risks)	$79	$16	20.0%	$95	3.1%	$82	$16	$98	2026Q3	1.5%	$83	$17	$100
	0.2%	Contracting & Reprographics	$79	$16	20.0%	$95	3.1%	$82	$16	$98	2026Q3	1.5%	$83	$17	$100
	0.6%	Engineering During Construction	$304	$61	20.0%	$365	3.1%	$313	$63	$376	2027Q4	5.5%	$331	$66	$397
	0.4%	Planning During Construction	$185	$37	20.0%	$222	3.1%	$191	$38	$229	2027Q4	5.5%	$201	$40	$241
	0.0%	Adaptive Mgmt & Monit (Shellfish Relocation)	$49	$10	20.0%	$58	3.1%	$50	$10	$60	2027Q4	5.5%	$53	$11	$63
	0.1%	Project Operations	$53	$11	20.0%	$63	3.1%	$54	$11	$65	2026Q3	1.5%	$55	$11	$66
		Real Estate (All Federal Labor)	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	4.0%	**total**													
31		CONSTRUCTION MANAGEMENT													
	1.6%	Construction Management	$819	$213	26.0%	$1,032	3.1%	$845	$220	$1,064	2027Q4	5.5%	$891	$232	$1,123
	0.7%	Project Operation:	$344	$89	26.0%	$433	3.1%	$354	$92	$446	2027Q4	5.5%	$374	$97	$471
	0.3%	Project Management	$159	$41	26.0%	$200	3.1%	$163	$43	$206	2027Q4	5.5%	$172	$45	$217
	2.5%	**total**													
		CONTRACT COST TOTALS:	$56,345	$16,634		$72,980		$58,248	$17,197	**$75,445**			$60,904	$17,985	**$78,889**

**** TOTAL PROJECT COST SUMMARY ****

**** CONTRACT COST SUMMARY ****

PROJECT: Providence River DMMP
LOCATION: Providence River DMMP
This Estimate reflects the scope and schedule in report; Misc info by PDT

DISTRICT: NAE
POC: CHIEF, COST ENGINEERING, Chris Tilley (Acting)
PREPARED: 12/16/2024

Civil Works Work Breakdown Structure | **ESTIMATED COST** | **PROJECT FIRST COST (Constant Dollar Basis)** | **TOTAL PROJECT COST (FULLY FUNDED)**

<> Maintenance Dredge FNP with Disposal to Edgewood Shoals South CAD Cell.*
* PDT revised contingency from original 2022 ARA at 34% CAD Cell Construction to 30% contingecy , and PED and CM was revised from 5% to 4%, and 3% to 2.5% per PDT.

Estimate Prepared: **4-Oct-24**
Effective Price Level: 1-Oct-24

Program Year (Budget EC): 2026
Effective Price Level Date: 1 OCT 25

WBS NUMBER A	Civil Works Feature & Sub-Feature Description B	COST ($K) C	CNTG ($K) D	CNTG (%) E	TOTAL ($K) F	ESC (%) G	COST ($K) H	CNTG ($K) I	TOTAL ($K) J	Mid-Point Date P	INFLATED (%) L	COST ($K) M	CNTG ($K) N	FULL ($K) O
	PHASE 2 or CONTRACT 2													
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
12	Providence River FNP Maintenance Dredging	$19,726	$5,918	30.0%	$25,643	3.4%	$20,395	$6,119	$26,514	2028Q4	7.3%	$21,892	$6,568	$28,460
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	CONSTRUCTION ESTIMATE TOTALS:	$19,726	$5,918	30.0%	**$25,643**		$20,395	$6,119	$26,514			$21,892	$6,568	$28,460
01	LANDS AND DAMAGES	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN													
0.5%	Project Management	$89	$18	20.0%	$107	3.1%	$92	$18	$110	2026Q3	1.5%	$93	$19	$112
0.2%	Planning & Environmental Compliance	$35	$7	20.0%	$41	3.1%	$36	$7	$43	2026Q3	1.5%	$36	$7	$43
1.9%	Engineering & Design	$375	$75	20.0%	$450	3.1%	$386	$77	$464	2026Q3	1.5%	$392	$78	$471
0.2%	Reviews, ATRs, IEPRs, VE	$30	$6	20.0%	$36	3.1%	$31	$6	$37	2026Q3	1.5%	$31	$6	$37
0.2%	Life Cycle Updates (cost, schedule, risks)	$30	$6	20.0%	$36	3.1%	$31	$6	$37	2026Q3	1.5%	$31	$6	$37
0.2%	Contracting & Reprographics	$30	$6	20.0%	$36	3.1%	$31	$6	$37	2026Q3	1.5%	$31	$6	$37
0.6%	Engineering During Construction	$113	$23	20.0%	$136	3.1%	$117	$23	$140	2028Q4	8.8%	$127	$25	$153
0.4%	Planning During Construction	$69	$14	20.0%	$83	3.1%	$71	$14	$85	2028Q4	8.8%	$77	$15	$93
0.0%	Adaptive Management & Monitoring	$0	$0	20.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.1%	Project Operations	$20	$4	20.0%	$24	3.1%	$20	$4	$24	2026Q3	1.5%	$21	$4	$25
	Real Estate (All Federal Labor)	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
4.0%	**total**													
31	CONSTRUCTION MANAGEMENT													
1.6%	Construction Management	$306	$79	26.0%	$385	3.1%	$315	$82	$397	2028Q4	8.8%	$343	$89	$432
0.7%	Project Operation:	$128	$33	26.0%	$162	3.1%	$132	$34	$167	2028Q4	8.8%	$144	$37	$181
0.3%	Project Management	$59	$15	26.0%	$75	3.1%	$61	$16	$77	2028Q4	8.8%	$66	$17	$84
2.5%	**total**													
	CONTRACT COST TOTALS:	$21,008	$6,204		$27,212		$21,717	$6,414	**$28,131**			$23,285	$6,879	**$30,164**

**** TOTAL PROJECT COST SUMMARY ****

PROJECT: **Providence River DMMP** | **DISTRICT: NAE** | **PREPARED: 12/16/2024**
PROJECT NO: n/a | **POC: CHIEF, COST ENGINEERING, Chris Tilley (Acting)**
LOCATION: Providence River DMMP

This Estimate reflects the scope and schedule in report; Misc info by PDT

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
Construct Fox Point Reach CAD Cell (w/BU's)						Program Year (Budget EC): 2026	Effective Price Level Date: 1 OCT 25								
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	**TOTAL ($K)**	Spent Thru: **1-Oct-24** ($K)	**TOTAL FIRST COST** ($K)	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***I***	***J***		***K***	***L***	***M***	***N***	***O***
12	Construct Fox Point Reach CAD Cell (w/BU's)	$56,734	$17,020	30.0%	$73,755	3.4%	$58,661	$17,598	$76,259	$0	$76,259	4.6%	$61,371	$18,411	$79,782
12	Providence River FNP Maintenance Dredging	$19,256	$5,777	30.0%	$25,033	3.4%	$19,910	$5,973	$25,883	$0	$25,883	7.3%	$21,372	$6,411	$27,783
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	CONSTRUCTION ESTIMATE TOTALS:	$75,991	$22,797		$98,788	3.4%	$78,571	$23,571	$102,142	$0	$102,142	5.3%	$82,742	$24,823	$107,565
01	LANDS AND DAMAGES	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN	$3,088	$618	20.0%	$3,706	3.1%	$3,184	$637	$3,821	$0	$3,821	2.7%	$3,269	$654	$3,923
31	CONSTRUCTION MANAGEMENT	$1,900	$494	26.0%	$2,394	3.1%	$1,959	$509	$2,468	$0	$2,468	6.3%	$2,082	$541	$2,624
	PROJECT COST TOTALS:	$80,979	$23,909	29.5%	$104,888		$83,713	$24,717	**$108,430**	$0	**$108,430**	5.2%	$88,094	$26,018	$114,112

ESTIMATED TOTAL PROJECT COST: $114,112

_____________________________ **CHIEF, COST ENGINEERING, Chris Tilley (Acting)**

_____________________________ **PROJECT MANAGER, Sam Bell**

_____________________________ **CHIEF, REAL ESTATE, xxx**

_____________________________ **CHIEF, PLANNING, xxx**

_____________________________ **CHIEF, ENGINEERING, xxx**

_____________________________ **CHIEF, OPERATIONS, xxx**

_____________________________ **CHIEF, CONSTRUCTION, xxx**

_____________________________ **CHIEF, CONTRACTING,xxx**

_____________________________ **CHIEF, PM-PB, xxxx**

_____________________________ **CHIEF, DPM, xxx**

**** TOTAL PROJECT COST SUMMARY ****

**** CONTRACT COST SUMMARY ****

PROJECT: Providence River DMMP
LOCATION: Providence River DMMP
This Estimate reflects the scope and schedule in report; Misc info by PDT

DISTRICT: NAE
POC: CHIEF, COST ENGINEERING, Chris Tilley (Acting)
PREPARED: 12/16/2024

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
<> Dredging to Create New Fox Point Reach CAD Cell (3,603,200 cy) with Disposal to Various Locations INCLUDING the Beneficial Use Locations* * PDT confirms original 2022 ARA is still current and the same contingecy can be used, and PED and CM was revised from 5% to 4%, and 3% to 2.5% per PDT.		Estimate Prepared:			**4-Oct-24**	Program Year (Budget EC):			2026					
		Effective Price Level:			1-Oct-24	Effective Price Level Date:			1 OCT 25					
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	RISK BASED CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*P*	*L*	*M*	*N*	*O*
	PHASE 1 or CONTRACT 1													
12	Construct Fox Point Reach CAD Cell (w/BU's)	$56,734	$17,020	30.0%	$73,755	3.4%	$58,661	$17,598	$76,259	2027Q4	4.6%	$61,371	$18,411	$79,782
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	CONSTRUCTION ESTIMATE TOTALS:	$56,734	$17,020	30.0%	**$73,755**		$58,661	$17,598	$76,259			$61,371	$18,411	$79,782
01	LANDS AND DAMAGES	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN													
0.5%	Project Management	$255	$51	20.0%	$306	3.1%	$263	$53	$316	2026Q3	1.5%	$267	$53	$321
0.2%	Planning & Environmental Compliance	$99	$20	20.0%	$119	3.1%	$102	$20	$123	2026Q3	1.5%	$104	$21	$125
1.9%	Engineering & Design	$1,078	$216	20.0%	$1,294	3.1%	$1,111	$222	$1,334	2026Q3	1.5%	$1,128	$226	$1,354
0.2%	Reviews, ATRs, IEPRs, VE	$85	$17	20.0%	$102	3.1%	$88	$18	$105	2026Q3	1.5%	$89	$18	$107
0.2%	Life Cycle Updates (cost, schedule, risks)	$85	$17	20.0%	$102	3.1%	$88	$18	$105	2026Q3	1.5%	$89	$18	$107
0.2%	Contracting & Reprographics	$85	$17	20.0%	$102	3.1%	$88	$18	$105	2026Q3	1.5%	$89	$18	$107
0.6%	Engineering During Construction	$326	$65	20.0%	$391	3.1%	$336	$67	$404	2027Q4	5.5%	$355	$71	$426
0.4%	Planning During Construction	$199	$40	20.0%	$238	3.1%	$205	$41	$246	2027Q4	5.5%	$216	$43	$259
0.0%	Adaptive Mgmt & Monit (Shellfish Relocation)	$49	$10	20.0%	$58	3.1%	$50	$10	$60	2027Q4	5.5%	$53	$11	$63
0.1%	Project Operations	$57	$11	20.0%	$68	3.1%	$58	$12	$70	2026Q3	1.5%	$59	$12	$71
	Real Estate (All Federal Labor)	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
4.0%	**total**													
31	CONSTRUCTION MANAGEMENT													
1.6%	Construction Management	$879	$229	26.0%	$1,108	3.1%	$907	$236	$1,142	2027Q4	5.5%	$956	$249	$1,205
0.7%	Project Operation:	$369	$96	26.0%	$465	3.1%	$380	$99	$479	2027Q4	5.5%	$401	$104	$505
0.3%	Project Management	$170	$44	26.0%	$214	3.1%	$175	$46	$221	2027Q4	5.5%	$185	$48	$233
2.5%	**total**													
	CONTRACT COST TOTALS:	$60,471	$17,853		$78,323		$62,513	$18,456	**$80,969**			$65,363	$19,302	**$84,665**

**** TOTAL PROJECT COST SUMMARY ****

**** CONTRACT COST SUMMARY ****

PROJECT: Providence River DMMP
LOCATION: Providence River DMMP
This Estimate reflects the scope and schedule in report; Misc info by PDT

DISTRICT: NAE PREPARED: 12/16/2024
POC: CHIEF, COST ENGINEERING, Chris Tilley (Acting)

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
<> Maintenance Dredge FNP with Disposal to Edgewood Shoals South CAD Cell.* * PDT confirms original 2022 ARA is still current and the same contingecy can be used, and PED and CM was revised from 5% to 4%, and 3% to 2.5% per PDT.		Estimate Prepared:			4-Oct-24	Program Year (Budget EC):			2026					
		Effective Price Level:			1-Oct-24	Effective Price Level Date:			1 OCT 25					
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*P*	*L*	*M*	*N*	*O*
	PHASE 2 or CONTRACT 2													
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
12	Providence River FNP Maintenance Dredging	$19,256	$5,777	30.0%	$25,033	3.4%	$19,910	$5,973	$25,883	2028Q4	7.3%	$21,372	$6,411	$27,783
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	CONSTRUCTION ESTIMATE TOTALS:	$19,256	$5,777	30.0%	**$25,033**		$19,910	$5,973	$25,883			$21,372	$6,411	$27,783
01	LANDS AND DAMAGES	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN													
0.5%	Project Management	$87	$17	20.0%	$104	3.1%	$89	$18	$107	2026Q3	1.5%	$91	$18	$109
0.2%	Planning & Environmental Compliance	$34	$7	20.0%	$40	3.1%	$35	$7	$42	2026Q3	1.5%	$35	$7	$42
1.9%	Engineering & Design	$366	$73	20.0%	$439	3.1%	$377	$75	$453	2026Q3	1.5%	$383	$77	$460
0.2%	Reviews, ATRs, IEPRs, VE	$29	$6	20.0%	$35	3.1%	$30	$6	$36	2026Q3	1.5%	$30	$6	$36
0.2%	Life Cycle Updates (cost, schedule, risks)	$29	$6	20.0%	$35	3.1%	$30	$6	$36	2026Q3	1.5%	$30	$6	$36
0.2%	Contracting & Reprographics	$29	$6	20.0%	$35	3.1%	$30	$6	$36	2026Q3	1.5%	$30	$6	$36
0.6%	Engineering During Construction	$111	$22	20.0%	$133	3.1%	$114	$23	$137	2028Q4	8.8%	$124	$25	$149
0.4%	Planning During Construction	$67	$13	20.0%	$81	3.1%	$69	$14	$83	2028Q4	8.8%	$76	$15	$91
0.0%	Adaptive Management & Monitoring	$0	$0	20.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.1%	Project Operations	$19	$4	20.0%	$23	3.1%	$20	$4	$24	2026Q3	1.5%	$20	$4	$24
	Real Estate (All Federal Labor)	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
4.0%	**total**													
31	CONSTRUCTION MANAGEMENT													
1.6%	Construction Management	$298	$78	26.0%	$376	3.1%	$308	$80	$388	2028Q4	8.8%	$335	$87	$422
0.7%	Project Operation:	$125	$33	26.0%	$158	3.1%	$129	$34	$163	2028Q4	8.8%	$140	$36	$177
0.3%	Project Management	$58	$15	26.0%	$73	3.1%	$60	$15	$75	2028Q4	8.8%	$65	$17	$82
2.5%	**total**													
	CONTRACT COST TOTALS:	$20,508	$6,056		$26,564		$21,201	$6,261	**$27,462**			$22,731	$6,716	**$29,447**

**** TOTAL PROJECT COST SUMMARY ****

PROJECT: **Providence River DMMP**
PROJECT NO: n/a
LOCATION: Providence River DMMP

DISTRICT: NAE
POC: CHIEF, COST ENGINEERING, Chris Tilley (Acting)

PREPARED: 12/16/2024

This Estimate reflects the scope and schedule in report; Misc info by PDT

Civil Works Work Breakdown Structure		**ESTIMATED COST**				**PROJECT FIRST COST (Constant Dollar Basis)**						**TOTAL PROJECT COST (FULLY FUNDED)**			
Construct Fox Point Reach CAD Cell						Program Year (Budget EC): 2026 Effective Price Level Date: 1 OCT 25									
WBS NUMBER *A*	Civil Works Feature & Sub-Feature Description *B*	COST ($K) *C*	CNTG ($K) *D*	CNTG (%) *E*	TOTAL ($K) *F*	ESC (%) *G*	COST ($K) *H*	CNTG ($K) *I*	**TOTAL ($K)** *J*	Spent Thru: **1-Oct-24** ($K)	**TOTAL FIRST COST** ($K) *K*	INFLATED (%) *L*	COST ($K) *M*	CNTG ($K) *N*	FULL ($K) *O*
12	Construct Fox Point Reach CAD Cell	$65,962	$19,789	30.0%	$85,751	3.4%	$68,201	$20,460	$88,662	$0	$88,662	4.6%	$71,352	$21,406	$92,758
12	Providence River FNP Maintenance Dredging	$19,256	$5,777	30.0%	$25,033	3.4%	$19,910	$5,973	$25,883	$0	$25,883	7.3%	$21,372	$6,411	$27,783
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	CONSTRUCTION ESTIMATE TOTALS:	$85,219	$25,566		$110,784	3.4%	$88,112	$26,434	$114,545	$0	$114,545	5.2%	$92,724	$27,817	$120,541
01	LANDS AND DAMAGES	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN	$3,457	$691	20.0%	$4,149	3.1%	$3,564	$713	$4,277	$0	$4,277	2.7%	$3,659	$732	$4,391
31	CONSTRUCTION MANAGEMENT	$2,130	$554	26.0%	$2,684	3.1%	$2,197	$571	$2,768	$0	$2,768	6.2%	$2,333	$607	$2,940
	PROJECT COST TOTALS:	$90,806	$26,811	29.5%	$117,617		$93,873	$27,717	**$121,590**	$0	**$121,590**	5.2%	$98,717	$29,156	$127,873

________________ **CHIEF, COST ENGINEERING, Chris Tilley (Acting)**

ESTIMATED TOTAL PROJECT COST: $127,873

________________ **PROJECT MANAGER, Sam Bell**

________________ **CHIEF, REAL ESTATE, xxx**

________________ **CHIEF, PLANNING, xxx**

________________ **CHIEF, ENGINEERING, xxx**

________________ **CHIEF, OPERATIONS, xxx**

________________ **CHIEF, CONSTRUCTION, xxx**

________________ **CHIEF, CONTRACTING,xxx**

________________ **CHIEF, PM-PB, xxxx**

________________ **CHIEF, DPM, xxx**

****** TOTAL PROJECT COST SUMMARY ******

****** CONTRACT COST SUMMARY ******

PROJECT: Providence River DMMP
LOCATION: Providence River DMMP
This Estimate reflects the scope and schedule in report; Misc info by PDT

DISTRICT: NAE
POC: CHIEF, COST ENGINEERING, Chris Tilley (Acting)

PREPARED: 12/16/2024

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
<> Dredging to Create New Fox Point Reach CAD Cell (3,603,200 cy) with Disposal to Various Locations NOT Including the Beneficial Use Locations* * PDT confirms original 2022 ARA is still current and the same contingecy can be used, and PED and CM was revised from 5% to 4%, and 3% to 2.5% per PDT.		Estimate Prepared: Effective Price Level:			4-Oct-24 1-Oct-24	Program Year (Budget EC): Effective Price Level Date:			2026 1 OCT 25					
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	RISK BASED CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*P*	*L*	*M*	*N*	*O*
	PHASE 1 or CONTRACT 1													
12	Construct Fox Point Reach CAD Cell	$65,962	$19,789	30.0%	$85,751	3.4%	$68,201	$20,460	$88,662	2027Q4	4.6%	$71,352	$21,406	$92,758
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	CONSTRUCTION ESTIMATE TOTALS:	$65,962	$19,789	30.0%	**$85,751**		$68,201	$20,460	$88,662			$71,352	$21,406	$92,758
01	LANDS AND DAMAGES	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN													
0.5%	Project Management	$297	$59	20.0%	$356	3.1%	$306	$61	$367	2026Q3	1.5%	$311	$62	$373
0.2%	Planning & Environmental Compliance	$115	$23	20.0%	$139	3.1%	$119	$24	$143	2026Q3	1.5%	$121	$24	$145
1.9%	Engineering & Design	$1,253	$251	20.0%	$1,504	3.1%	$1,292	$258	$1,551	2026Q3	1.5%	$1,312	$262	$1,574
0.2%	Reviews, ATRs, IEPRs, VE	$99	$20	20.0%	$119	3.1%	$102	$20	$122	2026Q3	1.5%	$104	$21	$124
0.2%	Life Cycle Updates (cost, schedule, risks)	$99	$20	20.0%	$119	3.1%	$102	$20	$122	2026Q3	1.5%	$104	$21	$124
0.2%	Contracting & Reprographics	$99	$20	20.0%	$119	3.1%	$102	$20	$122	2026Q3	1.5%	$104	$21	$124
0.6%	Engineering During Construction	$379	$76	20.0%	$455	3.1%	$391	$78	$469	2027Q4	5.5%	$413	$83	$495
0.4%	Planning During Construction	$231	$46	20.0%	$277	3.1%	$238	$48	$286	2027Q4	5.5%	$251	$50	$301
0.0%	Adaptive Mgmt & Monit (Shellfish Relocation)	$49	$10	20.0%	$58	3.1%	$50	$10	$60	2027Q4	5.5%	$53	$11	$63
0.1%	Project Operations	$66	$13	20.0%	$79	3.1%	$68	$14	$82	2026Q3	1.5%	$69	$14	$83
	Real Estate (All Federal Labor)	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
4.0%	**total**													
31	CONSTRUCTION MANAGEMENT													
1.6%	Construction Management	$1,022	$266	26.0%	$1,288	3.1%	$1,054	$274	$1,328	2027Q4	5.5%	$1,112	$289	$1,401
0.7%	Project Operation:	$429	$111	26.0%	$540	3.1%	$442	$115	$557	2027Q4	5.5%	$466	$121	$588
0.3%	Project Management	$198	$51	26.0%	$249	3.1%	$204	$53	$257	2027Q4	5.5%	$215	$56	$271
2.5%	**total**													
	CONTRACT COST TOTALS:	$70,298	$20,755		$91,053		$72,672	$21,457	**$94,128**			$75,986	$22,440	**$98,426**

**** TOTAL PROJECT COST SUMMARY ****

**** CONTRACT COST SUMMARY ****

PROJECT: Providence River DMMP
LOCATION: Providence River DMMP
This Estimate reflects the scope and schedule in report; Misc info by PDT

DISTRICT: NAE PREPARED: 12/16/2024
POC: CHIEF, COST ENGINEERING, Chris Tilley (Acting)

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
<> Maintenance Dredge FNP with Disposal to Edgewood Shoals South CAD Cell.* * PDT confirms original 2022 ARA is still current and the same contingecy can be used, and PED and CM was revised from 5% to 4%, and 3% to 2.5% per PDT.		Estimate Prepared:			4-Oct-24	Program Year (Budget EC):			2026					
		Effective Price Level:			1-Oct-24	Effective Price Level Date:			1 OCT 25					
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*P*	*L*	*M*	*N*	*O*
	PHASE 2 or CONTRACT 2													
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
12	Providence River FNP Maintenance Dredging	$19,256	$5,777	30.0%	$25,033	3.4%	$19,910	$5,973	$25,883	2028Q4	7.3%	$21,372	$6,411	$27,783
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	CONSTRUCTION ESTIMATE TOTALS:	$19,256	$5,777	30.0%	**$25,033**		$19,910	$5,973	$25,883			$21,372	$6,411	$27,783
01	LANDS AND DAMAGES	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN													
0.5%	Project Management	$87	$17	20.0%	$104	3.1%	$89	$18	$107	2026Q3	1.5%	$91	$18	$109
0.2%	Planning & Environmental Compliance	$34	$7	20.0%	$40	3.1%	$35	$7	$42	2026Q3	1.5%	$35	$7	$42
1.9%	Engineering & Design	$366	$73	20.0%	$439	3.1%	$377	$75	$453	2026Q3	1.5%	$383	$77	$460
0.2%	Reviews, ATRs, IEPRs, VE	$29	$6	20.0%	$35	3.1%	$30	$6	$36	2026Q3	1.5%	$30	$6	$36
0.2%	Life Cycle Updates (cost, schedule, risks)	$29	$6	20.0%	$35	3.1%	$30	$6	$36	2026Q3	1.5%	$30	$6	$36
0.2%	Contracting & Reprographics	$29	$6	20.0%	$35	3.1%	$30	$6	$36	2026Q3	1.5%	$30	$6	$36
0.6%	Engineering During Construction	$111	$22	20.0%	$133	3.1%	$114	$23	$137	2028Q4	8.8%	$124	$25	$149
0.4%	Planning During Construction	$67	$13	20.0%	$81	3.1%	$69	$14	$83	2028Q4	8.8%	$76	$15	$91
0.0%	Adaptive Management & Monitoring	$0	$0	20.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.1%	Project Operations	$19	$4	20.0%	$23	3.1%	$20	$4	$24	2026Q3	1.5%	$20	$4	$24
	Real Estate (All Federal Labor)	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
4.0%	**total**													
31	CONSTRUCTION MANAGEMENT													
1.6%	Construction Management	$298	$78	26.0%	$376	3.1%	$308	$80	$388	2028Q4	8.8%	$335	$87	$422
0.7%	Project Operation:	$125	$33	26.0%	$158	3.1%	$129	$34	$163	2028Q4	8.8%	$140	$36	$177
0.3%	Project Management	$58	$15	26.0%	$73	3.1%	$60	$15	$75	2028Q4	8.8%	$65	$17	$82
2.5%	**total**													
	CONTRACT COST TOTALS:	$20,508	$6,056		$26,564		$21,201	$6,261	**$27,462**			$22,731	$6,716	**$29,447**

Providence River and Harbor Federal Navigation Project Rhode Island Dredged Material Management Plan and Environmental Assessment

Appendix K
Annual Average Cost of Design and Construction by Alternative

Providence DMMP Alternative 2A

Cycle One - ESN-With BU, Cycle Two - ESS-No BU

O&M Rate = 5 years
2022 Interest Rate = 3.00%

Project Year		Cost 1	Cost 2	Cost 3	Cost 4	Contract Cost	PV Factor	Present Value
2021	-4					$ -	0.00000000	$ -
2022	-3					$ -	0.00000000	$ -
2023	-2					$ -	0.00000000	$ -
2024	-1					$ -	0.00000000	$ -
2025	0					$ -	1.00000000	$ -
2026	1	$ 1,488,375	$ 52,500	$ 738,000	$ -	$ 2,278,875	0.97087379	$ 2,212,500
2027	2	$ 52,585,750	$ 1,718,500			$ 54,304,250	0.94259591	$ 51,186,964
2028	3	$ 26,085,000	$ 853,000			$ 26,938,000	0.91514166	$ 24,652,086
2029	4					$ -	0.88848705	$ -
2030	5					$ -	0.86260878	$ -
2031	6					$ -	0.83748426	$ -
2032	7					$ -	0.81309151	$ -
2033	8					$ -	0.78940923	$ -
2034	9					$ -	0.76641673	$ -
2035	10					$ -	0.74409391	$ -
2036	11					$ -	0.72242128	$ -
2037	12					$ -	0.70137988	$ -
2038	13					$ -	0.68095134	$ -
2039	14					$ -	0.66111781	$ -
2040	15					$ -	0.64186195	$ -
2041	16					$ -	0.62316694	$ -
2042	17					$ -	0.60501645	$ -
2043	18					$ -	0.58739461	$ -
2044	19					$ -	0.57028603	$ -
2045	20					$ -	0.55367575	$ -
2046	21	$ 1,758,750	$ 52,500	$ 752,000	$ 306,250	$ 2,869,500	0.53754928	$ 1,542,498
2047	22	$ 62,170,500	$ 2,030,875			$ 64,201,375	0.52189250	$ 33,506,216
2048	23	$ 26,514,000	$ 866,000			$ 27,380,000	0.50669175	$ 13,873,220
2049	24					$ -	0.49193374	$ -
2050	25					$ -	0.47760557	$ -
2051	26					$ -	0.46369473	$ -
2052	27					$ -	0.45018906	$ -
2053	28					$ -	0.43707675	$ -
2054	29					$ -	0.42434636	$ -
2055	30					$ -	0.41198676	$ -
2056	31					$ -	0.39998715	$ -
2057	32					$ -	0.38833703	$ -
2058	33					$ -	0.37702625	$ -
2059	34					$ -	0.36604490	$ -
2060	35					$ -	0.35538340	$ -
2061	36					$ -	0.34503243	$ -
2062	37					$ -	0.33498294	$ -
2063	38					$ -	0.32522615	$ -
2064	39					$ -	0.31575355	$ -
2065	40					$ -	0.30655684	$ -
2066	41					$ -	0.29762800	$ -
2067	42					$ -	0.28895922	$ -
2068	43					$ -	0.28054294	$ -
2069	44					$ -	0.27237178	$ -
2070	45					$ -	0.26443862	$ -
2071	46					$ -	0.25673653	$ -
2072	47					$ -	0.24925876	$ -
2073	48					$ -	0.24199880	$ -
2074	49					$ -	0.23495029	$ -
2075	50					$ -	0.22810708	$ -

capital recovery factor	CRF	0.038865494
		Annual Average Costs
	First Costs	$0
	Interest	$0
	OMRR&R	$ 4,934,887

Providence DMMP Alternative 2B

Cycle One - ESN-With BU, Cycle Two - FPRS-No BU

O&M Rate = 5 years

2022 Interest Rate = 3.00%

Project Year						Contract Cost	PV Factor	Present Value
2021	-4					$ -	0.00000000	$ -
2022	-3					$ -	0.00000000	$ -
2023	-2					$ -	0.00000000	$ -
2024	-1					$ -	0.00000000	$ -
2025	0					$ -	1.00000000	$ -
2026	1	$ 1,488,375	$ 52,500	$ 738,000	$ -	$ 2,278,875	0.97087379	$ 2,212,500
2027	2	$ 52,585,750	$ 1,718,500			$ 54,304,250	0.94259591	$ 51,186,964
2028	3	$ 26,085,000	$ 853,000			$ 26,938,000	0.91514166	$ 24,652,086
2029	4					$ -	0.88848705	$ -
2030	5					$ -	0.86260878	$ -
2031	6					$ -	0.83748426	$ -
2032	7					$ -	0.81309151	$ -
2033	8					$ -	0.78940923	$ -
2034	9					$ -	0.76641673	$ -
2035	10					$ -	0.74409391	$ -
2036	11					$ -	0.72242128	$ -
2037	12					$ -	0.70137988	$ -
2038	13					$ -	0.68095134	$ -
2039	14					$ -	0.66111781	$ -
2040	15					$ -	0.64186195	$ -
2041	16					$ -	0.62316694	$ -
2042	17					$ -	0.60501645	$ -
2043	18					$ -	0.58739461	$ -
2044	19					$ -	0.57028603	$ -
2045	20					$ -	0.55367575	$ -
2046	21	$ 2,195,375	$ -	$ 734,000	$ 306,250	$ 3,235,625	0.53754928	$ 1,739,308
2047	22	$ 77,579,250	$ 2,534,875			$ 80,114,125	0.52189250	$ 41,810,961
2048	23	$ 25,883,000	$ 846,000			$ 26,729,000	0.50669175	$ 13,543,364
2049	24					$ -	0.49193374	$ -
2050	25					$ -	0.47760557	$ -
2051	26					$ -	0.46369473	$ -
2052	27					$ -	0.45018906	$ -
2053	28					$ -	0.43707675	$ -
2054	29					$ -	0.42434636	$ -
2055	30					$ -	0.41198676	$ -
2056	31					$ -	0.39998715	$ -
2057	32					$ -	0.38833703	$ -
2058	33					$ -	0.37702625	$ -
2059	34					$ -	0.36604490	$ -
2060	35					$ -	0.35538340	$ -
2061	36					$ -	0.34503243	$ -
2062	37					$ -	0.33498294	$ -
2063	38					$ -	0.32522615	$ -
2064	39					$ -	0.31575355	$ -
2065	40					$ -	0.30655684	$ -
2066	41					$ -	0.29762800	$ -
2067	42					$ -	0.28895922	$ -
2068	43					$ -	0.28054294	$ -
2069	44					$ -	0.27237178	$ -
2070	45					$ -	0.26443862	$ -
2071	46					$ -	0.25673653	$ -
2072	47					$ -	0.24925876	$ -
2073	48					$ -	0.24199880	$ -
2074	49					$ -	0.23495029	$ -
2075	50					$ -	0.22810708	$ -

CRF	0.038865494
	Annual Average Costs
First Costs	$0
Interest	$0
OMRR&R	$ 5,252,484

Providence DMMP Alternative 2C

Cycle One - ESN-No BU, Cycle Two - ESS-No BU

O&M Rate =	5 years
2022 Interest Rate =	3.00%

Project Year						Contract Cost	PV Factor	Present Value
2021	-4					$ -	0.00000000	$ -
2022	-3					$ -	0.00000000	$ -
2023	-2					$ -	0.00000000	$ -
2024	-1					$ -	0.00000000	$ -
2025	0					$ -	1.00000000	$ -
2026	1	$ 1,830,500	$ 52,500	$ 738,000	$ -	$ 2,621,000	0.97087379	$ 2,544,660
2027	2	$ 64,696,625	$ 2,113,125			$ 66,809,750	0.94259591	$ 62,974,597
2028	3	$ 26,085,000	$ 853,000			$ 26,938,000	0.91514166	$ 24,652,086
2029	4					$ -	0.88848705	$ -
2030	5					$ -	0.86260878	$ -
2031	6					$ -	0.83748426	$ -
2032	7					$ -	0.81309151	$ -
2033	8					$ -	0.78940923	$ -
2034	9					$ -	0.76641673	$ -
2035	10					$ -	0.74409391	$ -
2036	11					$ -	0.72242128	$ -
2037	12					$ -	0.70137988	$ -
2038	13					$ -	0.68095134	$ -
2039	14					$ -	0.66111781	$ -
2040	15					$ -	0.64186195	$ -
2041	16					$ -	0.62316694	$ -
2042	17					$ -	0.60501645	$ -
2043	18					$ -	0.58739461	$ -
2044	19					$ -	0.57028603	$ -
2045	20					$ -	0.55367575	$ -
2046	21	$ 1,758,750	$ 52,500	$ 752,000	$ 306,250	$ 2,869,500	0.53754928	$ 1,542,498
2047	22	$ 62,170,500	$ 2,030,875			$ 64,201,375	0.52189250	$ 33,506,216
2048	23	$ 26,514,000	$ 866,000			$ 27,380,000	0.50669175	$ 13,873,220
2049	24					$ -	0.49193374	$ -
2050	25					$ -	0.47760557	$ -
2051	26					$ -	0.46369473	$ -
2052	27					$ -	0.45018906	$ -
2053	28					$ -	0.43707675	$ -
2054	29					$ -	0.42434636	$ -
2055	30					$ -	0.41198676	$ -
2056	31					$ -	0.39998715	$ -
2057	32					$ -	0.38833703	$ -
2058	33					$ -	0.37702625	$ -
2059	34					$ -	0.36604490	$ -
2060	35					$ -	0.35538340	$ -
2061	36					$ -	0.34503243	$ -
2062	37					$ -	0.33498294	$ -
2063	38					$ -	0.32522615	$ -
2064	39					$ -	0.31575355	$ -
2065	40					$ -	0.30655684	$ -
2066	41					$ -	0.29762800	$ -
2067	42					$ -	0.28895922	$ -
2068	43					$ -	0.28054294	$ -
2069	44					$ -	0.27237178	$ -
2070	45					$ -	0.26443862	$ -
2071	46					$ -	0.25673653	$ -
2072	47					$ -	0.24925876	$ -
2073	48					$ -	0.24199880	$ -
2074	49					$ -	0.23495029	$ -
2075	50					$ -	0.22810708	$ -

CRF	0.038865494
	Annual Average Costs
First Costs	$0
Interest	$0
OMRR&R	$ 5,405,929

Providence River and Harbor Rhode Island
Dredged Material Management Plan
Annual Average Cost of Design and Construction by Alternative

Providence DMMP Alternative 2D

Cycle One - ESN-No BU, Cycle Two - FPRS-No BU

O&M Rate = 5 years
2022 Interest Rate = 3.00%

Project Year						Contract Cost	PV Factor	Present Value
2021	-4					$ -	0.00000000	$ -
2022	-3					$ -	0.00000000	$ -
2023	-2					$ -	0.00000000	$ -
2024	-1					$ -	0.00000000	$ -
2025	0					$ -	1.00000000	$ -
2026	1	$ 1,830,500	$ 52,500	$ 738,000	$ -	$ 2,621,000	0.97087379	$ 2,544,660
2027	2	$ 64,696,625	$ 2,113,125			$ 66,809,750	0.94259591	$ 62,974,597
2028	3	$ 26,085,000	$ 853,000			$ 26,938,000	0.91514166	$ 24,652,086
2029	4					$ -	0.88848705	$ -
2030	5					$ -	0.86260878	$ -
2031	6					$ -	0.83748426	$ -
2032	7					$ -	0.81309151	$ -
2033	8					$ -	0.78940923	$ -
2034	9					$ -	0.76641673	$ -
2035	10					$ -	0.74409391	$ -
2036	11					$ -	0.72242128	$ -
2037	12					$ -	0.70137988	$ -
2038	13					$ -	0.68095134	$ -
2039	14					$ -	0.66111781	$ -
2040	15					$ -	0.64186195	$ -
2041	16					$ -	0.62316694	$ -
2042	17					$ -	0.60501645	$ -
2043	18					$ -	0.58739461	$ -
2044	19					$ -	0.57028603	$ -
2045	20					$ -	0.55367575	$ -
2046	21	$ 2,195,375	$ -	$ 734,000	$ 306,250	$ 3,235,625	0.53754928	$ 1,739,308
2047	22	$ 77,579,250	$ 2,534,875			$ 80,114,125	0.52189250	$ 41,810,961
2048	23	$ 25,883,000	$ 846,000			$ 26,729,000	0.50669175	$ 13,543,364
2049	24					$ -	0.49193374	$ -
2050	25					$ -	0.47760557	$ -
2051	26					$ -	0.46369473	$ -
2052	27					$ -	0.45018906	$ -
2053	28					$ -	0.43707675	$ -
2054	29					$ -	0.42434636	$ -
2055	30					$ -	0.41198676	$ -
2056	31					$ -	0.39998715	$ -
2057	32					$ -	0.38833703	$ -
2058	33					$ -	0.37702625	$ -
2059	34					$ -	0.36604490	$ -
2060	35					$ -	0.35538340	$ -
2061	36					$ -	0.34503243	$ -
2062	37					$ -	0.33498294	$ -
2063	38					$ -	0.32522615	$ -
2064	39					$ -	0.31575355	$ -
2065	40					$ -	0.30655684	$ -
2066	41					$ -	0.29762800	$ -
2067	42					$ -	0.28895922	$ -
2068	43					$ -	0.28054294	$ -
2069	44					$ -	0.27237178	$ -
2070	45					$ -	0.26443862	$ -
2071	46					$ -	0.25673653	$ -
2072	47					$ -	0.24925876	$ -
2073	48					$ -	0.24199880	$ -
2074	49					$ -	0.23495029	$ -
2075	50					$ -	0.22810708	$ -

CRF	0.038865494
	Annual Average Costs
First Costs	$0
Interest	$0
OMRR&R	$ 5,723,526

Providence River and Harbor Rhode Island
Dredged Material Management Plan
Annual Average Cost of Design and Construction by Alternative

Providence DMMP Alternative 3A

Cycle One - FPRS-With BU, Cycle - Two ESN-No BU

O&M Rate = 5 years
2022 Interest Rate = 3.00%

Project Year						Contract Cost	PV Factor	Present Value
2021	-4					$ -	0.00000000	$ -
2022	-3					$ -	0.00000000	$ -
2023	-2					$ -	0.00000000	$ -
2024	-1					$ -	0.00000000	$ -
2025	0					$ -	1.00000000	$ -
2026	1	$ 1,888,250	$ 52,500	$ 734,000	$ -	$ 2,674,750	0.97087379	$ 2,596,845
2027	2	$ 66,726,625	$ 2,180,500			$ 68,907,125	0.94259591	$ 64,951,574
2028	3	$ 25,883,000	$ 846,000			$ 26,729,000	0.91514166	$ 24,460,821
2029	4					$ -	0.88848705	$ -
2030	5					$ -	0.86260878	$ -
2031	6					$ -	0.83748426	$ -
2032	7					$ -	0.81309151	$ -
2033	8					$ -	0.78940923	$ -
2034	9					$ -	0.76641673	$ -
2035	10					$ -	0.74409391	$ -
2036	11					$ -	0.72242128	$ -
2037	12					$ -	0.70137988	$ -
2038	13					$ -	0.68095134	$ -
2039	14					$ -	0.66111781	$ -
2040	15					$ -	0.64186195	$ -
2041	16					$ -	0.62316694	$ -
2042	17					$ -	0.60501645	$ -
2043	18					$ -	0.58739461	$ -
2044	19					$ -	0.57028603	$ -
2045	20					$ -	0.55367575	$ -
2046	21	$ 1,830,500	$ 52,500	$ 738,000	$ 306,250	$ 2,927,250	0.53754928	$ 1,573,541
2047	22	$ 64,696,625	$ 2,113,125			$ 66,809,750	0.52189250	$ 34,867,508
2048	23	$ 26,085,000	$ 853,000			$ 26,938,000	0.50669175	$ 13,649,262
2049	24					$ -	0.49193374	$ -
2050	25					$ -	0.47760557	$ -
2051	26					$ -	0.46369473	$ -
2052	27					$ -	0.45018906	$ -
2053	28					$ -	0.43707675	$ -
2054	29					$ -	0.42434636	$ -
2055	30					$ -	0.41198676	$ -
2056	31					$ -	0.39998715	$ -
2057	32					$ -	0.38833703	$ -
2058	33					$ -	0.37702625	$ -
2059	34					$ -	0.36604490	$ -
2060	35					$ -	0.35538340	$ -
2061	36					$ -	0.34503243	$ -
2062	37					$ -	0.33498294	$ -
2063	38					$ -	0.32522615	$ -
2064	39					$ -	0.31575355	$ -
2065	40					$ -	0.30655684	$ -
2066	41					$ -	0.29762800	$ -
2067	42					$ -	0.28895922	$ -
2068	43					$ -	0.28054294	$ -
2069	44					$ -	0.27237178	$ -
2070	45					$ -	0.26443862	$ -
2071	46					$ -	0.25673653	$ -
2072	47					$ -	0.24925876	$ -
2073	48					$ -	0.24199880	$ -
2074	49					$ -	0.23495029	$ -
2075	50					$ -	0.22810708	$ -

CRF	0.038865494
	Annual Average Costs
First Costs	$0
Interest	$0
OMRR&R	$ 5,522,769

Providence DMMP Alternative 3B

Cycle One - FPRS-With BU, Cycle Two - ESS-No BU

O&M Rate = 5 years

2022 Interest Rate = 3.00%

Project Year						Contract Cost	PV Factor	Present Value
2021	-4					$ -	0.00000000	$ -
2022	-3					$ -	0.00000000	$ -
2023	-2					$ -	0.00000000	$ -
2024	-1					$ -	0.00000000	$ -
2025	0					$ -	1.00000000	$ -
2026	1	$ 1,888,250	$ 52,500	$ 734,000	$ -	$ 2,674,750	0.97087379	$ 2,596,845
2027	2	$ 66,726,625	$ 2,180,500			$ 68,907,125	0.94259591	$ 64,951,574
2028	3	$ 25,883,000	$ 846,000			$ 26,729,000	0.91514166	$ 24,460,821
2029	4					$ -	0.88848705	$ -
2030	5					$ -	0.86260878	$ -
2031	6					$ -	0.83748426	$ -
2032	7					$ -	0.81309151	$ -
2033	8					$ -	0.78940923	$ -
2034	9					$ -	0.76641673	$ -
2035	10					$ -	0.74409391	$ -
2036	11					$ -	0.72242128	$ -
2037	12					$ -	0.70137988	$ -
2038	13					$ -	0.68095134	$ -
2039	14					$ -	0.66111781	$ -
2040	15					$ -	0.64186195	$ -
2041	16					$ -	0.62316694	$ -
2042	17					$ -	0.60501645	$ -
2043	18					$ -	0.58739461	$ -
2044	19					$ -	0.57028603	$ -
2045	20					$ -	0.55367575	$ -
2046	21	$ 1,758,750	$ 52,500	$ 752,000	$ 306,250	$ 2,869,500	0.53754928	$ 1,542,498
2047	22	$ 62,170,500	$ 2,030,875			$ 64,201,375	0.52189250	$ 33,506,216
2048	23	$ 26,514,000	$ 866,000			$ 27,380,000	0.50669175	$ 13,873,220
2049	24					$ -	0.49193374	$ -
2050	25					$ -	0.47760557	$ -
2051	26					$ -	0.46369473	$ -
2052	27					$ -	0.45018906	$ -
2053	28					$ -	0.43707675	$ -
2054	29					$ -	0.42434636	$ -
2055	30					$ -	0.41198676	$ -
2056	31					$ -	0.39998715	$ -
2057	32					$ -	0.38833703	$ -
2058	33					$ -	0.37702625	$ -
2059	34					$ -	0.36604490	$ -
2060	35					$ -	0.35538340	$ -
2061	36					$ -	0.34503243	$ -
2062	37					$ -	0.33498294	$ -
2063	38					$ -	0.32522615	$ -
2064	39					$ -	0.31575355	$ -
2065	40					$ -	0.30655684	$ -
2066	41					$ -	0.29762800	$ -
2067	42					$ -	0.28895922	$ -
2068	43					$ -	0.28054294	$ -
2069	44					$ -	0.27237178	$ -
2070	45					$ -	0.26443862	$ -
2071	46					$ -	0.25673653	$ -
2072	47					$ -	0.24925876	$ -
2073	48					$ -	0.24199880	$ -
2074	49					$ -	0.23495029	$ -
2075	50					$ -	0.22810708	$ -

CRF	0.038865494
	Annual Average Costs
First Costs	$0
Interest	$0
OMRR&R	$ 5,477,360

Providence River and Harbor Rhode Island
Dredged Material Management Plan
Annual Average Cost of Design and Construction by Alternative

Providence DMMP Alternative 3C

Cycle One - FPRS-No BU, Cycle Two - ESN-No BU

O&M Rate = 5 years
2022 Interest Rate = 3.00%

Project Year						Contract Cost	PV Factor	Present Value
2021	-4					$ -	0.00000000	$ -
2022	-3					$ -	0.00000000	$ -
2023	-2					$ -	0.00000000	$ -
2024	-1					$ -	0.00000000	$ -
2025	0					$ -	1.00000000	$ -
2026	1	$ 2,195,375	$ 52,500	$ 734,000	$ -	$ 2,981,875	0.97087379	$ 2,895,024
2027	2	$ 77,579,250	$ 2,534,875			$ 80,114,125	0.94259591	$ 75,515,246
2028	3	$ 25,883,000	$ 846,000			$ 26,729,000	0.91514166	$ 24,460,821
2029	4					$ -	0.88848705	$ -
2030	5					$ -	0.86260878	$ -
2031	6					$ -	0.83748426	$ -
2032	7					$ -	0.81309151	$ -
2033	8					$ -	0.78940923	$ -
2034	9					$ -	0.76641673	$ -
2035	10					$ -	0.74409391	$ -
2036	11					$ -	0.72242128	$ -
2037	12					$ -	0.70137988	$ -
2038	13					$ -	0.68095134	$ -
2039	14					$ -	0.66111781	$ -
2040	15					$ -	0.64186195	$ -
2041	16					$ -	0.62316694	$ -
2042	17					$ -	0.60501645	$ -
2043	18					$ -	0.58739461	$ -
2044	19					$ -	0.57028603	$ -
2045	20					$ -	0.55367575	$ -
2046	21	$ 1,830,500	$ 52,500	$ 738,000	$ 306,250	$ 2,927,250	0.53754928	$ 1,573,541
2047	22	$ 64,696,625	$ 2,113,125			$ 66,809,750	0.52189250	$ 34,867,508
2048	23	$ 26,085,000	$ 853,000			$ 26,938,000	0.50669175	$ 13,649,262
2049	24					$ -	0.49193374	$ -
2050	25					$ -	0.47760557	$ -
2051	26					$ -	0.46369473	$ -
2052	27					$ -	0.45018906	$ -
2053	28					$ -	0.43707675	$ -
2054	29					$ -	0.42434636	$ -
2055	30					$ -	0.41198676	$ -
2056	31					$ -	0.39998715	$ -
2057	32					$ -	0.38833703	$ -
2058	33					$ -	0.37702625	$ -
2059	34					$ -	0.36604490	$ -
2060	35					$ -	0.35538340	$ -
2061	36					$ -	0.34503243	$ -
2062	37					$ -	0.33498294	$ -
2063	38					$ -	0.32522615	$ -
2064	39					$ -	0.31575355	$ -
2065	40					$ -	0.30655684	$ -
2066	41					$ -	0.29762800	$ -
2067	42					$ -	0.28895922	$ -
2068	43					$ -	0.28054294	$ -
2069	44					$ -	0.27237178	$ -
2070	45					$ -	0.26443862	$ -
2071	46					$ -	0.25673653	$ -
2072	47					$ -	0.24925876	$ -
2073	48					$ -	0.24199880	$ -
2074	49					$ -	0.23495029	$ -
2075	50					$ -	0.22810708	$ -

CRF	0.038865494
	Annual Average Costs
First Costs	#REF!
Interest	$0
OMRR&R	$ 5,944,921

Providence River and Harbor Rhode Island
Dredged Material Management Plan
Annual Average Cost of Design and Construction by Alternative

Providence DMMP Alternative 3D

Cycle One - FPRS-No BU, Cycle Two - ESS-No BU

O&M Rate = 5 years
2022 Interest Rate = 3.00%

Project Year						Contract Cost	PV Factor	Present Value
2021	-4					$ -	0.00000000	$ -
2022	-3					$ -	0.00000000	$ -
2023	-2					$ -	0.00000000	$ -
2024	-1					$ -	0.00000000	$ -
2025	0					$ -	1.00000000	$ -
2026	1	$ 2,195,375	$ 52,500	$ 734,000	$ -	$ 2,981,875	0.97087379	$ 2,895,024
2027	2	$ 77,579,250	$ 2,534,875			$ 80,114,125	0.94259591	$ 75,515,246
2028	3	$ 25,883,000	$ 846,000			$ 26,729,000	0.91514166	$ 24,460,821
2029	4					$ -	0.88848705	$ -
2030	5					$ -	0.86260878	$ -
2031	6					$ -	0.83748426	$ -
2032	7					$ -	0.81309151	$ -
2033	8					$ -	0.78940923	$ -
2034	9					$ -	0.76641673	$ -
2035	10					$ -	0.74409391	$ -
2036	11					$ -	0.72242128	$ -
2037	12					$ -	0.70137988	$ -
2038	13					$ -	0.68095134	$ -
2039	14					$ -	0.66111781	$ -
2040	15					$ -	0.64186195	$ -
2041	16					$ -	0.62316694	$ -
2042	17					$ -	0.60501645	$ -
2043	18					$ -	0.58739461	$ -
2044	19					$ -	0.57028603	$ -
2045	20					$ -	0.55367575	$ -
2046	21	$ 1,758,750	$ 52,500	$ 752,000	$ 306,250	$ 2,869,500	0.53754928	$ 1,542,498
2047	22	$ 62,170,500	$ 2,030,875			$ 64,201,375	0.52189250	$ 33,506,216
2048	23	$ 26,514,000	$ 866,000			$ 27,380,000	0.50669175	$ 13,873,220
2049	24					$ -	0.49193374	$ -
2050	25					$ -	0.47760557	$ -
2051	26					$ -	0.46369473	$ -
2052	27					$ -	0.45018906	$ -
2053	28					$ -	0.43707675	$ -
2054	29					$ -	0.42434636	$ -
2055	30					$ -	0.41198676	$ -
2056	31					$ -	0.39998715	$ -
2057	32					$ -	0.38833703	$ -
2058	33					$ -	0.37702625	$ -
2059	34					$ -	0.36604490	$ -
2060	35					$ -	0.35538340	$ -
2061	36					$ -	0.34503243	$ -
2062	37					$ -	0.33498294	$ -
2063	38					$ -	0.32522615	$ -
2064	39					$ -	0.31575355	$ -
2065	40					$ -	0.30655684	$ -
2066	41					$ -	0.29762800	$ -
2067	42					$ -	0.28895922	$ -
2068	43					$ -	0.28054294	$ -
2069	44					$ -	0.27237178	$ -
2070	45					$ -	0.26443862	$ -
2071	46					$ -	0.25673653	$ -
2072	47					$ -	0.24925876	$ -
2073	48					$ -	0.24199880	$ -
2074	49					$ -	0.23495029	$ -
2075	50					$ -	0.22810708	$ -

CRF	0.038865494
	Annual Average Costs
First Costs	$0
Interest	$0
OMRR&R	$ 5,899,511

U.S. Army Corps of Engineers
New England District

PROVIDENCE RIVER AND HARBOR

FEDERAL NAVIGATION PROJECT

RHODE ISLAND

DREDGED MATERIAL MANAGEMENT PLAN

APPENDIX L
DRAFT REAL ESTATE PLAN

PREPARED BY:

U.S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DISTRICT

EFFECTIVE DATE:
MAY 2025

PROVIDENCE RIVER AND HARBOR
FEDERAL NAVIGATION PROJECT
RHODE ISLAND
DREDGED MATERIAL MANAGEMENT PLAN

JANUARY 2025 REAL ESTATE PLAN

Contents

Figures

Exhibits

1. Statement of Purpose

Purpose – The purpose of this Real Estate Plan (REP), prepared in accordance with ER 405-1-12, is to describe the minimum Lands, Easements, Right- of-Ways, Relocations and Disposal Areas (LERRD) required for the construction, operation and maintenance of the proposed project described in the Providence River and Harbor, Providence, Rhode Island, Dredged Material Management Plan (DMMP) and Environmental Assessment (EA), the "main report". The main report describes in detail the overall purpose to restore the Providence River and Harbor Federal Navigation Project (FNP) to authorized dimensions using maintenance dredging. The purpose of the DMMP is to determine the alternative placement sites for the dredged material over a twenty-year period (approximately two dredge cycles) as well as address the additional capacity identified by the state for placement of Non-Federal dredged material from the Providence River and Narragansett Bay. This REP is the first prepared for the main report. This REP was prepared during a feasibility level study at a low-level project design. The LERRD requirements and cost presented herein are preliminary in nature for planning purposes only and may change with plan optimization leading to a final design of the proposed project.

Study Authorization – The Providence River and Harbor FNP was originally adopted in 1852 and modified by 17 subsequent authorizations. The 40-foot channel depth of the existing project that is now being maintained was authorized by the River and Harbor Act of 1965. The FNP currently has an authorized depth of -40 feet below Mean Lower Low Water (MLLW) and channel width of 600 feet, with wider bends and a 1,700-foot-wide harbor area at the upstream end. The total authorized channel length is approximately 16 miles long, extending from its upstream limit just downstream of the Providence (Fox Point) Hurricane Barrier to its downstream limit between Prudence Island and Aquidneck Island in the Eastern Passage of Narragansett Bay.

Non-Federal Sponsor – The Non-Federal Sponsor for the project is the Rhode Island Coastal Resources Management Council.

2. Real Estate Requirements

a. Recommended Plan – The Federal Base Plan for dredged material placement over the 20-year planning period involves two maintenance dredge cycles, cycle one starting in the year 2026, and cycle two approximately 15 years later, starting in 2041. The plan consists of excavating two Confined Aquatic Disposal (CAD) cells in subtidal waters to the west of the existing channel. The first CAD cell, known as the Edgewood Shoals North (ESN) site, would be constructed during the maintenance cycle one, and would be about 1,600 feet by 1,400 feet and would be dredged to a depth of about -60 feet MLLW to provide a capacity of about 3 million cubic yards. The material excavated from the CAD cell would be placed in four locations:

1. As beneficial-use fill and capping material in the Port Edgewood Basin just north of the CAD cell site.

2. As beneficial-use capping material in the old CAD cells (used during the 2003-2005 maintenance cycle of the Providence River FNP) in the northern end of Fox Point Reach in the Providence River FNP.

3. As beneficial-use capping material in an abandoned subtidal dredged material disposal site in Narragansett Bay adjacent to Prudence Island.

4. Suitable material placed in ocean waters at the EPA designated Rhode Island Sound disposal site.

All four placement locations are in subtidal waters.

A new access channel would be constructed between the Providence FNP channel and the proposed ESN CAD cell. The dredged material from the new access channel would be placed in open water.

The second CAD cell, known as the Edgewood Shoals South (ESS) site, would be constructed during the maintenance cycle two, and would be about 1,600 feet by 1,400 feet and would be dredged to a depth of about -60 feet MLLW to provide a capacity of about 3 million cubic yards. The material excavated from the CAD cell would be placed in at least two locations:

1. As beneficial-use capping material in the ESN CAD cell, which would be closed out.

2. As suitable material placed in ocean waters at the EPA designated Rhode Island Sound disposal site.

Both of these placement sites are in subtidal waters.

b. <u>Required Lands, Easements, and Rights-of-Way</u> – There are no real estate acquisition requirements for the Federal Base Plan. All lands required for dredging lie within the Federal Navigation Servitude, and Navigation Servitude will be exercised for the Federal Base Plan. Since all equipment is expected to be brought in by water, staging or work areas are not needed and no real estate interests need to be acquired.

c. <u>Land Value Estimate</u> – Because implementation of the Federal Base Plan would be by entirely water-based equipment and methods, no land value estimates were required or developed.

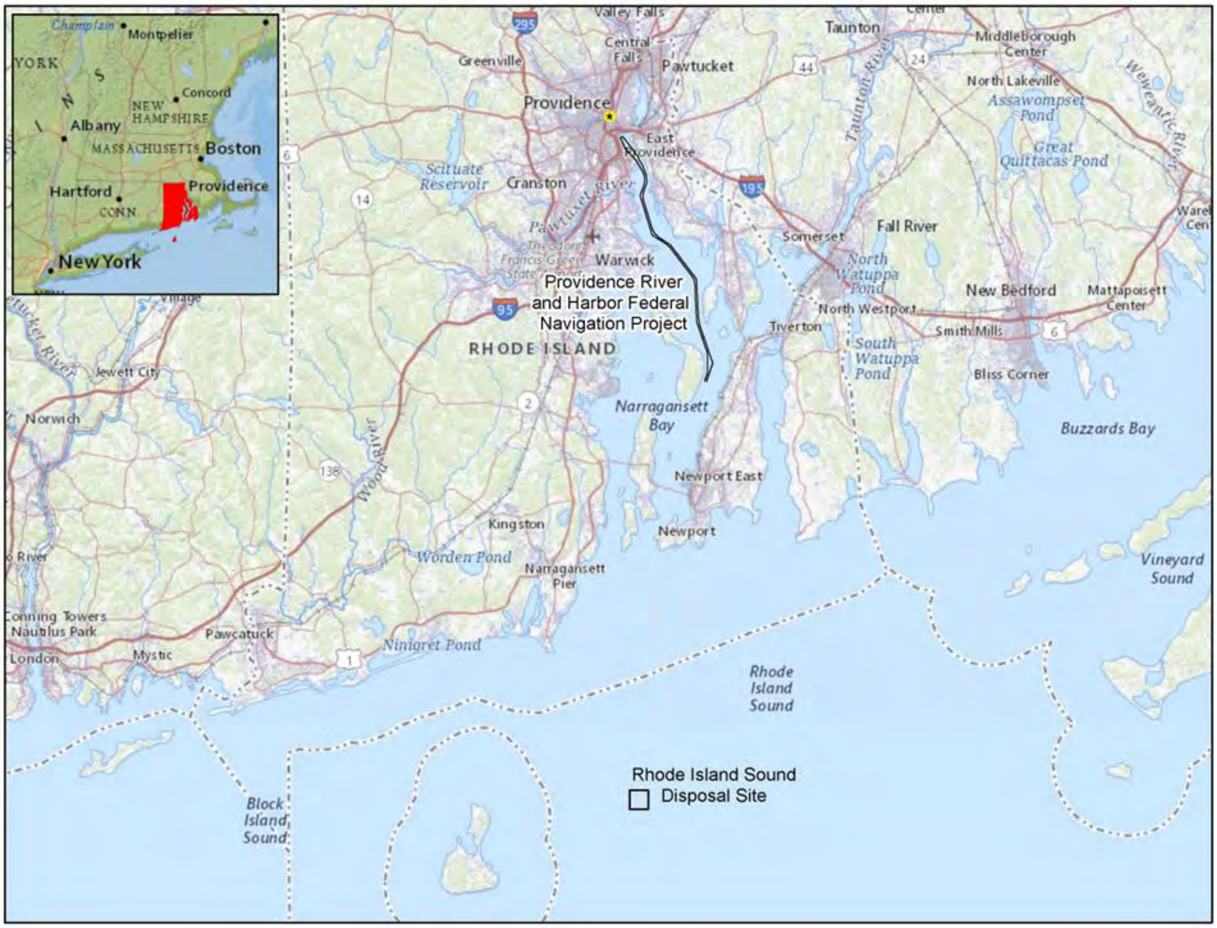

Figure 1: The Study Area.

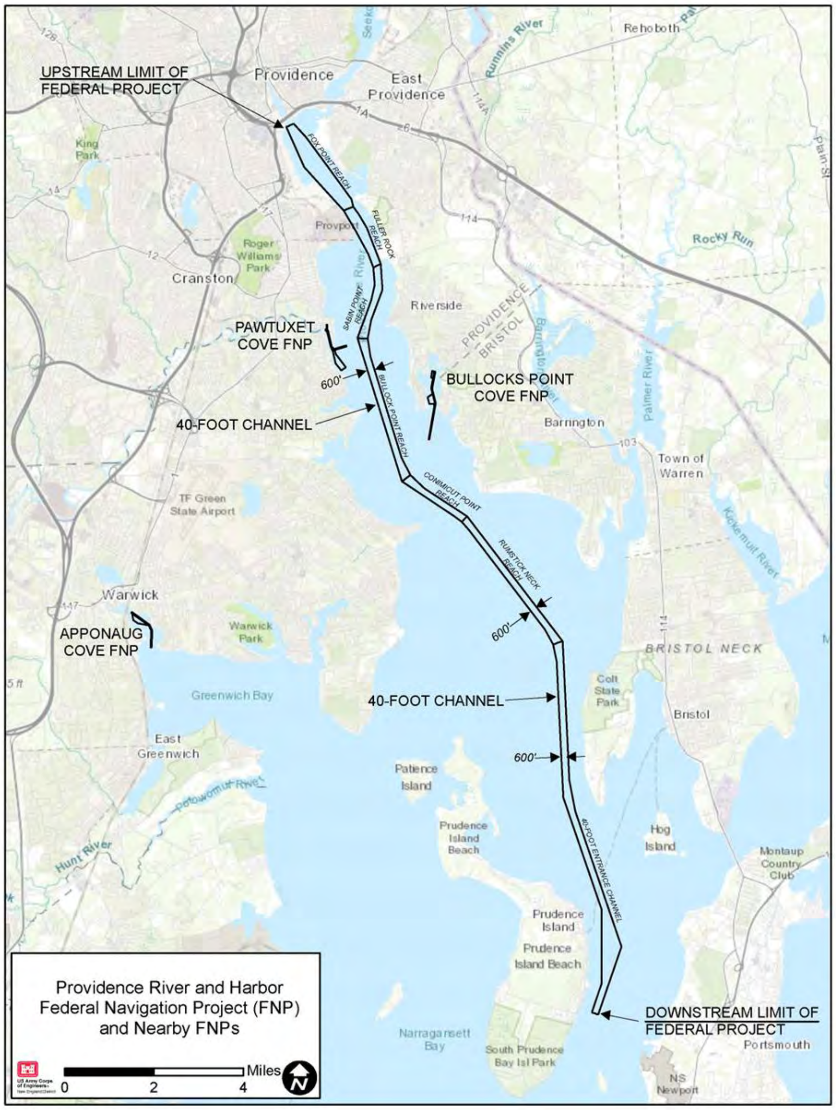

Figure 2: Providence River and Harbor Federal Navigation Project Features and Nearby federal navigation projects.

3. Real Estate Owned by the Non-Federal Sponsor

The Non-Federal Sponsor is a state agency, the Rhode Island Coastal Resources Management Council. However, no real estate interests are required for project implementation.

4. Non-standard Estates

There are no non-standard estates proposed for the project.

5. Existing Federal Projects

The Providence River DMMP is intended to address the maintenance dredging of the authorized Providence River and Harbor Federal Navigation Project and three associated shallow draft FNPs that will also require maintenance in the same 20-year planning horizon for dredged material disposal. Those projects are Bullocks Point Cover, Pawtuxet Cove and Apponaug Cove. Bullocks and Pawtuxet Coves FNP maintenance materials were placed in the CAD cells constructed for Providence River in 2003-2005 after completion of the Providence River maintenance. The CAD cell placement was the Federal Base Plan for each of those projects.

6. Federally Owned Land

There are no existing federal lands included within the required LERRD for the proposed project.

7. Federal Navigational Servitude

The Federal Navigation Servitude is the dominant right of the Federal Government under the Commerce Clause of the U.S. Constitution to use, control, and regulate the navigable waters of the United States, and the submerged lands thereunder, for various commerce-related purposes, including navigation and flood control. In tidal areas, the servitude extends to all lands below mean high water mark. Generally, the Federal Government does not acquire interests in real property that it already possesses or over which its use or control is, or can be, legally exercised. If navigational servitude is found to be available, then the Federal Government will generally exercise its right thereunder and, to the extent of such rights, will not acquire a real property interest in the land to which the navigational servitude applies.

The determination of the availability of the navigation servitude is a two-step process. First, the Federal Government must determine whether the project feature serves a purpose which is in the aid of commerce. Such purposes recognized by the courts include navigation, flood control, and hydro-electric power. If it is so determined, then the second step is to determine whether the land at issue is located below the mean or ordinary high-water mark of a navigable watercourse. Since the project is a navigation project that aids in commerce and since all the lands required for the project lie below the mean high-water mark, the application of Navigational Servitude for the Base Plan is available. Navigation Servitude will be exercised for the lands required for the dredging. The conclusion on the availability of Navigation Servitude for the Federal Base Plan was coordinated with New England District Office of Counsel.

8. Real Estate Mapping

Real Estate Maps are provided in Exhibit A, showing all areas to be dredged, FNP channel delineation and CAD cell footprints.

9. Induced Flooding

There is no evidence from the study that the proposed project will induce flooding in new areas or increase in existing flood prone areas.

10. Baseline Cost Estimate for Real Estate

The BCERE establishes the estimated financial costs (for both the Government and Sponsor) that are attributed to the proposed project's real estate requirements. It consists of the 01-Lands and Damages, 02-Relocation (utilities/facilities), and 30-Planning, Engineering and Design project cost accounts. The 01-account includes all Sponsor land acquisition administrative expenses, which there are none for the proposed project. The 02-account includes the cost to relocate any required utility or facility to construct, operate, or maintain the proposed project including any land acquisition cost associated with said relocation, which there are none for the proposed project. The 30-account includes all federal administrative costs. The below table summarizes the real estate costs that has been estimated for the proposed project.

PROJECT COST CATEGORY	COST	CONTGY (%)	CONTGY ($)	TOTAL COST
01-Land and Damages	$ 0	% 0	$ 0	$ 0
02-Relocation (Utility/Facility)	$ 0	% 0	$ 0	$ 0
30-PED	$ 0	% 0	$ 0	$ 0
TOTAL	$ 0	% 0	$ 0	$ 0

11. Uniform Relocation Assistance (Public Law 91-646)

The proposed project does not require the displacement of residences and/or businesses.

12. Minerals and Timber Activity

There is no present or anticipated mining and drilling activity in the vicinity of the project that may affect project purposes and the operation thereof. No timber harvesting activities are anticipated to occur within the proposed project footprint.

13. Non-Federal Sponsor Capability Assessment

The Federal Base Plan requires no acquisition of real estate. However, the NFS is a state agency fully capable of acquiring real property rights, including utilization of condemnation authority, should a change of the real estate requirements occur.

14. Land Use Zoning

There are no zoning ordinances currently proposed to be enacted or applied in lieu of or to facilitate acquisition of any LERRD in connection with this project.

15. Real Estate Acquisition Schedule

No Lands, Easements, Rights-of-Way, Relocations, or Disposal Areas (LERRD) are required for this project.

16. Facility and Utility Relocations

There are no utility or facility relocations anticipated or currently required within the proposed project.

17. Environmental Contamination

There have been measurable spills (e.g., spills capable of being quantified) of diesel fuel, gasoline, home heating oil (#2 fuel oil), hydraulic oils, raw sewage, waste motor oil, and antifreeze throughout the Providence FNP. The project is not anticipated to contribute any new hazardous, toxic, or radioactive waste material to Narragansett Bay or the Providence River and Harbor system. The fill to be placed in the disposal areas described in Section 2 above will be clean.

There are no known or suspected presence of Hazardous, Toxic, or Radioactive Waste located in, on, under, or adjacent to the real estate required for the proposed project.

18. Project Public Support

Although no formal scoping meeting or public awareness meeting has been held, communication regarding USACE activities have occurred with community leaders, resource agencies and other stakeholders with an interest in activities in and around Narragansett Bay. The record does not indicate any known opposition or public concerns which cannot be overcome.

19. Non-Federal Sponsor Risk Notification

Not applicable. The non-Federal sponsor for CAD cell implementation is a state agency, the Rhode Island Coastal Resources Management Council. However, there are no LERRDs required for implementation of the Federal Base Plan.

20. Other Pertinent Information

No other information to discuss.

PREPARER:

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NAME: William C. Mehr III
TITLE: Realty Specialist

DISTRICT CHIEF OF REAL ESTATE

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NAME: Timothy W. Shugert
TITLE: NAE District Chief Of Real Estate

Exhibit A
Real Estate Map

Exhibit B

Non-Federal Sponsor Real Estate Acquisition Capability Assessment Form