Application for State Water Quality Certification and Marine Dredging and Associated Activities

Revolution Wind Project

JULY 30, 2021

Submitted to

Rhode Island Coastal Resources Management Council

and

Rhode Island Department of Environmental Management

Submitted by

Revolution Wind | Powered by Ørsted & Eversource

Prepared by

vhb

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July 30, 2021

Ron Gagnon, Administrator
Rhode Island Department of Environmental Management
Office of Customer & Technical Assistance
235 Promenade Street, Room 260
Providence, Rhode Island 02908

Jeffrey Willis, Executive Director
Rhode Island Coastal Resources Management Council
Stedman Government Center, Suite 3
4808 Tower Hill Road
Wakefield, Rhode Island 02879-1900

Re: Revolution Wind Project Water Quality Certification and Marine Dredging Application

Dear Mr. Gagnon and Mr. Willis,
Revolution Wind, LLC (Revolution Wind; formally DWW Rev I, LLC), a 50/50 joint venture between Orsted North America Inc. and Eversource Investment LLC, is pleased to submit this application for the Revolution Wind Project to the Rhode Island Department of Environmental Management (RIDEM) for a Water Quality Certification, and RIDEM and Rhode Island Coastal Resources Management Council (CRMC) for a Marine Dredging approval, pursuant to the applicable provisions of 250 Rhode Island Code of Regulations (RICR)-150-05-01 and 250-RICR-150-05-02, respectively. This filing includes the required application forms, narrative, and supporting information as identified on the Water Quality Certification and Marine Dredging checklists.

Revolution Wind, LLC., would like to thank the RIDEM and CRMC for their thorough review and consideration and respectfully requests that the agencies grant the Water Quality Certification and marine dredging approval to construct the Revolution Wind Project, pursuant to 250 RICR-150-05-01 and 250-RICR-150-05-02. Please do not hesitate to contact Mark Roll, Permit Manager – Revolution Wind, at MROLL@orsted.com or (857) 360-8811 with any questions on this submission.

Sincerely,

Kenneth Bowes
Authorized Representative – Revolution Wind
107 Sheldon Street
Berlin, CT 06307
Phone: (860) 883-5830
kenneth.bowes@eversource.com

Cc: Mark Roll, Permit Manager – Revolution Wind, Orsted
James Boyd, CRMC
Justin Skenyon, CRMC

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Revolution Wind Project

State Waters of Rhode Island Sound and West Passage of Narragansett Bay, Rhode Island

PREPARED FOR

Revolution Wind | Powered by Ørsted & Eversource

Revolution Wind, LLC
56 Exchange Terrace, Suite 300
Providence, RI 02903

PREPARED BY

1 Cedar Street, Suite 400
Providence, RI 02903

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Acronyms and Abbreviations

A

Ac	acres
AC	alternating current
ADCP	Acoustic Doppler Current Profiler
AEM	aquatic environmental monitor
ALARP	As Low As Reasonably Practicable
AMAPPS	Atlantic Marine Assessment Program for Protected Species
ANSI	American National Standards Institute
AP	Assessor's Plat
APE	Area of Potential Effects
APRA	Access to Public Records Act (RIGL § 38-2-1)
ASMFC	Atlantic States Marine Fisheries Commission

B

BMP	best management practice
BOEM	Bureau of Ocean Energy Management

C

CBI	Chlorophyll Bloom Index
CBRA	Cable Burial Risk Assessment
CEC	chemical contaminants of emerging concern
CETAP	Cetacean and Turtle Assessment Program
CFE	Controlled Flow Excavation
CFR	Code of Federal Regulations
COLREGS	Convention on the International Regulations for Preventing Collisions at Sea 1972
COP	Construction and Operations Plan
CRMP	Coastal Resource Management Program
CVA	Certified Verification Agent
CWA	Clean Water Act of 1972
Cy	cubic yard(s)

D

DO	dissolved oxygen
DoD	United States Department of Defense
DP	dynamic positioning

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DPS	distinct population segment

E

EA	Environmental Assessment
EFH	essential fish habitat
EIS	Environmental Impact Statement
EMF	electric and magnetic fields
EO	Executive Order
EPA	United States Environmental Protection Agency
ERM	effects range median (water quality) or RIDEM Environmental Resource Map
ERP/OSRP	Emergency Response Plan/Oil Spill Response Plan
ESA	Endangered Species Act of 1973

F

FDR	Facility Design Report
FEMA	Federal Emergency Management Agency
FIR	Fabrication and Installation Report or Fishing Industry Representatives
FIRM	Flood Insurance Rate Map
FOIA	Freedom of Information Act (5 U.S.C. § 552)
ft	foot or feet
ft^2	square foot (feet)

G

g C m^{-2} day^{-1}	grams of carbon per meter squared per day
G&G	geophysical and geotechnical
Gal	gallon
GLD	Geographic Location Description

H

Ha	hectare
HDD	horizontal directional drilling
HDPE	high-density polyethylene
HVAC	High voltage alternating current
Hz	hertz

I

IAC	Inter-Array Cable
ICF	Interconnection Facility
IEEE	Institute of Electrical and Electronics Engineers
IMO	International Maritime Organization

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in	inch or inches

K

kg	kilogram(s)
km	kilometer(s)
kV	kilovolt(s)
kW	kilowatt(s)

L

L	liter
Lbs	pounds
LNM	Local Notice to Mariners

M

M	meter(s)
µM	micromoles
MA	Massachusetts
m/s	meter(s) per second
m^2	square meter(s)
m^3	cubic meter(s)
MARPOL	International Convention for the Prevention of Pollution from Ships
MBTA	Migratory Bird Treaty Act
MA WEA	Massachusetts Wind Energy Area
mG	milligauss
mg/L	milligram(s) per liter
Mm	millimeter(s)
MMPA	Marine Mammal Protection Act of 1972
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
MSL	mean sea level
MEC	Munitions and Explosives of Concern
MW	megawatt(s)

N

NARW	North Atlantic right whale
NAVD88	North American Vertical Datum of 1988
NBC	Narragansett Bay Commission
NBEP	Narragansett Bay Estuary Program
NBFSMN	Narragansett Bay Fixed Site Monitoring Network
NBNERR	Narragansett Bay National Estuarine Research Reserve

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NBWTR	State of Narragansett Bay and Its Watershed Technical Report
NCCR	National Coastal Condition Report
NEPA	National Environmental Policy Act
ng/L	nanograms per liter
NH_3	Ammonia
NHPA	National Historic Preservation Act
Nm	nautical mile(s)
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide or nitrite
NO_3	nitrate
NOAA	National Oceanic and Atmospheric Administration
NOx	nitrogen oxide(s)
NRCS	Natural Resources Conservation Service
NSF	National Sanitation Foundation International
NTSC	National Transportation Safety Council
NUWC	U.S. Navy Undersea Warfare Command
NYSERDA	New York State Energy Research and Development Authority

O

O&M	operations and maintenance
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
Ocean SAMP	Ocean Special Area Management Plan
OSRP	Oil Spill Response Plan
OSS	offshore substation
ONRW	Outstanding National Resource Water

P

PATON	Private Aids to Navigation
PCB	polychlorinated biphenyl
PLGR	pre-lay grapnel run
PO_4	orthophosphate
POI	Point of Interconnection
PPA	Power Purchase Agreement
Project	Revolution Wind Farm Project

R

RARMS	Risk Assessment with Risk Mitigation Strategy

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RI	Rhode Island
RICR	Rhode Island Code of Regulations
RI CRMC	Rhode Island Coastal Resources Management Council
RI CRMP	Rhode Island Coastal Resources Management Program
RIDEM	Rhode Island Department of Environmental Management
RIGL	Rhode Island General Law
RI-MA WEA	Rhode Island-Massachusetts Wind Energy Area
RIPDES	Rhode Island Pollutant Discharge Elimination System
ROW	right(s)-of-way
RWEC	Revolution Wind Export Cable
RWEC-OCS	Revolution Wind Export Cable-Outer Continental Shelf
RWEC-RI	Revolution Wind Export Cable-Rhode Island Waters
RWF	Revolution Wind Farm

S

SAMP	Special Area Management Plan
SAP	Site Assessment Plan
SAV	submerged aquatic vegetation
SCADA	Supervisory Control and Data Acquisition
sf	square foot or square feet
SFWF	South Fork Wind Farm
SLR	sea level rise
SRPW	Special Resource Protection Waters

T

THPO	Tribal Historic Preservation Office(r)
TNEC	The Narragansett Electric Company d/b/a National Grid
TOY	Time of Year
TSS	total suspended solids

U

U.S.C.	United States Code
UDP	unanticipated discovery plan
URI	University of Rhode Island
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service
UXO	unexploded ordnance

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VHB	Vanasse Hangen Brustlin, Inc.

W

WEA	Wind Energy Area
WTG	wind turbine generator
WWTF	wastewater treatment facilities

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Glossary and Terms

Term	Definition
Bundle	Two or more wires joined together to operate as a single phase.
Cable	A fully insulated conductor installed underground.
Circuit	A system of conductors (three conductors or three bundles of conductors) through which an electric current is intended to flow, and which may be supported above ground by transmission structures or placed underground.
Conduit	Pipes, typically encased in concrete to house and protect underground power cables or other subsurface utilities.
Certified Verification Agent ("CVA")	An individual or organization, experienced in the design, fabrication, and installation of offshore marine facilities or structures, who will conduct specified third-party reviews, inspections, and verifications in accordance with 30 Code of Federal Regulations ("CFR") 585.705.
Duct	Pipe for underground power cables (see also Conduit).
Duct Bank	A group of ducts or conduit usually encased in concrete in a trench.
Facility Design Report and Fabrication and Installation Report ("FDR"/"FIR")	The FDR provides specific details of the design of any facilities, including cables and pipelines that are outlined in a BOEM-approved Construction and Operations Plan ("COP"). The FIR demonstrates how the facilities will be fabricated and installed in a manner that conforms to developer responsibilities listed in CFR §585.105(a).
Foundation	The bases to which the wind turbine generators ("WTGs") and Offshore Substations ("OSSs") are installed on the seabed.
Gauss ("G")	A unit of measure for magnetic fields. 1G equals 1,000 milliGauss.
Glacial till	Type of surficial geologic deposit that consists of boulders, gravel, sand silt, and clay mixed in various proportions. These deposits are predominantly nonsorted, nonstratified sediment and are deposited directly by glaciers.
Hertz ("Hz")	A measure of the frequency of alternating current; expressed in units of cycles per second.
Horizontal Directional Drill ("HDD")	Subsurface installation technique that will create an underground conduit through which an export cable may be installed through the intertidal zone.
Inter-Array Cable ("IAC")	Cables that connect individual wind turbine generators ("WTGs") and transfers power between the WTGs and the Offshore Substation ("OSS").
Landfall Work Area	Location on the shore in Quonset Business Park of Quonset Point in North Kingstown, Rhode Island, considered for a sea-to-shore export cable transition
Mechanical cutter	Method of submarine cable installation equipment that involves a cutting wheel or excavation chain to cut a narrow trench into the seabed allowing the cable to sink under its own weight or be pushed to the bottom of the trench via a cable depressor.
Mechanical plow	Method of submarine cable installation equipment that involves pulling a plow along the cable route to lay and bury the cable. The plow's share cuts into the soil, opening a

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Term	Definition
	temporary trench which is held open by the side walls of the share, while the cable is lowered to the base of the trench via a depressor. Some plows may use additional jets to fluidize the soil in front of the share.
Offshore Substation	Substation facility that collects electric energy generated by the WTG through the IACs for transmission through the Revolution Wind Export Cable ("RWEC"). Mounted on dedicated foundation or co-located on one foundation with a WTG. The Project will include up to two OSSs.
OSS-Link Cable	Submarine transmission cable connecting the two OSSs (presuming two OSSs).
Operations and Maintenance ("O&M") Facility	An ancillary facility of the Project that may be located at an existing port facility. The O&M facility will support remote monitoring of the wind farm and offshore maintenance activities.
Power Purchase Agreement ("PPA")	A financial agreement between two parties. This Project has three PPAs with the States of Connecticut and Rhode Island
Power Transformer	A device used to transform voltage levels to facilitate the efficient transfer of power from the generating plant to the customer. A step-up transformer increases the voltage while a step-down transformer decreases it. Power transformers have a high voltage and a low voltage winding for each phase.
Pre-lay grapnel run ("PLGR")	Process to remove possible obstructions and debris (such as abandoned fishing nets, wires, and hawsers) by pulling a grapnel along the proposed routes of the inter-array and export cables.
Revolution Wind, LLC	Owner and future operator of the Project and the Project Applicant.
Revolution Wind Export Cable ("RWEC")	Comprised of an alternating current ("AC") electric cable that will connect the RWF to the existing onshore regional electric transmission grid in North Kingstown, Rhode Island. The export cable located in both federal waters along the outer continental shelf ("RWEC-OCS") and Rhode Island state waters ("RWEC-RI")
RWEC-OCS	The submarine segment of the export cable buried beneath the seabed within federal waters on the OCS from the OSS to the boundary of Rhode Island state waters.
RWEC-RI	The submarine segment of the export cable buried beneath the seabed within state territorial waters from the boundary of Rhode Island state waters to the onshore transition joint bay at Quonset Point.
Revolution Wind Farm ("RWF")	Comprised of up to 100 WTGs, IACs, OSS-Link Cable and up to two OSSs, all of which will be located within federal waters on the outer continental shelf ("OCS").
Right-of-way	Corridor of land within which a utility company holds legal rights necessary to build, operate and maintain power lines.
Substation	A fenced-in yard containing switches, power transformers, line terminal structures, and other equipment enclosures and structures. Voltage change, adjustments of voltage, monitoring of circuits and other service functions take place in this installation.
Supervisory Control and Data Acquisition ("SCADA")	Fiber optic system embedded in the Project cables that provides remote wind farm monitoring and control between the WTG, substations, and remote operation center(s). The SCADA provides a live status of environmental conditions within the RWF, as well as mechanical and electrical state of each WTG.

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Term	Definition
Time of Year ("TOY") Restriction	Period of time during any calendar year when construction activity is restricted to minimize impact to sensitive species.
Transition Joint Bay	An underground vault where the RWEC is jointed with the Onshore Transmission Cable. In each TJB, each RWEC cable will be spliced into 3-single conductor onshore cables.
Transmission Line	An electric power line operating at 69,000 or more volts.
Wetland	Land, including submerged land, which consists of any of the soil types designated as poorly drained, very poorly drained, alluvial or floodplain by the United States Department of Agriculture, Natural Resources Conservation Service. Wetlands include federally jurisdictional wetlands of the U.S. and navigable waters, freshwater wetlands or coastal resources regulated by a state or local regulatory authority. Jurisdictional wetlands are classified based on a combination of soil type, wetland plants, and hydrologic regime, or state-defined wetland types.
Wind Turbine Generator	Electricity-generating wind turbine made of a tower, nacelle, rotor, and blades, with a nameplate capacity of 8 to 12 megawatts ("MW") per turbine.

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Water Quality Certification Application Form & Checklist

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RHODE ISLAND DEPARTMENT OF ENVIROMENTAL MANAGEMENT
Office of Water Resources – Groundwater and Freshwater Wetlands
Protection
235 Promenade Street, Providence, RI 02908
Telephone: 401-222-6820; Rhode Island Relay: 711

Received by RIDEM
[illegible]

Application for Stormwater Construction Permit and Water Quality Certification

Use this form to request a Stormwater Construction Permit (RIPDES CGP or GWD/UIC) or Water Quality Certification (WQC). If a Freshwater Wetlands (FWW) Application is required, this form must be submitted in addition to the FWW Application form.

If a WQC is requested as part of a Federal Permit which is not covered under a General Permit and therefore requires State certification, this form must be submitted **in addition to** the Supplemental Water Quality Certification Request Form.

Please fill out this form electronically. Print the completed form and submit with all required documentation and fee to:
(Check or money order must be made payable to the Rhode Island General Treasurer.)
Stormwater Construction Permit Fee will be waived for applications submitted concurrently with a Freshwater Wetlands Application.

Permit Application Center (PAC)
RIDEM
235 Promenade Street, Room 260
Providence, RI 02908-5767

Provide all applicable information by completing the **shaded** areas.

Double-click to select:	☑ **New Permit** Fee = $400.	☐ **Permit Modification**	

Site & Project

City/Town:	Street Address:		Water Body Class:
North Kingstown	N/A		SB
Plat(s):	**Lot(s):**	**Project Name:**	
N/A	N/A	Revolution Wind: Rhode Island State Waters	
Location:		**Water Body Name(s):**	
Revolution Wind Export Cable - RI State Waters; See narrative for additional information		West Passage of Narragansett Bay, Rhode Island Sound	
Latitude:	**Longitude:**	**Utility Pole #:**	**Total Site Area:**	**Site Area to be Disturbed:**
N/A	N/A	N/A	3,658 acres	730 acres
RIDOT PSID #:	**RI Contract #:**	**Was there a Pre-Application Meeting?**	**Provide Meeting Date:**
		☑ Yes ☐ No	6/18/20 & 12/21/2020

Owner / Applicant

Organization/Company Name:		Name and Email of Owner's Representative for Questions:	
Revolution Wind, LLC		Susan Moberg; smoberg@vhb.com	
First Name:	**Last Name:**	**Owner's Email:**	**Phone:**
Kenneth	Bowes	kenneth.bowes@eversource.ocm	860-883-5830
Address:		**City/Town:**	**State:**	**Zip:**
56 Exchance Terrace, Suite 300		Providence	RI	02903

I certify under penalty of law that I've requested and authorized the investigation, compilation, and submission of all the information, in whatever form, contained in this Application; I have personally examined and am familiar with the information submitted herein; and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe the information is true, accurate and complete. I'm aware that it's the owner's responsibility to implement or hire a qualified contractor responsible to implement any required Soil Erosion and Sediment Control Plan, so as to effectively control stormwater discharges leaving the site during the construction period. I authorize RIDEM personnel access to the property for purposes of observing conditions pertinent to this application and assessing compliance with any permit or determination resulting from this application.

Applicant's Signature:	Title:	Date:
Kenneth Bowes	VP - Siting + Permitting	07/28/21

Professional

Organization/Company Name:	Professional's License Type(s) and Number(s):	
Mott MacDonald	Professional Engineer 9816	
Professional's Name:	**Professional's Email:**	**Phone:**
Christopher A. Cockshaw	christopher.cockshaw@mottmac.com	413-315-2146

I certify under penalty of law that the project described in this application and associated materials is in compliance with the RI Stormwater Design and Installation Standards Manual (as amended) and the Rhode Island Soil Erosion and Sediment Control Handbook (as amended) [if required] and I believe all information presented in this application and the accompanying materials are true, accurate and complete. All engineering designs, plans and specifications [if required] included in this application were done by me or by someone working directly for me. The Natural Heritage Area Information [if required] and the site specific Soil Erosion and Sediment Control Plan [if required] were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering or developing the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete at the time this application is made. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

The professional engineer's signature below only certifies that the preliminary offshore conduit installation drawings and HDD landfall drawings were prepared under the direct supervision of a PE licensed in the State of Rhode Island. It does not certify that any other documentation or material associated with this application, including the attached narrative, were prepared under this Professional Engineer's oversight.

Professional's Signature:	Title:	Date:
[signature]	Professional Engineer	07/28/21

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PERMIT HISTORY AND APPLICABILITY - **Double-click** to check all boxes that apply to the proposed project.

Permit History

Provide all other application or file numbers associated with this site.

RI CRMC Assent:	US Army Corps of Engineers:	RIDEM Program Name & File Number:	RIDEM USE ONLY
2021-07-005			

Stormwater Construction Activity

Select all that apply. [Stormwater submissions must comply with all requirements of the Stormwater Management, Design and Installation Rules.] Click links below to refer to other applicable Rules.]

There are Freshwater Wetlands on the subject or adjacent property, AND the project proposes:

- ☐ New or increased impervious cover for property other than a single family home; or
- ☐ Disturbance of more than 10,000 sq. ft. of existing impervious cover; or
- ☐ To fill in any amount of floodplain or alter storm flowage to a river, stream or wetland on any lot.

Refer to Freshwater Wetland Rules

The project proposes an infiltration system listed in 8.21 of the *Stormwater Rules* (i.e. infiltration trench, infiltration basin, UIC chamber or drywell) that receives stormwater from:

- ☐ A residential impervious area that is more than 10,000 sq. ft.; or
- ☐ A non-residential roof area greater than 10,000 sq. ft.; or
- ☐ A non-residential (commercial, industrial, institutional...) road or parking area of any size.

Indicate if the treatment system discharges:

- ☐ **Below** the ground (UIC); or
- ☐ Above the ground and infiltrates (not UIC), but must be reviewed for compliance with the RISDISM to be protective of groundwater.

Refer to Groundwater Discharge Rules

The project proposes **discharge of stormwater** to waters of the State [including a Separate Storm Sewer System (MS4)], AND :

- ☐ Disturbs less than 1 acre, but the activity is part of a larger common plan resulting in more than 1 acre of disturbance.
- ☐ Disturbs more than 1 acre of property.

Refer to RI Pollutant Discharge Elimination System General Permit

STW/WQC Application # Required:

Water Quality Certification (WQC)

Select all project type(s):

- ☑ Discharge that requires a Federal Permit — Check all that apply:
  - ☐ Federal Energy Regulatory Commission (FERC)
  - ☐ Marinas-New Construction or Expansion
  - ☐ Fill Waters of the U.S.
  - ☑ ACOE Individual Permit
  - ☑ ACOE Fill in Coastal Waters
  - ☐ Other
- ☐ Harbor Management Plan
- ☐ Flow Alterations/Water Withdrawals
- ☐ Stormwater Master Plan

Refer to Water Quality Rules and Application Guidance

Submission Requirements

Please submit separately bound documents, as required. Additional copies are required when submitting concurrently with a Freshwater Wetlands Application.

1 Site Plan(s)
1 Appendix A Checklist/LID Planning Assessment
1 Stormwater Management Plan (Includes SESC Plan, O&M Plan, and SW Drainage/Analysis Report)

Appropriate Fee: New Permit = $400; Permit Modification = $200.

Amt Paid:

Check No:

Date Received:

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RHODE ISLAND DEPARTMENT OF ENVIROMENTAL MANAGEMENT
Office of Water Resources – Groundwater and Freshwater Wetlands Protection
[illegible]omenade Street, Providence, RI 02908
Telephone: 401-222-6820; Rhode Island Relay: 711

Supplemental Water Quality Certification Request Form

This form only applies to projects that are requesting a Water Quality Certification as part of a Federal permit which is not covered by a General Permit and therefore requires State certification. Review the WQC Application Instructions and Required Enclosures document for additional submittal requirements.

Provide all applicable information by completing the **shaded** areas.

Applicant Name: Revolution Wind, LLC c/o Kenneth Bowes	**Project Name:** Revolution Wind: Rhode Island State Waters

Additional Permits. Describe all additional permits and/or authorizations required for the project (federal, interstate, state, tribal, terretorial, local, etc.). Indicate whether the authorization has already been approved or denied.

Federal	State	Local	Other
Individual Section 404 and Section 10 USACE Permit - not authorized yet			Please see Table 1.4-1 in the attached narrativefor a complete list of permits

Date of Pre-application Meeting Request. Attach documentation showing proof of pre-application meeting request. The Pre-application Meeting Request must be made at least 30 days prior to the submittal of the WQC Request.	Meetings were held on 6/18/20 & 12/21/20

Certification

I hereby certify that all information contained herein is true, accurate, and complete, to the best of my knowledge and belief, and hereby request that the certifying authority review and take action on this CWA 401 certification request within the applicable reasonable period of time.

Applicant/Project Proponent's Signature: Kenneth Bowes	Title: Authorized Representative	Date: 07/28/21

Please note that RIDEM OWR reserves the right to request additional information from the applicant during the Reasonable Period of Time that is needed to determine impact to State waters.

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VANASSE HANGEN BRUSTLIN, INC.
101 WALNUT STREET • PO BOX 9151
WATERTOWN, MASSACHUSETTS 02471

CITIZENS BANK
MASSACHUSETTS
5-7017/2110

367303
CHECK DATE

July 28, 2021

Four Hundred and 00/100

AMOUNT

$400.00

Rhode Island General Treasurer
82 Smith Street
Suite 102
Providence, RI 02903

MP
AUTHORIZED SIGNATURE

Security Check features included. Details on back.

⑈367303⑈ ⑆211070175⑆ 1130161371⑈

VANASSE HANGEN BRUSTLIN, INC.
101 WALNUT STREET • PO BOX 9151
WATERTOWN, MASSACHUSETTS 02471

EMILY BUSINESS FORMS 800.392.6018 VISION

367303

Check Date: 7/28/2021

Invoice Number	Date	Voucher	Amount	Discounts	Previous Pay	Net Amount
Sue Moberg 7/27	7/27/2021	1412715	$400.00			$400.00
Rhode Island General Treasurer		TOTAL	$400.00			$400.00
Citizens 74		0002233				

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Water Quality Certification Checklist

Water Quality Certification Application Required Enclosures

Application Requirement	Where Provided in Application
Application fee	A check in the amount of $400.00 is enclosed herewith.
1. Completed application form	A completed application form is enclosed herein.
2. Site Plans	One set of Site Plans providing both existing and proposed project conditions and meeting the Site Plan Requirements outlined in Section 4.(A) of the checklist is provided in Appendix A of this Application.
3. List of direct abutting property owners and current mailing addresses.	Provided herein.
For Dredging Projects	
1. Proposed sampling plan must be submitted for review and approval prior to samples being taken.	A sampling plan was submitted on June 23, 2020 and approved on July 3, 2020. A copy of the sampling plan and approval is provided at Appendix B.
2. A species inventory addressing community structure may be required.	A species inventory is provided in the RWEC-RI Benthic Habitat Maps and Report provided at Appendix C; Essential Fish Habitat Assessment Revolution Wind Offshore Wind Farm provided at Appendix D; and Assessment of Impacts to Marine Mammals, Sea Turtles, and ESA-Listed Fish Species Revolution Wind Offshore Wind Farm provided at Appendix E.
3. Project Plans	One set of Site Plans providing both existing and proposed project conditions and meeting the Site Plan Requirements outlined in Section DP 3 of the checklist is provided in Appendix A.
4. A letter requesting the time frame for dredging if work is proposed anytime other than November 1 - December 31.	Time of Year restrictions are currently being discussed with the RI Department of Environmental Management Division of Marine Fisheries.
5. A Narrative report including the following:	
1. The proposed dredging method and an estimate of the length of time to conduct the dredging project.	Refer to Section 2.2.1 of this narrative.
2. Calculations verifying the estimated volume of dredge material in cubic yards (cy).	Refer to Appendix A HDD Landfall Design Plans sheets 5 and 6 of 6, Note 2.
3. Aquatic resources in the area such as shellfish beds, eel grass beds, migratory pathways, habitat for finfish, etc.	Refer to Sections 3.3, 3.4, 3.5, and 3.6 of this narrative.
4. Information on past dredging events, historical spills, past sediment test data taken in or near proposed dredge area, and the	Revolution Wind reviewed dredge permit information for two adjacent projects: Electric Boat Channel Dredge (CRMC File 2017-03-066; Dredge Permit 17-

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Application Requirement	Where Provided in Application
presence of outfalls for both the dredging and surrounding areas.	156; WQC 17-059) and RI Fast Ferry Dredge (CRMC File 2018-06-084; Dredge Permit 18-169; WQC 18-132).
5. The method of transport to the disposal area.	Not applicable.
6. Calculations verifying the capacity of any dewatering area(s) and the disposal area (Does not apply to CAD cell nor RISDS disposals).	Not applicable.
7. A letter from the property owner of the dewatering and the disposal areas indicating approval for the estimated volume of dredge material to be dewatered and/or disposed of on their property (Does not apply to CAD cell nor RISDS disposals).	Not applicable.
6. Approval letters from the solid waste landfill and/or the RIDEM - OLRSMM may be required for upland disposal at a solid waste landfill.	Not applicable.
7. Disposal in open water requires a narrative discussing the alternatives to open water disposal that were considered and why these alternatives were not chosen. The Office of Water Resources (OWR) will coordinate with the ACOE and the EPA in developing a sampling plan for open water disposal.	Not applicable
Marinas:	Not applicable.
Harbor Management Plans:	Not applicable.
Flow Alterations and Water Withdrawals:	Not applicable.
Filling of Waters of the State:	
1. Site plans must include the following: (a) The existing and proposed physical site conditions. (b) MHW and MLW elevations. (c) The datum used to reference all grades and depths (NAVD88 when possible).	One set of Site Plans providing both existing and proposed project conditions and meeting the Site Plan Requirements outlined in Section DP 3 of the checklist is provided in Appendix A of this Application.
2. A species inventory addressing aquatic resources and community structure. The scope of work must be approved by the OWR prior to performing the inventory.	A species inventory is provided in the RWEC-RI Benthic Habitat Maps and Report provided at Appendix C; Essential Fish Habitat Assessment Revolution Wind Offshore Wind Farm provided at Appendix D; and Assessment of Impacts to Marine Mammals, Sea Turtles, and ESA-Listed Fish Species Revolution Wind Offshore Wind Farm provided at Appendix E.
3. A narrative report including:	A narrative report evaluating purpose and need, alternatives, existing uses and potential impacts is provided herein.

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Application Requirement	Where Provided in Application
(a) Analysis of the existing uses of the area and discussion of any changes that will result due to the project. (b) A description of the need for the filling and a discussion of the alternatives to filling that were investigated.	
4. Proposed mitigation to filling and resulting impacts.	Refer to Section 3.1.2, 3.1.3, 3.2.2 and 3.2.3 of this narrative.
5. Calculations showing the proposed volume of new net Fill in State waters (in cubic yards).	Refer to Appendix A, Site Plans
Hydropower/FERC Projects:	Not applicable.

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Marine Dredging Application Form & Checklist

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Rhode Island Coastal Resources Management Council
Oliver H. Stedman Government Center
Wakefield, RI 02879
(401) 783-3370

Rhode Island Department of Environmental Management
235 Promenade Street
Providence, RI 02908-5767
(401) 222-6820

APPLICATION FOR MARINE DREDGING AND ASSOCIATED ACTIVITIES pursuant to the Marine Infrastructure Maintenance Act of 1996 and the Marine Waterways and Boating Facilities Act of 2001, Chapter 46-6.1 of the Rhode Island General Laws.

PURPOSE OF APPLICATION

Agency Use Only
File Number
2021-07-097
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- [x] Application for Dredging and Disposal of Dredged Material
- [ ] Request Renewal of RIDEM Dredge Permit File # _____
- [ ] Request Renewal of CRMC Dredge Permit File # _____
- [ ] Request Modification of RIDEM Dredge Permit File # _____
- [ ] Request Modification of CRMC Dredge Permit File # _____

(Please Type or Print)

APPLICANT INFORMATION

Applicant Name: Revolution Wind, LCC c/o Kenneth Bowes

(NOTE: Applicant must be the owner of the property on which the activity is proposed)

Applicant Address: 56 Exchange Terrace, Suite 300 Telephone No. 860-883-5830

City/Town: Providence State: RI Zip: 02903

PROJECT INFORMATION

Project Address: Narragansett Bay off of Quonset Point; please see attached narrative for description of dredging location

City/Town: North Kingstown State: RI Zip: 02852

Tax Assessor's Plat(s) and Lot Number(s): _____

Project Consultant/Engineer Name: VHB c/o Susan Moberg, PWS / Mott MacDonald c/o Christopher Cockshaw, PE

Consultant/Engineer Address 1 Cedar Street, Suite 400, Providence, RI 02903 / 134 Capital Drive, Suite D, West Springfield, MA 01089

Consultant/Engineer Telephone No. (401) 457-2055 / (413) 315-2146

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ACTIVITIES ASSOCIATED WITH THE PROPOSED DREDGE PROJECT (check all that apply)*

- [x] Filling of Waters of the State
- [ ] Marinas – New construction or expansion
- [ ] Site Disturbances
  - __ Residential Development: six (6) or more dwellings
  - __ Commercial, Industrial, State or Municipal Development
  - __ Any project ≥ five (5) acres of disturbance
- [ ] Flow Alterations
- [ ] Point Source Discharge of Pollutants

GENERAL INFORMATION

Identify program and associated application number for any other RIDEM applications filed for this project

____	Freshwater Wetlands	Application Number _____
X	RIPDES	Application Number Not yet assigned
____	Individual Sewage Disposal System	Application Number _____
X	Other (CRMC / Water Quality Certification)	Application Number 2021-07-005 / not yet assigned

If you have any questions, please contact the RIDEM at 222-7500 or CRMC at 783-3379.

CERTIFICATION OF APPLICANT

I hereby certify that I have requested and authorized the investigation, compilation, and submission of all the information, in whatever form, contained in this Application; that I have personally examined and am familiar with the information submitted herein; and that such information is true, accurate and complete to the best of my knowledge.

Signature of Applicant: Kenneth Bowes Date: 7/28/2021

Please return this completed application form and all supporting information, as indicated on the accompanying Submittal Checklist to:

Rhode Island Coastal Resources Management Council
Oliver H. Stedman Government Center
Wakefield, RI, 02879

and

Rhode Island Department of Environmental Management
Office of Technical & Customer Assistance
235 Promenade Street
Providence, RI 02908

* Water Quality Certification required for these activities pursuant to Section 401 of the CWA and the Rhode Island Water Quality Rules may be incorporated into an approval issued as part of this application.

Office Use Only:

Suitable for Public Notice _____ Date: _____

- [ ] Approved
- [ ] Denied
- [ ] Withdrawn

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Marine Dredging Checklist

Application for Marine Dredging and Associated Activities submittal checklist.

Application Requirement	Where Provided in Application
1. Completed application form	A completed application form is enclosed herein.
2. Site Plans	Eight sets of Site Plans providing both existing and proposed project conditions and meeting the Site Plan Requirements outlined in the checklist is provided in Appendix A of this Application.
FOR DREDGING ACTIVITY:	
1. The analytical results of the sampling conducted pursuant to the Sediment Sampling Plan	A sampling plan was submitted on June 23, 2020 and approved on July 3, 2020. A copy of the sampling plan and approval, and the analytical results are provided at Appendix B.
2. A narrative description of the proposed dredging method, type of dredging equipment to be used, and an estimate of the length of time (proposed starting and completion dates) necessary to complete the dredging project. Depending on the size, location and complexity of the project, an evaluation of the impacts to fishery resources including migratory and spawning behavior and habitat, and the presence of early life stages of particular sensitivity may be required. Dredging projects proposed outside the standard dredge window may require the submission of additional resource information	A narrative description of the proposed activity and an evaluation of existing resources and potential impacts is provided herein.
3. A narrative description and location of aquatic resources in the area to be dredged such as shellfish beds, eel grass beds, spawning areas and migratory pathways for finfish, and other aquatic resources	Refer to Sections 3.3, 3.4, 3.5, and 3.6 of this narrative.
4. The proposed depth of dredging and the datum used to reference all grades and depths	Refer to Appendix A, Site Plans
5. Stamped calculations performed by a Professional Engineer, verifying the estimated volume of material to be dredged	Refer to Appendix A, Site Plans
IN-WATER DISPOSAL OF DREDGED MATERIALS:	Not applicable.
DEWATERING OF DREDGED MATERIAL:	Refer to Section 2.2.1
UPLAND DISPOSAL/BENEFICIAL USE OF DREDGED MATERIAL:	Not applicable.
UPLAND DISPOSAL PROJECTS THAT MAY IMPACT FRESHWATER WETLANDS:	Not applicable.
DREDGED MATERIAL REHANDLING:	Not applicable.

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List of Direct Property Abutters

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List Of Direct Abutting Property Owners and Current Mailing Addresses

Property ID	Property Owner	Property Address	Owners Mailing Address
185-001 (Locus)	Newton Properties LLC	244 Burlingham Avenue	244 Burlingham Avenue North Kingstown, RI 02852
185-004 (Locus)	Newton Properties LLC	Burlingham Avenue	244 Burlingham Avenue North Kingstown, RI 02852
185-008 (Locus)	Vantage Point Properties LLC	50 Whitecap Drive	50 Whitecap Drive, Suite 302 North Kingstown, RI 02852
185-002	Electric Boat Corporation	180 McNaught Street	75 Eastern Point Road Dept 613, J88-10 Groton, CT 06340
185-020	Falvey Realty LLC	66 Whitecap Drive	66 Whitecap Drive North Kingstown, RI 02852
185-021	Vantage Point Properties LLC	50 Whitecap Drive	50 Whitecap Drive, Suite 302 North Kingstown, RI 02852
185-029	RI Commerce Corporation	10 McNaught Street	95 Cripe Street North Kingstown, RI 02852

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Executive Summary

Revolution Wind, LLC (formerly known as DWW Rev I, LLC) ("Revolution Wind"), which is a 50|50 joint venture partnership between Orsted North America Inc. ("Orsted") and Eversource Investment LLC ("Eversource"), proposes to construct the Revolution Wind Project ("Project"), an offshore wind farm that will deliver approximately 704 megawatts ("MW") of renewable energy to the States of Rhode Island and Connecticut. The Project will provide clean, reliable offshore wind energy that will significantly increase the renewable energy pool available to Rhode Island and Connecticut and reduce carbon emissions across the region. The Project will displace electricity generated by fossil fuel-powered plants, improve energy system reliability and security, and enhance economic competitiveness by attracting new investments and job growth opportunities.

Revolution Wind developed the Project in direct response to the ambitious clean energy goals of the State of Rhode Island. The Project significantly advances Rhode Island's renewable energy directives set forth in the State energy plan – Energy 2035 – which calls for Rhode Island to "increase sector fuel diversity, produce net economic benefits, and reduce greenhouse gas emissions by 45 percent by the year 2035" in part "through support for state and federal offshore wind projects." The Project plays an integral role in advancing Rhode Island's goal of procuring 1,000 MW of renewable energy by 2020 and a 100 percent Renewable Energy Future by 2030, as set forth in former Governor Gina Raimondo's Executive Order No. 20-01. Moreover, the Project helps to meet the State of Rhode Island's needs under the Resilient Rhode Island Act to reduce greenhouse gas emissions to eighty percent (80%) below 1990 levels by the year 2050.

Rhode Island and Connecticut have awarded Revolution Wind five Power Purchase Agreements ("PPAs") to-date, totaling approximately 704 MW of generation capacity. These PPAs help meet the region's expressed need and demand for additional renewable energy resources. The Project will fulfill Revolution Wind's obligations to both Connecticut and Rhode Island in accordance with the PPAs and provide substantial environmental and economic benefits. Revolution Wind is also committed to supporting offshore wind education and supply chain and workforce development for the growing offshore wind industry in Rhode Island and Connecticut. Revolution Wind has memoranda of understanding with both states setting forth the specific initiatives and commitments to be undertaken-positioning both states as offshore wind leaders.

Project components include wind turbine generators ("WTGs"), a network of inter-array cable ("IAC"), offshore substations ("OSS"), and an OSS-Link cable in federal waters on the Outer Continental Shelf ("OCS") and within the designated Bureau of Ocean Energy Management ("BOEM") Renewable Energy Lease Area OCS-A 0486 ("Lease Area"), which at its closest edge, is approximately 15 miles southeast of the Rhode Island coast. The boundaries of this Lease

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Area were established by BOEM utilizing the diverse and detailed research datasets commissioned for the preparation of the National Oceanic and Atmospheric Administration ("NOAA") Office of Coastal Management federally-approved Coastal Resources Management Council ("CRMC") Ocean Special Area Management Plan ("Ocean SAMP"). The Project's two subsea export cables (referred to as the "RWEC") travel north from the Lease Area before trending in a northwest direction after entering Rhode Island state waters. The RWEC travels north through the West Passage of Narragansett Bay to a landfall location at Quonset Point in the Town of North Kingstown. The Project's point of interconnection to the existing electrical transmission grid is The Narragansett Electric Company d/b/a National Grid's ("TNEC") Davisville Substation, also in North Kingstown.

Revolution Wind is submitting this Water Quality Certification and Marine Dredging Application in compliance with 250- Rhode Island Code of Regulations ("RICR")-150-05-1 and 250-RICR-150-05-2 for the installation and operation of approximately 23 miles of the RWEC within Rhode Island state waters ("RWEC-RI").

Revolution Wind collected, assembled, and analyzed extensive resource data sets characterizing the Project Area and leveraged the pioneering research and data synthesis completed by the CRMC and BOEM to strike a balance between the needs for clean renewable energy with the protection of Rhode Island's and the region's ocean-based resources and existing uses during the Project design. Revolution Wind believes this Project complies with the goals, policies, and standards contained within the Water Quality Regulations and the Rules and Regulations for Dredging and the Management of Dredged Materials and offers a meaningful opportunity to reduce future carbon emissions in the Rhode Island region. Revolution Wind respectfully requests that the Rhode Island Department of Environmental Management ("RIDEM") and the Coastal Resources Management Council ("CRMC") approve this Application for State Water Quality Certification and Marine Dredging and Associated Activities.

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1 Introduction

1.1 Project Summary and Location

Revolution Wind, LLC (formerly known as DWW Rev I, LLC) ("Revolution Wind"), a 50|50 joint venture partnership between Orsted North America Inc. ("Orsted") and Eversource Investment LLC ("Eversource"), proposes to construct the Revolution Wind Project (Project). The Project involves installation of an offshore wind farm and associated transmission facilities that will deliver approximately 704 megawatts ("MW") of clean wind power to the States of Rhode Island and Connecticut. The Project will provide clean, reliable offshore wind energy that will significantly increase the renewable energy delivered to Rhode Island and Connecticut, reducing carbon emissions across the region. The Project will displace electricity generated by fossil fuel-powered plants, improve energy system reliability and security, and enhance economic competitiveness by reducing energy costs to attract new investments and job growth opportunities.

The State of Rhode Island has set ambitious clean energy goals. Consistent with the State Guide Plan Energy 2035, former Governor Gina Raimondo proposed to increase the State's clean energy portfolio ten-fold to 1,000 MW by 2020, in large part through support for state and federal offshore wind projects. Building on this foundation, the Governor issued an Executive Order in January 2020 committing Rhode Island to be powered by 100 percent renewable electricity by 2030. Executive Order No. 20-01, Advancing a 100% Renewable Energy Future for Rhode Island by 2030 (January 17, 2020). These goals have made Rhode Island a national leader with respect to climate change resiliency. The Project will play an integral role in meeting these aggressive targets and was developed in direct response to Rhode Island's and Connecticut's needs to increase the renewable energy load serving each State. Beyond mere consistency with State policies, the Project will facilitate the plans of both Rhode Island and Connecticut to meet their targets for renewable energy, economic growth in the renewable energy sector, and greenhouse gas reductions.

Project components include wind turbine generators ("WTGs"), a network of inter-array cable ("IAC"), offshore substations ("OSS"), and an OSS-Link cable in federal waters on the Outer Continental Shelf ("OCS") and within the designated Bureau of Ocean Energy Management ("BOEM") Renewable Energy Lease Area OCS-A 0486 ("Lease Area"), which at its closest edge, is approximately 15 miles (mi) southeast of the Rhode Island coast. The boundaries of this

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Lease Area were established by BOEM utilizing the diverse and detailed research data sets commissioned for the preparation of the National Oceanic and Atmospheric Administration ("NOAA") Office of Coastal Management federally-approved Coastal Resources Management Council ("CRMC") Ocean Special Area Management Plan ("Ocean SAMP"). The Project's subsea export cable (referred to as the "RWEC"; "RWEC-RI" for the portion in Rhode Island state waters) travels north from the Lease Area before trending in a northwest direction after entering Rhode Island state waters. The RWEC-RI travels north through the West Passage of Narragansett Bay to a landfall location at Quonset Point in the Town of North Kingstown. The Project's point of interconnection to the existing electrical transmission grid is The Narragansett Electric Company d/b/a National Grid's ("TNEC") Davisville Substation, also located in North Kingstown.

The following Project components proposed in Rhode Island state waters are addressed in this application (the "Application"):

- The RWEC-RI, which includes two submarine export cables, each measuring approximately 23 mi (37 km; approximately 13 mi [21 km] in Rhode Island Sound and 10 mi [16 km]) in the West Passage of Narragansett Bay to the three-nautical mile limit of state waters.
- Work will be initiated from a Landfall Work Area onshore in North Kingstown, Rhode Island, where horizontal directional drilling ("HDD") will be employed to make the submarine export cables' transitions to shore. This operation will require the excavation of two temporary HDD exit pits approximately 800 feet offshore in subtidal waters.

Figure 1.1-1 depicts the overall location of the Project and shows the limits of CRMC and RIDEM jurisdiction applicable to this Application (depicted in the purple line).

This narrative, supporting documents, and the accompanying design plans are Revolution Wind's Application for a state Water Quality Certification and a Dredge Permit. The narrative of this Application is organized as follows:

- Section 1 outlines the requirements of the Application, describes the Project's purpose and need, and summarizes other local, state, and federal approvals required for the Project.
- Section 2 provides a Project description.
- Section 3 describes the affected environment, potential Project impacts, and proposed avoidance, minimization, and mitigation measures.
- Section 4 provide the analyses of Project activities against the specific policies and regulations in RIDEM's Water Quality Regulations (250-Rhode Island Code of Regulations ["RICR"]-150-05-1) and Rules and Regulations for Dredging and the Management of Dredged Materials (250-RICR-150-05-2).

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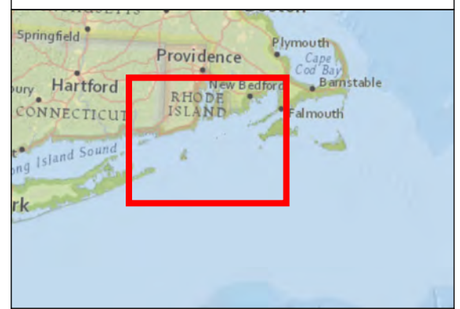
Revolution Wind
Figure 1.1-1
Project Location

Legend
- OnSS
- RWEC-OCS Project Area
- RWEC-RI Project Area
- RWF Boundary Lease Area OCS-A 0486

*Not part of this Category B Assent application; refer to separate Application to Alter Freshwater Wetlands filed on June 30, 2021.

Service Layer Credits: National Geographic World Map: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
World Topographic Map: Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS



Reference system: NAD83 (2011)
Projection: UTM Zone 19N

0 4000 8000 12000 Meters

0 10,000 20,000 30,000 Feet

Date: 05/19/2020
Document no:

Created by: S. PELLETIER
Checked by: S. MOBERG
Approved by: STEPW

Revolution Wind | Powered by Ørsted & Eversource

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1.2 Regulatory Requirements

The Project includes the following proposed activities in state waters to the three-nautical mile limit:

- Installation, operation and maintenance of the RWEC-RI, which consists of two submarine export cables, each measuring up to 23 mi (37 km) in Type 4 and Type 6 Waters.
- Placement of fill in state waters to protect segments of the RWEC-RI and existing utilities. Fill may consist of rock bags, concrete mattresses, fronded mattresses, and/or rock berms in Type 4 Waters/SA waters.
- Installation of the RWEC-RI at the Project's proposed Landfall Work Area utilizing HDD with work including temporary excavation of two offshore exit pits in Type 6 Waters/SB waters.

The entirety of the proposed work outlined above is subject to the jurisdiction of RIDEM pursuant to the RIDEM Water Quality Regulations ("WQR") (250-RICR-150-05-1) and require a Water Quality Certification ("WQC") pursuant to WQR Section 1.15(A)(3). The proposed HDD exit pits are the only proposed work that meet the definition of "Dredging" in the Dredging Regulations, §2.4.13 in the Rules and Regulations for Dredging and the Management of Dredged Materials ("Dredging Regulations") (250 RICR-150-05-2), and as such require a Dredge Permit. Sediments excavated from the HDD exit pits will be stored on barges before being mechanically replaced within the excavated pit. In contrast, the cable installation results in an activity that has incidental fallback of sediment; backfill of the trench is expected shortly after installation due to collapse of the trench walls and/or by natural infill.

Most of the RWEC-RI within Narragansett Bay is mapped as SA, which are waters designated for shellfish harvesting for direct human consumption, primary and secondary contact recreational activities, and fish and wildlife habitat (see Figure 1.2-1). Waters adjacent to the landfall location are mapped as SB, which are waters designated for primary and secondary contact recreational activities, shellfish harvesting for controlled relay and depuration, and fish and wildlife habitat. Both SA and SB waters have good aesthetic value.

The majority of the RWEC-RI is within CRMC designated Type 4: Multipurpose Waters (see Figure 1.2-2). A small portion of the cable corridor at and near the landfall location is within Type 6: Industrial Waterfront and Commercial Navigation Channels, but outside of the designated navigation channel. Another small segment is proximate, but not within, Type 2: Low Intensity Use waters west of the landfall location adjacent to Blue Beach. Type 4 Multipurpose Waters include large expanses of open water in Narragansett Bay and the Sound that support a variety of commercial and recreational activities while maintaining good value as a fish and wildlife habitat and open waters adjacent to shorelines that could support water dependent commercial, industrial, and/or high intensity recreational activities. Type 6 Industrial Waterfronts and Commercial Navigation Channels are waters that are extensively altered to accommodate commercial and industrial water dependent and water enhanced activities.

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The policies and standards of the Water Quality Regulations and the Rules and Regulations for Dredging and the Management of Dredged Materials are addressed in Section 4 of this Application.

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Figure 1.2-1
Offshore Water Quality Standards

Legend
- RWEC-OCS Project Area
- RWEC-RI Project Area
- 3-Nautical Mile State Water Boundary

Estuarine Water Quality Standard
- SA
- SA{b}
- SB
- SB1

Service Layer Credits: National Geographic World Map: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
World Ocean Base: Esri, DeLorme, NaturalVue

Reference system: NAD83 (2011)
Projection: UTM Zone 19N

0 1000 2000 3000 Meters

0 4,000 8,000 12,000 Feet

Date: 05/19/2020
Document no:

Created by: S. PELLETIER
Checked by: S. MOBERG
Approved by: STEPW

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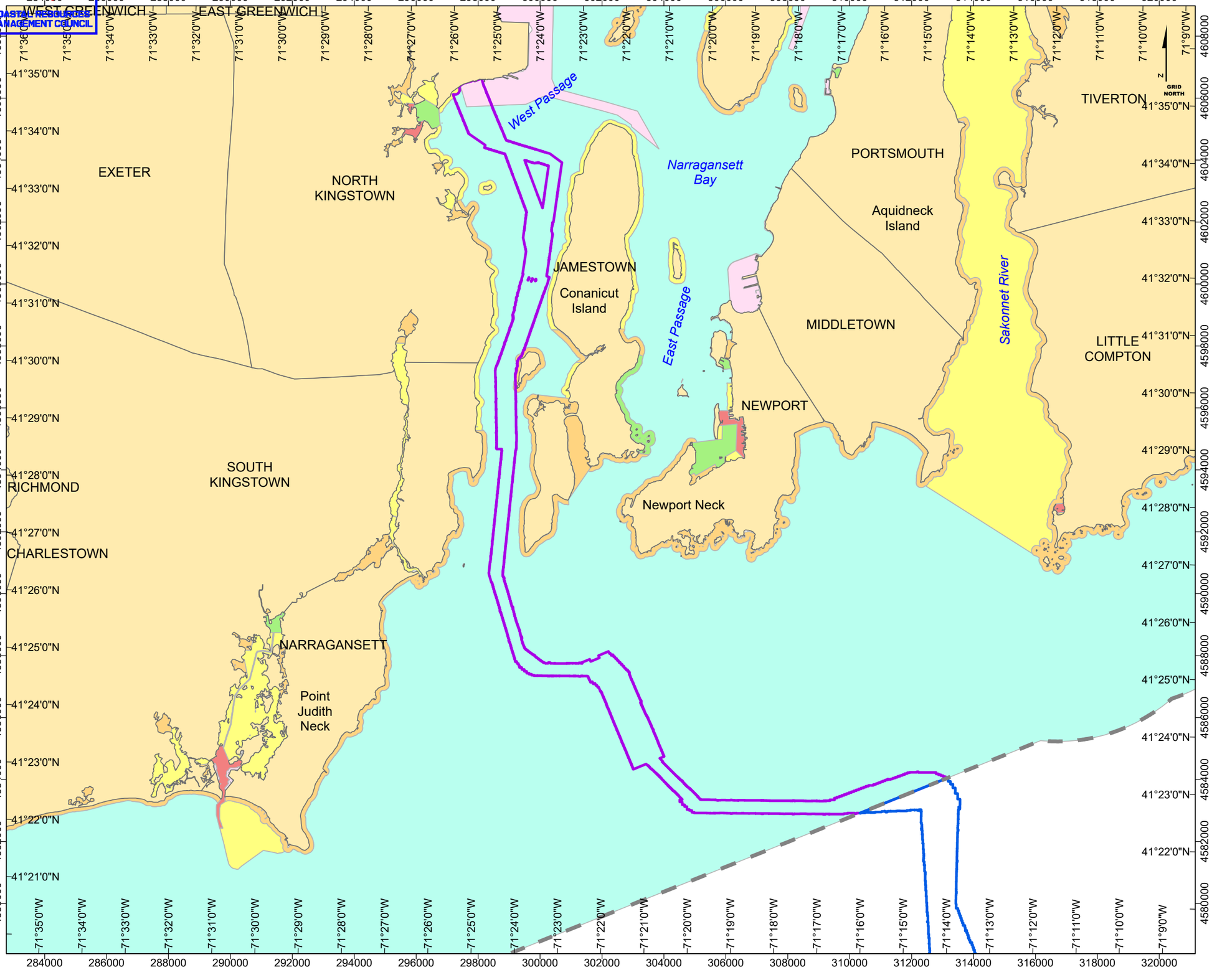
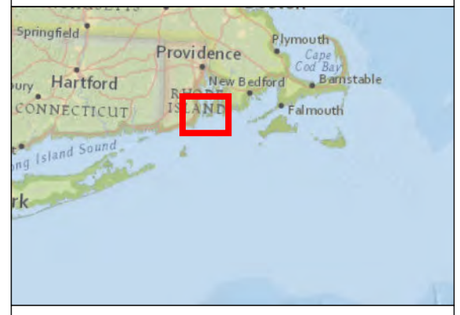
Figure 1.2-2
CRMC Water Use Types



Legend
- RWEC-OCS Project Area
- RWEC-RI Project Area
- 3-Nautical Mile State Water Boundary

CRMC Water Use Types
- Commercial & Recreational Harbor
- Type 1:Conservation Area
- Type 2: Low Intensity Use
- Type 3: High Intensity Boating
- Type 4: Multi-Purpose Water
- Type 6: Industrial Waterfronts and Commercial Navigation Channels

Service Layer Credits: National Geographic World Map: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.



Reference system: NAD83 (2011)
Projection: UTM Zone 19N

0 1000 2000 3000 Meters

0 4,000 8,000 12,000 Feet

Date: 05/19/2020
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1.3 Purpose and Need

The purpose of the Project is to provide clean, reliable offshore wind energy that will significantly increase the renewable energy supply available to Rhode Island and Connecticut consumers and reduce carbon emissions across the region. The Project will displace electricity generated by fossil fuel-powered plants, improve energy system reliability and security, and enhance economic competitiveness by reducing energy costs to attract new investments and job growth opportunities.

Revolution Wind developed the Project in direct response to the expressed needs of the States of Rhode Island and Connecticut to increase the renewable energy load serving each state. Specifically, the Project significantly advances Rhode Island's renewable energy directives set forth in the State energy plan – Energy 2035 – which calls for Rhode Island to "increase sector fuel diversity, produce net economic benefits, and reduce greenhouse gas emissions by 45 percent by the year 2035" in part "through support for state and federal offshore wind projects." The Project also contributes 400 MW of renewable energy toward Rhode Island's ambitious goal of procuring 1,000 MW of renewable energy by 2020 and converting Rhode Island to 100% renewable energy by 2030, set forth in former Governor Gina Raimondo's executive orders. Moreover, the Project contributes to the State of Rhode Island's needs under the Resilient Rhode Island Act to reduce greenhouse gas emissions to 80 percent below 1990 levels by the year 2050.

In response to this expressed need and demand, Rhode Island[1] and Connecticut[2] have awarded Revolution Wind five Power Purchase Agreements ("PPAs") to-date, totaling approximately 704 MW of generation capacity. These PPAs help meet the region's expressed need and demand for additional renewable energy resources. The Project will fulfill Revolution Wind's obligations to both Rhode Island and Connecticut in accordance with the PPAs and provide substantial environmental and economic benefits.

BOEM is the federal regulatory authority over offshore energy development including renewable energy production from wind, waves, and currents and must comply with the National Environmental Policy Act ("NEPA") before approving a lessee's Construction and Operations Plan ("COP") for a wind or other renewable energy production project on the OCS. BOEM published a Notice of Intent ("NOI") on April 30, 2021 for the Project that initiates the NEPA scoping of the environmental review, identifies stakeholders, and begins

1 Offshore Wind Generation Unit Power Purchase Agreement between The Narragansett Electric Company, d/b/a National Grid, as Buyer and DWW Rev I, LLC as Seller, dated December 6, 2018, which the Rhode Island Public Utilities Commission approved in Report and Order No. 23609 dated June 7, 2019.

2 There are four separate PPAs between Revolution Wind and electric utilities in Connecticut. These PPAs are: (1) RPS Class I Renewable Generation Unit Power Purchase Agreement between The Connecticut Light and Power Company d/b/a Eversource Energy and DWW Rev I, LLC, dated October 1, 2018, (2) RPS Class I Renewable Generation Unit Power Purchase Agreement between The United Illuminating Company and DWW Rev I, LLC, dated October 1, 2018, (3) Amended and Restated Zero Carbon Emissions Class I Renewable Generation Unit Power Purchase Agreement between The United Illuminating Company [Buyer] and DWW Rev I, LLC [Seller], dated November 22, 2019, and (4) Amended and Restated Zero Carbon Emissions Class I Renewable Generation Unit Power Purchase Agreement between The Connecticut Light and Power Company d/b/a Eversource Energy [Buyer] and DWW Rev I, LLC [Seller], dated November 22, 2019. PURA approved the first two of the Connecticut PPAs in its Decision dated December 19, 2018 in Docket No. 18-06-37, PURA approves the third and fourth of the Connecticut PPAs in its Decision dated November 27, 2019 in Docket No. 18-05-04.

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the public participation process. The NEPA documentation prepared under this process will further establish the purpose and need for the Project and disclose environmental effects on the natural and human environment both detrimental and beneficial.

1.4 Other Project Approvals and Permits

In addition to a Water Quality Certification and Dredge Permit, the Project requires permits and approvals from other state and federal regulatory agencies. Table 1.4-1 provides a summary of the other required approvals and permits along with dates of approval or estimated dates of approvals for those permits that have not been issued.

Table 1.4-1 Summary of the Project's Federal, State, & Local Permits or Approvals

Regulatory Authority	Permit, Approval, or Consultation	Date of Approval or Anticipated Approval
Federal Permits, Approvals, and Consultations		
BOEM	Commercial Lease of Submerged Lands for Renewable Energy Development on the OCS, in accordance with the Outer Continental Shelf Lands Act ("OCSLA") (43 U.S.C. §§ 1331 et seq.); Section 388 of the Energy Policy Act of 2005, BOEM implementing regulations (30 CFR § 585)	OCS-A 0486 Lease effective on October 1, 2013
	Site Assessment Plan ("SAP") approval pursuant to 30 CFR §§ 585.610-618	Approved October 12, 2017
	COP approval pursuant to 30 CFR §§ 585.621-627	Anticipated between Q1 and Q3 2023
	Facility Design Report ("FDR") approval pursuant to 30 CFR 585.701 (33 U.S.C. § 1221)	To be reviewed by a Certified Verification Agent ("CVA") and submitted to BOEM after COP approval
	Fabrication and Installation Report ("FIR") approval pursuant to 30 CFR § 585.700	To be reviewed by a CVA and submitted to BOEM after COP approval
	Consultation pursuant to Section 7 of the Endangered Species Act ("ESA") (16 U.S.C. §§ 1531 et seq.), with National Marine Fisheries Service ("NMFS") and United States Fish and Wildlife Service ("USFWS")	Anticipated between Q1 and Q3 2023
	Essential Fish Habitat ("EFH") Consultation pursuant to the Magnuson-Stevens Fishery Conservation and Management Act ("MSFCMA") (16 U.S.C. §§1801 et seq.)	Anticipated between Q1 and Q3 2023

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Regulatory Authority	Permit, Approval, or Consultation	Date of Approval or Anticipated Approval
	Consultation pursuant to the Migratory Bird Treaty Act ("MBTA") (16 U.S.C. §§ 703 et seq.) and Bald and Golden Eagle Protection Act (16 U.S.C. §§ 668 et seq.)	Anticipated between Q1 and Q3 2023
	Review pursuant to the NEPA (42 U.S.C. §§4321 et seq.), BOEM regulations (30 CFR §§ 585.646,585. 648(b)), and other relevant regulations in consultation with the USACE, Department of Defense ("DoD"), Advisory Council on Historic Preservation, and other cooperating regulatory agencies	Anticipated between Q1 and Q3 2023
USACE New England District	Section 10 Individual Permit pursuant to the Rivers and Harbors Appropriation Act of 1899 (33 U.S.C. §§ 401 *et seq.*)	Anticipated between Q1 and Q3 2023
	Section 404 Individual Permit pursuant to the Clean Water Act of 1972 ("CWA") (33 U.S.C. § 1344)	Anticipated between Q1 and Q3 2023
United States Coast Guard ("USCG"), District 1	Private Aids to Navigation ("PATON") Permit pursuant to 33 CFR § 66 (49 U.S.C. § 44718)	Issued four weeks prior to offshore construction
	Local Notice to Mariners ("LNM")	Issued two weeks prior to vessel mobilization for offshore construction
United States EPA New England (Region 1)	OCS Air Quality Permit pursuant to 40 CFR § 55 (Clean Air Act., 42 U.S.C. § 7627)	Anticipated between Q1 and Q3 2023
Federal Aviation Administration	Determination of No Hazard to Air Navigation pursuant to 14 CFR §77	Anticipated between Q3 and Q4 2022
NOAA	Request Incidental Take Authorization pursuant to the Marine Mammal Protection Act ("MMPA") (16 U.S.C. §§ 1361 et seq.)	Anticipated between Q1 and Q3 2023
	Request for Incidental Take Statement ("ITS") pursuant to Section 7 of the ESA of 1973 (16 U.S.C. §§ 1531 *et seq.*)	

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Regulatory Authority	Permit, Approval, or Consultation	Date of Approval or Anticipated Approval
State Permits, Approvals, and Consultation/Advisories		
Rhode Island Energy Facility Siting Board	License pursuant to the Energy Facility Siting Act (Rhode Island General Laws ["RIGL"] §§ 42-98-1 *et seq.*)	Anticipated between Q4 2021 and Q1 2022 EFSB Docket: SB-2021-01
Rhode Island Coastal Resources Management Council	Federal Consistency Determination pursuant to Section 307 of the CZMA (16 U.S.C. § 1456) and § 11.10 of RI Ocean Special Area Management Plan [Ocean SAMP] (650-RICR-20-05-2.1 *et seq.*)	Anticipated between Q1 and Q3 2023
	Category B Assent and Submerged Lands License pursuant to RI CRMC Management Procedures (the "Red Book") (650-RICR-20-00-1 et seq.; consultation as required with the Rhode Island Department of Environmental Management ("RIDEM") regarding the Rhode Island Endangered Species of Animals and Plants Act (Rhode Island ESA) (RIGL § 20-37-3); Rhode Island Bureau of Natural Resources, Division of Fish and Wildlife; and Rhode Island Historical Preservation and Heritage Commission ("RIHPHC") (RIGL 42-45-1 et seq.)	Anticipated between Q4 2022 and Q2 2023 CRMC File No. 2021-07-005
	Permit to Alter Freshwater Wetland in the Vicinity of the Coast for the ICF (650-RICR-20-00-2)	Anticipated between Q4 2022 and Q2 2023 CRMC File No. 2021-07-010
Rhode Island Department of Environmental Management ("RIDEM") Office of Water Resources	Authorization under the RIPDES General Permit for Stormwater Discharge Associated with Construction Activity (Construction General Permit or CGP). To be field concurrently with WQC Application.	Anticipated between Q1 and Q3 2022
Quonset Development Corporation ("QDC")	Development Review Process (RIGL 42-64.10-5; QDC Development Regulations, 880-RICR-00-00-4 *et seq.*)	Anticipated between Q3 2021 and Q4 2021

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2

RWEC Project Description

The wind farm portion of the Project is proposed within the Lease Area on the OCS established by BOEM through a coordinated data collection and planning process, much of it documented in the Ocean SAMP, consistent with the objectives of the National Ocean Policy and NEPA and considering the policies and objectives of the State of Rhode Island and the Commonwealth of Massachusetts. BOEM reduced the limits of the original Lease Area based on environmental constraints, efforts to decrease user group conflicts, navigational safety, public health and safety, and stakeholder concerns (e.g., commercial fishing).

Transmission and interconnection facilities are required to export the electricity generated by the offshore wind farm to the broader electrical transmission grid. For the RWEC-RI, Revolution Wind evaluated seven different cable route configurations and selected the cable route that is included in this Application because it accommodates the full generation capacity of the Project and results in minimal resource impacts due to the shortest overall transmission route offshore and onshore, existing bathymetry, favorable geology, avoidance of use conflicts and environmental constraints, available land for interconnection equipment, favorable zoning and allows for beneficial reuse of contaminated properties.

The following sections describe the design, construction, operations & maintenance, decommissioning and environmental compliance of the RWEC-RI, including offshore and onshore HDD. This section also details Revolution Wind's commitments to environmental compliance and monitoring.

2.1 Design

The RWEC-RI will consist of two 275 kilovolt ("kV") High voltage alternating current subsea cables located within the same approximate 1,312-ft (400-m)-wide submarine right-of-way ("ROW"). Based on site-specific conditions (e.g., water depth and seabed constraints), each cable of the RWEC-RI will be spaced, where practical, a minimum spacing of 164 ft (50 m) apart; spacing between each cable will be less where the RWEC-RI comes ashore at the landfall location (e.g., approximately 23-49 ft [7-15 m]). Each cable of the RWEC-RI will consist of three bundled copper or aluminum conductor cores surrounded by layers of cross-linked polyethylene ("XPLE") insulation and various protective armoring and sheathing

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to protect the cable from external damage and keep it watertight. Several fiber optic cables will also be included in the interstitial space between the three conductors for continuous monitoring of the wind farm. The maximum design scenario for the RWEC is provided in Table 2.1-1.

Table 2.1-1 RWEC-RI Maximum Design Scenario

Export Cable Characteristics	Maximum Design Scenario
Number of Cables	2
Voltage per Cable	275 kV
Cable Diameter	11.8 in (300 mm)
Target Burial Depth (below seabed)	4 to 6 ft (1.2 to 1.8 m)[1]
Maximum Disturbance Depth	10 ft (3 m)[2]
Corridor Length (RI state waters)	23 mi (37 km)
Disturbance Corridor (Total Width per Cable)[3]	up to 131 ft (40 m)
Operational ROW (Total Width)[4]	approximate 1,312 ft (400 m)

1 Burial of the RWEC will typically target a depth of 4 to 6 ft (1.2 to 1.8 m) below seabed. The target burial depth for the RWEC will be determined based on an assessment of seabed conditions, seabed mobility, the risk of interaction with external hazards such as fishing gear and vessel anchors, and a site-specific Cable Burial Risk Assessment ("CBRA").

2 These maximum depths are exceeded for the landfall transition which will be installed using HDD.

3 The disturbance corridor reflects the maximum area that will be subject to seafloor preparation prior to cable installation.

4 An operational ROW for the RWEC will be requested in accordance with 30 CFR § 585.200(b). The two cables of the RWEC will be sited within this corridor. The Project will also seek a license and/or commercial lease of submerged lands for renewable energy development, as appropriate, from CRMC pursuant to CRMC's Enabling Act, R.I. Gen. Laws Section 46-23-1 et seq, and applicable CRMC regulations.

2.2 Construction

The RWEC-RI will be laid and buried using industry standard subsea cable installation and burial methods. Installation techniques will vary by segment of the RWEC-RI. Therefore, there are separate subsections below describing construction of the RWEC-RI at the landfall location and more generally in the offshore environment.

2.2.1 Landfall Construction

After collection of site-specific geotechnical data and discussions with agencies, Revolution Wind concluded that HDD is the preferred method at the Quonset Point landfall location. This involves work on land and in Type 6 and Class SB waters, and avoids disturbance of the intertidal zone, Coastal Beach and Manmade Shoreline by boring underneath these features to install conduit. It is anticipated that from start to completion the HDD operation will take between two and three months to complete. A summary of the HDD operation is as follows:

› **Onshore site preparation and equipment setup**: A workspace will be prepared for HDD equipment mobilization and setup. Prior to construction, erosion and

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sedimentation controls will be established to prevent discharges into Narragansett Bay. Once equipment is in place, the HDDs are proposed to be conducted simultaneously, beginning with the excavation of the onshore entry pits. A temporary sheet pile anchor wall may be installed onshore to provide stability of the HDD rig while conducting drilling activities. If required, this sheet pile anchor wall will be approximately 30 feet long and will be driven to a depth of approximately 20 feet. In addition to the anchor wall, the workspace may also require the installation of other temporary sheet piles to aid in anchoring of the rig and/or to provide soil stabilization of the excavated area.

- **Offshore site preparation and equipment setup**: The marine spread will consist of jack-up barges and support vessels and equipment. Offshore exit pits will be excavated using a backhoe excavator with a bucket or similar. The maximum footprint of the base of each excavation is not expected to exceed 110 feet in length or 30 feet in width. The sides of the excavation will be graded for stability and as such the overall footprint will be larger. The depth of the excavation will be approximately 15 feet but will depend on the seabed elevation at the time of excavation. Excavated material will be temporarily loaded onto a support barge for reuse during backfill. No side-casting of the excavated material will occur. Dewatering effluent from excavated material stored on barges may be decanted into tidal waters after a sufficient settling period. The excavated pits will be temporarily filled with rock bags to prevent natural backfilling during the HDD operation.
- **Pilot bore and casing pipe installation**: A steerable drill bit is advanced along the design alignment for the eventual cable conduit from the onshore entry pits to the offshore exit pits. A casing pipe to house the pilot bore drill bit and string once it exits the seafloor will be driven into the seafloor at an angle close to the pilot bore using a pneumatic hammer. The casing pipe will further be supported by "goal post" steel piles driven into the seabed with a pneumatic hammer. The casing pipe provides a means to collect and process drilling fluids on the deck of a jack-up barge. Fluids will either be processed offshore and reused for drilling operations or collected and stored on the jack-up barge or support barge for proper disposal.
- **Reaming**: The pilot bore is enlarged, often involving more than one back and forth pass, to a diameter that can accept the high-density polyethylene ("HDPE") conduit that will house the landfall cables.
- **Swab pass**: After reaming is completed, the condition of the HDD bore is assessed by completing a "swab pass" through the bore. A slightly smaller diameter barrel or ball reamer is drawn through the fully reamed bore from start to finish in the direction of the anticipated installation (offshore to onshore) while the drill rig torque and thrust/pullback forces are monitored, in order to determine if the bore is ready for the HDPE conduit installation stage.
- **HDPE conduit pullback**: The final stage of conduit installation consists of continuously pulling/installing the fully assembled HDPE conduit from the offshore exit pits to the onshore HDD drill rig.
- **Post installation conduit verification**: Once the HDPE conduit is installed, testing will be completed to verify the condition of the conduit. This will involve pigging of the pipe with a calibration tool encompassing a gauging plate equal to 90 percent of the average

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inner diameter of the HDPE conduit. At the same time the calibration tool ("pig") is advanced through the pipe, a sacrificial messenger rope wire will be installed for cable pull in purposes.

- **Cable pull-in**: Once the HDPE conduit is installed and tested, the rock bags placed within the offshore exit pits will removed to a support barge and cable pull-in will occur from offshore to onshore. Following cable pull-in, concrete mattresses or equivalent protection will be used to protect the HDPE conduit at the exit pits and the exit pits will be backfilled using the material that was excavated.

Figure 2.2-1 depicts the location of the proposed HDD entry and exit pits.

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Figure 2.2-1
HDD Entry and Exit Pits SAV and Benthic Habitat
NORTH KINGSTOWN, RI

Legend
- Proposed HDD Cable
- Entry Pit Area
- Exit Pit Area
- Landfall Work Area
- Shellfish Closure Area GA7-1

Benthic Habitat
- Anthropogenic
- Coarse Sediment
- Mixed-Size Gravel in Muddy Sand
- Mud and Sandy Mud
- SAV Habitat

Service Layer Credits: National Geographic World Map: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
Rhode Island Aerial Photographs (Spring 2021):
Inspire, June 30, 2021. Benthic Habitats in Rhode Island State Waters
Revolution Wind Offshore Wind Farm

Reference system: NAD83 (2011)
Projection: UTM Zone 19N

0 25 50 75 Meters

0 90 180 270 Feet

Original Date: 06/12/2020
Revised Date: 12/09/2020
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During HDD operations, water-based drilling fluids, consisting of a mixture of water and bentonite, and sometimes mixed with polymers are used. Bentonite is a naturally occurring soil clay mineral that meets the National Sanitation Foundation International ("NSF")/ American National Standards Institute ("ANSI")-60 Drinking Water Additive Standards and is used in potable water wells. Soda ash is used to raise the pH of the drilling fluid and can also meet NSF/ANSI-60 Drinking Water Additive Standards. The exact mixture of fluids is typically determined by the contractor based on the inferred sediment characteristic from borings and actual geotechnical materials encountered within the bore. The fluids can be modified based on the performance of the drilling equipment as the drilling process progresses. A typical drilling fluid consists of 95 percent water, 4 percent bentonite and less than one percent polymers.

Controlling and managing drilling fluid flow within the bore is critical to the success of an HDD installation. Installation risks significantly increase when the slurry circulation is not maintained within the HDD bore. While HDD installations carry a risk of an inadvertent drilling fluid return, these risks can be reduced along most of the alignment by providing an appropriate depth of cover so that overlying sediments resist the necessary fluid pressures and by modifying the pump rates as the pilot bore approaches the exit point. A conservative design depth of the proposed profile has been selected to limit the potential for inadvertent returns. Revolution Wind will prepare and implement an HDD Contingency Plan to minimize the potential risks associated with release of drilling fluids.

2.2.2 Offshore Construction

Offshore the RWEC-RI (inclusive of two cables) will be installed within the approximate 1,312-ft (400-m)-wide operational ROW. The total width of the disturbance corridor for installation of the RWEC-RI will be up to 131 feet (40 m) per cable, inclusive of any required sandwave leveling and boulder clearance (see Sandwave Leveling and Boulder Clearance subsection below). Dynamic positioning ("DP") vessels will generally be used for cable burial activities. If anchoring (or a pull ahead anchor) is necessary during cable installation it will occur within an approximate 1,312 ft (400-m) wide ROW. Anchors associated with cable laying vessels will have a maximum penetration depth of 15 ft (4.6 m).

Burial of the RWEC-RI will typically target a depth of 4 to 6 ft (1.2 to 1.8 m) below seabed. The target burial depth for the RWEC will be determined based on an assessment of seabed conditions, seabed mobility, the risk of interaction with external hazards such as fishing gear and vessel anchors, and a site-specific CBRA. Where burial cannot occur, sufficient burial depth cannot be achieved, or protection is required due to cables crossing other cables or pipelines, additional cable protection methods may be used (cable protection is discussed further below). The location of the RWEC-RI and associated cable protection will be provided to NOAA Office of Coast Survey after installation is completed so that they may be marked on nautical charts.

Installation of the RWEC-RI consists of a sequence of events, including pre-lay cable surveys, seabed preparation, cable installation, joint construction, cable installation surveys, and cable protection, as summarized in Table 2.2-1. It is anticipated that construction of the RWEC will be completed within approximately 8 months (not necessarily consecutive months), inclusive

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of the portion in federal waters not subject to this Application. In addition to the summary below the following subsections describe seabed preparation, cable installation methodologies, and cable protection strategies in more detail

Table 2.2-1 Expected Export Cable Construction Sequence

Activity/Action	Construction Summary
Pre-lay Cable Surveys	Prior to installation, geophysical surveys will be performed to check for debris and obstructions that may affect cable installation
Seabed Preparation	Seabed preparation will include required sandwave leveling, boulder clearance and removal of any Out of Service Cables. Boulder clearance trials may be performed prior to wide-scale seabed preparation activities to evaluate efficacy of boulder clearing techniques
Pre-Lay Grapnel Run ("PLGR")	PLGR runs will be undertaken to remove any seabed debris along the export cable route. A specialized vessel will tow a grapnel rig along the centerline of each cable route to recover any debris to the deck for appropriate licensed disposal ashore.
Cable Installation	The offshore cable laying vessel will move along the pre-determined route. Cable laying and burial may occur simultaneously using a lay and bury tool, or the cable may be laid on the seabed and then trenched post-lay. Alternatively, a trench may be pre-cut prior to cable installation. Cable installation and burial trials within the 131-ft (40-m) wide disturbance corridor may be performed prior to main cable installation activities to test equipment.
Joint Construction	Installation of the RWEC-RI will require offshore subsea joints due to the length of the RWEC-RI (up to two per cable planned). The joints will be located within the 131-ft (40-m) wide disturbance corridor. The subsea joint will be protected by marinized housing approximately four times the cross-sectional diameter of the cable. The joint housing will be protected using similar methods to those described below for Cable Protection. In case of repair due to damage additional joints may be required during construction.
Cable Installation Surveys	Cable installation surveys will be required, including pre- and post-installation surveys, to determine the cable burial depth. Depending on the instruments selected, type of survey, length of cable, etc. the survey will be completed by equipment mounted to a vessel and/or remote operated vehicle.
Cable Protection	Cable protection in the form of rock berms, rock bags and/or mattresses will be installed as determined necessary by the site-specific CBRA. Cable protection will be installed from an anchored or DP support vessel that will place the protection material over the designated area(s).

2.2.2.1 Sandwave Leveling and Boulder Clearance

Prior to installation of the RWEC-RI, seabed preparation activities including sandwave leveling and boulder clearance will be required. As noted above, any required sandwave leveling and boulder clearance will occur within the 131-ft (40-m) -wide disturbance corridor for each cable of the RWEC-RI.

Based on collected geophysical data, Revolution Wind estimates up to 7% of each cable route of the RWEC-RI will require sandwave leveling before the cables can be installed. This is a conservative estimate as it assumes that all seabed features along the route are mobile; the actual number will be refined following the results of the geophysical surveys and additional sediment mobility studies. Sandwave leveling is typically completed for the following reasons:

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- Many of the cable installation tools proposed require a relatively flat seabed surface to ensure operational criteria (pitch and roll) of the tools are not exceeded.
- Sandwaves are generally mobile in nature, therefore, the export cables must be buried in a manner to prevent cable exposure over time. In areas where larger sandwaves exist, this is achieved by removing a portion of the mobile features before installation takes place.

Sandwave leveling and/or deeper cable burial may require use of a Trailing Suction Hopper Dredger ("TSHD") or Controlled Flow Excavation ("CFE"). Any sediment removed will be relocated within the local area.

- TSHD is mainly used for excavating loose and soft soils such as sand, gravel, silt or clay. One or two suction tubes, equipped with a drag head, are lowered on the seabed, and the drag head is trailed over the bottom to excavate a trench. This method is typically used for sandwave leveling.
- CFE is a non-contact methodology. The jetting tool draws in seawater from the sides and then jets this water out at a specified pressure and volume. The tool can be positioned over the sandwaves to level the seabed.

Boulder clearance may be required to relocate boulders within the RWEC-RI route. Revolution Wind assumes up to 70% of each cable route of the RWEC-RI will require boulder clearance. The following two techniques may be used to complete boulder clearance during installation of the RWEC-RI. Boulder clearance will occur prior to installation and will be completed by a support vessel based on pre-construction surveys.

- **Boulder Grab**: A grab is lowered to seabed, over the targeted boulder. Once "grabbed", the boulder is relocated away from the RWEC route.
- **Boulder Plow**: Boulder clearance is completed by a high-bollard pull vessel, with a towed plow generally forming an extended V-shaped configuration, splaying from the rear of the main chassis. The V-shaped configuration displaces any boulders to the extremities of the plow, thus establishing a clear corridor. Multiple passes may be required.

Prior to wide-scale seabed preparation activities, boulder clearance trials may occur within cable corridors to test that the equipment is working properly and is appropriate for the seabed conditions. Each trial would include the deployment and towing of boulder clearing equipment and/or use of boulder grab tool; each trial would be approximately 0.62 mi (1 km, 0.53 nm) in length. It is anticipated that approximately 5 to 10 trials may be necessary in different areas. The trials may also include pre- and post-trial geophysical survey work potentially utilizing a remotely operated vehicle and bathymetric survey equipment. Because trials will occur within cable corridors, the temporary seabed disturbance from these trials is accounted for in estimates provided in Table 2.2-2. Later in this document disturbance of 730 acres of seafloor during cable installation is classified as short-term disturbance and the 22 acres of cable protection is considered long-term because the protection may convert a soft-bottom seafloor to a hardened concrete or rock substrate that will support different infauna.

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Table 2.2-2 Maximum Seabed Disturbance for RWEC-RI Installation[1]

RWEC-RI Disturbance	Construction Footprint	Operation Footprint
General Disturbance Corridor[2]	730 ac (295 ha)	-
Boulder Clearance (70% of route for each cable)	511.3 ac (206.9 ha)	-
Sandwave Leveling/Dredging (7% of route for each cable) [3]	51.1 ac (20.7 ha)	-
Secondary Cable Protection (10% of route for each cable)	-	22.0 ac (8.9 ha)

1 Disturbance estimates presented in this table are not additive as disturbance types may overlap (e.g., cable protection placed in areas where boulders were cleared). Vessel anchoring disturbances are not included; if anchoring (or a pull ahead anchor) is necessary during cable installation it will occur within a 1,312 ft (400 m) wide ROW.

2 The general disturbance corridor for the RWEC–RI is 131-ft (40-m)-wide. Boulder clearance, sandwave leveling, excavation, and secondary cable protection will not extend beyond this corridor. Also, if they are performed along the RWEC-RI, boulder clearance and cable installation/burial trials will occur within this general disturbance corridor.

3 Accounts for use of CFE and/or TSHD.

2.2.2.2 Offshore Export Cable Installation Methodology

Revolution Wind (Fugro 2020) has completed geophysical and geotechnical ("G&G") surveys of the RWEC-RI corridor to inform cable routing and selection of the most appropriate tools for installation of the RWEC-RI. Based on these G&G surveys and Revolution Wind's understanding of site-specific conditions between the landfall and the RWEC-RI, Revolution Wind will use the following burial tools as the primary installation methodologies.

- **Jet-Plow:** This technique involves the use of water jets to fluidize the soil temporarily opening a channel to enable the cable to be lowered under its own weight or be pushed to the bottom of the trench via a cable depressor. The cable is either installed simultaneously to cable installation operations or after the cable has been laid on the seabed. Typical types of jet-plows include towed jet sleds, tracked jet-trencher, or vertical injectors. Backfill of the trench is expected to occur naturally shortly after installation due to settlement of fluidized sediments and/or trench collapse. Immediately after installation a depression will likely be visible on the seabed as well as tracks/skids from the installation equipment; however, over time this will backfill to the original seabed level. No permanent seabed impacts are associated with this installation methodology.
- **Mechanical Plowing:** There are three types of mechanical plowing used for cable installation:
  - Simultaneous lay and bury involves pulling a plow along the cable route to simultaneously lay and bury the cable. The plow's share cuts into the soil, opening a temporary trench which is held open by the side walls of the share, while the cable is lowered to the base of the trench via a depressor. This narrow trench infills itself behind the tool, primarily by collapse of the trench walls and/or by natural infill, usually over a relatively brief period. Some plows may use additional jets to fluidize

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the soil in front of the share. The plow pulling force is either provided by bollard pull (moving vessel) or winches (anchored vessel). Backfill of the trench is expected shortly after installation due to trench collapse. Immediately after installation a trench will likely be visible on the seabed as well as tracks/skids from the installation equipment; however, over time this will restore to the original seabed level. No permanent seabed impacts are associated with this installation methodology.

- Pre-cut plowing involves pre-cutting a trench in advance of the cable installation operations. Following cable installation, the trench is backfilled naturally and/or via an additional pass using the displaced material to provide sufficient protection to the cable. Trenching may require multiple passes. Pre-cut plowing is suitable to a range of soil conditions and is usually preferred over simultaneous lay and bury plowing when localized challenging ground conditions are expected (i.e., very hard soils and/or where subsurface boulder risk is high). Given that the tool is commonly used to target challenging ground conditions (i.e., very hard soils and/or where subsurface boulder risk is high), the disturbed area created by the plow is not expected to recover quickly. The volume of disturbed material is calculated from the cross-sectional area of the trench along its length; the disturbed area also includes the temporary berms created on the seabed. Temporary seabed impacts include the total area of the skids in contact with the seabed, the trench itself, and spoil on the sides of the trench.

› **Mechanical Cutters** employ either a cutting wheel or an excavation chain to cut a narrow trench into the seabed allowing the cable to sink under its own weight or be pushed to the bottom of the trench via a cable depressor. This installation methodology is typically used for post lay burial operations. Seabed disturbance associated with mechanical cutting is less than that associated with pre-cut plowing, as described above.

Prior to the main cable installation activities, cable installation and burial trials may occur within the 131-ft (40-m) wide disturbance corridor to test the equipment is working properly and is appropriate for the seabed conditions. Each trial includes operating the installation equipment within a portion of the cable corridor, offset from the cable centerline, and may also include installing a proportion of cable. It is anticipated that approximately 5-10 trials may be necessary to test the various pieces of equipment. The trial cable would be recovered towards the end of the cable installation process.

The final G&G survey data is being used to complete final cable route engineering. The purpose of the final cable routing process is to avoid, where possible, features along the route which have the potential to impact cable installation. In the event that features cannot be avoided (such as boulder fields), Revolution Wind will plan appropriate mitigation measures to manage the risks. In addition to final cable routing, the Revolution Wind will complete a site-specific CBRA in which the site conditions will be described in detail, identifying features such as boulder distribution and dimensions, sandwave height and mobility, soil strength and classification, seabed obstructions and unexploded ordinance ("UXO") and Munitions and Explosives of Concern ("MEC"). (see Preliminary Cable Burial Feasibility Assessment in Appendix F, which is provided under confidential cover because it contains confidential commercial information not subject to disclosure under Access to Public Records Act ("APRA"; RIGL § 38-2-1) or Freedom of Information Act ("FOIA"; 5 U.S.C. §

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552)). Final cable route engineering and a final CBRA will be included in the Facility Design Report ("FDR") and Fabrication and Installation Report ("FIR"), to be reviewed by the CVA and submitted to BOEM and CRMC prior to construction.

2.2.2.3 MEC/UXO Risk Mitigation

Prior to seafloor preparation, cable routing, and micrositing of all assets, Revolution Wind will implement a MEC/UXO Risk Assessment with Risk Mitigation Strategy ("RARMS") designed to evaluate and reduce risk in accordance with the As Low As Reasonably Practicable ("ALARP") risk mitigation principle. The RARMS consists of a phased process beginning with a Desktop Study and Risk Assessment that identifies potential sources of MEC/UXO hazard based on charted MEC/UXO locations and historical activities, assesses the baseline (pre-mitigation) risk that MEC/UXO pose to the Project, and recommends a strategy to mitigate that risk to ALARP.

Avoidance is the preferred approach for MEC/UXO mitigation; however, it is anticipated that there may be instances where confirmed MEC/UXO avoidance is not possible due to layout restrictions, presence of archaeological resources, or other factors that preclude micrositing. In such situations, confirmed MEC/UXO may be removed through in-situ disposal or physical relocation. Selection of a removal method will depend on the location, size, and condition of the confirmed MEC/UXO, and will be made in consultation with a MEC/UXO specialist and in coordination with the appropriate agencies.

In-situ disposal will be done with low noise methods like deflagration of the MEC/UXO or cutting the MEC/UXO to extract the explosive components. The MEC/UXO might also be relocated through a "Lift and Shift" operation. The relocation would be to another suitable location on the seabed within the RWEC-RI corridor or previously designated disposal areas for either wet storage or disposal through low noise methods as described for in situ disposal. For all MEC/UXO clearance methods, safety measures such as the use of guard vessels, enforcement of safety zones, and others will be identified in consultation with a UXO/MEC specialist and the appropriate agencies and implemented as appropriate.

2.2.2.4 Secondary Cable Protection

Secondary cable protection may be applied where burial cannot occur, sufficient burial depth cannot be achieved due to seabed conditions, or to avoid risk of interaction with external hazards. The need for secondary cable protection in specific locations will be based on the site-specific CBRA. Revolution Wind assumes that 10 percent of the route for each cable comprising the RWEC-RI will require secondary cable protection. The area of impact for secondary cable protection is accounted for in Table 2.2-2. It is assumed that secondary cable protection will measure up to 39 feet (12 meter) wide.

One or more of the following cable protection solutions may be used for secondary cable protection. Cable protection solutions implemented will be of the type that minimizes the potential for gear snags, as feasible, and can include the following:

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- Rock berm involves dumping or placing rock overtop of a cable.
- Concrete mattresses are composed of cast concrete blocks interlinked to form a flexible, articulated mat, which can be placed on the seabed over a cable.
- Fronded mattresses are concrete mattress with 'fronds' that are designed to slow down current and naturally allow sediment to deposit and form a bank over the mattress.
- Rock bags are rock-filled mesh bags placed over the cable.

As noted previously, the location of the RWEC and associated cable protection will be provided to NOAA's Office of Coast Survey after installation is completed so that they may be marked on nautical charts.

2.2.2.5 Cable Crossings

The RWEC-RI crosses existing submarine assets. There are seven potential existing assets that have been identified to-date along the RWEC-RI, some of which are in close proximity to each other (see Revolution Wind RWEC Design plans in Appendix A). Their asset status is unknown at this stage and will require further investigation and engineering assessment for determining their status which will be identified in the FDR/FIR.

Cable protection at these crossings will be applied for both In-Service assets as well as Out-of-Service assets that cannot be safely removed and pose a risk to the RWEC-RI. Rock berm, rock bag or concrete mattress separation layers will be installed prior to cable installation, while the rock berm, rock bag or concrete mattress cover layers will be installed after cable installation. Any rock berm separation and cover layers and will be installed using suitably approved rock material. The rock berm separation and cover layers are defined by minimum geometry and vertical and horizontal tolerances. The amount of cable protection will be as required for suitable coverage and technical agreements with respective asset owners. It is assumed that up to 1,640 feet (500 m) of cable protection will be required per crossing. The cable protection required for cable crossings is in addition to the secondary cable protection requirements previously described above.

Final crossing designs will be completed in coordination with asset owners and formalized in crossing and proximity agreements, in line with International Cable Protection Committee recommendations.

The total area of seafloor hardening with cable protection and utility crossings is estimated to be 22 acres (refer to Table 2.2-2).

2.3 Operations and Maintenance

The RWEC-RI typically does not have routine maintenance requirements, unless a fault or failure occurs. To evaluate integrity of the assets, Revolution Wind intends to conduct an as-built survey/bathymetry survey along the entirety of the cable routes immediately following installation (scope of installation contractor). Bathymetry surveys will be performed one year after commissioning, two to three years after commissioning, and five to eight years after commissioning. Survey frequency thereafter will depend on the findings of the initial surveys

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(i.e., site seabed dynamics and soil conditions). A survey may also be conducted after a major storm event (i.e., greater than 10-year event).

It is possible submarine cables may need to be repaired or replaced due to fault or failure. Also, it is expected that a maximum of 10 percent of the cable protection placed during installation may require replacement/remediation over the lifetime of the Project. These maintenance activities are considered non-routine. If cable repair/replacement or remedial cable protection are required, the Project will obtain necessary approvals. These activities will result in a short-term disturbance of the seabed similar to or less than what is anticipated during construction; these activities will be limited to the disturbance corridors previously defined for construction of the RWEC-RI.

2.4 Decommissioning

At the end of the Project's operational life, it will be decommissioned in accordance with a detailed Project decommissioning plan that will be developed in compliance with applicable laws, regulations, and Best Management Practices ("BMPs") at that time. BOEM regulations require removal of all facilities to a depth of 15 ft (4.6 m) below the mudline, unless otherwise authorized by BOEM (30 CFR § 585.910(a)). Care will be taken to handle waste in a hierarchy that prefers re-use or recycling, and leaves waste disposal as the last option. Absent permission from BOEM, Revolution Wind will complete decommissioning within two years of termination of the Project's lease.

Revolution Wind will develop a final decommissioning and removal plan for the Project that complies with all relevant permitting requirements. This plan will account for changing circumstances during the operational phase of the Project and will reflect new discoveries particularly in the areas of marine environment, technological change, and any relevant amended legislation.

2.5 Environmental Compliance, Protective Measures, and Monitoring

Prior to the commencement of construction, operation, and decommissioning activities, a facility-specific environmental compliance manual will be prepared for the Project outlining specific construction and operating obligations. This manual, in conjunction with an Emergency Response Plan for the construction and operation of the Project, will ensure that no adverse impacts on public services in area communities result throughout the Project life cycle. The following subsections describe best management practices, applicant-proposed environmental protection measures, and monitoring that Revolution Wind is committed to implementing.

2.5.1 Best Management Practices

Best management practices are structural or non−structural measures, practices, techniques or devices employed to avoid or minimize impact to sensitive resources. This section describes BMPs the Revolution Wind will employ during construction and include:

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- Time of Year ("TOY") restrictions
- Chemical and Waste Management

2.5.1.1 Time of Year Restrictions

Revolution Wind has coordinated with RIDEM and NOAA NMFS regarding time of year TOY restrictions in state waters. Based on the coordination conducted to-date, in general, offshore site preparation for and installation of the RWEC-RI north of the Convention on the International Regulations for Preventing Collisions at Sea ("COLREGS") line of demarcation will occur between the day after Labor Day and February 1 to avoid and minimize impacts to winter flounder (*Pseudopleuronectes americanus*) and shellfish. Revolution Wind will continue to coordinate with RIDEM and NOAA NMFS regarding TOY restrictions through the permitting process and will adhere to requirements imposed by these agencies.

2.5.1.2 Chemical and Waste Management

During construction, all chemicals needed for maintenance and operation of equipment will be brought to site aboard vessels and be transported in manufacturer's original packaging or in National Transportation Safety Council ("NTSC") approved tote containers. It is anticipated that any chemicals to be stored on site will be integral with associated equipment and will not be transported independently from this equipment.

During construction, chemicals transfers may take place daily depending on operational requirements of the various contractors. Chemical transfers will be executed in accordance with industry best practices considering health, safety, and environment, and will be in compliance with local, state, and federal regulations. Chemical transfer volumes will be determined by operational requirements of the various contractors, and will be in compliance with all local, state, and federal regulations.

Any chemicals to be treated or disposed of will be transported to typical onshore waste receiving sites within the area that conform to safe and environmentally friendly methods in accordance with local, state, and federal regulations. Revolution Wind will also implement an Emergency Response Plan/Oil Spill Response Plan ("ERP/OSRP") (see Appendix G).

Revolution Wind will meet applicable regulations and standards, as set by the International Maritime Organization's ("IMO") International Convention for the Prevention of Pollution from Ships ("MARPOL"), the USCG, and the State of Rhode Island, for treatment and disposal of solid and liquid wastes generated during all phases of the Project.

2.5.2 Proposed Avoidance, Minimization, and Mitigation Measures

The Project was sited, planned, and designed to avoid and minimize impacts. To the extent there are potential adverse impacts that cannot be avoided, these will be mitigated. Potential impacts to resources from the RWEC-RI are expected to be limited temporally and/or spatially. Table 2.5-1 below outlines the protective measures and modifications that have been incorporated into the Project to avoid or minimize environmental impacts.

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Table 2.5-1 RWEC-RI Avoidance, Minimization, and Mitigation Measures for Natural, Socioeconomic, Cultural, and Visual Resources

Project Phase	Avoidance, Minimization, and Mitigation Measures: Natural Resources
Design	› To the extent feasible, the RWEC-RI will typically target a burial depth of 4 to 6 ft (1.2 to 1.8 m) below seabed. The target burial depth will be determined based on an assessment of seabed conditions, seabed mobility, the risk of interaction with external hazards such as fishing gear and vessel anchors, and a site-specific CBRA. › The RWEC-RI will be sited to avoid and minimize impacts to sensitive habitats (e.g., hard bottom habitats) to the extent practicable. › Revolution Wind is committed to collaborative science with the commercial and recreational fishing industries pre-, during, and post-construction. Fisheries monitoring studies are being planned to assess the impacts associated with the Project on economically and ecologically important fisheries resources. These studies will be conducted in collaboration with the local fishing industry and will build upon monitoring efforts being conducted by affiliates of Revolution Wind at other wind farms in the region. › A preconstruction submerged aquatic vegetation ("SAV") survey will be completed to identify any new or expanded SAV beds. The Project design will be refined to avoid impacts to SAV to the extent practicable. › The RWEC-RI will be sited to avoid or minimize impacts to potential submerged cultural sites and paleo landforms, to the extent practicable. › Native American Tribal representatives were involved, and will continue to be involved, in marine survey protocol design, execution of the surveys, and interpretation of the results. › RWEC-RI was sited to avoid conflicts with DoD use areas and navigational areas identified by the USCG, as applicable. › Communications and outreach with the commercial and recreational fishing industries will be guided by the Project-specific Fisheries Communication Plan.
Construction	› To the extent feasible, installation of the RWEC-RI will occur using equipment such as mechanical cutter, mechanical plow, or jet plow. › Revolution Wind is committed to collaborative science with the commercial and recreational fishing industries pre-, during, and post-construction. Fisheries monitoring studies are being planned to assess the impacts associated with the Project on economically and ecologically important fisheries resources. These studies will be conducted in collaboration with the local fishing industry and will build upon monitoring efforts being conducted by affiliates of Revolution Wind at other wind farms in the region. › RWEC-RI will avoid identified shallow hazards to the extent practicable. › Exclusion and monitoring zones for marine mammals and sea turtles will be established for impact and pneumatic hammering and vibratory pile driving activities. › A ramp-up or soft-start will be used at the beginning of each pile segment during pile driving to provide additional protection to mobile species in the vicinity by allowing them to vacate the area prior to the commencement of pile driving activities.

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- Environmental protection measures will be implemented for pile driving activities. These measures will include seasonal restrictions, soft-start measures, shut-down procedures, marine mammal and sea turtle monitoring protocols, the use of qualified and NOAA-approved protected species observers, and noise attenuation systems such as bubble curtains, as appropriate.
- Vessels:
  - Vessels will follow NOAA and BOEM guidelines for marine mammal and sea turtle strike avoidance measures, including vessel speed restrictions.
  - All personnel working offshore will receive training on marine mammal and sea turtle awareness and marine debris awareness.
  - Revolution Wind will require all construction and operations vessels to comply with regulatory requirements related to the prevention and control of spills and discharges.
  - Accidental spill or release of oils or other hazardous materials offshore will be managed through the Oil Spill Response Plan.
  - DP vessels will be used for installation of the RWEC-RI to the extent possible.
  - A plan for vessels will be developed prior to construction to identify no-anchorage areas to avoid documented sensitive resources.
  - All vessels will comply with USCG and EPA regulations that require operators to develop waste management plans, post informational placards, manifest trash sent to shore, and use special precautions such as covering outside trash bins to prevent accidental loss of solid materials. Vessels will also comply with BOEM lease stipulations that require adherence to NTL 2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of placards at prominent locations on offshore vessels and structures, and mandates a yearly marine trash and debris awareness training and certification process.
- HDD drilling fluids will be managed within a contained system following punch out of the pilot drilling to be collected for reuse as necessary. An HDD Contingency Plan will be prepared and implemented to minimize the potential risks associated with release of drilling fluids.
- Communications and outreach with the commercial and recreational fishing industries will be guided by the Project-specific Fisheries Communication Plan.
- A plan for vessels will be developed prior to construction to identify no-anchorage areas to avoid documented sensitive resources.
- Revolution Wind will consult with USCG, the U.S. Navy Undersea Warfare Command ("NUWC") Newport RI, Northeast Marine Pilots Association and regional ferry service operators to avoid or reduce use conflicts.
- Project construction and O&M activities will be coordinated with appropriate contacts at USCG, the NUWC Newport, and the Northeast Marine Pilots.
- A comprehensive communication plan will be implemented during offshore construction to inform all mariners, including commercial and recreational fishermen, and recreational boaters of construction activities and vessel

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	movements. Communication will be facilitated through a Fisheries Liaison, Project website, and public notices to mariners (in coordination with USCG). › As appropriate and feasible, BMPs will be implemented to minimize impacts on fisheries, as described in the Guidelines for Providing Information on Fisheries Social and Economic Conditions for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585 (BOEM, 2015).
Post-Construction	› Revolution Wind is committed to collaborative science with the commercial and recreational fishing industries pre-, during, and post-construction. Fisheries monitoring studies are being planned to assess the impacts associated with the Project on economically and ecologically important fisheries resources. These studies will be conducted in collaboration with the local fishing industry and will build upon monitoring efforts being conducted by affiliates of Revolution Wind at other wind farms in the region. › Communications and outreach with the commercial and recreational fishing industries will be guided by the Project-specific Fisheries Communication Plan. › Project construction and O&M activities will be coordinated with appropriate contacts at USCG, NUWC Newport, and the Northeast Marine Pilots.

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2.5.3 Monitoring

2.5.3.1 Environmental Compliance Monitoring

Revolution Wind will use an aquatic environmental monitor ("AEM") throughout the entire offshore construction process in RI state waters. The primary responsibility of the AEM will be to confirm compliance with federal, state, and local environmental permit requirements, environmental regulations, and Project environmental policies and procedures while working in Rhode Island state waters. The AEM will inspect and monitor offshore construction activities and areas to determine that the environmental controls are functioning properly and to make recommendations for corrective actions and/or maintenance, as necessary. The AEM will ensure completion of any required WQ monitoring and sampling, environmental inspections, environmental forms/checklists, and have knowledge of TSS monitoring/sampling techniques, seabed cable installation methodologies, jet trenching tools and operation, pre-lay grapnel runs, in-water HDD installations, and reporting requirements for regulatory agencies. The AEM will also be responsible for providing direction to the other members of the offshore construction crew regarding environmental compliance conditions and BMPs and ensure compliance documents are logged and tracked on the Compliance Management Software Tool. Additionally, all offshore construction personnel will be briefed on Project environmental issues and obligations prior to the start of construction. Regular construction progress meetings will reinforce the contractor's awareness of these issues.

2.5.3.2 Bathymetry/Cable Burial Surveys

To evaluate integrity of the assets, Revolution Wind intends to conduct an as-built multi-beam survey along the entirety of the cable routes within state waters following installation and the placement of any secondary cable protection. Bathymetry surveys will also be performed one year after commissioning, two to three years after commissioning, and five to eight years after commissioning. Survey frequency thereafter will depend on the findings of the initial surveys (i.e., site seabed dynamics and soil conditions). A survey may also be conducted after a major storm event (i.e., greater than 10-year event). Surveys of the cables may be conducted in coordination with scour surveys at the foundations. Should the periodic bathymetry surveys indicate that a portion or portions of the cables no longer meet an acceptable burial depth (as determined by the site-specific CBRA), the following actions may be taken:

- Alert the necessary regulatory authorities, as appropriate;
- Undertake an updated cable burial risk assessment to establish whether cable is at risk from external threats (i.e., anchors, fishing, dredging);
- Survey monitoring campaign for the specific zone around the shallow buried cable; and
- Assess the risk to cable integrity.

Based on the outcome of these assessments, several options may be undertaken, as feasible, permitted, and practical:

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- Remedial burial if feasible and practical;
- Secondary protection (rock protection, rock bags or mattresses); and/or
- Increased frequency of bathymetry surveys to assess reburial.

2.5.3.3 Fisheries and Benthic Habitat Monitoring

As outlined in Table 2.5-1, Revolution Wind is committed to collaborative science with the commercial and recreational fishing industries pre-, during, and post-construction. Fisheries and benthic monitoring studies are being planned to assess the potential impacts associated with the Project on economically and ecologically important fisheries resources. These studies will be conducted in collaboration with the local fishing industry and will build upon monitoring efforts being conducted by affiliates of Revolution Wind at other wind farms in the region. In addition, Revolution Wind is collaborating with RIDEM Division of Marine Fisheries for monitoring within state waters.

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3

Affected Environment, Potential Impacts, and Proposed Avoidance, Minimization, and Mitigation

This section describes the offshore affected environment within RIDEM jurisdiction; potential impacts associated construction, operations and maintenance, and decommissioning of Project components applicable to this Application; and proposed avoidance, minimization, and mitigation measures to address these potential impacts. Generally, decommissioning impacts are commensurate with construction phase impacts and are therefore discussed together. These discussions address the entire length of the RWEC-RI because it is subject to review and authorization under the Water Quality Regulations (250-RICR-150-05-1). However, it is important to note that the only portion of the Project that is subject to the Rules and Regulations for Dredging and the Management of Dredged Materials (250-RICR-150-05-2) are the two HDD exit pits.

The Project was sited, planned, and designed to avoid and minimize impacts. To the extent there are potential adverse impacts that cannot be avoided, these will be mitigated. All proposed avoidance, minimization, and mitigation measures proposed for the Project are in Table 2.5-1 in Section 2.5.2. Potential impacts to resources from the RWEC-RI are expected to be limited temporally and/or spatially. Post-construction environmental monitoring of various resources will take place and will include, at a minimum, coordination and data sharing with regional monitoring efforts. Monitoring plans will also be developed in coordination with the relevant agencies prior to construction.

The RWEC-RI Project Area is variable, with it being approximately 10,500-ft (3,200-m) at its widest point and approximately 1,300-ft (396 m) at its narrowest. See Figure 1.2-1 in Section 1.2. Summaries from the following technical studies and reports that have been prepared for the Project are included in the following applicable subsections:

- Technical Report Hydrodynamic and Sediment Transport Modeling Report – Rhode Island State Waters (RPS, 2021) (Appendix H).
- RWEC-RI Benthic Habitat Maps and Report (INSPIRE, 2021a) (Appendix C).
- Essential Fish Habitat Assessment Revolution Wind Offshore Wind Farm (INSPIRE, 2020) (Appendix D).

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- Assessment of Impacts to Marine Mammals, Sea Turtles, and ESA-Listed Fish Species Revolution Wind Farm (CSA, 2021) (Appendix E).
- Commercial and Recreational Fisheries Technical Report Revolution Wind Offshore Wind Farm (INSPIRE, 2021b) (Appendix I).

3.1 Surficial Geology

3.1.1 Affected Environment

The surficial geology within portions of the Narragansett Bay and RWEC-RI Project Area has been previously described by J. King Consulting, LLC (King, undated), prepared by analyzing published work by Needell et al. (1983), McMaster (1984), Oakley (2012), and by re-analyzing open file data from these surveys (McMullen et al. 2009). More recent data are also available from a multiyear seismic reflection survey conducted by the University of Rhode Island ("URI") between 2004 and 2008. Finally, the entire RWEC-RI Project Area was evaluated by Fugro in their G&G Report (Fugro, 2020). The site-specific data collected by Fugro during 2019/2020 surveys are being used to identify potential geologic and anthropogenic hazards that could affect the design, installation, and operation of the RWEC-RI, as well as other offshore components of the Project.

3.1.1.1 General Characterization of Surficial Geology in Narragansett Bay

King (undated) defined an obstruction as a bedrock outcropping, shallow bedrock less than 16 ft (5 m) below the seafloor or sediment containing boulders. The West Passage of Narragansett Bay includes several islands that are bedrock cored along with bouldery glacial till and moraine deposits. This report identified three sub-areas along the RWEC–RI which are further characterized in the following subsections and depicted in Figure 3.1-1:

- Rhode Island Sound and Lower West Passage sub-area
- Middle West Passage sub-area
- Upper West Passage sub-area

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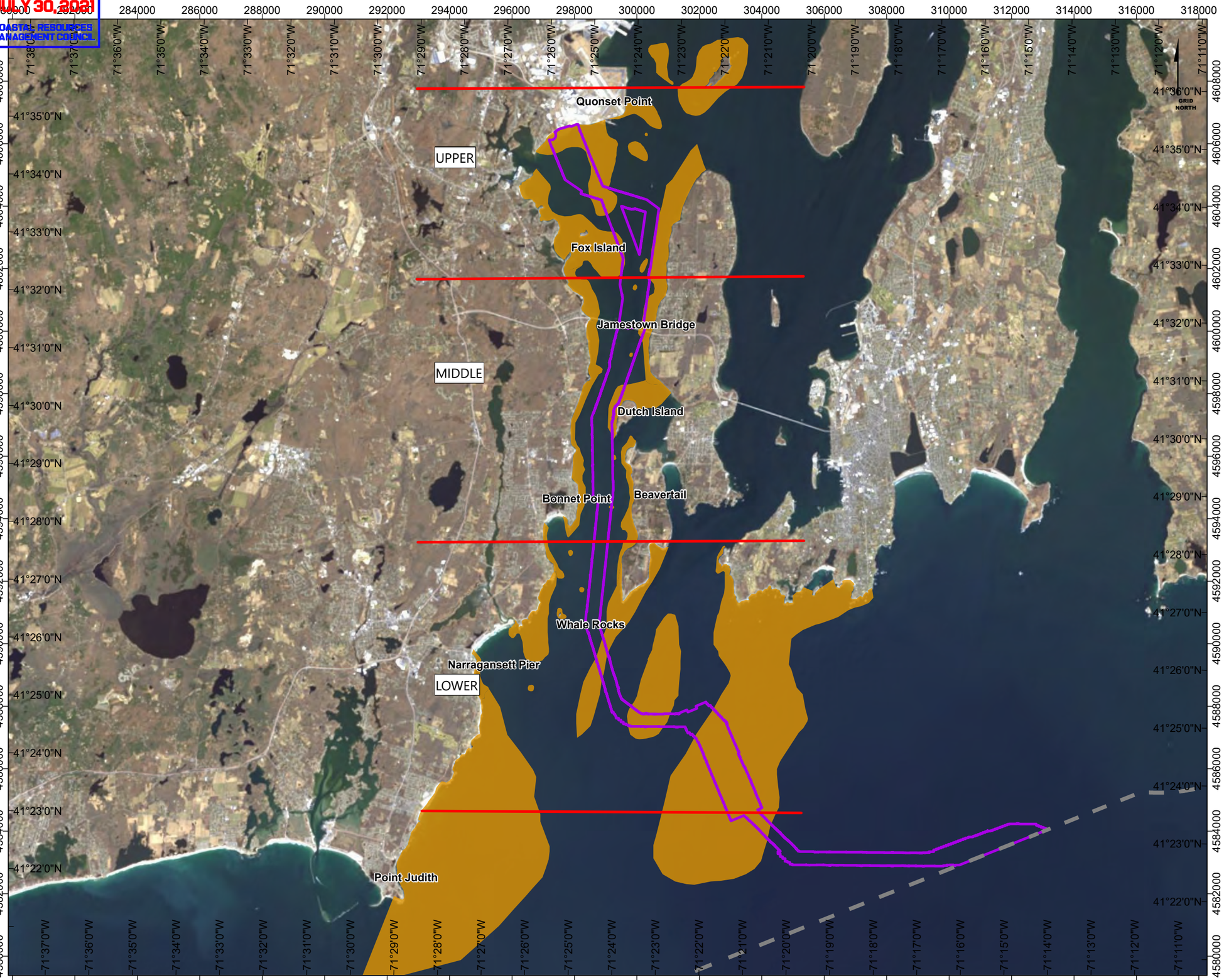
Revolution Wind
Figure 3.1-1
RWEC-RI Geologic Hazards



Legend
- RWEC-RI Project Area
- Geological Obstructions (King)
- 3-Nautical Mile State Water Boundary

Service Layer Credits: Landsat 8 Imagery: Bathymetric with DRA: National Geographic World Map: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
World_Ocean_Base: Esri, DeLorme, NaturalVue

Reference system: NAD83 (2011)
Projection: UTM Zone 19N

0 1000 2000 3000 Meters

0 3,000 6,000 9,000 Feet

Date: 05/19/2020
Document no:

Created by: S. PELLETIER
Checked by: S. MOBERG
Approved by: STEPW

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Rhode Island Sound and Lower West Passage Sub-Area

This sub-area begins in Rhode Island Sound and continues north to Beavertail on Conanicut Island (Jamestown). Shallow bedrock was encountered in several areas in this sub-area including submerged continuations of Aquidneck and Conanicut Islands that extend several miles (km) south from their coastlines.

King (undated) reports that this bedrock is the same suite associated with the islands, a late Paleozoic meta-sedimentary rock rich in carbon. Boulder fields and bedrock outcrops extend offshore from Point Judith to Narragansett Pier. Part of this boulder field is associated with the Point Judith and Buzzards Bay recessional moraines. This report cautions that seismic reflections from this boulder field end about 0.9 miles (1.5 km) from the shoreline, but NOAA charts indicate that this obstruction is continuous to the shore as shown in Figure 3.1-1.

Other obstructions in this sub-area include named features such as Whale Rock, Jones Ledge and River Ledge. These all represent outcropping bedrock or rocky seafloor conditions.

Middle West Passage Sub-Area

This sub-area begins near Bonnet Point and continues north to the Jamestown Verrazano Bridge (Jamestown Bridge). King (undated) used Compressed High Impact Radar Pulse ("CHIRP") seismic reflection data collected by URI to evaluate obstructions in this area. This reach of the West Passage is described as mostly unobstructed. Shallow depths to bedrock are reported along the western coastline of Conanicut Island and the rocky shorelines of Narragansett, Saunderstown and North Kingstown. Borings completed in 1979 for the Jamestown Bridge indicated 16 ft (5 m) and 33 ft (10 m) of sediment over bedrock along the eastern third of the bridge approaching Jamestown. The area around Dutch Island, including Dutch Harbor contains bouldery till or shallow bedrock.

Oakley (2012) studied the stratigraphy of Glacial Lake Narragansett and identified two glacial deltaic deposits fed by subglacial flows emerging at the ice front in this area: The Dutch Island Delta west of Dutch Island and the Annaquatucket Delta near the Jamestown Bridge. King (undated) cautioned that seismic reflection data collected from these thick sand and gravel deposits were not sufficient to confirm the absence of obstructions.

Upper West Passage Sub-Area

This sub-area begins north of the Jamestown Bridge and continues north to the landfall location at Quonset Business Park in North Kingstown. The surveys in the sub-area revealed several potential obstructions including shallow bedrock and bouldery till. Seismic data in the vicinity of Fox Island showed the area to be very rocky and that these obstructions were continuous as it approached the mid-point of the West Passage with only a narrow unobstructed corridor. Prominent obstructions are also present on the seafloor south of Quonset Point. Approaching the landfall location, Fugro (2019) identified a line of boulder piles with an 820 ft (250 m) gap where the RWEC–RI will be routed.

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3.1.1.2 Summary of Site-Specific Survey Date

Data collected by Fugro (2020) within the RWEC-RI Project Area is more detailed but generally does not conflict with King's general characterization of surficial geology and obstructions. This site-specific G&G Report is being used to microsite the RWEC-RI cables and avoid potential geological constraints where practicable.

Beginning near the shore, the surficial geology of the seafloor is predominantly comprised of fine-grained sediment in the upper 10 ft (3 m), with potential bedrock and/or glacial till exposed in localized areas. Bedrock/glacial till is exposed in the eastern portion of the Project Area and is interpreted to only be 33 ft (10 m) deep in the western portion.

West Passage of Narragansett Bay

Beginning at the landfall location, the RWEC-RI Project Area crosses an area of limited sediment thickness as it proceeds south. A north-south trending feature described on nautical charts as "ledge" may represent shallow glacial till or rock. Before reaching the Jamestown-Verrazzano Bridge, a prominent flood shoal or bar feature comprised of 10 ft (3 m) of coarse-grained deposits is passed. This bar feature may shift during tidal currents or varying flow conditions in the West Passage river system. As the Jamestown-Verrazzano Bridge is approached, bouldery glacial till deposits are exposed in the eastern portion of the RWEC-RI Project Area and large amounts of debris from the demolition of the former Jamestown-Verrazzano Bridge were observed. The main part of the channel appears to be naturally deep in this area, which is indicative of strong tidal currents.

South of the bridge, the upper 10 ft (3 m) is comprised of very soft to firm fine-grained deposits. The main part of the channel is naturally deep and, based on hydrodynamic studies, is prone to strong ebb and flood tidal currents. Continuing south toward Dutch Island, the naturally deepened channel achieves depths of 33 ft (10 m) to 66 ft (20 m). A prominent bar deposit crosses the channel at a northwest-southeast orientation. This feature may be the result of high ebb and flood tidal currents and is an area with high potential seabed mobility conditions. Glacial till outcrops are present in localized areas along the eastern perimeter of the survey corridor. South of Dutch Island headed to the mouth of the West Passage glacial till deposits were interpreted to be present within 1 to 3 ft (0.3 to1 m) of the seafloor surface. Bedrock may also be present beneath the till surface.

Rhode Island Sound

Within the Rhode Island Sound, the typical stratigraphy consists of approximately 0.5 m thick layer of sand overlying soft to firm clay to Brenton Reef. At Brenton Reef, shallow bedrock is exposed or covered by sediment mantles of ranging from sand to clay texture. Crystalline bedrock outcrops are present that typically extend approximately 3.3 feet (1 m) to 6.5 feet (2 m), but a suitable cable route is available through the reef.

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3.1.2 Potential Project Impacts

3.1.2.1 Construction and Decommissioning

The RWEC-RI installation will require a temporary disturbance corridor of approximately 131 feet (40 m) for 23 miles (37 km) for each cable, which is a total disturbance corridor of approximately 730 acres (295 ha) (see Table 2.2-2). Impacts to geological resources will be limited to the area of the seafloor disturbed during preparation for and installation of the two export cables, which includes boulder clearance, sandwave leveling, cable installation, and installation of secondary cable protection. It is estimated that approximately 22 acres (8.9 ha) of secondary cable protection will be required (approximately 10% for each cable route in state waters).

The RWEC-RI will be installed to a target burial depth of approximately 4 to 6 feet (1.2 to 1.8 m) below the seabed. Installation of the RWEC-RI will mostly affect surficial geology, but not to such an extent that there would be a perceptible change in overall regional geological resources. The RWEC-RI will be installed to avoid shallow hazards using equipment such as a mechanical cutter, mechanical plow, or jet plow to the extent practicable. These installation techniques are not expected to result in any permanent seabed impacts because the trench naturally backfills with the temporarily suspended sediment. The use of a TSHD and/or CFE may be required in certain locations. In addition, DP vessels will be used to the extent possible during installation of the RWEC-RI. DP vessels do not require anchors to maintain their position and therefore avoid additional geological impacts. If DP vessels cannot be used in certain locations, vessels that require anchoring will be used, which will result in temporary seafloor disturbance in isolated locations. “No anchorage areas” will be identified prior to construction to avoid any documented sensitive resources.

In addition, DP vessels will be used to the extent possible during installation of the RWEC-RI. DP vessels do not require anchors to maintain their position and therefore avoid additional geological impacts. If DP vessels cannot be used in certain locations, vessels that require anchoring will be used, which will result in short-term seafloor disturbance. These impacts cannot be quantified at this time, but anchoring will be limited to within the RWEC-RI’s 1,312-ft (400-m) ROW. “No anchorage areas” will also be identified prior to construction to avoid any documented sensitive resources.

Sediment suspension and deposition for seabed preparation activities, installation of the offshore RWEC-RI, and installation of the RWEC-RI at the landfall location have been modeled (see Appendix H). For surficial geology, sediment deposition was evaluated for potential impacts. For the offshore RWEC-RI, deposition was modeled using CFE, TSHD split bottom, TSHD continuous overflow, and jet plow. For the RWEC-RI at the landfall location, it was modeled using HDD. The area where deposition is 10 mm or greater in thickness was predicted to be 453.4 ac (183.5 ha), 481.9 ac (195.0), 48.0 ac (194.3), and 7.4 ac (3.0) for CFE, TSHD split bottom, TSHD continuous flow, and HDD, respectively. The jet plow did not have any predicted depths of 10 mm or greater. The spatial extent of deposition of 10 mm or greater was 688.8 ft (210 m), 1,033.2 ft (315 m), 85.28 ft (260 m) and 738 ft (225 m) for CFE, TSHD split bottom, TSHD continuous flow, and HDD, respectively.

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3.1.2.2 Operations and Maintenance

Once the RWEC–RI is installed, the disturbance corridor will recover as part of processes associated with dynamic marine sediments. The RWEC-RI has no maintenance requirements unless a cable repair is required. Repair or replacement of cables or cable protection are considered non-routine maintenance activities and will potentially result in the same or lesser impacts as construction.

3.1.3 Proposed Avoidance, Minimization, and Mitigation Measures

Environmental protective measures proposed by Revolution Wind are summarized in Section 2.5.2. Below is a list of measures applicable to surficial geology:

- RWEC-RI will be sited to avoid identified shallow hazards to the extent practicable.
- To the extent feasible, installation of the RWEC-RI will occur using equipment such as mechanical cutter, mechanical plow, or jet plow.
- DP vessels will be used for installation of the RWEC to the extent practicable to avoid the need for anchoring.
- A plan for vessels will be developed prior to construction to identify no-anchorage areas to avoid documented sensitive resources.

3.2 Water Quality

3.2.1 Affected Environment

This section includes surface water quality for the RWEC-RI. Several parameters were evaluated, including dissolved oxygen ("DO"), chlorophyll *a*, nutrient content, turbidity, and anthropogenic activities that have in the past or currently impact water quality. The description of the affected environment and assessment of potential impacts for water quality were determined by reviewing public data sources and conducting project-specific studies including the following: Rhode Island Ocean SAMP; Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Continental Shelf Offshore Rhode Island and Massachusetts, Revised Environmental Assessment (RI-MA WEA) (BOEM, 2013); National Coastal Condition Report IV ("NCCR") (US EPA, 2012); Narragansett Bay Commission ("NBC") Snapshot of Upper Narragansett Bay data; State of Narragansett Bay and Its Watershed Technical Report ("NBWTR") (Narragansett Bay Estuary Program ["NBEP"], 2017) and Revolution Wind Integrated Geotechnical and Geophysical Site Characterization Study (Fugro, 2020). Available surface and quality data were also reviewed with available RIGIS data and the RIDEM Water Quality Regulations (RIDEM, 2018a). Most of the RWEC-RI is mapped as SA, which are waters designated for shellfish harvesting for direct human consumption, primary and secondary contact recreational activities, and fish and wildlife habitat. The landfall location is mapped as SB, which are waters designated for primary and secondary contact recreational activities, shellfish harvesting for controlled relay and depuration, and fish and wildlife habitat. Both SA and SB waters have good aesthetic value. See Figure 1.2-1 in Section 1.2.

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3.2.1.1 RWEC Rhode Island Sound

Dissolved Oxygen

DO refers to the concentration of oxygen present in water. The source of the DO may be the atmosphere and from photosynthesis from aquatic plants including phytoplankton. Low levels of oxygen (hypoxia) or no oxygen levels (anoxia) can occur when excess organic material, such as produced during large algal blooms are decomposed by microorganisms (LICAP, 2016). Water sampling conducted at four stations in Rhode Island Sound in 2002 by the USACE found that DO concentrations both at the surface and in bottom waters remained above established levels for the "highest quality marine waters" and suggests that hypoxic and anoxic conditions do not typically occur in those areas (RI CRMC, 2010).

Chlorophyll a

Chlorophyll a is measured as a surrogated to determine concentrations of phytoplankton, which can indicate overproduction of algae and degraded water quality (NCCR, US EPA 2012). For this reason, chlorophyll a is used as a metric of plant production, called "primary production" because of the ability of plants to capture energy from sunlight and is measured in units of grams of carbon per meter squared per day (g C m-2 day-1).

The RI CRMC Ocean SAMP adapted a table (Table 3.2-1) from Hyde (2009) to compare the range of primary production throughout the year for Ocean SAMP waters and nearby ecosystems. Primary production in the Ocean SAMP area is comparable to other coastal systems and is just slightly lower than the value ranges presented for Narragansett Bay and New York Bight. Chlorophyll a sampling at four locations in Rhode Island Sound found concentrations ranging from six to nine µg 1-1 (USACE 2002), which is "consistent with oceanic systems and slightly lower than an average estimate of phytoplankton production on continental shelves (Mann 2000)," (RI CRMC 2010).

Table 3.2-1 Comparison of the Range of Primary Production (g C m-2day-1)

Ecosystem	Production (g C m^{-2} d^{-1})	Reference
Ocean SAMP	143-204	Hyde, 2009
Narragansett Bay	160-619	Oviatt et al., 2002
Massachusetts Bay	160-570	Keller et al., 2001; Oviatt et al., 2007; Hyde et al., 2008
New York Bight	370-480	Malone and Chervin, 1979

Nutrients

Nutrients are chemical elements that all living organisms need to sustain life and for growth. Problems may arise when too much of a particular nutrient is introduced into the environment through human activities (i.e., eutrophication). In surface waters, excess nutrients fuel algal blooms which can lead to water quality degradation. Severe or harmful algal blooms can result in the depletion of oxygen in the water column and benthos that

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aquatic life needs for survival. Algal blooms also reduce water clarity, which reduces desirable plant growth, such as seagrasses, reduces the ability of aquatic life to find food, and clog fish gills. Freshwaters are more sensitive to excess phosphorus, while in coastal waters, nitrogen is the nutrient of highest concern. In some cases, both nutrients may interact and contribute to a water pollution problem (RIDEM, 2018b).

Dissolved nutrients reach the RWEC from Narragansett Bay, Long Island Sound, and Buzzards Bay. Table 3.2-2 below was taken from the RI CRMC Ocean SAMP (2010), which published the Oviatt and Pastore 1980 nutrient sample results for the Rhode Island Sound. Research on Block Island Sound water quality suggests that nutrient concentrations (measured in micromoles, µM) have seasonal variation, with peaks in the autumn, and nearly undetectable levels in the late spring and early summer months (Staker and Bruno, 1977). Although additional sampling is required, the data suggest that nutrient availability may be a limiting factor, resulting in lower primary production.

Table 3.2-2 Nutrient Concentrations Measured in the Rhode Island Sound (Oviatt and Pastore, 1980)

	Concentration (µM)		
Nutrient	Station 16 (mouth of Narragansett Bay)	Station 17 (just outside mouth of Narragansett Bay)	Time
Ammonia (NH_3)	-	0	Jan-May
	1	1.5-2	Jun-Aug
	3-4	2-2.5	Nov-Dec
Nitrite + Nitrate (NO_2 + NO_3)	6	6	Jan
	1-2	5	Feb
	0.5	0.5	Mar
	5	4	Apr
	0	1-2	May-Aug
	6	6	Nov
	12	10	Dec
Orthophosphate (PO_4)	1-2	1-1.5	Jan-Aug
	1.5	1.5-2	Nov-Dec

Pathogens

There is little information on the algal and bacteria dynamics in Rhode Island Sound. According to RI CRMC (2010), there were no documented reports of harmful algal blooms or waterborne pathogen outbreaks Rhode Island Sound as of 2010.

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Contamination

Data on water-column contaminant levels in Rhode Island Sound are limited. Organic contaminants (polychlorinated biphenyls ["PCBs"] and pesticides) measured in 2001 and 2002 were generally below method detection limits for these analytes (USACE, 2004). For example, total PCB concentrations were less than 46 nanograms per liter (ng/L), and total dichlorodiphenyltrichloroethanes were less than 4 ng/L. Water-column dissolved metals concentrations in Rhode Island Sound were also low, with concentrations generally less than 1 microgram per liter (µg/L). Dissolved metal concentrations appeared similar throughout the year and throughout Rhode Island Sound. Metals, PCBs, and organic and inorganic pollutant concentrations measured in the water column within the Ocean SAMP area in 2002 were well below ambient RIDEM water quality criteria (RI CRMC, 2010).

Turbidity

Turbidity is the measure of cloudiness or haziness (opacity) of water caused by suspended solids (e.g., sediments or algae). Ocean waters beyond 3 mi (4.8 km) offshore typically have very low concentrations of suspended particles and low turbidity. Turbidity in Rhode Island Sound from five studies cited by the USACE (2004) ranged from 0.1 to 7.4 milligrams per liter (mg/L) of total suspended solids. Bottom currents may re-suspend silt and fine-grained sands, causing higher suspended particle levels in benthic waters. Storm events, particularly frequent intense wintertime storms, may also cause a short-term increase in suspended sediment levels. (BOEM, 2013)

Anthropogenic Activities

Current anthropogenic activities that are sources of water quality degradation include point source pollution and nonpoint source pollution. Point source pollutants, which enter waterways at well-defined locations, such as pipe or sewer outflows, are common sources of water pollution. There are no direct municipal wastewater or industrial point sources of pollution into or within the Project Area. Vessels may release discharges that have the potential to impact water quality.

3.2.1.2 RWEC Narragansett Bay

Dissolved Oxygen

The Narragansett Bay Fixed Site Monitoring Network ("NBFSMN") is a multi-agency collaborative that continuously collects data, including DO, at 13 fixed stations throughout the Narragansett Bay. The data collected at the fixed stations shows that the majority of the stations experience or are vulnerable to periodic episodes of hypoxia and occasional anoxia (RIDEM, [ND]). In addition, although the NCCR (EPA, 2012) states that the overall condition of DO in the Northeast Coast region is fair, more extensive data collection, such as that by NBFSMN and Brown University, have shown that the Narragansett Bay has a higher incidence of hypoxia.

DO within the Bay was also evaluated by the NBEP, which used a Hypoxia Index. The Hypoxia Index evaluated data from the NBFSMN to identify sample areas that experience hypoxia and combined the duration that this condition persisted. The Hypoxia Index "measures of

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the amount or magnitude that bottom water DO concentrations fell below a fixed threshold, and how long they stayed below the threshold" (NBEP, 2017). NBEP used a threshold of 2.9 mg/L and the Hypoxia Index to identify acute hypoxia, which evaluated each individual site/year as the sum of all deficit-durations from mid-May through mid-October (NBEP, 2017). The occurrences of hypoxia at given sites varied from year to year, with precipitation playing a factor. Wetter years experienced greater incidents of hypoxia. NBEP also found that periods of hypoxia have a higher chance of occurrence during the summer months, when the warm waters support high productivity and respiration rates and the Bay is thermally stratified with poor exchange between strata (NBEP, 2017). The proposed RWEC-RI will make landfall at Quonset Business Park within North Kingstown and pass within a portion of the Upper West Passage that is prone to sporadic hypoxic events (NBEP, 2017).

Chlorophyll a

A Chlorophyll Bloom Index ("CBI") was developed to quantify phytoplankton blooms based on a time series of chlorophyll measurements and data from ten NBSFMN sites that were analyzed (NBEP, 2017). The CBI measured the surplus-duration of an event, which is both the intensity and time period of the event. Since the State of Rhode Island has not established water quality criteria for chlorophyll a concentrations, the federal threshold of 20 µg/L was used. Although long-term trends could not be readily identified, the CBI indicated that spikes in chlorophyll a levels in Narragansett Bay are most frequent in the summer and show a spatial gradient decrease when moving north to south throughout the Bay with the Upper West Passage having values ranging from five to nine µg/L (NBEP, 2017). This is likely the result of nutrient inputs from rivers and wastewater treatment facilities ("WWTF") (i.e., riverine loading) (NBEP 2017).

The NBC also monitored chlorophyll a in the Providence and Seekonk River estuaries within the upper Narragansett Bay. Table 3.2-3 below was adapted from available 2019 NBC data from the two buoys (Bullock Reach Buoy and Conimicut Point Buoy) maintained proximate to the southern terminus of the Providence River at Upper Narragansett Bay. Samples were taken 1.6 to 3.3 ft (0.5-1 m) below the surface. As shown in Table 3.2-3, the chlorophyll a levels exceeded the federal threshold (20 µg/L) on June 19, 2019 at the Bullock Reach Buoy and on August 15, 2019 at both the Bullock Reach Buoy and the Conimicut Point Buoy.

Table 3.2-3 2019 Chlorophyll a Levels from NBC Data Collected at Bullock Reach Buoy and Conimicut Point Buoy

Collection Date	Station	Chl a (µg/L)	Station	Chl a (µg/L)
1/3/2019	Bullock Reach Buoy Surface	2.2302	Conimicut Point Surface	0.36123
3/13/2019	Bullock Reach Buoy Surface	0.8307	Conimicut Point Surface	7.13
3/27/2019	Bullock Reach Buoy Surface	3.5457	Conimicut Point Surface	2.7547

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Collection Date	Station	Chl a (µg/L)	Station	Chl a (µg/L)
4/10/2019	Bullock Reach Buoy Surface	7.0368	Conimicut Point Surface	7.7439
4/24/2019	Bullock Reach Buoy Surface	7.9713	Conimicut Point Surface	19.647
5/8/2019	Bullock Reach Buoy Surface	1.7406	Conimicut Point Surface	1.7828
5/21/2019	Bullock Reach Buoy Surface	3.3849	Conimicut Point Surface	4.1268
6/5/2019	Bullock Reach Buoy Surface	3.1776	Conimicut Point Surface	2.709
6/19/2019	Bullock Reach Buoy Surface	30.393	Conimicut Point Surface	14.577
7/3/2019	Bullock Reach Buoy Surface	9.3984	Conimicut Point Surface	5.1741
7/17/2019	Bullock Reach Buoy Surface	10.909	Conimicut Point Surface	9.3837
7/31/2019	Bullock Reach Buoy Surface	1.8061	Conimicut Point Surface	2.1052
8/15/2019	Bullock Reach Buoy Surface	33.026	Conimicut Point Surface	48.981

Nutrients

There is limited data available for nutrient levels within Narragansett Bay. However, NBEP monitors nitrogen and phosphorus levels with a focus on WWTFs and riverine discharges. Data suggests that nutrient levels have dropped within a 15-year period since Rhode Island enacted a statute to reduce summer nutrient loading into the Bay from WWTFs (NBEP, 2017). Table 3.2-4 was adapted from the NBWTR (NBEP, 2017) and summarizes a comparison of WWTF nitrogen loading levels from 2000-2004, 2007-2010, and 2013-2015. The data indicates a decrease in total nitrogen discharging from WWTFs in the Coastal Narragansett Bay Basin.

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Table 3.2-4 NBEP Data for Nitrogen Loading Levels from Wastewater Treatment Facilities

	WWTF Total Nitrogen Loading ($x10^3$ lbs/year)		
	Nixon et al (2008)	Krumholz (2012)	NBEP Study
Coastal Narragansett Bay Basin	2000-2004	2007-2010	2013-2015
Narragansett Bay	5,253	4,420	2,777
Ten Mile River	379	328	170
Woonasquatucket River	134	45	52

Total phosphorus was similarly analyzed for discharges from WWTFs and it was found that WWTFs that directly discharge to "Narragansett Bay account for 74 percent of total phosphorus loading" (NBEP, 2017). Table 3.2-5 was adapted from the NBWTR (NBEP, 2017) and summarizes a comparison of phosphorus loading levels from 2000-2004, 2007-2010, and 2013-2015.

Table 3.2-5 NBEP Data for Phosphorus Loading from Wastewater Treatment Facilities

	WWTF Total Nitrogen Loading ($x10^3$ lbs/year)		
	Nixon et al (2008)	Krumholz (2012)	NBEP Study
Coastal Narragansett Bay Basin	2000-2004	2007-2010	2013-2015
Narragansett Bay	551	618	526
Ten Mile River	26	3	3
Woonasquatucket River	21	1	1

Pathogens

The NBEP monitors Narragansett Bay for pathogens to monitor potential health concerns regarding recreation (e.g., swimming and boating) and shellfishing by testing for Escherichia coli, general fecal coliform, and Enterococci bacteria (NBEP, 2017). Sources of these pathogens include WWTFs, stormwater runoff, septic systems, and wildlife. It was found that 20 percent of streams and rivers and 97 percent of lakes and ponds in the Coastal Narragansett Bay area were acceptable for recreational use (NBEP, 2017). For shellfishing, 63 percent of Narragansett Bay was classified as approved, 13 percent was classified as conditionally approved, and 24 percent was classified as prohibited in 2015. However, the sampling locations at the Mouth of the Bay and the West Passage, where the Project will occur, each have 90 percent classified as approved for shellfishing, indicating good water quality regarding pathogens.

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Contamination

NBEP monitors both of what it considers legacy and emerging contaminants in Narragansett Bay. Legacy contaminants are those such as heavy metals that have been present and regulated for many years and may persist in the environment (NBEP, 2017). Research conducted during the 1980s and 1990s on legacy contaminants found that there was a north-south gradient in the Bay, with the northern reaches having the highest concentrations of legacy contaminants. NBEP also evaluated legacy contaminants by analyzing dated sediment cores and blue mussel (*Mytilus edulis*) tissue (NBEP, 2017). The sediment cores were evaluated for levels of copper, lead, cadmium and chromium and the effects range median (ERM – threshold where detected levels of a contaminant above the ERM likely or always result in observed effects) were compared to levels of the contaminants in the 1770s. The analysis showed that the levels for all contaminants spiked during the Industrial Revolution and then dramatically reduced with the introduction of environmental regulations (i.e., Clean Water Act and Clean Air Act). Additional analysis showed that all analyzed contaminants within the sediment cores dropped below the ERM after 1990. Similarly, data on metals and PCBs from tissue from blue mussels showed a trend in declining levels of contaminants from 1976 to 2012 (NBEP, 2017).

Emerging contaminants, or "chemical contaminants of emerging concern ("CECs") refers to chemicals with unknown ecological effects and no associated regulatory standards" (NBEP, 2017). Sources of CECs include pharmaceuticals, personal care products, and industrial chemicals, and information on them within the Bay is limited (NBEP, 2017). Due to the lack of sufficient data, the extent and magnitude of CECs within the Bay are not available.

Turbidity

There are limited data available on turbidity within Narragansett Bay. The NBC measures turbidity using a Secchi disk. A Secchi disk measures water clarity by lowering a black and white disk into the water column until it is no longer visible; the depth at which the disk is last visible is then recorded. Table 3.2-6 was adapted from available data from NBC for Bullock Reach and Conimicut Point, which are the two monitoring locations that are closest to the mouth of Narragansett Bay. Several readings were taken every month and the data below represents the annual average for depth visibility. All depths are in meters (NBC, 2019).

Table 3.2-6 2017-2019 Water Clarity Depths Measured by NBC at Bullock Reach and Conimicut Point Monitoring Stations using a Secchi Disk

Sample Location and Year	Greatest Depth (m) (Date)	Shallowest Depth (m) (Date)	Annual Average Depth of Visibility (m)
Bullock's Reach – 2017	3.9 (11/29/2017)	0.8 (8/23/2017)	1.7
Bullock's Reach – 2018	3.9 (10/17/2018)	1.3 (5/24/2018, 7/25/2018, 8/1/2018, 8/8/2018)	2.1
Bullock's Reach – 2019	3.9 (3/13/2019)	0.9 (5/30/2019	1.7

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Sample Location and Year	Greatest Depth (m) (Date)	Shallowest Depth (m) (Date)	Annual Average Depth of Visibility (m)
Conimicut Point – 2017	4.2 (10/18/2017)	1.1 (7/6/2017)	1.8
Conimicut Point – 2018	5.4 (3/28/2018)	1.3 (8/8/2018)	1.7
Conimicut Point – 2019	3.6 (1/3/2019)	0.9 (5/30/2019)	2.3

Anthropogenic Activities

The watersheds of Narragansett Bay have experienced development and population growth since the 1700s and continued residential, commercial, and industrial development. These factors have shaped the area and introduced nutrients, pathogens and pollutants into streams, rivers and the Bay. Both point and non-point sources of pollution are present, and the effects of those sources as well as others are discussed above.

3.2.2 Potential Project Impacts

3.2.2.1 Construction and Decommissioning

The primary concern to surface water quality is sediment suspension and deposition during installation of the RWEC-RI. To assess these impacts, Revolution Wind prepared a sediment transport modeling analysis to support this Application.

RPS's Hydrodynamic and Sediment Transport Modeling Report – Rhode Island State Waters (Appendix H) assessed and characterized the modeled sediment suspension and deposition associated with seabed preparation activities and installation of the RWEC-RI. For deposition impacts, refer to the discussion in Section 3.1.2.1 above.

The volume of resuspended sediment (i.e., total suspended solid ["TSS"]) into the water column was predicted to be 103,875.3 cy (79,418.4 m^3), 103,163.2 cy (78,873.9 m^3), 103,875.3 cy (79,418.4 m^3), 46,287.1 cy (35,388.9 m^3), and 3,097.8 cy (2,368.4 m^3) for CFE, TSHD split bottom, TSDH continuous overflow, jet plow, and HDD, respectively. The modeling also showed that TSS plumes are limited to the bottom of the water column for seabed preparation and cable installation using CFE and were more widely distributed throughout the entire water column for TSHD.

The maximum amount of time a plume of greater than 100 mg/L is predicted to remain suspended for the various activities and installation methods was:

- For seabed preparation, no greater than 2.3 hours, 13.5 hours, and 13.8 hours for CFE, TSHD split bottom, and TSDH continuous overflow
- For jet plow installation, no greater than 4.5 hours
- For HDD at the landfall location, no greater than 70.2 hours

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The Rhode Island Water Use Classification for the HDD work area (Waterbody ID RI0007027E-03D) is SB.[3] Two temporary exit pits will be excavated offshore and a casing pipe will be installed to receive the boring head and collect boring fluids. The sediments excavated from the exit pits will be stored on a barge and will ultimately be used to backfill the exit pits (see Section 2.2.1 under Landfall Construction for detailed description of HDD process). To minimize the potential risks for an inadvertent drilling fluid release, an HDD Contingency Plan will be developed and BMPs will be implemented during construction.

A pre-application meeting was held with the CRMC and RIDEM on June 18, 2020 to discuss environmental sampling in accordance with the Rules and Regulations for Dredging and the Management of Dredged Materials (250-RICR-150-05-2). Revolution Wind conducted sediment sampling at the exit pit locations in accordance with consultation with the two agencies.[4] Laboratory analytical results were returned from ESS Laboratories on January 4, 2021. Key findings include the following:

- Total petroleum hydrocarbons, Semi-Volatile Organic Compounds and PCBs were not detected in any of the sediment samples
- Metals were not detected in concentrations exceeding the RIDEM Residential or Industrial/Commercial Direct Exposure Criteria or the CAD Cap Criteria
- Percent fines (silt/clay) exceeding 10% was detected in all samples

Based on these results, the dredge/excavations for the HDD pits will be suitable for disposal in any of the potential disposal locations except beach disposal (nourishment). That said, the Project does not propose disposal of dredged material. Dredge material at the HDD exit pits will be re-used for backfill. Sediments disturbed during cable installation will naturally backfill or fallback into the cable trench.

Vessels will be used during construction and decommissioning of the RWEC-RI and will comply with regulatory requirements for management of onboard fluids and fuels, including prevention and control of discharges and accidental spills. Revolution Wind will meet applicable regulations and standards, as set by the IMO MARPOL, the USCG, and the State of Rhode Island, for treatment and disposal of solid and liquid wastes generated during all phases of the Project. Revolution Wind will also implement an ERP/OSRP (see Appendix G). Overall, installation of the RWEC-RI will not result in significant impacts to water quality from sediment suspension and deposition and is not expected to impact DO, chlorophyll a, or nutrient balance in the region. Due to proper handling and disposal of solid and liquid waste generated by the vessels, no impacts to surface water quality are expected from vessels.

Based on RPS's simulation and the implementation of the avoidance, minimization and mitigation measures discussed in 3.2.2.4 below, impacts to water quality from seabed disturbance would be temporary and would not impact DO, chlorophyll a, or nutrient balance in the region.

3 These waters are designated for primary and secondary contact recreational activities; shellfish harvesting for controlled relay and depuration; and fish and wildlife habitat. They shall be suitable for aquacultural uses (other than shellfish for direct human consumption), navigation, and industrial cooling. These waters shall have good aesthetic value.

4 Reference sediment sampling Plan approval dated July 3, 2020.

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3.2.2.2 Operations and Maintenance

There are no anticipated impacts to water quality during O&M of the RWEC-RI unless a cable repair is required. Repair or replacement of cables or cable protection associated with the RWEC-RI during operations are considered non-routine maintenance activities potentially resulting in the same or lesser impacts as construction.

3.2.3 Proposed Avoidance, Minimization, and Mitigation

Environmental protective measures proposed by Revolution Wind are summarized in Section 2.5.2. Below is a list of measures applicable to water quality:

- To the extent feasible, installation of the RWEC-RI will occur using equipment such as mechanical cutter, mechanical plow, or jet plow.
- Revolution Wind will require all construction and operations vessels to comply with regulatory requirements related to the prevention and control of spills and discharges.
- Accidental spill or release of oils or other hazardous materials offshore will be managed through the OSRP (see Appendix G).
- All vessels will comply with USCG and EPA regulations that require operators to develop waste management plans, post informational placards, manifest trash sent to shore, and use special precautions such as covering outside trash bins to prevent accidental loss of solid materials. Vessels will also comply with BOEM lease stipulations that require adherence to NTL 2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of placards at prominent locations on offshore vessels and structures, and mandates a yearly marine trash and debris awareness training and certification process.
- HDD drilling fluids will be managed within a contained system following punch out of the pilot drilling to be collected for reuse as necessary. An HDD Contingency Plan will be prepared and implemented to minimize the potential risks associated with release of drilling fluids.
- A Soil Erosion and Sediment Control Plan, including erosion and sedimentation control measures, will be implemented to minimize potential water quality impacts during construction and operation of the onshore Project components.

3.3 Benthic and Shellfish Resources

3.3.1 Affected Environment

Benthic and shellfish resources in the RWEC-RI Project Area were evaluated by reviewing public data sources and conducting Project-specific studies. Sources reviewed included state and federal agency-published papers and databases (McMullen et al., 2009; RI CRMC, 2010; LaFrance et al., 2010; Poppe et al., 2014a; Collie and King, 2016; Siemann and Smolowitz, 2017 ; Shumchenia and King 2019; LaFrance et al. 2019), published journal articles (McMaster, 1960), online data portals and mapping databases (Northeast Ocean Data, 2019; USGS, 2017), an academic thesis (Malek, 2015), studies conducted for the planned South

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Fork Wind Farm ("SFWF") (Deepwater Wind South Fork, 2019), and correspondence and consultation with federal and state agencies.

Benthic and shellfish resources are described in the following subsections in terms of benthic habitat types and commonly associated taxa, including SAV, macroalgal assemblages, and micro- and macrobenthic communities.

Broadly, the habitats within the RWEC-RI Project Area are low in environmental complexity, consisting mainly of sand and mud habitats (Appendix C). The exceptions are habitats located in the central portions of the West Passage and at the entrance to Narragansett Bay. Six primary benthic habitat types were mapped within the RWEC-RI: Glacial Moraine B, Glacial Moraine A, Coarse Sediment, Sand and Muddy Sand, Mud and Sandy Mud, and Bedrock. The majority of the RWEC-RI in Rhode Island Sound was mapped as Sand and Muddy Sand – Mobile, whereas Mud and Sandy Mud comprised the majority of primary habitat types mapped within Narragansett Bay. While six primary benthic habitat types were mapped, when modifiers are added 17 distinct habitats are present. Not all types are present in each portion of the RWEC-RI corridor. In addition, a few anthropogenic features (dredged material, demolition debris, revetment walls) were also mapped within Narragansett Bay. Habitats with modifiers (e.g., Mobile, Shell Substrate, Low Density Boulder Field, SAV), provide a greater level of detail in describing these benthic environments and highlight the spatial variation in diversity found on the seafloor within the RWEC-RI Project Area.

The habitats mapped in Rhode Island Sound are primarily dynamic sands and muds typical of offshore environments in Southern New England. These habitats provide a mix of mobile sands and depositional muddy environments that support a combination of small and large tube-building and burrowing infauna, as well as mobile epifauna (mollusks and crustaceans) (Appendix C).

The benthic habitats mapped within Narragansett Bay, from the West Passage to Quonset Point, were primarily depositional muds and sandy mud. These habitats support a combination of small and large tube-building and burrowing infauna, as well as mobile epifauna (mollusks and crustaceans). Where these habitats are modified by shell substrate, additional taxa are supported, such as blue mussels and sessile gastropods (i.e., Crepidula), that provide important filtration ecosystem services. In shallow nearshore water, mud and sandy mud habitats may support SAV beds. These habitats also provide important ecosystem services related to water clarity and nutrient cycling, and provide critical habitat for invertebrates and demersal fish, particular juveniles. Outcroppings of Bedrock, Glacial Moraine B, and Glacial Moraine A habitats were mapped within the RWEC-RI Project Area near Conanicut and Dutch Islands within the West Passage of Narragansett Bay. These habitats, as well as nearby Low or Medium Density Boulder Fields coincident with sand and mud habitats, provide structure that supports attached fauna such as sponges and, in shallower photic waters, flora such as benthic macroalgae, as well as demersal fish, such as black sea bass and tautog, that utilize hard bottom substrates and structure.

These findings are consistent with recent surveys in the area (Shumchenia and King, 2019) and expected fauna based on historical studies (Hale et al. 2018).

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No sensitive taxa or species of concern were observed within the RWEC-RI Project Area. However, SAV beds consisting primarily of eelgrass (*Zostera marina*), with additional presence of widgeon grass (*Ruppia maritima*), occur in Narragansett Bay. SAV beds are found in shallow coastal areas, including along the western shores of Conanicut and Dutch Islands, at the mouth of Wickford Harbor adjacent to Cornelius Island, and on the west side of Compass Rose Beach (Appendix C). During Revolution Wind's SAV video survey in September 2020, a total of 52 transect lines of a variety of distances and orientations were mapped in nearshore regions of the RWEC-RI Project Area, around the landfall location where SAV was expected at a higher probability. SAV, specifically eelgrass (*Zostera marina*), was observed along the shoreline at the west side of Compass Rose Beach, approximately 845 feet (257 m) east of the proposed HDD exit pits.

3.3.2 Potential Project Impacts

3.3.2.1 Construction and Decommissioning

During construction and decommissioning of the RWEC-RI, benthic resources and shellfish are expected to experience impacts from sediment suspension and deposition and habitat alteration from vessel anchoring and cable installation. Most marine species have some degree of tolerance to higher concentrations of suspended sediment because storms, currents, and other natural processes regularly result in increases in turbidity (MMS 2009). However, eggs and larval organisms are especially susceptible to smothering through sedimentation; for example, winter flounder generally spawn in shallow coastal waters between late November and early December and their eggs are known to be susceptible to adverse effects related to sediment deposition. In areas of sediment disturbance, benthic habitat recovery and benthic infaunal and epifaunal species abundances may take up to 1 to 3 years to recover to pre-impact levels, based on the results of a number of studies on benthic recovery (e.g., AKRF, Inc. et al. 2012; Germano et al. 1994; Hirsch et al. 1978; Kenny and Rees 1994).

Benthic species may also experience localized, long-term impacts caused by the conversion of soft-bottom habitat to hard-bottom habitat associated with cable protection along portions of the RWEC-RI route. None of the impacts are expected to result in population-level effects on benthic species, due to the limited scale and intensity of the RWEC-RI activities, and the availability of similar habitat in the surrounding area.

The nearest SAV bed to the indicative RWEC-RI route within the West Passage is approximately 1,150 ft (350 m) from the route, on the western side of Dutch Island. At this distance, SAV habitat near the cable corridor is 35 m beyond the projected impact distance for deposition and is within the projected impact distance for elevated turbidity (RPS 2021). The SAV bed mapped at the landfall location during the 2020 video survey is 32 m beyond the projected impact distance for deposition and is within the projected impact distance for elevated turbidity (RPS 2021). Revolution Wind will utilize HDD to avoid documented SAV near the Project's landfall location. In addition, Revolution Wind will avoid construction during the peak SAV growing season (i.e., July to September), which will minimize potential effects due to increased turbidity and sediment deposition associated with cable installation and excavation of the HDD exit pits.

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3.3.2.2 Operations and Maintenance

There are no anticipated impacts during O&M of the RWEC-RI unless a cable repair is required. Repair or replacement of cables or cable protection associated with the RWEC-RI during operations are considered non-routine maintenance activities potentially resulting in the same or lesser impacts as construction.

Revolution Wind evaluated electric and magnetic fields ("EMF") associated with operation of the RWEC-RI and the calculated magnetic-field and induced electric-field levels for the Project cables are not expected to affect populations of marine organisms in the area (Exponent, 2020). This conclusion is based on comparisons of the reported EMF sensitivity of select, local marine species to the levels of EMF produced by the submarine cables. As part of the evaluation process, Exponent calculated the magnetic-field levels and induced electric-field levels associated with the Project cables. These calculations show that for the offshore segment of the RWEC and the RWEC Landfall Cables the highest magnetic field at 3.3 feet (1 m) above the seabed will be 6.3 milligauss ("mG") or less at average loading and less than 8.4 mG at peak loading. These maximum calculated field levels were then compared to magnetic-field levels reported in the scientific literature as causing behavioral responses in species groups expected to inhabit the Project Area, including marine invertebrates, fish, and elasmobranchs. This conservative evaluation resulted in the following conclusions (Exponent, 2020), which are consistent with those of a 2019 BOEM report (Snyder et al., 2019):

- Data from field surveys conducted at 60-hertz ("Hz") alternating current ("AC") submarine cable sites demonstrate that behavior and distribution of large crustaceans are unaffected by these magnetic fields.
- Observations of cephalopod distributions at the same 60-Hz AC cable sites also indicated that these species are not affected by the presence of AC EMF.
- Magnetic-field levels calculated for cables are below thresholds at which laboratory and field studies reported behavioral changes in magnetosensitive fish species.
- Elasmobranchs (sharks, rays and skates) are not expected to detect the magnetic fields generated by the 60-Hz AC submarine cables.
- Calculated electric fields associated with Project cables are below the published detection thresholds of electrosensitive fish and elasmobranchs.

In conclusion, the 60-Hz magnetic- and induced electric-field levels calculated from conservative models of the Project's cables during operation will be below the detection thresholds of magnetosensitive and electrosensitive marine organisms in the Project Area.

3.3.3 Proposed Avoidance, Minimization, and Mitigation Measures

Environmental protective measures proposed by Revolution Wind are summarized in Section 2.5.2. Below is a list of measures applicable to benthic and shellfish resources:

- The RWEC will be sited to avoid and minimize impacts to sensitive habitats (e.g., hard bottom habitats) to the extent practicable.

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- A preconstruction SAV survey will be completed to identify any new or expanded SAV beds. The Project design will be refined to avoid impacts to SAV to the extent practicable.
- To the extent feasible, installation of the RWEC-RI will occur using equipment such as mechanical cutter, mechanical plow, or jet plow.
- DP vessels will be used for installation of the RWEC-RI to the extent possible.
- A plan for vessels will be developed prior to construction to identify no-anchorage areas to avoid documented sensitive resources.
- Revolution Wind will require all construction and operations vessels to comply with regulatory requirements related to the prevention and control of spills and discharges.
- Accidental spill or release of oils or other hazardous materials offshore will be managed through the Oil Spill Response Plan.

Finally, as described in Section 2.5.1.1, in general, offshore site preparation and installation north of the COLREGS line of demarcation will occur between the day after Labor Day and February 1 to avoid and minimize impacts to winter flounder (*Pseudopleuronectes americanus*) and shellfish.

3.4 Finfish and Essential Fish Habitat

3.4.1 Affected Environment

This section describes finfish and Essential Fish Habitat ("EFH") within the RWEC-RI Project Area. Finfish evaluated include pelagic, demersal, and anadromous species that inhabit the region. EFH, as regulated by NMFS, is defined in the Magnuson-Stevens Fishery Conservation and Management Act ("MSFCMA") as those waters (e.g., aquatic areas and their associated physical, chemical, and biological properties used by fish) and substrate (e.g., sediment, hard bottom, underlying structures, and associated biological communities) necessary for the spawning, feeding, or growth to maturity of managed fish species. A 0.5 mi (800 m) wide corridor around the RWEC-RI Project Area was used for identifying species with EFH within the vicinity of the proposed cable corridor.

The regional waters off the coast of Rhode Island and Massachusetts are transitional waters that separate Narragansett Bay and Long Island Sound from the OCS (BOEM, 2013). These waters straddle the Mid-Atlantic and New England biogeographic regions and serve as the northern boundary for some Mid-Atlantic species and the southern boundary for some New England species. The species that may be found in the RWEC-RI reflect the transitional nature of this regional area.

Some demersal species are present year-round in the RWEC-RI Project Area; however, there are distinct seasonal variations in local populations because of seasonal migrations and inter-annual population dynamics (declines and increases) (Malek, 2015). Demersal species such as black sea bass (*Centropristis striata*), scup (*Stenotomus chrysops*), whiting (*Merlangius merlangus*), summer flounder (*Paralichthys dentatus*), winter flounder (*Pseudopleuronectes americanus*), yellowtail flounder (*Pleuronectes ferruginea*), and winter skate (*Leucoraja*

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ocellata) are important to both the stability and resiliency of the local marine community and have a large impact on commercial fisheries (RI CRMC, 2010).

Coastal pelagic species typically inhabit the photic zone over the continental shelf, in waters up to about 655 ft (200 m) deep (NOAA Fisheries, 2018). Example coastal pelagic species that may be found in the RWEC-RI Project Area include forage fish such as anchovy (*Anchoa mitchilli*), American shad (*Alosa sapidissima*), and Atlantic menhaden (*Brevoortia tyrannus*), as well as their predators. Certain pelagic species are considered highly migratory species; they travel long distances and often cross domestic and international boundaries. These include oceanic pelagic species such as many sharks. Many species of finfish that have pelagic life stages within the region are considered commercially or recreationally important. Some of these species (e.g., bluefish [*Pomatomus saltatrix*]) migrate seasonally to the RWEC-RI Project Area.

Anadromous species are those which migrate between the ocean and lower-salinity riverine environments for spawning. Demersal species of anadromous fish potentially present within the RWEC-RI Project Area include striped bass (*Morone saxatilis*) and Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), and potentially present pelagic species of anadromous fish include American shad, alewife (*Alosa pseudoharengus*), blueback herring (*Alosa aestivalis*), Atlantic menhaden, and Atlantic sea herring (*Clupea harengus*) (BOEM, 2013; Scotti et al., 2010). The most common finfish prey species within the RWEC-RI Project Area include alewife, Atlantic menhaden, northern sand lance (*Ammodytes dubius*), and whiting.

The federally listed Atlantic sturgeon could occasionally occur within the RWEC-RI Project Area. The Atlantic sturgeon is an anadromous, subtropical species that can be found along the Atlantic coast from Labrador, Canada to Florida (Murdy et al., 1997; Atlantic States Marine Fisheries Commission ["ASMFC"], 2019b). There are five distinct population segments ("DPS") (i.e., the New York Bight, Gulf of Maine, Chesapeake Bay, Carolina, and South Atlantic DPS), which are grouped by ranges according to designations published by NOAA Fisheries (77 Federal Register 5880; 77 Federal Register 5914). The DPS most likely to be found in the vicinity of the Project Area is the New York Bight DPS. There are no known spawning locations or Critical Habitats in Rhode Island. Historically, Atlantic sturgeon spawned in the Taunton River in Massachusetts, however, their current status in this river is unknown (ASMFC, 2019b). Juvenile and adult Atlantic sturgeon have been captured in otter trawls and sink gill nets in the region and commercial bycatch data indicates the greatest occurrence of offshore Atlantic sturgeon in Massachusetts and Rhode Island waters to occur from November through May (Stein et al., 2004).

Within Narragansett Bay, the demersal fish community structure has been changing over the past six decades with some demersal species declining (e.g., winter flounder, whiting, and red hake (*Urophycis chuss*)), while others have increased (e.g., Atlantic butterfish (*Peprilus triacanthus*), scup, and squid) (Collie et al., 2008). These population changes are thought to be related to overfishing, fishery closures, changes in food sources, and changes in habitat (ASMFC, 2019a). The abundance of coastal anadromous finfish, such as striped bass, American shad, and river herring (alewife and blueback herring, collectively), has declined substantially in Narragansett Bay due to habitat loss and exploitation (NBEP, 2017).

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These species migrate between the ocean and lower-salinity riverine environments, typically undergoing their upstream spawning migration in the spring.

Within the 0.5 mi (800 m) corridor around the RWEC-RI centerline, 32 species of fish and invertebrates have designated EFH for various life stages. These species and their EFH are described in detail in Appendix D.

3.4.2 Potential Project Impacts

3.4.2.1 Construction and Decommissioning

RWEC-RI construction and decommissioning impacts on EFH will vary for different species based on several factors including behavior and distribution in the water column diet, habitat preferences, the amount of suitable habitat present in the area, and life stage. Most of the potential impacts on EFH will be temporary and reversible as natural processes are expected to return the disturbed areas to pre-construction conditions apart from secondary cable protection. In addition, the spatial extent of anticipated habitat that is anticipated to be impacted is small relative to the amount of similar habitat in the region.

Species with a completely pelagic lifestyle are generally expected to be less negatively affected than demersal or benthic species from construction related impacts. Based on the results of a number of studies on benthic recovery (e.g., AKRF, Inc. et al., 2012; Germano et al., 1994; Hirsch et al., 1978; Kenny and Rees, 1994), the affected benthic communities in the disturbed area are expected to re-establish within 1 to 3 years as native assemblages recolonize the affected area or a new community develops as a result of immigration of organisms from nearby areas or from larval settlement. However, there are no expected population-level effects on EFH species due to the limited scale and intensity of the Project activities and the availability of similar habitat in the surrounding area. The species and associated life stages most likely to experience some level of negative impact are listed in Table 3.4-1 below.

3.4.2.2 Operations and Maintenance

There are no anticipated impacts during O&M of the RWEC-RI unless a cable repair is required. Repair or replacement of cables or cable protection associated with the RWEC-RI during operations are considered non-routine maintenance activities potentially resulting in the same or lesser impacts as construction.

Once the RWEC-RI becomes energized, the cables will produce a magnetic field, both perpendicularly and in a lateral direction around the cables. The cable will be shielded and, where feasible, buried beneath the seafloor and will otherwise be protected. Shielded electrical transmission cables do not directly emit electrical fields into surrounding areas but are surrounded by magnetic fields that can cause induced electrical fields in moving water (Gill et al., 2012). Based on EMF modeling performed for the Project (Exponent, 2020), behavioral effects and/or changes in finfish and EFH species abundance and distributions due to EMF are not expected. These conclusions are consistent with the findings of a previous comprehensive review of the ecological impacts of marine renewable energy projects, where it was determined that there has been no evidence demonstrating that EMF

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at the levels expected from marine renewable energy projects will cause an effect (negative or positive) on any species (Copping et al., 2016). Moreover, a 2019 BOEM report that assessed the potential for AC EMF from offshore wind facilities to affect marine populations concluded that, for the southern New England area, no negative effects are expected for populations of key commercial and recreational fish species (Snyder et al., 2019). Based on this information, it is not expected that finfish and EFH will be measurably affected by EMF from the cables.

Cable protection associated with the RWEC-RI also has the potential to have beneficial effects on species with life stages with a preference for hard-bottom habitats (e.g., gravel, rock, boulders, artificial reefs), depending on the quality of the newly-created hard-bottom habitat, and the composition of the colonizing benthic community. The species and life stages that may experience beneficial effect are listed in Table 3.4-2.

Note that some species could experience both negative and beneficial impacts at different phases of the Project. Thus, the same species and life stages may appear in both Table 3.4-1 and Table 3.4-2.

Table 3.4-1 EFH Species Most Likely to Experience Negative Impacts

Species	Egg	Larvae	Neonate	Juvenile	Adult
New England Finfish					
Atlantic cod (*Gadus morhua*)				●	●
Haddock (*Melanogrammus aeglefinus*)				●	
Monkfish (*Lophius americanus*)				●	●
Ocean pout (*Zoarces americanus*)	●			●	●
Red hake (*Urophycis chuss*)				●	●
Silver hake (*Merluccius bilinearis*)				●	●
White hake (*Urophycis tenuis*)				●	
Windowpane flounder (*Scophthalmus aquosus*)				●	●
Winter flounder (*Pseudopleuronectes americanus*)	●	●			●
Yellowtail flounder (*Limanda ferruginea*)				●	●
Mid-Atlantic Finfish					
Black sea bass (*Centropristis striata*)				●	●
Scup (*Stenotomus chrysops*)				●	●
Summer flounder (*Paralichthys dentatus*)				●	●
Invertebrates					
Atlantic sea scallop (*Placopecten magellanicus*)	●	●		●	●
Atlantic surfclam (*Spisula solidissima*)				●	●

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Species	Egg	Larvae	Neonate	Juvenile	Adult
Longfin inshore squid (*Doryteuthis pealeii*)	●				
Ocean quahog (*Arctica islandica*)				●	●
Skates					
Little skate (*Leucoraja erinacea*)				●	●
Winter skate (*Leucoraja ocellata*)				●	●
Sharks					
Spiny dogfish (*Squalus acanthias*)				●[1]	●

1 Includes sub-adult males and sub-adult females

Table 3.4-2 EFH Species That May Experience Beneficial Effects

Species	Egg	Larvae	Neonate	Juvenile	Adult
New England Finfish					
Atlantic cod (*Gadus morhua*)				●	●
Haddock (*Melanogrammus aeglefinus*)				●	
Monkfish (*Lophius americanus*)				●	●
Ocean pout (*Zoarces americanus*)	●			●	●
Pollock (*Pollachius virens*)				●	
Red hake (*Urophycis chuss*)				●	●
Silver hake (*Merluccius bilinearis*)					●
Winter flounder (*Pseudopleuronectes americanus*)				●	●
Yellowtail flounder (*Limanda ferruginea*)					●
Mid-Atlantic Finfish					
Black sea bass (*Centropristis striata*)				●	●
Scup (*Stenotomus chrysops*)					●
Invertebrates					
Atlantic sea scallop (*Placopecten magellanicus*)	●	●		●	●
Longfin inshore squid (*Doryteuthis pealeii*)	●				
Skates					
Little skate (*Leucoraja erinacea*)				●	●
Winter skate (*Leucoraja ocellata*)				●	●

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3.4.3 Proposed Avoidance, Minimization, and Mitigation Measures

Environmental protective measures proposed by Revolution Wind are summarized in Section 2.5.2. Below is a list of measures applicable to finfish and EFH:

- To the extent feasible, installation of the RWEC-RI will occur using equipment such as mechanical cutter, mechanical plow, or jet plow.
- To the extent feasible, the RWEC-RI will typically target a burial depth of 4 to 6 ft (1.2 to 1.8 m) below seabed. The target burial depth will be determined based on an assessment of seabed conditions, seabed mobility, the risk of interaction with external hazards such as fishing gear and vessel anchors, and a site-specific CBRA.
- DP vessels will be used for installation of the RWEC-RI to the extent practicable.
- A plan for vessels will be developed prior to construction to identify no-anchorage areas to avoid documented sensitive resources.
- Revolution Wind is committed to collaborative science with the commercial and recreational fishing industries pre-, during, and post-construction. Fisheries monitoring studies are being planned to assess the impacts associated with the Project on economically and ecologically important fisheries resources. These studies will be conducted in collaboration with the local fishing industry and will build upon monitoring efforts being conducted by affiliates of Revolution Wind at other wind farms in the region.
- Revolution Wind will require all construction and operations vessels to comply with regulatory requirements related to the prevention and control of spills and discharges.
- Accidental spill or release of oils or other hazardous materials offshore will be managed through the OSRP.
- A ramp-up or soft-start will be used at the beginning of each pile segment during pneumatic pile driving to provide additional protection to mobile species in the vicinity by allowing them to vacate the area prior to the commencement of pile driving activities.
- Construction and operational lighting will be limited to the minimum necessary to ensure safety and to comply with applicable regulations.
- All vessels will comply with USCG and EPA regulations that require operators to develop waste management plans, post informational placards, manifest trash sent to shore, and use special precautions such as covering outside trash bins to prevent accidental loss of solid materials. Vessels will also comply with BOEM lease stipulations that require adherence to NTL 2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of placards at prominent locations on offshore vessels and structures, and mandates a yearly marine trash and debris awareness training and certification process.
- Finally, as described in Section 2.5.1.1, in general, offshore site preparation and installation north of the COLREGS line of demarcation will occur between the day after Labor Day and February 1 to avoid and minimize impacts to winter flounder (*Pseudopleuronectes americanus*) and shellfish.

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3.5 Marine Mammals and Sea Turtles

3.5.1 Affected Environment

The description of the affected environment for marine mammals was developed by reviewing current public data sources related to marine mammals including: the NOAA Northeast Fisheries Science Center's ("NEFSC's") Atlantic Marine Assessment Program for Protected Species ("AMAPPS") (Palka et al., 2017), the Northeast Large Pelagic Survey Collaborative Aerial and Acoustic Surveys for Large Whales and Sea Turtles (Kraus et al., 2016), Remote Marine and Onshore Technology surveys for New York State Energy Research and Development Authority ("NYSERDA") (Normandeau Associates Inc. [Normandeau] and APEM, 2019); a technical report for the Ocean SAMP (Kenney and Vigness-Raposa, 2010); available marine mammal habitat density data available on the Northeast Ocean Data Portal (Curtice et al., 2019; Roberts et al., 2016, 2017, 2018; Roberts, 2018, 2020); NOAA stock assessment reports (Hayes et al., 2017, 2018, 2019, 2020); and relevant journal publications.

As summarized in Table 3.5-1 below, 36 species of marine mammals inhabit the regional waters of the western North Atlantic OCS. Of these, 5 species are not expected to occur within the RWEC-RI Project Area and 21 species are considered rare or uncommon in the RWEC-RI Project Area. See Appendix E for additional detail regarding marine mammals and sea turtles.

Information regarding distances from shore for marine mammal migratory routes are not available for all species. Surveys suggest that some cetacean species, notably the North Atlantic Right Whale (NARW) and humpback whale, can be found between 50 and 2,000 m from shore while migrating (Best et al., 1998; Hayes et al., 2020). Fin whales, humpback whales, NARWs, and minke whales have all been observed in the RWEC-RI Project Area and will be most abundant in the winter and spring (Kenney and Vigness-Raposa, 2010; Kraus et al., 2016). Sei whales and blue whales are not expected to occur within the RWEC-RI Project Area. Sperm whales in this area have been observed in Rhode Island state waters near Block Island following prey species and may therefore be encountered in the RWEC-RI Project Area during summer and fall (Cetacean and Turtle Assessment Program ["CETAP"], 1982; Kenney and Vigness-Raposa, 2010). Common bottlenose dolphin, common dolphins, and Atlantic white-sided dolphins are the only dolphin species expected to occur with regularity in the RWEC–RI Project Area (Kenney and Vigness-Raposa, 2010; Hayes et al., 2020). Harbor porpoises are known to prefer shallower waters closer to shore and are likely to occur in Rhode Island state waters as they travel between their winter habitat in the Mid-Atlantic to their summer habitat in the Gulf of Maine (Kenney and Vigness-Raposa, 2010). They are predominantly expected in the winter and spring. Historically, seals were rare in Rhode Island state waters, but since the passing of the MMPA in 1972 observations of harbor and gray seals have increased and they are most abundant in these waters from late fall until late spring (McLeish, 2016). Arctic species such as harp, hooded, and ringed seals have also been reported in Narragansett Bay, although sightings of these species are rare (Kenney and Vigness-Raposa, 2010). Harbor seals are the most frequently observed seal species throughout the coastal waters of Rhode Island and adjacent state waters (Kenney and Vigness-Raposa, 2010). Gray seals are less common in Rhode Island, but recovery of the

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Massachusetts and Canadian breeding populations has led to a recent increase in gray seal observations in New England waters (Kenney and Vigness-Raposa, 2010; Hayes et al., 2020). Both species are expected to occur in the RWEC–RI; harbor seals may be present year-round in lower densities, but peak presence of both species is likely to occur in late spring through early summer (Kenney and Vigness-Raposa, 2010).

The only species of marine mammal that can regularly be found onshore are seals. There have been six identified haul-out sites in Narragansett Bay, with the most observations at the Dumplings off Conanicut Island and Rome Point in North Kingstown (Kenney and Vigness-Raposa, 2010). The nearest haul-out site to the proposed landfall location at Quonset Point in North Kingstown, Rhode Island, is approximately 1.86 mi (3 km) away.

Table 3.5-1 Marine Mammals Potentially Occurring Within the Regional Western North Atlantic OCS Waters and the RWEC-RI Project Area

Common Name	Scientific Name	Stock	Current Population Status	Occurrence in the RWEC-RI Project Area	Best Abundance Estimate[1]
Fin whale	*Balaenoptera physalus*	Western North Atlantic	ESA Endangered MMPA Depleted and Strategic RI State Endangered	Common	7,418
Sei whale	*Balaenoptera borealis*	Nova Scotia	ESA Endangered MMPA Depleted and Strategic	Uncommon	6,292
Blue whale	*Balaenoptera musculus*	Western North Atlantic	ESA Endangered MMPA Depleted and Strategic	Not Expected	402
North Atlantic right whale	*Eubalaena glacialis*	Western North Atlantic	ESA Endangered MMPA Depleted and Strategic RI State Endangered	Common	428
Minke whale	*Balaenoptera acutorostrata*	Canadian East Coast	MMPA Non-strategic	Common	24,202
Humpback whale	*Megaptera novaeangliae*	Gulf of Maine	MMPA Non-strategic RI State Endangered	Common	1,396
Sperm whale	*Physeter macrocephalus*	North Atlantic	ESA Endangered MMPA Depleted and Strategic	Regular	4,349
Pygmy sperm whale	*Kogia breviceps*	Western North Atlantic	MMPA Non-strategic	Rare	7,750
Dwarf sperm whale	*Kogia sima*	Western North Atlantic	MMPA Non-strategic	Rare	7,750

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Common Name	Scientific Name	Stock	Current Population Status	Occurrence in the RWEC-RI Project Area	Best Abundance Estimate[1]
Northern bottlenose whale	*Hyperoodon ampullatus*	Western North Atlantic	MMPA Non-strategic	Not Expected	Unknown
Cuvier's beaked whale	*Ziphius cavirostris*	Western North Atlantic	MMPA Non-strategic	Rare	21,818
Mesoplodont beaked whales	*Mesoplodon* spp.	Western North Atlantic	MMPA Depleted	Rare	21,818
Killer whale	*Orcinus orca*	Western North Atlantic	MMPA Non-strategic	Rare	Unknown
False killer whale	*Pseudorca crassidens*	Western North Atlantic	MMPA Strategic	Rare	1,791
Pygmy killer whale	*Feresa attenuata*	Western North Atlantic	MMPA Non-strategic	Not Expected	Unknown
Short-finned pilot whale	*Globicephala macrorhynchus*	Western North Atlantic	MMPA Strategic	Rare	28,924
Long-finned pilot whale	*Globicephala melas*	Western North Atlantic	MMPA Strategic	Uncommon	39,215
Melon-headed whale	*Peponocephala electra*	Western North Atlantic	MMPA Non-strategic	Not Expected	Unknown
Risso's dolphin	*Grampus griseus*	Western North Atlantic	MMPA Non-strategic	Uncommon	35,493
Common dolphin	*Delphinus delphis*	Western North Atlantic	MMPA Non-strategic	Common	172,825
Fraser's dolphin	*Lagenodelphis hosei*	Western North Atlantic	MMPA Non-strategic	Rare	Unknown
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	Western North Atlantic	MMPA Non-strategic	Common	93,233
White-beaked dolphin	*Lagenorhynchus albirostris*	Western North Atlantic	MMPA Non-strategic	Rare	536,016
Pantropical spotted dolphin	*Stenella attenuata*	Western North Atlantic	MMPA Non-strategic	Rare	6,593
Clymene dolphin	*Stenella clymene*	Western North Atlantic	MMPA Non-strategic	Not Expected	Unknown
Striped dolphin	*Stenella coeruleoalba*	Western North Atlantic	MMPA Non-strategic	Rare	67,036
Atlantic spotted dolphin	*Stenella frontalis*	Western North Atlantic	MMPA Non-strategic	Uncommon	39,921

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Common Name	Scientific Name	Stock	Current Population Status	Occurrence in the RWEC-RI Project Area	Best Abundance Estimate[1]
Spinner dolphin	*Stenella longirostris*	Western North Atlantic	MMPA Non-strategic	Rare	4,102
Rough toothed dolphin	*Steno bredanensis*	Western North Atlantic	MMPA Non-strategic	Rare	136
Common bottlenose dolphin	*Tursiops truncatus*	Western North Atlantic, offshore	MMPA Non-strategic	Common	62,851
		Western North Atlantic, Northern migratory coastal	MMPA Depleted and Strategic	Rare	6,639
Harbor porpoise	*Phocoena phocoena*	Gulf of Maine/Bay of Fundy	MMPA Non-strategic RI State SGCN	Common	95,543
Harbor seal	*Phoca vitulina*	Western North Atlantic	MMPA Non-strategic RI State SGCN	Regular	75,834
Gray seal	*Halichoerus grypus*	Western North Atlantic	MMPA Non-strategic	Regular	27,131
Harp seal	*Pagophilus groenlandica*	Western North Atlantic	MMPA Non-strategic	Rare	Unknown
Hooded seal	*Cystophora cristata*	Western North Atlantic	MMPA Non-strategic	Rare	Unknown
Florida manatee[2]	*Trichechus manatus latirostris*	-	ESA Threatened MMPA Depleted and Strategic	Rare	Unknown

1 Best abundance estimate from the Draft 2019 Marine Mammal Stock Assessment Report, published by NMFS on the Federal Register on 27 November 2019 (84 FR 65353).

2 Under management jurisdiction of United States Fish and Wildlife Service rather than National Marine Fisheries Service (USFWS, 2019).

Definitions: Common – Occurring consistently in moderate to large numbers; Regular – Occurring in low to moderate numbers on a regular basis or seasonally; Uncommon – Occurring in low numbers or on an irregular basis; Rare – Records for some years but limited; and Not expected – Range includes the Project Area but due to habitat preferences and distribution information species are not expected to occur in the Project Area although records may exist for adjacent waters.

Species densities will likely be lower in state waters for some groups relative to OCS waters, and a few of the more offshore species whose densities are already low, are unlikely to occur in state waters. Information regarding distances from shore for marine mammal migratory routes are not available for all species. Surveys suggest that some cetacean species, notably the NARW and humpback whale, can be found between 50 and 2,000 m from shore while migrating (Best et al., 1998; Hayes et al., 2020). Fin whales, humpback whales, NARWs, and minke whales have all been observed in the Rhode Island state waters associated with the RWEC and will be most abundant in the winter and spring (Kenney and Vigness-Raposa, 2010; Kraus et al., 2016). Sei whales and blue whales are not anticipated in state waters. Sperm whales have been observed in Rhode Island state waters near Block Island following prey species and may be encountered in the RWEC–RI area during summer and fall (CETAP, 1982; Kenney and Vigness-Raposa, 2010).

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Common bottlenose dolphin, common dolphins, and Atlantic white-sided dolphins are the only dolphin species expected to occur with regularity in the RWEC–RI (Kenney and Vigness-Raposa, 2010; Hayes et al., 2020). Harbor porpoises are known to prefer shallower waters closer to shore and are likely to occur in Rhode Island state waters as they travel between their winter habitat in the Mid-Atlantic to their summer habitat in the Gulf of Maine (Kenney and Vigness-Raposa, 2010). They are predominantly expected in the winter and spring.

Historically, seals were rare in Rhode Island state waters, but since the passing of the MMPA in 1972 observations of harbor and gray seals have increased and they are most abundant in these waters from late fall until late spring (McLeish, 2016). Arctic species such as harp, hooded, and ringed seals have also been reported in Narragansett Bay, although sightings of these species are rare (Kenney and Vigness-Raposa, 2010). Harbor seals are the most frequently observed seal species throughout the coastal waters of Rhode Island and adjacent state waters (Kenney and Vigness-Raposa, 2010). Gray seals are less common in Rhode Island, but recovery of the Massachusetts and Canadian breeding populations has led to a recent increase in gray seal observations in New England waters (Kenney and Vigness-Raposa, 2010; Hayes et al., 2020). Both species are expected to occur in the RWEC–RI; harbor seals may be present year-round in lower densities, but peak presence of both species is likely to occur in late spring through early summer (Kenney and Vigness-Raposa, 2010).

The Northeastern United States coast, including waters off Rhode Island, contains a variety of marine habitats that are suitable for these sea turtles, such as the shallow enclosed waters of the Peconic Bay and other bays in Long Island, the deeper waters of Long Island Sound and the Atlantic Ocean (Burke et al., 1993). With Rhode Island state waters being located within three miles of shore, more suitable habitat for adult sea turtles would be available compared to areas farther offshore.

There are four sea turtle species commonly found throughout the western North Atlantic which may occur within the Study Area. Consequently, these four species are considered potentially affected species. These species include the green sea turtle (*Chelonia mydas*), Kemp's ridley sea turtle (*Lepidochelys kempii*), leatherback sea turtle (*Dermochelys coriacea*), and loggerhead sea turtle (*Caretta caretta*). A fifth species, hawksbill sea turtle (*Eretmochelys imbricata*), may potentially occur within the region, but was not considered further in the impact assessment due to its use of tropical waters and coral reef habitats. Since this habitat is not present within the North Atlantic region, the presence of the hawksbill sea turtle would be extremely rare (NOAA Greater Atlantic Region Fisheries Office ["GARFO"], 2017). The four turtle species discussed in this section are listed as Endangered or Threatened under the ESA and are also listed as Endangered by the state of Rhode Island (RIDEM, 2021b). USFWS and NMFS share the responsibility for sea turtle recovery under the authority of the ESA.

3.5.2 Potential Project Impacts

3.5.2.1 Construction and Decommissioning

Seafloor disturbances associated with installation and removal of the RWEC-RI may impact marine mammals and sea turtles by disrupting and temporarily displacing potential benthic prey species in the immediate area around the cable route. Marine mammals and sea turtles

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occurring in the area would likely be transiting in search of prey species, which may occasionally be benthic species. As discussed within Section 3.3.2, benthic species are expected to recover within 1 to 3 years.

Underwater noise generated by construction activities (including use of a pneumatic hammer at the landfall location for installation of the casing pipe and "goal posts") could result in potential physiological and behavioral impacts on marine mammals and sea turtles. However, some marine mammal species show a preference for deeper waters and are less likely to occur in shallower Rhode Island state waters of the RWEC–RI, which may reduce the risk for potential impacts from nearshore construction.

Seasonal increases in marine mammal presence within offshore areas may increase the risk of exposure to above-threshold noise. For those very few individuals that may perceive the non-impulsive noise from DP vessels, impacts may be considered consequential if behavioral disruptions, short-term disruptions in communication, or temporary displacement from the ensonified area were to occur as this could result in the interruption of biologically significant behaviors.

Pinnipeds that may be present along the RWEC–RI could also be susceptible to in-air noise disturbance at haul out sites or pupping grounds, and in-air thresholds have been established by NMFS. However, above water noise impacts to pinnipeds are not expected to occur because the nearest known haul site for seals is approximately 3 km (1.86 mi) from the proposed location of the onshore Project components, and activities at this location are anticipated to produce relatively low levels of in-air noise.

Vessel strikes are another potential impact to marine mammals and sea turtles. Vessel strikes happen when either the animal or the vessel fails to detect one another in time to avoid the collision. Variables that contribute to the likelihood of a collision include vessel speed, vessel size and type and barriers to vessel detection by an animal (e.g. acoustic masking, heavy traffic, biologically focused activity). Most reports of collisions involve large whales, but collisions with smaller species have been reported (Evans et al., 2011; Van Waerebeek et al., 2007). Construction vessel traffic will result in a relatively localized impact that will occur sporadically throughout the approximate 8-month construction period, temporarily increasing the volume and movement of vessels. In the unlikely event that a strike resulting in injury or mortality were to occur, impacts could result in removal of those individuals from the population. The impacts resulting from the removal of an individual from a population that is listed as Endangered is countered by their overall resilience to population-level impacts. Due to comparatively low species densities, and the implementation of the avoidance measures discussed in 3.2.5.3 below, there is a low risk of impacts to occur. However, increased vessel traffic poses a strike risk for marine mammals during RWEC-RI construction.

Artificial lighting during installation and removal of the RWEC-RI will be associated with navigational and deck lighting on vessels from dusk to dawn. Only a limited area would be associated with the artificial lighting used on vessels relative to the surrounding unlit areas and the linear installation of the RWEC-RI will cause the lit area to constantly move along the cable route. Because of the relatively short duration of installation activities, lighting impacts for marine mammals will not be significant.

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3.5.2.2 Operations and Maintenance

There are no anticipated impacts during O&M of the RWEC-RI unless a cable repair is required. Repair or replacement of cables or cable protection associated with the RWEC-RI during operations are considered non-routine maintenance activities potentially resulting in the same or lesser impacts as construction.

3.5.3 Proposed Avoidance, Minimization, and Mitigation Measures

Environmental protective measures proposed by Revolution Wind are summarized in Section 2.5.2. Below is a list of measures applicable to marine mammals and sea turtles:

- To the extent feasible, installation of the RWEC-RI will occur using equipment such as mechanical cutter, mechanical plow, or jet plow.
- To the extent feasible, the RWEC-RI will typically target a burial depth of 4 to 6 ft (1.2 to 1.8 m) below seabed. The target burial depth will be determined based on an assessment of seabed conditions, seabed mobility, the risk of interaction with external hazards such as fishing gear and vessel anchors, and a site-specific CBRA.
- DP vessels will be used for installation of the RWEC-RI to the extent practicable.
- A plan for vessels will be developed prior to construction to identify no-anchorage areas to avoid documented sensitive resources.
- Vessels will follow NOAA and BOEM guidelines for marine mammal and sea turtle strike avoidance measures, including vessel speed restrictions.
- All personnel working offshore will receive training on marine mammal and sea turtle awareness and marine debris awareness.
- Revolution Wind will require all construction and operations vessels to comply with regulatory requirements related to the prevention and control of spills and discharges.
- Accidental spill or release of oils or other hazardous materials offshore will be managed through the OSRP.
- A ramp-up or soft-start will be used at the beginning of each pile segment during pneumatic pile driving to provide additional protection to mobile species in the vicinity by allowing them to vacate the area prior to the commencement of pile driving activities.
- Construction and operational lighting will be limited to the minimum necessary to ensure safety and to comply with applicable regulations.
- All vessels will comply with USCG and EPA regulations that require operators to develop waste management plans, post informational placards, manifest trash sent to shore, and use special precautions such as covering outside trash bins to prevent accidental loss of solid materials. Vessels will also comply with BOEM lease stipulations that require adherence to NTL 2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of placards at prominent locations on offshore vessels and structures, and mandates a yearly marine trash and debris awareness training and certification process.

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3.6 Commercial and Recreational Fishing

3.6.1 Affected Environment

The regional waters off the coast of Rhode Island and Massachusetts are transitional waters that separate Narragansett Bay and Long Island Sound from the OCS (BOEM, 2013). These waters straddle the Mid-Atlantic and New England regions and serve as the northern boundary for some Mid-Atlantic species and the southern boundary for some New England species. The species that may be found in the RWEC-RI reflect the transitional nature of this regional area.

Several factors directly affect spatial and temporal patterns of fish species, including habitat. The coastal waters of New England have diverse habitats that are defined by their temperature, salinity, pH, nutrient concentrations, physical structure, biotic structure, depth, and currents. The unique combination of habitat characteristics shapes the community of fish and invertebrate species that inhabit the area. Habitat characteristics influence species composition, distribution, and predator/prey dynamics. Benthic communities have experienced increased water temperatures in the region in the past several decades, and average pH is expected to continue to decline as seawater becomes more saturated with carbon dioxide (Saba et al., 2016). Acidification of seawater poses a threat to the health and survival of organisms with calcareous shells (such as the Atlantic scallop, blue clam, and hard clam), but less is known about direct effects of acidification on cartilaginous and bony fishes.

The distributional ranges of several groundfish species in New England waters have shifted northward and into deeper waters in response to increasing water temperatures (Pinsky et al., 2013; Nye et al., 2009) and more species are predicted to follow (Selden et al., 2018; Kleisner et al., 2017). The black sea bass, identified as particularly sensitive to habitat alteration (Guida et al., 2017), has been increasing in abundance over the past several years, and is expected to continue its expansion in southern New England as water temperatures increase (Kuffner, 2018; McBride et al., 2018). Several pelagic forage species have been increasing in the region, including butterfish, scup, squid (Collie et al., 2008) and Atlantic mackerel (McManus et al., 2018). Distributions of other species are reported to be shifting southward, including spiny dogfish, little skate, and silver hake (Walsh et al., 2015). It has been suggested that the spiny dogfish may replace the Atlantic cod as a major predator in southern New England as the cod is driven north by warm waters that the spiny dogfish tolerates well (Selden et al., 2018). Detailed information on commercial and recreational fishing can be found in Appendix I.

Further temperature increases in southern New England are expected to exceed the global ocean average by at least a factor of two, and ocean circulation patterns are projected to change (Saba et al., 2016). Distributional shifts are occurring in both demersal and pelagic species, perhaps mediated by changes in spawning locations and dates (Walsh et al., 2015). Southern species, including some highly migratory species such as mahi mahi that prefer warmer waters, are expected to follow the warming trend and become more abundant in the area (Walsh et al., 2015; South Atlantic Fishery Management Council, 2003). Climate change may also influence the migration behavior of anadromous fish in the region. The herrings, shad, and sturgeon were identified as having high biological sensitivity to adverse effects of

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climate change (Hare et al., 2016). In addition to physiological effects of temperature and pH, anadromous fishes face a physical risk caused by flooding in their spawning rivers.

As summarized in BOEM's Revised Environmental Assessment (BOEM, 2013), finfish assemblages off the coast of Rhode Island include demersal, pelagic, and shark species. In addition, there are important shellfish and migratory pelagic finfish throughout the region. Demersal species including groundfish such as cod and haddock, as well as other commercially important species such as monkfish, black sea bass, and winter skate. Many of these demersal fish species are considered to be high-value and are sought by both commercial and recreational anglers. Pelagic fishes are generally schooling and occupy the mid- to upper water column as juveniles and adults and are distributed from the nearshore to the continental slope and beyond. Some species are highly migratory and are reported to be present in the near-coastal and shelf surface waters of Southern New England waters in the summer, taking advantage of the abundant prey in the warm surface waters. Coastal migratory pelagics include fast-swimming schooling fishes that range from shore to the continental shelf edge and are sought by both recreational and commercial anglers. These fish use the highly productive coastal waters of the more expansive Mid-Atlantic Bight during the summer months and migrate to deeper and/or distant waters during the remainder of the year (BOEM, 2013). Several shark species also occupy this region.

3.6.2 Potential Project Impacts

3.6.2.1 Construction and Decommissioning

Construction and decommissioning activities associated with the RWEC-RI are generally expected to have short-term, localized impacts on access to fishing grounds due to safety measures on entering the area. In Rhode Island state waters fishing activity primarily uses pots and traps, followed by fixed nets, and the top species landed are scup, channeled whelk and summer flounder (Atlantic Coastal Cooperative Statistics Program, 2019). According to available VMS data (Northeast Regional Ocean Council, 2020), vessel intensity for the Atlantic herring, pelagic species (herring, mackerel, squid), monkfish, and squid fisheries are medium-high to very high along portions of the RWEC-RI route; therefore these fisheries are most likely to be affected during installation of the RWEC-RI.

3.6.2.2 Operations and Maintenance

During O&M of the RWEC-RI, commercial and recreational fisheries are expected to experience no effect or limited effects because the cables will be buried beneath the seabed. The USCG's stated policy is that "in the United States vessels will have the freedom to navigate through [wind farms], including export cable routes." (See USCG Navigation and Vessel Inspection Circular 01-19 dated 1 August 2019.) Therefore, commercial fishermen will have the ability to continue to fish along the RWEC-RI corridor.

As discussed in Sections 3.3.2.2 and 3.4.2.2, based on EMF modeling performed for the Project (Exponent, 2020), behavioral effects and/or changes in abundance and distributions of marine organisms due to EMF are not expected.

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3.6.3 Proposed Avoidance, Minimization, and Mitigation Measures

Environmental protective measures proposed by Revolution Wind are summarized in Section 2.5.2. Below is a list of measures applicable to commercial and recreational fishing:

- To the extent feasible, installation of the RWEC-RI will occur using equipment such as mechanical cutter, mechanical plow, or jet plow.
- Revolution Wind is committed to collaborative science with the commercial and recreational fishing industries pre-, during, and post-construction. Fisheries monitoring studies are being planned to assess the impacts associated with the Project on economically and ecologically important fisheries resources. These studies will be conducted in collaboration with the local fishing industry and will build upon monitoring efforts being conducted by affiliates of Revolution Wind at other wind farms in the region.
- Communications and outreach with the commercial and recreational fishing industries will be guided by the Project-specific Fisheries Communication and Outreach Plan (see Appendix DD of the Project's COP).
- RWEC was sited to avoid conflicts with DoD use areas and navigational areas identified by the USCG, as applicable.
- Revolution Wind will consult with USCG, NUWC-Newport RI, the Northeast Marine Pilots Association and regional ferry service operators to avoid or reduce use conflicts.
- Project construction and O&M activities will be coordinated with appropriate contacts at USCG, NUWC-Newport, RI, and the Northeast Marine Pilots.
- A comprehensive communication plan will be implemented during offshore construction to inform all mariners, including commercial and recreational fishermen, and recreational boaters of construction activities and vessel movements. Communication will be facilitated through a Fisheries Liaison, Project website, and public notices to mariners (in coordination with USCG).

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4

Regulatory Standards

4.1 Water Quality Regulatory Standards

The RIDEM Water Quality Regulations, codified at 250-RICR-150-05-1[5], establish surface water quality standards, water use classifications and water quality criteria applicable to all waters of the state. Revolution Wind requires a Water Quality Certification pursuant to WQR Section 1.15(A)(3)

> *(a) In accordance with Section 401 of the Clean Water Act, 33 U.S.C. § 1341, applicants for any project which may result in a discharge to waters of the State and which requires a federal permit….*

and

> *(b) projects involving one or more of the activities listed below which are within the jurisdiction of the Rhode Island Coastal Resources Management Council in accordance with R.I. Gen. Laws Chapter 46-23….*
>
> *(1) Dredging and Dredged Material Disposal*
>
> and
>
> *(2) Filling of Waters of the State*

As described in Section 3.2 of this Application, surface waters within the RWEC-RI Project Area include SB waters within approximately 3,700 feet of the shoreline at Quonset (Waterbody ID RI0007027E-03D), and SA waters for the remainder of the RWEC-RI (Waterbody IDs RI0007027E-03A and -03F; RI0010042C-02). These waters are not identified as Outstanding National Resource Water ("ONRWs") or Special Resource Protection Waters ("SRPWs"). For the purposes of assessing the Antidegradation Provisions of the Water Quality Regulations, Revolution Wind assumes that the RWEC-RI is within High Quality Waters ("HQWs") since they are not listed in the State of Rhode Island 2018-2020 Impaired Waters Report[6].

5 https://risos-apa-production-public.s3.amazonaws.com/DEM/REG_10722_20190117114831.pdf

6 http://dem.ri.gov/programs/benviron/water/quality/pdf/iwr1820.pdf

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Sections 1.1 through 1.9, 1.10(A), (D) and (F), 1.14, 1.15, 1.17-1.19, 1.23-1.25,1.28 and 1.29 of the WQR are noted and/or do not apply to the Project and are therefore not restated herein. WQR Section 1.10 (B), (C) and (E), 1.11, 1.12, 1.13, 1.16, 1.20-1.22, 1.26 and 1.27 are applicable to the Project and addressed below.

The WQR identify the following criteria, conditions, prohibitions and standards:

4.1.1 WQR Section 1.10 B - General Criteria

The following minimum criteria are applicable to all waters of the State, unless criteria specified for individual classes are more stringent:

1. At a minimum, all waters shall be free of pollutants in concentrations or combinations or from anthropogenic activities subject to these regulations that:

a. Adversely affect the composition of fish and wildlife;

b. Adversely affect the physical, chemical, or biological integrity of the habitat;

c. Interfere with the propagation of fish and wildlife;

d. Adversely alter the life cycle functions, uses, processes and activities of fish and wildlife; or

e. Adversely affect human health.

The Project will not adversely affect, alter, or interfere with fish and wildlife; the physical, chemical, or biological integrity of the habitat; the life cycle functions, uses, processes and activities of fish and wildlife; or human health. The Project also will not interfere with the propagation of fish and wildlife due to the temporary and isolated nature of the impacts. Refer to Sections 3.2.2, 3.3.2, 3.4.2, 3.5.2 and 3.6.2 of this Application.

2. Aesthetics - all waters shall be free from pollutants in concentrations or combinations that:

a. Settle to form deposits that are unsightly, putrescent, or odorous to such a degree as to create a nuisance, or interfere with the existing or designated uses;

b. Float as debris, oil, grease, scum or other floating material attributable to wastes in amounts to such a degree as to create a nuisance or interfere with the existing or designated uses;

c. Produce odor or taste or change the color or physical, chemical or biological conditions to such a degree as to create a nuisance or interfere with the existing or designated uses; or,

d. Result in the dominance of species of fish and wildlife to such a degree as to create a nuisance or interfere with the existing or designated uses.

The Project will not discharge pollutants to waters of the state. Refer to Sections 2.5.1.2, 3.2.3 and 3.3.3 of this Application.

3. Radioactive substances - The level of radioactive materials in all waters shall not be in concentrations or combinations which will likely be harmful to humans, fish and wildlife, or result in concentrations in organisms producing undesirable conditions.

The Project will not discharge radioactive substances to waters of the state.

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4. Nutrients - Nutrients shall not exceed the limitations specified in §§ 1.10(D)(1) and 1.10(E)(1) of this Part and/or more stringent site-specific limits necessary to prevent or minimize accelerated or cultural eutrophication.

The Project will not discharge nutrients to waters of the state.

5. Thermal Mixing Zones - In the case of thermal discharges into tidal rivers, fresh water streams or estuaries, where thermal mixing zones are allowed by the Director, the mixing zone will be limited to no more than one quarter (1/4) of the cross sectional area and/or volume of river flow, stream or estuary, leaving at least three quarters (3/4) free as a zone of passage. In wide estuaries and oceans, the limits of mixing zones will be established by the Director.

Not applicable. The Project does not propose thermal discharges to waters of the state.

6. Non-thermal Mixing Zones - In the case of non-thermal discharges, in applying these standards the Director may recognize, where appropriate, a limited acute and/or chronic mixing zone(s) on a case-by-case basis. The locations, size and shape of these zones shall provide for the maximum protection of fish and wildlife.

Not applicable. The Project does not propose non-thermal discharges to waters of the state. Revolution Wind will also comply with TOY restrictions (see Section 2.5.1.1).

7. At a minimum, all mixing zones must:

a. Meet the criteria for aesthetics, in accordance with § 1.10(B)(2) of this Part;

b. Be limited to an area or volume that will prevent interference with the existing and designated uses in the associated waterbody segment and beyond;

c. Allow an appropriate zone of passage for migrating fish and other organisms, prohibit lethality to organisms passing through the mixing zone, and protect for spawning and nursery habitat; and

d. Not allow substances to accumulate in sediments, fish and wildlife or food chains such that known or predicted safe exposure levels for the health of humans or fish and wildlife will be exceeded.

Not applicable. The Project does not propose discharges to waters of the state. Revolution Wind will also comply with TOY restrictions (see Section 2.5.1.1).

8. For activities that will likely cause or contribute to flow alterations, streamflow conditions must be adequate to support existing and designated uses.

Not applicable. The Project does not propose activities that would alter flows or stream flow conditions and proposes no water withdrawals.

4.1.2 WQR Section 1.10 C – Applicable Conditions

The water quality standards apply under the most adverse conditions, as determined by the Director according to sound engineering and scientific practices on a case-by-case basis unless defined below. The ambient water quality criteria are applicable at or in excess of the following flow conditions:

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1. Aquatic Life Criteria - The acute and chronic aquatic life criteria for freshwaters shall not be exceeded at or above the lowest average 7 consecutive day low flow with an average recurrence frequency of once in 10 years (7Q10). The acute and chronic aquatic life criteria for seawater shall not be exceeded beyond the boundary of the mixing zone(s), as defined and determined by §§ 1.10(B)(5) and (6) of this Part, and thence throughout the waterbody. If a mixing zone has not been established, these criteria shall not be exceeded in any portion of the receiving water.

Not applicable. The Project does not propose discharges to freshwaters or discharges to seawaters requiring a mixing zone. Revolution Wind will also comply with TOY restrictions (see Section 2.5.1.1).

2. Human Health Criteria - The freshwater human health criteria for non-carcinogens and carcinogens are applicable at or in excess of the harmonic mean flow, which is a long-term mean flow value calculated by dividing the number of daily flows analyzed by the sum of the reciprocals of those daily flows. For seawaters, the ambient human health water quality criteria for carcinogens and non-carcinogens are applicable when the most adverse hydrographic and pollution conditions occur at the particular point of evaluation.

Not applicable. The Project does not propose discharges to waters of the state.

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4.1.3 WQR Section 1.10 E – Class Specific Criteria-Saltwaters

Criterion	Class SA, SA{b}	Class SB, SB1, SB{a}, SB1{a}	Response
Sludge deposits, solid refuse, floating solids, oil, grease, scum	*None allowable.*	*None allowable.*	**Not applicable. The Project proposes no such discharges.**
Color and turbidity	*None in such concentrations that would impair any usages specifically assigned to this class. Turbidity not to exceed 5 NTU over background.*	*None in such concentrations that would impair any usages specifically assigned to this class. Turbidity not to exceed 10 NTU over background.*	**Short term temporary sediment suspension is expected to occur during cable installation activities and excavation/backfill of the HDD exits pits. Duration and extent of potential effects are described in Section 3.2.2.1 and the Hydrodynamic and Sediment Transport Modeling Report – Rhode Island State Waters provided at Appendix H.**
Fecal Coliform Bacteria	*Shellfishing Criteria: - Not to exceed a geometric mean MPN or MF (mTEC) value of 14 per 100ml and not more than either 10% of the estimated 90th percentile of the samples shall exceed an MPN value of 49 per 100ml for a three-tube decimal dilution or 31 cfu per 100ml for MF (mTEC).*		**Not applicable. The Project proposes no such discharges.** **The State of Rhode Island does not allow the discharge of untreated sewage from boats within the three-nautical mile limit of state waters. Boats with permanently installed marine toilets must be inspected and certified as compliant with Rhode Island No-Discharge Law.** **All vessels will comply with USCG and EPA regulations that require operators to develop waste management plans, post informational placards, manifest trash sent to shore, and use special precautions such as covering outside trash bins to prevent accidental loss of solid materials.**
	Primary Contact Recreational/Swimming Criteria - Not to exceed a geometric mean value of 50 MPN/100 ml and not more than 10% of the total samples taken shall exceed 400 MPN/100 ml, applied only when adequate enterococci data are not available.		
Enterococci	*Primary Contact Recreational/Swimming Criteria Geometric Mean Density: 35 colonies/100 ml Single Sample Maximum*: 104 colonies/100 ml* ** Criteria for determining beach swimming advisories at designated beaches as evaluated by the Rhode Island Department of Health.*		**Not applicable. The Project proposes no such discharges. See previous response.**

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Taste and odor	*None allowable except as naturally occurs.*	*None in such concentrations that would impair any usages specifically assigned to this class nor cause taste or odor in edible portions of fish or shellfish.*	**Not applicable. The Project does not propose activities that will affect ambient water taste and odor nor cause taste or odor in edible portions of fish or shellfish.**
pH	*6.5 - 8.5 but not more than 0.2 units outside of the normally occurring range.*		**Not applicable. The Project does not propose activities that will affect ambient water pH.**
Dissolved Oxygen	*See § 1.10(F) of this Part.*		**Not applicable. The Project does not propose activities that will affect ambient water DO.**
Chemical constituents	*None in concentrations or combinations that could be harmful to humans or fish and wildlife for the most sensitive and governing water class use, or unfavorably alter the biota, or which would make the waters unsafe or unsuitable for fish and wildlife or their propagation, impair the palatability of same, or impair the waters for any other existing or designated use. None in such concentrations that would exceed the Water Quality Criteria and Guidelines as found in § 1.26 of this Part.* *The ambient concentration of a pollutant in a water body shall not exceed the RI DEM Ambient Water Quality Criteria & Guidelines (§ 1.26 of this Part) for the protection of aquatic organisms from acute or chronic effects, unless the criteria or guideline is modified by the Director based on results of bioassay tests conducted in accordance with the terms and conditions provided in § 1.29 of this Part.*		**Not applicable. Revolution Wind proposes no such discharges.**
Nutrients	*None in such concentration that would impair any usages specifically assigned to said Class, or cause undesirable or nuisance aquatic species associated with cultural eutrophication. Shall not exceed site-specific limits if deemed necessary by the Director to prevent or minimize accelerated or cultural eutrophication. Total phosphorus, nitrates and ammonia may be assigned site-specific permit limits based on reasonable Best Available Technologies.*		**Not applicable. The Project proposes no such discharges.**

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	Where waters have low tidal flushing rates, applicable treatment to prevent or minimize accelerated or cultural eutrophication may be required for regulated nonpoint source activities.	
Temperature/ Temperature Increase	*Activities shall not increase the temperature except where the increase will not exceed the recommended limit on the most sensitive receiving water use and in no case shall an activity cause the temperature to exceed 83 degrees F nor raise the normal temperature more than 1.6 degrees F, 16 June through September and not more than 4 degrees F from October through 16 June. All measurements shall be made at the boundary of such mixing zones as is found to be reasonable by the Director.*	**Not applicable. The Project does not propose activities that will affect ambient water temperatures.**

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4.1.4 WQR Section 1.11 – Effect of Activities on Water Quality Standards

A. Activities Shall Not Violate Water Quality Standards - No person shall discharge pollutants into any waters of the State or perform any activities alone or in combination which the Director determines will likely result in the violation of any State water quality criterion or interfere with one or more of the existing or designated uses assigned to the receiving waters or to downstream waters in accordance with §§ 1.9, 1.10, and 1.20 of this Part. In addition, Best Management Practices, as determined by the Director, shall be used to control erosion, sedimentation and runoff in accordance with § 1.17 of this Part.

Revolution Wind will comply. The Project does not propose discharges of pollutants to waters of the state. Best management practices will be used as described in Section 2.5. Best management practices will also be used at the proposed Landfall Work Area to control erosion and sedimentation during onshore construction in accordance with the RIPDES Construction General Permit requirements.

B. Activities Shall Not Further Degrade Low Quality Waters….

C. Activities Shall Not Violate Antidegradation….

D. Mixing Zone - Due to discharges to surface waters, the Director may recognize, where appropriate, a limited mixing zone on a case-by-case basis. In no case may a mixing zone cause a loss of, or impair, any existing or designated use.

E. Restrictions to New Discharges….

1. New discharges into the terminal reservoir of a public drinking water supply….

2. New discharges into waters that are not public drinking water supplies may include:

a. discharges of stormwater drainage;

b. discharges from industrial non-contact cooling water;

c. discharges from construction site dewatering provided that the applicant has demonstrated to the satisfaction of the Director that no reasonable alternatives exist;

d. discharges from groundwater remediation projects provided that the applicant has demonstrated to the satisfaction of the Director that no reasonable alternatives exist;

e. discharges from aquaculture facilities as appropriately authorized by all required state agencies;

f. discharges from water main maintenance such as main flushing and cleaning operations;

g. discharges of dredged material;

h. discharges from farming activities into surface waters which are hydrographically disconnected from all other surface waters;

i. placement of suitable solid materials in appropriate amounts for the purpose of the formation of an artificial reef as approved by the Director;

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j. discharges from aquatic research related activities provided that the applicant has demonstrated to the satisfaction of the Director that no reasonable alternatives exist;

k. discharges from desalination facilities into seawaters; and

l. other new discharges provided the applicant demonstrates to the satisfaction of the Director that:

(1) the discharge serves a compelling public purpose which provides benefits to the public as a whole as opposed to individual or private interests;

(2) there is no reasonable alternative means of, or location for, serving the compelling public purpose cited; and

(3) the discharge will not impair existing uses nor attainment of designated uses.

Not applicable. The Project will not result in discharges of pollutants to waters of the State.

4.1.5 WQR Section 1.12 – Procedures for Determining Additional Requirements for Effluent Limitations, Treatment and Pretreatment

A. Effluent Limited and Water Quality Limited Waters - No person shall discharge pollutants into any surface waters of the State or discharge to a treatment works unless the discharge complies with any additional effluent limitations and receives any additional treatment/pretreatment which the Director determines is necessary to comply with § 1.11 of this Part, or to prevent overloading or damaging effect upon a treatment works. In order to determine which waters require additional effluent limitations, treatment or pretreatment to comply with § 1.11 of this Part, or to prevent overloading or damaging effects upon a treatment works, the Director will categorize the surface waters of the State into effluent limited and water quality limited waters. Such classifications will be recorded in Section 305(b) of the Clean Water Act, 33 U.S.C. § 1315, biennial State of the State's waters reports, and will be revised as necessary.

Not applicable. The Project does not propose discharges to waters of the state or a treatment works.

B. Total Maximum Daily Loads in Water Quality Limited Waters - For water quality limited waters, the Director shall identify those pollutants within discharges to the water quality limited waters which do or have the reasonable potential to cause or contribute to a violation of § 1.11 of this Part. The Director shall develop a total maximum daily load (TMDL) for each of these pollutants. The TMDL shall determine the maximum amount of the pollutant that can be discharged into the water quality limited waters and be in compliance with § 1.11 of this Part. The TMDL shall be based on best available scientific information and allocation of the TMDL may be based on, but not limited to, technical feasibility of pollutant removal, the relative costs of treatment to the contributing discharges, and the relative contribution from each source. The Director shall not be required to allocate the full amount of the pollutant specified in § 1.11 of this Part, but may designate a portion of the allocation as a reserve or margin of safety as deemed necessary.

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Not applicable. The RWEC-RI is not proposed within a water quality limited water.

4.1.6 WQR Section 1.13 – Prohibited Discharges

Revolution Wind acknowledges the standards set forth in WQR Section 1.13 of the WRR and does not restate those herein. The Project does not propose any of the prohibited discharges described in WQR Section 1.13.

Project vessels operating in state waters will adhere to Rhode Island's No-Discharge Compliance Program. All vessels equipped with permanent marine toilets will be inspected and certified as compliant as required by Rhode Island state law. Revolution Wind will also meet other applicable regulations and standards, as set by the International Maritime Organization's ("IMO") International Convention for the Prevention of Pollution from Ships ("MARPOL"), the USCG, and the State of Rhode Island, for treatment and disposal of solid and liquid wastes generated during all phases of the Project. Refer to Table 2.5-1 in Section 2.5.2 of this Application.

Refer to Appendix G for the Project's OSRP/ERP.

4.1.7 WQR Section 1.16 Application for Approvals

Revolution Wind acknowledges the application requirements in Section 1.16 of the WQR and does not restate them here. This Application narrative and supporting documents are provided for review and approval per WQR Section 1.16.

4.1.8 WQR Section 1.20 – Antidegradation of Water Quality Standards

A. Purpose - The State Antidegradation Regulations are based on the federal Antidegradation Policy requirements, Antidegradation Policy and Implementation Methods, 40 C.F.R. § 131.12 and have as their objective the maintenance and protection of various levels of surface water quality and uses. Antidegradation applies to all projects or activities subject to these regulations which will likely lower water quality or affect existing or designated water uses, including but not limited to all Water Quality Certification reviews and any new or modified RIPDES permits. For the disposal of dredged or fill material into the waters of the State, Guidelines for Specification of Disposal Sites for Dredged or Fill Material, 40 C.F.R. § 404(b)(1), incorporated above in § 1.3(C) of this Part, guidelines shall be followed in the evaluation of 40 C.F.R. § 131.12(a)(1), incorporated above in § 1.3(F) of this Part, and the State's Antidegradation Policy. The Antidegradation regulations consist of four (4) tiers of water quality protection.

B. Tier 1 - Protection of Existing Uses - Any existing in situ water uses and level of surface water quality necessary to protect the existing uses, shall be maintained and protected.

Revolution Wind will comply. The Project does not propose any discharges to waters of the state and the Project will not affect existing water uses or water quality.

C. Tier 2 - Protection of Water Quality in High Quality Waters

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Revolution Wind will comply. The Project does not propose any discharges to waters of the state. In addition, as discussed throughout Sections 3.3 through 3.6 of this Application, the Project will not adversely impact fish, wildlife, or recreation in and on the water.

D. Tier 2½– Protection of Water Quality for SRPWs

Not applicable. The RWEC-RI is not proposed within a SRPW.

E. Tier 3 - Protection of Water Quality for ONRWs

Not applicable. The RWEC-RI is not proposed within a ONRW.

F. Implementation - The Antidegradation provisions shall be implemented in accordance with the Antidegradation Implementation Policy § 1.27 of this Part.

The Project will comply with the Antidegradation Implementation Policy. See Section 4.1.12.

4.1.9 WQR Section 1.21 – Modification of Water Quality Standards

The Project does not require a modification to a water quality standard.

4.1.10 WQR Section 1.22 – Variances from Water Quality Standards

The Project does not anticipate requiring a variance from any water quality standard because all standards will be attained.

4.1.11 WQR Section 1.26 – RIDEM Ambient Water Quality Criteria and Guidelines for Toxic Pollutants

Revolution Wind acknowledges the standards in Section 1.26 of the WQR and does not restate them here because the Project does not involve discharges to waters of the state. In addition, as discussed within Section 2.5.1 of this Application, BMPs will be implemented during construction of the Project.

4.1.12 WQR Section 1.27 – The Implementation of the Antidegradation Provisions of the Rhode Island Water Quality Regulations

Revolution Wind acknowledges the standards in Section 1.27 of the WQR and does not restate them here. The Project seeks a Water Quality Certification to license the installation of two submarine electric transmission cables in Narragansett Bay to deliver offshore renewable wind energy to the Rhode Island and Connecticut electric grids. The Project does not propose to create a new discharge or create new untreated impervious surfaces that would discharge pollutants to waters of the state. The Project is therefore consistent with the Antidegradation Implementation Policy.

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4.2 Dredging and the Management of Dredged Materials Regulatory Standards

The RIDEM/CRMC Rules and Regulations for Dredging and the Management of Dredged Materials, codified at 250-RICR-150-05-2[7], establish standards to ensure that dredging and management of associated dredged material is managed in a way that is protective of groundwater and surface water quality so as to ensure the continued viability and integrity of drinking water and fish and wildlife resources. Revolution Wind has prepared this application for a Dredge Permit pursuant to the Dredging Regulations. The project meets the definition of "Dredging" provided in the Dredging Regulations §2.4.13.:

> *"Dredging" means the movement of sediments from beneath surface waters by mechanical or hydraulic means*.

Revolution Wind does not propose disposal of dredged materials. This Application is being filed to license the temporary excavation of two HDD exit pits in subtidal waters approximately 800 feet from the shoreline at Quonset Point. The spoils from the two exit pits will be stored on a barge until the submarine renewable energy export cables are pulled to shore and properly embedded below the seafloor at the exit pits. After this work is completed, the spoils from the barge will be reinterred to backfill the exit pits and re-establish pre-disturbance seafloor grades. If additional fill is necessary to backfill the exit pits, clean fill of similar grain size will be acquired from an upland source. The process involves excavation and backfill beneath surface waters rather than dredge and transport of spoils to a disposal site.

Subparts 2.1 through 2.4 and 2.13 through 2.15 are noted and are not restated or addressed herein. Subparts 2.5C-E, 2.7C-E, 2.9, 2.10 and 2.12, which address disposal or beneficial reuse of dredged material, and Subparts 2.17 through 2.19 do not apply to the Project and are therefore not restated herein. Subparts 2.5A and B; 2.7A, B, and F; 2.8; and 2.16 are applicable to the Project and are addressed below.

4.2.1 Dredging Regulations Section 2.5 – General Provisions

A. No person shall perform dredging, dewatering, handling, disposal, or make beneficial use of dredged material without prior written approval from the Director, except as provided for in § 2.12 of this Part.

Noted. Revolution Wind is submitting this Application to obtain authorization to construct the Project.

B. Dredging, dewatering, handling, disposal, or beneficial use of dredged material, whether licensed or unlicensed, shall not cause pollution of the waters of the United States or the State of Rhode Island so as to violate the Water Pollution Act, R.I. Gen. Laws., Chapter 46-12, the Groundwater Protection Act, R.I. Gen. Laws Chapter 46-13.1, the Fresh Water Wetlands Act, R.I. Gen. Laws § 2-1- 18 et seq., or §§ 402 and 404 of the Clean Water Act, 33 U.S.C. 1251 et seq.; or cause air pollution, including objectionable odors and fugitive dust, so as to violate the

7 https://rules.sos.ri.gov/regulations/part/250-150-05-2

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Clean Air Act, R.I. Gen. Laws Chapter 23-23 or the federal Clean Air Act, 42 U.S.C. § 7401 et seq., and any regulations promulgated under these authorities.

Revolution Wind will comply. Section 2.5 of this Application discusses the BMPs, avoidance and minimization measures, and monitoring that will be implemented. In addition, the ERP/OSRP included in Attachment F will be implemented.

4.2.2 Dredging Regulations Section 2.6 – Pre-Application Process

Meetings were held with RIDEM and CRMC on June 18, 2020 and November 16, 2020 to discuss the Sediment Sampling Plan and the cable installation methodology at the nearshore portion of the cable. A Sediment Sampling Plan was submitted on June 23, 2020 and approved on July 3, 2020. While the subject of the November 16, 2020 meeting did not specifically address HDD, the agencies shared valuable feedback regarding concerns they might have with those portions of the landfall activities that could be implemented.

4.2.3 Dredging Regulations Section 2.7 – Characterizing Material to be Dredged

A. An application for permission to dredge must include adequate characterization of the material to be dredged, in accordance with the specific provisions set forth in these regulations and any guidance provided by the Department with the application form(s). The Department may waive a specific requirement to the extent the Department finds the requirement is not applicable or the information requested is either not necessary or already available to determine compliance.

B. The Sediment Sampling Plan must provide the following information:

1. A site plan of the area to be dredged, including topography and bathymetry;

The HDD Landfall Design plan set in Appendix A depicts the two offshore exit pits where the horizontal drilling cutting head will emerge and later be used to pull the export cables to shore. The existing bathymetry and dimensions of the proposed exit pits are shown on plan sheets 5 and 6 of 6. The proposed depths of these exit pits are shown in both plan view and profile.

2. The proposed depth of dredging;

3. The location of all proposed sample collection points, which must be representative of the material(s) to be dredged. Sampling points must include, but not be limited to, areas impacted by past spill events or otherwise known or suspected to contain contamination, and areas near outfalls, fueling docks or pumps;

4. Proposed testing parameters and protocols in accordance with § 2.7(C) of this Part; and

5. Proposed sampling procedures and sample handling protocols conducted in accordance with § 2.7(F) of this Part.

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Refer to Figure X in Appendix B Sediment Data and Appendix A Site Plans. A meeting was held with RIDEM on June 18, 2020 to discuss installation methodology at the landfall area and sediment sampling. RIDEM provided guidance on sampling which informed the Sediment Sampling Plan that was submitted on June 23, 2020 and approved on July 3, 2020.

F. Sampling Procedures

1. Core samples must be taken to the proposed depth of dredging including any overdraft, depending on the dredging methodology anticipated.

2. Each core shall be described. Grain size analysis shall be required for each core. A core may be homogenized unless there are distinct strata in grain size and composition, which are at least 2 feet in depth. The Department shall be notified of any cores that show grain size stratification prior to homogenizing. For cores that show grain size stratification, each strata with a depth of 2 feet or greater must be tested for grain size, Total Organic Carbon and percentage moisture.

3. Separate core samples may be composited when the grain size and likelihood of contamination is uniform based on depositional characteristics, spill history, and location of outfalls. Approval must be obtained prior to compositing the samples.

4. Samples must be collected and managed to meet the method requirements for handling, preservation and storage outlined in the documents as noted above in § 2.7(E) of this Part.

Revolution Wind has complied. Refer to Appendix B Sediment Data.

G. Approval of the Sampling Plan: Once the Department has reviewed the sampling plan and accepted it, the Department will issue a written approval of the sampling plan. Upon receipt of approval, the applicant may go forward with implementation. For in- water disposal, this evaluation will be conducted in coordination with the Council and the USACE.

Revolution Wind submitted a Sediment Sampling Plan in accordance with this section on June 23, 2020 and received approval on July 3, 2020 (see Appendix B). The sampling was completed in December 2020 according to the approved plan and the requirements stated herein, and the chemical analysis results indicated that the sediment was suitable for reuse as backfill.

H. Modification of the Sampling Plan: The applicant may only modify the sampling plan with prior approval from the Department.

The Sediment Sampling Plan was implemented as approved and was not modified.

I. Recognition of Results: Once the results of the sampling have been received, the applicant may request a meeting with the Department to help the applicant identify potential disposal locations and discuss refinements of the project design. If a meeting is requested pursuant to this section, the Department will notify the Council of this meeting and work with the Council to provide coordinated, multi-agency input into the project design. Following the meeting, the Department will provide written acknowledgement of the results of the sampling and a determination as to what disposal options are available to the applicant based on the results provided.

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The Project does not propose the disposal of dredged material but return of the excavated sediments to the exit pit following completion of the HDD installation. A sampling plan was submitted on June 23, 2020 and approved on July 3, 2020. A copy of the sampling plan and approval is provided at Appendix B.

J. Sampling Results: Sampling results shall be valid for use in a dredging application for 5 years.

Noted. Revolution Wind will comply.

4.2.4 Dredging Regulations Section 2.8 – Application for Dredging and the Management of Dredged Material

A. An application for permission to dredge in the marine waters of the state and/or to dewater, dispose or make beneficial use of dredged material shall be submitted to both the Department [RIDEM] *and the Council* [CRMC] *on forms prescribed and provided by the agencies. The Department will accept applications that have been made part of a submittal to the Council, provided such part complies with all requirements set forth in these regulations and in the form(s) prescribed by the Department.*

Noted. An Application For Marine Dredging and Associated Activities pursuant to the Marine Infrastructure Maintenance Act of 1996 and the Marine Waterways and Boating Facilities Act of 2001, Chapter 46-6.1 of the Rhode Island General Laws is submitted with the CRMC and RIDEM as part of this Application.

B. To be accepted as complete, an application must include, or address, at a minimum, all of the following:

1. Site plan(s), including all applicable requirements as identified in § 2.16 of this Part, Appendix A;

Site plans that include all applicable requirements are provided in Appendix A.

2. Results of the sampling conducted pursuant to the Sediment Sampling Plan, as approved by the Department in accordance with § 2.7 of this Part;

Analytical results of the sampling that was completed in accordance with the approved Sediment Sampling Plan are included in Appendix B.

3. A description of the dredging process, including the proposed dredging method and an estimate of the length of time necessary to complete the dredging project;

A description of the HDD process is included in Section 2.2.1.

4. Type of dredging equipment to be used;

A description of the HDD process, including the type of equipment that will be used, is included in Section 2.2.1.

5. Stamped calculations performed by a Professional Engineer with experience with dredge projects, verifying the estimated volume of dredged material;

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The Project does not involve standard dredging and disposal of material. During HDD operations, material excavated from temporary HDD exit pits in subtidal waters will be stored on a barge and later used to backfill the HDD exit pits after cable installation is completed in the area. The combined calculated volume of material that will be temporarily removed from both exit pits is 8,704 cubic yards (4,352 cubic yards per pit). The volumes are provided on the stamped engineering HDD Landfall Design plans provided in Appendix A.

6. Cross sectional plans of the area to be dredged. Plans must show the existing and proposed contours of the dredging area;

Longitudinal sections of the HDD exit pits are provided in the HDD Landfall Design plans in Appendix A.

7. A narrative description of aquatic resources in the area to be dredged such as shellfish beds, eel grass beds, spawning areas and migratory pathways for finfish, and other aquatic resources;

Descriptions of the affected environment (i.e., existing conditions) for installation of the RWEC-RI, including the HDD exit pits, are provided in Section 3 of this Application narrative. Benthic habitat mapping for the entire RWEC-RI, including the HDD exit pits was completed (refer to Appendix C). The dominant benthic habitat in the HDD exit pit excavation areas has been classified as Mud and Sandy Mud. This habitat is characterized by the presence of large and small burrowing taxa, large and small tube-building taxa, amphipods, and mobile crustaceans and mollusks. Sessile epifauna associated with Mud and Sandy Mud habitats include barnacles and hydroids. Mobile epifauna observed in this common habitat include crabs, Gastropods, Paguroids, Amphipods, and shrimp. Use of HDD will avoid SAV mapped at Quonset Point as well as fish and other marine epi- and endo-fauna that utilize SAV for habitat. Revolution Wind will perform a preconstruction SAV survey to identify any new or expanded SAV beds prior to construction.

Lastly, according to the RIDEM 2018 Shellfish Program Classification Report (RIDEM, 2018) and the May 2021 Notice of Polluted Shellfishing Grounds, the area is mapped as prohibited for shellfishing due to elevated levels of fecal coliform associated with Source 7-023.

8. The proposed starting and completion dates for the dredging project. Depending on the size, location and complexity of the project, the Department may require the submission of an evaluation of the impacts to fishery resources including migratory and spawning behavior and habitat, and the presence of early life stages of particular sensitivity. Dredging projects proposed outside the standard dredge window may require the submission of additional resource information;

It is anticipated that from start to completion the HDD operation will take between two and three months to complete. Revolution Wind will continue to coordinate with RIDEM and NOAA NMFS on TOY restrictions and will comply with all enforced TOY restrictions (see Section 2.5.1.1).

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9. The method of transport to the disposal or beneficial use area and a description of handling techniques (i.e. stockpiling, dewatering);

10. Consistency of the proposed project with the beneficial use and disposal priorities for dredged material management established in the R.I. Gen. Laws Chapter 46-6.1-2 and with the dredging plan adopted by the Council pursuant to R.I. Gen. Laws § 46-6.1-5;

11. Location(s) of dredged material dewatering, handling, disposal or beneficial use site(s); and

12. Other specific information required by §§ 2.9, 2.10 and 2.11 of this Part, to the extent applicable.

The Project does not propose disposal of dredged material. Dredge material at the HDD exit pits will be re-used for backfill of the pits.

4.2.5 Dredging Regulations Section 2.11 – Dewatering of Dredged Material

Revolution Wind acknowledges the standards in Section 2.11 of the Dredging Regulations and does not restate them here because the Project does not propose dewatering of dredged material.

4.2.6 Dredging Regulations Section 2.16 – Appendix A – Application Site Plan Requirements

The plans submitted in Appendix A of this Application meet the requirements stated within Section 2.16A through G. Subparts H through L do not apply because the Project does not include disposal or beneficial reuse of dredged material, beach nourishment, freshwater wetlands, or rehandling facility projects.

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Appendix A: Site Plans

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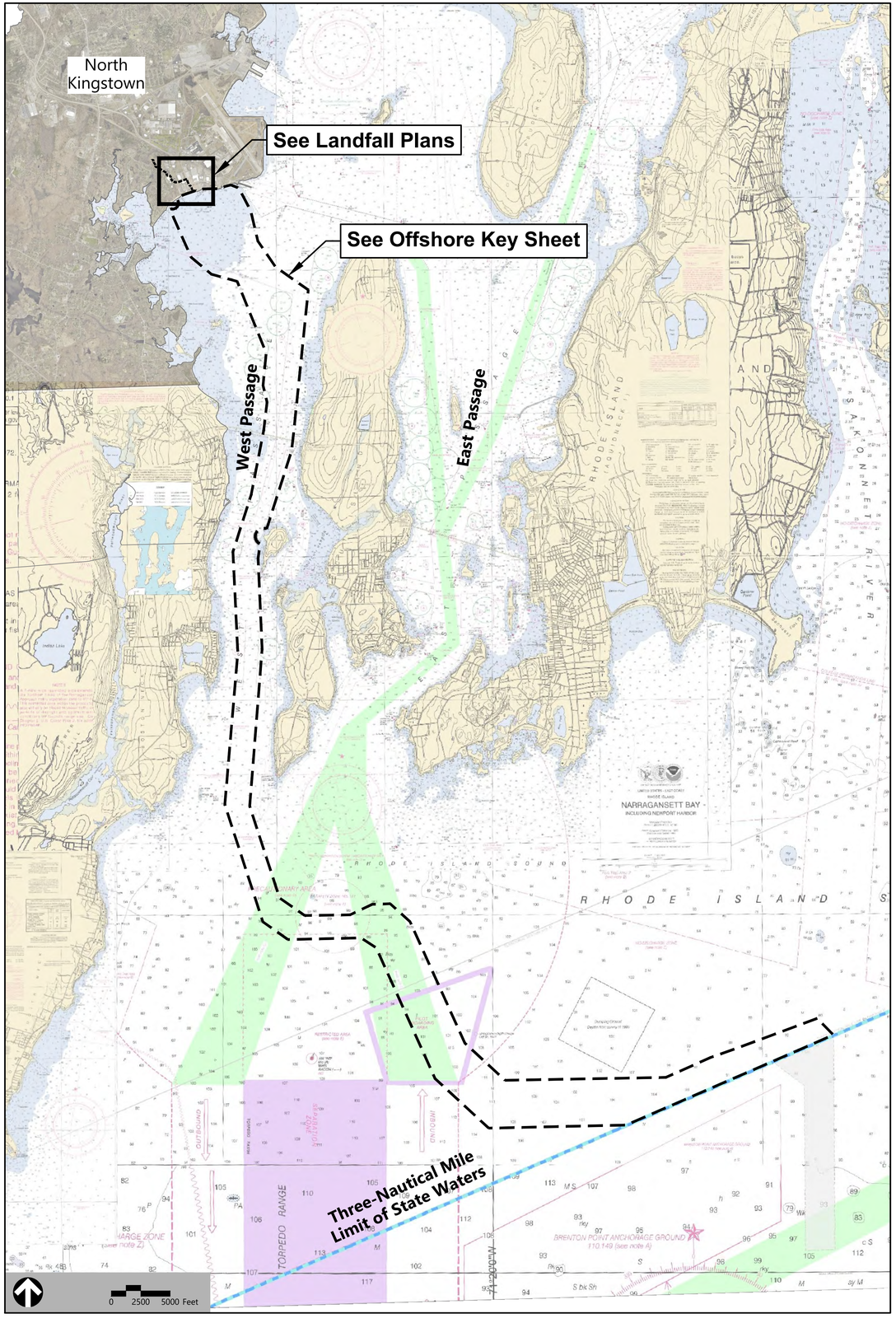
Revolution Wind Proposed Offshore Transmission Cable & Landfall Work Area

North Kingstown, RI and Tidal Waters of the State of Rhode Island



Owner/Applicant

Revolution Wind, LLC
c/o Kenneth Bowes
56 Exchange Terrace, Suite 300
Providence, Rhode Island 02903
(860) 883-5830
Kenneth.bowes@eversource.com

North Kingstown Assessor's Map: 185
Lots: 001, 004, 008

Tidal Waters of the State of Rhode Island

Revolution Wind | Powered by Ørsted & Eversource

vhb.com
vhb
1 Cedar Street
Suite 400
Providence, RI 02903
401.272.8100

Sheet 2 of 33
Revolution Wind Proposed Landfall Area Soil Erosion and Sediment Control Plan
Vanasse Hangen Brustlin, Inc.
c/o Susan Moberg PWS
1 Cedar Street Suite 400
Providence, Rhode Island 02903
(401) 457-2055
smoberg@vhb.com

Sheets 4 and 5 of 33
Revolution Wind Proposed Landfall Area Property Boundary and Existing Conditions Plan
Vanasse Hangen Brustlin, Inc.
c/o Patrick McCourt PLS
1 Cedar Street Suite 400
Providence, Rhode Island 02903
(401) 457-2049
PMcCourt@vhb.com

Sheets 6-11 of 33
Revolution Wind HDD Landfall Design
Mott MacDonald, Inc.
c/o Christopher A. Cockshaw
134 Capital Drive, Suite D
West Springfield, Massachusetts 01089
(413) 315-2146
christopher.cockshaw@mottmac.com

Sheets 12-33 of 33
Revolution Wind Export Cable
Mott MacDonald, Inc.
c/o Christopher A. Cockshaw
134 Capital Drive, Suite D
West Springfield, Massachusetts 01089
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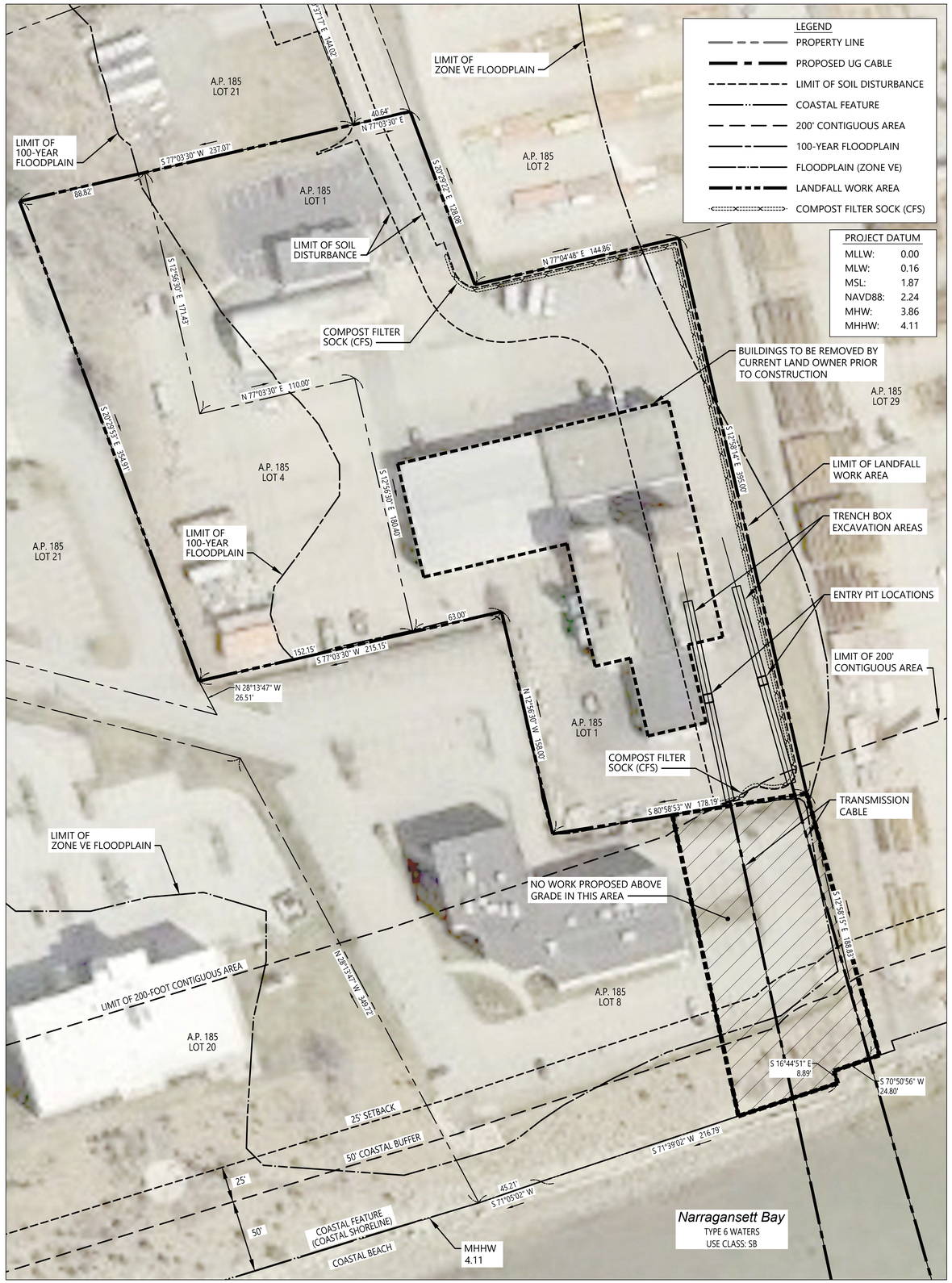
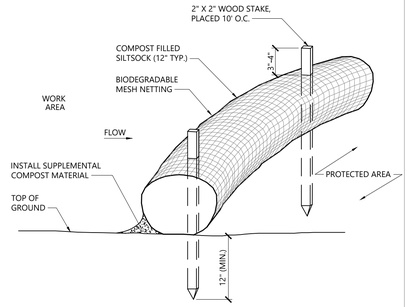


NOTES

1. GB GROUNDWATER ZONE
2. FEMA FLOOD INSURANCE RATE MAP 44009C0108J, FLOOD ZONES VE21, AE12 AND X
3. NO POINT SOURCE DISCHARGE PROPOSED
4. TIDAL WATERS: TYPE 6 INDUSTRIAL WATERFRONT AND COMMERCIAL NAVIGATION CHANNELS
5. USE CLASSIFICATION: SB WATERS
6. SHELLFISH HARVEST RESTRICTION AREA GA7-1
7. THIS PLAN SUBMITTED UNDER SEPARATE COVER FOR REVIEW AND AUTHORIZATION UNDER THE GENERAL PERMIT FOR STORMWATER DISCHARGES ASSOCIATED WITH CONSTRUCTION ACTIVITY. INFORMATION DEPICTED HEREON IS FOR REFERENCE ONLY.

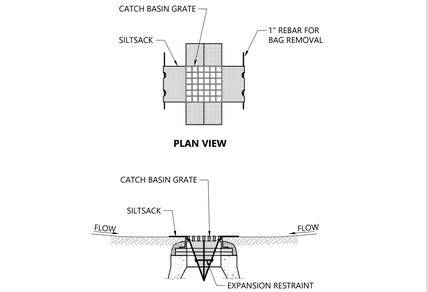


NOTES

1. SILTSOCK SHALL BE FILTREXX SILTSOXX, OR APPROVED EQUAL.
2. SILTSOCKS SHALL OVERLAP A MINIMUM OF 12 INCHES.
3. SILTSOCK SHALL BE INSPECTED PERIODICALLY AND AFTER ALL STORM EVENTS, AND REPAIR OR REPLACEMENT SHALL BE PERFORMED PROMPTLY AS NEEDED.
4. COMPOST MATERIAL SHALL BE DISPERSED ON SITE, AS DETERMINED BY THE ENGINEER.
5. IF NON BIODEGRADABLE NETTING IS USED THE NETTING SHALL BE COLLECTED AND DISPOSED OF OFFSITE.

Siltsock - Erosion Control Barrier 1/16

N.T.S. Source: VHB LD_658



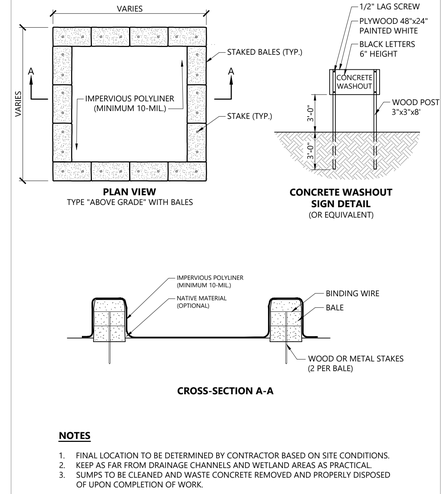
SECTION VIEW

NOTES

1. INSTALL SILTSACK IN ALL CATCH BASINS WHERE INDICATED ON THE PLAN BEFORE COMMENCING WORK OR IN PAVED AREAS AFTER BINDER COURSE IS PLACED AND HAY BALES HAVE BEEN REMOVED.
2. GRATE TO BE PLACED OVER SILTSACK.
3. SILTSACK SHALL BE INSPECTED PERIODICALLY AND AFTER ALL STORM EVENTS AND CLEANING OR REPLACEMENT SHALL BE PERFORMED PROMPTLY AS NEEDED. MAINTAIN UNTIL UPSTREAM AREAS HAVE BEEN PERMANENTLY STABILIZED

Siltsack Sediment Trap 1/16

N.T.S. Source: VHB LD_674

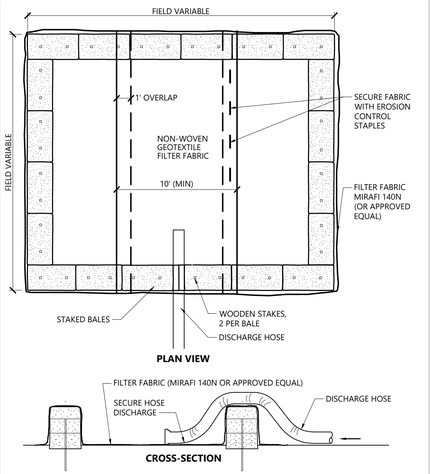


NOTES

1. FINAL LOCATION TO BE DETERMINED BY CONTRACTOR BASED ON SITE CONDITIONS.
2. KEEP AS FAR FROM DRAINAGE CHANNELS AND WETLAND AREAS AS PRACTICAL.
3. SUMPS TO BE CLEANED AND WASTE CONCRETE REMOVED AND PROPERLY DISPOSED OF UPON COMPLETION OF WORK.

Concrete Washout 12/17

N.T.S. Source: VHB



NOTES

1. NUMBER OF BALES MAY VARY DEPENDING ON SITE CONDITIONS.
2. THE BASIN TO BE SIZED TO PREVENT DISCHARGE WATER FROM OVERTOPPING BASIN.

Dewatering Straw Bale Basin 1/16

N.T.S. Source: VHB LD_690

ISSUED FOR PERMITS

PRELIMINARY - NOT FOR CONSTRUCTION

NORTH

0 40 80
SCALE IN FEET

vhb

NO.	DATE	AS BUILT REVISIONS	BY	CHK	APP	APP

REVISIONS DURING CONSTRUCTION

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TITLE
REVOLUTION WIND
PROP. OFFSHORE TRANS. CABLE & LANDFALL WORK AREA
LANDFALL SESC PLAN
NORTH KINGSTOWN, RHODE ISLAND

BY	CHKD	APP	APP
DATE 07/30/21	DATE	DATE	DATE
H-SCALE AS NOTED	SIZE ARCH D	FIELD BOOK & PAGES	
V-SCALE	V.S.	R.E.DWG.	
R.E. PROJ. NUMBER		DWG NO. KEY-02	

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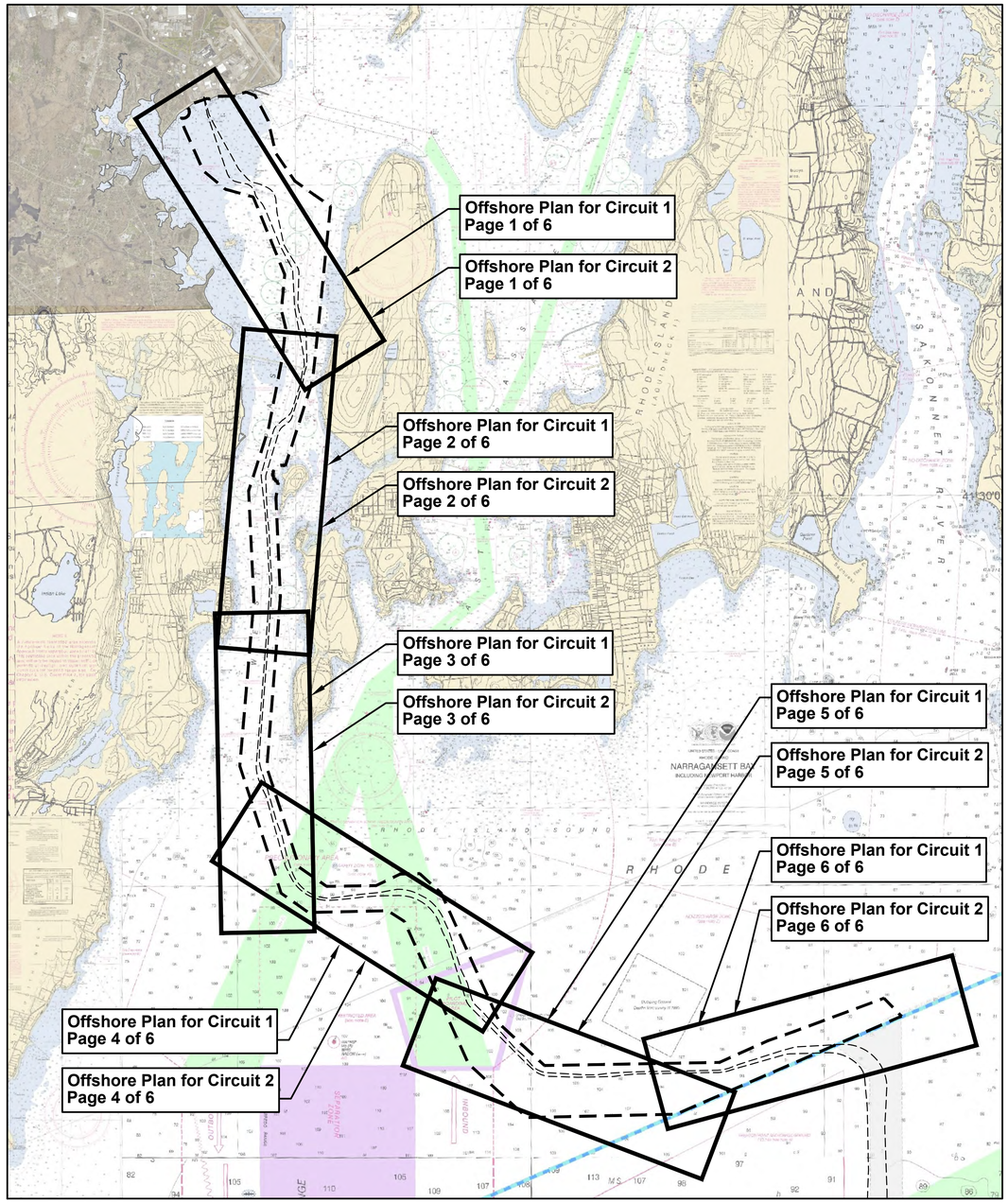
ES VER: 05/2019



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NORTH

0 1 2
SCALE IN MILES

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REVISIONS DURING CONSTRUCTION						

NO.	DATE	AS BUILT REVISIONS	BY	CHK	APP	APP

Revolution Wind | Powered by Ørsted & Eversource

TITLE
REVOLUTION WIND
PROP. OFFSHORE TRANS. CABLE & LANDFALL WORK AREA
OFFSHORE KEY SHEET
NORTH KINGSTOWN, RHODE ISLAND

BY	CHKD	APP	APP
DATE 07/30/21	DATE	DATE	DATE
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V-SCALE	V.S.	R.E.DWG.	
R.E. PROJ. NUMBER		DWG NO.	KEY-03

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JULY 30, 2021
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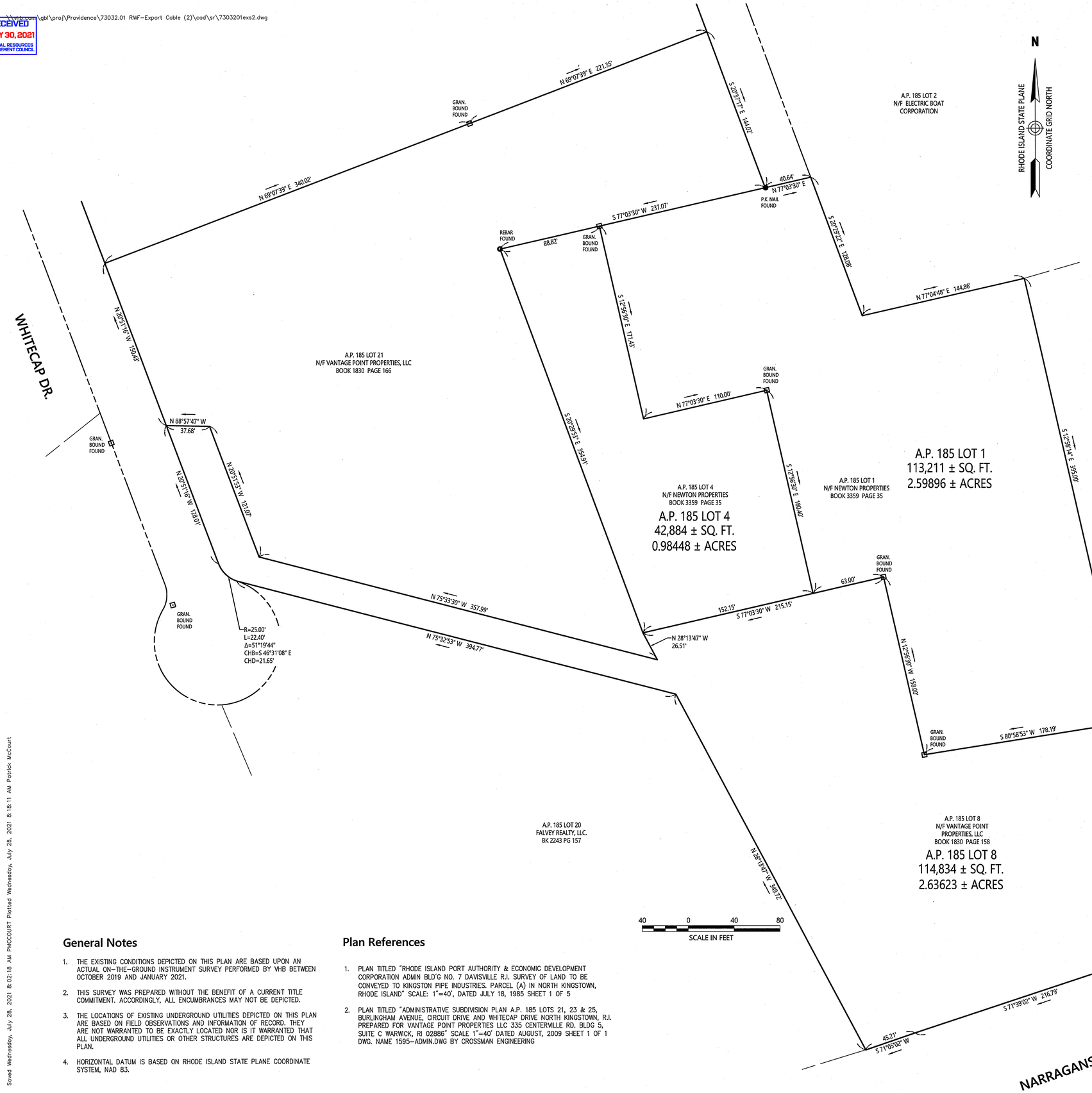

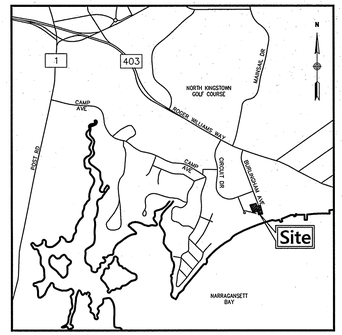

Locus Map
(NOT TO SCALE)

vhb.com

1 Cedar Street
Suite 400
Providence, RI 02903
401.272.8100

Legend

- CATCH BASIN
- DRAIN MANHOLE
- SEWER MANHOLE
- ELECTRIC MANHOLE
- TELEPHONE MANHOLE
- MANHOLE
- WATER GATE
- FIRE HYDRANT
- GAS GATE
- SHRUB
- DECIDUOUS TREE
- EVERGREEN TREE
- DRILL HOLE FOUND
- IRON PIN/REBAR FOUND
- MONUMENT FOUND
- UP UTILITY POLE
- RCP REINFORCED CONCRETE PIPE
- PVC POLYVINYLCHLORIDE PIPE
- DIP DUCTILE IRON PIPE
- CMP CORRUGATED METAL PIPE
- CPP CORRUGATED PLASTIC PIPE
- VC VITRIFIED CLAY PIPE
- MW MONITORING WELL
- TP TEST PIT
- CURB
- EDGE OF PAVEMENT
- UNDERGROUND DRAINAGE LINE
- UNDERGROUND SEWER LINE
- OVERHEAD WIRE
- E UNDERGROUND ELECTRIC LINE
- G UNDERGROUND GAS LINE
- W UNDERGROUND WATER LINE
- T UNDERGROUND TELEPHONE LINE
- CATV UNDERGROUND CABLE LINE
- FO UNDERGROUND FIBER OPTIC LINE
- R PROPERTY LINE
- ASSESSORS LINE
- CITY/TOWN LAYOUT LINE

General Notes

1. THE EXISTING CONDITIONS DEPICTED ON THIS PLAN ARE BASED UPON AN ACTUAL ON-THE-GROUND INSTRUMENT SURVEY PERFORMED BY VHB BETWEEN OCTOBER 2019 AND JANUARY 2021.
2. THIS SURVEY WAS PREPARED WITHOUT THE BENEFIT OF A CURRENT TITLE COMMITMENT. ACCORDINGLY, ALL ENCUMBRANCES MAY NOT BE DEPICTED.
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4. HORIZONTAL DATUM IS BASED ON RHODE ISLAND STATE PLANE COORDINATE SYSTEM, NAD 83.

Plan References

1. PLAN TITLED "RHODE ISLAND PORT AUTHORITY & ECONOMIC DEVELOPMENT CORPORATION ADMIN BLD'G NO. 7 DAVISVILLE R.I. SURVEY OF LAND TO BE CONVEYED TO KINGSTON PIPE INDUSTRIES. PARCEL (A) IN NORTH KINGSTOWN, RHODE ISLAND" SCALE: 1"=40', DATED JULY 18, 1985 SHEET 1 OF 5
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THIS SURVEY HAS BEEN CONDUCTED AND THE PLAN HAS BEEN PREPARED PURSUANT TO SECTION 9 OF THE RULES AND REGULATIONS ADOPTED BY THE RHODE ISLAND STATE BOARD OF REGISTRATION FOR PROFESSIONAL LAND SURVEYORS ON NOVEMBER 25, 2015, AS FOLLOWS:

(A)	TYPE OF BOUNDARY SURVEY: LIMITED CONTENT BOUNDARY SURVEY	MEASUREMENT SPECIFICATION: I
(B)	OTHER TYPE OF SURVEY DATA ACCUMULATION SURVEY	III
(C)	STATEMENT OF PURPOSE	

THE PURPOSE FOR THE CONDUCT OF THE SURVEY AND FOR THE PREPARATION OF THE PLAN IS AS FOLLOWS: LANDFALL CABLE DESIGN

BY _____ 7/28/21

PATRICK W. McCOURT, P.L.S. #1964
C.O.A. #A92

Revolution Wind
Landfall Work Area
50 White Cap Dr. 244 Burlingham Ave.
North Kingstown, Rhode Island

No.	Revision	Date	Appvd.

Designed by | Checked by
Issued for | Date
Permits | July 28, 2021

Drawing Title
Existing Conditions Plan of Land Assessor's Plat 185 Lots 1, 4 & 8

PATRICK W. McCOURT
STATE OF RHODE ISLAND
No. 1964
PROFESSIONAL LAND SURVEYOR
7/28/21

Drawing Number
Sv-1
Sheet 1 of 2
Project Number
73032.01

Saved Wednesday, July 28, 2021 8:02:18 AM PMCCOURT Plotted Wednesday, July 28, 2021 8:18:11 AM Patrick McCourt

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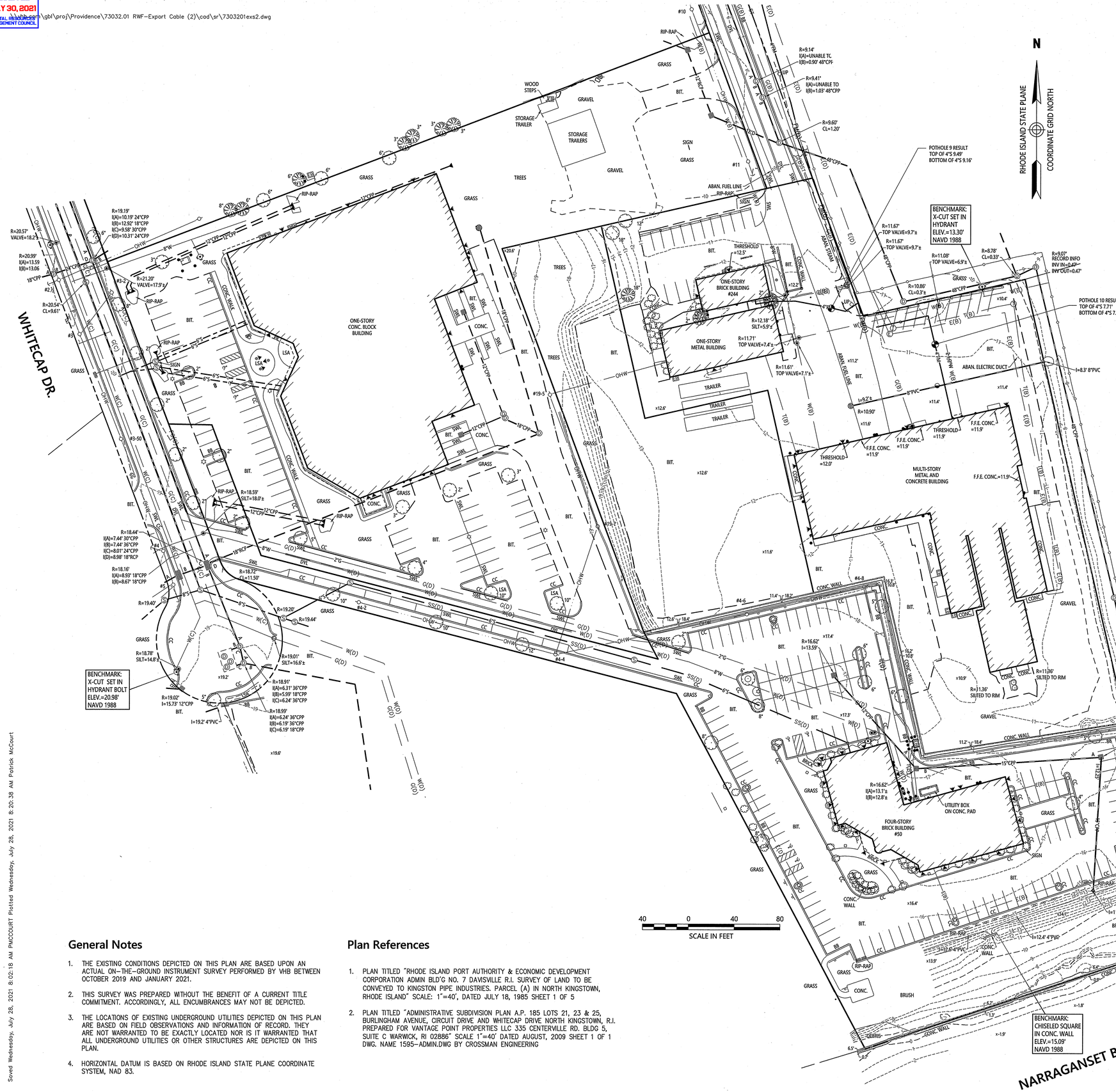

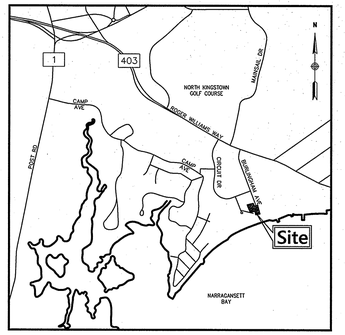

Locus Map
(NOT TO SCALE)

Legend

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- ELECTRIC MANHOLE
- TELEPHONE MANHOLE
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(B)	OTHER TYPE OF SURVEY	
	DATA ACCUMULATION SURVEY	III
(C)	STATEMENT OF PURPOSE	

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BY _____ 7/28/21

PATRICK W. McCOURT, P.L.S. #1964
C.O.A. #A92

Revolution Wind
Landfall Work Area

50 White Cap Dr. 244 Burlingham Ave.
North Kingstown, Rhode Island

No.	Revision	Date	Appvd.

Designed by _____ Checked by _____

Issued for _____ Date _____

Permits July 28, 2021

Drawing Title
Existing Conditions Plan of Land Assessor's Plat 185 Lots 1, 4 & 8

PATRICK W. McCOURT — STATE OF RHODE ISLAND — No. 1964 — PROFESSIONAL LAND SURVEYOR
7/28/21

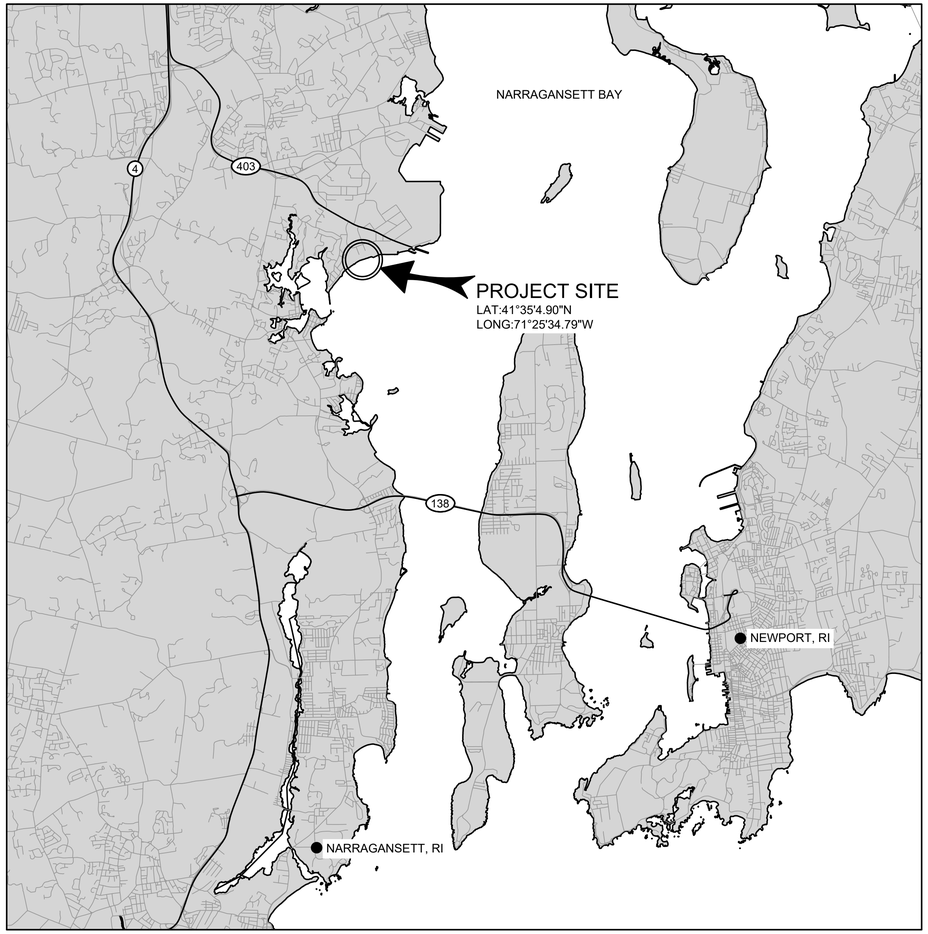
Drawing Number
Sv-2

Sheet 2 of 2

Project Number
73032.01

REVOLUTION WIND

HDD LANDFALL DESIGN

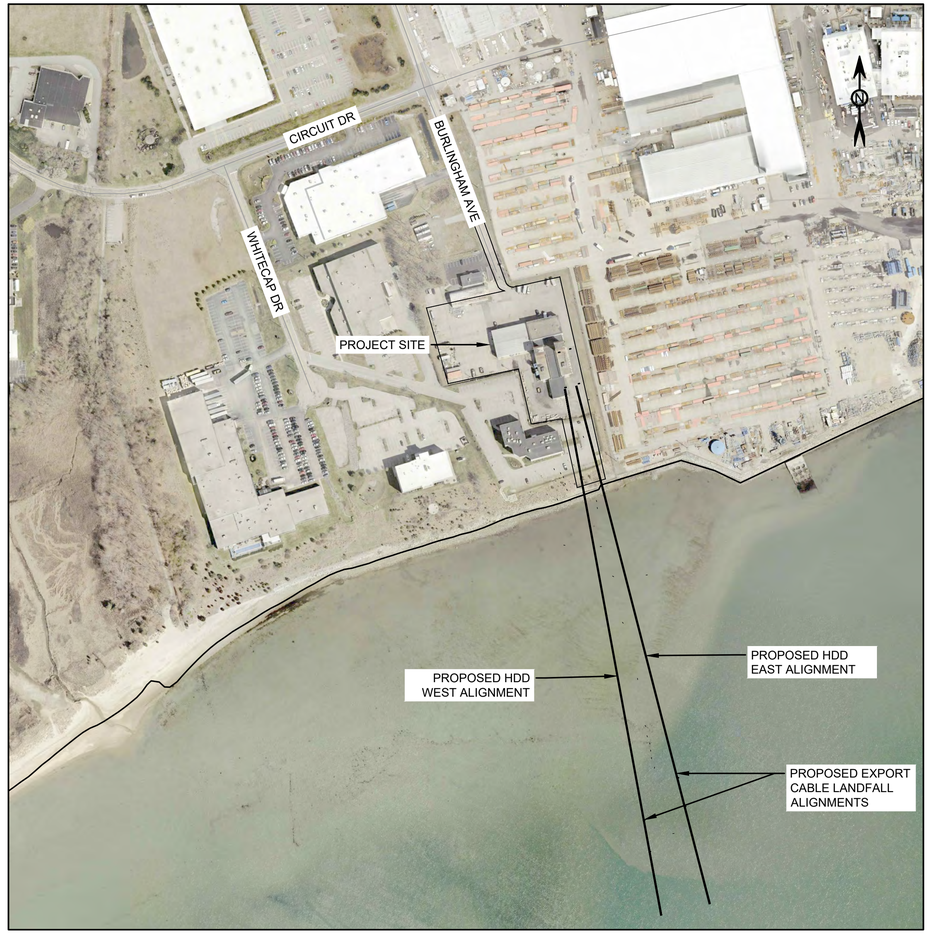


VICINITY MAP

0 6,000 12,000

SCALE IN FEET

DRAWING INDEX	
NAME	SHEET #
COVER SHEET	1
OVERALL SITE PLAN	2
HDD EAST LANDFALL	3
HDD WEST LANDFALL	4
EXCAVATION DETAILS HDD EAST LANDFALL	5
EXCAVATION DETAILS HDD WEST LANDFALL	6



LOCATION MAP

0 200 400

SCALE IN FEET

Rev	Date	Accep.	Appr.	Description
D	06/18/21	ML	GD	ISSUED FOR PERMIT
C	06/01/21	ML	GD	ISSUED FOR FURTHER REVIEW
B	05/19/21	ML	GD	ISSUED FOR FURTHER REVIEW
A	05/03/21	ML	GD	ISSUED FOR REVIEW

Drawn by	Accepted	Approved
05/03/2021 KLH	05/03/2021 ML	05/03/2021 GD
Scale: 1" = 100'	Size: D-SIZE	Ørsted Document No.: 07059047
Supplier		Supplier Document No.

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06/21/2021

ISSUED FOR PERMIT - NOT FOR CONSTRUCTION

CHRISTOPHER A. COCKSHAW
No. 9816
REGISTERED PROFESSIONAL ENGINEER
CIVIL

CONTRACTOR

MOTT MACDONALD

MOTT MACDONALD NY INC.

111 Wood Avenue South
Iselin, NJ 08830-4112

Certificate of Authorization #: 0017019

COVER SHEET
NORTH KINGSTOWN, RHODE ISLAND

DRAWING NUMBER: 07059047 Rev.: D

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HDD OVERALL SITE PLAN

SCALE BAR
100' 50' 0' 100'

CROSSING SPECIFIC HDD NOTES:

1. ALL EQUIPMENT SHALL BE STAGED WITHIN THE IDENTIFIED WORK SPACE.
2. ELEVATIONS REFERENCED TO 0.00' MLLW = 4.11' MHHW, 3.86' MHW, 2.24' NAVD88, 1.87' MSL, and 0.16' MLW. HORIZONTAL DATUM REFERS TO NAD83 UTM ZONE 19 US FOOT CENTRAL MERIDIAN 69D W.
3. DIMENSIONS PROVIDED ON THE DRAWING ARE IN FEET, UNLESS OTHERWISE NOTED.
4. ALIGNMENT STATIONING IS HORIZONTAL.

LEGEND:

- NATURAL GAS
- PROPERTY LINE
- MINOR CONTOUR
- MINOR CONTOUR
- WATER LINE
- SANITARY SEWER
- EXISTING FENCE
- COMMUNICATIONS LINE
- ELECTRIC & POLE
- LIGHTING ELECTRIC
- RETAINING WALL
- STORM DRAIN
- STORM MANHOLE
- SIGN
- ELECTRIC BOX
- CATCH BASIN
- MANMADE SHORELINE
- COASTAL BEACH
- WATER USE CATEGORY 6

Rev	Date	Accep.	Appr.	Description
D	06/18/21	ML	GD	ISSUED FOR PERMIT
C	06/01/21	ML	GD	ISSUED FOR FURTHER REVIEW
B	05/19/21	ML	GD	ISSUED FOR FURTHER REVIEW
A	05/03/21	ML	GD	ISSUED FOR REVIEW

Drawn by	Accepted	Approved
05/03/2021 KLH	05/03/2021 ML	05/03/2021 GD

Scale	Size	Ørsted Document No.
1" = 100'	D-SIZE	07059048

Supplier | Supplier Document No.

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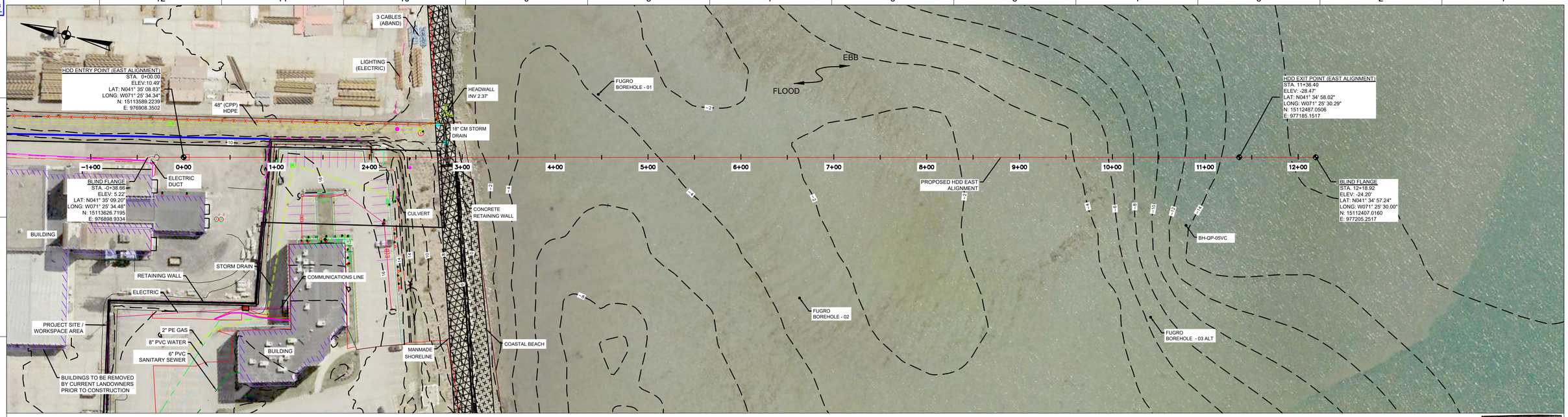
06/21/2021
ISSUED FOR PERMIT - NOT FOR CONSTRUCTION

CHRISTOPHER A. COCKSHAW
No. 9816
REGISTERED PROFESSIONAL ENGINEER
CIVIL

HDD OVERALL SITE PLAN
NORTH KINGSTOWN, RHODE ISLAND

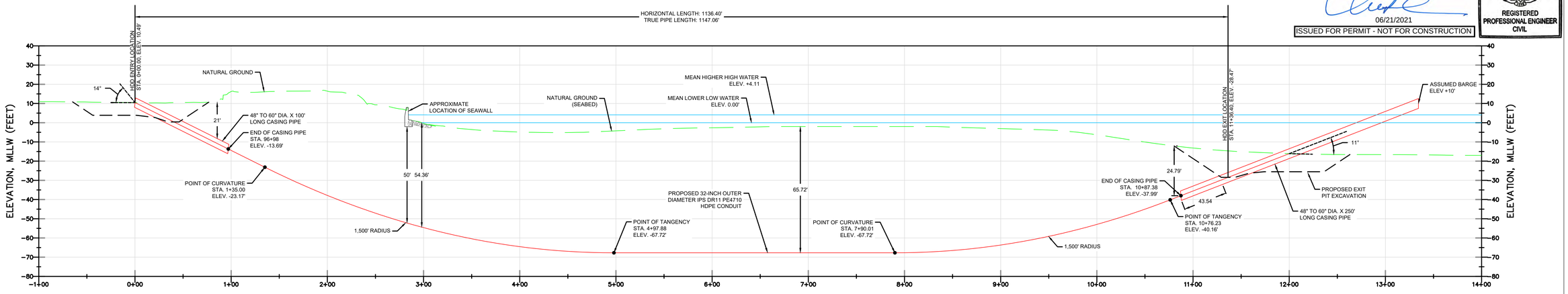
DRAWING NUMBER: 07059048 | Rev.: D

RECEIVED
JULY 30, 2021
COASTAL RESOURCES MANAGEMENT COUNCIL



HDD EAST SITE PLAN

SCALE BAR
50' 25' 0' 50'



PROFILE

HORIZ. SCALE: 1"=50'
VERT. SCALE: 1"=25'

CROSSING SPECIFIC HDD NOTES:

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3. DIMENSIONS PROVIDED ON THE DRAWING ARE IN FEET, UNLESS OTHERWISE NOTED.
4. ALIGNMENT STATIONING IS HORIZONTAL.
5. METHOD OF HDPE CONDUIT INSTALLATION SHALL BE BY HORIZONTAL DIRECTIONAL DRILL.
6. CONTRACTOR SHALL DETERMINE FINAL LOCATIONS AND DIMENSIONS OF ALL MUD PITS NECESSARY TO ACCOMMODATE THEIR MEANS AND METHODS.
7. IT IS THE CONTRACTOR'S RESPONSIBILITY TO IDENTIFY AND PROTECT ANY FOREIGN UTILITY THAT MAY BE AFFECTED BY THE OPERATIONS. CONTRACTOR SHALL CALL DIG SAFE PRIOR TO CONSTRUCTION. EXISTING UTILITY LOCATIONS AND DEPTHS, INCLUDING PRIVATE SERVICES, ARE APPROXIMATE AND SHALL BE FIELD VERIFIED BY THE CONTRACTOR PRIOR TO ANY CONSTRUCTION OPERATIONS. CONTRACTOR TO STAGE ALL PERSONNEL AND EQUIPMENT WITHIN THE PERMITTED LIMIT OF DISTURBANCE, UNLESS OTHERWISE AUTHORIZED BY THE CLIENT.
8. CONTRACTOR SHALL DETERMINE DIAMETER, GRADE, WALL THICKNESS AND ANY ADDITIONAL LENGTH OF THE TEMPORARY CONDUCTOR CASING. ANY INSTALLED TEMPORARY CONDUCTOR CASING AND OFFSHORE GOAL POSTS SHALL BE FULLY REMOVED UPON COMPLETION OF PULLBACK OPERATIONS. CONTRACTOR TO DETERMINE OFFSHORE GOAL POST SUPPORTS NECESSARY FOR SUPPORTING THE CASING PIPE.
9. HDD EXIT POINT IS LOCATED WITHIN AN EXCAVATION. THIS EXCAVATION WILL HELP ACHIEVE THE REQUIRED BURIAL DEPTH OF THE HDPE CONDUIT. DEPTH AND EXTENT OF EXCAVATION SHOWN ON DRAWINGS SUBJECT TO CHANGE.
10. APPROXIMATE EXIT PIT LOCATION MAY INCLUDE TEMPORARY SUPPORT STRUCTURES. TEMPORARY SUPPORT STRUCTURES INCLUDING BUT NOT LIMITED TO CONDUIT SUPPORT PILES AND SECONDARY PROTECTION MAY BE INSTALLED AT THE EXIT PIT LOCATION TO AID IN THE INSTALLATION OF THE HDD. THESE FEATURES WILL BE REMOVED UPON COMPLETION OF THE CABLE INSTALLATION.
11. THE INITIAL EXIT PIT EXCAVATION SHALL BE CONDUCTED WITH TOOTHED BUCKET. DREDGED SEDIMENT SHALL BE PLACED IN A HOPPER SCOW(S) OR SIMILAR FOR TEMPORARY STORAGE. THE SCOW(S) MAY REQUIRE OCCASIONAL DECANTING TO REMOVE EXCESS WATER DURING DREDGING OPERATIONS. UPON COMPLETION OF THE HDD INSTALLATION, THE DREDGED SEDIMENT SHALL BE USED TO BACKFILL AND RESTORE THE EXIT PIT TO ITS PRE-EXCAVATION CONDITIONS. IF ADDITIONAL FILL IS NECESSARY TO RESTORE THE AREA TO ITS PRE-EXCAVATED CONDITIONS, CLEAN FILL OF SIMILAR GRAINSIZE SHALL BE ACQUIRED FROM AN UPLAND SOURCE AND PLACED AS BACKFILL.
12. STEEL CASING AT EXIT LOCATION SHALL BE INSTALLED OVER THE DRILL PIPE ONCE THE PILOT BORE HAS BEEN COMPLETED.
13. THE MINIMUM ALLOWABLE DRILLING RADIUS SHALL BE 900 FEET BASED ON A 3-JOINT AVERAGE.
14. HDD OPERATIONS SHALL BE CONDUCTED IN ACCORDANCE WITH ALL PERMIT REQUIREMENTS.
15. DOWNHOLE ANNULAR DRILLING FLUID PRESSURES SHALL BE MONITORED AT ALL TIMES DURING THE PILOT BORE DRILLING PROCESS. LOCATION OF MONITORING SHALL BE AS CLOSE TO THE DRILL BIT AS POSSIBLE. CONTRACTOR SHALL MAINTAIN FLUID PRESSURES AS LOW AS POSSIBLE AND REACT TO CLEAN THE BORE SHOULD FLUID PRESSURES DIFFER FROM CALCULATED VALUES.
16. PILOT BORE SHALL BE CONTINUOUSLY TRACKED AT ALL TIMES. NO BLIND SECTIONS SHALL BE PERMITTED, EVEN WHEN THE DRILL BIT IS UNDER WATER.
17. ROCK BAGS OR EQUIVALENT MAY BE TEMPORARILY PLACED WITHIN EXCAVATION TO PREVENT INFILLING DURING HDD OPERATIONS.
18. PRIOR TO CABLE PULL IN, THE DREDGED AREA AT THE END OF THE HDPE CONDUIT MAY REQUIRE TARGETED REMOVAL/CLEARING OF ACCUMULATED SEDIMENT DUE TO INFILLING. TO AVOID DAMAGING THE CONDUIT, THIS WORK SHALL BE CONDUCTED WITH THE USE OF AN AIRLIFT, CONTROLLED FLOW EXCAVATION, AND/OR SUCTION DREDGING OR SIMILAR EQUIPMENT.
19. SOIL IN VICINITY OF THE HDD ENTRY LOCATION SHALL BE COMPACTED FOLLOWING COMPLETION OF HDD OPERATIONS TO AVOID FUTURE SETTLEMENT.
20. SPILL-PREVENTION: REFUELING OF ALL EQUIPMENT SHALL BE COMPLETED IN ACCORDANCE WITH CONTRACTORS JOB SAFETY PLAN.
21. THE HDPE CONDUIT SHALL BE FABRICATED WITHIN THE APPROVED PRODUCT PIPE STRINGING AND FABRICATION AREA.
22. HDPE CONDUIT SHALL BE INTERNALLY AND EXTERNALLY DEBEADED AS IT IS FABRICATED.
23. PRE-INSTALLATION LOW PRESSURE AIR TEST AND MANDREL TEST SIZED 90 PERCENT OF THE HDPE CONDUIT INTERNAL DIAMETER SHALL BE COMPLETED PRIOR TO TOWING TO HDD EXIT LOCATION.
24. POST-INSTALLATION TEST SHALL CONSIST OF PULLING A CALIBRATION TOOL WITH A GAUGING PLATE SIZED TO 90 PERCENT OF HDPE INNER DIAMETER THROUGH THE INSTALLED CONDUIT. MANDREL TO BE SIZED TO 90 PERCENT OF THE HDPE CONDUIT INTERNAL DIAMETER.
25. CONTRACTOR SHALL FULLY FILL THE HDPE CONDUIT WITH WATER DURING PULLBACK OPERATIONS. CONDUIT TO BE LEFT FULL OF WATER.
26. EROSION AND SEDIMENT CONTROL: CONTRACTOR SHALL SUPPLY, INSTALL AND MAINTAIN SEDIMENT CONTROL STRUCTURES IN ACCORDANCE WITH SOIL EROSION AND CONTROL PLAN.
27. CLEANUP / STABILIZATION / RESTORATION: ALL DISTURBED AREAS ONSHORE SHALL BE RETURNED TO THE ORIGINAL CONTOURS. DISTURBED AREAS SHALL BE RETURNED TO ORIGINAL CONDITION OR BETTER.
28. AERIAL IMAGERY PROVIDED BY ESRI BASEMAP IMAGERY, 2020.
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30. SPILL KITS SHALL BE STAGED AT THE HDD ENTRY AND EXIT LOCATIONS.
31. WATER SOURCE: CONTRACTOR IS RESPONSIBLE FOR SOURCING A RELIABLE WATER SOURCE FOR ALL HDD OPERATIONS. DRILL WATER SHALL BE OBTAINED FROM COMPANY APPROVED SOURCE.
32. DRILL PATH SHOWN ON THE DRAWINGS REFERS TO THE CENTERLINE OF THE PROPOSED HDD INSTALLATION. DRILLING TOLERANCES MAY RESULT IN SLIGHT DEVIATIONS FROM THESE STATIONS AND ELEVATIONS. PILOT BORE DRILLING TOLERANCES ARE AS INDICATED IN TOLERANCE TABLE.

LEGEND:

NATURAL GAS	WATER LINE	ELECTRIC & POLE E(B)	STORM MANHOLE
PROPERTY LINE	SANITARY SEWER	LIGHTING ELECTRIC	SIGN
MINOR CONTOUR X'	EXISTING FENCE −X−X−X−	RETAINING WALL	ELECTRIC BOX EB
MINOR CONTOUR X'	COMMUNICATIONS LINE	STORM DRAIN	CATCH BASIN

ITEM	TOLERANCE
PILOT ENTRY ANGLE	INCREASE ANGLE UP TO 1° (STEEPER), BUT NO DECREASE IN ANGLE ALLOWED.
PILOT ENTRY LOCATION	AS STAKED BY OWNER. NO CHANGES WITHOUT OWNER APPROVAL.
PILOT EXIT ANGLE	DECREASE ANGLE UP TO 2° (FLATTER), BUT NO INCREASES IN EXIT ANGLE ALLOWED.
PILOT EXIT LOCATION	UP TO FIVE (5) FEET SHORTER AND 15 FEET LONGER.
PILOT DEPTH	UP TO THREE (3) FEET SHALLOWER ALLOWED. UP TO EIGHT (8) FEET DEEPER ALLOWED.
PILOT ALIGNMENT	UP TO FIVE (5) FEET LEFT OR RIGHT OF THE OWNER SURVEY CENTERLINE BUT NOT WITHIN THREE (3) FEET OF THE RIGHT-OF-WAY/EASEMENT BOUNDARY.

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CHRISTOPHER A. COCKSHAW
No. 9816
REGISTERED PROFESSIONAL ENGINEER
CIVIL

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Drawn by	Accep.	Appr.	Description
05/03/2021 KLH			Accepted 05/03/2021 ML / Approved 05/03/2021 GD
Scale 1" = 100'	Size D-SIZE		Ørsted Document No. 07015963
Supplier			Supplier Document No.

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HDD PLAN & PROFILE
HDD EAST LANDFALL
NORTH KINGSTOWN, RHODE ISLAND

DRAWING NUMBER: 07015963 Rev.: D

RECEIVED
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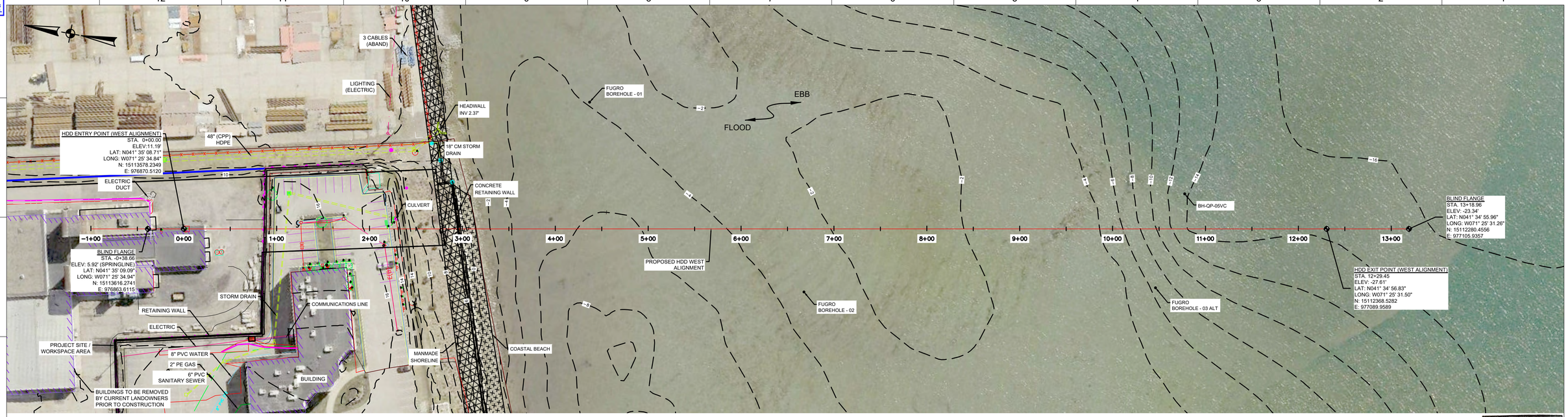
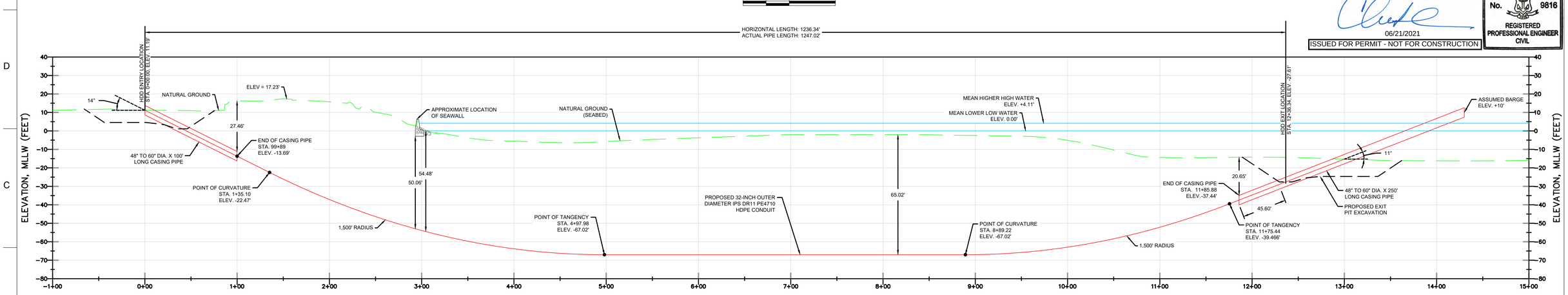


HDD WEST SITE PLAN

SCALE BAR
50' 25' 0' 50'



PROFILE

HORIZ. SCALE: 1"=50'
VERT. SCALE: 1"=25'

CROSSING SPECIFIC HDD NOTES:

1. ALL EQUIPMENT SHALL BE STAGED WITHIN THE IDENTIFIED WORK SPACE.
2. ELEVATIONS REFERENCED TO 0.00' MLLW = 4.11' MHHW, 3.86' MHW, 2.24' NAVD88, 1.87' MSL, and 0.16' MLW. HORIZONTAL DATUM REFERS TO NAD83 UTM ZONE 19 US FOOT CENTRAL MERIDIAN 69D W.
3. DIMENSIONS PROVIDED ON THE DRAWING ARE IN FEET, UNLESS OTHERWISE NOTED.
4. ALIGNMENT STATIONING IS HORIZONTAL.
5. METHOD OF HDPE CONDUIT INSTALLATION SHALL BE BY HORIZONTAL DIRECTIONAL DRILL.
6. CONTRACTOR SHALL DETERMINE FINAL LOCATIONS AND DIMENSIONS OF ALL MUD PITS NECESSARY TO ACCOMMODATE THEIR MEANS AND METHODS.
7. IT IS THE CONTRACTOR'S RESPONSIBILITY TO IDENTIFY AND PROTECT ANY FOREIGN UTILITY THAT MAY BE AFFECTED BY THE OPERATIONS. CONTRACTOR SHALL CALL DIG SAFE PRIOR TO CONSTRUCTION. EXISTING UTILITY LOCATIONS AND DEPTHS, INCLUDING PRIVATE SERVICES, ARE APPROXIMATE AND SHALL BE FIELD VERIFIED BY THE CONTRACTOR PRIOR TO ANY CONSTRUCTION OPERATIONS. CONTRACTOR TO STAGE ALL PERSONNEL AND EQUIPMENT WITHIN THE PERMITTED LIMIT OF DISTURBANCE, UNLESS OTHERWISE AUTHORIZED BY THE CLIENT.
8. CONTRACTOR SHALL DETERMINE DIAMETER, GRADE, WALL THICKNESS AND ANY ADDITIONAL LENGTH OF THE TEMPORARY CONDUCTOR CASING. ANY INSTALLED TEMPORARY CONDUCTOR CASING AND OFFSHORE GOAL POSTS SHALL BE FULLY REMOVED UPON COMPLETION OF PULLBACK OPERATIONS. CONTRACTOR TO DETERMINE OFFSHORE GOAL POST SUPPORTS NECESSARY FOR SUPPORTING THE CASING PIPE.
9. HDD EXIT POINT IS LOCATED WITHIN AN EXCAVATION. THIS EXCAVATION WILL HELP ACHIEVE THE REQUIRED BURIAL DEPTH OF THE HDPE CONDUIT. DEPTH AND EXTENT OF EXCAVATION SHOWN ON DRAWINGS SUBJECT TO CHANGE.
10. APPROXIMATE EXIT PIT LOCATION MAY INCLUDE TEMPORARY SUPPORT STRUCTURES. TEMPORARY SUPPORT STRUCTURES INCLUDING BUT NOT LIMITED TO CONDUIT SUPPORT PILES AND SECONDARY PROTECTION MAY BE INSTALLED AT THE EXIT PIT LOCATION TO AID IN THE INSTALLATION OF THE HDD. THESE FEATURES WILL BE REMOVED UPON COMPLETION OF THE CABLE INSTALLATION.
11. THE INITIAL EXIT PIT EXCAVATION SHALL BE CONDUCTED WITH TOOTHED BUCKET. DREDGED SEDIMENT SHALL BE PLACED IN A HOPPER SCOW(S) OR SIMILAR FOR TEMPORARY STORAGE. THE SCOW(S) MAY REQUIRE OCCASIONAL DECANTING TO REMOVE EXCESS WATER DURING DREDGING OPERATIONS. UPON COMPLETION OF THE HDD INSTALLATION, THE DREDGED SEDIMENT SHALL BE USED TO BACKFILL AND RESTORE THE EXIT PIT TO ITS PRE-EXCAVATION CONDITIONS. IF ADDITIONAL FILL IS NECESSARY TO RESTORE THE AREA TO ITS PRE-EXCAVATED CONDITIONS, CLEAN FILL OF SIMILAR GRAINSIZE SHALL BE ACQUIRED FROM AN UPLAND SOURCE AND PLACED AS BACKFILL.
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LEGEND:

NATURAL GAS	WATER LINE	ELECTRIC & POLE E(B)	STORM MANHOLE
PROPERTY LINE	SANITARY SEWER	LIGHTING ELECTRIC	SIGN
MINOR CONTOUR X'	EXISTING FENCE	RETAINING WALL	ELECTRIC BOX EB
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No. 9816
REGISTERED PROFESSIONAL ENGINEER
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Drawn by		Accepted		Approved
05/03/2021	KLH	05/03/2021	ML	05/03/2021 GD
Scale		Size	Ørsted Document No.	
1" = 100'		D-SIZE	07015967	
Supplier			Supplier Document No.	

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HDD PLAN & PROFILE
HDD WEST LANDFALL
NORTH KINGSTOWN, RHODE ISLAND

DRAWING NUMBER: 07015967 Rev.: D

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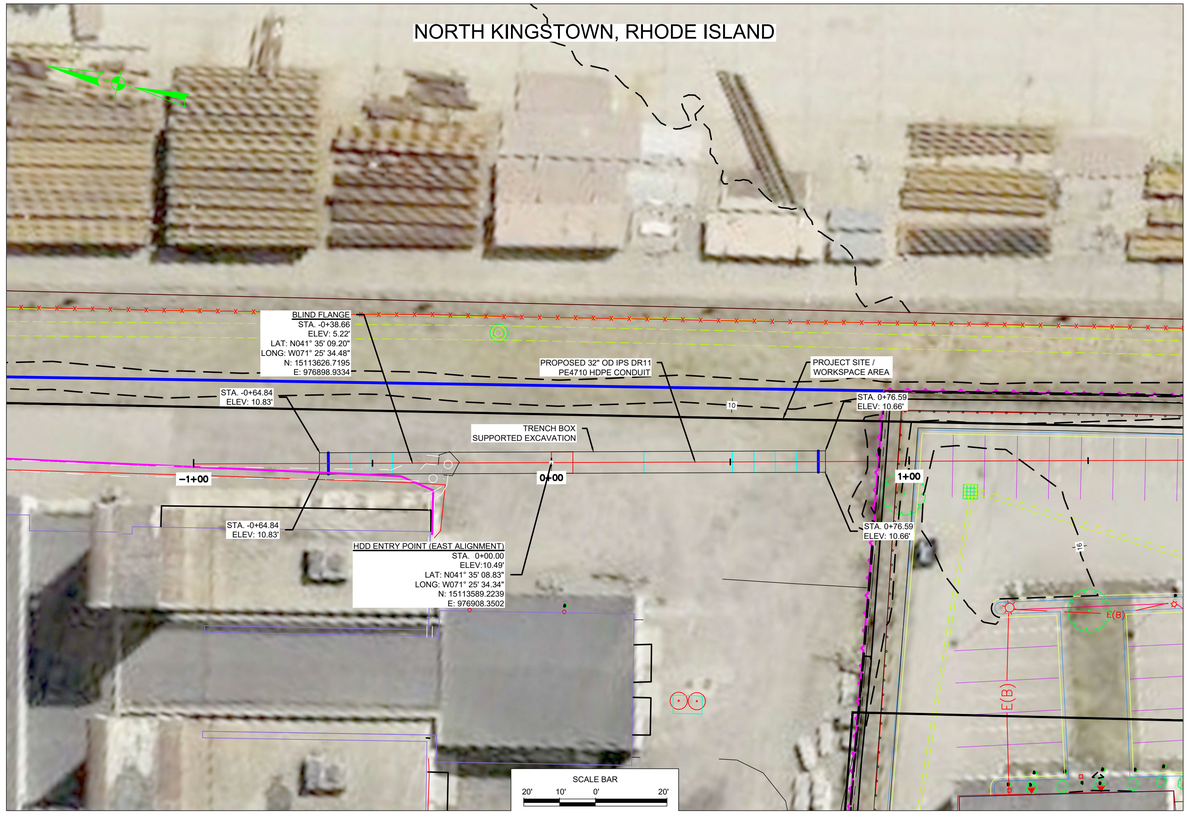
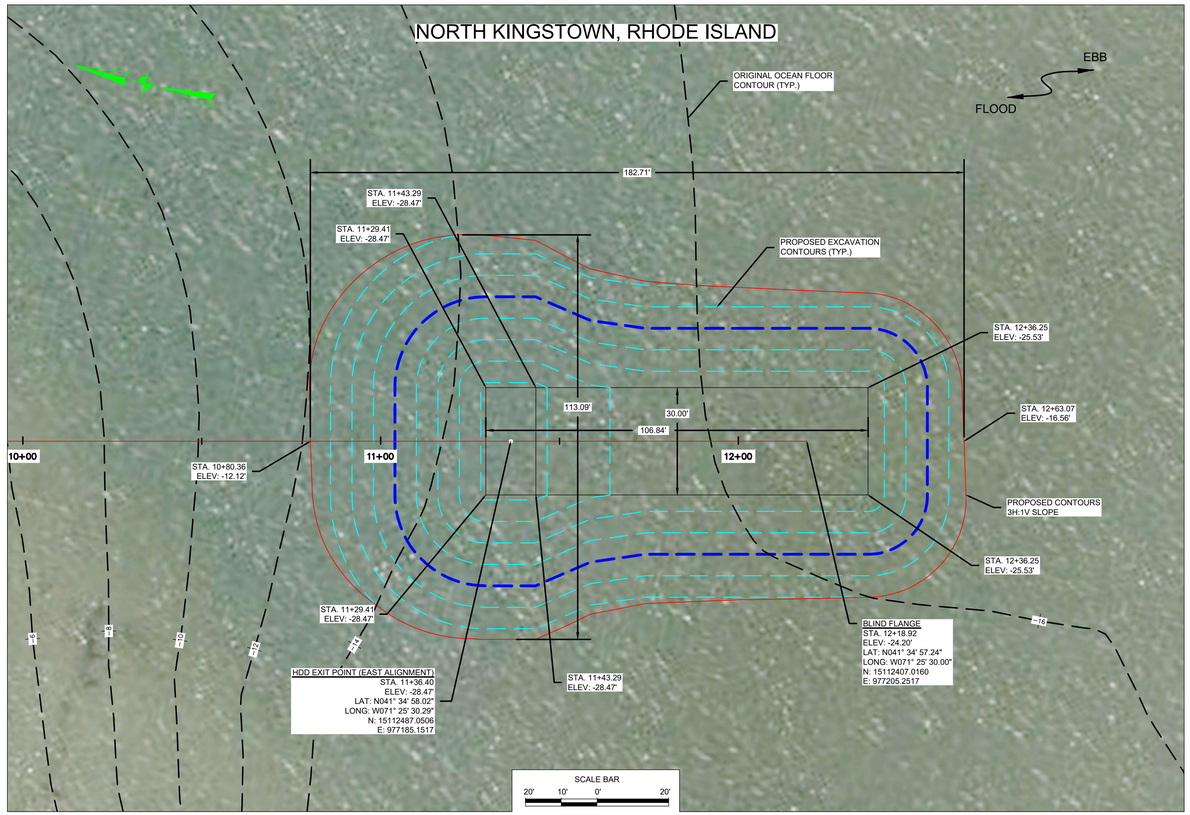
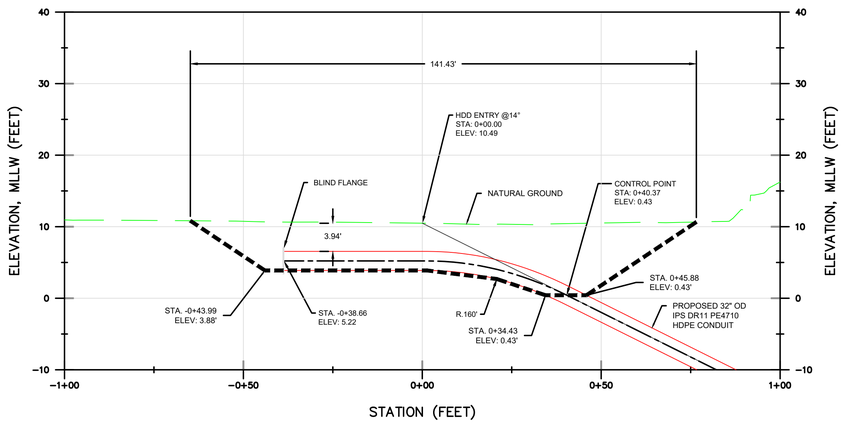
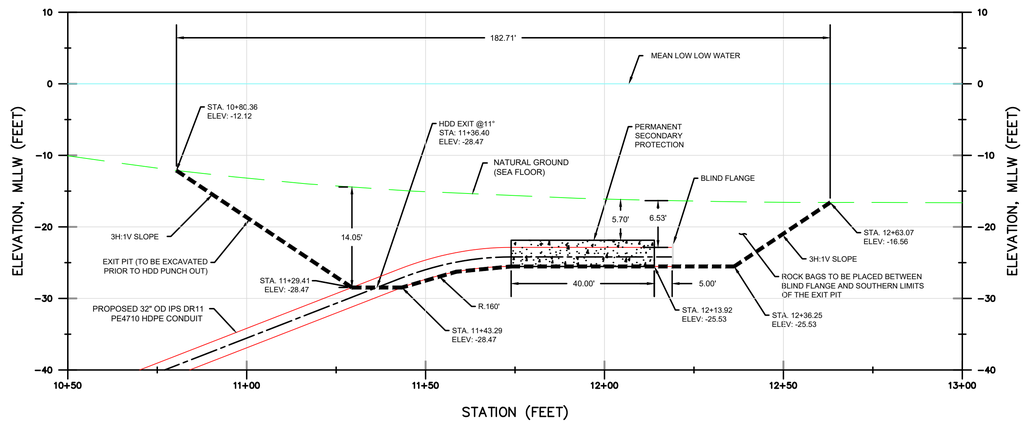






PROFILE
HORIZ. SCALE: 1"=20'
VERT. SCALE: 1"=10'



PROFILE
HORIZ. SCALE: 1"=20'
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LEGEND:

NATURAL GAS	WATER LINE	ELECTRIC & POLE	STORM MANHOLE
PROPERTY LINE	SANITARY SEWER	LIGHTING ELECTRIC	SIGN
MINOR CONTOUR	EXISTING FENCE	RETAINING WALL	ELECTRIC BOX (EB)
MINOR CONTOUR	COMMUNICATIONS LINE	STORM DRAIN	CATCH BASIN

NOTES:
1. PERMANENT SECONDARY PROTECTION MAY BE PLACED ABOVE THE HDPE CONDUIT AT THE EXIT PIT EXCAVATION. IF CONCRETE MATTRESSES ARE USED FOR SECONDARY PROTECTION, INDIVIDUAL MATTRESS DIMENSIONS WILL BE APPROXIMATELY 8' WIDE BY 20' LONG BY 1' THICK. IF OTHER SECONDARY PROTECTION METHODS ARE PROPOSED (ROCK BAGS OR SIMILAR), DIMENSIONS MAY VARY.
2. THE ESTIMATED SPOIL VOLUME TO BE EXCAVATED FOR THE PROPOSED OFFSHORE EXIT PIT IS 4,352 CUBIC YARDS AND PROPOSED ONSHORE ENTRY PIT IS 200 CUBIC YARDS.
3. ELEVATIONS REFERENCED TO 0.00' MLLW = 4.11' MHHW, 3.86' MHW, 2.24' NAVD88, 1.87' MSL, AND 0.16' MLW. HORIZONTAL DATUM REFERS TO NAD83 UTM ZONE 19 US FOOT CENTRAL MERIDIAN 69D W.
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5. ALIGNMENT STATIONING IS HORIZONTAL.

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EXCAVATION DETAILS
HDD EAST LANDFALL
NORTH KINGSTOWN, RHODE ISLAND

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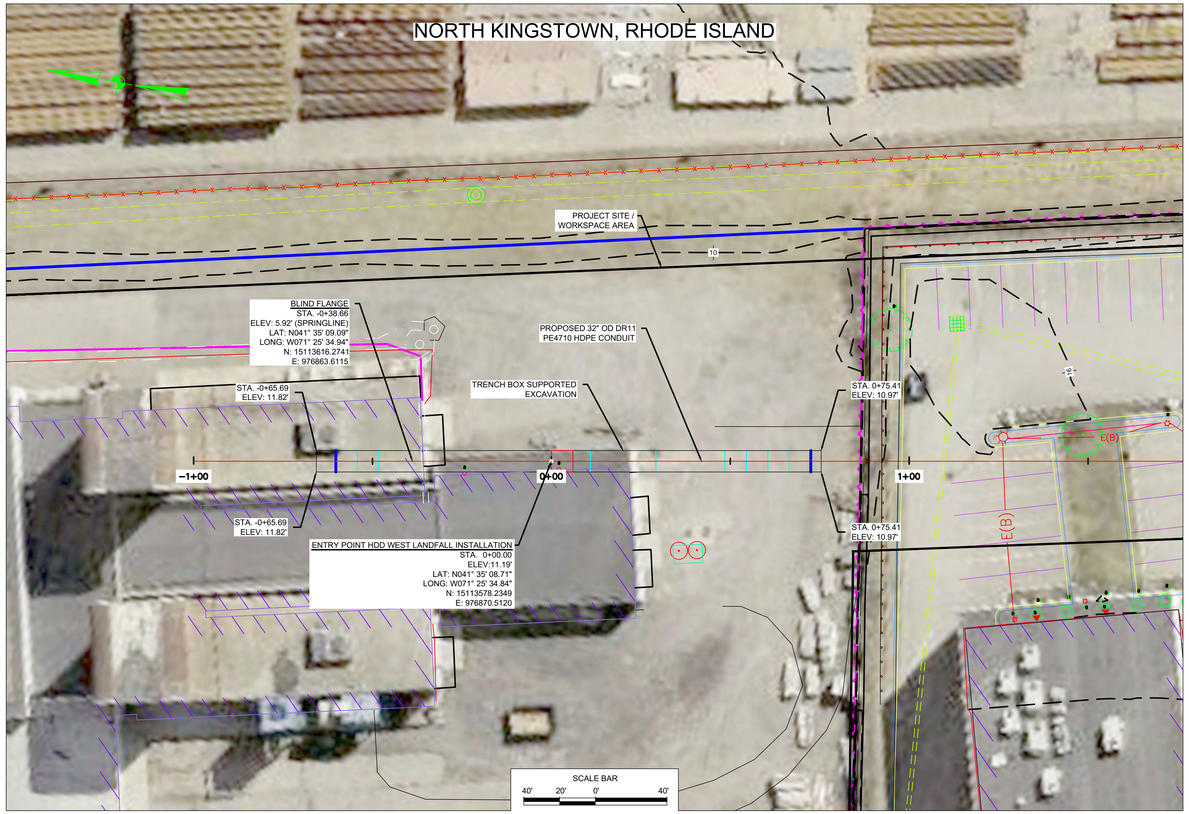

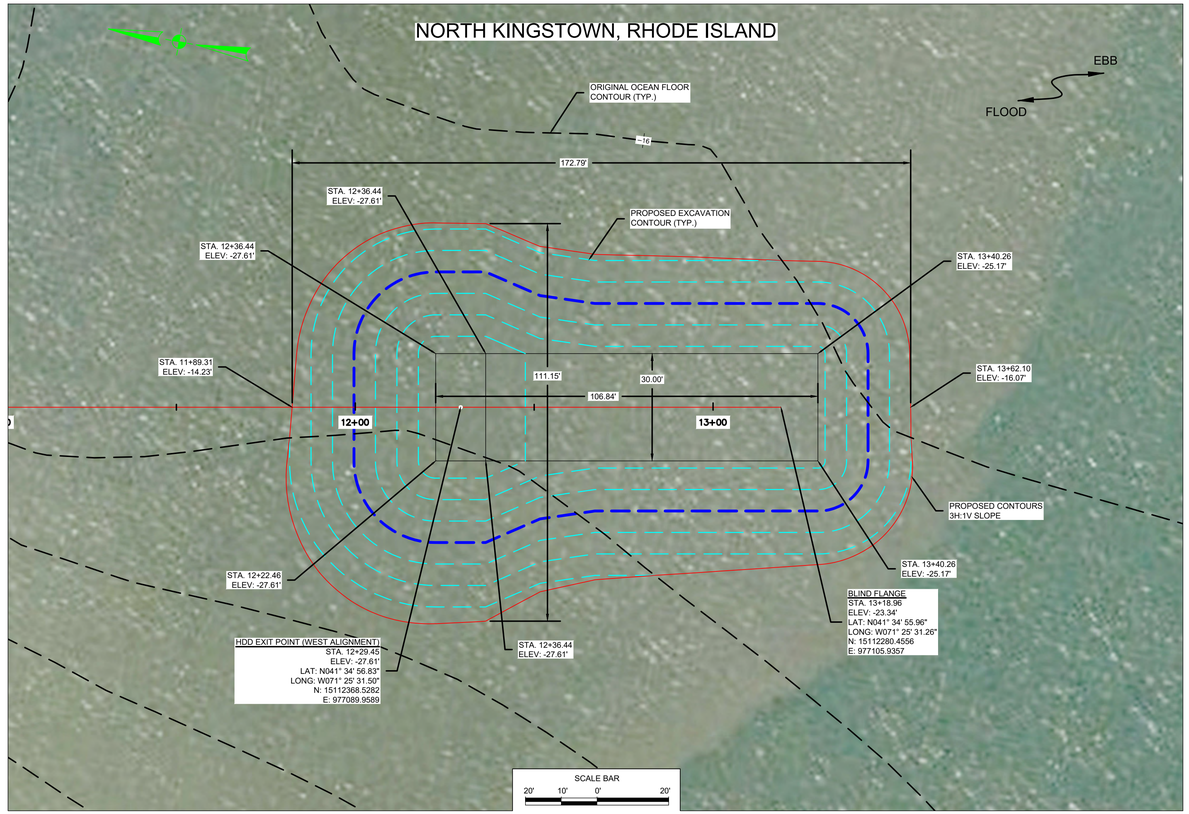

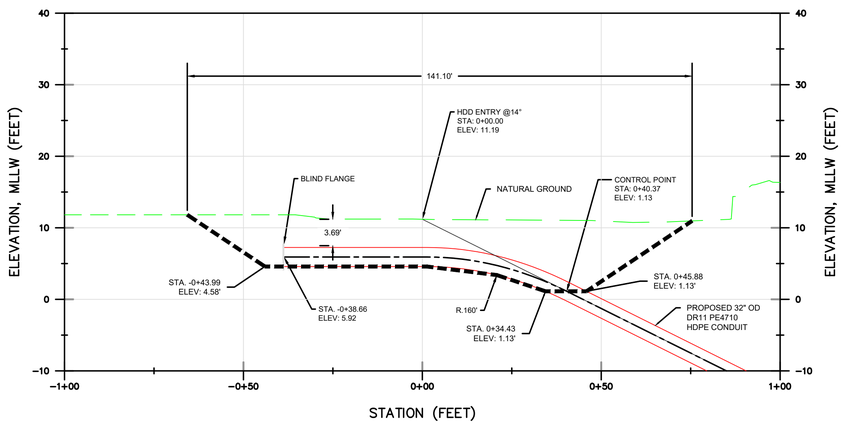

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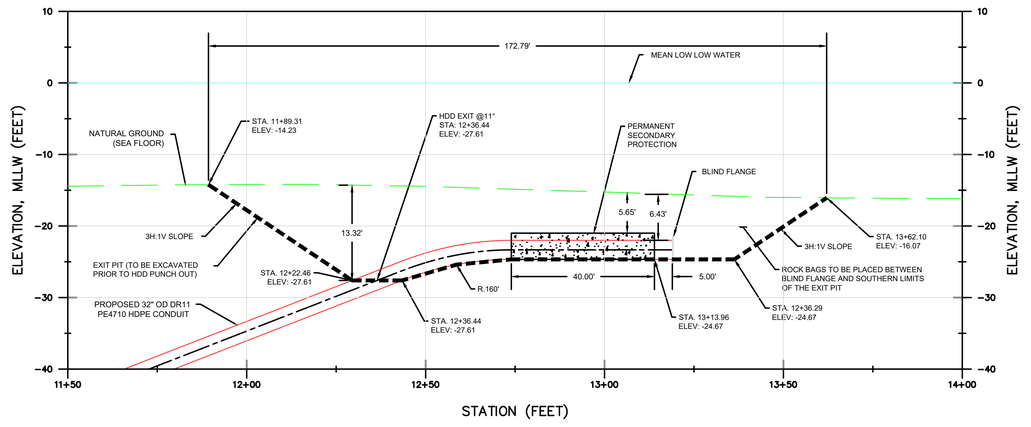

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LEGEND:

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EXCAVATION DETAILS
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REVOLUTION WIND

RWEC Design

DRAWING INDEX		
NAME	PAGE	DRAWING SHEET
Cover Sheet	0	1
Circuit 1	1-6	1-6
Circuit 2	7-12	1-6
Typical Crossing	13-22	1-9

Date: 23/06/2021
Created by: XDAEF
Checked by: AMIJA
Accepted by: XANSD
Approved by: HENMN

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Reference system: NAD83 (2011)
Projection: UTM Zone 19N
Vertical reference: NAVD88

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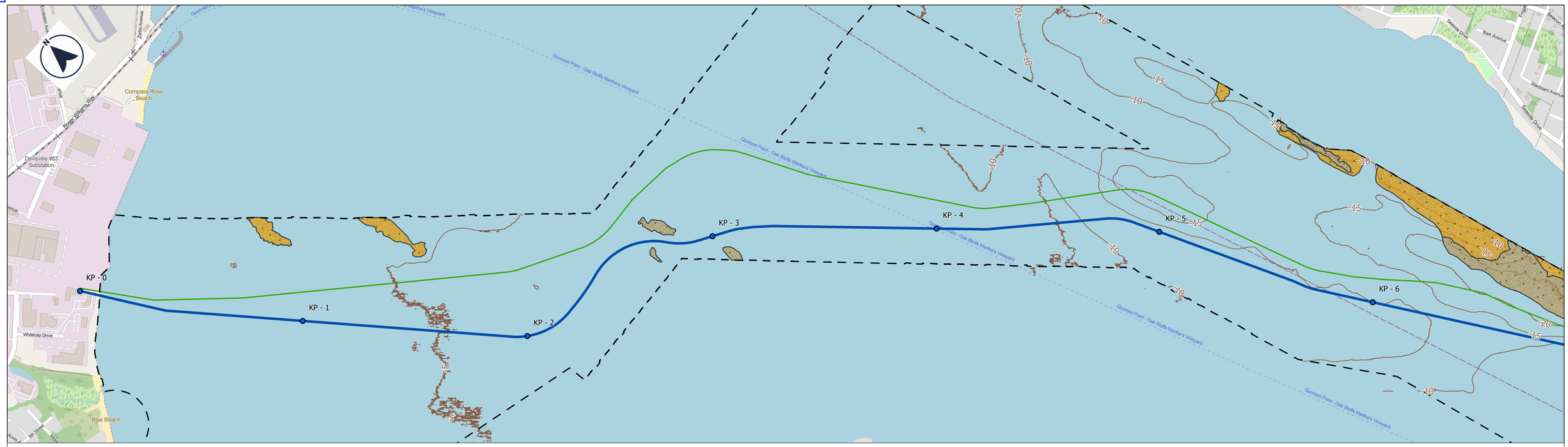

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Legend
- Kilometer Point (KP)
- Revolution Wind Export Cable (RWEC) Corridor
- Possible Cable Crossing Intersection*
- Possible Cable Crossings (Fugro)*
- Indicative Circuit 1 Cable Burial Profile
- Indicative Circuit 2 Cable
- 3 NM State Water Limit

Areas of Particular Concern
- Glacial Moraine A
- Glacial Moraine B
- BOEM Lease OSC-A 0486
- Elevation Contours in Meters

Crossing	Depth at Crossing (m, MLLW)	KP
A1	-8.69	9.73
B1	-13.86	11.35
C1	-13.62	11.42
D1	-13.87	11.78
E1	-13.89	11.81
F1	-13.77	11.89
G1	-25.49	18.21

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CHRISTOPHER A. COCKSHAW
No. 9816
REGISTERED PROFESSIONAL ENGINEER
CIVIL

MOTT MACDONALD

MOTT MACDONALD NY INC.
111 Wood Avenue South
Iselin, NJ 08830-4112
Certificate of Authorization #: 0017019

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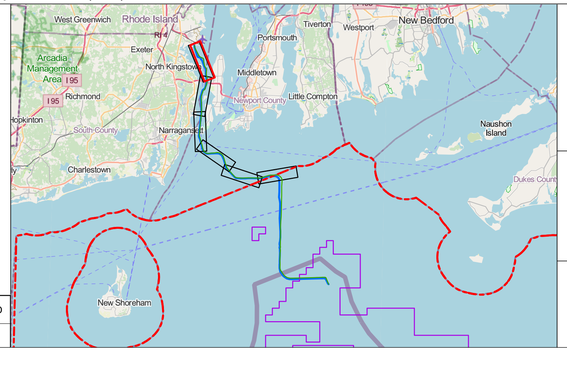

Indicative Cable Burial Plan and Profile Circuit 1 (Page 1 of 6) Sheet 13 of 33

Date: 16/06/2021
Created by: XDAEF
Checked by: MATJO
Accepted by: XDARY
Approved by: ANFRY

Revolution Wind | Powered by Ørsted & Eversource

0 0.15 0.3 0.45 Kilometers
0 0.15 0.3 Nautical Miles

Reference system: NAD83 (2011)
Projection: UTM Zone 19N
Vertical reference: NAVD88

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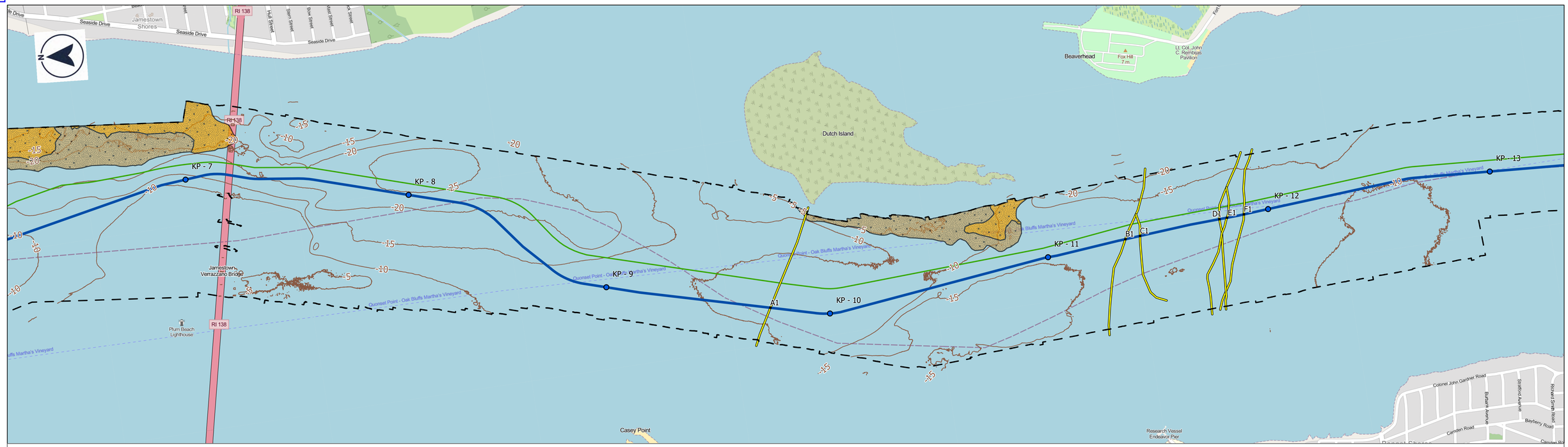

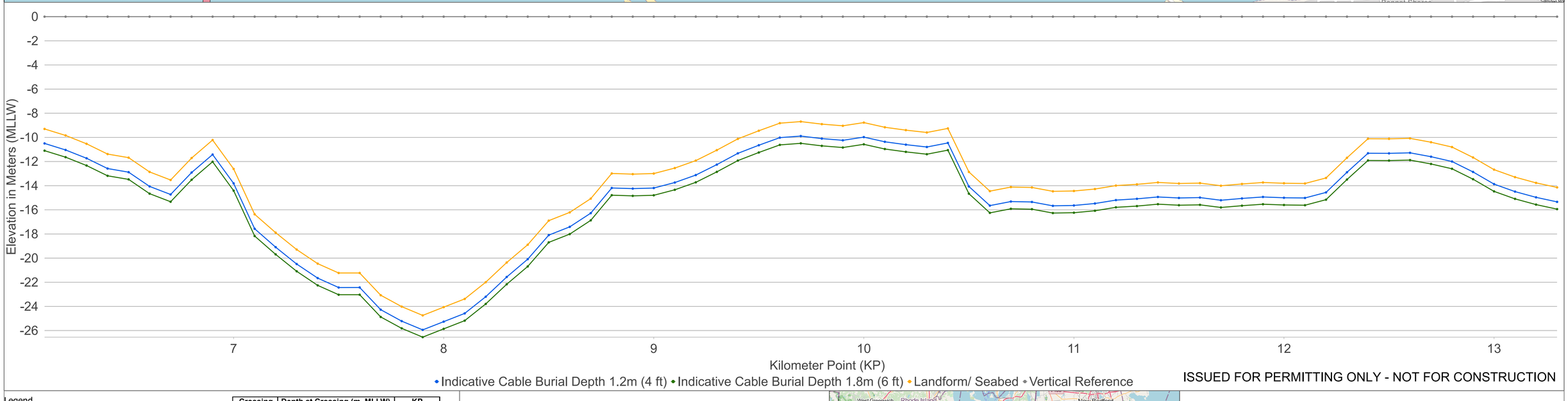

• Indicative Cable Burial Depth 1.2m (4 ft) • Indicative Cable Burial Depth 1.8m (6 ft) • Landform/ Seabed • Vertical Reference

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- Indicative Circuit 2 Cable
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Areas of Particular Concern
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- Glacial Moraine B
- BOEM Lease OSC-A 0486
- Elevation Contours in Meters

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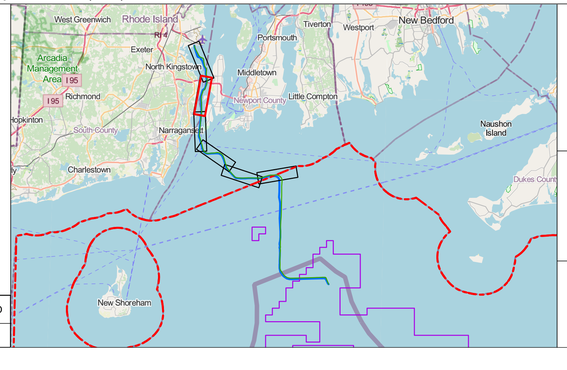

Indicative Cable Burial Plan and Profile Circuit 1 (Page 2 of 6) Sheet 14 of 33

Date: 16/06/2021
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Revolution Wind | Powered by Ørsted & Eversource

0 0.15 0.3 0.45 Kilometers
0 0.15 0.3 Nautical Miles

Reference system: NAD83 (2011)
Projection: UTM Zone 19N
Vertical reference: NAVD88

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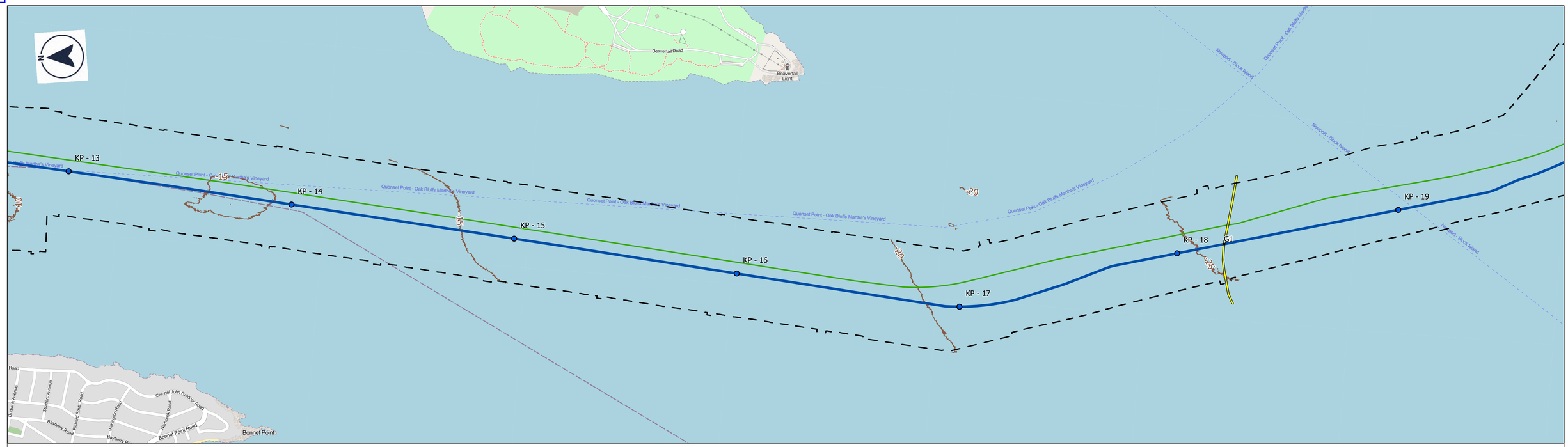

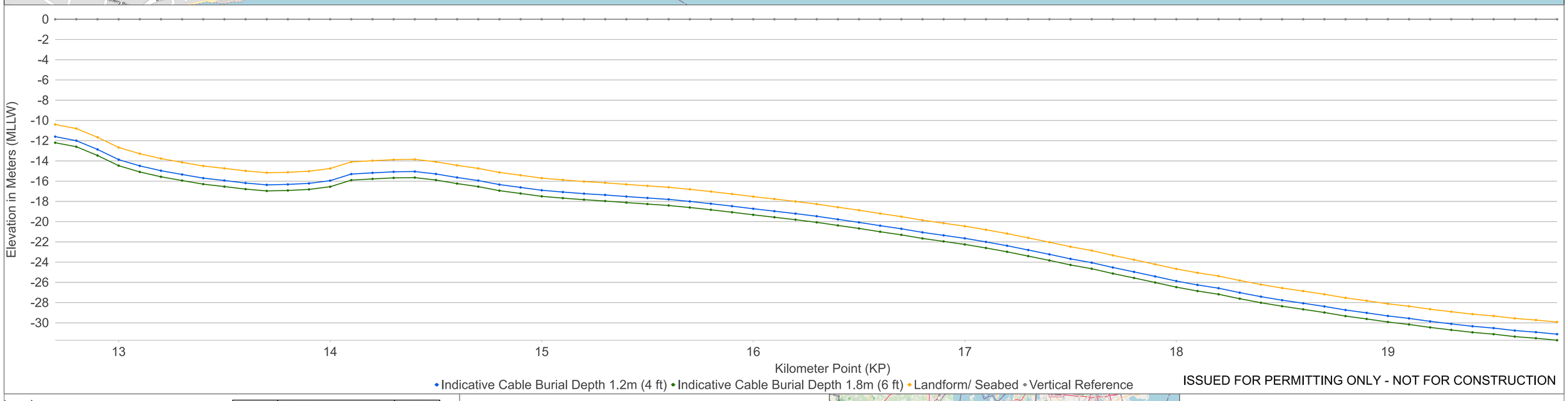

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Indicative Cable Burial Plan and Profile Circuit 1 (Page 3 of 6) Sheet 15 of 33

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Revolution Wind
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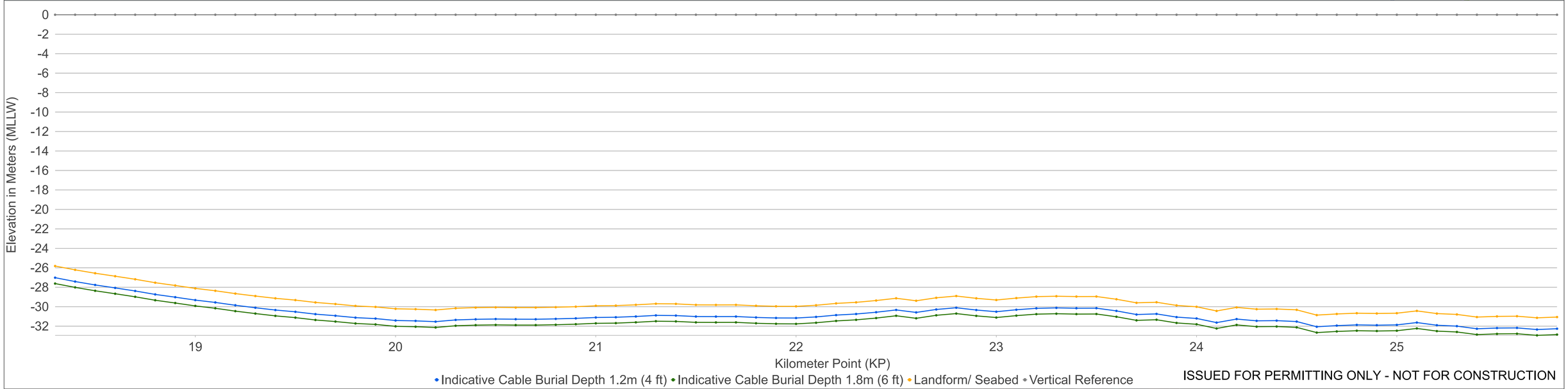

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- Elevation Contours in Meters

Crossing	Depth at Crossing (m, MLLW)	KP
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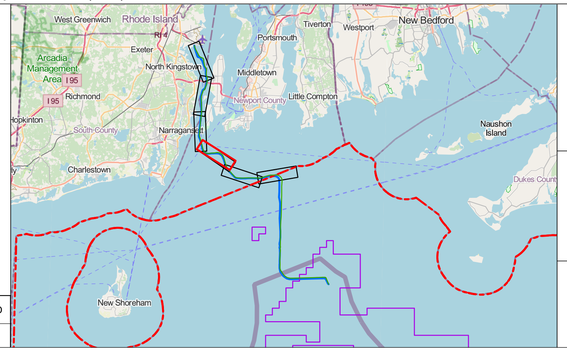

Indicative Cable Burial Plan and Profile Circuit 1 (Page 4 of 6) Sheet 16 of 33

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Revolution Wind | Powered by Ørsted & Eversource

0 0.15 0.3 0.45 Kilometers
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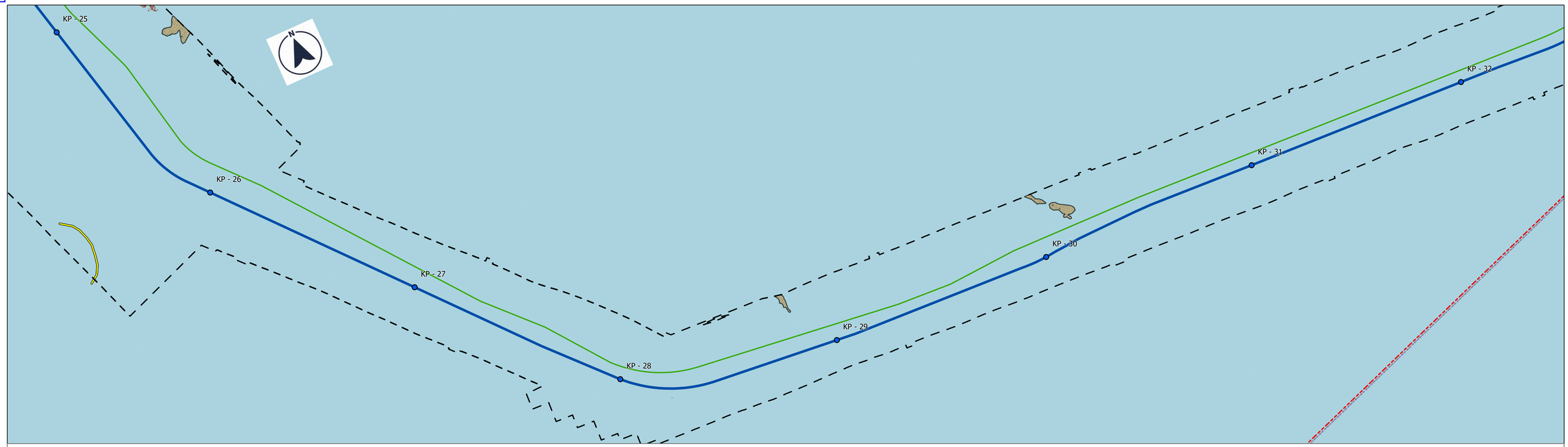

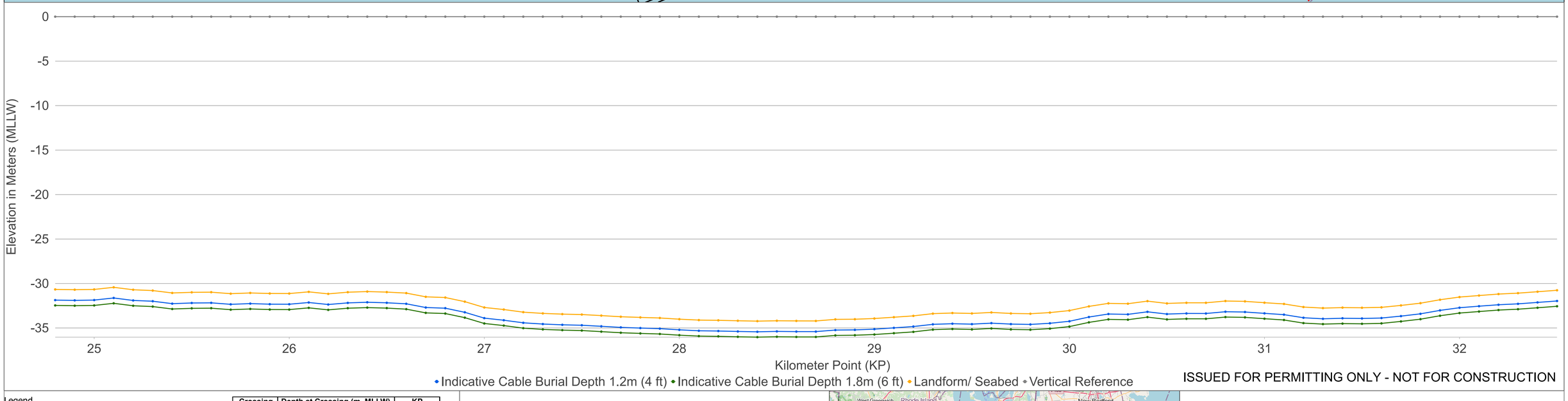

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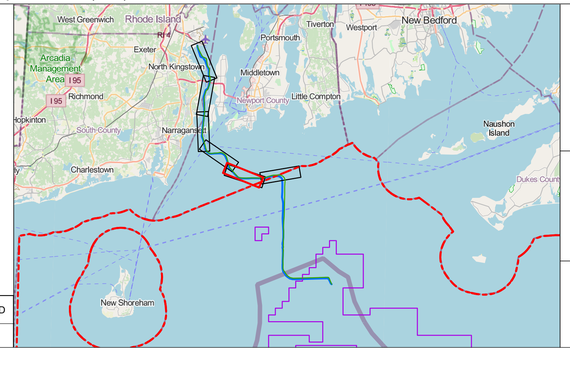

Indicative Cable Burial Plan and Profile Circuit 1 (Page 5 of 6) Sheet 17 of 33

Date: 16/06/2021
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Revolution Wind | Powered by Ørsted & Eversource

0 0.15 0.3 0.45 Kilometers
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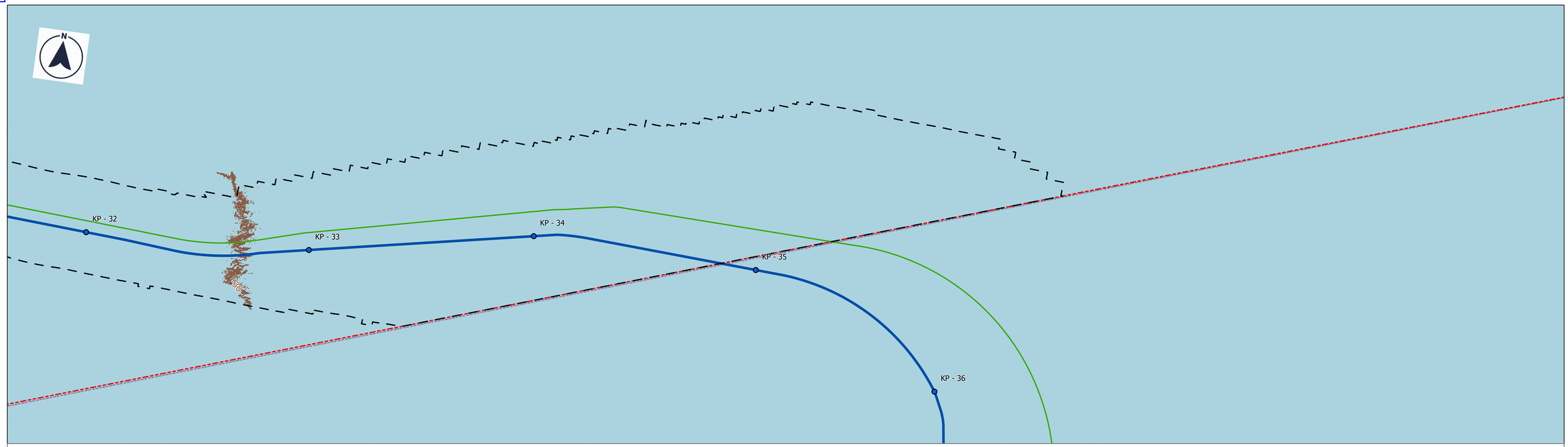

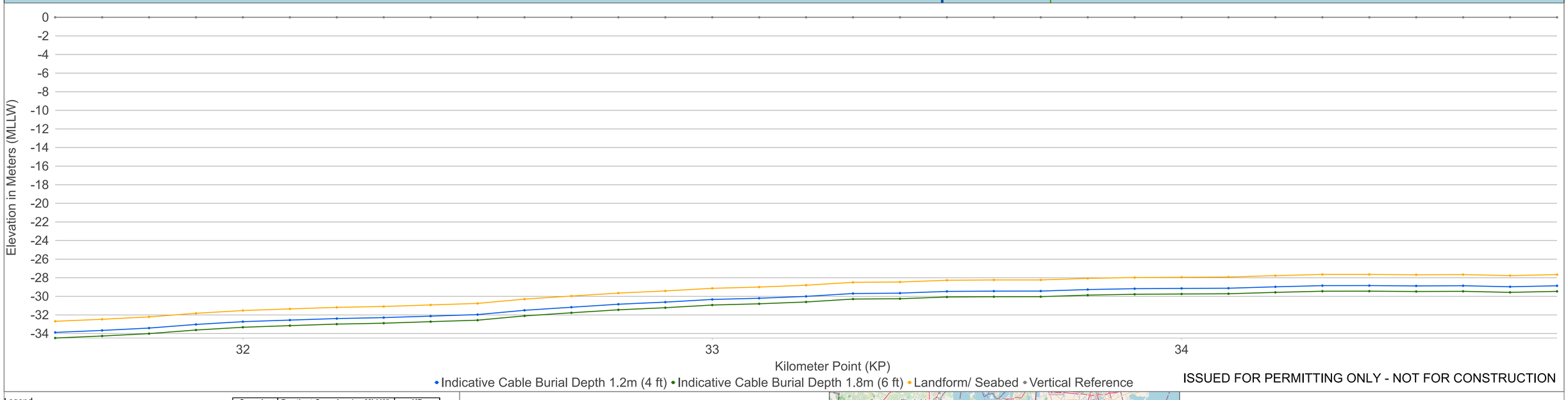

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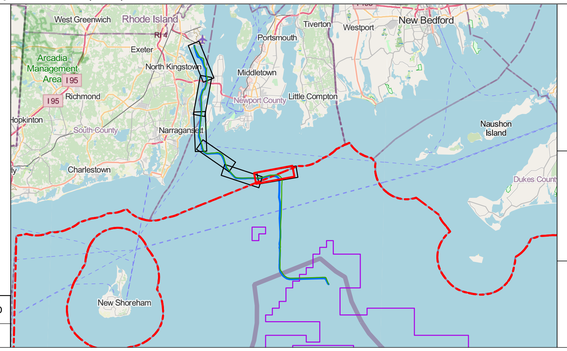

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Revolution Wind | Powered by Ørsted & Eversource

0 0.15 0.3 0.45 Kilometers
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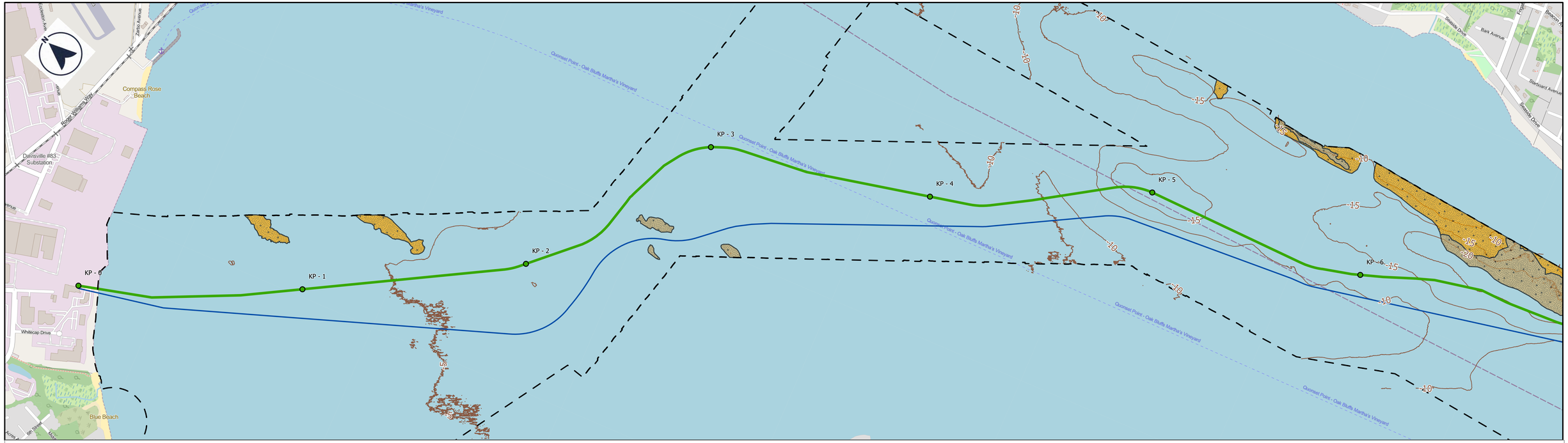

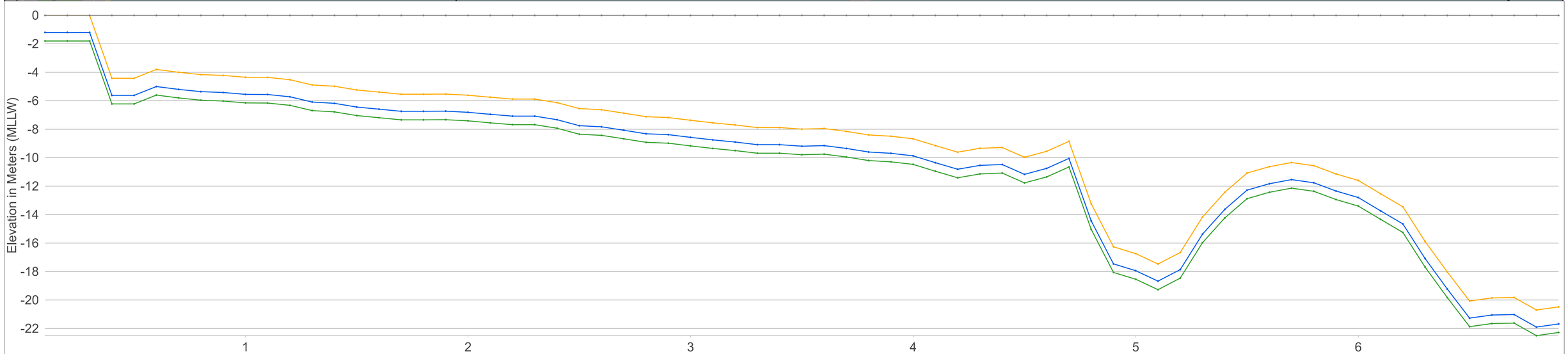

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Crossing	Depth at Crossing (m, MLLW)	KP
A2	-8.58	9.85
B2	-13.57	11.44
C2	-13.63	11.48
D2	-13.93	11.84
E2	-13.88	11.88
F2	-13.86	11.95
G2	-25.75	18.27

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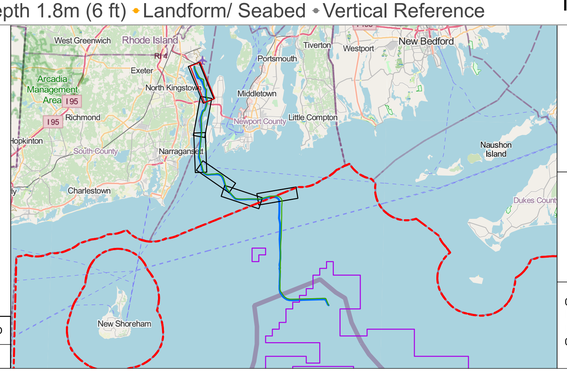
01	18/06/2021	ISSUED FOR PERMITTING	CSS	CAC/CE	ORSTED



Indicative Cable Burial Plan and Profile Circuit 2 (Page 1 of 6) Sheet 19 of 33

Date: 16/06/2021
Created by: XDAEF
Checked by: XCHGG
Accepted by: XDARY
Approved by: ANFRY

Revolution Wind | Powered by Ørsted & Eversource

0 0.3 0.6 Kilometers
0 0.15 0.3 Nautical Miles

Reference system: NAD83 (2011)
Projection: UTM Zone 19N
Vertical reference: NAVD88

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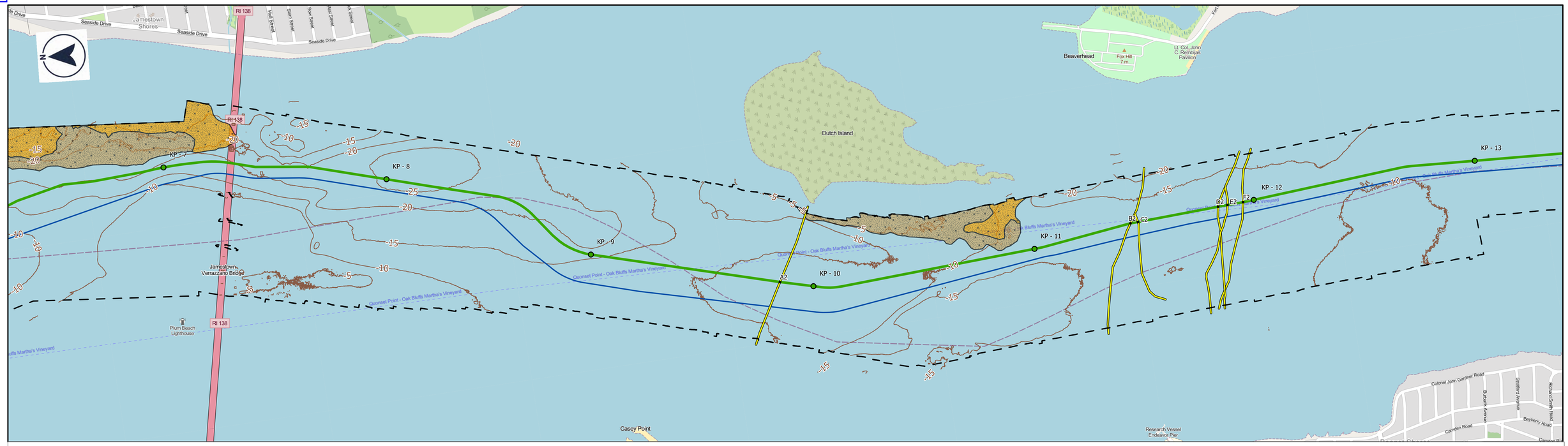

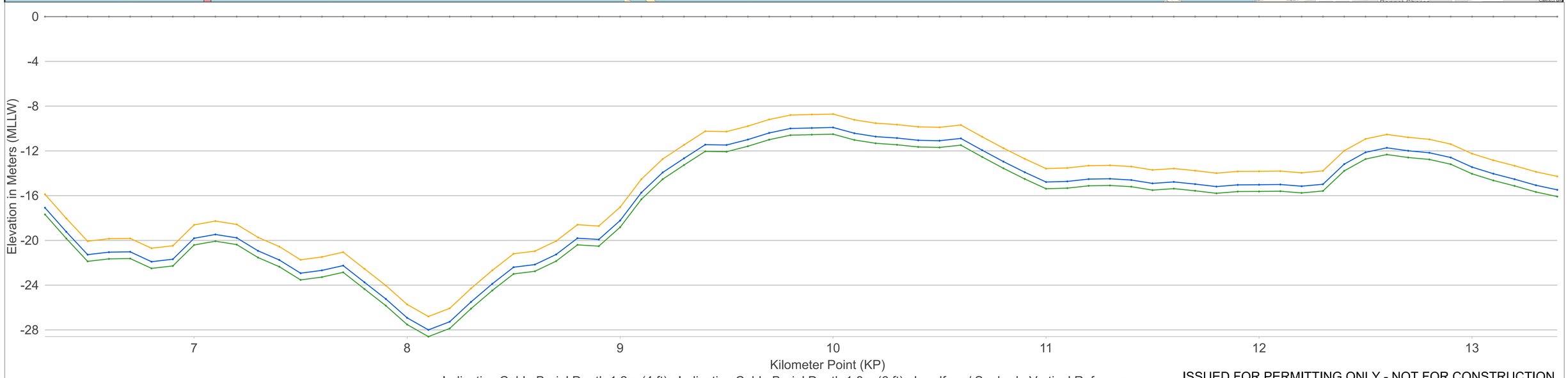

ISSUED FOR PERMITTING ONLY - NOT FOR CONSTRUCTION

Legend

- Kilometer Point (KP)
- Revolution Wind Export Cable (RWEC) Corridor
- Possible Cable Crossing Intersection*
- Potential Cable Crossings (Fugro)*
- Indicative Circuit 1 Cable Burial Profile
- Indicative Circuit 2 Cable
- 3 NM State Water Limit

Areas of Particular Concern

- Glacial Moraine A
- Glacial Moraine B
- BOEM Lease OSC-A 0486
- Elevation Contours in Meters

Crossing	Depth at Crossing (m, MLLW)	KP
A2	-8.58	9.85
B2	-13.57	11.44
C2	-13.63	11.48
D2	-13.93	11.84
E2	-13.88	11.88
F2	-13.86	11.95
G2	-25.75	18.27

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Iselin, NJ 08830-4112
Certificate of Authorization #: 0017019

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CHRISTOPHER A. COCKSHAW
No. 9816
REGISTERED PROFESSIONAL ENGINEER
CIVIL

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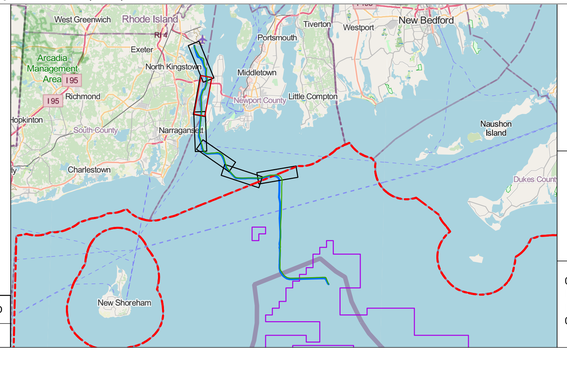

Indicative Cable Burial Plan and Profile Circuit 2 (Page 2 of 6) Sheet 20 of 33

Date: 16/06/2021
Created by: XDAEF
Checked by: XCHGG
Accepted by: XDARY
Approved by: ANFRY

Revolution Wind | Powered by Ørsted & Eversource

0 0.3 0.6 Kilometers
0 0.15 0.3 Nautical Miles

Reference system: NAD83 (2011)
Projection: UTM Zone 19N
Vertical reference: NAVD88

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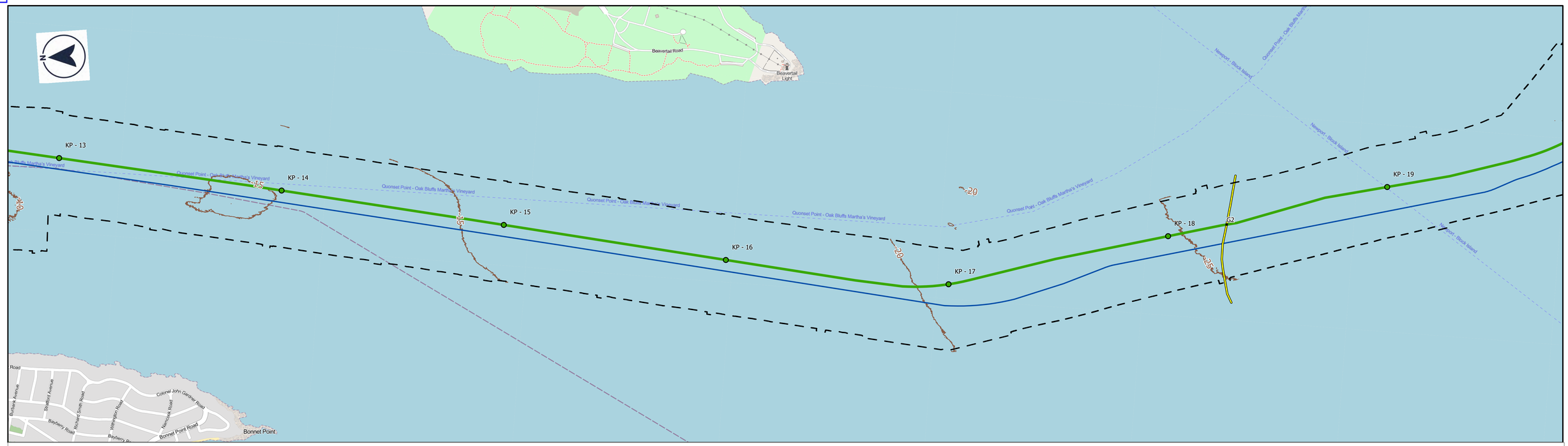

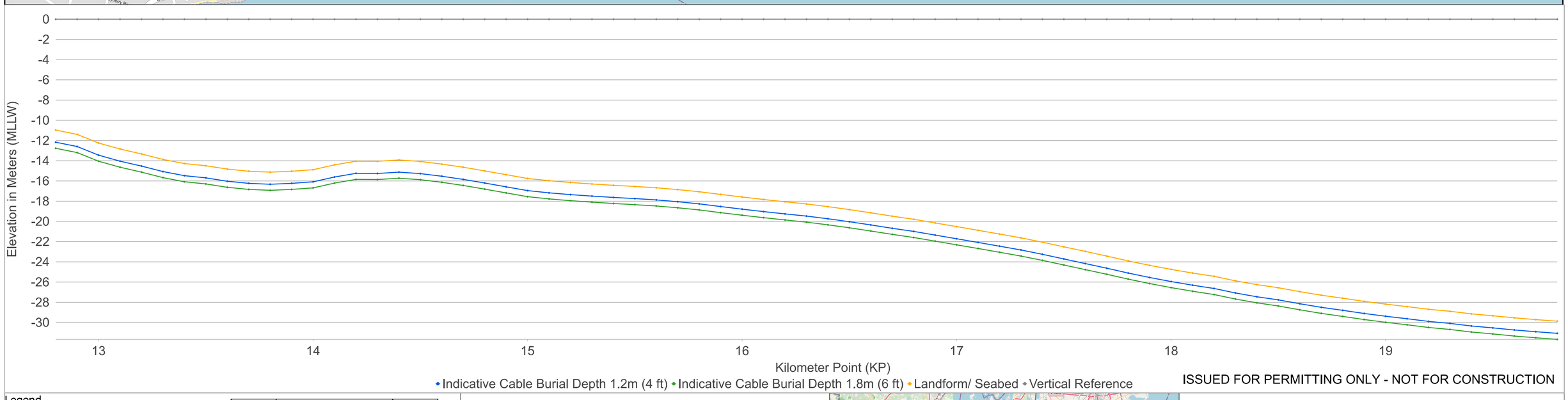

• Indicative Cable Burial Depth 1.2m (4 ft) • Indicative Cable Burial Depth 1.8m (6 ft) • Landform/ Seabed • Vertical Reference

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Legend
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- Possible Cable Crossing Intersection*
- Potential Cable Crossings (Fugro)*
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- Indicative Circuit 2 Cable
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MOTT MACDONALD

MOTT MACDONALD NY INC.
111 Wood Avenue South
Iselin, NJ 08830-4112
Certificate of Authorization #: 0017019

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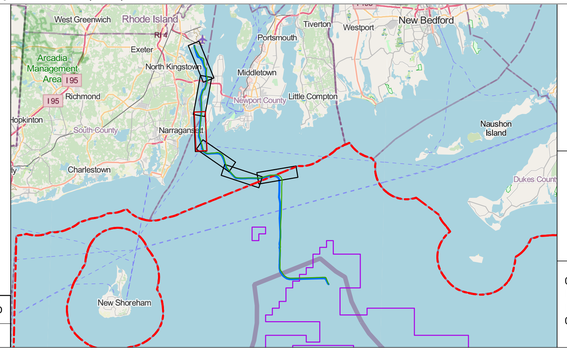

Indicative Cable Burial Profile - Circuit 2 (Page 3 of 6) Sheet 21 of 33

Date: 16/06/2021
Created by: XDAEF
Checked by: XCHGG
Accepted by: XDARY
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Revolution Wind | Powered by Ørsted & Eversource

0 0.3 0.6 Kilometers
0 0.15 0.3 Nautical Miles

Reference system: NAD83 (2011)
Projection: UTM Zone 19N
Vertical reference: NAVD88

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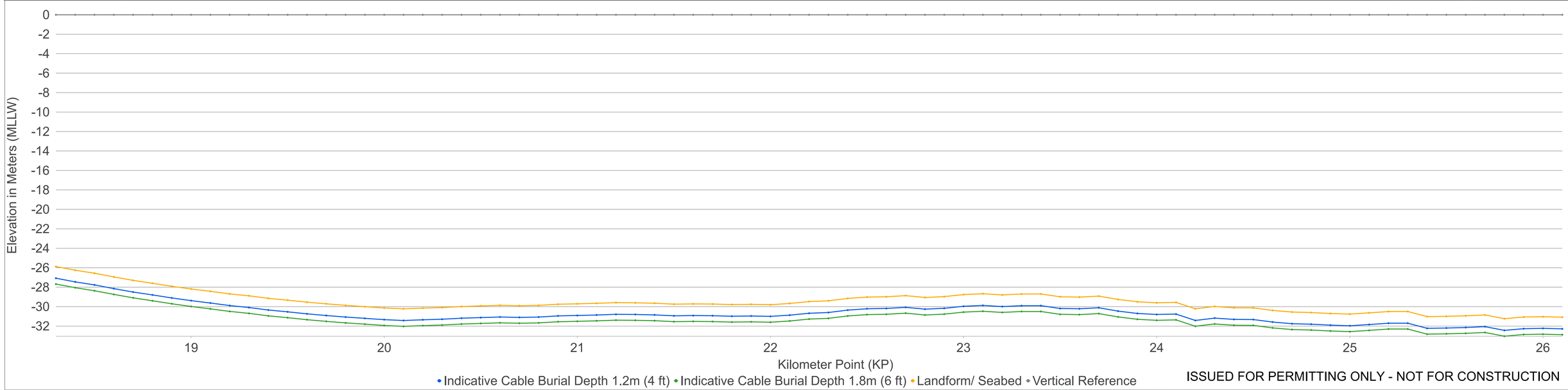

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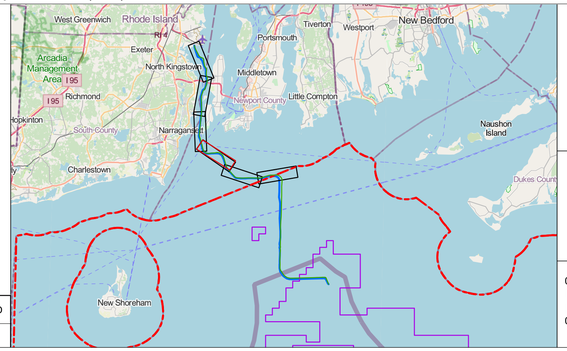

Indicative Cable Burial Plan and Profile Circuit 2 (Page 4 of 6) Sheet 22 of 33

Date: 16/06/2021
Created by: XDAEF
Checked by: XCHGG
Accepted by: XDARY
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Revolution Wind | Powered by Ørsted & Eversource

0 0.3 0.6 Kilometers
0 0.15 0.3 Nautical Miles

Reference system: NAD83 (2011)
Projection: UTM Zone 19N
Vertical reference: NAVD88

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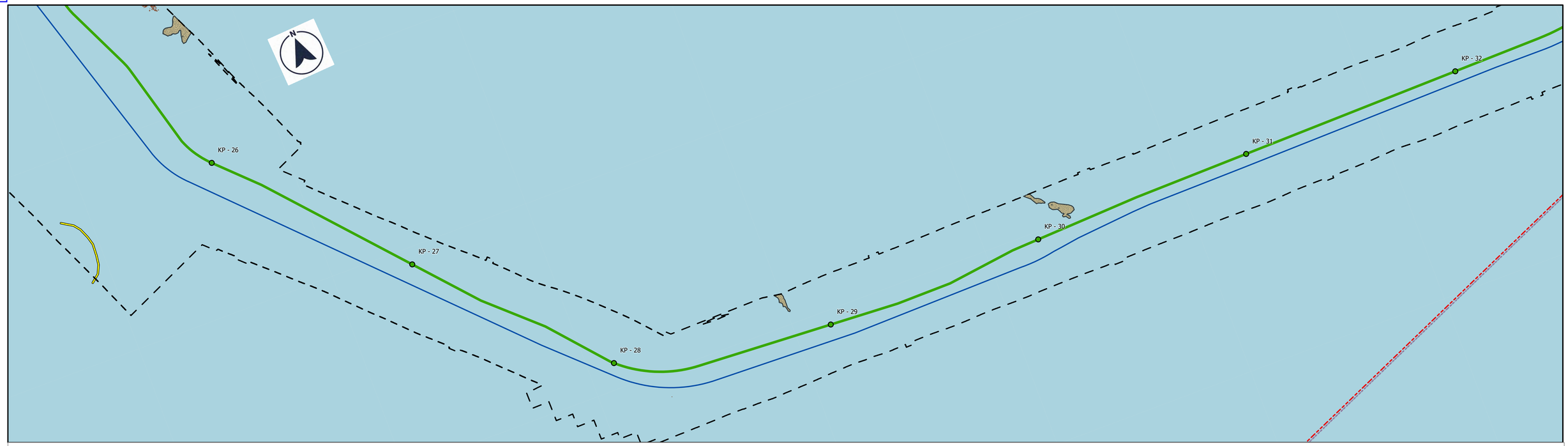

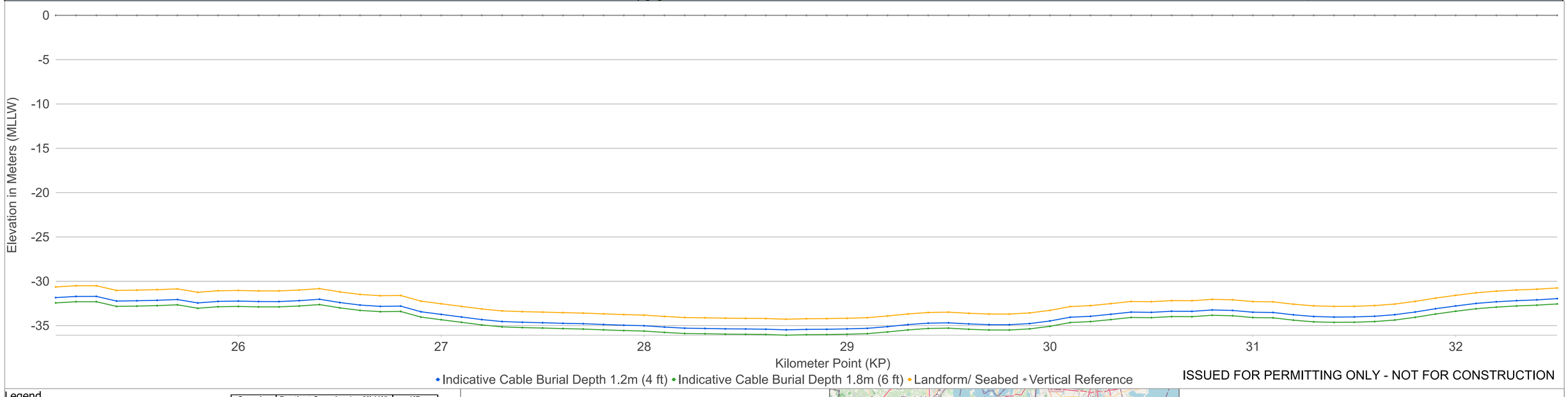

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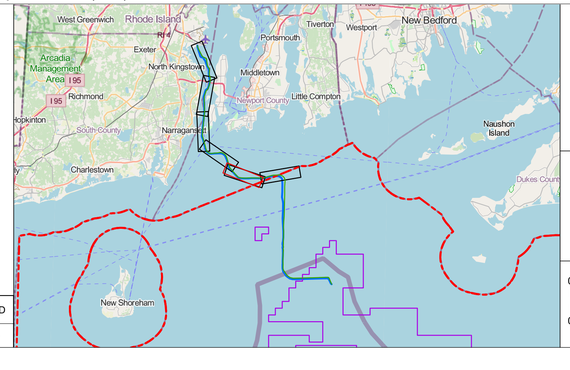

Indicative Cable Burial Plan and Profile Circuit 2 (Page 5 of 6) Sheet 23 of 33

Date: 16/06/2021
Created by: XDAEF
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Revolution Wind | Powered by Ørsted & Eversource

0 0.3 0.6 Kilometers
0 0.15 0.3 Nautical Miles

Reference system: NAD83 (2011)
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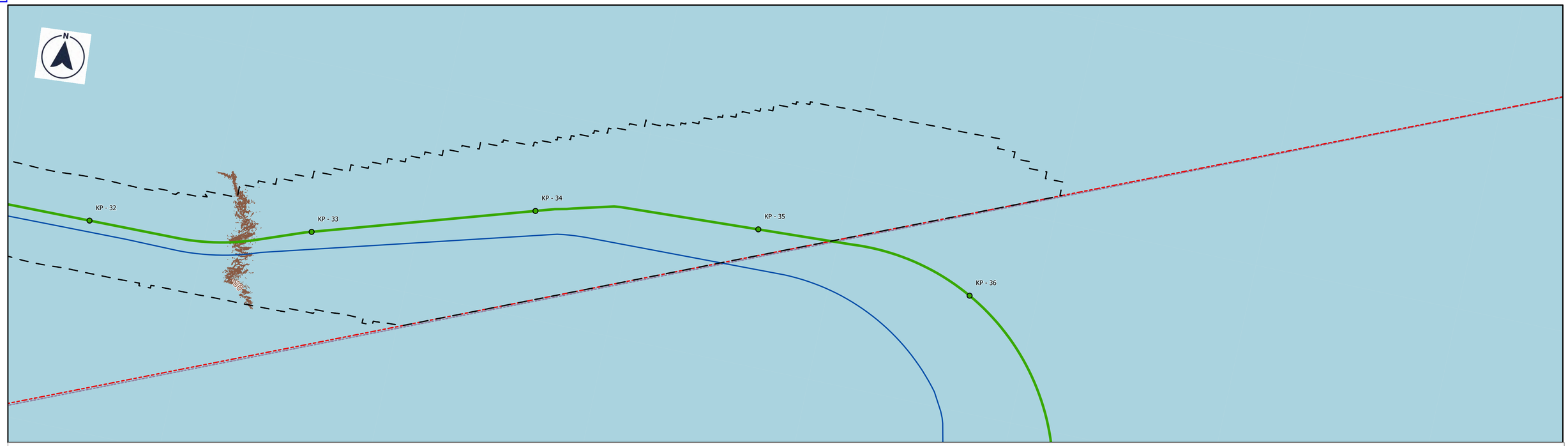

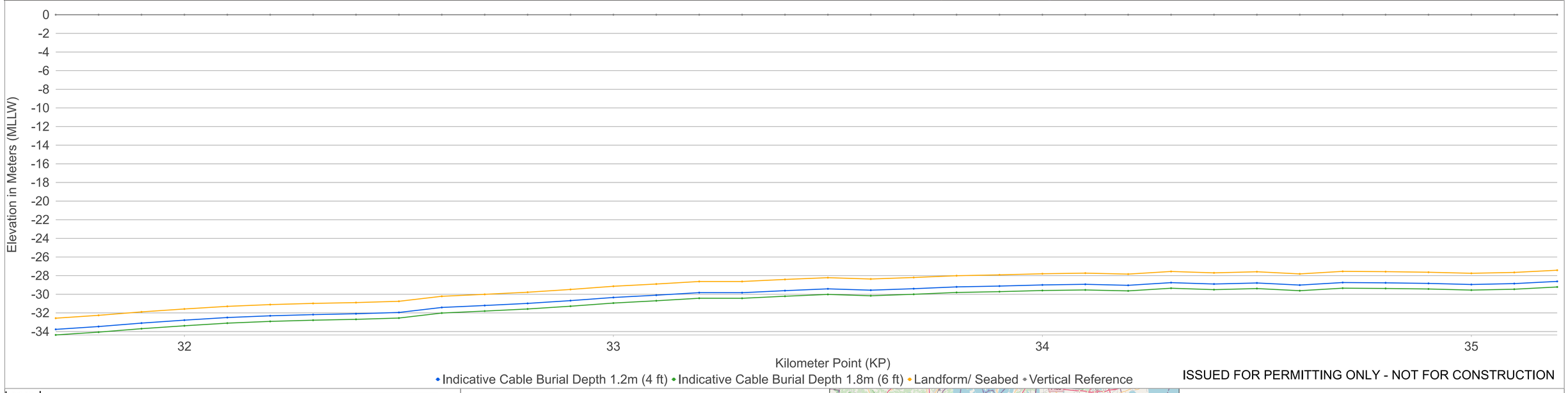

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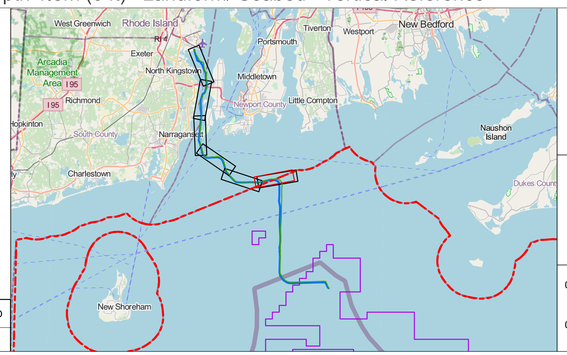

Indicative Cable Burial Plan and Profile Circuit 2 (Page 6 of 6) Sheet 24 of 33

Date: 16/06/2021
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Revolution Wind | Powered by Ørsted & Eversource

0 0.3 0.6 Kilometers
0 0.15 0.3 Nautical Miles

Reference system: NAD83 (2011)
Projection: UTM Zone 19N
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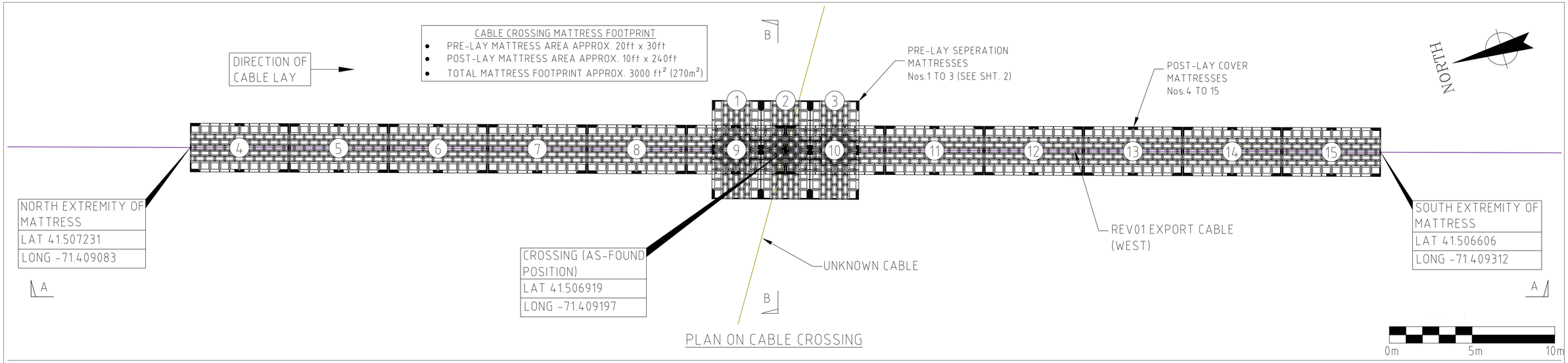
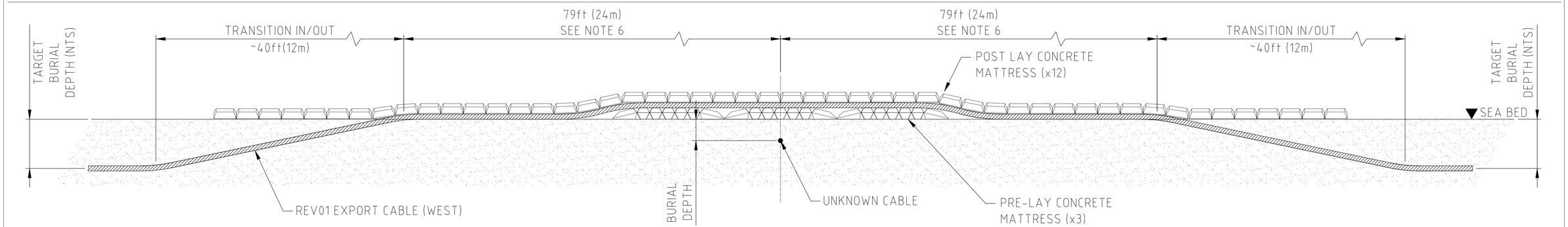


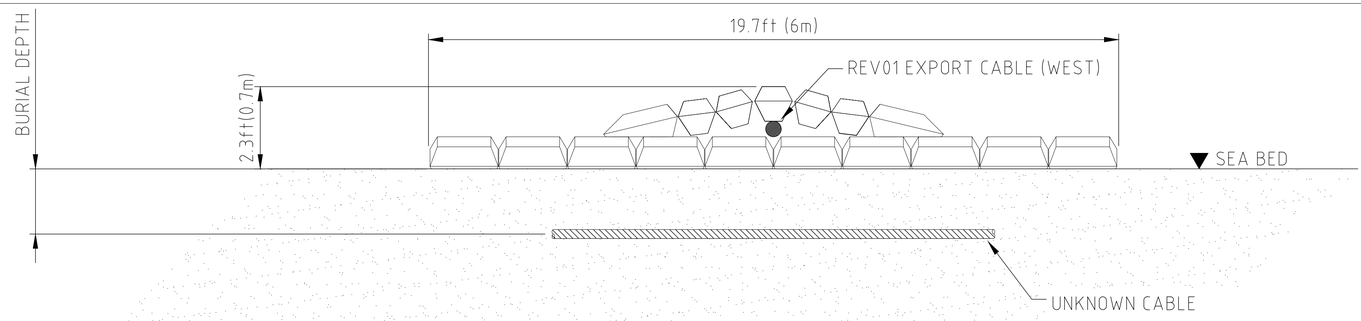
PLAN ON CABLE CROSSING



SECTION A - A
ELEVATION ON MATTRESS CONFIGURATION - (NTS)

NOTES:

1. FOR FURTHER CROSSING DETAIL REFER TO CROSSING DESIGN PACK & MATTRESS INSTALLATION PROCEDURE
2. COORDINATE SYSTEM - NAD83(2011)UTM ZONE 19N
3. PRE-LAY MATTRESSES: 3 OFF
4. POST LAY MATTRESSES: 12 OFF
5. POST LAY MATTRESSES WILL BE LAID TO FOLLOW "AS LAID" CABLE POSITION.
6. DISTANCE TO TRANSITION OF BURIAL TO BE AGREED WITH ASSET OWNER, AND WILL ALSO DEPEND ON CABLE BURIAL METHOD
7. THIS DRAWING HAS BEEN PREPARED ACCORDING TO DATA PROVIDED AND QA/QC'D BY ORSTED AND TO BE CONSIDERED SOLELY FOR CABLE INSTALLATION PERMITTING PURPOSES.



SECTION B - B
END ELEVATION ON MATTRESS CONFIGURATION - (NTS)

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No. 9816
REGISTERED PROFESSIONAL ENGINEER
CIVIL

SHEET 25 OF 33

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Tel. +45 9955 1111
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REV01
UNKNOWN_CABLE
A1_CABLE-CROSSING-DETAILS
FOR-INITIAL-REVIEW-AND-COMMENT

MOTT MACDONALD
MOTT MACDONALD NY INC.
111 Wood Avenue South
Iselin, NJ 08830-4112
Certificate of Authorization #: 0017019

Ørsted Document No.	Drawn by	Accepted	Approved
TBC	XMGRI/XDAEF	XMGRI	HENMN

Scale	Size	RDS-PP code	Rev.
NTS	36"X24"		FOR-INITIAL-REVIEW

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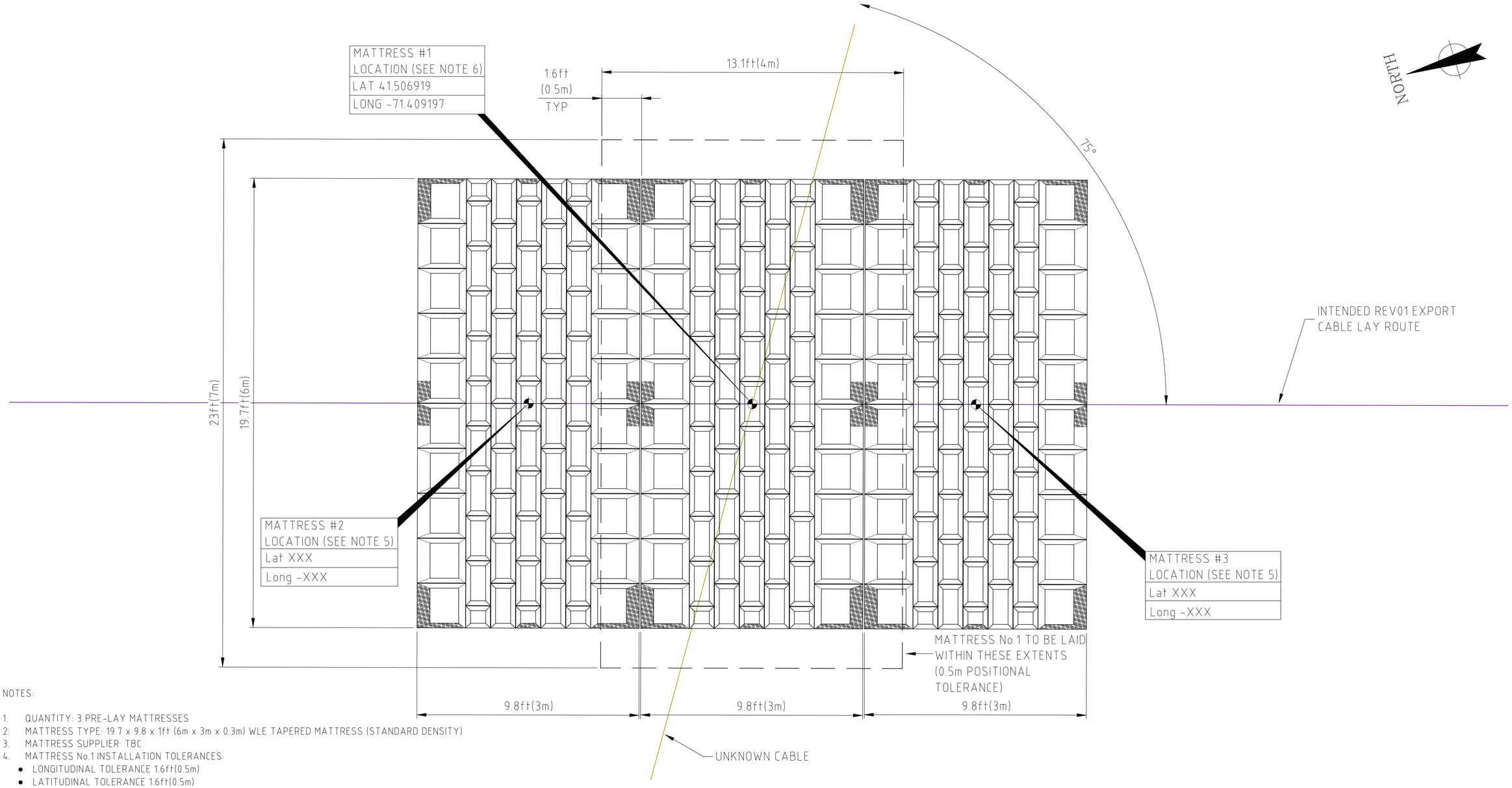

NOTES:

1. QUANTITY: 3 PRE-LAY MATTRESSES
2. MATTRESS TYPE: 19.7 x 9.8 x 1ft (6m x 3m x 0.3m) WLE TAPERED MATTRESS (STANDARD DENSITY)
3. MATTRESS SUPPLIER: TBC
4. MATTRESS No.1 INSTALLATION TOLERANCES:
   - LONGITUDINAL TOLERANCE 1.6ft(0.5m)
   - LATITUDINAL TOLERANCE 1.6ft(0.5m)
5. MATTRESSES No.2 & No.3 TO BE LAID AS CLOSE TO BEST CASE AS POSSIBLE, HOWEVER RELEVANT TO MATTRESS No.1 TOLERANCES:
   - MAXIMUM OVERLAP OF 1 BLOCK
   - MAXIMUM GAP BETWEEN MATTRESSES OF 1.6ft(0.5m)
6. MATTRESS LOCATION SUBJECT TO MINOR ADJUSTMENT AFTER PRE-LAY ROV SURVEY CONFIRMING CROSSING LOCATION.
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PLAN ON UNKNOWN CABLE CROSSING - (SCALE 1:50)
PRE-LAY MATTRESS INSTALLATION

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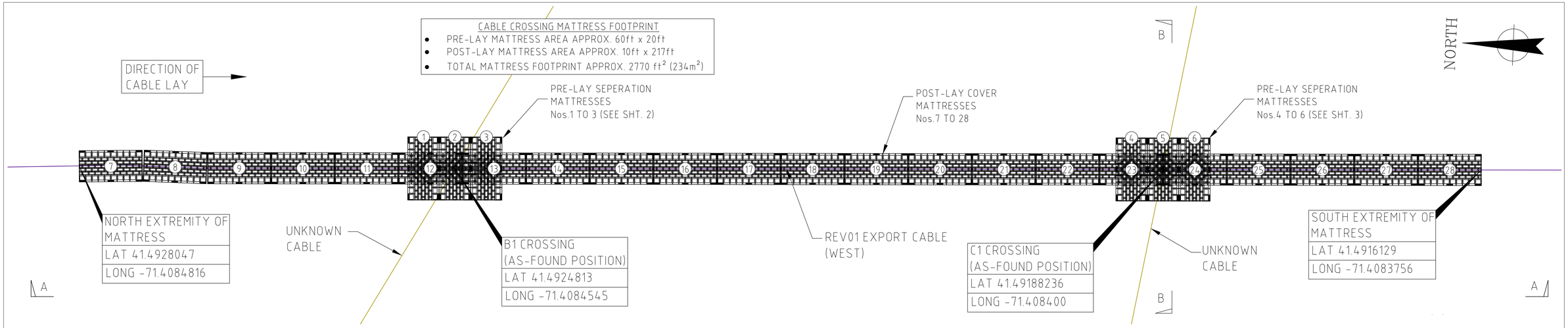
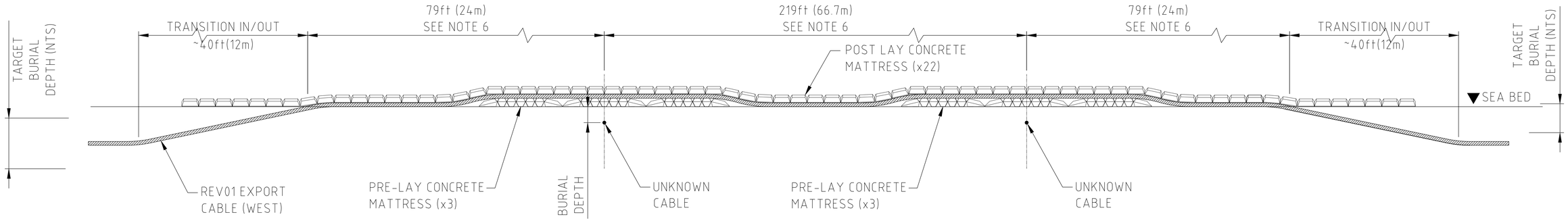
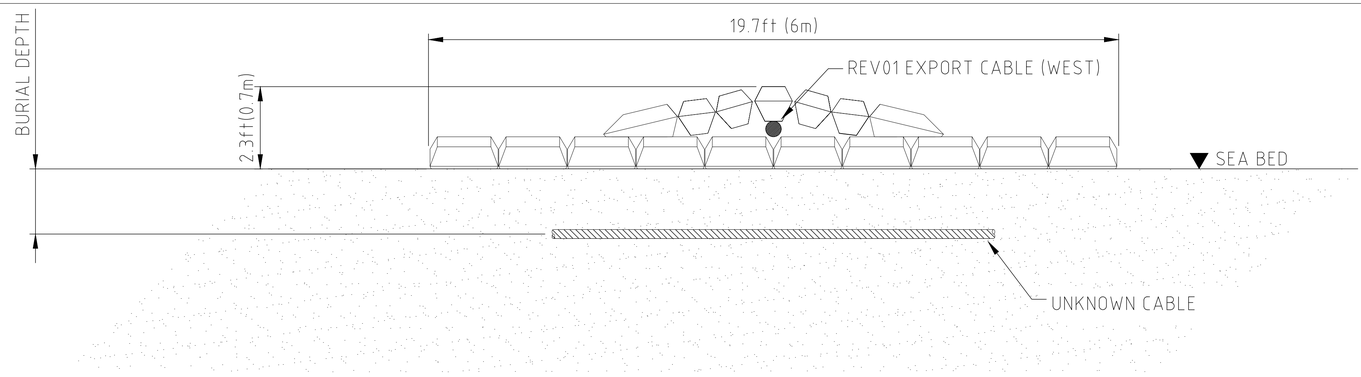


PLAN ON CABLE CROSSING



SECTION A - A
ELEVATION ON MATTRESS CONFIGURATION - (NTS)



SECTION B - B
END ELEVATION ON MATTRESS CONFIGURATION - (NTS)

NOTES:

1. FOR FURTHER CROSSING DETAIL REFER TO CROSSING DESIGN PACK & MATTRESS INSTALLATION PROCEDURE.
2. COORDINATE SYSTEM - NAD83(2011)UTM ZONE 19N
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4. POST LAY MATTRESSES: 22 OFF
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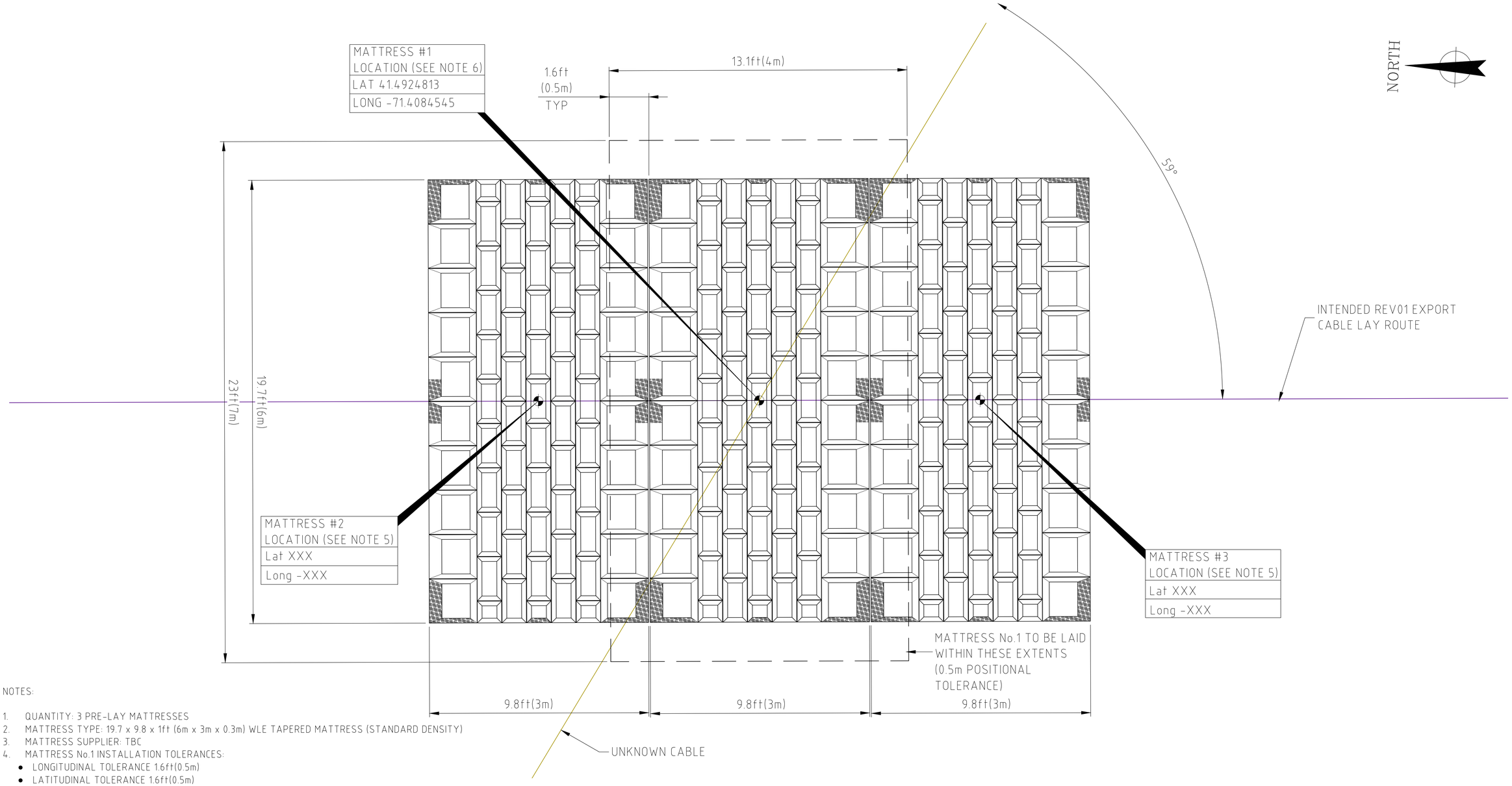

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PRE-LAY MATTRESS INSTALLATION

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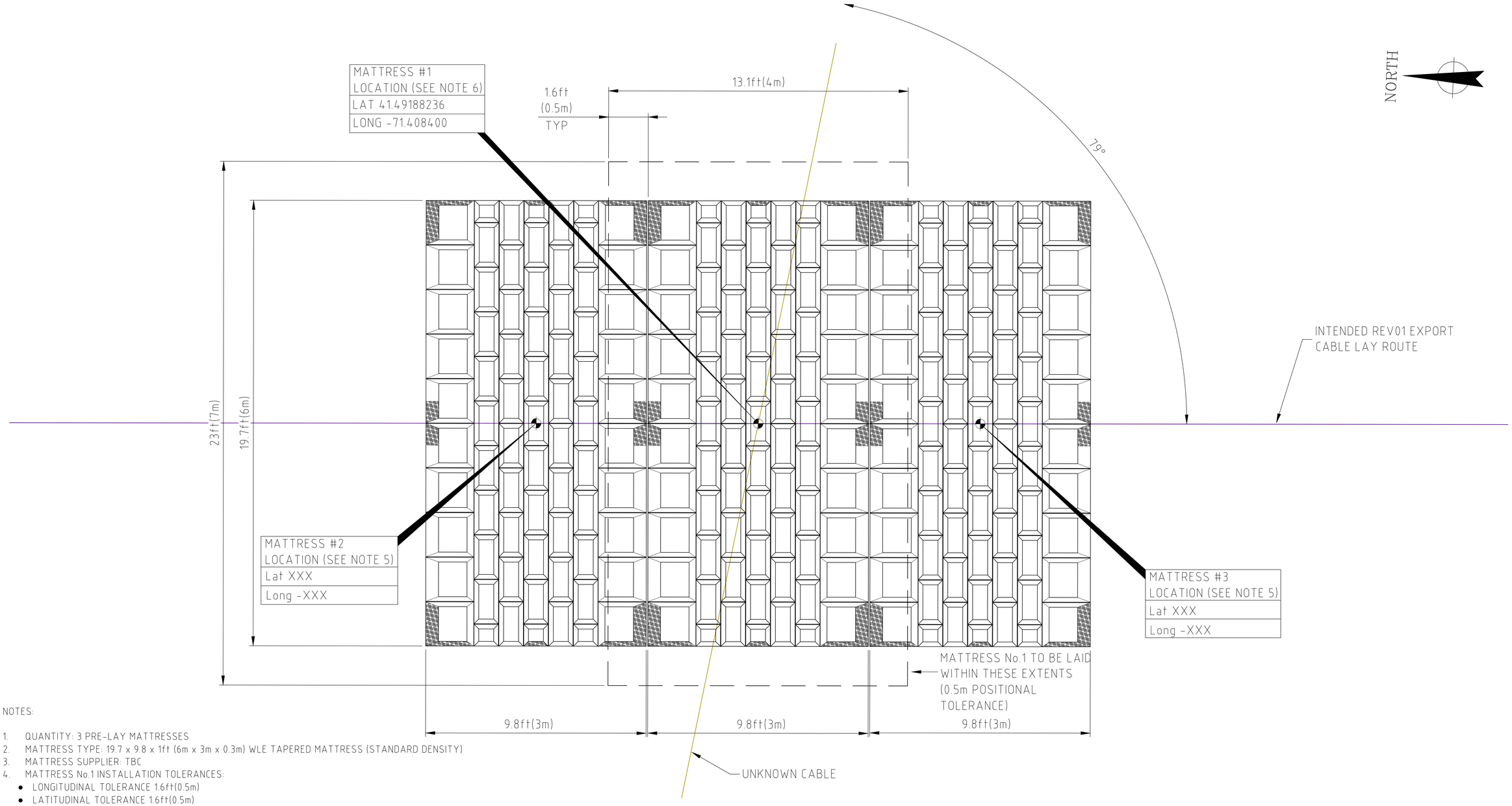

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PRE-LAY MATTRESS INSTALLATION

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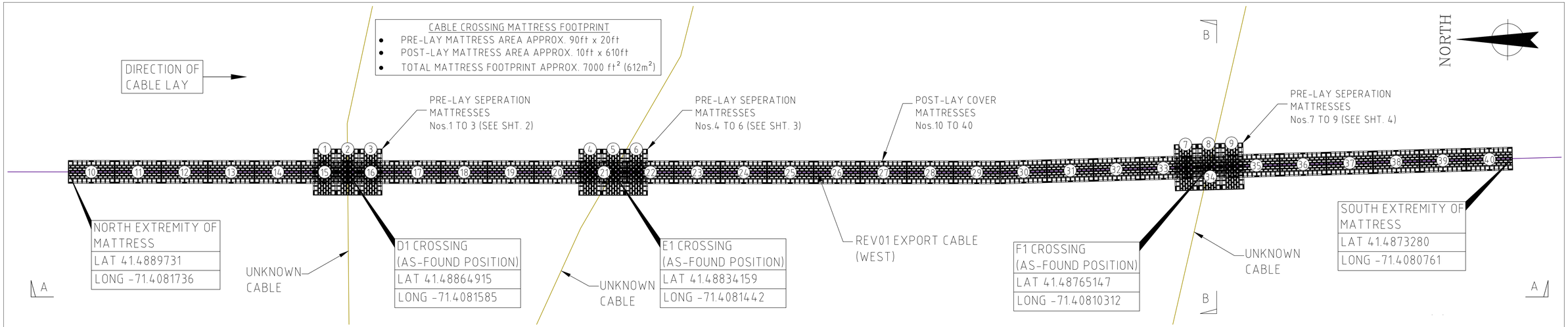
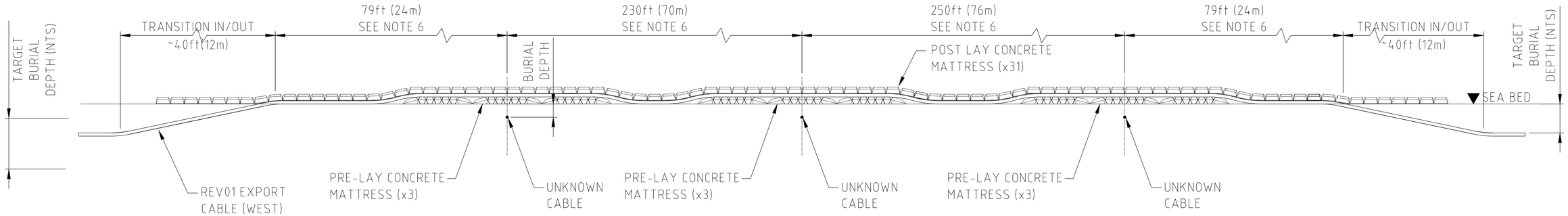


PLAN ON CABLE CROSSING



SECTION A - A
ELEVATION ON MATTRESS CONFIGURATION - (NTS)

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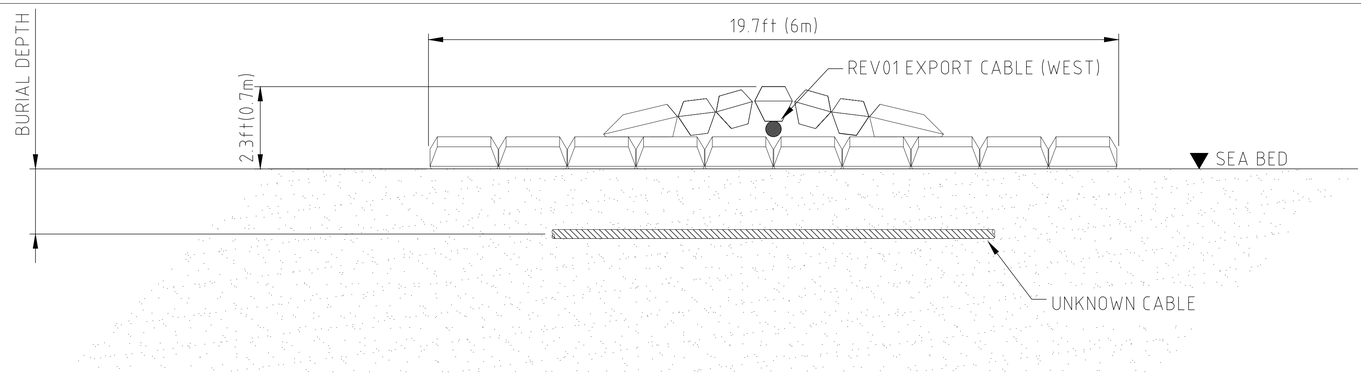

SECTION B - B
END ELEVATION ON MATTRESS CONFIGURATION - (NTS)

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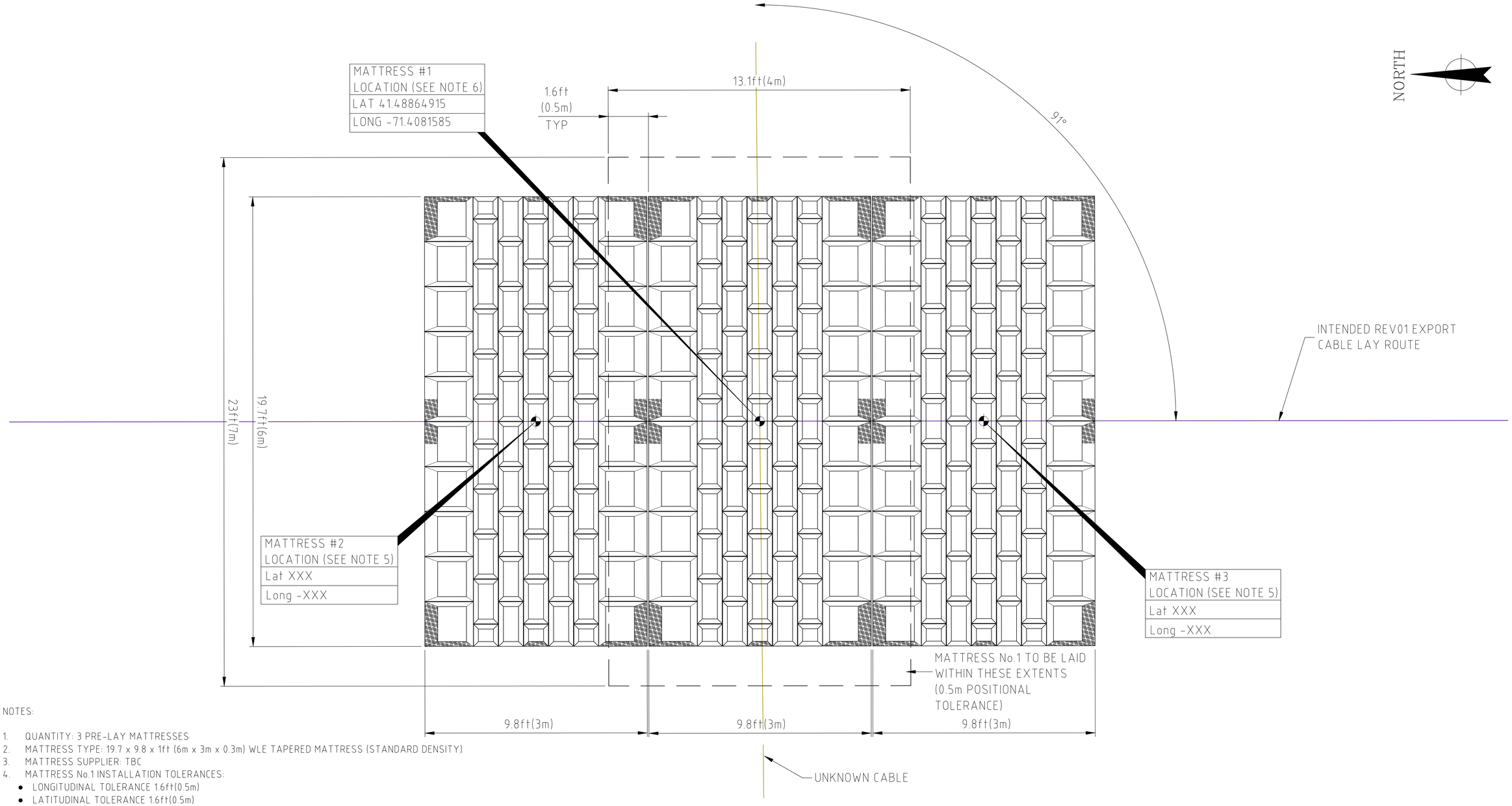

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PRE-LAY MATTRESS INSTALLATION

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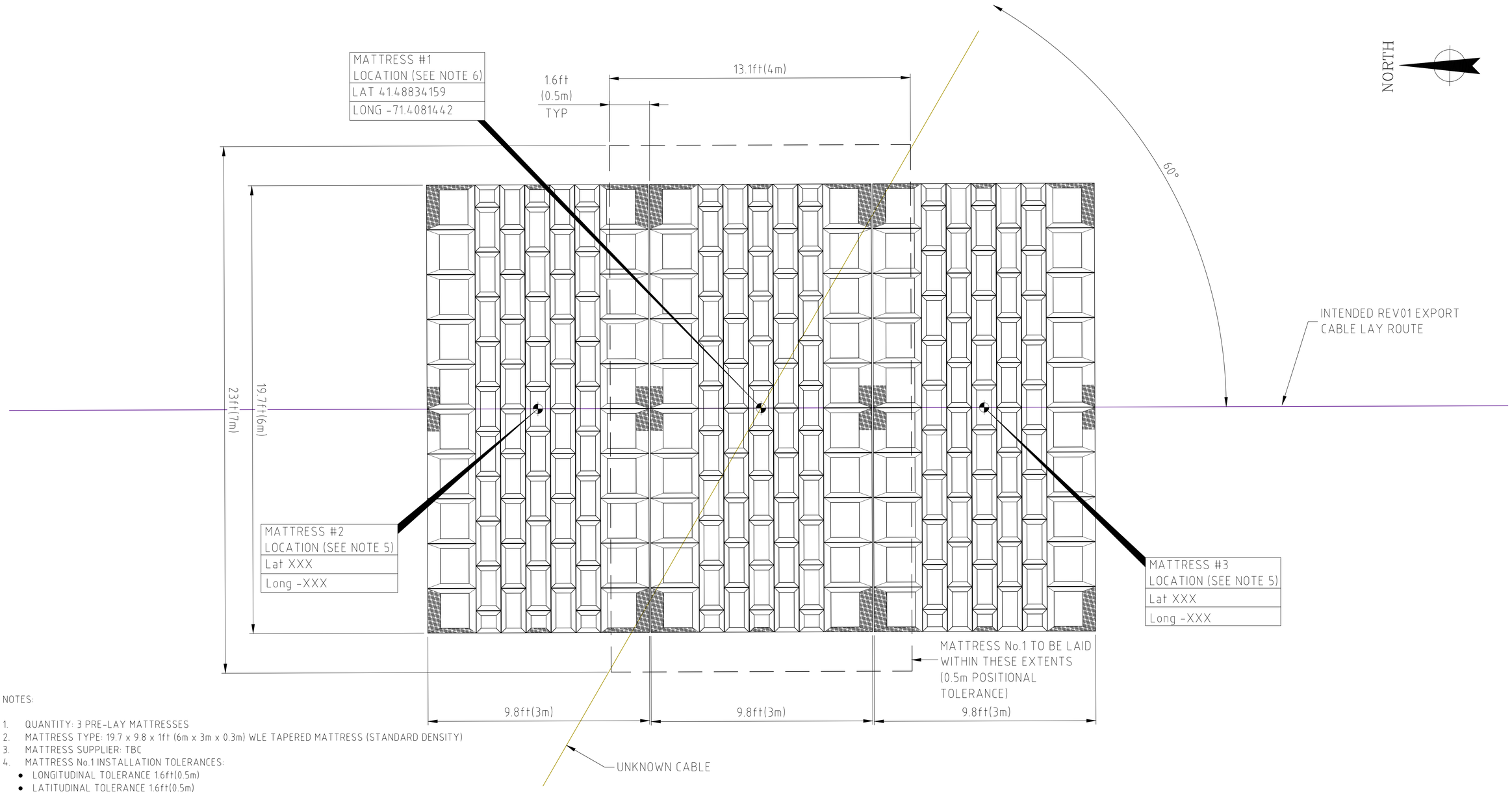

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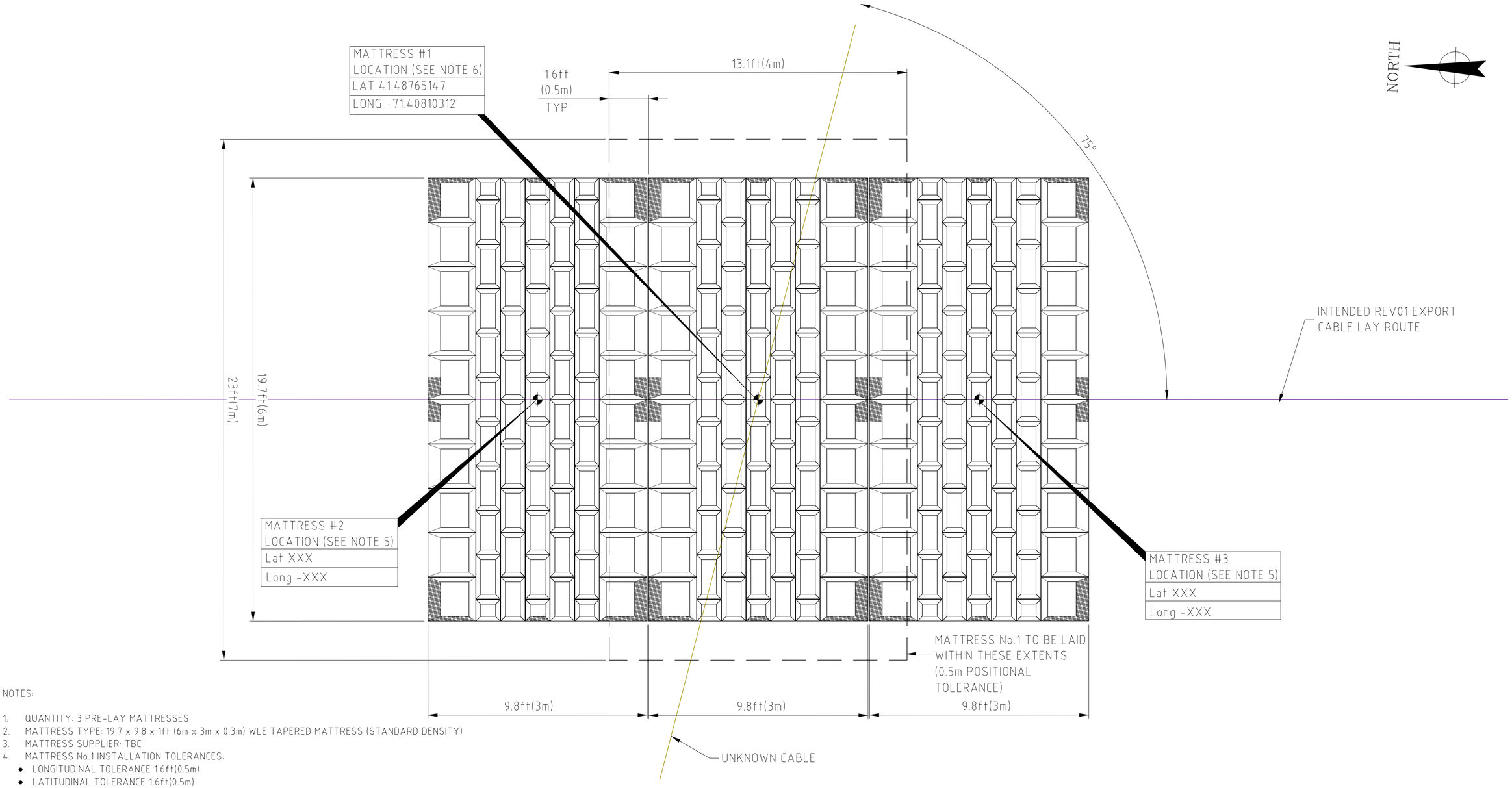

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Appendix B: Dredge Sampling Plan, Approval and Analytical Results

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Memorandum

To: Mr. Mark Roll
Revolution Wind Permitting
Manager
Ørsted North America

Date: March 24, 2021

Project #: 73030.00

From: Susan Moberg PWS
Fred Bevans

Re: Proposed Environmental Sediment Sampling
Revolution Wind Export Cable

At the request of Ørsted and in order to facilitate management of excess sediments or dredge spoils, VHB prepared a sediment investigation plan. In order to develop this plan, VHB conducted a regulatory review and determined that based upon the RWEC scope, the federal and state Section 401 water quality review will be performed by RIDEM in accordance with the RI Water Quality Regulations (250-RICR-150-05-1, effective 08/19/2018) and the Rules and Regulations for Dredging and the Management of Dredged Materials (Dredge Regulations; 250-RICR-150-05-2, effective 10/5/2010).

VHB performed a review of files available at the RI Department of Environmental Management (RIDEM) that involved dredging of sediment in the area proximate to the proposed landfall. The following sites were identified by RIDEM near the landfall:

- General Dynamics, Electric Boat - Dredge disposal at CAD Facility; no sample data included
- Rhode Island Mooring Service - Dredging at Marina at 15 Patrol Rd; 2 samples collected and analyzed for TPH, SVOCs, PCB, arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc. Lab results complied with the RIDEM Residential Exposure Criteria. Dredge material was used for common fill within QDC property.
- RI Fast Ferry - Dredging at Small Boat Basin
- SENESCO Marine – dredging; no analytical data included. Application denied for in-water disposal.

A site plan of the area to be dredged, including topography, bathymetry and the location of all proposed sample collection points, is provided as Figure 1.

Environmental Sampling

Geotechnical vibracores of sediments were collected for the Revolution Wind Farm Export Cable Route (RWEC) by Mott Macdonald (Mott) on December 20, 2020. Environmental sediment cores were collected at 6 locations along the cable landfall route within approximately 1,000 feet of shore (see Figure 1). Samples ENV-01 and ENV-02 are intended to be representative of the Open Cut Solution and ENV-04 through 06 are intended to be representative of the exit pit for the Trenchless Solution. For environmental sampling, Mott and VHB conformed to the following procedures outlined in the Dredge Regulations:

1) All working surfaces and non-disposable instruments were thoroughly decontaminated between sampling as described below.
2) Disposable gloves were used and discarded after processing each sample and replaced prior to handling decontaminated instruments or work surfaces.
3) Sample containers were kept in packaging as received from the analytical lab until use.

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4) Sample containers were withdrawn only when a sample was to be collected.

5) Core samples were taken to the proposed maximum depth of 13-feet below sediment surface.

6) Cores were cut into 3-foot sections, labeled with the applicable sampling location and indicating the top and bottom of each core.

7) Cores were sealed with a cap at both ends and taped and delivered to VHB under chain of custody documentation.

8) Sediment cores stored on ice as a preservation method until the cores were subsequently inspected, logged and samples collected by VHB.

9) Each core was cut open lengthwise and inspected by visual examination. Observations of distinct strata based upon color or grain size were noted, and the depths of any distinct layers were documented in the notes. Sediment descriptions recorded include density/consistency, color, grain size distribution, moisture, plasticity/cohesiveness, and sedimentary structure.

10) Composite samples were collected from each coring location based on distinct layers of stratification which are at least 2 feet in thickness for the following analysis in accordance with the Sediment Sampling Plan for Dredging Projects approved by the Coastal Resources Management Council (CRMC) and RIDEM (attached):

    - Total organic carbon
    - Grain size
    - % moisture
    - Total Petroleum Hydrocarbons (TPH) via SW8015C
    - Semi Volatile Organic Compounds (SVOCs) via 78270 SIM
    - Polychlorinated Biphenyls (PCBs) via 8082
    - Total metals (see Sampling Plan for approved EPA methods): arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc
    - Toxicity characteristic leaching procedure (TCLP) metals (see Sampling Plan for approved EPA methods): arsenic, cadmium, chromium, lead, mercury, nickel, barium, selenium, silver

11) One blind duplicate was collected for this project using the procedures outlined above, filling the parent and duplicate sample at the same time, and with material from the same interval. A fictitious name and same time was used for the duplicate, with the name of the parent sample documented only in the field notes, and not provided to the laboratory. Some laboratory methods require additional sample volumes for internal quality control/quality assurance. These samples were collected similar to the duplicate in numbers directed by the laboratory.

12) Samples will be collected and managed to meet the method requirements for handling, preservation and storage outlined below. A completed Chain-of-Custody Form shall accompany each set of samples released from the study site, and the chain-of-custody number recorded in the field notes. The chain of custody shall include the following at a minimum: Client/Company Name, Project Name/Number, Sample Number/Identification, Date and time of sample collection, Analysis requested, Inclusive Dates of Possession,

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Signatures of persons involved in chain of possession, VHB project contact information (phone and E-mail), and Laboratory project manager contact information (phone and E-mail).

Other requirements of the Dredge Regulations that were not triggered during the sampling include the following:

1) If insufficient sample volume for analysis is recovered from a single core, separate core samples may be composited when the grain size and likelihood of contamination is uniform based on depositional characteristics, spill history, and location. Approval must be obtained prior to compositing the samples.

As noted above and in accordance with the Dredge Regulations, the 6 vibracores were inspected and logged by VHB in VHB's in house soil laboratory located at 1 Cedar Street, Providence, RI. Descriptions of sediment characteristics including horizon designation and thickness, color, texture, consistence, odor and the presence of redoximorphic features and artifacts. Photographs were also collected. Sediment description and photographic log are attached. Horizons within a thickness of 2 feet or greater were isolated for sample collection. Contiguous horizons less than 2 feet in thickness were considered a single horizon in accordance with the regulations. Composite samples were collected from each horizon sampled as follows:

REV01-ENV-01 0-11.5 FT
REV01-ENV-02 0-5.5 FT
REV01-ENV-200 0-5.5 FT (blind duplicate)
REV01-ENV-02 5.5-8.5 FT
REV01-ENV-02 8.5-13 FT
REV01-ENV-02 13-16 FT
REV01-ENV-03A 0-5 FT
REV01-ENV-03A 5-7.5 FT
REV01-ENV-03A 7.5-10.5 FT
REV01-ENV-03A 10.5-13 FT
REV01-ENV-04 0-2 FT
REV01-ENV-04 2-9.5 FT
REV01-ENV-04 9.5-11.5 FT
REV01-ENV-04 11.5-16.5 FT
REV01-ENV-05 0-2.5 FT
REV01-ENV-05 2.5-7.5 FT
REV01-ENV-05 7.5-13.5 FT
REV01-ENV-05 13.5-15.5 FT
REV01-ENV-06 0-4.5 FT
REV01-ENV-06 4.5-10 FT
REV01-ENV-06 10-15 FT

Composited samples were sent for analysis under chain of custody to ESS Laboratories of Cranston, Rhode Island. Sample coolers were dropped off to the laboratory as soon as practicable, but no later than 48 hours after sample collection. Analysis was performed as described in step 10 above and in accordance with laboratory preservation procedures. Procedures for sample identification and chain-of-custody documentation were strictly followed and maintained at all times through each stage of the sample collection, transfer, and analysis process.

Findings

Laboratory analytical results were returned from ESS Laboratories on January 4, 2021. Copies of the lab reports are attached. The analytical results are summarized in the Master Sediment Table attached to this memo. Significant findings include the following:

- TPH, SVOCs and PCBs were not detected in any of the sediment samples

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- Metals were not detected in concentrations exceeding the RIDEM Residential or Industrial/Commercial Direct Exposure Criteria or the CAD Cap Criteria
- Metals exceeding the Beach disposal criteria included:
    - Arsenic in ENV-03A between 5 and 13 feet, ENV-04 0-2 feet, ENV-05 0-2 feet and ENV-06 0-4.5 feet and 10-15 feet
    - Chromium and copper in ENV-04 0-2 feet and ENV-05 0-2 feet
    - Lead in ENV-04 0-2 feet
    - Nickel in ENV-03A 10.5-13 feet, ENV-04 0-2 feet, ENV-05 0-2 feet and ENV-06 10-15 feet
    - Zinc in ENV-02 13-16 feet, ENV-03A 7.5-10.5, ENV-03A 10.5-13 feet, ENV-04 0-2 feet, ENV-04 11.5-16.5 feet, ENV-05 0-2 feet, ENV-05 13.5-15.5 feet, ENV-06 0-4.5 feet and ENV-06 10-15 feet
- Under TCLP analysis, Lead was detected in one sample (ENV-01 0-11.5 feet) in exceedance of the RIDEM GA Leachability Criteria
- Percent moisture exceeding 25% was detected in ENV-04 0-2 feet and ENV-05 0-2.5 feet
- Percent fines (silt/clay) exceeding 10% was detected in all of the samples except ENV-02 0-5.5 feet

Based on these results, it appears that the dredge/excavations for the nearshore cable installation would be suitable for disposal in any of the potential locations except beach disposal (nourishment).

Attachments:

- Sampling location figure
- Approved Sediment Sampling Plan
- Sediment Descriptions
- Photographic log
- Laboratory Reports
- Sediment Summary Table

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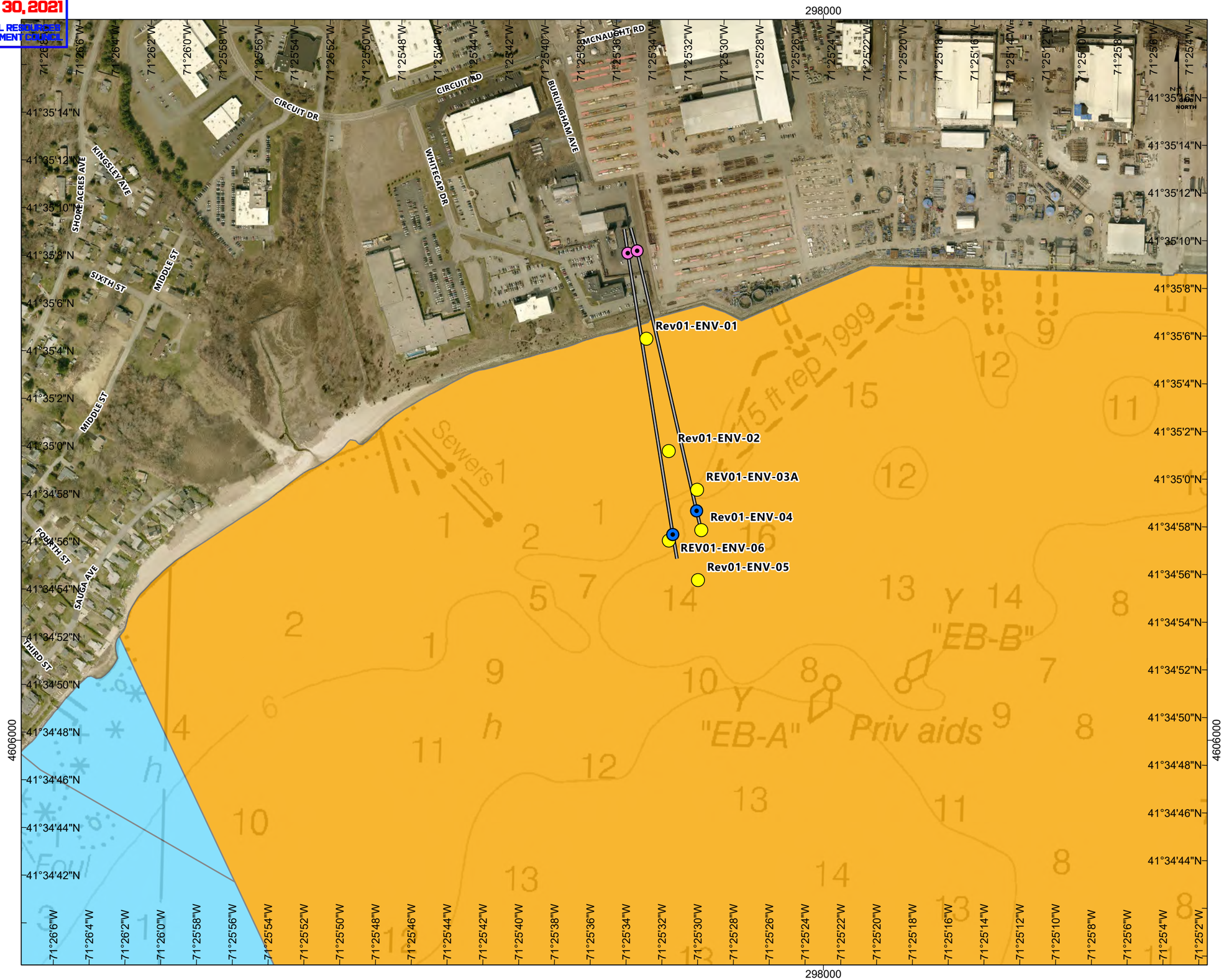

Revolution Wind

Figure X
Offshore Sampling Locations
NORTH KINGSTOWN, RI

Legend
- Sediment Sampling Location
- HDD Entry Point
- HDD Exit Point
- HDD Cable Alignment

Estuarine Water Quality Standard
- SA
- SB

Service Layer Credits: National Geographic World Map: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
NOAA Raster Nautical Charts (RNC): NOAA Office of Coast Survey
Rhode Island Aerial Photographs (Spring 2018; State Plane):

Reference system: NAD83 (2011)
Projection: UTM Zone 19N

0 50 100 150 Meters

0 180 360 540 Feet

Original Date: 06/12/2020
Revised Date: 12/09/2020
Document no:

Created by: S. PELLETIER
Checked by: S. MOBERG
Approved by: STEPW

Revolution Wind | Powered by Ørsted & Eversource

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Date: June 23, 2020 Applicant(s): DWW Rev I, LLC

Project Name: Revolution Wind Address: 56 Exchange Terrace Ste 300, Prov. RI 02903

Estimated Volume of Dredge (cy): TBD New (cy): TBD Maintenance (cy): 0

Area of Dredge (sf): TBD Depth of Dredge: 13 feet

Proposed Disposal Location (include Plat/Lot if on land): N/A

WQ Class of Dredge Area (if known): SB GW Class of Disposal Area (if, known): SB

Sediment Sampling Plan for Dredging Projects

Submit Site plan 8½" x 11" (Google Earth printout and Navigation Chart or engineered plans) Mark all within 200' of proposed dredge limits:

- ☐ Outfalls and Gas docks or any other potential areas of contamination
- ☐ eelgrass, salt marsh, flounder or shellfish habitat
- ☐ Proposed dredge footprint and average depth of dredge

Proposed Depth of Samples 13 feet
Proposed Coring Method vibracore
# of Sampling Locations 22

Submit Proposed Analysis and detection limits depending on disposal location: The detection limits for an analyte should be no greater than one-third (one-half log unit) of the appropriate value for the analyte and matrix of concern. Whenever possible, an MDL of three to five times below the criteria is expected: If the criteria are Non-Detect then the procedures and MRL's set forth in the OTM (USEPA and USACE 1991) below are appropriate to follow. In-water disposal must meet all Army Corps Requirements.

Place a ☐*CHECK* in each box you are proposing to sample and *CIRCLE* intended laboratory method.

Sample	Beach Criteria	CAD Cap Criteria	GA Leachability Criteria TCLP/SPLP	Residential Disposal Criteria[1]	Commercial/ Industrial Exposure[2]	TCLP Criteria for Haz. Waste[3]	Acceptable EPA Method(s)	MRL**
Grain Size	☐<10% silt/clay	☐	☐	☐	☐	☐		
% Moisture	☐<25%	☐	☐	☐	☐	☐		
TPH	☐ND	☐	☐500 mg/kg	☐500 mg/kg	☐2500 mg/kg		SW 8015C	100 mg/Kg
SVOC		☐	☐Table 2[3]	☐Table1[1]	☐Table1[2]		8270 SIM	10 ug/Kg
PCB	☐*ND	☐0.4 mg/kg	☐10 mg/kg	☐10 mg/kg	☐10 mg/kg		8082	*.02 mg/Kg
PAH		☐4.0 mg/kg					8270– Six (6) Tier 1 compounds	
Arsenic (As)	☐1.7 mg/kg	☐10 mg/kg		☐7.0 mg/kg	☐7.0 mg/kg	☐5.0 mg/L	6010,6020,7061,7062,7000, 7010	0.4 mg/Kg
Cadmium (Cd)	☐1 mg/kg	☐5 mg/kg	☐0.03 mg/L	☐39 mg/kg	☐1000 mg/kg	☐1.0 mg/L	6010,6020,7000,7010	0.07 mg/Kg
Chromium (Cr)	☐10 mg/kg	☐100 mg/kg	☐1.1 mg/L	☐390 mg/kg	☐10000 mg/kg	☐5.0 mg/L	6010,6020,7000,7010	0.5 mg/Kg
Copper (Cu)	☐10 mg/kg	☐200 mg/kg		☐3100 mg/kg	☐10000 mg/kg		6010,6020,7000,7010	0.5 mg/Kg
Lead (Pb)	☐25 mg/kg	☐100 mg/kg	☐0.04 mg/L	☐150 mg/kg	☐500 mg/kg	☐5.0 mg/L	6010,6020,7000, 7010	0.5 mg/Kg
Mercury (Hg)	☐0.5 mg/kg	☐0.5 mg/kg	☐0.02 mg/L	☐23 mg/kg	☐610 mg/kg	☐0.2 mg/L	7470,7471,7472	0.07 mg/Kg
Nickel (Ni)	☐5 mg/kg	☐50 mg/kg	☐1 mg/L	☐1000 mg/kg			6010, 6020,7000, 7010	0.5 mg/Kg
Zinc (Zn)	☐25 mg/kg	☐200 mg/kg		☐6000 mg/kg			6010,6020,7000,7010	1.0 mg/Kg
TCLP or SPLP							1311 or 1312	
Barium (Ba)						☐100 mg/L	6010, 6020	
Selenium (Se)						☐1.0 mg/L	6010, 6020, 7741, 7742	
Silver (Ag)						☐5.0 mg/L	6010, 6020	

* For each arochlor **For Beach Critera – any other MRL should be at least three to five times below the criteria

[1] Residential Direct Exposure Criteria are defined in Table 1 in Section 8 of the Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases.

[2] Commercial/Industrial Direct Exposure Criteria are defined in Table 1 in Section 8 of the Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases.

[3] GA Leachability Criteria are defined in Table 2 in Section 8 of the Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases.

Approvals

Dredge Coordinator (CRMC): _____ Date: 7/7/2020

WQC Program (DEM): _____ Date: 7-3-2020

GW Program (DEM), if upland _____ Date: _____

Dredge Coordinator (DEM): _____ Date: 7/3/2020

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RWF Near Shore Sediment Sample Descriptions
All colors follow the Munsell Color System. Profile layer designations and textures follow the USDA system of soil description (Soil Survey Manual, Agricultural Handbook No. 18).
Cores collected by others opened and described on 12/21/2020 and 12/22/2020

ENV-04

Oa1	0 to 16 inches	N 2.5/0 muck; massive; firm; non-fluid.
Oa2	16 to 24 inches	N 3/0 muck; massive; firm; non-fluid.
C1	24 to 41 inches	5Y 5/1 fine sand with streaks of 5Y 5/2 and N 3/1; massive; friable; non-fluid.
C2	41 to 114 inches	5Y 5/2 fine sand with 5Y 5/1 masses; massive; very friable; non-fluid.
C3	114 to 134 inches	5Y 5/2 fine sand with 30 percent 5Y 5/3 and 10 percent 5Y 5/1; with thin bands of 10YR 4/4; massive; friable; non-fluid.
2C4	134 to 147 inches	5Y 5/2 loamy very fine sand with thin bands of N 3/0 silt; massive; friable; non fluid.
3C5	147 to 155 inches	5Y 5/2 fine sand with thin bands of 10YR 4/4; massive; friable; non-fluid.
4C6	155 to 180 inches	5Y 5/2 loamy very fine sand interbedded with N 4/1 silt and 10YR4/4 sand; massive; friable; non fluid.
5C7	180 to 199 inches	5Y 5/2 very fine sand interbedded with N 4/0 silt and silty clay and 2.5Y 3/1 silt; massive; friable; slightly fluid.

ENV-02

C1	0 to 65 inches	5Y 5/1 sand; thin vertical band of N 3/1 (sampling artifact?); massive; very friable; non-fluid.
C2	65 to 74 inches	5Y 5/1 fine sand with 20 percent masses of 5Y 5/3; massive; firm; non-fluid.
C3	74 to 100 inches	5Y 5/1 very fine sand; massive; friable; non-fluid.
C4se	100 to 160 inches	5Y 5/2 very fine sand with 30 percent 5Y 5/1 masses and several thin bands of N 3/1 silt; massive; very friable; non-fluid.
C3	160 to 196 inches	5Y 5/1 fine sand with to loamy very fine sand with thin bands of N 3/1 silt and N 2.5/1 muck; massive; friable; non-fluid.

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ENV-05

Oa1	0 to 2 inches	N 2.5/0 muck; massive; very fluid.
C1	2 to 8 inches	N 4/0 very fine sand; massive; friable; non-fluid.
C2	8 to 17 inches	N 3/0 mucky silt loam; massive; slightly sticky; non-fluid; many vertical worm channels.
C3	17 to 29 inches	2.5Y 4/1 fine sand; massive; very friable; non-fluid.
C4	29 to 37 inches	N 4/0 fine sand and very fine sand; massive; friable; non-fluid.
C5	37 to 69 inches	5Y 5/1 loamy fine sand with 40 percent 5Y 5/2; massive; friable; non fluid.
C6	69 to 91 inches	5Y 5/1 loamy very fine sand with 20 percent N 3/0 silt; massive; friable; slightly fluid.
C7	91 to 145 inches	5Y 5/2 loamy fine sand; massive; firm; non fluid.
2C8	145 to 190 inches	2.5Y 5/1 loamy very fine sand interbedded with thin layers of N 4/0 and N 2.5/0 silt and silty clay and 2.5Y 5/3 fine sand; tightly varved; massive; friable; non-fluid. (See photo)

Sample from ENV-5 2C7 layer showing varves typical of low energy estuarine or glacial lacustral settings. Ruler for scale only.

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ENV-03A

C1	0 to 8 inches	5Y 5/1 fine sand; massive; friable; non-fluid.
Ab	8 to 18 inches	N 3/0 silty clay; with masses of N 4/0 silt; massive; slightly sticky; non-fluid; many graminoid leaf and root fibers; many vertical worm channels; (drowned marsh?).
2C2	18 to 57 inches	5Y 5/1 very fine sand; massive; very friable; non-fluid.
2C3	57 to 80 inches	10Y 6/1 loamy very fine sand; massive; friable; non-fluid.
2C5	80 to 126 inches	5Y 5/1 loamy very fine sand with bands of 2.5Y 5/4 fine sand and 2.5Y 4/1 silt and silt loam throughout; massive; friable; non fluid.
3C6	126 to 129 inches	5Y 4/1 silt loam; massive; firm; slightly-fluid.
4C7	129 to 156 inches	5Y 5/2 very fine sand interbedded with 2.5Y 4/1 silt and 2.5Y 5/4 fine sand; massive; friable; slightly fluid.

ENV-06

C1	0 to 6 inches	N 4/0 loamy fine sand with 20 percent masses N 2.5/0 muck; 5 percent rounded gravel; massive; friable; non-fluid.
Ab	6 to 22 inches	N 2.5/0 mucky silt loam and silty clay; massive; slightly sticky; non-fluid.
2C2	22 to 50 inches	N 4/0 and 5Y 5/1 loamy very fine sand; massive; very friable; slightly fluid.
2C3	50 to 55 inches	5Y 5/1 loamy fine sand with many coarse 5Y 5/3 bands; massive; friable; slightly fluid.
2C4	55 to 101 inches	5Y 6/1 fine sand with bands of 5Y 5/1 fine sand; massive; friable; non fluid.
2C5	101 to 121 inches	5Y 5/1 loamy fine sand with bands of 5Y 5/3 fine sand; massive; firm; non-fluid.
3C6	121 to 142 inches	5Y 5/2 loamy fine sand interbedded with thin layers 5Y 6/1 very fine sand; 5Y 5/3 fine sand and N 3/0 silt and silty clay; massive; friable; non fluid.
3C7	142 to 154 inches	5Y 5/1 loamy very fine sand with masses of 10YR 4/4 fine sand throughout and few bands of N 4/0 silt; massive; friable non-fluid.
3C8	154 to 180 inches	5Y 5/1 and 5Y 5/2 loamy fine sand interbedded with thin bands of N 4/0 silty clay; 2.5Y 4/4 fine sand; 5Y 4/1 silt; thin layer deformed by sampling; massive; friable; slightly fluid.

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ENV-1

C1	0 to 46 inches	5Y 5/1 fine sand with 20 percent masses of N 3/0 silt; massive; friable; non-fluid.
C2	46 to 56 inches	5Y 5/2 loamy fine sand with bands of 2.5Y 5/4 fine sand; massive; friable; non-fluid.
C3	56 to 68 inches	5Y 5/2 and 5Y 5/3 loamy fine sand; 5 percent shell fragments; massive; very friable; non-fluid.
C3	68 to 90 inches	2.5Y 5/1 loamy fine sand; massive; friable; non-fluid.
C4	90 to 105 inches	5Y 5/1 loamy very fine sand with bands of 2.5Y 5/3 fine sand throughout; massive; friable; non fluid.
2C5	105 to 112 inches	5Y 5/3 loamy very fine sand with thin layers of N 4/0 silt and 5Y 5/1 fine sand; massive; firm; non-fluid.
3C6	112 to 138 inches	5Y 5/2 loamy fine sand and 5Y 5/1 very fine sand; massive; friable; slightly fluid.

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© VHB

Photography Log

PROJECT NUMBER

73032.00

CLIENT

Ørsted North America Inc.

56 Exchange Terrace Suite 300

Providence, Rhode Island 02903

LOCATION

Narragansett Bay

North Kingston, RI

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PHOTO NO. 1
DATE: 12.21.2020

REV01-ENV-04 (0-3')

PHOTO NO. 2
DATE: 12.21.2020

REV01-ENV-04 (3-6')

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PHOTO NO. 3
DATE: 12.21.2020

REV01-ENV-04 (6-9')

PHOTO NO. 4
DATE: 12.21.2020

REV01-ENV-04 (9-12')

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PHOTO NO. 5
DATE: 12.21.2020

REV01-ENV-04 (12-15')

PHOTO NO. 6
DATE: 12.21.2020

REV01-ENV-04 (15-16.6')

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PHOTO NO. 7
DATE: 12.21.2020

REV01-ENV-02 (0-3')

PHOTO NO. 8
DATE: 12.21.2020

REV01-ENV-02 (3-6')

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PHOTO NO. 9
DATE: 12.21.2020

REV01-ENV-02 (6-9') (bottom)

REV01-ENV-02 (9-12') (top)

PHOTO NO. 10
DATE: 12.21.2020

REV01-ENV-02 (12-15') (bottom)

REV01-ENV-02 (15-16.6') (top)

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PHOTO NO. 11
DATE: 12.21.2020

REV01-ENV-05 (0-3') (bottom)

REV01-ENV-05 (3-6') (middle)

REV01-ENV-05 (6-9') (top)

PHOTO NO. 12
DATE: 12.21.2020

REV01-ENV-05 (9-12') (bottom)

REV01-ENV-05 (12-15') (top)

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PHOTO NO. 13
DATE: 12.21.2020

Close up of a stratified section from REV-01-05 (12-15')

PHOTO NO. 14
DATE: 12.21.2020

Close up of a stratified section from REV-01-05 (12-15')

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PHOTO NO. 15
DATE: 12.22.2020

REV01-ENV-03A (0-3') (bottom)

REV01-ENV-03A (3-6') (top)

PHOTO NO. 16
DATE: 12.22.2020

REV01-ENV-03A (6-9') (bottom)

REV01-ENV-03A (9-12') (middle)

REV01-ENV-03A (12-13') (top)

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PHOTO NO. 17
DATE: 12.22.2020

Close up of REV01-ENV-03A (12-13')

PHOTO NO. 18
DATE: 12.22.2020

REV01-ENV-06 (0-3') (bottom)

REV01-ENV-06 (3-6') (middle)

REV01-ENV-06 (6-9') (top)

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PHOTO NO. 19
DATE: 12.22.2020

REV01-ENV-06 (6-9') (bottom)

REV01-ENV-06 (9-12') (middle)

REV01-ENV-06 (12-15') (top)

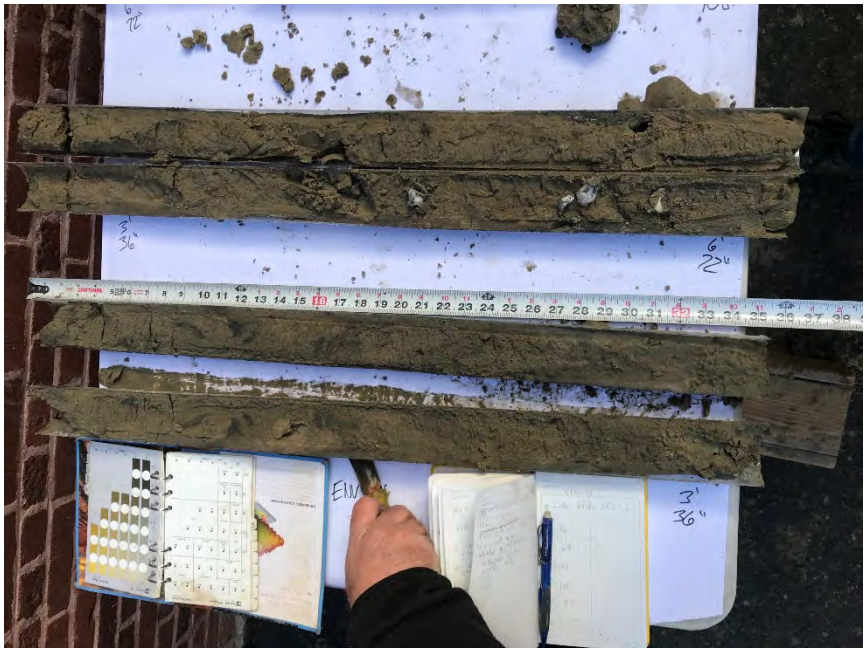

PHOTO NO. 20
DATE: 12.22.2020

REV01-ENV-01 (0-3') (bottom)

REV01-ENV-01 (3-6') (top)

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PHOTO NO. 21
DATE: 12.22.2020

REV01-ENV-01 (6-9') (bottom)

REV01-ENV-01 (9-11.5') (top)

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CERTIFICATE OF ANALYSIS

Sue Moberg
Vanasse Hangen Brustlin, Inc.
1 Cedar Street Suite 400
Providence, RI 02903

RE: Rev Wind (73032.00)
ESS Laboratory Work Order Number: 20L0755

This signed Certificate of Analysis is our approved release of your analytical results. These results are only representative of sample aliquots received at the laboratory. ESS Laboratory expects its clients to follow all regulatory sampling guidelines. Beginning with this page, the entire report has been paginated. This report should not be copied except in full without the approval of the laboratory. Samples will be disposed of thirty days after the final report has been delivered. If you have any questions or concerns, please feel free to call our Customer Service Department.

Laurel Stoddard
Laboratory Director

REVIEWED
By ESS Laboratory at 4:42 pm, Jan 04, 2021

Analytical Summary
The project as described above has been analyzed in accordance with the ESS Quality Assurance Plan. This plan utilizes the following methodologies: US EPA SW-846, US EPA Methods for Chemical Analysis of Water and Wastes per 40 CFR Part 136, APHA Standard Methods for the Examination of Water and Wastewater, American Society for Testing and Materials (ASTM), and other recognized methodologies. The analyses with these noted observations are in conformance to the Quality Assurance Plan. In chromatographic analysis, manual integration is frequently used instead of automated integration because it produces more accurate results.

The test results present in this report are in compliance with TNI and relative state standards, and/or client Quality Assurance Project Plans (QAPP). The laboratory has reviewed the following: Sample Preservations, Hold Times, Initial Calibrations, Continuing Calibrations, Method Blanks, Blank Spikes, Blank Spike Duplicates, Duplicates, Matrix Spikes, Matrix Spike Duplicates, Surrogates and Internal Standards. Any results which were found to be outside of the recommended ranges stated in our SOPs will be noted in the Project Narrative.

Subcontracted Analyses

CTS - Cranston, RI	Grain Size Analysis

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind

ESS Laboratory Work Order: 20L0755

SAMPLE RECEIPT

The following samples were received on December 22, 2020 for the analyses specified on the enclosed Chain of Custody Record.

The cooler temperature was not within the acceptance limit of <6°C, however, samples were delivered on ice and therefore meet regulatory criteria.

Lab Number	Sample Name	Matrix	Analysis
20L0755-01	Rev01-ENV-04 0-2ft	Sediment	1311, 1311/6010C, 1311/7470A, 2540G, 6010C, 7471B, 8082A, 8100M, 8270D, 9060, SUB
20L0755-02	Rev01-ENV-04 2-9.5ft	Sediment	1311, 1311/6010C, 1311/7470A, 2540G, 6010C, 7471B, 8082A, 8100M, 8270D, 9060, SUB
20L0755-03	Rev01-ENV-04 9.5-11.5ft	Sediment	1311, 1311/6010C, 1311/7470A, 2540G, 6010C, 7471B, 8082A, 8100M, 8270D, 9060, SUB
20L0755-04	Rev01-ENV-04 11.5-16.5ft	Sediment	1311, 1311/6010C, 1311/7470A, 2540G, 6010C, 7471B, 8082A, 8100M, 8270D, 9060, SUB
20L0755-05	Rev01-ENV-02 0-5.5ft	Sediment	1311, 1311/6010C, 1311/7470A, 2540G, 6010C, 7471B, 8082A, 8100M, 8270D, 9060, SUB
20L0755-06	Rev01-ENV-200 0-5.5ft	Sediment	1311, 1311/6010C, 1311/7470A, 2540G, 6010C, 7471B, 8082A, 8100M, 8270D, 9060, SUB
20L0755-07	Rev01-ENV-02 5.5-8.5ft	Sediment	1311, 1311/6010C, 1311/7470A, 2540G, 6010C, 7471B, 8082A, 8100M, 8270D, 9060, SUB
20L0755-08	Rev01-ENV-02 8.5-13ft	Sediment	1311, 1311/6010C, 1311/7470A, 2540G, 6010C, 7471B, 8082A, 8100M, 8270D, 9060, SUB
20L0755-09	Rev01-ENV-02 13-16ft	Sediment	1311, 1311/6010C, 1311/7470A, 2540G, 6010C, 7471B, 8082A, 8100M, 8270D, 9060, SUB
20L0755-10	Rev01-ENV-05 0-2.5ft	Sediment	1311, 1311/6010C, 1311/7470A, 2540G, 6010C, 7471B, 8082A, 8100M, 8270D, 9060, SUB

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind

ESS Laboratory Work Order: 20L0755

PROJECT NARRATIVE

8100M Total Petroleum Hydrocarbons

D0L0485-CCV3 **Continuing Calibration %Diff/Drift is above control limit (CD+).**
Hexadecane (C16) (21% @ 20%)

8270D Semi-Volatile Organic Compounds

D0L0410-CCV1 **Analyte does not meet the Relative Response Factor (RRF) criteria in the calibration**
2,4-Dinitrophenol (81% @ 80-120%), Benzo(a)pyrene (106% @ 80-120%)

D0L0410-CCV1 **Calibration required quadratic regression (Q).**
2,4-Dinitrophenol (81% @ 80-120%), 4,6-Dinitro-2-Methylphenol (83% @ 80-120%), Benzoic Acid (81% @ 80-120%), Pentachlorophenol (95% @ 80-120%)

D0L0410-CCV1 **Continuing Calibration %Diff/Drift is above control limit (CD+).**
2-Nitroaniline (23% @ 20%), N-Nitroso-Di-n-Propylamine (25% @ 20%), Phenol (24% @ 20%)

D0L0410-CCV1 **Continuing Calibration %Diff/Drift is below control limit (CD-).**
Hexachlorocyclopentadiene (32% @ 20%)

D0L0410-CCV1 **Initial Calibration Verification recovery is below lower control limit (ICV-).**
Hexachlorocyclopentadiene

D0L0410-TUN1 **Benzidine tailing factor >2.**

D0L0410-TUN1 **Pentachlorophenol tailing factor > 2.**

D0L0440-CCV1 **Analyte does not meet the Relative Response Factor (RRF) criteria in the calibration**
2,4-Dinitrophenol (53% @ 80-120%), Benzo(a)pyrene (95% @ 80-120%)

D0L0440-CCV1 **Calibration required quadratic regression (Q).**
2,4-Dinitrophenol (53% @ 80-120%), 4,6-Dinitro-2-Methylphenol (67% @ 80-120%), Benzoic Acid (69% @ 80-120%), Pentachlorophenol (90% @ 80-120%)

D0L0440-CCV1 **Continuing Calibration %Diff/Drift is below control limit (CD-).**
2,4-Dinitrophenol (47% @ 20%), 4,6-Dinitro-2-Methylphenol (33% @ 20%), Benzoic Acid (31% @ 20%)

D0L0440-CCV1 **Initial Calibration Verification recovery is below lower control limit (ICV-).**
Hexachlorocyclopentadiene

D0L0497-CCV1 **Analyte does not meet the Relative Response Factor (RRF) criteria in the calibration**
Benzo(a)pyrene (94% @ 80-120%)

D0L0497-CCV1 **Calibration required quadratic regression (Q).**
2,4-Dinitrophenol (90% @ 80-120%), 4,6-Dinitro-2-Methylphenol (96% @ 80-120%), Benzoic Acid (90% @ 80-120%), Pentachlorophenol (105% @ 80-120%)

D0L0497-CCV1 **Continuing Calibration %Diff/Drift is above control limit (CD+).**
Hexachlorobutadiene (32% @ 20%), Nitrobenzene (24% @ 20%), Nitrobenzene-d5 (21% @ 20%)

D0L0497-CCV1 **Continuing Calibration %Diff/Drift is below control limit (CD-).**
4-Nitroaniline (23% @ 20%), bis(2-Ethylhexyl)phthalate (27% @ 20%), Butylbenzylphthalate (25% @ 20%), Di-n-octylphthalate (32% @ 20%)

D0L0497-CCV1 **Initial Calibration Verification recovery is below lower control limit (ICV-).**
Hexachlorocyclopentadiene

D0L0497-TUN1 **Benzidine tailing factor >2.**

D0L0497-TUN1 **Pentachlorophenol tailing factor > 2.**

DL02238-BSD1 **Relative percent difference for duplicate is outside of criteria (D+).**

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
4-Chloroaniline (32% @ 30%)

ESS Laboratory Work Order: 20L0755

No other observations noted.

End of Project Narrative.

DATA USABILITY LINKS

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Definitions of Quality Control Parameters

Semivolatile Organics Internal Standard Information

Semivolatile Organics Surrogate Information

Volatile Organics Internal Standard Information

Volatile Organics Surrogate Information

EPH and VPH Alkane Lists

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind

ESS Laboratory Work Order: 20L0755

CURRENT SW-846 METHODOLOGY VERSIONS

Analytical Methods

1010A - Flashpoint
6010C - ICP
6020A - ICP MS
7010 - Graphite Furnace
7196A - Hexavalent Chromium
7470A - Aqueous Mercury
7471B - Solid Mercury
8011 - EDB/DBCP/TCP
8015C - GRO/DRO
8081B - Pesticides
8082A - PCB
8100M - TPH
8151A - Herbicides
8260B - VOA
8270D - SVOA
8270D SIM - SVOA Low Level
9014 - Cyanide
9038 - Sulfate
9040C - Aqueous pH
9045D - Solid pH (Corrosivity)
9050A - Specific Conductance
9056A - Anions (IC)
9060A - TOC
9095B - Paint Filter
MADEP 04-1.1 - EPH
MADEP 18-2.1 - VPH

Prep Methods

3005A - Aqueous ICP Digestion
3020A - Aqueous Graphite Furnace / ICP MS Digestion
3050B - Solid ICP / Graphite Furnace / ICP MS Digestion
3060A - Solid Hexavalent Chromium Digestion
3510C - Separatory Funnel Extraction
3520C - Liquid / Liquid Extraction
3540C - Manual Soxhlet Extraction
3541 - Automated Soxhlet Extraction
3546 - Microwave Extraction
3580A - Waste Dilution
5030B - Aqueous Purge and Trap
5030C - Aqueous Purge and Trap
5035A - Solid Purge and Trap

SW846 Reactivity Methods 7.3.3.2 (Reactive Cyanide) and 7.3.4.1 (Reactive Sulfide) have been withdrawn by EPA. These methods are reported per client request and are not NELAP accredited.

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 0-2ft
Date Sampled: 12/21/20 12:00
Percent Solids: 56

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-01
Sample Matrix: Sediment
Units: mg/kg dry

Extraction Method: 3050B

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	**5.64** (0.70)		6010C		1	KJK	12/29/20 14:12	5.07	100	DL02838
Cadmium	**0.69** (0.35)		6010C		1	KJK	12/29/20 14:12	5.07	100	DL02838
Chromium	**47.3** (0.70)		6010C		1	KJK	12/29/20 14:12	5.07	100	DL02838
Copper	**55.5** (1.76)		6010C		1	KJK	12/29/20 14:12	5.07	100	DL02838
Lead	**37.0** (3.52)		6010C		1	KJK	12/29/20 14:12	5.07	100	DL02838
Mercury	**0.286** (0.017)		7471B		1	MKS	12/29/20 10:37	2.03	40	DL02840
Nickel	**16.0** (1.76)		6010C		1	KJK	12/29/20 14:12	5.07	100	DL02838
Zinc	**113** (1.76)		6010C		1	KJK	12/29/20 14:12	5.07	100	DL02838

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Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 0-2ft
Date Sampled: 12/21/20 12:00
Percent Solids: 56

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-01
Sample Matrix: Sediment
Units: mg/L

Extraction Method: 3005A TCLP

1311 TCLP Metals

Analyte	Results (MRL)	MDL	Method	TCLP Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	ND (0.050)		1311/6010C		1	BJV	12/28/20 10:44	50	50	DL02346
Barium	ND (0.050)		1311/6010C		1	BJV	12/28/20 10:44	50	50	DL02346
Cadmium	ND (0.0100)		1311/6010C		1	BJV	12/28/20 10:44	50	50	DL02346
Chromium	ND (0.020)		1311/6010C		1	BJV	12/28/20 10:44	50	50	DL02346
Lead	ND (0.050)		1311/6010C		1	BJV	12/28/20 10:44	50	50	DL02346
Mercury	ND (0.00050)		1311/7470A		1	MKS	12/28/20 10:43	20	40	DL02347
Nickel	ND (0.050)		1311/6010C		1	BJV	12/28/20 10:44	50	50	DL02346
Selenium	ND (0.050)		1311/6010C		1	BJV	12/28/20 10:44	50	50	DL02346
Silver	ND (0.010)		1311/6010C		1	BJV	12/28/20 10:44	50	50	DL02346

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 0-2ft
Date Sampled: 12/21/20 12:00
Percent Solids: 56
Initial Volume: 20.5
Final Volume: 10
Extraction Method: 3540C

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-01
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: MJV
Prepared: 12/22/20 21:00

8082A Polychlorinated Biphenyls (PCB)

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aroclor 1016	ND (0.09)		8082A		1	12/23/20 19:20		DL02203
Aroclor 1221	ND (0.09)		8082A		1	12/23/20 19:20		DL02203
Aroclor 1232	ND (0.09)		8082A		1	12/23/20 19:20		DL02203
Aroclor 1242	ND (0.09)		8082A		1	12/23/20 19:20		DL02203
Aroclor 1248	ND (0.09)		8082A		1	12/23/20 19:20		DL02203
Aroclor 1254	ND (0.09)		8082A		1	12/23/20 19:20		DL02203
Aroclor 1260	ND (0.09)		8082A		1	12/23/20 19:20		DL02203
Aroclor 1262	ND (0.09)		8082A		1	12/23/20 19:20		DL02203
Aroclor 1268	ND (0.09)		8082A		1	12/23/20 19:20		DL02203

	%Recovery	Qualifier	Limits
Surrogate: Decachlorobiphenyl	*94 %*		*30-150*
Surrogate: Decachlorobiphenyl [2C]	*98 %*		*30-150*
Surrogate: Tetrachloro-m-xylene	*77 %*		*30-150*
Surrogate: Tetrachloro-m-xylene [2C]	*86 %*		*30-150*

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 0-2ft
Date Sampled: 12/21/20 12:00
Percent Solids: 56
Initial Volume: 19.4
Final Volume: 1
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-01
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: AMF
Prepared: 12/22/20 22:00

8100M Total Petroleum Hydrocarbons

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Total Petroleum Hydrocarbons	ND (69.1)		8100M		1	12/24/20 21:03	D0L0485	DL02237

	%Recovery	Qualifier	Limits
Surrogate: O-Terphenyl	*91 %*		*40-140*

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 0-2ft
Date Sampled: 12/21/20 12:00
Percent Solids: 56
Initial Volume: 14.3
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-01
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/22/20 22:00

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,1-Biphenyl	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
1,2,4-Trichlorobenzene	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
1,2-Dichlorobenzene	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
1,3-Dichlorobenzene	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
1,4-Dichlorobenzene	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
2,3,4,6-Tetrachlorophenol	ND (3.13)		8270D		1	12/24/20 7:48	D0L0440	DL02238
2,4,5-Trichlorophenol	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
2,4,6-Trichlorophenol	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
2,4-Dichlorophenol	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
2,4-Dimethylphenol	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
2,4-Dinitrophenol	ND (3.13)		8270D		1	12/24/20 7:48	D0L0440	DL02238
2,4-Dinitrotoluene	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
2,6-Dinitrotoluene	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
2-Chloronaphthalene	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
2-Chlorophenol	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
2-Methylnaphthalene	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
2-Methylphenol	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
2-Nitroaniline	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
2-Nitrophenol	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
3,3´-Dichlorobenzidine	ND (1.25)		8270D		1	12/24/20 7:48	D0L0440	DL02238
3+4-Methylphenol	ND (1.25)		8270D		1	12/24/20 7:48	D0L0440	DL02238
3-Nitroaniline	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
4,6-Dinitro-2-Methylphenol	ND (3.13)		8270D		1	12/24/20 7:48	D0L0440	DL02238
4-Bromophenyl-phenylether	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
4-Chloro-3-Methylphenol	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
4-Chloroaniline	ND (1.25)		8270D		1	12/24/20 7:48	D0L0440	DL02238
4-Chloro-phenyl-phenyl ether	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
4-Nitroaniline	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
4-Nitrophenol	ND (3.13)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Acenaphthene	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Acenaphthylene	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Acetophenone	ND (1.25)		8270D		1	12/24/20 7:48	D0L0440	DL02238

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 0-2ft
Date Sampled: 12/21/20 12:00
Percent Solids: 56
Initial Volume: 14.3
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-01
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/22/20 22:00

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aniline	ND (1.25)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Anthracene	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Azobenzene	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Benzo(a)anthracene	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Benzo(a)pyrene	ND (0.313)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Benzo(b)fluoranthene	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Benzo(g,h,i)perylene	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Benzo(k)fluoranthene	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Benzoic Acid	ND (3.13)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Benzyl Alcohol	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
bis(2-Chloroethoxy)methane	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
bis(2-Chloroethyl)ether	ND (0.313)		8270D		1	12/24/20 7:48	D0L0440	DL02238
bis(2-chloroisopropyl)Ether	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
bis(2-Ethylhexyl)phthalate	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Butylbenzylphthalate	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Carbazole	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Chrysene	ND (0.313)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Dibenzo(a,h)Anthracene	ND (0.313)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Dibenzofuran	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Diethylphthalate	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Dimethylphthalate	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Di-n-butylphthalate	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Di-n-octylphthalate	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Fluoranthene	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Fluorene	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Hexachlorobenzene	ND (0.313)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Hexachlorobutadiene	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Hexachlorocyclopentadiene	ND (3.13)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Hexachloroethane	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Indeno(1,2,3-cd)Pyrene	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Isophorone	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Naphthalene	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238

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Client Project ID: Rev Wind
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Date Sampled: 12/21/20 12:00
Percent Solids: 56
Initial Volume: 14.3
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-01
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/22/20 22:00

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Nitrobenzene	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
N-Nitrosodimethylamine	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
N-Nitroso-Di-n-Propylamine	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
N-nitrosodiphenylamine	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Pentachlorophenol	ND (3.13)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Phenanthrene	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Phenol	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Pyrene	ND (0.624)		8270D		1	12/24/20 7:48	D0L0440	DL02238
Pyridine	ND (3.13)		8270D		1	12/24/20 7:48	D0L0440	DL02238

	%Recovery	Qualifier	Limits
Surrogate: 1,2-Dichlorobenzene-d4	*71 %*		*30-130*
Surrogate: 2,4,6-Tribromophenol	*68 %*		*30-130*
Surrogate: 2-Chlorophenol-d4	*71 %*		*30-130*
Surrogate: 2-Fluorobiphenyl	*75 %*		*30-130*
Surrogate: 2-Fluorophenol	*69 %*		*30-130*
Surrogate: Nitrobenzene-d5	*83 %*		*30-130*
Surrogate: Phenol-d6	*78 %*		*30-130*
Surrogate: p-Terphenyl-d14	*91 %*		*30-130*

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 0-2ft
Date Sampled: 12/21/20 12:00
Percent Solids: 56

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-01
Sample Matrix: Sediment

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Percent Moisture	**44** (1)		2540G		1	JMG	12/23/20 15:56	%	DL02314
Total Organic Carbon (Average)	**17400** (96.1)		9060		1	CCP	12/28/20 13:56	mg/kg dry	[CALC]

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 0-2ft
Date Sampled: 12/21/20 12:00

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-01
Sample Matrix: Sediment

Subcontracted Analysis

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Grain Size	**See Attached** (N/A)								

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 0-2ft
Date Sampled: 12/21/20 12:00
Percent Solids: 56
Initial Volume: 100
Final Volume: 2000
Extraction Method: 1311

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-01
Sample Matrix: Sediment
Units: °C
Analyst: CCY
Prepared: 12/23/20 18:22

TCLP Extraction by 1311

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Batch
Temperature (Min C)	**23.2** (N/A)		1311		1	CCY	12/24/20 11:45	DL02349
Temperature (Max C)	**24.5** (N/A)		1311		1	CCY	12/24/20 11:45	DL02349
Temperature (Range)	**Temperature is within 23 +/-2 °C.** (N/A)							

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 2-9.5ft
Date Sampled: 12/21/20 12:25
Percent Solids: 82

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-02
Sample Matrix: Sediment
Units: mg/kg dry

Extraction Method: 3050B

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	**0.88** (0.46)		6010C		1	KJK	12/29/20 14:14	5.26	100	DL02838
Cadmium	ND (0.23)		6010C		1	KJK	12/29/20 14:14	5.26	100	DL02838
Chromium	**1.25** (0.46)		6010C		1	KJK	12/29/20 14:14	5.26	100	DL02838
Copper	**1.80** (1.16)		6010C		1	KJK	12/29/20 14:14	5.26	100	DL02838
Lead	ND (2.32)		6010C		1	KJK	12/29/20 14:14	5.26	100	DL02838
Mercury	ND (0.012)		7471B		1	MKS	12/29/20 10:43	2.07	40	DL02840
Nickel	**1.32** (1.16)		6010C		1	KJK	12/29/20 14:14	5.26	100	DL02838
Zinc	**13.7** (1.16)		6010C		1	KJK	12/29/20 14:14	5.26	100	DL02838

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 2-9.5ft
Date Sampled: 12/21/20 12:25
Percent Solids: 82

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-02
Sample Matrix: Sediment
Units: mg/L

Extraction Method: 3005A TCLP

1311 TCLP Metals

Analyte	Results (MRL)	MDL	Method	TCLP Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	ND (0.050)		1311/6010C		1	BJV	12/28/20 10:46	50	50	DL02346
Barium	ND (0.050)		1311/6010C		1	BJV	12/28/20 10:46	50	50	DL02346
Cadmium	ND (0.0100)		1311/6010C		1	BJV	12/28/20 10:46	50	50	DL02346
Chromium	ND (0.020)		1311/6010C		1	BJV	12/28/20 10:46	50	50	DL02346
Lead	ND (0.050)		1311/6010C		1	BJV	12/28/20 10:46	50	50	DL02346
Mercury	ND (0.00050)		1311/7470A		1	MKS	12/28/20 10:45	20	40	DL02347
Nickel	ND (0.050)		1311/6010C		1	BJV	12/28/20 10:46	50	50	DL02346
Selenium	ND (0.050)		1311/6010C		1	BJV	12/28/20 10:46	50	50	DL02346
Silver	ND (0.010)		1311/6010C		1	BJV	12/28/20 10:46	50	50	DL02346

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 2-9.5ft
Date Sampled: 12/21/20 12:25
Percent Solids: 82
Initial Volume: 19.7
Final Volume: 10
Extraction Method: 3540C

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-02
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: MJV
Prepared: 12/22/20 21:00

8082A Polychlorinated Biphenyls (PCB)

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aroclor 1016	ND (0.06)		8082A		1	12/23/20 19:39		DL02203
Aroclor 1221	ND (0.06)		8082A		1	12/23/20 19:39		DL02203
Aroclor 1232	ND (0.06)		8082A		1	12/23/20 19:39		DL02203
Aroclor 1242	ND (0.06)		8082A		1	12/23/20 19:39		DL02203
Aroclor 1248	ND (0.06)		8082A		1	12/23/20 19:39		DL02203
Aroclor 1254	ND (0.06)		8082A		1	12/23/20 19:39		DL02203
Aroclor 1260	ND (0.06)		8082A		1	12/23/20 19:39		DL02203
Aroclor 1262	ND (0.06)		8082A		1	12/23/20 19:39		DL02203
Aroclor 1268	ND (0.06)		8082A		1	12/23/20 19:39		DL02203

	%Recovery	Qualifier	Limits
Surrogate: Decachlorobiphenyl	*100 %*		*30-150*
Surrogate: Decachlorobiphenyl [2C]	*103 %*		*30-150*
Surrogate: Tetrachloro-m-xylene	*81 %*		*30-150*
Surrogate: Tetrachloro-m-xylene [2C]	*90 %*		*30-150*

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 2-9.5ft
Date Sampled: 12/21/20 12:25
Percent Solids: 82
Initial Volume: 19.2
Final Volume: 1
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-02
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: AMF
Prepared: 12/22/20 22:00

8100M Total Petroleum Hydrocarbons

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Total Petroleum Hydrocarbons	ND (47.6)		8100M		1	12/24/20 21:37	D0L0485	DL02237

	%Recovery	Qualifier	Limits
Surrogate: O-Terphenyl	*89 %*		*40-140*

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 2-9.5ft
Date Sampled: 12/21/20 12:25
Percent Solids: 82
Initial Volume: 14.9
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-02
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/22/20 22:00

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,1-Biphenyl	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
1,2,4-Trichlorobenzene	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
1,2-Dichlorobenzene	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
1,3-Dichlorobenzene	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
1,4-Dichlorobenzene	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
2,3,4,6-Tetrachlorophenol	ND (2.05)		8270D		1	12/24/20 8:17	D0L0440	DL02238
2,4,5-Trichlorophenol	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
2,4,6-Trichlorophenol	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
2,4-Dichlorophenol	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
2,4-Dimethylphenol	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
2,4-Dinitrophenol	ND (2.05)		8270D		1	12/24/20 8:17	D0L0440	DL02238
2,4-Dinitrotoluene	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
2,6-Dinitrotoluene	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
2-Chloronaphthalene	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
2-Chlorophenol	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
2-Methylnaphthalene	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
2-Methylphenol	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
2-Nitroaniline	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
2-Nitrophenol	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
3,3´-Dichlorobenzidine	ND (0.818)		8270D		1	12/24/20 8:17	D0L0440	DL02238
3+4-Methylphenol	ND (0.818)		8270D		1	12/24/20 8:17	D0L0440	DL02238
3-Nitroaniline	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
4,6-Dinitro-2-Methylphenol	ND (2.05)		8270D		1	12/24/20 8:17	D0L0440	DL02238
4-Bromophenyl-phenylether	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
4-Chloro-3-Methylphenol	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
4-Chloroaniline	ND (0.818)		8270D		1	12/24/20 8:17	D0L0440	DL02238
4-Chloro-phenyl-phenyl ether	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
4-Nitroaniline	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
4-Nitrophenol	ND (2.05)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Acenaphthene	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Acenaphthylene	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Acetophenone	ND (0.818)		8270D		1	12/24/20 8:17	D0L0440	DL02238

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COASTAL RESOURCES MANAGEMENT COUNCIL

CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 2-9.5ft
Date Sampled: 12/21/20 12:25
Percent Solids: 82
Initial Volume: 14.9
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-02
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/22/20 22:00

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aniline	ND (0.818)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Anthracene	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Azobenzene	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Benzo(a)anthracene	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Benzo(a)pyrene	ND (0.205)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Benzo(b)fluoranthene	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Benzo(g,h,i)perylene	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Benzo(k)fluoranthene	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Benzoic Acid	ND (2.05)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Benzyl Alcohol	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
bis(2-Chloroethoxy)methane	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
bis(2-Chloroethyl)ether	ND (0.205)		8270D		1	12/24/20 8:17	D0L0440	DL02238
bis(2-chloroisopropyl)Ether	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
bis(2-Ethylhexyl)phthalate	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Butylbenzylphthalate	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Carbazole	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Chrysene	ND (0.205)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Dibenzo(a,h)Anthracene	ND (0.205)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Dibenzofuran	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Diethylphthalate	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Dimethylphthalate	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Di-n-butylphthalate	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Di-n-octylphthalate	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Fluoranthene	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Fluorene	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Hexachlorobenzene	ND (0.205)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Hexachlorobutadiene	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Hexachlorocyclopentadiene	ND (2.05)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Hexachloroethane	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Indeno(1,2,3-cd)Pyrene	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Isophorone	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Naphthalene	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238

RECEIVED
JULY 30, 2021
COASTAL RESOURCES MANAGEMENT COUNCIL

CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 2-9.5ft
Date Sampled: 12/21/20 12:25
Percent Solids: 82
Initial Volume: 14.9
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-02
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/22/20 22:00

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Nitrobenzene	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
N-Nitrosodimethylamine	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
N-Nitroso-Di-n-Propylamine	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
N-nitrosodiphenylamine	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Pentachlorophenol	ND (2.05)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Phenanthrene	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Phenol	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Pyrene	ND (0.409)		8270D		1	12/24/20 8:17	D0L0440	DL02238
Pyridine	ND (2.05)		8270D		1	12/24/20 8:17	D0L0440	DL02238

	%Recovery	Qualifier	Limits
Surrogate: 1,2-Dichlorobenzene-d4	*65 %*		*30-130*
Surrogate: 2,4,6-Tribromophenol	*61 %*		*30-130*
Surrogate: 2-Chlorophenol-d4	*66 %*		*30-130*
Surrogate: 2-Fluorobiphenyl	*70 %*		*30-130*
Surrogate: 2-Fluorophenol	*64 %*		*30-130*
Surrogate: Nitrobenzene-d5	*78 %*		*30-130*
Surrogate: Phenol-d6	*74 %*		*30-130*
Surrogate: p-Terphenyl-d14	*101 %*		*30-130*

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 2-9.5ft
Date Sampled: 12/21/20 12:25
Percent Solids: 82

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-02
Sample Matrix: Sediment

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Percent Moisture	**18** (1)		2540G		1	JMG	12/23/20 17:08	%	DL02316
Total Organic Carbon (Average)	**620** (94.2)		9060		1	CCP	12/28/20 17:49	mg/kg dry	[CALC]

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COASTAL RESOURCES MANAGEMENT COUNCIL

CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 2-9.5ft
Date Sampled: 12/21/20 12:25

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-02
Sample Matrix: Sediment

Subcontracted Analysis

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Grain Size	**See Attached** (N/A)								

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JULY 30, 2021
COASTAL RESOURCES MANAGEMENT COUNCIL

CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 2-9.5ft
Date Sampled: 12/21/20 12:25
Percent Solids: 82
Initial Volume: 100
Final Volume: 2000
Extraction Method: 1311

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-02
Sample Matrix: Sediment
Units: °C
Analyst: CCY
Prepared: 12/23/20 18:22

TCLP Extraction by 1311

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Batch
Temperature (Min C)	**23.2** (N/A)		1311		1	CCY	12/24/20 11:45	DL02349
Temperature (Max C)	**24.5** (N/A)		1311		1	CCY	12/24/20 11:45	DL02349
Temperature (Range)	**Temperature is within 23 +/-2 °C.** (N/A)							

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 9.5-11.5ft
Date Sampled: 12/21/20 12:50
Percent Solids: 82

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-03
Sample Matrix: Sediment
Units: mg/kg dry

Extraction Method: 3050B

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	**0.99** (0.48)		6010C		1	KJK	12/29/20 14:15	5.11	100	DL02838
Cadmium	ND (0.24)		6010C		1	KJK	12/29/20 14:15	5.11	100	DL02838
Chromium	**1.13** (0.48)		6010C		1	KJK	12/29/20 14:15	5.11	100	DL02838
Copper	**1.74** (1.19)		6010C		1	KJK	12/29/20 14:15	5.11	100	DL02838
Lead	ND (2.38)		6010C		1	KJK	12/29/20 14:15	5.11	100	DL02838
Mercury	ND (0.011)		7471B		1	MKS	12/29/20 10:45	2.11	40	DL02840
Nickel	**1.25** (1.19)		6010C		1	KJK	12/29/20 14:15	5.11	100	DL02838
Zinc	**14.4** (1.19)		6010C		1	KJK	12/29/20 14:15	5.11	100	DL02838

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 9.5-11.5ft
Date Sampled: 12/21/20 12:50
Percent Solids: 82

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-03
Sample Matrix: Sediment
Units: mg/L

Extraction Method: 3005A TCLP

1311 TCLP Metals

Analyte	Results (MRL)	MDL	Method	TCLP Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	ND (0.050)		1311/6010C		1	BJV	12/28/20 10:48	50	50	DL02346
Barium	**0.202** (0.050)		1311/6010C		1	BJV	12/28/20 10:48	50	50	DL02346
Cadmium	ND (0.0100)		1311/6010C		1	BJV	12/28/20 10:48	50	50	DL02346
Chromium	ND (0.020)		1311/6010C		1	BJV	12/28/20 10:48	50	50	DL02346
Lead	ND (0.050)		1311/6010C		1	BJV	12/28/20 10:48	50	50	DL02346
Mercury	ND (0.00050)		1311/7470A		1	MKS	12/28/20 10:47	20	40	DL02347
Nickel	ND (0.050)		1311/6010C		1	BJV	12/28/20 10:48	50	50	DL02346
Selenium	ND (0.050)		1311/6010C		1	BJV	12/28/20 10:48	50	50	DL02346
Silver	ND (0.010)		1311/6010C		1	BJV	12/28/20 10:48	50	50	DL02346

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 9.5-11.5ft
Date Sampled: 12/21/20 12:50
Percent Solids: 82
Initial Volume: 19.2
Final Volume: 10
Extraction Method: 3540C

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-03
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: MJV
Prepared: 12/22/20 21:00

8082A Polychlorinated Biphenyls (PCB)

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aroclor 1016	ND (0.06)		8082A		1	12/23/20 19:59		DL02203
Aroclor 1221	ND (0.06)		8082A		1	12/23/20 19:59		DL02203
Aroclor 1232	ND (0.06)		8082A		1	12/23/20 19:59		DL02203
Aroclor 1242	ND (0.06)		8082A		1	12/23/20 19:59		DL02203
Aroclor 1248	ND (0.06)		8082A		1	12/23/20 19:59		DL02203
Aroclor 1254	ND (0.06)		8082A		1	12/23/20 19:59		DL02203
Aroclor 1260	ND (0.06)		8082A		1	12/23/20 19:59		DL02203
Aroclor 1262	ND (0.06)		8082A		1	12/23/20 19:59		DL02203
Aroclor 1268	ND (0.06)		8082A		1	12/23/20 19:59		DL02203

	%Recovery	Qualifier	Limits
Surrogate: Decachlorobiphenyl	*81 %*		*30-150*
Surrogate: Decachlorobiphenyl [2C]	*85 %*		*30-150*
Surrogate: Tetrachloro-m-xylene	*63 %*		*30-150*
Surrogate: Tetrachloro-m-xylene [2C]	*72 %*		*30-150*

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 9.5-11.5ft
Date Sampled: 12/21/20 12:50
Percent Solids: 82
Initial Volume: 19.8
Final Volume: 1
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-03
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: AMF
Prepared: 12/22/20 22:00

8100M Total Petroleum Hydrocarbons

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Total Petroleum Hydrocarbons	ND (46.1)		8100M		1	12/24/20 22:11	D0L0485	DL02237

	%Recovery	Qualifier	Limits
Surrogate: O-Terphenyl	*93 %*		*40-140*

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 9.5-11.5ft
Date Sampled: 12/21/20 12:50
Percent Solids: 82
Initial Volume: 15.4
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-03
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/22/20 22:00

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,1-Biphenyl	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
1,2,4-Trichlorobenzene	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
1,2-Dichlorobenzene	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
1,3-Dichlorobenzene	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
1,4-Dichlorobenzene	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
2,3,4,6-Tetrachlorophenol	ND (1.98)		8270D		1	12/24/20 8:46	D0L0440	DL02238
2,4,5-Trichlorophenol	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
2,4,6-Trichlorophenol	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
2,4-Dichlorophenol	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
2,4-Dimethylphenol	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
2,4-Dinitrophenol	ND (1.98)		8270D		1	12/24/20 8:46	D0L0440	DL02238
2,4-Dinitrotoluene	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
2,6-Dinitrotoluene	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
2-Chloronaphthalene	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
2-Chlorophenol	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
2-Methylnaphthalene	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
2-Methylphenol	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
2-Nitroaniline	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
2-Nitrophenol	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
3,3´-Dichlorobenzidine	ND (0.790)		8270D		1	12/24/20 8:46	D0L0440	DL02238
3+4-Methylphenol	ND (0.790)		8270D		1	12/24/20 8:46	D0L0440	DL02238
3-Nitroaniline	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
4,6-Dinitro-2-Methylphenol	ND (1.98)		8270D		1	12/24/20 8:46	D0L0440	DL02238
4-Bromophenyl-phenylether	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
4-Chloro-3-Methylphenol	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
4-Chloroaniline	ND (0.790)		8270D		1	12/24/20 8:46	D0L0440	DL02238
4-Chloro-phenyl-phenyl ether	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
4-Nitroaniline	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
4-Nitrophenol	ND (1.98)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Acenaphthene	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Acenaphthylene	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Acetophenone	ND (0.790)		8270D		1	12/24/20 8:46	D0L0440	DL02238

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 9.5-11.5ft
Date Sampled: 12/21/20 12:50
Percent Solids: 82
Initial Volume: 15.4
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-03
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/22/20 22:00

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aniline	ND (0.790)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Anthracene	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Azobenzene	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Benzo(a)anthracene	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Benzo(a)pyrene	ND (0.198)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Benzo(b)fluoranthene	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Benzo(g,h,i)perylene	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Benzo(k)fluoranthene	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Benzoic Acid	ND (1.98)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Benzyl Alcohol	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
bis(2-Chloroethoxy)methane	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
bis(2-Chloroethyl)ether	ND (0.198)		8270D		1	12/24/20 8:46	D0L0440	DL02238
bis(2-chloroisopropyl)Ether	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
bis(2-Ethylhexyl)phthalate	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Butylbenzylphthalate	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Carbazole	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Chrysene	ND (0.198)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Dibenzo(a,h)Anthracene	ND (0.198)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Dibenzofuran	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Diethylphthalate	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Dimethylphthalate	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Di-n-butylphthalate	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Di-n-octylphthalate	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Fluoranthene	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Fluorene	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Hexachlorobenzene	ND (0.198)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Hexachlorobutadiene	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Hexachlorocyclopentadiene	ND (1.98)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Hexachloroethane	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Indeno(1,2,3-cd)Pyrene	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Isophorone	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Naphthalene	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 9.5-11.5ft
Date Sampled: 12/21/20 12:50
Percent Solids: 82
Initial Volume: 15.4
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-03
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/22/20 22:00

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Nitrobenzene	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
N-Nitrosodimethylamine	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
N-Nitroso-Di-n-Propylamine	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
N-nitrosodiphenylamine	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Pentachlorophenol	ND (1.98)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Phenanthrene	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Phenol	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Pyrene	ND (0.395)		8270D		1	12/24/20 8:46	D0L0440	DL02238
Pyridine	ND (1.98)		8270D		1	12/24/20 8:46	D0L0440	DL02238

	%Recovery	Qualifier	Limits
Surrogate: 1,2-Dichlorobenzene-d4	*70 %*		*30-130*
Surrogate: 2,4,6-Tribromophenol	*60 %*		*30-130*
Surrogate: 2-Chlorophenol-d4	*70 %*		*30-130*
Surrogate: 2-Fluorobiphenyl	*75 %*		*30-130*
Surrogate: 2-Fluorophenol	*69 %*		*30-130*
Surrogate: Nitrobenzene-d5	*82 %*		*30-130*
Surrogate: Phenol-d6	*79 %*		*30-130*
Surrogate: p-Terphenyl-d14	*105 %*		*30-130*

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 9.5-11.5ft
Date Sampled: 12/21/20 12:50
Percent Solids: 82

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-03
Sample Matrix: Sediment

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Percent Moisture	**18** (1)		2540G		1	JMG	12/23/20 17:08	%	DL02316
Total Organic Carbon (Average)	ND (97.6)		9060		1	CCP	12/28/20 14:30	mg/kg dry	[CALC]

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 9.5-11.5ft
Date Sampled: 12/21/20 12:50

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-03
Sample Matrix: Sediment

Subcontracted Analysis

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Grain Size	**See Attached** (N/A)								

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 9.5-11.5ft
Date Sampled: 12/21/20 12:50
Percent Solids: 82
Initial Volume: 100
Final Volume: 2000
Extraction Method: 1311

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-03
Sample Matrix: Sediment
Units: °C
Analyst: CCY
Prepared: 12/23/20 18:22

TCLP Extraction by 1311

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Batch
Temperature (Min C)	**23.2** (N/A)		1311		1	CCY	12/24/20 11:45	DL02349
Temperature (Max C)	**24.5** (N/A)		1311		1	CCY	12/24/20 11:45	DL02349
Temperature (Range)	**Temperature is within 23 +/-2 °C.** (N/A)							

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 11.5-16.5ft
Date Sampled: 12/21/20 13:15
Percent Solids: 82

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-04
Sample Matrix: Sediment
Units: mg/kg dry

Extraction Method: 3050B

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	**1.48** (0.96)		6010C		2	KJK	12/29/20 16:36	5.09	100	DL02838
Cadmium	ND (0.48)		6010C		2	KJK	12/29/20 16:36	5.09	100	DL02838
Chromium	**3.50** (0.96)		6010C		2	KJK	12/29/20 16:36	5.09	100	DL02838
Copper	**4.00** (2.39)		6010C		2	KJK	12/29/20 16:36	5.09	100	DL02838
Lead	ND (4.79)		6010C		2	KJK	12/29/20 16:36	5.09	100	DL02838
Mercury	ND (0.012)		7471B		1	MKS	12/29/20 10:47	2.06	40	DL02840
Nickel	**3.72** (2.39)		6010C		2	KJK	12/29/20 16:36	5.09	100	DL02838
Zinc	**25.2** (2.39)		6010C		2	KJK	12/29/20 16:36	5.09	100	DL02838

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 11.5-16.5ft
Date Sampled: 12/21/20 13:15
Percent Solids: 82

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-04
Sample Matrix: Sediment
Units: mg/L

Extraction Method: 3005A TCLP

1311 TCLP Metals

Analyte	Results (MRL)	MDL	Method	TCLP Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	ND (0.050)		1311/6010C		1	BJV	12/28/20 10:58	50	50	DL02346
Barium	ND (0.050)		1311/6010C		1	BJV	12/28/20 10:58	50	50	DL02346
Cadmium	ND (0.0100)		1311/6010C		1	BJV	12/28/20 10:58	50	50	DL02346
Chromium	ND (0.020)		1311/6010C		1	BJV	12/28/20 10:58	50	50	DL02346
Lead	ND (0.050)		1311/6010C		1	BJV	12/28/20 10:58	50	50	DL02346
Mercury	ND (0.00050)		1311/7470A		1	MKS	12/28/20 10:49	20	40	DL02347
Nickel	ND (0.050)		1311/6010C		1	BJV	12/28/20 10:58	50	50	DL02346
Selenium	ND (0.050)		1311/6010C		1	BJV	12/28/20 10:58	50	50	DL02346
Silver	ND (0.010)		1311/6010C		1	BJV	12/28/20 10:58	50	50	DL02346

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 11.5-16.5ft
Date Sampled: 12/21/20 13:15
Percent Solids: 82
Initial Volume: 19.5
Final Volume: 10
Extraction Method: 3540C

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-04
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: MJV
Prepared: 12/22/20 21:00

8082A Polychlorinated Biphenyls (PCB)

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aroclor 1016	ND (0.06)		8082A		1	12/23/20 20:18		DL02203
Aroclor 1221	ND (0.06)		8082A		1	12/23/20 20:18		DL02203
Aroclor 1232	ND (0.06)		8082A		1	12/23/20 20:18		DL02203
Aroclor 1242	ND (0.06)		8082A		1	12/23/20 20:18		DL02203
Aroclor 1248	ND (0.06)		8082A		1	12/23/20 20:18		DL02203
Aroclor 1254	ND (0.06)		8082A		1	12/23/20 20:18		DL02203
Aroclor 1260	ND (0.06)		8082A		1	12/23/20 20:18		DL02203
Aroclor 1262	ND (0.06)		8082A		1	12/23/20 20:18		DL02203
Aroclor 1268	ND (0.06)		8082A		1	12/23/20 20:18		DL02203

	%Recovery	Qualifier	Limits
Surrogate: Decachlorobiphenyl	*95 %*		*30-150*
Surrogate: Decachlorobiphenyl [2C]	*98 %*		*30-150*
Surrogate: Tetrachloro-m-xylene	*78 %*		*30-150*
Surrogate: Tetrachloro-m-xylene [2C]	*88 %*		*30-150*

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 11.5-16.5ft
Date Sampled: 12/21/20 13:15
Percent Solids: 82
Initial Volume: 20.9
Final Volume: 1
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-04
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: AMF
Prepared: 12/30/20 17:00

8100M Total Petroleum Hydrocarbons

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Total Petroleum Hydrocarbons	ND (43.7)		8100M		1	12/31/20 16:42	D0L0593	DL03020

	%Recovery	Qualifier	Limits
Surrogate: O-Terphenyl	*85 %*		*40-140*

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 11.5-16.5ft
Date Sampled: 12/21/20 13:15
Percent Solids: 82
Initial Volume: 14.4
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-04
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/22/20 22:00

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,1-Biphenyl	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
1,2,4-Trichlorobenzene	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
1,2-Dichlorobenzene	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
1,3-Dichlorobenzene	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
1,4-Dichlorobenzene	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
2,3,4,6-Tetrachlorophenol	ND (2.12)		8270D		1	12/24/20 9:15	D0L0440	DL02238
2,4,5-Trichlorophenol	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
2,4,6-Trichlorophenol	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
2,4-Dichlorophenol	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
2,4-Dimethylphenol	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
2,4-Dinitrophenol	ND (2.12)		8270D		1	12/24/20 9:15	D0L0440	DL02238
2,4-Dinitrotoluene	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
2,6-Dinitrotoluene	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
2-Chloronaphthalene	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
2-Chlorophenol	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
2-Methylnaphthalene	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
2-Methylphenol	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
2-Nitroaniline	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
2-Nitrophenol	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
3,3´-Dichlorobenzidine	ND (0.847)		8270D		1	12/24/20 9:15	D0L0440	DL02238
3+4-Methylphenol	ND (0.847)		8270D		1	12/24/20 9:15	D0L0440	DL02238
3-Nitroaniline	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
4,6-Dinitro-2-Methylphenol	ND (2.12)		8270D		1	12/24/20 9:15	D0L0440	DL02238
4-Bromophenyl-phenylether	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
4-Chloro-3-Methylphenol	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
4-Chloroaniline	ND (0.847)		8270D		1	12/24/20 9:15	D0L0440	DL02238
4-Chloro-phenyl-phenyl ether	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
4-Nitroaniline	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
4-Nitrophenol	ND (2.12)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Acenaphthene	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Acenaphthylene	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Acetophenone	ND (0.847)		8270D		1	12/24/20 9:15	D0L0440	DL02238

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 11.5-16.5ft
Date Sampled: 12/21/20 13:15
Percent Solids: 82
Initial Volume: 14.4
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-04
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/22/20 22:00

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aniline	ND (0.847)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Anthracene	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Azobenzene	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Benzo(a)anthracene	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Benzo(a)pyrene	ND (0.212)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Benzo(b)fluoranthene	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Benzo(g,h,i)perylene	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Benzo(k)fluoranthene	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Benzoic Acid	ND (2.12)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Benzyl Alcohol	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
bis(2-Chloroethoxy)methane	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
bis(2-Chloroethyl)ether	ND (0.212)		8270D		1	12/24/20 9:15	D0L0440	DL02238
bis(2-chloroisopropyl)Ether	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
bis(2-Ethylhexyl)phthalate	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Butylbenzylphthalate	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Carbazole	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Chrysene	ND (0.212)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Dibenzo(a,h)Anthracene	ND (0.212)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Dibenzofuran	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Diethylphthalate	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Dimethylphthalate	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Di-n-butylphthalate	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Di-n-octylphthalate	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Fluoranthene	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Fluorene	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Hexachlorobenzene	ND (0.212)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Hexachlorobutadiene	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Hexachlorocyclopentadiene	ND (2.12)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Hexachloroethane	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Indeno(1,2,3-cd)Pyrene	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Isophorone	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Naphthalene	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 11.5-16.5ft
Date Sampled: 12/21/20 13:15
Percent Solids: 82
Initial Volume: 14.4
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-04
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/22/20 22:00

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Nitrobenzene	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
N-Nitrosodimethylamine	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
N-Nitroso-Di-n-Propylamine	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
N-nitrosodiphenylamine	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Pentachlorophenol	ND (2.12)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Phenanthrene	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Phenol	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Pyrene	ND (0.423)		8270D		1	12/24/20 9:15	D0L0440	DL02238
Pyridine	ND (2.12)		8270D		1	12/24/20 9:15	D0L0440	DL02238

	%Recovery	Qualifier	Limits
Surrogate: 1,2-Dichlorobenzene-d4	*65 %*		*30-130*
Surrogate: 2,4,6-Tribromophenol	*58 %*		*30-130*
Surrogate: 2-Chlorophenol-d4	*67 %*		*30-130*
Surrogate: 2-Fluorobiphenyl	*70 %*		*30-130*
Surrogate: 2-Fluorophenol	*64 %*		*30-130*
Surrogate: Nitrobenzene-d5	*76 %*		*30-130*
Surrogate: Phenol-d6	*75 %*		*30-130*
Surrogate: p-Terphenyl-d14	*101 %*		*30-130*

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 11.5-16.5ft
Date Sampled: 12/21/20 13:15
Percent Solids: 82

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-04
Sample Matrix: Sediment

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Percent Moisture	**18** (1)		2540G		1	JMG	12/23/20 17:08	%	DL02316
Total Organic Carbon (Average)	ND (94.5)		9060		1	CCP	12/28/20 14:46	mg/kg dry	[CALC]

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 11.5-16.5ft
Date Sampled: 12/21/20 13:15

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-04
Sample Matrix: Sediment

Subcontracted Analysis

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Grain Size	**See Attached** (N/A)								

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-04 11.5-16.5ft
Date Sampled: 12/21/20 13:15
Percent Solids: 82
Initial Volume: 100
Final Volume: 2000
Extraction Method: 1311

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-04
Sample Matrix: Sediment
Units: °C
Analyst: CCY
Prepared: 12/23/20 18:22

TCLP Extraction by 1311

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Batch
Temperature (Min C)	**23.2** (N/A)		1311		1	CCY	12/24/20 11:45	DL02349
Temperature (Max C)	**24.5** (N/A)		1311		1	CCY	12/24/20 11:45	DL02349
Temperature (Range)	**Temperature is within 23 +/-2 °C.** (N/A)							

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 0-5.5ft
Date Sampled: 12/21/20 13:42
Percent Solids: 85

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-05
Sample Matrix: Sediment
Units: mg/kg dry

Extraction Method: 3050B

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	**1.23** (0.47)		6010C		1	KJK	12/29/20 14:25	5.06	100	DL02838
Cadmium	ND (0.23)		6010C		1	KJK	12/29/20 14:25	5.06	100	DL02838
Chromium	**1.46** (0.47)		6010C		1	KJK	12/29/20 14:25	5.06	100	DL02838
Copper	**1.49** (1.17)		6010C		1	KJK	12/29/20 14:25	5.06	100	DL02838
Lead	ND (2.34)		6010C		1	KJK	12/29/20 14:25	5.06	100	DL02838
Mercury	ND (0.011)		7471B		1	MKS	12/29/20 10:49	2.06	40	DL02840
Nickel	**1.28** (1.17)		6010C		1	KJK	12/29/20 14:25	5.06	100	DL02838
Zinc	**9.67** (1.17)		6010C		1	KJK	12/29/20 14:25	5.06	100	DL02838

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 0-5.5ft
Date Sampled: 12/21/20 13:42
Percent Solids: 85

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-05
Sample Matrix: Sediment
Units: mg/L

Extraction Method: 3005A TCLP

1311 TCLP Metals

Analyte	Results (MRL)	MDL	Method	TCLP Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:00	50	50	DL02346
Barium	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:00	50	50	DL02346
Cadmium	ND (0.0100)		1311/6010C		1	BJV	12/28/20 11:00	50	50	DL02346
Chromium	ND (0.020)		1311/6010C		1	BJV	12/28/20 11:00	50	50	DL02346
Lead	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:00	50	50	DL02346
Mercury	ND (0.00050)		1311/7470A		1	MKS	12/28/20 10:51	20	40	DL02347
Nickel	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:00	50	50	DL02346
Selenium	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:00	50	50	DL02346
Silver	ND (0.010)		1311/6010C		1	BJV	12/28/20 11:00	50	50	DL02346

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 0-5.5ft
Date Sampled: 12/21/20 13:42
Percent Solids: 85
Initial Volume: 20.7
Final Volume: 10
Extraction Method: 3540C

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-05
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: MJV
Prepared: 12/22/20 21:00

8082A Polychlorinated Biphenyls (PCB)

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aroclor 1016	ND (0.06)		8082A		1	12/23/20 20:37		DL02203
Aroclor 1221	ND (0.06)		8082A		1	12/23/20 20:37		DL02203
Aroclor 1232	ND (0.06)		8082A		1	12/23/20 20:37		DL02203
Aroclor 1242	ND (0.06)		8082A		1	12/23/20 20:37		DL02203
Aroclor 1248	ND (0.06)		8082A		1	12/23/20 20:37		DL02203
Aroclor 1254	ND (0.06)		8082A		1	12/23/20 20:37		DL02203
Aroclor 1260	ND (0.06)		8082A		1	12/23/20 20:37		DL02203
Aroclor 1262	ND (0.06)		8082A		1	12/23/20 20:37		DL02203
Aroclor 1268	ND (0.06)		8082A		1	12/23/20 20:37		DL02203

	%Recovery	Qualifier	Limits
Surrogate: Decachlorobiphenyl	*98 %*		*30-150*
Surrogate: Decachlorobiphenyl [2C]	*102 %*		*30-150*
Surrogate: Tetrachloro-m-xylene	*80 %*		*30-150*
Surrogate: Tetrachloro-m-xylene [2C]	*89 %*		*30-150*

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COASTAL RESOURCES MANAGEMENT COUNCIL

CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 0-5.5ft
Date Sampled: 12/21/20 13:42
Percent Solids: 85
Initial Volume: 19.7
Final Volume: 1
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-05
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: AMF
Prepared: 12/22/20 22:00

8100M Total Petroleum Hydrocarbons

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Total Petroleum Hydrocarbons	ND (45.0)		8100M		1	12/25/20 1:30	D0L0485	DL02237

	%Recovery	Qualifier	Limits
Surrogate: O-Terphenyl	*108 %*		*40-140*

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COASTAL RESOURCES MANAGEMENT COUNCIL

CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 0-5.5ft
Date Sampled: 12/21/20 13:42
Percent Solids: 85
Initial Volume: 14.8
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-05
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/22/20 22:00

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,1-Biphenyl	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
1,2,4-Trichlorobenzene	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
1,2-Dichlorobenzene	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
1,3-Dichlorobenzene	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
1,4-Dichlorobenzene	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
2,3,4,6-Tetrachlorophenol	ND (2.00)		8270D		1	12/24/20 9:44	D0L0440	DL02238
2,4,5-Trichlorophenol	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
2,4,6-Trichlorophenol	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
2,4-Dichlorophenol	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
2,4-Dimethylphenol	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
2,4-Dinitrophenol	ND (2.00)		8270D		1	12/24/20 9:44	D0L0440	DL02238
2,4-Dinitrotoluene	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
2,6-Dinitrotoluene	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
2-Chloronaphthalene	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
2-Chlorophenol	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
2-Methylnaphthalene	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
2-Methylphenol	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
2-Nitroaniline	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
2-Nitrophenol	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
3,3´-Dichlorobenzidine	ND (0.799)		8270D		1	12/24/20 9:44	D0L0440	DL02238
3+4-Methylphenol	ND (0.799)		8270D		1	12/24/20 9:44	D0L0440	DL02238
3-Nitroaniline	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
4,6-Dinitro-2-Methylphenol	ND (2.00)		8270D		1	12/24/20 9:44	D0L0440	DL02238
4-Bromophenyl-phenylether	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
4-Chloro-3-Methylphenol	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
4-Chloroaniline	ND (0.799)		8270D		1	12/24/20 9:44	D0L0440	DL02238
4-Chloro-phenyl-phenyl ether	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
4-Nitroaniline	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
4-Nitrophenol	ND (2.00)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Acenaphthene	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Acenaphthylene	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Acetophenone	ND (0.799)		8270D		1	12/24/20 9:44	D0L0440	DL02238

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COASTAL RESOURCES MANAGEMENT COUNCIL

CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 0-5.5ft
Date Sampled: 12/21/20 13:42
Percent Solids: 85
Initial Volume: 14.8
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-05
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/22/20 22:00

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aniline	ND (0.799)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Anthracene	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Azobenzene	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Benzo(a)anthracene	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Benzo(a)pyrene	ND (0.200)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Benzo(b)fluoranthene	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Benzo(g,h,i)perylene	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Benzo(k)fluoranthene	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Benzoic Acid	ND (2.00)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Benzyl Alcohol	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
bis(2-Chloroethoxy)methane	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
bis(2-Chloroethyl)ether	ND (0.200)		8270D		1	12/24/20 9:44	D0L0440	DL02238
bis(2-chloroisopropyl)Ether	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
bis(2-Ethylhexyl)phthalate	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Butylbenzylphthalate	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Carbazole	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Chrysene	ND (0.200)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Dibenzo(a,h)Anthracene	ND (0.200)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Dibenzofuran	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Diethylphthalate	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Dimethylphthalate	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Di-n-butylphthalate	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Di-n-octylphthalate	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Fluoranthene	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Fluorene	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Hexachlorobenzene	ND (0.200)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Hexachlorobutadiene	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Hexachlorocyclopentadiene	ND (2.00)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Hexachloroethane	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Indeno(1,2,3-cd)Pyrene	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Isophorone	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Naphthalene	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 0-5.5ft
Date Sampled: 12/21/20 13:42
Percent Solids: 85
Initial Volume: 14.8
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-05
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/22/20 22:00

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Nitrobenzene	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
N-Nitrosodimethylamine	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
N-Nitroso-Di-n-Propylamine	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
N-nitrosodiphenylamine	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Pentachlorophenol	ND (2.00)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Phenanthrene	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Phenol	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Pyrene	ND (0.399)		8270D		1	12/24/20 9:44	D0L0440	DL02238
Pyridine	ND (2.00)		8270D		1	12/24/20 9:44	D0L0440	DL02238

	%Recovery	Qualifier	Limits
Surrogate: 1,2-Dichlorobenzene-d4	*63 %*		*30-130*
Surrogate: 2,4,6-Tribromophenol	*69 %*		*30-130*
Surrogate: 2-Chlorophenol-d4	*64 %*		*30-130*
Surrogate: 2-Fluorobiphenyl	*68 %*		*30-130*
Surrogate: 2-Fluorophenol	*64 %*		*30-130*
Surrogate: Nitrobenzene-d5	*76 %*		*30-130*
Surrogate: Phenol-d6	*71 %*		*30-130*
Surrogate: p-Terphenyl-d14	*100 %*		*30-130*

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 0-5.5ft
Date Sampled: 12/21/20 13:42
Percent Solids: 85

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-05
Sample Matrix: Sediment

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Percent Moisture	**15** (1)		2540G		1	JMG	12/23/20 17:08	%	DL02316
Total Organic Carbon (Average)	**1060** (96.8)		9060		1	CCP	12/28/20 15:36	mg/kg dry	[CALC]

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 0-5.5ft
Date Sampled: 12/21/20 13:42

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-05
Sample Matrix: Sediment

Subcontracted Analysis

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Grain Size	**See Attached** (N/A)								

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 0-5.5ft
Date Sampled: 12/21/20 13:42
Percent Solids: 85
Initial Volume: 100
Final Volume: 2000
Extraction Method: 1311

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-05
Sample Matrix: Sediment
Units: °C
Analyst: CCY
Prepared: 12/23/20 18:22

TCLP Extraction by 1311

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Batch
Temperature (Min C)	**23.2** (N/A)		1311		1	CCY	12/24/20 11:45	DL02349
Temperature (Max C)	**24.5** (N/A)		1311		1	CCY	12/24/20 11:45	DL02349
Temperature (Range)	**Temperature is within 23 +/-2 °C.** (N/A)							

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-200 0-5.5ft
Date Sampled: 12/21/20 14:00
Percent Solids: 84

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-06
Sample Matrix: Sediment
Units: mg/kg dry

Extraction Method: 3050B

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	**1.16** (0.46)		6010C		1	KJK	12/29/20 14:27	5.22	100	DL02838
Cadmium	ND (0.23)		6010C		1	KJK	12/29/20 14:27	5.22	100	DL02838
Chromium	**1.90** (0.46)		6010C		1	KJK	12/29/20 14:27	5.22	100	DL02838
Copper	**1.30** (1.14)		6010C		1	KJK	12/29/20 14:27	5.22	100	DL02838
Lead	ND (2.28)		6010C		1	KJK	12/29/20 14:27	5.22	100	DL02838
Mercury	ND (0.011)		7471B		1	MKS	12/29/20 10:51	2.07	40	DL02840
Nickel	**1.39** (1.14)		6010C		1	KJK	12/29/20 14:27	5.22	100	DL02838
Zinc	**8.81** (1.14)		6010C		1	KJK	12/29/20 14:27	5.22	100	DL02838

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-200 0-5.5ft
Date Sampled: 12/21/20 14:00
Percent Solids: 84

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-06
Sample Matrix: Sediment
Units: mg/L

Extraction Method: 3005A TCLP

1311 TCLP Metals

Analyte	Results (MRL)	MDL	Method	TCLP Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:03	50	50	DL02346
Barium	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:03	50	50	DL02346
Cadmium	ND (0.0100)		1311/6010C		1	BJV	12/28/20 11:03	50	50	DL02346
Chromium	ND (0.020)		1311/6010C		1	BJV	12/28/20 11:03	50	50	DL02346
Lead	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:03	50	50	DL02346
Mercury	ND (0.00050)		1311/7470A		1	MKS	12/28/20 10:53	20	40	DL02347
Nickel	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:03	50	50	DL02346
Selenium	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:03	50	50	DL02346
Silver	ND (0.010)		1311/6010C		1	BJV	12/28/20 11:03	50	50	DL02346

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-200 0-5.5ft
Date Sampled: 12/21/20 14:00
Percent Solids: 84
Initial Volume: 19.5
Final Volume: 10
Extraction Method: 3540C

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-06
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: MJV
Prepared: 12/22/20 21:03

8082A Polychlorinated Biphenyls (PCB)

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aroclor 1016	ND (0.06)		8082A		1	12/23/20 15:45		DL02204
Aroclor 1221	ND (0.06)		8082A		1	12/23/20 15:45		DL02204
Aroclor 1232	ND (0.06)		8082A		1	12/23/20 15:45		DL02204
Aroclor 1242	ND (0.06)		8082A		1	12/23/20 15:45		DL02204
Aroclor 1248	ND (0.06)		8082A		1	12/23/20 15:45		DL02204
Aroclor 1254	ND (0.06)		8082A		1	12/23/20 15:45		DL02204
Aroclor 1260	ND (0.06)		8082A		1	12/23/20 15:45		DL02204
Aroclor 1262	ND (0.06)		8082A		1	12/23/20 15:45		DL02204
Aroclor 1268	ND (0.06)		8082A		1	12/23/20 15:45		DL02204

	%Recovery	Qualifier	Limits
Surrogate: Decachlorobiphenyl	*87 %*		*30-150*
Surrogate: Decachlorobiphenyl [2C]	*107 %*		*30-150*
Surrogate: Tetrachloro-m-xylene	*72 %*		*30-150*
Surrogate: Tetrachloro-m-xylene [2C]	*96 %*		*30-150*

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-200 0-5.5ft
Date Sampled: 12/21/20 14:00
Percent Solids: 84
Initial Volume: 19.8
Final Volume: 1
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-06
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: AMF
Prepared: 12/22/20 22:00

8100M Total Petroleum Hydrocarbons

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Total Petroleum Hydrocarbons	ND (45.1)		8100M		1	12/25/20 2:04	D0L0485	DL02237

	%Recovery	Qualifier	Limits
Surrogate: O-Terphenyl	*100 %*		*40-140*

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COASTAL RESOURCES MANAGEMENT COUNCIL

CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-200 0-5.5ft
Date Sampled: 12/21/20 14:00
Percent Solids: 84
Initial Volume: 15.6
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-06
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/22/20 22:00

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,1-Biphenyl	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
1,2,4-Trichlorobenzene	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
1,2-Dichlorobenzene	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
1,3-Dichlorobenzene	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
1,4-Dichlorobenzene	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
2,3,4,6-Tetrachlorophenol	ND (1.91)		8270D		1	12/28/20 22:12	D0L0497	DL02238
2,4,5-Trichlorophenol	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
2,4,6-Trichlorophenol	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
2,4-Dichlorophenol	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
2,4-Dimethylphenol	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
2,4-Dinitrophenol	ND (1.91)		8270D		1	12/28/20 22:12	D0L0497	DL02238
2,4-Dinitrotoluene	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
2,6-Dinitrotoluene	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
2-Chloronaphthalene	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
2-Chlorophenol	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
2-Methylnaphthalene	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
2-Methylphenol	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
2-Nitroaniline	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
2-Nitrophenol	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
3,3´-Dichlorobenzidine	ND (0.764)		8270D		1	12/28/20 22:12	D0L0497	DL02238
3+4-Methylphenol	ND (0.764)		8270D		1	12/28/20 22:12	D0L0497	DL02238
3-Nitroaniline	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
4,6-Dinitro-2-Methylphenol	ND (1.91)		8270D		1	12/28/20 22:12	D0L0497	DL02238
4-Bromophenyl-phenylether	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
4-Chloro-3-Methylphenol	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
4-Chloroaniline	ND (0.764)		8270D		1	12/28/20 22:12	D0L0497	DL02238
4-Chloro-phenyl-phenyl ether	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
4-Nitroaniline	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
4-Nitrophenol	ND (1.91)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Acenaphthene	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Acenaphthylene	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Acetophenone	ND (0.764)		8270D		1	12/28/20 22:12	D0L0497	DL02238

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-200 0-5.5ft
Date Sampled: 12/21/20 14:00
Percent Solids: 84
Initial Volume: 15.6
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-06
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/22/20 22:00

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aniline	ND (0.764)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Anthracene	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Azobenzene	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Benzo(a)anthracene	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Benzo(a)pyrene	ND (0.191)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Benzo(b)fluoranthene	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Benzo(g,h,i)perylene	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Benzo(k)fluoranthene	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Benzoic Acid	ND (1.91)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Benzyl Alcohol	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
bis(2-Chloroethoxy)methane	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
bis(2-Chloroethyl)ether	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
bis(2-chloroisopropyl)Ether	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
bis(2-Ethylhexyl)phthalate	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Butylbenzylphthalate	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Carbazole	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Chrysene	ND (0.191)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Dibenzo(a,h)Anthracene	ND (0.191)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Dibenzofuran	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Diethylphthalate	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Dimethylphthalate	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Di-n-butylphthalate	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Di-n-octylphthalate	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Fluoranthene	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Fluorene	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Hexachlorobenzene	ND (0.191)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Hexachlorobutadiene	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Hexachlorocyclopentadiene	ND (1.91)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Hexachloroethane	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Indeno(1,2,3-cd)Pyrene	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Isophorone	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Naphthalene	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-200 0-5.5ft
Date Sampled: 12/21/20 14:00
Percent Solids: 84
Initial Volume: 15.6
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-06
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/22/20 22:00

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Nitrobenzene	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
N-Nitrosodimethylamine	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
N-Nitroso-Di-n-Propylamine	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
N-nitrosodiphenylamine	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Pentachlorophenol	ND (1.91)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Phenanthrene	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Phenol	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Pyrene	ND (0.381)		8270D		1	12/28/20 22:12	D0L0497	DL02238
Pyridine	ND (1.91)		8270D		1	12/28/20 22:12	D0L0497	DL02238

	%Recovery	Qualifier	Limits
Surrogate: 1,2-Dichlorobenzene-d4	*64 %*		*30-130*
Surrogate: 2,4,6-Tribromophenol	*83 %*		*30-130*
Surrogate: 2-Chlorophenol-d4	*65 %*		*30-130*
Surrogate: 2-Fluorobiphenyl	*69 %*		*30-130*
Surrogate: 2-Fluorophenol	*71 %*		*30-130*
Surrogate: Nitrobenzene-d5	*79 %*		*30-130*
Surrogate: Phenol-d6	*76 %*		*30-130*
Surrogate: p-Terphenyl-d14	*94 %*		*30-130*

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-200 0-5.5ft
Date Sampled: 12/21/20 14:00
Percent Solids: 84

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-06
Sample Matrix: Sediment

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Percent Moisture	**16** (1)		2540G		1	JMG	12/23/20 17:08	%	DL02316
Total Organic Carbon (Average)	ND (97.4)		9060		1	CCP	12/28/20 15:53	mg/kg dry	[CALC]

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-200 0-5.5ft
Date Sampled: 12/21/20 14:00

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-06
Sample Matrix: Sediment

Subcontracted Analysis

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Grain Size	**See Attached** (N/A)								

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-200 0-5.5ft
Date Sampled: 12/21/20 14:00
Percent Solids: 84
Initial Volume: 100
Final Volume: 2000
Extraction Method: 1311

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-06
Sample Matrix: Sediment
Units: °C
Analyst: CCY
Prepared: 12/23/20 18:22

TCLP Extraction by 1311

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Batch
Temperature (Min C)	**23.2** (N/A)		1311		1	CCY	12/24/20 11:45	DL02349
Temperature (Max C)	**24.5** (N/A)		1311		1	CCY	12/24/20 11:45	DL02349
Temperature (Range)	**Temperature is within 23 +/-2 °C.** (N/A)							

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 5.5-8.5ft
Date Sampled: 12/21/20 14:10
Percent Solids: 82

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-07
Sample Matrix: Sediment
Units: mg/kg dry

Extraction Method: 3050B

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	**0.86** (0.47)		6010C		1	KJK	12/29/20 14:28	5.16	100	DL02838
Cadmium	**0.41** (0.24)		6010C		1	KJK	12/29/20 14:28	5.16	100	DL02838
Chromium	**1.35** (0.47)		6010C		1	KJK	12/29/20 14:28	5.16	100	DL02838
Copper	**1.93** (1.19)		6010C		1	KJK	12/29/20 14:28	5.16	100	DL02838
Lead	ND (2.37)		6010C		1	KJK	12/29/20 14:28	5.16	100	DL02838
Mercury	ND (0.011)		7471B		1	MKS	12/29/20 10:53	2.18	40	DL02840
Nickel	**1.59** (1.19)		6010C		1	KJK	12/29/20 14:28	5.16	100	DL02838
Zinc	**15.9** (1.19)		6010C		1	KJK	12/29/20 14:28	5.16	100	DL02838

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 5.5-8.5ft
Date Sampled: 12/21/20 14:10
Percent Solids: 82

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-07
Sample Matrix: Sediment
Units: mg/L

Extraction Method: 3005A TCLP

1311 TCLP Metals

Analyte	Results (MRL)	MDL	Method	TCLP Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:05	50	50	DL02346
Barium	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:05	50	50	DL02346
Cadmium	ND (0.0100)		1311/6010C		1	BJV	12/28/20 11:05	50	50	DL02346
Chromium	ND (0.020)		1311/6010C		1	BJV	12/28/20 11:05	50	50	DL02346
Lead	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:05	50	50	DL02346
Mercury	ND (0.00050)		1311/7470A		1	MKS	12/28/20 10:55	20	40	DL02347
Nickel	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:05	50	50	DL02346
Selenium	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:05	50	50	DL02346
Silver	ND (0.010)		1311/6010C		1	BJV	12/28/20 11:05	50	50	DL02346

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 5.5-8.5ft
Date Sampled: 12/21/20 14:10
Percent Solids: 82
Initial Volume: 19
Final Volume: 10
Extraction Method: 3540C

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-07
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: MJV
Prepared: 12/24/20 14:05

8082A Polychlorinated Biphenyls (PCB)

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aroclor 1016	ND (0.06)		8082A		1	12/28/20 23:53		DL02402
Aroclor 1221	ND (0.06)		8082A		1	12/28/20 23:53		DL02402
Aroclor 1232	ND (0.06)		8082A		1	12/28/20 23:53		DL02402
Aroclor 1242	ND (0.06)		8082A		1	12/28/20 23:53		DL02402
Aroclor 1248	ND (0.06)		8082A		1	12/28/20 23:53		DL02402
Aroclor 1254	ND (0.06)		8082A		1	12/28/20 23:53		DL02402
Aroclor 1260	ND (0.06)		8082A		1	12/28/20 23:53		DL02402
Aroclor 1262	ND (0.06)		8082A		1	12/28/20 23:53		DL02402
Aroclor 1268	ND (0.06)		8082A		1	12/28/20 23:53		DL02402

	%Recovery	Qualifier	Limits
Surrogate: Decachlorobiphenyl	*84 %*		*30-150*
Surrogate: Decachlorobiphenyl [2C]	*77 %*		*30-150*
Surrogate: Tetrachloro-m-xylene	*80 %*		*30-150*
Surrogate: Tetrachloro-m-xylene [2C]	*81 %*		*30-150*

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 5.5-8.5ft
Date Sampled: 12/21/20 14:10
Percent Solids: 82
Initial Volume: 19.4
Final Volume: 1
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-07
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: AMF
Prepared: 12/22/20 22:00

8100M Total Petroleum Hydrocarbons

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Total Petroleum Hydrocarbons	ND (47.3)		8100M		1	12/25/20 2:37	D0L0485	DL02237

	%Recovery	Qualifier	Limits
Surrogate: O-Terphenyl	*99 %*		*40-140*

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 5.5-8.5ft
Date Sampled: 12/21/20 14:10
Percent Solids: 82
Initial Volume: 14.3
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-07
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/22/20 22:00

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,1-Biphenyl	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
1,2,4-Trichlorobenzene	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
1,2-Dichlorobenzene	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
1,3-Dichlorobenzene	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
1,4-Dichlorobenzene	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
2,3,4,6-Tetrachlorophenol	ND (2.14)		8270D		1	12/28/20 22:41	D0L0497	DL02238
2,4,5-Trichlorophenol	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
2,4,6-Trichlorophenol	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
2,4-Dichlorophenol	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
2,4-Dimethylphenol	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
2,4-Dinitrophenol	ND (2.14)		8270D		1	12/28/20 22:41	D0L0497	DL02238
2,4-Dinitrotoluene	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
2,6-Dinitrotoluene	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
2-Chloronaphthalene	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
2-Chlorophenol	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
2-Methylnaphthalene	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
2-Methylphenol	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
2-Nitroaniline	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
2-Nitrophenol	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
3,3´-Dichlorobenzidine	ND (0.856)		8270D		1	12/28/20 22:41	D0L0497	DL02238
3+4-Methylphenol	ND (0.856)		8270D		1	12/28/20 22:41	D0L0497	DL02238
3-Nitroaniline	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
4,6-Dinitro-2-Methylphenol	ND (2.14)		8270D		1	12/28/20 22:41	D0L0497	DL02238
4-Bromophenyl-phenylether	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
4-Chloro-3-Methylphenol	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
4-Chloroaniline	ND (0.856)		8270D		1	12/28/20 22:41	D0L0497	DL02238
4-Chloro-phenyl-phenyl ether	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
4-Nitroaniline	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
4-Nitrophenol	ND (2.14)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Acenaphthene	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Acenaphthylene	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Acetophenone	ND (0.856)		8270D		1	12/28/20 22:41	D0L0497	DL02238

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COASTAL RESOURCES MANAGEMENT COUNCIL

CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 5.5-8.5ft
Date Sampled: 12/21/20 14:10
Percent Solids: 82
Initial Volume: 14.3
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-07
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/22/20 22:00

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aniline	ND (0.856)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Anthracene	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Azobenzene	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Benzo(a)anthracene	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Benzo(a)pyrene	ND (0.214)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Benzo(b)fluoranthene	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Benzo(g,h,i)perylene	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Benzo(k)fluoranthene	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Benzoic Acid	ND (2.14)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Benzyl Alcohol	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
bis(2-Chloroethoxy)methane	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
bis(2-Chloroethyl)ether	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
bis(2-chloroisopropyl)Ether	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
bis(2-Ethylhexyl)phthalate	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Butylbenzylphthalate	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Carbazole	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Chrysene	ND (0.214)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Dibenzo(a,h)Anthracene	ND (0.214)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Dibenzofuran	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Diethylphthalate	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Dimethylphthalate	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Di-n-butylphthalate	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Di-n-octylphthalate	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Fluoranthene	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Fluorene	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Hexachlorobenzene	ND (0.214)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Hexachlorobutadiene	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Hexachlorocyclopentadiene	ND (2.14)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Hexachloroethane	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Indeno(1,2,3-cd)Pyrene	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Isophorone	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Naphthalene	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 5.5-8.5ft
Date Sampled: 12/21/20 14:10
Percent Solids: 82
Initial Volume: 14.3
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-07
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/22/20 22:00

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Nitrobenzene	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
N-Nitrosodimethylamine	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
N-Nitroso-Di-n-Propylamine	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
N-nitrosodiphenylamine	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Pentachlorophenol	ND (2.14)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Phenanthrene	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Phenol	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Pyrene	ND (0.427)		8270D		1	12/28/20 22:41	D0L0497	DL02238
Pyridine	ND (2.14)		8270D		1	12/28/20 22:41	D0L0497	DL02238

	%Recovery	Qualifier	Limits
Surrogate: 1,2-Dichlorobenzene-d4	*64 %*		*30-130*
Surrogate: 2,4,6-Tribromophenol	*82 %*		*30-130*
Surrogate: 2-Chlorophenol-d4	*69 %*		*30-130*
Surrogate: 2-Fluorobiphenyl	*71 %*		*30-130*
Surrogate: 2-Fluorophenol	*75 %*		*30-130*
Surrogate: Nitrobenzene-d5	*82 %*		*30-130*
Surrogate: Phenol-d6	*81 %*		*30-130*
Surrogate: p-Terphenyl-d14	*102 %*		*30-130*

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 5.5-8.5ft
Date Sampled: 12/21/20 14:10
Percent Solids: 82

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-07
Sample Matrix: Sediment

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Percent Moisture	**18** (1)		2540G		1	JMG	12/23/20 17:08	%	DL02316
Total Organic Carbon (Average)	**928** (97.1)		9060		1	CCP	12/28/20 16:09	mg/kg dry	[CALC]

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 5.5-8.5ft
Date Sampled: 12/21/20 14:10

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-07
Sample Matrix: Sediment

Subcontracted Analysis

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Grain Size	**See Attached** (N/A)								

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 5.5-8.5ft
Date Sampled: 12/21/20 14:10
Percent Solids: 82
Initial Volume: 100
Final Volume: 2000
Extraction Method: 1311

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-07
Sample Matrix: Sediment
Units: °C
Analyst: CCY
Prepared: 12/23/20 18:22

TCLP Extraction by 1311

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Batch
Temperature (Min C)	**23.2** (N/A)		1311		1	CCY	12/24/20 11:45	DL02349
Temperature (Max C)	**24.5** (N/A)		1311		1	CCY	12/24/20 11:45	DL02349
Temperature (Range)	**Temperature is within 23 +/-2 °C.** (N/A)							

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ESS Laboratory
Division of Thielsch Engineering, Inc.

BAL Laboratory
The Microbiology Division of Thielsch Engineering, Inc.

CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 8.5-13ft
Date Sampled: 12/21/20 14:20
Percent Solids: 81

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-08
Sample Matrix: Sediment
Units: mg/kg dry

Extraction Method: 3050B

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	**0.99** (0.92)		6010C		2	KJK	12/29/20 16:38	5.35	100	DL02838
Cadmium	ND (0.46)		6010C		2	KJK	12/29/20 16:38	5.35	100	DL02838
Chromium	**1.74** (0.92)		6010C		2	KJK	12/29/20 16:38	5.35	100	DL02838
Copper	**2.67** (2.31)		6010C		2	KJK	12/29/20 16:38	5.35	100	DL02838
Lead	ND (4.62)		6010C		2	KJK	12/29/20 16:38	5.35	100	DL02838
Mercury	ND (0.012)		7471B		1	MKS	12/29/20 10:55	2.11	40	DL02840
Nickel	ND (2.31)		6010C		2	KJK	12/29/20 16:38	5.35	100	DL02838
Zinc	**22.5** (2.31)		6010C		2	KJK	12/29/20 16:38	5.35	100	DL02838

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 8.5-13ft
Date Sampled: 12/21/20 14:20
Percent Solids: 81

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-08
Sample Matrix: Sediment
Units: mg/L

Extraction Method: 3005A TCLP

1311 TCLP Metals

Analyte	Results (MRL)	MDL	Method	TCLP Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:08	50	50	DL02346
Barium	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:08	50	50	DL02346
Cadmium	ND (0.0100)		1311/6010C		1	BJV	12/28/20 11:08	50	50	DL02346
Chromium	ND (0.020)		1311/6010C		1	BJV	12/28/20 11:08	50	50	DL02346
Lead	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:08	50	50	DL02346
Mercury	ND (0.00050)		1311/7470A		1	MKS	12/28/20 10:57	20	40	DL02347
Nickel	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:08	50	50	DL02346
Selenium	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:08	50	50	DL02346
Silver	ND (0.010)		1311/6010C		1	BJV	12/28/20 11:08	50	50	DL02346

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 8.5-13ft
Date Sampled: 12/21/20 14:20
Percent Solids: 81
Initial Volume: 20.2
Final Volume: 10
Extraction Method: 3540C

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-08
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: MJV
Prepared: 12/22/20 21:03

8082A Polychlorinated Biphenyls (PCB)

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aroclor 1016	ND (0.06)		8082A		1	12/23/20 16:24		DL02204
Aroclor 1221	ND (0.06)		8082A		1	12/23/20 16:24		DL02204
Aroclor 1232	ND (0.06)		8082A		1	12/23/20 16:24		DL02204
Aroclor 1242	ND (0.06)		8082A		1	12/23/20 16:24		DL02204
Aroclor 1248	ND (0.06)		8082A		1	12/23/20 16:24		DL02204
Aroclor 1254	ND (0.06)		8082A		1	12/23/20 16:24		DL02204
Aroclor 1260	ND (0.06)		8082A		1	12/23/20 16:24		DL02204
Aroclor 1262	ND (0.06)		8082A		1	12/23/20 16:24		DL02204
Aroclor 1268	ND (0.06)		8082A		1	12/23/20 16:24		DL02204

	%Recovery	Qualifier	Limits
Surrogate: Decachlorobiphenyl	*87 %*		*30-150*
Surrogate: Decachlorobiphenyl [2C]	*104 %*		*30-150*
Surrogate: Tetrachloro-m-xylene	*70 %*		*30-150*
Surrogate: Tetrachloro-m-xylene [2C]	*95 %*		*30-150*

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 8.5-13ft
Date Sampled: 12/21/20 14:20
Percent Solids: 81
Initial Volume: 19.4
Final Volume: 1
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-08
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: AMF
Prepared: 12/22/20 22:00

8100M Total Petroleum Hydrocarbons

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Total Petroleum Hydrocarbons	ND (47.7)		8100M		1	12/25/20 3:10	D0L0485	DL02237

	%Recovery	Qualifier	Limits
Surrogate: O-Terphenyl	*94 %*		*40-140*

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 8.5-13ft
Date Sampled: 12/21/20 14:20
Percent Solids: 81
Initial Volume: 15.5
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-08
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/22/20 22:00

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,1-Biphenyl	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
1,2,4-Trichlorobenzene	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
1,2-Dichlorobenzene	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
1,3-Dichlorobenzene	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
1,4-Dichlorobenzene	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
2,3,4,6-Tetrachlorophenol	ND (2.00)		8270D		1	12/28/20 23:10	D0L0497	DL02238
2,4,5-Trichlorophenol	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
2,4,6-Trichlorophenol	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
2,4-Dichlorophenol	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
2,4-Dimethylphenol	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
2,4-Dinitrophenol	ND (2.00)		8270D		1	12/28/20 23:10	D0L0497	DL02238
2,4-Dinitrotoluene	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
2,6-Dinitrotoluene	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
2-Chloronaphthalene	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
2-Chlorophenol	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
2-Methylnaphthalene	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
2-Methylphenol	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
2-Nitroaniline	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
2-Nitrophenol	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
3,3´-Dichlorobenzidine	ND (0.797)		8270D		1	12/28/20 23:10	D0L0497	DL02238
3+4-Methylphenol	ND (0.797)		8270D		1	12/28/20 23:10	D0L0497	DL02238
3-Nitroaniline	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
4,6-Dinitro-2-Methylphenol	ND (2.00)		8270D		1	12/28/20 23:10	D0L0497	DL02238
4-Bromophenyl-phenylether	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
4-Chloro-3-Methylphenol	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
4-Chloroaniline	ND (0.797)		8270D		1	12/28/20 23:10	D0L0497	DL02238
4-Chloro-phenyl-phenyl ether	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
4-Nitroaniline	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
4-Nitrophenol	ND (2.00)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Acenaphthene	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Acenaphthylene	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Acetophenone	ND (0.797)		8270D		1	12/28/20 23:10	D0L0497	DL02238

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COASTAL RESOURCES MANAGEMENT COUNCIL

CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 8.5-13ft
Date Sampled: 12/21/20 14:20
Percent Solids: 81
Initial Volume: 15.5
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-08
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/22/20 22:00

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aniline	ND (0.797)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Anthracene	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Azobenzene	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Benzo(a)anthracene	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Benzo(a)pyrene	ND (0.200)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Benzo(b)fluoranthene	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Benzo(g,h,i)perylene	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Benzo(k)fluoranthene	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Benzoic Acid	ND (2.00)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Benzyl Alcohol	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
bis(2-Chloroethoxy)methane	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
bis(2-Chloroethyl)ether	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
bis(2-chloroisopropyl)Ether	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
bis(2-Ethylhexyl)phthalate	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Butylbenzylphthalate	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Carbazole	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Chrysene	ND (0.200)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Dibenzo(a,h)Anthracene	ND (0.200)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Dibenzofuran	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Diethylphthalate	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Dimethylphthalate	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Di-n-butylphthalate	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Di-n-octylphthalate	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Fluoranthene	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Fluorene	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Hexachlorobenzene	ND (0.200)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Hexachlorobutadiene	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Hexachlorocyclopentadiene	ND (2.00)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Hexachloroethane	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Indeno(1,2,3-cd)Pyrene	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Isophorone	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Naphthalene	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238

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JULY 30, 2021
COASTAL RESOURCES MANAGEMENT COUNCIL

CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 8.5-13ft
Date Sampled: 12/21/20 14:20
Percent Solids: 81
Initial Volume: 15.5
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-08
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/22/20 22:00

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Nitrobenzene	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
N-Nitrosodimethylamine	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
N-Nitroso-Di-n-Propylamine	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
N-nitrosodiphenylamine	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Pentachlorophenol	ND (2.00)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Phenanthrene	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Phenol	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Pyrene	ND (0.398)		8270D		1	12/28/20 23:10	D0L0497	DL02238
Pyridine	ND (2.00)		8270D		1	12/28/20 23:10	D0L0497	DL02238

	%Recovery	Qualifier	Limits
Surrogate: 1,2-Dichlorobenzene-d4	*70 %*		*30-130*
Surrogate: 2,4,6-Tribromophenol	*82 %*		*30-130*
Surrogate: 2-Chlorophenol-d4	*72 %*		*30-130*
Surrogate: 2-Fluorobiphenyl	*74 %*		*30-130*
Surrogate: 2-Fluorophenol	*79 %*		*30-130*
Surrogate: Nitrobenzene-d5	*85 %*		*30-130*
Surrogate: Phenol-d6	*83 %*		*30-130*
Surrogate: p-Terphenyl-d14	*97 %*		*30-130*

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 8.5-13ft
Date Sampled: 12/21/20 14:20
Percent Solids: 81

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-08
Sample Matrix: Sediment

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Percent Moisture	**19** (1)		2540G		1	JMG	12/23/20 17:08	%	DL02316
Total Organic Carbon (Average)	ND (93.4)		9060		1	CCP	12/28/20 16:26	mg/kg dry	[CALC]

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 8.5-13ft
Date Sampled: 12/21/20 14:20

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-08
Sample Matrix: Sediment

Subcontracted Analysis

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Grain Size	**See Attached** (N/A)								

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 8.5-13ft
Date Sampled: 12/21/20 14:20
Percent Solids: 81
Initial Volume: 100
Final Volume: 2000
Extraction Method: 1311

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-08
Sample Matrix: Sediment
Units: °C
Analyst: CCY
Prepared: 12/23/20 18:22

TCLP Extraction by 1311

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Batch
Temperature (Min C)	**23.2** (N/A)		1311		1	CCY	12/24/20 11:45	DL02349
Temperature (Max C)	**24.5** (N/A)		1311		1	CCY	12/24/20 11:45	DL02349
Temperature (Range)	**Temperature is within 23 +/-2 °C.** (N/A)							

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ESS Laboratory
Division of Thielsch Engineering, Inc.

BAL Laboratory
The Microbiology Division of Thielsch Engineering, Inc.

CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 13-16ft
Date Sampled: 12/21/20 14:33
Percent Solids: 83

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-09
Sample Matrix: Sediment
Units: mg/kg dry

Extraction Method: 3050B

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	**1.38** (0.85)		6010C		2	KJK	12/29/20 16:40	5.7	100	DL02838
Cadmium	ND (0.42)		6010C		2	KJK	12/29/20 16:40	5.7	100	DL02838
Chromium	**3.62** (0.85)		6010C		2	KJK	12/29/20 16:40	5.7	100	DL02838
Copper	**4.23** (2.12)		6010C		2	KJK	12/29/20 16:40	5.7	100	DL02838
Lead	ND (4.25)		6010C		2	KJK	12/29/20 16:40	5.7	100	DL02838
Mercury	ND (0.012)		7471B		1	MKS	12/29/20 10:58	2.05	40	DL02840
Nickel	**4.00** (2.12)		6010C		2	KJK	12/29/20 16:40	5.7	100	DL02838
Zinc	**27.6** (2.12)		6010C		2	KJK	12/29/20 16:40	5.7	100	DL02838

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 13-16ft
Date Sampled: 12/21/20 14:33
Percent Solids: 83

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-09
Sample Matrix: Sediment
Units: mg/L

Extraction Method: 3005A TCLP

1311 TCLP Metals

Analyte	Results (MRL)	MDL	Method	TCLP Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:11	50	50	DL02346
Barium	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:11	50	50	DL02346
Cadmium	ND (0.0100)		1311/6010C		1	BJV	12/28/20 11:11	50	50	DL02346
Chromium	ND (0.020)		1311/6010C		1	BJV	12/28/20 11:11	50	50	DL02346
Lead	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:11	50	50	DL02346
Mercury	ND (0.00050)		1311/7470A		1	MKS	12/28/20 11:04	20	40	DL02347
Nickel	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:11	50	50	DL02346
Selenium	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:11	50	50	DL02346
Silver	ND (0.010)		1311/6010C		1	BJV	12/28/20 11:11	50	50	DL02346

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 13-16ft
Date Sampled: 12/21/20 14:33
Percent Solids: 83
Initial Volume: 20.7
Final Volume: 10
Extraction Method: 3540C

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-09
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: MJV
Prepared: 12/22/20 21:03

8082A Polychlorinated Biphenyls (PCB)

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aroclor 1016	ND (0.06)		8082A		1	12/23/20 16:44		DL02204
Aroclor 1221	ND (0.06)		8082A		1	12/23/20 16:44		DL02204
Aroclor 1232	ND (0.06)		8082A		1	12/23/20 16:44		DL02204
Aroclor 1242	ND (0.06)		8082A		1	12/23/20 16:44		DL02204
Aroclor 1248	ND (0.06)		8082A		1	12/23/20 16:44		DL02204
Aroclor 1254	ND (0.06)		8082A		1	12/23/20 16:44		DL02204
Aroclor 1260	ND (0.06)		8082A		1	12/23/20 16:44		DL02204
Aroclor 1262	ND (0.06)		8082A		1	12/23/20 16:44		DL02204
Aroclor 1268	ND (0.06)		8082A		1	12/23/20 16:44		DL02204

	%Recovery	Qualifier	Limits
Surrogate: Decachlorobiphenyl	*89 %*		*30-150*
Surrogate: Decachlorobiphenyl [2C]	*108 %*		*30-150*
Surrogate: Tetrachloro-m-xylene	*70 %*		*30-150*
Surrogate: Tetrachloro-m-xylene [2C]	*96 %*		*30-150*

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 13-16ft
Date Sampled: 12/21/20 14:33
Percent Solids: 83
Initial Volume: 19.7
Final Volume: 1
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-09
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: AMF
Prepared: 12/22/20 22:00

8100M Total Petroleum Hydrocarbons

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Total Petroleum Hydrocarbons	ND (46.1)		8100M		1	12/25/20 3:43	D0L0485	DL02237

	%Recovery	Qualifier	Limits
Surrogate: O-Terphenyl	*94 %*		*40-140*

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 13-16ft
Date Sampled: 12/21/20 14:33
Percent Solids: 83
Initial Volume: 15
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-09
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/22/20 22:00

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,1-Biphenyl	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
1,2,4-Trichlorobenzene	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
1,2-Dichlorobenzene	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
1,3-Dichlorobenzene	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
1,4-Dichlorobenzene	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
2,3,4,6-Tetrachlorophenol	ND (2.02)		8270D		1	12/28/20 23:39	D0L0497	DL02238
2,4,5-Trichlorophenol	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
2,4,6-Trichlorophenol	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
2,4-Dichlorophenol	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
2,4-Dimethylphenol	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
2,4-Dinitrophenol	ND (2.02)		8270D		1	12/28/20 23:39	D0L0497	DL02238
2,4-Dinitrotoluene	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
2,6-Dinitrotoluene	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
2-Chloronaphthalene	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
2-Chlorophenol	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
2-Methylnaphthalene	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
2-Methylphenol	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
2-Nitroaniline	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
2-Nitrophenol	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
3,3´-Dichlorobenzidine	ND (0.808)		8270D		1	12/28/20 23:39	D0L0497	DL02238
3+4-Methylphenol	ND (0.808)		8270D		1	12/28/20 23:39	D0L0497	DL02238
3-Nitroaniline	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
4,6-Dinitro-2-Methylphenol	ND (2.02)		8270D		1	12/28/20 23:39	D0L0497	DL02238
4-Bromophenyl-phenylether	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
4-Chloro-3-Methylphenol	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
4-Chloroaniline	ND (0.808)		8270D		1	12/28/20 23:39	D0L0497	DL02238
4-Chloro-phenyl-phenyl ether	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
4-Nitroaniline	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
4-Nitrophenol	ND (2.02)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Acenaphthene	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Acenaphthylene	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Acetophenone	ND (0.808)		8270D		1	12/28/20 23:39	D0L0497	DL02238

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 13-16ft
Date Sampled: 12/21/20 14:33
Percent Solids: 83
Initial Volume: 15
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-09
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/22/20 22:00

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aniline	ND (0.808)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Anthracene	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Azobenzene	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Benzo(a)anthracene	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Benzo(a)pyrene	ND (0.202)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Benzo(b)fluoranthene	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Benzo(g,h,i)perylene	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Benzo(k)fluoranthene	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Benzoic Acid	ND (2.02)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Benzyl Alcohol	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
bis(2-Chloroethoxy)methane	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
bis(2-Chloroethyl)ether	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
bis(2-chloroisopropyl)Ether	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
bis(2-Ethylhexyl)phthalate	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Butylbenzylphthalate	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Carbazole	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Chrysene	ND (0.202)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Dibenzo(a,h)Anthracene	ND (0.202)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Dibenzofuran	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Diethylphthalate	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Dimethylphthalate	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Di-n-butylphthalate	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Di-n-octylphthalate	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Fluoranthene	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Fluorene	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Hexachlorobenzene	ND (0.202)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Hexachlorobutadiene	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Hexachlorocyclopentadiene	ND (2.02)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Hexachloroethane	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Indeno(1,2,3-cd)Pyrene	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Isophorone	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Naphthalene	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238

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COASTAL RESOURCES MANAGEMENT COUNCIL

CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 13-16ft
Date Sampled: 12/21/20 14:33
Percent Solids: 83
Initial Volume: 15
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-09
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/22/20 22:00

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Nitrobenzene	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
N-Nitrosodimethylamine	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
N-Nitroso-Di-n-Propylamine	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
N-nitrosodiphenylamine	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Pentachlorophenol	ND (2.02)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Phenanthrene	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Phenol	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Pyrene	ND (0.403)		8270D		1	12/28/20 23:39	D0L0497	DL02238
Pyridine	ND (2.02)		8270D		1	12/28/20 23:39	D0L0497	DL02238

	%Recovery	Qualifier	Limits
Surrogate: 1,2-Dichlorobenzene-d4	*64 %*		*30-130*
Surrogate: 2,4,6-Tribromophenol	*84 %*		*30-130*
Surrogate: 2-Chlorophenol-d4	*66 %*		*30-130*
Surrogate: 2-Fluorobiphenyl	*73 %*		*30-130*
Surrogate: 2-Fluorophenol	*73 %*		*30-130*
Surrogate: Nitrobenzene-d5	*84 %*		*30-130*
Surrogate: Phenol-d6	*78 %*		*30-130*
Surrogate: p-Terphenyl-d14	*90 %*		*30-130*

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 13-16ft
Date Sampled: 12/21/20 14:33
Percent Solids: 83

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-09
Sample Matrix: Sediment

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Percent Moisture	**17** (1)		2540G		1	JMG	12/23/20 17:08	%	DL02316
Total Organic Carbon (Average)	ND (98.9)		9060		1	CCP	12/28/20 16:42	mg/kg dry	[CALC]

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COASTAL RESOURCES MANAGEMENT COUNCIL

CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 13-16ft
Date Sampled: 12/21/20 14:33

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-09
Sample Matrix: Sediment

Subcontracted Analysis

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Grain Size	**See Attached** (N/A)								

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COASTAL RESOURCES MANAGEMENT COUNCIL

CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-02 13-16ft
Date Sampled: 12/21/20 14:33
Percent Solids: 83
Initial Volume: 100
Final Volume: 2000
Extraction Method: 1311

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-09
Sample Matrix: Sediment
Units: °C
Analyst: CCY
Prepared: 12/23/20 18:22

TCLP Extraction by 1311

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Batch
Temperature (Min C)	**23.2** (N/A)		1311		1	CCY	12/24/20 11:45	DL02349
Temperature (Max C)	**24.5** (N/A)		1311		1	CCY	12/24/20 11:45	DL02349
Temperature (Range)	**Temperature is within 23 +/-2 °C.** (N/A)							

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COASTAL RESOURCES MANAGEMENT COUNCIL

CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-05 0-2.5ft
Date Sampled: 12/21/20 15:22
Percent Solids: 73

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-10
Sample Matrix: Sediment
Units: mg/kg dry

Extraction Method: 3050B

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	**2.25** (0.53)		6010C		1	KJK	12/29/20 14:33	5.23	100	DL02838
Cadmium	ND (0.26)		6010C		1	KJK	12/29/20 14:33	5.23	100	DL02838
Chromium	**12.7** (0.53)		6010C		1	KJK	12/29/20 14:33	5.23	100	DL02838
Copper	**14.5** (1.32)		6010C		1	KJK	12/29/20 14:33	5.23	100	DL02838
Lead	**10.9** (2.63)		6010C		1	KJK	12/29/20 14:33	5.23	100	DL02838
Mercury	**0.088** (0.013)		7471B		1	MKS	12/29/20 11:00	2.12	40	DL02840
Nickel	**5.24** (1.32)		6010C		1	KJK	12/29/20 14:33	5.23	100	DL02838
Zinc	**35.9** (1.32)		6010C		1	KJK	12/29/20 14:33	5.23	100	DL02838

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-05 0-2.5ft
Date Sampled: 12/21/20 15:22
Percent Solids: 73

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-10
Sample Matrix: Sediment
Units: mg/L

Extraction Method: 3005A TCLP

1311 TCLP Metals

Analyte	Results (MRL)	MDL	Method	TCLP Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:16	50	50	DL02346
Barium	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:16	50	50	DL02346
Cadmium	ND (0.0100)		1311/6010C		1	BJV	12/28/20 11:16	50	50	DL02346
Chromium	ND (0.020)		1311/6010C		1	BJV	12/28/20 11:16	50	50	DL02346
Lead	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:16	50	50	DL02346
Mercury	ND (0.00050)		1311/7470A		1	MKS	12/28/20 11:06	20	40	DL02347
Nickel	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:16	50	50	DL02346
Selenium	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:16	50	50	DL02346
Silver	ND (0.010)		1311/6010C		1	BJV	12/28/20 11:16	50	50	DL02346

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-05 0-2.5ft
Date Sampled: 12/21/20 15:22
Percent Solids: 73
Initial Volume: 20.5
Final Volume: 10
Extraction Method: 3540C

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-10
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: MJV
Prepared: 12/22/20 21:03

8082A Polychlorinated Biphenyls (PCB)

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aroclor 1016	ND (0.07)		8082A		1	12/23/20 17:04		DL02204
Aroclor 1221	ND (0.07)		8082A		1	12/23/20 17:04		DL02204
Aroclor 1232	ND (0.07)		8082A		1	12/23/20 17:04		DL02204
Aroclor 1242	ND (0.07)		8082A		1	12/23/20 17:04		DL02204
Aroclor 1248	ND (0.07)		8082A		1	12/23/20 17:04		DL02204
Aroclor 1254	ND (0.07)		8082A		1	12/23/20 17:04		DL02204
Aroclor 1260	ND (0.07)		8082A		1	12/23/20 17:04		DL02204
Aroclor 1262	ND (0.07)		8082A		1	12/23/20 17:04		DL02204
Aroclor 1268	ND (0.07)		8082A		1	12/23/20 17:04		DL02204

	%Recovery	Qualifier	Limits
Surrogate: Decachlorobiphenyl	*86 %*		*30-150*
Surrogate: Decachlorobiphenyl [2C]	*106 %*		*30-150*
Surrogate: Tetrachloro-m-xylene	*70 %*		*30-150*
Surrogate: Tetrachloro-m-xylene [2C]	*95 %*		*30-150*

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-05 0-2.5ft
Date Sampled: 12/21/20 15:22
Percent Solids: 73
Initial Volume: 19.2
Final Volume: 1
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-10
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: AMF
Prepared: 12/22/20 22:00

8100M Total Petroleum Hydrocarbons

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Total Petroleum Hydrocarbons	ND (53.8)		8100M		1	12/25/20 4:16	D0L0485	DL02237

	%Recovery	Qualifier	Limits
Surrogate: O-Terphenyl	*88 %*		*40-140*

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-05 0-2.5ft
Date Sampled: 12/21/20 15:22
Percent Solids: 73
Initial Volume: 15.1
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-10
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/22/20 22:00

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,1-Biphenyl	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
1,2,4-Trichlorobenzene	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
1,2-Dichlorobenzene	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
1,3-Dichlorobenzene	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
1,4-Dichlorobenzene	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
2,3,4,6-Tetrachlorophenol	ND (2.28)		8270D		1	12/29/20 0:08	D0L0497	DL02238
2,4,5-Trichlorophenol	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
2,4,6-Trichlorophenol	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
2,4-Dichlorophenol	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
2,4-Dimethylphenol	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
2,4-Dinitrophenol	ND (2.28)		8270D		1	12/29/20 0:08	D0L0497	DL02238
2,4-Dinitrotoluene	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
2,6-Dinitrotoluene	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
2-Chloronaphthalene	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
2-Chlorophenol	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
2-Methylnaphthalene	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
2-Methylphenol	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
2-Nitroaniline	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
2-Nitrophenol	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
3,3´-Dichlorobenzidine	ND (0.912)		8270D		1	12/29/20 0:08	D0L0497	DL02238
3+4-Methylphenol	ND (0.912)		8270D		1	12/29/20 0:08	D0L0497	DL02238
3-Nitroaniline	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
4,6-Dinitro-2-Methylphenol	ND (2.28)		8270D		1	12/29/20 0:08	D0L0497	DL02238
4-Bromophenyl-phenylether	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
4-Chloro-3-Methylphenol	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
4-Chloroaniline	ND (0.912)		8270D		1	12/29/20 0:08	D0L0497	DL02238
4-Chloro-phenyl-phenyl ether	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
4-Nitroaniline	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
4-Nitrophenol	ND (2.28)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Acenaphthene	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Acenaphthylene	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Acetophenone	ND (0.912)		8270D		1	12/29/20 0:08	D0L0497	DL02238

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-05 0-2.5ft
Date Sampled: 12/21/20 15:22
Percent Solids: 73
Initial Volume: 15.1
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-10
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/22/20 22:00

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aniline	ND (0.912)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Anthracene	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Azobenzene	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Benzo(a)anthracene	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Benzo(a)pyrene	ND (0.228)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Benzo(b)fluoranthene	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Benzo(g,h,i)perylene	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Benzo(k)fluoranthene	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Benzoic Acid	ND (2.28)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Benzyl Alcohol	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
bis(2-Chloroethoxy)methane	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
bis(2-Chloroethyl)ether	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
bis(2-chloroisopropyl)Ether	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
bis(2-Ethylhexyl)phthalate	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Butylbenzylphthalate	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Carbazole	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Chrysene	ND (0.228)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Dibenzo(a,h)Anthracene	ND (0.228)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Dibenzofuran	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Diethylphthalate	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Dimethylphthalate	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Di-n-butylphthalate	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Di-n-octylphthalate	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Fluoranthene	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Fluorene	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Hexachlorobenzene	ND (0.228)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Hexachlorobutadiene	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Hexachlorocyclopentadiene	ND (2.28)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Hexachloroethane	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Indeno(1,2,3-cd)Pyrene	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Isophorone	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Naphthalene	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-05 0-2.5ft
Date Sampled: 12/21/20 15:22
Percent Solids: 73
Initial Volume: 15.1
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-10
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/22/20 22:00

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Nitrobenzene	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
N-Nitrosodimethylamine	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
N-Nitroso-Di-n-Propylamine	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
N-nitrosodiphenylamine	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Pentachlorophenol	ND (2.28)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Phenanthrene	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Phenol	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Pyrene	ND (0.455)		8270D		1	12/29/20 0:08	D0L0497	DL02238
Pyridine	ND (2.28)		8270D		1	12/29/20 0:08	D0L0497	DL02238

	%Recovery	Qualifier	Limits
Surrogate: 1,2-Dichlorobenzene-d4	*61 %*		*30-130*
Surrogate: 2,4,6-Tribromophenol	*70 %*		*30-130*
Surrogate: 2-Chlorophenol-d4	*60 %*		*30-130*
Surrogate: 2-Fluorobiphenyl	*66 %*		*30-130*
Surrogate: 2-Fluorophenol	*65 %*		*30-130*
Surrogate: Nitrobenzene-d5	*77 %*		*30-130*
Surrogate: Phenol-d6	*70 %*		*30-130*
Surrogate: p-Terphenyl-d14	*86 %*		*30-130*

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Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-05 0-2.5ft
Date Sampled: 12/21/20 15:22
Percent Solids: 73

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-10
Sample Matrix: Sediment

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Percent Moisture	**27** (1)		2540G		1	JMG	12/23/20 17:08	%	DL02316
Total Organic Carbon (Average)	ND (93.9)		9060		1	CCP	12/28/20 17:32	mg/kg dry	[CALC]

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-05 0-2.5ft
Date Sampled: 12/21/20 15:22

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-10
Sample Matrix: Sediment

Subcontracted Analysis

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Grain Size	**See Attached** (N/A)								

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: Rev01-ENV-05 0-2.5ft
Date Sampled: 12/21/20 15:22
Percent Solids: 73
Initial Volume: 100
Final Volume: 2000
Extraction Method: 1311

ESS Laboratory Work Order: 20L0755
ESS Laboratory Sample ID: 20L0755-10
Sample Matrix: Sediment
Units: °C
Analyst: CCY
Prepared: 12/23/20 18:22

TCLP Extraction by 1311

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Batch
Temperature (Min C)	**23.2** (N/A)		1311		1	CCY	12/24/20 11:45	DL02349
Temperature (Max C)	**24.5** (N/A)		1311		1	CCY	12/24/20 11:45	DL02349
Temperature (Range)	**Temperature is within 23 +/-2 °C.** (N/A)							

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind

ESS Laboratory Work Order: 20L0755

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Total Metals										
Batch DL02838 - 3050B										
Blank										
Arsenic	ND	1.00	mg/kg wet							
Cadmium	ND	0.50	mg/kg wet							
Chromium	ND	1.00	mg/kg wet							
Copper	ND	2.50	mg/kg wet							
Lead	ND	5.00	mg/kg wet							
Nickel	ND	2.50	mg/kg wet							
Zinc	ND	2.50	mg/kg wet							
LCS										
Arsenic	40.0	3.28	mg/kg wet	43.10		93	80-120			
Cadmium	116	1.64	mg/kg wet	118.0		98	80-120			
Chromium	309	3.28	mg/kg wet	299.0		103	80-120			
Copper	340	8.20	mg/kg wet	330.0		103	80-120			
Lead	155	16.4	mg/kg wet	144.0		107	80-120			
Nickel	180	8.20	mg/kg wet	171.0		105	80-120			
Zinc	864	8.20	mg/kg wet	874.0		99	80-120			
LCS Dup										
Arsenic	40.6	3.28	mg/kg wet	43.10		94	80-120	2	20	
Cadmium	116	1.64	mg/kg wet	118.0		98	80-120	0.06	20	
Chromium	307	3.28	mg/kg wet	299.0		103	80-120	0.4	20	
Copper	342	8.20	mg/kg wet	330.0		104	80-120	0.7	20	
Lead	150	16.4	mg/kg wet	144.0		104	80-120	3	20	
Nickel	179	8.20	mg/kg wet	171.0		104	80-120	0.8	20	
Zinc	855	8.20	mg/kg wet	874.0		98	80-120	1	20	
Batch DL02840 - 3050B										
Blank										
Mercury	ND	0.033	mg/kg wet							
LCS										
Mercury	27.1	3.25	mg/kg wet	27.90		97	80-120			
LCS Dup										
Mercury	28.4	3.25	mg/kg wet	27.90		102	80-120	5	20	
Reference										
Mercury	1.04	0.230	mg/kg wet	1.000		104	0-200			
1311 TCLP Metals										
Batch DL02346 - 3005A_TCLP										
Blank										
Arsenic	ND	0.050	mg/L							
Barium	ND	0.050	mg/L							
Cadmium	ND	0.0100	mg/L							
Chromium	ND	0.020	mg/L							
Lead	ND	0.050	mg/L							
Nickel	ND	0.050	mg/L							

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind

ESS Laboratory Work Order: 20L0755

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
1311 TCLP Metals										
Batch DL02346 - 3005A_TCLP										
Selenium	ND	0.050	mg/L							
Silver	ND	0.010	mg/L							
LCS										
Arsenic	0.483	0.050	mg/L	0.5000		97	80-120			
Barium	0.471	0.050	mg/L	0.5000		94	80-120			
Cadmium	0.235	0.0100	mg/L	0.2500		94	80-120			
Chromium	0.462	0.020	mg/L	0.5000		92	80-120			
Lead	0.459	0.050	mg/L	0.5000		92	80-120			
Nickel	0.457	0.050	mg/L	0.5000		91	80-120			
Selenium	1.00	0.050	mg/L	1.000		100	80-120			
Silver	0.247	0.010	mg/L	0.2500		99	80-120			
LCS Dup										
Arsenic	0.494	0.050	mg/L	0.5000		99	80-120	2	20	
Barium	0.481	0.050	mg/L	0.5000		96	80-120	2	20	
Cadmium	0.240	0.0100	mg/L	0.2500		96	80-120	2	20	
Chromium	0.474	0.020	mg/L	0.5000		95	80-120	3	20	
Lead	0.468	0.050	mg/L	0.5000		94	80-120	2	20	
Nickel	0.469	0.050	mg/L	0.5000		94	80-120	3	20	
Selenium	1.01	0.050	mg/L	1.000		101	80-120	0.9	20	
Silver	0.252	0.010	mg/L	0.2500		101	80-120	2	20	
Batch DL02347 - 245.1/7470A										
Blank										
Mercury	ND	0.00050	mg/L							
Blank										
Mercury	ND	0.00050	mg/L							
LCS										
Mercury	0.00523	0.00050	mg/L	0.006042		87	80-120			
LCS Dup										
Mercury	0.00547	0.00050	mg/L	0.006042		90	80-120	4	20	
8082A Polychlorinated Biphenyls (PCB)										
Batch DL02203 - 3540C										
Blank										
Aroclor 1016	ND	0.02	mg/kg wet							
Aroclor 1016 [2C]	ND	0.02	mg/kg wet							
Aroclor 1221	ND	0.02	mg/kg wet							
Aroclor 1221 [2C]	ND	0.02	mg/kg wet							
Aroclor 1232	ND	0.02	mg/kg wet							
Aroclor 1232 [2C]	ND	0.02	mg/kg wet							
Aroclor 1242	ND	0.02	mg/kg wet							
Aroclor 1242 [2C]	ND	0.02	mg/kg wet							
Aroclor 1248	ND	0.02	mg/kg wet							
Aroclor 1248 [2C]	ND	0.02	mg/kg wet							

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind

ESS Laboratory Work Order: 20L0755

Quality Control Data

8082A Polychlorinated Biphenyls (PCB)

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Batch DL02203 - 3540C										
Aroclor 1254	ND	0.02	mg/kg wet							
Aroclor 1254 [2C]	ND	0.02	mg/kg wet							
Aroclor 1260	ND	0.02	mg/kg wet							
Aroclor 1260 [2C]	ND	0.02	mg/kg wet							
Aroclor 1262	ND	0.02	mg/kg wet							
Aroclor 1262 [2C]	ND	0.02	mg/kg wet							
Aroclor 1268	ND	0.02	mg/kg wet							
Aroclor 1268 [2C]	ND	0.02	mg/kg wet							
Surrogate: Decachlorobiphenyl	*0.0245*		mg/kg wet	*0.02500*		*98*	*30-150*			
Surrogate: Decachlorobiphenyl [2C]	*0.0220*		mg/kg wet	*0.02500*		*88*	*30-150*			
Surrogate: Tetrachloro-m-xylene	*0.0184*		mg/kg wet	*0.02500*		*74*	*30-150*			
Surrogate: Tetrachloro-m-xylene [2C]	*0.0197*		mg/kg wet	*0.02500*		*79*	*30-150*			
LCS										
Aroclor 1016	0.4	0.02	mg/kg wet	0.5000		88	40-140			
Aroclor 1016 [2C]	0.5	0.02	mg/kg wet	0.5000		91	40-140			
Aroclor 1260	0.5	0.02	mg/kg wet	0.5000		100	40-140			
Aroclor 1260 [2C]	0.5	0.02	mg/kg wet	0.5000		92	40-140			
Surrogate: Decachlorobiphenyl	*0.0242*		mg/kg wet	*0.02500*		*97*	*30-150*			
Surrogate: Decachlorobiphenyl [2C]	*0.0219*		mg/kg wet	*0.02500*		*88*	*30-150*			
Surrogate: Tetrachloro-m-xylene	*0.0200*		mg/kg wet	*0.02500*		*80*	*30-150*			
Surrogate: Tetrachloro-m-xylene [2C]	*0.0197*		mg/kg wet	*0.02500*		*79*	*30-150*			
LCS Dup										
Aroclor 1016	0.4	0.02	mg/kg wet	0.5000		89	40-140	0.9	30	
Aroclor 1016 [2C]	0.5	0.02	mg/kg wet	0.5000		95	40-140	4	30	
Aroclor 1260	0.5	0.02	mg/kg wet	0.5000		103	40-140	2	30	
Aroclor 1260 [2C]	0.5	0.02	mg/kg wet	0.5000		97	40-140	5	30	
Surrogate: Decachlorobiphenyl	*0.0249*		mg/kg wet	*0.02500*		*100*	*30-150*			
Surrogate: Decachlorobiphenyl [2C]	*0.0234*		mg/kg wet	*0.02500*		*94*	*30-150*			
Surrogate: Tetrachloro-m-xylene	*0.0199*		mg/kg wet	*0.02500*		*80*	*30-150*			
Surrogate: Tetrachloro-m-xylene [2C]	*0.0204*		mg/kg wet	*0.02500*		*82*	*30-150*			
Batch DL02204 - 3540C										
Blank										
Aroclor 1016	ND	0.02	mg/kg wet							
Aroclor 1016 [2C]	ND	0.02	mg/kg wet							
Aroclor 1221	ND	0.02	mg/kg wet							
Aroclor 1221 [2C]	ND	0.02	mg/kg wet							
Aroclor 1232	ND	0.02	mg/kg wet							
Aroclor 1232 [2C]	ND	0.02	mg/kg wet							
Aroclor 1242	ND	0.02	mg/kg wet							
Aroclor 1242 [2C]	ND	0.02	mg/kg wet							
Aroclor 1248	ND	0.02	mg/kg wet							
Aroclor 1248 [2C]	ND	0.02	mg/kg wet							

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Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8082A Polychlorinated Biphenyls (PCB)										
Batch DL02204 - 3540C										
Aroclor 1254	ND	0.02	mg/kg wet							
Aroclor 1254 [2C]	ND	0.02	mg/kg wet							
Aroclor 1260	ND	0.02	mg/kg wet							
Aroclor 1260 [2C]	ND	0.02	mg/kg wet							
Aroclor 1262	ND	0.02	mg/kg wet							
Aroclor 1262 [2C]	ND	0.02	mg/kg wet							
Aroclor 1268	ND	0.02	mg/kg wet							
Aroclor 1268 [2C]	ND	0.02	mg/kg wet							
Surrogate: Decachlorobiphenyl	*0.0204*		mg/kg wet	*0.02500*		*82*	*30-150*			
Surrogate: Decachlorobiphenyl [2C]	*0.0245*		mg/kg wet	*0.02500*		*98*	*30-150*			
Surrogate: Tetrachloro-m-xylene	*0.0157*		mg/kg wet	*0.02500*		*63*	*30-150*			
Surrogate: Tetrachloro-m-xylene [2C]	*0.0214*		mg/kg wet	*0.02500*		*86*	*30-150*			
LCS										
Aroclor 1016	0.4	0.02	mg/kg wet	0.5000		79	40-140			
Aroclor 1016 [2C]	0.5	0.02	mg/kg wet	0.5000		95	40-140			
Aroclor 1260	0.4	0.02	mg/kg wet	0.5000		85	40-140			
Aroclor 1260 [2C]	0.5	0.02	mg/kg wet	0.5000		99	40-140			
Surrogate: Decachlorobiphenyl	*0.0212*		mg/kg wet	*0.02500*		*85*	*30-150*			
Surrogate: Decachlorobiphenyl [2C]	*0.0258*		mg/kg wet	*0.02500*		*103*	*30-150*			
Surrogate: Tetrachloro-m-xylene	*0.0173*		mg/kg wet	*0.02500*		*69*	*30-150*			
Surrogate: Tetrachloro-m-xylene [2C]	*0.0215*		mg/kg wet	*0.02500*		*86*	*30-150*			
LCS Dup										
Aroclor 1016	0.4	0.02	mg/kg wet	0.5000		81	40-140	2	30	
Aroclor 1016 [2C]	0.5	0.02	mg/kg wet	0.5000		98	40-140	3	30	
Aroclor 1260	0.4	0.02	mg/kg wet	0.5000		86	40-140	2	30	
Aroclor 1260 [2C]	0.5	0.02	mg/kg wet	0.5000		102	40-140	3	30	
Surrogate: Decachlorobiphenyl	*0.0215*		mg/kg wet	*0.02500*		*86*	*30-150*			
Surrogate: Decachlorobiphenyl [2C]	*0.0260*		mg/kg wet	*0.02500*		*104*	*30-150*			
Surrogate: Tetrachloro-m-xylene	*0.0173*		mg/kg wet	*0.02500*		*69*	*30-150*			
Surrogate: Tetrachloro-m-xylene [2C]	*0.0216*		mg/kg wet	*0.02500*		*86*	*30-150*			
Batch DL02402 - 3540C										
Blank										
Aroclor 1016	ND	0.02	mg/kg wet							
Aroclor 1016 [2C]	ND	0.02	mg/kg wet							
Aroclor 1221	ND	0.02	mg/kg wet							
Aroclor 1221 [2C]	ND	0.02	mg/kg wet							
Aroclor 1232	ND	0.02	mg/kg wet							
Aroclor 1232 [2C]	ND	0.02	mg/kg wet							
Aroclor 1242	ND	0.02	mg/kg wet							
Aroclor 1242 [2C]	ND	0.02	mg/kg wet							
Aroclor 1248	ND	0.02	mg/kg wet							
Aroclor 1248 [2C]	ND	0.02	mg/kg wet							

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Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8082A Polychlorinated Biphenyls (PCB)										
Batch DL02402 - 3540C										
Aroclor 1254	ND	0.02	mg/kg wet							
Aroclor 1254 [2C]	ND	0.02	mg/kg wet							
Aroclor 1260	ND	0.02	mg/kg wet							
Aroclor 1260 [2C]	ND	0.02	mg/kg wet							
Aroclor 1262	ND	0.02	mg/kg wet							
Aroclor 1262 [2C]	ND	0.02	mg/kg wet							
Aroclor 1268	ND	0.02	mg/kg wet							
Aroclor 1268 [2C]	ND	0.02	mg/kg wet							
Surrogate: Decachlorobiphenyl	*0.0218*		mg/kg wet	*0.02500*		*87*	*30-150*			
Surrogate: Decachlorobiphenyl [2C]	*0.0226*		mg/kg wet	*0.02500*		*91*	*30-150*			
Surrogate: Tetrachloro-m-xylene	*0.0180*		mg/kg wet	*0.02500*		*72*	*30-150*			
Surrogate: Tetrachloro-m-xylene [2C]	*0.0191*		mg/kg wet	*0.02500*		*77*	*30-150*			
LCS										
Aroclor 1016	0.5	0.02	mg/kg wet	0.5000		96	40-140			
Aroclor 1016 [2C]	0.5	0.02	mg/kg wet	0.5000		101	40-140			
Aroclor 1260	0.5	0.02	mg/kg wet	0.5000		91	40-140			
Aroclor 1260 [2C]	0.5	0.02	mg/kg wet	0.5000		91	40-140			
Surrogate: Decachlorobiphenyl	*0.0216*		mg/kg wet	*0.02500*		*86*	*30-150*			
Surrogate: Decachlorobiphenyl [2C]	*0.0210*		mg/kg wet	*0.02500*		*84*	*30-150*			
Surrogate: Tetrachloro-m-xylene	*0.0192*		mg/kg wet	*0.02500*		*77*	*30-150*			
Surrogate: Tetrachloro-m-xylene [2C]	*0.0196*		mg/kg wet	*0.02500*		*78*	*30-150*			
LCS Dup										
Aroclor 1016	0.4	0.02	mg/kg wet	0.5000		86	40-140	10	30	
Aroclor 1016 [2C]	0.5	0.02	mg/kg wet	0.5000		95	40-140	7	30	
Aroclor 1260	0.4	0.02	mg/kg wet	0.5000		83	40-140	9	30	
Aroclor 1260 [2C]	0.4	0.02	mg/kg wet	0.5000		84	40-140	8	30	
Surrogate: Decachlorobiphenyl	*0.0191*		mg/kg wet	*0.02500*		*76*	*30-150*			
Surrogate: Decachlorobiphenyl [2C]	*0.0192*		mg/kg wet	*0.02500*		*77*	*30-150*			
Surrogate: Tetrachloro-m-xylene	*0.0164*		mg/kg wet	*0.02500*		*66*	*30-150*			
Surrogate: Tetrachloro-m-xylene [2C]	*0.0176*		mg/kg wet	*0.02500*		*70*	*30-150*			
8100M Total Petroleum Hydrocarbons										
Batch DL02237 - 3546										
Blank										
Decane (C10)	ND	0.2	mg/kg wet							
Docosane (C22)	ND	0.2	mg/kg wet							
Dodecane (C12)	ND	0.2	mg/kg wet							
Eicosane (C20)	ND	0.2	mg/kg wet							
Hexacosane (C26)	ND	0.2	mg/kg wet							
Hexadecane (C16)	ND	0.2	mg/kg wet							
Nonadecane (C19)	ND	0.2	mg/kg wet							
Nonane (C9)	ND	0.2	mg/kg wet							

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Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8100M Total Petroleum Hydrocarbons										
Batch DL02237 - 3546										
Octacosane (C28)	ND	0.2	mg/kg wet							
Octadecane (C18)	ND	0.2	mg/kg wet							
Tetracosane (C24)	ND	0.2	mg/kg wet							
Tetradecane (C14)	ND	0.2	mg/kg wet							
Total Petroleum Hydrocarbons	ND	37.5	mg/kg wet							
Triacontane (C30)	ND	0.2	mg/kg wet							
Surrogate: O-Terphenyl	*5.22*		mg/kg wet	*5.000*		*104*	*40-140*			
LCS										
Decane (C10)	2.1	0.2	mg/kg wet	2.500		82	40-140			
Docosane (C22)	2.4	0.2	mg/kg wet	2.500		97	40-140			
Dodecane (C12)	2.2	0.2	mg/kg wet	2.500		87	40-140			
Eicosane (C20)	2.4	0.2	mg/kg wet	2.500		96	40-140			
Hexacosane (C26)	2.4	0.2	mg/kg wet	2.500		96	40-140			
Hexadecane (C16)	2.3	0.2	mg/kg wet	2.500		93	40-140			
Nonadecane (C19)	2.3	0.2	mg/kg wet	2.500		94	40-140			
Nonane (C9)	1.8	0.2	mg/kg wet	2.500		73	30-140			
Octacosane (C28)	2.5	0.2	mg/kg wet	2.500		98	40-140			
Octadecane (C18)	2.3	0.2	mg/kg wet	2.500		93	40-140			
Tetracosane (C24)	2.4	0.2	mg/kg wet	2.500		96	40-140			
Tetradecane (C14)	2.3	0.2	mg/kg wet	2.500		90	40-140			
Total Petroleum Hydrocarbons	32.2	37.5	mg/kg wet	35.00		92	40-140			
Triacontane (C30)	2.4	0.2	mg/kg wet	2.500		96	40-140			
Surrogate: O-Terphenyl	*5.09*		mg/kg wet	*5.000*		*102*	*40-140*			
LCS Dup										
Decane (C10)	2.0	0.2	mg/kg wet	2.500		81	40-140	1	25	
Docosane (C22)	2.4	0.2	mg/kg wet	2.500		98	40-140	0.5	25	
Dodecane (C12)	2.2	0.2	mg/kg wet	2.500		89	40-140	2	25	
Eicosane (C20)	2.4	0.2	mg/kg wet	2.500		96	40-140	0.5	25	
Hexacosane (C26)	2.4	0.2	mg/kg wet	2.500		97	40-140	0.6	25	
Hexadecane (C16)	2.3	0.2	mg/kg wet	2.500		94	40-140	0.6	25	
Nonadecane (C19)	2.4	0.2	mg/kg wet	2.500		95	40-140	0.6	25	
Nonane (C9)	1.8	0.2	mg/kg wet	2.500		71	30-140	3	25	
Octacosane (C28)	2.5	0.2	mg/kg wet	2.500		99	40-140	0.5	25	
Octadecane (C18)	2.3	0.2	mg/kg wet	2.500		93	40-140	0.6	25	
Tetracosane (C24)	2.4	0.2	mg/kg wet	2.500		97	40-140	0.6	25	
Tetradecane (C14)	2.3	0.2	mg/kg wet	2.500		91	40-140	1	25	
Total Petroleum Hydrocarbons	32.3	37.5	mg/kg wet	35.00		92	40-140	0.4	25	
Triacontane (C30)	2.4	0.2	mg/kg wet	2.500		97	40-140	0.5	25	
Surrogate: O-Terphenyl	*5.03*		mg/kg wet	*5.000*		*101*	*40-140*			
Batch DL03020 - 3546										
Blank										
Decane (C10)	ND	0.2	mg/kg wet							

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Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8100M Total Petroleum Hydrocarbons										
Batch DL03020 - 3546										
Docosane (C22)	ND	0.2	mg/kg wet							
Dodecane (C12)	ND	0.2	mg/kg wet							
Eicosane (C20)	ND	0.2	mg/kg wet							
Hexacosane (C26)	ND	0.2	mg/kg wet							
Hexadecane (C16)	ND	0.2	mg/kg wet							
Nonadecane (C19)	ND	0.2	mg/kg wet							
Nonane (C9)	ND	0.2	mg/kg wet							
Octacosane (C28)	ND	0.2	mg/kg wet							
Octadecane (C18)	ND	0.2	mg/kg wet							
Tetracosane (C24)	ND	0.2	mg/kg wet							
Tetradecane (C14)	ND	0.2	mg/kg wet							
Total Petroleum Hydrocarbons	ND	37.5	mg/kg wet							
Triacontane (C30)	ND	0.2	mg/kg wet							
Surrogate: O-Terphenyl	*4.48*		mg/kg wet	*5.000*		*90*	*40-140*			
LCS										
Decane (C10)	1.7	0.2	mg/kg wet	2.500		69	40-140			
Docosane (C22)	2.1	0.2	mg/kg wet	2.500		86	40-140			
Dodecane (C12)	2.0	0.2	mg/kg wet	2.500		80	40-140			
Eicosane (C20)	2.1	0.2	mg/kg wet	2.500		85	40-140			
Hexacosane (C26)	2.1	0.2	mg/kg wet	2.500		85	40-140			
Hexadecane (C16)	2.0	0.2	mg/kg wet	2.500		82	40-140			
Nonadecane (C19)	2.1	0.2	mg/kg wet	2.500		86	40-140			
Nonane (C9)	1.5	0.2	mg/kg wet	2.500		60	30-140			
Octacosane (C28)	2.1	0.2	mg/kg wet	2.500		86	40-140			
Octadecane (C18)	2.0	0.2	mg/kg wet	2.500		82	40-140			
Tetracosane (C24)	2.1	0.2	mg/kg wet	2.500		85	40-140			
Tetradecane (C14)	2.0	0.2	mg/kg wet	2.500		79	40-140			
Total Petroleum Hydrocarbons	29.1	37.5	mg/kg wet	35.00		83	40-140			
Triacontane (C30)	2.1	0.2	mg/kg wet	2.500		83	40-140			
Surrogate: O-Terphenyl	*4.63*		mg/kg wet	*5.000*		*93*	*40-140*			
LCS Dup										
Decane (C10)	1.9	0.2	mg/kg wet	2.500		75	40-140	8	25	
Docosane (C22)	2.2	0.2	mg/kg wet	2.500		89	40-140	4	25	
Dodecane (C12)	2.2	0.2	mg/kg wet	2.500		87	40-140	8	25	
Eicosane (C20)	2.2	0.2	mg/kg wet	2.500		88	40-140	4	25	
Hexacosane (C26)	2.2	0.2	mg/kg wet	2.500		88	40-140	3	25	
Hexadecane (C16)	2.2	0.2	mg/kg wet	2.500		88	40-140	7	25	
Nonadecane (C19)	2.2	0.2	mg/kg wet	2.500		90	40-140	5	25	
Nonane (C9)	1.6	0.2	mg/kg wet	2.500		65	30-140	8	25	
Octacosane (C28)	2.2	0.2	mg/kg wet	2.500		88	40-140	3	25	
Octadecane (C18)	2.2	0.2	mg/kg wet	2.500		87	40-140	6	25	
Tetracosane (C24)	2.2	0.2	mg/kg wet	2.500		88	40-140	3	25	
Tetradecane (C14)	2.1	0.2	mg/kg wet	2.500		86	40-140	8	25	

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Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8100M Total Petroleum Hydrocarbons										
Batch DL03020 - 3546										
Total Petroleum Hydrocarbons	30.4	37.5	mg/kg wet	35.00		87	40-140	4	25	
Triacontane (C30)	2.1	0.2	mg/kg wet	2.500		85	40-140	3	25	
Surrogate: O-Terphenyl	*4.79*		mg/kg wet	*5.000*		*96*	*40-140*			
8270D Semi-Volatile Organic Compounds										
Batch DL02238 - 3546										
Blank										
1,1-Biphenyl	ND	0.333	mg/kg wet							
1,2,4-Trichlorobenzene	ND	0.333	mg/kg wet							
1,2-Dichlorobenzene	ND	0.333	mg/kg wet							
1,3-Dichlorobenzene	ND	0.333	mg/kg wet							
1,4-Dichlorobenzene	ND	0.333	mg/kg wet							
2,3,4,6-Tetrachlorophenol	ND	1.67	mg/kg wet							
2,4,5-Trichlorophenol	ND	0.333	mg/kg wet							
2,4,6-Trichlorophenol	ND	0.333	mg/kg wet							
2,4-Dichlorophenol	ND	0.333	mg/kg wet							
2,4-Dimethylphenol	ND	0.333	mg/kg wet							
2,4-Dinitrophenol	ND	1.67	mg/kg wet							
2,4-Dinitrotoluene	ND	0.333	mg/kg wet							
2,6-Dinitrotoluene	ND	0.333	mg/kg wet							
2-Chloronaphthalene	ND	0.333	mg/kg wet							
2-Chlorophenol	ND	0.333	mg/kg wet							
2-Methylnaphthalene	ND	0.333	mg/kg wet							
2-Methylphenol	ND	0.333	mg/kg wet							
2-Nitroaniline	ND	0.333	mg/kg wet							
2-Nitrophenol	ND	0.333	mg/kg wet							
3,3´-Dichlorobenzidine	ND	0.667	mg/kg wet							
3+4-Methylphenol	ND	0.667	mg/kg wet							
3-Nitroaniline	ND	0.333	mg/kg wet							
4,6-Dinitro-2-Methylphenol	ND	1.67	mg/kg wet							
4-Bromophenyl-phenylether	ND	0.333	mg/kg wet							
4-Chloro-3-Methylphenol	ND	0.333	mg/kg wet							
4-Chloroaniline	ND	0.667	mg/kg wet							
4-Chloro-phenyl-phenyl ether	ND	0.333	mg/kg wet							
4-Nitroaniline	ND	0.333	mg/kg wet							
4-Nitrophenol	ND	1.67	mg/kg wet							
Acenaphthene	ND	0.333	mg/kg wet							
Acenaphthylene	ND	0.333	mg/kg wet							
Acetophenone	ND	0.667	mg/kg wet							
Aniline	ND	0.667	mg/kg wet							
Anthracene	ND	0.333	mg/kg wet							
Azobenzene	ND	0.333	mg/kg wet							
Benzo(a)anthracene	ND	0.333	mg/kg wet							
Benzo(a)pyrene	ND	0.167	mg/kg wet							

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind

ESS Laboratory Work Order: 20L0755

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8270D Semi-Volatile Organic Compounds										
Batch DL02238 - 3546										
Benzo(b)fluoranthene	ND	0.333	mg/kg wet							
Benzo(g,h,i)perylene	ND	0.333	mg/kg wet							
Benzo(k)fluoranthene	ND	0.333	mg/kg wet							
Benzoic Acid	ND	1.67	mg/kg wet							
Benzyl Alcohol	ND	0.333	mg/kg wet							
bis(2-Chloroethoxy)methane	ND	0.333	mg/kg wet							
bis(2-Chloroethyl)ether	ND	0.167	mg/kg wet							
bis(2-chloroisopropyl)Ether	ND	0.333	mg/kg wet							
bis(2-Ethylhexyl)phthalate	ND	0.333	mg/kg wet							
Butylbenzylphthalate	ND	0.333	mg/kg wet							
Carbazole	ND	0.333	mg/kg wet							
Chrysene	ND	0.167	mg/kg wet							
Dibenzo(a,h)Anthracene	ND	0.167	mg/kg wet							
Dibenzofuran	ND	0.333	mg/kg wet							
Diethylphthalate	ND	0.333	mg/kg wet							
Dimethylphthalate	ND	0.333	mg/kg wet							
Di-n-butylphthalate	ND	0.333	mg/kg wet							
Di-n-octylphthalate	ND	0.333	mg/kg wet							
Fluoranthene	ND	0.333	mg/kg wet							
Fluorene	ND	0.333	mg/kg wet							
Hexachlorobenzene	ND	0.167	mg/kg wet							
Hexachlorobutadiene	ND	0.333	mg/kg wet							
Hexachlorocyclopentadiene	ND	1.67	mg/kg wet							
Hexachloroethane	ND	0.333	mg/kg wet							
Indeno(1,2,3-cd)Pyrene	ND	0.333	mg/kg wet							
Isophorone	ND	0.333	mg/kg wet							
Naphthalene	ND	0.333	mg/kg wet							
Nitrobenzene	ND	0.333	mg/kg wet							
N-Nitrosodimethylamine	ND	0.333	mg/kg wet							
N-Nitroso-Di-n-Propylamine	ND	0.333	mg/kg wet							
N-nitrosodiphenylamine	ND	0.333	mg/kg wet							
Pentachlorophenol	ND	1.67	mg/kg wet							
Phenanthrene	ND	0.333	mg/kg wet							
Phenol	ND	0.333	mg/kg wet							
Pyrene	ND	0.333	mg/kg wet							
Pyridine	ND	1.67	mg/kg wet							
Surrogate: 1,2-Dichlorobenzene-d4	*2.10*		mg/kg wet	*3.333*		*63*	*30-130*			
Surrogate: 2,4,6-Tribromophenol	*2.45*		mg/kg wet	*5.000*		*49*	*30-130*			
Surrogate: 2-Chlorophenol-d4	*3.22*		mg/kg wet	*5.000*		*64*	*30-130*			
Surrogate: 2-Fluorobiphenyl	*2.01*		mg/kg wet	*3.333*		*60*	*30-130*			
Surrogate: 2-Fluorophenol	*3.06*		mg/kg wet	*5.000*		*61*	*30-130*			
Surrogate: Nitrobenzene-d5	*2.40*		mg/kg wet	*3.333*		*72*	*30-130*			
Surrogate: Phenol-d6	*3.61*		mg/kg wet	*5.000*		*72*	*30-130*			
Surrogate: p-Terphenyl-d14	*3.16*		mg/kg wet	*3.333*		*95*	*30-130*			
LCS										

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Client Project ID: Rev Wind

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Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8270D Semi-Volatile Organic Compounds										
Batch DL02238 - 3546										
1,1-Biphenyl	2.62	0.333	mg/kg wet	3.333		78	40-140			
1,2,4-Trichlorobenzene	2.52	0.333	mg/kg wet	3.333		76	40-140			
1,2-Dichlorobenzene	2.39	0.333	mg/kg wet	3.333		72	40-140			
1,3-Dichlorobenzene	2.27	0.333	mg/kg wet	3.333		68	40-140			
1,4-Dichlorobenzene	2.35	0.333	mg/kg wet	3.333		70	40-140			
2,3,4,6-Tetrachlorophenol	2.53	1.67	mg/kg wet	3.333		76	30-130			
2,4,5-Trichlorophenol	2.86	0.333	mg/kg wet	3.333		86	30-130			
2,4,6-Trichlorophenol	2.66	0.333	mg/kg wet	3.333		80	30-130			
2,4-Dichlorophenol	2.79	0.333	mg/kg wet	3.333		84	30-130			
2,4-Dimethylphenol	2.76	0.333	mg/kg wet	3.333		83	30-130			
2,4-Dinitrophenol	1.43	1.67	mg/kg wet	3.333		43	30-130			
2,4-Dinitrotoluene	2.88	0.333	mg/kg wet	3.333		86	40-140			
2,6-Dinitrotoluene	2.66	0.333	mg/kg wet	3.333		80	40-140			
2-Chloronaphthalene	2.42	0.333	mg/kg wet	3.333		73	40-140			
2-Chlorophenol	2.59	0.333	mg/kg wet	3.333		78	30-130			
2-Methylnaphthalene	2.56	0.333	mg/kg wet	3.333		77	40-140			
2-Methylphenol	2.67	0.333	mg/kg wet	3.333		80	30-130			
2-Nitroaniline	3.01	0.333	mg/kg wet	3.333		90	40-140			
2-Nitrophenol	2.57	0.333	mg/kg wet	3.333		77	30-130			
3,3´-Dichlorobenzidine	2.84	0.667	mg/kg wet	3.333		85	40-140			
3+4-Methylphenol	5.18	0.667	mg/kg wet	6.667		78	30-130			
3-Nitroaniline	2.35	0.333	mg/kg wet	3.333		70	40-140			
4,6-Dinitro-2-Methylphenol	1.68	1.67	mg/kg wet	3.333		50	30-130			
4-Bromophenyl-phenylether	2.76	0.333	mg/kg wet	3.333		83	40-140			
4-Chloro-3-Methylphenol	2.95	0.333	mg/kg wet	3.333		89	30-130			
4-Chloroaniline	1.99	0.667	mg/kg wet	3.333		60	40-140			
4-Chloro-phenyl-phenyl ether	2.69	0.333	mg/kg wet	3.333		81	40-140			
4-Nitroaniline	2.41	0.333	mg/kg wet	3.333		72	40-140			
4-Nitrophenol	2.69	1.67	mg/kg wet	3.333		81	30-130			
Acenaphthene	2.30	0.333	mg/kg wet	3.333		69	40-140			
Acenaphthylene	2.51	0.333	mg/kg wet	3.333		75	40-140			
Acetophenone	2.62	0.667	mg/kg wet	3.333		78	40-140			
Aniline	2.02	0.667	mg/kg wet	3.333		61	40-140			
Anthracene	2.76	0.333	mg/kg wet	3.333		83	40-140			
Azobenzene	2.90	0.333	mg/kg wet	3.333		87	40-140			
Benzo(a)anthracene	2.92	0.333	mg/kg wet	3.333		87	40-140			
Benzo(a)pyrene	2.77	0.167	mg/kg wet	3.333		83	40-140			
Benzo(b)fluoranthene	2.75	0.333	mg/kg wet	3.333		83	40-140			
Benzo(g,h,i)perylene	2.54	0.333	mg/kg wet	3.333		76	40-140			
Benzo(k)fluoranthene	2.88	0.333	mg/kg wet	3.333		86	40-140			
Benzoic Acid	1.63	1.67	mg/kg wet	3.333		49	40-140			
Benzyl Alcohol	2.39	0.333	mg/kg wet	3.333		72	40-140			
bis(2-Chloroethoxy)methane	2.86	0.333	mg/kg wet	3.333		86	40-140			
bis(2-Chloroethyl)ether	2.64	0.167	mg/kg wet	3.333		79	40-140			
bis(2-chloroisopropyl)Ether	2.34	0.333	mg/kg wet	3.333		70	40-140			

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Client Project ID: Rev Wind

ESS Laboratory Work Order: 20L0755

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8270D Semi-Volatile Organic Compounds										
Batch DL02238 - 3546										
bis(2-Ethylhexyl)phthalate	2.50	0.333	mg/kg wet	3.333		75	40-140			
Butylbenzylphthalate	2.45	0.333	mg/kg wet	3.333		74	40-140			
Carbazole	2.73	0.333	mg/kg wet	3.333		82	40-140			
Chrysene	2.71	0.167	mg/kg wet	3.333		81	40-140			
Dibenzo(a,h)Anthracene	2.54	0.167	mg/kg wet	3.333		76	40-140			
Dibenzofuran	2.51	0.333	mg/kg wet	3.333		75	40-140			
Diethylphthalate	2.65	0.333	mg/kg wet	3.333		80	40-140			
Dimethylphthalate	2.62	0.333	mg/kg wet	3.333		79	40-140			
Di-n-butylphthalate	2.78	0.333	mg/kg wet	3.333		84	40-140			
Di-n-octylphthalate	2.48	0.333	mg/kg wet	3.333		74	40-140			
Fluoranthene	2.96	0.333	mg/kg wet	3.333		89	40-140			
Fluorene	2.72	0.333	mg/kg wet	3.333		82	40-140			
Hexachlorobenzene	2.86	0.167	mg/kg wet	3.333		86	40-140			
Hexachlorobutadiene	2.70	0.333	mg/kg wet	3.333		81	40-140			
Hexachlorocyclopentadiene	2.41	1.67	mg/kg wet	3.333		72	40-140			
Hexachloroethane	2.49	0.333	mg/kg wet	3.333		75	40-140			
Indeno(1,2,3-cd)Pyrene	2.54	0.333	mg/kg wet	3.333		76	40-140			
Isophorone	2.70	0.333	mg/kg wet	3.333		81	40-140			
Naphthalene	2.43	0.333	mg/kg wet	3.333		73	40-140			
Nitrobenzene	2.87	0.333	mg/kg wet	3.333		86	40-140			
N-Nitrosodimethylamine	2.41	0.333	mg/kg wet	3.333		72	40-140			
N-Nitroso-Di-n-Propylamine	2.91	0.333	mg/kg wet	3.333		87	40-140			
N-nitrosodiphenylamine	2.75	0.333	mg/kg wet	3.333		83	40-140			
Pentachlorophenol	2.04	1.67	mg/kg wet	3.333		61	30-130			
Phenanthrene	2.56	0.333	mg/kg wet	3.333		77	40-140			
Phenol	3.01	0.333	mg/kg wet	3.333		90	30-130			
Pyrene	2.71	0.333	mg/kg wet	3.333		81	40-140			
Pyridine	2.38	1.67	mg/kg wet	3.333		71	40-140			
Surrogate: 1,2-Dichlorobenzene-d4	*2.73*		mg/kg wet	*3.333*		*82*	*30-130*			
Surrogate: 2,4,6-Tribromophenol	*4.77*		mg/kg wet	*5.000*		*95*	*30-130*			
Surrogate: 2-Chlorophenol-d4	*4.29*		mg/kg wet	*5.000*		*86*	*30-130*			
Surrogate: 2-Fluorobiphenyl	*2.84*		mg/kg wet	*3.333*		*85*	*30-130*			
Surrogate: 2-Fluorophenol	*4.47*		mg/kg wet	*5.000*		*89*	*30-130*			
Surrogate: Nitrobenzene-d5	*3.24*		mg/kg wet	*3.333*		*97*	*30-130*			
Surrogate: Phenol-d6	*4.80*		mg/kg wet	*5.000*		*96*	*30-130*			
Surrogate: p-Terphenyl-d14	*3.21*		mg/kg wet	*3.333*		*96*	*30-130*			
LCS Dup										
1,1-Biphenyl	2.19	0.333	mg/kg wet	3.333		66	40-140	18	30	
1,2,4-Trichlorobenzene	2.06	0.333	mg/kg wet	3.333		62	40-140	20	30	
1,2-Dichlorobenzene	1.98	0.333	mg/kg wet	3.333		60	40-140	19	30	
1,3-Dichlorobenzene	1.89	0.333	mg/kg wet	3.333		57	40-140	18	30	
1,4-Dichlorobenzene	1.97	0.333	mg/kg wet	3.333		59	40-140	18	30	
2,3,4,6-Tetrachlorophenol	2.37	1.67	mg/kg wet	3.333		71	30-130	6	30	
2,4,5-Trichlorophenol	2.54	0.333	mg/kg wet	3.333		76	30-130	12	30	
2,4,6-Trichlorophenol	2.29	0.333	mg/kg wet	3.333		69	30-130	15	30	

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Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8270D Semi-Volatile Organic Compounds										
Batch DL02238 - 3546										
2,4-Dichlorophenol	2.31	0.333	mg/kg wet	3.333		69	30-130	19	30	
2,4-Dimethylphenol	2.25	0.333	mg/kg wet	3.333		67	30-130	20	30	
2,4-Dinitrophenol	1.95	1.67	mg/kg wet	3.333		58	30-130	30	30	
2,4-Dinitrotoluene	2.75	0.333	mg/kg wet	3.333		83	40-140	5	30	
2,6-Dinitrotoluene	2.40	0.333	mg/kg wet	3.333		72	40-140	10	30	
2-Chloronaphthalene	2.00	0.333	mg/kg wet	3.333		60	40-140	19	30	
2-Chlorophenol	2.13	0.333	mg/kg wet	3.333		64	30-130	19	30	
2-Methylnaphthalene	2.10	0.333	mg/kg wet	3.333		63	40-140	20	30	
2-Methylphenol	2.20	0.333	mg/kg wet	3.333		66	30-130	19	30	
2-Nitroaniline	2.71	0.333	mg/kg wet	3.333		81	40-140	11	30	
2-Nitrophenol	2.10	0.333	mg/kg wet	3.333		63	30-130	20	30	
3,3´-Dichlorobenzidine	2.50	0.667	mg/kg wet	3.333		75	40-140	13	30	
3+4-Methylphenol	4.74	0.667	mg/kg wet	6.667		71	30-130	9	30	
3-Nitroaniline	2.07	0.333	mg/kg wet	3.333		62	40-140	12	30	
4,6-Dinitro-2-Methylphenol	2.10	1.67	mg/kg wet	3.333		63	30-130	23	30	
4-Bromophenyl-phenylether	2.44	0.333	mg/kg wet	3.333		73	40-140	12	30	
4-Chloro-3-Methylphenol	2.59	0.333	mg/kg wet	3.333		78	30-130	13	30	
4-Chloroaniline	1.44	0.667	mg/kg wet	3.333		43	40-140	32	30	D+
4-Chloro-phenyl-phenyl ether	2.37	0.333	mg/kg wet	3.333		71	40-140	13	30	
4-Nitroaniline	2.33	0.333	mg/kg wet	3.333		70	40-140	3	30	
4-Nitrophenol	2.74	1.67	mg/kg wet	3.333		82	30-130	2	30	
Acenaphthene	1.97	0.333	mg/kg wet	3.333		59	40-140	16	30	
Acenaphthylene	2.13	0.333	mg/kg wet	3.333		64	40-140	16	30	
Acetophenone	2.20	0.667	mg/kg wet	3.333		66	40-140	17	30	
Aniline	1.54	0.667	mg/kg wet	3.333		46	40-140	27	30	
Anthracene	2.61	0.333	mg/kg wet	3.333		78	40-140	6	30	
Azobenzene	2.54	0.333	mg/kg wet	3.333		76	40-140	13	30	
Benzo(a)anthracene	2.87	0.333	mg/kg wet	3.333		86	40-140	2	30	
Benzo(a)pyrene	2.74	0.167	mg/kg wet	3.333		82	40-140	0.9	30	
Benzo(b)fluoranthene	2.77	0.333	mg/kg wet	3.333		83	40-140	0.8	30	
Benzo(g,h,i)perylene	2.50	0.333	mg/kg wet	3.333		75	40-140	2	30	
Benzo(k)fluoranthene	2.85	0.333	mg/kg wet	3.333		85	40-140	1	30	
Benzoic Acid	1.89	1.67	mg/kg wet	3.333		57	40-140	15	30	
Benzyl Alcohol	1.91	0.333	mg/kg wet	3.333		57	40-140	22	30	
bis(2-Chloroethoxy)methane	2.32	0.333	mg/kg wet	3.333		70	40-140	21	30	
bis(2-Chloroethyl)ether	2.23	0.333	mg/kg wet	3.333		67	40-140	17	30	
bis(2-chloroisopropyl)Ether	1.94	0.333	mg/kg wet	3.333		58	40-140	19	30	
bis(2-Ethylhexyl)phthalate	2.43	0.333	mg/kg wet	3.333		73	40-140	3	30	
Butylbenzylphthalate	2.40	0.333	mg/kg wet	3.333		72	40-140	2	30	
Carbazole	2.71	0.333	mg/kg wet	3.333		81	40-140	0.7	30	
Chrysene	2.65	0.167	mg/kg wet	3.333		80	40-140	2	30	
Dibenzo(a,h)Anthracene	2.47	0.167	mg/kg wet	3.333		74	40-140	2	30	
Dibenzofuran	2.18	0.333	mg/kg wet	3.333		65	40-140	14	30	
Diethylphthalate	2.47	0.333	mg/kg wet	3.333		74	40-140	7	30	
Dimethylphthalate	2.35	0.333	mg/kg wet	3.333		71	40-140	11	30	

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Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8270D Semi-Volatile Organic Compounds										
Batch DL02238 - 3546										
Di-n-butylphthalate	2.72	0.333	mg/kg wet	3.333		82	40-140	2	30	
Di-n-octylphthalate	2.48	0.333	mg/kg wet	3.333		74	40-140	0.2	30	
Fluoranthene	2.91	0.333	mg/kg wet	3.333		87	40-140	2	30	
Fluorene	2.43	0.333	mg/kg wet	3.333		73	40-140	11	30	
Hexachlorobenzene	2.61	0.167	mg/kg wet	3.333		78	40-140	9	30	
Hexachlorobutadiene	2.17	0.333	mg/kg wet	3.333		65	40-140	22	30	
Hexachlorocyclopentadiene	1.99	1.67	mg/kg wet	3.333		60	40-140	19	30	
Hexachloroethane	2.06	0.333	mg/kg wet	3.333		62	40-140	19	30	
Indeno(1,2,3-cd)Pyrene	2.48	0.333	mg/kg wet	3.333		74	40-140	3	30	
Isophorone	2.24	0.333	mg/kg wet	3.333		67	40-140	19	30	
Naphthalene	1.98	0.333	mg/kg wet	3.333		59	40-140	20	30	
Nitrobenzene	2.34	0.333	mg/kg wet	3.333		70	40-140	20	30	
N-Nitrosodimethylamine	2.04	0.333	mg/kg wet	3.333		61	40-140	17	30	
N-Nitroso-Di-n-Propylamine	2.42	0.333	mg/kg wet	3.333		73	40-140	18	30	
N-nitrosodiphenylamine	2.50	0.333	mg/kg wet	3.333		75	40-140	10	30	
Pentachlorophenol	2.24	1.67	mg/kg wet	3.333		67	30-130	9	30	
Phenanthrene	2.42	0.333	mg/kg wet	3.333		73	40-140	6	30	
Phenol	2.50	0.333	mg/kg wet	3.333		75	30-130	19	30	
Pyrene	2.68	0.333	mg/kg wet	3.333		80	40-140	0.9	30	
Pyridine	2.01	1.67	mg/kg wet	3.333		60	40-140	17	30	
Surrogate: 1,2-Dichlorobenzene-d4	*2.27*		mg/kg wet	*3.333*		*68*	*30-130*			
Surrogate: 2,4,6-Tribromophenol	*4.39*		mg/kg wet	*5.000*		*88*	*30-130*			
Surrogate: 2-Chlorophenol-d4	*3.55*		mg/kg wet	*5.000*		*71*	*30-130*			
Surrogate: 2-Fluorobiphenyl	*2.35*		mg/kg wet	*3.333*		*70*	*30-130*			
Surrogate: 2-Fluorophenol	*3.69*		mg/kg wet	*5.000*		*74*	*30-130*			
Surrogate: Nitrobenzene-d5	*2.62*		mg/kg wet	*3.333*		*79*	*30-130*			
Surrogate: Phenol-d6	*3.98*		mg/kg wet	*5.000*		*80*	*30-130*			
Surrogate: p-Terphenyl-d14	*3.15*		mg/kg wet	*3.333*		*95*	*30-130*			
Classical Chemistry										
Batch DL02358 - General Preparation										
Blank										
Total Organic Carbon (1)	ND	100	mg/kg							
Total Organic Carbon (2)	ND	100	mg/kg							
LCS										
Total Organic Carbon (1)	10900	100	mg/kg	10000		109	80-120			
Total Organic Carbon (2)	10000	100	mg/kg	10000		100	80-120			
LCS Dup										
Total Organic Carbon (1)	10300	100	mg/kg	10000		103	80-120	5	20	
Total Organic Carbon (2)	11000	100	mg/kg	10000		110	80-120	10	20	

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
ESS Laboratory Work Order: 20L0755

Notes and Definitions

Z17	Temperature is within 23 +/-2 ºC.
Z-08	See Attached
U	Analyte included in the analysis, but not detected
RRF	Analyte does not meet the Relative Response Factor (RRF) criteria in the calibration
Q	Calibration required quadratic regression (Q).
PT	Pentachlorophenol tailing factor > 2.
ICV-	Initial Calibration Verification recovery is below lower control limit (ICV-).
D+	Relative percent difference for duplicate is outside of criteria (D+).
D	Diluted.
CD+	Continuing Calibration %Diff/Drift is above control limit (CD+).
CD-	Continuing Calibration %Diff/Drift is below control limit (CD-).
BT	Benzidine tailing factor >2.
ND	Analyte NOT DETECTED at or above the MRL (LOQ), LOD for DoD Reports, MDL for J-Flagged Analytes
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference
MDL	Method Detection Limit
MRL	Method Reporting Limit
LOD	Limit of Detection
LOQ	Limit of Quantitation
DL	Detection Limit
I/V	Initial Volume
F/V	Final Volume
§	Subcontracted analysis; see attached report
1	Range result excludes concentrations of surrogates and/or internal standards eluting in that range.
2	Range result excludes concentrations of target analytes eluting in that range.
3	Range result excludes the concentration of the C9-C10 aromatic range.
Avg	Results reported as a mathematical average.
NR	No Recovery
[CALC]	Calculated Analyte
SUB	Subcontracted analysis; see attached report
RL	Reporting Limit
EDL	Estimated Detection Limit
MF	Membrane Filtration
MPN	Most Probably Number
TNTC	Too numerous to Count
CFU	Colony Forming Units

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind

ESS Laboratory Work Order: 20L0755

ESS LABORATORY CERTIFICATIONS AND ACCREDITATIONS

ENVIRONMENTAL

Rhode Island Potable and Non Potable Water: LAI00179
http://www.health.ri.gov/find/labs/analytical/ESS.pdf

Connecticut Potable and Non Potable Water, Solid and Hazardous Waste: PH-0750
http://www.ct.gov/dph/lib/dph/environmental_health/environmental_laboratories/pdf/OutofStateCommercialLaboratories.pdf

Maine Potable and Non Potable Water, and Solid and Hazardous Waste: RI00002
http://www.maine.gov/dhhs/mecdc/environmental-health/dwp/partners/labCert.shtml

Massachusetts Potable and Non Potable Water: M-RI002
http://public.dep.state.ma.us/Labcert/Labcert.aspx

New Hampshire (NELAP accredited) Potable and Non Potable Water, Solid and Hazardous Waste: 2424
http://des.nh.gov/organization/divisions/water/dwgb/nhelap/index.htm

New York (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: 11313
http://www.wadsworth.org/labcert/elap/comm.html

New Jersey (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: RI006
http://datamine2.state.nj.us/DEP_OPRA/OpraMain/pi_main?mode=pi_by_site&sort_order=PI_NAMEA&Select+a+Site:=58715

United States Department of Agriculture Soil Permit: P330-12-00139

Pennsylvania: 68-01752
http://www.dep.pa.gov/Business/OtherPrograms/Labs/Pages/Laboratory-Accreditation-Program.aspx

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THIELSCH ENGINEERING
195 Frances Avenue
Cranston RI, 02910
Phone: (401)-467-6454
Fax: (401)-467-2398
thielsch.com
Let's Build a Solid Foundation

Client Information:
VHB
Providence, RI
PM: Sue Moberg
Assigned By: Sue Moberg
Collected By: Client

Project Information:
Revolution Wind
North Kingston, RI
ESS Project Number: 20L0755
Summary Page: 1 of 1
Report Date: 12.29.2020

LABORATORY TESTING DATA SHEET, Report No.: 7420-M-183

Boring ID	Sample No.	Depth (ft)	Laboratory No.	Identification Tests						Corrosivity Tests								Laboratory Log and Soil Description
				As Received Water Content %	LL %	PL %	Gravel %	Sand %	Fines %	Resitivity (Mohms-cm)	Sulfate (mg/kg)	Chloride (mg/kg)	Sulfide (mg/kg)	Redox Potential (mv)	pH	Electrical Resist. As Received Ohm-cm @ 60°F	Electrial Resist. Saturated Ohm-cm @ 60°F	
				D2216	D4318		D6913			EPA						G57		
REV01-ENV-04		0-2	20L0755-01	78.1			0.0	21.3	78.7									Dark Gray Orangic silt with sand
REV01-ENV-04		2-9.5	20L0755-02	20.6			0.0	88.3	11.7									Light Brown poorly graded sand with silt
REV01-ENV-04		9.5-11.5	20L0755-03	20.2			0.0	82.9	17.1									Light Brown silty sand
REV01-ENV-04		11.5-16.5	20L0755-04	23.7			0.0	22.4	77.6									Brown silt with sand
REV01-ENV-02		0-5.5	20L0755-05	19.4			0.0	95.6	4.4									Gray poorly graded sand
REV01-ENV-200		0-5.5	20L0755-06	19.9			0.8	95.6	3.6									Gray poorly graded sand
REV01-ENV-02		5.5-8.5	20L0755-07	22.0			0.0	78.9	21.1									Light Gray silty sand
REV01-ENV-02		8.5-13	20L0755-08	23.5			0.0	45.3	54.7									Light Brown sandy silt
REV01-ENV-02		13-16	20L0755-09	19.9			0.0	27.8	72.2									Light Brown silt with sand
REV01-ENV-05		0-2.5	20L0755-10	25.4			0.0	62.6	37.4									Dark Brown silty sand

Date Received: *12.23.2020*

Reviewed By:

Date Reviewed: *12.30.2020*

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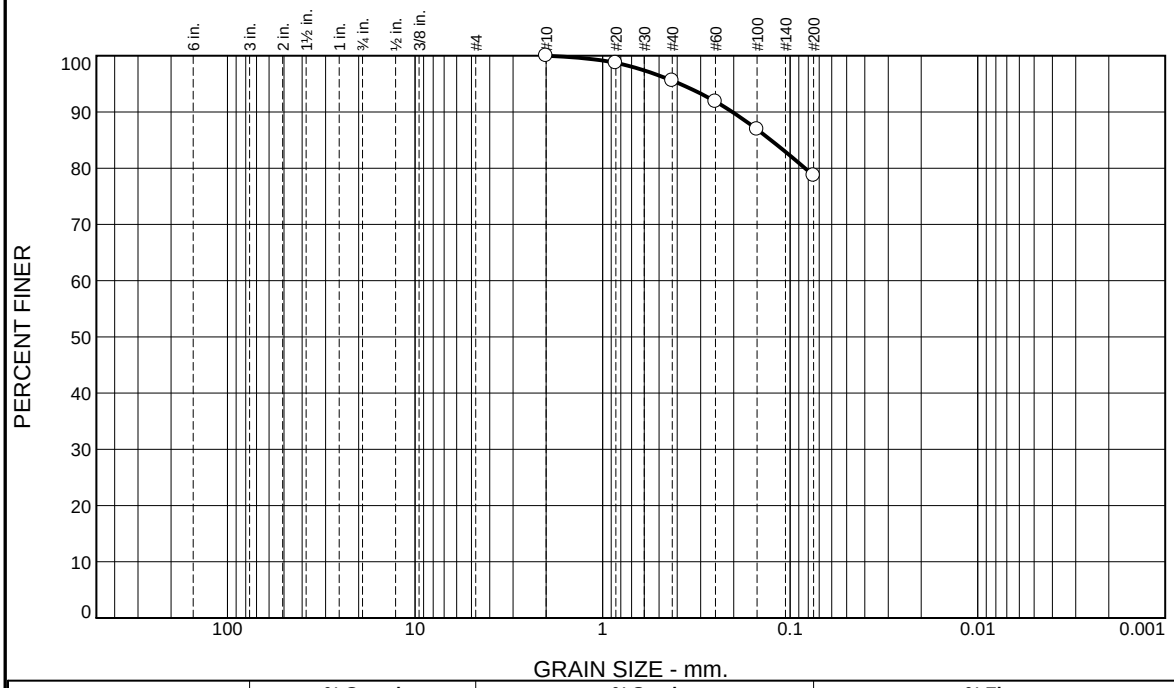
Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	4.4	16.9	78.7	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#10	100.0		
#20	98.7		
#40	95.6		
#60	91.9		
#100	86.9		
#200	78.7		

* (no specification provided)

Material Description

Dark Gray Orangic silt with sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= OL AASHTO (M 145)= A-6

Coefficients

D_{90}= 0.2032 D_{85}= 0.1266 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample visually classified as plastic. Sample rolled to 1/8".

Date Received: 12.23.2020 **Date Tested:** 12.29.2020

Tested By: AV / JM

Checked By: Steven Accetta

Title: Laboratory Coordinator

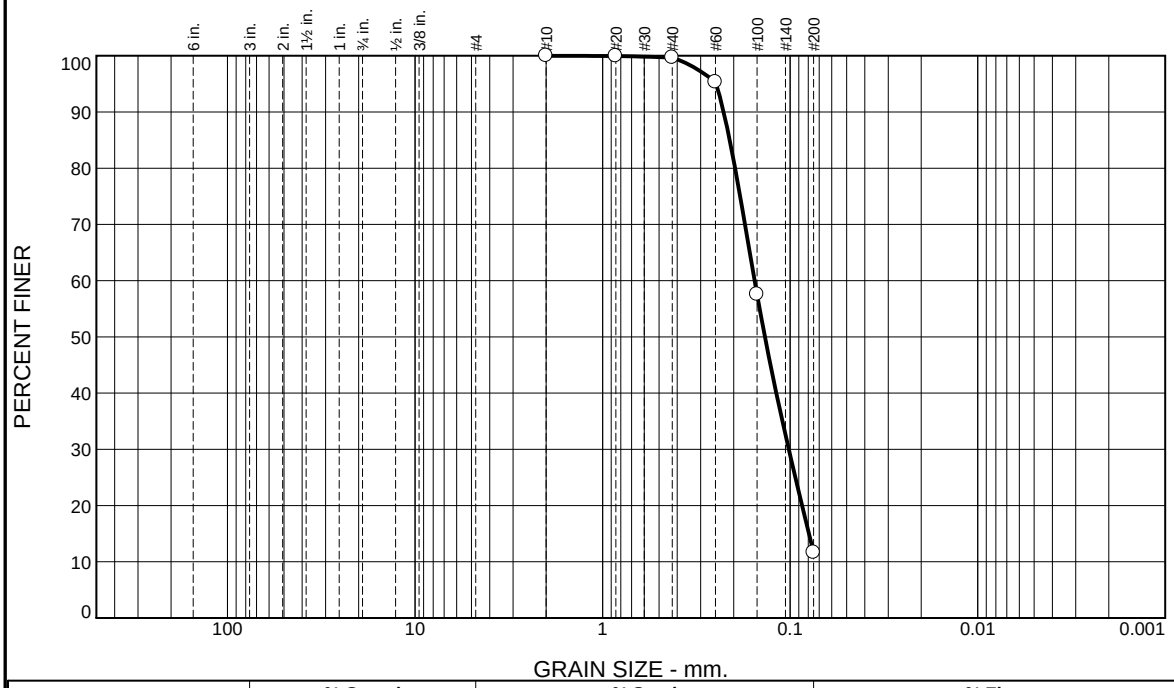
Source of Sample: REV01-ENV **Depth:** 0-2' **Date Sampled:** 121.2020
Sample Number: 04

Thielsch Engineering Inc.

Cranston, RI

Client: VHB
Project: Revolution Wind
North Kingston, RI
Project No: 20L0755 **Figure** 20L0755-01

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.3	88.0	11.7	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#10	100.0		
#20	100.0		
#40	99.7		
#60	95.3		
#100	57.5		
#200	11.7		

* (no specification provided)

Material Description

Light Brown poorly graded sand with silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SP-SM **AASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}= 0.2261 D_{85}= 0.2099 D_{60}= 0.1546
D_{50}= 0.1362 D_{30}= 0.1017 D_{15}= 0.0794
D_{10}= C_u= C_c=

Remarks

Date Received: 12.23.2020 **Date Tested:** 12.29.2020

Tested By: AV / JM

Checked By: Steven Accetta

Title: Laboratory Coordinator

Source of Sample: REV01-ENV **Depth:** 2-9.5' **Date Sampled:** 12.21.2020
Sample Number: 04

Thielsch Engineering Inc.

Cranston, RI

Client: VHB
Project: Revolution Wind
North Kingston, RI
Project No: 20L0755 **Figure** 20L0755-02

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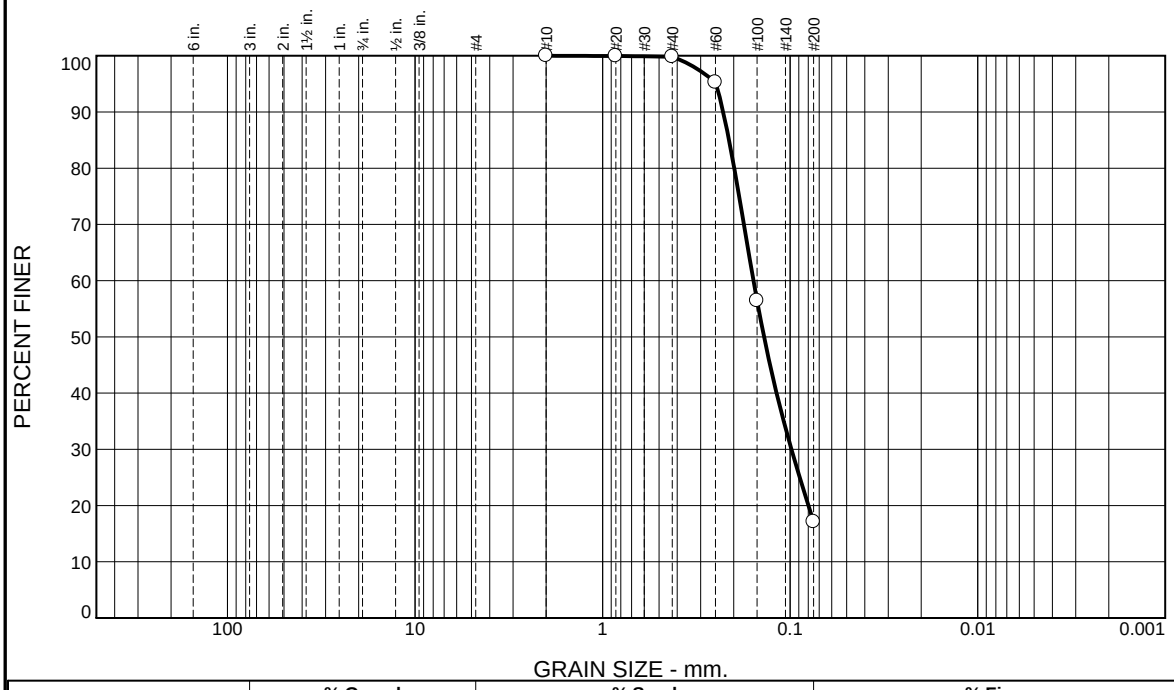
Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.2	82.7	17.1	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#10	100.0		
#20	100.0		
#40	99.8		
#60	95.3		
#100	56.4		
#200	17.1		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}= 0.2273 D_{85}= 0.2116 D_{60}= 0.1568
D_{50}= 0.1377 D_{30}= 0.0985 D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 12.23.2020 **Date Tested:** 12.29.2020

Tested By: AV / JM

Checked By: Steven Accetta

Title: Laboratory Coordinator

Source of Sample: REV01-ENV **Depth:** 9.5-11.5' **Date Sampled:** 12.21.2020
Sample Number: 04

Thielsch Engineering Inc.
Cranston, RI

Client: VHB
Project: Revolution Wind
North Kingston, RI
Project No: 20L0755 **Figure** 20L0755-03

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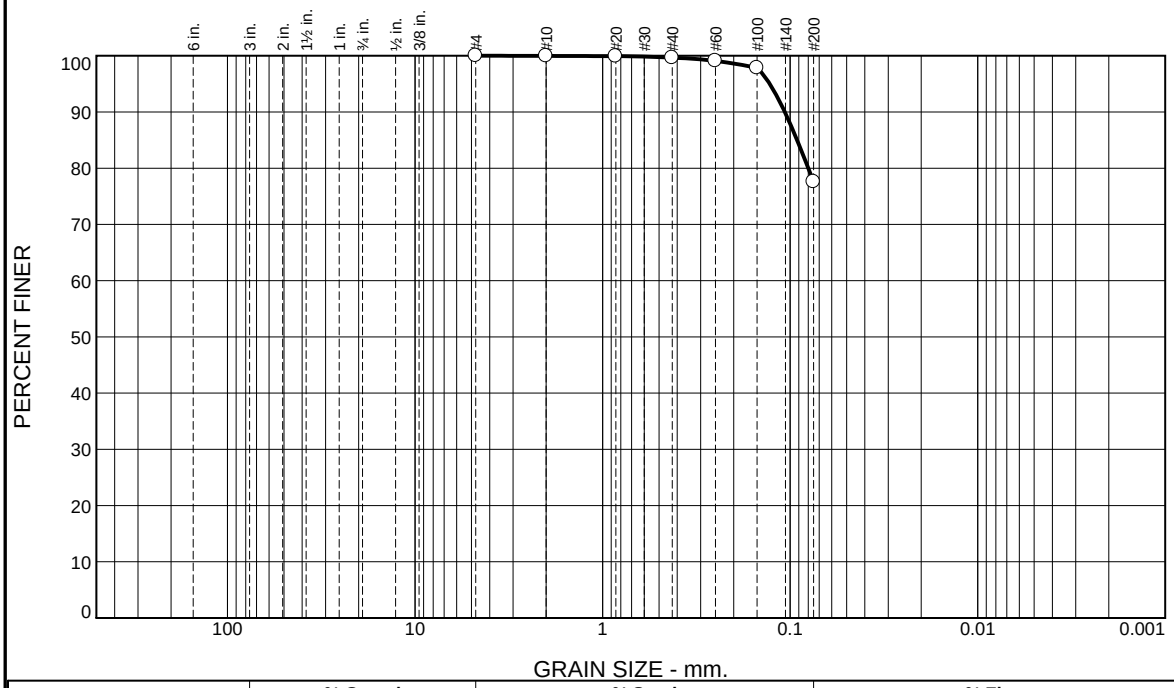
Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.4	22.0	77.6	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	100.0		
#20	99.9		
#40	99.6		
#60	99.1		
#100	97.8		
#200	77.6		

* (no specification provided)

Material Description

Brown silt with sand

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= ML **AASHTO (M 145)=** A-4(0)

Coefficients

D_{90}= 0.1068 D_{85}= 0.0919 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample visually classified as non-plastic.

Date Received: 12.23.2020 **Date Tested:** 12.29.2020

Tested By: AV / JM

Checked By: Steven Accetta

Title: Laboratory Coordinator

Source of Sample: REV01-ENV **Depth:** 11.5-16.5' **Date Sampled:** 12.21.2020
Sample Number: 04

Thielsch Engineering Inc.

Cranston, RI

Client: VHB
Project: Revolution Wind
North Kingston, RI
Project No: 20L0755 **Figure** 20L0755-04

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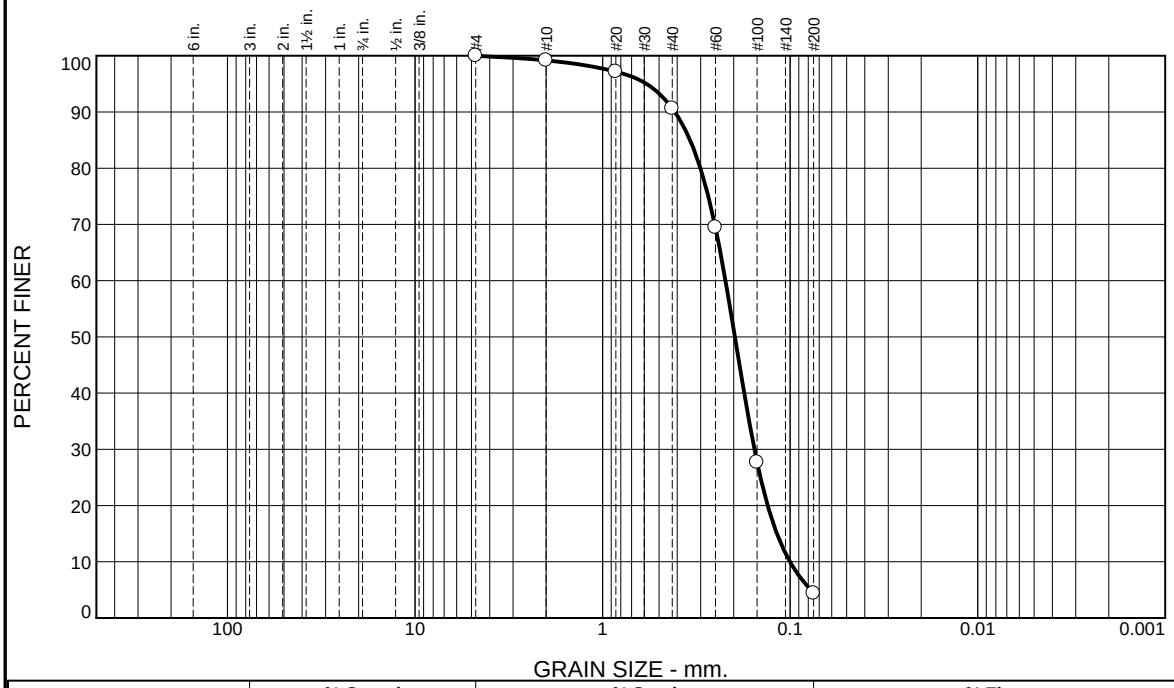
Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.8	8.6	86.2	4.4	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	99.2		
#20	97.2		
#40	90.6		
#60	69.4		
#100	27.7		
#200	4.4		

* (no specification provided)

Material Description

Gray poorly graded sand

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SP **AASHTO (M 145)=** A-3

Coefficients

D_{90}= 0.4119 D_{85}= 0.3414 D_{60}= 0.2212
D_{50}= 0.1970 D_{30}= 0.1550 D_{15}= 0.1177
D_{10}= 0.1003 C_u= 2.20 C_c= 1.08

Remarks

Date Received: 12.23.2020 **Date Tested:** 12.29.2020

Tested By: AV / JM

Checked By: Steven Accetta

Title: Laboratory Coordinator

Source of Sample: REV01-ENV **Depth:** 0-5.5' **Date Sampled:** 12.21.2020
Sample Number: 02

Thielsch Engineering Inc.

Cranston, RI

Client: VHB
Project: Revolution Wind
North Kingston, RI
Project No: 20L0755 **Figure** 20L0755-05

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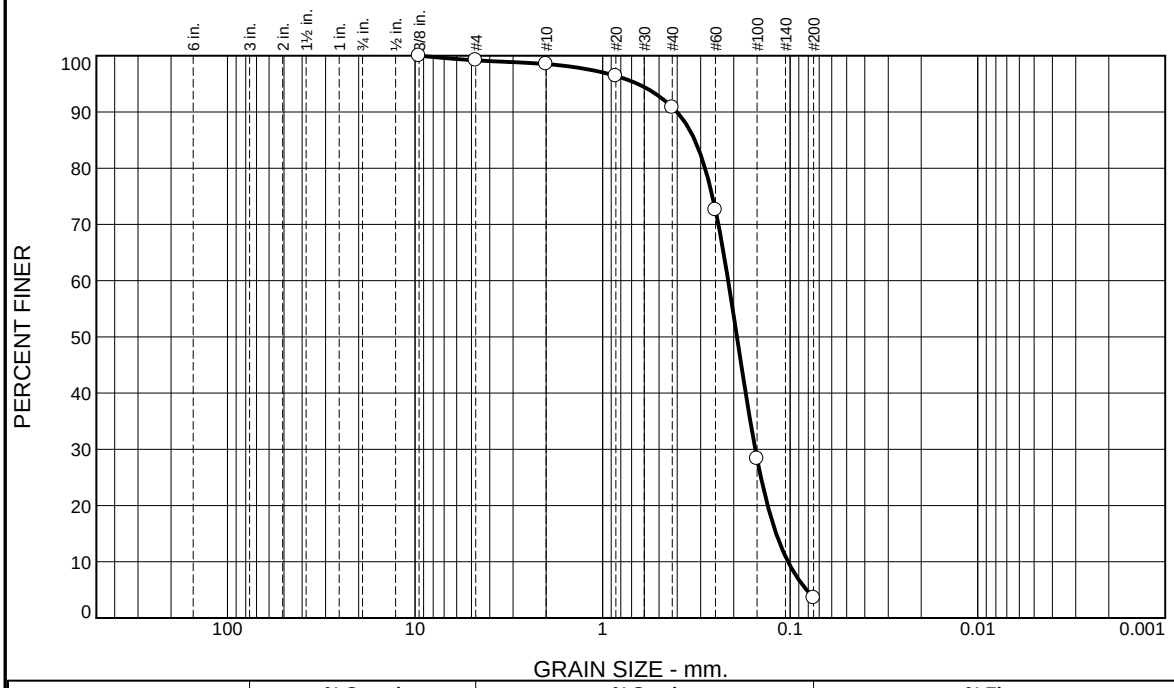
Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.8	0.7	7.7	87.2	3.6	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.375"	100.0		
#4	99.2		
#10	98.5		
#20	96.4		
#40	90.8		
#60	72.6		
#100	28.3		
#200	3.6		

* (no specification provided)

Material Description

Gray poorly graded sand

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SP **AASHTO (M 145)=** A-3

Coefficients

D_{90}= 0.4018 D_{85}= 0.3220 D_{60}= 0.2139
D_{50}= 0.1921 D_{30}= 0.1533 D_{15}= 0.1187
D_{10}= 0.1027 C_u= 2.08 C_c= 1.07

Remarks

Date Received: 12.23.2020 **Date Tested:** 12.29.2020

Tested By: AV / JM

Checked By: Steven Accetta

Title: Laboratory Coordinator

Source of Sample: REV01-ENV **Depth:** 0-5.5' **Date Sampled:** 12.21.2020
Sample Number: 200

Thielsch Engineering Inc.

Cranston, RI

Client: VHB
Project: Revolution Wind
North Kingston, RI
Project No: 20L0755 **Figure** 20L0755-06

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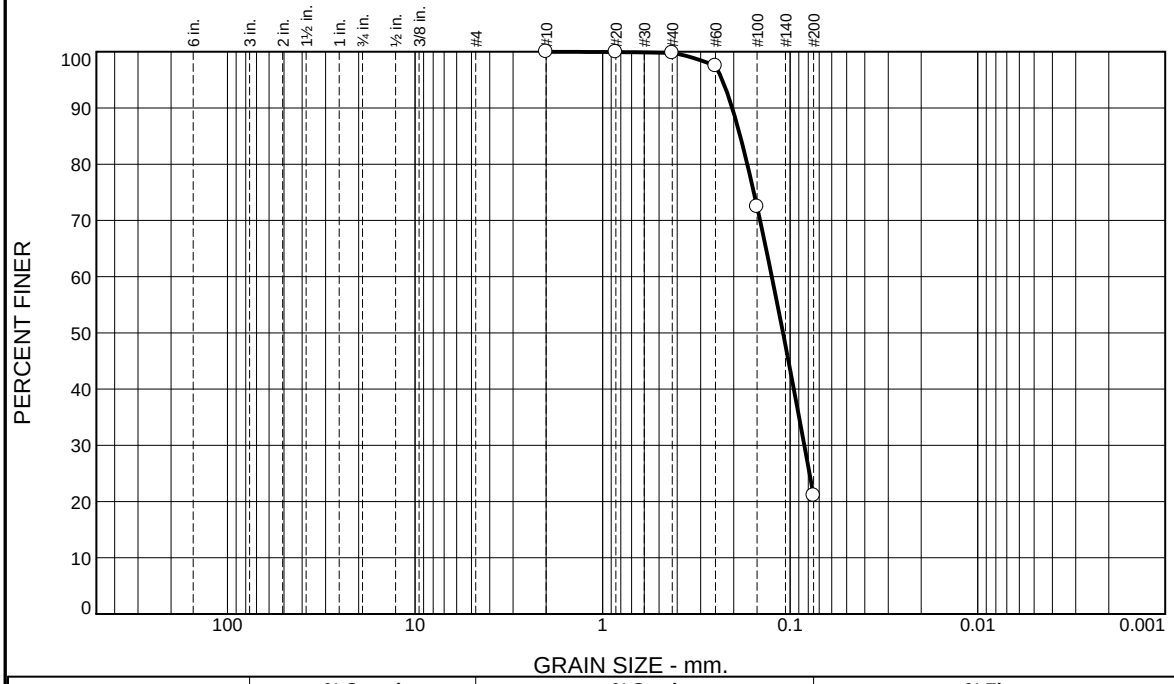
Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.2	78.7	21.1	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#10	100.0		
#20	99.9		
#40	99.8		
#60	97.5		
#100	72.4		
#200	21.1		

* (no specification provided)

Material Description

Light Gray silty sand

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}= 0.2035 D_{85}= 0.1844 D_{60}= 0.1252
D_{50}= 0.1092 D_{30}= 0.0841 D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 12.23.2020 **Date Tested:** 12.29.2020

Tested By: AV / JM

Checked By: Steven Accetta

Title: Laboratory Coordinator

Source of Sample: REV01-ENV **Depth:** 5.5-8.5' **Date Sampled:** 12.21.2020
Sample Number: 02

Thielsch Engineering Inc.
Cranston, RI

Client: VHB
Project: Revolution Wind
North Kingston, RI
Project No: 20L0755 **Figure** 20L0755-07

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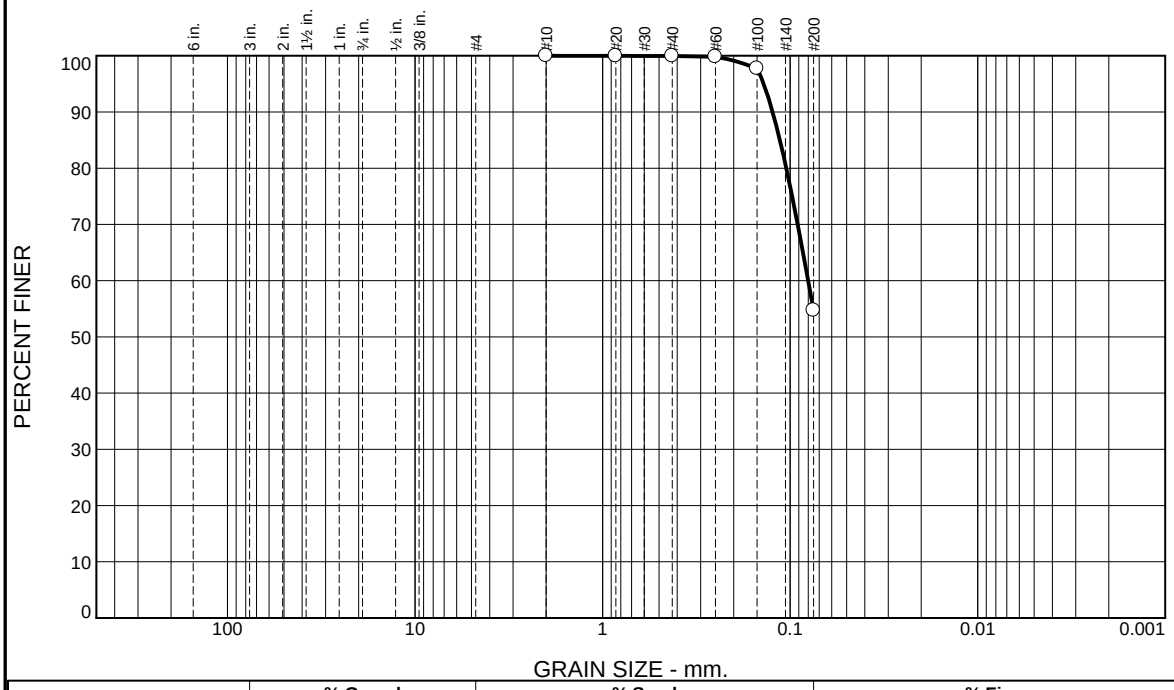
Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.1	45.2	54.7	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#10	100.0		
#20	100.0		
#40	99.9		
#60	99.8		
#100	97.7		
#200	54.7		

* (no specification provided)

Material Description

Light Brown sandy silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= ML **AASHTO (M 145)=** A-4(0)

Coefficients

D_{90}= 0.1239 D_{85}= 0.1134 D_{60}= 0.0802
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample visually classified as non-plastic.

Date Received: 12.23.2020 **Date Tested:** 12.29.2020

Tested By: AV / JM

Checked By: Steven Accetta

Title: Laboratory Coordinator

Source of Sample: REV01-ENV **Depth:** 8.5-13' **Date Sampled:** 12.21.2020
Sample Number: 02

Thielsch Engineering Inc.

Cranston, RI

Client: VHB
Project: Revolution Wind
North Kingston, RI
Project No: 20L0755 **Figure** 20L0755-08

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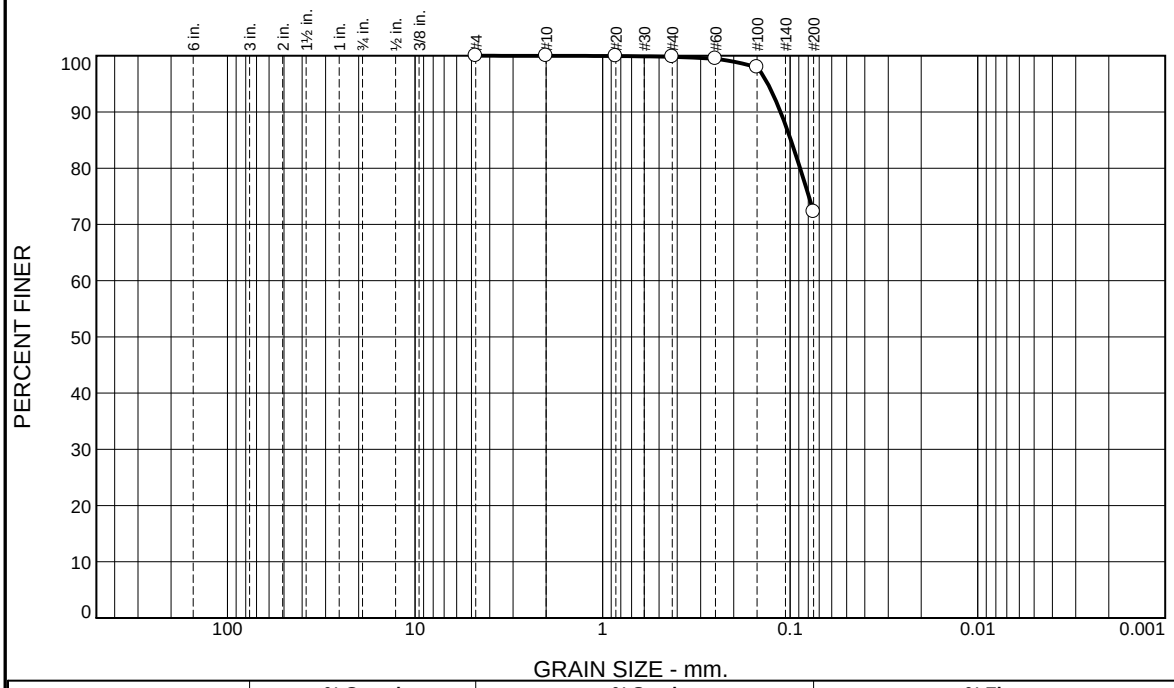
Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.2	27.6	72.2	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	100.0		
#20	100.0		
#40	99.8		
#60	99.5		
#100	98.0		
#200	72.2		

* (no specification provided)

Material Description

Light Brown silt with sand

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= ML **AASHTO (M 145)=** A-4(0)

Coefficients

D_{90}= 0.1125 D_{85}= 0.0992 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample visually classified as plastic. Sample rolled to 1/4".

Date Received: 12.23.2020 **Date Tested:** 12.29.2020

Tested By: AV / JM

Checked By: Steven Accetta

Title: Laboratory Coordinator

Source of Sample: REV01-ENV **Depth:** 13-16' **Date Sampled:** 12.21.2020
Sample Number: 02

Thielsch Engineering Inc.

Cranston, RI

Client: VHB
Project: Revolution Wind
North Kingston, RI
Project No: 20L0755 **Figure** 20L0755-09

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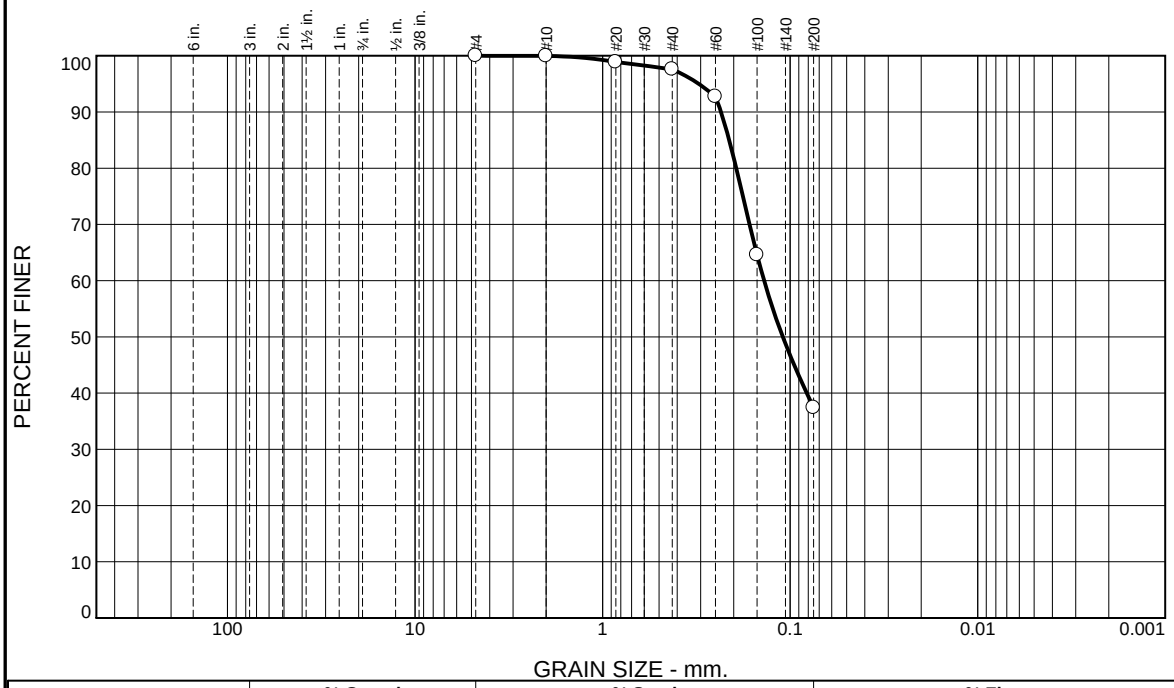
MANAGEMENT COUNCIL

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	2.4	60.2	37.4	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	100.0		
#20	98.9		
#40	97.6		
#60	92.7		
#100	64.6		
#200	37.4		

* (no specification provided)

Material Description

Dark Brown silty sand

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-4(0)

Coefficients

D_{90}= 0.2335 D_{85}= 0.2112 D_{60}= 0.1376
D_{50}= 0.1095 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample visually classified as non-plastic.

Date Received: 12.23.2020 **Date Tested:** 12.29.2020

Tested By: AV / JM

Checked By: Steven Accetta

Title: Laboratory Coordinator

Source of Sample: REV01-ENV **Depth:** 0-2.5' **Date Sampled:** 12.21.2020
Sample Number: 05

Thielsch Engineering Inc.

Cranston, RI

Client: VHB
Project: Revolution Wind
North Kingston, RI
Project No: 20L0755 **Figure** 20L0755-10

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ESS Laboratory Sample and Cooler Receipt Checklist

Client: VHB - Vanasse Hangen Brustlin, Inc - KPB

Shipped/Delivered Via: ESS Courier

ESS Project ID: 20L0755
Date Received: 12/22/2020
Project Due Date: 12/30/2020
Days for Project: 5 Day

1. Air bill manifest present? No
   Air No.: NA
2. Were custody seals present? No
3. Is radiation count <100 CPM? Yes
4. Is a Cooler Present? Yes
   Temp: 6.8 Iced with: Ice
5. Was COC signed and dated by client? Yes
6. Does COC match bottles? Yes
7. Is COC complete and correct? Yes
8. Were samples received intact? Yes
9. **Were labs informed about short holds & rushes?** (Yes) / No / NA
10. Were any analyses received outside of hold time? Yes (No)

11. Any Subcontracting needed? (Yes) / No
    ESS Sample IDs: All
    Analysis: Grain Size
    TAT: 5 Day
12. Were VOAs received? Yes / (No)
    a. Air bubbles in aqueous VOAs? Yes / No
    b. Does methanol cover soil completely? Yes / No / NA
13. Are the samples properly preserved? (Yes) / No
    a. If metals preserved upon receipt: Date: ____ Time: ____ By: ____
    b. Low Level VOA vials frozen: Date: ____ Time: ____ By: ____

Sample Receiving Notes:

14. Was there a need to contact Project Manager? Yes / (No)
    a. Was there a need to contact the client? Yes / (No)
    Who was contacted? ____ Date: ____ Time: ____ By: ____

Sample Number	Container ID	Proper Container	Air Bubbles Present	Sufficient Volume	Container Type	Preservative	Record pH (Cyanide and 608 Pesticides)
1	122161	Yes	N/A	Yes	Driller Jar	NP	
1	122162	Yes	N/A	Yes	Driller Jar	NP	
1	122163	Yes	N/A	Yes	Driller Jar	NP	
2	122164	Yes	N/A	Yes	Driller Jar	NP	
2	122165	Yes	N/A	Yes	Driller Jar	NP	
2	122166	Yes	N/A	Yes	Driller Jar	NP	
3	122167	Yes	N/A	Yes	Driller Jar	NP	
3	122168	Yes	N/A	Yes	Driller Jar	NP	
3	122169	Yes	N/A	Yes	Driller Jar	NP	
4	122170	Yes	N/A	Yes	Driller Jar	NP	
4	122171	Yes	N/A	Yes	Driller Jar	NP	
4	122172	Yes	N/A	Yes	Driller Jar	NP	
5	122173	Yes	N/A	Yes	Driller Jar	NP	
5	122174	Yes	N/A	Yes	Driller Jar	NP	
5	122175	Yes	N/A	Yes	Driller Jar	NP	
6	122176	Yes	N/A	Yes	Driller Jar	NP	
6	122177	Yes	N/A	Yes	Driller Jar	NP	

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ESS Laboratory Sample and Cooler Receipt Checklist

Client: VHB - Vanasse Hangen Brustlin, Inc - KPB

ESS Project ID: 20L0755
Date Received: 12/22/2020

6	122178	Yes	N/A	Yes	Driller Jar	NP
7	122179	Yes	N/A	Yes	Driller Jar	NP
7	122180	Yes	N/A	Yes	Driller Jar	NP
7	122181	Yes	N/A	Yes	Driller Jar	NP
8	122182	Yes	N/A	Yes	Driller Jar	NP
8	122183	Yes	N/A	Yes	Driller Jar	NP
8	122184	Yes	N/A	Yes	Driller Jar	NP
9	122185	Yes	N/A	Yes	Driller Jar	NP
9	122186	Yes	N/A	Yes	Driller Jar	NP
9	122187	Yes	N/A	Yes	Driller Jar	NP
10	122188	Yes	N/A	Yes	Driller Jar	NP
10	122189	Yes	N/A	Yes	Driller Jar	NP
10	122190	Yes	N/A	Yes	Driller Jar	NP

2nd Review

Were all containers scanned into storage/lab? Initials AG

Are barcode labels on correct containers? Yes / No

Are all Flashpoint stickers attached/container ID # circled? Yes / No / NA

Are all Hex Chrome stickers attached? Yes / No / NA

Are all QC stickers attached? Yes / No / NA

Are VOA stickers attached if bubbles noted? Yes / No / NA

Completed By: [signature] Date & Time: 12/22/20 19:17

Reviewed By: [signature] Date & Time: 12/22/20 1930

Delivered By: [signature] 12/22/20 1930

RECEIVED 12/30/2020 RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT OFFICE OF WASTE MANAGEMENT

185 Frances Avenue
Cranston, RI 02921
Phone: 401-461-7181
Fax: 401-461-4486
www.esslaboratory.com

CTS

CHAIN OF CUSTODY

ESS Lab # 2010755 | Page 1 of 3

Turn Time: ☐ >5 ☒ 5 ☐ 4 ☐ 3 ☐ 2 ☐ 1 ☐ Same Day

Regulatory State: RI Criteria: * See comment

Is this project for any of the following?: * See comment

☐ CT RCP ☐ MA MCP ☐ RGP ☐ Permit ☐ 401 WQ

ELECTRONIC DELIVERABLES (Final Reports are PDF)

☒ Limit Checker ☐ State Forms ☐ EQuIS
☒ Excel ☐ Hard Copy ☐ Enviro Data
☐ CLP-Like Package ☐ Other (Specify) →

CLIENT INFORMATION

Client: VHB
Address: 1 Cedar St. Suite 400
Providence RI
Phone: 401-574-5220
Email Distribution List: fpenn@vhb.com
tylerphillips@vhb.com

PROJECT INFORMATION

Project Name: Revolution Wind
Project Location: North Kingstown RI
Project Number: 73030.00
Project Manager: Sue Moberg
Bill to: vhb_ri_ap@vhb.com
PO#:
Quote#: Portion provided by Kevin Brown

Client acknowledges that sampling is compliant with all EPA / State regulatory programs

REQUESTED ANALYSES

ESS Lab ID	Collection Date	Collection Time	Sample Type	Sample Matrix	Sample ID	Total Organic Carbon	Grain Size	% Moisture	TPH	SVOCs	PCBs	Total As, Cd, Cr, Cu, Pb, Ni, Zn	Total Pb, Ag, Ni, Zn	TCLP As, Cd, Cr, Pb,	TCLP Hg, Ni, Ba, Se, Ag	Total Number of Bottles
1	12/21/20	1200	Comp	Sediment	REV01-ENV-04 (0-2')	X	X	X	X	X	X	X	X	X	X	3
2		1225			REV01-ENV-04 (2-9.5')											
3		1250			REV01-ENV-04 (9.5-11.5')											
4		1315			REV01-ENV-04 (11.5-16.5')											
5		1342			REV01-ENV-02 (0-5.5')											
6		1400			REV01-ENV-DUP-02 (0-5.5')											
7		1410			REV01-ENV-02 (5.5-8.5')											
8		1420			REV01-ENV-02 (8.5-13')											
9		1433			REV01-ENV-02 (13-16')											
10		1522			REV01-ENV-05 (0-2.5')											1

Container Type:	AC-Air Cassette	AG-Amber Glass	B-BOD Bottle	C-Cubitainer	J-Jar	O-Other	P-Poly	S-Sterile	V-Vial	J	
Container Volume:	1-100 mL	2-2.5 gal	3-250 mL	4-300 mL	5-500 mL	6-1L	7-VOA	8-2 oz	9-4 oz	10-8 oz	11-Other*	10	
Preservation Code:	1-Non Preserved	2-HCl	3-H2SO4	4-HNO3	5-NaOH	6-Methanol	7-Na2S2O3	8-ZnAce, NaOH	9-NH4Cl	10-DI H2O	11-Other*	1	

Sampled by: FTB

Chain needs to be filled out neatly and completely for on time delivery.

Laboratory Use Only
Cooler Temperature (°C): 6.8

Comments: * Please specify "Other" preservative and containers types in this space
Regulatory criteria, approved methods and DL/MDL requirements are on the attached RIDEM/CRMC app. Compare to Revett criteria.

All samples submitted are subject to ESS Laboratory's payment terms and conditions.

Dissolved Filtration
☐ Lab Filter

Relinquished by (Signature)	Date	Time	Received by (Signature)	Relinquished by (Signature)	Date	Time	Received by (Signature)
[signature]	12/22/20	1450	[signature] 12/22/20 17:08	[signature]	12/22/20	18:03	Amber Jarvis
[signature]	12/23/20	9:38	[signature]				

RECEIVED
DEC 30 2020
RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF WASTE MANAGEMENT

185 Frances Avenue
Cranston, RI 02921
Phone: 401-461-7181
Fax: 401-461-4486
www.esslaboratory.com

CHAIN OF CUSTODY

ESS Lab # 2010755 | Page 1 of 3

Turn Time: ☐ >5 ☒ 5 ☐ 4 ☐ 3 ☐ 2 ☐ 1 ☐ Same Day
Regulatory State: RI Criteria: * See comment
Is this project for any of the following?: * See comment
☐ CT RCP ☐ MA MCP ☐ RGP ☐ Permit ☐ 401 WQ

ELECTRONIC DELIVERABLES (Final Reports are PDF)
☒ Limit Checker ☐ State Forms ☐ EQuIS
☒ Excel ☐ Hard Copy ☐ Enviro Data
☐ CLP-Like Package ☐ Other (Specify) →

CLIENT INFORMATION

Client: VHB
Address: 1 Cedar St. Suite 400
Providence RI
Phone: 401-536-5226
Email Distribution List: FRevins@vhb.com
tylerphillips@vhb.com

PROJECT INFORMATION

Project Name: Revolution Wind
Project Location: North Kingstown RI
Project Number: 73030.00
Project Manager: Sue Moberg
Bill to: vhb_ri_apc@vhb.com
PO#:
Quote#: Prices provided by Kevin Brosa

Client acknowledges that sampling is compliant with all EPA / State regulatory programs

REQUESTED ANALYSES

ESS Lab ID	Collection Date	Collection Time	Sample Type	Sample Matrix	Sample ID	Total Organic Carbon	Grain Size	% Moisture	TPH	SVOCs	PCBs	Total As, Cd, Cr, Pb, Hg, Ni, Zn	Total Pb, Hg, Ni, Zn	TCLP As, Cd, Cr, Pb, Hg, Ni, Ba, Se, Ag	Total Number of Bottles
1	12/21/20	1200	Comp	Sediment	REV01-ENV-04 (0-2')	X	X	X	X	X	X	X	X	X	3
2		1225			REV01-ENV-04 (2-9.5')										
3		1250			REV01-ENV-04 (9.5-11.5')										
4		1315			REV01-ENV-04 (11.5-16.5')										
5		1342			REV01-ENV-02 (0-5.5')										
6		1400			REV01-ENV-DUP200 (0-5.5')										
7		1410			REV01-ENV-02 (5.5-8.5')										
8		1420			REV01-ENV-02 (8.5-12')										
9		1433			REV01-ENV-02 (12-16')										
10		1522			REV01-ENV-05 (0-2.5')										
															1
															10
															1

Container Type: AC-Air Cassette AG-Amber Glass B-BOD Bottle C-Cubitainer J-Jar O-Other P-Poly S-Sterile V-Vial
Container Volume: 1-100 mL 2-2.5 gal 3-250 mL 4-300 mL 5-500 mL 6-1L 7-VOA 8-2 oz 9-4 oz 10-8 oz 11-Other*
Preservation Code: 1-Non Preserved 2-HCl 3-H2SO4 4-HNO3 5-NaOH 6-Methanol 7-Na2S2O3 8-ZnAce, NaOH 9-NH4Cl 10-DI H2O 11-Other*

Sampled by : FTB

Chain needs to be filled out neatly and completely for on time delivery.

Laboratory Use Only
Cooler Temperature (°C): 6.8

Comments: * Please specify "Other" preservative and containers types in this space
Regulatory criteria, approved methods and DL/MDL requirements are on the attached RIDEM/CRMC app. Compare to current criteria.

All samples submitted are subject to ESS Laboratory's payment terms and conditions.

Dissolved Filtration
☐ Lab Filter

Relinquished by (Signature)	Date	Time	Received by (Signature)	Relinquished by (Signature)	Date	Time	Received by (Signature)
[signature]	12/22/20	1450	[signature] 12/22/20 17:28	[signature]	12/22/20	18:03	Amber Jarvis
Relinquished by (Signature)	Date	Time	Received by (Signature)	Relinquished by (Signature)	Date	Time	Received by (Signature)

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Date: June 23, 2020 Applicant(s): DWW Rev I, LLC

Project Name: Revolution Wind Address: 56 Exchange Terrace Ste 300, Prov. RI 02903

Estimated Volume of Dredge (cy): TBD New (cy): TBD Maintenance (cy): 0

Area of Dredge (sf): TBD Depth of Dredge: 13 feet

Proposed Disposal Location (include Plat/Lot if on land): N/A

WQ Class of Dredge Area (if known): SB GW Class of Disposal Area (if, known): SB

Sediment Sampling Plan for Dredging Projects

Submit Site plan 8½" x 11" (Google Earth printout and Navigation Chart or engineered plans) Mark all within 200' of proposed dredge limits:

- ☐ Outfalls and Gas docks or any other potential areas of contamination
- ☐ eelgrass, salt marsh, flounder or shellfish habitat
- ☐ Proposed dredge footprint and average depth of dredge

Proposed Depth of Samples 13 feet
Proposed Coring Method vibracore
# of Sampling Locations 22

Submit Proposed Analysis and detection limits depending on disposal location: The detection limits for an analyte should be no greater than one-third (one-half log unit) of the appropriate value for the analyte and matrix of concern. Whenever possible, an MDL of three to five times below the criteria is expected: If the criteria are Non-Detect then the procedures and MRL's set forth in the OTM (USEPA and USACE 1991) below are appropriate to follow. In-water disposal must meet all Army Corps Requirements.

Place a ☐*CHECK* in each box you are proposing to sample and *CIRCLE* intended laboratory method.

Sample	Beach Criteria	CAD Cap Criteria	GA Leachability Criteria TCLP/SPLP	Residential Disposal Criteria[1]	Commercial/ Industrial Exposure[2]	TCLP Criteria for Haz. Waste[3]	Acceptable EPA Method(s)	MRL**
Grain Size	☐<10% silt/clay	☐	☐	☐	☐	☐		
% Moisture	☐<25%	☐	☐	☐	☐	☐		
TPH	☐ND	☐	☐500 mg/kg	☐500 mg/kg	☐2500 mg/kg		SW 8015C	100 mg/Kg
SVOC		☐	☐Table 2[2]	☐Table1[1]	☐Table1[2]		8270 SIM	10 ug/Kg
PCB	☐*ND	☐0.4 mg/kg	☐10 mg/kg	☐10 mg/kg	☐10 mg/kg		8082	*.02 mg/Kg
PAH		☐4.0 mg/kg					8270– Six (6) Tier 1 compounds	
Arsenic (As)	☐1.7 mg/kg	☐10 mg/kg		☐7.0 mg/kg	☐7.0 mg/kg	☐5.0 mg/L	6010,6020,7061,7062,7000, 7010	0.4 mg/Kg
Cadmium (Cd)	☐1 mg/kg	☐5 mg/kg	☐0.03 mg/L	☐39 mg/kg	☐1000 mg/kg	☐1.0 mg/L	6010,6020,7000,7010	0.07 mg/Kg
Chromium (Cr)	☐10 mg/kg	☐100 mg/kg	☐1.1 mg/L	☐390 mg/kg	☐10000 mg/kg	☐5.0 mg/L	6010,6020,7000,7010	0.5 mg/Kg
Copper (Cu)	☐10 mg/kg	☐200 mg/kg		☐3100 mg/kg	☐10000 mg/kg		6010,6020,7000,7010	0.5 mg/Kg
Lead (Pb)	☐25 mg/kg	☐100 mg/kg	☐0.04 mg/L	☐150 mg/kg	☐500 mg/kg	☐5.0 mg/L	6010,6020,7000, 7010	0.5 mg/Kg
Mercury (Hg)	☐0.5 mg/kg	☐0.5 mg/kg	☐0.02 mg/L	☐23 mg/kg	☐610 mg/kg	☐0.2 mg/L	7470,7471,7472	0.07 mg/Kg
Nickel (Ni)	☐5 mg/kg	☐50 mg/kg	☐1 mg/L	☐1000 mg/kg			6010, 6020,7000, 7010	0.5 mg/Kg
Zinc (Zn)	☐25 mg/kg	☐200 mg/kg		☐6000 mg/kg			6010,6020,7000,7010	1.0 mg/Kg
TCLP or SPLP							1311 or 1312	
Barium (Ba)						☐100 mg/L	6010, 6020	
Selenium (Se)						☐1.0 mg/L	6010, 6020, 7741, 7742	
Silver (Ag)						☐5.0 mg/L	6010, 6020	

* For each arochlor **For Beach Critera – any other MRL should be at least three to five times below the criteria

[1] Residential Direct Exposure Criteria are defined in Table 1 in Section 8 of the Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases.

[2] Commercial/Industrial Direct Exposure Criteria are defined in Table 1 in Section 8 of the Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases.

[3] GA Leachability Criteria are defined in Table 2 in Section 8 of the Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases.

Approvals

Dredge Coordinator (CRMC): _____ Date: 7/7/2020

WQC Program (DEM): _____ Date: 7-3-2020

GW Program (DEM), if upland _____ Date: _____

Dredge Coordinator (DEM): _____ Date: 7/3/2020

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MANAGEMENT COUNCIL

Grain Size Table

Sediment Size Classes in SSFATE in Imperial (thou) and Metric (micron) units. A thou is 1/1000th of an inch.			
Class	Type	Size Range Imperial Units (thou)	Size Range Metric Units (microns)
1	Clay	0 – 0.3	0-7
2	Fine silt	0.3 – 1.4	7-35
3	Coarse silt	1.4 – 2.9	35-74
4	Fine sand	2.9 – 5.1	74-130
5	Coarse sand	> 5.1	>130

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CERTIFICATE OF ANALYSIS

Sue Moberg
Vanasse Hangen Brustlin, Inc.
1 Cedar Street Suite 400
Providence, RI 02903

RE: Rev Wind (73030.00)
ESS Laboratory Work Order Number: 20L0756

This signed Certificate of Analysis is our approved release of your analytical results. These results are only representative of sample aliquots received at the laboratory. ESS Laboratory expects its clients to follow all regulatory sampling guidelines. Beginning with this page, the entire report has been paginated. This report should not be copied except in full without the approval of the laboratory. Samples will be disposed of thirty days after the final report has been delivered. If you have any questions or concerns, please feel free to call our Customer Service Department.

Laurel Stoddard
Laboratory Director

REVIEWED
By ESS Laboratory at 4:57 pm, Jan 04, 2021

Analytical Summary
The project as described above has been analyzed in accordance with the ESS Quality Assurance Plan. This plan utilizes the following methodologies: US EPA SW-846, US EPA Methods for Chemical Analysis of Water and Wastes per 40 CFR Part 136, APHA Standard Methods for the Examination of Water and Wastewater, American Society for Testing and Materials (ASTM), and other recognized methodologies. The analyses with these noted observations are in conformance to the Quality Assurance Plan. In chromatographic analysis, manual integration is frequently used instead of automated integration because it produces more accurate results.

The test results present in this report are in compliance with TNI and relative state standards, and/or client Quality Assurance Project Plans (QAPP). The laboratory has reviewed the following: Sample Preservations, Hold Times, Initial Calibrations, Continuing Calibrations, Method Blanks, Blank Spikes, Blank Spike Duplicates, Duplicates, Matrix Spikes, Matrix Spike Duplicates, Surrogates and Internal Standards. Any results which were found to be outside of the recommended ranges stated in our SOPs will be noted in the Project Narrative.

Subcontracted Analyses

CTS - Cranston, RI	Grain Size Analysis

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind

ESS Laboratory Work Order: 20L0756

SAMPLE RECEIPT

The following samples were received on December 22, 2020 for the analyses specified on the enclosed Chain of Custody Record.

The cooler temperature was not within the acceptance limit of <6°C, however, samples were delivered on ice and therefore meet regulatory criteria.

Lab Number	Sample Name	Matrix	Analysis
20L0756-01	REV01-ENV-05 2.5-7.5	Sediment	1311, 1311/6010C, 1311/7470A, 2540G, 6010C, 7471B, 8082A, 8100M, 8270D, 9060, SUB
20L0756-02	REV01-ENV-05 7.5-13.5	Sediment	1311, 1311/6010C, 1311/7470A, 2540G, 6010C, 7471B, 8082A, 8100M, 8270D, 9060, SUB
20L0756-03	REV01-ENV-05 13.5-15.5	Sediment	1311, 1311/6010C, 1311/7470A, 2540G, 6010C, 7471B, 8082A, 8100M, 8270D, 9060, SUB
20L0756-04	REV01-ENV-03A 0-5	Sediment	1311, 1311/6010C, 1311/7470A, 2540G, 6010C, 7471B, 8082A, 8100M, 8270D, 9060, SUB
20L0756-05	REV01-ENV-03A 5-7.5	Sediment	1311, 1311/6010C, 1311/7470A, 2540G, 6010C, 7471B, 8082A, 8100M, 8270D, 9060, SUB
20L0756-06	REV01-ENV-03A 7.5-10.5	Sediment	1311, 1311/6010C, 1311/7470A, 2540G, 6010C, 7471B, 8082A, 8100M, 8270D, 9060, SUB
20L0756-07	REV01-ENV-03A 10.5-13	Sediment	1311, 1311/6010C, 1311/7470A, 2540G, 6010C, 7471B, 8082A, 8100M, 8270D, 9060, SUB
20L0756-08	REV01-ENV-06 0-4.5	Sediment	1311, 1311/6010C, 1311/7470A, 2540G, 6010C, 7471B, 8082A, 8100M, 8270D, 9060, SUB
20L0756-09	REV01-ENV-06 4.5-10	Sediment	1311, 1311/6010C, 1311/7470A, 2540G, 6010C, 7471B, 8082A, 8100M, 8270D, 9060, SUB
20L0756-10	REV01-ENV-06 10-15	Sediment	1311, 1311/6010C, 1311/7470A, 2540G, 6010C, 7471B, 8082A, 8100M, 8270D, 9060, SUB
20L0756-11	REV01-ENV-01 0-11.5	Sediment	1311, 1311/6010C, 1311/7470A, 2540G, 6010C, 7471B, 8082A, 8100M, 8270D, 9060, SUB

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind

ESS Laboratory Work Order: 20L0756

PROJECT NARRATIVE

8100M Total Petroleum Hydrocarbons

D0L0485-CCV3 **Continuing Calibration %Diff/Drift is above control limit (CD+).**
Hexadecane (C16) (21% @ 20%)

D0L0527-CCV2 **Continuing Calibration %Diff/Drift is above control limit (CD+).**
Dodecane (C12) (21% @ 20%)

8270D Semi-Volatile Organic Compounds

D0L0410-CCV1 **Analyte does not meet the Relative Response Factor (RRF) criteria in the calibration**
2,4-Dinitrophenol (81% @ 80-120%), Benzo(a)pyrene (106% @ 80-120%)

D0L0410-CCV1 **Calibration required quadratic regression (Q).**
2,4-Dinitrophenol (81% @ 80-120%), 4,6-Dinitro-2-Methylphenol (83% @ 80-120%), Benzoic Acid (81% @ 80-120%), Pentachlorophenol (95% @ 80-120%)

D0L0410-CCV1 **Continuing Calibration %Diff/Drift is above control limit (CD+).**
2-Nitroaniline (23% @ 20%), N-Nitroso-Di-n-Propylamine (25% @ 20%), Phenol (24% @ 20%)

D0L0410-CCV1 **Continuing Calibration %Diff/Drift is below control limit (CD-).**
Hexachlorocyclopentadiene (32% @ 20%)

D0L0410-CCV1 **Initial Calibration Verification recovery is below lower control limit (ICV-).**
Hexachlorocyclopentadiene

D0L0410-TUN1 **Benzidine tailing factor >2.**

D0L0410-TUN1 **Pentachlorophenol tailing factor > 2.**

D0L0440-CCV1 **Analyte does not meet the Relative Response Factor (RRF) criteria in the calibration**
2,4-Dinitrophenol (53% @ 80-120%), Benzo(a)pyrene (95% @ 80-120%)

D0L0440-CCV1 **Calibration required quadratic regression (Q).**
2,4-Dinitrophenol (53% @ 80-120%), 4,6-Dinitro-2-Methylphenol (67% @ 80-120%), Benzoic Acid (69% @ 80-120%), Pentachlorophenol (90% @ 80-120%)

D0L0440-CCV1 **Continuing Calibration %Diff/Drift is below control limit (CD-).**
2,4-Dinitrophenol (47% @ 20%), 4,6-Dinitro-2-Methylphenol (33% @ 20%), Benzoic Acid (31% @ 20%)

D0L0440-CCV1 **Initial Calibration Verification recovery is below lower control limit (ICV-).**
Hexachlorocyclopentadiene

D0L0497-CCV1 **Analyte does not meet the Relative Response Factor (RRF) criteria in the calibration**
Benzo(a)pyrene (94% @ 80-120%)

D0L0497-CCV1 **Calibration required quadratic regression (Q).**
2,4-Dinitrophenol (90% @ 80-120%), 4,6-Dinitro-2-Methylphenol (96% @ 80-120%), Benzoic Acid (90% @ 80-120%), Pentachlorophenol (105% @ 80-120%)

D0L0497-CCV1 **Continuing Calibration %Diff/Drift is above control limit (CD+).**
Hexachlorobutadiene (32% @ 20%), Nitrobenzene (24% @ 20%), Nitrobenzene-d5 (21% @ 20%)

D0L0497-CCV1 **Continuing Calibration %Diff/Drift is below control limit (CD-).**
4-Nitroaniline (23% @ 20%), bis(2-Ethylhexyl)phthalate (27% @ 20%), Butylbenzylphthalate (25% @ 20%), Di-n-octylphthalate (32% @ 20%)

D0L0497-CCV1 **Initial Calibration Verification recovery is below lower control limit (ICV-).**
Hexachlorocyclopentadiene

D0L0497-TUN1 **Benzidine tailing factor >2.**

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind ESS Laboratory Work Order: 20L0756

D0L0497-TUN1 **Pentachlorophenol tailing factor > 2.**

DL02238-BSD1 **Relative percent difference for duplicate is outside of criteria (D+).**
4-Chloroaniline (32% @ 30%)

No other observations noted.

End of Project Narrative.

DATA USABILITY LINKS

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Definitions of Quality Control Parameters

Semivolatile Organics Internal Standard Information

Semivolatile Organics Surrogate Information

Volatile Organics Internal Standard Information

Volatile Organics Surrogate Information

EPH and VPH Alkane Lists

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind

ESS Laboratory Work Order: 20L0756

CURRENT SW-846 METHODOLOGY VERSIONS

Analytical Methods

1010A - Flashpoint
6010C - ICP
6020A - ICP MS
7010 - Graphite Furnace
7196A - Hexavalent Chromium
7470A - Aqueous Mercury
7471B - Solid Mercury
8011 - EDB/DBCP/TCP
8015C - GRO/DRO
8081B - Pesticides
8082A - PCB
8100M - TPH
8151A - Herbicides
8260B - VOA
8270D - SVOA
8270D SIM - SVOA Low Level
9014 - Cyanide
9038 - Sulfate
9040C - Aqueous pH
9045D - Solid pH (Corrosivity)
9050A - Specific Conductance
9056A - Anions (IC)
9060A - TOC
9095B - Paint Filter
MADEP 04-1.1 - EPH
MADEP 18-2.1 - VPH

Prep Methods

3005A - Aqueous ICP Digestion
3020A - Aqueous Graphite Furnace / ICP MS Digestion
3050B - Solid ICP / Graphite Furnace / ICP MS Digestion
3060A - Solid Hexavalent Chromium Digestion
3510C - Separatory Funnel Extraction
3520C - Liquid / Liquid Extraction
3540C - Manual Soxhlet Extraction
3541 - Automated Soxhlet Extraction
3546 - Microwave Extraction
3580A - Waste Dilution
5030B - Aqueous Purge and Trap
5030C - Aqueous Purge and Trap
5035A - Solid Purge and Trap

SW846 Reactivity Methods 7.3.3.2 (Reactive Cyanide) and 7.3.4.1 (Reactive Sulfide) have been withdrawn by EPA. These methods are reported per client request and are not NELAP accredited.

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-05 2.5-7.5
Date Sampled: 12/21/20 15:28
Percent Solids: 83

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-01
Sample Matrix: Sediment
Units: mg/kg dry

Extraction Method: 3050B

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	**1.14** (0.45)		6010C		1	KJK	12/29/20 16:51	5.32	100	DL02839
Cadmium	ND (0.23)		6010C		1	KJK	12/29/20 16:51	5.32	100	DL02839
Chromium	**1.97** (0.45)		6010C		1	KJK	12/29/20 16:51	5.32	100	DL02839
Copper	**2.38** (1.13)		6010C		1	KJK	12/29/20 16:51	5.32	100	DL02839
Lead	**2.14** (1.13)		6010C		1	KJK	12/29/20 16:51	5.32	100	DL02839
Mercury	ND (0.012)		7471B		1	MKS	12/29/20 11:49	2.04	40	DL02841
Nickel	**1.92** (1.13)		6010C		1	KJK	12/29/20 16:51	5.32	100	DL02839
Zinc	**15.4** (1.13)		6010C		1	KJK	12/29/20 16:51	5.32	100	DL02839

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CERTIFICATE OF ANALYSIS

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Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-05 2.5-7.5
Date Sampled: 12/21/20 15:28
Percent Solids: 83

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-01
Sample Matrix: Sediment
Units: mg/L

Extraction Method: 3005A TCLP

1311 TCLP Metals

Analyte	Results (MRL)	MDL	Method	TCLP Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:31	50	50	DL02423
Barium	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:31	50	50	DL02423
Cadmium	ND (0.0100)		1311/6010C		1	BJV	12/28/20 11:31	50	50	DL02423
Chromium	ND (0.020)		1311/6010C		1	BJV	12/28/20 11:31	50	50	DL02423
Lead	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:31	50	50	DL02423
Mercury	ND (0.00050)		1311/7470A		1	MKS	12/28/20 12:22	20	40	DL02430
Nickel	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:31	50	50	DL02423
Selenium	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:31	50	50	DL02423
Silver	ND (0.010)		1311/6010C		1	BJV	12/28/20 11:31	50	50	DL02423

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Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-05 2.5-7.5
Date Sampled: 12/21/20 15:28
Percent Solids: 83
Initial Volume: 19.8
Final Volume: 10
Extraction Method: 3540C

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-01
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: MJV
Prepared: 12/22/20 21:03

8082A Polychlorinated Biphenyls (PCB)

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aroclor 1016	ND (0.06)		8082A		1	12/23/20 17:24		DL02204
Aroclor 1221	ND (0.06)		8082A		1	12/23/20 17:24		DL02204
Aroclor 1232	ND (0.06)		8082A		1	12/23/20 17:24		DL02204
Aroclor 1242	ND (0.06)		8082A		1	12/23/20 17:24		DL02204
Aroclor 1248	ND (0.06)		8082A		1	12/23/20 17:24		DL02204
Aroclor 1254	ND (0.06)		8082A		1	12/23/20 17:24		DL02204
Aroclor 1260	ND (0.06)		8082A		1	12/23/20 17:24		DL02204
Aroclor 1262	ND (0.06)		8082A		1	12/23/20 17:24		DL02204
Aroclor 1268	ND (0.06)		8082A		1	12/23/20 17:24		DL02204

	%Recovery	Qualifier	Limits
Surrogate: Decachlorobiphenyl	*53 %*		*30-150*
Surrogate: Decachlorobiphenyl [2C]	*64 %*		*30-150*
Surrogate: Tetrachloro-m-xylene	*40 %*		*30-150*
Surrogate: Tetrachloro-m-xylene [2C]	*52 %*		*30-150*

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Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-05 2.5-7.5
Date Sampled: 12/21/20 15:28
Percent Solids: 83
Initial Volume: 20.3
Final Volume: 1
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-01
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: AMF
Prepared: 12/28/20 20:00

8100M Total Petroleum Hydrocarbons

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Total Petroleum Hydrocarbons	ND (44.4)		8100M		1	12/29/20 19:16	D0L0529	DL02826

	%Recovery	Qualifier	Limits
Surrogate: O-Terphenyl	*76 %*		*40-140*

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Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-05 2.5-7.5
Date Sampled: 12/21/20 15:28
Percent Solids: 83
Initial Volume: 14.4
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-01
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/22/20 22:00

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,1-Biphenyl	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
1,2,4-Trichlorobenzene	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
1,2-Dichlorobenzene	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
1,3-Dichlorobenzene	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
1,4-Dichlorobenzene	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
2,3,4,6-Tetrachlorophenol	ND (2.09)		8270D		1	12/29/20 0:37	D0L0497	DL02238
2,4,5-Trichlorophenol	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
2,4,6-Trichlorophenol	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
2,4-Dichlorophenol	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
2,4-Dimethylphenol	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
2,4-Dinitrophenol	ND (2.09)		8270D		1	12/29/20 0:37	D0L0497	DL02238
2,4-Dinitrotoluene	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
2,6-Dinitrotoluene	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
2-Chloronaphthalene	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
2-Chlorophenol	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
2-Methylnaphthalene	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
2-Methylphenol	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
2-Nitroaniline	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
2-Nitrophenol	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
3,3′-Dichlorobenzidine	ND (0.835)		8270D		1	12/29/20 0:37	D0L0497	DL02238
3+4-Methylphenol	ND (0.835)		8270D		1	12/29/20 0:37	D0L0497	DL02238
3-Nitroaniline	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
4,6-Dinitro-2-Methylphenol	ND (2.09)		8270D		1	12/29/20 0:37	D0L0497	DL02238
4-Bromophenyl-phenylether	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
4-Chloro-3-Methylphenol	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
4-Chloroaniline	ND (0.835)		8270D		1	12/29/20 0:37	D0L0497	DL02238
4-Chloro-phenyl-phenyl ether	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
4-Nitroaniline	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
4-Nitrophenol	ND (2.09)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Acenaphthene	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Acenaphthylene	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Acetophenone	ND (0.835)		8270D		1	12/29/20 0:37	D0L0497	DL02238

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-05 2.5-7.5
Date Sampled: 12/21/20 15:28
Percent Solids: 83
Initial Volume: 14.4
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-01
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/22/20 22:00

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aniline	ND (0.835)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Anthracene	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Azobenzene	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Benzo(a)anthracene	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Benzo(a)pyrene	ND (0.209)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Benzo(b)fluoranthene	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Benzo(g,h,i)perylene	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Benzo(k)fluoranthene	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Benzoic Acid	ND (2.09)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Benzyl Alcohol	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
bis(2-Chloroethoxy)methane	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
bis(2-Chloroethyl)ether	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
bis(2-chloroisopropyl)Ether	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
bis(2-Ethylhexyl)phthalate	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Butylbenzylphthalate	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Carbazole	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Chrysene	ND (0.209)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Dibenzo(a,h)Anthracene	ND (0.209)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Dibenzofuran	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Diethylphthalate	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Dimethylphthalate	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Di-n-butylphthalate	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Di-n-octylphthalate	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Fluoranthene	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Fluorene	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Hexachlorobenzene	ND (0.209)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Hexachlorobutadiene	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Hexachlorocyclopentadiene	ND (2.09)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Hexachloroethane	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Indeno(1,2,3-cd)Pyrene	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Isophorone	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Naphthalene	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-05 2.5-7.5
Date Sampled: 12/21/20 15:28
Percent Solids: 83
Initial Volume: 14.4
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-01
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/22/20 22:00

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Nitrobenzene	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
N-Nitrosodimethylamine	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
N-Nitroso-Di-n-Propylamine	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
N-nitrosodiphenylamine	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Pentachlorophenol	ND (2.09)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Phenanthrene	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Phenol	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Pyrene	ND (0.417)		8270D		1	12/29/20 0:37	D0L0497	DL02238
Pyridine	ND (2.09)		8270D		1	12/29/20 0:37	D0L0497	DL02238

	%Recovery	Qualifier	Limits
Surrogate: 1,2-Dichlorobenzene-d4	*68 %*		*30-130*
Surrogate: 2,4,6-Tribromophenol	*88 %*		*30-130*
Surrogate: 2-Chlorophenol-d4	*65 %*		*30-130*
Surrogate: 2-Fluorobiphenyl	*76 %*		*30-130*
Surrogate: 2-Fluorophenol	*78 %*		*30-130*
Surrogate: Nitrobenzene-d5	*86 %*		*30-130*
Surrogate: Phenol-d6	*84 %*		*30-130*
Surrogate: p-Terphenyl-d14	*93 %*		*30-130*

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Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-05 2.5-7.5
Date Sampled: 12/21/20 15:28
Percent Solids: 83

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-01
Sample Matrix: Sediment

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Percent Moisture	**17** (1)		2540G		1	JMG	12/23/20 17:08	%	DL02316
Total Organic Carbon (Average)	**1110** (93.4)		9060		1	CCP	12/29/20 9:39	mg/kg dry	[CALC]

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-05 2.5-7.5
Date Sampled: 12/21/20 15:28

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-01
Sample Matrix: Sediment

Subcontracted Analysis

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Grain Size	**See Attached** (N/A)								

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-05 2.5-7.5
Date Sampled: 12/21/20 15:28
Percent Solids: 83
Initial Volume: 100
Final Volume: 2000
Extraction Method: 1311

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-01
Sample Matrix: Sediment
Units: °C
Analyst: CCY
Prepared: 12/23/20 18:22

TCLP Extraction by 1311

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Batch
Temperature (Min C)	**23.2** (N/A)		1311		1	CCY	12/24/20 11:45	DL02348
Temperature (Max C)	**24.5** (N/A)		1311		1	CCY	12/24/20 11:45	DL02348
Temperature (Range)	**Temperature is within 23 +/-2 °C.** (N/A)							

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-05 7.5-13.5
Date Sampled: 12/21/20 15:52
Percent Solids: 84

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-02
Sample Matrix: Sediment
Units: mg/kg dry

Extraction Method: 3050B

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	**1.06** (0.48)		6010C		1	KJK	12/29/20 16:53	5.01	100	DL02839
Cadmium	ND (0.24)		6010C		1	KJK	12/29/20 16:53	5.01	100	DL02839
Chromium	**1.20** (0.48)		6010C		1	KJK	12/29/20 16:53	5.01	100	DL02839
Copper	**1.89** (1.19)		6010C		1	KJK	12/29/20 16:53	5.01	100	DL02839
Lead	**2.08** (1.19)		6010C		1	KJK	12/29/20 16:53	5.01	100	DL02839
Mercury	ND (0.011)		7471B		1	MKS	12/29/20 12:04	2.2	40	DL02841
Nickel	**1.42** (1.19)		6010C		1	KJK	12/29/20 16:53	5.01	100	DL02839
Zinc	**17.6** (1.19)		6010C		1	KJK	12/29/20 16:53	5.01	100	DL02839

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-05 7.5-13.5
Date Sampled: 12/21/20 15:52
Percent Solids: 84

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-02
Sample Matrix: Sediment
Units: mg/L

Extraction Method: 3005A TCLP

1311 TCLP Metals

Analyte	Results (MRL)	MDL	Method	TCLP Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:42	50	50	DL02423
Barium	**0.053** (0.050)		1311/6010C		1	BJV	12/28/20 11:42	50	50	DL02423
Cadmium	ND (0.0100)		1311/6010C		1	BJV	12/28/20 11:42	50	50	DL02423
Chromium	ND (0.020)		1311/6010C		1	BJV	12/28/20 11:42	50	50	DL02423
Lead	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:42	50	50	DL02423
Mercury	ND (0.00050)		1311/7470A		1	MKS	12/28/20 12:33	20	40	DL02430
Nickel	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:42	50	50	DL02423
Selenium	ND (0.050)		1311/6010C		1	BJV	12/28/20 11:42	50	50	DL02423
Silver	ND (0.010)		1311/6010C		1	BJV	12/28/20 11:42	50	50	DL02423

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-05 7.5-13.5
Date Sampled: 12/21/20 15:52
Percent Solids: 84
Initial Volume: 19.7
Final Volume: 10
Extraction Method: 3540C

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-02
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: MJV
Prepared: 12/22/20 21:03

8082A Polychlorinated Biphenyls (PCB)

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aroclor 1016	ND (0.06)		8082A		1	12/23/20 17:44		DL02204
Aroclor 1221	ND (0.06)		8082A		1	12/23/20 17:44		DL02204
Aroclor 1232	ND (0.06)		8082A		1	12/23/20 17:44		DL02204
Aroclor 1242	ND (0.06)		8082A		1	12/23/20 17:44		DL02204
Aroclor 1248	ND (0.06)		8082A		1	12/23/20 17:44		DL02204
Aroclor 1254	ND (0.06)		8082A		1	12/23/20 17:44		DL02204
Aroclor 1260	ND (0.06)		8082A		1	12/23/20 17:44		DL02204
Aroclor 1262	ND (0.06)		8082A		1	12/23/20 17:44		DL02204
Aroclor 1268	ND (0.06)		8082A		1	12/23/20 17:44		DL02204

	%Recovery	*Qualifier*	*Limits*
Surrogate: Decachlorobiphenyl	*87 %*		*30-150*
Surrogate: Decachlorobiphenyl [2C]	*103 %*		*30-150*
Surrogate: Tetrachloro-m-xylene	*69 %*		*30-150*
Surrogate: Tetrachloro-m-xylene [2C]	*95 %*		*30-150*

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-05 7.5-13.5
Date Sampled: 12/21/20 15:52
Percent Solids: 84
Initial Volume: 19.6
Final Volume: 1
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-02
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: AMF
Prepared: 12/22/20 22:00

8100M Total Petroleum Hydrocarbons

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Total Petroleum Hydrocarbons	ND (45.8)		8100M		1	12/25/20 5:23	D0L0485	DL02237

	%Recovery	Qualifier	Limits
Surrogate: O-Terphenyl	*97 %*		*40-140*

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-05 7.5-13.5
Date Sampled: 12/21/20 15:52
Percent Solids: 84
Initial Volume: 15.8
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-02
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/23/20 14:35

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,1-Biphenyl	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
1,2,4-Trichlorobenzene	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
1,2-Dichlorobenzene	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
1,3-Dichlorobenzene	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
1,4-Dichlorobenzene	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
2,3,4,6-Tetrachlorophenol	ND (1.90)		8270D		1	12/29/20 1:06	D0L0497	DL02310
2,4,5-Trichlorophenol	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
2,4,6-Trichlorophenol	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
2,4-Dichlorophenol	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
2,4-Dimethylphenol	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
2,4-Dinitrophenol	ND (1.90)		8270D		1	12/29/20 1:06	D0L0497	DL02310
2,4-Dinitrotoluene	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
2,6-Dinitrotoluene	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
2-Chloronaphthalene	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
2-Chlorophenol	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
2-Methylnaphthalene	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
2-Methylphenol	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
2-Nitroaniline	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
2-Nitrophenol	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
3,3′-Dichlorobenzidine	ND (0.758)		8270D		1	12/29/20 1:06	D0L0497	DL02310
3+4-Methylphenol	ND (0.758)		8270D		1	12/29/20 1:06	D0L0497	DL02310
3-Nitroaniline	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
4,6-Dinitro-2-Methylphenol	ND (1.90)		8270D		1	12/29/20 1:06	D0L0497	DL02310
4-Bromophenyl-phenylether	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
4-Chloro-3-Methylphenol	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
4-Chloroaniline	ND (0.758)		8270D		1	12/29/20 1:06	D0L0497	DL02310
4-Chloro-phenyl-phenyl ether	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
4-Nitroaniline	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
4-Nitrophenol	ND (1.90)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Acenaphthene	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Acenaphthylene	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Acetophenone	ND (0.758)		8270D		1	12/29/20 1:06	D0L0497	DL02310

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-05 7.5-13.5
Date Sampled: 12/21/20 15:52
Percent Solids: 84
Initial Volume: 15.8
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-02
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/23/20 14:35

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aniline	ND (0.758)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Anthracene	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Azobenzene	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Benzo(a)anthracene	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Benzo(a)pyrene	ND (0.190)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Benzo(b)fluoranthene	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Benzo(g,h,i)perylene	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Benzo(k)fluoranthene	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Benzoic Acid	ND (1.90)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Benzyl Alcohol	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
bis(2-Chloroethoxy)methane	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
bis(2-Chloroethyl)ether	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
bis(2-chloroisopropyl)Ether	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
bis(2-Ethylhexyl)phthalate	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Butylbenzylphthalate	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Carbazole	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Chrysene	ND (0.190)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Dibenzo(a,h)Anthracene	ND (0.190)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Dibenzofuran	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Diethylphthalate	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Dimethylphthalate	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Di-n-butylphthalate	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Di-n-octylphthalate	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Fluoranthene	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Fluorene	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Hexachlorobenzene	ND (0.190)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Hexachlorobutadiene	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Hexachlorocyclopentadiene	ND (1.90)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Hexachloroethane	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Indeno(1,2,3-cd)Pyrene	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Isophorone	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Naphthalene	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-05 7.5-13.5
Date Sampled: 12/21/20 15:52
Percent Solids: 84
Initial Volume: 15.8
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-02
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/23/20 14:35

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Nitrobenzene	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
N-Nitrosodimethylamine	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
N-Nitroso-Di-n-Propylamine	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
N-nitrosodiphenylamine	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Pentachlorophenol	ND (1.90)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Phenanthrene	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Phenol	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Pyrene	ND (0.378)		8270D		1	12/29/20 1:06	D0L0497	DL02310
Pyridine	ND (1.90)		8270D		1	12/29/20 1:06	D0L0497	DL02310

	%Recovery	Qualifier	Limits
Surrogate: 1,2-Dichlorobenzene-d4	*63 %*		*30-130*
Surrogate: 2,4,6-Tribromophenol	*73 %*		*30-130*
Surrogate: 2-Chlorophenol-d4	*64 %*		*30-130*
Surrogate: 2-Fluorobiphenyl	*67 %*		*30-130*
Surrogate: 2-Fluorophenol	*71 %*		*30-130*
Surrogate: Nitrobenzene-d5	*78 %*		*30-130*
Surrogate: Phenol-d6	*75 %*		*30-130*
Surrogate: p-Terphenyl-d14	*88 %*		*30-130*

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-05 7.5-13.5
Date Sampled: 12/21/20 15:52
Percent Solids: 84

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-02
Sample Matrix: Sediment

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Percent Moisture	**16** (1)		2540G		1	JMG	12/23/20 17:08	%	DL02316
Total Organic Carbon (Average)	**481** (94.0)		9060		1	CCP	12/29/20 10:12	mg/kg dry	[CALC]

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-05 7.5-13.5
Date Sampled: 12/21/20 15:52

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-02
Sample Matrix: Sediment

Subcontracted Analysis

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Grain Size	**See Attached** (N/A)								

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-05 7.5-13.5
Date Sampled: 12/21/20 15:52
Percent Solids: 84
Initial Volume: 100
Final Volume: 2000
Extraction Method: 1311

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-02
Sample Matrix: Sediment
Units: °C
Analyst: CCY
Prepared: 12/23/20 18:22

TCLP Extraction by 1311

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Batch
Temperature (Min C)	**23.2** (N/A)		1311		1	CCY	12/24/20 11:45	DL02348
Temperature (Max C)	**24.5** (N/A)		1311		1	CCY	12/24/20 11:45	DL02348
Temperature (Range)	**Temperature is within 23 +/-2 °C.** (N/A)							

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-05 13.5-15.5
Date Sampled: 12/21/20 16:00
Percent Solids: 83

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-03
Sample Matrix: Sediment
Units: mg/kg dry

Extraction Method: 3050B

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	ND (1.41)		6010C		3	KJK	12/30/20 14:54	5.14	100	DL02839
Cadmium	ND (0.71)		6010C		3	KJK	12/29/20 19:31	5.14	100	DL02839
Chromium	**5.01** (1.41)		6010C		3	KJK	12/29/20 19:31	5.14	100	DL02839
Copper	**4.26** (3.54)		6010C		3	KJK	12/29/20 19:31	5.14	100	DL02839
Lead	**3.94** (3.54)		6010C		3	KJK	12/29/20 19:31	5.14	100	DL02839
Mercury	ND (0.012)		7471B		1	MKS	12/29/20 12:14	2.01	40	DL02841
Nickel	**4.97** (3.54)		6010C		3	KJK	12/29/20 19:31	5.14	100	DL02839
Zinc	**40.5** (3.54)		6010C		3	KJK	12/29/20 19:31	5.14	100	DL02839

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-05 13.5-15.5
Date Sampled: 12/21/20 16:00
Percent Solids: 83

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-03
Sample Matrix: Sediment
Units: mg/L

Extraction Method: 3005A TCLP

1311 TCLP Metals

Analyte	Results (MRL)	MDL	Method	TCLP Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:00	50	50	DL02423
Barium	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:00	50	50	DL02423
Cadmium	ND (0.0100)		1311/6010C		1	BJV	12/28/20 12:00	50	50	DL02423
Chromium	ND (0.020)		1311/6010C		1	BJV	12/28/20 12:00	50	50	DL02423
Lead	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:00	50	50	DL02423
Mercury	ND (0.00050)		1311/7470A		1	MKS	12/28/20 12:47	20	40	DL02430
Nickel	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:00	50	50	DL02423
Selenium	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:00	50	50	DL02423
Silver	ND (0.010)		1311/6010C		1	BJV	12/28/20 12:00	50	50	DL02423

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-05 13.5-15.5
Date Sampled: 12/21/20 16:00
Percent Solids: 83
Initial Volume: 19.9
Final Volume: 10
Extraction Method: 3540C

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-03
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: MJV
Prepared: 12/22/20 21:03

8082A Polychlorinated Biphenyls (PCB)

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aroclor 1016	ND (0.06)		8082A		1	12/23/20 18:03		DL02204
Aroclor 1221	ND (0.06)		8082A		1	12/23/20 18:03		DL02204
Aroclor 1232	ND (0.06)		8082A		1	12/23/20 18:03		DL02204
Aroclor 1242	ND (0.06)		8082A		1	12/23/20 18:03		DL02204
Aroclor 1248	ND (0.06)		8082A		1	12/23/20 18:03		DL02204
Aroclor 1254	ND (0.06)		8082A		1	12/23/20 18:03		DL02204
Aroclor 1260	ND (0.06)		8082A		1	12/23/20 18:03		DL02204
Aroclor 1262	ND (0.06)		8082A		1	12/23/20 18:03		DL02204
Aroclor 1268	ND (0.06)		8082A		1	12/23/20 18:03		DL02204

	%Recovery	Qualifier	Limits
Surrogate: Decachlorobiphenyl	*85 %*		*30-150*
Surrogate: Decachlorobiphenyl [2C]	*102 %*		*30-150*
Surrogate: Tetrachloro-m-xylene	*67 %*		*30-150*
Surrogate: Tetrachloro-m-xylene [2C]	*94 %*		*30-150*

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-05 13.5-15.5
Date Sampled: 12/21/20 16:00
Percent Solids: 83
Initial Volume: 19.4
Final Volume: 1
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-03
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: AMF
Prepared: 12/22/20 22:00

8100M Total Petroleum Hydrocarbons

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Total Petroleum Hydrocarbons	ND (46.9)		8100M		1	12/25/20 5:56	D0L0485	DL02237

	%Recovery	Qualifier	Limits
Surrogate: O-Terphenyl	*93 %*		*40-140*

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-05 13.5-15.5
Date Sampled: 12/21/20 16:00
Percent Solids: 83
Initial Volume: 14.4
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-03
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/23/20 14:35

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,1-Biphenyl	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
1,2,4-Trichlorobenzene	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
1,2-Dichlorobenzene	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
1,3-Dichlorobenzene	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
1,4-Dichlorobenzene	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
2,3,4,6-Tetrachlorophenol	ND (2.11)		8270D		1	12/29/20 1:35	D0L0497	DL02310
2,4,5-Trichlorophenol	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
2,4,6-Trichlorophenol	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
2,4-Dichlorophenol	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
2,4-Dimethylphenol	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
2,4-Dinitrophenol	ND (2.11)		8270D		1	12/29/20 1:35	D0L0497	DL02310
2,4-Dinitrotoluene	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
2,6-Dinitrotoluene	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
2-Chloronaphthalene	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
2-Chlorophenol	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
2-Methylnaphthalene	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
2-Methylphenol	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
2-Nitroaniline	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
2-Nitrophenol	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
3,3′-Dichlorobenzidine	ND (0.842)		8270D		1	12/29/20 1:35	D0L0497	DL02310
3+4-Methylphenol	ND (0.842)		8270D		1	12/29/20 1:35	D0L0497	DL02310
3-Nitroaniline	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
4,6-Dinitro-2-Methylphenol	ND (2.11)		8270D		1	12/29/20 1:35	D0L0497	DL02310
4-Bromophenyl-phenylether	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
4-Chloro-3-Methylphenol	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
4-Chloroaniline	ND (0.842)		8270D		1	12/29/20 1:35	D0L0497	DL02310
4-Chloro-phenyl-phenyl ether	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
4-Nitroaniline	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
4-Nitrophenol	ND (2.11)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Acenaphthene	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Acenaphthylene	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Acetophenone	ND (0.842)		8270D		1	12/29/20 1:35	D0L0497	DL02310

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-05 13.5-15.5
Date Sampled: 12/21/20 16:00
Percent Solids: 83
Initial Volume: 14.4
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-03
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/23/20 14:35

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aniline	ND (0.842)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Anthracene	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Azobenzene	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Benzo(a)anthracene	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Benzo(a)pyrene	ND (0.211)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Benzo(b)fluoranthene	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Benzo(g,h,i)perylene	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Benzo(k)fluoranthene	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Benzoic Acid	ND (2.11)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Benzyl Alcohol	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
bis(2-Chloroethoxy)methane	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
bis(2-Chloroethyl)ether	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
bis(2-chloroisopropyl)Ether	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
bis(2-Ethylhexyl)phthalate	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Butylbenzylphthalate	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Carbazole	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Chrysene	ND (0.211)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Dibenzo(a,h)Anthracene	ND (0.211)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Dibenzofuran	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Diethylphthalate	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Dimethylphthalate	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Di-n-butylphthalate	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Di-n-octylphthalate	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Fluoranthene	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Fluorene	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Hexachlorobenzene	ND (0.211)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Hexachlorobutadiene	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Hexachlorocyclopentadiene	ND (2.11)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Hexachloroethane	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Indeno(1,2,3-cd)Pyrene	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Isophorone	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Naphthalene	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-05 13.5-15.5
Date Sampled: 12/21/20 16:00
Percent Solids: 83
Initial Volume: 14.4
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-03
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/23/20 14:35

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Nitrobenzene	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
N-Nitrosodimethylamine	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
N-Nitroso-Di-n-Propylamine	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
N-nitrosodiphenylamine	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Pentachlorophenol	ND (2.11)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Phenanthrene	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Phenol	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Pyrene	ND (0.420)		8270D		1	12/29/20 1:35	D0L0497	DL02310
Pyridine	ND (2.11)		8270D		1	12/29/20 1:35	D0L0497	DL02310

	%Recovery	Qualifier	Limits
Surrogate: 1,2-Dichlorobenzene-d4	*58 %*		*30-130*
Surrogate: 2,4,6-Tribromophenol	*66 %*		*30-130*
Surrogate: 2-Chlorophenol-d4	*59 %*		*30-130*
Surrogate: 2-Fluorobiphenyl	*61 %*		*30-130*
Surrogate: 2-Fluorophenol	*65 %*		*30-130*
Surrogate: Nitrobenzene-d5	*70 %*		*30-130*
Surrogate: Phenol-d6	*70 %*		*30-130*
Surrogate: p-Terphenyl-d14	*79 %*		*30-130*

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-05 13.5-15.5
Date Sampled: 12/21/20 16:00
Percent Solids: 83

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-03
Sample Matrix: Sediment

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Percent Moisture	**17** (1)		2540G		1	JMG	12/23/20 17:08	%	DL02316
Total Organic Carbon (Average)	ND (95.9)		9060		1	CCP	12/29/20 10:55	mg/kg dry	[CALC]

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-05 13.5-15.5
Date Sampled: 12/21/20 16:00

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-03
Sample Matrix: Sediment

Subcontracted Analysis

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Grain Size	**See Attached** (N/A)								

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-05 13.5-15.5
Date Sampled: 12/21/20 16:00
Percent Solids: 83
Initial Volume: 100
Final Volume: 2000
Extraction Method: 1311

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-03
Sample Matrix: Sediment
Units: °C
Analyst: CCY
Prepared: 12/23/20 18:22

TCLP Extraction by 1311

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Batch
Temperature (Min C)	**23.2** (N/A)		1311		1	CCY	12/24/20 11:45	DL02348
Temperature (Max C)	**24.5** (N/A)		1311		1	CCY	12/24/20 11:45	DL02348
Temperature (Range)	**Temperature is within 23 +/-2 °C.** (N/A)							

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 0-5
Date Sampled: 12/22/20 12:03
Percent Solids: 82

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-04
Sample Matrix: Sediment
Units: mg/kg dry

Extraction Method: 3050B

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	**1.27** (0.47)		6010C		1	KJK	12/29/20 17:03	5.15	100	DL02839
Cadmium	ND (0.24)		6010C		1	KJK	12/29/20 17:03	5.15	100	DL02839
Chromium	**3.44** (0.47)		6010C		1	KJK	12/29/20 17:03	5.15	100	DL02839
Copper	**3.59** (1.18)		6010C		1	KJK	12/29/20 17:03	5.15	100	DL02839
Lead	**3.13** (1.18)		6010C		1	KJK	12/29/20 17:03	5.15	100	DL02839
Mercury	ND (0.012)		7471B		1	MKS	12/29/20 12:16	2.07	40	DL02841
Nickel	**2.01** (1.18)		6010C		1	KJK	12/29/20 17:03	5.15	100	DL02839
Zinc	**16.1** (1.18)		6010C		1	KJK	12/29/20 17:03	5.15	100	DL02839

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 0-5
Date Sampled: 12/22/20 12:03
Percent Solids: 82

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-04
Sample Matrix: Sediment
Units: mg/L

Extraction Method: 3005A TCLP

1311 TCLP Metals

Analyte	Results (MRL)	MDL	Method	TCLP Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:02	50	50	DL02423
Barium	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:02	50	50	DL02423
Cadmium	ND (0.0100)		1311/6010C		1	BJV	12/28/20 12:02	50	50	DL02423
Chromium	ND (0.020)		1311/6010C		1	BJV	12/28/20 12:02	50	50	DL02423
Lead	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:02	50	50	DL02423
Mercury	ND (0.00050)		1311/7470A		1	MKS	12/28/20 12:49	20	40	DL02430
Nickel	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:02	50	50	DL02423
Selenium	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:02	50	50	DL02423
Silver	ND (0.010)		1311/6010C		1	BJV	12/28/20 12:02	50	50	DL02423

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 0-5
Date Sampled: 12/22/20 12:03
Percent Solids: 82
Initial Volume: 19.7
Final Volume: 10
Extraction Method: 3540C

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-04
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: MJV
Prepared: 12/22/20 21:03

8082A Polychlorinated Biphenyls (PCB)

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aroclor 1016	ND (0.06)		8082A		1	12/23/20 18:23		DL02204
Aroclor 1221	ND (0.06)		8082A		1	12/23/20 18:23		DL02204
Aroclor 1232	ND (0.06)		8082A		1	12/23/20 18:23		DL02204
Aroclor 1242	ND (0.06)		8082A		1	12/23/20 18:23		DL02204
Aroclor 1248	ND (0.06)		8082A		1	12/23/20 18:23		DL02204
Aroclor 1254	ND (0.06)		8082A		1	12/23/20 18:23		DL02204
Aroclor 1260	ND (0.06)		8082A		1	12/23/20 18:23		DL02204
Aroclor 1262	ND (0.06)		8082A		1	12/23/20 18:23		DL02204
Aroclor 1268	ND (0.06)		8082A		1	12/23/20 18:23		DL02204

	%Recovery	Qualifier	Limits
Surrogate: Decachlorobiphenyl	*85 %*		*30-150*
Surrogate: Decachlorobiphenyl [2C]	*108 %*		*30-150*
Surrogate: Tetrachloro-m-xylene	*69 %*		*30-150*
Surrogate: Tetrachloro-m-xylene [2C]	*94 %*		*30-150*

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 0-5
Date Sampled: 12/22/20 12:03
Percent Solids: 82
Initial Volume: 19.1
Final Volume: 1
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-04
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: AMF
Prepared: 12/22/20 22:00

8100M Total Petroleum Hydrocarbons

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Total Petroleum Hydrocarbons	ND (47.8)		8100M		1	12/25/20 6:29	D0L0485	DL02237

	%Recovery	Qualifier	Limits
Surrogate: O-Terphenyl	98 %		40-140

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 0-5
Date Sampled: 12/22/20 12:03
Percent Solids: 82
Initial Volume: 14.6
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-04
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/23/20 14:35

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,1-Biphenyl	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
1,2,4-Trichlorobenzene	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
1,2-Dichlorobenzene	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
1,3-Dichlorobenzene	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
1,4-Dichlorobenzene	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
2,3,4,6-Tetrachlorophenol	ND (2.09)		8270D		1	12/29/20 2:04	D0L0497	DL02310
2,4,5-Trichlorophenol	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
2,4,6-Trichlorophenol	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
2,4-Dichlorophenol	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
2,4-Dimethylphenol	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
2,4-Dinitrophenol	ND (2.09)		8270D		1	12/29/20 2:04	D0L0497	DL02310
2,4-Dinitrotoluene	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
2,6-Dinitrotoluene	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
2-Chloronaphthalene	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
2-Chlorophenol	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
2-Methylnaphthalene	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
2-Methylphenol	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
2-Nitroaniline	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
2-Nitrophenol	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
3,3′-Dichlorobenzidine	ND (0.834)		8270D		1	12/29/20 2:04	D0L0497	DL02310
3+4-Methylphenol	ND (0.834)		8270D		1	12/29/20 2:04	D0L0497	DL02310
3-Nitroaniline	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
4,6-Dinitro-2-Methylphenol	ND (2.09)		8270D		1	12/29/20 2:04	D0L0497	DL02310
4-Bromophenyl-phenylether	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
4-Chloro-3-Methylphenol	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
4-Chloroaniline	ND (0.834)		8270D		1	12/29/20 2:04	D0L0497	DL02310
4-Chloro-phenyl-phenyl ether	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
4-Nitroaniline	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
4-Nitrophenol	ND (2.09)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Acenaphthene	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Acenaphthylene	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Acetophenone	ND (0.834)		8270D		1	12/29/20 2:04	D0L0497	DL02310

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 0-5
Date Sampled: 12/22/20 12:03
Percent Solids: 82
Initial Volume: 14.6
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-04
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/23/20 14:35

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aniline	ND (0.834)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Anthracene	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Azobenzene	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Benzo(a)anthracene	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Benzo(a)pyrene	ND (0.209)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Benzo(b)fluoranthene	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Benzo(g,h,i)perylene	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Benzo(k)fluoranthene	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Benzoic Acid	ND (2.09)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Benzyl Alcohol	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
bis(2-Chloroethoxy)methane	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
bis(2-Chloroethyl)ether	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
bis(2-chloroisopropyl)Ether	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
bis(2-Ethylhexyl)phthalate	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Butylbenzylphthalate	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Carbazole	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Chrysene	ND (0.209)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Dibenzo(a,h)Anthracene	ND (0.209)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Dibenzofuran	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Diethylphthalate	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Dimethylphthalate	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Di-n-butylphthalate	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Di-n-octylphthalate	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Fluoranthene	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Fluorene	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Hexachlorobenzene	ND (0.209)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Hexachlorobutadiene	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Hexachlorocyclopentadiene	ND (2.09)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Hexachloroethane	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Indeno(1,2,3-cd)Pyrene	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Isophorone	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Naphthalene	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 0-5
Date Sampled: 12/22/20 12:03
Percent Solids: 82
Initial Volume: 14.6
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-04
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/23/20 14:35

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Nitrobenzene	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
N-Nitrosodimethylamine	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
N-Nitroso-Di-n-Propylamine	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
N-nitrosodiphenylamine	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Pentachlorophenol	ND (2.09)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Phenanthrene	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Phenol	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Pyrene	ND (0.417)		8270D		1	12/29/20 2:04	D0L0497	DL02310
Pyridine	ND (2.09)		8270D		1	12/29/20 2:04	D0L0497	DL02310

	%Recovery	*Qualifier*	*Limits*
Surrogate: 1,2-Dichlorobenzene-d4	*63 %*		*30-130*
Surrogate: 2,4,6-Tribromophenol	*77 %*		*30-130*
Surrogate: 2-Chlorophenol-d4	*65 %*		*30-130*
Surrogate: 2-Fluorobiphenyl	*71 %*		*30-130*
Surrogate: 2-Fluorophenol	*71 %*		*30-130*
Surrogate: Nitrobenzene-d5	*82 %*		*30-130*
Surrogate: Phenol-d6	*76 %*		*30-130*
Surrogate: p-Terphenyl-d14	*85 %*		*30-130*

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 0-5
Date Sampled: 12/22/20 12:03
Percent Solids: 82

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-04
Sample Matrix: Sediment

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Percent Moisture	**18** (1)		2540G		1	JMG	12/23/20 17:08	%	DL02316
Total Organic Carbon (Average)	ND (96.4)		9060		1	CCP	12/29/20 11:44	mg/kg dry	[CALC]

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 0-5
Date Sampled: 12/22/20 12:03

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-04
Sample Matrix: Sediment

Subcontracted Analysis

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Grain Size	**See Attached** (N/A)								

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 0-5
Date Sampled: 12/22/20 12:03
Percent Solids: 82
Initial Volume: 100
Final Volume: 2000
Extraction Method: 1311

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-04
Sample Matrix: Sediment
Units: °C
Analyst: CCY
Prepared: 12/23/20 18:22

TCLP Extraction by 1311

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Batch
Temperature (Min C)	**23.2** (N/A)		1311		1	CCY	12/24/20 11:45	DL02348
Temperature (Max C)	**24.5** (N/A)		1311		1	CCY	12/24/20 11:45	DL02348
Temperature (Range)	**Temperature is within 23 +/-2 °C.** (N/A)							

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 5-7.5
Date Sampled: 12/22/20 12:10
Percent Solids: 85

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-05
Sample Matrix: Sediment
Units: mg/kg dry

Extraction Method: 3050B

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	**1.10** (0.90)		6010C		2	KJK	12/29/20 18:53	5.26	100	DL02839
Cadmium	ND (0.45)		6010C		2	KJK	12/29/20 18:53	5.26	100	DL02839
Chromium	**1.80** (0.90)		6010C		2	KJK	12/29/20 18:53	5.26	100	DL02839
Copper	**2.49** (2.25)		6010C		2	KJK	12/29/20 18:53	5.26	100	DL02839
Lead	ND (2.25)		6010C		2	KJK	12/29/20 18:53	5.26	100	DL02839
Mercury	ND (0.011)		7471B		1	MKS	12/29/20 12:23	2.08	40	DL02841
Nickel	ND (2.25)		6010C		2	KJK	12/29/20 18:53	5.26	100	DL02839
Zinc	**16.5** (2.25)		6010C		2	KJK	12/29/20 18:53	5.26	100	DL02839

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 5-7.5
Date Sampled: 12/22/20 12:10
Percent Solids: 85

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-05
Sample Matrix: Sediment
Units: mg/L

Extraction Method: 3005A TCLP

1311 TCLP Metals

Analyte	Results (MRL)	MDL	Method	TCLP Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:05	50	50	DL02423
Barium	**0.090** (0.050)		1311/6010C		1	BJV	12/28/20 12:05	50	50	DL02423
Cadmium	ND (0.0100)		1311/6010C		1	BJV	12/28/20 12:05	50	50	DL02423
Chromium	ND (0.020)		1311/6010C		1	BJV	12/28/20 12:05	50	50	DL02423
Lead	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:05	50	50	DL02423
Mercury	ND (0.00050)		1311/7470A		1	MKS	12/28/20 12:51	20	40	DL02430
Nickel	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:05	50	50	DL02423
Selenium	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:05	50	50	DL02423
Silver	ND (0.010)		1311/6010C		1	BJV	12/28/20 12:05	50	50	DL02423

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 5-7.5
Date Sampled: 12/22/20 12:10
Percent Solids: 85
Initial Volume: 19.6
Final Volume: 10
Extraction Method: 3540C

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-05
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: MJV
Prepared: 12/22/20 21:03

8082A Polychlorinated Biphenyls (PCB)

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aroclor 1016	ND (0.06)		8082A		1	12/23/20 18:43		DL02204
Aroclor 1221	ND (0.06)		8082A		1	12/23/20 18:43		DL02204
Aroclor 1232	ND (0.06)		8082A		1	12/23/20 18:43		DL02204
Aroclor 1242	ND (0.06)		8082A		1	12/23/20 18:43		DL02204
Aroclor 1248	ND (0.06)		8082A		1	12/23/20 18:43		DL02204
Aroclor 1254	ND (0.06)		8082A		1	12/23/20 18:43		DL02204
Aroclor 1260	ND (0.06)		8082A		1	12/23/20 18:43		DL02204
Aroclor 1262	ND (0.06)		8082A		1	12/23/20 18:43		DL02204
Aroclor 1268	ND (0.06)		8082A		1	12/23/20 18:43		DL02204

	%Recovery	Qualifier	Limits
Surrogate: Decachlorobiphenyl	*79 %*		*30-150*
Surrogate: Decachlorobiphenyl [2C]	*97 %*		*30-150*
Surrogate: Tetrachloro-m-xylene	*67 %*		*30-150*
Surrogate: Tetrachloro-m-xylene [2C]	*94 %*		*30-150*

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 5-7.5
Date Sampled: 12/22/20 12:10
Percent Solids: 85
Initial Volume: 19.4
Final Volume: 1
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-05
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: AMF
Prepared: 12/22/20 22:00

8100M Total Petroleum Hydrocarbons

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Total Petroleum Hydrocarbons	ND (45.7)		8100M		1	12/25/20 7:02	D0L0485	DL02237

	%Recovery	Qualifier	Limits
Surrogate: O-Terphenyl	*97 %*		*40-140*

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COASTAL RESOURCES MANAGEMENT COUNCIL

CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 5-7.5
Date Sampled: 12/22/20 12:10
Percent Solids: 85
Initial Volume: 14.8
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-05
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/23/20 14:35

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,1-Biphenyl	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
1,2,4-Trichlorobenzene	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
1,2-Dichlorobenzene	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
1,3-Dichlorobenzene	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
1,4-Dichlorobenzene	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
2,3,4,6-Tetrachlorophenol	ND (2.00)		8270D		1	12/29/20 2:33	D0L0497	DL02310
2,4,5-Trichlorophenol	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
2,4,6-Trichlorophenol	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
2,4-Dichlorophenol	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
2,4-Dimethylphenol	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
2,4-Dinitrophenol	ND (2.00)		8270D		1	12/29/20 2:33	D0L0497	DL02310
2,4-Dinitrotoluene	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
2,6-Dinitrotoluene	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
2-Chloronaphthalene	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
2-Chlorophenol	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
2-Methylnaphthalene	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
2-Methylphenol	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
2-Nitroaniline	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
2-Nitrophenol	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
3,3′-Dichlorobenzidine	ND (0.800)		8270D		1	12/29/20 2:33	D0L0497	DL02310
3+4-Methylphenol	ND (0.800)		8270D		1	12/29/20 2:33	D0L0497	DL02310
3-Nitroaniline	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
4,6-Dinitro-2-Methylphenol	ND (2.00)		8270D		1	12/29/20 2:33	D0L0497	DL02310
4-Bromophenyl-phenylether	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
4-Chloro-3-Methylphenol	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
4-Chloroaniline	ND (0.800)		8270D		1	12/29/20 2:33	D0L0497	DL02310
4-Chloro-phenyl-phenyl ether	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
4-Nitroaniline	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
4-Nitrophenol	ND (2.00)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Acenaphthene	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Acenaphthylene	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Acetophenone	ND (0.800)		8270D		1	12/29/20 2:33	D0L0497	DL02310

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 5-7.5
Date Sampled: 12/22/20 12:10
Percent Solids: 85
Initial Volume: 14.8
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-05
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/23/20 14:35

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aniline	ND (0.800)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Anthracene	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Azobenzene	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Benzo(a)anthracene	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Benzo(a)pyrene	ND (0.200)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Benzo(b)fluoranthene	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Benzo(g,h,i)perylene	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Benzo(k)fluoranthene	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Benzoic Acid	ND (2.00)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Benzyl Alcohol	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
bis(2-Chloroethoxy)methane	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
bis(2-Chloroethyl)ether	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
bis(2-chloroisopropyl)Ether	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
bis(2-Ethylhexyl)phthalate	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Butylbenzylphthalate	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Carbazole	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Chrysene	ND (0.200)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Dibenzo(a,h)Anthracene	ND (0.200)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Dibenzofuran	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Diethylphthalate	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Dimethylphthalate	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Di-n-butylphthalate	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Di-n-octylphthalate	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Fluoranthene	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Fluorene	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Hexachlorobenzene	ND (0.200)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Hexachlorobutadiene	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Hexachlorocyclopentadiene	ND (2.00)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Hexachloroethane	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Indeno(1,2,3-cd)Pyrene	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Isophorone	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Naphthalene	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 5-7.5
Date Sampled: 12/22/20 12:10
Percent Solids: 85
Initial Volume: 14.8
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-05
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/23/20 14:35

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Nitrobenzene	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
N-Nitrosodimethylamine	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
N-Nitroso-Di-n-Propylamine	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
N-nitrosodiphenylamine	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Pentachlorophenol	ND (2.00)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Phenanthrene	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Phenol	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Pyrene	ND (0.399)		8270D		1	12/29/20 2:33	D0L0497	DL02310
Pyridine	ND (2.00)		8270D		1	12/29/20 2:33	D0L0497	DL02310

	%Recovery	Qualifier	Limits
Surrogate: 1,2-Dichlorobenzene-d4	*63 %*		*30-130*
Surrogate: 2,4,6-Tribromophenol	*85 %*		*30-130*
Surrogate: 2-Chlorophenol-d4	*65 %*		*30-130*
Surrogate: 2-Fluorobiphenyl	*69 %*		*30-130*
Surrogate: 2-Fluorophenol	*72 %*		*30-130*
Surrogate: Nitrobenzene-d5	*78 %*		*30-130*
Surrogate: Phenol-d6	*76 %*		*30-130*
Surrogate: p-Terphenyl-d14	*96 %*		*30-130*

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 5-7.5
Date Sampled: 12/22/20 12:10
Percent Solids: 85

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-05
Sample Matrix: Sediment

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Percent Moisture	**15** (1)		2540G		1	JMG	12/23/20 17:08	%	DL02316
Total Organic Carbon (Average)	**437** (97.7)		9060		1	CCP	12/29/20 12:16	mg/kg dry	[CALC]

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 5-7.5
Date Sampled: 12/22/20 12:10

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-05
Sample Matrix: Sediment

Subcontracted Analysis

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Grain Size	**See Attached** (N/A)								

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 5-7.5
Date Sampled: 12/22/20 12:10
Percent Solids: 85
Initial Volume: 100
Final Volume: 2000
Extraction Method: 1311

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-05
Sample Matrix: Sediment
Units: °C
Analyst: CCY
Prepared: 12/23/20 18:22

TCLP Extraction by 1311

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Batch
Temperature (Min C)	**23.2** (N/A)		1311		1	CCY	12/24/20 11:45	DL02348
Temperature (Max C)	**24.5** (N/A)		1311		1	CCY	12/24/20 11:45	DL02348
Temperature (Range)	**Temperature is within 23 +/-2 °C.** (N/A)							

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 7.5-10.5
Date Sampled: 12/22/20 12:18
Percent Solids: 83

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-06
Sample Matrix: Sediment
Units: mg/kg dry

Extraction Method: 3050B

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	**1.72** (0.93)		6010C		2	KJK	12/29/20 18:55	5.22	100	DL02839
Cadmium	ND (0.46)		6010C		2	KJK	12/29/20 18:55	5.22	100	DL02839
Chromium	**3.18** (0.93)		6010C		2	KJK	12/29/20 18:55	5.22	100	DL02839
Copper	**3.72** (2.32)		6010C		2	KJK	12/29/20 18:55	5.22	100	DL02839
Lead	**3.26** (2.32)		6010C		2	KJK	12/29/20 18:55	5.22	100	DL02839
Mercury	ND (0.012)		7471B		1	MKS	12/29/20 12:25	2.03	40	DL02841
Nickel	**3.83** (2.32)		6010C		2	KJK	12/29/20 18:55	5.22	100	DL02839
Zinc	**32.5** (2.32)		6010C		2	KJK	12/29/20 18:55	5.22	100	DL02839

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 7.5-10.5
Date Sampled: 12/22/20 12:18
Percent Solids: 83

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-06
Sample Matrix: Sediment
Units: mg/L

Extraction Method: 3005A TCLP

1311 TCLP Metals

Analyte	Results (MRL)	MDL	Method	TCLP Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:07	50	50	DL02423
Barium	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:07	50	50	DL02423
Cadmium	ND (0.0100)		1311/6010C		1	BJV	12/28/20 12:07	50	50	DL02423
Chromium	ND (0.020)		1311/6010C		1	BJV	12/28/20 12:07	50	50	DL02423
Lead	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:07	50	50	DL02423
Mercury	ND (0.00050)		1311/7470A		1	MKS	12/28/20 12:54	20	40	DL02430
Nickel	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:07	50	50	DL02423
Selenium	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:07	50	50	DL02423
Silver	ND (0.010)		1311/6010C		1	BJV	12/28/20 12:07	50	50	DL02423

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 7.5-10.5
Date Sampled: 12/22/20 12:18
Percent Solids: 83
Initial Volume: 19.8
Final Volume: 10
Extraction Method: 3540C

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-06
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: MJV
Prepared: 12/22/20 21:03

8082A Polychlorinated Biphenyls (PCB)

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aroclor 1016	ND (0.06)		8082A		1	12/23/20 19:02		DL02204
Aroclor 1221	ND (0.06)		8082A		1	12/23/20 19:02		DL02204
Aroclor 1232	ND (0.06)		8082A		1	12/23/20 19:02		DL02204
Aroclor 1242	ND (0.06)		8082A		1	12/23/20 19:02		DL02204
Aroclor 1248	ND (0.06)		8082A		1	12/23/20 19:02		DL02204
Aroclor 1254	ND (0.06)		8082A		1	12/23/20 19:02		DL02204
Aroclor 1260	ND (0.06)		8082A		1	12/23/20 19:02		DL02204
Aroclor 1262	ND (0.06)		8082A		1	12/23/20 19:02		DL02204
Aroclor 1268	ND (0.06)		8082A		1	12/23/20 19:02		DL02204

	%Recovery	Qualifier	Limits
Surrogate: Decachlorobiphenyl	*86 %*		*30-150*
Surrogate: Decachlorobiphenyl [2C]	*104 %*		*30-150*
Surrogate: Tetrachloro-m-xylene	*65 %*		*30-150*
Surrogate: Tetrachloro-m-xylene [2C]	*89 %*		*30-150*

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 7.5-10.5
Date Sampled: 12/22/20 12:18
Percent Solids: 83
Initial Volume: 19.2
Final Volume: 1
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-06
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: AMF
Prepared: 12/22/20 22:00

8100M Total Petroleum Hydrocarbons

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Total Petroleum Hydrocarbons	ND (47.3)		8100M		1	12/25/20 7:36	D0L0485	DL02237

	%Recovery	Qualifier	Limits
Surrogate: O-Terphenyl	*92 %*		*40-140*

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 7.5-10.5
Date Sampled: 12/22/20 12:18
Percent Solids: 83
Initial Volume: 14.3
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-06
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/23/20 14:35

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,1-Biphenyl	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
1,2,4-Trichlorobenzene	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
1,2-Dichlorobenzene	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
1,3-Dichlorobenzene	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
1,4-Dichlorobenzene	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
2,3,4,6-Tetrachlorophenol	ND (2.12)		8270D		1	12/29/20 3:01	D0L0497	DL02310
2,4,5-Trichlorophenol	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
2,4,6-Trichlorophenol	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
2,4-Dichlorophenol	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
2,4-Dimethylphenol	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
2,4-Dinitrophenol	ND (2.12)		8270D		1	12/29/20 3:01	D0L0497	DL02310
2,4-Dinitrotoluene	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
2,6-Dinitrotoluene	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
2-Chloronaphthalene	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
2-Chlorophenol	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
2-Methylnaphthalene	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
2-Methylphenol	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
2-Nitroaniline	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
2-Nitrophenol	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
3,3′-Dichlorobenzidine	ND (0.847)		8270D		1	12/29/20 3:01	D0L0497	DL02310
3+4-Methylphenol	ND (0.847)		8270D		1	12/29/20 3:01	D0L0497	DL02310
3-Nitroaniline	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
4,6-Dinitro-2-Methylphenol	ND (2.12)		8270D		1	12/29/20 3:01	D0L0497	DL02310
4-Bromophenyl-phenylether	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
4-Chloro-3-Methylphenol	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
4-Chloroaniline	ND (0.847)		8270D		1	12/29/20 3:01	D0L0497	DL02310
4-Chloro-phenyl-phenyl ether	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
4-Nitroaniline	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
4-Nitrophenol	ND (2.12)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Acenaphthene	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Acenaphthylene	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Acetophenone	ND (0.847)		8270D		1	12/29/20 3:01	D0L0497	DL02310

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COASTAL RESOURCES MANAGEMENT COUNCIL

CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 7.5-10.5
Date Sampled: 12/22/20 12:18
Percent Solids: 83
Initial Volume: 14.3
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-06
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/23/20 14:35

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aniline	ND (0.847)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Anthracene	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Azobenzene	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Benzo(a)anthracene	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Benzo(a)pyrene	ND (0.212)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Benzo(b)fluoranthene	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Benzo(g,h,i)perylene	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Benzo(k)fluoranthene	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Benzoic Acid	ND (2.12)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Benzyl Alcohol	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
bis(2-Chloroethoxy)methane	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
bis(2-Chloroethyl)ether	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
bis(2-chloroisopropyl)Ether	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
bis(2-Ethylhexyl)phthalate	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Butylbenzylphthalate	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Carbazole	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Chrysene	ND (0.212)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Dibenzo(a,h)Anthracene	ND (0.212)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Dibenzofuran	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Diethylphthalate	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Dimethylphthalate	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Di-n-butylphthalate	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Di-n-octylphthalate	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Fluoranthene	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Fluorene	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Hexachlorobenzene	ND (0.212)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Hexachlorobutadiene	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Hexachlorocyclopentadiene	ND (2.12)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Hexachloroethane	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Indeno(1,2,3-cd)Pyrene	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Isophorone	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Naphthalene	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310

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JULY 30, 2021
COASTAL RESOURCES MANAGEMENT COUNCIL

CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 7.5-10.5
Date Sampled: 12/22/20 12:18
Percent Solids: 83
Initial Volume: 14.3
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-06
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/23/20 14:35

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Nitrobenzene	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
N-Nitrosodimethylamine	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
N-Nitroso-Di-n-Propylamine	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
N-nitrosodiphenylamine	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Pentachlorophenol	ND (2.12)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Phenanthrene	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Phenol	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Pyrene	ND (0.423)		8270D		1	12/29/20 3:01	D0L0497	DL02310
Pyridine	ND (2.12)		8270D		1	12/29/20 3:01	D0L0497	DL02310

	%Recovery	*Qualifier*	*Limits*
Surrogate: 1,2-Dichlorobenzene-d4	*63 %*		*30-130*
Surrogate: 2,4,6-Tribromophenol	*66 %*		*30-130*
Surrogate: 2-Chlorophenol-d4	*61 %*		*30-130*
Surrogate: 2-Fluorobiphenyl	*62 %*		*30-130*
Surrogate: 2-Fluorophenol	*67 %*		*30-130*
Surrogate: Nitrobenzene-d5	*77 %*		*30-130*
Surrogate: Phenol-d6	*70 %*		*30-130*
Surrogate: p-Terphenyl-d14	*88 %*		*30-130*

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 7.5-10.5
Date Sampled: 12/22/20 12:18
Percent Solids: 83

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-06
Sample Matrix: Sediment

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Percent Moisture	**17** (1)		2540G		1	JMG	12/23/20 17:08	%	DL02316
Total Organic Carbon (Average)	**1050** (93.9)		9060		1	CCP	12/29/20 12:32	mg/kg dry	[CALC]

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 7.5-10.5
Date Sampled: 12/22/20 12:18

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-06
Sample Matrix: Sediment

Subcontracted Analysis

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Grain Size	**See Attached** (N/A)								

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Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 7.5-10.5
Date Sampled: 12/22/20 12:18
Percent Solids: 83
Initial Volume: 100
Final Volume: 2000
Extraction Method: 1311

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-06
Sample Matrix: Sediment
Units: °C
Analyst: CCY
Prepared: 12/23/20 18:22

TCLP Extraction by 1311

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Batch
Temperature (Min C)	**23.2** (N/A)		1311		1	CCY	12/24/20 11:45	DL02348
Temperature (Max C)	**24.5** (N/A)		1311		1	CCY	12/24/20 11:45	DL02348
Temperature (Range)	**Temperature is within 23 +/-2 °C.** (N/A)							

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 10.5-13
Date Sampled: 12/22/20 12:26
Percent Solids: 83

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-07
Sample Matrix: Sediment
Units: mg/kg dry

Extraction Method: 3050B

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	**1.87** (0.94)		6010C		2	KJK	12/29/20 18:57	5.13	100	DL02839
Cadmium	ND (0.47)		6010C		2	KJK	12/29/20 18:57	5.13	100	DL02839
Chromium	**6.72** (0.94)		6010C		2	KJK	12/29/20 18:57	5.13	100	DL02839
Copper	**7.60** (2.35)		6010C		2	KJK	12/29/20 18:57	5.13	100	DL02839
Lead	**4.33** (2.35)		6010C		2	KJK	12/29/20 18:57	5.13	100	DL02839
Mercury	ND (0.011)		7471B		1	MKS	12/29/20 12:27	2.12	40	DL02841
Nickel	**6.73** (2.35)		6010C		2	KJK	12/29/20 18:57	5.13	100	DL02839
Zinc	**37.6** (2.35)		6010C		2	KJK	12/29/20 18:57	5.13	100	DL02839

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Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 10.5-13
Date Sampled: 12/22/20 12:26
Percent Solids: 83

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-07
Sample Matrix: Sediment
Units: mg/L

Extraction Method: 3005A TCLP

1311 TCLP Metals

Analyte	Results (MRL)	MDL	Method	TCLP Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:10	50	50	DL02423
Barium	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:10	50	50	DL02423
Cadmium	ND (0.0100)		1311/6010C		1	BJV	12/28/20 12:10	50	50	DL02423
Chromium	ND (0.020)		1311/6010C		1	BJV	12/28/20 12:10	50	50	DL02423
Lead	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:10	50	50	DL02423
Mercury	ND (0.00050)		1311/7470A		1	MKS	12/28/20 12:56	20	40	DL02430
Nickel	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:10	50	50	DL02423
Selenium	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:10	50	50	DL02423
Silver	ND (0.010)		1311/6010C		1	BJV	12/28/20 12:10	50	50	DL02423

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Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 10.5-13
Date Sampled: 12/22/20 12:26
Percent Solids: 83
Initial Volume: 19.7
Final Volume: 10
Extraction Method: 3540C

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-07
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: MJV
Prepared: 12/22/20 21:03

8082A Polychlorinated Biphenyls (PCB)

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aroclor 1016	ND (0.06)		8082A		1	12/23/20 19:22		DL02204
Aroclor 1221	ND (0.06)		8082A		1	12/23/20 19:22		DL02204
Aroclor 1232	ND (0.06)		8082A		1	12/23/20 19:22		DL02204
Aroclor 1242	ND (0.06)		8082A		1	12/23/20 19:22		DL02204
Aroclor 1248	ND (0.06)		8082A		1	12/23/20 19:22		DL02204
Aroclor 1254	ND (0.06)		8082A		1	12/23/20 19:22		DL02204
Aroclor 1260	ND (0.06)		8082A		1	12/23/20 19:22		DL02204
Aroclor 1262	ND (0.06)		8082A		1	12/23/20 19:22		DL02204
Aroclor 1268	ND (0.06)		8082A		1	12/23/20 19:22		DL02204

	%Recovery	Qualifier	Limits
Surrogate: Decachlorobiphenyl	*85 %*		*30-150*
Surrogate: Decachlorobiphenyl [2C]	*105 %*		*30-150*
Surrogate: Tetrachloro-m-xylene	*67 %*		*30-150*
Surrogate: Tetrachloro-m-xylene [2C]	*90 %*		*30-150*

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 10.5-13
Date Sampled: 12/22/20 12:26
Percent Solids: 83
Initial Volume: 19
Final Volume: 1
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-07
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: AMF
Prepared: 12/28/20 20:00

8100M Total Petroleum Hydrocarbons

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Total Petroleum Hydrocarbons	ND (47.7)		8100M		1	12/29/20 19:48	D0L0529	DL02826

	%Recovery	Qualifier	Limits
Surrogate: O-Terphenyl	*79 %*		*40-140*

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 10.5-13
Date Sampled: 12/22/20 12:26
Percent Solids: 83
Initial Volume: 15.2
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-07
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/23/20 14:35

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,1-Biphenyl	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
1,2,4-Trichlorobenzene	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
1,2-Dichlorobenzene	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
1,3-Dichlorobenzene	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
1,4-Dichlorobenzene	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
2,3,4,6-Tetrachlorophenol	ND (1.99)		8270D		1	12/29/20 3:30	D0L0497	DL02310
2,4,5-Trichlorophenol	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
2,4,6-Trichlorophenol	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
2,4-Dichlorophenol	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
2,4-Dimethylphenol	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
2,4-Dinitrophenol	ND (1.99)		8270D		1	12/29/20 3:30	D0L0497	DL02310
2,4-Dinitrotoluene	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
2,6-Dinitrotoluene	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
2-Chloronaphthalene	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
2-Chlorophenol	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
2-Methylnaphthalene	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
2-Methylphenol	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
2-Nitroaniline	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
2-Nitrophenol	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
3,3′-Dichlorobenzidine	ND (0.795)		8270D		1	12/29/20 3:30	D0L0497	DL02310
3+4-Methylphenol	ND (0.795)		8270D		1	12/29/20 3:30	D0L0497	DL02310
3-Nitroaniline	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
4,6-Dinitro-2-Methylphenol	ND (1.99)		8270D		1	12/29/20 3:30	D0L0497	DL02310
4-Bromophenyl-phenylether	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
4-Chloro-3-Methylphenol	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
4-Chloroaniline	ND (0.795)		8270D		1	12/29/20 3:30	D0L0497	DL02310
4-Chloro-phenyl-phenyl ether	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
4-Nitroaniline	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
4-Nitrophenol	ND (1.99)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Acenaphthene	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Acenaphthylene	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Acetophenone	ND (0.795)		8270D		1	12/29/20 3:30	D0L0497	DL02310

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COASTAL RESOURCES MANAGEMENT COUNCIL

CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 10.5-13
Date Sampled: 12/22/20 12:26
Percent Solids: 83
Initial Volume: 15.2
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-07
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/23/20 14:35

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aniline	ND (0.795)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Anthracene	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Azobenzene	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Benzo(a)anthracene	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Benzo(a)pyrene	ND (0.199)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Benzo(b)fluoranthene	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Benzo(g,h,i)perylene	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Benzo(k)fluoranthene	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Benzoic Acid	ND (1.99)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Benzyl Alcohol	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
bis(2-Chloroethoxy)methane	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
bis(2-Chloroethyl)ether	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
bis(2-chloroisopropyl)Ether	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
bis(2-Ethylhexyl)phthalate	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Butylbenzylphthalate	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Carbazole	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Chrysene	ND (0.199)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Dibenzo(a,h)Anthracene	ND (0.199)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Dibenzofuran	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Diethylphthalate	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Dimethylphthalate	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Di-n-butylphthalate	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Di-n-octylphthalate	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Fluoranthene	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Fluorene	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Hexachlorobenzene	ND (0.199)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Hexachlorobutadiene	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Hexachlorocyclopentadiene	ND (1.99)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Hexachloroethane	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Indeno(1,2,3-cd)Pyrene	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Isophorone	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Naphthalene	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 10.5-13
Date Sampled: 12/22/20 12:26
Percent Solids: 83
Initial Volume: 15.2
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-07
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/23/20 14:35

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Nitrobenzene	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
N-Nitrosodimethylamine	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
N-Nitroso-Di-n-Propylamine	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
N-nitrosodiphenylamine	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Pentachlorophenol	ND (1.99)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Phenanthrene	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Phenol	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Pyrene	ND (0.397)		8270D		1	12/29/20 3:30	D0L0497	DL02310
Pyridine	ND (1.99)		8270D		1	12/29/20 3:30	D0L0497	DL02310

	%Recovery	*Qualifier*	*Limits*
Surrogate: 1,2-Dichlorobenzene-d4	*57 %*		*30-130*
Surrogate: 2,4,6-Tribromophenol	*76 %*		*30-130*
Surrogate: 2-Chlorophenol-d4	*56 %*		*30-130*
Surrogate: 2-Fluorobiphenyl	*59 %*		*30-130*
Surrogate: 2-Fluorophenol	*63 %*		*30-130*
Surrogate: Nitrobenzene-d5	*70 %*		*30-130*
Surrogate: Phenol-d6	*66 %*		*30-130*
Surrogate: p-Terphenyl-d14	*88 %*		*30-130*

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COASTAL RESOURCES MANAGEMENT COUNCIL

CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 10.5-13
Date Sampled: 12/22/20 12:26
Percent Solids: 83

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-07
Sample Matrix: Sediment

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Percent Moisture	**17** (1)		2540G		1	JMG	12/23/20 17:08	%	DL02316
Total Organic Carbon (Average)	**1790** (97.4)		9060		1	CCP	12/29/20 12:49	mg/kg dry	[CALC]

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 10.5-13
Date Sampled: 12/22/20 12:26

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-07
Sample Matrix: Sediment

Subcontracted Analysis

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Grain Size	**See Attached** (N/A)								

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-03A 10.5-13
Date Sampled: 12/22/20 12:26
Percent Solids: 83
Initial Volume: 100
Final Volume: 2000
Extraction Method: 1311

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-07
Sample Matrix: Sediment
Units: °C
Analyst: CCY
Prepared: 12/23/20 18:22

TCLP Extraction by 1311

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Batch
Temperature (Min C)	**23.2** (N/A)		1311		1	CCY	12/24/20 11:45	DL02348
Temperature (Max C)	**24.5** (N/A)		1311		1	CCY	12/24/20 11:45	DL02348
Temperature (Range)	**Temperature is within 23 +/-2 °C.** (N/A)							

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-06 0-4.5
Date Sampled: 12/22/20 13:18
Percent Solids: 82

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-08
Sample Matrix: Sediment
Units: mg/kg dry

Extraction Method: 3050B

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	**1.84** (0.46)		6010C		1	KJK	12/29/20 17:10	5.31	100	DL02839
Cadmium	ND (0.23)		6010C		1	KJK	12/29/20 17:10	5.31	100	DL02839
Chromium	**5.73** (0.46)		6010C		1	KJK	12/29/20 17:10	5.31	100	DL02839
Copper	**7.38** (1.15)		6010C		1	KJK	12/29/20 17:10	5.31	100	DL02839
Lead	**5.14** (1.15)		6010C		1	KJK	12/29/20 17:10	5.31	100	DL02839
Mercury	**0.012** (0.012)		7471B		1	MKS	12/29/20 12:29	2.06	40	DL02841
Nickel	**4.69** (1.15)		6010C		1	KJK	12/29/20 17:10	5.31	100	DL02839
Zinc	**32.2** (1.15)		6010C		1	KJK	12/29/20 17:10	5.31	100	DL02839

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-06 0-4.5
Date Sampled: 12/22/20 13:18
Percent Solids: 82

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-08
Sample Matrix: Sediment
Units: mg/L

Extraction Method: 3005A TCLP

1311 TCLP Metals

Analyte	Results (MRL)	MDL	Method	TCLP Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:13	50	50	DL02423
Barium	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:13	50	50	DL02423
Cadmium	ND (0.0100)		1311/6010C		1	BJV	12/28/20 12:13	50	50	DL02423
Chromium	ND (0.020)		1311/6010C		1	BJV	12/28/20 12:13	50	50	DL02423
Lead	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:13	50	50	DL02423
Mercury	ND (0.00050)		1311/7470A		1	MKS	12/28/20 12:58	20	40	DL02430
Nickel	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:13	50	50	DL02423
Selenium	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:13	50	50	DL02423
Silver	ND (0.010)		1311/6010C		1	BJV	12/28/20 12:13	50	50	DL02423

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-06 0-4.5
Date Sampled: 12/22/20 13:18
Percent Solids: 82
Initial Volume: 19.5
Final Volume: 10
Extraction Method: 3540C

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-08
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: MJV
Prepared: 12/22/20 21:03

8082A Polychlorinated Biphenyls (PCB)

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aroclor 1016	ND (0.06)		8082A		1	12/23/20 19:42		DL02204
Aroclor 1221	ND (0.06)		8082A		1	12/23/20 19:42		DL02204
Aroclor 1232	ND (0.06)		8082A		1	12/23/20 19:42		DL02204
Aroclor 1242	ND (0.06)		8082A		1	12/23/20 19:42		DL02204
Aroclor 1248	ND (0.06)		8082A		1	12/23/20 19:42		DL02204
Aroclor 1254	ND (0.06)		8082A		1	12/23/20 19:42		DL02204
Aroclor 1260	ND (0.06)		8082A		1	12/23/20 19:42		DL02204
Aroclor 1262	ND (0.06)		8082A		1	12/23/20 19:42		DL02204
Aroclor 1268	ND (0.06)		8082A		1	12/23/20 19:42		DL02204

	%Recovery	Qualifier	Limits
Surrogate: Decachlorobiphenyl	*82 %*		*30-150*
Surrogate: Decachlorobiphenyl [2C]	*102 %*		*30-150*
Surrogate: Tetrachloro-m-xylene	*66 %*		*30-150*
Surrogate: Tetrachloro-m-xylene [2C]	*88 %*		*30-150*

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-06 0-4.5
Date Sampled: 12/22/20 13:18
Percent Solids: 82
Initial Volume: 20.4
Final Volume: 1
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-08
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: AMF
Prepared: 12/23/20 20:30

8100M Total Petroleum Hydrocarbons

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Total Petroleum Hydrocarbons	ND (44.8)		8100M		1	12/24/20 18:18	D0L0487	DL02311

	%Recovery	Qualifier	Limits
Surrogate: O-Terphenyl	68 %		40-140

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COASTAL RESOURCES MANAGEMENT COUNCIL

CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-06 0-4.5
Date Sampled: 12/22/20 13:18
Percent Solids: 82
Initial Volume: 14.1
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-08
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/23/20 14:35

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,1-Biphenyl	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
1,2,4-Trichlorobenzene	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
1,2-Dichlorobenzene	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
1,3-Dichlorobenzene	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
1,4-Dichlorobenzene	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
2,3,4,6-Tetrachlorophenol	ND (2.17)		8270D		1	12/29/20 3:59	D0L0497	DL02310
2,4,5-Trichlorophenol	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
2,4,6-Trichlorophenol	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
2,4-Dichlorophenol	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
2,4-Dimethylphenol	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
2,4-Dinitrophenol	ND (2.17)		8270D		1	12/29/20 3:59	D0L0497	DL02310
2,4-Dinitrotoluene	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
2,6-Dinitrotoluene	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
2-Chloronaphthalene	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
2-Chlorophenol	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
2-Methylnaphthalene	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
2-Methylphenol	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
2-Nitroaniline	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
2-Nitrophenol	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
3,3′-Dichlorobenzidine	ND (0.865)		8270D		1	12/29/20 3:59	D0L0497	DL02310
3+4-Methylphenol	ND (0.865)		8270D		1	12/29/20 3:59	D0L0497	DL02310
3-Nitroaniline	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
4,6-Dinitro-2-Methylphenol	ND (2.17)		8270D		1	12/29/20 3:59	D0L0497	DL02310
4-Bromophenyl-phenylether	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
4-Chloro-3-Methylphenol	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
4-Chloroaniline	ND (0.865)		8270D		1	12/29/20 3:59	D0L0497	DL02310
4-Chloro-phenyl-phenyl ether	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
4-Nitroaniline	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
4-Nitrophenol	ND (2.17)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Acenaphthene	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Acenaphthylene	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Acetophenone	ND (0.865)		8270D		1	12/29/20 3:59	D0L0497	DL02310

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COASTAL RESOURCES MANAGEMENT COUNCIL

CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-06 0-4.5
Date Sampled: 12/22/20 13:18
Percent Solids: 82
Initial Volume: 14.1
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-08
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/23/20 14:35

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aniline	ND (0.865)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Anthracene	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Azobenzene	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Benzo(a)anthracene	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Benzo(a)pyrene	ND (0.217)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Benzo(b)fluoranthene	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Benzo(g,h,i)perylene	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Benzo(k)fluoranthene	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Benzoic Acid	ND (2.17)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Benzyl Alcohol	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
bis(2-Chloroethoxy)methane	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
bis(2-Chloroethyl)ether	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
bis(2-chloroisopropyl)Ether	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
bis(2-Ethylhexyl)phthalate	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Butylbenzylphthalate	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Carbazole	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Chrysene	ND (0.217)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Dibenzo(a,h)Anthracene	ND (0.217)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Dibenzofuran	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Diethylphthalate	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Dimethylphthalate	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Di-n-butylphthalate	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Di-n-octylphthalate	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Fluoranthene	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Fluorene	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Hexachlorobenzene	ND (0.217)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Hexachlorobutadiene	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Hexachlorocyclopentadiene	ND (2.17)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Hexachloroethane	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Indeno(1,2,3-cd)Pyrene	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Isophorone	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Naphthalene	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310

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JULY 30, 2021
COASTAL RESOURCES MANAGEMENT COUNCIL

CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-06 0-4.5
Date Sampled: 12/22/20 13:18
Percent Solids: 82
Initial Volume: 14.1
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-08
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/23/20 14:35

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Nitrobenzene	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
N-Nitrosodimethylamine	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
N-Nitroso-Di-n-Propylamine	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
N-nitrosodiphenylamine	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Pentachlorophenol	ND (2.17)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Phenanthrene	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Phenol	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Pyrene	ND (0.432)		8270D		1	12/29/20 3:59	D0L0497	DL02310
Pyridine	ND (2.17)		8270D		1	12/29/20 3:59	D0L0497	DL02310

	%Recovery	*Qualifier*	*Limits*
Surrogate: 1,2-Dichlorobenzene-d4	*60 %*		*30-130*
Surrogate: 2,4,6-Tribromophenol	*72 %*		*30-130*
Surrogate: 2-Chlorophenol-d4	*61 %*		*30-130*
Surrogate: 2-Fluorobiphenyl	*66 %*		*30-130*
Surrogate: 2-Fluorophenol	*68 %*		*30-130*
Surrogate: Nitrobenzene-d5	*76 %*		*30-130*
Surrogate: Phenol-d6	*71 %*		*30-130*
Surrogate: p-Terphenyl-d14	*74 %*		*30-130*

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-06 0-4.5
Date Sampled: 12/22/20 13:18
Percent Solids: 82

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-08
Sample Matrix: Sediment

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Percent Moisture	**18** (1)		2540G		1	JMG	12/23/20 17:08	%	DL02316
Total Organic Carbon (Average)	**1520** (95.3)		9060		1	CCP	12/29/20 13:05	mg/kg dry	[CALC]

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-06 0-4.5
Date Sampled: 12/22/20 13:18

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-08
Sample Matrix: Sediment

Subcontracted Analysis

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Grain Size	**See Attached** (N/A)								

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COASTAL RESOURCES MANAGEMENT COUNCIL

CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-06 0-4.5
Date Sampled: 12/22/20 13:18
Percent Solids: 82
Initial Volume: 100
Final Volume: 2000
Extraction Method: 1311

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-08
Sample Matrix: Sediment
Units: °C
Analyst: CCY
Prepared: 12/23/20 18:22

TCLP Extraction by 1311

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Batch
Temperature (Min C)	**23.2** (N/A)		1311		1	CCY	12/24/20 11:45	DL02348
Temperature (Max C)	**24.5** (N/A)		1311		1	CCY	12/24/20 11:45	DL02348
Temperature (Range)	**Temperature is within 23 +/-2 °C.** (N/A)							

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-06 4.5-10
Date Sampled: 12/22/20 13:30
Percent Solids: 82

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-09
Sample Matrix: Sediment
Units: mg/kg dry

Extraction Method: 3050B

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	**0.69** (0.48)		6010C		1	KJK	12/29/20 17:12	5.03	100	DL02839
Cadmium	ND (0.24)		6010C		1	KJK	12/29/20 17:12	5.03	100	DL02839
Chromium	**1.20** (0.48)		6010C		1	KJK	12/29/20 17:12	5.03	100	DL02839
Copper	**1.59** (1.21)		6010C		1	KJK	12/29/20 17:12	5.03	100	DL02839
Lead	**1.99** (1.21)		6010C		1	KJK	12/29/20 17:12	5.03	100	DL02839
Mercury	ND (0.012)		7471B		1	MKS	12/29/20 12:31	2.07	40	DL02841
Nickel	**1.55** (1.21)		6010C		1	KJK	12/29/20 17:12	5.03	100	DL02839
Zinc	**17.0** (1.21)		6010C		1	KJK	12/29/20 17:12	5.03	100	DL02839

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-06 4.5-10
Date Sampled: 12/22/20 13:30
Percent Solids: 82

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-09
Sample Matrix: Sediment
Units: mg/L

Extraction Method: 3005A TCLP

1311 TCLP Metals

Analyte	Results (MRL)	MDL	Method	TCLP Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:15	50	50	DL02423
Barium	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:15	50	50	DL02423
Cadmium	ND (0.0100)		1311/6010C		1	BJV	12/28/20 12:15	50	50	DL02423
Chromium	ND (0.020)		1311/6010C		1	BJV	12/28/20 12:15	50	50	DL02423
Lead	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:15	50	50	DL02423
Mercury	ND (0.00050)		1311/7470A		1	MKS	12/28/20 13:00	20	40	DL02430
Nickel	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:15	50	50	DL02423
Selenium	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:15	50	50	DL02423
Silver	ND (0.010)		1311/6010C		1	BJV	12/28/20 12:15	50	50	DL02423

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-06 4.5-10
Date Sampled: 12/22/20 13:30
Percent Solids: 82
Initial Volume: 20
Final Volume: 10
Extraction Method: 3540C

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-09
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: MJV
Prepared: 12/22/20 21:03

8082A Polychlorinated Biphenyls (PCB)

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aroclor 1016	ND (0.06)		8082A		1	12/23/20 20:02		DL02204
Aroclor 1221	ND (0.06)		8082A		1	12/23/20 20:02		DL02204
Aroclor 1232	ND (0.06)		8082A		1	12/23/20 20:02		DL02204
Aroclor 1242	ND (0.06)		8082A		1	12/23/20 20:02		DL02204
Aroclor 1248	ND (0.06)		8082A		1	12/23/20 20:02		DL02204
Aroclor 1254	ND (0.06)		8082A		1	12/23/20 20:02		DL02204
Aroclor 1260	ND (0.06)		8082A		1	12/23/20 20:02		DL02204
Aroclor 1262	ND (0.06)		8082A		1	12/23/20 20:02		DL02204
Aroclor 1268	ND (0.06)		8082A		1	12/23/20 20:02		DL02204

	%Recovery	Qualifier	Limits
Surrogate: Decachlorobiphenyl	*87 %*		*30-150*
Surrogate: Decachlorobiphenyl [2C]	*105 %*		*30-150*
Surrogate: Tetrachloro-m-xylene	*68 %*		*30-150*
Surrogate: Tetrachloro-m-xylene [2C]	*93 %*		*30-150*

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-06 4.5-10
Date Sampled: 12/22/20 13:30
Percent Solids: 82
Initial Volume: 19.2
Final Volume: 1
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-09
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: AMF
Prepared: 12/23/20 20:30

8100M Total Petroleum Hydrocarbons

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Total Petroleum Hydrocarbons	ND (47.5)		8100M		1	12/24/20 16:38	D0L0487	DL02311

	%Recovery	Qualifier	Limits
Surrogate: O-Terphenyl	68 %		40-140

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-06 4.5-10
Date Sampled: 12/22/20 13:30
Percent Solids: 82
Initial Volume: 14.6
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-09
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/23/20 14:35

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,1-Biphenyl	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
1,2,4-Trichlorobenzene	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
1,2-Dichlorobenzene	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
1,3-Dichlorobenzene	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
1,4-Dichlorobenzene	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
2,3,4,6-Tetrachlorophenol	ND (2.09)		8270D		1	12/29/20 4:28	D0L0497	DL02310
2,4,5-Trichlorophenol	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
2,4,6-Trichlorophenol	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
2,4-Dichlorophenol	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
2,4-Dimethylphenol	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
2,4-Dinitrophenol	ND (2.09)		8270D		1	12/29/20 4:28	D0L0497	DL02310
2,4-Dinitrotoluene	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
2,6-Dinitrotoluene	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
2-Chloronaphthalene	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
2-Chlorophenol	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
2-Methylnaphthalene	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
2-Methylphenol	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
2-Nitroaniline	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
2-Nitrophenol	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
3,3′-Dichlorobenzidine	ND (0.833)		8270D		1	12/29/20 4:28	D0L0497	DL02310
3+4-Methylphenol	ND (0.833)		8270D		1	12/29/20 4:28	D0L0497	DL02310
3-Nitroaniline	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
4,6-Dinitro-2-Methylphenol	ND (2.09)		8270D		1	12/29/20 4:28	D0L0497	DL02310
4-Bromophenyl-phenylether	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
4-Chloro-3-Methylphenol	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
4-Chloroaniline	ND (0.833)		8270D		1	12/29/20 4:28	D0L0497	DL02310
4-Chloro-phenyl-phenyl ether	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
4-Nitroaniline	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
4-Nitrophenol	ND (2.09)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Acenaphthene	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Acenaphthylene	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Acetophenone	ND (0.833)		8270D		1	12/29/20 4:28	D0L0497	DL02310

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-06 4.5-10
Date Sampled: 12/22/20 13:30
Percent Solids: 82
Initial Volume: 14.6
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-09
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/23/20 14:35

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aniline	ND (0.833)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Anthracene	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Azobenzene	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Benzo(a)anthracene	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Benzo(a)pyrene	ND (0.209)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Benzo(b)fluoranthene	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Benzo(g,h,i)perylene	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Benzo(k)fluoranthene	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Benzoic Acid	ND (2.09)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Benzyl Alcohol	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
bis(2-Chloroethoxy)methane	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
bis(2-Chloroethyl)ether	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
bis(2-chloroisopropyl)Ether	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
bis(2-Ethylhexyl)phthalate	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Butylbenzylphthalate	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Carbazole	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Chrysene	ND (0.209)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Dibenzo(a,h)Anthracene	ND (0.209)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Dibenzofuran	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Diethylphthalate	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Dimethylphthalate	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Di-n-butylphthalate	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Di-n-octylphthalate	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Fluoranthene	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Fluorene	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Hexachlorobenzene	ND (0.209)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Hexachlorobutadiene	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Hexachlorocyclopentadiene	ND (2.09)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Hexachloroethane	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Indeno(1,2,3-cd)Pyrene	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Isophorone	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Naphthalene	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-06 4.5-10
Date Sampled: 12/22/20 13:30
Percent Solids: 82
Initial Volume: 14.6
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-09
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/23/20 14:35

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Nitrobenzene	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
N-Nitrosodimethylamine	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
N-Nitroso-Di-n-Propylamine	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
N-nitrosodiphenylamine	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Pentachlorophenol	ND (2.09)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Phenanthrene	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Phenol	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Pyrene	ND (0.416)		8270D		1	12/29/20 4:28	D0L0497	DL02310
Pyridine	ND (2.09)		8270D		1	12/29/20 4:28	D0L0497	DL02310

	%Recovery	Qualifier	Limits
Surrogate: 1,2-Dichlorobenzene-d4	*66 %*		*30-130*
Surrogate: 2,4,6-Tribromophenol	*72 %*		*30-130*
Surrogate: 2-Chlorophenol-d4	*63 %*		*30-130*
Surrogate: 2-Fluorobiphenyl	*70 %*		*30-130*
Surrogate: 2-Fluorophenol	*70 %*		*30-130*
Surrogate: Nitrobenzene-d5	*81 %*		*30-130*
Surrogate: Phenol-d6	*75 %*		*30-130*
Surrogate: p-Terphenyl-d14	*81 %*		*30-130*

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-06 4.5-10
Date Sampled: 12/22/20 13:30
Percent Solids: 82

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-09
Sample Matrix: Sediment

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Percent Moisture	**18** (1)		2540G		1	JMG	12/23/20 17:08	%	DL02316
Total Organic Carbon (Average)	**392** (92.7)		9060		1	CCP	12/29/20 14:53	mg/kg dry	[CALC]

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-06 4.5-10
Date Sampled: 12/22/20 13:30

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-09
Sample Matrix: Sediment

Subcontracted Analysis

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Grain Size	**See Attached** (N/A)								

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-06 4.5-10
Date Sampled: 12/22/20 13:30
Percent Solids: 82
Initial Volume: 100
Final Volume: 2000
Extraction Method: 1311

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-09
Sample Matrix: Sediment
Units: °C
Analyst: CCY
Prepared: 12/23/20 18:22

TCLP Extraction by 1311

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Batch
Temperature (Min C)	**23.2** (N/A)		1311		1	CCY	12/24/20 11:45	DL02348
Temperature (Max C)	**24.5** (N/A)		1311		1	CCY	12/24/20 11:45	DL02348
Temperature (Range)	**Temperature is within 23 +/-2 °C.** (N/A)							

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-06 10-15
Date Sampled: 12/22/20 13:38
Percent Solids: 82

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-10
Sample Matrix: Sediment
Units: mg/kg dry

Extraction Method: 3050B

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	**1.81** (0.97)		6010C		2	KJK	12/29/20 18:58	5.02	100	DL02839
Cadmium	ND (0.49)		6010C		2	KJK	12/29/20 18:58	5.02	100	DL02839
Chromium	**6.37** (0.97)		6010C		2	KJK	12/29/20 18:58	5.02	100	DL02839
Copper	**6.43** (2.43)		6010C		2	KJK	12/29/20 18:58	5.02	100	DL02839
Lead	**4.34** (2.43)		6010C		2	KJK	12/29/20 18:58	5.02	100	DL02839
Mercury	ND (0.011)		7471B		1	MKS	12/29/20 12:33	2.17	40	DL02841
Nickel	**6.38** (2.43)		6010C		2	KJK	12/29/20 18:58	5.02	100	DL02839
Zinc	**41.0** (2.43)		6010C		2	KJK	12/29/20 18:58	5.02	100	DL02839

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-06 10-15
Date Sampled: 12/22/20 13:38
Percent Solids: 82

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-10
Sample Matrix: Sediment
Units: mg/L

Extraction Method: 3005A TCLP

1311 TCLP Metals

Analyte	Results (MRL)	MDL	Method	TCLP Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:18	50	50	DL02423
Barium	**0.062** (0.050)		1311/6010C		1	BJV	12/28/20 12:18	50	50	DL02423
Cadmium	ND (0.0100)		1311/6010C		1	BJV	12/28/20 12:18	50	50	DL02423
Chromium	ND (0.020)		1311/6010C		1	BJV	12/28/20 12:18	50	50	DL02423
Lead	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:18	50	50	DL02423
Mercury	ND (0.00050)		1311/7470A		1	MKS	12/28/20 13:02	20	40	DL02430
Nickel	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:18	50	50	DL02423
Selenium	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:18	50	50	DL02423
Silver	ND (0.010)		1311/6010C		1	BJV	12/28/20 12:18	50	50	DL02423

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-06 10-15
Date Sampled: 12/22/20 13:38
Percent Solids: 82
Initial Volume: 19.3
Final Volume: 10
Extraction Method: 3540C

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-10
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: MJV
Prepared: 12/22/20 21:03

8082A Polychlorinated Biphenyls (PCB)

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aroclor 1016	ND (0.06)		8082A		1	12/23/20 20:22		DL02204
Aroclor 1221	ND (0.06)		8082A		1	12/23/20 20:22		DL02204
Aroclor 1232	ND (0.06)		8082A		1	12/23/20 20:22		DL02204
Aroclor 1242	ND (0.06)		8082A		1	12/23/20 20:22		DL02204
Aroclor 1248	ND (0.06)		8082A		1	12/23/20 20:22		DL02204
Aroclor 1254	ND (0.06)		8082A		1	12/23/20 20:22		DL02204
Aroclor 1260	ND (0.06)		8082A		1	12/23/20 20:22		DL02204
Aroclor 1262	ND (0.06)		8082A		1	12/23/20 20:22		DL02204
Aroclor 1268	ND (0.06)		8082A		1	12/23/20 20:22		DL02204

	%Recovery	Qualifier	Limits
Surrogate: Decachlorobiphenyl	*84 %*		*30-150*
Surrogate: Decachlorobiphenyl [2C]	*102 %*		*30-150*
Surrogate: Tetrachloro-m-xylene	*67 %*		*30-150*
Surrogate: Tetrachloro-m-xylene [2C]	*91 %*		*30-150*

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-06 10-15
Date Sampled: 12/22/20 13:38
Percent Solids: 82
Initial Volume: 19.5
Final Volume: 1
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-10
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: AMF
Prepared: 12/23/20 20:30

8100M Total Petroleum Hydrocarbons

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Total Petroleum Hydrocarbons	ND (46.9)		8100M		1	12/24/20 17:12	D0L0487	DL02311

	%Recovery	Qualifier	Limits
Surrogate: O-Terphenyl	64 %		40-140

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-06 10-15
Date Sampled: 12/22/20 13:38
Percent Solids: 82
Initial Volume: 15.9
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-10
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/23/20 14:35

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,1-Biphenyl	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
1,2,4-Trichlorobenzene	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
1,2-Dichlorobenzene	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
1,3-Dichlorobenzene	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
1,4-Dichlorobenzene	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
2,3,4,6-Tetrachlorophenol	ND (1.92)		8270D		1	12/29/20 4:57	D0L0497	DL02310
2,4,5-Trichlorophenol	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
2,4,6-Trichlorophenol	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
2,4-Dichlorophenol	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
2,4-Dimethylphenol	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
2,4-Dinitrophenol	ND (1.92)		8270D		1	12/29/20 4:57	D0L0497	DL02310
2,4-Dinitrotoluene	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
2,6-Dinitrotoluene	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
2-Chloronaphthalene	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
2-Chlorophenol	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
2-Methylnaphthalene	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
2-Methylphenol	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
2-Nitroaniline	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
2-Nitrophenol	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
3,3′-Dichlorobenzidine	ND (0.767)		8270D		1	12/29/20 4:57	D0L0497	DL02310
3+4-Methylphenol	ND (0.767)		8270D		1	12/29/20 4:57	D0L0497	DL02310
3-Nitroaniline	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
4,6-Dinitro-2-Methylphenol	ND (1.92)		8270D		1	12/29/20 4:57	D0L0497	DL02310
4-Bromophenyl-phenylether	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
4-Chloro-3-Methylphenol	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
4-Chloroaniline	ND (0.767)		8270D		1	12/29/20 4:57	D0L0497	DL02310
4-Chloro-phenyl-phenyl ether	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
4-Nitroaniline	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
4-Nitrophenol	ND (1.92)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Acenaphthene	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Acenaphthylene	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Acetophenone	ND (0.767)		8270D		1	12/29/20 4:57	D0L0497	DL02310

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-06 10-15
Date Sampled: 12/22/20 13:38
Percent Solids: 82
Initial Volume: 15.9
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-10
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/23/20 14:35

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aniline	ND (0.767)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Anthracene	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Azobenzene	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Benzo(a)anthracene	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Benzo(a)pyrene	ND (0.192)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Benzo(b)fluoranthene	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Benzo(g,h,i)perylene	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Benzo(k)fluoranthene	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Benzoic Acid	ND (1.92)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Benzyl Alcohol	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
bis(2-Chloroethoxy)methane	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
bis(2-Chloroethyl)ether	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
bis(2-chloroisopropyl)Ether	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
bis(2-Ethylhexyl)phthalate	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Butylbenzylphthalate	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Carbazole	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Chrysene	ND (0.192)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Dibenzo(a,h)Anthracene	ND (0.192)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Dibenzofuran	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Diethylphthalate	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Dimethylphthalate	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Di-n-butylphthalate	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Di-n-octylphthalate	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Fluoranthene	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Fluorene	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Hexachlorobenzene	ND (0.192)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Hexachlorobutadiene	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Hexachlorocyclopentadiene	ND (1.92)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Hexachloroethane	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Indeno(1,2,3-cd)Pyrene	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Isophorone	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Naphthalene	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-06 10-15
Date Sampled: 12/22/20 13:38
Percent Solids: 82
Initial Volume: 15.9
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-10
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/23/20 14:35

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Nitrobenzene	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
N-Nitrosodimethylamine	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
N-Nitroso-Di-n-Propylamine	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
N-nitrosodiphenylamine	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Pentachlorophenol	ND (1.92)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Phenanthrene	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Phenol	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Pyrene	ND (0.383)		8270D		1	12/29/20 4:57	D0L0497	DL02310
Pyridine	ND (1.92)		8270D		1	12/29/20 4:57	D0L0497	DL02310

	%Recovery	Qualifier	Limits
Surrogate: 1,2-Dichlorobenzene-d4	*64 %*		*30-130*
Surrogate: 2,4,6-Tribromophenol	*79 %*		*30-130*
Surrogate: 2-Chlorophenol-d4	*66 %*		*30-130*
Surrogate: 2-Fluorobiphenyl	*69 %*		*30-130*
Surrogate: 2-Fluorophenol	*71 %*		*30-130*
Surrogate: Nitrobenzene-d5	*81 %*		*30-130*
Surrogate: Phenol-d6	*79 %*		*30-130*
Surrogate: p-Terphenyl-d14	*96 %*		*30-130*

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-06 10-15
Date Sampled: 12/22/20 13:38
Percent Solids: 82

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-10
Sample Matrix: Sediment

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Percent Moisture	**18** (1)		2540G		1	JMG	12/23/20 17:08	%	DL02316
Total Organic Carbon (Average)	ND (96.1)		9060		1	CCP	12/29/20 14:12	mg/kg dry	[CALC]

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-06 10-15
Date Sampled: 12/22/20 13:38

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-10
Sample Matrix: Sediment

Subcontracted Analysis

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Grain Size	**See Attached** (N/A)								

CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-06 10-15
Date Sampled: 12/22/20 13:38
Percent Solids: 82
Initial Volume: 100
Final Volume: 2000
Extraction Method: 1311

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-10
Sample Matrix: Sediment
Units: °C
Analyst: CCY
Prepared: 12/23/20 18:22

TCLP Extraction by 1311

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Batch
Temperature (Min C)	**23.2** (N/A)		1311		1	CCY	12/24/20 11:45	DL02348
Temperature (Max C)	**24.5** (N/A)		1311		1	CCY	12/24/20 11:45	DL02348
Temperature (Range)	**Temperature is within 23 +/-2 °C.** (N/A)							

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-01 0-11.5
Date Sampled: 12/22/20 14:14
Percent Solids: 85

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-11
Sample Matrix: Sediment
Units: mg/kg dry

Extraction Method: 3050B

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	**0.82** (0.45)		6010C		1	KJK	12/30/20 14:55	5.23	100	DL02839
Cadmium	ND (0.22)		6010C		1	KJK	12/29/20 17:15	5.23	100	DL02839
Chromium	**1.45** (0.45)		6010C		1	KJK	12/29/20 17:15	5.23	100	DL02839
Copper	**2.26** (1.12)		6010C		1	KJK	12/29/20 17:15	5.23	100	DL02839
Lead	**1.74** (1.12)		6010C		1	KJK	12/29/20 17:15	5.23	100	DL02839
Mercury	ND (0.011)		7471B		1	MKS	12/29/20 12:35	2.02	40	DL02841
Nickel	**1.53** (1.12)		6010C		1	KJK	12/29/20 17:15	5.23	100	DL02839
Zinc	**12.9** (1.12)		6010C		1	KJK	12/29/20 17:15	5.23	100	DL02839

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-01 0-11.5
Date Sampled: 12/22/20 14:14
Percent Solids: 85

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-11
Sample Matrix: Sediment
Units: mg/L

Extraction Method: 3005A TCLP

1311 TCLP Metals

Analyte	Results (MRL)	MDL	Method	TCLP Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:21	50	50	DL02423
Barium	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:21	50	50	DL02423
Cadmium	ND (0.0100)		1311/6010C		1	BJV	12/28/20 12:21	50	50	DL02423
Chromium	ND (0.020)		1311/6010C		1	BJV	12/28/20 12:21	50	50	DL02423
Lead	**0.220** (0.050)		1311/6010C		1	BJV	12/28/20 12:21	50	50	DL02423
Mercury	ND (0.00050)		1311/7470A		1	MKS	12/28/20 13:08	20	40	DL02430
Nickel	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:21	50	50	DL02423
Selenium	ND (0.050)		1311/6010C		1	BJV	12/28/20 12:21	50	50	DL02423
Silver	ND (0.010)		1311/6010C		1	BJV	12/28/20 12:21	50	50	DL02423

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-01 0-11.5
Date Sampled: 12/22/20 14:14
Percent Solids: 85
Initial Volume: 20.3
Final Volume: 10
Extraction Method: 3540C

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-11
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: MJV
Prepared: 12/22/20 21:03

8082A Polychlorinated Biphenyls (PCB)

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aroclor 1016	ND (0.06)		8082A		1	12/23/20 20:42		DL02204
Aroclor 1221	ND (0.06)		8082A		1	12/23/20 20:42		DL02204
Aroclor 1232	ND (0.06)		8082A		1	12/23/20 20:42		DL02204
Aroclor 1242	ND (0.06)		8082A		1	12/23/20 20:42		DL02204
Aroclor 1248	ND (0.06)		8082A		1	12/23/20 20:42		DL02204
Aroclor 1254	ND (0.06)		8082A		1	12/23/20 20:42		DL02204
Aroclor 1260	ND (0.06)		8082A		1	12/23/20 20:42		DL02204
Aroclor 1262	ND (0.06)		8082A		1	12/23/20 20:42		DL02204
Aroclor 1268	ND (0.06)		8082A		1	12/23/20 20:42		DL02204

	%Recovery	Qualifier	Limits
Surrogate: Decachlorobiphenyl	*80 %*		*30-150*
Surrogate: Decachlorobiphenyl [2C]	*97 %*		*30-150*
Surrogate: Tetrachloro-m-xylene	*65 %*		*30-150*
Surrogate: Tetrachloro-m-xylene [2C]	*84 %*		*30-150*

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COASTAL RESOURCES MANAGEMENT COUNCIL

CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-01 0-11.5
Date Sampled: 12/22/20 14:14
Percent Solids: 85
Initial Volume: 20.1
Final Volume: 1
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-11
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: AMF
Prepared: 12/23/20 20:30

8100M Total Petroleum Hydrocarbons

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Total Petroleum Hydrocarbons	ND (43.7)		8100M		1	12/24/20 15:00	D0L0487	DL02311

	%Recovery	Qualifier	Limits
Surrogate: O-Terphenyl	*71 %*		*40-140*

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COASTAL RESOURCES MANAGEMENT COUNCIL

CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-01 0-11.5
Date Sampled: 12/22/20 14:14
Percent Solids: 85
Initial Volume: 15.8
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-11
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/23/20 14:35

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,1-Biphenyl	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
1,2,4-Trichlorobenzene	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
1,2-Dichlorobenzene	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
1,3-Dichlorobenzene	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
1,4-Dichlorobenzene	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
2,3,4,6-Tetrachlorophenol	ND (1.86)		8270D		1	12/29/20 5:26	D0L0497	DL02310
2,4,5-Trichlorophenol	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
2,4,6-Trichlorophenol	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
2,4-Dichlorophenol	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
2,4-Dimethylphenol	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
2,4-Dinitrophenol	ND (1.86)		8270D		1	12/29/20 5:26	D0L0497	DL02310
2,4-Dinitrotoluene	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
2,6-Dinitrotoluene	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
2-Chloronaphthalene	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
2-Chlorophenol	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
2-Methylnaphthalene	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
2-Methylphenol	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
2-Nitroaniline	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
2-Nitrophenol	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
3,3′-Dichlorobenzidine	ND (0.741)		8270D		1	12/29/20 5:26	D0L0497	DL02310
3+4-Methylphenol	ND (0.741)		8270D		1	12/29/20 5:26	D0L0497	DL02310
3-Nitroaniline	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
4,6-Dinitro-2-Methylphenol	ND (1.86)		8270D		1	12/29/20 5:26	D0L0497	DL02310
4-Bromophenyl-phenylether	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
4-Chloro-3-Methylphenol	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
4-Chloroaniline	ND (0.741)		8270D		1	12/29/20 5:26	D0L0497	DL02310
4-Chloro-phenyl-phenyl ether	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
4-Nitroaniline	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
4-Nitrophenol	ND (1.86)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Acenaphthene	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Acenaphthylene	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Acetophenone	ND (0.741)		8270D		1	12/29/20 5:26	D0L0497	DL02310

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-01 0-11.5
Date Sampled: 12/22/20 14:14
Percent Solids: 85
Initial Volume: 15.8
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-11
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/23/20 14:35

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Aniline	ND (0.741)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Anthracene	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Azobenzene	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Benzo(a)anthracene	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Benzo(a)pyrene	ND (0.186)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Benzo(b)fluoranthene	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Benzo(g,h,i)perylene	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Benzo(k)fluoranthene	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Benzoic Acid	ND (1.86)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Benzyl Alcohol	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
bis(2-Chloroethoxy)methane	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
bis(2-Chloroethyl)ether	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
bis(2-chloroisopropyl)Ether	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
bis(2-Ethylhexyl)phthalate	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Butylbenzylphthalate	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Carbazole	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Chrysene	ND (0.186)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Dibenzo(a,h)Anthracene	ND (0.186)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Dibenzofuran	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Diethylphthalate	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Dimethylphthalate	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Di-n-butylphthalate	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Di-n-octylphthalate	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Fluoranthene	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Fluorene	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Hexachlorobenzene	ND (0.186)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Hexachlorobutadiene	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Hexachlorocyclopentadiene	ND (1.86)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Hexachloroethane	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Indeno(1,2,3-cd)Pyrene	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Isophorone	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Naphthalene	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-01 0-11.5
Date Sampled: 12/22/20 14:14
Percent Solids: 85
Initial Volume: 15.8
Final Volume: 0.5
Extraction Method: 3546

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-11
Sample Matrix: Sediment
Units: mg/kg dry
Analyst: TJ
Prepared: 12/23/20 14:35

8270D Semi-Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Nitrobenzene	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
N-Nitrosodimethylamine	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
N-Nitroso-Di-n-Propylamine	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
N-nitrosodiphenylamine	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Pentachlorophenol	ND (1.86)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Phenanthrene	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Phenol	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Pyrene	ND (0.370)		8270D		1	12/29/20 5:26	D0L0497	DL02310
Pyridine	ND (1.86)		8270D		1	12/29/20 5:26	D0L0497	DL02310

	%Recovery	Qualifier	Limits
Surrogate: 1,2-Dichlorobenzene-d4	*56 %*		*30-130*
Surrogate: 2,4,6-Tribromophenol	*65 %*		*30-130*
Surrogate: 2-Chlorophenol-d4	*56 %*		*30-130*
Surrogate: 2-Fluorobiphenyl	*61 %*		*30-130*
Surrogate: 2-Fluorophenol	*60 %*		*30-130*
Surrogate: Nitrobenzene-d5	*71 %*		*30-130*
Surrogate: Phenol-d6	*66 %*		*30-130*
Surrogate: p-Terphenyl-d14	*85 %*		*30-130*

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-01 0-11.5
Date Sampled: 12/22/20 14:14
Percent Solids: 85

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-11
Sample Matrix: Sediment

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Percent Moisture	**15** (1)		2540G		1	JMG	12/23/20 17:20	%	DL02317
Total Organic Carbon (Average)	**379** (95.8)		9060		1	CCP	12/29/20 15:10	mg/kg dry	[CALC]

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-01 0-11.5
Date Sampled: 12/22/20 14:14

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-11
Sample Matrix: Sediment

Subcontracted Analysis

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Grain Size	**See Attached** (N/A)								

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind
Client Sample ID: REV01-ENV-01 0-11.5
Date Sampled: 12/22/20 14:14
Percent Solids: 85
Initial Volume: 100
Final Volume: 2000
Extraction Method: 1311

ESS Laboratory Work Order: 20L0756
ESS Laboratory Sample ID: 20L0756-11
Sample Matrix: Sediment
Units: °C
Analyst: CCY
Prepared: 12/23/20 18:22

TCLP Extraction by 1311

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Batch
Temperature (Min C)	**23.2** (N/A)		1311		1	CCY	12/24/20 11:45	DL02348
Temperature (Max C)	**24.5** (N/A)		1311		1	CCY	12/24/20 11:45	DL02348
Temperature (Range)	**Temperature is within 23 +/-2 °C.** (N/A)							

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind

ESS Laboratory Work Order: 20L0756

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Total Metals										
Batch DL02839 - 3050B										
Blank										
Arsenic	ND	1.00	mg/kg wet							
Cadmium	ND	0.50	mg/kg wet							
Chromium	ND	1.00	mg/kg wet							
Copper	ND	2.50	mg/kg wet							
Lead	ND	2.50	mg/kg wet							
Nickel	ND	2.50	mg/kg wet							
Zinc	ND	2.50	mg/kg wet							
LCS										
Arsenic	39.8	3.28	mg/kg wet	43.10		92	80-120			
Cadmium	114	1.64	mg/kg wet	118.0		97	80-120			
Chromium	308	3.28	mg/kg wet	299.0		103	80-120			
Copper	340	8.20	mg/kg wet	330.0		103	80-120			
Lead	147	8.20	mg/kg wet	144.0		102	80-120			
Nickel	179	8.20	mg/kg wet	171.0		104	80-120			
Zinc	850	8.20	mg/kg wet	874.0		97	80-120			
LCS Dup										
Arsenic	40.5	3.33	mg/kg wet	43.10		94	80-120	2	20	
Cadmium	117	1.67	mg/kg wet	118.0		99	80-120	2	20	
Chromium	312	3.33	mg/kg wet	299.0		104	80-120	2	20	
Copper	343	8.33	mg/kg wet	330.0		104	80-120	0.7	20	
Lead	150	8.33	mg/kg wet	144.0		104	80-120	2	20	
Nickel	181	8.33	mg/kg wet	171.0		106	80-120	1	20	
Zinc	864	8.33	mg/kg wet	874.0		99	80-120	2	20	
Batch DL02841 - 3050B										
Blank										
Mercury	ND	0.033	mg/kg wet							
LCS										
Mercury	26.2	3.25	mg/kg wet	27.90		94	80-120			
LCS Dup										
Mercury	26.4	3.00	mg/kg wet	27.90		95	80-120	0.8	20	
1311 TCLP Metals										
Batch DL02423 - 3005A_TCLP										
Blank										
Arsenic	ND	0.050	mg/L							
Barium	ND	0.050	mg/L							
Cadmium	ND	0.0100	mg/L							
Chromium	ND	0.020	mg/L							
Lead	ND	0.050	mg/L							
Nickel	ND	0.050	mg/L							
Selenium	ND	0.050	mg/L							
Silver	ND	0.010	mg/L							

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind

ESS Laboratory Work Order: 20L0756

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
1311 TCLP Metals										
Batch DL02423 - 3005A_TCLP										
LCS										
Arsenic	0.505	0.050	mg/L	0.5000		101	80-120			
Barium	0.501	0.050	mg/L	0.5000		100	80-120			
Cadmium	0.245	0.0100	mg/L	0.2500		98	80-120			
Chromium	0.486	0.020	mg/L	0.5000		97	80-120			
Lead	0.481	0.050	mg/L	0.5000		96	80-120			
Nickel	0.484	0.050	mg/L	0.5000		97	80-120			
Selenium	1.04	0.050	mg/L	1.000		104	80-120			
Silver	0.260	0.010	mg/L	0.2500		104	80-120			
LCS Dup										
Arsenic	0.505	0.050	mg/L	0.5000		101	80-120	0.1	20	
Barium	0.505	0.050	mg/L	0.5000		101	80-120	0.9	20	
Cadmium	0.246	0.0100	mg/L	0.2500		99	80-120	0.7	20	
Chromium	0.491	0.020	mg/L	0.5000		98	80-120	1	20	
Lead	0.486	0.050	mg/L	0.5000		97	80-120	1	20	
Nickel	0.488	0.050	mg/L	0.5000		98	80-120	0.7	20	
Selenium	1.04	0.050	mg/L	1.000		104	80-120	0.09	20	
Silver	0.262	0.010	mg/L	0.2500		105	80-120	0.9	20	
Batch DL02430 - 245.1/7470A										
Blank										
Mercury	ND	0.00050	mg/L							
LCS										
Mercury	0.00576	0.00050	mg/L	0.006042		95	80-120			
LCS Dup										
Mercury	0.00545	0.00050	mg/L	0.006042		90	80-120	5	20	
8082A Polychlorinated Biphenyls (PCB)										
Batch DL02204 - 3540C										
Blank										
Aroclor 1016	ND	0.02	mg/kg wet							
Aroclor 1016 [2C]	ND	0.02	mg/kg wet							
Aroclor 1221	ND	0.02	mg/kg wet							
Aroclor 1221 [2C]	ND	0.02	mg/kg wet							
Aroclor 1232	ND	0.02	mg/kg wet							
Aroclor 1232 [2C]	ND	0.02	mg/kg wet							
Aroclor 1242	ND	0.02	mg/kg wet							
Aroclor 1242 [2C]	ND	0.02	mg/kg wet							
Aroclor 1248	ND	0.02	mg/kg wet							
Aroclor 1248 [2C]	ND	0.02	mg/kg wet							
Aroclor 1254	ND	0.02	mg/kg wet							
Aroclor 1254 [2C]	ND	0.02	mg/kg wet							
Aroclor 1260	ND	0.02	mg/kg wet							
Aroclor 1260 [2C]	ND	0.02	mg/kg wet							

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind

ESS Laboratory Work Order: 20L0756

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8082A Polychlorinated Biphenyls (PCB)										
Batch DL02204 - 3540C										
Aroclor 1262	ND	0.02	mg/kg wet							
Aroclor 1262 [2C]	ND	0.02	mg/kg wet							
Aroclor 1268	ND	0.02	mg/kg wet							
Aroclor 1268 [2C]	ND	0.02	mg/kg wet							
Surrogate: Decachlorobiphenyl	*0.0204*		mg/kg wet	*0.02500*		*82*	*30-150*			
Surrogate: Decachlorobiphenyl [2C]	*0.0245*		mg/kg wet	*0.02500*		*98*	*30-150*			
Surrogate: Tetrachloro-m-xylene	*0.0157*		mg/kg wet	*0.02500*		*63*	*30-150*			
Surrogate: Tetrachloro-m-xylene [2C]	*0.0214*		mg/kg wet	*0.02500*		*86*	*30-150*			
LCS										
Aroclor 1016	0.4	0.02	mg/kg wet	0.5000		79	40-140			
Aroclor 1016 [2C]	0.5	0.02	mg/kg wet	0.5000		95	40-140			
Aroclor 1260	0.4	0.02	mg/kg wet	0.5000		85	40-140			
Aroclor 1260 [2C]	0.5	0.02	mg/kg wet	0.5000		99	40-140			
Surrogate: Decachlorobiphenyl	*0.0212*		mg/kg wet	*0.02500*		*85*	*30-150*			
Surrogate: Decachlorobiphenyl [2C]	*0.0258*		mg/kg wet	*0.02500*		*103*	*30-150*			
Surrogate: Tetrachloro-m-xylene	*0.0173*		mg/kg wet	*0.02500*		*69*	*30-150*			
Surrogate: Tetrachloro-m-xylene [2C]	*0.0215*		mg/kg wet	*0.02500*		*86*	*30-150*			
LCS Dup										
Aroclor 1016	0.4	0.02	mg/kg wet	0.5000		81	40-140	2	30	
Aroclor 1016 [2C]	0.5	0.02	mg/kg wet	0.5000		98	40-140	3	30	
Aroclor 1260	0.4	0.02	mg/kg wet	0.5000		86	40-140	2	30	
Aroclor 1260 [2C]	0.5	0.02	mg/kg wet	0.5000		102	40-140	3	30	
Surrogate: Decachlorobiphenyl	*0.0215*		mg/kg wet	*0.02500*		*86*	*30-150*			
Surrogate: Decachlorobiphenyl [2C]	*0.0260*		mg/kg wet	*0.02500*		*104*	*30-150*			
Surrogate: Tetrachloro-m-xylene	*0.0173*		mg/kg wet	*0.02500*		*69*	*30-150*			
Surrogate: Tetrachloro-m-xylene [2C]	*0.0216*		mg/kg wet	*0.02500*		*86*	*30-150*			
8100M Total Petroleum Hydrocarbons										
Batch DL02237 - 3546										
Blank										
Decane (C10)	ND	0.2	mg/kg wet							
Docosane (C22)	ND	0.2	mg/kg wet							
Dodecane (C12)	ND	0.2	mg/kg wet							
Eicosane (C20)	ND	0.2	mg/kg wet							
Hexacosane (C26)	ND	0.2	mg/kg wet							
Hexadecane (C16)	ND	0.2	mg/kg wet							
Nonadecane (C19)	ND	0.2	mg/kg wet							
Nonane (C9)	ND	0.2	mg/kg wet							
Octacosane (C28)	ND	0.2	mg/kg wet							
Octadecane (C18)	ND	0.2	mg/kg wet							
Tetracosane (C24)	ND	0.2	mg/kg wet							
Tetradecane (C14)	ND	0.2	mg/kg wet							

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind

ESS Laboratory Work Order: 20L0756

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8100M Total Petroleum Hydrocarbons										
Batch DL02237 - 3546										
Total Petroleum Hydrocarbons	ND	37.5	mg/kg wet							
Triacontane (C30)	ND	0.2	mg/kg wet							
Surrogate: O-Terphenyl	*5.22*		mg/kg wet	*5.000*		*104*	*40-140*			
LCS										
Decane (C10)	2.1	0.2	mg/kg wet	2.500		82	40-140			
Docosane (C22)	2.4	0.2	mg/kg wet	2.500		97	40-140			
Dodecane (C12)	2.2	0.2	mg/kg wet	2.500		87	40-140			
Eicosane (C20)	2.4	0.2	mg/kg wet	2.500		96	40-140			
Hexacosane (C26)	2.4	0.2	mg/kg wet	2.500		96	40-140			
Hexadecane (C16)	2.3	0.2	mg/kg wet	2.500		93	40-140			
Nonadecane (C19)	2.3	0.2	mg/kg wet	2.500		94	40-140			
Nonane (C9)	1.8	0.2	mg/kg wet	2.500		73	30-140			
Octacosane (C28)	2.5	0.2	mg/kg wet	2.500		98	40-140			
Octadecane (C18)	2.3	0.2	mg/kg wet	2.500		93	40-140			
Tetracosane (C24)	2.4	0.2	mg/kg wet	2.500		96	40-140			
Tetradecane (C14)	2.3	0.2	mg/kg wet	2.500		90	40-140			
Total Petroleum Hydrocarbons	32.2	37.5	mg/kg wet	35.00		92	40-140			
Triacontane (C30)	2.4	0.2	mg/kg wet	2.500		96	40-140			
Surrogate: O-Terphenyl	*5.09*		mg/kg wet	*5.000*		*102*	*40-140*			
LCS Dup										
Decane (C10)	2.0	0.2	mg/kg wet	2.500		81	40-140	1	25	
Docosane (C22)	2.4	0.2	mg/kg wet	2.500		98	40-140	0.5	25	
Dodecane (C12)	2.2	0.2	mg/kg wet	2.500		89	40-140	2	25	
Eicosane (C20)	2.4	0.2	mg/kg wet	2.500		96	40-140	0.5	25	
Hexacosane (C26)	2.4	0.2	mg/kg wet	2.500		97	40-140	0.6	25	
Hexadecane (C16)	2.3	0.2	mg/kg wet	2.500		94	40-140	0.6	25	
Nonadecane (C19)	2.4	0.2	mg/kg wet	2.500		95	40-140	0.6	25	
Nonane (C9)	1.8	0.2	mg/kg wet	2.500		71	30-140	3	25	
Octacosane (C28)	2.5	0.2	mg/kg wet	2.500		99	40-140	0.5	25	
Octadecane (C18)	2.3	0.2	mg/kg wet	2.500		93	40-140	0.6	25	
Tetracosane (C24)	2.4	0.2	mg/kg wet	2.500		97	40-140	0.6	25	
Tetradecane (C14)	2.3	0.2	mg/kg wet	2.500		91	40-140	1	25	
Total Petroleum Hydrocarbons	32.3	37.5	mg/kg wet	35.00		92	40-140	0.4	25	
Triacontane (C30)	2.4	0.2	mg/kg wet	2.500		97	40-140	0.5	25	
Surrogate: O-Terphenyl	*5.03*		mg/kg wet	*5.000*		*101*	*40-140*			
Batch DL02311 - 3546										
Blank										
Decane (C10)	ND	0.2	mg/kg wet							
Docosane (C22)	ND	0.2	mg/kg wet							
Dodecane (C12)	ND	0.2	mg/kg wet							
Eicosane (C20)	ND	0.2	mg/kg wet							
Hexacosane (C26)	ND	0.2	mg/kg wet							

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CERTIFICATE OF ANALYSIS

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Client Project ID: Rev Wind

ESS Laboratory Work Order: 20L0756

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8100M Total Petroleum Hydrocarbons										
Batch DL02311 - 3546										
Hexadecane (C16)	ND	0.2	mg/kg wet							
Nonadecane (C19)	ND	0.2	mg/kg wet							
Nonane (C9)	ND	0.2	mg/kg wet							
Octacosane (C28)	ND	0.2	mg/kg wet							
Octadecane (C18)	ND	0.2	mg/kg wet							
Tetracosane (C24)	ND	0.2	mg/kg wet							
Tetradecane (C14)	ND	0.2	mg/kg wet							
Total Petroleum Hydrocarbons	ND	37.5	mg/kg wet							
Triacontane (C30)	ND	0.2	mg/kg wet							
Surrogate: O-Terphenyl	*5.05*		mg/kg wet	*5.000*		*101*	*40-140*			
LCS										
Decane (C10)	2.1	0.2	mg/kg wet	2.500		83	40-140			
Docosane (C22)	2.4	0.2	mg/kg wet	2.500		96	40-140			
Dodecane (C12)	2.2	0.2	mg/kg wet	2.500		89	40-140			
Eicosane (C20)	2.4	0.2	mg/kg wet	2.500		95	40-140			
Hexacosane (C26)	2.4	0.2	mg/kg wet	2.500		95	40-140			
Hexadecane (C16)	2.3	0.2	mg/kg wet	2.500		93	40-140			
Nonadecane (C19)	2.3	0.2	mg/kg wet	2.500		93	40-140			
Nonane (C9)	1.8	0.2	mg/kg wet	2.500		74	30-140			
Octacosane (C28)	2.4	0.2	mg/kg wet	2.500		96	40-140			
Octadecane (C18)	2.3	0.2	mg/kg wet	2.500		92	40-140			
Tetracosane (C24)	2.4	0.2	mg/kg wet	2.500		95	40-140			
Tetradecane (C14)	2.3	0.2	mg/kg wet	2.500		91	40-140			
Total Petroleum Hydrocarbons	32.2	37.5	mg/kg wet	35.00		92	40-140			
Triacontane (C30)	2.4	0.2	mg/kg wet	2.500		94	40-140			
Surrogate: O-Terphenyl	*5.03*		mg/kg wet	*5.000*		*101*	*40-140*			
LCS Dup										
Decane (C10)	2.0	0.2	mg/kg wet	2.500		79	40-140	4	25	
Docosane (C22)	2.3	0.2	mg/kg wet	2.500		93	40-140	3	25	
Dodecane (C12)	2.2	0.2	mg/kg wet	2.500		86	40-140	3	25	
Eicosane (C20)	2.3	0.2	mg/kg wet	2.500		92	40-140	3	25	
Hexacosane (C26)	2.3	0.2	mg/kg wet	2.500		93	40-140	2	25	
Hexadecane (C16)	2.3	0.2	mg/kg wet	2.500		91	40-140	3	25	
Nonadecane (C19)	2.3	0.2	mg/kg wet	2.500		90	40-140	3	25	
Nonane (C9)	1.8	0.2	mg/kg wet	2.500		71	30-140	4	25	
Octacosane (C28)	2.4	0.2	mg/kg wet	2.500		95	40-140	2	25	
Octadecane (C18)	2.2	0.2	mg/kg wet	2.500		89	40-140	4	25	
Tetracosane (C24)	2.3	0.2	mg/kg wet	2.500		93	40-140	2	25	
Tetradecane (C14)	2.2	0.2	mg/kg wet	2.500		88	40-140	3	25	
Total Petroleum Hydrocarbons	31.3	37.5	mg/kg wet	35.00		89	40-140	3	25	
Triacontane (C30)	2.3	0.2	mg/kg wet	2.500		93	40-140	2	25	
Surrogate: O-Terphenyl	*4.84*		mg/kg wet	*5.000*		*97*	*40-140*			

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Client Project ID: Rev Wind

ESS Laboratory Work Order: 20L0756

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8100M Total Petroleum Hydrocarbons										
Batch DL02826 - 3546										
Blank										
Decane (C10)	ND	0.2	mg/kg wet							
Docosane (C22)	ND	0.2	mg/kg wet							
Dodecane (C12)	ND	0.2	mg/kg wet							
Eicosane (C20)	ND	0.2	mg/kg wet							
Hexacosane (C26)	ND	0.2	mg/kg wet							
Hexadecane (C16)	ND	0.2	mg/kg wet							
Nonadecane (C19)	ND	0.2	mg/kg wet							
Nonane (C9)	ND	0.2	mg/kg wet							
Octacosane (C28)	ND	0.2	mg/kg wet							
Octadecane (C18)	ND	0.2	mg/kg wet							
Tetracosane (C24)	ND	0.2	mg/kg wet							
Tetradecane (C14)	ND	0.2	mg/kg wet							
Total Petroleum Hydrocarbons	ND	37.5	mg/kg wet							
Triacontane (C30)	ND	0.2	mg/kg wet							
Surrogate: O-Terphenyl	*5.12*		mg/kg wet	*5.000*		*102*	*40-140*			
LCS										
Decane (C10)	2.0	0.2	mg/kg wet	2.500		78	40-140			
Docosane (C22)	2.1	0.2	mg/kg wet	2.500		85	40-140			
Dodecane (C12)	2.1	0.2	mg/kg wet	2.500		84	40-140			
Eicosane (C20)	2.1	0.2	mg/kg wet	2.500		85	40-140			
Hexacosane (C26)	2.1	0.2	mg/kg wet	2.500		85	40-140			
Hexadecane (C16)	2.2	0.2	mg/kg wet	2.500		86	40-140			
Nonadecane (C19)	2.1	0.2	mg/kg wet	2.500		82	40-140			
Nonane (C9)	1.8	0.2	mg/kg wet	2.500		70	30-140			
Octacosane (C28)	2.2	0.2	mg/kg wet	2.500		87	40-140			
Octadecane (C18)	2.1	0.2	mg/kg wet	2.500		84	40-140			
Tetracosane (C24)	2.1	0.2	mg/kg wet	2.500		85	40-140			
Tetradecane (C14)	2.1	0.2	mg/kg wet	2.500		85	40-140			
Total Petroleum Hydrocarbons	29.8	37.5	mg/kg wet	35.00		85	40-140			
Triacontane (C30)	2.1	0.2	mg/kg wet	2.500		84	40-140			
Surrogate: O-Terphenyl	*4.62*		mg/kg wet	*5.000*		*92*	*40-140*			
LCS Dup										
Decane (C10)	2.1	0.2	mg/kg wet	2.500		83	40-140	7	25	
Docosane (C22)	2.3	0.2	mg/kg wet	2.500		93	40-140	9	25	
Dodecane (C12)	2.3	0.2	mg/kg wet	2.500		91	40-140	8	25	
Eicosane (C20)	2.3	0.2	mg/kg wet	2.500		93	40-140	9	25	
Hexacosane (C26)	2.3	0.2	mg/kg wet	2.500		93	40-140	9	25	
Hexadecane (C16)	2.4	0.2	mg/kg wet	2.500		95	40-140	9	25	
Nonadecane (C19)	2.3	0.2	mg/kg wet	2.500		91	40-140	10	25	
Nonane (C9)	1.8	0.2	mg/kg wet	2.500		73	30-140	5	25	
Octacosane (C28)	2.4	0.2	mg/kg wet	2.500		94	40-140	9	25	
Octadecane (C18)	2.3	0.2	mg/kg wet	2.500		92	40-140	9	25	

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Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8100M Total Petroleum Hydrocarbons										
Batch DL02826 - 3546										
Tetracosane (C24)	2.3	0.2	mg/kg wet	2.500		92	40-140	9	25	
Tetradecane (C14)	2.3	0.2	mg/kg wet	2.500		92	40-140	8	25	
Total Petroleum Hydrocarbons	32.5	37.5	mg/kg wet	35.00		93	40-140	8	25	
Triacontane (C30)	2.3	0.2	mg/kg wet	2.500		92	40-140	9	25	
Surrogate: O-Terphenyl	*4.97*		mg/kg wet	*5.000*		*99*	*40-140*			
8270D Semi-Volatile Organic Compounds										
Batch DL02238 - 3546										
Blank										
1,1-Biphenyl	ND	0.333	mg/kg wet							
1,2,4-Trichlorobenzene	ND	0.333	mg/kg wet							
1,2-Dichlorobenzene	ND	0.333	mg/kg wet							
1,3-Dichlorobenzene	ND	0.333	mg/kg wet							
1,4-Dichlorobenzene	ND	0.333	mg/kg wet							
2,3,4,6-Tetrachlorophenol	ND	1.67	mg/kg wet							
2,4,5-Trichlorophenol	ND	0.333	mg/kg wet							
2,4,6-Trichlorophenol	ND	0.333	mg/kg wet							
2,4-Dichlorophenol	ND	0.333	mg/kg wet							
2,4-Dimethylphenol	ND	0.333	mg/kg wet							
2,4-Dinitrophenol	ND	1.67	mg/kg wet							
2,4-Dinitrotoluene	ND	0.333	mg/kg wet							
2,6-Dinitrotoluene	ND	0.333	mg/kg wet							
2-Chloronaphthalene	ND	0.333	mg/kg wet							
2-Chlorophenol	ND	0.333	mg/kg wet							
2-Methylnaphthalene	ND	0.333	mg/kg wet							
2-Methylphenol	ND	0.333	mg/kg wet							
2-Nitroaniline	ND	0.333	mg/kg wet							
2-Nitrophenol	ND	0.333	mg/kg wet							
3,3´-Dichlorobenzidine	ND	0.667	mg/kg wet							
3+4-Methylphenol	ND	0.667	mg/kg wet							
3-Nitroaniline	ND	0.333	mg/kg wet							
4,6-Dinitro-2-Methylphenol	ND	1.67	mg/kg wet							
4-Bromophenyl-phenylether	ND	0.333	mg/kg wet							
4-Chloro-3-Methylphenol	ND	0.333	mg/kg wet							
4-Chloroaniline	ND	0.667	mg/kg wet							
4-Chloro-phenyl-phenyl ether	ND	0.333	mg/kg wet							
4-Nitroaniline	ND	0.333	mg/kg wet							
4-Nitrophenol	ND	1.67	mg/kg wet							
Acenaphthene	ND	0.333	mg/kg wet							
Acenaphthylene	ND	0.333	mg/kg wet							
Acetophenone	ND	0.667	mg/kg wet							
Aniline	ND	0.667	mg/kg wet							
Anthracene	ND	0.333	mg/kg wet							
Azobenzene	ND	0.333	mg/kg wet							

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Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8270D Semi-Volatile Organic Compounds										
Batch DL02238 - 3546										
Benzo(a)anthracene	ND	0.333	mg/kg wet							
Benzo(a)pyrene	ND	0.167	mg/kg wet							
Benzo(b)fluoranthene	ND	0.333	mg/kg wet							
Benzo(g,h,i)perylene	ND	0.333	mg/kg wet							
Benzo(k)fluoranthene	ND	0.333	mg/kg wet							
Benzoic Acid	ND	1.67	mg/kg wet							
Benzyl Alcohol	ND	0.333	mg/kg wet							
bis(2-Chloroethoxy)methane	ND	0.333	mg/kg wet							
bis(2-Chloroethyl)ether	ND	0.167	mg/kg wet							
bis(2-chloroisopropyl)Ether	ND	0.333	mg/kg wet							
bis(2-Ethylhexyl)phthalate	ND	0.333	mg/kg wet							
Butylbenzylphthalate	ND	0.333	mg/kg wet							
Carbazole	ND	0.333	mg/kg wet							
Chrysene	ND	0.167	mg/kg wet							
Dibenzo(a,h)Anthracene	ND	0.167	mg/kg wet							
Dibenzofuran	ND	0.333	mg/kg wet							
Diethylphthalate	ND	0.333	mg/kg wet							
Dimethylphthalate	ND	0.333	mg/kg wet							
Di-n-butylphthalate	ND	0.333	mg/kg wet							
Di-n-octylphthalate	ND	0.333	mg/kg wet							
Fluoranthene	ND	0.333	mg/kg wet							
Fluorene	ND	0.333	mg/kg wet							
Hexachlorobenzene	ND	0.167	mg/kg wet							
Hexachlorobutadiene	ND	0.333	mg/kg wet							
Hexachlorocyclopentadiene	ND	1.67	mg/kg wet							
Hexachloroethane	ND	0.333	mg/kg wet							
Indeno(1,2,3-cd)Pyrene	ND	0.333	mg/kg wet							
Isophorone	ND	0.333	mg/kg wet							
Naphthalene	ND	0.333	mg/kg wet							
Nitrobenzene	ND	0.333	mg/kg wet							
N-Nitrosodimethylamine	ND	0.333	mg/kg wet							
N-Nitroso-Di-n-Propylamine	ND	0.333	mg/kg wet							
N-nitrosodiphenylamine	ND	0.333	mg/kg wet							
Pentachlorophenol	ND	1.67	mg/kg wet							
Phenanthrene	ND	0.333	mg/kg wet							
Phenol	ND	0.333	mg/kg wet							
Pyrene	ND	0.333	mg/kg wet							
Pyridine	ND	1.67	mg/kg wet							
Surrogate: 1,2-Dichlorobenzene-d4	*2.10*		mg/kg wet	*3.333*		*63*	*30-130*			
Surrogate: 2,4,6-Tribromophenol	*2.45*		mg/kg wet	*5.000*		*49*	*30-130*			
Surrogate: 2-Chlorophenol-d4	*3.22*		mg/kg wet	*5.000*		*64*	*30-130*			
Surrogate: 2-Fluorobiphenyl	*2.01*		mg/kg wet	*3.333*		*60*	*30-130*			
Surrogate: 2-Fluorophenol	*3.06*		mg/kg wet	*5.000*		*61*	*30-130*			
Surrogate: Nitrobenzene-d5	*2.40*		mg/kg wet	*3.333*		*72*	*30-130*			
Surrogate: Phenol-d6	*3.61*		mg/kg wet	*5.000*		*72*	*30-130*			
Surrogate: p-Terphenyl-d14	*3.16*		mg/kg wet	*3.333*		*95*	*30-130*			

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Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8270D Semi-Volatile Organic Compounds										
Batch DL02238 - 3546										
LCS										
1,1-Biphenyl	2.62	0.333	mg/kg wet	3.333		78	40-140			
1,2,4-Trichlorobenzene	2.52	0.333	mg/kg wet	3.333		76	40-140			
1,2-Dichlorobenzene	2.39	0.333	mg/kg wet	3.333		72	40-140			
1,3-Dichlorobenzene	2.27	0.333	mg/kg wet	3.333		68	40-140			
1,4-Dichlorobenzene	2.35	0.333	mg/kg wet	3.333		70	40-140			
2,3,4,6-Tetrachlorophenol	2.53	1.67	mg/kg wet	3.333		76	30-130			
2,4,5-Trichlorophenol	2.86	0.333	mg/kg wet	3.333		86	30-130			
2,4,6-Trichlorophenol	2.66	0.333	mg/kg wet	3.333		80	30-130			
2,4-Dichlorophenol	2.79	0.333	mg/kg wet	3.333		84	30-130			
2,4-Dimethylphenol	2.76	0.333	mg/kg wet	3.333		83	30-130			
2,4-Dinitrophenol	1.43	1.67	mg/kg wet	3.333		43	30-130			
2,4-Dinitrotoluene	2.88	0.333	mg/kg wet	3.333		86	40-140			
2,6-Dinitrotoluene	2.66	0.333	mg/kg wet	3.333		80	40-140			
2-Chloronaphthalene	2.42	0.333	mg/kg wet	3.333		73	40-140			
2-Chlorophenol	2.59	0.333	mg/kg wet	3.333		78	30-130			
2-Methylnaphthalene	2.56	0.333	mg/kg wet	3.333		77	40-140			
2-Methylphenol	2.67	0.333	mg/kg wet	3.333		80	30-130			
2-Nitroaniline	3.01	0.333	mg/kg wet	3.333		90	40-140			
2-Nitrophenol	2.57	0.333	mg/kg wet	3.333		77	30-130			
3,3´-Dichlorobenzidine	2.84	0.667	mg/kg wet	3.333		85	40-140			
3+4-Methylphenol	5.18	0.667	mg/kg wet	6.667		78	30-130			
3-Nitroaniline	2.35	0.333	mg/kg wet	3.333		70	40-140			
4,6-Dinitro-2-Methylphenol	1.68	1.67	mg/kg wet	3.333		50	30-130			
4-Bromophenyl-phenylether	2.76	0.333	mg/kg wet	3.333		83	40-140			
4-Chloro-3-Methylphenol	2.95	0.333	mg/kg wet	3.333		89	30-130			
4-Chloroaniline	1.99	0.667	mg/kg wet	3.333		60	40-140			
4-Chloro-phenyl-phenyl ether	2.69	0.333	mg/kg wet	3.333		81	40-140			
4-Nitroaniline	2.41	0.333	mg/kg wet	3.333		72	40-140			
4-Nitrophenol	2.69	1.67	mg/kg wet	3.333		81	30-130			
Acenaphthene	2.30	0.333	mg/kg wet	3.333		69	40-140			
Acenaphthylene	2.51	0.333	mg/kg wet	3.333		75	40-140			
Acetophenone	2.62	0.667	mg/kg wet	3.333		78	40-140			
Aniline	2.02	0.667	mg/kg wet	3.333		61	40-140			
Anthracene	2.76	0.333	mg/kg wet	3.333		83	40-140			
Azobenzene	2.90	0.333	mg/kg wet	3.333		87	40-140			
Benzo(a)anthracene	2.92	0.333	mg/kg wet	3.333		87	40-140			
Benzo(a)pyrene	2.77	0.167	mg/kg wet	3.333		83	40-140			
Benzo(b)fluoranthene	2.75	0.333	mg/kg wet	3.333		83	40-140			
Benzo(g,h,i)perylene	2.54	0.333	mg/kg wet	3.333		76	40-140			
Benzo(k)fluoranthene	2.88	0.333	mg/kg wet	3.333		86	40-140			
Benzoic Acid	1.63	1.67	mg/kg wet	3.333		49	40-140			
Benzyl Alcohol	2.39	0.333	mg/kg wet	3.333		72	40-140			
bis(2-Chloroethoxy)methane	2.86	0.333	mg/kg wet	3.333		86	40-140			
bis(2-Chloroethyl)ether	2.64	0.167	mg/kg wet	3.333		79	40-140			

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind

ESS Laboratory Work Order: 20L0756

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8270D Semi-Volatile Organic Compounds										
Batch DL02238 - 3546										
bis(2-chloroisopropyl)Ether	2.34	0.333	mg/kg wet	3.333		70	40-140			
bis(2-Ethylhexyl)phthalate	2.50	0.333	mg/kg wet	3.333		75	40-140			
Butylbenzylphthalate	2.45	0.333	mg/kg wet	3.333		74	40-140			
Carbazole	2.73	0.333	mg/kg wet	3.333		82	40-140			
Chrysene	2.71	0.167	mg/kg wet	3.333		81	40-140			
Dibenzo(a,h)Anthracene	2.54	0.167	mg/kg wet	3.333		76	40-140			
Dibenzofuran	2.51	0.333	mg/kg wet	3.333		75	40-140			
Diethylphthalate	2.65	0.333	mg/kg wet	3.333		80	40-140			
Dimethylphthalate	2.62	0.333	mg/kg wet	3.333		79	40-140			
Di-n-butylphthalate	2.78	0.333	mg/kg wet	3.333		84	40-140			
Di-n-octylphthalate	2.48	0.333	mg/kg wet	3.333		74	40-140			
Fluoranthene	2.96	0.333	mg/kg wet	3.333		89	40-140			
Fluorene	2.72	0.333	mg/kg wet	3.333		82	40-140			
Hexachlorobenzene	2.86	0.167	mg/kg wet	3.333		86	40-140			
Hexachlorobutadiene	2.70	0.333	mg/kg wet	3.333		81	40-140			
Hexachlorocyclopentadiene	2.41	1.67	mg/kg wet	3.333		72	40-140			
Hexachloroethane	2.49	0.333	mg/kg wet	3.333		75	40-140			
Indeno(1,2,3-cd)Pyrene	2.54	0.333	mg/kg wet	3.333		76	40-140			
Isophorone	2.70	0.333	mg/kg wet	3.333		81	40-140			
Naphthalene	2.43	0.333	mg/kg wet	3.333		73	40-140			
Nitrobenzene	2.87	0.333	mg/kg wet	3.333		86	40-140			
N-Nitrosodimethylamine	2.41	0.333	mg/kg wet	3.333		72	40-140			
N-Nitroso-Di-n-Propylamine	2.91	0.333	mg/kg wet	3.333		87	40-140			
N-nitrosodiphenylamine	2.75	0.333	mg/kg wet	3.333		83	40-140			
Pentachlorophenol	2.04	1.67	mg/kg wet	3.333		61	30-130			
Phenanthrene	2.56	0.333	mg/kg wet	3.333		77	40-140			
Phenol	3.01	0.333	mg/kg wet	3.333		90	30-130			
Pyrene	2.71	0.333	mg/kg wet	3.333		81	40-140			
Pyridine	2.38	1.67	mg/kg wet	3.333		71	40-140			
Surrogate: 1,2-Dichlorobenzene-d4	*2.73*		mg/kg wet	*3.333*		*82*	*30-130*			
Surrogate: 2,4,6-Tribromophenol	*4.77*		mg/kg wet	*5.000*		*95*	*30-130*			
Surrogate: 2-Chlorophenol-d4	*4.29*		mg/kg wet	*5.000*		*86*	*30-130*			
Surrogate: 2-Fluorobiphenyl	*2.84*		mg/kg wet	*3.333*		*85*	*30-130*			
Surrogate: 2-Fluorophenol	*4.47*		mg/kg wet	*5.000*		*89*	*30-130*			
Surrogate: Nitrobenzene-d5	*3.24*		mg/kg wet	*3.333*		*97*	*30-130*			
Surrogate: Phenol-d6	*4.80*		mg/kg wet	*5.000*		*96*	*30-130*			
Surrogate: p-Terphenyl-d14	*3.21*		mg/kg wet	*3.333*		*96*	*30-130*			
LCS Dup										
1,1-Biphenyl	2.19	0.333	mg/kg wet	3.333		66	40-140	18	30	
1,2,4-Trichlorobenzene	2.06	0.333	mg/kg wet	3.333		62	40-140	20	30	
1,2-Dichlorobenzene	1.98	0.333	mg/kg wet	3.333		60	40-140	19	30	
1,3-Dichlorobenzene	1.89	0.333	mg/kg wet	3.333		57	40-140	18	30	
1,4-Dichlorobenzene	1.97	0.333	mg/kg wet	3.333		59	40-140	18	30	
2,3,4,6-Tetrachlorophenol	2.37	1.67	mg/kg wet	3.333		71	30-130	6	30	
2,4,5-Trichlorophenol	2.54	0.333	mg/kg wet	3.333		76	30-130	12	30	

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind

ESS Laboratory Work Order: 20L0756

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8270D Semi-Volatile Organic Compounds										
Batch DL02238 - 3546										
2,4,6-Trichlorophenol	2.29	0.333	mg/kg wet	3.333		69	30-130	15	30	
2,4-Dichlorophenol	2.31	0.333	mg/kg wet	3.333		69	30-130	19	30	
2,4-Dimethylphenol	2.25	0.333	mg/kg wet	3.333		67	30-130	20	30	
2,4-Dinitrophenol	1.95	1.67	mg/kg wet	3.333		58	30-130	30	30	
2,4-Dinitrotoluene	2.75	0.333	mg/kg wet	3.333		83	40-140	5	30	
2,6-Dinitrotoluene	2.40	0.333	mg/kg wet	3.333		72	40-140	10	30	
2-Chloronaphthalene	2.00	0.333	mg/kg wet	3.333		60	40-140	19	30	
2-Chlorophenol	2.13	0.333	mg/kg wet	3.333		64	30-130	19	30	
2-Methylnaphthalene	2.10	0.333	mg/kg wet	3.333		63	40-140	20	30	
2-Methylphenol	2.20	0.333	mg/kg wet	3.333		66	30-130	19	30	
2-Nitroaniline	2.71	0.333	mg/kg wet	3.333		81	40-140	11	30	
2-Nitrophenol	2.10	0.333	mg/kg wet	3.333		63	30-130	20	30	
3,3´-Dichlorobenzidine	2.50	0.667	mg/kg wet	3.333		75	40-140	13	30	
3+4-Methylphenol	4.74	0.667	mg/kg wet	6.667		71	30-130	9	30	
3-Nitroaniline	2.07	0.333	mg/kg wet	3.333		62	40-140	12	30	
4,6-Dinitro-2-Methylphenol	2.10	1.67	mg/kg wet	3.333		63	30-130	23	30	
4-Bromophenyl-phenylether	2.44	0.333	mg/kg wet	3.333		73	40-140	12	30	
4-Chloro-3-Methylphenol	2.59	0.333	mg/kg wet	3.333		78	30-130	13	30	
4-Chloroaniline	1.44	0.667	mg/kg wet	3.333		43	40-140	32	30	D+
4-Chloro-phenyl-phenyl ether	2.37	0.333	mg/kg wet	3.333		71	40-140	13	30	
4-Nitroaniline	2.33	0.333	mg/kg wet	3.333		70	40-140	3	30	
4-Nitrophenol	2.74	1.67	mg/kg wet	3.333		82	30-130	2	30	
Acenaphthene	1.97	0.333	mg/kg wet	3.333		59	40-140	16	30	
Acenaphthylene	2.13	0.333	mg/kg wet	3.333		64	40-140	16	30	
Acetophenone	2.20	0.667	mg/kg wet	3.333		66	40-140	17	30	
Aniline	1.54	0.667	mg/kg wet	3.333		46	40-140	27	30	
Anthracene	2.61	0.333	mg/kg wet	3.333		78	40-140	6	30	
Azobenzene	2.54	0.333	mg/kg wet	3.333		76	40-140	13	30	
Benzo(a)anthracene	2.87	0.333	mg/kg wet	3.333		86	40-140	2	30	
Benzo(a)pyrene	2.74	0.167	mg/kg wet	3.333		82	40-140	0.9	30	
Benzo(b)fluoranthene	2.77	0.333	mg/kg wet	3.333		83	40-140	0.8	30	
Benzo(g,h,i)perylene	2.50	0.333	mg/kg wet	3.333		75	40-140	2	30	
Benzo(k)fluoranthene	2.85	0.333	mg/kg wet	3.333		85	40-140	1	30	
Benzoic Acid	1.89	1.67	mg/kg wet	3.333		57	40-140	15	30	
Benzyl Alcohol	1.91	0.333	mg/kg wet	3.333		57	40-140	22	30	
bis(2-Chloroethoxy)methane	2.32	0.333	mg/kg wet	3.333		70	40-140	21	30	
bis(2-Chloroethyl)ether	2.23	0.333	mg/kg wet	3.333		67	40-140	17	30	
bis(2-chloroisopropyl)Ether	1.94	0.333	mg/kg wet	3.333		58	40-140	19	30	
bis(2-Ethylhexyl)phthalate	2.43	0.333	mg/kg wet	3.333		73	40-140	3	30	
Butylbenzylphthalate	2.40	0.333	mg/kg wet	3.333		72	40-140	2	30	
Carbazole	2.71	0.333	mg/kg wet	3.333		81	40-140	0.7	30	
Chrysene	2.65	0.167	mg/kg wet	3.333		80	40-140	2	30	
Dibenzo(a,h)Anthracene	2.47	0.167	mg/kg wet	3.333		74	40-140	2	30	
Dibenzofuran	2.18	0.333	mg/kg wet	3.333		65	40-140	14	30	
Diethylphthalate	2.47	0.333	mg/kg wet	3.333		74	40-140	7	30	

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind

ESS Laboratory Work Order: 20L0756

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8270D Semi-Volatile Organic Compounds										
Batch DL02238 - 3546										
Dimethylphthalate	2.35	0.333	mg/kg wet	3.333		71	40-140	11	30	
Di-n-butylphthalate	2.72	0.333	mg/kg wet	3.333		82	40-140	2	30	
Di-n-octylphthalate	2.48	0.333	mg/kg wet	3.333		74	40-140	0.2	30	
Fluoranthene	2.91	0.333	mg/kg wet	3.333		87	40-140	2	30	
Fluorene	2.43	0.333	mg/kg wet	3.333		73	40-140	11	30	
Hexachlorobenzene	2.61	0.167	mg/kg wet	3.333		78	40-140	9	30	
Hexachlorobutadiene	2.17	0.333	mg/kg wet	3.333		65	40-140	22	30	
Hexachlorocyclopentadiene	1.99	1.67	mg/kg wet	3.333		60	40-140	19	30	
Hexachloroethane	2.06	0.333	mg/kg wet	3.333		62	40-140	19	30	
Indeno(1,2,3-cd)Pyrene	2.48	0.333	mg/kg wet	3.333		74	40-140	3	30	
Isophorone	2.24	0.333	mg/kg wet	3.333		67	40-140	19	30	
Naphthalene	1.98	0.333	mg/kg wet	3.333		59	40-140	20	30	
Nitrobenzene	2.34	0.333	mg/kg wet	3.333		70	40-140	20	30	
N-Nitrosodimethylamine	2.04	0.333	mg/kg wet	3.333		61	40-140	17	30	
N-Nitroso-Di-n-Propylamine	2.42	0.333	mg/kg wet	3.333		73	40-140	18	30	
N-nitrosodiphenylamine	2.50	0.333	mg/kg wet	3.333		75	40-140	10	30	
Pentachlorophenol	2.24	1.67	mg/kg wet	3.333		67	30-130	9	30	
Phenanthrene	2.42	0.333	mg/kg wet	3.333		73	40-140	6	30	
Phenol	2.50	0.333	mg/kg wet	3.333		75	30-130	19	30	
Pyrene	2.68	0.333	mg/kg wet	3.333		80	40-140	0.9	30	
Pyridine	2.01	1.67	mg/kg wet	3.333		60	40-140	17	30	
Surrogate: 1,2-Dichlorobenzene-d4	*2.27*		mg/kg wet	*3.333*		*68*	*30-130*			
Surrogate: 2,4,6-Tribromophenol	*4.39*		mg/kg wet	*5.000*		*88*	*30-130*			
Surrogate: 2-Chlorophenol-d4	*3.55*		mg/kg wet	*5.000*		*71*	*30-130*			
Surrogate: 2-Fluorobiphenyl	*2.35*		mg/kg wet	*3.333*		*70*	*30-130*			
Surrogate: 2-Fluorophenol	*3.69*		mg/kg wet	*5.000*		*74*	*30-130*			
Surrogate: Nitrobenzene-d5	*2.62*		mg/kg wet	*3.333*		*79*	*30-130*			
Surrogate: Phenol-d6	*3.98*		mg/kg wet	*5.000*		*80*	*30-130*			
Surrogate: p-Terphenyl-d14	*3.15*		mg/kg wet	*3.333*		*95*	*30-130*			
Batch DL02310 - 3546										
Blank										
1,1-Biphenyl	ND	0.333	mg/kg wet							
1,2,4-Trichlorobenzene	ND	0.333	mg/kg wet							
1,2-Dichlorobenzene	ND	0.333	mg/kg wet							
1,3-Dichlorobenzene	ND	0.333	mg/kg wet							
1,4-Dichlorobenzene	ND	0.333	mg/kg wet							
2,3,4,6-Tetrachlorophenol	ND	1.67	mg/kg wet							
2,4,5-Trichlorophenol	ND	0.333	mg/kg wet							
2,4,6-Trichlorophenol	ND	0.333	mg/kg wet							
2,4-Dichlorophenol	ND	0.333	mg/kg wet							
2,4-Dimethylphenol	ND	0.333	mg/kg wet							
2,4-Dinitrophenol	ND	1.67	mg/kg wet							
2,4-Dinitrotoluene	ND	0.333	mg/kg wet							
2,6-Dinitrotoluene	ND	0.333	mg/kg wet							
2-Chloronaphthalene	ND	0.333	mg/kg wet							

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Client Name: Vanasse Hangen Brustlin, Inc.
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ESS Laboratory Work Order: 20L0756

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8270D Semi-Volatile Organic Compounds										
Batch DL02310 - 3546										
2-Chlorophenol	ND	0.333	mg/kg wet							
2-Methylnaphthalene	ND	0.333	mg/kg wet							
2-Methylphenol	ND	0.333	mg/kg wet							
2-Nitroaniline	ND	0.333	mg/kg wet							
2-Nitrophenol	ND	0.333	mg/kg wet							
3,3´-Dichlorobenzidine	ND	0.667	mg/kg wet							
3+4-Methylphenol	ND	0.667	mg/kg wet							
3-Nitroaniline	ND	0.333	mg/kg wet							
4,6-Dinitro-2-Methylphenol	ND	1.67	mg/kg wet							
4-Bromophenyl-phenylether	ND	0.333	mg/kg wet							
4-Chloro-3-Methylphenol	ND	0.333	mg/kg wet							
4-Chloroaniline	ND	0.667	mg/kg wet							
4-Chloro-phenyl-phenyl ether	ND	0.333	mg/kg wet							
4-Nitroaniline	ND	0.333	mg/kg wet							
4-Nitrophenol	ND	1.67	mg/kg wet							
Acenaphthene	ND	0.333	mg/kg wet							
Acenaphthylene	ND	0.333	mg/kg wet							
Acetophenone	ND	0.667	mg/kg wet							
Aniline	ND	0.667	mg/kg wet							
Anthracene	ND	0.333	mg/kg wet							
Azobenzene	ND	0.333	mg/kg wet							
Benzo(a)anthracene	ND	0.333	mg/kg wet							
Benzo(a)pyrene	ND	0.167	mg/kg wet							
Benzo(b)fluoranthene	ND	0.333	mg/kg wet							
Benzo(g,h,i)perylene	ND	0.333	mg/kg wet							
Benzo(k)fluoranthene	ND	0.333	mg/kg wet							
Benzoic Acid	ND	1.67	mg/kg wet							
Benzyl Alcohol	ND	0.333	mg/kg wet							
bis(2-Chloroethoxy)methane	ND	0.333	mg/kg wet							
bis(2-Chloroethyl)ether	ND	0.333	mg/kg wet							
bis(2-chloroisopropyl)Ether	ND	0.333	mg/kg wet							
bis(2-Ethylhexyl)phthalate	ND	0.333	mg/kg wet							
Butylbenzylphthalate	ND	0.333	mg/kg wet							
Carbazole	ND	0.333	mg/kg wet							
Chrysene	ND	0.167	mg/kg wet							
Dibenzo(a,h)Anthracene	ND	0.167	mg/kg wet							
Dibenzofuran	ND	0.333	mg/kg wet							
Diethylphthalate	ND	0.333	mg/kg wet							
Dimethylphthalate	ND	0.333	mg/kg wet							
Di-n-butylphthalate	ND	0.333	mg/kg wet							
Di-n-octylphthalate	ND	0.333	mg/kg wet							
Fluoranthene	ND	0.333	mg/kg wet							
Fluorene	ND	0.333	mg/kg wet							
Hexachlorobenzene	ND	0.167	mg/kg wet							
Hexachlorobutadiene	ND	0.333	mg/kg wet							

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Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8270D Semi-Volatile Organic Compounds										
Batch DL02310 - 3546										
Hexachlorocyclopentadiene	ND	1.67	mg/kg wet							
Hexachloroethane	ND	0.333	mg/kg wet							
Indeno(1,2,3-cd)Pyrene	ND	0.333	mg/kg wet							
Isophorone	ND	0.333	mg/kg wet							
Naphthalene	ND	0.333	mg/kg wet							
Nitrobenzene	ND	0.333	mg/kg wet							
N-Nitrosodimethylamine	ND	0.333	mg/kg wet							
N-Nitroso-Di-n-Propylamine	ND	0.333	mg/kg wet							
N-nitrosodiphenylamine	ND	0.333	mg/kg wet							
Pentachlorophenol	ND	1.67	mg/kg wet							
Phenanthrene	ND	0.333	mg/kg wet							
Phenol	ND	0.333	mg/kg wet							
Pyrene	ND	0.333	mg/kg wet							
Pyridine	ND	1.67	mg/kg wet							
Surrogate: 1,2-Dichlorobenzene-d4	*2.54*		mg/kg wet	*3.333*		*76*	*30-130*			
Surrogate: 2,4,6-Tribromophenol	*3.40*		mg/kg wet	*5.000*		*68*	*30-130*			
Surrogate: 2-Chlorophenol-d4	*3.80*		mg/kg wet	*5.000*		*76*	*30-130*			
Surrogate: 2-Fluorobiphenyl	*2.47*		mg/kg wet	*3.333*		*74*	*30-130*			
Surrogate: 2-Fluorophenol	*3.74*		mg/kg wet	*5.000*		*75*	*30-130*			
Surrogate: Nitrobenzene-d5	*2.93*		mg/kg wet	*3.333*		*88*	*30-130*			
Surrogate: Phenol-d6	*4.33*		mg/kg wet	*5.000*		*87*	*30-130*			
Surrogate: p-Terphenyl-d14	*3.37*		mg/kg wet	*3.333*		*101*	*30-130*			
LCS										
1,1-Biphenyl	2.46	0.333	mg/kg wet	3.333		74	40-140			
1,2,4-Trichlorobenzene	2.33	0.333	mg/kg wet	3.333		70	40-140			
1,2-Dichlorobenzene	2.15	0.333	mg/kg wet	3.333		64	40-140			
1,3-Dichlorobenzene	2.08	0.333	mg/kg wet	3.333		62	40-140			
1,4-Dichlorobenzene	2.15	0.333	mg/kg wet	3.333		64	40-140			
2,3,4,6-Tetrachlorophenol	2.75	1.67	mg/kg wet	3.333		82	30-130			
2,4,5-Trichlorophenol	2.74	0.333	mg/kg wet	3.333		82	30-130			
2,4,6-Trichlorophenol	2.59	0.333	mg/kg wet	3.333		78	30-130			
2,4-Dichlorophenol	2.56	0.333	mg/kg wet	3.333		77	30-130			
2,4-Dimethylphenol	2.59	0.333	mg/kg wet	3.333		78	30-130			
2,4-Dinitrophenol	1.81	1.67	mg/kg wet	3.333		54	30-130			
2,4-Dinitrotoluene	2.97	0.333	mg/kg wet	3.333		89	40-140			
2,6-Dinitrotoluene	2.65	0.333	mg/kg wet	3.333		80	40-140			
2-Chloronaphthalene	2.25	0.333	mg/kg wet	3.333		68	40-140			
2-Chlorophenol	2.29	0.333	mg/kg wet	3.333		69	30-130			
2-Methylnaphthalene	2.35	0.333	mg/kg wet	3.333		70	40-140			
2-Methylphenol	2.41	0.333	mg/kg wet	3.333		72	30-130			
2-Nitroaniline	2.96	0.333	mg/kg wet	3.333		89	40-140			
2-Nitrophenol	2.31	0.333	mg/kg wet	3.333		69	30-130			
3,3´-Dichlorobenzidine	2.64	0.667	mg/kg wet	3.333		79	40-140			
3+4-Methylphenol	5.18	0.667	mg/kg wet	6.667		78	30-130			
3-Nitroaniline	2.26	0.333	mg/kg wet	3.333		68	40-140			

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind

ESS Laboratory Work Order: 20L0756

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8270D Semi-Volatile Organic Compounds										
Batch DL02310 - 3546										
4,6-Dinitro-2-Methylphenol	2.46	1.67	mg/kg wet	3.333		74	30-130			
4-Bromophenyl-phenylether	2.75	0.333	mg/kg wet	3.333		83	40-140			
4-Chloro-3-Methylphenol	2.80	0.333	mg/kg wet	3.333		84	30-130			
4-Chloroaniline	1.53	0.667	mg/kg wet	3.333		46	40-140			
4-Chloro-phenyl-phenyl ether	2.65	0.333	mg/kg wet	3.333		80	40-140			
4-Nitroaniline	2.34	0.333	mg/kg wet	3.333		70	40-140			
4-Nitrophenol	2.89	1.67	mg/kg wet	3.333		87	30-130			
Acenaphthene	2.19	0.333	mg/kg wet	3.333		66	40-140			
Acenaphthylene	2.38	0.333	mg/kg wet	3.333		71	40-140			
Acetophenone	2.42	0.667	mg/kg wet	3.333		73	40-140			
Aniline	1.73	0.667	mg/kg wet	3.333		52	40-140			
Anthracene	2.86	0.333	mg/kg wet	3.333		86	40-140			
Azobenzene	2.92	0.333	mg/kg wet	3.333		88	40-140			
Benzo(a)anthracene	3.08	0.333	mg/kg wet	3.333		93	40-140			
Benzo(a)pyrene	2.97	0.167	mg/kg wet	3.333		89	40-140			
Benzo(b)fluoranthene	2.86	0.333	mg/kg wet	3.333		86	40-140			
Benzo(g,h,i)perylene	2.92	0.333	mg/kg wet	3.333		88	40-140			
Benzo(k)fluoranthene	3.16	0.333	mg/kg wet	3.333		95	40-140			
Benzoic Acid	2.00	1.67	mg/kg wet	3.333		60	40-140			
Benzyl Alcohol	2.23	0.333	mg/kg wet	3.333		67	40-140			
bis(2-Chloroethoxy)methane	2.68	0.333	mg/kg wet	3.333		80	40-140			
bis(2-Chloroethyl)ether	2.41	0.333	mg/kg wet	3.333		72	40-140			
bis(2-chloroisopropyl)Ether	2.09	0.333	mg/kg wet	3.333		63	40-140			
bis(2-Ethylhexyl)phthalate	2.66	0.333	mg/kg wet	3.333		80	40-140			
Butylbenzylphthalate	2.60	0.333	mg/kg wet	3.333		78	40-140			
Carbazole	2.87	0.333	mg/kg wet	3.333		86	40-140			
Chrysene	2.88	0.167	mg/kg wet	3.333		86	40-140			
Dibenzo(a,h)Anthracene	2.78	0.167	mg/kg wet	3.333		84	40-140			
Dibenzofuran	2.42	0.333	mg/kg wet	3.333		72	40-140			
Diethylphthalate	2.73	0.333	mg/kg wet	3.333		82	40-140			
Dimethylphthalate	2.62	0.333	mg/kg wet	3.333		78	40-140			
Di-n-butylphthalate	2.95	0.333	mg/kg wet	3.333		89	40-140			
Di-n-octylphthalate	2.62	0.333	mg/kg wet	3.333		79	40-140			
Fluoranthene	3.09	0.333	mg/kg wet	3.333		93	40-140			
Fluorene	2.68	0.333	mg/kg wet	3.333		80	40-140			
Hexachlorobenzene	2.94	0.167	mg/kg wet	3.333		88	40-140			
Hexachlorobutadiene	2.50	0.333	mg/kg wet	3.333		75	40-140			
Hexachlorocyclopentadiene	2.22	1.67	mg/kg wet	3.333		67	40-140			
Hexachloroethane	2.24	0.333	mg/kg wet	3.333		67	40-140			
Indeno(1,2,3-cd)Pyrene	2.83	0.333	mg/kg wet	3.333		85	40-140			
Isophorone	2.53	0.333	mg/kg wet	3.333		76	40-140			
Naphthalene	2.20	0.333	mg/kg wet	3.333		66	40-140			
Nitrobenzene	2.68	0.333	mg/kg wet	3.333		80	40-140			
N-Nitrosodimethylamine	2.31	0.333	mg/kg wet	3.333		69	40-140			
N-Nitroso-Di-n-Propylamine	2.73	0.333	mg/kg wet	3.333		82	40-140			

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Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind

ESS Laboratory Work Order: 20L0756

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8270D Semi-Volatile Organic Compounds										
Batch DL02310 - 3546										
N-nitrosodiphenylamine	2.82	0.333	mg/kg wet	3.333		85	40-140			
Pentachlorophenol	2.77	1.67	mg/kg wet	3.333		83	30-130			
Phenanthrene	2.69	0.333	mg/kg wet	3.333		81	40-140			
Phenol	2.77	0.333	mg/kg wet	3.333		83	30-130			
Pyrene	3.01	0.333	mg/kg wet	3.333		90	40-140			
Pyridine	2.35	1.67	mg/kg wet	3.333		70	40-140			
Surrogate: 1,2-Dichlorobenzene-d4	*2.46*		mg/kg wet	*3.333*		*74*	*30-130*			
Surrogate: 2,4,6-Tribromophenol	*4.96*		mg/kg wet	*5.000*		*99*	*30-130*			
Surrogate: 2-Chlorophenol-d4	*3.81*		mg/kg wet	*5.000*		*76*	*30-130*			
Surrogate: 2-Fluorobiphenyl	*2.66*		mg/kg wet	*3.333*		*80*	*30-130*			
Surrogate: 2-Fluorophenol	*3.80*		mg/kg wet	*5.000*		*76*	*30-130*			
Surrogate: Nitrobenzene-d5	*2.97*		mg/kg wet	*3.333*		*89*	*30-130*			
Surrogate: Phenol-d6	*4.35*		mg/kg wet	*5.000*		*87*	*30-130*			
Surrogate: p-Terphenyl-d14	*3.50*		mg/kg wet	*3.333*		*105*	*30-130*			
LCS Dup										
1,1-Biphenyl	2.46	0.333	mg/kg wet	3.333		74	40-140	0.04	30	
1,2,4-Trichlorobenzene	2.39	0.333	mg/kg wet	3.333		72	40-140	2	30	
1,2-Dichlorobenzene	2.18	0.333	mg/kg wet	3.333		66	40-140	2	30	
1,3-Dichlorobenzene	2.13	0.333	mg/kg wet	3.333		64	40-140	2	30	
1,4-Dichlorobenzene	2.18	0.333	mg/kg wet	3.333		66	40-140	2	30	
2,3,4,6-Tetrachlorophenol	2.61	1.67	mg/kg wet	3.333		78	30-130	5	30	
2,4,5-Trichlorophenol	2.75	0.333	mg/kg wet	3.333		83	30-130	0.5	30	
2,4,6-Trichlorophenol	2.50	0.333	mg/kg wet	3.333		75	30-130	3	30	
2,4-Dichlorophenol	2.52	0.333	mg/kg wet	3.333		76	30-130	1	30	
2,4-Dimethylphenol	2.56	0.333	mg/kg wet	3.333		77	30-130	1	30	
2,4-Dinitrophenol	1.81	1.67	mg/kg wet	3.333		54	30-130	0.4	30	
2,4-Dinitrotoluene	2.80	0.333	mg/kg wet	3.333		84	40-140	6	30	
2,6-Dinitrotoluene	2.53	0.333	mg/kg wet	3.333		76	40-140	5	30	
2-Chloronaphthalene	2.27	0.333	mg/kg wet	3.333		68	40-140	0.6	30	
2-Chlorophenol	2.28	0.333	mg/kg wet	3.333		68	30-130	0.3	30	
2-Methylnaphthalene	2.36	0.333	mg/kg wet	3.333		71	40-140	0.6	30	
2-Methylphenol	2.36	0.333	mg/kg wet	3.333		71	30-130	2	30	
2-Nitroaniline	2.84	0.333	mg/kg wet	3.333		85	40-140	4	30	
2-Nitrophenol	2.34	0.333	mg/kg wet	3.333		70	30-130	1	30	
3,3´-Dichlorobenzidine	2.42	0.667	mg/kg wet	3.333		73	40-140	9	30	
3+4-Methylphenol	5.01	0.667	mg/kg wet	6.667		75	30-130	3	30	
3-Nitroaniline	2.10	0.333	mg/kg wet	3.333		63	40-140	7	30	
4,6-Dinitro-2-Methylphenol	2.60	1.67	mg/kg wet	3.333		78	30-130	6	30	
4-Bromophenyl-phenylether	2.69	0.333	mg/kg wet	3.333		81	40-140	2	30	
4-Chloro-3-Methylphenol	2.70	0.333	mg/kg wet	3.333		81	30-130	4	30	
4-Chloroaniline	1.44	0.667	mg/kg wet	3.333		43	40-140	6	30	
4-Chloro-phenyl-phenyl ether	2.58	0.333	mg/kg wet	3.333		77	40-140	3	30	
4-Nitroaniline	2.23	0.333	mg/kg wet	3.333		67	40-140	5	30	
4-Nitrophenol	2.76	1.67	mg/kg wet	3.333		83	30-130	5	30	
Acenaphthene	2.16	0.333	mg/kg wet	3.333		65	40-140	1	30	

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CERTIFICATE OF ANALYSIS

Client Name: Vanasse Hangen Brustlin, Inc.
Client Project ID: Rev Wind

ESS Laboratory Work Order: 20L0756

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8270D Semi-Volatile Organic Compounds										
Batch DL02310 - 3546										
Acenaphthylene	2.33	0.333	mg/kg wet	3.333		70	40-140	2	30	
Acetophenone	2.36	0.667	mg/kg wet	3.333		71	40-140	2	30	
Aniline	1.59	0.667	mg/kg wet	3.333		48	40-140	8	30	
Anthracene	2.77	0.333	mg/kg wet	3.333		83	40-140	3	30	
Azobenzene	2.91	0.333	mg/kg wet	3.333		87	40-140	0.5	30	
Benzo(a)anthracene	3.02	0.333	mg/kg wet	3.333		91	40-140	2	30	
Benzo(a)pyrene	2.90	0.167	mg/kg wet	3.333		87	40-140	2	30	
Benzo(b)fluoranthene	2.80	0.333	mg/kg wet	3.333		84	40-140	2	30	
Benzo(g,h,i)perylene	2.99	0.333	mg/kg wet	3.333		90	40-140	2	30	
Benzo(k)fluoranthene	3.01	0.333	mg/kg wet	3.333		90	40-140	5	30	
Benzoic Acid	2.20	1.67	mg/kg wet	3.333		66	40-140	9	30	
Benzyl Alcohol	2.21	0.333	mg/kg wet	3.333		66	40-140	0.7	30	
bis(2-Chloroethoxy)methane	2.68	0.333	mg/kg wet	3.333		80	40-140	0.1	30	
bis(2-Chloroethyl)ether	2.42	0.333	mg/kg wet	3.333		73	40-140	0.5	30	
bis(2-chloroisopropyl)Ether	2.12	0.333	mg/kg wet	3.333		64	40-140	2	30	
bis(2-Ethylhexyl)phthalate	2.56	0.333	mg/kg wet	3.333		77	40-140	3	30	
Butylbenzylphthalate	2.51	0.333	mg/kg wet	3.333		75	40-140	3	30	
Carbazole	2.77	0.333	mg/kg wet	3.333		83	40-140	4	30	
Chrysene	2.84	0.167	mg/kg wet	3.333		85	40-140	1	30	
Dibenzo(a,h)Anthracene	2.81	0.167	mg/kg wet	3.333		84	40-140	1	30	
Dibenzofuran	2.36	0.333	mg/kg wet	3.333		71	40-140	2	30	
Diethylphthalate	2.59	0.333	mg/kg wet	3.333		78	40-140	5	30	
Dimethylphthalate	2.52	0.333	mg/kg wet	3.333		76	40-140	4	30	
Di-n-butylphthalate	2.86	0.333	mg/kg wet	3.333		86	40-140	3	30	
Di-n-octylphthalate	2.44	0.333	mg/kg wet	3.333		73	40-140	7	30	
Fluoranthene	2.99	0.333	mg/kg wet	3.333		90	40-140	3	30	
Fluorene	2.62	0.333	mg/kg wet	3.333		79	40-140	2	30	
Hexachlorobenzene	2.84	0.167	mg/kg wet	3.333		85	40-140	3	30	
Hexachlorobutadiene	2.59	0.333	mg/kg wet	3.333		78	40-140	3	30	
Hexachlorocyclopentadiene	2.31	1.67	mg/kg wet	3.333		69	40-140	4	30	
Hexachloroethane	2.35	0.333	mg/kg wet	3.333		70	40-140	5	30	
Indeno(1,2,3-cd)Pyrene	2.88	0.333	mg/kg wet	3.333		86	40-140	2	30	
Isophorone	2.53	0.333	mg/kg wet	3.333		76	40-140	0.1	30	
Naphthalene	2.24	0.333	mg/kg wet	3.333		67	40-140	2	30	
Nitrobenzene	2.67	0.333	mg/kg wet	3.333		80	40-140	0.2	30	
N-Nitrosodimethylamine	2.39	0.333	mg/kg wet	3.333		72	40-140	3	30	
N-Nitroso-Di-n-Propylamine	2.67	0.333	mg/kg wet	3.333		80	40-140	2	30	
N-nitrosodiphenylamine	2.76	0.333	mg/kg wet	3.333		83	40-140	2	30	
Pentachlorophenol	2.78	1.67	mg/kg wet	3.333		83	30-130	0.3	30	
Phenanthrene	2.58	0.333	mg/kg wet	3.333		78	40-140	4	30	
Phenol	2.35	0.333	mg/kg wet	3.333		71	30-130	16	30	
Pyrene	2.89	0.333	mg/kg wet	3.333		87	40-140	4	30	
Pyridine	2.49	1.67	mg/kg wet	3.333		75	40-140	6	30	
Surrogate: 1,2-Dichlorobenzene-d4	*2.53*		mg/kg wet	*3.333*		*76*	*30-130*			
Surrogate: 2,4,6-Tribromophenol	*4.81*		mg/kg wet	*5.000*		*96*	*30-130*			

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CERTIFICATE OF ANALYSIS

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Client Project ID: Rev Wind

ESS Laboratory Work Order: 20L0756

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8270D Semi-Volatile Organic Compounds										
Batch DL02310 - 3546										
Surrogate: 2-Chlorophenol-d4	*3.82*		mg/kg wet	*5.000*		*76*	*30-130*			
Surrogate: 2-Fluorobiphenyl	*2.68*		mg/kg wet	*3.333*		*80*	*30-130*			
Surrogate: 2-Fluorophenol	*3.84*		mg/kg wet	*5.000*		*77*	*30-130*			
Surrogate: Nitrobenzene-d5	*3.03*		mg/kg wet	*3.333*		*91*	*30-130*			
Surrogate: Phenol-d6	*4.30*		mg/kg wet	*5.000*		*86*	*30-130*			
Surrogate: p-Terphenyl-d14	*3.41*		mg/kg wet	*3.333*		*102*	*30-130*			
Classical Chemistry										
Batch DL02804 - General Preparation										
Blank										
Total Organic Carbon (1)	ND	100	mg/kg							
Total Organic Carbon (2)	ND	100	mg/kg							
LCS										
Total Organic Carbon (1)	9980	100	mg/kg	10000		100	80-120			
Total Organic Carbon (2)	11100	100	mg/kg	10000		111	80-120			
LCS Dup										
Total Organic Carbon (1)	10000	100	mg/kg	10000		100	80-120	0.1	20	
Total Organic Carbon (2)	9890	100	mg/kg	10000		99	80-120	11	20	

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Notes and Definitions

Z17	Temperature is within 23 +/-2 ºC.
Z-08	See Attached
U	Analyte included in the analysis, but not detected
RRF	Analyte does not meet the Relative Response Factor (RRF) criteria in the calibration
Q	Calibration required quadratic regression (Q).
PT	Pentachlorophenol tailing factor > 2.
ICV-	Initial Calibration Verification recovery is below lower control limit (ICV-).
D+	Relative percent difference for duplicate is outside of criteria (D+).
D	Diluted.
CD+	Continuing Calibration %Diff/Drift is above control limit (CD+).
CD-	Continuing Calibration %Diff/Drift is below control limit (CD-).
BT	Benzidine tailing factor >2.
ND	Analyte NOT DETECTED at or above the MRL (LOQ), LOD for DoD Reports, MDL for J-Flagged Analytes
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference
MDL	Method Detection Limit
MRL	Method Reporting Limit
LOD	Limit of Detection
LOQ	Limit of Quantitation
DL	Detection Limit
I/V	Initial Volume
F/V	Final Volume
§	Subcontracted analysis; see attached report
1	Range result excludes concentrations of surrogates and/or internal standards eluting in that range.
2	Range result excludes concentrations of target analytes eluting in that range.
3	Range result excludes the concentration of the C9-C10 aromatic range.
Avg	Results reported as a mathematical average.
NR	No Recovery
[CALC]	Calculated Analyte
SUB	Subcontracted analysis; see attached report
RL	Reporting Limit
EDL	Estimated Detection Limit
MF	Membrane Filtration
MPN	Most Probably Number
TNTC	Too numerous to Count
CFU	Colony Forming Units

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ESS LABORATORY CERTIFICATIONS AND ACCREDITATIONS

ENVIRONMENTAL

Rhode Island Potable and Non Potable Water: LAI00179
http://www.health.ri.gov/find/labs/analytical/ESS.pdf

Connecticut Potable and Non Potable Water, Solid and Hazardous Waste: PH-0750
http://www.ct.gov/dph/lib/dph/environmental_health/environmental_laboratories/pdf/OutofStateCommercialLaboratories.pdf

Maine Potable and Non Potable Water, and Solid and Hazardous Waste: RI00002
http://www.maine.gov/dhhs/mecdc/environmental-health/dwp/partners/labCert.shtml

Massachusetts Potable and Non Potable Water: M-RI002
http://public.dep.state.ma.us/Labcert/Labcert.aspx

New Hampshire (NELAP accredited) Potable and Non Potable Water, Solid and Hazardous Waste: 2424
http://des.nh.gov/organization/divisions/water/dwgb/nhelap/index.htm

New York (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: 11313
http://www.wadsworth.org/labcert/elap/comm.html

New Jersey (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: RI006
http://datamine2.state.nj.us/DEP_OPRA/OpraMain/pi_main?mode=pi_by_site&sort_order=PI_NAMEA&Select+a+Site:=58715

United States Department of Agriculture Soil Permit: P330-12-00139

Pennsylvania: 68-01752
http://www.dep.pa.gov/Business/OtherPrograms/Labs/Pages/Laboratory-Accreditation-Program.aspx

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THIELSCH ENGINEERING
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Cranston RI, 02910
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Let's Build a Solid Foundation

Client Information:
VHB
Providence, RI
PM: Sue Moberg
Assigned By: Sue Moberg
Collected By: Client

Project Information:
Revolution Wind
North Kingston, RI
ESS Project Number: 20L0756
Summary Page: 1 of 1
Report Date: 12.30.2020

LABORATORY TESTING DATA SHEET, Report No.: 7420-M-182

Boring ID	Sample No.	Depth (ft)	Laboratory No.	Identification Tests						Corrosivity Tests								Laboratory Log and Soil Description
				As Received Water Content %	LL %	PL %	Gravel %	Sand %	Fines %	Resitivity (Mohms-cm)	Sulfate (mg/kg)	Chloride (mg/kg)	Sulfide (mg/kg)	Redox Potential (mv)	pH	Electrical Resist. As Received Ohm-cm @ 60°F	Electrial Resist. Saturated Ohm-cm @ 60°F	
				D2216	D4318		D6913			EPA						G57		
REV01-ENV-05		2.5-7.5	20L0756-01	20.5			0.0	76.2	23.8									Brown silty sand
REV01-ENV-05		7.5-13.5	20L0756-02	19.8			0.0	73.9	26.1									Light Brown silty sand
REV01-ENV-05		13.5-15.5	20L0756-03	20.1			0.0	15.5	84.5									Brown lean clay with sand
REV01-ENV-03A		0-5	20L0756-04	22.4			0.0	87.1	12.9									Gray silty sand
REV01-ENV-03A		5-7.5	20L0756-05	19.6			0.0	77.8	22.2									Light Gray silty sand
REV01-ENV-03A		7.5-10.5	20L0756-06	21.7			0.0	33.2	66.8									Brown sandy silt
REV01-ENV-03A		10.5-13	20L0756-07	20.7			0.0	14.6	85.4									Brown lean clay with sand
REV01-ENV-06		0-4.5	20L0756-08	20.0			0.0	76.7	23.3									Light Gray silty sand
REV01-ENV-06		4.5-10	20L0756-09	20.5			0.0	77.3	22.7									Light Brown silty sand
REV01-ENV-06		10-15	20L0756-10	22.3			0.0	16.3	83.7									Brown lean clay with sand
REV01-ENV-01		0-11.5	20L0756-11	18.0			1.2	80.7	18.1									Brown silty sand

Date Received: *12.23.2020*

Reviewed By:

Date Reviewed: *12.31.2020*

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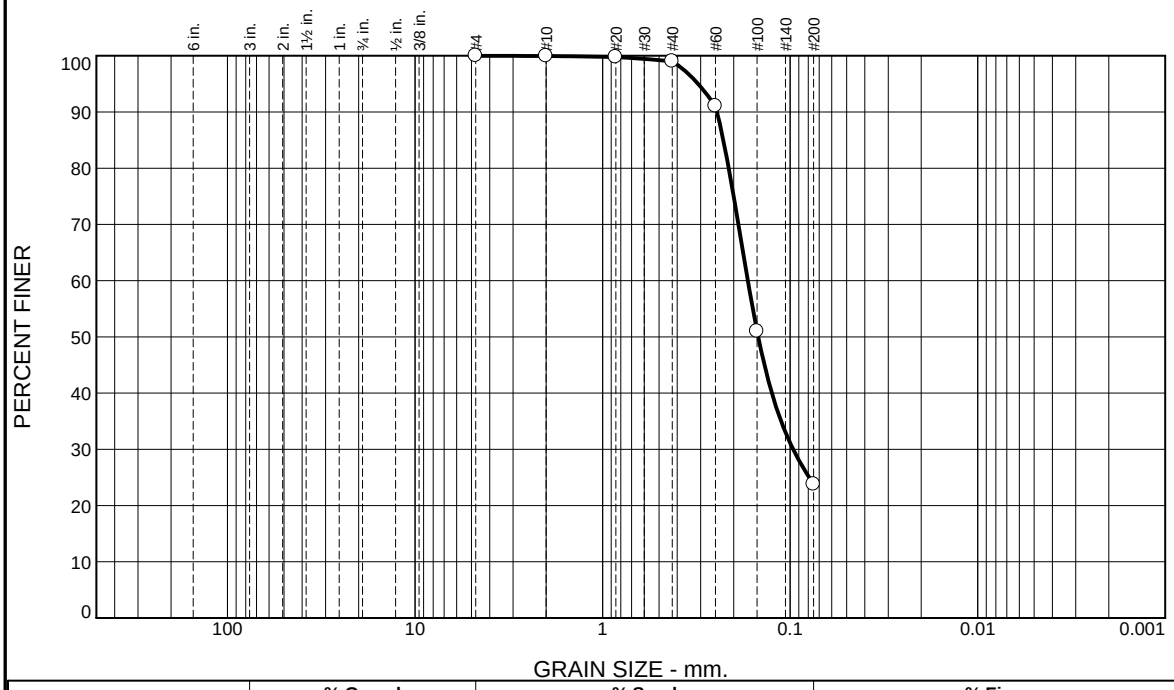
JULY 30, 2021
COASTAL RESOURCES
MANAGEMENT COUNCIL

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	1.0	75.2	23.8	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	100.0		
#20	99.8		
#40	99.0		
#60	91.0		
#100	51.0		
#200	23.8		

* (no specification provided)

Material Description

Brown silty sand

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}= 0.2454 D_{85}= 0.2270 D_{60}= 0.1680
D_{50}= 0.1479 D_{30}= 0.0964 D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 12.23.2020 **Date Tested:** 12.29.2020

Tested By: AV / JM

Checked By: Steven Accetta

Title: Laboratory Coordinator

Source of Sample: REV01-ENV **Depth:** 2.5-7.5' **Date Sampled:** 12.21.2020
Sample Number: 05

Thielsch Engineering Inc.

Cranston, RI

Client: VHB
Project: Revolution Wind
North Kingston, RI
Project No: 20L0756 **Figure** 20L0756-01

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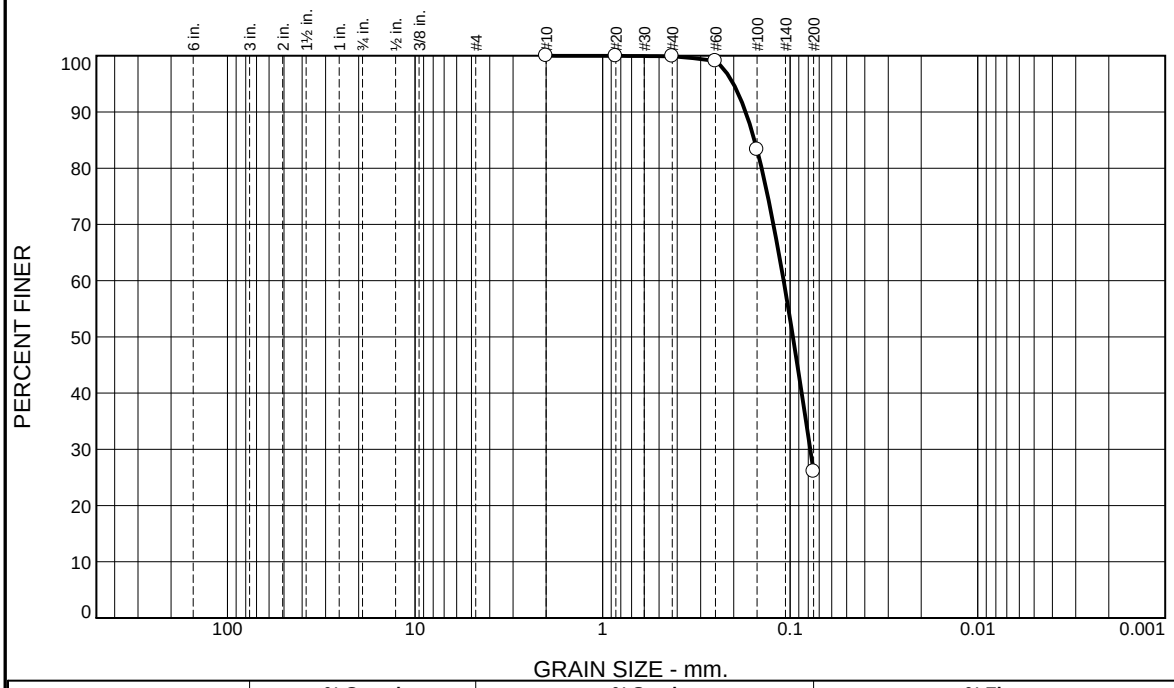
MANAGEMENT COUNCIL

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.1	73.8	26.1	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#10	100.0		
#20	100.0		
#40	99.9		
#60	99.1		
#100	83.3		
#200	26.1		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}= 0.1725 D_{85}= 0.1548 D_{60}= 0.1084
D_{50}= 0.0967 D_{30}= 0.0781 D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 12.23.2020 **Date Tested:** 12.30.2020

Tested By: AV / JM

Checked By: Steven Accetta

Title: Laboratory Coordinator

Source of Sample: REV01-ENV **Depth:** 7.5-13.5' **Date Sampled:** 12.21.2020
Sample Number: 05

Thielsch Engineering Inc.
Cranston, RI

Client: VHB
Project: Revolution Wind
North Kingston, RI
Project No: 20L0756 **Figure** 20L0756-02

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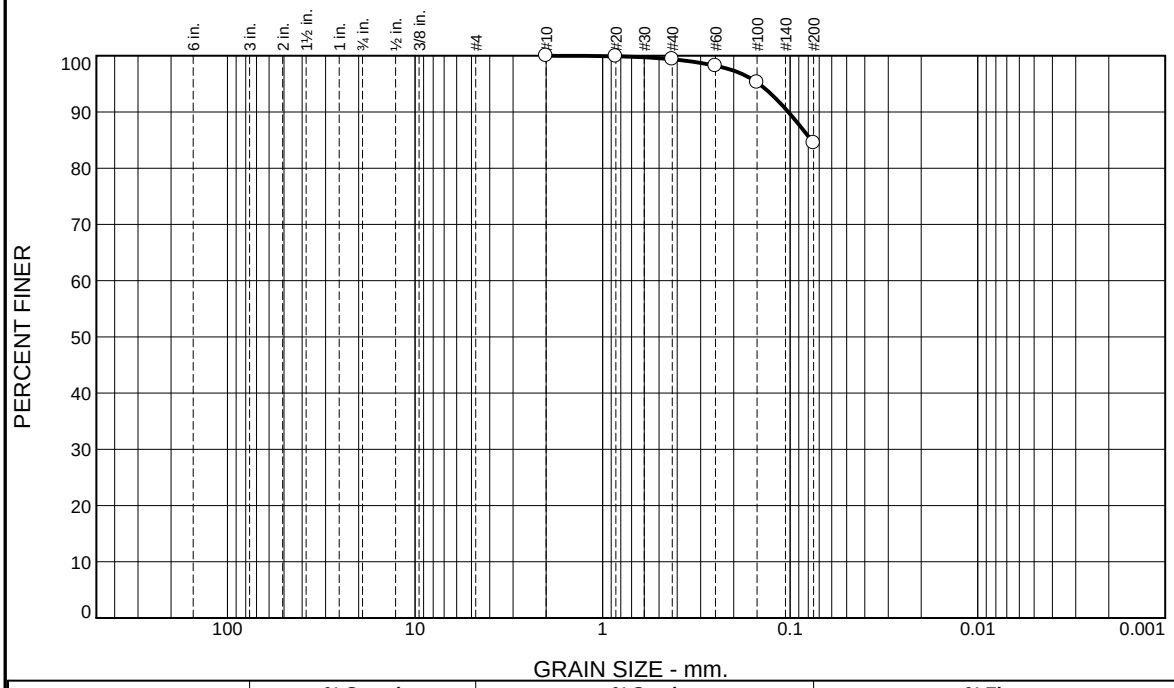
COASTAL RESOURCES
MANAGEMENT COUNCIL

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.6	14.9	84.5	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#10	100.0		
#20	99.9		
#40	99.4		
#60	98.2		
#100	95.3		
#200	84.5		

* (no specification provided)

Material Description

Brown lean clay with sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= CL AASHTO (M 145)= A-4(0)

Coefficients

D_{90}= 0.1023 D_{85}= 0.0771 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample visually classified as plastic. Sample rolled to 1/8".

Date Received: 12.23.2020 **Date Tested:** 12.29.2020

Tested By: AV / JM

Checked By: Steven Accetta

Title: Laboratory Coordinator

Source of Sample: REV01-ENV **Depth:** 13.5-15.5' **Date Sampled:** 12.21.2020
Sample Number: 05

Thielsch Engineering Inc.

Cranston, RI

Client: VHB
Project: Revolution Wind
North Kingston, RI
Project No: 20L0756 **Figure** 20L0756-03

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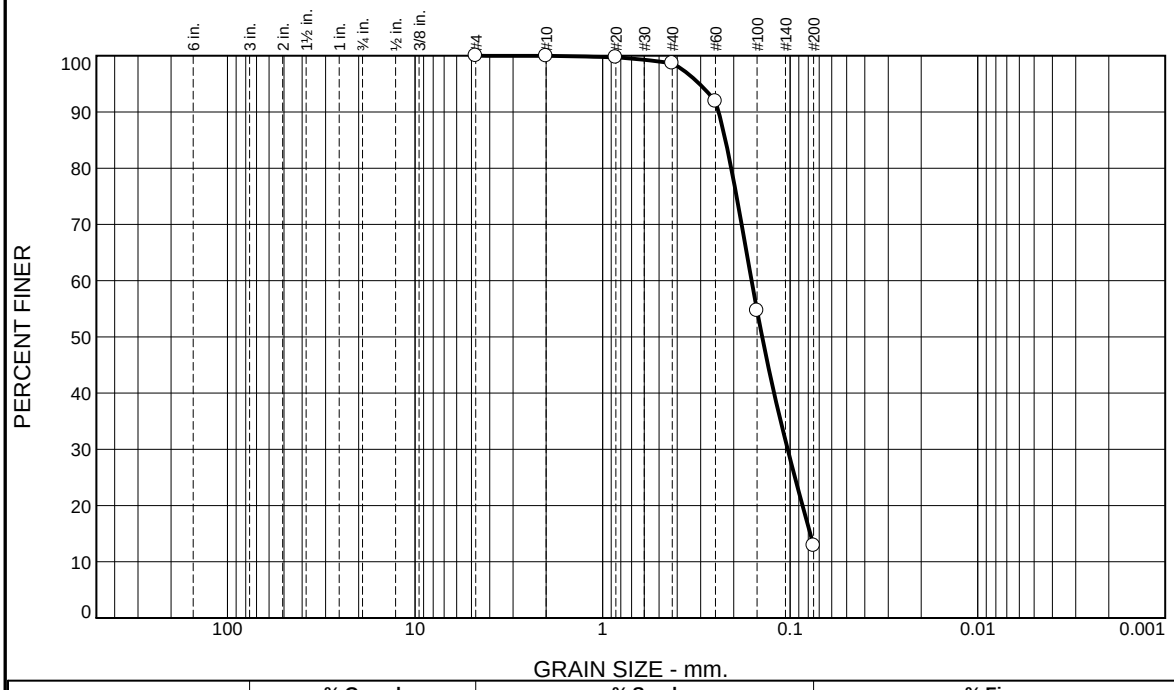
COASTAL RESOURCES
MANAGEMENT COUNCIL

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	1.3	85.8	12.9	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	100.0		
#20	99.7		
#40	98.7		
#60	91.9		
#100	54.7		
#200	12.9		

* (no specification provided)

Material Description

Gray silty sand

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}= 0.2406 D_{85}= 0.2212 D_{60}= 0.1604
D_{50}= 0.1409 D_{30}= 0.1032 D_{15}= 0.0781
D_{10}= C_u= C_c=

Remarks

Date Received: 12.29.2020 **Date Tested:** 12.29.2020

Tested By: AV / JM

Checked By: Steven Accetta

Title: Laboratory Coordinator

Source of Sample: REV01-ENV **Depth:** 0-5' **Date Sampled:** 12.22.2020
Sample Number: 03A

Thielsch Engineering Inc.

Cranston, RI

Client: VHB
Project: Revolution Wind
North Kingston, RI
Project No: 20L0756 **Figure** 20L0756-04

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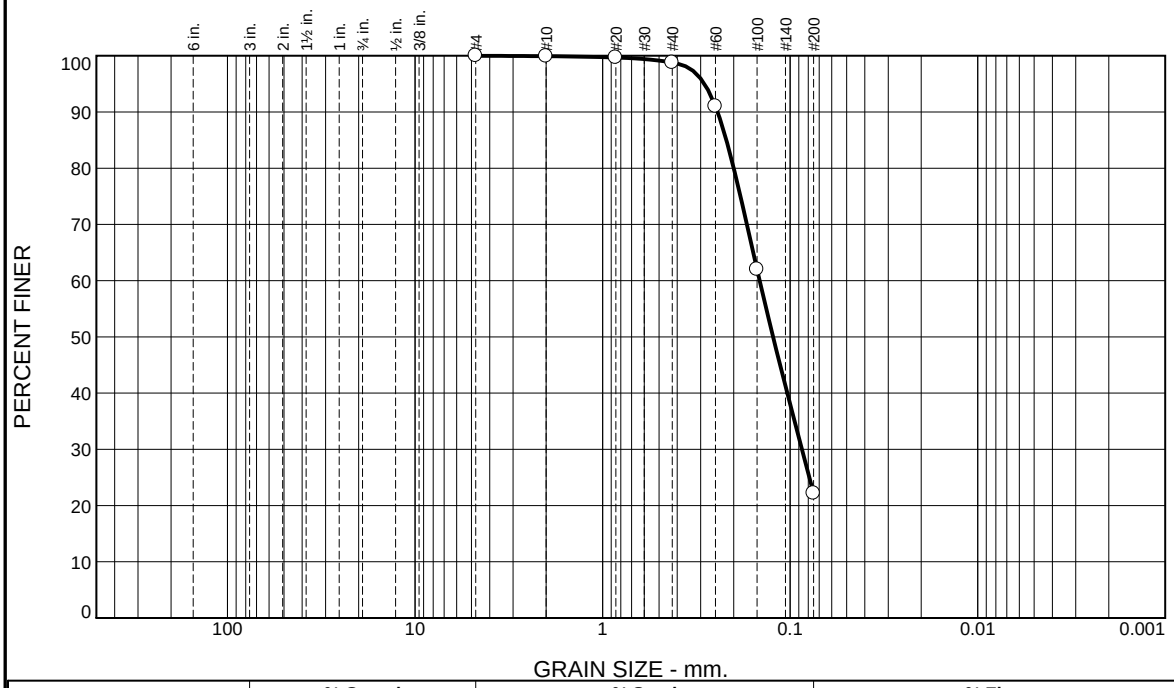
COASTAL RESOURCES
MANAGEMENT COUNCIL

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	1.1	76.6	22.2	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	99.9		
#20	99.7		
#40	98.8		
#60	91.0		
#100	62.0		
#200	22.2		

* (no specification provided)

Material Description

Light Gray silty sand

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}= 0.2436 D_{85}= 0.2188 D_{60}= 0.1453
D_{50}= 0.1232 D_{30}= 0.0866 D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 12.23.2020 **Date Tested:** 12.29.2020

Tested By: AV / JM

Checked By: Steven Accetta

Title: Laboratory Coordinator

Source of Sample: REV01-ENV **Depth:** 5-7.5' **Date Sampled:** 12.22.2020
Sample Number: 03A

Thielsch Engineering Inc.

Cranston, RI

Client: VHB
Project: Revolution Wind
North Kingston, RI
Project No: 20L0756 **Figure** 20L0756-05

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COASTAL RESOURCES
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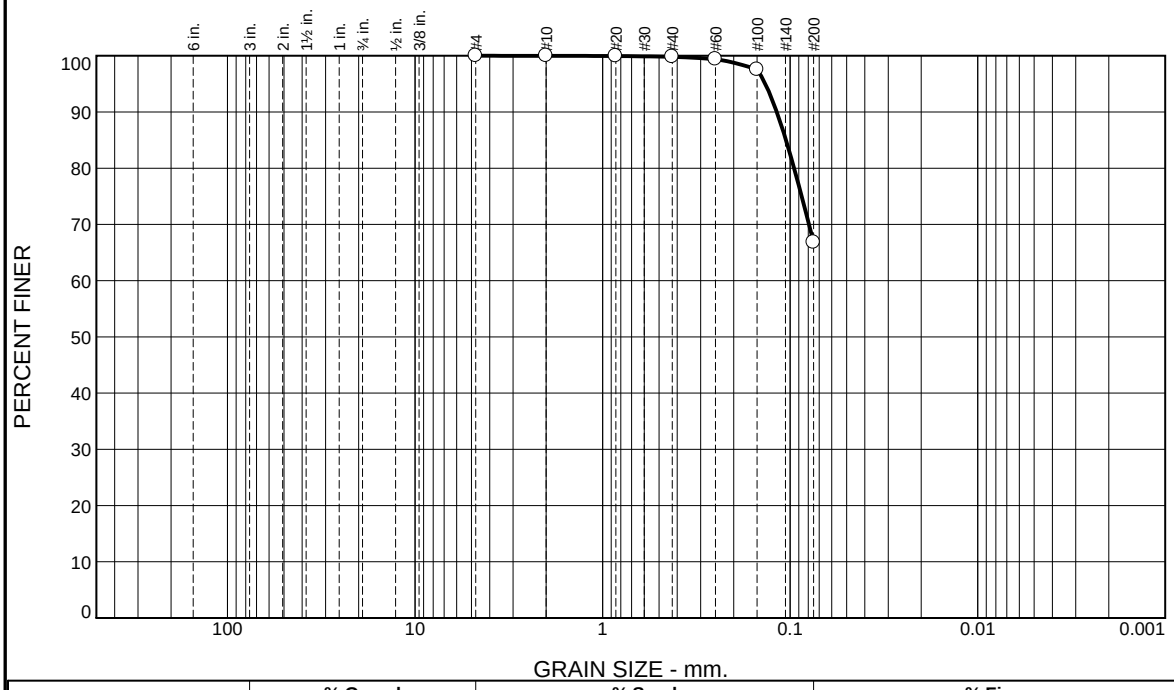
Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.2	33.0	66.8	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	100.0		
#20	100.0		
#40	99.8		
#60	99.4		
#100	97.5		
#200	66.8		

* (no specification provided)

Material Description

Brown sandy silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= ML **AASHTO (M 145)=** A-4(0)

Coefficients

D_{90}= 0.1178 D_{85}= 0.1053 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample visually classified as non-plastic.

Date Received: 12.23.2020 **Date Tested:** 12.29.2020

Tested By: AV / JM

Checked By: Steven Accetta

Title: Laboratory Coordinator

Source of Sample: REV01-ENV **Depth:** 7.5-10.5' **Date Sampled:** 12.22.2020
Sample Number: 03A

Thielsch Engineering Inc.

Cranston, RI

Client: VHB
Project: Revolution Wind
North Kingston, RI
Project No: 20L0756 **Figure** 20L0756-06

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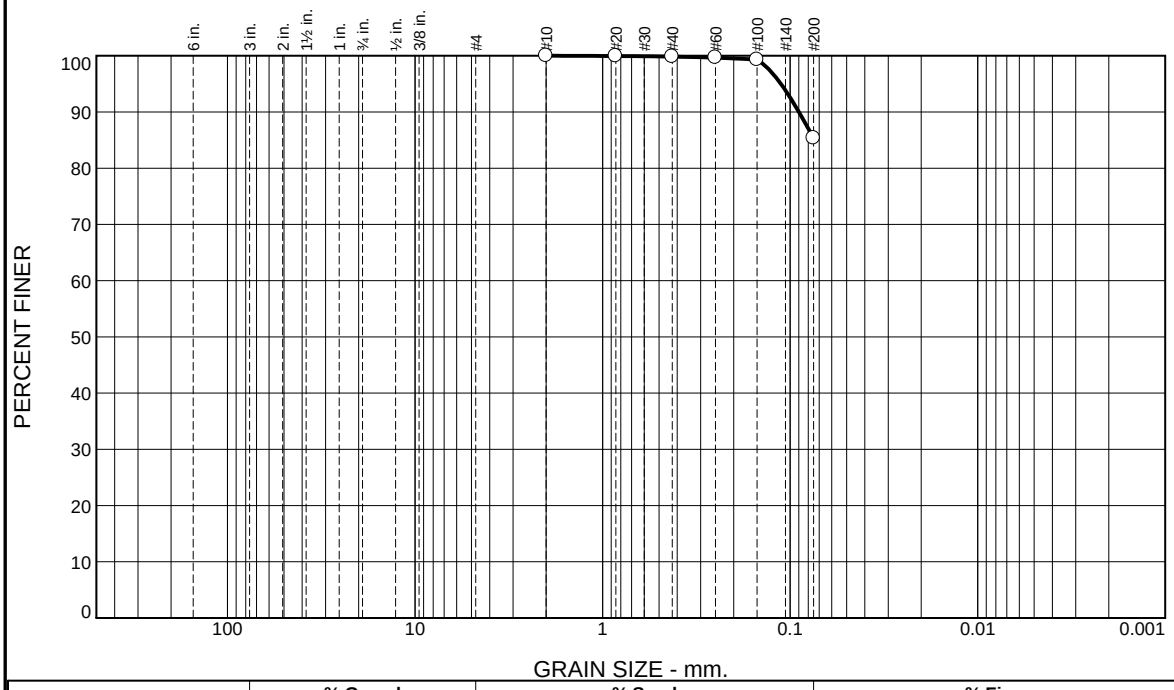
MANAGEMENT COUNCIL

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.2	14.4	85.4	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#10	100.0		
#20	100.0		
#40	99.8		
#60	99.7		
#100	99.3		
#200	85.4		

* (no specification provided)

Material Description

Brown lean clay with sand

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= CL **AASHTO (M 145)=** A-4(0)

Coefficients

D_{90}= 0.0899 D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample visually classified as plastic. Sample rolled to 1/8".

Date Received: 12.23.2020 **Date Tested:** 12.29.2020

Tested By: AV / JM

Checked By: Steven Accetta

Title: Laboratory Coordinator

Source of Sample: REV01-ENV **Depth:** 10.5-13' **Date Sampled:** 12.22.2020
Sample Number: 03A

Thielsch Engineering Inc.

Cranston, RI

Client: VHB
Project: Revolution Wind
North Kingston, RI
Project No: 20L0756 **Figure** 20L0756-07

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COASTAL RESOURCES
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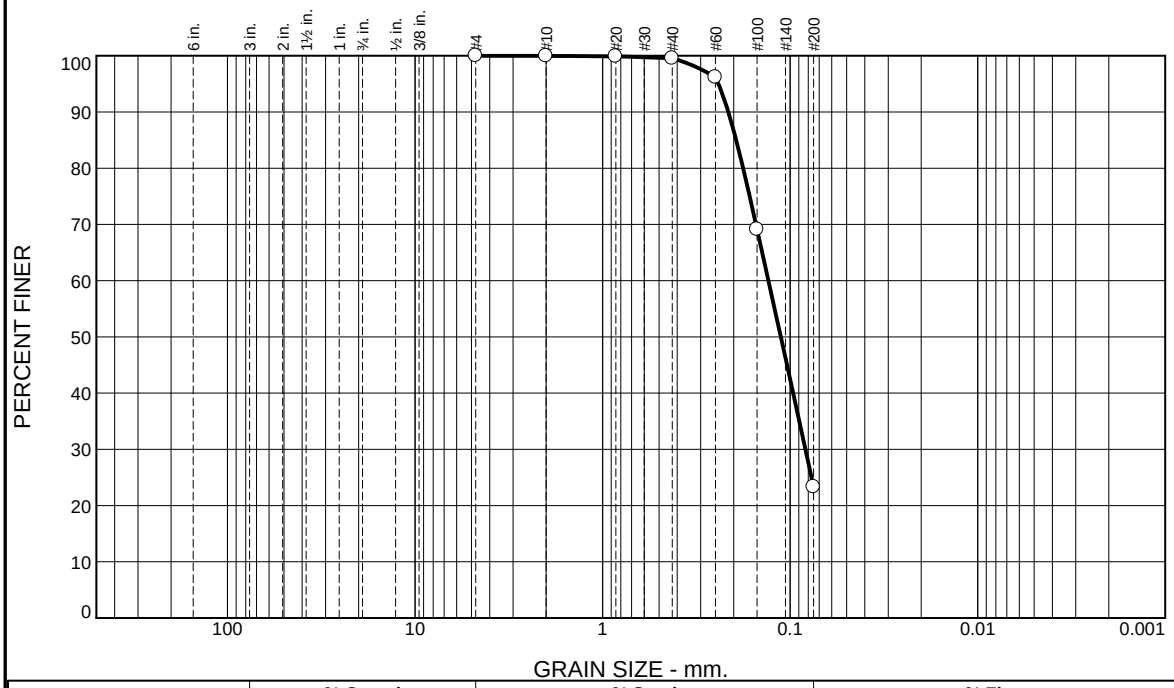
Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.5	76.2	23.3	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	100.0		
#20	99.9		
#40	99.5		
#60	96.2		
#100	69.1		
#200	23.3		

* (no specification provided)

Material Description

Light Gray silty sand

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}= 0.2135 D_{85}= 0.1939 D_{60}= 0.1305
D_{50}= 0.1122 D_{30}= 0.0829 D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 12.23.2020 **Date Tested:** 12.29.2020

Tested By: AV / JM

Checked By: Steven Accetta

Title: Laboratory Coordinator

Source of Sample: REV01-ENV **Depth:** 0-4.5' **Date Sampled:** 12.22.2020
Sample Number: 06

Thielsch Engineering Inc.

Cranston, RI

Client: VHB
Project: Revolution Wind
North Kingston, RI
Project No: 20L0756 **Figure** 20L0756-08

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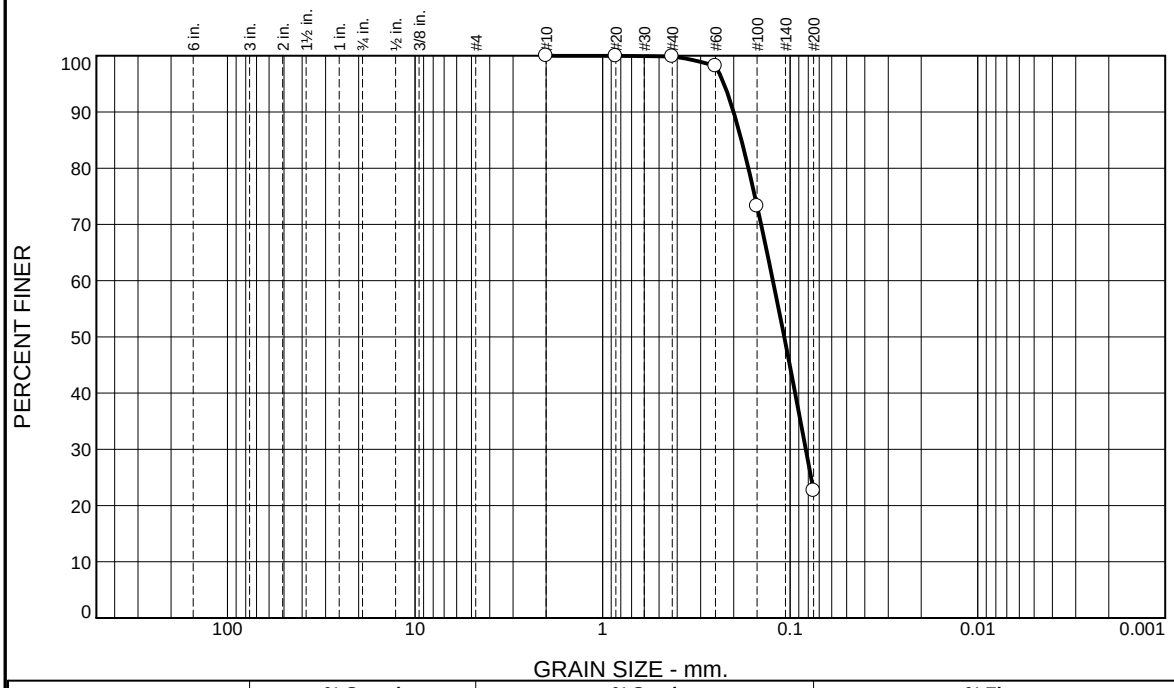
COASTAL RESOURCES
MANAGEMENT COUNCIL

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.1	77.2	22.7	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#10	100.0		
#20	100.0		
#40	99.9		
#60	98.2		
#100	73.3		
#200	22.7		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}= 0.2002 D_{85}= 0.1818 D_{60}= 0.1235
D_{50}= 0.1076 D_{30}= 0.0825 D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 12.23.2020 **Date Tested:** 12.29.2020

Tested By: AV / JM

Checked By: Steven Accetta

Title: Laboratory Coordinator

Source of Sample: REV01-ENV **Depth:** 4.5-10' **Date Sampled:** 12.22.2020
Sample Number: 06

Thielsch Engineering Inc.

Cranston, RI

Client: VHB
Project: Revolution Wind
North Kingston, RI
Project No: 20L0756 **Figure** 20L0756-09

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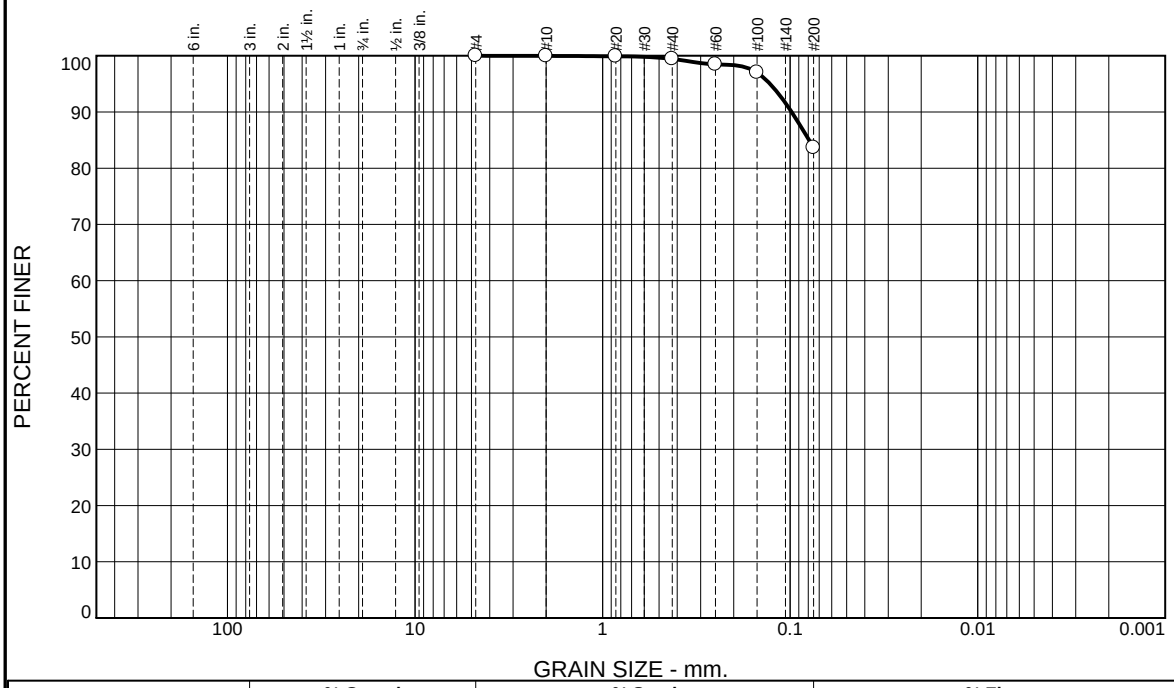
JULY 30, 2021
COASTAL RESOURCES
MANAGEMENT COUNCIL

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.6	15.7	83.7	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	100.0		
#20	99.9		
#40	99.4		
#60	98.5		
#100	97.0		
#200	83.7		

* (no specification provided)

Material Description

Brown lean clay with sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= CL AASHTO (M 145)= A-4(0)

Coefficients

D_{90}= 0.0983 D_{85}= 0.0793 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample visually classified as plastic. Sample rolled to 1/8".

Date Received: 12.23.2020 **Date Tested:** 12.29.2020

Tested By: AV / JM

Checked By: Steven Accetta

Title: Laboratory Coordinator

Source of Sample: REV01-ENV **Depth:** 10-15' **Date Sampled:** 12.22.2020
Sample Number: 06

Thielsch Engineering Inc.

Cranston, RI

Client: VHB
Project: Revolution Wind
North Kingston, RI
Project No: 20L0756 **Figure** 20L0756-10

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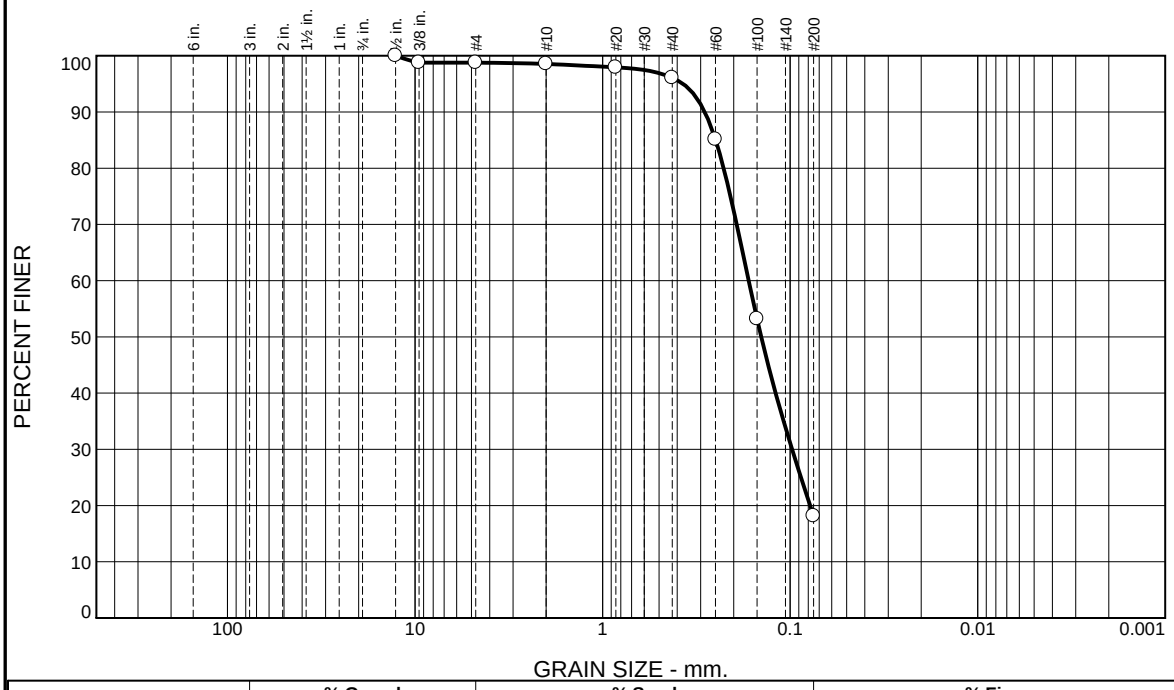
JULY 30, 2021
COASTAL RESOURCES
MANAGEMENT COUNCIL

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.2	0.2	2.5	78.0	18.1	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.5"	100.0		
0.375"	98.8		
#4	98.8		
#10	98.6		
#20	97.9		
#40	96.1		
#60	85.1		
#100	53.2		
#200	18.1		

* (no specification provided)

Material Description

Brown silty sand

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}= 0.2851 D_{85}= 0.2494 D_{60}= 0.1663
D_{50}= 0.1425 D_{30}= 0.0977 D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 12.23.2020 **Date Tested:** 12.29.2020

Tested By: AV / JM

Checked By: Steven Accetta

Title: Laboratory Coordinator

Source of Sample: REV01-ENV **Depth:** 0-11.5' **Date Sampled:** 12.22.2020
Sample Number: 01

Thielsch Engineering Inc.

Cranston, RI

Client: VHB
Project: Revolution Wind
North Kingston, RI
Project No: 20L0756 **Figure** 20L0756-11

RECEIVED 12/30/2020 RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT OFFICE OF WATER RESOURCES

ESS LABORATORY
185 Frances Avenue
Cranston, RI 02921
Phone: 401-461-7181
Fax: 401-461-4486
www.esslaboratory.com

CTS

CHAIN OF CUSTODY

ESS Lab # 2010756 | Page 2 of 3

Turn Time: ☐ >5 ☒ 5 ☐ 4 ☐ 3 ☐ 2 ☐ 1 ☐ Same Day

Regulatory State: RI Criteria: * See comment

Is this project for any of the following?: * See comment

☐ CT RCP ☐ MA MCP ☐ RGP ☐ Permit ☐ 401 WQ

ELECTRONIC DELIVERABLES (Final Reports are PDF)

☒ Limit Checker ☐ State Forms ☐ EQuIS

☒ Excel ☐ Hard Copy ☐ Enviro Data

☐ CLP-Like Package ☐ Other (Specify) →

CLIENT INFORMATION

Client: VHB

Address: 1 Cedar St. Suite 400
Providence RI

Phone: 401-536-5226

Email Distribution List: fberman@vhb.com
tylerphillips@vhb.com

PROJECT INFORMATION

Project Name: Revolution Wind

Project Location: North Kingstown RI

Project Number: 73020.00

Project Manager: Sue Moberg

Bill to: vhb_ri_ap@vhb.com

PO#:

Quote#: Portion carried by Kevin Brosa

Client acknowledges that sampling is compliant with all EPA / State regulatory programs

REQUESTED ANALYSES

ESS Lab ID	Collection Date	Collection Time	Sample Type	Sample Matrix	Sample ID	Total Organic Carbon	Grain Size	% Moisture	TPH	SVOCs	PCBs	Total As, Cd, Cr, Cu, Pb, Hg, Ni, Ba, Zn, Ag	Total Pb, Hg, Ni, Ba, Zn	TCLP As, Cd, Cr, Pb, Hg, Ni, Ba, Zn, Ag	Total Number of Bottles
1	12/21/20	12/22/20 1528	Comp	Sediment	REV01-ENV-05 (2.5-7.5)	X	X	X	X	X	X	X	X	X	3
2	"	1552	"	"	REV01-ENV-05 (7.5-13.5)	"	"	"	"	"	"	"	"	"	"
3	"	1600	"	"	REV01-ENV-05 (13.5-15.5)	"	"	"	"	"	"	"	"	"	"
4	12/22/20	1203	"	"	REV01-ENV-05A (0-5')	"	"	"	"	"	"	"	"	"	"
5	"	1210	"	"	REV01-ENV-05A (5-7.5')	"	"	"	"	"	"	"	"	"	"
6	"	1218	"	"	REV01-ENV-05A (7.5-10.5')	"	"	"	"	"	"	"	"	"	"
7	"	1226	"	"	REV01-ENV-05A (10.5-13')	"	"	"	"	"	"	"	"	"	"
8	"	1318	"	"	REV01-ENV-06 (0-4.5')	"	"	"	"	"	"	"	"	"	"
9	"	1330	"	"	REV01-ENV-06 (4.5-10')	"	"	"	"	"	"	"	"	"	"
10	"	1338	"	"	REV01-ENV-06 (10-15')	"	"	"	"	"	"	"	"	"	"

Container Type: AC-Air Cassette AG-Amber Glass B-BOD Bottle C-Cubitainer J-Jar O-Other P-Poly S-Sterile V-Vial — J

Container Volume: 1-100 mL 2-2.5 gal 3-250 mL 4-300 mL 5-500 mL 6-1L 7-VOA 8-2 oz 9-4 oz 10-8 oz 11-Other* — 10

Preservation Code: 1-Non Preserved 2-HCl 3-H2SO4 4-HNO3 5-NaOH 6-Methanol 7-Na2S2O3 8-ZnAce, NaOH 9-NH4Cl 10-DI H2O 11-Other* — 1

Sampled by: FTB

Chain needs to be filled out neatly and completely for on time delivery.

Laboratory Use Only

Cooler Temperature (°C): 6-8

Comments: * Please specify "Other" preservative and containers types in this space

Regulatory criteria, approved methods and DL/MDL requirements are on the attached RIDEM/CRMC app. Compare to Quoted criteria.

All samples submitted are subject to ESS Laboratory's payment terms and conditions.

Dissolved Filtration ☐ Lab Filter

Relinquished by (Signature)	Date	Time	Received by (Signature)	Relinquished by (Signature)	Date	Time	Received by (Signature)
	12/22/20	1450			12/22/20	18:02	Amber Garcia
Relinquished by (Signature)	Date	Time	Received by (Signature)	Relinquished by (Signature)	Date	Time	Received by (Signature)
	12/23/20	9:38					

RECEIVED 12/30/2020 RHODE ISLAND RESOURCE RECOVERY CORPORATION

ESS LABORATORY
185 Frances Avenue
Cranston, RI 02921
Phone: 401-461-7181
Fax: 401-461-4486
www.esslaboratory.com

CTS

CHAIN OF CUSTODY

ESS Lab # 2010756 | Page 3 of 3

Turn Time: ☐ >5 ☒ 5 ☐ 4 ☐ 3 ☐ 2 ☐ 1 ☐ Same Day
Regulatory State: RI Criteria: * See comment
Is this project for any of the following?: * See comment
☐ CT RCP ☐ MA MCP ☐ RGP ☐ Permit ☐ 401 WQ

ELECTRONIC DELIVERABLES (Final Reports are PDF)
☒ Limit Checker ☐ State Forms ☐ EQuIS
☒ Excel ☐ Hard Copy ☐ Enviro Data
☐ CLP-Like Package ☐ Other (Specify) →

CLIENT INFORMATION

Client: VHB
Address: 1 Cedar St. Suite 400
Providence RI
Phone: 401-574-5220
Email Distribution List: fpeirce@vhb.com
tylerphillips@vhb.com

PROJECT INFORMATION

Project Name: Resolution Wind
Project Location: North Kingstown RI
Project Number: 73030.00
Project Manager: Sue Moberg
Bill to: vhb_ri_ap@vhb.com
PO#:
Quote#: Portion carried by Kevin Brown

Client acknowledges that sampling is compliant with all EPA / State regulatory programs

REQUESTED ANALYSES

ESS Lab ID	Collection Date	Collection Time	Sample Type	Sample Matrix	Sample ID	Total Organic Carbon	Grain Size	% Moisture	TPH	Sulfides	PCBs	Total As, Cd, Cr, Cu, Pb, Hg, Ni, Zn	total Pb, Hg, Ni, Zn	TCLP As, Cd, Cr, Pb, Hg, Ni, Ba, Se, Ag	TCLP Hg, Ni, Ba, Se, Ag	Total Number of Bottles
11	12/22/20	1414	Comp	Sediment	RFV01-ENV-01 (0-11.5')	X	X	X	X	X	X	X	X	X	X	3

Container Type: AC-Air Cassette AG-Amber Glass B-BOD Bottle C-Cubitainer J-Jar O-Other P-Poly S-Sterile V-Vial — J 1
Container Volume: 1-100 mL 2-2.5 gal 3-250 mL 4-300 mL 5-500 mL 6-1L 7-VOA 8-2 oz 9-4 oz 10-8 oz 11-Other* — 10 1
Preservation Code: 1-Non Preserved 2-HCl 3-H2SO4 4-HNO3 5-NaOH 6-Methanol 7-Na2S2O3 8-ZnAce, NaOH 9-NH4Cl 10-DI H2O 11-Other* — 1

Sampled by: FTB

Chain needs to be filled out neatly and completely for on time delivery.

Laboratory Use Only
Cooler Temperature (°C): 6.7

Comments: * Please specify "Other" preservative and containers types in this space
Regulatory criteria, approved methods and DL/MDL requirements are on the attached RIDEM/CRMC app. Compare to Quantit criteria.

All samples submitted are subject to ESS Laboratory's payment terms and conditions.

Dissolved Filtration
☐ Lab Filter

Relinquished by (Signature)	Date	Time	Received by (Signature)	Relinquished by (Signature)	Date	Time	Received by (Signature)
[signature]	12/22/20	1450	[signature] 12/23/20 17:38		12/22/20	18:03	Amber Jarvis
[signature]	12/23/20	9:38	[signature]				

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ESS Laboratory Sample and Cooler Receipt Checklist

Client: VHB - Vanasse Hangen Brustlin, Inc - KPB

Shipped/Delivered Via: ESS Courier

ESS Project ID: 20L0756
Date Received: 12/22/2020
Project Due Date: 12/30/2020
Days for Project: 5 Day

1. Air bill manifest present? No
   Air No.: NA
2. Were custody seals present? No
3. Is radiation count <100 CPM? Yes
4. Is a Cooler Present? Yes
   Temp: 6.8 Iced with: Ice
5. Was COC signed and dated by client? Yes
6. Does COC match bottles? Yes
7. Is COC complete and correct? Yes
8. Were samples received intact? Yes
9. **Were labs informed about short holds & rushes?** (Yes) / No / NA
10. Were any analyses received outside of hold time? Yes (No)

11. Any Subcontracting needed? Yes / (No) 12/22/20
    ESS Sample IDs: All
    Analysis: Grain Size
    TAT: 5 Day
12. Were VOAs received? Yes (No)
    a. Air bubbles in aqueous VOAs? Yes / No
    b. Does methanol cover soil completely? Yes / No / NA
13. Are the samples properly preserved? (Yes) / No
    a. If metals preserved upon receipt: Date: ____ Time: ____ By: ____
    b. Low Level VOA vials frozen: Date: ____ Time: ____ By: ____

Sample Receiving Notes:

14. Was there a need to contact Project Manager? Yes (No)
    a. Was there a need to contact the client? Yes (No)
    Who was contacted: ____ Date: ____ Time: ____ By: ____

Sample Number	Container ID	Proper Container	Air Bubbles Present	Sufficient Volume	Container Type	Preservative	Record pH (Cyanide and 608 Pesticides)
1	122191	Yes	N/A	Yes	Driller Jar	NP	
1	122192	Yes	N/A	Yes	Driller Jar	NP	
1	122193	Yes	N/A	Yes	Driller Jar	NP	
2	122194	Yes	N/A	Yes	Driller Jar	NP	
2	122195	Yes	N/A	Yes	Driller Jar	NP	
2	122196	Yes	N/A	Yes	Driller Jar	NP	
3	122197	Yes	N/A	Yes	Driller Jar	NP	
3	122198	Yes	N/A	Yes	Driller Jar	NP	
3	122199	Yes	N/A	Yes	Driller Jar	NP	
4	122200	Yes	N/A	Yes	Driller Jar	NP	
4	122201	Yes	N/A	Yes	Driller Jar	NP	
4	122202	Yes	N/A	Yes	Driller Jar	NP	
5	122203	Yes	N/A	Yes	Driller Jar	NP	
5	122204	Yes	N/A	Yes	Driller Jar	NP	
5	122205	Yes	N/A	Yes	Driller Jar	NP	
6	122206	Yes	N/A	Yes	Driller Jar	NP	
6	122207	Yes	N/A	Yes	Driller Jar	NP	

RECEIVED
JULY 30, 2021
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ESS Laboratory Sample and Cooler Receipt Checklist

Client: VHB - Vanasse Hangen Brustlin, Inc - KPB

ESS Project ID: 20L0756
Date Received: 12/22/2020

6	122208	Yes	N/A	Yes	Driller Jar	NP
7	122209	Yes	N/A	Yes	Driller Jar	NP
7	122210	Yes	N/A	Yes	Driller Jar	NP
7	122211	Yes	N/A	Yes	Driller Jar	NP
8	122212	Yes	N/A	Yes	Driller Jar	NP
8	122213	Yes	N/A	Yes	Driller Jar	NP
8	122214	Yes	N/A	Yes	Driller Jar	NP
9	122215	Yes	N/A	Yes	Driller Jar	NP
9	122216	Yes	N/A	Yes	Driller Jar	NP
9	122217	Yes	N/A	Yes	Driller Jar	NP
10	122218	Yes	N/A	Yes	Driller Jar	NP
10	122219	Yes	N/A	Yes	Driller Jar	NP
10	122220	Yes	N/A	Yes	Driller Jar	NP
11	122221	Yes	N/A	Yes	Driller Jar	NP
11	122222	Yes	N/A	Yes	Driller Jar	NP
11	122223	Yes	N/A	Yes	Driller Jar	NP

2nd Review

Were all containers scanned into storage/lab? Initials AG

Are barcode labels on correct containers? (Yes) / No

Are all Flashpoint stickers attached/container ID # circled? Yes / No / NA

Are all Hex Chrome stickers attached? Yes / No / NA

Are all QC stickers attached? Yes / No / NA

Are VOA stickers attached if bubbles noted? Yes / No / NA

Completed By: [signature] Date & Time: 12/22/20 19:31

Reviewed By: [signature] Date & Time: 12/22/20 1936

Delivered By: [signature] 12/22/20 1936

RECEIVED 12/30/2020 RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT OFFICE OF WASTE MANAGEMENT

185 Frances Avenue
Cranston, RI 02921
Phone: 401-461-7181
Fax: 401-461-4486
www.esslaboratory.com

CHAIN OF CUSTODY

ESS Lab # 20L0756 | Page 2 of 3

Turn Time: ☐ >5 ☒ 5 ☐ 4 ☐ 3 ☐ 2 ☐ 1 ☐ Same Day

Regulatory State: RI | Criteria: * See comment

Is this project for any of the following?: * See comment

☐ CT RCP ☐ MA MCP ☐ RGP ☐ Permit ☐ 401 WQ

ELECTRONIC DELIVERABLES (Final Reports are PDF)

☒ Limit Checker ☐ State Forms ☐ EQuIS
☒ Excel ☐ Hard Copy ☐ Enviro Data
☐ CLP-Like Package ☐ Other (Specify) →

CLIENT INFORMATION

Client: VHB
Address: 1 Cedar St. Suite 400
Providence RI
Phone: 401-536-5220
Email Distribution List: fbevans@vhb.com
tylerphillips@vhb.com

PROJECT INFORMATION

Project Name: Revolution Wind
Project Location: North Kingstown RI
Project Number: 73030.00
Project Manager: Sue Moberg
Bill to: vhb_ri_ap@vhb.com
PO#:
Quote#: Pricing provided by Kevin Brosa

Client acknowledges that sampling is compliant with all EPA / State regulatory programs

REQUESTED ANALYSES

ESS Lab ID	Collection Date	Collection Time	Sample Type	Sample Matrix	Sample ID	Total Organic Carbon	Grain Size	% Moisture	TPH	SVOCs	PCBs	Total As, Cd, Cr, Cu, Pb, Hg, Ni, Zn	Total Pb, Hg, Ni, Zn	TCLP As, Cd, Cr, Pb	TCLP Hg, Ni, Ba, Se, Ag	Total Number of Bottles
1	12/21/20	12/21/20	R28 Comp	Sediment	REV01-ENV-05 (2.5-7.5)	X	X	X	X	X	X	X	X	X	X	3
2	"	1552	"	"	REV01-ENV-05 (7.5-13.5)	"	"	"	"	"	"	"	"	"	"	"
3	"	1600	"	"	REV01-ENV-05 (13.5-15.5)	"	"	"	"	"	"	"	"	"	"	"
4	12/22/20	1203	"	"	REV01-ENV-03A (0-5')	"	"	"	"	"	"	"	"	"	"	"
5	"	1210	"	"	REV01-ENV-03A (5-7.5')	"	"	"	"	"	"	"	"	"	"	"
6	"	1218	"	"	REV01-ENV-03A (7.5-10.5')	"	"	"	"	"	"	"	"	"	"	"
7	"	1226	"	"	REV01-ENV-03A (10.5-13')	"	"	"	"	"	"	"	"	"	"	"
8	"	1318	"	"	REV01-ENV-06 (0-4.5')	"	"	"	"	"	"	"	"	"	"	"
9	"	1330	"	"	REV01-ENV-06 (4.5-10')	"	"	"	"	"	"	"	"	"	"	"
10	"	1338	"	"	REV01-ENV-06 (10-15')	"	"	"	"	"	"	"	"	"	"	"
Container Type:						J										
Container Volume:						10										
Preservation Code:						1										

Container Type: AC-Air Cassette AG-Amber Glass B-BOD Bottle C-Cubitainer J-Jar O-Other P-Poly S-Sterile V-Vial

Container Volume: 1-100 mL 2-2.5 gal 3-250 mL 4-300 mL 5-500 mL 6-1L 7-VOA 8-2 oz 9-4 oz 10-8 oz 11-Other*

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Laboratory Use Only

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CHAIN OF CUSTODY

ESS Lab # 20L0756 | Page 3 of 3

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Bill to: vhb_ri_ap@vhb.com
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11	12/22/20	1414	Comp	Sediment	REV01-ENV-01 (0-11.5')	X	X	X	X	X	X	X	X	X	X	3

Container Type: AC-Air Cassette AG-Amber Glass B-BOD Bottle C-Cubitainer J-Jar O-Other P-Poly S-Sterile V-Vial — J

Container Volume: 1-100 mL 2-2.5 gal 3-250 mL 4-300 mL 5-500 mL 6-1L 7-VOA 8-2 oz 9-4 oz 10-8 oz 11-Other* — 10

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Laboratory Use Only

Cooler Temperature (°C): 6.7

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Dissolved Filtration

☐ Lab Filter

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[signature]	12/22/20	1450	[signature] 12/22/20 17:38		12/22/20	18:03	Amber Jones
Relinquished by (Signature)	Date	Time	Received by (Signature)	Relinquished by (Signature)	Date	Time	Received by (Signature)

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COASTAL RESOURCES MANAGEMENT COUNCIL

Date: June 23, 2020 Applicant(s): DWW Rev I, LLC

Project Name: Revolution Wind Address: 56 Exchange Terrace Ste 300, Prov. RI 02903

Estimated Volume of Dredge (cy): TBD New (cy): TBD Maintenance (cy): 0

Area of Dredge (sf): TBD Depth of Dredge: 13 feet

Proposed Disposal Location (include Plat/Lot if on land): N/A

WQ Class of Dredge Area (if known): SB GW Class of Disposal Area (if, known): SB

Sediment Sampling Plan for Dredging Projects

Submit Site plan 8½" x 11" (Google Earth printout and Navigation Chart or engineered plans) Mark all within 200' of proposed dredge limits:

- ☐ Outfalls and Gas docks or any other potential areas of contamination
- ☐ eelgrass, salt marsh, flounder or shellfish habitat
- ☐ Proposed dredge footprint and average depth of dredge

Proposed Depth of Samples 13 feet
Proposed Coring Method vibracore
# of Sampling Locations 22

Submit Proposed Analysis and detection limits depending on disposal location: The detection limits for an analyte should be no greater than one-third (one-half log unit) of the appropriate value for the analyte and matrix of concern. Whenever possible, an MDL of three to five times below the criteria is expected: If the criteria are Non-Detect then the procedures and MRL's set forth in the OTM (USEPA and USACE 1991) below are appropriate to follow. In-water disposal must meet all Army Corps Requirements.

Place a ☐*CHECK* in each box you are proposing to sample and *CIRCLE* intended laboratory method.

Sample	Beach Criteria	CAD Cap Criteria	GA Leachability Criteria TCLP/SPLP	Residential Disposal Criteria[1]	Commercial/ Industrial Exposure[2]	TCLP Criteria for Haz. Waste[3]	Acceptable EPA Method(s)	MRL**
Grain Size	☐<10% silt/clay	☐	☐	☐	☐	☐		
% Moisture	☐<25%	☐	☐	☐	☐	☐		
TPH	☐ND	☐	☐500 mg/kg	☐500 mg/kg	☐2500 mg/kg		SW 8015C	100 mg/Kg
SVOC		☐	☐Table 2[2]	☐Table1[1]	☐Table1[2]		8270 SIM	10 ug/Kg
PCB	☐*ND	☐0.4 mg/kg	☐10 mg/kg	☐10 mg/kg	☐10 mg/kg		8082	*.02 mg/Kg
PAH		☐4.0 mg/kg					8270– Six (6) Tier 1 compounds	
Arsenic (As)	☐1.7 mg/kg	☐10 mg/kg		☐7.0 mg/kg	☐7.0 mg/kg	☐5.0 mg/L	6010,6020,7061,7062,7000, 7010	0.4 mg/Kg
Cadmium (Cd)	☐1 mg/kg	☐5 mg/kg	☐0.03 mg/L	☐39 mg/kg	☐1000 mg/kg	☐1.0 mg/L	6010,6020,7000,7010	0.07 mg/Kg
Chromium (Cr)	☐10 mg/kg	☐100 mg/kg	☐1.1 mg/L	☐390 mg/kg	☐10000 mg/kg	☐5.0 mg/L	6010,6020,7000,7010	0.5 mg/Kg
Copper (Cu)	☐10 mg/kg	☐200 mg/kg		☐3100 mg/kg	☐10000 mg/kg		6010,6020,7000,7010	0.5 mg/Kg
Lead (Pb)	☐25 mg/kg	☐100 mg/kg	☐0.04 mg/L	☐150 mg/kg	☐500 mg/kg	☐5.0 mg/L	6010,6020,7000, 7010	0.5 mg/Kg
Mercury (Hg)	☐0.5 mg/kg	☐0.5 mg/kg	☐0.02 mg/L	☐23 mg/kg	☐610 mg/kg	☐0.2 mg/L	7470,7471,7472	0.07 mg/Kg
Nickel (Ni)	☐5 mg/kg	☐50 mg/kg	☐1 mg/L	☐1000 mg/kg			6010, 6020,7000, 7010	0.5 mg/Kg
Zinc (Zn)	☐25 mg/kg	☐200 mg/kg		☐6000 mg/kg			6010,6020,7000,7010	1.0 mg/Kg
TCLP or SPLP							1311 or 1312	
Barium (Ba)						☐100 mg/L	6010, 6020	
Selenium (Se)						☐1.0 mg/L	6010, 6020, 7741, 7742	
Silver (Ag)						☐5.0 mg/L	6010, 6020	

* For each arochlor **For Beach Critera – any other MRL should be at least three to five times below the criteria

[1] Residential Direct Exposure Criteria are defined in Table 1 in Section 8 of the Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases.

[2] Commercial/Industrial Direct Exposure Criteria are defined in Table 1 in Section 8 of the Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases.

[3] GA Leachability Criteria are defined in Table 2 in Section 8 of the Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases.

Approvals

Dredge Coordinator (CRMC): _____ Date: 7/7/2020

WQC Program (DEM): _____ Date: 7-3-2020

GW Program (DEM), if upland _____ Date: _____

Dredge Coordinator (DEM): _____ Date: 7/3/2020

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MANAGEMENT COUNCIL

Grain Size Table

Sediment Size Classes in SSFATE in Imperial (thou) and Metric (micron) units. A thou is 1/1000th of an inch.			
Class	Type	Size Range Imperial Units (thou)	Size Range Metric Units (microns)
1	Clay	0 – 0.3	0-7
2	Fine silt	0.3 – 1.4	7-35
3	Coarse silt	1.4 – 2.9	35-74
4	Fine sand	2.9 – 5.1	74-130
5	Coarse sand	> 5.1	>130

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vhb

Table 1
Revolution Wind
Sediment Analysis

Sample ID		RIDEM Direct Exposure Criteria		RIDEM Leachability Criteria		RIDEM Dredging Criteria		EPA MCCTC	REV01-ENV-01 (0-11.5ft)		Rev01-ENV-02 (0-5.5ft)		Rev01-ENV-200 (0-5.5ft)		Rev01-ENV-02 (5.5-8.5ft)		Rev01-ENV-02 (8.5-13ft)		Rev01-ENV-02 (13-16ft)		REV01-ENV-03A (0-5ft)		REV01-ENV-03A (5-7.5ft)		REV01-ENV-03A (7.5-10.5ft)		REV01-ENV-03A (10.5-13ft)		Rev01-ENV-04 (0-2ft)	
Coordinates (lat. / long.)									Lat: 41.584787		Lat: 41.583486		Lat: 41.583486		Lat: 41.583486		Lat: 41.583486		Lat: 41.583486		Lat: 41.583044		Lat: 41.583044		Lat: 41.583044		Lat: 41.583044		Lat: 41.582575	
									Long: -71.426067		Long: -71.425671		Long: -71.425671		Long: -71.425671		Long: -71.425671		Long: -71.425671		Long: -71.425214		Long: -71.425214		Long: -71.425214		Long: -71.425214		Long: -71.425132	
Laboratory Sample Designation									20L0756-11		20L0755-05		20L0755-06		20L0755-07		20L0755-08		20L0755-09		20L0756-04		20L0756-05		20L0756-06		20L0756-07		20L0755-01	
Sample Date	Units	RIDEM RDEC	RIDEM I/CDEC	GA	GB	Beach Criteria	Confined Aquatic Disposal (CAD) Cap	TCLP Criteria for Haz. Waste	12/22/2020		12/21/2020		12/21/2020		12/21/2020		12/21/2020		12/21/2020		12/22/2020		12/22/2020		12/22/2020		12/22/2020		12/21/2020	
SVOCs																														
1,1-Biphenyl	mg/kg	0.8	10000	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
1,2,4-Trichlorobenzene	mg/kg	96	10000	140	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
1,2-Dichlorobenzene	mg/kg	510	10000	41	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
1,3-Dichlorobenzene	mg/kg	430	10000	41	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
1,4-Dichlorobenzene	mg/kg	27	240	41	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
2,3,4,6-Tetrachlorophenol	mg/kg	NE	NE	NE	NE	NE	NE	NE	1.86	U	2	U	1.91	U	2.14	U	2	U	2.02	U	2.09	U	2	U	2.12	U	1.99	U	3.13	U
2,4,5-Trichlorophenol	mg/kg	330	10000	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
2,4,6-Trichlorophenol	mg/kg	58	520	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
2,4-Dichlorophenol	mg/kg	30	6100	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
2,4-Dimethylphenol	mg/kg	1400	10000	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
2,4-Dinitrophenol	mg/kg	160	4100	NE	NE	NE	NE	NE	1.86	U	2	U	1.91	U	2.14	U	2	U	2.02	U	2.09	U	2	U	2.12	U	1.99	U	3.13	U
2,4-Dinitrotoluene	mg/kg	0.9	8.4	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
2,6-Dinitrotoluene	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
2-Chloronaphthalene	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
2-Chlorophenol	mg/kg	50	10000	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
2-Methylnaphthalene	mg/kg	123	10000	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
2-Methylphenol	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
2-Nitroaniline	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
2-Nitrophenol	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
3,3'-Dichlorobenzidine	mg/kg	1.4	13	NE	NE	NE	NE	NE	0.741	U	0.799	U	0.764	U	0.856	U	0.797	U	0.808	U	0.834	U	0.8	U	0.847	U	0.795	U	1.25	U
3+4-Methylphenol	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.741	U	0.799	U	0.764	U	0.856	U	0.797	U	0.808	U	0.834	U	0.8	U	0.847	U	0.795	U	1.25	U
3-Nitroaniline	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
4,6-Dinitro-2-Methylphenol	mg/kg	NE	NE	NE	NE	NE	NE	NE	1.86	U	2	U	1.91	U	2.14	U	2	U	2.02	U	2.09	U	2	U	2.12	U	1.99	U	3.13	U
4-Bromophenyl-phenylether	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
4-Chloro-3-Methylphenol	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
4-Chloroaniline	mg/kg	310	8200	NE	NE	NE	NE	NE	0.741	U	0.799	U	0.764	U	0.856	U	0.797	U	0.808	U	0.834	U	0.8	U	0.847	U	0.795	U	1.25	U
4-Chloro-phenyl-phenyl ether	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
4-Nitroaniline	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
4-Nitrophenol	mg/kg	NE	NE	NE	NE	NE	NE	NE	1.86	U	2	U	1.91	U	2.14	U	2	U	2.02	U	2.09	U	2	U	2.12	U	1.99	U	3.13	U
Acenaphthene	mg/kg	43	10000	NE	NE	NE	4.0	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
Acenaphthylene	mg/kg	23	10000	NE	NE	NE	4.0	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
Acetophenone	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.741	U	0.799	U	0.764	U	0.856	U	0.797	U	0.808	U	0.834	U	0.8	U	0.847	U	0.795	U	1.25	U
Aniline	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.741	U	0.799	U	0.764	U	0.856	U	0.797	U	0.808	U	0.834	U	0.8	U	0.847	U	0.795	U	1.25	U
Anthracene	mg/kg	35	10000	NE	NE	NE	4.0	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
Azobenzene	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
Benzo(a)anthracene	mg/kg	0.9	7.8	NE	NE	NE	4.0	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
Benzo(a)pyrene	mg/kg	0.4	0.8	240	NE	NE	4.0	NE	0.186	U	0.2	U	0.191	U	0.214	U	0.2	U	0.202	U	0.209	U	0.2	U	0.212	U	0.199	U	0.313	U
Benzo(b)fluoranthene	mg/kg	0.9	7.8	NE	NE	NE	4.0	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
Benzo(g,h,i)perylene	mg/kg	0.8	10000	NE	NE	NE	4.0	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
Benzo(k)fluoranthene	mg/kg	0.9	78	NE	NE	NE	4.0	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
Benzoic Acid	mg/kg	NE	NE	NE	NE	NE	NE	NE	1.86	U	2	U	1.91	U	2.14	U	2	U	2.02	U	2.09	U	2	U	2.12	U	1.99	U	3.13	U
Benzyl Alcohol	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
bis(2-Chloroethoxy)methane	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
bis(2-Chloroethyl)ether	mg/kg	0.6	5.2	NE	NE	NE	NE	NE	0.37	U	0.2	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.313	U
bis(2-chloroisopropyl)Ether	mg/kg	9.1	82	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
bis(2-Ethylhexyl)phthalate	mg/kg	46	410	120	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
Butylbenzylphthalate	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
Carbazole	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
Chrysene	mg/kg	0.4	780	NE	NE	NE	4.0	NE	0.186	U	0.2	U	0.191	U	0.214	U	0.2	U	0.202	U	0.209	U	0.2	U	0.212	U	0.199	U	0.313	U
Dibenzo(a,h)Anthracene	mg/kg	0.4	0.8	NE	NE	NE	4.0	NE	0.186	U	0.2	U	0.191	U	0.214	U	0.2	U	0.202	U	0.209	U	0.2	U	0.212	U	0.199	U	0.313	U
Dibenzofuran	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
Diethylphthalate	mg/kg	340	10000	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
Dimethylphthalate	mg/kg	1900	10000	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
Di-n-butylphthalate	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
Di-n-octylphthalate	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
Fluoranthene	mg/kg	20	10000	NE	NE	NE	4.0	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
Fluorene	mg/kg	28	10000	NE	NE	NE	4.0	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
Hexachlorobenzene	mg/kg	0.4	3.6	NE	NE	NE	NE	NE	0.186	U	0.2	U	0.191	U	0.214	U	0.2	U	0.202	U	0.209	U	0.2	U	0.212	U	0.199	U	0.313	U
Hexachlorobutadiene	mg/kg	8.2	73	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
Hexachlorocyclopentadiene	mg/kg	NE	NE	NE	NE	NE	NE	NE	1.86	U	2	U	1.91	U	2.14	U	2	U	2.02	U	2.09	U	2	U	2.12	U	1.99	U	3.13	U
Hexachloroethane	mg/kg	46	410	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
Indeno(1,2,3-cd)Pyrene	mg/kg	0.9	7.8	NE	NE	NE	4.0	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
Isophorone	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
Naphthalene	mg/kg	54	10000	0.8	NE	NE	4.0	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
Nitrobenzene	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
N-Nitrosodimethylamine	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
N-Nitroso-Di-n-Propylamine	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
N-nitrosodiphenylamine	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
Pentachlorophenol	mg/kg	5.3	48	7.1	NE	NE	NE	NE	1.86	U	2	U	1.91	U	2.14	U	2	U	2.02	U	2.09	U	2	U	2.12	U	1.99	U	3.13	U
Phenanthrene	mg/kg	40	10000	NE	NE	NE	4.0	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
Phenol	mg/kg	6000	10000	NE	NE	NE	NE	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
Pyrene	mg/kg	13	10000	NE	NE	NE	4.0	NE	0.37	U	0.399	U	0.381	U	0.427	U	0.398	U	0.403	U	0.417	U	0.399	U	0.423	U	0.397	U	0.624	U
Pyridine	mg/kg	NE	NE	NE	NE	NE	NE	NE	1.86	U	2	U	1.91	U	2.14	U	2	U	2.02	U	2.09	U	2	U	2.12	U	1.99	U	3.13	U

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Table 1
Revolution Wind
Sediment Analysis

Sample ID		RIDEM Direct Exposure Criteria		RIDEM Leachability Criteria		RIDEM Dredging Criteria		EPA MCCTC	REV01-ENV-01 (0-11.5ft)		Rev01-ENV-02 (0-5.5ft)		Rev01-ENV-200 (0-5.5ft)		Rev01-ENV-02 (5.5-8.5ft)		Rev01-ENV-02 (8.5-13ft)		Rev01-ENV-02 (13-16ft)		REV01-ENV-03A (0-5ft)		REV01-ENV-03A (5-7.5ft)		REV01-ENV-03A (7.5-10.5ft)		REV01-ENV-03A (10.5-13ft)		Rev01-ENV-04 (0-2ft)	
Coordinates (lat. / long.)									Lat: 41.584787		Lat: 41.583486		Lat: 41.583486		Lat: 41.583486		Lat: 41.583486		Lat: 41.583486		Lat: 41.583044		Lat: 41.583044		Lat: 41.583044		Lat: 41.583044		Lat: 41.582575	
									Long: -71.426067		Long: -71.425671		Long: -71.425671		Long: -71.425671		Long: -71.425671		Long: -71.425671		Long: -71.425214		Long: -71.425214		Long: -71.425214		Long: -71.425214		Long: -71.425132	
Laboratory Sample Designation									20L0756-11		20L0755-05		20L0755-06		20L0755-07		20L0755-08		20L0755-09		20L0756-04		20L0756-05		20L0756-06		20L0756-07		20L0755-01	
Sample Date	Units	RIDEM RDEC	RIDEM I/CDEC	GA	GB	Beach Criteria	Confined Aquatic Disposal (CAD) Cap	TCLP Criteria for Haz. Waste	12/22/2020		12/21/2020		12/21/2020		12/21/2020		12/21/2020		12/21/2020		12/22/2020		12/22/2020		12/22/2020		12/22/2020		12/21/2020	
TPH - ETPH																														
Total Petroleum Hydrocarbons	mg/kg	500	2500	500	2500	ND	NE	NE	43.7	U	45	U	45.1	U	47.3	U	47.7	U	46.1	U	47.8	U	45.7	U	47.3	U	47.7	U	69.1	U
Total Metals																														
Arsenic	mg/kg	7	7	NE	NE	1.7	10	NE	**0.82**	-	**1.23**	-	**1.16**	-	**0.86**	-	**0.99**	D	**1.38**	D	**1.27**	-	**1.1**	D	**1.72**	D	**1.87**	D	**5.64**	-
Cadmium	mg/kg	39	1000	NE	NE	1	5	NE	0.22	U	0.23	U	0.23	U	**0.41**	-	0.46	U, D	0.42	U, D	0.24	U	0.45	U, D	0.46	U, D	0.47	U, D	**0.69**	-
Chromium	mg/kg	1400	10000	NE	NE	10	100	NE	**1.45**	-	**1.46**	-	**1.9**	-	**1.35**	-	**1.74**	D	**3.62**	D	**3.44**	-	**1.8**	D	**3.18**	D	**6.72**	D	**47.3**	-
Copper	mg/kg	3100	10000	NE	NE	10	200	NE	**2.26**	-	**1.49**	-	**1.3**	-	**1.93**	-	**2.67**	D	**4.23**	D	**3.59**	-	**2.49**	D	**3.72**	D	**7.6**	D	**55.5**	-
Lead	mg/kg	150	500	NE	NE	25	100	NE	**1.74**	-	2.34	U	2.28	U	2.37	U	4.62	U, D	4.25	U, D	**3.13**	-	2.25	U, D	**3.26**	D	**4.33**	D	**37**	-
Mercury	mg/kg	23	610	NE	NE	0.5	0.5	NE	0.011	U	0.011	U	0.011	U	0.011	U	0.012	U	0.012	U	0.012	U	0.011	U	0.012	U	0.011	U	**0.286**	-
Nickel	mg/kg	1000	10000	NE	NE	5	50	NE	**1.53**	-	**1.28**	-	**1.39**	-	**1.59**	-	2.31	U, D	**4**	D	**2.01**	-	2.25	U, D	**3.83**	D	**6.73**	D	**16**	-
Zinc	mg/kg	6000	10000	NE	NE	25	200	NE	**12.9**	-	**9.67**	-	**8.81**	-	**15.9**	-	**22.5**	D	**27.6**	D	**16.1**	-	**16.5**	D	**32.5**	D	**37.6**	D	**113**	-
TCLP Metals																														
Arsenic	mg/L	NE	NE	NE	NE	NE	NE	5	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U
Barium	mg/L	NE	NE	23	NE	NE	NE	1	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	**0.09**	-	0.05	U	0.05	U	0.05	U
Cadmium	mg/L	NE	NE	0.03	NE	NE	NE	1	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
Chromium	mg/L	NE	NE	1.1	NE	NE	NE	5	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
Lead	mg/L	NE	NE	0.04	NE	NE	NE	5	**0.22**	-	*0.05*	U	*0.05*	U	*0.05*	U	*0.05*	U	*0.05*	U	*0.05*	U	*0.05*	U	*0.05*	U	*0.05*	U	*0.05*	U
Mercury	mg/L	NE	NE	0.02	NE	NE	NE	0.2	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.0005	U
Nickel	mg/L	NE	NE	1	NE	NE	NE	NE	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U
Selenium	mg/L	NE	NE	0.6	NE	NE	NE	1	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U
Silver	mg/L	NE	NE	NE	NE	NE	NE	5	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
PCBs																														
Aroclor 1016	mg/kg	10	10	10	10	ND	0.4	NE	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.09	U
Aroclor 1221	mg/kg	10	10	10	10	ND	0.4	NE	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.09	U
Aroclor 1232	mg/kg	10	10	10	10	ND	0.4	NE	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.09	U
Aroclor 1242	mg/kg	10	10	10	10	ND	0.4	NE	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.09	U
Aroclor 1248	mg/kg	10	10	10	10	ND	0.4	NE	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.09	U
Aroclor 1254	mg/kg	10	10	10	10	ND	0.4	NE	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.09	U
Aroclor 1260	mg/kg	10	10	10	10	ND	0.4	NE	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.09	U
Aroclor 1262	mg/kg	10	10	10	10	ND	0.4	NE	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.09	U
Aroclor 1268	mg/kg	10	10	10	10	ND	0.4	NE	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.09	U
Classical Chemistry																														
Percent Moisture	%	NE	NE	NE	NE	25	NE	NE	**15**	-	**15**	-	**16**	-	**18**	-	**19**	-	**17**	-	**18**	-	**15**	-	**17**	-	**17**	-	**44**	-
Total Organic Carbon (Average)	mg/kg dry	NE	NE	NE	NE	NE	NE	NE	**379**	-	**1060**	-	97.4	U	**928**	-	93.4	U	98.9	U	96.4	U	**437**	-	**1050**	-	**1790**	-	**17400**	-
Grain Size																														
% Fines (Silt / Clay)	%	NE	NE	NE	NE	10	NE	NE	**18.1**	-	**4.4**	-	**3.6**	-	**21.1**	-	**54.7**	-	**72.2**	-	**12.9**	-	**22.2**	-	**66.8**	-	**85.4**	-	**78.7**	-

Notes:
1. Values in bold are results that exceed the laboratory's reporting limits.
2. Values that are shaded in grey exceed RIDEM GA Leachability Criteria.
3. Values that are shaded in light blue exceed CRMC/RIDEM Beach Dredge Disposal Criteria.
4. Values that are italiczed exceed one or more of the criteria but do not exceed the laboratory's reporting limits.
5. mg/kg = milligrams per kilogram, or parts per million
6. mg/L = milligrams per liter, or parts per million
7. U = undetected
8. D = diluted
9. NE = no criterion is applicable
10. The RIDEM Residential Direct Exposure Criteria (RDEC) and Industrial/Commercial Direct Exposure Crtieria (I/CDEC) are found within the RIDEM Remediation Regulations.
11. The TCLP Criteria for Haz Waste is found within the EPA MCCTC.
12. The Beach Criteria and CAD Cap Criteria are found within the CRMC/RIDEM Dredging Regulations.

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Table 1
Revolution Wind
Sediment Analysis

Sample ID		RIDEM Direct Exposure Criteria		RIDEM Leachability Criteria		RIDEM Dredging Criteria		EPA MCCTC	Rev01-ENV-04 (2-9.5ft)		Rev01-ENV-04 (9.5-11.5ft)		Rev01-ENV-04 (11.5-16.5ft)		Rev01-ENV-05 (0-2.5ft)		REV01-ENV-05 (2.5-7.5ft)		REV01-ENV-05 (7.5-13.5ft)		REV01-ENV-05 (13.5-15.5ft)		REV01-ENV-06 (0-4.5ft)		REV01-ENV-06 (4.5-10ft)		REV01-ENV-06 (10-15ft)	
Coordinates (lat. / long.)									Lat: 41.582575 Long: -71.425132		Lat: 41.582575 Long: -71.425132		Lat: 41.582575 Long: -71.425132		Lat: 41.581992 Long: -71.42554		Lat: 41.581992 Long: -71.42554		Lat: 41.581992 Long: -71.42554		Lat: 41.581992 Long: -71.42554		Lat: 41.582443 Long: -71.425631		Lat: 41.582443 Long: -71.425631		Lat: 41.582443 Long: -71.425631	
Laboratory Sample Designation									20L0755-02		20L0755-03		20L0755-04		20L0755-10		20L0756-01		20L0756-02		20L0756-03		20L0756-08		20L0756-09		20L0756-10	
Sample Date	Units	RIDEM RDEC	RIDEM I/CDEC	GA	GB	Beach Criteria	Confined Aquatic Disposal (CAD) Cap	TCLP Criteria for Haz. Waste	12/21/2020		12/21/2020		12/21/2020		12/21/2020		12/21/2020		12/21/2020		12/21/2020		12/22/2020		12/22/2020		12/22/2020	
SVOCs																												
1,1-Biphenyl	mg/kg	0.8	10000	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
1,2,4-Trichlorobenzene	mg/kg	96	10000	140	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
1,2-Dichlorobenzene	mg/kg	510	10000	41	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
1,3-Dichlorobenzene	mg/kg	430	10000	41	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
1,4-Dichlorobenzene	mg/kg	27	240	41	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
2,3,4,6-Tetrachlorophenol	mg/kg	NE	NE	NE	NE	NE	NE	NE	2.05	U	1.98	U	2.12	U	2.28	U	2.09	U	1.9	U	2.11	U	2.17	U	2.09	U	1.92	U
2,4,5-Trichlorophenol	mg/kg	330	10000	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
2,4,6-Trichlorophenol	mg/kg	58	520	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
2,4-Dichlorophenol	mg/kg	30	6100	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
2,4-Dimethylphenol	mg/kg	1400	10000	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
2,4-Dinitrophenol	mg/kg	160	4100	NE	NE	NE	NE	NE	2.05	U	1.98	U	2.12	U	2.28	U	2.09	U	1.9	U	2.11	U	2.17	U	2.09	U	1.92	U
2,4-Dinitrotoluene	mg/kg	0.9	8.4	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
2,6-Dinitrotoluene	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
2-Chloronaphthalene	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
2-Chlorophenol	mg/kg	50	10000	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
2-Methylnaphthalene	mg/kg	123	10000	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
2-Methylphenol	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
2-Nitroaniline	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
2-Nitrophenol	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
3,3'-Dichlorobenzidine	mg/kg	1.4	13	NE	NE	NE	NE	NE	0.818	U	0.79	U	0.847	U	0.912	U	0.835	U	0.758	U	0.842	U	0.865	U	0.833	U	0.767	U
3+4-Methylphenol	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.818	U	0.79	U	0.847	U	0.912	U	0.835	U	0.758	U	0.842	U	0.865	U	0.833	U	0.767	U
3-Nitroaniline	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
4,6-Dinitro-2-Methylphenol	mg/kg	NE	NE	NE	NE	NE	NE	NE	2.05	U	1.98	U	2.12	U	2.28	U	2.09	U	1.9	U	2.11	U	2.17	U	2.09	U	1.92	U
4-Bromophenyl-phenylether	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
4-Chloro-3-Methylphenol	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
4-Chloroaniline	mg/kg	310	8200	NE	NE	NE	NE	NE	0.818	U	0.79	U	0.847	U	0.912	U	0.835	U	0.758	U	0.842	U	0.865	U	0.833	U	0.767	U
4-Chloro-phenyl-phenyl ether	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
4-Nitroaniline	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
4-Nitrophenol	mg/kg	NE	NE	NE	NE	NE	NE	NE	2.05	U	1.98	U	2.12	U	2.28	U	2.09	U	1.9	U	2.11	U	2.17	U	2.09	U	1.92	U
Acenaphthene	mg/kg	43	10000	NE	NE	NE	4.0	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
Acenaphthylene	mg/kg	23	10000	NE	NE	NE	4.0	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
Acetophenone	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.818	U	0.79	U	0.847	U	0.912	U	0.835	U	0.758	U	0.842	U	0.865	U	0.833	U	0.767	U
Aniline	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.818	U	0.79	U	0.847	U	0.912	U	0.835	U	0.758	U	0.842	U	0.865	U	0.833	U	0.767	U
Anthracene	mg/kg	35	10000	NE	NE	NE	4.0	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
Azobenzene	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
Benzo(a)anthracene	mg/kg	0.9	7.8	NE	NE	NE	4.0	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
Benzo(a)pyrene	mg/kg	0.4	0.8	240	NE	NE	4.0	NE	0.205	U	0.198	U	0.212	U	0.228	U	0.209	U	0.19	U	0.211	U	0.217	U	0.209	U	0.192	U
Benzo(b)fluoranthene	mg/kg	0.9	7.8	NE	NE	NE	4.0	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
Benzo(g,h,i)perylene	mg/kg	0.8	10000	NE	NE	NE	4.0	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
Benzo(k)fluoranthene	mg/kg	0.9	78	NE	NE	NE	4.0	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
Benzoic Acid	mg/kg	NE	NE	NE	NE	NE	NE	NE	2.05	U	1.98	U	2.12	U	2.28	U	2.09	U	1.9	U	2.11	U	2.17	U	2.09	U	1.92	U
Benzyl Alcohol	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
bis(2-Chloroethoxy)methane	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
bis(2-Chloroethyl)ether	mg/kg	0.6	5.2	NE	NE	NE	NE	NE	0.205	U	0.198	U	0.212	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
bis(2-chloroisopropyl)Ether	mg/kg	9.1	82	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
bis(2-Ethylhexyl)phthalate	mg/kg	46	410	120	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
Butylbenzylphthalate	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
Carbazole	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
Chrysene	mg/kg	0.4	780	NE	NE	NE	4.0	NE	0.205	U	0.198	U	0.212	U	0.228	U	0.209	U	0.19	U	0.211	U	0.217	U	0.209	U	0.192	U
Dibenzo(a,h)Anthracene	mg/kg	0.4	0.8	NE	NE	NE	4.0	NE	0.205	U	0.198	U	0.212	U	0.228	U	0.209	U	0.19	U	0.211	U	0.217	U	0.209	U	0.192	U
Dibenzofuran	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
Diethylphthalate	mg/kg	340	10000	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
Dimethylphthalate	mg/kg	1900	10000	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
Di-n-butylphthalate	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
Di-n-octylphthalate	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
Fluoranthene	mg/kg	20	10000	NE	NE	NE	4.0	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
Fluorene	mg/kg	28	10000	NE	NE	NE	4.0	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
Hexachlorobenzene	mg/kg	0.4	3.6	NE	NE	NE	NE	NE	0.205	U	0.198	U	0.212	U	0.228	U	0.209	U	0.19	U	0.211	U	0.217	U	0.209	U	0.192	U
Hexachlorobutadiene	mg/kg	8.2	73	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
Hexachlorocyclopentadiene	mg/kg	NE	NE	NE	NE	NE	NE	NE	2.05	U	1.98	U	2.12	U	2.28	U	2.09	U	1.9	U	2.11	U	2.17	U	2.09	U	1.92	U
Hexachloroethane	mg/kg	46	410	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
Indeno(1,2,3-cd)Pyrene	mg/kg	0.9	7.8	NE	NE	NE	4.0	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
Isophorone	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
Naphthalene	mg/kg	54	10000	0.8	NE	NE	4.0	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
Nitrobenzene	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
N-Nitrosodimethylamine	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
N-Nitroso-Di-n-Propylamine	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
N-nitrosodiphenylamine	mg/kg	NE	NE	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
Pentachlorophenol	mg/kg	5.3	48	7.1	NE	NE	NE	NE	2.05	U	1.98	U	2.12	U	2.28	U	2.09	U	1.9	U	2.11	U	2.17	U	2.09	U	1.92	U
Phenanthrene	mg/kg	40	10000	NE	NE	NE	4.0	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
Phenol	mg/kg	6000	10000	NE	NE	NE	NE	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
Pyrene	mg/kg	13	10000	NE	NE	NE	4.0	NE	0.409	U	0.395	U	0.423	U	0.455	U	0.417	U	0.378	U	0.42	U	0.432	U	0.416	U	0.383	U
Pyridine	mg/kg	NE	NE	NE	NE	NE	NE	NE	2.05	U	1.98	U	2.12	U	2.28	U	2.09	U	1.9	U	2.11	U	2.17	U	2.09	U	1.92	U

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Table 1
Revolution Wind
Sediment Analysis

Sample ID		RIDEM Direct Exposure Criteria		RIDEM Leachability Criteria		RIDEM Dredging Criteria		EPA MCCTC	Rev01-ENV-04 (2-9.5ft)		Rev01-ENV-04 (9.5-11.5ft)		Rev01-ENV-04 (11.5-16.5ft)		Rev01-ENV-05 (0-2.5ft)		REV01-ENV-05 (2.5-7.5ft)		REV01-ENV-05 (7.5-13.5ft)		REV01-ENV-05 (13.5-15.5ft)		REV01-ENV-06 (0-4.5ft)		REV01-ENV-06 (4.5-10ft)		REV01-ENV-06 (10-15ft)	
Coordinates (lat. / long.)									Lat: 41.582575 Long: -71.425132		Lat: 41.582575 Long: -71.425132		Lat: 41.582575 Long: -71.425132		Lat: 41.581992 Long: -71.42554		Lat: 41.581992 Long: -71.42554		Lat: 41.581992 Long: -71.42554		Lat: 41.581992 Long: -71.42554		Lat: 41.582443 Long: -71.425631		Lat: 41.582443 Long: -71.425631		Lat: 41.582443 Long: -71.425631	
Laboratory Sample Designation	Units	RIDEM RDEC	RIDEM I/CDEC	GA	GB	Beach Criteria	Confined Aquatic Disposal (CAD) Cap	TCLP Criteria for Haz. Waste	20L0755-02		20L0755-03		20L0755-04		20L0755-10		20L0756-01		20L0756-02		20L0756-03		20L0756-08		20L0756-09		20L0756-10	
Sample Date									12/21/2020		12/21/2020		12/21/2020		12/21/2020		12/21/2020		12/21/2020		12/21/2020		12/22/2020		12/22/2020		12/22/2020	
TPH - ETPH																												
Total Petroleum Hydrocarbons	mg/kg	500	2500	500	2500	ND	NE	NE	47.6	U	46.1	U	43.7	U	53.8	U	44.4	U	45.8	U	46.9	U	44.8	U	47.5	U	46.9	U
Total Metals																												
Arsenic	mg/kg	7	7	NE	NE	1.7	10	NE	**0.88**	-	**0.99**	-	**1.48**	D	**2.25**	-	**1.14**	-	**1.06**	-	1.41	U, D	**1.84**	-	**0.69**	-	**1.81**	D
Cadmium	mg/kg	39	1000	NE	NE	1	5	NE	0.23	U	0.24	U	0.48	U, D	0.26	U	0.23	U	0.24	U	0.71	U, D	0.23	U	0.24	U	0.49	U, D
Chromium	mg/kg	1400	10000	NE	NE	10	100	NE	**1.25**	-	**1.13**	-	**3.5**	D	**12.7**	-	**1.97**	-	**1.2**	-	**5.01**	D	**5.73**	-	**1.2**	-	**6.37**	D
Copper	mg/kg	3100	10000	NE	NE	10	200	NE	**1.8**	-	**1.74**	-	**4**	D	**14.5**	-	**2.38**	-	**1.89**	-	**4.26**	D	**7.38**	-	**1.59**	-	**6.43**	D
Lead	mg/kg	150	500	NE	NE	25	100	NE	2.32	U	2.38	U	4.79	U, D	**10.9**	-	**2.14**	-	**2.08**	-	**3.94**	D	**5.14**	-	**1.99**	-	**4.34**	D
Mercury	mg/kg	23	610	NE	NE	0.5	0.5	NE	0.012	U	0.011	U	0.012	U	**0.088**	-	0.012	U	0.011	U	0.012	U	**0.012**	-	0.012	U	0.011	U
Nickel	mg/kg	1000	10000	NE	NE	5	50	NE	**1.32**	-	**1.25**	-	**3.72**	D	**5.24**	-	**1.92**	-	**1.42**	-	**4.97**	D	**4.69**	-	**1.55**	-	**6.38**	D
Zinc	mg/kg	6000	10000	NE	NE	25	200	NE	**13.7**	-	**14.4**	-	**25.2**	D	**35.9**	-	**15.4**	-	**17.6**	-	**40.5**	D	**32.2**	-	**17**	-	**41**	D
TCLP Metals																												
Arsenic	mg/L	NE	NE	NE	NE	NE	NE	5	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U
Barium	mg/L	NE	NE	23	NE	NE	NE	1	0.05	U	**0.202**	-	0.05	U	0.05	U	0.05	U	**0.053**	-	0.05	U	0.05	U	0.05	U	**0.062**	-
Cadmium	mg/L	NE	NE	0.03	NE	NE	NE	1	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
Chromium	mg/L	NE	NE	1.1	NE	NE	NE	5	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
Lead	mg/L	NE	NE	0.04	NE	NE	NE	5	*0.05*	U	*0.05*	U	*0.05*	U	*0.05*	U	*0.05*	U	*0.05*	U	*0.05*	U	*0.05*	U	*0.05*	U	*0.05*	U
Mercury	mg/L	NE	NE	0.02	NE	NE	NE	0.2	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.0005	U
Nickel	mg/L	NE	NE	1	NE	NE	NE	NE	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U
Selenium	mg/L	NE	NE	0.6	NE	NE	NE	1	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U
Silver	mg/L	NE	NE	NE	NE	NE	NE	5	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
PCBs																												
Aroclor 1016	mg/kg	10	10	10	10	ND	0.4	NE	0.06	U	0.06	U	0.06	U	0.07	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U
Aroclor 1221	mg/kg	10	10	10	10	ND	0.4	NE	0.06	U	0.06	U	0.06	U	0.07	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U
Aroclor 1232	mg/kg	10	10	10	10	ND	0.4	NE	0.06	U	0.06	U	0.06	U	0.07	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U
Aroclor 1242	mg/kg	10	10	10	10	ND	0.4	NE	0.06	U	0.06	U	0.06	U	0.07	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U
Aroclor 1248	mg/kg	10	10	10	10	ND	0.4	NE	0.06	U	0.06	U	0.06	U	0.07	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U
Aroclor 1254	mg/kg	10	10	10	10	ND	0.4	NE	0.06	U	0.06	U	0.06	U	0.07	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U
Aroclor 1260	mg/kg	10	10	10	10	ND	0.4	NE	0.06	U	0.06	U	0.06	U	0.07	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U
Aroclor 1262	mg/kg	10	10	10	10	ND	0.4	NE	0.06	U	0.06	U	0.06	U	0.07	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U
Aroclor 1268	mg/kg	10	10	10	10	ND	0.4	NE	0.06	U	0.06	U	0.06	U	0.07	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U
Classical Chemistry																												
Percent Moisture	%	NE	NE	NE	NE	25	NE	NE	**18**	-	**18**	-	**18**	-	**27**	-	**17**	-	**16**	-	**17**	-	**18**	-	**18**	-	**18**	-
Total Organic Carbon (Average)	mg/kg dry	NE	NE	NE	NE	NE	NE	NE	**620**	-	97.6	U	94.5	U	93.9	U	**1110**	-	**481**	-	95.9	U	**1520**	-	**392**	-	96.1	U
Grain Size																												
% Fines (Silt / Clay)	%	NE	NE	NE	NE	10	NE	NE	**11.7**	-	**17.1**	-	**77.6**	-	**37.4**	-	**23.8**	-	**26.1**	-	**84.5**	-	**23.3**	-	**22.7**	-	**83.7**	-

Notes:
1. Values in bold are results that exceed the laboratory's reporting limits.
2. Values that are shaded in grey exceed RIDEM GA Leachability Criteria.
3. Values that are shaded in light blue exceed CRMC/RIDEM Beach Dredge Disposal Criteria.
4. Values that are italiczed exceed one or more of the criteria but do not exceed the laboratory's reporting limits.
5. mg/kg = milligrams per kilogram, or parts per million
6. mg/L = milligrams per liter, or parts per million
7. U = undetected
8. D = diluted
9. NE = no criterion is applicable
10. The RIDEM Residential Direct Exposure Criteria (RDEC) and Industrial/Commercial Direct Exposure Crtieria (I/CDEC) are found within the RIDEM
11. The TCLP Criteria for Haz Waste is found within the EPA MCCTC.
12. The Beach Criteria and CAD Cap Criteria are found within the CRMC/RIDEM Dredging Regulations.

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Appendix C: RWEC-RI Benthic Habitat Maps and Report

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Benthic Habitats in Rhode Island State Waters

Revolution Wind Offshore Wind Farm

Prepared for:

Revolution Wind | Powered by Ørsted & Eversource

Revolution Wind, LLC

Submitted by:

INSPIRE Environmental
Newport, Rhode Island 02840

June 30, 2021

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APCs	Areas of particular concern
BOEM	Bureau of Ocean Energy Management
CMECS	Coastal and Marine Ecological Classification Standard
COP	Construction and Operations Plan
CRMC	Rhode Island Coastal Resources Management Council
EFH	Essential fish habitat
FGDC	Federal Geographic Data Committee
Fugro	Fugro USA Marine, Inc.
GIS	Geographic Information System
HAPC	Habitat Area of Particular Concern
HDD	horizontal directional drilling
INSPIRE	INSPIRE Environmental, LLC
MBES	Multibeam echosounder
mmu	Minimum mapping unit
NOAA	National Oceanic and Atmospheric Administration
NOAA Habitat	NOAA National Marine Fisheries Greater Atlantic Regional Fisheries Office Habitat Conservation and Ecosystem Services Division
OCS	Outer continental shelf
OSAMP	Ocean Special Area Management Plan
PV	Plan View
RWEC	Revolution Wind Farm Export Cable
RWEC-RI	Revolution Wind Farm Export Cable in Rhode Island state waters
RWEC-OCS	Revolution Wind Farm Export Cable traversing federal waters
RWF	Revolution Wind Farm
SAV	Submerged aquatic vegetation
SPI	Sediment Profile Imaging
SSS	Side-scan sonar

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GLOSSARY

Revolution Wind & CRMC Permitting: Key Terms & Abbreviations

Term	Definition
Boulder picks	Isolated boulders, outside boulder field; Boulders >= 50 cm (0.5 m) identified from geophysical data
Facies	Bodies of sediment that are recognizably distinct from adjacent sediments that resulted from different depositional environments.
Hard bottom	Stable cobbles and boulders found predominantly within Glacial Moraine A & B habitats and within Boulder Fields.
horizontal directional drilling (HDD)	Landfall of RWEC will be completed via HDD. HDD is a subsurface installation technique that will create an underground conduit through which the RWEC will be installed through the intertidal zone. The HDD methodology avoids impacts to the beach and nearshore environment.
Benthic Habitat Classification	Benthic habitat classifications with a minimum mapping unit of 2,000 m^2, prepared by INSPIRE
Minimum mapping unit (mmu)	The smallest size areal seabed or habitat polygon to be mapped as a discrete entity
Revolution Wind Farm Project (the Project)	Revolution Wind Farm (RWF) and the Revolution Export Cable (RWEC), collectively, the Project. The purpose of the Project is to construct and operate a new offshore wind farm designed to provide renewable energy to New England.
Revolution Wind Farm (RWF)	Located in federal waters off the coast of Rhode Island, within the Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf (OCS) #OCS-A 0486 (Lease Area). The RWF will consist of up to 100 WTGs, inter-array cables (IAC), up to two offshore substations (OSSs), and an OSS-Link Cable.
Revolution Export Cable (RWEC)	The export cable system from the RWF to the mainland electric grid interconnection includes RWEC in federal waters (RWEC-OCS), RWEC in state waters (RWEC-RI), and onshore components (Onshore Facilities), collectively referred to as the RWEC.
Revolution Export Cable – Outer Continental Shelf (RWEC-OCS)	The submarine segment of the export cable system located on the OCS from the RWF to the 3-nautical mile (3.5-mile; 5.6-km) state boundary.
Revolution Export Cable – RI State Waters (RWEC-RI)	The submarine segment of the export cable system located within the state waters of Rhode Island to the landfall location at Quonset Point.

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1.0 INTRODUCTION

1.1 Revolution Wind Project Overview and Layout

Revolution Wind, LLC (Revolution Wind), a 50/50 joint venture between Orsted North America Inc. (Orsted NA) and Eversource Investment LLC (Eversource), proposes to construct and operate the Revolution Wind Farm Project (hereinafter referred to as the Project). The wind farm portion of the Project will be located in federal waters on the Outer Continental Shelf (OCS) in the designated Bureau of Ocean Energy Management (BOEM) Renewable Energy Lease Area OCS-A 0486 (Lease Area) (Figure 1-1). The Project consists of the Revolution Wind Farm (RWF), located within the Lease Area, and the Revolution Wind Farm Export Cable (RWEC), traversing federal waters (RWEC-OCS) and Rhode Island state waters (RWEC-RI) (Figures 1-1 and 1-2) to a landfall location at Quonset Point in North Kingstown, Rhode Island (Figure 1-3).

The Project will be comprised of both offshore and onshore components, which are described in detail in Section 3 of the Construction and Operations Plan (COP) (Revolution Wind, LLC 2021a). This Report focuses on evaluation of the Project's offshore components within Rhode Island state waters, which includes up to two submarine export cables (referred to as the RWEC-RI).

This report provides a detailed assessment of benthic habitats that have been mapped from geophysical and benthic ground-truth data within the RWEC-RI Study Area. The RWEC-RI Study Area is defined as the area Revolution Wind surveyed for siting the RWEC-RI, ranging in width from approximately 10,500 ft (3,200 m) at its widest point and approximately 1,300 ft (396 m) at its narrowest. Ultimately, the RWEC-RI route will be sited within this broader Study Area and impacts will be limited to an approximate 131-foot (40-meter) -wide disturbance corridor centered on each cable. To provide information on offshore habitats compared to estuarine habitats, benthic habitats are presented both in Rhode Island Sound and in Narragansett Bay (Figure 1-2).

1.2 Rhode Island State Permitting Overview

The Project requires approvals from various state agencies, including the Rhode Island Energy Facility Siting Board, the Coastal Resources Management Council (CRMC), and the Rhode Island Department of Environmental Management. Most relevant to this report, CRMC regulations in both the Coastal Resources Management Program, or "Red Book", (650-RICR-20-00-1 et seq.) and the Ocean Special Area Management Plan (OSAMP) (RI CRMC 2010) include requirements pertaining to identification and evaluation of benthic habitats. This report provides the baseline data and information necessary to support CRMC's review of any Project impacts on benthic habitats under its regulations.

Specific Red Book requirements related to benthic habitats pertain to those habitats that support submerged aquatic vegetation (SAV). Section 1.3.1(R) of the Red Book defines CRMC's goals to preserve, protect, and where possible, restore SAV habitat. These habitats are found throughout shallow coastal areas in Narragansett Bay and their presence is periodically mapped

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across the Bay using aerial imagery and field verification by the URI Environmental Data Center (URI Environmental Data Center and RIGIS). The Red Book outlines information pertaining to site-specific monitoring, assessment of impacts, and mitigation for SAV.

Specific OSAMP requirements related to benthic habitats pertain to those habitats that meet the criteria for areas of particular concern (APCs), as defined by CRMC in Section 11.10.2 of the OSAMP. Glacial moraines are considered to be "areas of particular concern" because they provide structural complexity and permanence that serve to provide valuable habitat for benthic species and demersal fish.[1] Glacial moraines are complex geoforms that may have many different expressions at the seafloor surface based on geological origin, position within a larger moraine complex, and modern geological processes, including sediment supply. Rhode Island's marine landscapes were carved by glaciers and remnants of this glaciation are evident on the seafloor. Deposits on the surface of glacial moraine landforms can be a mix of till, stratified drift, and reworked sediments derived from the glacial deposits and subsequent marine transgression. The OSAMP presumptively excludes development from APCs unless an applicant demonstrates, for example, "by clear and convincing evidence that there are no practicable alternatives that are less damaging in areas outside of the APC, or that the proposed project will not result in a significant alteration to the values and resources of the APC."

1.3 Benthic Habitat Mapping Assessment Purpose

The purpose of this report and associated data is to provide detailed information about the physical and biological characteristics and spatial composition of benthic habitats found within the RWEC-RI Study Area. These data are compared to existing data on the seafloor in Rhode Island Sound and Narragansett Bay for additional context concerning the habitats within the RWEC-RI Study Area. Results from the habitat mapping assessment will be used to evaluate the potential impacts for the Project to benthic habitats and to support Rhode Island state permitting efforts, as summarized above in Section 1.2. To achieve these results, high-resolution geophysical and ground-truth data were used to further delineate and refine geological seabed interpretations prepared for the Revolution Wind Marine Site Investigation Report (Revolution Wind, LLC 2021b) into a detailed benthic habitat map for the RWEC-RI.

[1] The Ocean SAMP describes Areas of Particular Concern: (APC): "Glacial moraines are important habitat areas for a diversity of fish and other marine plants and animals because of their relative structural permanence and structural complexity. Glacial moraines create a unique bottom topography that allows for habitat diversity and complexity, which allows for species diversity in these areas and creates environments that exhibit some of the highest biodiversity within the entire Ocean SAMP area. The Council also recognizes that because glacial moraines contain valuable habitats for fish and other marine life, they are also important to commercial and recreational fishermen. Accordingly, the Council shall designate glacial moraines as identified in Figures 11.3 and 11.4 as Areas of Particular Concern." CRMC 1160.2 (RI CRMC 2010)

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2.0 INPUT DATA AND APPROACH

Multiple sources of geophysical and ground-truth data were used as input data sources for mapping benthic habitats within the RWEC-RI Study Area. Brief summaries of these data sources and details pertinent to their use in the habitat mapping process are described here. Full details of geophysical and ground-truth data collection, processing, and analysis are provided in the Marine Site Investigation Report (Revolution Wind, LLC 2021b) and benthic assessment report (Revolution Wind, LLC 2021c) appended to the Revolution Wind COP (Revolution Wind, LLC 2021a).

2.1 Input Data

2.1.1 Geophysical Data

To support Revolution Wind Site Investigations, Fugro USA Marine, Inc. (Fugro) conducted high-resolution multibeam echosounder (MBES) and side-scan sonar (SSS) surveys within the Project Area (Revolution Wind, LLC 2021b). MBES and SSS are collected using different instruments deployed from the same survey vessel (Figure 2-1). The MBES is mounted to the vessel and provides the highest degree of positional accuracy; the MBES can be optimized either for bathymetric or backscatter data, not for both. The geophysical surveys conducted for offshore wind development are designed to support engineering and construction design and, therefore, the MBES was optimized for bathymetric data and backscatter data were collected as an ancillary data product. Bathymetric data were derived from the MBES and processed to a resolution of 50 cm (Revolution Wind, LLC 2021b). Bathymetric data provide information on depth and seafloor topography (Figure 2-2). Backscatter data were derived from the MBES and processed to a resolution of 25 cm (Revolution Wind, LLC 2021b). Backscatter data are based on the strength of the acoustic return to the instrument and provide information on seafloor sediment composition and texture and are best interpreted in concert with hill-shaded bathymetry (Figure 2-3). Backscatter returns are relative (see below) and referred to in terms of low, medium, and high reflectance rather than absolute decibel values. Nominally softer, fine-grained sediments absorb more of the acoustic signal and a weaker signal is returned to the MBES. Although backscatter data provide valuable information about sediment grain size, decibel values reflect not only sediment grain size, but also compaction, water content, and texture (Lurton and Lamarche 2015). For example, sand that is hard-packed and sand that has prominent ripples may have higher acoustic returns than sediments of similar grain size that do not exhibit these characteristics.

In addition, backscatter decibel values are also influenced by water temperature and salinity, sensor settings, seafloor rugosity, and MBES operating frequency, among others (Lurton and Lamarche 2015; Brown et al. 2019). Differences in backscatter decibel values can also occur when data have been collected over a very large survey area under dynamic conditions, with different instruments, and in different years. This scenario is common and does not nullify the data; rather geophysicists and geographic information system (GIS) practitioners experienced at working with these data have developed methods to optimize processing (as appropriate to the sensors) and to display the data in a manner optimal for interpretation (Lurton and Lamarche

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2015; Schimel et al. 2018). Backscatter data products vary based on processing (Lucieer et al. 2017) and data display procedures. Mapping of seafloor composition and habitats, while greatly aided by backscatter data, rarely relies solely on these data (see Table 1 in Brown et al. 2011). The manner in which the suite of data collected were used for habitat delineations is described further in Section 2.2.

SSS data were generated from a towed instrument and, thus, have a lower positional accuracy than MBES data. However, because the SSS is closer to the seafloor with a lower angle of incidence the resolution, signal to noise ratio and intensity contrast of SSS images are higher than those of MBES backscatter images (Lurton and Jackson 2008). The processed SSS images provide the highest resolution data on sediment textures and objects on the seafloor (boulders, debris) (Figure 2-4). Thermoclines and haline variations affected the acoustic signal and resulted in data artifacts, presenting as sinuous rippling of alternating low and high returns that could not be removed from the data; they are visible when viewed at very close range. SSS data were processed to a resolution of 10 cm along the RWEC-RI; this resolution permits detection of boulders but does not permit the reliable detection of individual cobbles (6.4 cm to 25.6 cm).

An artificial intelligence algorithm paired with a manual review step was used to aggregate boulders into boulder fields where they were present in low (20 – 99 per 10,000 m^2), medium (100 – 99 per 10,000 m^2) and high (>199 per 10,000 m^2) densities. (Revolution Wind, LLC 2021b). These density values were set by the Revolution Wind Site Investigations team; boulder fields are defined as a geoform by the federal Coastal and Ecological Marine Classification Standard (CMECS; FGDC 2012), however no density values are provided. Isolated individual boulders greater than or equal to 50 cm (0.5 m) outside the boulder fields were identified from the MBES and SSS data using automatic and manual detection methods to generate a “boulder pick” data set to accompany the boulder field dataset (Figure 2-5). In addition to individual boulders, other solitary objects (known as “contacts” in geophysical survey terminology), such as various types of debris were identified in this manner. A combination of these geophysical data was used to detect large and small-scale bedforms, such as mega-ripples and ripples (*sensu* BOEM 2020a) (Figure 2-6).

2.1.2 Ground-Truth Data

Sediment profile and plan view images (SPI/PV) were collected at 34 stations along the RWEC-RI Study Area in July 2019; 10 stations within Rhode Island Sound and 24 stations within Narragansett Bay (Figure 2-7). All 34 stations were within the footprint of the RWEC-RI Study Area; summarized data results are presented in Attachment A. SPI/PV images were used to ground-truth sediment types, bedform dynamics, presence of sensitive habitats and taxa, and to characterize benthic biological communities. SPI/PV images were analyzed for a suite of variables (Table 2-1) and were classified using CMECS Substrate and Biotic components (Table 2-2). CMECS Substrate Group/Subgroup was particularly useful as ground-truth data for purposes of delineating seafloor sediments and benthic habitats (Figure 2-8). CMECS Biotic Subclasses and notations of sessile and mobile epifauna present (Figure 2-9) were used to

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provide detail about the biological communities observed within each mapped habitat type. Detailed descriptions of each variable analyzed and full data analysis results can be found in the COP Benthic Assessment (Revolution Wind, LLC 2021c).

In addition, a towed video survey along 52 transect lines was conducted near the RWEC-RI landfall at Quonset Point (Figure 2-10). This survey focused on nearshore regions around the landfall where there was a higher probability of SAV presence. Survey planning and analysis followed protocols as outlined in federal agency protocols (Colarusso and Verkade 2016) and in the CRMC Red Book (detailed in Attachment B). Video transect data were analyzed to identify the presence or absence of SAV in each video file. Additional parameters were analyzed where SAV was present including SAV bed extent and general sediment type, in accordance with federal agency protocols (Colarusso and Verkade 2016).

2.2 Habitat Mapping Approach

Geophysical and ground-truth data were reviewed in an iterative process to delineate benthic habitats. MBES data, viewed as backscatter draped over a hill-shaded bathymetric relief model, was used at a “zoomed out” scale (~1:10,000) to identify large-scale facies – areas of sedimentary characteristics (reflectance, bedform, slope) distinct from those adjacent. These initial delineations were further refined at “zoomed in” scales (~1:2,000 or finer) using the MBES data in combination with SSS, boulder picks, and ground-truth data (Figure 2-11). Delineations must be of a size appropriate both to the resolution of the data and to the subject of interpretation. For these purposes, a minimum mapping unit (mmu) is defined as “the smallest size areal entity to be mapped as a discrete entity” (Lillesand et al. 2015). Minimum mapping units, the resolution of the geophysical data, and the use the CMECS Substrate Component meet agency recommendations (NOAA Habitat 2020, 2021).

2.2.1 Geological Seabed Characterization

Revolution Wind developed information on the geological seabed to characterize the geological provenance and stratigraphic conditions of the seafloor inclusive of surface and subsurface features. Methods used to collect this information included MBES bathymetry and backscatter, SSS, sub-bottom profile, magnetometer, and seismic profile data, along with vibracores. For the purposes of defining geological seabed types present at the sediment surface, the Folk classification (Folk 1954) was used, which aligns with CMECS Substrate classifications (Figure 2-12). Seabed types present along the RWEC-RI based solely on this scheme are Mud and Sandy Mud, Sand and Muddy Sand, and Coarse Sediment. In addition, areas of the seabed of unconsolidated and consolidated glacial drift deposits were mapped as Glacial Moraine and exposed bedrock was mapped as such. Anthropogenic features, such as dredged material and debris from the former Jamestown Bridge were also mapped as such. The geological seabed characterization map was developed using a minimum mapping unit of 4,000 m^2

2.2.2 Delineation of Benthic Habitat Types

Geological characterizations of seabed conditions are not strictly equivalent to benthic habitats as experienced by benthic biological communities and demersal fish. To map these habitats for

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the purposes of assessing the potential impacts of the Project on these biotic communities, INSPIRE refined the seabed interpretations to map benthic habitats with a minimum mapping unit of 2,000 m^2 along the RWEC-RI Study Area. Multibeam 50-cm resolution bathymetry, 25-cm resolution backscatter, and 10-cm SSS data were examined along with boulder picks and SPI/PV data (Figure 2-13) to delineate new habitat polygons and to refine the seabed classifications for the purposes of evaluating benthic habitats (Figure 2-14).

Modifiers were used to provide additional descriptive information about the benthic habitats found along the RWEC-RI; CMECS modifier and Geoform or Substrate terms were used to the extent practicable. These modifiers include features of the seafloor that are relevant to the biota that utilize these habitats and describe the value of the habitats for these biota beyond what is provided in the geological seabed mapping. Modifiers are related to features that describe the mobility, stability, and complexity of the benthic habitats mapped along the RWEC-RI. Where bedforms indicating frequent physical disturbance of the seafloor were observed, the “Mobile” modifier was used. Boulder fields mapped by Fugro were used to refine habitat boundaries and applied as modifiers, except where they overlapped with glacial habitats, as these habitats are all characterized by high densities of boulders. Shell substrate (living or non-living shells) and submerged aquatic vegetation both provide unique habitats for certain species of benthic invertebrates and demersal fish; modifiers have been applied for both.

Glacial moraine habitats do not fit neatly into the Folk or CMECS classification schemes and modifiers were not applied to these habitats as they were to those described above. Glacial moraines are complex and heterogeneous environments with characteristic surface and subsurface features that relate to their glacial origin. The surface benthic habitats associated with glacial moraines often provide valuable habitat for sessile and mobile benthic invertebrates and for demersal fish. Glacial Moraine habitats are presented as two types (A and B), in order to distinguish unconsolidated glacial moraine deposits (A) from consolidated moraine habitats that have high structural complexity and structural permanence (B).

All habitats and their distributions along the RWEC-RI Study Area are described in more detail in Section 3.0. In addition to the habitat data present on maps in this report, the geospatial data contain separate attributes to record several other features of each habitat polygon: type of bedforms observed, area, presence of scattered boulders and debris, and refinements of Coarse Sediment habitats. In addition to the natural bedforms defined in the BOEM Geophysical Survey Guidelines (2020a): mega-ripples = 5 - 60 m wavelength and 0.5 - 1.5 m height; ripples = <5 m wavelength and <0.5 m height; other bedforms such as linear depressions and trawl marks were noted where present. The presence of isolated boulders and debris identified by Fugro in the geophysical analysis (boulder picks and debris contacts) were noted as “scattered boulders and debris” in the habitat data. Additionally, further characterization of Coarse Sediment habitat polygons was recorded as “coarse sediment refinements” to provide additional detail on the nature of coarse sediment (e.g., gravelly sand or sandy gravel) where it could be reliably determined from ground-truth geophysical data. These data are available in the interactive Popup map which will be provided to CRMC upon request.

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Table 2-1. SPI/PV Ground-truth Parameters with Corresponding BOEM COP Requirements and Guidelines (BOEM 2019, 2020b; NOAA Habitat 2021)

BOEM COP Guidelines and *NOAA*† *Recommendations*	Parameters Derived from PV Images	Parameters Derived from SPI Images
Classification of CMECS sediment type Grain size analysis	CMECS Substrate Group CMECS Substrate Subgroup Gravel measurements	Sediment type (based on grain size major mode)
Identification of distinct horizons in subsurface sediment	None	Sediment type (based on grain size major mode) Apparent Redox Potential Discontinuity (aRPD)*
Delineate hard bottom substrates	CMECS Substrate Group CMECS Substrate Subgroup	Sediment type (based on grain size major mode)
Identification of bedforms Characterization of physical hydrodynamic properties	Bedform type	Boundary roughness
Identification of rock outcrops and boulders Characterization and delineation of any hard bottom gradients of low to high relief such as coral (heads/reefs), rock or clay outcroppings, or other shelter-forming features	CMECS Substrate Group CMECS Substrate Subgroup Gravel measurements	None
Characterization of benthic habitat attributes	Gravel measurements Sediment Descriptor* Macrohabitat	aRPD* Prism penetration depth Sediment oxygen demand and proxies (methane, *Beggiatoa*)
Classification to CMECS Biotic Component to lowest taxonomic unit practicable	CMECS Dominant Biotic Subclass CMECS Co-occurring Biotic Subclass	None
Characterization of benthic community composition (identify and confirm benthic species (flora and fauna) that inhabit the area) Identification of communities of sessile and slow-moving marine invertebrates (clams, quahogs,	CMECS Dominant Biotic Subclass CMECS Co-occurring Biotic Subclass Epifauna* Sensitive taxa Attached Flora/Fauna Percent Cover* Burrows/Tubes/Tracks	Epifauna* Sensitive taxa Tubes/Voids Successional Stage*

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BOEM COP Guidelines and *NOAA† Recommendations*	**Parameters Derived from PV Images**	**Parameters Derived from SPI Images**
mussels, polychaetes, anemones, sponges, echinoderms) *Identification of potentially sensitive seafloor habitat* *Identification of important biogenic habitats:* • *Hard bottom substrates with epifauna* • *Hard bottom substrates with macroalgae* • *Submerged aquatic vegetation (seagrass)* • *Long-lived and habitat forming taxa (e.g. emergent fauna)*	Macrohabitat	

† NOAA Habitat Recommendations are indicated by use of italicized characters and support BOEM Guidelines with further detail.

* Indicates variable that is a CMECS modifier. CMECS Modifiers provide additional detail to further characterize habitat components using a consistent set of definitions.

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Table 2-2. CMECS Classification Levels Used in Analysis and Classifications for the Revolution Wind SPI/PV Survey in Rhode Island State Waters – Rhode Island Sound

CMECS Term	Scale of Classification	Classifications
Substrate Component		
Substrate Origin	Site	Geologic Substrate
Substrate Class	SPI/PV	Unconsolidated Mineral Substrate
Substrate Subclass	SPI/PV	Fine Unconsolidated Substrate
[+]Substrate Group	PV	Sand or finer
[+]Substrate Subgroup	SPI	Silt-Clay; Very Fine Sand; Fine Sand; Medium Sand; Coarse Sand
Biotic Component		
Biotic Setting	SPI/PV	Benthic/Attached Biota
Biotic Class	SPI/PV	Faunal Bed
Biotic Subclass	SPI/PV	**Soft Sediment Fauna**; Inferred Fauna
[+]Biotic Group	SPI/PV	**Larger Tube-Building Fauna; Larger Deep-Burrowing Fauna**; Small Tube-Building Fauna

[+] Indicates variability within the surveyed area at this level of the hierarchy.
Bold text indicates an overwhelming dominant classification across the surveyed area.

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Table 2-3. CMECS Classification Levels Used in Analysis and Classifications for the Revolution Wind SPI/PV Survey in Rhode Island State Waters – Narragansett Bay

CMECS Term	Scale of Classification	Classifications
Substrate Component		
Substrate Origin	Site	Geologic Substrate
Substrate Class	SPI/PV	Unconsolidated Mineral Substrate
Substrate Subclass	SPI/PV	Fine Unconsolidated Substrate
[+]Substrate Group	PV	**Sand**; Slightly Gravelly; Shell Substrate
[+]Substrate Subgroup	SPI	Silt-Clay; Very Fine Sand; Fine Sand; Medium Sand; Coarse Sand; Slightly Gravelly Sand; Crepidula Reef Substrate; Shell Hash;
Biotic Component		
Biotic Setting	SPI/PV	Benthic/Attached Biota
Biotic Class	SPI/PV	Faunal Bed
[+]Biotic Subclass	SPI/PV	**Soft Sediment Fauna**; Attached Fauna; Benthic Macroalgae; Inferred Fauna;
[+]Biotic Group	SPI/PV	**Larger Deep-Burrowing Fauna;** Larger Tube-Building Fauna; Small Tube-Building Fauna; Tracks and Trails; Attached Hydroids; Attached Sponges; Filamentous Algal Bed; Mussel Bed; Sessile Gastropods; Tunneling Megafauna

[+] Indicates variability within the surveyed area at this level of the hierarchy.
Bold text indicates an overwhelming dominant classification across the surveyed area.

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3.0 RESULTS

3.1 Benthic Habitat Types

Six primary benthic habitat types were mapped within the RWEC-RI: Glacial Moraine B, Glacial Moraine A, Coarse Sediment, Sand and Muddy Sand, Mud and Sandy Mud, and Bedrock. When habitats were updated with modifiers, a total of 17 were mapped within the RWEC-RI Study Area (12 within Rhode Island Sound and 14 within Narragansett Bay). In addition, Anthropogenic Features were mapped in several locations near landfall and near the Jamestown Bridge. Overall descriptions of each habitat type as observed across the RWEC-RI are provided below and descriptions of spatial distribution within the Rhode Island Sound and Narragansett Bay are provided in Section 3.2. Spatial distributions and characteristics of the benthic habitat types are summarized in Table 3-1 for Rhode Island Sound and Table 3-3 for Narragansett Bay. One very small (~0.01 acres) area of Mixed-Sized Gravel in Muddy Sand habitat was identified from aerial imagery along the shoreline west of the landfall location in Quonset Point; this habitat is not discussed further in the section below. Each of the benthic habitat categories mapped are also crosswalked to CMECS Substrate and Biotic component classifications using SPI/PV ground-truth data; these data are presented in Table 3-2 for Rhode Island Sound and in Table 3-4 for Narragansett Bay. Full data results by station are provided in Attachment A. A range of substrate and biotic communities were present within each benthic habitat category as expected, given the differences in observation scale between geophysical data and ground-truth point samples (Tables 3-2 and 3-4).

3.1.1 Glacial Habitats

Many of the habitats within the RWEC-RI have their origin in the region's glacial history. Glaciation results in characteristic geologic remnants that indicate how glaciers sculpted the landscape and seascape. For example, Narragansett Bay and Rhode Island Sound were once both glacial lakes and Narragansett Bay is a drowned river valley that was shaped by actions of the Laurentide ice sheet during the last glacial period (~18,000 years ago). Channels cut by the ice are evident in the channels of the West and East Passages of the Bay on either side of Conanicut Island. Deglaciation and modern geological action have continued to influence the seafloor and benthic habitats found within Narragansett Bay and Rhode Island Sound. Subsurface expressions of glaciation are present in the study area and are reviewed in detail in the Marine Site Investigation Report (Revolution Wind, LLC 2021b); only the surface expression of these geologic features represent benthic habitats and are of relevance to the assessment presented here. Three of the primary benthic habitat types mapped for the present assessment are direct remnants of glaciation that remain present at the seafloor surface. These three habitat types are Glacial Moraine B, Glacial Moraine A, and Bedrock, all of which have distinct geophysical signatures (Figure 3-1). Due to the presence of very coarse and poorly sorted sediment, the seabed of these habitat types generally exhibits high reflectance in backscatter data and SSS data reveal distinct characteristics of each glacial habitat. Bedrock habitats consist of exposed outcroppings of bedrock, either present as solitary outcrops or in groupings of large bedrock outcrops (Figure 3-1). Glacial Moraine habitats, on the other hand, are complex habitat classification categories composed of consolidated and unconsolidated geologic debris

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directly deposited by glacial movement (rather than reworking from meltwaters or transgressive seas) and are limited in distribution along the outer continental shelf near New England.

A distinction was made between Glacial Moraine A and Glacial Moraine B habitats to distinguish between areas of unconsolidated geological debris (A) and consolidated geological debris (B). The surface of Glacial Moraine B deposits appeared poorly sorted and dense with very high boulder densities resulting in greater structural complexity and permanence. By comparison, the surfaces of Glacial Moraine A units have been reworked with sand and gravel deposits resulting in less structural complexity and permanence. More specifically, Glacial Moraine B habitats are characterized by marked topographic relief, highly consolidated cobble and boulder features that commonly lack loose / mobile cover sediments (Figure 3-1), and, in locations further offshore, evidence of striations oriented NNW-SSE. In contrast, densities of boulders are generally lower and distribution of cobbles and boulders is more dispersed and patchy within Glacial Moraine A habitats (Figure 3-1). The seabed of Glacial Moraine A habitats is typically irregular and contains loose mobile sediments near/at the boulders, which can also display morphological features (ripples). Generally, however, boulders appear chaotic with no apparent structural pattern. Because medium to high density boulder fields are typically a characteristic of both of these moraine habitats, boulder field modifiers were not applied to Glacial Moraine A & B habitat types.

Sediments include sand, small mobile gravel, and areas with high density of cobbles and boulders; small patchy areas of ripples are also present (Tables 3-1 and 3-3). Although the density of cobbles and boulders is generally high in areas designated as Glacial Moraine A, the areas of high density are rarely continuous; rather, distribution of cobbles and boulders is very patchy and not well captured by point sampling approaches (SPI/PV stations); therefore, a high degree of heterogeneity was observed among ground-truth sampling with few capturing features diagnostic of Glacial Moraine A & B habitats (cobbles, boulder, attached fauna) (Table 3-4). Glacial Moraine A & B habitats were limited in distribution in the RWEC-RI Study Area in both Rhode Island Sound (0.3%; Table 3-1) and Narragansett Bay (3%; Table 3-3). Within Rhode Island state waters, these moraine habitats were generally present as discrete surface outcroppings and reefs. Only one ground-truth SPI/PV station sampled Glacial Moraine B and none sampled Glacial Moraine A habitats (Tables 3-2 and 3-4). At that one station, the CMECS Substrate Subgroup was Slightly Gravelly Sand and a mix of CMECS Biotic Subclasses Soft Sediment Fauna and Attached Fauna (barnacles, sponges) were observed (Table 3-4). As noted in Section 5 of this report, Revolution Wind anticipates siting the RWEC-RI to avoid the areas of Glacial Moraine A and B identified within the broader RWEC-RI Study Area.

3.1.2 Coarse Sediment Habitats

Coarse Sediment habitat types encompass sands with varying degrees of gravel. The Coarse Sediment – Mobile habitat type describes these sand and gravel habitats where the seafloor is subjected to small, but frequent currents and storm events and is common on the outer continental shelf. The seafloor of these Coarse Sediment habitat types exhibited generally medium to high reflectance values in backscatter and SSS data (Figure 3-2). Expressions of

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these habitats in Rhode Island state waters was often characterized as gravelly sands collected with depressions on the seafloor surrounds by sand (Figure 3-2); depressions were most evident in bathymetric data and the coarser nature of the sediment was evident in backscatter data. Ripples and/or mega-ripples were prevalent in Coarse Sediment – Mobile habitats (Tables 3-1 and 3-3; Figure 3-3). Coarse Sediment – Mobile was limited in distribution in the RWEC-RI Study Area in both Rhode Island Sound (5%; Table 3-1) and Narragansett Bay (2%; Table 3-3). Coarse Sediment with Low or Medium Density Boulder Field were very limited in distribution in Rhode Island Sound (<0.1%; Table 3-1). Examples of Low and Medium Density Boulder Fields are provided in Figure 3-4. Only two ground-truth SPI/PV stations sampled Coarse Sediment habitats (Tables 3-2 and 3-4). At those two stations, the CMECS Substrate Subgroup was Sand and a mix of CMECS Biotic Subclasses Soft Sediment Fauna and Inferred Fauna (tracks and trails of mobile epifauna) were observed (Table 3-4). Taxa were generally comprised of amphipods, and mobile crustaceans and mollusks (Attachment A; Tables 3-2 and 3-4; Figure 2-9). In a few cases, ground-truth data and/or geophysical data supported a refinement of coarse sediment to Gravelly Sand.

3.1.3 Sand and Muddy Sand Habitats

The Sand and Muddy Sand habitat types consist of sand that has been subjected to a wide range of oceanic processes. These habitat types are very common on the outer continental shelf and were widespread in the RWEC-RI Study Area, both in Rhode Island Sound and in Narragansett Bay. The Muddy Sand included in this category has a high sand to mud ratio, ranging from an 8:2 sand to mud ratio to 100% sand (Figure 2-12). The seafloor of these habitats exhibited a range of values in backscatter and SSS data reflectance but were predominantly low to medium (Figure 3-2). The Sand and Muddy Sand – Mobile habitat type describes these sandy habitats where the seafloor is subjected to small but frequent currents and storm events where ripples and/or mega-ripples are prevalent. (Figure 3-3) These habitats and bedform comprised the majority of the Rhode Island Sound portion of the RWEC-RI Study Area (57%; Table 3-1). In addition to Sand and Muddy Sand – Mobile, sandy habitats within the RWEC-RI Study Area also included a small delta near the shoreline at Quonset Point and small areas coincident with Low and Medium Density Boulder Fields (Tables 3-1 and 3-3; Figure 3-4).

Thirteen ground-truth SPI/PV stations were sampled within Sand and Muddy Sand habitats within the RWEC-RI Study Area (Tables 3-2 and 3-4). The sediments within these habitats were generally composed of very fine and fine sands (Attachment A) and included the CMECS Substrate Subgroup of Sand or finer (Tables 3-2 and 3-4). The CMECS Biotic Subclasses of Soft Sediment Fauna and Inferred Fauna were observed within Sand and Muddy Sand – Mobile habitats (Tables 3-2 and 3-4). Of these, Soft Sediment Fauna were observed most frequently, with Inferred Fauna (epifaunal tracks and trails) generally observed as the co-occurring Subclass (Attachment A). Soft Sediment Taxa were generally comprised of large and small burrowing taxa, large and small tube-building taxa, amphipods, and mobile crustaceans and mollusks (Attachment A; Tables 3-2 and 3-4; Figure 2-9A). In the non-mobile Sand and Muddy Sand habitats sampled with SPI/PV in Narragansett Bay, sediments ranged from fine to coarse

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sand with sparse gravel presence and benthic macroalgae and sponges were observed (Table 3-4; Figure 2-9D).

3.1.4 Mud and Sandy Mud Habitats

The Mud and Sandy Mud habitat types consist of relatively featureless mud and sand, except where described by modifiers for boulder fields, shell substrate, and SAV. The sand to silt/clay ratio within these habitat types is expected to be less than 8:2 (Figure 2-12). The seafloor of these habitats exhibited predominantly low backscatter and SSS data reflectance (Figure 3-5) indicating that the surface is less dense and the sediments more fine-grained compared to other habitat types. Backscatter values were higher and of medium reflectance in one area in Narragansett Bay where Shell Substrate was evident in ground-truth data and was used as a modifier to these habitats (15%; Tables 3-3 and 3-4; Figure 3-5). These Shell Substrates were composed of both living and dead mollusks (Table 3-4; Figures 2-9B and 2-9C) namely blue mussels and Crepidula. These habitats also support mobile mollusks and crustaceans (Table 3-4). A very small area of Mud and Sandy Mud with SAV habitat was observed and mapped near the shoreline at Quonset Point in Narragansett Bay based on aerial imagery and ground-truth video data (0.004%; Table 3-3; Figure 3-6). In addition, very small areas of Mud and Sandy Mud were coincident with Low Density Boulder Fields (0.05% and 0.45%; Tables 3-1 and 3-3). Trawl marks related to fishing activity were also observed within many of the Mud and Sandy Mud habitats mapped (Tables 3-2 and 3-4).

Thirteen ground-truth SPI/PV stations were sampled within Mud and Sandy Mud habitats, and five within Mud and Sandy Mud with Shell Substrate habitats, within the RWEC-RI Study Area (Tables 3-2 and 3-4). The sediments within these habitats were generally composed of very fine sands and silt/clay (Attachment A) and included the CMECS Substrate Subgroup of Sand or finer (Tables 3-2 and 3-4). The CMECS Biotic Subclasses of Soft Sediment Fauna and Inferred Fauna were observed within Mud and Sandy Mud habitats (Tables 3-2 and 3-4). Of these, Soft Sediment Fauna were observed most frequently, with Inferred Fauna (epifaunal tracks and trails) generally observed as the co-occurring Subclass (Attachment A). Soft Sediment Taxa were generally comprised of large and small burrowing taxa, large and small tube-building taxa, amphipods, and mobile crustaceans and mollusks (Attachment A; Tables 3-2 and 3-4; Figure 2-9A). In the Mud and Sandy Mud with Shell Substrate habitats, CMECS Substrate Subgroups included Crepidula Reef Substrate and Shell Hash and the Biotic Subclasses included Soft Sediment Fauna, Inferred Fauna, and Attached Fauna (Tables 3-2 and 3-4). Sessile and mobile epifauna characteristic of these habitats were observed, namely blue mussels, barnacles, Crepidula, and mobile crustaceans and mollusks (Tables 3-2 and 3-3; Figures 2-9B and 2-9C).

3.1.5 Anthropogenic Features

Distinct features of anthropogenic origin were mapped on the seafloor within the RWEC-RI Study Area in Narragansett Bay. These features may provide some habitat value but are considered separately from the primary habitats evaluated. A series of structural objects and debris associated with the demolition of the old Jamestown Bridge were identified in geophysical data (Figure 3-7). A number of shoreline-related structures such as boat ramps and

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revetment walls along the shoreline in Quonset Point were identified in aerial imagery. Two areas of dredged material were also identified, one near the landfall location and one just south of the Jamestown Bridge.

3.2 Benthic Habitat Distributions

Distributions of benthic habitat types in the RWEC-RI Study Area are related to a combination of ancient and modern geological events in the region. The geophysical and benthic survey data collected by Revolution Wind have refined the understanding of the distribution of the habitats within Rhode Island Sound and Narragansett Bay. While six primary benthic habitat types were mapped, 17 with modifiers, not all types were present in each portion of the RWEC-RI Study Area. In addition, a few anthropogenic features (dredged material, demolition debris, revetment walls) was also mapped within Narragansett Bay. Habitat composition and characteristics and corresponding ground-truth data within the RWEC-RI Study Area in Rhode Island Sound are provided in Tables 3-1 and 3-2. Habitat composition and characteristics, and corresponding ground-truth data within the RWEC-RI Study Area in Narragansett Bay are provided in Tables 3-3 and 3-4.

3.2.1 Rhode Island Sound

A total of 1,629 acres were mapped within the RWEC-RI Study Area in Rhode Island state waters. Sand and Muddy Sand – Mobile was the primary habitat type mapped (930 acres, 57%), followed by Mud and Sandy Mud (450 acres, 28%) (Table 3-1; Figures 3-8 and 3-9). Sand and Muddy Sand without prevalent ripples was also present in patches totaling 143 acres (~9%) along a section of the RWEC-RI mostly characterized as Mud and Sandy Mud (Figure 3-10). The remainder of the habitats mapped within Rhode Island Sound were small areas of Coarse Sediment, Glacial Moraine A & B, Bedrock, and non-moraine habitats with Low or Medium Density Boulder Fields interspersed within the predominant sand and mud habitats (Table 3-1; Figures 3-9 and 3-10). Boulder fields were generally associated with areas of coarse sediment and bedrock, particular in the region of Brenton Reef, near the dividing line with Narragansett Bay (Figure 1-2).

Ten ground-truth SPI/PV stations were sampled within the RWEC-RI Study Area in Rhode Island Sound, seven in Sand and Muddy Sand – Mobile habitats and three in Mud and Sandy Mud habitats. As expected, the CMECS Substrate Subgroup of Sand was recorded at all of these stations and grain size major mode as measured in SPI ranged from very fine sand over silt/clay to fine sand (Table 3-1; Figure 3-11). Although all habitat types were dominated by Soft Sediment Fauna (Attachments A), a few patterns were evident at the Biotic Group classification level (Figure 3-12). Small and Larger Tube-building Fauna were the predominant Biotic Group observed in the sand and mud habitats furthest offshore and Larger Deep-Burrowing Fauna were the predominant group in the Sand and Muddy Sand – Mobile habitats at Brenton Reef close to the dividing line with Narragansett Bay (Figure 3-12).

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Table 3-1. Composition & Characteristics of Mapped Benthic Habitat Types within the RWEC-RI Study Area – Rhode Island Sound

Rhode Island Sound ***(~1,629 acres mapped)***	**Presence in Project Area**		**Bedforms** *Type Present in Given Percentage of Habitats*			
	Area (acres)	Percentage of Project Area	Mega-ripples	Ripples	Linear Depression	Trawl marks
Glacial Moraine B	3	0.2%	0%	46%	0%	0%
Glacial Moraine A	2	0.1%	0%	0%	0%	0%
Coarse Sediment with Medium Density Boulder Field	0.6	0.04%	0%	100%	0%	0%
Coarse Sediment with Low Density Boulder Field	0.5	0.03%	0%	54%	0%	0%
Coarse Sediment - Mobile	80	5%	0%	100%	13%	0%
Sand and Muddy Sand with Medium Density Boulder Field	5	0.3%	0%	0%	0%	0%
Sand and Muddy Sand with Low Density Boulder Field	2	0.1%	0%	87%	0%	0%
Sand and Muddy Sand - Mobile	930	57%	98%	100%	47%	0%
Sand and Muddy Sand	143	9%	0%	8%	2%	0%
Mud and Sandy Mud with Low Density Boulder Field	1	0.05%	0%	0%	0%	100%
Mud and Sandy Mud	450	28%	0%	0%	0%	57%
Bedrock	12	1%	0%	69%	0%	0%

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Table 3-2. Characteristics of Mapped Benthic Habitat Types as Informed by SPI/PV Ground-truth Data within the RWEC-RI Study Area – Rhode Island Sound

Rhode Island Sound *(~1,629 acres mapped)*		Sand and Muddy Sand - Mobile	Mud and Sandy Mud
SPI/PV Ground-truth Values	Number of SPI/PV stations	7	3
	CMECS Substrate Subgroups Observed in Ground-truth Data	Sand or finer	Sand or finer
	CMECS Biotic Subclasses Observed in Ground-truth Data	Inferred Fauna, Soft Sediment Fauna	Inferred Fauna, Soft Sediment Fauna
	Maximum Percent Cover of Attached Fauna Observed in Ground-truth Data	None	None
	Sessile Epifauna Observed in Ground-truth Data	None	None
	Mobile Epifauna Observed in Ground-truth Data	Ampeliscid Amphipod, Gastropod(s), Moon Snail, Paguroid, Podocerid Amphipod, Shrimp	Ampeliscid Amphipod, Crab, Podocerid Amphipod

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3.2.2 Narragansett Bay

A total of 4,100 acres were mapped within the RWEC-RI Study Area in Narragansett Bay. Mud and Sandy Mud comprised the majority of primary habitat types mapped (~65%; Table 3-3) followed by Sand and Muddy Sand, which totaled nearly 30% of habitats mapped (Table 3-3). Coarse Sediment, Glacial Moraine A, and Glacial Moraine B habitats each represented between 1 and 2% of the area mapped within the RWEC-RI in Narragansett Bay (Table 3-3). Bedrock, Mixed-Size Gravel in Muddy Sand habitats, and Anthropogenic features each represented less than 1% of the area mapped (Table 3-3). Sand and Muddy Sand habitats were located on the northwestern side of Conanicut Island north of the Jamestown Bridge and near the mouth of the Bay at Brenton Reef where Coarse Sediment habitats were interspersed within the sand matrix (Figure 3-13). Glacial Moraine A and B as well as Bedrock habitats were present at the edges of the RWEC-RI Study Area and near Conanicut and Dutch Islands within the West Passage of Narragansett Bay (Figure 3-13). Boulder fields in the Bay were generally associated with these same areas where outcroppings of bedrock and moraine were mapped (Figure 3-14). Anthropogenic features were mapped near the Jamestown Bridge and near the shoreline at Quonset Point (Figure 3-13).

Additional detail emerges when benthic habitats are described with modifiers (Figure 3-15). Notably, a large area of Mud and Sandy Mud habitat south of the Jamestown Bridge was characterized by a surface of Shell Substrate and comprised approximately 620 acres and 15% of the habitats mapped with the RWEC-RI Study Area in Narragansett Bay (Table 3-3; Figure 3-15). Sand and Muddy Sand – Mobile was mapped at the mouth of the Bay, whereas Sand and Muddy Sand habitats in the West Passage were not assigned the Mobile modifier because ripples did not dominate the habitat features, although there was some evidence of ripples in these habitats (Table 3-3; Figure 3-15). Smaller areas with distinct characteristics were captured with modifiers as well. Discrete areas of Sand and Muddy Sand and Mud and Sandy Mud with Low Density Boulder Fields were mapped near the Glacial Moraine habitats on the edges of Conanicut and Dutch Islands (Figure 3-15). A Sand and Muddy Sand – Delta was evident in aerial imagery along the shoreline at Quonset Point west of the landfall, as were areas of Coarse Sediment – Mobile and a very small area of Mixed-Sized Gravel in Muddy Sand (Figure 3-16). Mud and Sandy Mud with SAV was mapped to the east of the proposed landfall location (Figure 3-16).

Twenty-four ground-truth SPI/PV stations were sampled within the RWEC-RI Study Area in Narragansett Bay, ten in Mud and Sandy Mud habitats, five in Mud and Sandy Mud with Shell Substrate habitats, three within Sand and Muddy Sand habitats, three within Sand and Muddy Sand – Mobile habitats, two within Coarse Sediment – Mobile habitats, and one within Glacial Moraine B habitats. The CMECS Substrate Subgroup of Sand was recorded within all of these habitats with the exception of Glacial Moraine B and Mud and Sandy Mud with Shell Substrate habitats (Table 3-4; Figure 3-17). The Substrate Subgroup of Slightly Gravelly Sand was observed in Glacial Moraine B and Sand and Muddy Sand habitats, and Shell Hash and Crepidula Reef Substrate were recorded within Mud and Sandy Mud with Shell Substrate habitats (Table 3-4). The grain size major mode as measured in SPI within the Mud and Sandy

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Mud with Shell Substrate habitats was silt/clay and in Mud and Sandy Mud ranged from very fine sand over silt/clay to very fine sand (Attachment A; Figure 3-17). The grain size major mode as measured in SPI within Sand and Muddy Sand habitats was very fine to medium sand, within Coarse Sediments habitats was fine to coarse sand, and within Glacial Moraine B was fine sand (Attachment A; Figure 3-17).

Most habitat types were dominated by Soft Sediment Fauna, with Attached Fauna dominating in Glacial Moraine B and Mud and Sandy Mud with Shell Substrate habitats. Benthic Macroalgae was the dominant Subclass at one Sand and Muddy Sand station (Attachment A), and additional patterns were evident at the Biotic Group classification level (Figure 3-12). Small and Larger Tube-Building Fauna were the predominant Biotic Group observed in the sand and mud habitats furthest offshore and Larger Deep-Burrowing Fauna were the predominant group in the Sand and Muddy Sand – Mobile habitats at Brenton Reef close to the dividing line with Narragansett Bay (Figure 3-12). Biotic Groups of Larger Deep-Burrowing Fauna were prevalent across the sand and mud habitats at the mouth of the Bay and within the West Passage, except in the section of Mud and Sandy Mud with Shell Substrate habitats where Sessile Gastropods, Mussel Bed, Attached Hydroids, and Small Tube-Building Fauna were the predominant Biotic Groups (Attachment A; Figure 3-18). Small Tube-Building Fauna were also the predominant Biotic Group in Sand and Muddy Sand near Brenton Reef at the mouth of Narragansett Bay and within Coarse Sediment - Mobile habitats (Attachment A; Figure 3-18). Attached Sponges were observed at Station 452 (north of the Jamestown Bridge) coincident with Glacial Moraine B habitats (Attachment A; Figure 3-18). Other Biotic Groups observed within sand and mud habitats included Tunneling Megafauna, Small and Larger Tube-Building Fauna and Tracks and Trails related to mobile epifauna (Attachment A; Figure 3-18).

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Table 3-3. Composition & Characteristics of Mapped Benthic Habitat Types within the RWEC-RI Study Area – Narragansett Bay

Narragansett Bay ***(~4,100 acres mapped)***	**Presence in Project Area**		**Bedforms** Type Present in Given Percentage of Habitats			
	Area (acres)	Percentage of Project Area	Mega-ripples	Ripples	Linear Depression	Trawl marks
Glacial Moraine B	47	1%	0%	0%	0%	0%
Glacial Moraine A	87	2%	0%	2%	0%	0%
Mixed - Sized Gravel in Muddy Sand	0.01	0.0002%	0%	0%	0%	0%
Coarse Sediment - Mobile	69	2%	0%	99%	7%	0%
Sand and Muddy Sand with Low Density Boulder Field	20	0.5%	0%	0%	0%	0%
Sand and Muddy Sand - Mobile	392	10%	100%	100%	100%	0%
Sand and Muddy Sand - Delta	0.3	0.01%	0%	0%	0%	0%
Sand and Muddy Sand	735	18%	0%	88%	0%	4%
Mud and Sandy Mud with Low Density Boulder Field	19	0.5%	0%	0%	0%	43%
Mud and Sandy Mud with Shell Substrate	620	15%	0%	0%	0%	100%
Mud and Sandy Mud with SAV	0.2	0.004%	0%	0%	0%	0%
Mud and Sandy Mud	2,060	50%	0%	0%	0%	79%
Bedrock	27	0.7%	0%	0%	0%	0%
Anthropogenic	26	0.6%	0%	0%	0%	0%

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Table 3-4. Characteristics of Mapped Benthic Habitat Types as Informed by SPI/PV Ground-truth Data within the RWEC-RI Study Area – Narragansett Bay

Narragansett Bay *(~4,100 acres mapped)*		**Glacial Moraine B**	**Coarse Sediment - Mobile**	**Sand and Muddy Sand - Mobile**	**Sand and Muddy Sand**	**Mud and Sandy Mud with Shell Substrate**	**Mud and Sandy Mud**
SPI/PV Ground-truth Values	Number of SPI/PV stations	1	2	3	3	5	10
	CMECS Substrate Subgroups Observed in Ground-truth Data	Slightly Gravelly Sand	Sand or finer	Sand or finer	Slightly Gravelly Sand, Sand or finer	Crepidula Reef Substrate, Shell Hash	Sand or finer
	CMECS Biotic Subclasses Observed in Ground-truth Data	Attached Fauna, Soft Sediment Fauna	Inferred Fauna, Soft Sediment Fauna	Inferred Fauna, Soft Sediment Fauna	Benthic Macroalgae, Soft Sediment Fauna	Attached Fauna, Inferred Fauna, Soft Sediment Fauna	Soft Sediment Fauna
	Maximum Percent Cover of Attached Fauna Observed in Ground-truth Data	Sparse (1 to <30%)	None	None	Moderate (30 to <70%)	Complete (90-100%)	Sparse (1 to <30%)
	Sessile Epifauna Observed in Ground-truth Data	Barnacles, Sponge(s)	None	None	Sponge(s)	Barnacles, Hydroids, Mussels, Sponges	Barnacles, Hydroids
	Mobile Epifauna Observed in Ground-truth Data	Gastropod(s)	Gastropod(s), Paguroid(s), Podocerid Amphipod	Gastropod(s), Moon Snail, Paguroid(s), Podocerid Amphipod	Gastropod, Whelk	Crab, Crepidula, Gastropod, Jonah Crab	Crab(s), Gastropod(s), Paguroid(s), Podocerid Amphipod, Shrimp

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4.0 DISCUSSION OF BENTHIC HABITATS AND BIOLOGICAL VALUE

The habitats mapped within the RWEC-RI Study Area and in Rhode Island Sound were primarily dynamic sands and muds typical of offshore environments in Southern New England. These habitats provide a mix of mobile sands and depositional muddy environments that support a combination of small and large tube-building and burrowing infauna, as well as mobile epifauna (mollusks and crustaceans). Monitoring results from the nearby Brenton Reef Disposal Site, which is located just north of RWEC-RI in Rhode Island Sound (Figure 1-2) indicate that the soft, muddy sediments and related infaunal and epifaunal communities mapped within the RWEC-RI Study Area are typical of the area (Carey et al. 2012). Where Low or Medium Density Boulder Fields coincide with these sand and mud habitats, structure is provided that supports attached fauna and demersal fish, such as black sea bass and tautog, that utilize hard bottom substrates and structure. A variety in benthic habitats is present near the mouth of Narragansett Bay at Brenton Reef. Outcroppings of Bedrock, Glacial Moraine B, and Glacial Moraine A habitats, which also provide valuable structure, were mapped at the end of the RWEC-RI Study Area. Discrete areas of Coarse Sediment - Mobile habitats were mapped within depressions in the seafloor interspersed within a Sand and Muddy Sand – Mobile matrix. This mapping effort adds to the collective understanding of benthic habitats in the offshore waters of Narragansett Bay near Brenton Reef and the Rhode Island state waters line given that few published benthic studies cover this specific area.

The benthic habitats mapped within the RWEC-RI Study Area and in Narragansett Bay, from the West Passage to Quonset Point, were primarily depositional muds and sandy mud. These habitats support a combination of small and large tube-building and burrowing infauna, as well as mobile epifauna (mollusks and crustaceans). Where these habitats are modified by shell substrate, additional taxa are supported, such as blue mussels and sessile gastropods (i.e., Crepidula), that provide filtration ecosystem services. In shallow nearshore water, mud and sandy mud habitats may support SAV beds, such as the one mapped to the east of the landfall location at Quonset Point. As noted in Section 5, Revolution Wind will avoid SAV mapped at Quonset Point by utilizing horizontal directional drilling (HDD) to install the RWEC-RI at the landfall location. These habitats also provide important ecosystem services related to water clarity and nutrient cycling, and provide habitat for invertebrates and demersal fish, particularly juveniles. Outcroppings of Bedrock, Glacial Moraine B, and Glacial Moraine A habitats were mapped within the RWEC-RI Study Area near Conanicut and Dutch Islands within the West Passage of Narragansett Bay. These habitats, as well as nearby Low or Medium Density Boulder Fields coincident with sand and mud habitats, provide structure that supports attached fauna such as sponges and, in shallower photic waters, flora such as benthic macroalgae, as well as demersal fish, such as black sea bass and tautog, that utilize hard bottom substrates and structure. As noted in Section 5, Revolution Wind anticipates siting the RWEC-RI to avoid the areas of Glacial Moraine A and B identified within the broader RWEC-RI Study Area.

Several recently published studies are available in the peer-reviewed and gray literature related to benthic habitats and fauna within the West Passage of Narragansett Bay (e.g., LaFrance et

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al. 2019; Hale et al. 2018; Shumchenia and King 2019; Shumchenia et al. 2016). The benthic habitats and their characterizing sediments and benthic biological communities as mapped for this Revolution Wind assessment generally agree with recent biotopes mapped from a SPI survey conducted throughout the Bay (Shumchenia and King 2019). For example, “Mud with shell hash” was the biotope identified at the sampling station coincident with the Mud and Sandy Mud with Shell Substrate habitat type mapped within the RWEC-RI Study Area. Similarly, mud dominated by burrowing fauna was documented at a station sampled at the south end of the West Passage in the vicinity of Mud and Sandy Mud habitats with the predominant Biotic Group of Larger Deep-Burrowing Fauna. There was similar concordance between the two data near Quonset Point. In contrast, recent surficial sediment and benthic habitat maps compiled from a suite of geophysical data and sediment grab samples show the West Passage as having a higher gravelly component compared with the habitats mapped within the RWEC-RI (LaFrance et al. 2019). Gravelly muddy sand is mapped where the Mud and Sandy Mud with Shell Substrate habitat type was identified, and gravelly sands were mapped north and south of the Jamestown Bridge where Sand and Muddy Sand habitats with fine to slightly gravelly sands were mapped. The authors of this report (LaFrance et al. 2019) recommend caution when using their maps as the sediment units represent average dominant sediment type from a suite of samples that were collected over a time period of 50 years; the geophysical data used was also collected over a time period from 2006 to 2012. Therefore, the habitats mapped within the RWEC-RI are more likely to be representative of current conditions, particularly given the concordance with 2018 biotope data (Shumchenia and King 2019).

SAV beds, dominated by *Zostera marina*, represent unique habitats throughout the shallow coastal waters of Narragansett Bay and their distribution is periodically mapped across the Bay using aerial imagery and field verification by the URI Environmental Data Center (URI Environmental Data Center and RIGIS). SAV extent varies over time and these aquatic plants experience peak growth during late summer months. SAV are found in mud and muddy sand sediments, and a single Mud and Sandy Mud with SAV habitat was mapped within the area east of the landfall location.

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5.0 SUMMARY AND CONCLUSIONS

The benthic habitats mapped within the RWEC-RI Study Area that are currently subject to CRMC regulations include Mud and Sandy Mud with SAV, Glacial Moraine B, and Glacial Moraine A. All three of these habitats were limited in their distribution within the mapped RWEC-RI Study Area and were mostly located on the periphery.

Mud and Sandy Mud with SAV habitats totaled 0.004% (0.2 acres) of the habitats mapped within the RWEC-RI Study Area in Narragansett Bay. The western edge of the SAV habitat mapped at Compass Rose Beach is approximately 845 feet (257 m) east of the proposed location of HDD exit pits. SAV beds are found in shallow coastal areas throughout the Bay, including along the western shores of Conanicut and Dutch Islands, proximal to the RWEC-RI route. The nearest SAV bed within the West Passage is approximately 1,150 ft (350 m) from the indicative RWEC-RI route, on the western side of Dutch Island. At a distance of 1,150 ft (350 m), SAV habitat near the indicative cable route is 115 ft (35 m) beyond the projected impact distance for deposition and is within the projected impact distance for elevated turbidity (RPS 2021). The SAV bed mapped at the landfall location during the 2020 video survey is 105 ft (32 m) beyond the projected impact distance for deposition and is within the projected impact distance for elevated turbidity (RPS 2021).

Revolution Wind will utilize an HDD cable installation methodology to avoid documented SAV near the Project's landfall location. In addition, Revolution Wind will avoid construction during the peak SAV growing season (i.e., July 1 to September), which will minimize potential effects due to increased turbidity and sediment deposition associated with cable installation and excavation of the HDD exit pits.

Collectively, Glacial Moraine A and B habitats comprised 0.3% (5 acres) of the habitats mapped in the portion of the RWEC-RI Study Area in Rhode Island Sound and 3% (132 acres) of the habitats mapped in the portion of the Study Area in Narragansett Bay. A distinction was made between Glacial Moraine A and Glacial Moraine B habitats to distinguish between areas of unconsolidated geological debris (A) and consolidated geological debris (B). The surface of Glacial Moraine B deposits appeared poorly sorted and dense with very high boulder densities resulting in greater structural complexity and permanence. By comparison, the surface of Glacial Moraine A units was reworked with sand and gravel deposits resulting in less structural complexity and permanence. Glacial Moraine B and Glacial Moraine A benthic habitats were discrete areas of surface deposits along the edges of the RWEC-RI Study Area and were limited in distribution.

As described in Section 1.1, the RWEC-RI Study Area represents a broad area evaluated by Revolution Wind for siting of the export cables. Revolution Wind anticipates avoidance of Glacial Moraine A and B with siting of the RWEC-RI. Should complete avoidance of Glacial Moraine A and B habitats not be possible due to other, currently unknown, constraints (e.g., unexploded ordnance), Revolution Wind will take all feasible efforts to avoid any damage to the glacial moraine benthic habitats.

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Benthic Habitats in Rhode Island State Waters

Revolution Wind Offshore Wind Farm

FIGURES

Prepared for:

Revolution Wind | Powered by Ørsted & Eversource

Revolution Wind, LLC

Submitted by:

INSPIRE Environmental
Newport, Rhode Island 02840

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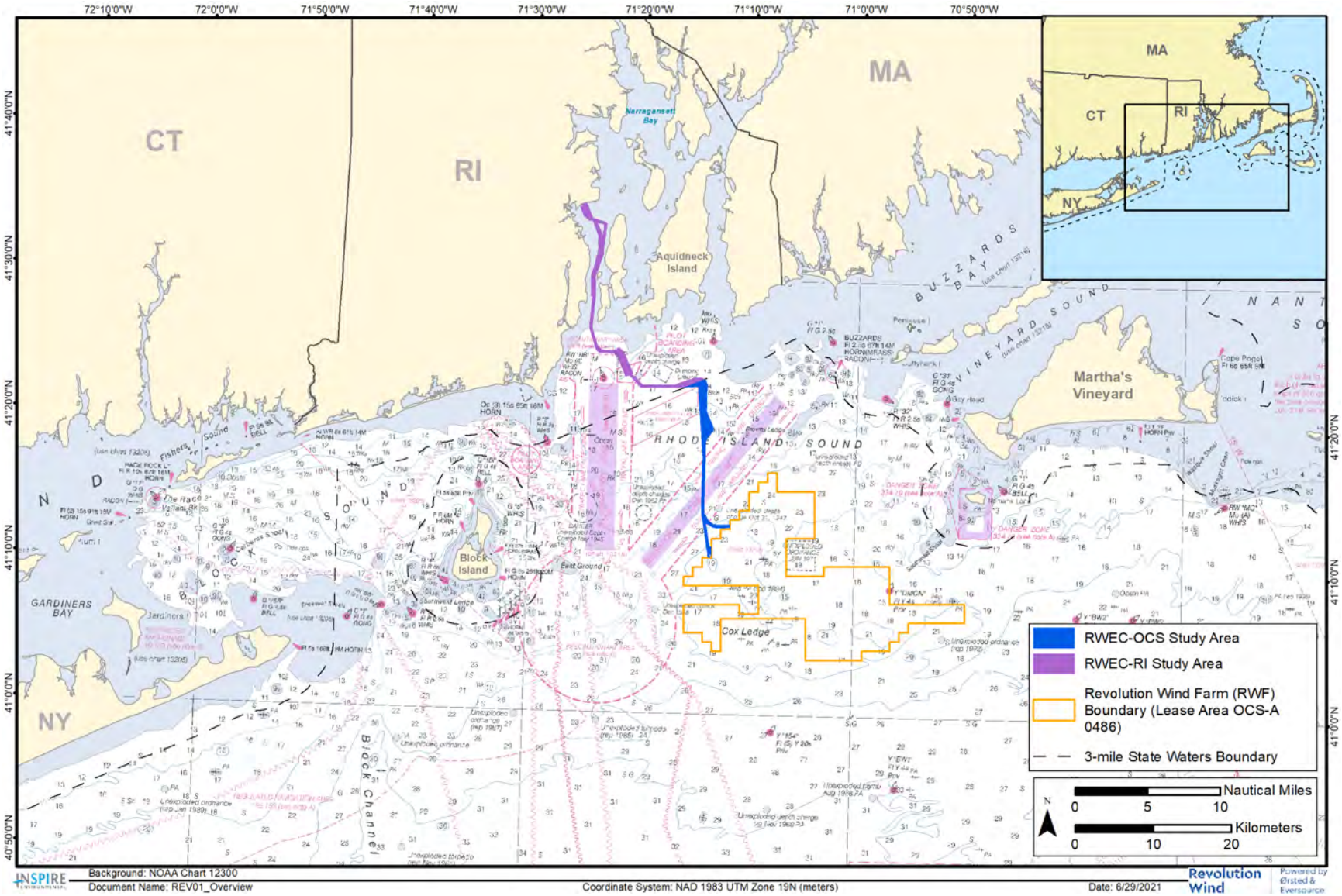

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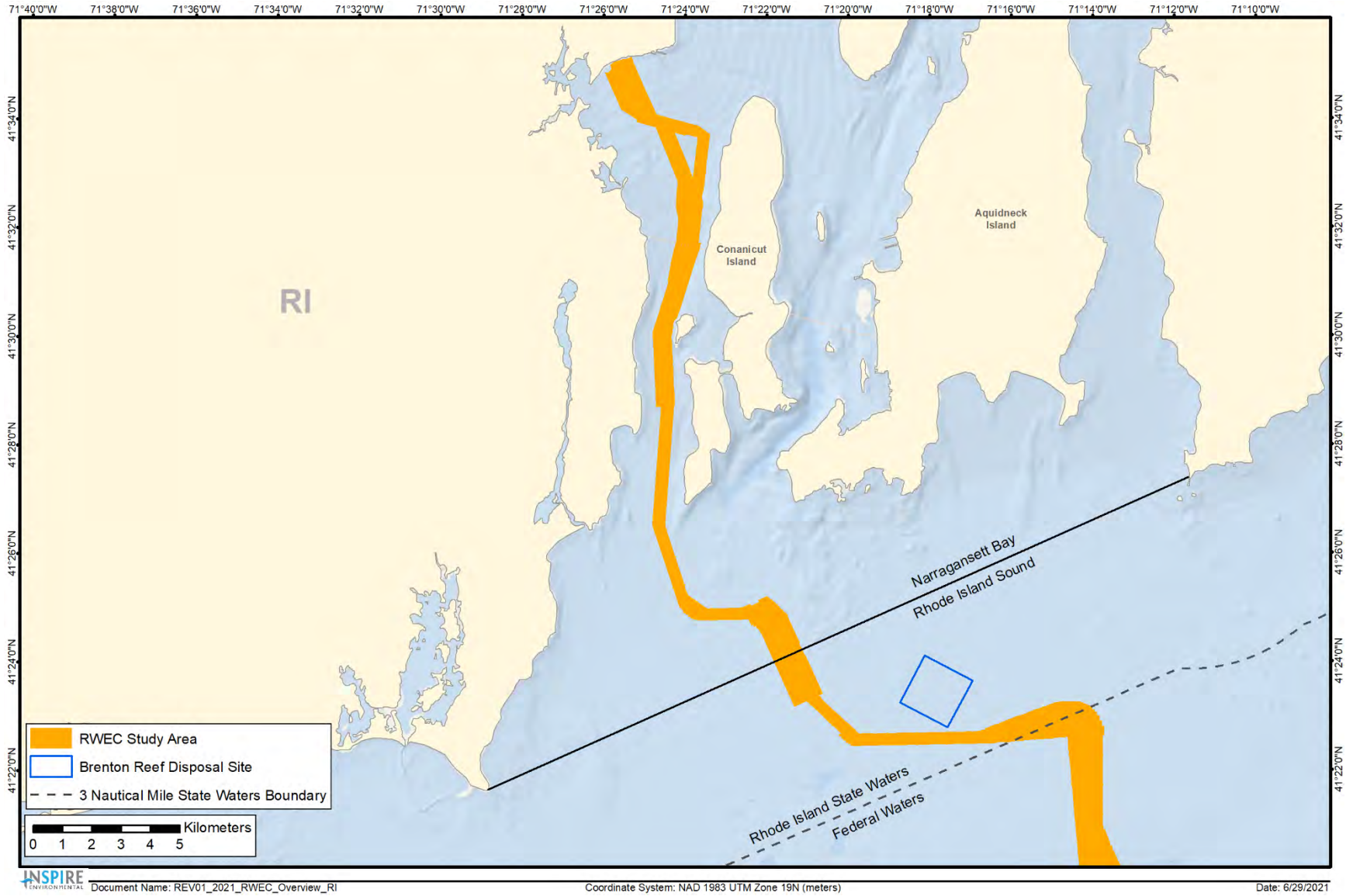

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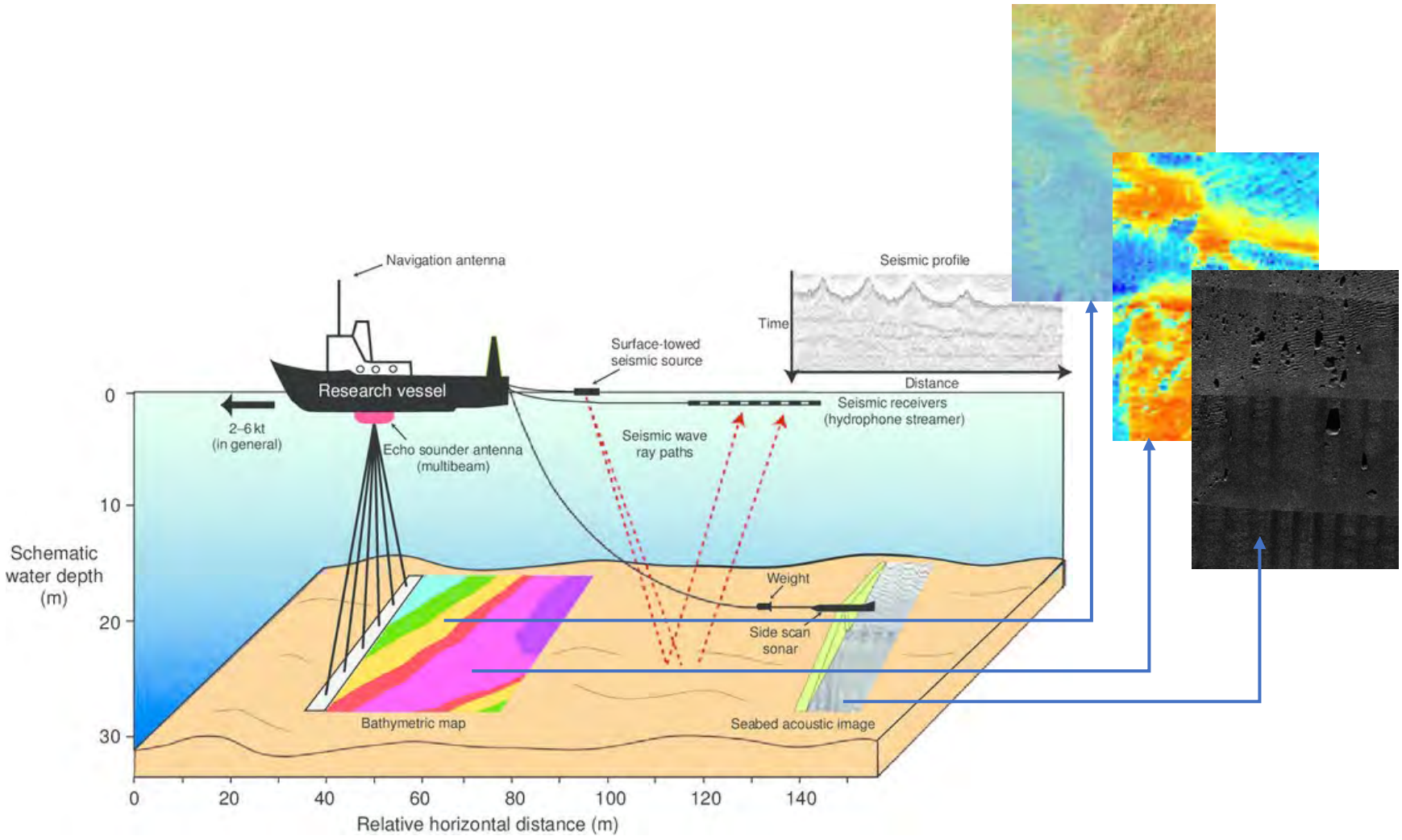

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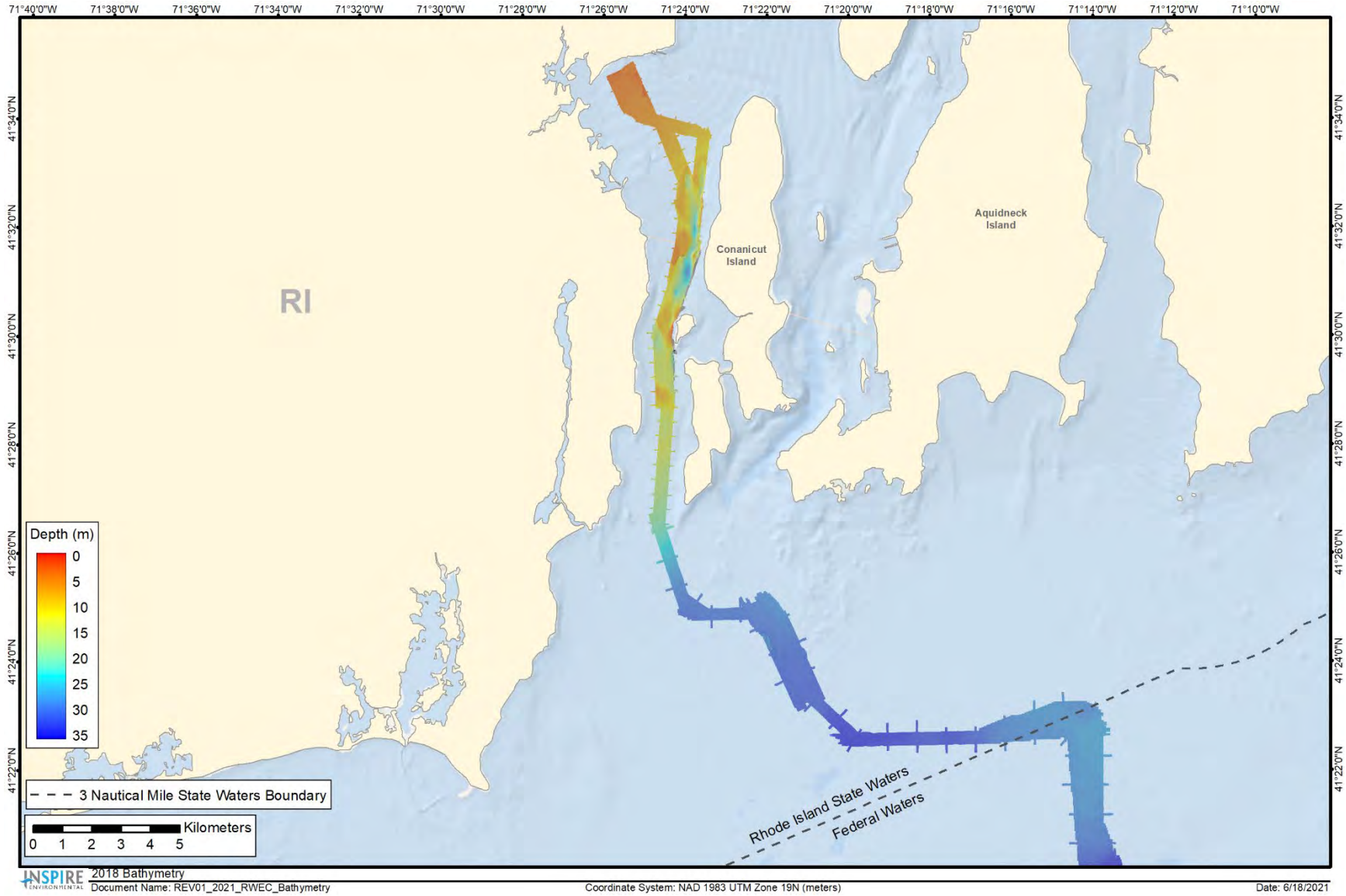

Figure 2-2. Bathymetric data along the RWEC-RI

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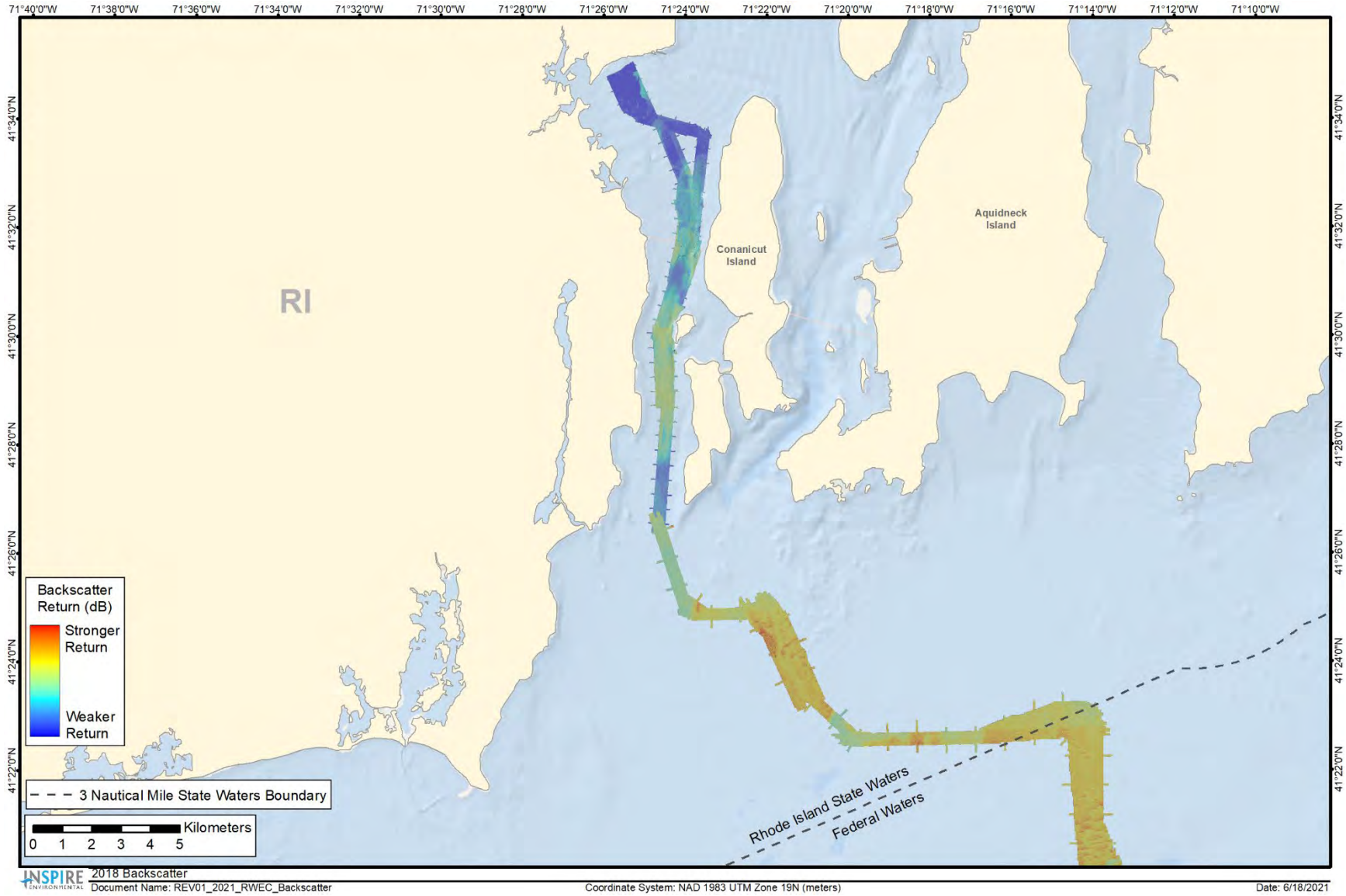

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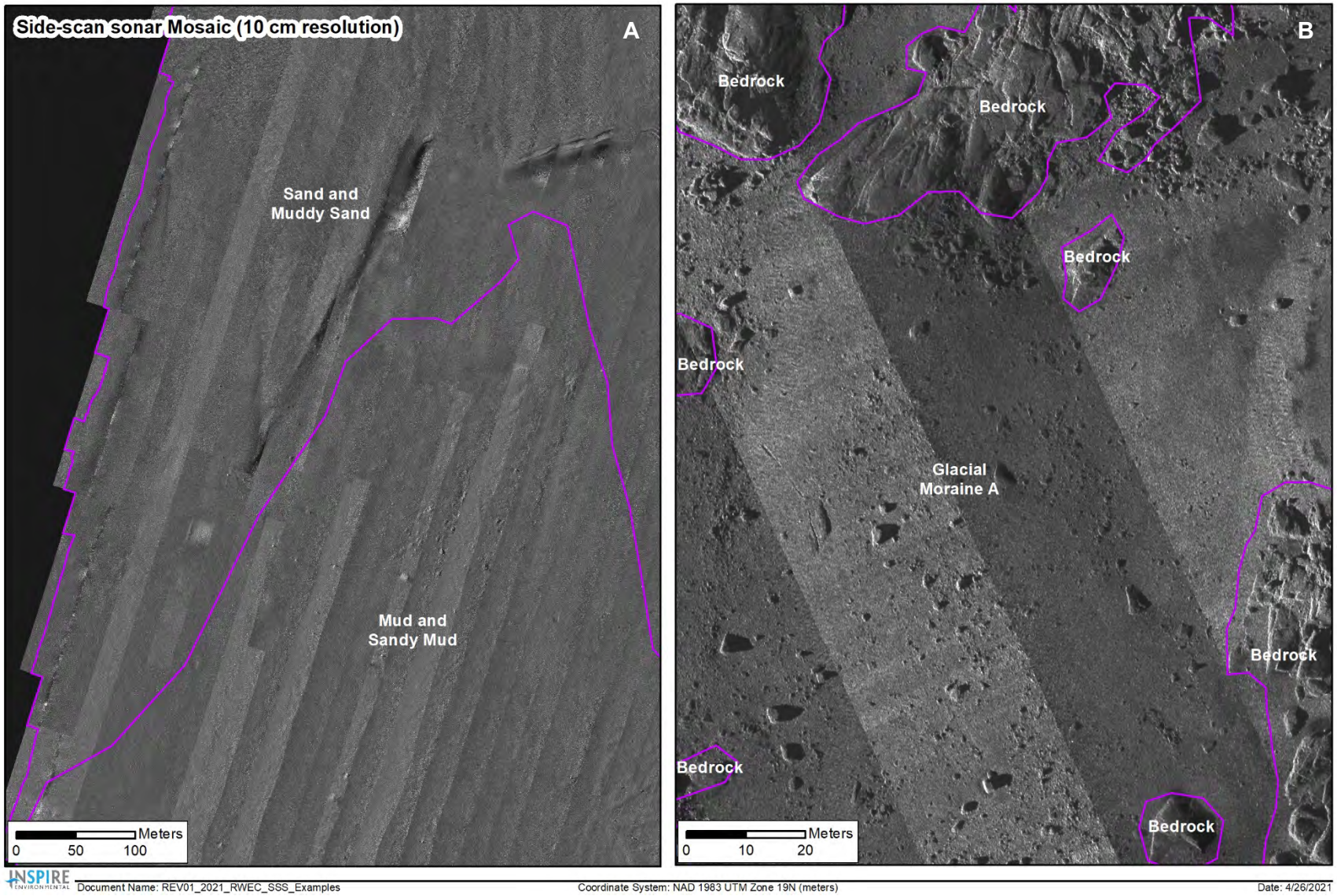

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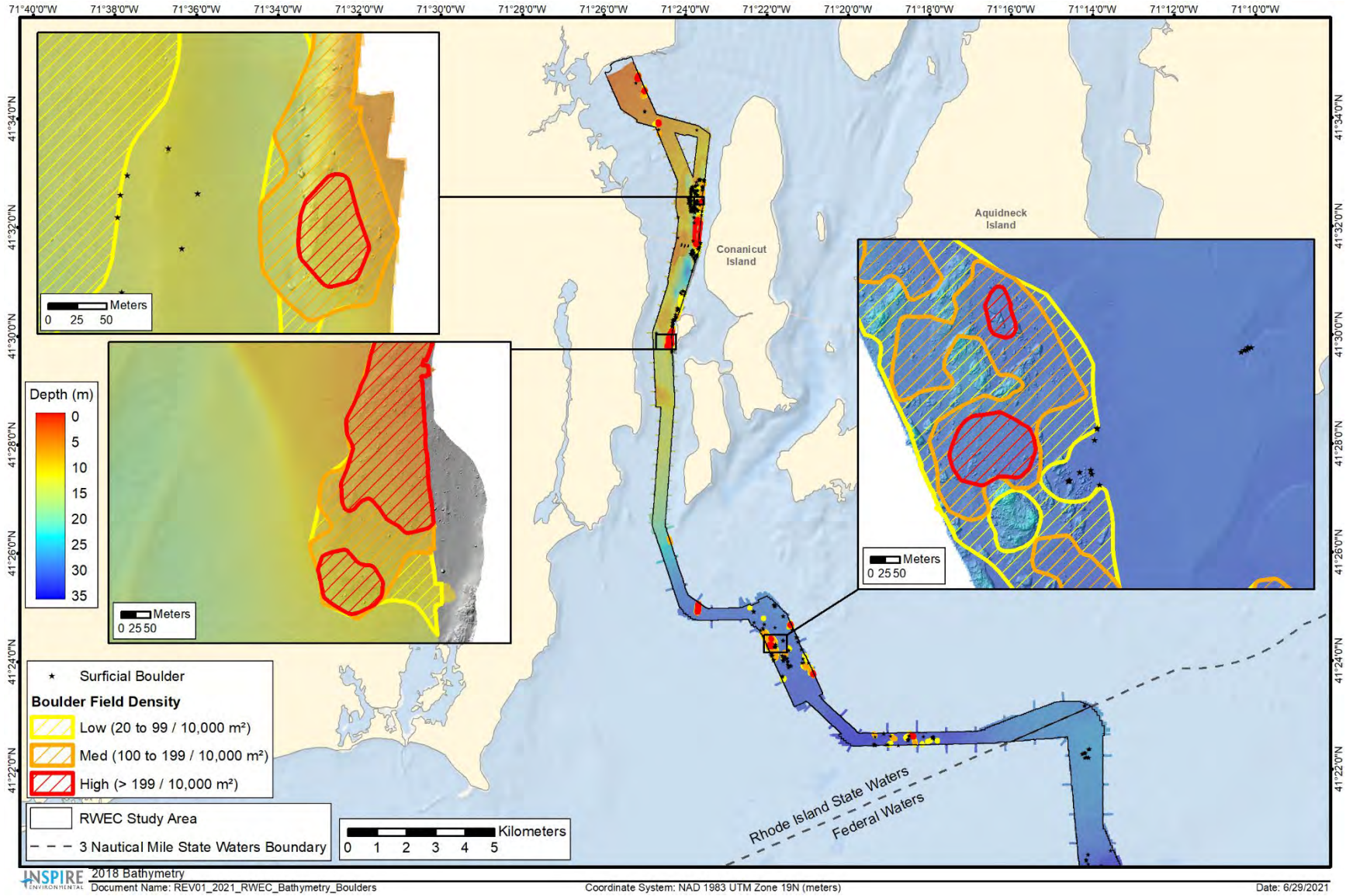

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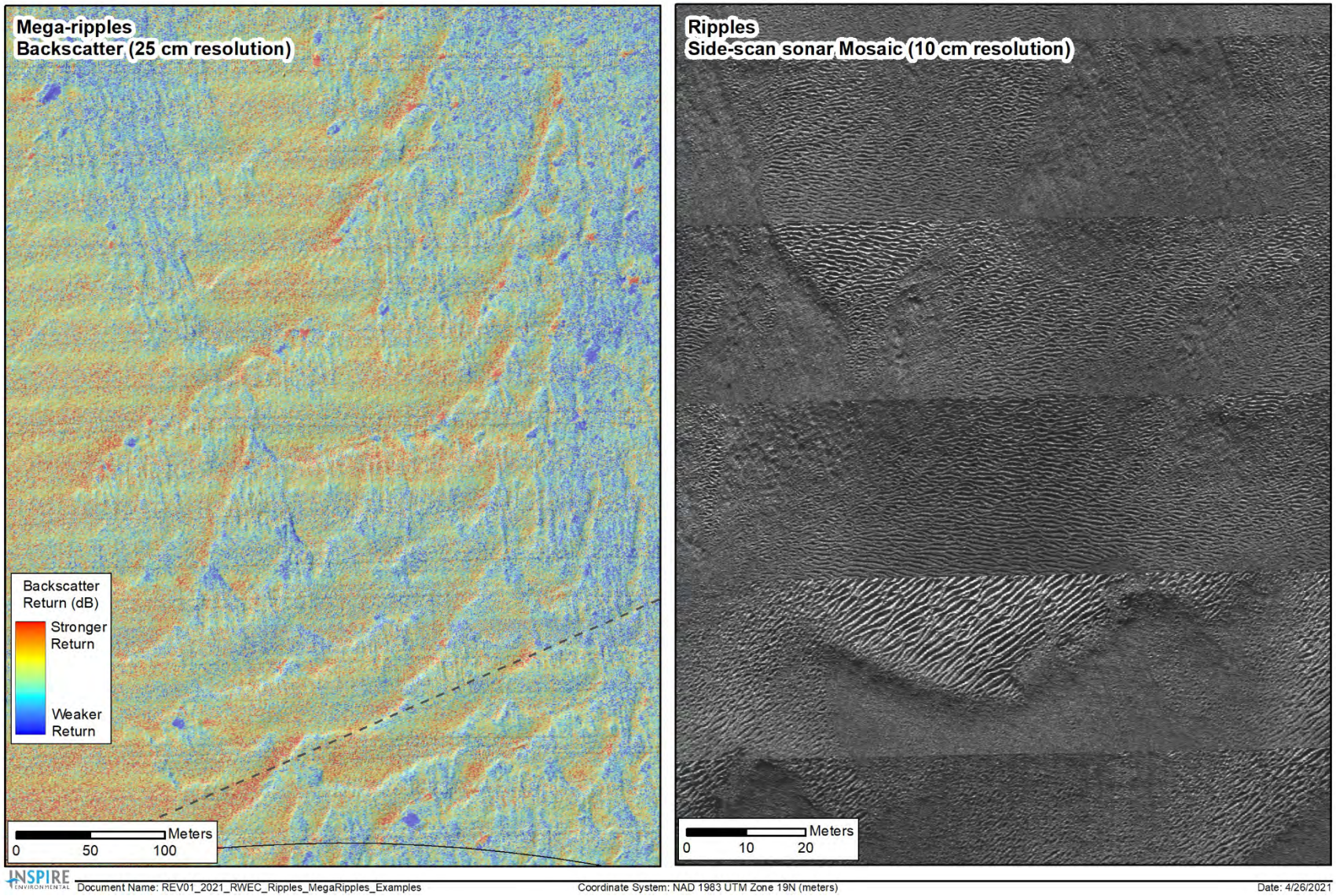

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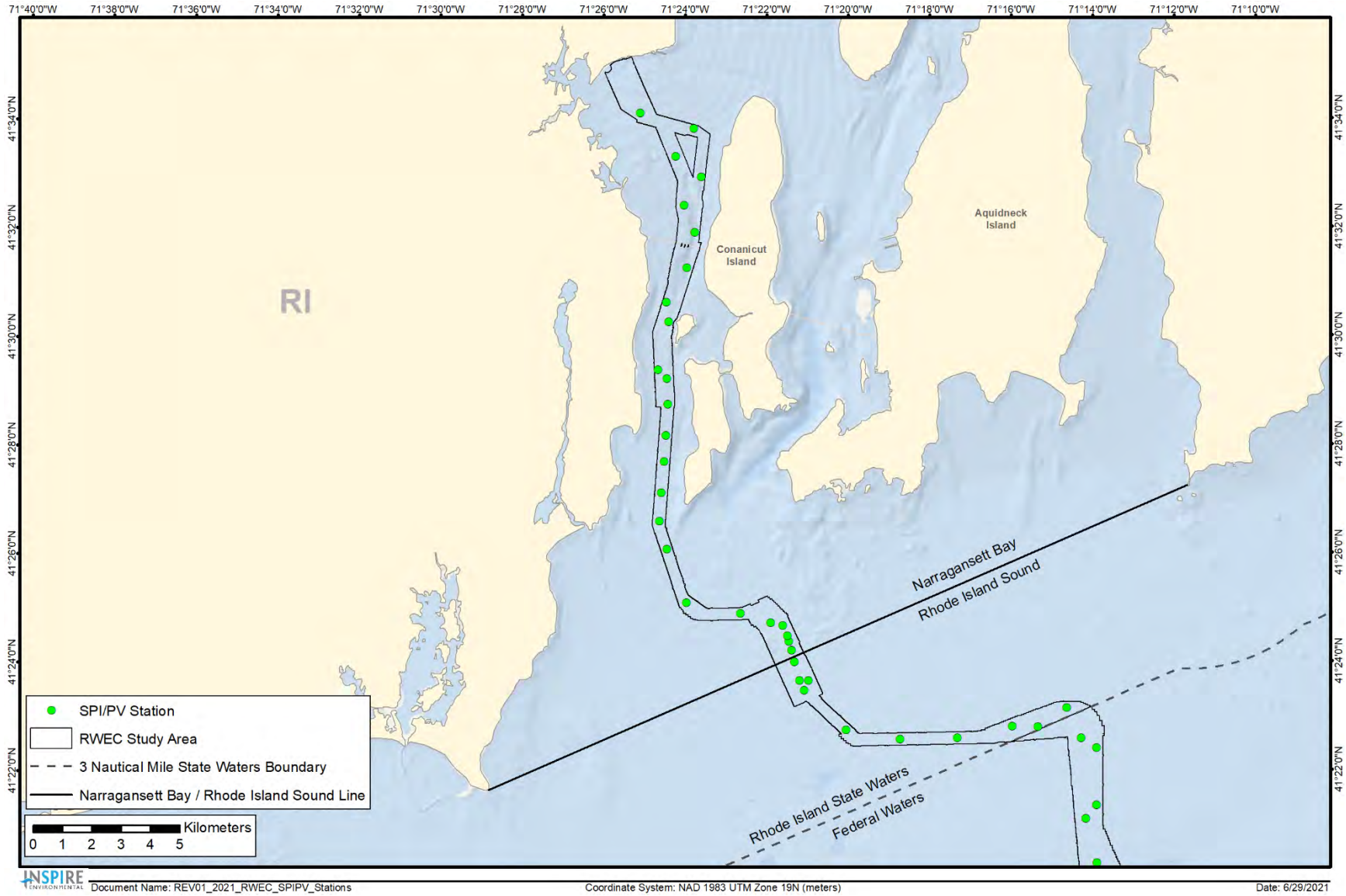

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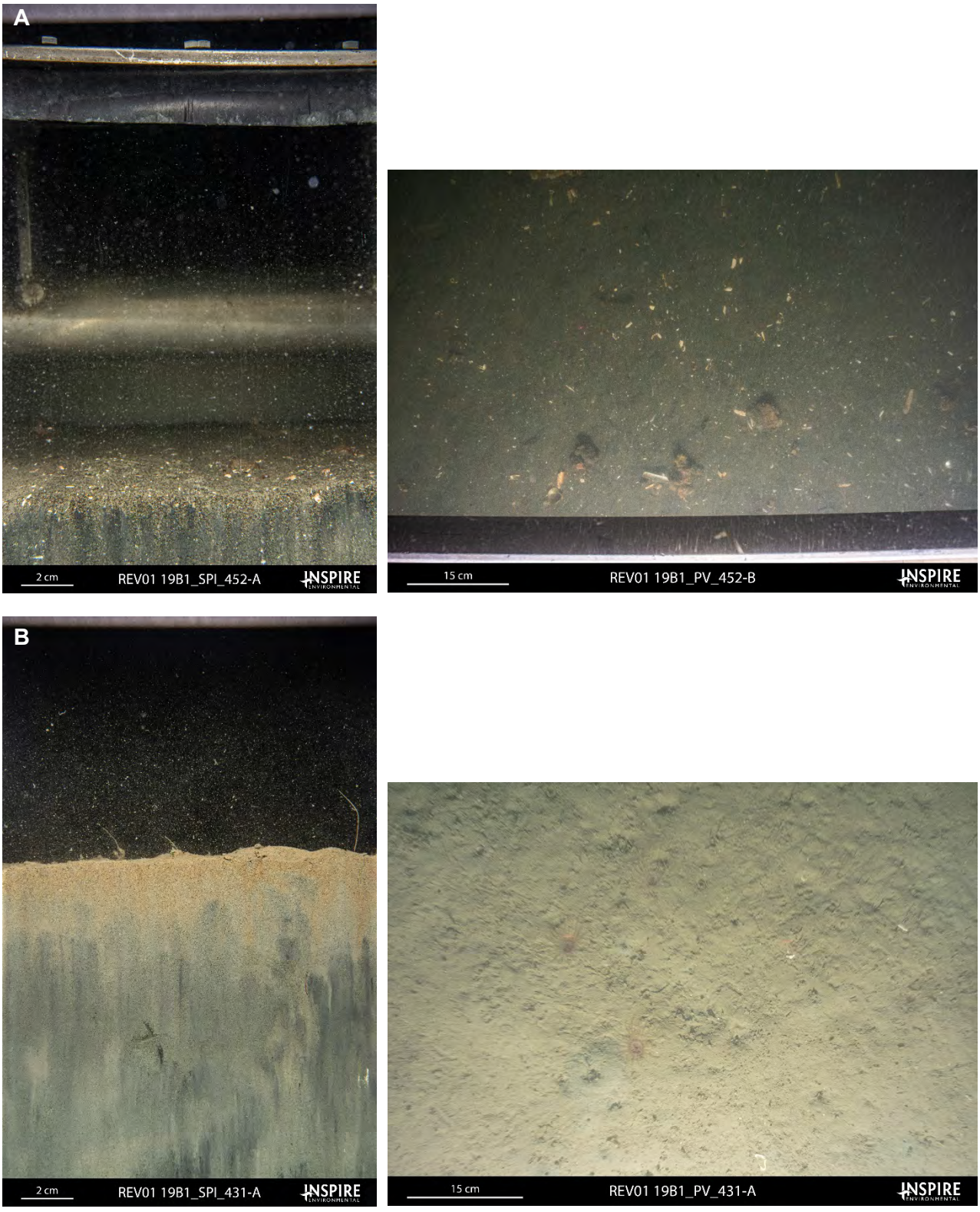

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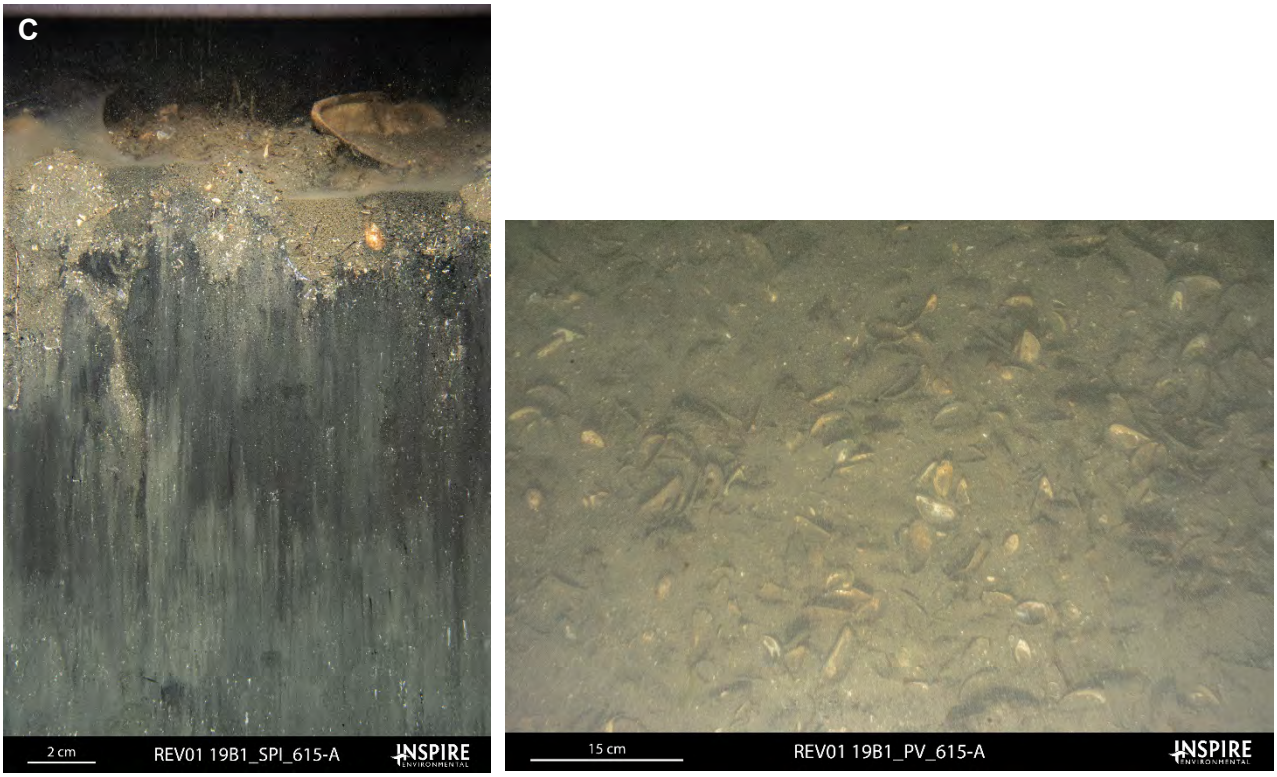

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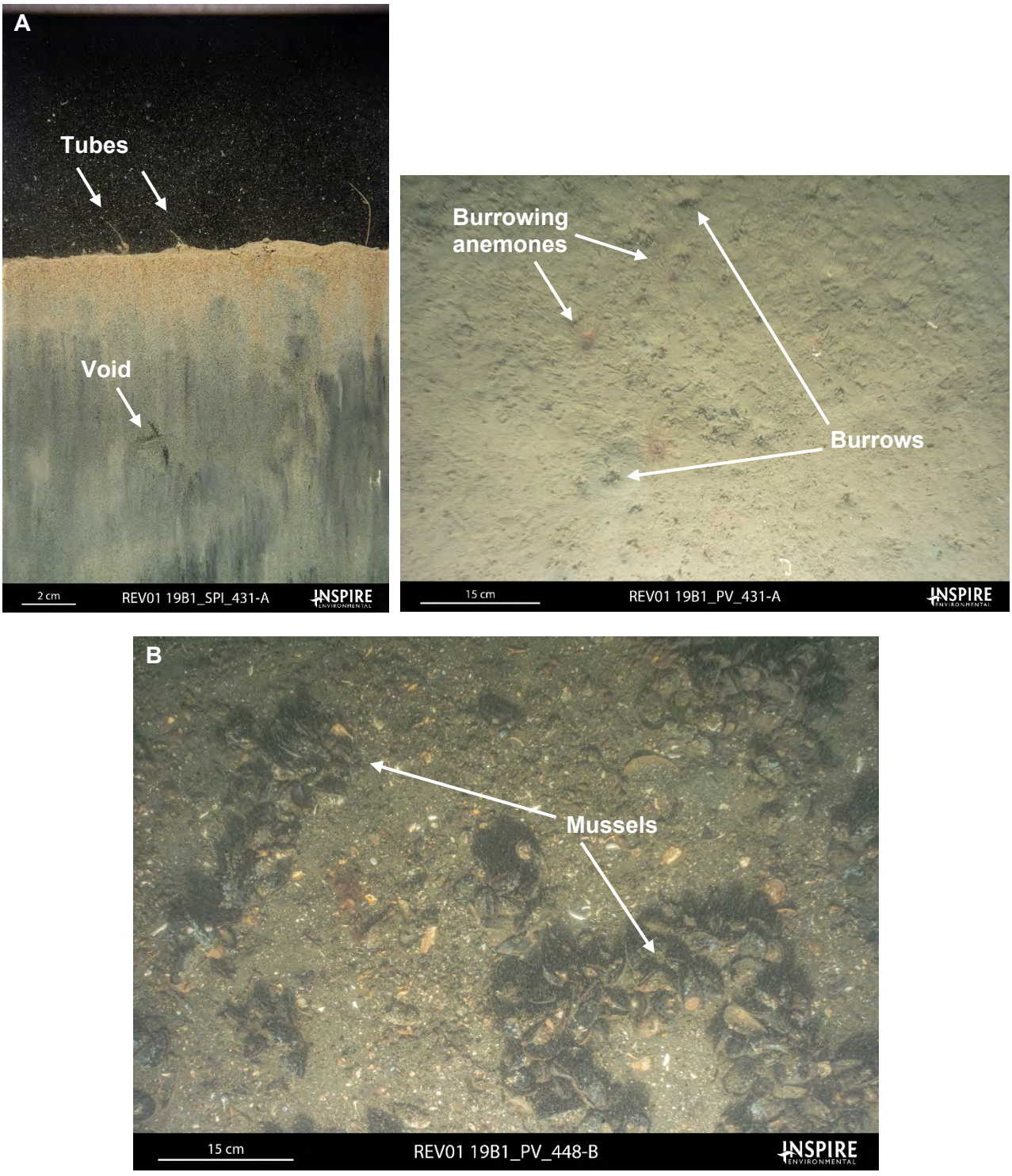

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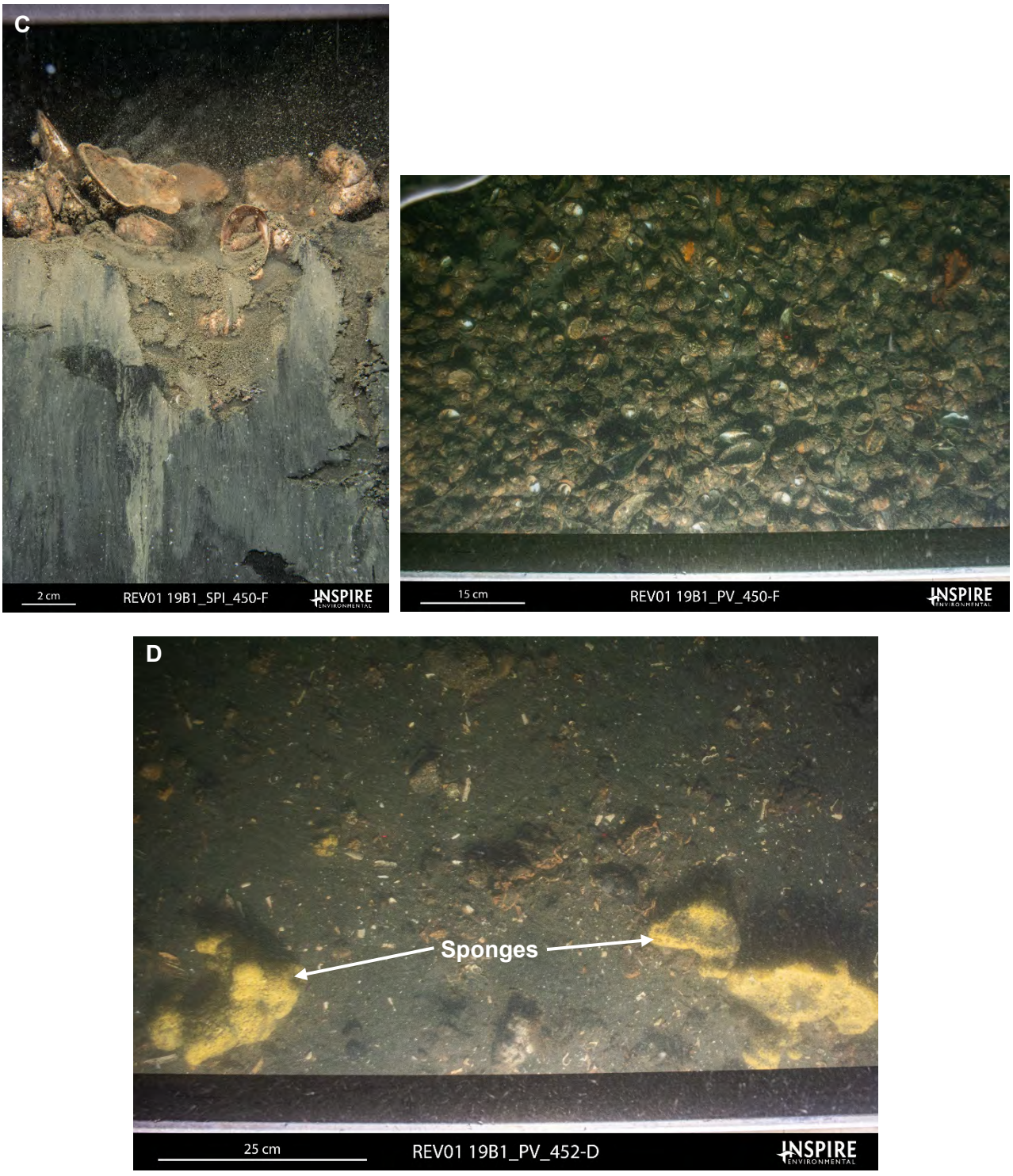

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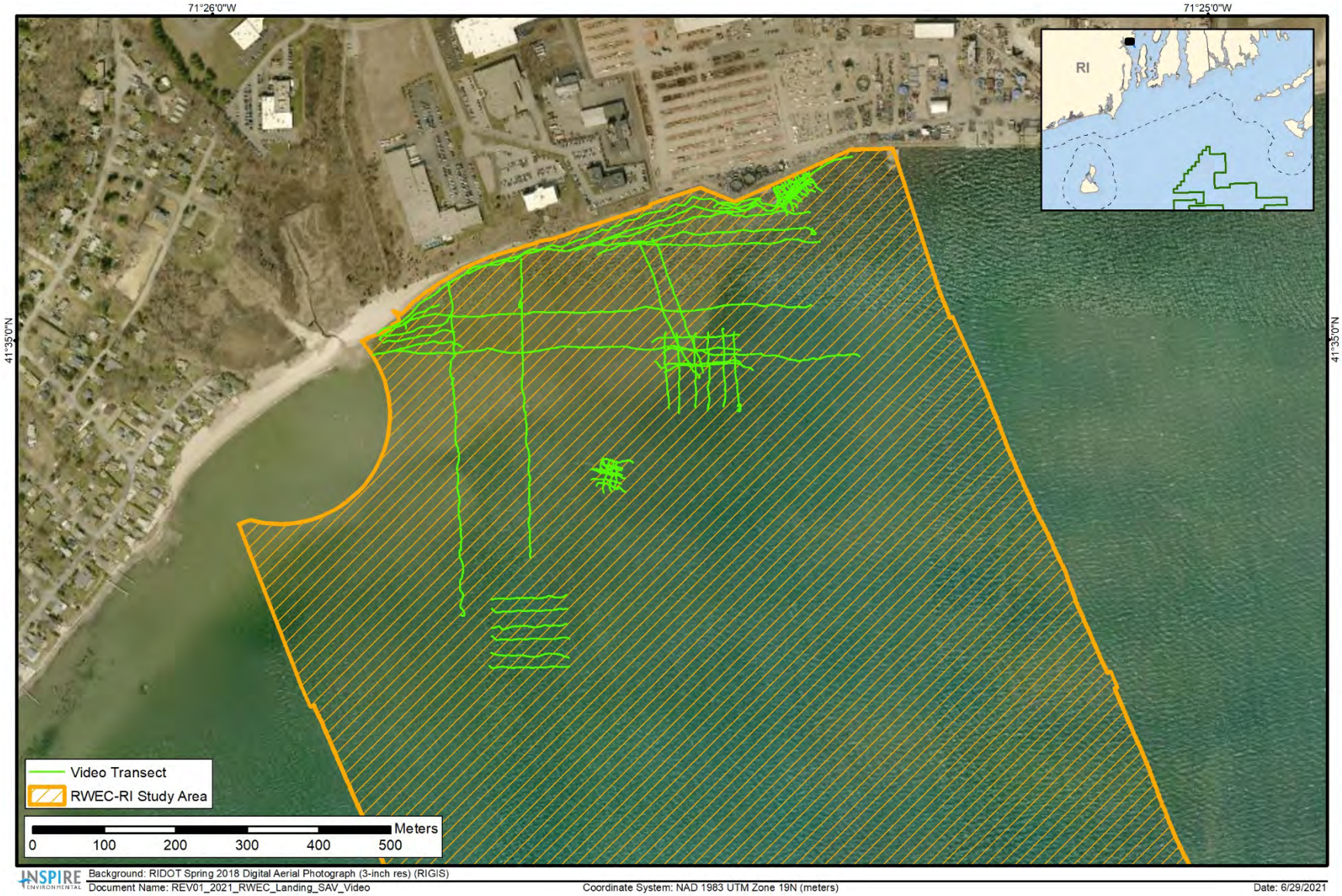

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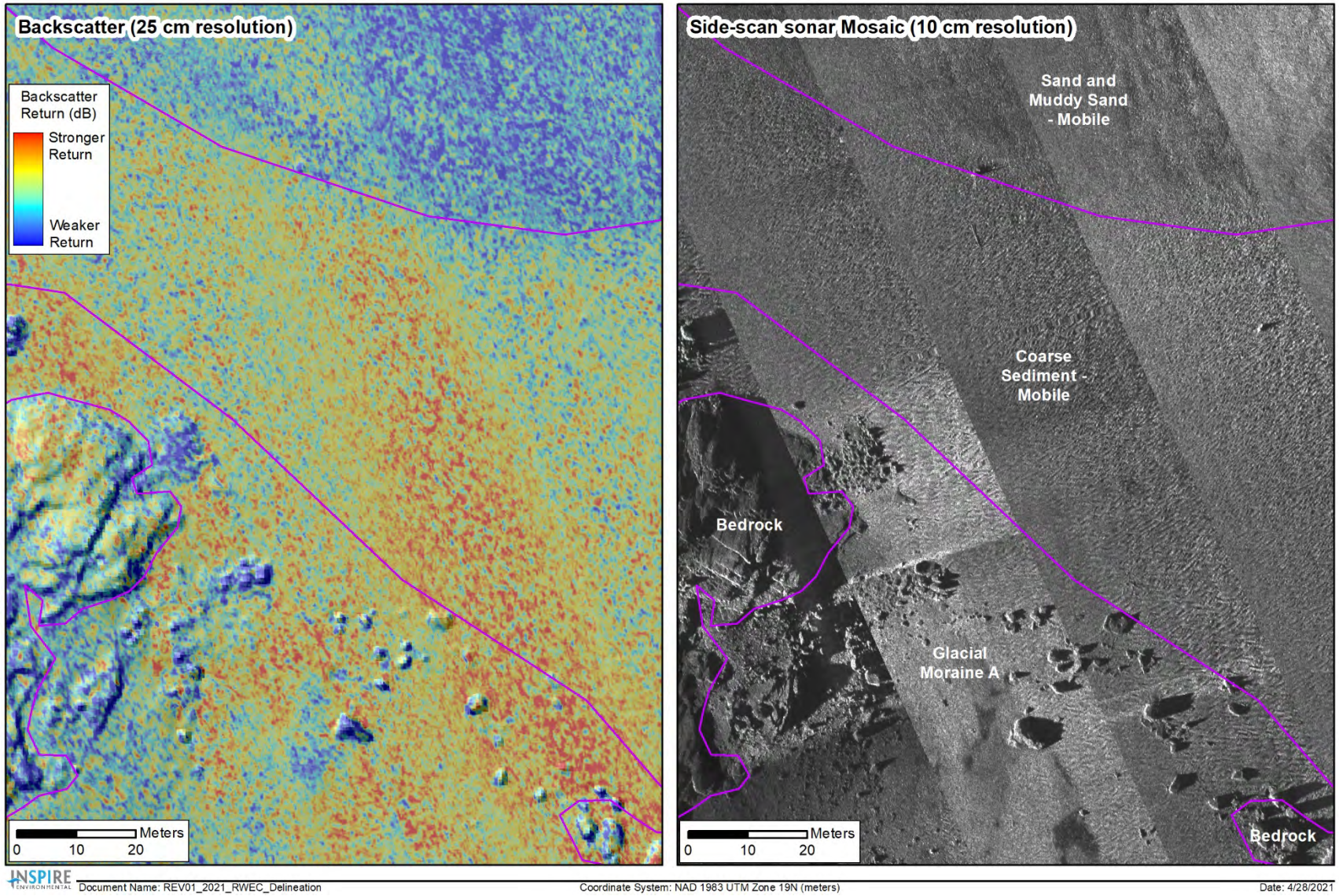

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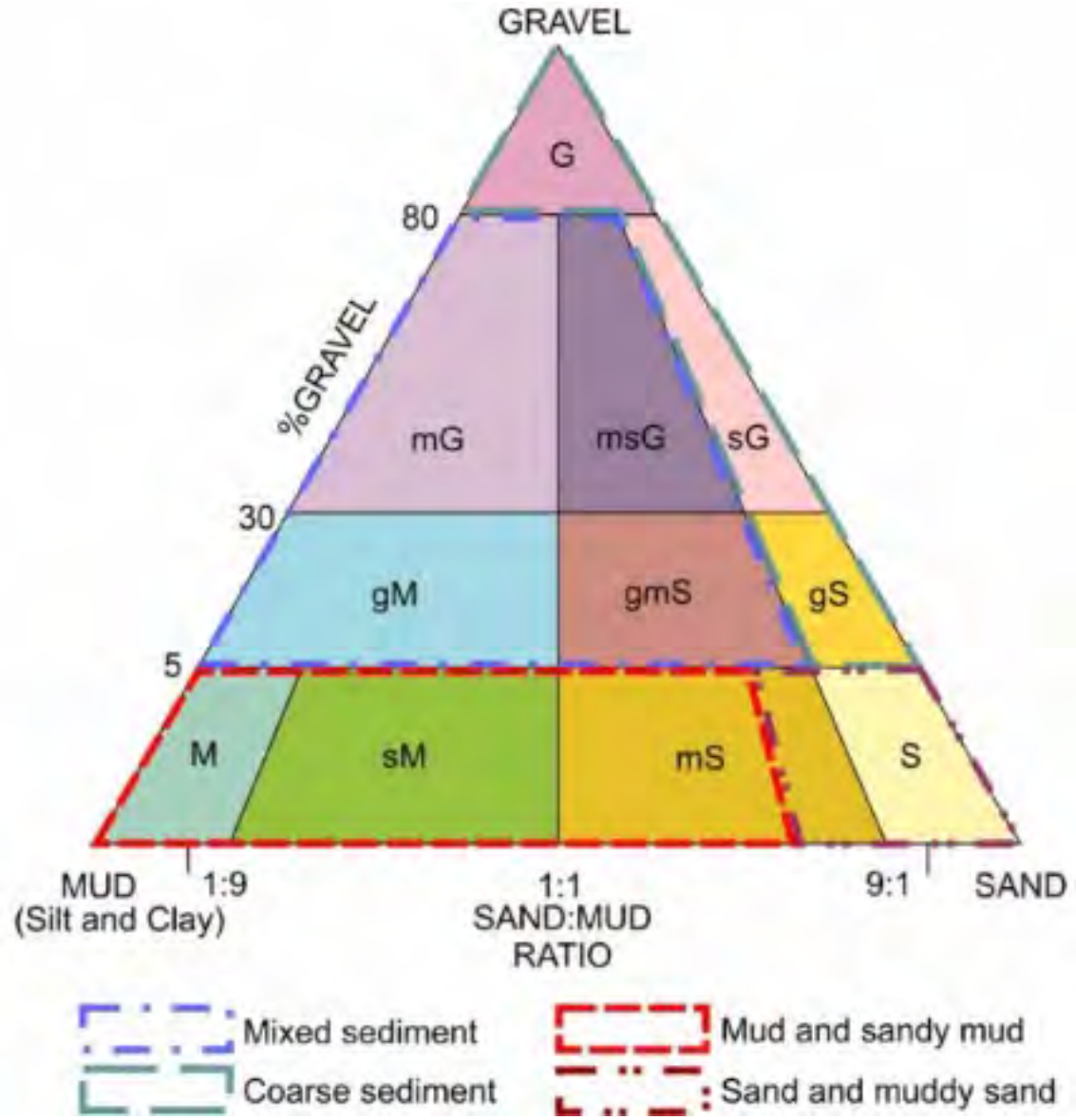

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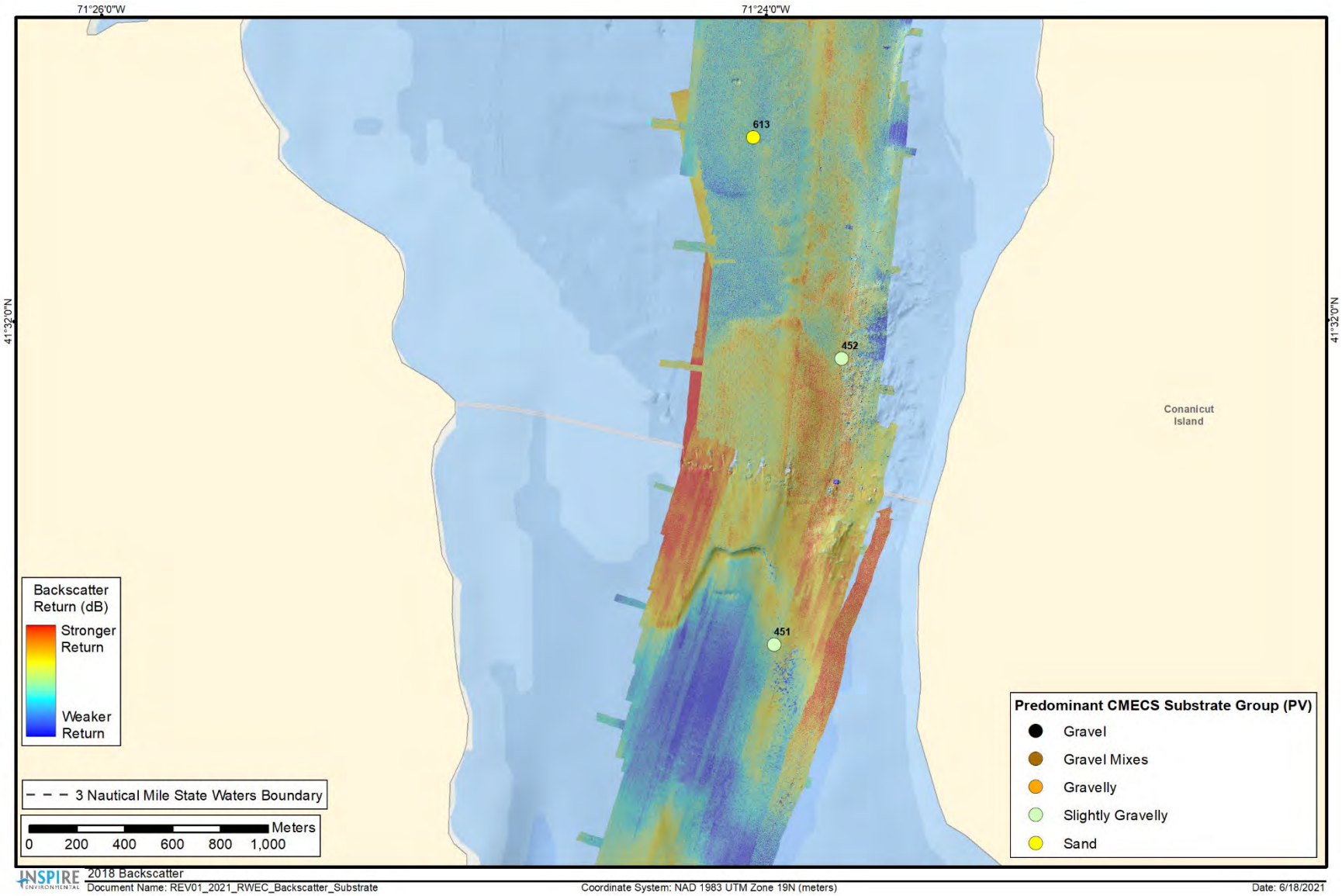

Figure 2-13. Ground-truth PV data for CMECS Substrate Group on backscatter data

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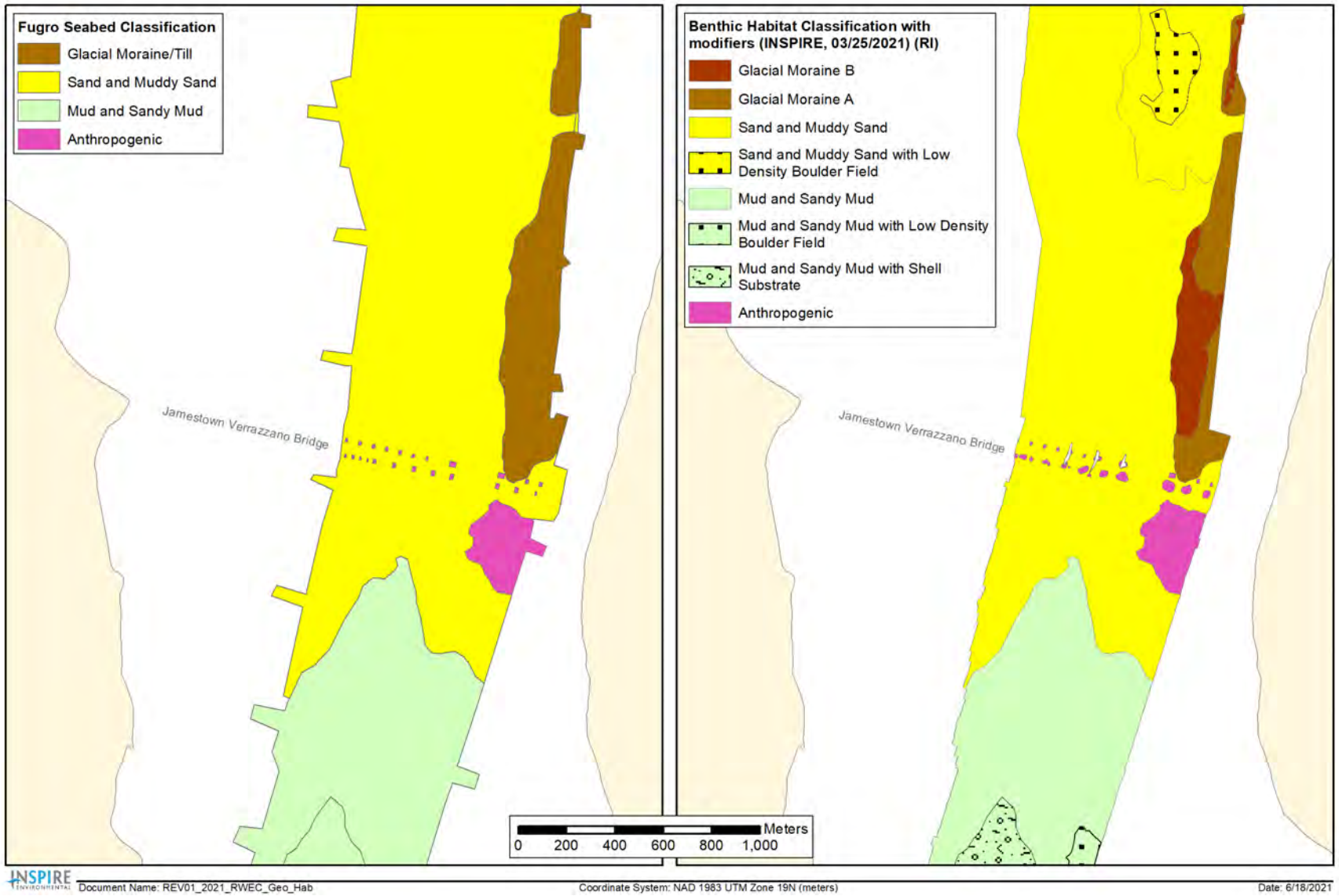

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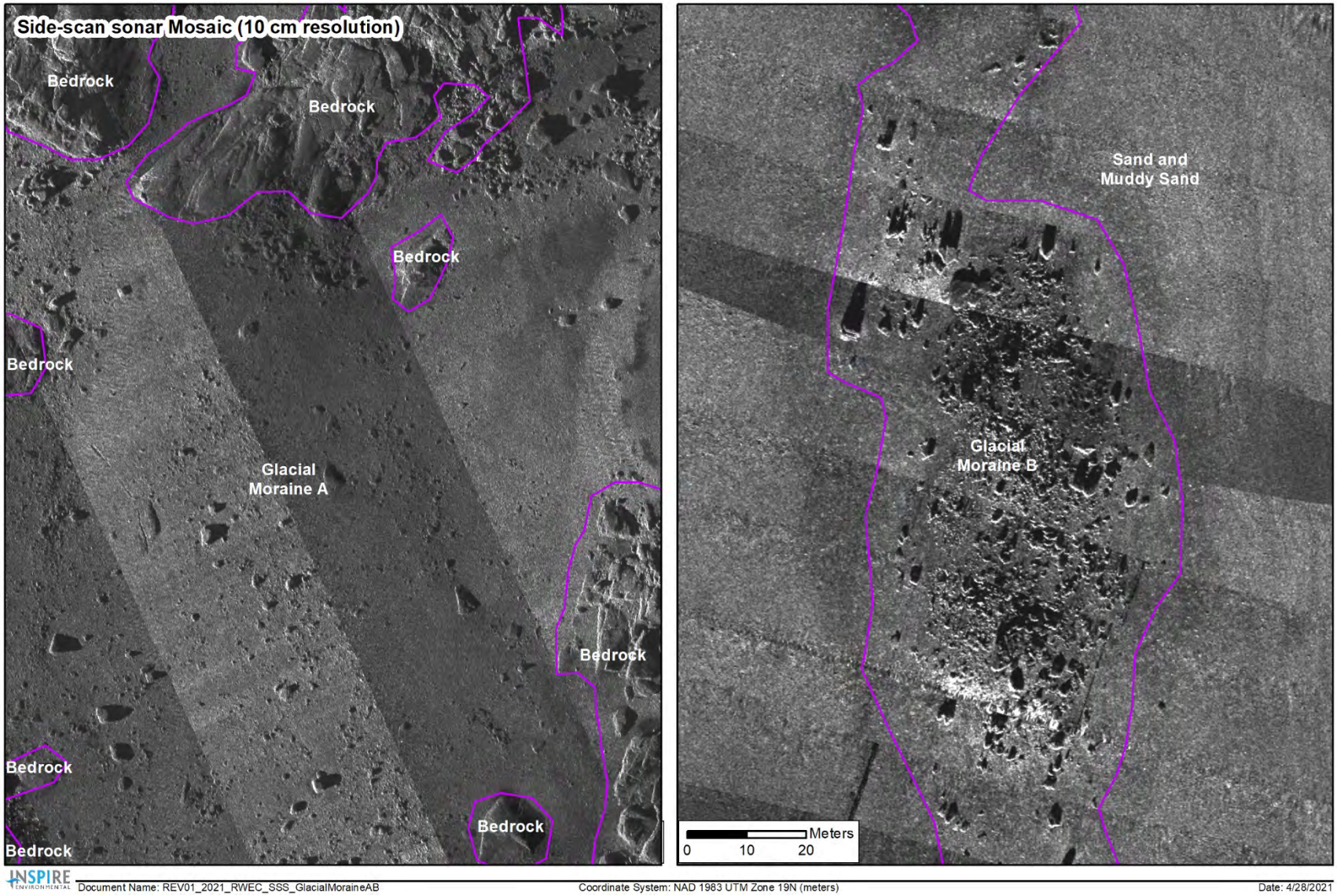

Figure 3-1. Glacial Moraine B, Glacial Moraine A, and Bedrock as detected in geophysical data

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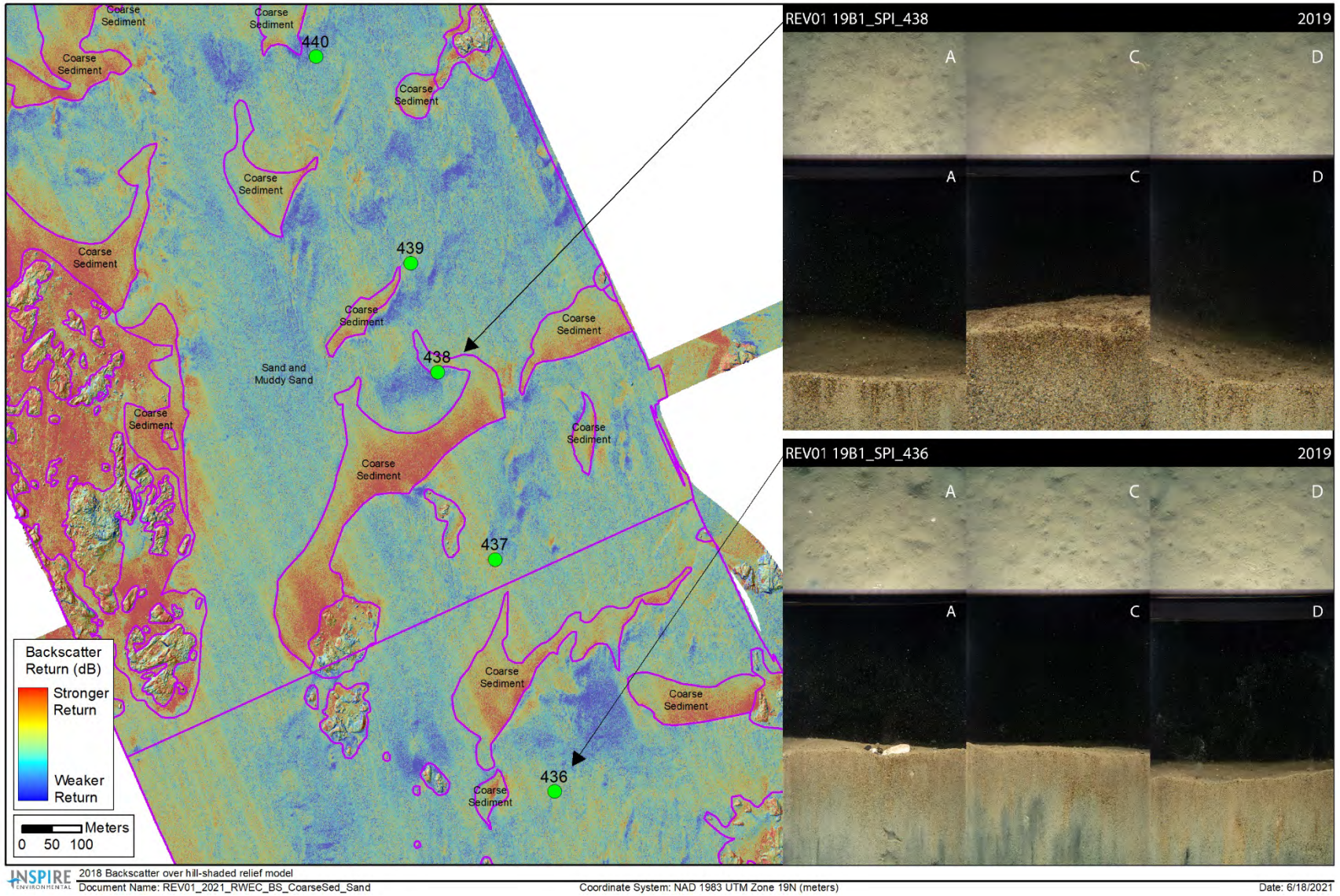

Figure 3-2. Coarse Sediment in depressions in the seafloor detected in geophysical data, surrounded by Sand and Muddy Sand detected in geophysical and ground-truth data

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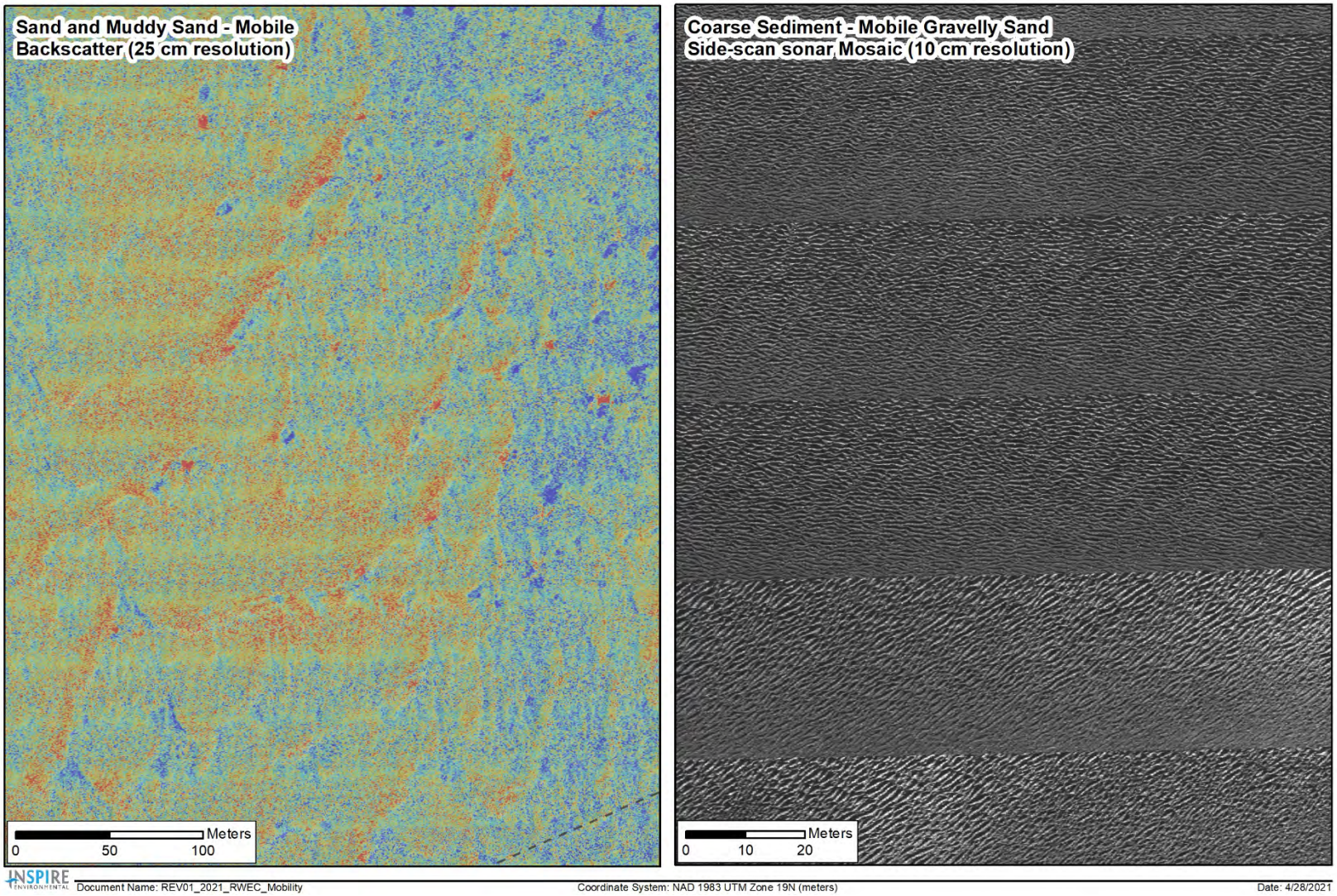

Figure 3-3. Mobility of the seafloor evident in geophysical data: mega-ripples detected in backscatter and bathymetric relief in Sand and Muddy Sand (left); and ripples detected in Coarse Sediment - Gravelly Sand in geophysical data (right). The modifier of "- Mobile" is applied to these habitats where seafloor features, including mega-ripples and/or ripples, are observed.

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Figure 3-4. Low density (20 to 99 boulders / 10,000 m^2) (left) and medium density (100 to 199 boulders / 10,000 m^2) (right) boulder fields identified from geophysical data and included as a habitat type modifier for mud, sand, and coarse sediment habitat types where present

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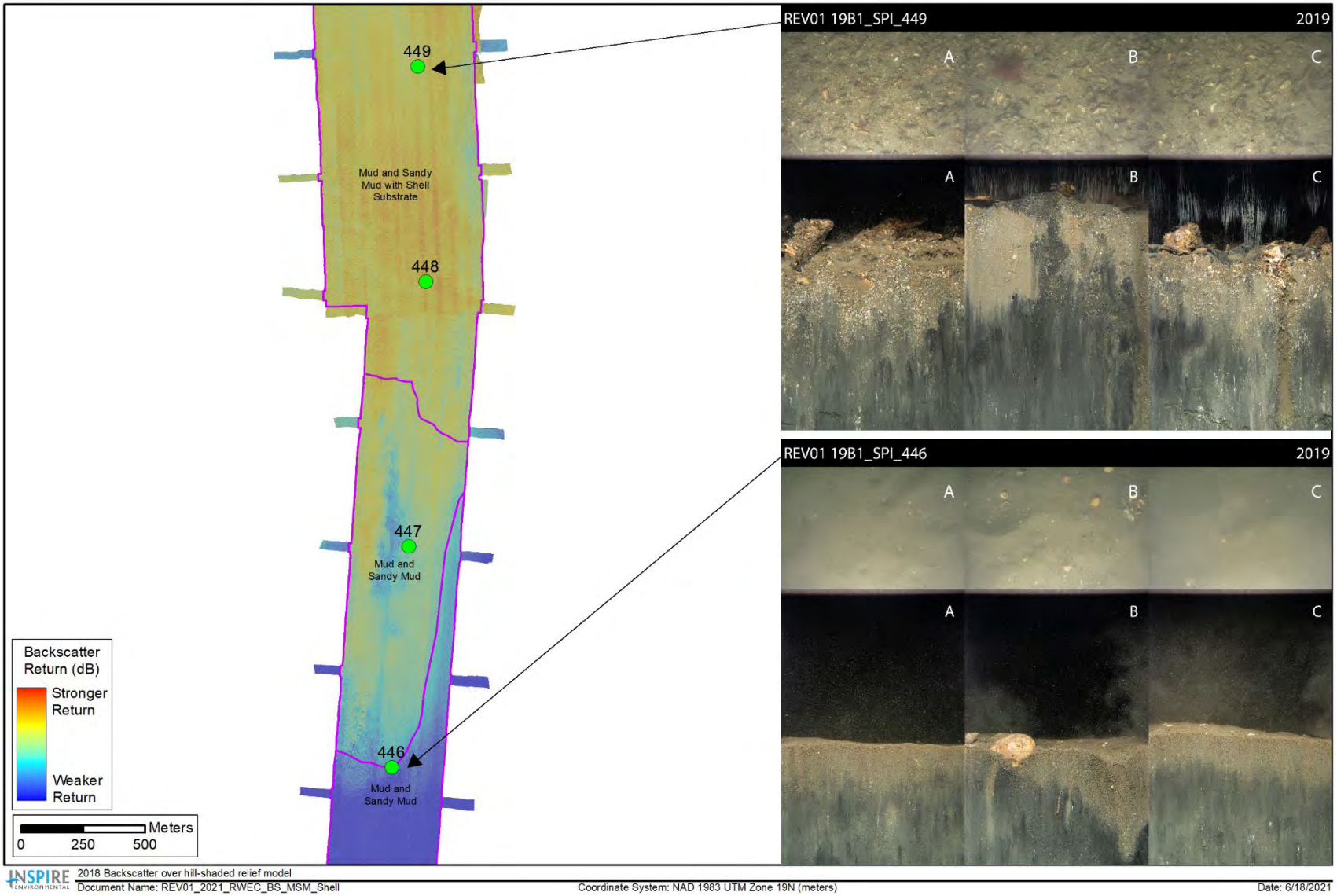

Figure 3-5. Mud and Sandy Mud and Mud and Sandy Mud with Shell Substrate as detected in geophysical and ground-truth data

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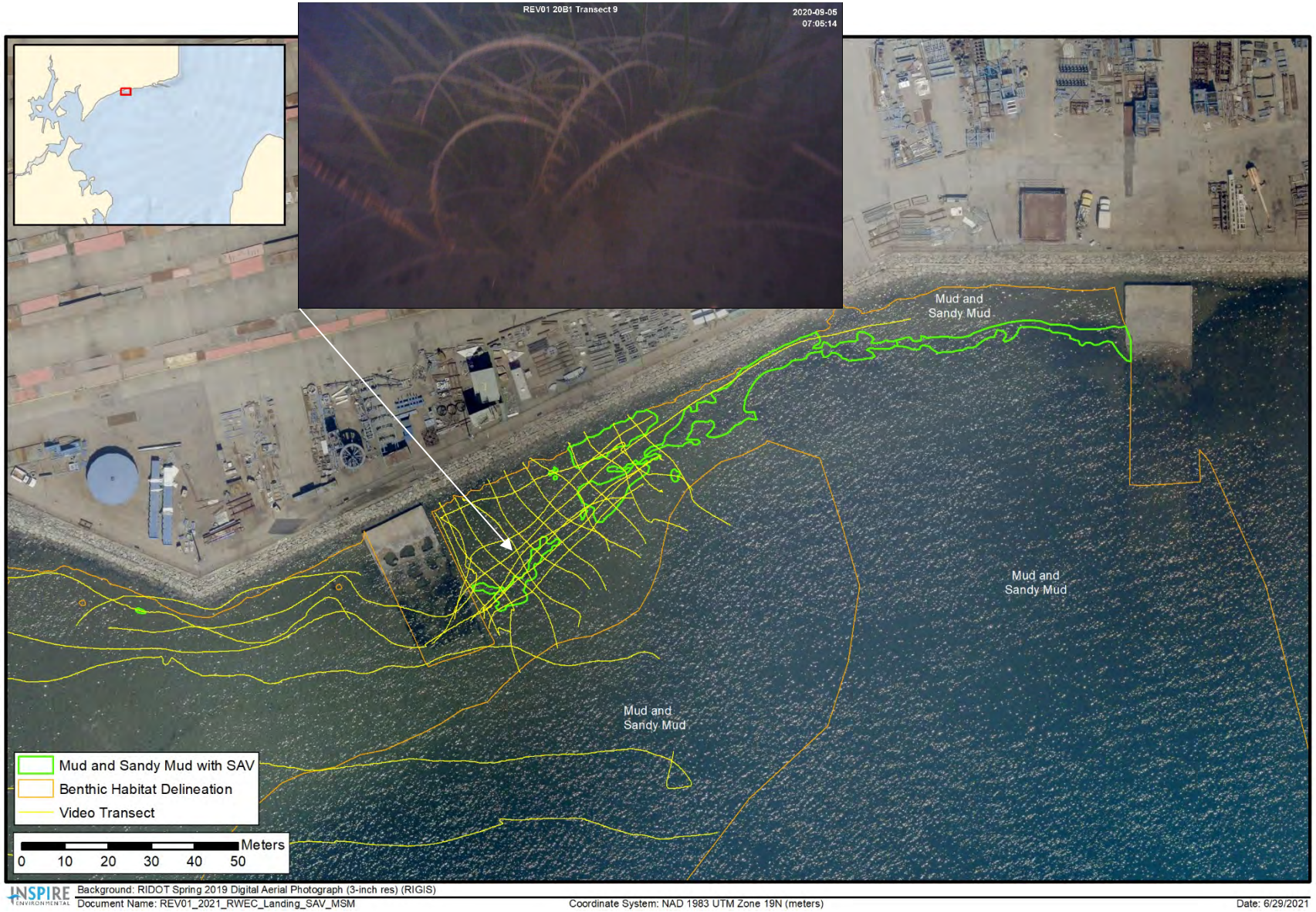

Figure 3-6. Mud and Sandy Mud with submerged aquatic vegetation (SAV) habitat detected in aerial imagery and underwater video footage

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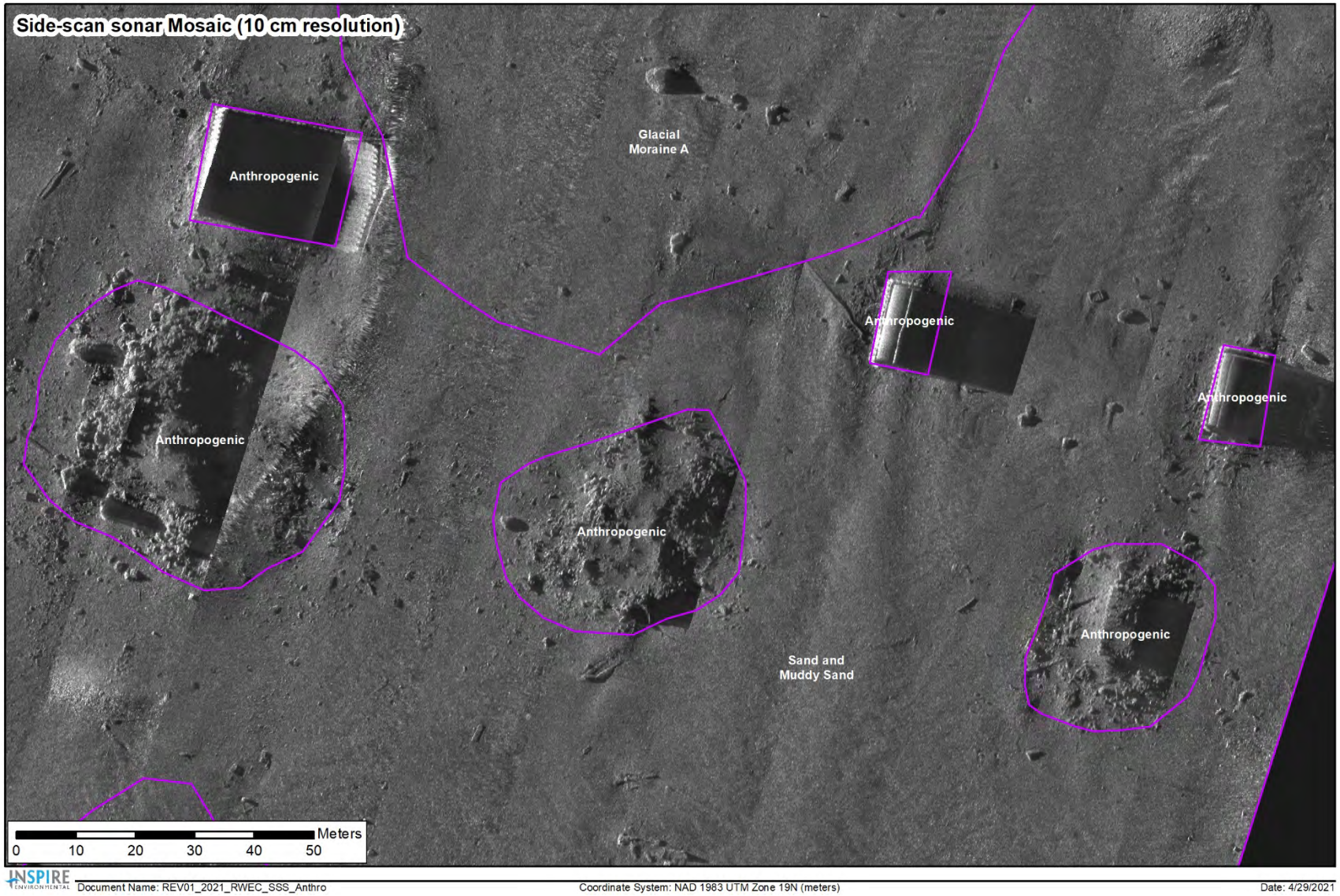

Figure 3-7. Anthropogenic features, such as debris related to the demolition of the old Jamestown Bridge, as detected in geophysical data

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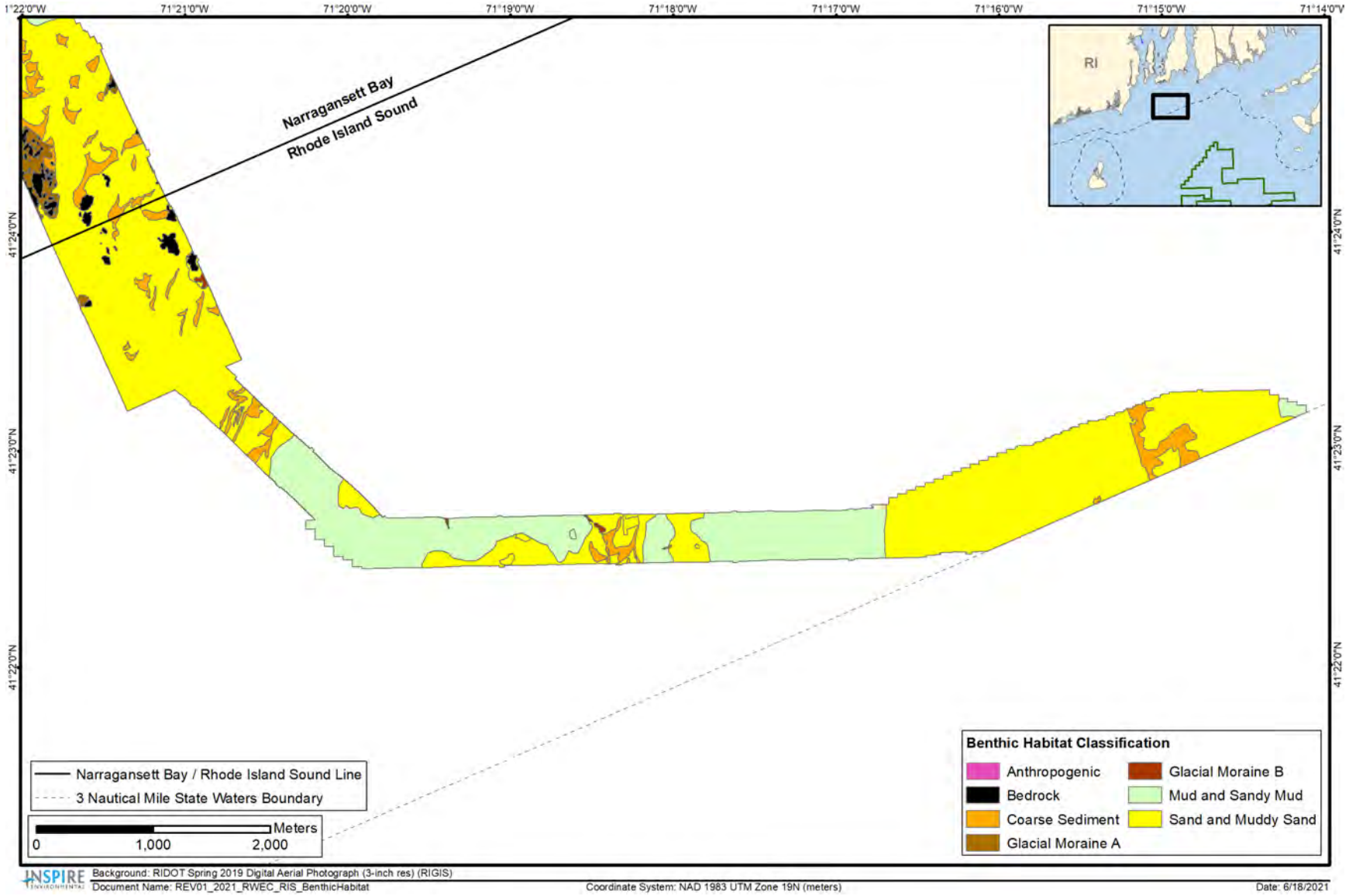

Figure 3-8. Benthic habitat types mapped along the RWEC-RI in RI Sound

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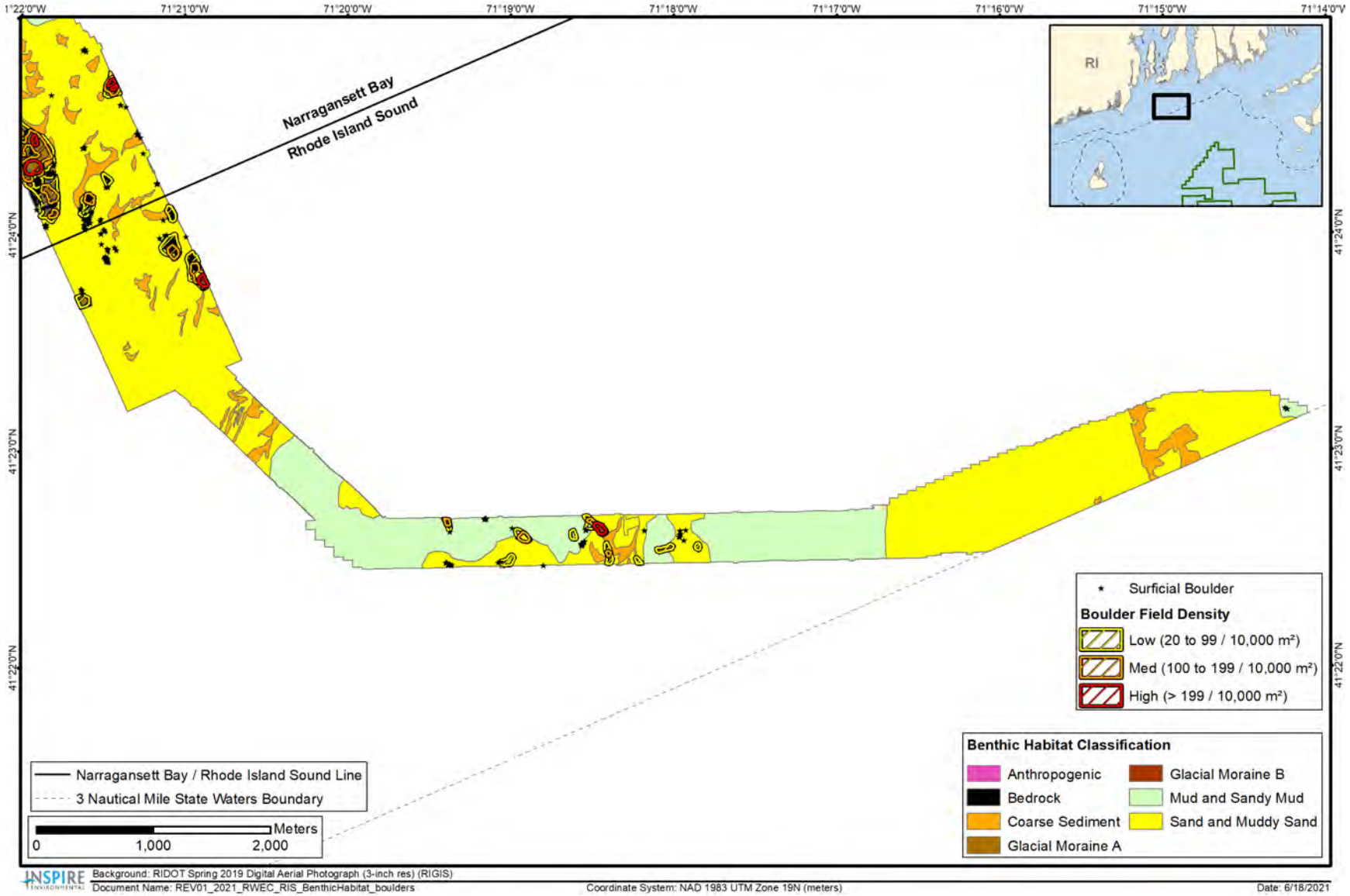

Figure 3-9. Benthic habitat types, boulder fields, and individual large boulders (>0.5 m) mapped along the RWEC-RI in RI Sound

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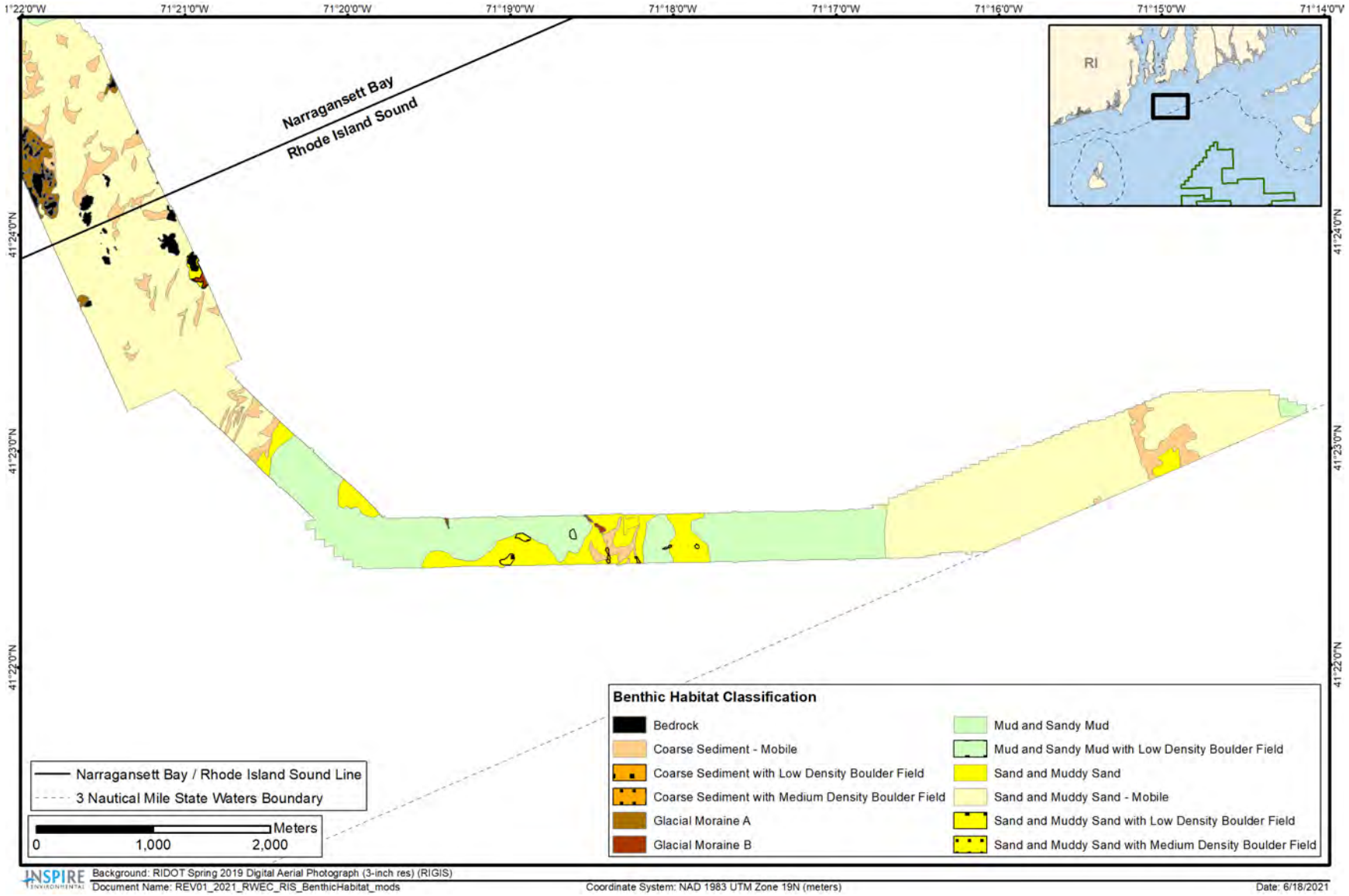

Figure 3-10. Benthic habitat types with modifiers along the RWEC-RI in RI Sound

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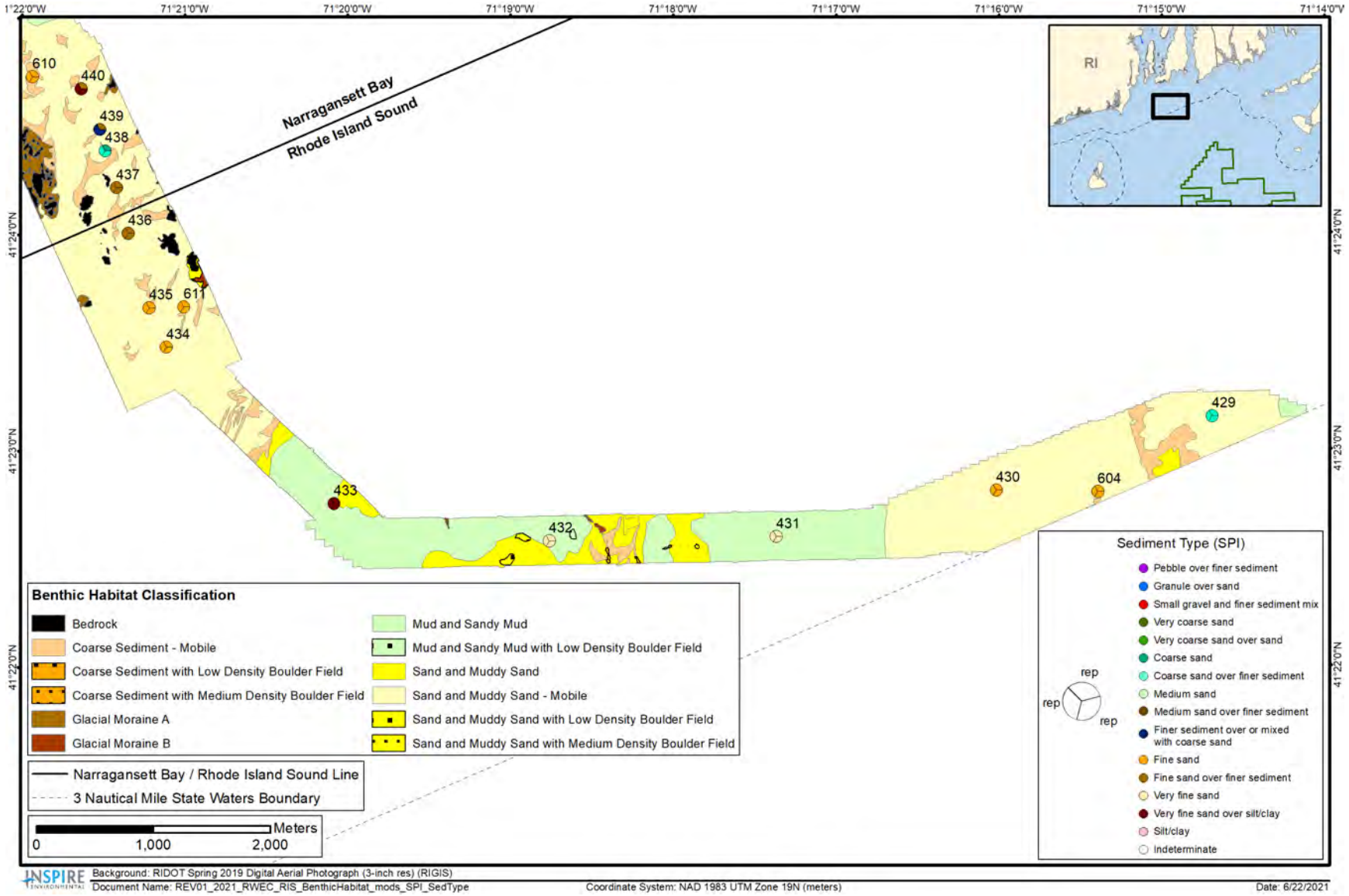

Figure 3-11. Benthic habitat types with modifiers and ground-truth sediment type from SPI along the RWEC-RI in RI Sound

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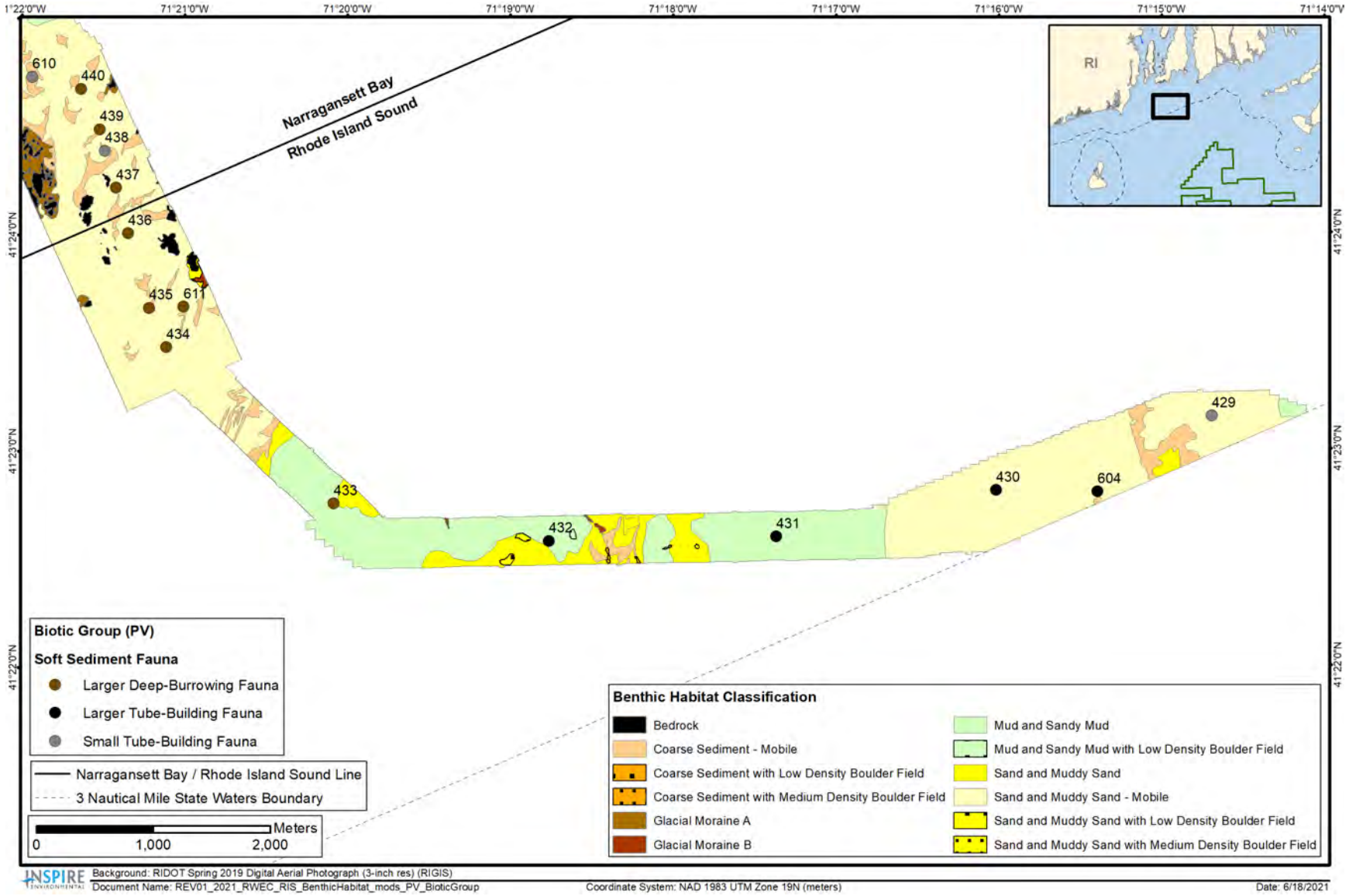

Figure 3-12. Benthic habitat types with modifiers and ground-truth CMECS Biotic Group along the RWEC-RI in RI Sound

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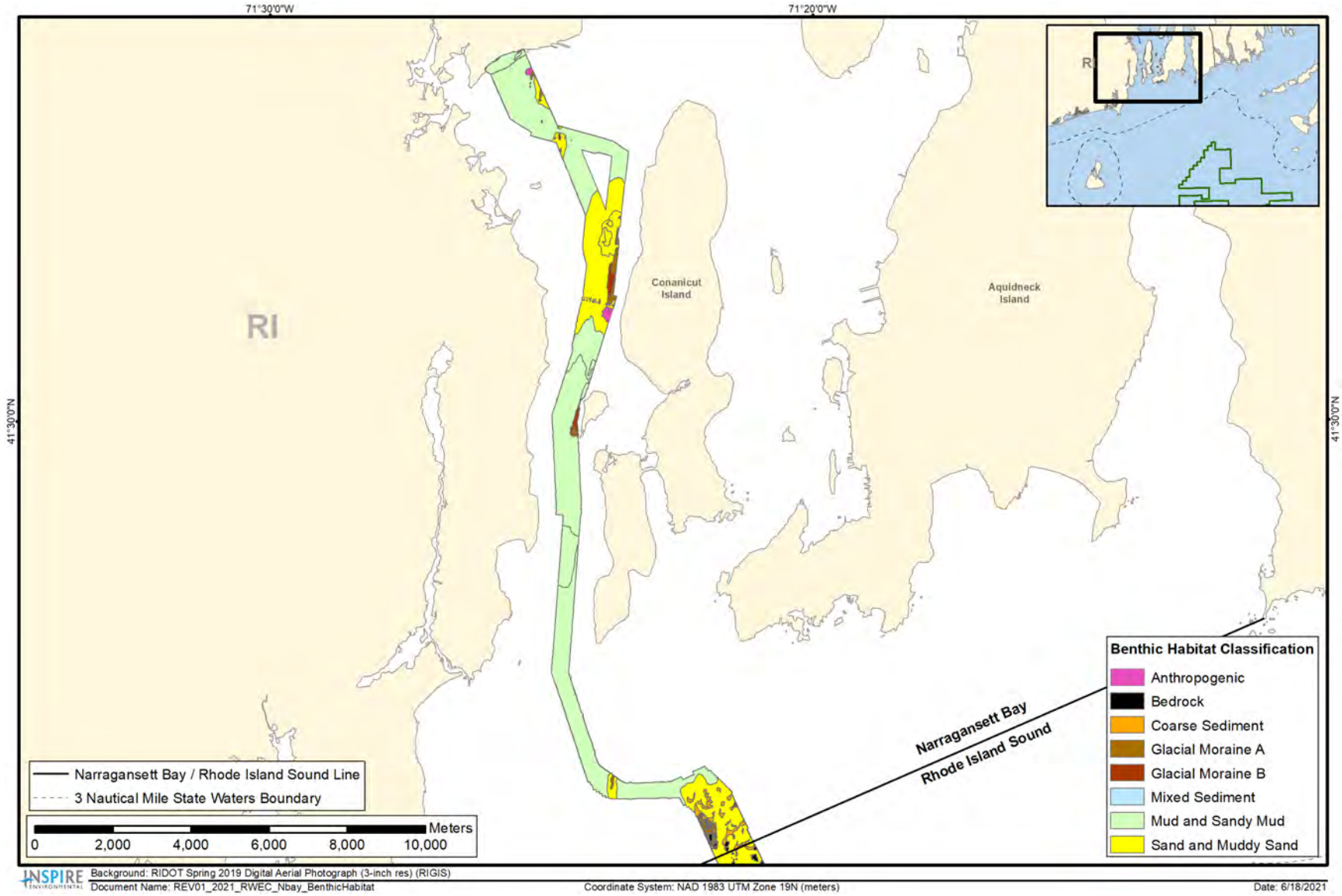

Figure 3-13. Benthic habitat types mapped along the RWEC-RI in Narragansett Bay

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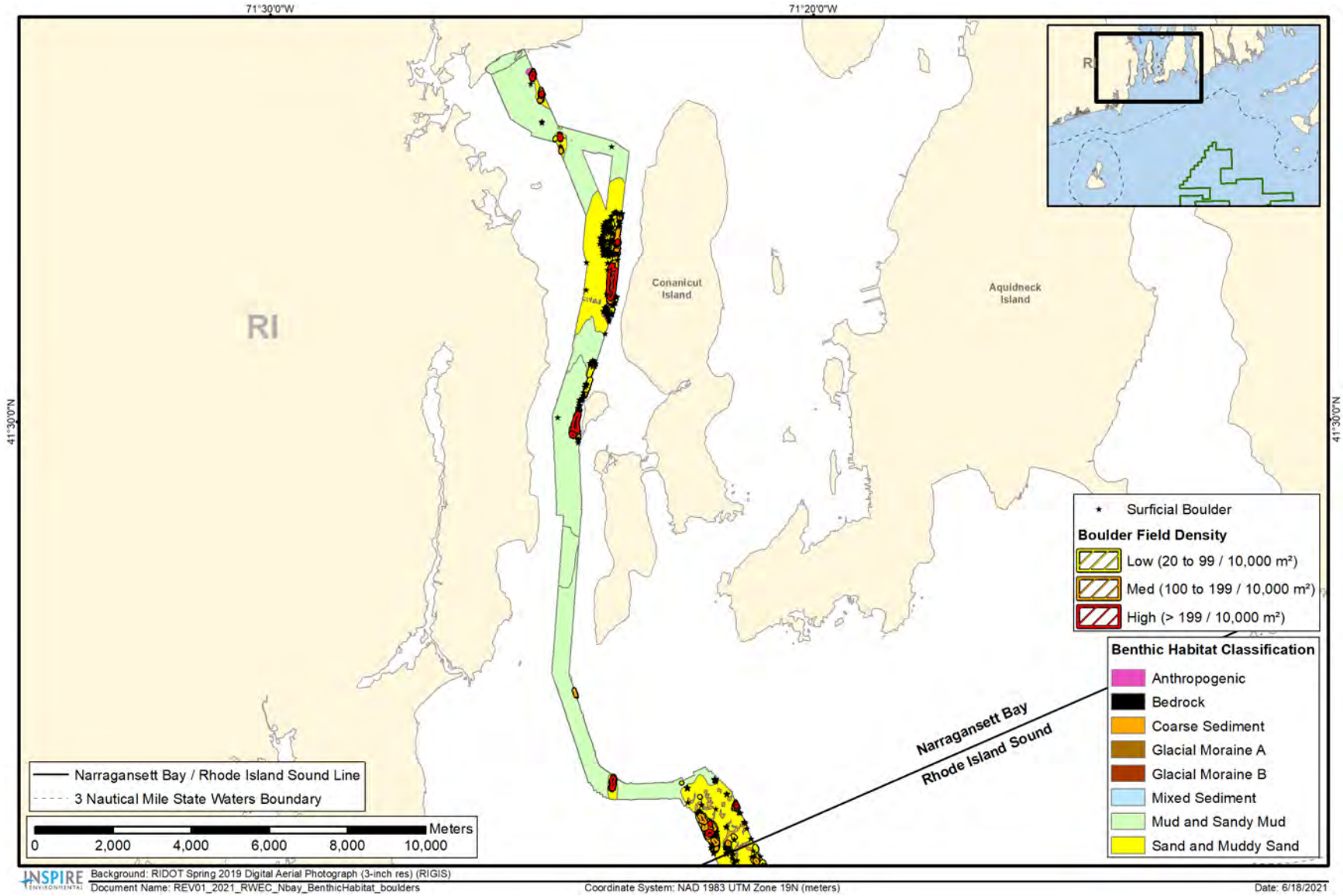

Figure 3-14. Benthic habitat types, boulder fields, and individual large boulders (>0.5 m) mapped along the RWEC-RI in Narragansett Bay

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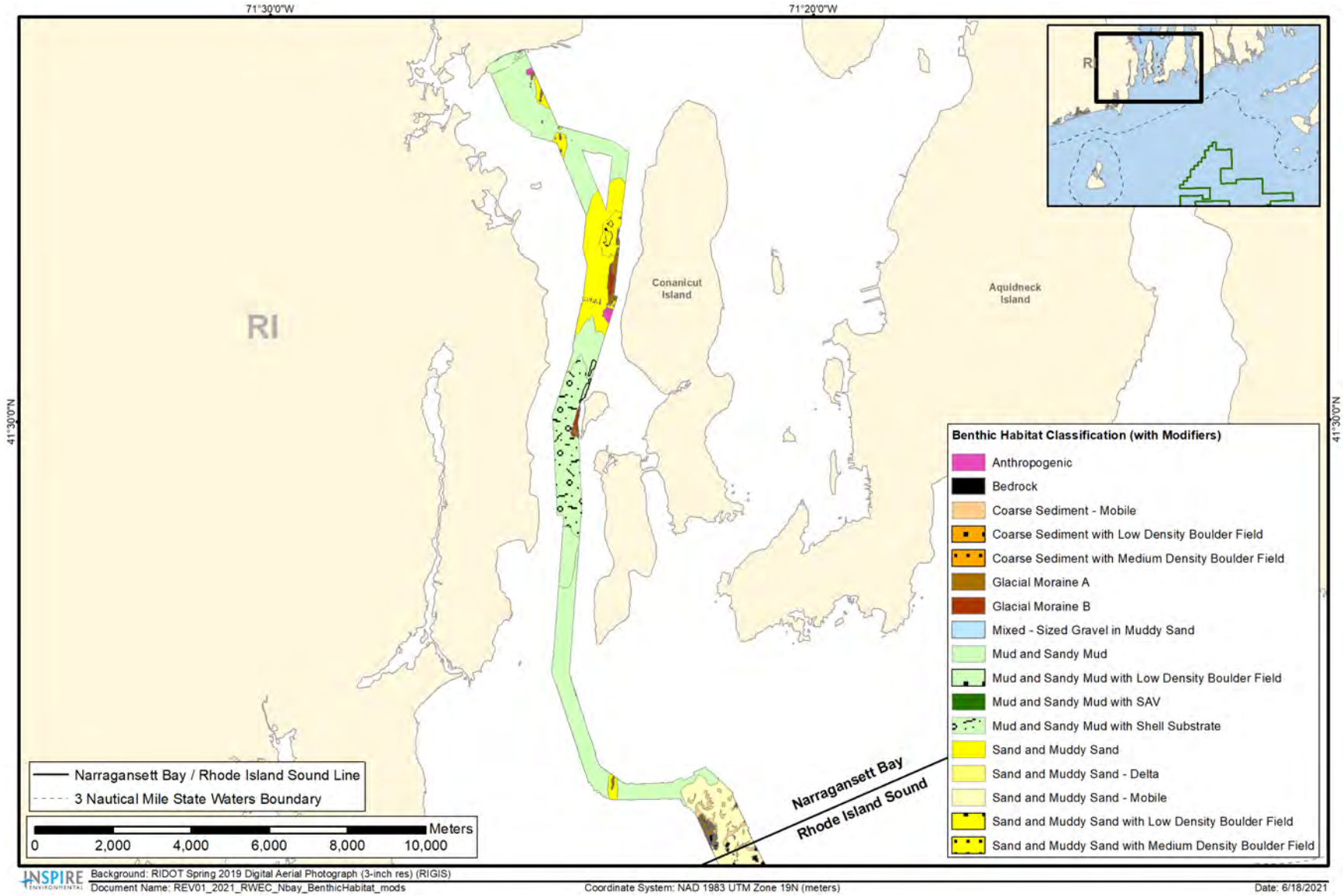

Figure 3-15. Benthic habitat types with modifiers along the RWEC-RI in Narragansett Bay

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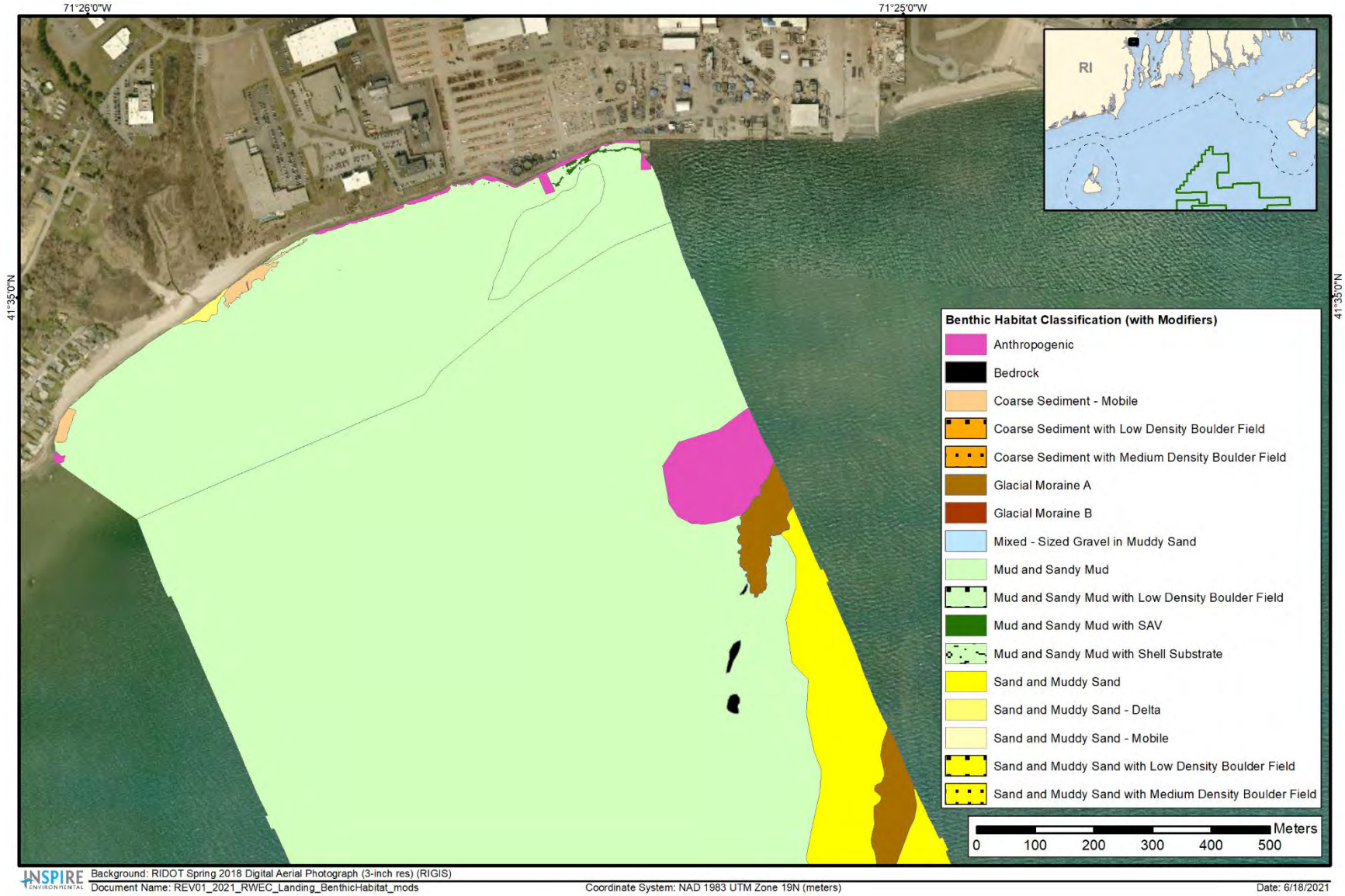

Figure 3-16. Benthic habitat types with modifiers along the RWEC-RI at the Quonset Point landfall

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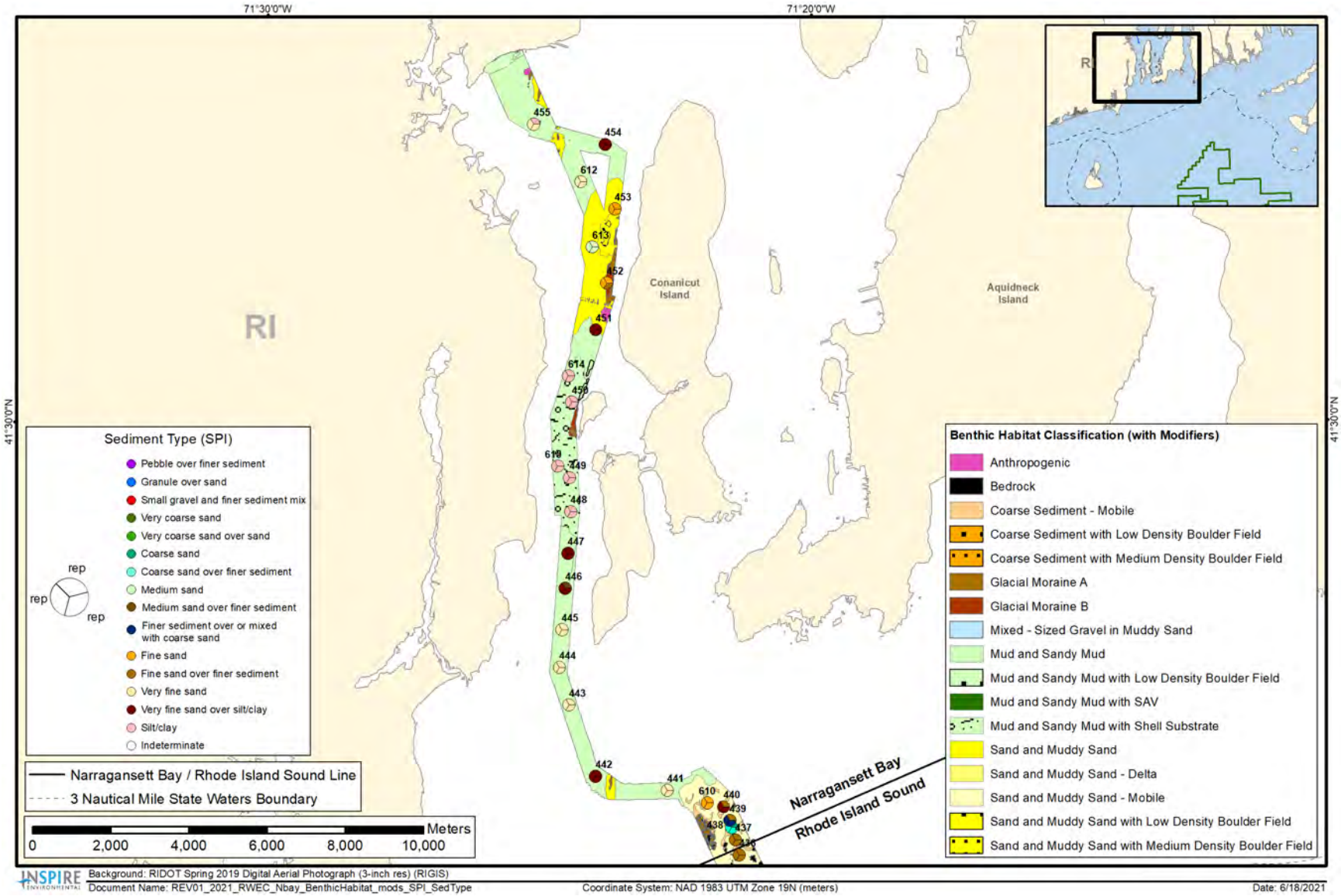

Figure 3-17. Benthic habitat types with modifiers and ground-truth sediment type from SPI along the RWEC-RI in Narragansett Bay

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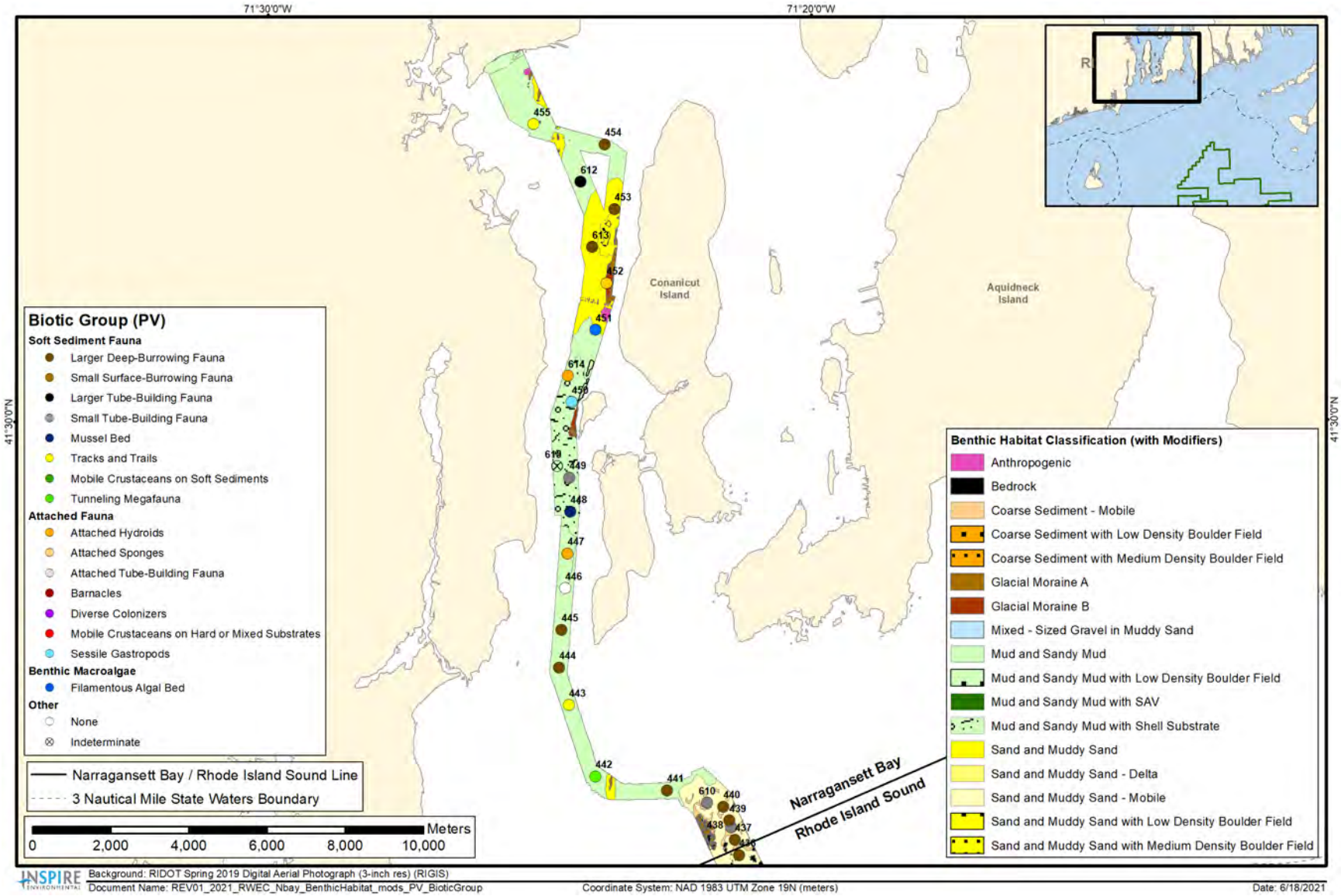

Figure 3-18. Benthic habitat types with modifiers and ground-truth CMECS Biotic Group along the RWEC-RI in Narragansett Bay

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Benthic Habitats in Rhode Island State Waters

Revolution Wind Offshore Wind Farm

ATTACHMENTS

Prepared for:

Revolution Wind | Powered by Ørsted & Eversource

Revolution Wind, LLC

Submitted by:

INSPIRE Environmental
Newport, Rhode Island 02840

June 2021

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Attachment A: Benthic Ground-Truth Data Analysis Results

Notes:

IND=Indeterminate

N/A=Not Applicable

1 Successional Stage: “on” indicates one Stage is found on top of another Stage (i.e., 1 on 3); “->” indicates one Stage is progressing to another Stage (i.e., 2 -> 3).

2 Variable determined from combined SPI and PV analysis

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Area	Water Body	Station ID	Water Depth (m)	PV Replicate (n)	Mapped Habitat Type	PV Macrohabitat (# of reps)	PV CMECS Substrate Group	PV CMECS Substrate Subgroup	PV Max Gravel Measurement (mm)	PV Boulder Presence	PV Bedforms (# of reps)	PV Mean Bedform Wavelength (cm)	PV Biological Debris	PV CMECS Biotic Subclass	PV CMECS Co-occurring Biotic Subclasses	PV CMECS Biotic Group	PV CMECS Co-occurring Biotic Group	PV Maximum Attached Fauna Percent Cover	PV Burrow Presence	PV Tracks Presence	PV Fish Presence/Type
RWEC-RI	Rhode Island Sound	429	27.5	3	Sand and Muddy Sand - Mobile	Sand Sheet (3)	Sand	Sand or finer	IND	No	None	N/A	Moon Snail Egg Case, Shell Hash, Small Shell Fragment(s)	Soft Sediment Fauna	Inferred Fauna	Small Tube-Building Fauna	None	None	No	Yes	None
RWEC-RI	Rhode Island Sound	430	28.2	3	Sand and Muddy Sand - Mobile	Sand Sheet (3)	Sand	Sand or finer	IND	No	None	N/A	Shell Hash, Small Shell Fragment(s)	Soft Sediment Fauna	Inferred Fauna	Larger Tube-Building Fauna	Varies	None	Yes	Yes	None
RWEC-RI	Rhode Island Sound	431	32.4	3	Mud and Sandy Mud	Sand Sheet (3)	Sand	Sand or finer	IND	No	None	N/A	None	Soft Sediment Fauna	Inferred Fauna	Larger Tube-Building Fauna	Larger Deep-Burrowing Fauna	None	Yes	Yes	None
RWEC-RI	Rhode Island Sound	432	34.1	3	Mud and Sandy Mud	Sand Sheet (3)	Sand	Sand or finer	IND	No	None	N/A	None	Soft Sediment Fauna	Inferred Fauna	Larger Tube-Building Fauna	Larger Deep-Burrowing Fauna	None	Yes	Yes	None
RWEC-RI	Rhode Island Sound	433	33.7	3	Mud and Sandy Mud	Sand Sheet (3)	Sand	Sand or finer	IND	No	None	N/A	None	Soft Sediment Fauna	Inferred Fauna	Larger Deep-Burrowing Fauna	Small Tube-Building Fauna	None	Yes	Yes	None
RWEC-RI	Rhode Island Sound	434	31.0	3	Sand and Muddy Sand - Mobile	Sand Sheet (3)	Sand	Sand or finer	IND	No	None	N/A	Small Shell Fragment(s)	Soft Sediment Fauna	Inferred Fauna	Larger Deep-Burrowing Fauna	Larger Tube-Building Fauna	None	Yes	Yes	None
RWEC-RI	Rhode Island Sound	435	31.1	3	Sand and Muddy Sand - Mobile	Sand Sheet (3)	Sand	Sand or finer	IND	No	None	N/A	Small Shell Fragment(s)	Soft Sediment Fauna	Inferred Fauna	Larger Deep-Burrowing Fauna	Larger Tube-Building Fauna	None	Yes	Yes	None
RWEC-RI	Rhode Island Sound	436	31.1	3	Sand and Muddy Sand - Mobile	Sand Sheet (3)	Sand	Sand or finer	IND	No	None	N/A	Small Shell Fragment(s)	Soft Sediment Fauna	Inferred Fauna	Larger Deep-Burrowing Fauna	Larger Tube-Building Fauna	None	Yes	Yes	None
RWEC-RI	Narragansett Bay	437	30.5	3	Sand and Muddy Sand - Mobile	Sand Sheet (3)	Sand	Sand or finer	IND	No	None	N/A	Small Shell Fragment(s)	Soft Sediment Fauna	Inferred Fauna	Larger Deep-Burrowing Fauna	Larger Tube-Building Fauna	None	Yes	Yes	None
RWEC-RI	Narragansett Bay	438	30.1	3	Coarse Sediment - Mobile	Sand Sheet (3)	Sand	Sand or finer	IND	No	None	N/A	Large Shell Fragment(s), Small Shell Fragment(s)	Soft Sediment Fauna	Inferred Fauna	Small Tube-Building Fauna	None	None	Yes	Yes	None
RWEC-RI	Narragansett Bay	439	29.9	3	Sand and Muddy Sand - Mobile	Sand Sheet (3)	Sand	Sand or finer	IND	No	None	N/A	Small Shell Fragment(s)	Soft Sediment Fauna	Inferred Fauna	Larger Deep-Burrowing Fauna	Varies	None	Yes	Yes	None
RWEC-RI	Narragansett Bay	440	29.4	3	Sand and Muddy Sand - Mobile	Sand Sheet (3)	Sand	Sand or finer	IND	No	None	N/A	Moon Snail Egg Case	Soft Sediment Fauna	Inferred Fauna	Larger Deep-Burrowing Fauna	Tracks and Trails	None	Yes	Yes	None
RWEC-RI	Narragansett Bay	441	29.8	3	Mud and Sandy Mud	Sand Sheet (3)	Sand	Sand or finer	IND	No	None	N/A	None	Soft Sediment Fauna	Inferred Fauna	Larger Deep-Burrowing Fauna	Tunneling Megafauna	None	Yes	Yes	None
RWEC-RI	Narragansett Bay	442	29.4	3	Mud and Sandy Mud	Sand Sheet (3)	Sand	Sand or finer	IND	No	None	N/A	None	Soft Sediment Fauna	Inferred Fauna	Tunneling Megafauna	Tracks and Trails	None	Yes	Yes	None
RWEC-RI	Narragansett Bay	443	23.5	3	Mud and Sandy Mud	Sand Sheet (3)	Sand	Sand or finer	IND	No	Ripples (3)	11.93	None	Soft Sediment Fauna	Inferred Fauna	Tracks and Trails	Varies	None	Yes	Yes	None
RWEC-RI	Narragansett Bay	444	19.9	3	Mud and Sandy Mud	Sand Sheet (3)	Sand	Sand or finer	IND	No	Ripples (3)	IND	None	Soft Sediment Fauna	Inferred Fauna	Larger Deep-Burrowing Fauna	None	None	Yes	Yes	None

Area	Water Body	Station ID	Water Depth (m)	PV Replicate (n)	Mapped Habitat Type	PV Macrohabitat (# of reps)	PV CMECS Substrate Group	PV CMECS Substrate Subgroup	PV Max Gravel Measurement (mm)	PV Boulder Presence	PV Bedforms (# of reps)	PV Mean Bedform Wavelength (cm)	PV Biological Debris	PV CMECS Biotic Subclass	PV CMECS Co-occurring Biotic Subclasses	PV CMECS Biotic Group	PV CMECS Co-occurring Biotic Group	PV Maximum Attached Fauna Percent Cover	PV Burrow Presence	PV Tracks Presence	PV Fish Presence/Type
RWEC-RI	Narragansett Bay	445	17.6	2	Mud and Sandy Mud	Sand Sheet (2)	Sand	Sand or finer	IND	No	Ripples (1)	IND	Large Shell Fragment(s)	Soft Sediment Fauna	Attached Fauna	Larger Deep-Burrowing Fauna	None	Trace (<1%)	Yes	Yes	None
RWEC-RI	Narragansett Bay	446	14.7	3	Mud and Sandy Mud	Sand Sheet (3)	Sand	Sand or finer	IND	No	None	N/A	Large Shell Fragment(s), Small Shell Fragment(s)	Soft Sediment Fauna	Inferred Fauna	None	None	None	No	Yes	Northern Sea Robin
RWEC-RI	Narragansett Bay	447	15.0	3	Mud and Sandy Mud	Sand Sheet (3)	Sand	Sand or finer	IND	No	None	N/A	Large Shell Fragment(s)	Soft Sediment Fauna	Attached Fauna	Attached Hydroids	None	Sparse (1 to <30%)	Yes	Yes	None
RWEC-RI	Narragansett Bay	448	10.9	3	Mud and Sandy Mud with Shell Substrate	Mollusk Bed (or Shells) on Mud (3)	Shell Substrate	Shell Hash	IND	No	None	N/A	Large Mussel Shell Fragments	Soft Sediment Fauna	Attached Fauna	Mussel Bed	Varies	Moderate (30 to < 70%)	Yes	No	None
RWEC-RI	Narragansett Bay	449	13.8	3	Mud and Sandy Mud with Shell Substrate	Mollusk Bed (or Shells) on Mud (3)	Shell Substrate	Shell Hash	IND	No	None	N/A	Large Mussel Shell Fragments	Soft Sediment Fauna	Attached Fauna	Small Tube-Building Fauna	Filamentous Algal Bed	Sparse (1 to <30%)	No	No	None
RWEC-RI	Narragansett Bay	450	11.0	3	Mud and Sandy Mud with Shell Substrate	Mollusk Bed (or Shells) on Mud (3)	Shell Substrate	Crepidula Reef Substrate	IND	No	None	N/A	Large Shell Fragment(s)	Attached Fauna	None	Sessile Gastropods	Attached Hydroids	Complete (90-100%)	No	No	None
RWEC-RI	Narragansett Bay	451	25.5	3	Sand and Muddy Sand	IND (1), Patchy Cobbles on Sand (2)	Slightly Gravelly	Slightly Gravelly Sand	IND	No	None	N/A	Large Shell Fragment(s)	Benthic Macroalgae	Soft Sediment Fauna	Filamentous Algal Bed	Attached Sponges	Moderate (30 to < 70%)	IND	Yes	None
RWEC-RI	Narragansett Bay	452	21.5	3	Glacial Moraine B	Patchy Cobbles on Sand (2), Patchy Pebbles on Sand (1)	Slightly Gravelly	Slightly Gravelly Sand	114.61	No	None	N/A	Large Shell Fragment(s), Small Shell Fragment(s)	Attached Fauna	Soft Sediment Fauna	Attached Sponges	None	Sparse (1 to <30%)	No	Yes	None
RWEC-RI	Narragansett Bay	453	13.6	3	Sand and Muddy Sand	Sand Sheet (3)	Sand	Sand or finer	IND	No	None	N/A	Small Shell Fragment(s)	Soft Sediment Fauna	Benthic Macroalgae	Larger Deep-Burrowing Fauna	Filamentous Algal Bed	Sparse (1 to <30%)	Yes	No	None
RWEC-RI	Narragansett Bay	454	8.6	2	Mud and Sandy Mud	Sand Sheet (2)	Sand	Sand or finer	IND	No	None	N/A	None	Soft Sediment Fauna	Inferred Fauna	Larger Deep-Burrowing Fauna	None	None	Yes	Yes	None
RWEC-RI	Narragansett Bay	455	5.2	1	Mud and Sandy Mud	Sand Sheet (1)	Sand	Sand or finer	IND	No	None	N/A	None	Soft Sediment Fauna	Inferred Fauna	Tracks and Trails	Larger Deep-Burrowing Fauna	None	Yes	Yes	None
RWEC-RI	Rhode Island Sound	604	27.8	3	Sand and Muddy Sand - Mobile	Sand Sheet (3)	Sand	Sand or finer	IND	No	None	N/A	Small Shell Fragment(s)	Soft Sediment Fauna	Inferred Fauna	Larger Tube-Building Fauna	None	None	No	Yes	None
RWEC-RI	Narragansett Bay	610	29.5	3	Coarse Sediment - Mobile	Sand Sheet (3)	Sand	Sand or finer	IND	No	None	N/A	None	Soft Sediment Fauna	Inferred Fauna	Small Tube-Building Fauna	Tracks and Trails	None	Yes	Yes	None
RWEC-RI	Rhode Island Sound	611	30.8	3	Sand and Muddy Sand - Mobile	Sand Sheet (3)	Sand	Sand or finer	IND	No	None	N/A	None	Soft Sediment Fauna	Inferred Fauna	Larger Deep-Burrowing Fauna	Larger Tube-Building Fauna	None	Yes	Yes	None
RWEC-RI	Narragansett Bay	612	8.9	2	Mud and Sandy Mud	Sand Sheet (2)	Sand	Sand or finer	IND	No	None	N/A	None	Soft Sediment Fauna	Inferred Fauna	Larger Tube-Building Fauna	Tracks and Trails	None	Yes	Yes	None

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Area	Water Body	Station ID	Water Depth (m)	PV Replicate (n)	Mapped Habitat Type	PV Macrohabitat (# of reps)	PV CMECS Substrate Group	PV CMECS Substrate Subgroup	PV Max Gravel Measurement (mm)	PV Boulder Presence	PV Bedforms (# of reps)	PV Mean Bedform Wavelength (cm)	PV Biological Debris	PV CMECS Biotic Subclass	PV CMECS Co-occurring Biotic Subclasses	PV CMECS Biotic Group	PV CMECS Co-occurring Biotic Group	PV Maximum Attached Fauna Percent Cover	PV Burrow Presence	PV Tracks Presence	PV Fish Presence/Type
RWEC-RI	Narragansett Bay	613	9.2	3	Sand and Muddy Sand	Sand Sheet (3)	Sand	Sand or finer	IND	No	None	N/A	Shell Hash	Soft Sediment Fauna	None	Larger Deep-Burrowing Fauna	IND	None	Yes	IND	None
RWEC-RI	Narragansett Bay	614	11.2	3	Mud and Sandy Mud with Shell Substrate	Mollusk Bed (or Shells) on Mud (3)	Shell Substrate	Shell Hash	IND	No	None	N/A	Large Shell Fragment(s), Shell Hash	Attached Fauna	None	Attached Hydroids	None	Sparse (1 to <30%)	No	No	None
RWEC-RI	Narragansett Bay	615	14.2	3	Mud and Sandy Mud with Shell Substrate	Mollusk Bed (or Shells) on Mud (3)	Shell Substrate	Shell Hash	IND	No	None	N/A	Large Mussel Shell Fragments	Attached Fauna	None	IND	None	Sparse (1 to <30%)	No	No	None

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Area	Water Body	Station ID	SPI Replicate (n)	SPI Sediment Type (# of reps)	SPI Mean Prism Penetration Depth (cm)	SPI Mean Boundary Roughness (cm)	SPI Mean aRPD Depth (cm)	SPI Sediment Oxygen Demand Level	SPI Successional Stage (by replicate)[1]			SPI/PV Sensitive Taxa Type[2]	SPI/PV Species of Concern[2]	SPI/PV Presence of Tubes[2]	SPI/PV Amphipod Presence/Type[2]	SPI/PV Sea Pen Presence[2]	SPI/PV Other Epifauna Present[2]	SPI/PV Possible Non-Native *Botrylloides sp.*[2]
RWEC-RI	Rhode Island Sound	429	3	Coarse sand over finer sediment (3)	5.4	0.8	IND	Low	2	2	2 -> 3	None	None	Yes	Unidentified	No	Shrimp	No
RWEC-RI	Rhode Island Sound	430	3	Fine sand (3)	4.6	0.4	IND	Low	2 -> 3	2 -> 3	2 -> 3	None	None	Yes	None	No	None	No
RWEC-RI	Rhode Island Sound	431	3	Very fine sand (3)	13.4	0.6	1.80	Low	2 on 3	2 on 3	2 on 3	None	None	Yes	Ampeliscid, Podoceridae	No	None	No
RWEC-RI	Rhode Island Sound	432	3	Very fine sand (3)	13.8	1.5	2.08	Low	2 on 3	2 on 3	2 on 3	None	None	Yes	Ampeliscid, Podoceridae	No	None	No
RWEC-RI	Rhode Island Sound	433	3	Very fine sand over silt/clay (3)	14.7	1.1	1.63	Low	2 on 3	2 on 3	2 on 3	None	None	Yes	Podoceridae	No	Crab	No
RWEC-RI	Rhode Island Sound	434	3	Fine sand (3)	5.8	0.9	1.97	Low	2	2 -> 3	2 -> 3	None	None	Yes	Ampeliscid	No	Paguroid	No
RWEC-RI	Rhode Island Sound	435	3	Fine sand (3)	6.0	1.3	2.51	Low	2 -> 3	2 -> 3	2 -> 3	None	None	Yes	Ampeliscid, Podoceridae	No	Moon Snail, Paguroid	No
RWEC-RI	Rhode Island Sound	436	3	Fine sand over very fine sand (3)	8.2	1.0	2.95	Low	2 -> 3	2 -> 3	3	None	None	Yes	None	No	Gastropods, Paguroid, Unidentified Organism	No
RWEC-RI	Narragansett Bay	437	3	Fine sand over very fine sand (3)	9.1	1.9	3.16	Low	2 -> 3	2 -> 3	2 -> 3	None	None	Yes	Podoceridae	No	Gastropod(s)	No
RWEC-RI	Narragansett Bay	438	3	Coarse sand (1), Coarse sand over finer sediment (2)	5.3	1.3	IND	Low	2	2	2	None	None	Yes	Podoceridae	No	Gastropod(s), Paguroid(s)	No
RWEC-RI	Narragansett Bay	439	3	Fine sand over very fine sand (1), Finer sediment over coarse sand (2)	7.3	1.6	2.92	Low	2	2 -> 3	2 -> 3	None	None	Yes	Podoceridae	No	Gastropod(s), Moon Snail, Paguroid(s)	No
RWEC-RI	Narragansett Bay	440	3	Fine sand over very fine sand (1), Very fine sand over silt/clay (2)	18.0	1.2	2.00	Medium	1 on 3	1 on 3	1 on 3	None	None	Yes	None	No	Gastropod, Paguroid, Unidentified Organism	No
RWEC-RI	Narragansett Bay	441	3	Very fine sand (3)	16.7	1.1	2.30	Low	2 -> 3	2 on 3	2 on 3	None	None	Yes	Podoceridae	No	None	No
RWEC-RI	Narragansett Bay	442	3	Very fine sand over silt/clay (3)	14.7	2.5	1.77	Low	2 -> 3	2 on 3	2 on 3	None	None	Yes	Podoceridae	No	Crab(s)	No
RWEC-RI	Narragansett Bay	443	3	Very fine sand (3)	10.0	1.5	1.99	Low	1 on 3	1 on 3	1 on 3	None	None	Yes	None	No	Gastropod(s), Paguroid(s)	No
RWEC-RI	Narragansett Bay	444	3	Very fine sand (3)	10.8	0.7	2.26	Medium	2 -> 3	1 on 3	2 on 3	None	None	Yes	Unidentified	No	Paguroid(s), Shrimp	No

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Area	Water Body	Station ID	SPI Replicate (n)	SPI Sediment Type (# of reps)	SPI Mean Prism Penetration Depth (cm)	SPI Mean Boundary Roughness (cm)	SPI Mean aRPD Depth (cm)	SPI Sediment Oxygen Demand Level	SPI Successional Stage (by replicate)[1]			SPI/PV Sensitive Taxa Type[2]	SPI/PV Species of Concern[2]	SPI/PV Presence of Tubes[2]	SPI/PV Amphipod Presence/Type[2]	SPI/PV Sea Pen Presence[2]	SPI/PV Other Epifauna Present[2]	SPI/PV Possible Non-Native *Botrylloides sp.*[2]
RWEC-RI	Narragansett Bay	445	3	Very fine sand (3)	8.4	1.1	1.84	Medium	2	2	2	None	None	Yes	Podoceridae	No	Barnacles, Gastropod(s), Paguroid(s)	No
RWEC-RI	Narragansett Bay	446	3	Medium sand over finer sediment (1), Very fine sand over silt/clay (2)	9.5	0.9	1.52	Medium	2 -> 3	1 on 3	2 on 3	None	None	Yes	None	No	Crab, Gastropod, Paguroid(s)	No
RWEC-RI	Narragansett Bay	447	3	Very fine sand over silt/clay (3)	9.3	0.8	1.22	Medium	2	2	1 on 3	None	None	Yes	None	No	Barnacles, Hydroids, Paguroid(s)	No
RWEC-RI	Narragansett Bay	448	3	Silt/clay (3)	8.2	1.2	0.98	Medium	2 -> 3	IND	IND	None	None	Yes	None	No	Barnacles, Gastropod, Hydroids, Mussels	No
RWEC-RI	Narragansett Bay	449	3	Silt/clay (3)	15.1	1.5	0.98	Medium	3	3	3	None	None	Yes	None	No	Crab, Hydroids	No
RWEC-RI	Narragansett Bay	450	3	Silt/clay (3)	11.8	3.3	IND	Medium	IND	IND	IND	None	None	No	None	No	Barnacles, Crepidula, Hydroids, Sponges	No
RWEC-RI	Narragansett Bay	451	3	Very fine sand over silt/clay (3)	11.6	1.3	1.06	Medium	1	2 -> 3	3	None	None	Yes	None	No	Gastropod, Sponge(s), Whelk	No
RWEC-RI	Narragansett Bay	452	3	Fine sand (2), Fine sand over silt/clay (1)	3.1	0.9	0.02	Medium	1	1	1	None	None	No	None	No	Barnacles, Barnacles, Gastropod(s), Sponge(s)	No
RWEC-RI	Narragansett Bay	453	3	Fine sand (3)	1.9	0.9	1.10	Low	1	IND	IND	None	None	No	None	No	None	No
RWEC-RI	Narragansett Bay	454	3	Very fine sand over silt/clay (3)	13.3	1.0	1.96	Low	2 -> 3	2 on 3	2 on 3	None	None	No	None	No	None	No
RWEC-RI	Narragansett Bay	455	3	Silt/clay (1), Very fine sand (2)	8.9	1.3	2.20	Medium	2	2 -> 3	2 on 3	None	None	Yes	None	No	None	No
RWEC-RI	Rhode Island Sound	604	3	Fine sand (3)	4.6	1.0	IND	Low	2	2	2	None	None	Yes	Ampeliscid	No	Gastropod(s)	No
RWEC-RI	Narragansett Bay	610	3	Fine sand (3)	5.1	1.7	IND	Low	2 -> 3	2 -> 3	2 -> 3	None	None	Yes	Podoceridae	No	Paguroid(s)	No
RWEC-RI	Rhode Island Sound	611	3	Fine sand (3)	5.3	1.6	4.62	Low	2 -> 3	2 -> 3	IND	None	None	Yes	Ampeliscid, Podoceridae	No	Gastropods, Paguroid	No
RWEC-RI	Narragansett Bay	612	3	Very fine sand (3)	11.7	1.1	2.10	Low	2 on 3	2 on 3	2 on 3	None	None	Yes	None	No	None	No

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Area	Water Body	Station ID	SPI Replicate (n)	SPI Sediment Type (# of reps)	SPI Mean Prism Penetration Depth (cm)	SPI Mean Boundary Roughness (cm)	SPI Mean aRPD Depth (cm)	SPI Sediment Oxygen Demand Level	SPI Successional Stage (by replicate)[1]			SPI/PV Sensitive Taxa Type[2]	SPI/PV Species of Concern[2]	SPI/PV Presence of Tubes[2]	SPI/PV Amphipod Presence/Type[2]	SPI/PV Sea Pen Presence[2]	SPI/PV Other Epifauna Present[2]	SPI/PV Possible Non-Native *Botrylloides sp.*[2]
RWEC-RI	Narragansett Bay	613	3	Medium sand (3)	2.2	1.3	IND	None	IND	IND	IND	None	None	No	None	No	None	No
RWEC-RI	Narragansett Bay	614	3	Silt/clay (3)	9.4	0.7	2.18	High	3	3	IND	None	None	No	None	No	Hydroids, Sponges	No
RWEC-RI	Narragansett Bay	615	3	Silt/clay (3)	15.7	1.5	1.55	High	3	2 on 3	2 on 3	None	None	Yes	None	No	Hydroids, Jonah Crab	No

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Appendix D: Essential Fish Habitat Assessment Revolution Wind Offshore Wind Farm

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Revolution Wind | Powered by Ørsted & Eversource

Technical Report

Essential Fish Habitat Assessment

Revolution Wind Offshore Wind Farm

Prepared for:

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List of Acronyms

ASMFC	Atlantic States Marine Fisheries Commission
CMECS	Coastal and Marine Ecological Classification Standard
EEZ	exclusive economic zone
EFH	essential fish habitat
ESA	Endangered Species Act
HAPC	Habitat Area of Particular Concern
ICCAT	International Commission for the Conservation of Atlantic Tunas
IPF	impact-producing factor
Lease	Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf OCS-A 0486
Lease Area	BOEM-designated Renewable Energy Lease Area OCS-A 0486
MHW	mean high water
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
NEFMC	New England Fishery Management Council
NEFSC	Northeast Fisheries Science Center
NEPA	National Environmental Policy Act
NOAA Fisheries	National Marine Fisheries Service
O&M	operations and maintenance
OCS	Outer Continental Shelf
OnSS	onshore substation
OSS	offshore substation
Project	Revolution Wind Farm Project
Project Area	Proposed Wind Farm Area, Export Cable Corridor, and all onshore project facility locations including the Onshore Transmission Cable Corridor, and Onshore Substation
RIGIS	Rhode Island Geographic Information System
RWEC	Revolution Wind Farm Export Cable
RWEC-RI	Revolution Wind Farm Export Cable-Rhode Island State Waters
RWEC-OCS	Revolution Wind Farm Export Cable-Outer Continental Shelf
RWF	Revolution Wind Farm
TJB	transition joint bay

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U.S.C.	United States Code
WTG	wind turbine generator

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1.0 INTRODUCTION

1.1 Description of the Proposed Action

Revolution Wind, LLC (Revolution Wind), a 50/50 joint venture between Orsted North America Inc. (Orsted NA) and Eversource Investment LLC (Eversource), proposes to construct and operate the Revolution Wind Farm Project (hereinafter referred to as the Project). The wind farm portion of the Project will be located in federal waters on the Outer Continental Shelf (OCS) in the designated Bureau of Ocean Energy Management (BOEM) Renewable Energy Lease Area OCS-A 0486 (Lease Area). The Lease Area is approximately 20 statute miles (mi) (17.4 nautical miles [nm], 30 kilometers [km]) south of the coast of Rhode Island (Figure 1.1-1).

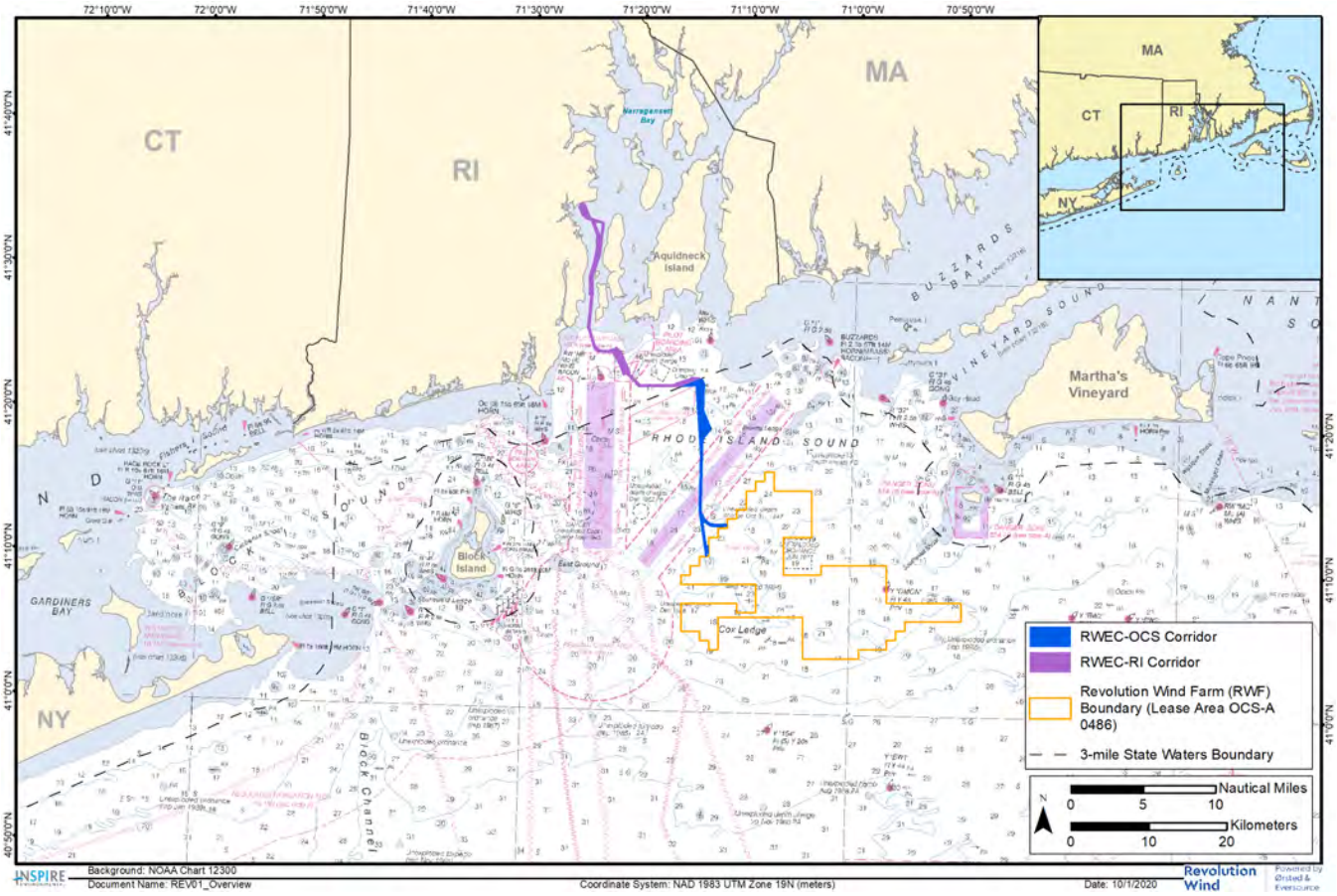

Figure 1.1-1 Map of the Project Area, including the Potential Export Cable Corridor and Revolution Wind Farm.

The Project will be comprised of both offshore and onshore components, which are described in detail in Section 3 of the Construction and Operations Plan.

Offshore:

- up to 100 Wind Turbine Generators (WTGs) connected by a network of Inter-Array Cables (IAC);
- up to two Offshore Substations (OSSs) connected by an OSS-Link Cable; and

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- up to two submarine export cables (referred to as the RWEC), generally co-located within a single corridor.

Onshore:

- a landfall location located at Quonset Point in North Kingstown, Rhode Island (referred to as the Landfall Work Area);
- up to two underground transmission circuits (referred to as the Onshore Transmission Cable), co-located within a single corridor; and
- a new Onshore Substation (OnSS) located adjacent to the existing Davisville Substation with up to two interconnection circuits (overhead or underground) connecting the OnSS to the existing substation.

The Project's components are further grouped into four general categories: the Revolution Wind Farm (RWF), inclusive of the WTGs, OSSs, IAC, and OSS-Link Cable; the RWEC–OCS, inclusive of up to 25 mi (40 km) of the RWEC in federal waters; the RWEC–RI State Waters, inclusive of up to 23 mi (37 km) of the RWEC in state waters; and Onshore Facilities, inclusive of an up to 328-foot (ft) (100-meter [m]) segment of the RWEC, Landfall Work Area, Onshore Transmission Cable, and OnSS (including interconnection circuits). Power from the RWF will be delivered to the electric grid via two distinct transmission cable segments: the RWEC and the Onshore Transmission Cable. The intersect of the RWEC and Onshore Transmission Cable will occur at co-located transition joint bays (TJBs), which will be located at the Landfall Work Area. Multiple landfall sites are currently being evaluated within the Landfall Work Area.

The Project will be commissioned and operational by end of Q4 2023. Revolution Wind assumes all permits will be obtained in Q3 2022. It is further assumed construction will begin by the end of Q3 2022 with installation of the onshore components and initiation of seabed preparation activities (clearing of debris and obstructions).

1.2 Regulatory Context and Resource Definition

Coastal and marine natural resources in the United States are governed and managed by multiple entities at the federal, state, interstate, and tribal level. The Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), passed in 1976, established eight regional fishery management councils for the conservation and management of fisheries from 3 to 200 miles (4.8 to 322 km, 2.6 to 133.8 nm) off the U.S. coast. Fisheries and stocks within 3 nm (5.6 km) of shore are managed by state governments. In the greater Atlantic region, management of certain fisheries that are shared coastal resources is coordinated through the Atlantic States Marine Fisheries Commission (ASMFC). The MSFCMA was revised and amended in 1996 with the passage of the Sustainable Fisheries Act to strengthen conservation and increase the focus on sustainability, in part by requiring the identification of essential fish habitat (EFH) (16 United States Code [U.S.C.] 1801-1884). The MSFCMA was again revised and reauthorized in 2007, with additional conservation and management requirements to further the effort against overfishing, support conservation, and improve fisheries science research (16 U.S.C. 1801-1884).

The MSFCMA was established, along with other goals, to promote the protection of EFH in the review of projects conducted under federal permits, licenses, or other authorities that affect or have the potential to affect such habitat. EFH is defined in the MSFCMA as those waters (e.g., aquatic areas and their associated physical, chemical, and biological properties used by fish) and substrate (e.g., sediment, hard bottom, underlying structures, and associated biological communities) necessary for the spawning, feeding, or growth to maturity of managed fish species. Managed species include marine, estuarine, and anadromous finfish; mollusks; and crustaceans.

1.3 Regulatory Coordination and Required Permits

Federal agencies that authorize, fund, or undertake activities that may adversely affect EFH must consult with the National Oceanic Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries). An adverse effect includes direct or indirect physical, chemical, or biological alterations, including changes to waters or substrate, species and their habitat, other ecosystem components, or the quality and/or quantity of EFH. Although

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absolute criteria have not been established for conducting EFH consultations, the guidelines issued by NOAA Fisheries recommend consolidated EFH consultations with interagency coordination procedures required by other statutes, such as the National Environmental Policy Act (NEPA) or the Endangered Species Act (ESA), to reduce duplication and improve efficiency. Generally, the EFH consultation process includes the following steps:

1. Notification – The action agency provides notification of the action to NOAA Fisheries.
2. EFH Assessment – The action agency prepares and submits an EFH Assessment that includes both identification of affected EFH and an assessment of effects. Required elements of the assessment include a description of the proposed action; an analysis of the potential adverse effects of that action on EFH and the managed species; the federal action agency's conclusions regarding the effects of the action on EFH; and proposed environmental protection measures, if applicable.
3. EFH Conservation Recommendations – After reviewing the EFH Assessment, NOAA Fisheries provides recommendations to the action agency regarding measures that can be taken by that agency to conserve EFH.
4. Agency Response – Within 30 days of receiving the recommendations, the action agency must respond to NOAA Fisheries with information on how it will proceed with the action. The response must include a description of measures proposed by the agency to avoid, mitigate, or offset the impact of the activity on EFH. For any conservation recommendation that is not adopted, the action agency must explain its reason to NOAA Fisheries for not following the recommendation.

This technical report was prepared to provide federal permitting authorities (e.g., BOEM, ACOE) with the information necessary to complete EFH consultation with NOAA Fisheries, as well as to facilitate BOEM's review of the Project under NEPA.

1.4 Contents of This Technical Report

Section 2.0 of this technical report describes the species and life stages with designated EFH, as well as Habitat Areas of Particular Concern (HAPCs), that may occur within the RWF area and/or the RWEC corridor. Potential impacts and environmental protection measures are discussed in Section 3.0.

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2.0 AFFECTED ENVIRONMENT

2.1 Methodology

EFH data and text descriptions were downloaded from the NOAA Habitat Conservation EFH Mapper, an online mapping application (NOAA Fisheries, 2019a) and supplemented with additional literature sources where necessary. EFH data were queried using GIS software based on RWF and RWEC Project components and manually verified. A 0.5-mile buffer centered on the RWEC route was assumed in order to query the data.

2.2 Baseline Conditions

2.2.1 Offshore

The RI-MA WEA is located offshore on the northeastern Atlantic continental shelf in Rhode Island Sound. The waters in the vicinity of the RWF and RWEC are transitional waters that separate Narragansett Bay and Long Island Sound from the outer continental shelf (OCS). Organisms that inhabit in these areas are adapted to survive in this dynamic environment. In general, the benthic communities of these OCS areas are diverse, with lower densities of organisms than in the northern portion of the Mid-Atlantic Bight and in deeper areas of the OCS (MMS, 2007). The RI-MA WEA is composed of a mix of soft and hard bottom environments defined by dominant sediment grain size and composition. Due to light requirements, SAV beds are limited to shallower depths and thus, do not occur within the RI-MA WEA. However, SAV beds are found in parts of Narragansett Bay, Rhode Island, through which the RWEC-RI transits before making landfall.

Based on data from site-specific benthic habitat surveys conducted for the Project (Benthic Assessment; INSPIRE Environmental, 2020), across the vast majority of the RWEC-OCS and the northern region of the RWF, the predominant habitat type was sand sheet, aside from a cluster of 4 stations in the northern center of the RWF that consisted of a variety of habitat types including patchy pebbles on sand with mobile gravel, patchy cobbles and boulders on sand, and sand with mobile gravel. Other regions of the RWF such as the southwest region of the RWF and the central and southern portions of the RWF, tended to have more heterogeneous habitat types composed of patchy pebbles on sand with mobile gravel, patchy cobbles on sand, and patchy boulders on sand. As a result of the more heterogeneous physical composition and generally coarser substrates, these benthic environments harbored more diverse epifaunal assemblages compared to the northern region of the RWF and the RWEC-OCS stations.

In general, stations sampled along the RWEC-RI were low in environmental complexity, consisting mainly of sand sheet habitat type. The exception was stations located in central Narragansett Bay, which were characterized by the Coastal and Marine Ecological Classification Standard (CMECS) Biotic Subclass Attached Fauna and included the habitat types of mollusk bed (or shells) on mud and patchy cobbles on sand. Along the RWEC-RI there were spatial trends associated with the observed biological and physical features. The up-estuary stations were generally characterized by finer substrate, dominated by soft-sediment fauna, higher turbidity, and more reduced sediments. The mid-bay stations were characterized by mussel and *Crepidula* beds with other attached organisms including barnacles, sponges, and macroalgae. The stations at the mouth of Narragansett Bay and the stations leading offshore to the 3-mile state water boundary were generally dominated by soft sediment infauna.

Benthic communities have experienced increased water temperatures in the Project Area in the past several decades, and average pH is expected to continue to decline as seawater becomes more saturated with carbon dioxide (Saba et al., 2016). Acidification of seawater is associated with decreased survival and health of organisms with calcareous shells (such as the Atlantic scallop, blue clam, and hard clam), but less is known about direct effects of acidification on cartilaginous and bony fishes.

Modeled scenarios of decreasing seawater pH predict a substantial decline in the harvestable stock of the Atlantic scallop, with collateral loss of economic value (Rheuban et al., 2018). Numerous benthic and pelagic species are predicted to shift their ranges northward and into deeper waters in response to increasing water temperatures

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(Selden et al., 2018; Kleisner et al., 2017). The ranges of dozens of groundfish species in New England waters have shifted northward and into deeper waters in response to increasing water temperatures (Pinsky et al., 2013; Nye et al., 2009) and more species are predicted to follow (Selden et al., 2018; Kleisner et al., 2017). The black sea bass, identified as particularly sensitive to habitat alteration (Guida et al., 2017), has been increasing in abundance over the past several years, and is expected to continue its expansion in southern New England as water temperatures increase (Kuffner, 2018; McBride et al., 2018). Several pelagic forage species have been increasing in the Project Area, including butterfish, scup, squid (Collie et al., 2008) and Atlantic mackerel (McManus et al., 2018). Perhaps counterintuitively, distributions of other species are reported to be shifting southward, including spiny dogfish, little skate, and silver hake (Walsh et al., 2015). It has been suggested that the spiny dogfish may replace the Atlantic cod as a major predator in southern New England as the cod is driven north by warm waters that the spiny dogfish tolerates well (Selden et al., 2018). Further temperature increases in southern New England are expected to exceed the global ocean average by at least a factor of two, and ocean circulation patterns are projected to change (Saba et al., 2016). Distributional shifts are occurring in both demersal and pelagic species, perhaps mediated by changes in spawning locations and dates (Walsh et al., 2015). Southern species, including some highly migratory species such as mahi that prefer warmer waters, are expected to follow the warming trend and become more abundant in the area (Walsh et al., 2015; South Atlantic Fishery Management Council, 2003). Climate change may also be affecting the migrations of anadromous fish in the region. The herrings, shad, and sturgeon were identified as having high biological sensitivity to adverse effects of climate change (Hare et al., 2016). In addition to physiological effects of temperature and pH, anadromous fishes face a physical risk caused by flooding in their spawning rivers.

Modeling predicts that bottom temperatures in southern New England will become too warm to support larval development of the commercially valuable American lobster, causing this species to move offshore and northward (Rheuban et al., 2017). Lobster catches have declined in recent decades, which may be attributable to increases water temperatures and associated increases in shell disease (Groner et al., 2018; Jaini et al., 2018; Collie and King, 2016; Wahle et al., 2015). Egg-bearing female lobsters occur in warm coastal water in spring but may aggregate offshore for spawning where waters are cooler and strong currents are favorable for larval transport (Carloni et al., 2018). Larval lobster may be transported from Georges Bank to Rhode Island waters by currents along the continental shelf during the 2 to 9 weeks of development to recruitment size (Carloni et al., 2018).

2.2.2 Coastal

The RWEC will make landfall at Quonset Point in North Kingstown, Rhode Island, where multiple locations for the Landfall Work Area are being evaluated. Given that multiple locations are under consideration, a Landfall Envelope has been identified to characterize the range of baseline conditions that may be affected by the Landfall Work Area. Coastal habitats within the Landfall Envelope and vicinity include coastal beach, coastal dune, and tidal salt marsh habitats (Figure 2-2-1). These habitats were delineated, photographed, characterized, and mapped during 2019 and 2020 field surveys to identify baseline conditions (Onshore Natural Resources & Biological Assessment; VHB, 2020).

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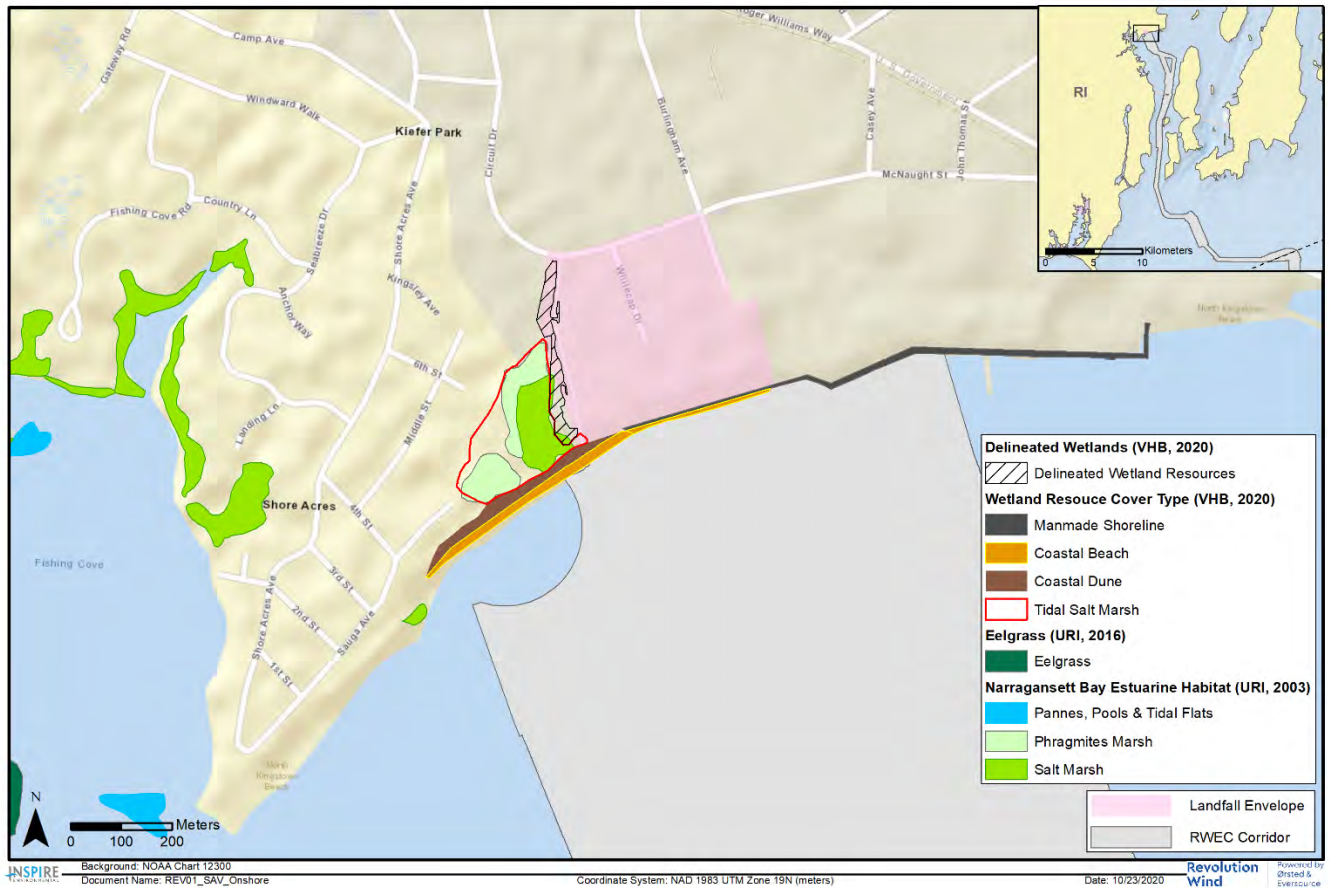

Figure 2.2-1 Tidally-influenced Habitats within the Project Area

Most of the coastal habitats in the area proximate to the Landfall Envelope are disturbed from previous anthropogenic uses. At Blue Beach, the open beach habitat consists of sand and the dune vegetation is made up of American beach grass (*Ammophila breviligulata*), seaside goldenrod (*Solidago sempervirens*), rough cocklebur (*Xanthium strumarium*), prickly lettuce (*Lactuca serriola*), switch grass (*Panicum virgatum*), spotted knapweed (*Centaurea stoebe*), orangegrass (*Hypericum gentianoides*), common evening-primrose (*Oenothera biennis*), and spearscale orache (*Atriplex patula*). Non-native plant species were observed within the coastal beach and coastal dune area, but none of these species are documented as invasive. The landward side of the coastal dune at Blue Beach transitions to tidal salt marsh. This wetland is likely infrequently inundated during extremely high tides and storm surge events. The central area of the marsh bordering Blue Beach is dominated by saltmeadow cordgrass (*Spartina patens*) and the perimeter is mostly composed of common reed (*Phragmites australis*), maritime marsh-elder (*Iva frutescens*) and groundsel tree (*Bacharis halimifolia*). The common reed that occurs along the perimeter of the tidal salt marsh is considered invasive. A tidal channel (potentially manmade) flows through the length of the saltmarsh and connects to the inland freshwater forested swamp near the Blue Beach access path from Circuit Drive.

Th eastern reach of Blue Beach has been altered with a seawall and riprap revetment such that the sandy beach is exposed only during low tides. Vegetation that occurs at the base of the seawall and along the top of the seawall includes spotted knapweed, common milkweed (*Asclepias syriaca*), prickly lettuce, and American pokeweed (*Phytolacca americana*). Spotted knapweed is a weedy invasive species that occurs along the top of the seawall.

2.2.3 Essential Fish Habitat Designations

Within the RWF area, 40 species of fish and invertebrates have designated EFH for various life stages (Table 2.2-1). Within the 0.5-mile (800-m) corridor around the RWEC centerline, 39 species of fish and invertebrates have

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designated EFH with the RWEC-OCS, and 32 species have designated EFH within the RWEC-RI. Full descriptions of each of these species and life stages are provided in Section 2.2.5.

Table 2.2-1 EFH Designations for Species in the RWF and RWEC

Table 2.2-1			
Species	**Life Stages within RWF**	**Life Stages within RWEC-OCS**	**Life Stages within RWEC-RI**
New England Finfish			
Atlantic cod (*Gadus morhua*)	Egg, Larvae, Juvenile, Adult	Egg, Larvae, Juvenile, Adult	Egg, Larvae, Juvenile Adult
Atlantic herring (*Clupea harengus*)	Larvae, Juvenile, Adult	Larvae, Juvenile, Adult	Larvae, Juvenile, Adult
Atlantic wolfish (*Anarhichas lupus*)	Egg, Larvae, Juvenile, Adult	-	-
Haddock (*Melanogrammus aeglefinus*)	Egg, Larvae, Juvenile	Larvae, Juvenile	-
Monkfish (*Lophius americanus*)	Egg, Larvae, Juvenile, Adult	Egg, Larvae, Juvenile, Adult	Egg, Larvae
Ocean pout (*Zoarces americanus*)	Egg, Juvenile, Adult	Egg, Juvenile, Adult	Egg, Juvenile, Adult
Pollock (*Pollachius virens*)	Egg, Larvae, Juvenile	Egg, Larvae, Juvenile	Juvenile
Red hake (*Urophycis chuss*)	Egg, Larvae, Juvenile, Adult	Egg, Larvae, Juvenile, Adult	Egg, Larvae, Juvenile, Adult
Silver hake (*Merluccius bilinearis*)	Egg, Larvae, Juvenile, Adult	Egg, Larvae, Juvenile, Adult	Egg, Larvae, Adult
White hake (*Urophycis tenuis*)	Larvae, Juvenile	Larvae, Juvenile	Juvenile
Windowpane flounder (*Scophthalmus aquosus*)	Egg, Larvae, Juvenile, Adult	Egg, Larvae, Juvenile, Adult	Egg, Larvae, Juvenile, Adult
Winter flounder (*Pseudopleuronectes americanus*)	Larvae, Juvenile, Adult	Larvae, Juvenile, Adult	Egg, Larvae, Juvenile, Adult
Witch flounder (*Glyptocephalus cynoglossus*)	Egg, Larvae	Egg, Larvae	-
Yellowtail flounder (*Limanda ferruginea*)	Egg, Larvae, Juvenile, Adult	Egg, Larvae, Juvenile, Adult	Juvenile, Adult
Mid-Atlantic Finfish			
Atlantic butterfish (*Peprilus triacanthus*)	Egg, Larvae, Juvenile, Adult	Egg, Larvae, Juvenile, Adult	Egg, Larvae, Juvenile, Adult
Atlantic mackerel (*Scomber scombrus*)	Egg, Larvae, Juvenile	Egg, Larvae, Juvenile	Egg, Larvae, Juvenile, Adult
Black sea bass (*Centropristis striata*)	Juvenile, Adult	Juvenile, Adult	Juvenile, Adult
Bluefish (*Pomatomus saltatrix*)	Egg, Larvae, Juvenile, Adult	Egg, Larvae, Juvenile, Adult	Juvenile, Adult
Scup (*Stenotomus chrysops*)	Juvenile, Adult	Juvenile, Adult	Egg, Larvae, Juvenile, Adult
Summer flounder (*Paralichthys dentatus*)	Egg, Larvae, Juvenile, Adult	Egg, Larvae, Juvenile, Adult	Larvae, Juvenile, Adult
Invertebrates			
Atlantic sea scallop (*Placopecten magellanicus*)	Egg, Larvae, Juvenile, Adult	Egg, Larvae, Juvenile, Adult	Egg, Larvae, Juvenile, Adult
Atlantic surfclam (*Spisula solidissima*)	-	Adult	Juvenile, Adult
Longfin inshore squid (*Doryteuthis pealeii*)	Egg, Juvenile, Adult	Egg, Juvenile, Adult	Egg, Juvenile, Adult
Northern shortfin squid (*Illex illecebrosus*)	Adult	-	-
Ocean quahog (*Arctica islandica*)	Juvenile, Adult	Juvenile, Adult	-
Highly Migratory Species			
Albacore tuna (*Thunnus alalunga*)	Juvenile, Adult	Juvenile, Adult	Juvenile
Bluefin tuna (*Thunnus thynnus*)	Juvenile, Adult	Juvenile, Adult	Juvenile, Adult
Skipjack tuna (*Katsuwonus pelamis*)	Juvenile, Adult	Adult	Adult
Yellowfin tuna (*Thunnus albacares*)	Juvenile, Adult	Juvenile, Adult	Juvenile
Skates			

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Table 2.2-1			
Species	**Life Stages within RWF**	**Life Stages within RWEC-OCS**	**Life Stages within RWEC-RI**
Little skate (*Leucoraja erinacea*)	Juvenile, Adult	Juvenile, Adult	Juvenile, Adult
Winter skate (*Leucoraja ocellata*)	Juvenile, Adult	Juvenile, Adult	Juvenile, Adult
Sharks			
Basking shark (*Cetorhinus maximus*)	Neonate, Juvenile, Adult	Neonate, Juvenile, Adult	-
Blue shark (*Prionace glauca*)	Neonate, Juvenile, Adult	Neonate, Juvenile, Adult	-
Common thresher shark (*Alopias vulpinus*)	Neonate, Juvenile, Adult	Neonate, Juvenile, Adult	Neonate, Juvenile, Adult
Dusky shark (*Carcharhinus obscurus*)	Neonate, Juvenile, Adult	Neonate, Juvenile, Adult	-
Sand tiger shark (*Carcharias taurus*)	Neonate, Juvenile	Neonate, Juvenile	Neonate, Juvenile
Sandbar shark (*Carcharhinus plumbeus*)	Juvenile, Adult	Juvenile, Adult	Juvenile, Adult
Shortfin mako shark (*Isurus oxyrinchus*)	Neonate, Juvenile, Adult	Neonate, Juvenile, Adult	-
Smoothhound shark complex (Atlantic stock) (*Mustelus canis*)	Neonate, Juvenile, Adult	Neonate, Juvenile, Adult	Neonate, Juvenile, Adult
Spiny dogfish (*Squalus acanthias*)	Sub-adult male, Sub-adult female, Adult male, Adult female	Sub-adult male, Sub-adult female, Adult male, Adult female	Sub-adult female, Adult male
White shark (*Carcharodon carcharias*)	Neonate, Juvenile, Adult	Neonate, Juvenile, Adult	Neonate

2.2.4 Habitat Areas of Particular Concern

Within the areas designated as EFH for various species, particular areas termed Habitat Areas of Particular Concern (HAPCs) are also identified. HAPCs are discrete subsets of EFH that provide extremely important ecological functions or are especially vulnerable to degradation, but this designation does not confer any particular protections.

The RWEC-RI corridor crosses HAPC for juvenile Atlantic cod in Rhode Island state waters. The juvenile cod HAPC is a subset of the area designated as juvenile cod EFH, and is defined as the inshore areas of the Gulf of Maine and Southern New England between 0 to 66 feet (0 to 20 m), relative to mean high water, as shown in Map 245 of the Final Omnibus EFH Amendment 2 (New England Fishery Management Council [NEFMC], 2017). This HAPC contains structurally complex rocky-bottom habitat that provides juvenile cod with protection from predation and supports a wide variety of prey items (NEFMC, 2017).

Maps for summer flounder HAPC are not available for the Project Area, but it is defined as all native species of macroalgae, seagrasses, and freshwater and tidal macrophytes in any size bed, as well as loose aggregations, within adult and juvenile summer flounder EFH. Juvenile and adult summer flounder EFH is present within the RWF area, RWEC-OCS, and RWEC-RI, but summer flounder HAPC, if present, is most likely to occur within Narragansett Bay and nearshore portions of the Project Area. The Project does not cross known areas of submerged aquatic vegetation, but during the site-specific benthic habitat surveys, isolated patches of attached macroflora were observed at four stations along the RWEC in Narraganset Bay. Based on GIS analysis of available eelgrass mapping for Narragansett Bay (Rhode Island Geographic Information System [RIGIS], 2017), a small section of eelgrass is present on the western side of Dutch Island, approximately 679 feet (207 m) from the proposed RWEC cable centerline. The next closest area of mapped eelgrass is on the western side of Conanicut Island, approximately 1,411 feet (430 m) from the RWEC cable centerline. See the Benthic Assessment (INSPIRE Environmental, 2020) for a detailed description of benthic habitats in the Project Area.

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2.2.5 Essential Fish Habitat Species and Life Stages

2.2.5.1 New England Finfish Species

2.2.5.1.1 Atlantic Cod

Atlantic cod have two separate stocks managed by NOAA Fisheries, the Gulf of Maine stock, and the Georges Bank stock. Atlantic cod range from Greenland to Cape Hatteras, North Carolina, but are most common on Georges Bank and in the western Gulf of Maine (NOAA Fisheries, 2019b). Atlantic cod can be found at depths between 32 and 492 feet (10 and 150 m), and spawn near the seafloor from winter to early spring (NOAA Fisheries, 2019b). They are top predators in demersal habitats, and feed on a variety of invertebrates and fish. They prefer muddy, gravelly, or rocky substrates. Atlantic cod are historically an important commercial and recreational species and are still fished at low levels; however, as of the 2017 stock assessment, both stocks are considered overfished, and are currently subject to overfishing (Northeast Fisheries Science Center [NEFSC], 2017a). Atlantic cod EFH designations are listed below for the life stages found within the Project Area. Egg, larvae, juvenile, and adult life stages have EFH within the RWF area, RWEC-OCS corridor, and RWEC-RI corridor.

Eggs: EFH is pelagic habitats in the Gulf of Maine, on Georges Bank, and in the Mid-Atlantic region, as shown on Map 38 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017), and in the high salinity zones of the bays and estuaries listed in Table 19 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017).

Larvae: EFH is pelagic habitats in the Gulf of Maine, on Georges Bank, and in the Mid-Atlantic region, as shown on Map 39 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017), and in the high salinity zones of the bays and estuaries listed in Table 19 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017).

Juveniles: EFH is intertidal and subtidal benthic habitats in the Gulf of Maine, southern New England, and on Georges Bank, to a maximum depth of 394 feet (120 m) (see Map 40 in NEFMC [2017]), including high salinity zones in the bays and estuaries listed in Table 19 of NEFMC (2017). Structurally complex habitats, including eelgrass, mixed sand and gravel, and rocky habitats (gravel pavements, cobble, and boulder) with and without attached macroalgae and emergent epifauna, are essential habitats for juvenile cod. In inshore waters, young-of-the-year juveniles prefer gravel and cobble habitats and eelgrass beds after settlement, but in the absence of predators also utilize adjacent unvegetated sandy habitats for feeding. Survival rates for young-of-the-year cod are higher in more structured rocky habitats than in flat sand or eelgrass; growth rates are higher in eelgrass. Older juveniles move into deeper water and are associated with gravel, cobble, and boulder habitats, particularly those with attached organisms. Gravel is a preferred substrate for young-of-the-year juveniles on Georges Bank and they have also been observed along the small boulders and cobble margins of rocky reefs in the Gulf of Maine.

Adults: EFH is subtidal benthic habitats in the Gulf of Maine, south of Cape Cod, and on Georges Bank, between 98 and 525 feet (30 and 160 m) (see Map 41 in NEFMC [2017]), including high salinity zones in the bays and estuaries listed in Table 19 of NEFMC (2017). Structurally complex hard bottom habitats composed of gravel, cobble, and boulder substrates with and without emergent epifauna and macroalgae are essential habitats for adult cod. Adult cod are also found on sandy substrates and frequent deeper slopes of ledges along shore. South of Cape Cod, spawning occurs in nearshore areas and on the continental shelf, usually in depths less than 230 feet (70 m).

2.2.5.1.2 Atlantic Herring

Atlantic herring are managed in one stock complex encompassing Georges Bank and the Gulf of Maine, with two major spawning components. Atlantic herring are a small schooling fish found on both sides of the North Atlantic. In the western North Atlantic, Atlantic herring range from Labrador, Canada to Cape Hatteras, North Carolina (NOAA Fisheries, 2019c) and are highly concentrated in Georges Bank, the Gulf of Maine, and Nantucket Shoals (Reid et al., 1999). In the region of interest, Atlantic herring are typically present in the winter at average depths of about 120 to 360 feet (36 to 110 m) (Collette and Klein-MacPhee, 2002). They feed on zooplankton, krill, and fish larvae, and are an important species in the food web of the northwest Atlantic (NOAA Fisheries, 2019c). Spawning grounds are limited to rocky, gravelly, or pebbly bottom and on clay, from 12 to 180 feet (3 to 55 m) deep (Collette

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and Klein-MacPhee, 2002). Atlantic herring are an important commercial fishery in New England and their stock biomass is currently well above target levels (NOAA Fisheries, 2019c). According to the 2018 stock assessment, Atlantic herring are not overfished, and not currently subject to overfishing (NEFSC, 2018a).

The Atlantic herring EFH designations are reproduced below for the life stages found within the Project Area. Larvae, juvenile, and adult life stages have EFH within the RWF area, RWEC-OCS corridor, and RWEC-RI corridor.

Larvae: EFH is inshore and offshore pelagic habitats in the Gulf of Maine, on Georges Bank, and in the upper Mid-Atlantic Bight, as shown on Map 99 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017), and in the bays and estuaries listed in Table 30 of NEFMC (2017). 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.

Juveniles: EFH is intertidal and subtidal pelagic habitats to 984 feet (300 m) throughout the region, as shown on Map 100 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017), including the bays and estuaries listed in Table 30 of NEFMC (2017). 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 37 to 59 °F (3 to 15 °C) in the northern part of their range and as high as 72 °F (22 °C) in the Mid-Atlantic. Young-of-the-year juveniles can tolerate low salinities, but older juveniles avoid brackish water.

Adults: EFH is subtidal pelagic habitats with maximum depths of 984 feet (300 m) throughout the region, as shown on Map 100 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017), including the bays and estuaries listed in Table 30 of NEFMC (2017). 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 328 feet (100 m) and—unless they are preparing to spawn—usually remain near the surface. They generally avoid water temperatures above 50 °F (10 °C) and low salinities. Spawning takes place on the bottom, generally in depths of 41–194 feet (5–90 m) on a variety of substrates.

2.2.5.1.3 Atlantic Wolffish

The Atlantic wolffish is found on both sides of the North Atlantic and infrequently in the Arctic. In the northwestern Atlantic, they range from Davis Strait, Canada, to Cape Hatteras, North Carolina (Fisheries and Oceans Canada, 2018a). In U.S. waters, the species is managed as a single stock. Atlantic wolffish prefer colder water temperatures and prey mainly on brittle stars, sea urchins, crabs, and shrimp (Fisheries and Oceans Canada, 2018a). Adult Atlantic wolffish generally move inshore to spawn during the spring and summer, establishing nesting sites on boulders and in rocky crevices, which are guarded by the males until the eggs hatch in late summer and early fall (Fisheries and Oceans Canada, 2018a). According to the 2017 stock assessment, Atlantic wolffish are overfished and not currently experiencing overfishing (NEFSC, 2017a).

The Atlantic wolffish EFH designations are reproduced below for the life stages found within the Project Area. Egg, larvae, juvenile, and adult life stages have EFH within the RWF area.

Eggs: EFH is subtidal benthic habitats at depths less than 328 feet (100 m) within the geographic area shown on Map 43 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017). Wolffish egg masses are hidden under rocks and boulders in nests.

Larvae: EFH is pelagic and subtidal benthic habitats within the geographic area shown on Map 43 of NEFMC (2017). Atlantic wolffish larvae remain near the bottom for up to six days after hatching, but gradually become more buoyant as the yolk sac is absorbed.

Juveniles: EFH is subtidal benthic habitats at depths of 230 to 604 feet (70 to 184 m) within the geographic area shown on Map 43 of NEFMC (2017). Juvenile Atlantic wolffish do not have strong substrate preferences.

Adults: EFH is subtidal benthic habitats at depths less than 568 feet (173 m) within the geographic area shown on Map 43 of NEFMC (2017). Adult Atlantic wolffish have been observed spawning and guarding eggs in rocky habitats

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in less than 98 feet (30 m) of water in the Gulf of St. Lawrence and Newfoundland and in deeper (164 to 328 feet [50 to100 m]) boulder reef habitats in the Gulf of Maine. Egg masses have been collected on the Scotian Shelf in depths of 328 to 426 feet (100 to 130 m), indicating that spawning is not restricted to coastal waters. Adults are distributed over a wider variety of sand and gravel substrates once they leave rocky spawning habitats, but are not caught over muddy bottom.

2.2.5.1.4 Haddock

In the western North Atlantic, haddock range from Newfoundland to Cape May, New Jersey, with the highest abundance on Georges Bank and in the Gulf of Maine (NOAA Fisheries, 2019d). Haddock in U.S. waters are managed as two stocks: the Gulf of Maine stock and the Georges Bank stock. Haddock are found at depths ranging from 59 to 1,148 feet (15 to 350 m) and there is a very minimal seasonal difference between depths aside from a slightly wider range of depths in the fall (Cargnelli et al., 1999a). Haddock prefer gravely, pebbly, clay, and sandy substrates and avoid ledges and large rocks (Collette and Klein-MacPhee, 2002). They spawn on eastern Georges Bank, to the east of Nantucket Shoals, and along the Maine coast between January and June (NOAA Fisheries, 2019d). Haddock prey items include mollusks, worms, crustaceans, sea stars, sea urchins, sand dollars, brittle stars, fish eggs, and occasionally small fish such as herring (NOAA Fisheries, 2019d). Adults sometimes eat small fish, especially herring. As of the 2017 stock assessment, the Georges Bank and Gulf of Maine stocks are not overfished and are not subject to overfishing (NEFSC, 2017a).

The haddock EFH designations are reproduced below for the life stages found within the Project Area. Egg, larvae, and juveniles have EFH within the RWF area, and larvae and juveniles have EFH within the RWEC-OCS corridor.

Eggs: EFH is pelagic habitats in coastal and offshore waters in the Gulf of Maine, southern New England, and on Georges Bank, as shown on Map 44 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017).

Larvae: EFH is pelagic habitats in coastal and offshore waters in the Gulf of Maine, the Mid-Atlantic, and on Georges Bank, as shown on Map 45 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017).

Juveniles: EFH is subtidal benthic habitats between 131 and 459 feet (40 and 140 m) in the Gulf of Maine, on Georges Bank and in the Mid-Atlantic region, and as shallow as 66 feet (20 m) along the coast of Massachusetts, New Hampshire, and Maine, as shown on Map 46 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017). Young-of-the-year juveniles settle on sand and gravel on Georges Bank, but are found predominantly on gravel pavement areas within a few months after settlement. As they grow, they disperse over a greater variety of substrate types on the bank. Young-of-the-year haddock do not inhabit shallow, inshore habitats.

2.2.5.1.5 Monkfish

Monkfish are found in the northwest Atlantic Ocean from the Grand Banks and northern Gulf of St. Lawrence south to Cape Hatteras, NC. In U.S. waters, the monkfish fishery is divided into two management areas, north and south of Georges Bank. According to the 2013 stock assessment, monkfish are not overfished and are not subject to overfishing in either management area (NEFSC, 2013). Monkfish can tolerate a wide range of temperatures and depths, and migrate seasonally to spawn and feed (NOAA Fisheries, 2019e). Monkfish are present from summer to fall from the tideline down to 2,160 feet (658 m) (Collette and Klein-MacPhee, 2002). Monkfish prefer hard sand, pebbly bottom, gravel, and broken shells for their habitats (Collette and Klein-MacPhee, 2002). Monkfish spawn from February to October, producing very large buoyant mucoidal egg “veils.” They are opportunistic feeders with prey including a wide range of benthic and pelagic fish and invertebrate species along with sea birds, and diving ducks. Monkfish ambush their prey through rapidly opening their mouth, creating a vacuum, and sucking the prey into their needle-like, backward curving teeth (NOAA Fisheries, 2019e). They also have a small, dangling appendage in the back of their mouth to attract small fish.

The monkfish EFH designations are reproduced below for the life stages found within the Project Area. Eggs, larvae, juvenile, and adult life stages have EFH within the RWF area and RWEC-OCS corridor. In the RWEC-RI corridor, only EFH for eggs and larvae is present.

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Eggs and Larvae: EFH is pelagic habitats in inshore areas, and on the continental shelf and slope throughout the Northeast region, as shown on Map 82 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017). Monkfish larvae are more abundant in the Mid-Atlantic region and occur over a wide depth range, from the surf zone to depths of 3,281 to 4,921 feet (1,000 to 1,500 m) on the continental slope. Monkfish egg veils and larvae are most often observed during the months from March to September.

Juveniles: EFH is subtidal benthic habitats in depths of 164 to 1,312 feet (50 to 400 m) in the Mid-Atlantic, between 66 and 1,312 feet (20 and 400 m) in the Gulf of Maine, and to a maximum depth of 3,281 feet (1,000 m) on the continental slope, as shown on Map 83 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017). A variety of habitats are essential for juvenile monkfish, including hard sand, pebbles, gravel, broken shells, and soft mud; they also seek shelter among rocks with attached algae. Juveniles collected on mud bottom next to rock-ledge and boulder fields in the western Gulf of Maine were in better condition than juveniles collected on isolated mud bottom, indicating that feeding conditions in these edge habitats are better. Young-of-the-year juveniles have been collected primarily on the central portion of the shelf in the Mid- Atlantic, but also in shallow nearshore waters off eastern Long Island, up the Hudson Canyon shelf valley, and around the perimeter of Georges Bank. They have also been collected as deep as 2,953 feet (900 m) on the continental slope.

Adults: EFH is subtidal benthic habitats in depths of 164 to 1,312 feet (50 to 400 m) in southern New England and Georges Bank, between 66 and 1,312 feet (20 and 400 m) in the Gulf of Maine, and to a maximum depth of 3,281 feet (1,000 m) on the continental slope, as shown on Map 84 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017). EFH for adult monkfish is composed of hard sand, pebbles, gravel, broken shells, and soft mud. They seem to prefer soft sediments (fine sand and mud) over sand and gravel, and, like juveniles, utilize the edges of rocky areas for feeding.

2.2.5.1.6 Ocean Pout

The ocean pout is currently managed in two stocks, northern and southern, and ranges from Labrador, Canada to Virginia (Steimle et al., 1999a). This finfish is typically present in southern New England from late summer to winter. According to the 2017 stock assessment, ocean pout is overfished and is not currently experiencing overfishing (NEFSC, 2017a). Ocean pout are found in habitats that contain sandy mud, “sticky” sand, broken bottom, or pebbles and gravel (Collette and Klein-MacPhee, 2002). Juveniles and adults feed by filtering sediment for prey items, which include polychaetes, mollusks, crustaceans, and echinoderms (Steimle et al., 1999a). They spawn in protected habitats, such as rock crevices and man-made artifacts, where they lay eggs and engage in nest-guarding behavior (Steimle et al., 1999a).

The ocean pout EFH designations are reproduced below for the life stages found within the Project Area. Eggs, juvenile, and adult life stages have EFH within the RWF area, RWEC-OCS corridor, and RWEC-RI corridor.

Eggs: EFH is hard bottom habitats on Georges Bank, in the Gulf of Maine, and in the Mid-Atlantic Bight (see Map 48 in NEFMC [2017]), as well as the high salinity zones of the bays and estuaries listed in Table 20 of NEFMC (2017). Eggs are laid in gelatinous masses, generally in sheltered nests, holes, or rocky crevices. EFH for ocean pout eggs occurs in depths less than 328 feet (100 m) on rocky bottom habitats.

Juveniles: EFH is intertidal and subtidal benthic habitats in the Gulf of Maine and on the continental shelf north of Cape May, New Jersey, on the southern portion of Georges Bank, and in the high salinity zones of a number of bays and estuaries north of Cape Cod, extending to a maximum depth of 394 feet (120 m) (see Map 49 and Table 20 in NEFMC [2017]). EFH for juvenile ocean pout occurs on a wide variety of substrates, including shells, rocks, algae, soft sediments, sand, and gravel.

Adults: EFH is subtidal benthic habitats between 66 and 459 feet (20 and 140 m) in the Gulf of Maine, on Georges Bank, in coastal and continental shelf waters north of Cape May, New Jersey, and in the high salinity zones of a number of bays and estuaries north of Cape Cod (see Map 50 and Table 20 in NEFMC, 2017). EFH for adult ocean pout includes mud and sand, particularly in association with structure-forming habitat types; i.e., shells, gravel, or boulders. In softer sediments, they burrow tail first and leave a depression on the sediment surface. Ocean pout

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congregate in rocky areas prior to spawning and frequently occupy nesting holes under rocks or in crevices in depths less than 328 feet (100 m).

2.2.5.1.7 Pollock

Pollock range throughout the northwestern Atlantic Ocean and are most commonly found on the western Scotian Shelf and in the Gulf of Maine (NOAA Fisheries, 2019f). They spawn multiple times per season between November through February over hard, stony, or rocky ocean bottoms in the Gulf of Maine and on Georges Bank. Smaller pollock in inshore waters prey on small crustaceans and fish, and larger pollock prey predominantly on fish, but their diet also includes euphausiids and mollusks (NOAA Fisheries, 2019f; Cargnelli et al., 1999b). Pollock are a schooling species with a semi-pelagic lifestyle, and they can be found throughout the water column (Cargnelli et al., 1999b). Pollock are managed as a single stock, and according to the 2017 stock assessment, they are not overfished and are not currently subject to overfishing (NEFSC, 2017a).

The pollock EFH designations are reproduced below for the life stages found within the Project Area. Eggs, larvae, and juvenile life stages have EFH within the RWF area and RWEC-OCS corridor. Within the RWEC-RI corridor, EFH is only present for juveniles.

Eggs: EFH is pelagic inshore and offshore habitats in the Gulf of Maine, on Georges Bank, and in southern New England, as shown on Map 51 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017), including the bays and estuaries listed in Table 21 of (NEFMC, 2017).

Larvae: EFH is pelagic inshore and offshore habitats in the Gulf of Maine, on Georges Bank, and in the Mid-Atlantic region, as shown on Map 52 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017), including the bays and estuaries listed in Table 21 of (NEFMC, 2017).

Juveniles: EFH is inshore and offshore pelagic and benthic habitats from the intertidal zone to 591 feet (180 m) in the Gulf of Maine, in Long Island Sound, and Narragansett Bay, between 131 and 591 feet (40 and 180 m) on western Georges Bank and the Great South Channel (see Map 53 in NEFMC [2017]), and in mixed and full salinity waters in a number of bays and estuaries north of Cape Cod (Table 21 in NEFMC [2017]). 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 in the Gulf of Maine. Older juveniles move into deeper water into habitats also occupied by adults.

2.2.5.1.8 Red Hake

Red hake are managed as two stocks, the Gulf of Maine and Northern Georges Bank (northern) stock, and the Southern Georges Bank and Mid-Atlantic (southern) stock (Steimle et al., 1999b; NOAA Fisheries, 2019g). Red hake range from Newfoundland to North Carolina, but are most abundant from the western Gulf of Maine through southern New England waters (NOAA Fisheries, 2019g). During warmer seasons, red hake are common at depths greater than 328 feet (100 m), and during colder months, their depth range is from 90 to 1,214 feet (30 to 370 m) (Steimle et al., 1999b). Red hake prey consists primarily of crustaceans and fish such as haddock, silver hake, sea robins, sand lance, mackerel, and small red hake (NOAA Fisheries, 2019g). This groundfish species prefers deep water environments with bottom habitat consisting of both soft and pebbly substrate. Spawning occurs uniformly from Georges Bank to Nova Scotia and typically occurs nearshore as early as June and continues through fall (Collette and Klein-MacPhee, 2002). According to the 2018 stock assessment, both the northern and southern stocks are not considered overfished and are not currently subject to overfishing (Alade and Traver, 2018).

The red hake EFH designations are reproduced below for the life stages found within the Project Area. Egg, larvae, juvenile, and adult life stages have EFH within the RWF area, RWEC-OCS corridor, and RWEC-RI corridor.

Eggs and Larvae: EFH is pelagic habitats in the Gulf of Maine, on Georges Bank, and in the Mid- Atlantic, as shown on Map 77 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017), and in the bays and estuaries listed in Table 27 of NEFMC (2017).

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Juveniles: EFH is intertidal and subtidal benthic habitats throughout the region on mud and sand substrates, to a maximum depth of 262 feet (80 m), as shown on Map 77 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017), including the bays and estuaries listed in Table 27 of NEFMC (2017). Bottom habitats providing shelter are essential for juvenile red hake, including mud substrates with biogenic depressions, substrates providing biogenic complexity (e.g., eelgrass, macroalgae, shells, anemone and polychaete tubes), and artificial reefs. Newly settled juveniles occur in depressions on the open seabed. Older juveniles are commonly associated with shelter or structure and often found inside live bivalves.

Adults: EFH is benthic habitats in the Gulf of Maine and the outer continental shelf and slope in depths of 164 to 2,461 feet (50 to 750 m) (see Map 78 in NEFMC [2017]) and as shallow as 66 feet (20 m) in a number of inshore estuaries and embayments (see Table 27 in NEFMC [2017]) as far south as Chesapeake Bay. Shell beds, soft sediments (mud and sand), and artificial reefs provide essential habitats for adult red hake. They are usually found in depressions in softer sediments or in shell beds and not on open sandy bottom. In the Gulf of Maine, they are much less common on gravel or hard bottom, but they are reported to be abundant on hard bottoms in temperate reef areas of Maryland and northern Virginia.

2.2.5.1.9 Silver Hake

Two stocks of silver hake are managed in U.S. waters, the Gulf of Maine and Northern Georges Bank (northern) stock and the Southern Georges Bank and Mid-Atlantic (southern) stock, which includes southern silver hake and offshore hake (NOAA Fisheries, 2019h). Silver hake are found from Cape Sable, Nova Scotia to Cape Hatteras, North Carolina and are concentrated in deep basins in the Gulf of Maine and along the continental slope in winter and spring. White hake are voracious nocturnal feeders, preying on fish, crustaceans and squid (NOAA Fisheries, 2019h; Lock and Packer, 2004). White hake spawn along the coast of the Gulf of Maine from Cape Cod to Grand Manan Island, on southern and southeastern Georges Bank, and in southern New England to the south of Martha's Vineyard (NOAA Fisheries, 2019h). Peak spawning occurs from May to June in the southern area of their range, and from July to August in the northern area of their range (NOAA Fisheries, 2019h). The 2018 stock assessment concluded that the both the northern and southern stock are not overfished and are not currently subject to overfishing (Alade and Traver, 2018).

The silver hake EFH designations are reproduced below for the life stages found within the Project Area. Eggs, larvae, juvenile, and adult life stages have EFH within the RWF area and RWEC-OCS corridor. Within the RWEC-RI corridor, EFH is designated for eggs, larvae, and adults.

Eggs and Larvae: EFH is pelagic habitats from the Gulf of Maine to Cape May, New Jersey, including Cape Cod and Massachusetts Bays (see Map 74 and Table 26 in NEFMC [2017]).

Juveniles: EFH is pelagic and benthic habitats in the Gulf of Maine, including the coastal bays and estuaries listed in Table 26 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017), and on the continental shelf as far south as Cape May, New Jersey, at depths greater than 33 feet (10 m) in coastal waters in the Mid-Atlantic and between 131 and 1,312 feet (40 and 400 m) in the Gulf of Maine, on Georges Bank, and in the middle continental shelf in the Mid-Atlantic, on sandy substrates (see Map 75 in NEFMC [2017]). Juvenile silver hake are found in association with sand-waves, flat sand with amphipod tubes, and shells, and in biogenic depressions. Juveniles in the New York Bight settle to the bottom at mid-shelf depths on muddy sand substrates and find refuge in amphipod tube mats.

Adults: EFH is pelagic and benthic habitats at depths greater than 115 feet (35 m) in the Gulf of Maine and the coastal bays and estuaries listed in Table 26 of NEFMC (2017), between 230 and 1,312 feet (70 and 400 m) on Georges Bank and the outer continental shelf in the northern portion of the Mid-Atlantic Bight, and in some shallower locations nearer the coast, on sandy substrates (see Map 76 of NEFMC [2017]). Adult silver hake are often found in bottom depressions or in association with sand waves and shell fragments. They have also been observed at high densities in mud habitats bordering deep boulder reefs, resting on boulder surfaces, and foraging over deep boulder reefs in the southwestern Gulf of Maine. This species makes greater use of the water column (for feeding, at night) than red or white hake.

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2.2.5.1.10 White Hake

White hake range from the Gulf of St. Lawrence to the Mid-Atlantic Bight, and the population is divided into two stocks: a Canadian stock primarily occurring in the Gulf of St. Lawrence and Scotian Shelf, and a U.S. stock primarily occurring in the Gulf of Maine and on Georges Bank. Their range also includes estuaries along the continental shelf to the submarine canyons of the upper continental slope, as well as the deep, muddy basins of the Gulf of Maine (Chang et al., 1999a). Early juveniles are pelagic before settling to muddy and fine-grained sandy bottom or eelgrass habitats. Older juveniles feed on polychaetes, shrimps, and other crustaceans. Adults are demersal, prefer fine grained, muddy substrates, and feed predominantly on fish (Chang et al., 1999a). The timing and extent of spawning in southern New England waters is not well defined, but is thought to occur in early spring in deep waters along the continental slope (Chang et al., 1999a). The most recent stock assessment for the U.S. stock of white hake concluded that the stock is not overfished and not currently subject to overfishing (NEFSC, 2017a).

The white hake EFH designations are reproduced below for the life stages found within the Project Area. Larvae and juvenile life stages have EFH within the RWF area and RWEC-OCS corridor. Within the RWEC-RI corridor, only EFH for juveniles is present.

Larvae: EFH is pelagic habitats in the Gulf of Maine, in southern New England, and on Georges Bank, as shown in Map 56 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017). Early stage white hake larvae have been collected on the continental slope, but cross the shelf-slope front and use nearshore habitats for juvenile nurseries. Larger larvae and pelagic juveniles have been found only on the continental shelf.

Juveniles: EFH is intertidal and subtidal estuarine and marine habitats in the Gulf of Maine, on Georges Bank, and in southern New England, including mixed and high salinity zones in a number of bays and estuaries north of Cape Cod (see Table 22 in NEFMC [2017]), to a maximum depth of 984 feet (300 m) (see Map 57 in NEFMC [2017]). Pelagic phase juveniles remain in the water column for about 2 months. In nearshore waters, EFH for benthic phase juveniles occurs on fine-grained, sandy substrates in eelgrass, macroalgae, and un-vegetated habitats. In the Mid-Atlantic, most juveniles settle to the bottom on the continental shelf, but some enter estuaries, especially those in southern New England. Older young-of-the-year juveniles occupy the same habitat types as the recently-settled juveniles but move into deeper water (>164 feet [50 m]).

2.2.5.1.11 Windowpane Flounder

The windowpane flounder range extends from the Gulf of St. Lawrence to Florida, but the species is most abundant from Georges Bank to Chesapeake Bay (Chang et al., 1999b). Windowpane flounder is managed as two stocks: the Gulf of Maine-Georges Bank (northern) stock and the Southern New England-Middle Atlantic Bight (southern) stock. Windowpane flounder spawning is thought to begin in February or March in inshore waters, peaking in the Mid-Atlantic Bight in May, and extending into Georges Bank during the summer (Chang et al., 1999b). Windowpane flounder typically prefer sandy bottom habitats and range from just below the tide line to 150 feet (46 m) deep (Collette and Klein-MacPhee, 2002). They feed on small crustaceans and various fish larvae, including hakes and tomcod (Chang et al., 1999b). The 2017 stock assessments concluded that the northern stock of windowpane flounder is overfished, but not currently experiencing overfishing, and the southern stock is not overfished and not experiencing overfishing (NEFSC, 2017a).

The windowpane flounder EFH designations are reproduced below for the life stages found within the Project Area. Egg, larvae, juvenile, and adult life stages have EFH within the RWF area, RWEC-OCS corridor, and RWEC-RI corridor.

Eggs and Larvae: EFH is pelagic habitats on the continental shelf from Georges Bank to Cape Hatteras and in mixed and high salinity zones of coastal bays and estuaries throughout the region (see Map 59, Map 60, and Table 23 in NEFMC [2017]).

Juveniles: EFH is intertidal and subtidal benthic habitats in estuarine, coastal marine, and continental shelf waters from the Gulf of Maine to northern Florida, as shown on Map 61 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017), including mixed and high salinity zones in the bays and estuaries listed in Table 23 of NEFMC (2017). EFH

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for juvenile windowpane flounder is found on mud and sand substrates and extends from the intertidal zone to a maximum depth of 197 feet (60 m). Young-of-the-year juveniles prefer sand over mud.

Adults: EFH is intertidal and subtidal benthic habitats in estuarine, coastal marine, and continental shelf waters from the Gulf of Maine to Cape Hatteras, as shown on Map 62 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017), including mixed and high salinity zones in the bays and estuaries listed in Table 23 of NEFMC (2017). Essential fish habitat for adult windowpane flounder is found on mud and sand substrates and extends from the intertidal zone to a maximum depth of 230 feet (70 m).

2.2.5.1.12 Winter Flounder

Winter flounder is managed as three stocks: the Gulf of Maine stock, Georges Bank stock, and the Southern New England/Mid-Atlantic stock (NOAA Fisheries, 2019i). Winter flounder range from the Gulf of St. Lawrence to North Carolina, and are found in estuaries and on the continental shelf. Winter flounder prefer muddy, sandy, cobbled, gravelly, or boulder substrate in mostly nearshore environments (Pereira et al., 1999). Winter flounder spawn over sandy bottoms and algal mats in shallow nearshore habitats during the winter and spring (NFMS, 2019i). They are opportunistic feeders, and prey items include polychaetes, amphipods, shrimp, clams, capelin eggs, and fish (Pereira et al., 1999; NOAA Fisheries, 2019i). The 2017 stock assessment concluded that spawning stock biomass of the Georges Bank stock has been increasing since 2005, and the stock is not overfished and not subject to overfishing (NEFSC, 2017a). The Southern New England/Mid-Atlantic stock is overfished, but not currently experiencing overfishing (NEFSC, 2017a). The results for the Gulf of Maine stock were highly uncertain. The authors were unable to determine an abundance estimate for the Gulf of Maine stock, but concluded that it is not currently subject to overfishing (NEFSC, 2017a).

The winter flounder EFH designations are reproduced below for the life stages found within the Project Area. Larvae, juvenile, and adult life stages have EFH within the RWF area and RWEC-OCS corridor. Egg, larvae, juvenile, and adult life stages have EFH within the RWEC-RI corridor.

Eggs: EFH is subtidal estuarine and coastal benthic habitats from mean low water to 16 feet (5 m) from Cape Cod to Absecon Inlet (39° 22’ N), and as deep as 230 feet (70 m) on Georges Bank and in the Gulf of Maine (see Map 63 in NEFMC [2017]), including mixed and high salinity zones in the bays and estuaries listed in Table 24 of NEFMC (2017). The eggs are adhesive and deposited in clusters on the bottom. Essential habitats for winter flounder eggs include mud, muddy sand, sand, gravel, macroalgae, and submerged aquatic vegetation. Bottom habitats are unsuitable if exposed to excessive sedimentation which can reduce hatching success.

Larvae: EFH is estuarine, coastal, and continental shelf water column habitats from the shoreline to a maximum depth of 230 feet (70 m) from the Gulf of Maine to Absecon Inlet (39° 22’ N), and including Georges Bank, as shown on Map 65 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017), including mixed and high salinity zones in the bays and estuaries listed in Table 24 of NEFMC (2017). Larvae hatch in nearshore waters and estuaries or are transported shoreward from offshore spawning sites where they metamorphose and settle to the bottom as juveniles. They are initially planktonic but become increasingly less buoyant and occupy the lower water column as they get older.

Juveniles: EFH is estuarine, coastal, and continental shelf benthic habitats from the Gulf of Maine to Absecon Inlet (39° 22’ N), and including Georges Bank, as shown on Map 64 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017), and in mixed and high salinity zones in the bays and estuaries listed in Table 24 of NEFMC (2017). Essential fish habitat for juvenile winter flounder extends from the intertidal zone (mean high water) to a maximum depth of 197 feet (60 m) and occurs on a variety of bottom types, such as mud, sand, rocky substrates with attached macroalgae, tidal wetlands, and eelgrass. Young-of-the-year juveniles are found inshore on muddy and sandy sediments in and adjacent to eelgrass and macroalgae, in bottom debris, and in marsh creeks. They tend to settle to the bottom in soft-sediment depositional areas where currents concentrate late-stage larvae and disperse into coarser-grained substrates as they get older.

Adults: EFH is estuarine, coastal, and continental shelf benthic habitats extending from the intertidal zone (mean high water) to a maximum depth of 230 feet (70 m) from the Gulf of Maine to Absecon Inlet (39° 22’ N), and including

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Georges Bank, as shown on Map 65 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017), and in mixed and high salinity zones in the bays and estuaries listed in Table 24 of NEFMC (2017). EFH for adult winter flounder occurs on muddy and sandy substrates, and on hard bottom on offshore banks. In inshore spawning areas, EFH includes a variety of substrates where eggs are deposited on the bottom.

2.2.5.1.13 Witch Flounder

Witch flounder are managed as a single stock and in U.S. waters, range from the Gulf of Maine to Cape Hatteras, North Carolina (Cargnelli et al., 1999c). Witch flounder spawn from April to November in the Gulf of Maine/Georges Bank region, and from April to August in the Mid-Atlantic Bight, peaking in the summer in both regions (Cargnelli et al., 1999c). Primary prey items include polychaetes, crustaceans, mollusks, and echinoderms. As of the 2017 stock assessment, witch flounder is overfished, overfishing status is unknown, and the condition of the stock is poor (NEFSC, 2017a).

The witch flounder EFH designations are reproduced below for the life stages found within the Project Area. EFH for eggs and larvae is present within the RWF area and RWEC-OCS corridor.

Eggs and Larvae: EFH is pelagic habitats on the continental shelf throughout the Northeast region, as shown on Map 66 and Map 67 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017).

2.2.5.1.14 Yellowtail Flounder

In U.S. waters, yellowtail flounder are managed as three stocks: the Gulf of Maine/Cape Cod stock, the Georges Bank stock, and the Southern New England/Mid-Atlantic stock. Yellowtail flounder range from Newfoundland to Chesapeake Bay (NOAA Fisheries, 2019j). These bottom-dwelling finfish prefer habitats with a mixture of sand and mud (Collette and Klein-MacPhee, 2002; Johnson et al., 1999), and spawn during the spring and summer (NFMS, 2019j). Adult prey items consist mainly of benthic macrofauna such as crustaceans and worms (NOAA Fisheries, 2019j; Johnson et al., 1999). As of the 2017 stock assessment (NEFSC, 2017a), all three stocks are overfished, currently subject to overfishing, and drastically below the biomass target level. (Johnson et al., 1999).

The yellowtail flounder EFH designations are reproduced below for the life stages found within the Project Area. Egg, larvae, juvenile, and adult life stages have EFH within the RWF area and RWEC-OCS corridor. Juvenile and adult life stages have EFH within the RWEC-RI corridor.

Eggs: EFH is coastal and continental shelf pelagic habitats in the Gulf of Maine, on Georges Bank, and in the Mid-Atlantic region as far south as the upper Delmarva peninsula, as shown on Map 70 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017), including the high salinity zones of the bays and estuaries listed in Table 25 of NEFMC (2017).

Larvae: EFH is coastal marine and continental shelf pelagic habitats in the Gulf of Maine, and from Georges Bank to Cape Hatteras, as shown on Map 71 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017), including the high salinity zones of the bays and estuaries listed in Table 25 of NEFMC (2017).

Juveniles: EFH is subtidal benthic habitats in coastal waters in the Gulf of Maine and on the continental shelf on Georges Bank and in the Mid-Atlantic as shown on Map 72 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017), including the high salinity zones of the bays and estuaries listed in Table 25 of NEFMC (2017). EFH for juvenile yellowtail flounder occurs on sand and muddy sand between 66 and 262 feet (20 and 80 m). In the Mid-Atlantic, young-of-the-year juveniles settle to the bottom on the continental shelf, primarily at depths of 131 to 230 feet (40 to 70 m), on sandy substrates.

Adults: EFH is subtidal benthic habitats in coastal waters in the Gulf of Maine and on the continental shelf on Georges Bank and in the Mid-Atlantic as shown on Map 73 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017), including the high salinity zones of the bays and estuaries listed in Table 25 of NEFMC (2017). EFH for adult yellowtail flounder occurs on sand and sand with mud, shell hash, gravel, and rocks at depths between 82 and 295 feet (25 and 90 m).

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2.2.5.2 Mid-Atlantic Finfish Species

2.2.5.2.1 Atlantic Butterfish

The Atlantic butterfish is a semi-pelagic fish that tends to form loose schools and ranges from Newfoundland to Florida (NOAA Fisheries, 2019k). They are most commonly found from the Gulf of Maine to Cape Hatteras, North Carolina (Cross et al., 1999; NFMS, 2019k). Butterfish are managed as one stock in the northern region (New England to Cape Hatteras) and two stocks south of Cape Hatteras. Butterfish are present in New England waters from spring to fall and are found from the surface to 180 feet (54 m) deep in the summer, but as deep as 690 feet (210 m) in the winter (Collette and Klein-MacPhee, 2002). Butterfish prefer sandy bottom environments rather than rocky environments. Spawning occurs on the continental shelf and in nearshore areas and is very common in Long Island Sound and the New York Bight (Cross et al., 1999). As of the 2018 stock assessment (Adams, 2018), Atlantic butterfish are not overfished and not subject to overfishing.

The Atlantic butterfish EFH designations are reproduced below for the life stages found within the Project Area. Egg, larvae, juvenile, and adult life stages have EFH within the RWF area, RWEC-OCS corridor, and RWEC-RI corridor.

Eggs: EFH is pelagic habitats in inshore estuaries and embayments 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 4,921 feet (1,500 m) or less where average temperatures in the upper 656 feet (200 m) of the water column are 43.7 to 70.7 °F (6.5 to 21.5 °C).

Larvae: EFH is pelagic habitats in inshore estuaries and embayments 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 134 and 1148 feet (41 and 350 m) where average temperatures in the upper 656 feet (200 m) of the water column are 47 to 71 °F (8.5 to 21.5 °C).

Juveniles: EFH is pelagic habitats in inshore estuaries and embayments from Massachusetts Bay to Pamlico Sound, North Carolina, in inshore waters of the Gulf of Maine and the South Atlantic Bight, and on the inner continental shelf and OCS from southern New England to South Carolina. EFH for juvenile Atlantic butterfish is generally found over bottom depths between 32 and 918 feet (10 and 280 m) where bottom water temperatures are between 43 and 80 °F (6.5 and 27 °C) and salinities are above 5 ppt. Juvenile butterfish feed mainly on planktonic prey.

Adults: EFH is pelagic habitats in inshore estuaries and embayments from Massachusetts Bay to Pamlico Sound, North Carolina, inshore waters of the Gulf of Maine and the South Atlantic Bight, on Georges Bank, on the inner continental shelf south of Delaware Bay, and on the OCS from southern New England to South Carolina. EFH for adult Atlantic butterfish is generally found over bottom depths between 32 and 820 feet (10 and 250 m) where bottom water temperatures are between 40 and 81 °F (4.5 and 27.5 °C) and salinities are above 5 ppt. Spawning probably does not occur at temperatures below 59 °F (15 °C). Adult butterfish feed mainly on planktonic prey, including squids and fishes.

2.2.5.2.2 Atlantic Mackerel

In the northwestern Atlantic, Atlantic mackerel range from Labrador to North Carolina (NOAA Fisheries, 2019l). They are a pelagic, schooling species and are managed as a single stock. Mackerel spawn off the coast (10 to 30 miles offshore) in deeper waters in two groups. The southern group primarily spawns in the Mid-Atlantic Bight from April to May, and the northern group spawns in the Gulf of St. Lawrence in June and July (NOAA Fisheries, 2019l). There is no known preferred breeding habitat (Collette and Klein-MacPhee, 2002). Atlantic mackerel prey on crustaceans (e.g., copepods, krill, and shrimp), fish, and ascidians (sea squirts) (NOAA Fisheries, 2019l). Prior to the 2018 stock assessment, the status of Atlantic mackerel was unknown (NOAA Fisheries, 2019l). The 2018 stock

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assessment concluded that Atlantic mackerel are overfished, subject to overfishing, and have been overfished for nearly a decade (NEFSC, 2018b).

The Atlantic mackerel EFH designations are reproduced below for the life stages found within the Project Area. Egg, larvae, and juvenile life stages have EFH within the RWF area and RWEC-OCS corridor. Egg, larvae, juvenile, and adult life stages have EFH within the RWEC-RI corridor.

Eggs: EFH is pelagic habitats in inshore estuaries and embayments 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 (mostly north of 38°N). EFH for Atlantic mackerel eggs is generally found over bottom depths of 328 feet (100 m) or less with average water temperatures of 43 to 54 °F (6.5 to 12.5 °C) in the upper 59 feet (15 m) of the water column.

Larvae: EFH is pelagic habitats in inshore estuaries and embayments from Great Bay, New Hampshire to the south shore of Long Island, New York, inshore waters of the Gulf of Maine, and on the continental shelf from Georges Bank to Cape Hatteras, North Carolina (mostly north of 38°N). EFH for Atlantic mackerel larvae is generally found over bottom depths between 68 and 328 feet (21 and 100 m) with average water temperatures of 42 to 52 °F (5.5 to 11.5 °C) in the upper 656 feet (200 m) of the water column.

Juveniles: EFH is pelagic habitats in inshore estuaries and embayments 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 Atlantic mackerel is generally found over bottom depths between 32 and 360 feet (10 and 110 m) and in water temperatures of 41 to 68 °F (5 to 20 °C). Juvenile Atlantic mackerel feed primarily on small crustaceans, larval fish, and other pelagic organisms.

Adults: EFH is pelagic habitats in inshore estuaries and embayments from Passamaquoddy Bay, Maine to the Hudson River, and on the continental shelf from Georges Bank to Cape Hatteras, North Carolina. EFH for adult Atlantic mackerel is generally found over bottom depths less than 558 feet (170 m) and in water temperatures of 41 to 68 °F (5 to 20 °C). Spawning occurs at temperatures above 45 °F (7 °C), with a peak between 48 and 57 °F (9 and 14 °C). 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.

2.2.5.2.3 Black Sea Bass

The black sea bass is a demersal finfish species that range from Nova Scotia to Florida and is managed as two stocks: Mid-Atlantic and South-Atlantic (NOAA Fisheries, 2019m). Black sea bass spend the summer in northern inshore waters at depths of less than 120 feet (37 m) and spend the winter in southern offshore waters at depths of 240 to 540 feet (73 to 165 m) (ASMFC, 2019a). Black sea bass prefer structured habitats such as reefs, pilings, jetties, shipwrecks, and lobster pots along the continental shelf (Steimle et al., 1999c; ASMFC, 2019a). Black sea bass spawn in May along the North Carolina coast, then spawn from the middle of May until the end of June in New Jersey, New York, and southern New England waters (Collette and Klein-MacPhee, 2002). Black sea bass consume a variety of prey items, but prefer crabs, shrimp, worms, small fish, and clams (NOAA Fisheries, 2019m). The most recent stock assessments for black sea bass concluded that both the Mid-Atlantic and South Atlantic stocks are not overfished and not subject to overfishing (NEFSC, 2017b; Southeast Data Assessment and Review [SEDAR], 2018).

The black sea bass EFH designations are reproduced below for the life stages found within the Project Area. Juvenile and adult life stages have EFH within the RWF area, RWEC-OCS corridor, and RWEC-RI corridor.

Juveniles: Offshore, EFH is the demersal waters over the continental shelf (from the coast out to the limits of the exclusive economic zone [EEZ]), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90 percent of all the ranked squares of the area where juvenile black sea bass are collected in the NEFSC trawl survey. Inshore, EFH is the estuaries where black sea bass are identified as being common, abundant, or highly abundant in the Estuarine Living Marine Resources (ELMR) database for the "mixing" and "seawater" salinity zones. Juveniles are found in the estuaries in the summer and spring. Generally, juvenile black sea bass are found in waters warmer

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than 43 °F (6 °C) with salinities greater than 18 ppt and coastal areas between Virginia and Massachusetts, but winter offshore from New Jersey and south. Juvenile black sea bass are usually found in association with rough bottom, shellfish and eelgrass beds, and man-made structures in sandy-shelly areas; offshore clam beds and shell patches may also be used for over-wintering.

Adults: Offshore, EFH is the demersal waters over the continental shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90 percent of all the ranked 10-minute squares of the area where adult black sea bass are collected in the NEFSC trawl survey. Inshore, EFH is the estuaries where adult black sea bass were identified as being common, abundant, or highly abundant in the ELMR database for the "mixing" and "seawater" salinity zones. Black sea bass are generally found in estuaries from May through October. Wintering adults (November through April) are generally offshore, south of New York to North Carolina. Temperatures above 43 °F (6 °C) seem to be the minimum requirements. Structured habitats (natural and man-made), sand, and shell are usually the substrate preference.

2.2.5.2.4 Bluefish

Bluefish are a migratory species that is found throughout the world in most temperate coastal regions except the eastern Pacific. In the U.S., they range from Maine to eastern Florida and are managed as a single stock (NOAA Fisheries, 2019n). Bluefish generally school by size, concentrating between Maine and Cape Hatteras, North Carolina in the summer, and offshore between Cape Hatteras and Florida in the winter (ASMFC, 2019b). Bluefish spawn multiple times in spring and summer, with discrete groups spawning at different times (NOAA Fisheries, 2019n; ASMFC, 2019b). Bluefish are voracious, opportunistic predators, preying on squid and fish, particularly menhaden and smaller fish such as silversides (NOAA Fisheries, 2019n; ASMFC, 2019b). Based on the most recent stock assessment, bluefish are not overfished and not subject to overfishing (NEFSC, 2015).

The bluefish EFH designations are reproduced below for the life stages found within the Project Area. Egg, larvae, juvenile, and adult life stages have EFH within the RWF area and RWEC-OCS corridor. Juvenile and adult life stages have EFH within the RWEC-RI corridor.

Eggs: North of Cape Hatteras, EFH is pelagic waters found over the continental shelf (from the coast out to the limits of the EEZ) at mid-shelf depths, from Montauk Point, New York south to Cape Hatteras in the highest 90 percent of the area where bluefish eggs were collected in the Marine Resources Monitoring, Assessment, and Prediction (MARMAP) surveys. Bluefish eggs are generally not collected in estuarine waters and thus there is no EFH designation inshore. Generally, bluefish eggs are collected between April through August in temperatures greater than 64 °F (18 °C) and normal shelf salinities (>31 ppt).

Larvae: North of Cape Hatteras, EFH is pelagic waters found over the continental shelf (from the coast out to the limits of the EEZ) most commonly above 59 feet (15 m), from Montauk Point, New York south to Cape Hatteras, in the highest 90 percent of the area where bluefish larvae were collected during the MARMAP surveys. EFH also includes the "slope sea" and Gulf Stream between latitudes 29° 00 N and 40° 00 N. Bluefish larvae are not generally collected inshore so there is not EFH designation inshore for larvae. Generally, bluefish larvae are collected April through September in temperatures greater than 64 °F (18 °C) in normal shelf salinities (>30 ppt).

Juveniles: North of Cape Hatteras, EFH is pelagic waters found over the continental shelf (from the coast out to the limits of the EEZ) from Nantucket Island, Massachusetts south to Cape Hatteras, in the highest 90 percent of the area where juvenile bluefish are collected in the NEFSC trawl survey. EFH also includes the "slope sea" and Gulf Stream between latitudes 29° 00 N and 40° 00 N. Inshore, EFH is all major estuaries between Penobscot Bay, Maine and St. Johns River, Florida. Generally juvenile bluefish occur in North Atlantic estuaries from June through October, Mid-Atlantic estuaries from May through October, and South Atlantic estuaries March through December, within the "mixing" and "seawater" zones. Distribution of juveniles by temperature, salinity, and depth over the continental shelf is undescribed.

Adults: North of Cape Hatteras, EFH is the pelagic waters found over the continental shelf (from the coast out to the limits of the EEZ), from Cape Cod Bay, Massachusetts south to Cape Hatteras, in the highest 90 percent of the area where adult bluefish were collected in the NEFSC trawl survey. Inshore, EFH is all major estuaries between

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Penobscot Bay, Maine and St. Johns River, Florida. Adult bluefish are found in North Atlantic estuaries from June through October, Mid-Atlantic estuaries from April through October, and in South Atlantic estuaries from May through January in the "mixing" and "seawater" zones. Bluefish adults are highly migratory, and distribution varies seasonally and according to the size of the individuals comprising the schools. Bluefish are generally found in normal shelf salinities (>25 ppt).

2.2.5.2.5 Scup

Scup are a migratory, schooling species found in the northwest Atlantic Ocean, primarily between Cape Cod, Massachusetts, and Cape Hatteras, North Carolina (NOAA Fisheries, 2019o). Scup are currently managed as two stocks, the Mid-Atlantic/New England stock, and the South Atlantic stock. Scup spend the winter in offshore waters between southern New Jersey and Cape Hatteras, migrating to more northern and inshore waters when water temperatures begin to rise in spring and summer (ASMFC, 2019c). Scup are known to congregate in nearshore areas of New England from early April to December, at depths between 270 and 420 feet (82 to 128 m) (Collette and Klein-MacPhee, 2002). Scup spawn over weedy or sandy areas in southern New England between Massachusetts Bay and the New York Bight between May and August, with peak spawning activity taking place in June (NOAA Fisheries, 2019o). Scup prefer smooth to rocky bottom habitats and usually form schools around such bottoms, feeding on demersal invertebrates. The 2017 stock assessment for the Mid-Atlantic/New England stock indicated that scup are not overfished and not currently subject to overfishing (NEFSC, 2017c). The population status of the South Atlantic stock has not been assessed (NOAA Fisheries, 2019o).

The scup EFH designations are reproduced below for the life stages found within the Project Area. Juvenile and adult life stages have EFH within the RWF area and RWEC-OCS corridor. Egg, larvae, juvenile, and adult life stages have EFH within the RWEC-RI corridor.

Eggs: EFH is estuaries where scup eggs were identified as common, abundant, or highly abundant in the ELMR database for the "mixing" and "seawater" salinity zones. In general, scup eggs are found from May through August in southern New England to coastal Virginia, in waters between 55 and 73 °F (12 to 23 °C) and in salinities greater than 15 ppt.

Larvae: EFH is estuaries where scup were identified as common, abundant, or highly abundant in the ELMR database for the "mixing" and "seawater" salinity zones. In general, scup larvae are most abundant nearshore from May through September, in waters between 55 and 73 °F (12 to 23 °C) and in salinities greater than 15 ppt.

Juveniles: Offshore, EFH is the demersal waters over the continental shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90 percent of all the ranked 10-minute squares of the area where juvenile scup are collected in the NEFSC trawl survey. Inshore, EFH is the estuaries where scup has been identified as common, abundant, or highly abundant in the ELMR database for the "mixing" and "seawater" salinity zones. In general, juvenile scup are found during the summer and spring in estuaries and bays between Virginia and Massachusetts, in association with various sands, mud, mussel, and eelgrass bed type substrates and in water temperatures greater than 45 °F (7 °C) and salinities greater than 15 ppt.

Adults: Offshore, EFH is the demersal waters over the continental shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90 percent of all the ranked 10-minute squares of the area where adult scup are collected in the NEFSC trawl survey. Inshore, EFH is the estuaries where scup has been identified as common, abundant, or highly abundant in the ELMR database for the "mixing" and "seawater" salinity zones. Generally, wintering adults (November through April) are usually offshore, south of New York to North Carolina, in waters above 45 °F (7 °C).

2.2.5.2.6 Summer Flounder

Summer flounder are found in inshore and offshore waters from Nova Scotia to the east coast of Florida, concentrating in the Mid-Atlantic region from Cape Cod, Massachusetts to Cape Fear, North Carolina (NOAA Fisheries, 2019p; ASMFC, 2019d). Summer flounder are managed as a single stock. Summer flounder move offshore in the fall to depths of 120 to 600 feet (37 to 183 m) to spawn (ASMFC, 2019d). Spawning peaks in October

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and November, and larvae migrate to inshore coastal and estuarine nursey areas (NOAA Fisheries, 2019p; ASMFC, 2019d). Adult summer flounder prefer sandy habitats, but can be found in a variety of habitat with both mud and sand substrates (Packer et al., 1999). Summer flounder are ambush predators, and prey opportunistically on fish and invertebrates including sea worms, squid, shrimp, and other crustaceans (ASFMC, 2019d). The 2019 stock assessment concluded that summer flounder are not overfished and not subject to overfishing (NEFSC, 2019).

The summer flounder EFH designations are reproduced below for the life stages found within the Project Area. Egg, larvae, juvenile, and adult life stages have EFH within the RWF area and RWEC-OCS corridor. Larvae, juvenile, and adult life stages have EFH within the RWEC-RI corridor.

Eggs: North of Cape Hatteras, EFH is the pelagic waters found over the continental shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90 percent of the all the ranked 10-minute squares for the area where summer flounder eggs are collected in the MARMAP survey. In general, summer flounder eggs are found between October and May, being most abundant between Cape Cod and Cape Hatteras, with the heaviest concentrations within 9 miles (14.5 km, 7.8 nm) of shore off New Jersey and New York. Eggs are most commonly collected at depths of 30 to 360 feet (9 to 110 m).

Larvae: North of Cape Hatteras, EFH is the pelagic waters found over the continental shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90 percent of all the ranked 10-minute squares for the area where summer flounder larvae are collected in the MARMAP survey. Inshore, EFH is all the estuaries where summer flounder were identified as being present (rare, common, abundant, or highly abundant) in the ELMR database, in the "mixing" (defined in ELMR as 0.5 to 25.0 ppt) and "seawater" (defined in ELMR as greater than 25 ppt) salinity zones. In general, summer flounder larvae are most abundant nearshore (12 to 50 miles [19 to 80.5 km, 10.4 to 43.4 nm] from shore) at depths between 30 to 230 feet (9 to 70 m). They are most frequently found in the northern part of the Mid-Atlantic Bight from September to February, and in the southern part from November to May.

Juveniles: North of Cape Hatteras, EFH is the demersal waters over the continental shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90 percent of all the ranked 10-minute squares for the area where juvenile summer flounder are collected in the NEFSC trawl survey. Inshore, EFH is all the estuaries where summer flounder were identified as being present (rare, common, abundant, or highly abundant) in the ELMR database for the "mixing" and "seawater" salinity zones. In general, juveniles use several estuarine habitats as nursery areas, including salt marsh creeks, seagrass beds, mudflats, and open bay areas in water temperatures greater than 37 °F (3 °C) and salinities from 10 to 30 ppt range.

Adults: North of Cape Hatteras, EFH is the demersal waters over the continental shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90 percent of all the ranked 10-minute squares for the area where adult summer flounder are collected in the NEFSC trawl survey. Inshore, EFH is the estuaries where summer flounder were identified as being common, abundant, or highly abundant in the ELMR database for the "mixing" and "seawater" salinity zones. Generally, summer flounder inhabit shallow coastal and estuarine waters during warmer months and move offshore on the outer continental shelf at depths of 500 feet (152 m) in colder months.

2.2.5.3 Invertebrates

2.2.5.3.1 Atlantic Sea Scallop

The Atlantic sea scallop is managed as a single stock that ranges from Newfoundland to Cape Hatteras, North Carolina (NOAA Fisheries, 2019q). Atlantic sea scallop occur along the continental shelf, typically at depths ranging from 59 to 360 feet (18 to 110 m), and are generally found in seabed areas with coarse substrates consisting of firm sand, gravel, shells, and rocks (Hart and Chute, 2004). The sea scallop spawning season is usually in the late summer or early fall, and spawning may also occur in the spring in the Mid-Atlantic Bight (NOAA Fisheries, 2019q). The 2018 stock assessment concluded that Atlantic sea scallop are not overfished and are not subject to overfishing (NEFSC, 2018a).

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The Atlantic sea scallop EFH designations are reproduced below for the life stages found within the Project Area. Egg, larvae, juvenile, and adult life stages have EFH within the RWF area, RWEC-OCS corridor, and RWEC-RI corridor.

Eggs: EFH is benthic habitats in inshore areas and on the continental shelf as shown on Map 97 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017), 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.

Larvae: EFH is benthic and water column habitats in inshore and offshore areas throughout the region, as shown on Map 97 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017). 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.

Juveniles: EFH is benthic habitats in the Gulf of Maine, on Georges Bank, and in the Mid-Atlantic, as shown on Map 97 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017), in depths of 59 to 361 feet (18 to 110 m). Juveniles (0.2 to 0.5 inch [5 to 12 mm] shell height) leave the original substrate on which they settle (see spat, above) and attach themselves with byssal threads to shells, gravel, and small rocks (pebble, cobble), 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. Bottom currents stronger than 10 cm/sec retard feeding and growth. In laboratory studies, maximum survival of juvenile scallops occurred between 34 and 59 °F (1.2 and 15 °C) and above salinities of 25 ppt. 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 the same as for the adults (gravel and sand).

Adults: EFH is benthic habitats in the Gulf of Maine, on Georges Bank, and in the Mid-Atlantic, as shown on Map 97 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017). Essential habitats for older juvenile and adult sea scallops are found on sand and gravel substrates in depths of 59 to 361 feet (18 to 110 m), but they are also found in shallower water and as deep as 591 feet (180 m) in the Gulf of Maine. In the Mid-Atlantic they are found primarily between 148 and 246 feet (45 and 75 m) and on Georges Bank they are more abundant between 197 and 295 feet (60 and 90 m). They often occur in aggregations called beds which may be sporadic or essentially 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 50 and 59 °F (10 and 15 °C) and they prefer full strength seawater.

2.2.5.3.2 Atlantic Surfclam

The Atlantic surfclam ranges from the southern Gulf of St. Lawrence to Cape Hatteras, North Carolina. The species prefers sandy habitats along the continental shelf (Cargnelli et al., 1999d), and is most abundant on Georges Bank, the south shore of Long Island, and along the coasts of New Jersey and the Delmarva Peninsula (NOAA Fisheries, 2019r). Atlantic surfclam spawn in the late spring through the early fall (NOAA Fisheries, 2019r). According to the most recent stock assessment, Atlantic surfclam are not overfished and not subject to overfishing (NEFSC, 2016).

The Atlantic surfclam EFH designations are reproduced below for the life stages found within the Project Area. Adults have EFH designated within the RWEC-OCS corridor, and juveniles and adults have EFH designated within the RWEC-RI corridor.

Juveniles and Adults: EFH is throughout the substrate, to a depth of 3 feet (1 m) below the water/sediment interface, within federal waters from the eastern edge of Georges Bank and the Gulf of Maine throughout the Atlantic EEZ, in areas that encompass the top 90 percent of all the ranked 10-minute squares for the area where surfclams were caught in the NEFSC surfclam and ocean quahog dredge surveys. Surfclams generally occur from the beach zone to a depth of about 200 feet (656 m), but beyond about 125 feet (52 m) abundance is low.

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2.2.5.3.3 Longfin Inshore Squid

The longfin squid is a pelagic, schooling species that ranges from Newfoundland to the Gulf of Venezuela. In U.S. waters, longfin inshore squid are managed as a single stock and are most abundant between Georges Bank and Cape Hatteras, North Carolina (NOAA Fisheries, 2019s). Longfin inshore squid have a very short life span (less than 1 year), and spawn year-round with peak productions in winter and summer (NOAA Fisheries, 2019s). Juvenile longfin inshore squid feed on plankton, and adults are aggressive hunters that feed on fish, crustaceans, and their own species (NOAA Fisheries, 2019s). The 2017 stock assessment concluded that longfin inshore squid are not overfished, but there was not enough information to determine whether the stock is experiencing overfishing (Hendrickson, 2017).

The longfin inshore squid EFH designations are reproduced below for the life stages found within the Project Area. Egg, juvenile, and adult life stages have EFH within the RWF area, RWEC-OCS corridor, and RWEC-RI corridor.

Eggs: EFH for longfin inshore squid eggs occurs in inshore and offshore bottom habitats from Georges Bank southward to Cape Hatteras. EFH for eggs is generally found where bottom water temperatures are between 50 and 73 °F (10 and 23 °C), salinities are between 30 and 32 ppt and depth is less than 164 feet (50 m). Longfin inshore squid eggs have also been collected in bottom trawls in deeper water at various places on the continental shelf. Like most loliginid squids, longfin inshore squid egg masses or “mops” are demersal and anchored to the substrates on which they are laid, which include a variety of hard bottom types (e.g., shells, lobster pots, piers, fish traps, boulders, and rocks), submerged aquatic vegetation (e.g., *Fucus* sp.), sand, and mud.

Juveniles (Pre-Recruits): EFH is pelagic habitats in inshore and offshore continental shelf waters from Georges Bank to South Carolina, in the southwestern Gulf of Maine, and in embayments such as Narragansett Bay, Long Island Sound, and Raritan Bay. EFH is generally found over bottom depths between 20 and 525 feet (6 and 160 m) where bottom water temperatures are 47 to 76 °F (8.5 to 24.5 °C) and salinities are 28.5 to 36.5 ppt. Pre-recruits migrate offshore in the fall where they overwinter in deeper waters along the edge of the shelf. They make daily vertical migrations, moving in the water column at night and down in the daytime. Small immature individuals feed on planktonic organisms while larger individuals feed on crustaceans and small fish.

Adults (Recruits): EFH is pelagic habitats in inshore and offshore continental shelf waters from Georges Bank to South Carolina, in inshore waters of the Gulf of Maine, and in embayments such as Narragansett Bay, Long Island Sound, Raritan Bay, and Delaware Bay. EFH is generally found over bottom depths between 20 and 656 feet (6 and 200 m) where bottom water temperatures are 47 to 57 °F (8.5 to 14 °C) and salinities are 24 to 36.5 ppt. Recruits inhabit the continental shelf and upper continental slope to depths of 1,312 feet (400 m). They migrate offshore in the fall and overwinter in warmer waters along the edge of the shelf. Like the pre-recruits, they make daily vertical migrations. Individuals larger than 4.7 inches (12 cm) feed on fish and those larger than 6.3 inches (16 cm) feed on fish and squid. Females deposit eggs in gelatinous capsules which are attached in clusters to rocks, boulders, and aquatic vegetation and on sand or mud bottom, generally in depths less than 164 feet (50 m).

2.2.5.3.4 Northern Shortfin Squid

The northern shortfin squid is a highly migratory species found in the northwest Atlantic Ocean between the Labrador Sea and the Florida Straits (Hendrickson and Holmes, 2004). In U.S. waters, northern shortfin squid are managed as a single stock. Northern shortfin squid have a very short life span (less than 1 year). The species migrates onto the continental shelf in the spring, and migrates offshore in the late autumn, presumably to a winter spawning site (Hendrickson and Holmes, 2004). Winter habitats of the species are not well known, and the only confirmed spawning area is located in the Mid-Atlantic Bight at depths of 371 to 1,237 feet (113 to 377 m) (Hendrickson and Holmes, 2004). It is unknown whether the stock of northern shortfin squid is overfished or experiencing overfishing, as relative abundance and biomass indices are highly variable and lacking a trend (Mid-Atlantic Fishery Management Council and NOAA Fisheries, 2018).

The northern shortfin squid EFH designation for adults is reproduced below; this is the only life stage with EFH within the RWF area. Northern shortfin squid EFH is not found within the RWEC-OCS or RWEC-RI corridor.

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Adults (Recruits): EFH is pelagic habitats on the continental shelf and slope from Georges Bank to South Carolina, and in inshore and offshore waters of the Gulf of Maine. EFH for adult northern shortfin squid is generally found on the shelf over bottom depths between 135 and 1,312 feet (41 and 400 m) where bottom temperatures are 40.1 to 58.1 °F (4.5 to 14.5 °C) and salinities are 34.5 to 36.5 ppt. They have also been caught in bottom trawls as deep as 8,202 feet (2,500 m) in waters beyond the edge of the shelf and on Bear Seamount. Adults make daily vertical migrations, moving up in the water column at night and down in the daytime. They feed primarily on fish and euphausiids and are also cannibalistic (larger females consume smaller males).

2.2.5.3.5 Ocean Quahog

Ocean quahog are managed as a single stock and range from Newfoundland to Cape Hatteras. The highest concentrations of ocean quahog are found are south of Nantucket to the Delmarva Peninsula in offshore waters (Cargnelli et al., 1999e). The species prefers medium- to fine-grain sand, sandy mud, and silty sand (Cargnelli et al., 1999e). Ocean quahogs spawn once a year in the summer or fall, but the spawning season can be extended over several months (NOAA Fisheries, 2019t). The 2017 stock assessment concluded that ocean quahog are not overfished and not subject to overfishing (NEFSC, 2017d).

The ocean quahog EFH designations are reproduced below for the life stages found within the Project Area. Juvenile and adult life stages have EFH within the RWF area and RWEC-OCS corridor.

Juveniles and Adults: EFH is throughout the substrate, to a depth of 3 feet (1 m) below the water/sediment interface, within federal waters from the eastern edge of Georges Bank and the Gulf of Maine throughout the Atlantic EEZ, in areas that encompass the top 90 percent of all the ranked 10-minute squares for the area where ocean quahogs were caught in the NEFSC surfclam and ocean quahog dredge surveys. Distribution in the western Atlantic ranges in depths from 30 feet (9 m) to about 800 feet (244 m). Ocean quahogs are rarely found where bottom water temperatures exceed 60 °F (16 °C) and occur progressively further offshore between Cape Cod and Cape Hatteras.

2.2.5.4 Highly Migratory Species

2.2.5.4.1 Albacore Tuna

Albacore Tuna is a circumglobal, epipelagic species that is managed in three stocks: North Atlantic, South Atlantic, and Mediterranean (NOAA Fisheries, 2017). They travel in large schools that are sometimes mixed with other tuna species (NOAA Fisheries, 2019u). Albacore tuna forage down to depth of 1,640 feet (500 m), preying opportunistically on a wide variety of fishes and invertebrates (NOAA Fisheries, 2017). Albacore tuna spawn in the spring and summer in the western tropical areas of the Atlantic, and then they move northward and use the central and northern portions of the Atlantic as their wintering area (NOAA Fisheries, 2017). The most recent stock assessment concluded that the North Atlantic stock of albacore tuna is not overfished, has rebuilt to target population levels, and is not subject to overfishing (International Commission for the Conservation of Atlantic Tunas [ICCAT], 2016a).

The albacore tuna EFH designations are reproduced below for the life stages found within the Project Area. Juvenile and adult life stages have EFH within the RWF area and RWEC-OCS corridor. Within the RWEC-RI corridor, only juveniles have EFH.

Juveniles and Adults: EFH is offshore, pelagic habitats of the Atlantic Ocean from the outer edge of the U.S. EEZ through Georges Bank to pelagic habitats south of Cape Cod, and from Cape Cod to Cape Hatteras, North Carolina. EFH also includes offshore pelagic habitats near the outer U.S. EEZ between North Carolina and Florida, and offshore pelagic habitats associated with the Blake Plateau. EFH also includes offshore pelagic habitats in the western and central Gulf of Mexico.

2.2.5.4.2 Bluefin Tuna

Bluefin tuna are a highly migratory, epipelagic species managed in two stocks: western and eastern, separated by the 45° W meridian (NOAA Fisheries, 2017). In the western Atlantic, bluefin tuna range from Newfoundland to the Gulf of Mexico (NOAA Fisheries, 2019v). Bluefin tuna are thought to forage off the eastern U.S. and Canadian

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coasts from June through March, migrating to spawning grounds in the Gulf of Mexico, Bahamas, and the Straits of Florida in April and May, and then generally moving back to foraging grounds of the Gulf Stream and North American continental shelf and slope waters, including the South and Mid-Atlantic Bight, the Gulf of Maine, and the Nova Scotia Shelf (NOAA Fisheries, 2017). Adult bluefin tuna feed opportunistically on a variety of schooling fish, cephalopods, and benthic invertebrates, including silver hake, Atlantic mackerel, Atlantic herring, krill, sandlance, and squid (NOAA Fisheries, 2017). The 2017 stock assessment concluded that the western Atlantic bluefin tuna stock is not subject to overfishing, but the information was insufficient to determine whether the stock status is overfished (ICCAT, 2017; NOAA Fisheries, 2019v).

The bluefin tuna EFH designations are reproduced below for the life stages found within the Project Area. Juvenile and adult life stages have EFH within the RWF area, RWEC-OCS corridor, and RWEC-RI corridor.

Juveniles: EFH is coastal and pelagic habitats of the Mid-Atlantic Bight and the Gulf of Maine, between southern Maine and Cape Lookout, from shore (excluding Long Island Sound, Delaware Bay, Chesapeake Bay, and Pamlico Sound) to the continental shelf break. EFH in coastal areas of Cape Cod are located between the Great South Passage and shore. EFH follows the continental shelf from the outer extent of the U.S. EEZ on Georges Bank to Cape Lookout. EFH is associated with certain environmental conditions in the Gulf of Maine (61 to 66 °F (16 to 19 °C); 0 to 131 feet (0 to 40 m) deep). EFH in other locations associated with temperatures ranging from 39 to 79 °F (4 to 26 °C), often in depths of less than 66 feet (20 m) (but can be found in waters that are 131–328 feet (40–100 m) in depth in winter).

Adults: EFH is located in offshore and coastal regions of the Gulf of Maine the mid-coast of Maine to Massachusetts; on Georges Bank; offshore pelagic habitats of southern New England; from southern New England to coastal areas between the mouth of Chesapeake Bay and Onslow Bay, North Carolina; from coastal North Carolina south to the outer extent of the U.S. EEZ, inclusive of pelagic habitats of the Blake Plateau, Charleston Bump, and Blake Ridge. EFH also consists of pelagic waters of the central Gulf of Mexico from the continental shelf break to the seaward extent of the U.S. EEZ between Apalachicola, Florida and Texas.

2.2.5.4.3 Skipjack Tuna

The skipjack tuna is a circumglobal, epipelagic species that is managed as two stocks, eastern and western. Skipjack tuna in the western Atlantic range are found in tropical and warm-temperate waters from Newfoundland to Brazil (NOAA Fisheries, 2017). They are a schooling species, and have been known to associate with birds, drifting objects, whales, sharks, and other tunas (NOAA Fisheries, 2017). Skipjack tuna feed opportunistically on a variety of fishes, cephalopods, crustaceans, mollusks, and sometimes other skipjack tuna (NOAA Fisheries, 2017; NOAA Fisheries, 2019w). The species spawns throughout the year in warm equatorial waters and from spring to early fall in subtropical waters (NOAA Fisheries, 2017). Based on the 2014 stock assessment, western Atlantic skipjack tuna are not overfished and not subject to overfishing (ICCAT, 2014).

The skipjack tuna EFH designations are reproduced below for the life stages found within the Project Area. Juvenile and adult life stages have EFH within the RWF area. Within the RWEC-OCS corridor and RWEC-RI corridor, only adults have EFH.

Juveniles: EFH is offshore pelagic habitats seaward of the continental shelf break between the seaward extent of the U.S. EEZ boundary on Georges Bank (off Massachusetts), coastal and offshore habitats between Massachusetts and South Carolina, localized areas off Georgia and South Carolina, and from the Blake Plateau through the Florida Straits. EFH also includes offshore waters in the central Gulf of Mexico from Texas through the Florida Panhandle. In all areas, juveniles are found in waters greater than 66 feet (20 m).

Adults: EFH is coastal and offshore habitats between Massachusetts and Cape Lookout, North Carolina and localized areas in the Atlantic off South Carolina and Georgia, and the northern east coast of Florida. EFH in the Atlantic Ocean is also located on the Blake Plateau, in the Florida Straits through the Florida Keys, and areas in the central Gulf of Mexico, offshore in pelagic habitats seaward of the southeastern edge of the West Florida Shelf to Texas.

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2.2.5.4.4 Yellowfin Tuna

The yellowfin tuna is a circumglobal, epipelagic species found in tropical and temperate waters (NOAA Fisheries, 2017). In the western Atlantic, yellowfin tuna are managed as a single stock and spawn from May to August in the Gulf of Mexico and from July to November in the southeastern Caribbean (NOAA Fisheries, 2019x). The species travel in schools, with juveniles found at the surface in mixed schools with other tuna species (NOAA Fisheries, 2017). Yellowfin tuna feed primarily in surface waters down to a depth of 328 feet (100 m), preying on a wide variety of fish and invertebrates (NOAA Fisheries, 2017). According to the 2016 stock assessment, Atlantic yellowfin tuna are not overfished and are not currently subject to overfishing (ICCAT, 2016b).

The yellowfin tuna EFH designations are reproduced below for the life stages found within the Project Area. Juvenile and adult life stages have EFH within the RWF area and RWEC-OCS corridor. Within the RWEC-RI corridor, only juveniles have EFH.

Juveniles: EFH is offshore pelagic habitats seaward of the continental shelf break between the seaward extent of the U.S. EEZ boundary on Georges Bank and Cape Cod, Massachusetts. EFH also includes offshore and coastal habitats from Cape Cod to the mid-east coast of Florida and the Blake Plateau, locally distributed areas in the Florida Straits and off the southwestern edge of the West Florida Shelf, the central Gulf of Mexico from the Florida Panhandle to southern Texas, and localized areas southeast of Puerto Rico.

Adults: EFH is offshore pelagic habitats seaward of the continental shelf break between the seaward extent of the U.S. EEZ boundary on Georges Bank and Cape Cod, Massachusetts. EFH also includes offshore and coastal habitats from Cape Cod to North Carolina, offshore pelagic habitats of the Blake Plateau. EFH in the Gulf of Mexico spans throughout much of the offshore pelagic habitat from the West Florida Shelf to the continental shelf off southern Texas.

2.2.5.5 Skates

2.2.5.5.1 Little Skate

The little skate is a demersal species that ranges from Nova Scotia to Cape Hatteras and is most abundant in the northern Mid-Atlantic Bight and on Georges Bank (Packer et al., 2003a). Little skate are managed as a single stock as part of the Northeast Skate Complex. The little skate is present in New England year-round, and mating may take place at any time throughout the year, although there is evidence that most egg cases are found fully or partially developed from late October to January and from June to July (Packer et al., 2003a). Little skate primarily prey on decapod crustaceans, amphipods, and polychaetes, and to a lesser extent, isopods, bivalves, and fishes (Packer et al., 2003a). According to the 2016 stock status update, little skate are not overfished and not experiencing overfishing (Sosebee, 2017).

The little skate EFH designations are reproduced below for the life stages found within the Project Area. Juvenile and adult life stages have EFH within the RWF area, RWEC-OCS corridor, and RWEC-RI corridor.

Juveniles: EFH is intertidal and subtidal 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 262 feet (80 m), as shown on Map 90 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017), and including high salinity zones in the bays and estuaries listed in Table 28 of NEFMC (2017). EFH for juvenile little skates occurs on sand and gravel substrates, but they are also found on mud.

Adults: EFH is intertidal and subtidal 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 328 feet (100 m), as shown on Map 91 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017), and including high salinity zones in the bays and estuaries listed in Table 28 of NEFMC (2017). EFH for adult little skates occurs on sand and gravel substrates, but they are also found on mud.

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2.2.5.5.2 Winter Skate

Winter skate range from the Gulf of St. Lawrence in Canada to Cape Hatteras, North Carolina, and have concentrated populations on Georges Bank and the northern section of the Mid-Atlantic Bight (Packer et al., 2003b; NOAA Fisheries, 2019y). Winter skate are managed as a single stock as part of the Northeast Skate Complex (NOAA Fisheries, 2019y). Mating is thought to take place year-round, though female winter skates with fully formed egg capsules are more abundant in summer and fall (Packer et al., 2003b). Winter skate primarily prey on polychaetes and amphipods, followed by decapod crustaceans, isopods, bivalves, and fishes (Packer et al., 2003b). According to the most recent stock assessment, winter skate are not overfished and not experiencing overfishing (Sosebee, 2017).

The winter skate EFH designations are reproduced below for the life stages found within the Project Area. Juvenile and adult life stages have EFH within the RWF area, RWEC-OCS corridor, and RWEC-RI corridor.

Juveniles: EFH is subtidal benthic habitats in coastal waters from eastern Maine to Delaware Bay and on the continental shelf in southern New England and the Mid-Atlantic region, and on Georges Bank, from the shoreline to a maximum depth of 295 feet (90 m), as shown on Map 92 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017), including the high salinity zones of the bays and estuaries listed in Table 28 of NEFMC (2017). EFH for juvenile winter skates occurs on sand and gravel substrates, but they are also found on mud.

Adults: EFH is subtidal benthic habitats in coastal waters in the southwestern Gulf of Maine, in coastal and continental shelf waters in southern New England and the Mid-Atlantic region, and on Georges Bank, from the shoreline to a maximum depth of 262 feet (80 m), as shown on Map 93 of the Final Omnibus EFH Amendment 2 (NEFMC, 2017), including the high salinity zones of the bays and estuaries listed in Table 28 of NEFMC (2017). EFH for adult winter skates occurs on sand and gravel substrates, but they are also found on mud.

2.2.5.6 Sharks

2.2.5.6.1 Basking Shark

The basking shark is a large, migratory species found in subpolar and cold temperate seas throughout the world (NOAA Fisheries, 2017). In the western Atlantic, basking sharks are found in coastal regions from April to October, with the highest abundance in May through August (NOAA Fisheries, 2017). Basking shark are filter-feeders that feed swimming forward with an opened mouth to filter planktonic prey. Little is known about the reproductive habits of basking shark, though aggregations of basking shark displaying courtship behaviors are thought to associate with persistent thermal fronts in areas of high prey density (NOAA Fisheries, 2017). Harvest of basking shark is prohibited in the U.S., and the species is listed as “Vulnerable” on the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species (Fowler, 2009). A stock assessment has not been conducted for basking shark (NOAA Fisheries, 2017).

The basking shark EFH designations are reproduced below for the life stages found within the Project Area. Neonate, juvenile, and adult life stages have EFH within the RWF area and RWEC-OCS corridor.

Neonate/Young-of-the-Year (YOY), Juveniles and Adults: At this time, insufficient data are available to differentiate EFH between size classes; therefore, EFH designations for all life stages have been combined and are considered the same. EFH is the Atlantic east coast from the Gulf of Maine to the northern Outer Banks of North Carolina, and from mid-South Carolina to coastal areas of northeast Florida. Aggregations of basking sharks were observed from the south and southeast of Long Island, east of Cape Cod, and along the coast of Maine, in the Gulf of Maine and near the Great South Channel, approximately 59 miles (95 km) southeast of Cape Cod, Massachusetts as well as approximately 47 miles (75 km) south of Martha’s Vineyard and 56 miles (90 km) south of Moriche’s Inlet, Long Island. These aggregations tend to be associated with persistent thermal fronts within areas of high prey density.

2.2.5.6.2 Blue Shark

The blue shark is a common pelagic shark that ranges widely in tropical, subtropical, and temperate waters (NOAA Fisheries, 2017). In the western Atlantic Ocean, they range from Newfoundland to Argentina (Fisheries and Oceans

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Canada, 2018b). Blue shark migrate great distances and prefer deep, clear, blue waters, usually with temperatures between 50 and 68 °F (10 and 20 °C) and depths greater than 591 feet (180 m) (NOAA Fisheries, 2017). Blue sharks are thought to have an annual reproductive cycle, and nursery areas appear to be in open oceanic waters in the higher latitudes of the its range (NOAA Fisheries, 2017). Blue shark prey mostly on squid and pelagic schooling fishes, and are known to feed opportunistically on marine mammal and turtle carcasses (Fisheries and Oceans Canada, 2018b). The 2015 stock assessment concluded that blue shark are not overfished and not experiencing overfishing, though the authors acknowledged a high level of uncertainty in the results (ICCAT, 2015).

The blue shark EFH designations are reproduced below for the life stages found within the Project Area. Neonate, juvenile, and adult life stages have EFH within the RWF area and RWEC-OCS corridor.

Neonates/YOY: EFH includes the Atlantic in areas offshore of Cape Cod through New Jersey, seaward of the 98 foot (30 m) bathymetric line (and excluding inshore waters such as Long Island Sound). EFH follows the continental shelf south of Georges Bank to the outer extent of the U.S. EEZ in the Gulf of Maine.

Juveniles and Adults: EFH includes localized areas in the Atlantic Ocean in the Gulf of Maine, from Georges Bank to North Carolina, South Carolina, Georgia, and off Florida.

2.2.5.6.3 Common Thresher Shark

The common thresher shark is a pelagic shark found in warm and temperate coastal and oceanic waters around the world, with higher abundance near land (NOAA Fisheries, 2017). In the northwest Atlantic Ocean, they are found from Newfoundland to Cuba. Common thresher shark prey on squid, pelagic crabs, and small fishes such as anchovy, sardines, hakes, and small mackerels (NOAA Fisheries, 2017). Common thresher shark mating is thought to occur in the late summer and fall, with females giving birth in spring (NOAA Fisheries, 2017; NOAA Fisheries, 2019z). A stock assessment has not been conducted for common thresher shark (NOAA Fisheries, 2019z).

The common thresher shark EFH designations are reproduced below for the life stages found within the Project Area. Neonate, juvenile, and adult life stages have EFH within the RWF area, RWEC-OCS corridor, and RWEC-RI corridor.

Neonate/YOY, Juveniles, and Adults: At this time, insufficient data are available to differentiate EFH between the juvenile and adult size classes; therefore, EFH is the same for those life stages. EFH is located in the Atlantic Ocean, from Georges Bank (at the offshore extent of the U.S. EEZ boundary) to Cape Lookout, North Carolina; and from Maine to locations offshore of Cape Ann, Massachusetts. EFH occurs with certain habitat associations in nearshore waters of North Carolina, especially in areas with temperatures from 65 to 70 °F (18.2 to 20.9 °C) and at depths from 15 to 45 feet (4.6 to 13.7 m).

2.2.5.6.4 Dusky Shark

The dusky shark is a migratory species found in warm and temperate waters over the continental shelf throughout the Atlantic, Pacific, and Indian Oceans (NOAA Fisheries, 2017). The reproductive habits of dusky shark are not well known, but the species is thought to give birth in Bulls Bay, South Carolina in April and May, and in the Chesapeake Bay, Maryland in June and July (NOAA Fisheries, 2017). The shallow, coastal waters of Massachusetts serve as nursery habitat for young dusky sharks. Dusky shark prey on a variety of fishes, squid, and other elasmobranchs such as dogfish, catsharks, skates, and rays (Fisheries and Oceans Canada, 2018c; Musick et al., 2009a). Harvest of dusky shark is prohibited in the U.S., and the species is listed as “Vulnerable” on the IUCN Red List of Threatened Species (Musick et al., 2009a). The most recent stock assessment concluded that dusky shark are overfished and subject to overfishing (SEDAR, 2016).

The dusky shark EFH designations are reproduced below for the life stages found within the Project Area. Neonate, juvenile, and adult life stages have EFH within the RWF area and RWEC-OCS corridor.

Neonate/YOY: EFH in the Atlantic Ocean includes offshore areas of southern New England to Cape Lookout, North Carolina. Specifically, EFH is associated with habitat conditions including temperatures from 65 to 72 °F (18.1 to

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22.2 °C), salinities of 25 to 35 ppt and depths at 14 to 51 feet (4.3 to 15.5 m). The seaward extent of EFH for this life stage in the Atlantic is 197 feet (60 m) in depth.

Juveniles and Adults: EFH is the coastal and pelagic waters inshore of the continental shelf break (< 656 feet [200 m] in depth) along the Atlantic east coast from habitats offshore of southern Cape Cod to Georgia, including the Charleston Bump and adjacent pelagic habitats. The inshore extent for these life stages is the 66 foot (20 m) bathymetric line, except in habitats of southern New England, where EFH is extended seaward of Martha's Vineyard, Block Island, and Long Island. EFH also includes pelagic habitats of southern Georges Bank and the adjacent continental shelf break from Nantucket Shoals and the Great South Channel to the eastern boundary of the United States EEZ. Adults are generally found deeper (to 6,562 feet [2,000 m]) than juveniles; however, there is overlap in the habitats utilized by both life stages. In the Gulf of Mexico, EFH includes offshore waters of the western and north Gulf, at and seaward of the continental shelf break, and in proximity to numerous banks along the continental shelf edge (e.g., Ewing and Sackett Bank). The continental shelf edge habitat from Desoto Canyon west to the Mexican border is important habitat for adult dusky sharks.

2.2.5.6.5 Sand Tiger Shark

Sand tiger shark are a large, coastal species found in tropical and warm temperate waters around the world, often in very shallow water (13 feet [4 m]) (NOAA Fisheries, 2017). In the northwestern Atlantic, mature sand tiger shark males and juveniles are found between Cape Cod and Cape Hatteras, and mature and pregnant females are found between Cape Hatteras and Florida (NOAA Fisheries, 2017). Sand tiger reproductive habits are not well known, but in the northwestern Atlantic they are thought to give birth in March and April. In the southern portions of its range, females are believed to give birth in the winter, with neonates migrating northward to summer nurseries such as Narragansett Bay (NOAA Fisheries, 2017). Sand tiger sharks feed on a variety of bony fishes, as well as other elasmobranchs. Harvest of sand tiger shark is prohibited in the U.S., and the species is listed as "Vulnerable" on the IUCN Red List of Threatened Species (Pollard and Smith, 2009).

The sand tiger shark EFH designations are reproduced below for the life stages found within the Project Area. Neonate and juvenile life stages have EFH within the RWF area, RWEC-OCS corridor, and RWEC-RI corridor.

Neonate/YOY and Juveniles: Neonate EFH ranges from Massachusetts to Florida, specifically the Plymouth, Kingston, Duxbury Bay system, Sandy Hook, and Narragansett Bays as well as coastal sounds, lower Chesapeake Bay, Delaware Bay (and adjacent coastal areas), Raleigh Bay and habitats surrounding Cape Hatteras. Juvenile EFH includes habitats between Massachusetts and New York (Plymouth, Kingston, Duxbury Bay system), and between mid-New Jersey and the mid-east coast of Florida. EFH can be described via known habitat associations in the lower Chesapeake Bay and Delaware Bay (and adjacent coastal areas) where temperatures range from 66 to 77 °F (19 to 25 °C), salinities range from 23 to 30 ppt at depths of 9 to 23 feet (2.8 to 7.0 m) in sand and mud areas, and in coastal North Carolina habitats with temperatures from 66 to 81 °F (19 to 27 °C), salinities from 30 to 31 ppt, depths of 27 to 45 feet (8.2 to 13.7 m), in rocky and mud substrate or in areas surrounding Cape Lookout that contain benthic structure.

2.2.5.6.6 Sandbar Shark

The sandbar shark is a large, coastal species found in subtropical and warm temperate waters. In the northwestern Atlantic, sandbar shark range from Cape Cod to the western Gulf of Mexico (NOAA Fisheries, 2017). Sandbar sharks prefer bottom habitats and are most commonly found in 66 to 180 feet (20 to 55 m) of water, and occasionally at depths of about 656 feet (200 m) (NOAA Fisheries, 2017). The species preys on a variety of bony fishes, other elasmobranchs, mollusks, and crustaceans (Musick et al., 2009b). Sandbar sharks migrate seasonally, and males and females segregate during most of the year (NFMS, 2017). Mating and birthing activities are thought to peak between April and July, with most near-term pregnant and postpartum females observed in the Florida Keys (NOAA Fisheries, 2017). In U.S. waters, sandbar shark nursery areas consist of shallow coastal waters from Cape Canaveral, Florida to Martha's Vineyard, Massachusetts. The 2017 stock assessment indicated that sandbar shark are overfished and not experiencing overfishing (Southeast Data and Assessment Review, 2017).

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The sandbar shark EFH designations are reproduced below for the life stages found within the Project Area. Juvenile and adult life stages have EFH within the RWF area, RWEC-OCS corridor, and RWEC-RI corridor.

Juveniles: EFH includes coastal portions of the Atlantic Ocean between southern New England (Nantucket Sound, Massachusetts) and Georgia in water temperatures ranging from 68 to 75 °F (20 to 24 °C) and depths from 7.9 to 21 feet (2.4 to 6.4 m). Important nurseries include Delaware Bay, Delaware, and New Jersey; Chesapeake Bay, Virginia; Great Bay, New Jersey; and the waters off Cape Hatteras, North Carolina. For all EFH, water temperatures range from 59 to 86 °F (15 to 30 °C), salinities range from 15 to 35 ppt, water depth ranges from 2.6 to 75 feet (0.8 to 23 m), and substrate includes sand, mud, shell, and rocky habitats. EFH in the Gulf of Mexico includes localized areas off Apalachicola Bay, Florida.

Adults: EFH in the Atlantic Ocean includes coastal areas from southern New England to the Florida Keys, ranging from inland waters of Delaware Bay and the mouth of Chesapeake Bay to the continental shelf break. EFH in the Gulf of Mexico includes coastal areas between the Florida Keys and Anclote Key, Florida; areas offshore of the Big Bend region; coastal areas of the Florida panhandle and Gulf coast between Apalachicola and the Mississippi River; and habitats surrounding the continental shelf between Louisiana and south Texas. Adults commonly use habitats in the West Florida Shelf, off Cape San Blas, and cool, deep, clear water offshore of Texas and Louisiana.

2.2.5.6.7 Shortfin Mako Shark

The shortfin mako shark is a highly migratory, pelagic species found in warm and warm-temperate waters around the world. In eastern U.S. waters, shortfin mako shark are found from New England to Florida, in the Gulf of Mexico, and in the Caribbean Sea. Shortfin mako prey on fast-moving fishes such as swordfish, tuna, and other sharks, as well as other bony fishes, marine mammals, crustaceans, and cephalopods (NOAA Fisheries, 2017; NOAA Fisheries, 2019aa). Shortfin mako reproductive habits and mating grounds are not well known, but mating is thought to occur from summer to fall and pregnant females have only been captured between 20 and 30° N or S latitude (NOAA Fisheries, 2017; NOAA Fisheries, 2019aa). According to the 2017 stock assessment, shortfin mako shark are overfished and subject to overfishing (ICCAT, 2017).

The shortfin mako shark EFH designations are reproduced below for the life stages found within the Project Area. Neonate, juvenile, and adult life stages have EFH within the RWF area and RWEC-OCS corridor.

Neonate/YOY, Juveniles, and Adults: At this time, available information is insufficient for the identification of EFH by life stage, therefore all life stages are combined in the EFH designation. EFH in the Atlantic Ocean includes pelagic habitats seaward of the continental shelf break between the seaward extent of the U.S. EEZ boundary on Georges Bank (off Massachusetts) to Cape Cod (seaward of the 656-foot [200 m] bathymetric line); coastal and offshore habitats between Cape Cod and Cape Lookout, North Carolina; and localized habitats off South Carolina and Georgia. EFH in the Gulf of Mexico is seaward of the 656-foot (200 m) isobaths in the Gulf of Mexico, although in some areas (e.g., northern Gulf of Mexico by the Mississippi delta) EFH extends closer to shore. EFH in the Gulf of Mexico is located along the edge of the continental shelf off Fort Myers to Key West (southern West Florida Shelf), and extends from the northern central Gulf of Mexico around Desoto Canyon and the Mississippi Delta to pelagic habitats of the western Gulf of Mexico that are roughly in line with the Texas/Louisiana border.

2.2.5.6.8 Smoothhound Shark Complex (Atlantic Stock)

The smoothhound shark complex consists of three species: smooth dogfish (*Mustelus canis*), Florida smoothhound (*Mustelus norrisi*), and Gulf smoothhound (*Mustelus sinusmexicanus*). Due to the difficulty in differentiating these three species, EFH is designated for these sharks as a complex. However, smooth dogfish is the only smoothhound shark complex species found in the Atlantic, so for the purposes of this report, we focus solely on smooth dogfish.

Smooth dogfish is a common, demersal coastal shark species that ranges from Massachusetts to northern Argentina, typically inhabiting inshore waters down to 656 feet (200 m) (NOAA Fisheries, 2017). Smooth dogfish migrate seasonally, congregating between the Chesapeake Bay and southern North Carolina in the winter, and moving along the coast in the spring as waters warm (NOAA Fisheries, 2017). Smooth dogfish primarily consume large crustaceans such as crabs and American lobster. During the spring in New England waters, smooth dogfish

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are also known to feed on small bony fishes (NOAA Fisheries, 2017). Mating is through to occur between May and September, and research suggests that estuaries are critically-important nursery habitats in the Mid-Atlantic Bight (NOAA Fisheries, 2017). The 2015 stock assessment indicated that smooth dogfish are not overfished and not experiencing overfishing (Southeast Data and Assessment Review, 2015).

The smoothhound shark complex EFH designations are reproduced below for the life stages found within the Project Area. Neonate, juvenile, and adult life stages have EFH within the RWF area, RWEC-OCS corridor, and RWEC-RI corridor.

Neonate/YOY, Juveniles, and Adults: At this time, available information is insufficient for the identification of EFH for this life stage, therefore all life stages are combined in the EFH designation. Smoothhound shark EFH identified in the Atlantic is exclusively for smooth dogfish. EFH in Atlantic coastal areas ranges from Cape Cod Bay, Massachusetts to South Carolina, inclusive of inshore bays and estuaries (e.g., Pamlico Sound, Core Sound, Delaware Bay, Long Island Sound, Narragansett Bay, etc.). EFH also includes continental shelf habitats between southern New Jersey and Cape Hatteras, North Carolina.

2.2.5.6.9 Spiny Dogfish

The spiny dogfish is found in temperate and subarctic areas of the North Atlantic and North Pacific Oceans. In the northwest Atlantic, their range extends from Labrador to Florida, which the highest concentrations between Nova Scotia and Cape Hatteras, North Carolina (NOAA Fisheries, 2019ab). Spiny dogfish migrate seasonally, moving north in the spring and summer and south in the fall and winter (ASMFC, 2019e). In Southern New England, spiny dogfish abundance is highest in the fall (ASMFC, 2019e). Mating and birthing take place during the winter on offshore wintering grounds (ASMFC, 2019e; NOAA Fisheries, 2019ab). Spiny dogfish are opportunistic feeders, with smaller individuals primarily preying on crustaceans, and larger individuals preying on jellyfish, squid, and schooling fishes (NOAA Fisheries, 2019ab). The 2018 stock assessment concluded that Atlantic spiny dogfish are not overfished and not subject to overfishing (NOAA Fisheries, 2019ab).

The spiny dogfish EFH designations are reproduced below for the life stages found within the Project Area. Sub-adult male, sub-adult female, adult male, and adult female life stages have EFH within the RWF area and RWEC-OCS corridor. Sub-adult female and adult male life stages have EFH within the RWEC-RI corridor.

Sub-Adult Females: EFH is pelagic and epibenthic habitats throughout the region. Sub-adult females are found over a wide depth range in full salinity seawater (32–35 ppt) where bottom temperatures range from 44.6 to 59 °F (7 to 15 °C). Sub-adult females are widely distributed throughout the region in the winter and spring when water temperatures are lower, but very few remain in the Mid-Atlantic area in the summer and fall after water temperatures rise above 59 °F (15 °C).

Sub-Adults Males: EFH is pelagic and epibenthic habitats, primarily in the Gulf of Maine and on the outer continental shelf from Georges Bank to Cape Hatteras. Sub-adult males are found over a wide depth range in full salinity seawater (32–35 ppt) where bottom temperatures range from 44.6 to 59 °F (7 to 15 °C). Sub-adult males are not as widely distributed over the continental shelf as the females and are generally found in deeper water. They are widely distributed throughout the region in the winter and spring when water temperatures are lower, but very few remain in the Mid-Atlantic area in the summer and fall after water temperatures rise above 59 °F (15 °C).

Adult Females: EFH is pelagic and epibenthic habitats throughout the region. Adults are found over a wide depth range in full salinity seawater (32–35 ppt) where bottom temperatures range from 44.6 to 59 °F (7 to 15 °C). They are widely distributed throughout the region in the winter and spring when water temperatures are lower, but very few remain in the Mid-Atlantic area in the summer and fall after water temperatures rise above 59 °F (15 °C).

Adult Males: EFH is pelagic and epibenthic habitats throughout the region. Adults are found over a wide depth range in full salinity seawater (32–35 ppt) where bottom temperatures range from 44.6 to 59 °F (7 to 15 °C). They are widely distributed throughout the region in the winter and spring when water temperatures are lower, but very few remain in the Mid-Atlantic area in the summer and fall after water temperatures rise above 59 °F (15 °C).

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2.2.5.6.10 White Shark

The white shark is a large species found in coastal and offshore waters of cold and temperate seas (NOAA Fisheries, 2017). In the northwestern Atlantic, white shark range sporadically from Newfoundland to the Gulf of Mexico, but are most abundant on the continental shelf between Cape Hatteras and Cape Cod (NOAA Fisheries, 2017). White shark are seasonally common in some locations, including New England in the summer (NOAA Fisheries, 2017). Juvenile white sharks prey primarily on fish, but shift to a diet of mostly marine mammals as they grow (NOAA Fisheries, 2017). The reproductive habits of white sharks and locations of nursery areas are not well known. Harvest of white shark is prohibited in the U.S., and the species is listed as “Vulnerable” on the IUCN Red List of Threatened Species (Fergusson et al., 2009).

The white shark EFH designations are reproduced below for the life stages found within the Project Area. Neonate, juvenile, and adult life stages have EFH within the RWF area and RWEC-OCS corridor. Within the RWEC-RI corridor, only neonates have EFH.

Neonate/YOY: EFH includes inshore waters out to 65 miles (105 km) from Cape Cod, Massachusetts, to an area offshore of Ocean City, New Jersey.

Juveniles and Adults: Known EFH includes inshore waters to habitats 65 miles (105 km) from shore, in water temperatures ranging from 48 to 82 °F (9 to 28 °C), but more commonly found in water temperatures from 57 to 73 °F (14 to 23 °C) from Cape Ann, Massachusetts, including parts of the Gulf of Maine, to Long Island, New York, and from Jacksonville to Cape Canaveral, Florida.

2.3 Summary of EFH in the Project Area

Tables 2.3-1 and 2.3-2 summarize early (i.e., eggs, larvae) and late (i.e., neonate, juveniles, adults) benthic life stages of species with designated EFH in the Project Area, provide a description of preferred habitat, and provide an assessment of whether the preferred habitat is present in the Project Area. Tables 2.3-3 and 2.3-4 summarize the early and late pelagic life stages of species with designated EFH in the Project Area.

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Table 2.3-1 Habitat Preferences of Early Benthic Life Stages with EFH in the Project Area

Table 2.3-1				
Species	**Life Stage**	**Location**	**Description of Preferred Habitat**	**Preferred Habitat Present in Project Area?**
Finfish				
Atlantic wolffish	Egg	RWF	Subtidal benthic habitats. Egg masses are hidden under rocks and boulders in nests.	Yes
	Larvae	RWF	Pelagic and subtidal benthic habitats.	Yes
Ocean pout	Egg	RWF, RWEC-OCS, RWEC-RI	Hard bottom habitats – sheltered nests, holes, and crevices.	Limited
Winter flounder	Egg	RWEC-RI	Bottom habitats with a substrate of mud, muddy sand, sand, gravel, macroalgae, and submerged aquatic vegetation.	Yes
	Larvae	RWF, RWEC-OCS, RWEC-RI	Pelagic and bottom habitats.	Yes
Invertebrates				
Atlantic sea scallop	Egg	RWF, RWEC-OCS, RWEC-RI	Coarse substrates of gravel, shells, and rocks.	Yes
	Larvae	RWF, RWEC-OCS, RWEC-RI	Hard surfaces for pelagic larvae to settle, including shells, pebbles, and gravel. Larvae also attach to macroalgae and other benthic organisms such as hydroids.	Yes
Longfin inshore squid	Egg	RWF, RWEC-OCS, RWEC-RI	Egg masses or “mops” are laid on a variety of substrates, including hard bottom (shells, lobster pots, fish traps, boulders, and rocks), submerged aquatic vegetation (e.g. *Fucus*), sand, and mud.	Yes

Table 2.3-2 Habitat Preferences of Late Benthic Life Stages with EFH in the Project Area

Table 2.3-2				
Species	**Life Stage**	**Location**	**Description of Preferred Habitat**	**Preferred Habitat Present in Project Area?**
Finfish				
Atlantic cod	Juvenile	RWF, RWEC-OCS, RWEC-RI	Bottom habitats with a substrate of gravel or cobble, and boulder habitats, especially those with attached organisms.	Yes
	Adult	RWF, RWEC-OCS, RWEC-RI	Bottom habitats with a substrate of rocks, pebbles, gravel, or boulders. Also found on sandy substrates.	Yes
Atlantic wolffish	Juvenile	RWF	Subtidal benthic habitats. Juveniles do not have strong substrate preferences	Yes
	Adult	RWF	Subtidal benthic habitats, including a wide variety of sand and gravel substrates. Rocky spawning habitats.	Yes
Black sea bass	Juvenile	RWF, RWEC-OCS, RWEC-RI	Usually found in association with rough-bottom, shellfish and eelgrass beds, and man-made structures in sandy-shelly areas. Offshore clam beds and shell patches may also be used during the winter.	Yes
	Adult	RWF, RWEC-OCS, RWEC-RI	Usually structured habitats (natural and man-made), sand, and shell substrates.	Yes
Haddock	Juvenile	RWF, RWEC-OCS	Young-of-the-year juveniles settle on sand and gravel but are found predominantly on gravel pavement areas.	Yes

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Table 2.3-2				
Species	**Life Stage**	**Location**	**Description of Preferred Habitat**	**Preferred Habitat Present in Project Area?**
			As they grow, they disperse over a greater variety of substrate types.	
Monkfish	Juvenile and Adult	RWF, RWEC-OCS	Bottom habitats with substrates of a sand-shell mix, algae-covered rocks, hard sand, pebbly gravel, or soft mud.	Yes
Ocean pout	Juvenile	RWF, RWEC-OCS, RWEC-RI	Bottom habitats on a wide variety of substrates, including shells, rocks, algae, soft sediments, sand, and gravel.	Yes
	Adult	RWF, RWEC-OCS, RWEC-RI	Mud and sand, particularly in association with structure-forming habitat types (i.e., shells, gravel, boulders).	Yes
Pollock	Juvenile	RWF, RWEC-OCS, RWEC-RI	Rocky bottom habitats with attached macroalgae (rockweed and kelp).	No
Red hake	Juvenile	RWF, RWEC-OCS, RWEC-RI	Intertidal and subtidal benthic habitats on mud and sand substrates. Bottom habitats providing shelter, including mud substrates with biogenic depressions, substrates providing biogenic complexity (e.g., eelgrass, macroalgae, shells, anemone and polychaete tubes), and artificial reefs. Newly settled juveniles occur in depressions on the open seabed. Older juveniles are commonly associated with shelter or structure and often found inside live bivalves.	Yes
	Adult	RWF, RWEC-OCS, RWEC-RI	Shell beds, soft sediments (mud and sand), and artificial reefs. Usually found in depressions in softer sediments or in shell beds and not on open sandy bottom.	Yes
Scup	Juvenile	RWF, RWEC-OCS, RWEC-RI	Associated with various sands, mud, mussel, and eelgrass bed substrates	Yes
	Adult	RWF, RWEC-OCS, RWEC-RI	Prefer smooth to rocky bottom habitats.	Yes
Silver hake	Juvenile	RWF, RWEC-OCS	Sandy substrates; found in association with sand waves, flat sand with amphipod tubes, and shells, and in biogenic depressions.	Yes
	Adult	RWF, RWEC-OCS, RWEC-RI	Pelagic and benthic habitats, including sandy substrates, bottom depressions, mud habitats bordering deep boulder reefs, boulder habitat, and associated with sand waves and shell fragments.	Yes
Summer flounder	Juvenile	RWF, RWEC-OCS, RWEC-RI	Prefer sandy or muddy bottom habitats. Use estuarine habitats as nursery areas, including salt marsh creeks, seagrass beds, mudflats, and open bay areas.	Yes
	Adult	RWF, RWEC-OCS, RWEC-RI	Prefer sandy or muddy bottom habitats. Inhabit shallow coastal and estuarine waters.	Yes
White hake	Juvenile	RWF, RWEC-OCS, RWEC-RI	Fine-grained, sandy substrates in eelgrass, macroalgae, and unvegetated habitats.	Yes
Windowpane flounder	Juvenile and Adult	RWF, RWEC-OCS, RWEC-RI	Bottom habitats with a substrate of mud or sand.	Yes
Winter flounder	Juvenile	RWF, RWEC-OCS, RWEC-RI	Variety of bottom types such as mud, sand, rocky substrates with attached macroalgae, tidal wetlands, and eelgrass. Young-of-the-year juveniles are found inshore on muddy and sandy sediments in and adjacent to eelgrass and macroalgae, in bottom debris, and in marsh creeks. They tend to settle to the bottom in soft-sediment depositional areas and disperse into coarser-grained substrates as they get older.	No

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Table 2.3-2				
Species	**Life Stage**	**Location**	**Description of Preferred Habitat**	**Preferred Habitat Present in Project Area?**
	Adult	RWF, RWEC-OCS, RWEC-RI	Muddy and sandy substrates, and on hard bottom on offshore banks.	Yes
Yellowtail flounder	Juvenile	RWF, RWEC-OCS, RWEC-RI	Sand and muddy sand.	Yes
	Adult	RWF, RWEC-OCS, RWEC-RI	Sand and sand with mud, shell hash, gravel, and rocks.	Yes
Invertebrates				
Atlantic sea scallop	Juvenile	RWF, RWEC-OCS, RWEC-RI	Bottom habitats with a substrate of shells, gravel, and small rocks (pebble, cobble), preferring gravel.	Yes
	Adult	RWF, RWEC-OCS, RWEC-RI	Bottom habitats with sand and gravel substrates.	Yes
Atlantic surfclam	Juvenile	RWEC-RI	Sandy habitats along the continental shelf.	Yes
	Adult	RWEC-OCS, RWEC-RI	Sandy habitats along the continental shelf.	Yes
Ocean quahog	Juvenile and Adult	RWF, RWEC-OCS	Prefers medium to fine sandy bottom with mud and silt.	Yes
Skates				
Little skate	Juvenile and Adult	RWF, RWEC-OCS, RWEC-RI	Bottom habitats with a sandy or gravelly substrate, or mud.	Yes
Winter skate	Juvenile and Adult	RWF, RWEC-OCS, RWEC-RI	Bottom habitats with a substrate of sand and gravel or mud.	Yes
Sharks [1]				
Spiny dogfish	Sub-adult male, Adult female	RWF, RWEC-OCS	Pelagic and epibenthic habitats.	Yes
	Sub-adult female, Adult male	RWF, RWEC-OCS, RWEC-RI	Pelagic and epibenthic habitats.	Yes

[1] The neonate/young-of-the year life stage for shark species is more similar to a juvenile life stage than a larval life stage. Thus, neonate/young-of-the year is considered to be a “late” life stage for the purpose of this analysis.

Table 2.3-3 Early Pelagic Life Stages with EFH in the Project Area

Table 2.3-3		
Species	**Life Stage**	**Location**
Finfish		
Atlantic butterfish	Egg, Larvae	RWF, RWEC-OCS, RWEC-RI
Atlantic cod	Egg, Larvae	RWF, RWEC-OCS, RWEC-RI
Atlantic herring	Larvae	RWF, RWEC-OCS, RWEC-RI
Atlantic mackerel	Egg, Larvae	RWF, RWEC-OCS, RWEC-RI
Atlantic wolffish	Larvae	RWF
Bluefish	Egg, Larvae	RWF, RWEC-OCS
Haddock	Egg	RWF

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Table 2.3-3		
Species	**Life Stage**	**Location**
	Larvae	RWF, RWEC-OCS
Monkfish	Egg, Larvae	RWF, RWEC-OCS, RWEC-RI
Pollock	Egg, Larvae	RWF, RWEC-OCS
Red hake	Egg, Larvae	RWF, RWEC-OCS, RWEC-RI
Scup	Egg, Larvae	RWEC-RI
Silver hake	Egg, Larvae	RWF, RWEC-OCS, RWEC-RI
Summer flounder	Egg	RWF, RWEC-OCS
	Larvae	RWF, RWEC-OCS, RWEC-RI
White hake	Larvae	RWF, RWEC-OCS
Windowpane flounder	Egg, Larvae	RWF, RWEC-OCS, RWEC-RI
Winter flounder	Larvae	RWF, RWEC-OCS, RWEC-RI
Witch flounder	Egg, Larvae	RWF, RWEC-OCS
Yellowtail flounder	Egg, Larvae	RWF, RWEC-OCS
Invertebrates		
Atlantic sea scallop	Larvae	RWF, RWEC-OCS, RWEC-RI

Table 2.3-4 Late Pelagic Life Stages with EFH in the Project Area

Table 2.3-4		
Species	**Life Stage**	**Location**
Finfish		
Atlantic butterfish	Juvenile, Adult	RWF, RWEC-OCS, RWEC-RI
Atlantic herring	Juvenile, Adult	RWF, RWEC-OCS, RWEC-RI
Atlantic mackerel	Juvenile	RWF, RWEC-OCS, RWEC-RI
	Adult	RWEC-RI
Bluefish	Juvenile, Adult	RWF, RWEC-OCS, RWEC-RI
Pollock	Juvenile	RWF, RWEC-OCS, RWEC-RI
Silver hake	Adult	RWF, RWEC-OCS, RWEC-RI
White hake	Juvenile	RWF, RWEC-OCS, RWEC-RI
Invertebrates		
Longfin inshore squid	Juvenile, Adult	RWF, RWEC-OCS, RWEC-RI
Northern shortfin squid	Adult	RWF
Highly Migratory Species		
Albacore tuna	Juvenile	RWF, RWEC-OCS, RWEC-RI
	Adult	RWF, RWEC-OCS
Bluefin tuna	Juvenile, Adult	RWF, RWEC-OCS, RWEC-RI
Skipjack tuna	Juvenile	RWF
	Adult	RWF, RWEC-OCS, RWEC-RI
Yellowfin tuna	Juvenile	RWF, RWEC-OCS, RWEC-RI
	Adult	RWF, RWEC-OCS
Sharks [1]		

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Table 2.3-4		
Species	**Life Stage**	**Location**
Basking shark	Neonate, Juvenile, Adult	RWF, RWEC-OCS
Blue shark	Neonate, Juvenile, Adult	RWF, RWEC-OCS
Common thresher shark	Neonate, Juvenile, Adult	RWF, RWEC-OCS, RWEC-RI
Dusky shark	Neonate, Juvenile, Adult	RWF, RWEC-OCS
Sand tiger shark	Neonate, Juvenile	RWF, RWEC-OCS, RWEC-RI
Sandbar shark	Juvenile, Adult	RWF, RWEC-OCS, RWEC-RI
Shortfin mako shark	Neonate, Juvenile, Adult	RWF, RWEC-OCS
Smoothhound shark complex (Atlantic stock)	Neonate, Juvenile, Adult	RWF, RWEC-OCS, RWEC-RI
Spiny dogfish	Sub-adult male, Adult female	RWF, RWEC-OCS
	Sub-adult female, Adult male	RWF, RWEC-OCS, RWEC-RI
White shark	Neonate	RWF, RWEC-OCS, RWEC-RI
	Juvenile, Adult	RWF, RWEC-OCS

[1] The neonate/young-of-the year life stage for shark species is more similar to a juvenile life stage than a larval life stage. Thus, neonate/young-of-the year is considered to be a “late” life stage for the purpose of this analysis.

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3.0 ENVIRONMENTAL CONSEQUENCES AND PROTECTION MEASURES

3.1 Impact Assessment

Potential impacts are characterized as direct or indirect and categorized by Project phase. Anticipated impacts are characterized as short-term or long-term. Consistent with NEPA (40 C.F.R. § 1508.8.), evaluations in this report consider both detrimental (or negative) and beneficial impacts of the Project.

- *Direct or Indirect*: Direct effects are those occurring at the same place and time as the initial cause or action. Indirect effects are those that occur later in time or are spatially removed from the activity.
- *Short-term or Long-term Impacts*: Short- or long-term impacts do not refer to any defined period. In general, short-term impacts are those that occur only for a limited period or only during the time required for construction activities. Impacts that are short-lived, such as noise from routine maintenance work during operations, may also be short-term if the activity is short in duration and the impact is restricted to a short, defined period. Long-term impacts are those that are likely to occur on a recurring or permanent basis or impacts from which a resource does not recover quickly. In general, direct impacts associated with construction and decommissioning are considered short-term because they will occur within the approximate 1-year construction phase. Indirect impacts are determined to be either short-term or long-term depending on if resource recovery may take several years. Impacts associated with Operations & Maintenance (O&M) are considered long-term because they occur over the life of the Project (i.e., 25 years per the Lease but could be extended up to 35 years.
- *Proposed Environmental Protection Measures* – If measures are proposed to avoid or minimize potential impacts, the impact evaluation included consideration of these environmental protection measures.

Different impact-producing factors (IPFs) may result in varying levels of impact on EFH and the species/life stages that associate with those habitats. IPFs that could impact EFH include seafloor disturbance, sediment suspension and deposition, habitat alteration, noise, traffic, lighting, discharges and releases, and trash and debris.

Impacts on EFH vary by habitat, species, and life stage as discussed below, with some species/life stages being more vulnerable than others. The analysis of impacts on EFH are discussed separately for the RWF and RWEC in the following sections. The IPFs are further subdivided into IPFs during the construction and decommissioning phases of the Project and the O&M phase of the Project. The construction and decommissioning phases are grouped as activities and equipment usage are similar between these two phases.

3.1.1 Revolution Wind Farm

IPFs resulting in potential impacts on EFH in the RWF area are described in Table 3.1-1 for the construction and decommissioning phases and in Table 3.1-2 for the O&M phase. At the end of the Project's operational life, the Project will be decommissioned in accordance with a detailed decommissioning plan to be developed in compliance with applicable laws, regulations, and BMPs at that time. All of the impacts associated with these activities are anticipated to be similar to or less than those described for construction, unless otherwise noted.

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Table 3.1-1 IPFs and Impact Characterization for EFH within the RWF during Construction and Decommissioning

Table 3.1-1						
IPF	**Project Activity**	**Impact Characterization for on EFH**				**Discussion**
		Benthic/ Demersal Early Life Stages [1]	**Pelagic Early Life Stages [1]**	**Benthic/ Demersal Late Life Stages [1]**	**Pelagic Late Life Stages [1]**	
Seafloor Disturbance	Seafloor preparation	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term	Direct Impacts: Impacts on EFH associated with seafloor preparation will primarily be associated with species that have benthic/demersal early life stages (eggs and larvae, Table 2.3-1) and later life stages (neonates, juveniles, and adults, Table 2.3-2) and prefer the types of habitats that will be disturbed by seafloor preparation. These activities could cause injury or mortality to benthic/demersal species, affect their habitat, and disrupt their spawning. Similarly, seafloor-disturbing activities could result in a small loss of spawning habitat for Atlantic cod, as studies completed in other regions suggest that cod often demonstrate spawning site fidelity, returning to the same fine-scale bathymetric locations year after year to spawn (Hernandez et al. 2013; Siceloff and Howell 2013; Zemeckis et al., 2014a). However, such homing behavior has not yet been documented amongst individual cod in southern New England, although conventional tagging studies suggest there is little dispersal during the winter spawning season (Cadrin et al., 2020). An active Atlantic cod winter spawning ground has been identified in a broad geographical area that includes Cox Ledge and surrounding locations (Zemeckis et al. 2014b; Dean et al., 2020). In southern New England, cod spawn primarily from December through May (Dean et al., 2020; Langan et al., 2020). There is currently a BOEM funded acoustic telemetry study to better understand the distribution and habitat use of spawning cod on and around Cox Ledge. Additionally, in a sampling effort on Cox Ledge by Kovach et al. (2010), the majority of Atlantic cod collected were in spawning condition. Atlantic cod were not among the consistently prevalent (top 25) species collected during multi-year sampling by otter trawl and beam trawl in areas that included Cox Ledge (Malek et al., 2014). Given the availability of similar surrounding habitat, Project activities are not expected to result in measurable impacts on spawning Atlantic cod. Non-lethal impacts on EFH are expected to be short-term as the direct effects will cease after seafloor preparation is completed in a given area and only a small portion of the available EFH in the area will be disturbed. Impacts on species with designated EFH that have pelagic early and/or later life stages within the RWF (Tables 2.3-3 and 2.3-4) are expected to be limited, as pelagic habitats will not be directly affected by seafloor preparation. However, these species may temporarily vacate the area of disturbance. Decommissioning activities are expected to cause similar impacts as construction, but these impacts would be shorter in duration. Impacts on EFH associated with boulder clearance and related seafloor preparation activities are expected to be direct and short-term. Boulders relocated during seafloor preparation will be in new locations and may be in new physical configurations in relation to other boulders. Concerning these spatial and physical attributes, the boulders are not expected to return to pre-project conditions. However, relatively rapid (< 1 year) recolonization of these boulders is expected (Guarinello and Carey, 2020) and will return these boulders to their pre-project habitat function. Additionally, if relocation results in aggregations of boulders, these new features could serve as high value refuge habitat for juvenile lobster and fish as they may provide more complexity and opportunity for refuge than surrounding patchy habitat.
	Impact pile driving and/or vibratory pile driving/foundation installation	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term	Direct Impacts: Direct impacts on EFH associated with seafloor disturbance from impact pile driving and/or vibratory pile driving and installation of the foundations (WTG and OSS) and scour protection are expected to result in similar direct impacts on EFH as seafloor preparation. Impacts on EFH will be primarily associated with species that have

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Table 3.1-1

IPF	Project Activity	Impact Characterization for on EFH				Discussion
		Benthic/ Demersal Early Life Stages [1]	Pelagic Early Life Stages [1]	Benthic/ Demersal Late Life Stages [1]	Pelagic Late Life Stages [1]	
						benthic/demersal life stages. Impact pile driving and/or vibratory pile driving and foundation installation could crush benthic/demersal species, particularly eggs and larvae, but also less mobile older life stages that do not vacate the area. **Minimal** impacts on EFH are expected for pelagic species because they are not expected to be near the seafloor during work activities or subject to crushing or injury through placement of the piles and foundations or removal of the foundations during decommissioning.
	RWF IAC and OSS-Link Cable installation	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term	Direct Impacts: Direct impacts on EFH associated with the IAC and OSS-Link Cable installation are expected to result in similar impacts as those discussed for seafloor preparation, as the IAC will be installed in the same area that will have been disturbed during seafloor preparation. Decommissioning activities are expected to cause similar impacts as construction, but these impacts would be shorter in duration. Additionally, fish eggs and larvae (ichthyoplankton), as well as zooplankton, are expected to be entrained during hydraulic dredging and jet trencher embedment of the IAC. Jet trencher and hydraulic dredging equipment use seawater to circulate through hydraulic motors and jets during installation. Although this seawater is released back into the ocean, it is assumed that all entrained eggs, larvae, and zooplankton will be killed. These losses are expected to be low and short-term. A previous assessment conducted for the South Fork Wind Farm found that the total estimated losses of zooplankton and ichthyoplankton from jet trencher entrainment were less than 0.001% of the total zooplankton and ichthyoplankton abundance present in the study area, which encompassed a linearly buffered region of 15 km around the SFEC and 25 km around the SFWF (INSPIRE Environmental, 2018). Only early life stages may be affected by jet plow entrainment; later life stages will not be affected. Limited research has been conducted on the potential impacts of hydraulic dredge entrainment, but because the volumes of water used by dredges are relatively small, the entrainment rates of ichthyoplankton are generally thought to be only a small proportion of the total local production (Reine and Clark, 1998; Reine et al., 1998). Egg and larval life stages are most likely to experience lethal impacts (Wenger et al., 2017), but later life stages could also be entrained by hydraulic dredging, with benthic species or species occurring in high densities having the highest risk (Drabble, 2012; Reine et al., 1998). However, the entrainment rates for mobile species are considered to be low, and mortality rates of entrained fish may also be low (Wenger et al., 2017; Drabble, 2012; Reine et al., 1998). Jet plow and hydraulic dredge entrainment losses are not expected to result in large losses of zooplankton, ichthyoplankton, or later life stages, and population-level impacts on EFH species are not anticipated.
	Vessel anchoring (including spuds)	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term	Direct Impacts: Direct impacts on EFH associated with vessel anchoring (including spuds) are similar to those discussed in seafloor preparation.
Habitat Alteration	Seafloor preparation Impact pile driving and/or vibratory pile driving/foundation installation	Indirect, long-term	Indirect, long-term	Indirect, long-term	Indirect, long-term	Indirect Impacts: Immediately following impact-producing activities, species with designated EFH are expected to move back into the area; however, in areas of sediment disturbance and/or areas with increased sedimentation, demersal/benthic habitat recovery and benthic infaunal and epifaunal species abundances may take up to 1 to 3 years to recover to pre-impact levels, based on the results of a number of studies on benthic recovery (e.g., AKRF, Inc. et al., 2012; Germano et al., 1994; Hirsch et al., 1978; Kenny and Rees, 1994). This recovery time may result in an indirect, long-term impact on designated EFH for species with benthic/demersal life stages. Recolonization of sediments by epifaunal and infaunal species

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Table 3.1-1

IPF	Project Activity	Impact Characterization for on EFH				Discussion
		Benthic/ Demersal Early Life Stages [1]	Pelagic Early Life Stages [1]	Benthic/ Demersal Late Life Stages [1]	Pelagic Late Life Stages [1]	
	RWF IAC and OSS-Link Cable installation Vessel anchoring (including spuds)					and the return of mobile fish and invertebrate species will allow this area to continue to serve as foraging habitat for EFH species. Pelagic species/life stages may be indirectly affected by the temporary reduction of benthic forage species, but these impacts are expected to be small given the availability of similar habitats in the area. Other species may be attracted to the disruption and prey on dislodged benthic species or other species injured or flushed during seafloor preparation, IAC and OSS-Link Cable installation, and vessel anchoring activities. During decommissioning, foundations and other facilities will be removed to a depth of 15 ft (4.6 m) below the mudline, unless otherwise authorized by BOEM (30 CFR § 585.910(a)). Decommissioning would result in the reversal of beneficial effects for species and life stages that inhabited the structures during the life of the Project. Over time, the disturbed area is expected to revert to pre-construction conditions, which would result in a beneficial impact for species and life stages that inhabit soft bottom habitats. Overall, habitat alteration from decommissioning is expected to cause minimal impacts because similar soft and hard bottom habitats are already present in and around the RWF (Benthic Assessment; INSPIRE Environmental, 2020), and the conversion of a relatively small area of habitat is unlikely to result in substantial effects, as any effect observed will be limited to the immediate vicinity of the individual structures.
Sediment Suspension and Deposition	Seafloor preparation Impact pile driving and/or vibratory pile driving/foundation installation RWF IAC and OSS-Link Cable installation Vessel anchoring (including spuds)	**Direct, short-term**	**Direct, short-term**	**Direct, short-term**	**Direct, short-term**	Direct Impacts: Seafloor-disturbing activities will result in temporary increases in sediment suspension and deposition. Sediment transport modeling was performed using RPS' Suspended Sediment Fate (SSFATE) model, which is a three-dimensional model developed jointly with the USACE and the Environmental Research Development Center. SSFATE is a well-known model that has been successfully applied in projects around the globe to simulate the sediment transport from dredging, cable and pipeline burial operations, sediment dumping, dewatering operations, and other sediment-disturbing activities. SSFATE computes TSS concentrations released into the water column and predicts the transport, dispersion, and settling of the suspended sediment. RPS also performed hydrodynamic modeling using their 3-dimensional HYDROMAP modeling system to simulate water levels, circulation patterns, and water volume flux through the study area and to provide hydrodynamic input (spatially and temporally varying currents) for input into the sediment transport model. The models, inputs, and results are described in detail in the Hydrodynamic and Sediment Transport Modeling Report (RPS, 2020). Several model simulations were run to evaluate the concentrations of suspended sediments, spatial extent and duration of sediment plumes, and the seafloor deposition resulting from cable burial activities. The grain size distributions used for modeling were based on samples collected during field studies performed for the project (Fugro, 2019), which indicate the sediments are predominately coarse grained in the RWF. For the RWF IAC, a representative segment of 7,392 ft (2,253 m) of installation was simulated and the modeling results indicate that sediment plumes with TSS concentrations exceeding the ambient conditions by 100 mg/L could extend up to 853 (260 m) feet from the cable centerline. The plume is expected to be mostly contained within the bottom of the water column. The model estimated that the elevated TSS concentrations would be of short duration and expected to return to ambient conditions in less than 4.8 hours following the cessation of cable burial activities. The modeling results indicate that sedimentation from IAC burial may exceed 0.4 inch (10 mm) of deposition up to 197 feet (60 m) from the cable and could cover up to 47 acres (190,202 m^2).

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Table 3.1-1

IPF	Project Activity	Impact Characterization for on EFH				Discussion
		Benthic/ Demersal Early Life Stages [1]	Pelagic Early Life Stages [1]	Benthic/ Demersal Late Life Stages [1]	Pelagic Late Life Stages [1]	
						Sediment suspension and deposition associated with decommissioning activities are expected to be similar to those from cable burial, but slightly lower in magnitude. Most marine species have some degree of tolerance to higher concentrations of suspended sediment because storms, currents, and other natural processes regularly result in increases in turbidity (MMS, 2009). However, these increases in sediment suspension and deposition may cause temporary impacts on benthic/demersal EFH. Direct impacts could include mortality, injury, or temporary displacement of the organisms living on, in, or near the seafloor. Sediment deposition on eggs or larvae may result in smothering, potentially resulting in mortality (MMS, 2007). Larger benthic organisms such as shellfish as may be able to extend feeding tubes and respiratory structures above the sediment (United Kingdom Department for Business Enterprise and Regulatory Reform, 2008). Maurer et al. (1986) found that several species of marine benthic infauna (including the clam *Mercenaria mercenaria*) exhibited little to no mortality when buried under up to 3 inches (8 cm) of various types of sediment (from predominantly silt-clay to pure sand). Demersal/benthic early life stages in or near the area of disturbance would likely be most affected, but these impacts are not expected to result in population-level effects. Pelagic species could also be affected, but are expected to temporarily vacate the area to avoid the disturbance and pelagic habitat quality is expected to quickly return to pre-disturbance levels.
Noise	Impact pile driving and/or vibratory pile driving	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term	Direct Impacts: To evaluate the levels of underwater noise likely to be generated during construction, modeling was conducted using JASCO's Marine Operations Noise model (MONM) and Full Wave Range Dependent Acoustic Model (FWRAM). These models combine the outputs of the source model with the spatial and temporal environmental context (e.g., location, oceanographic conditions, and seabed type) to estimate acoustic sound fields. For impact hammering of monopile foundations, the physical injury peak sound pressure threshold of 206 dB (re 1 µPa) for finfish, is predicted to be exceeded within a maximum range of 337 ft (115 m) from the sound source. Accumulated sound exposure levels of 187 dB (re 1 $\mu Pa^{2}\cdot sec$) and 183 dB (re 1 $\mu Pa^{2}\cdot sec$) were predicted to be exceeded within a maximum distance of 5.9 miles (9,464 m) and 7.9 miles (12,673 m), respectively. The finfish behavioral disturbance threshold of 150 dB (re 1 µPa RMS) is predicted to be exceeded within a maximum distance of 6.6 miles (10,664 m) from the sound source. Full modeling results are available in the Underwater Acoustic Analysis (Denes et al., 2020). Sound exposure guidelines and regulations designed to protect finfish are described in terms of sound pressure levels, but the observable effects of high intensity noise sources on finfish may actually be caused by exposure to particle motion (Popper and Hawkins, 2018). However, the particle motion levels associated with a high intensity noise source are difficult to measure and isolate from sound pressure levels. There is currently very limited understanding of the potential effects of particle motion on finfish and invertebrates. All fishes (including elasmobranchs) detect and use particle motion, even for those fishes that are also sensitive to sound pressure (Popper and Hawkins, 2019). Fishes that do not possess a swim bladder (sharks, mackerel, flatfish), as well as fishes with a swim bladder distant from the ear (salmon, tuna, most teleosts) are thought to primarily be sensitive to particle motion (Hawkins et al., 2020). Fishes with the swim bladder close to the ear (Atlantic cod, eels) or where the swim bladder is connected to the ear (herrings) are able to detect sound pressure as well as particle motion (Hawkins et al., 2020). In these finfish, the swim bladder and other gas-filled organs may act as a type of acoustic transformer, converting

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Table 3.1-1

IPF	Project Activity	Impact Characterization for on EFH				Discussion
		Benthic/ Demersal Early Life Stages [1]	Pelagic Early Life Stages [1]	Benthic/ Demersal Late Life Stages [1]	Pelagic Late Life Stages [1]	
						sound pressure into particle motion (Popper and Hawkins, 2018). The movement of these organs may indirectly stimulate the otolith structures such that fishes experience particle motion both from the noise source and from this indirect signal (Popper and Hawkins, 2018). Cephalopods, including cuttlefish, octopus, and squid species, are likely sensitive to particle motion rather than sound pressure (e.g. Packard et al., 1990; Mooney et al., 2010), with the lowest particle motion thresholds reported at 1 to 2 Hz (Packard et al., 1990). Particle motion thresholds were measured for longfin squid between 100 and 300 Hz, with a threshold of 110 dB re 1 µPa reported at 200 Hz (Mooney et al., 2010). No other studies have measured particle motion. Cephalopods appear to be particularly sensitive to low frequency sound. Solé et al. (2017) estimated that trauma onset may begin to occur in cephalopods at sound pressure levels (SPL_{rms}) from 139 to 142 dB re 1 µPa at one-third octave bands centered at 315 Hz and 400 Hz. A recent study found impulsive pile driving noise resulted in a change in squid (*Doryteuthis pealeii*) behavior, with squid exhibiting body pattern changes, inking, jetting, and startle responses (Jones et al., 2020). Sessile invertebrates such as bivalves may respond to sound exposure by closing their valves (e.g. Kastelein, 2008; Roberts et al., 2015; Solan et al., 2016) much as they do when water quality is temporarily unsuitable. In one study, the duration of valve closure was shown to increase with increasing vibrational strength (Roberts et al., 2015). Clams may respond to anthropogenic noise by reducing activity and moving to a position above the sediment-water interface. In response to noise associated with pile driving at the RWF, it is expected that finfish and mobile macroinvertebrates would temporarily relocate during construction and would not be in the areas of greatest acoustic stressors. Slow start (ramp up) of pile driving equipment would allow mobile species to move out of the area and not be subject to mortality or injury but they may still experience some direct impact, such as behavioral responses. For exposed species, noise from impact pile driving and/or vibratory pile driving may temporarily reduce habitat quality. However, population-level impacts of impact pile driving and/or vibratory pile driving noise are not expected. Pile driving will be suspended during the winter months, thereby avoiding potential noise impacts that may disrupt the spawning activity of Atlantic cod. In conclusion, impact pile driving and/or vibratory pile driving is expected to result in a direct impact on EFH for both pelagic and demersal life stages, but this impact will be short-term as once pile driving is completed, the habitat suitability is expected to return to pre-pile driving conditions.
	Vessel noise, construction equipment noise, aircraft noise	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term	Direct Impacts: Short-term impacts on EFH could occur due to vessel noise, construction equipment noise (exclusive of impact pile driving and/or vibratory pile driving noise), and/or aircraft noise during construction and decommissioning. Sounds created by mechanical/hydro-jet plows, vessels, or aircraft are continuous or non-impulsive sounds, which have different characteristics underwater and impacts on marine life. Limited research has been conducted on underwater noise from mechanical/hydro-jet plows. Generally, the noise from this equipment is expected to be masked by louder sounds from vessels. Also, as most noise generated by these pieces of equipment will be below the sediment surface and associated with the high-pressure jets, noise levels are not expected to result in injury or mortality on EFH species, but may cause finfish to temporarily vacate the area. The duration of noise at a given location will be short, as vessels will only be present for a short period at any given location along the cable corridor.

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Table 3.1-1

IPF	Project Activity	Impact Characterization for on EFH				Discussion
		Benthic/ Demersal Early Life Stages [1]	Pelagic Early Life Stages [1]	Benthic/ Demersal Late Life Stages [1]	Pelagic Late Life Stages [1]	
						Helicopters will be used for crew transfers between the WTGs and shore. Underwater noise associated with helicopters is generally brief as compared with the duration of audibility in the air (Richardson et al., 1995). Vessel noise may also cause mobile EFH species to temporarily vacate the area. Vessel sound source levels have been shown to cause several different effects in behavior, TTS, auditory masking, and blood chemistry. The most common behavioral responses are avoidance, alteration of swimming speed and direction, and alteration of schooling behavior (Vabø et al., 2002; Handegard and Tjøstheim, 2005; Sarà et al., 2007; Becker et al., 2013). These studies also demonstrated that the behavioral changes generally were temporary or that fish habituated to the noises. EFH species in the vicinity of Project vessels may be affected by vessel noise but the duration of the disturbance will occur over a very short period at any given location. Direct impacts on EFH may result from a temporary degradation of habitat for species that vacate the area due to elevated noise levels. However, the noise generated by vessel and aircrafts will be similar to the range of noise from existing vessel and aircraft traffic in the region, and are not expected to substantially affect the existing underwater noise environment.
Discharges and Releases	Hazardous materials spills Wastewater discharge	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term	Direct Impacts: Routine discharges of wastewater (e.g., gray water or black water) or liquids (e.g., ballast, bilge, deck drainage, stormwater) may occur from vessels, WTGs, or the OSS during construction and decommissioning; however, those discharges and releases are not anticipated to result in impacts because all vessel waste will be offloaded, stored, and disposed of in accordance with all applicable local, state and federal laws and regulations, such as the Environmental Protection Agency (EPA) and U.S. Coast Guard (USCG) requirements for discharges and releases to surface waters. In addition, compliance with applicable Project-specific management practices and requirements will minimize the potential for adversely impacting water quality and marine life. The construction/decommissioning of the RWF is not anticipated to lead to any spills of hazardous materials into the marine environment. Minor releases of hazardous materials could result in direct and indirect, short-term impacts on EFH. The impacts of spills are caused by either the physical nature of the material (e.g., physical contamination and smothering) or by its chemical components (e.g., toxic effects and bioaccumulation). Minor releases of hazardous materials could also result in indirect impacts on fish and invertebrate species if the spilled materials affect their eggs and food sources. Impacts would depend on the depth and volume of the spill, as well as the properties of the material spilled. All vessels participating in the construction of the RWF will comply with USCG requirements for management of onboard fluids and fuels, including maintaining and implementing spill prevention, control, and countermeasure (SPCC) plans. Vessels will be navigated by trained, licensed vessel operators who will adhere to navigational rules and regulations and vessels will be equipped with spill handling materials adequate to control or clean up an accidental spill. Best management practices (BMPs) for fueling and power equipment servicing will be incorporated into the Project's Emergency Response Plan and Oil Spill Response Plan (ERP/OSRP). Accidental releases are minimized by containment and clean-up measures detailed in the OSRP. Given these measures and the very low likelihood of an inadvertent release, impacts on EFH are not anticipated.

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Table 3.1-1						
IPF	**Project Activity**	**Impact Characterization for on EFH**				**Discussion**
		Benthic/ Demersal Early Life Stages [1]	**Pelagic Early Life Stages [1]**	**Benthic/ Demersal Late Life Stages [1]**	**Pelagic Late Life Stages [1]**	
Marine Trash and Debris		**Direct, short-term**	**Direct, short-term**	**Direct, short-term**	**Direct, short-term**	Direct Impacts: The release of trash and debris into offshore waters potentially may occur from any on-water activities. Certain types of trash and debris could be accidentally lost overboard during construction and decommissioning, with subsequent effects on EFH. USCG and EPA regulations require operators to develop waste management plans, post informational placards, manifest trash sent to shore, and use special precautions such as covering outside trash bins to prevent accidental loss of solid materials. Also, BOEM lease stipulations require adherence to Notice to Lessee (NTL) 2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of placards at prominent locations on offshore vessels and structures, and mandates a yearly marine trash and debris awareness training and certification process. As such, measures will be implemented prior to and during construction to avoid, minimize, and mitigate impacts related to trash and debris disposal. Given these measures, impacts from trash and debris on EFH are not anticipated.
Traffic	See Seafloor Disturbance, Noise, Sediment Suspension and Deposition, and Lighting IPFs.					
Lighting	Construction and vessel lighting	**Direct, short-term**	**Direct, short-term**	**Direct, short-term**	**Direct, short-term**	Direct Impacts: Artificial lighting during construction/decommissioning at the RWF will be associated with navigational and deck lighting on vessels from dusk to dawn. The response of fish species to artificial lights is highly variable and depends on a number of factors such as the species, life stage, and the intensity of the light. Small organisms are often attracted to lights, which in turn attract larger predators to feed on the prey aggregations. Other species may avoid artificially illuminated areas. Artificial lighting may disrupt the diel vertical migration patterns of fish and this may affect species richness and community composition (Nightingale et al., 2006; Phipps, 2001). It could also increase the risk of predation and disruption of predator/prey interactions and result in the loss of opportunity for dark-adapted behaviors including foraging and migration (Orr et al., 2013). Artificial lighting associated with construction and decommissioning would be temporary and limited relative to the surrounding areas. Lighting will be limited to the minimum necessary to ensure safety and to comply with applicable regulations. Additionally, no underwater lighting is proposed. Artificial lighting is not expected to result in measurable impacts on EFH.

[1]Early life stages include eggs and larvae. Late life stages include neonates, juveniles, and adults.

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Table 3.1-2 IPFs and Impact Characterization for EFH within the RWF during Operations and Maintenance

Table 3.1-2						
IPF	**Project Activity**	**Impact Characterization for EFH**				**Discussion**
		Benthic/ Demersal Early Life Stages [1]	**Pelagic Early Life Stages [1]**	**Benthic/ Demersal Late Life Stages [1]**	**Pelagic Late Life Stages [1]**	
Seafloor Disturbance	Foundations (WTG and OSS)	**Direct, short-term**	**Direct, short-term**	**Direct, short-term**	**Direct, short-term**	Direct Impacts: Seafloor disturbance during O&M of the RWF may occur during non-routine maintenance of bottom-founded infrastructure (e.g., foundations, scour protection). These maintenance activities are expected to result in similar impacts on EFH as those discussed for construction/decommissioning (Table 3.1-1), although the extent of disturbance would be limited to specific areas.
	RWF IAC and OSS-Link Cable non-routine O&M	**Direct, short-term**	**Direct, short-term**	**Direct, short-term**	**Direct, short-term**	Direct Impacts: Minimal impacts on EFH are expected from operation of the IAC and OSS-Link Cable themselves, as they will be buried beneath the seabed. However, non-routine maintenance may involve sediment-disturbing activities. These maintenance activities are expected to result in similar direct impacts on EFH as those discussed for construction/decommissioning (Table 3.1-1), although the extent of the disturbance would be limited to specific areas along the cable corridor.
	Vessel anchoring (including spuds)	**Direct, short-term**	**Direct, short-term**	**Direct, short-term**	**Direct, short-term**	Direct Impacts: During O&M, anchoring will be limited to vessels required to be onsite for an extended duration. Impacts on EFH resulting from potential vessel anchoring during O&M activities are expected to be similar to those discussed in Table 3.1-1.
Habitat Alteration	Foundations RWF IAC and OSS-Link Cable non-routine O&M	**Indirect, long-term**	**Indirect, long-term**	**Indirect, long-term**	**Indirect, long-term**	Indirect Impacts: Once constructed, the RWF will result in changes to seafloor topography and hydrodynamics because of the presence of foundations, scour protection, and cable protection. In previous assessments, offshore structures have not been shown to change the strength or direction of regional oceanic currents that transport eggs and larvae of marine fishes (RI CRMC, 2010; DONG Energy et al., 2006). Larval recruitment of EFH species from the water column is not anticipated to be affected by the RWF structures because the vertical foundations represent a miniscule surface area within the surrounding waters, and recruitment is generally influenced by numerous environmental signals other than the presence of physical structure (including stage of larval development, temperature, prey availability, and chemical odor of conspecifics) (McManus et al., 2018; Pineda et al., 2007). Foundations have been hypothesized as serving as attachment sites for eggs of squid and herrings in the North Sea, but data so far are lacking (Vandendriessche et al., 2016). Planktonic life stages of EFH species would not be directly affected by the introduction of foundations and scour protection. The seafloor overlaying the majority of buried IAC and OSS-Link Cable (where cable protection will not exist) is expected to return to pre-construction conditions over time and no long-term changes to sediment mobility and depositional patterns are expected. The presence of the foundations, associated scour protection, and cable protection may result in both negative and beneficial indirect impacts on EFH due to conversion of habitat from primarily soft-bottom to hard-bottom. Habitat conversion is expected to cause a shift in species assemblages towards those found in rocky reef/rock outcrop habitat; this is known as the “reef effect” (Wilhelmsson et al., 2006; Reubens et al., 2013). This effect is also well known from other anthropogenic structures in the sea, such as oil platforms, artificial reefs piers, and shipwrecks (Claudet and Pelletier, 2004; Wilhelmsson et al., 2006; Seaman, 2007; Langhamer and Wilhelmsson, 2009). The use of gravel, boulders, and/or concrete mats will create new hard substrate, and this substrate is expected to be initially colonized by barnacles, tube-forming species, hydroids, and other fouling species found on existing hard bottom habitat in the region. Mobile

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Table 3.1-2

IPF	Project Activity	Impact Characterization for EFH				Discussion
		Benthic/ Demersal Early Life Stages [1]	Pelagic Early Life Stages [1]	Benthic/ Demersal Late Life Stages [1]	Pelagic Late Life Stages [1]	
						organisms, such as lobsters and crabs, may also be attracted to and occur in and around the foundation in higher numbers than surrounding areas. Monopiles attract a range of attached epifauna and epiflora, including barnacles and filamentous algae (Petersen and Malm, 2006). Jacket foundations (which may be used for the OSS) provide a more complex structure than monopile foundations, and may increase habitat complexity through more suitable fouling surfaces and increased protection from predators (MMS, 2009). As these foundations extend from below the seafloor to above the surface of the water, there is expected to be a zonation of macroalgae from deeper growing red foliose algae and calcareous algae, to kelps and other species, including those that may grow in subtidal, intertidal, and splash zone areas. Foundations and cable protection typically also have crevices that increase structural complexity of the area and attract finfish and invertebrate species seeking shelter. EFH for species that have life stages associated with soft-bottom habitats may experience long-term impacts, as available habitat will be slightly reduced. EFH for species and life stages that inhabit hard bottom habitats may experience a beneficial effect, depending on the quality of the habitat created by the foundations and scour protection, and the quality of the benthic community that colonizes that habitat. Overall, habitat alteration is expected to cause minimal impacts because similar soft and hard bottom habitats are already present in and around the RWF (Benthic Assessment; INSPIRE Environmental, 2020), and the conversion of a relatively small area of habitat is unlikely to result in substantial effects, as any "reef effect" observed will be limited to the immediate vicinity of the individual structures. Given the availability of similar surrounding habitat and the limited area of habitat conversion, O&M of the RWF is not expected to result in measurable impacts on spawning Atlantic cod. The potential effects of removal of Project structures during decommissioning are discussed in Table 3.1-1.
Sediment Suspension and Deposition	RWF IAC and OSS-Link Cable Vessel anchoring (including spuds)	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term	Direct Impacts: Increases in sediment suspension and deposition during the O&M phase will result from vessel anchoring and non-routine maintenance activities that require exposing the IAC and/or OSS-Link Cable. Direct impacts on EFH resulting from sediment suspension and deposition during the O&M phase are expected to be similar to those discussed for the construction and decommissioning phase (Table 3.1-1), but on a more limited spatial scale.
Noise	Vessel and aircraft noise	Direct, long-term	Direct, long-term	Direct, long-term	Direct, long-term	Direct Impacts: Impacts on EFH from ship and aircraft (i.e., helicopter) noise during O&M of the RWF are expected to be similar to those discussed for the construction/decommissioning phase (Table 3.1-1), though lesser in extent. The noise generated by vessel and aircrafts will be similar to the range of noise from existing vessel and aircraft traffic in the region, and are not expected to substantially affect the existing underwater noise environment.
	WTG operational noise	Direct, long-term	Direct, long-term	Direct, long-term	Direct, long-term	Direct Impacts: The underwater noise levels produced by WTGs are expected to be within the hearing ranges of fish. Depending on the noise intensity, these noises could disturb or displace fisheries species within the surrounding area or cause auditory masking (MMS, 2007). Noise levels from operation of the RWF WTGs are not expected to result in injury or mortality, and finfish may become habituated to the operational noise (Thomsen et al., 2006; Bergström et al., 2014). Lindeboom et al. (2011) found no difference in the residency times of juvenile cod around monopiles between periods of WTG operation or when WTGs were out-of-order. This study also found that sand eels did not avoid the wind farm. In a similar study, the abundance of cod, eel, shorthorn sculpin, and goldsinny wrasse, were found to be higher near WTGs, suggesting that potential noise impacts from operation did not override

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Table 3.1-2

IPF	Project Activity	Impact Characterization for EFH				Discussion
		Benthic/ Demersal Early Life Stages [1]	Pelagic Early Life Stages [1]	Benthic/ Demersal Late Life Stages [1]	Pelagic Late Life Stages [1]	
						the attraction of these species to the artificial reef habitat (Bergström et al., 2013). Based on the available literature, operational noise from the WTGs is expected to have minimal impacts on EFH.
Electric and Magnetic Fields	RWF IAC and OSS-Link Cable	Direct, long-term	Direct, long-term	Direct, long-term	Direct, long-term	Direct Impacts: Operation of the WTGs does not generate electric and magnetic fields (EMF); however, once the IAC and OSS-Link Cables become energized, the cables will produce a magnetic field, both perpendicularly and in a lateral direction around the cables. The cable will be shielded and, where feasible, buried beneath the seafloor and will otherwise be protected. Shielded electrical transmission cables do not directly emit electrical fields into surrounding areas, but are surrounded by magnetic fields that can cause induced electrical fields in moving water (Gill et al., 2012). Exposure to EMF could be short- or long-term, depending on the mobility of the species/life stage. A modeling analysis of the magnetic fields and induced electric fields anticipated to be produced during operation of the RWF IAC, OSS-Link Cable, and RWEC was performed and results are included in the Offshore Electric- and Magnetic-Field Assessment (Exponent, 2020). That assessment also summarizes data from field studies conducted to assess impacts of EMF on marine organisms. These studies constitute the best source of evidence to assess the potential impacts on finfish and invertebrate behavior or distribution in the presence of energized cables. Compared to fish and elasmobranchs, relatively little is known about the response of marine invertebrates to EMF. Field surveys on the behavior of large crab species and lobster at submarine cable sites (Love et al., 2017; Hutchison et al., 2018) indicate that the Project's calculated magnetic-field levels are not likely to impact the distribution and movement of large epibenthic crustaceans. Ancillary data and observations from these field studies also suggest that cephalopod behavior is similarly unaffected by the presence of 60-Hz AC cables. Based on the modeling results and existing evidence, the EMF associated with the cables will be below the detection capability of invertebrate species. The available laboratory-generated research regarding the effects of 50- or 60-Hz on fish behavior do not indicate that produced fields will have adverse effects on magnetosensitive and electrosensitive species. Controlled laboratory studies conducted with eel and salmon (Richardson et al., 1976; Armstrong et al., 2015; Orpwood et al., 2015) support the conclusion that EMF produced by 50-75 Hz AC cables do not alter the behavior of magnetosensitive fish species, indicating that high frequency EMF is not easily detected by magnetosensitive migratory fish species. Laboratory studies assessing the EMF detection abilities indicate that the EMF detection ability of elasmobranchs decreases as the source frequency increases over 20 Hz, and suggest that elasmobranchs are unlikely to easily detect electric fields produced by 50/60 Hz power sources (Andrianov et al., 1984; Kempster et al., 2013). In a laboratory study, demersal catshark were exposed to magnetic fields produced by a 50-Hz source and did not exhibit any significant behavioral changes (Orr, 2016). Field studies have also concluded that energized power cables neither attract nor repel elasmobranchs (Love et al., 2016). Based on the available information, EMF produced by 50/60 Hz power sources is unlikely to be detected by elasmobranchs, and is unlikely to cause changes in elasmobranch behavior or distribution. Love et al. (2016) conducted a series of surveys between 2010 and 2014 to track fish populations at both energized and unenergized 60-Hz submarine cables off the California

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Table 3.1-2

IPF	Project Activity	Impact Characterization for EFH				Discussion
		Benthic/ Demersal Early Life Stages [1]	Pelagic Early Life Stages [1]	Benthic/ Demersal Late Life Stages [1]	Pelagic Late Life Stages [1]	
						coast. These studies were designed to assess whether EMF produced by the energized cable had any in situ effects on the distribution of marine species. Over three years of observations, no differences in fish communities at energized and unenergized cable sites were noted, indicating that EMF had no effect on fish distributions, although the physical structure of the unburied cables did attract a higher number of fish versus sediment bottoms, creating a "reef effect" (Love et al., 2016). Additionally, multiple fish surveys have been conducted at existing offshore windfarm sites. Results from these studies strongly indicate that operating windfarms and cables do not adversely affect the distributions of resident fish populations. Nearly 10 years of pre- and post-operational data from the Horns Rev Offshore Wind Farm site near Denmark indicate "no general significant changes in the abundance or distribution patterns of pelagic and demersal fish" (Leonhard et al., 2011), including species similar to those expected to inhabit the RWF. Researchers did note an increase in fish species associated with hard ground and vertical features, especially around WTG footings (Leonhard et al., 2011). Based on the modeling results and existing evidence, EMF associated with the IAC and OSS-Link Cable is not expected to adversely affect the populations or distributions of EFH species in the Project Area. These conclusions are consistent with the findings of a previous comprehensive review of the ecological impacts of marine renewable energy projects, where it was determined that there has been no evidence demonstrating that EMF at the levels expected from marine renewable energy projects will cause an effect (negative or positive) on any species (Copping et al., 2016). Moreover, a 2019 BOEM report that assessed the potential for AC EMF from offshore wind facilities to affect marine populations concluded that, for the southern New England area, no negative effects are expected for populations of key commercial and recreational fish species (Snyder et al., 2019). Based on this information, it is not expected that EFH species will be measurably affected by EMF from the cables.
Discharges and Releases	Hazardous materials spills Wastewater discharge	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term	Direct Impacts: As discussed for the construction/decommissioning phase, routine discharges of wastewater or liquids (e.g., ballast, bilge, deck drainage, stormwater) are not anticipated to result in impacts because all vessel waste will be offloaded, stored, and disposed of in accordance with all applicable local, state and federal regulations. In addition, compliance with applicable Project-specific management practices and requirements will minimize the potential for adversely impacting water quality and marine life. The operation of the RWF is not anticipated to lead to any spills of hazardous materials into the marine environment. Per the information requirements outlined in 30 CFR 585.626, a list of solid and liquid wastes generated, including disposal methods and locations, as well as federally regulated chemical products, is found in the Project's ERP/OSRP. The WTG and the OSS will be designed for secondary levels of containment to prevent accidental discharges of hazardous materials to the marine environment. Most maintenance will occur inside the WTGs, thereby reducing the risk of a spill, and no oils or other wastes are expected to be discharged during maintenance activities. All vessels participating in O&M of the RWF will comply with USCG requirements for management of onboard fluids and fuels, including maintaining and implementing SPCC plans. Vessels will be navigated by trained, licensed vessel operators who will adhere to navigational rules and regulations and vessels will be equipped with spill handling materials adequate to control or clean up an accidental spill. Best management practices (BMPs) for

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Table 3.1-2

IPF	Project Activity	Impact Characterization for EFH				Discussion
		Benthic/ Demersal Early Life Stages [1]	Pelagic Early Life Stages [1]	Benthic/ Demersal Late Life Stages [1]	Pelagic Late Life Stages [1]	
						fueling and power equipment servicing will be incorporated into the Project's ERP/OSRP. Accidental releases will be minimized by containment and clean-up measures detailed in the OSRP. Given these measures and the very low likelihood of an inadvertent release, potential impacts of a hazardous material spill on EFH are not anticipated.
Marine Trash and Debris		Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term	Direct Impacts: As discussed in Table 3.1-1, vessels will adhere to the USCG and EPA marine trash regulations, as well as BOEM guidance, and trash and debris generated during O&M of the RWF will be contained on vessels or at staging areas until disposal at an approved facility. Measures will be implemented prior to and during construction to avoid, minimize, and mitigate impacts related to trash and debris disposal. Given these measures, potential impacts from trash and debris on EFH are not anticipated.
Traffic	See Seafloor Disturbance, Noise, Sediment Suspension and Deposition, and Lighting IPFs.					
Lighting	RWF operational lighting	Direct, long-term	Direct, long-term	Direct, long-term	Direct, long-term	Direct Impacts: Artificial lighting during O&M will be associated with vessels, the WTGs, and the OSS for operational safety and security purposes. The response of fish species to artificial lights is highly variable and depends on a number of factors such as the species, life stage, and the intensity of the light. Small organisms are often attracted to lights, which in turn attract larger predators to feed on the prey aggregations. Other species may avoid artificially illuminated areas. However, lighting will be limited to the minimum necessary to ensure safety and to comply with applicable regulations. Because of the limited area that will have artificial lighting relative to the surrounding areas, and because no underwater lighting is proposed, overall impacts on EFH are expected to be minimal.

[1]Early life stages include eggs and larvae. Late life stages include neonates, juveniles, and adults.

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3.1.2 Revolution Wind Export Cable

IPFs resulting in potential impacts on EFH associated with the RWEC are described in Table 3.1-3 for the construction and decommissioning phases and in Table 3.1-4 for the O&M phase. At the end of the Project's operational life, the Project will be decommissioned in accordance with a detailed decommissioning plan to be developed in compliance with applicable laws, regulations, and BMPs at that time. All of the impacts associated with these activities are anticipated to be similar to or less than those described for construction, unless otherwise noted. The impacts discussed in this section apply to both the RWEC-OCS and RWEC-RI, though the impacts would vary slightly by habitat composition, which differs slightly between the nearshore and offshore portions of the RWEC corridor.

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Table 3.1-3 IPFs and Impact Characterization for EFH for the RWEC during Construction and Decommissioning

Table 3.1-3						
IPF	**Project Activity**	**Impact Characterization for EFH**				**Discussion**
		Benthic/ Demersal Early Life Stages [1]	**Pelagic Early Life Stages [1]**	**Benthic/ Demersal Late Life Stages [1]**	**Pelagic Late Life Stages [1]**	
Seafloor Disturbance	Seafloor preparation	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term	Direct Impacts: Direct impacts on benthic species and life stages from seafloor preparation are expected to be similar to those discussed in Table 3.1-1, with the exception of shallower areas being affected as the RWEC-RI nears landfall. These shallower areas are expected to have slightly different species assemblages than the deeper offshore areas near the RWF. For example, winter flounder eggs present in the shallow portions of the RWEC-RI corridor could be affected by seafloor disturbance if construction activities take place during the spawning period (generally December 15-May 31). As discussed in Section 2.2, the up-estuary stations sampled during the benthic survey conducted for the Project were generally characterized by finer substrate, dominated by soft-sediment fauna, higher turbidity, and more reduced sediments. The mid-bay stations were characterized by mussel and *Crepidula* beds with other attached organisms including barnacles, sponges, and macroalgae. The stations at the mouth of Narragansett Bay and the stations leading offshore to the 3-mile state water boundary were generally dominated by soft sediment infauna. The results of the benthic survey (Benthic Assessment; INSPIRE Environmental, 2020) did not indicate the presence of beds for EFH shellfish species within the RWEC-RI corridor, however, the mussel and *Crepidula* beds could serve as foraging or nursery habitat for certain finfish species. Disturbance of this shellfish bed habitat is not anticipated to result in population-level effects on EFH species, as only a small area would be affected, and similar habitat is common within the Bay. Seafloor preparation is expected to have limited impacts on EFH for species that have pelagic early or later life stages. Decommissioning activities are expected to cause similar impacts as construction, but these impacts would be shorter in duration.
	RWEC installation	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term	Direct Impacts: Direct impacts on EFH associated with the RWEC installation/ decommissioning are expected to result in similar impacts as those for seafloor preparation. Construction of the RWEC landfall would be accomplished with either HDD methodology. A cofferdam may be used to allow for a dry environment during construction and for managing sediment, contaminated soils, and bentonite (from HDD operations). Impacts associated with the installation of a cofferdam (if necessary) would be similar to those discussed for seafloor preparation, but on a smaller scale. The cofferdam will be a temporary structure used during construction only. Therefore, no conversion of habitat is expected, and the cofferdam will be removed prior to the O&M phase. In addition, as described in Table 3.1-1, fish eggs and larvae (ichthyoplankton), as well as zooplankton, are expected to be entrained and killed during hydraulic dredging and jet trencher embedment of the RWEC. These losses are expected to be very low and short-term. A previous assessment conducted for the South Fork Wind Farm found that the total estimated losses of zooplankton and ichthyoplankton from jet trencher entrainment were less than 0.001% of the total zooplankton and ichthyoplankton abundance present in the study area, which encompassed a linearly buffered region of 15 km around the SFEC and 25 km around the SFWF (INSPIRE Environmental, 2018). Limited research has been conducted on the potential impacts of hydraulic dredge entrainment, but because the volumes of water used by dredges are relatively small, the entrainment rates of ichthyoplankton are generally thought to be only a small proportion of the total fish production (Reine and Clark, 1998;

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Table 3.1-3

IPF	Project Activity	Impact Characterization for EFH				Discussion
		Benthic/ Demersal Early Life Stages [1]	Pelagic Early Life Stages [1]	Benthic/ Demersal Late Life Stages [1]	Pelagic Late Life Stages [1]	
						Reine et al., 1998). Jet plow and hydraulic dredge entrainment losses are not expected to result in large losses of zooplankton, ichthyoplankton, or later life stages, and population-level impacts on EFH species are not anticipated. A small amount of tidal salt marsh, and coastal beach/dune habitat may be affected during installation of the RWEC-RI. At this time, multiple landfall options are being considered within the Landfall Work Area, so it is not possible to quantify the areal extent of temporary or permanent impacts on these habitats. However, the Landfall Work Area would total up to 2.5 acres and would be sited to avoid and minimize impacts on wetland resources to the maximum extent practicable. If the Landfall Work Area is situated near the western end of the Landfall Envelope, use of the HDD method would minimize impacts on coastal habitats. Disturbance of tidally-influenced habitats could result in a direct, long-term impact on EFH for species that utilize these habitats, though this impact would be limited given the availability of similar habitat in the general area. Additionally, the tidal salt marsh at Blue Beach is located above MHW and is likely infrequently inundated only during extremely high tides and storm surge events. The perimeter of the salt marsh is mostly composed of invasive common reed (*Phragmites australis*) and is unlikely to function as high-quality habitat for EFH species.
	Vessel anchoring (including spuds)	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term	Direct Impacts: Direct impacts on EFH associated with vessel anchoring (including spuds) are similar to those discussed in seafloor preparation.
Habitat Alteration	Seafloor Preparation RWEC installation Vessel anchoring (including spuds)	Indirect, long-term	Indirect, long-term	Indirect, long-term	Indirect, long-term	Indirect Impacts: As discussed for the construction/decommissioning of the RWF (Table 3.1-1), in areas of sediment disturbance and/or areas with increased sedimentation, benthic habitat recovery and benthic infaunal and epifaunal species abundances may take up to 1 to 3 years to recover to pre-impact levels, based on the results of a number of studies on benthic recovery (e.g., AKRF, Inc. et al., 2012; Germano et al., 1994; Hirsch et al., 1978; Kenny and Rees, 1994). This recovery time may result in an indirect, long-term impact on designated EFH for species with benthic/demersal life stages. Recolonization of sediments by epifaunal and infaunal species and the return of mobile fish and invertebrate species will allow this area to continue to serve as foraging habitat for EFH species. Pelagic species/life stages may be indirectly affected by the temporary reduction of benthic forage species, but these impacts are expected to be very limited given the availability of similar habitats in the area. Other species may be attracted to the disruption and prey on dislodged benthic species or other species injured or flushed during seafloor preparation, RWEC installation, and vessel anchoring activities. During decommissioning, facilities will be removed to a depth of 15 ft (4.6 m) below the mudline, unless otherwise authorized by BOEM (30 CFR § 585.910(a)). Decommissioning would result in the reversal of beneficial effects for species and life stages that inhabited the cable protection (concrete mattresses or rock structures) during the life of the Project. Over time, the disturbed area is expected to revert to pre-construction conditions, which would result in a beneficial impact for species and life stages that inhabit soft bottom habitats. Overall, habitat alteration from decommissioning is expected to cause minimal impacts because similar soft and hard bottom habitats are already present in and around the RWEC corridor (Benthic Assessment; INSPIRE Environmental, 2020), and the conversion of a relatively small area of habitat is unlikely to result in substantial effects, as any effect observed will be limited to the immediate vicinity of the individual structures.

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Table 3.1-3

IPF	Project Activity	Impact Characterization for EFH				Discussion
		Benthic/ Demersal Early Life Stages [1]	Pelagic Early Life Stages [1]	Benthic/ Demersal Late Life Stages [1]	Pelagic Late Life Stages [1]	
Sediment Suspension and Deposition	Seafloor Preparation RWEC installation Vessel anchoring (including spuds)	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term	Direct Impacts: As discussed in Table 3.1-1, seafloor-disturbing activities will result in temporary increases in sediment suspension and deposition. Sediment transport modeling was performed using RPS' SSFATE model to evaluate the concentrations of suspended sediments, spatial extent and duration of sediment plumes, and the seafloor deposition resulting from Project cable burial activities. The modeling results indicate that sediment plumes with TSS concentrations exceeding the ambient conditions by 100 mg/L could extend up to 4,528 feet (1,380 m) from the RWEC-RI centerline in state waters, and up to 1,542 feet (470 m) from RWEC-OCS centerline in federal waters. The plume is expected to be mostly contained within the bottom of the water column, though in shallower waters it may occupy most of the water column due to the water depth. For the RWEC-OCS, predicted TSS concentrations above ambient for any single circuit installation do not persist in any given location for greater than 24 hours, and in most locations (>75 % of the affected area) concentrations return to ambient within 8 hours. This maximum was predicted to occur along a part of the route that will only see one circuit installation. The maximum duration above ambient along the portion of the RWEC where two circuits will be installed was predicted to be 14 hours per circuit. This corresponds to a total of 28 hours above ambient, however the two 14-hour periods will likely be separated by time. For installation of one circuit of the RWEC-RI, predicted TSS concentrations above ambient do not persist in any given location for greater than 16.3 hours, and in most locations (>75 % of the affected area) concentrations return to ambient within 4 hours). For installation of two circuits, the maximum plume exposure is doubled at 32.6 hours, however, the two 16.3-hour periods will likely be separated by time. The modeling results indicate that sedimentation from RWEC burial may exceed 0.4 inch (10 mm) of deposition up to 919 feet (280 m) from the cable centerline in state waters and up to 328 feet (100 m) in federal waters. This thickness of sedimentation could cover up to 1,126 acres (4,556,760 m^2) in state waters, and 1,020 acres (4,127,794 m^2) in federal waters. For the cable landfall, TSS concentrations exceeding ambient conditions by 100 mg/L could extend up 580 ft (177 m) from the centerline and plume concentrations above ambient could persist for 256 hours for the HDD. This duration is longer relative to the water jet assisted cable installation due to the slower installation rate of the activity and since both trenching and backfilling for two circuits are included. Sedimentation greater than 0.4 in (10 mm) may extend up to 509 ft (155 m) from the centerline and could cover up to 19 acres (76,890 m^2). The models, inputs, and results are described in detail in the Hydrodynamic and Sediment Transport Modeling Report (Exponent, 2020). Sediment suspension and deposition associated with decommissioning activities are expected to be similar, but slightly lower in magnitude. Similar to those discussed in Table 3.1-1, direct impacts on EFH from sediment suspension and deposition are expected to be similar to those discussed for construction of the RWF, with greater impacts on sessile and slow-moving benthic species/life stages compared to mobile and pelagic species/life stages. Winter flounder eggs are a sensitive resource within Narragansett Bay. Previous experiments have shown that a viable hatching rate of winter flounder eggs is reduced when the eggs are buried by as little as one half of one egg diameter, approximately 0.05 centimeter of sediment (Berry et al., 2003). In other laboratory experiments, winter flounder eggs were found to be affected by a sedimentation level of 0.065 centimeter, and almost complete mortality was observed when deposition exceeded 0.25 centimeter (Berry et al.,

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Table 3.1-3

IPF	Project Activity	Impact Characterization for EFH				Discussion
		Benthic/ Demersal Early Life Stages [1]	Pelagic Early Life Stages [1]	Benthic/ Demersal Late Life Stages [1]	Pelagic Late Life Stages [1]	
						2011), Winter flounder eggs could be affected by construction of the RWEC-RI if sedimentation is experienced in these shallow waters during the spawning period (generally December 15 to May 31). Given the high natural mortality that occurs during the early life history stages, adverse effects of burial at the population level are expected to be limited and only measurable in the immediate vicinity of the construction workspace. Revolution Wind will employ best management practices to minimize potential sedimentation impacts on winter flounder eggs in shallow waters. Revolution Wind will also coordinate with applicable regulatory agencies to define and comply with seasonal restrictions to minimize impacts on winter flounder and other sensitive finfish species.
Noise	Vibratory pile driving (cofferdam)	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term	Direct Impacts: The cofferdam at the RWEC landfall, if required, may be installed as either a sheet piled structure into the sea floor or a gravity cell structure placed on the sea floor using ballast weight. Sheet pile installation would require the use of a vibratory hammer to drive the sidewalls and endwalls into the seabed, which may take approximately up to 3 days. Vibratory devices use oscillatory hammers or spinning counterweights that vibrate the pile and cause the sediment surrounding the pile to liquefy, allowing the pile to move easily into or out of the sediment. Vibratory pile driving is considered a continuous low-frequency noise source because the device continuously vibrates until the pile reached the desired depth. Vibratory devices generally have sound source levels 10 to 20 dB lower than impact hammers, and the sound level generated rises relatively slowly (California Department of Transportation, 2009). Vibratory pile driving associated with the cofferdam is not anticipated to result in exceedance of the injury threshold for fish, however, noise from pile driving may temporarily reduce habitat quality, result in behavioral changes, or cause mobile species to temporarily vacate the area. Noise impacts on EFH species from vibratory pile driving may result in limited short-term impacts, as the habitat suitability is expected to return to pre-pile driving conditions shortly after cessation of the pile driving activity.
	Vessel noise, construction equipment noise, aircraft noise	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term	Direct Impacts: Direct impacts on EFH resulting from vessel, construction equipment, and aircraft noise during construction and decommissioning are expected to be similar to those discussed in Table 3.1-1.
Discharges and Releases	Hazardous materials spills Wastewater discharges	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term	Direct Impacts: Impacts associated with wastewater discharges or an inadvertent release of hazardous material during construction or decommissioning of the RWEC are expected to be similar to those discussed in Table 3.1-1.
Marine Trash and Debris		Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term	Direct Impacts: Impacts associated with marine trash and debris are expected to be similar to those discussed in Table 3.1-1.
Traffic	See Seafloor Disturbance, Noise, Sediment Suspension and Deposition, and Lighting IPFs.					
Lighting	Vessel and construction lighting	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term	Direct Impacts: During construction and decommissioning activities, lighting will be associated with the vessels that will be installing or decommissioning the RWEC. Direct impacts on EFH from artificial lighting are expected to be short-term because the vessels are expected to pass quickly along the RWEC corridor during cable installation. As discussed in

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Table 3.1-3						
IPF	**Project Activity**	**Impact Characterization for EFH**				**Discussion**
		Benthic/ Demersal Early Life Stages [1]	**Pelagic Early Life Stages [1]**	**Benthic/ Demersal Late Life Stages [1]**	**Pelagic Late Life Stages [1]**	
						Table 3.1-1, artificial lighting associated with cable installation would be temporary and limited relative to the surrounding areas. Lighting will be limited to the minimum necessary to ensure safety and to comply with applicable regulations. Additionally, no underwater lighting is proposed. Impacts on EFH due to artificial lighting are expected to be minimal.

[1]Early life stages include eggs and larvae. Late life stages include neonates, juveniles, and adults.

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Table 3.1-4 IPFs and Impact Characterization for EFH for the RWEC during Operations and Maintenance

Table 3.1-4						
IPF	**Project Activity**	**Impact Characterization for EFH**				**Discussion**
		Benthic/ Demersal Early Life Stages [1]	**Pelagic Early Life Stages [1]**	**Benthic/ Demersal Late Life Stages [1]**	**Pelagic Late Life Stages [1]**	
Seafloor Disturbance	RWEC non-routine O&M	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term	Direct Impacts: Minimal impacts on EFH are expected from operation of the RWEC, as it will be buried beneath the seabed, where feasible, and will otherwise be protected. Seafloor disturbance during O&M of the RWEC will be limited to non-routine maintenance that may require uncovering and reburial of the cables, as well as maintenance of cable protection where present. These maintenance activities are expected to result in similar direct impacts on EFH as those discussed for construction/decommissioning (Table 3.1-1), although the extent of disturbance would be limited to specific areas along the RWEC corridor.
	Vessel anchoring (including spuds)	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term	Direct Impacts: Impacts on EFH resulting from potential vessel anchoring during O&M activities are expected to be similar to those discussed in Table 3.1-1.
Habitat Alteration	RWEC O&M	Indirect, long-term	Indirect, long-term	Indirect, long-term	Indirect, long-term	Indirect Impacts: Cable protection (e.g., concrete mattresses) may be placed in select areas along the RWEC. The introduction of engineered concrete mattresses or rock to areas of the seafloor can cause local disruptions to circulation, currents, and natural sediment transport patterns, though these impacts as expected to be limited given the miniscule surface area associated with the cable protection compared to the surrounding waters. Under normal circumstances, these segments of the RWEC are expected to remain covered as accretion of sediment covers the cable and associated cable protection (where applicable). In non-routine situations, these segments may be uncovered, and re-burial might be required (for buried portions of the RWEC). The seafloor overlaying the majority of buried RWEC (where cable protection will not exist) is expected to return to pre-construction conditions over time and no long-term changes to sediment mobility and depositional patterns are expected. Indirect impacts on EFH associated with O&M activities for the RWEC are expected to result in similar impacts as those discussed for the IAC and OSS-Link Cable in Table 3.1-1, but will be limited in spatial extent. The protection of the cable may result in the long-term conversion of soft-bottom habitat to hard-bottom habitat. Similar to the foundations, this cable protection may have a long-term impact on EFH for species associated with soft-bottom habitats and a long-term beneficial impact on EFH for species associated with hard-bottom habitats, depending on the quality of the habitat created by the cable protection, and the quality of the benthic community that colonizes that habitat. The potential effects of removal of Project structures during decommissioning are discussed in Table 3.1-2.
Sediment Suspension and Deposition	RWEC non-routine O&M Vessel anchoring (including spuds)	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term	Direct Impacts: Increases in sediment suspension and deposition during the O&M phase may result from vessel anchoring and non-routine maintenance activities that require exposing portions of the RWEC. Direct impacts on EFH resulting from sediment suspension and deposition during the O&M phase are expected to be similar to those discussed for the construction and decommissioning phase (Table 3.1-1), but on a more limited spatial scale.
Noise	Vessel and aircraft noise	Direct, long-term	Direct, long-term	Direct, long-term	Direct, long-term	Direct Impacts: Impacts on EFH from ship and aircraft noise during O&M of the RWEC are expected to be similar to those discussed for the construction/decommissioning phase (Table 3.1-1), though lesser in extent.
Electric and Magnetic Fields	RWEC operations	Direct, long-term	Direct, long-term	Direct, long-term	Direct, long-term	Direct Impacts: Once the RWEC becomes energized, the cables will produce a magnetic field, both perpendicularly and in a lateral direction around the cables. The cable will be shielded, where feasible, and buried beneath the seafloor, and will otherwise be protected. Shielded electrical transmission cables do not directly emit electrical fields into surrounding areas, but are surrounded by magnetic fields that can cause induced electrical fields in

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Table 3.1-4

IPF	Project Activity	Impact Characterization for EFH				Discussion
		Benthic/ Demersal Early Life Stages [1]	Pelagic Early Life Stages [1]	Benthic/ Demersal Late Life Stages [1]	Pelagic Late Life Stages [1]	
						moving water (Gill et al., 2012). Exposure to EMF could be short- or long-term, depending on the mobility of the species. A modeling analysis of the magnetic fields and induced electric fields anticipated to be produced during operation of the RWF IAC, OSS-Link Cable, and RWEC was performed and results are included in the Offshore Electric- and Magnetic-Field Assessment (Exponent, 2020). That assessment also summarizes data from field studies conducted to assess impacts of EMF on marine organisms. As discussed for the RWF IAC and OSS-Link Cable in Table 3.1-2, behavioral effects and/or changes in EFH species abundance and distributions due to EMF are not expected. These conclusions are consistent with the findings of a previous comprehensive review of the ecological impacts of marine renewable energy projects, where it was determined that there has been no evidence demonstrating that EMF at the levels expected from marine renewable energy projects will cause an effect (negative or positive) on any species (Copping et al., 2016). Moreover, a 2019 BOEM report that assessed the potential for AC EMF from offshore wind facilities to affect marine populations concluded that, for the southern New England area, no negative effects are expected for populations of key commercial and recreational fish species (Snyder et al., 2019). Based on this information, it is not expected that EFH species will be measurably affected by EMF from the cables.
Discharges and Releases	Hazardous materials spills Wastewater discharges	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term	Direct Impacts: Impacts associated with wastewater discharges or an inadvertent release of hazardous material during O&M of the RWEC are expected to be similar to those discussed in Table 3.1-1.
Marine Trash and Debris		Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term	Direct Impacts: Impacts associated with marine trash and debris are expected to be similar to those discussed in Table 3.1-1.
Traffic	See Seafloor Disturbance, Noise, Sediment Suspension and Deposition, and Lighting IPFs.					
Lighting	Vessel lighting	Direct, long-term	Direct, long-term	Direct, long-term	Direct, long-term	Direct Impacts: Artificial lighting during O&M of the RWEC will be associated only with vessels. However, lighting will be limited to the minimum necessary to ensure safety and to comply with applicable regulations. Because of the limited area that will have artificial lighting relative to the surrounding areas, and because no underwater lighting is proposed, overall impacts on EFH are expected to be minimal.

[1]Early life stages include eggs and larvae. Late life stages include neonates, juveniles, and adults.

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3.2 Summary of Impacts

3.2.1 Summary of Impacts on EFH from RWF IPFs

Based on the IPFs discussed in Tables 3.1-1 and 3.1-2, species with a completely pelagic lifestyle are generally expected to be less negatively affected than demersal or benthic species. Overall, during construction, O&M, and decommissioning of the RWF, impacts on EFH species with benthic/demersal life stages are expected to be exposed to direct impacts from noise associated with impact pile driving and/or vibratory pile driving of foundations, other noise sources, seafloor disturbance, and sediment suspension/deposition, and indirect impacts from habitat alteration. EFH species with pelagic life stages are expected to be exposed to direct impacts from impact pile driving and/or vibratory pile driving noise and other construction/decommissioning noise sources, and indirect impacts from habitat alteration. Potential impacts from other IPFs are anticipated to be minimal. Potential long-term impacts may result from the conversion of soft-bottom habitat to hard-bottom habitat associated with the WTG foundations, scour protection, and protection of the OSS-Link Cable and IAC. These long-term impacts would be reversed following decommissioning of the Project. None of the IPFs are expected to result in population-level effects on EFH species, due to the limited scale and intensity of the Project activities, the availability of similar habitat in the surrounding area, and the implementation of avoidance, minimization, and mitigation measures.

3.2.1.1 EFH Species Least Likely to Experience Impacts

Of the species with EFH designated within the RWF area, those that are least likely to experience impacts have both pelagic early and late life stages, only have EFH associated with pelagic environments, and/or do not have preferred habitat present in the RWF area. They include the species and life stages listed in Table 3.2-1 below.

Table 3.2-1 EFH Species Least Likely to Experience Impacts – RWF

Table 3.2-1					
Species	**Egg**	**Larvae**	**Neonate**	**Juvenile**	**Adult**
New England Finfish					
Atlantic herring (*Clupea harengus*)		●		●	●
Pollock (*Pollachius virens*)				●	
Winter flounder (*Pseudopleuronectes americanus*)	●				
Witch flounder (*Glyptocephalus cynoglossus*)	●	●			
Mid-Atlantic Finfish					
Atlantic butterfish (*Peprilus triacanthus*)	●	●		●	●
Atlantic mackerel (*Scomber scombrus*)	●	●		●	
Bluefish (*Pomatomus saltatrix*)	●	●		●	●
Invertebrates					
Northern shortfin squid (*Illex illecebrosus*)					●
Highly Migratory Species					
Albacore tuna (*Thunnus alalunga*)				●	●
Bluefin tuna (*Thunnus thynnus*)				●	●
Skipjack tuna (*Katsuwonus pelamis*)				●	●
Yellowfin tuna (*Thunnus albacares*)				●	●
Sharks					
Basking shark (*Cetorhinus maximus*)			●	●	●
Blue shark (*Prionace glauca*)			●	●	●
Common thresher shark (*Alopias vulpinus*)			●	●	●
Dusky shark (*Carcharhinus obscurus*)			●	●	●
Sand tiger shark (*Carcharias taurus*)			●	●	

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Table 3.2-1					
Species	**Egg**	**Larvae**	**Neonate**	**Juvenile**	**Adult**
Sandbar shark (*Carcharhinus plumbeus*)				●	●
Shortfin mako shark (*Isurus oxyrinchus*)			●	●	●
Smoothhound shark complex (Atlantic stock) (*Mustelus canis*)			●	●	●
White shark (*Carcharodon carcharias*)			●	●	●

3.2.1.2 EFH Species Most Likely to Experience Impacts

Of the species with EFH designated within the RWF area that also have preferred habitat present, those with benthic/demersal early and/or late life stages are the most likely to experience impacts as a result of construction, O&M, and/or decommissioning of the RWF. The species and associated life stages most likely to experience some level of short-term or long-term, direct or indirect impact are listed in Table 3.2-2 below.

Conversion of soft-bottom habitat to hard-bottom habitat associated with the WTGs, scour protection, and protection of the OSS-Link Cable and IAC may have a long-term beneficial effect species with life stages with a preference for hard-bottom habitats (e.g., gravel, rock, boulders, artificial reefs), depending on the quality of the newly-created hard-bottom habitat, and the quality of the benthic community that colonizes that habitat. These species and life stages that may experience a long-term, beneficial effect are listed in Table 3.2-3.

Note that some species could experience both negative and beneficial impacts at different phases of the Project. Thus, the same species and life stages may appear in both Table 3.2-2 and Table 3.2-3.

Table 3.2-2 EFH Species Most Likely to Experience Negative Impacts – RWF

Table 3.2-2					
Species	**Egg**	**Larvae**	**Neonate**	**Juvenile**	**Adult**
New England Finfish					
Atlantic cod (*Gadus morhua*)				●	●
Atlantic wolfish (*Anarhichas lupus*)	●	●		●	●
Haddock (*Melanogrammus aeglefinus*)				●	
Monkfish (*Lophius americanus*)				●	●
Ocean pout (*Zoarces americanus*)	●			●	●
Red hake (*Urophycis chuss*)				●	●
Silver hake (*Merluccius bilinearis*)				●	●
White hake (*Urophycis tenuis*)				●	
Windowpane flounder (*Scophthalmus aquosus*)				●	●
Winter flounder (*Pseudopleuronectes americanus*)		●		●	●
Yellowtail flounder (*Limanda ferruginea*)				●	●
Mid-Atlantic Finfish					
Black sea bass (*Centropristis striata*)				●	●
Scup (*Stenotomus chrysops*)				●	●
Summer flounder (*Paralichthys dentatus*)				●	●
Invertebrates					
Atlantic sea scallop (*Placopecten magellanicus*)	●	●		●	●
Longfin inshore squid (*Doryteuthis pealeii*)	●				

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Table 3.2-2					
Species	**Egg**	**Larvae**	**Neonate**	**Juvenile**	**Adult**
Ocean quahog (*Arctica islandica*)				●	●
Skates					
Little skate (*Leucoraja erinacea*)				●	●
Winter skate (*Leucoraja ocellata*)				●	●
Sharks					
Spiny dogfish (*Squalus acanthias*)				●[1]	●

[1] Includes sub-adult males and sub-adult females.

Table 3.2-3 EFH Species That May Experience Beneficial Effects – RWF

Table 3.2-3					
Species	**Egg**	**Larvae**	**Neonate**	**Juvenile**	**Adult**
New England Finfish					
Atlantic cod (*Gadus morhua*)				●	●
Atlantic wolfish (*Anarhichas lupus*)	●				●
Haddock (*Melanogrammus aeglefinus*)				●	
Monkfish (*Lophius americanus*)				●	●
Ocean pout (*Zoarces americanus*)	●			●	●
Pollock (*Pollachius virens*)				●	
Red hake (*Urophycis chuss*)				●	●
Silver hake (*Merluccius bilinearis*)					●
Yellowtail flounder (*Limanda ferruginea*)					●
Mid-Atlantic Finfish					
Black sea bass (*Centropristis striata*)				●	●
Scup (*Stenotomus chrysops*)					●
Invertebrates					
Atlantic sea scallop (*Placopecten magellanicus*)	●	●		●	●
Longfin inshore squid (*Doryteuthis pealeii*)	●				
Skates					
Little skate (*Leucoraja erinacea*)				●	●
Winter skate (*Leucoraja ocellata*)				●	●

3.2.2 Summary of Impacts on EFH from RWEC IPFs

Based on the IPFs discussed in Tables 3.1-3 and 3.1-4, species with a completely pelagic lifestyle are generally expected to be less negatively affected than demersal or benthic species. Overall, during construction, O&M, and decommissioning of the RWEC, impacts on EFH species with benthic/demersal life stages are expected to be exposed to direct impacts from seafloor disturbance, sediment suspension/deposition, and noise IPFs, and indirect impacts from habitat alteration. EFH species with pelagic life stages are expected to be exposed to direct impacts from noise. Potential impacts from other IPFs are anticipated to be minimal. Potential long-term impacts may result from the conversion of soft-bottom habitat to hard-bottom habitat associated with the protection of the RWEC. These long-term impacts would be reversed following decommissioning of the Project. None of the IPFs are expected to result in population-level effects on EFH species, due to the limited scale and intensity of the Project activities, the

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availability of similar habitat in the surrounding area, and the implementation of avoidance, minimization, and mitigation measures.

3.2.2.1 EFH Species Least Likely to Experience Impacts

Of the species with EFH designated within the RWEC area, those that are least likely to experience impacts have both pelagic early and late life stages, only have EFH associated with pelagic environments, and/or do not have preferred habitat present in the RWF area. They include the species and life stages listed in Table 3.2-4 below.

Table 3.2-4 EFH Species Least Likely to Experience Impacts – RWEC

Table 3.2-4					
Species	**Egg**	**Larvae**	**Neonate**	**Juvenile**	**Adult**
New England Finfish					
Atlantic herring (*Clupea harengus*)		●		●	●
Pollock (*Pollachius virens*)				●	
Witch flounder (*Glyptocephalus cynoglossus*)	●	●			
Mid-Atlantic Finfish					
Atlantic butterfish (*Peprilus triacanthus*)	●	●		●	●
Atlantic mackerel (*Scomber scombrus*)	●	●		●	●
Bluefish (*Pomatomus saltatrix*)	●	●		●	●
Highly Migratory Species					
Albacore tuna (*Thunnus alalunga*)				●	●
Bluefin tuna (*Thunnus thynnus*)				●	●
Skipjack tuna (*Katsuwonus pelamis*)					●
Yellowfin tuna (*Thunnus albacares*)				●	●
Sharks					
Basking shark (*Cetorhinus maximus*)			●	●	●
Blue shark (*Prionace glauca*)			●	●	●
Common thresher shark (*Alopias vulpinus*)			●	●	●
Dusky shark (*Carcharhinus obscurus*)			●	●	●
Sand tiger shark (*Carcharias taurus*)			●	●	
Sandbar shark (*Carcharhinus plumbeus*)				●	●
Shortfin mako shark (*Isurus oxyrinchus*)			●	●	●
Smoothhound shark complex (Atlantic stock) (*Mustelus canis*)			●	●	●
White shark (*Carcharodon carcharias*)			●	●	●

3.2.2.2 EFH Species Most Likely to Experience Impacts

Of the species with EFH designated within the RWEC area that also have preferred habitat present, those with benthic/demersal early and/or late life stages are the most likely to experience impacts as a result of construction, O&M, and/or decommissioning of the RWEC. The species and associated life stages most likely to experience some level of short-term or long-term, direct or indirect impact are listed in Table 3.2-5 below.

Conversion of soft-bottom habitat to hard-bottom habitat associated with the cable protection may have a long-term beneficial effect on species with life stages with a preference for hard-bottom habitats (e.g., gravel, rock, boulders, artificial reefs), depending on the quality of the newly-created hard-bottom habitat, and the quality of the benthic

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community that colonizes that habitat. These species and life stages that may experience a long-term, beneficial effect are listed in Table 3.2-6.

Note that some species could experience both negative and beneficial impacts at different phases of the Project. Thus, the same species and life stages may appear in both Table 3.2-5 and Table 3.2-6.

Table 3.2-5 EFH Species Most Likely to Experience Negative Impacts – RWEC

Table 3.2-5					
Species	**Egg**	**Larvae**	**Neonate**	**Juvenile**	**Adult**
New England Finfish					
Atlantic cod (*Gadus morhua*)				●	●
Haddock (*Melanogrammus aeglefinus*)				●	
Monkfish (*Lophius americanus*)				●	●
Ocean pout (*Zoarces americanus*)	●			●	●
Red hake (*Urophycis chuss*)				●	●
Silver hake (*Merluccius bilinearis*)				●	●
White hake (*Urophycis tenuis*)				●	
Windowpane flounder (*Scophthalmus aquosus*)				●	●
Winter flounder (*Pseudopleuronectes americanus*)	●			●	●
Yellowtail flounder (*Limanda ferruginea*)				●	●
Mid-Atlantic Finfish					
Black sea bass (*Centropristis striata*)				●	●
Scup (*Stenotomus chrysops*)				●	●
Summer flounder (*Paralichthys dentatus*)				●	●
Invertebrates					
Atlantic sea scallop (*Placopecten magellanicus*)	●	●		●	●
Atlantic surfclam (*Spisula solidissima*)				●	●
Longfin inshore squid (*Doryteuthis pealeii*)	●				
Ocean quahog (*Arctica islandica*)				●	●
Skates					
Little skate (*Leucoraja erinacea*)				●	●
Winter skate (*Leucoraja ocellata*)				●	●
Sharks					
Spiny dogfish (*Squalus acanthias*)				●[1]	●

[1] Includes sub-adult males and sub-adult females.

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Table 3.2-6 EFH Species That May Experience Beneficial Effects – RWEC

Table 3.2-6					
Species	**Egg**	**Larvae**	**Neonate**	**Juvenile**	**Adult**
New England Finfish					
Atlantic cod (*Gadus morhua*)				●	●
Haddock (*Melanogrammus aeglefinus*)				●	
Monkfish (*Lophius americanus*)				●	●
Ocean pout (*Zoarces americanus*)	●			●	●
Pollock (*Pollachius virens*)				●	
Red hake (*Urophycis chuss*)				●	●
Silver hake (*Merluccius bilinearis*)					●
Yellowtail flounder (*Limanda ferruginea*)					●
Mid-Atlantic Finfish					
Black sea bass (*Centropristis striata*)				●	●
Scup (*Stenotomus chrysops*)					●
Invertebrates					
Atlantic sea scallop (*Placopecten magellanicus*)	●	●		●	●
Longfin inshore squid (*Doryteuthis pealeii*)	●				
Skates					
Little skate (*Leucoraja erinacea*)				●	●
Winter skate (*Leucoraja ocellata*)				●	●

3.3 Proposed Environmental Protection Measures

To ensure that impacts associated with the RWF and RWEC are minimized, Revolution Wind will implement the following environmental protection measures to reduce potential impacts on finfish and EFH. These measures are based on protocols and procedures successfully implemented for similar offshore projects.

- To the extent feasible, installation of the IACs, OSS-Interlink Cable, and RWEC will occur using equipment such mechanical cutter, mechanical plow, or jet plow.
- To the extent feasible, the IAC, OSS-Link Cable, and RWEC will target a burial depth of 4 to 6 ft (1.2 to 1.8 m) below seabed. The target burial depth will be determined based on an assessment of seabed conditions, seabed mobility, the risk of interaction with external hazards such as fishing gear and vessel anchors, and a site-specific Cable Burial Risk Assessment.
- Dynamic Positioning (DP) vessels will be used for installation of the IAC, OSS-Link Cable, and RWEC to the extent practicable. DP vessels minimize seafloor impacts, as compared to use of a vessel relying on multiple anchors.
- A plan for vessels will be developed prior to construction to identify no-anchor areas to avoid documented sensitive resources.
- Revolution Wind is committed to collaborative science with the commercial and recreational fishing industries pre-, during, and post-construction. Fisheries monitoring studies are being planned to assess the impacts associated with the Project on economically and ecologically important fisheries resources. These studies will be conducted in collaboration with the local fishing industry and will build upon monitoring efforts being conducted by affiliates of Revolution Wind at other wind farms in the region.

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- Revolution Wind will require all construction and operations vessels to comply with regulatory requirements related to the prevention and control of spills and discharges.
- Accidental spill or release of oils or other hazardous materials offshore will be managed through the Project's ERP/OSRP.
- A ramp-up or soft-start will be used at the beginning of each pile segment during impact pile driving and/or vibratory pile driving to provide additional protection to mobile species in the vicinity by allowing them to vacate the area prior to the commencement of pile-driving activities.
- Construction and operational lighting will be limited to the minimum necessary to ensure safety and compliance with applicable regulations.
- All vessels will comply with USCG and EPA regulations that require operators to develop waste management plans, post informational placards, manifest trash sent to shore, and use special precautions such as covering outside trash bins to prevent accidental loss of solid materials. Vessels will also comply with BOEM lease stipulations that require adherence to Notice to Lessee (NTL) 2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of placards at prominent locations on offshore vessels and structures, and mandates a yearly marine trash and debris awareness training and certification process.

4.0 CONCLUSIONS

Project-related impacts on EFH would vary for different species and life stages based on several factors including their lifestyle, degree of dependence on the substrate, diet, habitat preferences, and the amount of suitable habitat present in the area. Most of the potential impacts on EFH will be temporary and reversible as natural processes are expected to return the disturbed areas to pre-construction conditions apart from new manmade structures on the seafloor and in the water column. In addition, the extent of anticipated habitat impact is small relative to the availability of similar habitat in the region.

Construction impacts will largely be associated with the disturbance of benthic habitats in the Project Area. Based on the results of a number of studies on benthic recovery (e.g., AKRF, Inc. et al., 2012; Germano et al., 1994; Hirsch et al., 1978; Kenny and Rees, 1994), the affected benthic communities in the disturbed area are expected to re-establish within 1 to 3 years as native assemblages recolonize the affected area or a new community develops as a result of immigration of organisms from nearby areas or from larval settlement. Regardless of foundation type(s) installed, existing habitats will be converted to hard substrate with installation of the WTG foundations (inclusive of scour protection) and with the installation of cable protection along the IAC, OSS-Link Cable, and RWEC. However, following construction, these areas of new hard substrate may be suitable for colonization by sessile benthic species and may provide additional habitat for fish and invertebrate species that inhabit hard bottom habitats. Beneficial effects for these species would be dependent on their habitat preferences, the quality of the newly-created hard-bottom habitat, and the quality of the benthic community that colonizes the new habitat. These long-term impacts would be reversed following decommissioning of the Project. Additional impacts on EFH from operations and maintenance of the RWF and RWEC would be primarily associated with routine and non-routine maintenance activities that may require excavation of sediment within a small area. The temporary displacement of these sediments would impact benthic and demersal EFH in the vicinity, but the impact would be limited considering the small area affected and the long period of time between maintenance activities. Operational impacts of vessel noise, traffic, and lighting are considered to be minimal relative to existing marine use activities in the area.

Decommissioning activities associated with the Project, similar to construction activities, will result in temporary disturbances to EFH and EFH species, but effects and recovery rates are expected to be similar to those described for construction.

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The overall impacts on EFH associated with the construction, operation, and decommissioning of the RWF and RWEC are considered to be limited and are not likely to result in population-level effects on EFH species or life stages.

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Appendix E: Assessment of Impacts to Marine Mammals, Sea Turtles, and ESA-Listed Fish Species Revolution Wind Offshore Wind Farm

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Technical Report

Assessment of Impacts to Marine Mammals, Sea Turtles, and ESA-Listed Fish Species Revolution Wind Offshore Wind Farm

October 2020
Revised March 2021

Revolution Wind | Powered by Ørsted & Eversource

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Acronyms

AEP	auditory evoked potential
AMAPPS	Atlantic Marine Assessment Program for Protected Species
ASMFC	Atlantic States Marine Fisheries Commission
ASSRT	Atlantic Sturgeon Status Review Team
BIWF	Block Island Wind Farm
BOEM	Bureau of Ocean Energy Management
CETAP	Cetacean and Turtle Assessment Program
CFR	Code of Federal Regulation
COP	Construction and Operations Plan
CPA	closest point of approach
dB	decibel
DP	dynamic positioning
DPS	distinct population segment
EA	environmental assessment
EEZ	Exclusive Economic Zone
EIS	Environmental Impact Statement
$ER_{95\%}$	95^{th} percentile exposure-based ranges
ESA	Endangered Species Act
EZ	exclusion zone
FHWG	Fisheries Hydroacoustic Working Group
HF	high-frequency
HRG	high-resolution geophysical
IAC	inter-array cable
IPF	impact producing factor
ISO	International Organization for Standardization
IUCN	International Union for Conservation of Nature
JASCO	JASCO Applied Sciences
Lease Area	Lease Area OCS-A 0486
LF	low-frequency
µPa	micropascal
MEC	munitions and explosives of concern
MF	mid-frequency
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
MZ	monitoring zone
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NMS	noise mitigation system

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NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
NYSDEC	New York State Department of Environmental Conservation
NYSERDA	New York State Energy Research and Development Authority
O&M	operation and maintenance
OnSS	onshore substation
OCS	Outer Continental Shelf
Orsted NA	Orsted North America Inc.
OSRP	Oil Spill Response Plan
OSS	offshore substation
OW	otariid pinnipeds in water
PAM	passive acoustic monitoring
PBR	potential biological removal
PCW	phocid carnivores in water
PK	zero-to-peak sound pressure level
PPW	phocid pinnipeds in water
Project	Revolution Wind Farm Project
PSMMP	Protected Species Mitigation and Monitoring Plan
PSO	protected species observer
PTS	permanent threshold shift
re	referenced to
Revolution Wind	Revolution Wind, LLC
RI-MA WEA	Rhode Island-Massachusetts Wind Energy Area
RWEC	Revolution Wind Farm Export Cable
RWEC - OCS	Revolution Wind Farm Export Cable on the Outer Continental Shelf
RWEC - RI	Revolution Wind Farm Export Cable in Rhode Island state waters
RWF	Revolution Wind Farm
SAR	stock assessment report
SEL	sound exposure level
SEL_{24h}	sound exposure level over 24 hours
SL	source level
SMA	Seasonal Management Area
SPL	root-mean-square sound pressure level
TEWG	Turtle Expert Working Group
TTS	temporary threshold shift
UME	Unusual Mortality Event
U.S.	United States
USFWS	U.S. Fish and Wildlife Service
UXO	unexploded ordnance
VHF	very high-frequency
VLF	very low-frequency
WTG	wind turbine generator

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1.0 INTRODUCTION

Revolution Wind, LLC (Revolution Wind) (formerly DWW REV I, LLC), a 50/50 joint venture between Orsted North America Inc. (Orsted NA) and Eversource Investment LLC, proposes to construct, own, and operate the Revolution Wind Farm Project (hereinafter referred to as the Project). The wind farm portion of the Project will be located in federal waters on the Outer Continental Shelf (OCS) in the designated Bureau of Ocean Energy Management (BOEM) Renewable Energy Lease Area OCS-A 0486 (Lease Area). The Lease Area is approximately 30 km south of the coast of Rhode Island (**Figure 1.1-1** in **Section 1.1** of the Project's Construction and Operations Plan [COP]). Other components of the Project will be located in state waters of Rhode Island and onshore in North Kingstown, Rhode Island. The proposed interconnection location for the Project is the existing Davisville Substation, which is owned and operated by National Grid and located in North Kingstown, Rhode Island.

The Project will specifically include the following offshore and onshore components:

- Up to 100 wind turbine generators (WTGs) connected by a network of Inter-Array Cables (IACs);
- Up to two offshore substations (OSSs) connected by an OSS-Link Cable;
- Up to two submarine export cables (referred to as the Revolution Wind Export Cable [RWEC]), generally co-located within a single corridor;
- A landfall location located at Quonset Point in North Kingstown, Rhode Island (referred to as the Landfall Work Area);
- Up to two underground transmission circuits (referred to as the Onshore Transmission Cable), co-located within a single corridor; and
- A new Onshore Substation (OnSS) located adjacent to the existing Davisville Substation with up to two interconnection circuits (overhead or underground) connecting the OnSS to the existing substation.

The Project's components are further grouped into four general categories: the Revolution Wind Farm (RWF), inclusive of the WTGs, OSSs, IAC, and OSS-Link Cable; the RWEC – OCS inclusive of up to 40 km of the RWEC in federal waters; the RWEC – RI, inclusive of up to 37 km of the RWEC in state waters; and Onshore Facilities, inclusive of an up to 100-m segment of the RWEC, Landfall Work Area, Onshore Transmission Cable, and OnSS (including interconnection circuits). These categories collectively are referred to in this report as the Project Area.

1.1 Contents of Technical Report

This Technical Report is intended to provide the reader with a substantial overview of the baseline conditions in the Project Area as they pertain to marine mammals, sea turtles, and fish species listed under the Endangered Species Act (ESA). The Technical Report is designed to provide supplemental information for the Project-related impact producing factors (IPFs) discussed in **Sections 4.3.3.2**, **4.3.4.2**, and **4.3.5.2** of the Project's COP that have the potential to result in greater than negligible impacts on marine mammals, sea turtles, or Atlantic sturgeon. For the purposes of this report, negligible impacts are defined as those that, if perceptible, would not result in measurable impacts on the potentially affected resources. IPFs which may result in greater than negligible impacts were determined to be habitat alteration, underwater noise, and vessel traffic. (see **Table 1.2-1**). The underwater noise IPF is treated in more detail in this report because the affected resources are known to be vulnerable to potential impacts from underwater noise. The assessment of underwater noise impacts resulting from the construction for the Project are largely based on the underwater acoustic analysis conducted by JASCO Applied Sciences (JASCO) (Denes et al., 2020). Impact assessments for underwater noise produced during operations and maintenance (O&M), and decommissioning are based on literature and assessment of similar activities. A summary of the proposed environmental protection measures, which will be implemented during Project activities to reduce the potential for impacts, is also provided in **Section 5.5**.

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1.2 Regulatory Context and Resource Definition

The Project's COP provides the basis for assessed environmental and socioeconomic effects resulting from the Proposed Activities (**Section 3.0** of the COP) during construction, O&M, and decommissioning of the Project. It is prepared in accordance with 30 Code of Federal Regulation (CFR) Part 585, BOEM's Guidelines for Information Requirements for a Renewable Energy Construction and Operations Plan (BOEM, 2016), and other BOEM policy, guidance, and regulations (**Section 1.1** of the COP). The underwater acoustic propagation and animal exposure modeling results presented in the Underwater Acoustic Analysis report (Denes et al., 2020), in combination with the assessment provided in this Technical Report, are intended to provide BOEM with the necessary information to evaluate their permitted actions under the National Environmental Policy Act (NEPA) and Marine Mammal Protection Act (MMPA). As discussed in **Section 1.4** of the Project's COP, NEPA requires that Federal actions undertake an environmental assessment (EA) to produce an Environmental Impact Statement (EIS) to determine impacts to resources.

The resources of interest in this Technical Report include marine mammals, sea turtles, and ESA-listed fish species. All marine mammals are protected under the MMPA; some species are also listed as Endangered under the ESA (**Section 2.2.1**). Sea turtle and fish species included in this assessment are listed as either Endangered or Threatened under the ESA (**Section 2.2.2** and **Section 2.2.3**). The National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) share regulatory responsibility for these species under the MMPA and ESA. The MMPA requires any Project Activities that may produce noise be assessed for the potential "take" of marine mammals, as defined in the MMPA, and provided to NMFS for approval. ESA species will also be assessed under Section 7 inter-agency consultations between BOEM and NMFS for all activities that have the potential to affect listed species. The information presented in both the Project's COP and this Technical Report will provide the basis for these MMPA and ESA consultations.

1.3 Significance Threshold

Resources may be vulnerable to one or more IPF. Each IPF that has the potential to impact marine mammals, sea turtles, or Atlantic sturgeon were assessed in **Sections 4.3.3.2**, **4.3.4.2**, and **4.3.5.2** of the Project's COP. In the analysis for the Technical Report, IPFs associated with each resource were first categorized as: 1) having greater than negligible impacts (i.e., measurable, either negative or beneficial) and require analysis; 2) having negligible impacts to a resource (i.e., an impact that if perceptible, is not measurable); or 3) no expected impacts on the resource (i.e., no perceptible impact to a resource is evident). Those IPFs assessed in the COP which had the potential to result in greater than negligible impacts to the resources are further discussed in this Technical Report (**Table 1.2-1**). Supplementary information regarding the affected resources and potential impacts is provided to further support the impact assessment provided in the COP. There are multiple sources of noise during all phases of RWF development; however, not all sources have equivalent impact potential on a given resource. Therefore, each source is discussed separately in the Technical Report to allow the reader an understanding of the underwater noise components that contribute to the overall impact determination for the underwater noise IPF.

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Table 1.2-1. Summary of impact producing factors (IPFs) included in the Technical Report for marine mammals, sea turtles, and fish during construction, operation, or decommissioning of the Revolution Wind Farm and Revolution Wind Farm Export Cable.

Resource	IPF							
	Habitat Alteration	Underwater Noise						Vessel Traffic
		DP Vessel Noise	Impact Pile Driving Noise	Vibratory Pile Driving Noise	Geophysical Survey Noise	WTG Operational Noise	Aircraft Noise	
Marine Mammals	+/++	+	+	-	-	+	-	+
Sea Turtles	+/++	-	+	-	-	-	-	+
Atlantic Sturgeon	-	-	+	-	-	-	-	+

+ indicates a greater than negligible impact; ++ indicates a potential beneficial impact; - indicates negligible or no impact expected; DP = dynamic positioning; WTG = wind turbine generator.

Broad significance criteria were developed for the three resources addressed in this Technical Report. In order to assess the potential impacts, the IPFs were characterized as either direct or indirect, and short-term or long-term (as defined in **Section 4.0** of the Project's COP) primarily using the following four parameters:

- Detectability (i.e., measurable or detectable impact);
- Duration (i.e., short-term, long-term);
- Spatial extent (i.e., localized, extensive); and
- Severity (i.e., severe, less than severe).

Elements such as distribution, range, life history, sensitivity to the IPF, and potential outcomes of the impact were considered for each resource. The significance evaluations in **Sections 4.3.3.2**, **4.3.4.2**, and **4.3.5.2** of the Project's COP considered the potentially affected environment and the degree of the impact following NEPA regulations (40 CFR § 1501.3). The potentially affected area for a particular IPF considers the extent (i.e., national, regional, or local) of the effect and any special circumstances affecting resources within this area (e.g., ESA-listings or designated habitat). The degree of an impact considers the severity of the effect based on whether impacts are short-term or long-term, beneficial or adverse. The evaluation process also assessed the risk or likelihood (i.e., likely, not likely) of an effect to occur based on species' expected presence and perception of an IPF by the resource.

During the preparation of the impact assessment, each impact determination was accompanied by a statement or statements explaining how the impact determination was reached. The determinations were based on the best available information. Data or information from referenced journals used to support each determination were cited, as applicable, and professional judgement by experienced subject matter experts and impact analysts was considered in each evaluation. The impact assessment in **Section 5.0** of this Technical Report provides additional information intended to justify the assessment in **Sections 4.3.3.2**, **4.3.4.2**, and **4.3.5.2** of the Project's COP, with a focus on the duration of impacts (i.e., short-term, long-term) and identifying if impacts were direct or indirect, as defined in **Section 4.0** of the Project's COP. The impact determination process was designed to assess impacts at a population-scale rather than an individual-scale. Potential impacts to species listed as Endangered or Threatened under the ESA and marine mammal stocks listed as strategic by NMFS were given greater "weight" than impacts to non-listed species or non-strategic marine mammal stocks.

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2.0 UNDERWATER NOISE AS AN IPF

This document follows International Organization for Standardization (ISO) 18405:2017 (ISO, 2017) for all acoustic terminology. Acoustic terminology used in this report are provided in **Table 2.0-1**.

Table 2.0-1. Acoustic terminology used in this report based on International Organization for Standardization 18405 (ISO, 2017).

Metric Name	Abbreviation	Units
Root-mean-square sound pressure level	SPL	dB re 1 µPa
Zero-to-peak sound pressure level	PK	dB re 1 µPa
Sound exposure level	SEL	dB re 1 μPa^2 s
Sound exposure level over 24 hours	SEL_{24h}	dB re 1 μPa^2 s
Source level	SL	dB re 1 µPa m

dB = decibel; µPa = micropascal; re = referenced to.

Underwater noise generated by construction, operations, and decommissioning of an offshore wind farm can be assessed in the framework of impacts that may have physical or behavioral consequences for the animal exposed to the noise; or impacts that result in changes to the acoustic habitats (**Section 2.2**) from the introduction of man-made noise sources into the marine environment. Noise generated by human activities may be introduced into the environment for a specific purpose (e.g., navigational sonar, seismic exploration), or as an indirect by-product of activities such as shipping, pile driving, and other industrial activities. The propagation characteristics of these various noise sources are determined by the local physical and environmental conditions, while the perception of the noise by an animal "receiver" will be largely dependent upon individual hearing sensitivities. Outside of physiological effects, impacts on marine species from man-made noise are largely influenced by the context within which the noise is perceived by the animal.

2.1 Sources of Noise in the Project Area

Noise contributing to the acoustic habitat of the Rhode Island-Massachusetts Wind Energy Area (RI-MA WEA) is produced by both natural processes and offshore human activities within this region. Ambient noise sources can typically be divided into three general categories: physical, biological, and anthropogenic.

Physical Noise

The dominant cause of naturally occurring noise in the ocean resulting from physical processes occurs at or near the ocean surface in the form of wind and wave activity. As shown in **Figure 2.1-1**, noise produced by wind and waves are generally correlated with one another and fall within the 100 Hz to 100 kHz frequency band. Ambient noise levels tend to increase with increasing wind speed and wave height (Urick, 1962; Wenz, 1964; Erbe, 2011). In the frequency band between 3 and 30 MHz, "thermal noise" caused by the random motion of water molecules is the primary source contributing to ambient noise levels (Urick, 1962; Wenz, 1964; Hildebrand, 2009). Natural noise sources, especially noise from wave and tidal action, contribute to higher ambient noise levels typically found in shallower coastal environments.

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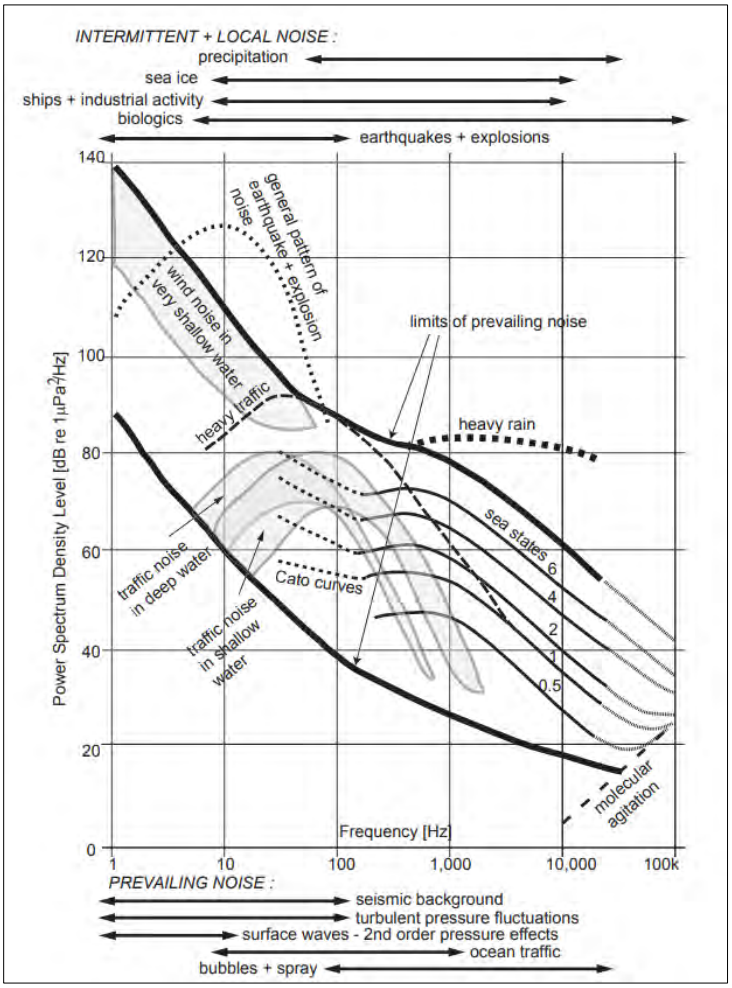

Figure 2.1-1. Wenz curve showing frequency and amplitude range of common sources of noise in the ocean. Figure from Erbe (2011) based on work from Wenz (1964).

Precipitation falling on the ocean's surface also contributes to natural noise in ocean environments. In general, noise from rain or hail is an important component of total noise at frequencies >500 Hz during periods of precipitation (**Figure 2.1-1**). Rain can increase natural ambient noise levels by up to 35 decibels (dB) across a broad range of frequencies from several hundred Hz to more than 20 kHz (National Research Council [NRC], 2003; Richardson et al., 1995). Heavy precipitation associated with large storms can generate noise at frequencies as low as 100 Hz and can significantly affect ambient noise levels at considerable distances from the storm's center (NRC, 2003). Movement of sediment by ocean currents across the ocean bottom can also be a significant source of ambient noise at frequencies from 1 kHz to over 200 kHz (NRC, 2003).

Biological Noise

Biological noise is created by marine animals and can contribute significantly to ambient noise levels in certain areas of the ocean. Marine mammals are major contributors, but noise produced by some crustaceans (e.g., snapping shrimp [Alpheidae]) and vocalizing fish can also be significant (NRC, 2003; Richardson et al., 1995).

Surveys conducted in the RI-MA WEA indicate that delphinids are the most commonly observed species in this region. Vocalizations from these mid- to high- frequency species can influence the local ambient noise conditions for short periods of time (Varga et al., 2017). Reported mid-frequency species include common

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bottlenose dolphins (*Tursiops truncatus*), common dolphins (*Delphinus delphis*), Risso's dolphins (*Grampus griseus*), Atlantic white-sided dolphins (*Lagenorhynchus acutus*), Atlantic spotted dolphins (*Stenella frontalis*), and long-finned pilot whales (*Globicephala melas*) (BOEM, 2013; Kraus et al., 2016). These species were observed during all seasons, with the highest number of recorded sightings in summer and fall. Harbor porpoises (*Phocoena phocoena*), the only high frequency species likely to occur in the Project Area, were also observed in this region, primarily in winter and spring (Kraus et al., 2016).

Acoustic detections of large whale species indicated that fin whales (*Balaenoptera physalus*) were the most commonly detected cetacean species in the RI-MA WEA, but humpback (*Megaptera novaeangliae*), minke (*Balaenoptera acutorostrata*), blue (*Balaenoptera musculus*), and North Atlantic right whale (*Eubalaena glacialis*) calls were also detected (BOEM, 2013; Kraus et al., 2016). Large whale vocalizations were primarily detected in the winter and spring, but fin and humpback whales were detected in all seasons, and minke whales showed a peak acoustic presence in May (BOEM, 2013; Kraus et al., 2016). Although there were no confirmed acoustic detections during the recording period, visual surveys indicated that sei whales (*Balaenoptera borealis*) were also present in the spring and summer, and sperm whales (*Physeter macrocephalus*) in the summer and autumn (Kraus et al., 2016). Baleen whale vocalizations have a marked effect on long term spectral average data with increases of up to 15 dB above ambient noise levels attributed to seasonal congregations of whales (Haver et al., 2018).

Fish vocalizations were also a substantial source of biological noise observed in this region. Series of buzzes, grunts, and thumps from unidentified fish species were heard primarily between December and February (Martin et al., 2014). The only identifiable fish call was detected between June and August, described as a jack-hammer sound, that was thought to correspond to striped cusk eel (*Ophidion marginatum*) vocalizations (Martin et al., 2014).

Anthropogenic noise

Vessels are a primary source of anthropogenic noise and contribute to ambient ocean noise, predominantly in low-frequency (LF) bands under 500 Hz (Hildebrand, 2009; NRC, 2003). A large portion of the noise from vessels comes from engine noise and propeller cavitation (Richardson et al., 1995). In the open water, vessel noise can influence ambient noise levels at distances of thousands of kilometers; however, the effects of vessel noise in shallower shelf and coastal waters are more variable due to physical and geological properties of the seabed, sea surface, and water column which influence reflection, refraction, and absorption and thus propagation, of noise in the water.

Underwater noise sources associated with Project Activities include impact and vibratory pile driving, geophysical surveys, and Project-related aircraft operations during the construction phase; vessels with and without dynamic positioning (DP) thrusters used during all Project phases; and WTG operations during the O&M phase. The potential for impacts on marine species from noise produced by these activities is highly dependent on the equipment scenarios and the context in which species perceive or are exposed to each noise source or activity.

The following sections provide further information about Project-related noise sources, and the corresponding acoustic characteristics and measurements based on previous assessments and published literature for all noise-producing Project Activities, and the results presented in the underwater acoustic analysis report (Denes et al., 2020) for impact pile driving activities.

2.1.1 Vessel Noise

Vessel noise is characterized as low frequency, typically <1,000 Hz with peak frequencies between 10 and 50 Hz, non-impulsive rather than impulsive like impact pile driving, and continuous, meaning there are no substantial pauses in the noise that vessels produce. The acoustic signature produced by a vessel varies based on the type of vessel (e.g., tanker, bulk carrier, tug, container ship) and vessel characteristics (e.g., engine specifications, propeller dimensions and number, length, draft, hull shape, gross tonnage, speed). Large shipping vessels and tankers produce lower frequency noise with a primary energy near 40 Hz and underwater source levels (SLs) for these commercial vessels can range from 177 to 188 dB

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referenced to (re) 1 micropascal (µPa) m (McKenna et al., 2012). Smaller vessels typically produce higher frequency noise (1,000 to 5,000 Hz) at SLs between 150 and 180 dB re 1 µPa m (Kipple and Gabriele, 2003, 2004). Vessels using DP thrusters are known to generate substantial underwater noise with SLs ranging from 150 to 180 dB re 1 µPa m depending on operations and thruster use (BOEM, 2013; McPherson et al., 2016). While vessel noise was not modeled for this Project, qualitative information about vessel noise which may be produced during Project activities is provided in the underwater acoustic analysis report (Denes et al., 2020).

2.1.2 Aircraft Noise

As discussed in **Section 4.1.4.1** of the Project's COP, helicopters will be used during construction and O&M activities to support crew transfers. Noise produced in air can be transmitted into the water column. Noise from a Bell 212 helicopter measured from a hydrophone deployed at 18 m depth showed frequencies ranged up to 340 Hz with received root-mean-square sound pressure levels (SPL) in the 10 to 500 Hz frequency band of approximately 106 dB re 1 µPa (Patenaude et al., 2002). Received SPL were generally higher at 3 m depth than 18 m depth by an average of 2.5 dB and decreased further as the altitude of the helicopter increased and speed decreased (Patenaude et al., 2002).

2.1.3 Impact Pile Driving Noise

Impact pile driving produces high intensity sound pulses at levels capable of producing injury to marine animals (Halvorsen et al., 2012a,b; NMFS, 2018; Popper et al., 2014). Subsequent effects from impact pile driving noise are dependent upon the physical characteristics of the environment, which influence noise propagation, receiver species, and the implementation and effectiveness of environmental protection measures (**Section 5.5**) such as noise attenuation systems. Impact pile driving noise produced from foundation installation is expected to fall predominately within LF bandwidths (below 1,000 Hz); however, Bailey et al. (2010) measured broadband noise within 1 km of impact pile driving in the Moray Firth off the coast of Ireland.

Noise produced during impact pile driving is a primary concern with respect to underwater noise impacts from RWF construction. Revolution Wind will use hydraulic (impact) hammers to install monopile foundations for the WTGs and either jacket or monopile foundations for the OSSs.

Environmental and seabed conditions, hammer type, and the size and type of pile will affect noise propagation and the estimated ranges to regulatory criteria. Due to the complexity of noise propagation generated from impact pile driving activities, modeled distances to acoustic thresholds often differ from field-measured distances and highlight the site-specific nature of noise propagation and impact radii during pile installation. While models and measurements from one project are not fully applicable across other similar projects, they do provide general information useful for predicting potential impacts during similar activities.

Modeled and *in situ* underwater noise measurements for jacket pile installation of the Block Island Wind Farm showed variability by distance and sample methods (Amaral et al., 2018). Similarly, Patricio et al. (2014) measured noise produced during impact pile driving for the Westernmost Rough Wind farm and compared modeled results to field measurements. The study found that modeled distances to injury criteria thresholds ranged from 15 to 300 m from the pile, while distances based on field measurements ranged from 200 to 1,500 m from the pile for cetaceans. Field measurements of offshore wind pile driving in Europe were summarized by Bellmann et al. (2020) and provide some of the most relevant information regarding sound levels expected during impact pile driving at RWF. Results from the Bellmann et al. (2020) measurements showed that piles without a noise mitigation system (NMS)(e.g., bubble curtain) produced noises with frequencies predominately within 32 Hz to 2 kHz and produced measured cumulative 24-h sound exposure levels (SEL_{24h}) up to 175 dB re 1 μPa^2 s at 750 m from the pile. When a single or combined NMS was applied to monopile installation, noise reductions ranging from 3 dB to 17 dB were achieved depending on the NMS combination, with some frequency-dependent reductions of >20 dB (Bellmann et al., 2020).

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To help identify the potential for impacts to marine species, site-specific acoustic propagation modeling was conducted for impact pile driving for the Project, as described by Denes et al. (2020), and results of this modeling effort, as they are applied to impact assessment in this Technical Report are summarized in **Section 4.2**.

2.1.4 Vibratory Pile Driving Noise

Vibratory pile driving produces a non-impulsive, intermittent noise with maximum sound levels lower than those generated by impact pile driving (Popper et al., 2014). Measurements from vibratory pile driving of sheet piles during construction activities for bridges and piers indicate that SPL produced by this activity can range from 130 to 170 dB re 1 µPa depending on the measured distance from the source and physical properties of the location (Buehler et al., 2015; Illingworth & Rodkin, 2017). At approximately 10 m from the source, the average SPL was approximately 155 dB re 1 µPa, while measurements taken 200 m away were closer to 140 dB re 1 µPa (Illingworth & Rodkin, 2017). SEL over 1 s measured at 10 m from the source were approximately 162 dB re 1 μPa^2 s (Buehler et al., 2015).

2.1.5 Geophysical Survey Noise

Prior to construction of the RWF and RWEC, geophysical surveys will be conducted to identify any seabed debris or munitions and explosives of concern and unexploded ordnances (MEC/UXOs) (**Section 3.3** of the Project's COP). Equipment used to conduct MEC/UXO surveys may include multi-beam echosounders, side-scan sonars, shallow penetration sub-bottom profilers, medium penetration sub-bottom profilers, and marine magnetometers or gradiometers. Equipment will be comparable to those used during high-resolution geophysical (HRG) site investigation surveys conducted in the region (CSA Ocean Sciences Inc., 2018, 2020; Feehan and Daniels, 2018). Estimated distances to SPL of 160 dB re 1 µPa resulting from HRG equipment ranged from a maximum of 141 m to less than 5 m depending on the source (CSA Ocean Sciences Inc., 2018, 2020).

As discussed in **Section 3.3.3.2** of the Project's COP, avoidance is the preferred approach for MEC/UXOs, and in any situation in which avoidance is not possible, the confirmed MEC/UXO may be removed through *in situ* disposal or physical relocation. The removal method used will depend on the location, size, and condition of the MEC/UXO, and will be made in consultation with specialists and the appropriate agencies. *In situ* disposal will be done using methods such as deflagration or cutting of the MEC/UXO and relocation will be accomplished through a "Lift and Shift" operation, both of which are expected to be low-noise methods (**Section 3.3.3.2** of the Project's COP). The risk mitigation measures in place will be used to avoid munitions and prevent the potential for underwater explosions if removal of any MEC/UXOs is warranted; therefore, only noise associated with the HRG surveys is evaluated for impact assessment.

2.1.6 Wind Turbine Generator Operational Noise

WTGs primarily produce two types of noise: aerodynamic turbine blade noise and mechanical noise (Minerals Management Service [MMS], 2007). Mechanical noise may be transmitted underwater through the turbine towers and foundations producing underwater SPL noise levels between 80 and 150 dB re 1 µPa and can increase noise in frequencies below 100 Hz by 3 to 10 dB (Bergström et al., 2014; HDR, 2019). A study by Miller and Potty (2017) measured an SPL of 100 dB re 1 µPa 50 m from a set of five GE Haliade 150-6 MW wind turbines with a peak signal frequency 72 Hz. Other studies estimated SLs of operational noise from WTGs ranging from 125 to 130 dB re 1 µPa m across all octave bands (Lindeboom et al., 2011; Tougaard et al., 2009). Maximum SPL occurred in the 25 Hz one-third octave band for a 450-kW turbine during normal operations (Lindeboom et al., 2011; Tougaard et al., 2009).

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In a compilation of case studies published by BOEM in 2017 (English et al., 2017), similar noise levels were identified:

- The one-third octave SPL were measured between 90 to 115 dB re 1 µPa 110 m from a 1.5-MW turbine in Sweden (Thomsen et al., 2006). The frequency range was 20 to 1,000 Hz with peak energy levels occurring at 50, 160, and 200 Hz.
- Pangerc et al. (2016) found the main signal associated with 3.6 MW turbine operations had a mean-square power spectral density level that peaked at 126 dB re 1 μPa^2 Hz^{-1} at the 162 Hz one-third octave band, and a broadband SPL of 128 dB re 1 µPa 50 m from the source at wind speeds of 10 m/s.
- Collett and Mason (2014) found that noise from operating 6 MW turbines dropped to ambient levels at approximately 100 m from the turbine.
- Noise associated with the 6 MW turbines at the Block Island Wind Farm were below SPL of 120 dB re 1 µPa measured 50 m from the turbines, except at wind speeds exceeding 13 m/s (HDR, 2019).

While underwater noise from turbines has been measured within the hearing frequency of marine animals, impacts at the anticipated noise levels would be limited to audibility, and perhaps some degree of behavioral response or auditory masking (MMS, 2007). Behavioral responses include changes in foraging, socialization, or movement, while auditory masking could impact foraging and predator avoidance. Due to the long-expected duration of this source and the low likelihood of impacts to marine animals, turbine noise was not included in the acoustic model presented by Denes et al. (2020). However, potential impacts from this noise source using published literature are discussed in **Section 3.3**.

2.2 Acoustic Habitat within the Project Area

The term acoustic habitat is defined here as the environment within which an animal perceives and transmits acoustic cues important for foraging, reproduction, socialization, and predator avoidance. Various natural and anthropogenic activities contribute noise to the ocean, creating a complex acoustic habitat. An animal's acoustic habitat is made up of concomitant noises generated biologically (biophony), physically (geophony), or anthropogenically (anthrophony) that create regional ambient noise conditions through which discrete signals must be sent and gathered by animals adapted to living in acoustically-dominated habitats. Changes in the acoustic habitat can therefore change an animal's ability to function within its environment. Acoustic habitats are not stagnant and will vary both temporally and spatially on large and small scales. Variations in the ambient noise level as a function of frequency can change by as much as 10 to 20 dB from day-to-day based on variations in the noise sources (Richardson et al., 1995; Kraus et al., 2016). Large- and small-scale temporal fluctuations (e.g., daily, seasonal) in the acoustic habitat and species vocalization patterns may influence or directly affect temporal patterns in animal communication systems and detections of other acoustic cues.

Marine animals can perceive underwater noise over a broad range of frequencies from about 10 Hz to more than 200 kHz. Where there is an overlap in the frequencies produced by anthropogenic noise sources and core frequencies used or produced by marine life, there is the potential for noise to interfere with their biological functions. The primary acoustic habitat for any species will fall within the bounds of that species' specific vocal and hearing ranges, and it is those primary acoustic habitats that were assessed when characterizing potential impacts. While many species hearing sensitivities overlap, there is evidence that acoustic habitats may be partitioned by species to maximize access to the necessary acoustic habitat (Gottesman et al., 2020). Resource partitioning may be viewed on a frequency-band or temporal basis as well as an energy basis (Ruppé et al., 2015; Gottesman et al., 2020). Ruppé et al. (2015) documented apparent resource partitioning in the acoustic communication behavior of a community of nocturnal marine fishes, in which 17 distinctive sounds that differed in peak frequency and pulsing characteristics were recorded. Furthermore, the sounds produced by soniferous species during the day did not overlap with those produced by nocturnal species and were far less diverse, indicating that the acoustic habitat use was maximized when visual resource use was less important (Hastings and Širović, 2015).

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Acoustic habitats can be represented by plotting the ratios of sound energy within selected frequency bandwidths for the habitat of interest. The acoustic habitat and changes within that habitat are demonstrated by shifts in the dominant frequency range and by increases or decreases in sound energy within selected bandwidths. Modeled soundscapes and sound maps, such as those provided in National Oceanographic and Atmospheric Administration's (NOAA's) sound data mapping products (NOAA, 2019), are generated by incorporating environmental (e.g., bathymetric, oceanographic), biological, and anthropogenic noise data then modeling the noise propagation over space and time. These models represent the basis for assessing acoustic habitats and are the baseline for a potential impact analysis to species due to the introduction of acoustic sources, such as those expected during offshore wind farm construction and operations, within that environment.

The ambient noise analysis for the RI-MA WEA was provided by Kraus et al. (2016) through the deployment of passive acoustic recorders from 2011 through 2015, and with dedicated recorders deployed specifically within the RI-MA WEA between 2013 and 2015. The acoustic data were analyzed for both ambient noise levels and biological signals. In the analyses, Kraus et al. (2016) built power spectral densities, which provided the received SPL within selected frequency bands, and the cumulative distribution, which provided the percentage of time that noise within a selected frequency band reached specific SPL. The cumulative distribution enables analysis of the acoustic habitat available within a species' specific vocal range. Kraus et al. (2016) used a frequency band of 20 to 447 Hz to capture the acoustic habitat of LF cetaceans. By correlating the ambient SPL within this band with the average SPL of the LF cetacean calls, some predictions can be made regarding acoustic habitat availability and potential masking.

As shown in **Figure 2.2-1**, Kraus et al. (2016) found that the power spectrum levels above 200 Hz did not differ greatly among the nine recording sites; however, sites that were closest to shipping lanes showed an increase in power spectrum levels for spectral content below 100 Hz. The site labeled RI-3, centrally located within the Project Lease Area, had one of the lowest overall ambient noise levels with an increase around the 20 Hz frequency band, which was attributed to persistent fin whale vocal pulses. For frequencies between 70.8 and 224 Hz, the RI-3 site recorded SPL of 95 dB re 1 µPa or less for 40% of the recoding time, and SPL of 104 dB re 1 µPa or greater for only 10% of the recording time.

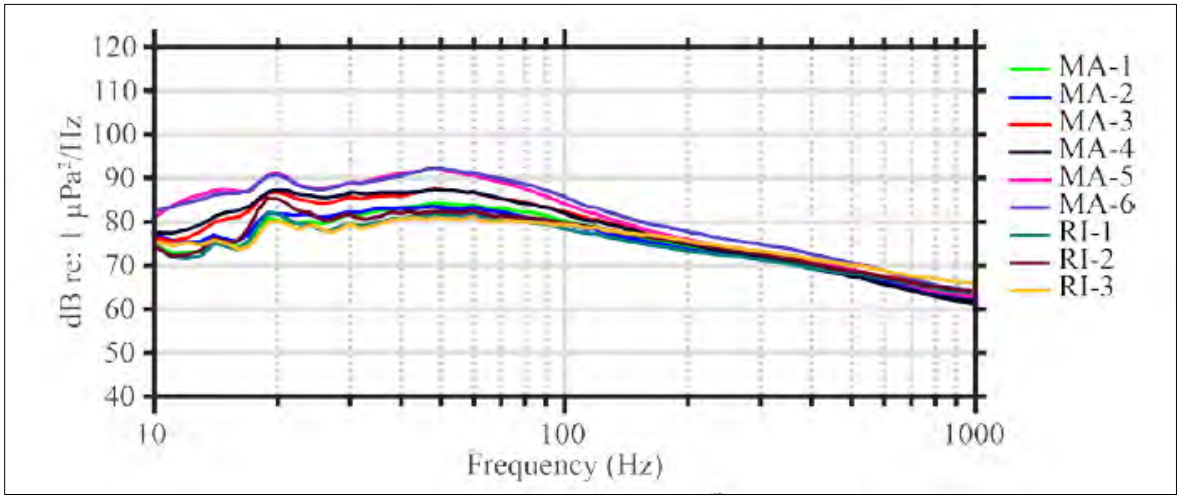

Figure 2.2-1. Power spectral density plot showing the 50th percentile power spectrum levels for each recording site within the Rhode Island-Massachusetts Wind Energy Area between November 2011 and March 2015. The yellow line labeled RI-3 represents the hydrophone located centrally within the Project Lease Area. From: Kraus et al. (2016).

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Amaral et al. (2018) collected ambient noise measurements during quiet periods of impact pile driving activities for the Block Island Wind Farm (BIWF) offshore Rhode Island. Results show SPL range from 107.4 dB re 1 µPa 30 km east of the BIWF site to 118.7 dB re 1 µPa within 1 km of the site (Amaral et al., 2018). Power spectral density plots (**Figure 2.2-2**) showed higher noise levels in frequencies between 30 and 300 Hz attributed to vessel and equipment noise from BIWF construction activities (Amaral et al., 2018).

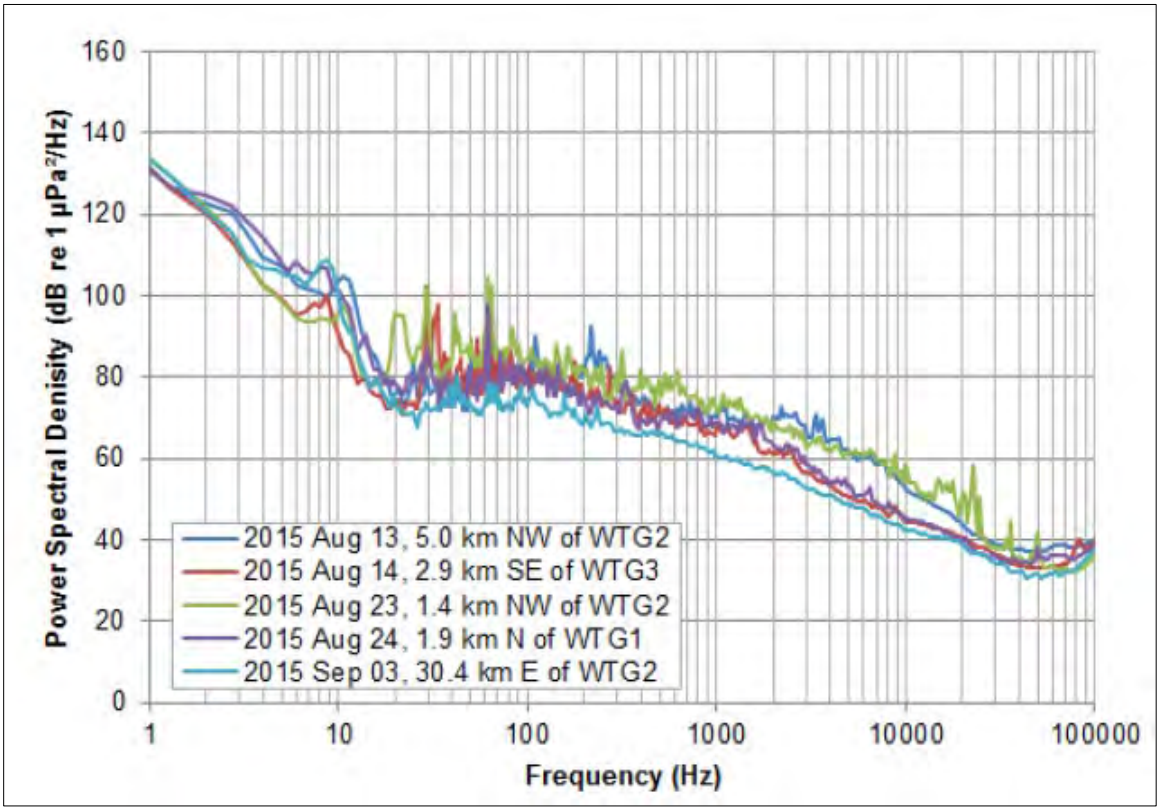

Figure 2.2-2. Power spectral density plot of ambient noise measurements collected within the vicinity of the Block Island Wind Farm. From Amaral et al. (2018).

2.3 Potential Impacts from Underwater Noise

Two primary components of underwater noise important for impact assessment include pressure and particle motion. Pressure can be characterized as the compression and rarefaction of the water as the noise wave propagates through it. Particle motion is the displacement, or back and forth motion, of the water molecules that creates the compression and rarefaction. Both factors contribute to the potential for impacts to affected resources from underwater noise. However, marine mammal and sea turtle hearing is based on the detection of sound pressure, and there is no evidence to suggest either group is able to detect particle motion for the purposes of hearing and noise detection (Bartol and Bartol, 2012; Nedelec et al., 2016). All discussions of particle motion are therefore focused on fish and invertebrate species.

All fishes can detect and use particle motion (Popper and Hawkins, 2019). The organ located in the inner ear of fishes contains a dense structure called the otolith (i.e., ear stone), which lies near the auditory sensory macula (i.e., layer of sensory hair cells). The otolith organ acts as an accelerometer and enables detection of particle motion. Particularly fish with primitive swim bladders that are not involved in hearing, like Atlantic sturgeon, particle motion is thought to play a key role in detection of underwater noise (Hawkins and Chapman, 2020). However, measurements of sensitivity to particle motion and pressure were rarely performed simultaneously, leaving a data gap in the understanding of particle motion sensitivity in fish

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(Popper and Hawkins, 2018). Additionally, particle motion levels associated with a high intensity noise sources are often difficult to measure and isolate from sound pressure levels (Popper and Hawkins, 2018). There is currently very limited understanding of the potential effects of particle motion on fish and invertebrates, and it is expected that particle motion associated with impulsive noise sources, such as impact pile driving, will have similar effects to pressure waves in fish species.

Currently, there are no accepted thresholds for particle motion for any noise-producing Project Activities from which the potential for impact may be assessed. Therefore, information available on particle motion detection in fish and invertebrate species is provided in the following subsections for reference, but the impact assessment in **Section 5.0** of this report focuses on the pressure component of underwater noise.

Underwater noise is the primary IPF expected to result from construction of the RWF and RWEC. Acoustic impacts can be generalized for marine mammals, sea turtles, and Atlantic sturgeon based on the type of source (i.e., impulsive versus non-impulsive). The general impacts of hearing threshold shifts, acoustic injury (i.e., barotrauma), auditory masking, stress and behavioral responses, and reduction in prey availability are discussed in the sections below. While most available references focus on impacts on marine mammal species, the general impact categories also apply to sea turtles and Atlantic sturgeon.

2.3.1 Hearing Threshold Shifts

The minimum sound level an animal can hear at a specific frequency is called a hearing threshold. Sound levels above a hearing threshold are accommodated until a certain level of noise intensity or duration is reached, after which the ear's hearing sensitivity decreases (i.e., the hearing threshold increases) (Southall et al., 2007). This process is referred to as a threshold shift, meaning that only noises louder than a certain level will be heard within a given frequency range following the shift. Threshold shifts can be temporary (TTS) or permanent (PTS) and are defined as follows (Au and Hastings, 2008; NMFS, 2018; Southall et al., 2007):

- TTS – also known as auditory fatigue, is the milder form of hearing impairment, or threshold shift, that is non-permanent and reversible. It results from exposure to high intensity noises for short durations or lower intensity noises for longer durations. Both conditions are species-specific, and lead to an elevation in the hearing threshold, meaning it is more difficult for an animal to hear noises. TTS can last for minutes, hours, or days; the magnitude of the TTS depends on the level (frequency and intensity), energy distribution, and duration of the noise exposure, among other considerations.
- PTS – is a permanent elevation in hearing threshold (i.e., permanent loss of hearing), which is considered an auditory injury. PTS is attributed to exposure to very high peak sound pressure levels (PK) and rapid increases in intensity, or very prolonged or repeated exposures to noise strong enough to elicit TTS. Permanent damage to the inner ear such as irreparable damage to sensory hair cells in the cochlea is associated with noise-induced PTS. Because few direct data are currently available regarding noise levels that might induce PTS in marine mammals, sea turtles, and fish, PTS onset thresholds are inferred from TTS onset data (NMFS, 2018; Popper et al., 2014). For impulsive sources, dual metric criteria, PK and cumulative 24-h sound exposure level (SEL_{24h}), are often used to define PTS onsets, as well as the incorporation of applicable frequency weighting functions (e.g., M-weighting for marine mammals) to account for the differential hearing abilities in the different functional hearing groups or species (NMFS, 2018; Popper et al., 2014).

Auditory impairment, either temporary or permanent, is a possibility when animals are exposed to underwater noise. The minimum PK or SEL_{24h} necessary to reach the onset of PTS is higher than the level that indicates onset of TTS, although data are insufficient to determine the precise difference. Data indicate that TTS onset in animals is more closely correlated with the received SEL_{24h} than with the PK and that received sound energy over time, not just the single strongest pulse, should be considered a primary measure of potential impact (NMFS, 2018; Southall et al., 2007).

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2.3.2 Barotrauma

Acoustic injury can occur in marine mammals, sea turtles, and fish exposed to rapid pressure changes that can theoretically be realized within close proximity to an impulsive noise source such as impact pile driving. However, barotrauma is typically only associated with explosives when considering impacts to marine mammals and sea turtles; therefore, it is only discussed within the context of impacts on fish for this Technical Report as they are the only species that could potentially be within the proximity of impact pile driving to receive the pressure changes necessary to induce barotrauma during Project construction.

Acoustic injury to fish from exposure to impulsive noise would likely be associated with barotrauma (Carlson, 2012; Halvorsen et al., 2012a, b). Barotrauma results from rapid and instantaneous changes in the ambient pressure level in the water as well as within the fluids and tissue of the animal, causing physical injury to soft tissue and organs. Barotrauma injuries in fish involve the swim bladder or dissolved gases in the blood and tissues. It can cause ruptured capillaries and internal hemorrhaging to the organs, fins, or eyes, hematoma, and a deflated or ruptured swim bladder. Depending on the affected tissues or organs, the resulting injuries may be mild (e.g., external fin hematoma; deflated, but not ruptured swim bladder), moderate (e.g., renal, intestinal, muscular hematoma), or lethal (e.g., pericardial or cerebral hemorrhage, gill embolism, ruptured swim bladder) (Brown et al., 2012; Christian, 1973; Gaspin, 1975; Goertner, 1978; Rummer and Bennett, 2005; Yelverton et al., 1975).

Some fishes, such as sturgeon and salmonids, can voluntarily release the gas from their swim bladder. The ability to rapidly vent swim bladder gas means that when the swim bladder is under pressure during an acoustic event, these fishes can decrease the volume of swim bladder gas, thereby partially protecting themselves from barotrauma injuries (Brown et al., 2016).

A controlled exposure laboratory study by Halvorsen et al. (2012a) exposed several fish species to an underwater SEL_{24h} ranging from 204 to 216 dB re 1 μPa^2 s. At SEL_{24h} >210 dB re 1 μPa^2 s, lake sturgeon (*Acipenser fulvescens*), whose swim bladder is not involved in hearing like Atlantic sturgeon, experienced recoverable barotrauma injuries characterized by hematomas on the swim bladder, kidney, and intestine, and a partially deflated swim bladder, but showed no external or mortal injuries. Conversely, Nile tilapia (*Oreochromis niloticus*) have a swim bladder that is involved in hearing, and they were shown to be more vulnerable to barotrauma at a relatively lower SEL_{24h}. They exhibited recoverable injuries including gonadal and swim bladder hematoma at 207 to 210 dB re 1 μPa^2 s, and lethal injuries such as a ruptured swim bladder and renal hemorrhage at 213 to 216 dB re 1 μPa^2 s. By contrast, no internal or external barotrauma injuries were observed at any of the SEL_{24h} for hogchoker (*Trinectes maculatus*), a flatfish that lacks a swim bladder (Halvorsen et al., 2012a). Although this study was conducted in a controlled laboratory setting, it replicated acoustic conditions in the field.

Barotrauma injuries may be more extensive in fish exposed to fewer hammer blows at higher energy versus a greater number of hammer blows at lower energy, even when the SEL_{24h} are equivalent. In a study by Halvorsen et al. (2012b), juvenile Chinook salmon (*Oncorhynchus tshawytscha*) were exposed to underwater SEL_{24h} ranging from 204 to 220 dB re 1 μPa^2 s and PK ranging from 199 to 213 dB re 1 µPa. The fish exposed to SEL_{24h} between 213 and 220 dB re 1 μPa^2 s and PK between 210 and 213 dB re 1 µPa exhibited a greater number of barotrauma injuries, specifically those that were classified as moderate or having the potential to cause lethal effects.

Overall, it is more likely that fish will experience sub-lethal impacts that increase the possibility for delayed mortality (Hawkins et al., 2014). Because the majority of Project construction sources produce LF noise that is within the sensitive hearing range of most fish, and most of the sources are non-impulsive, the potential for fish to experience TTS, masking, and behavioral impacts is higher than acoustic injury or mortality.

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2.3.3 Auditory Masking

In addition to affecting hearing through physical injury, noise can partially or completely reduce an individual's ability to effectively transmit and receive acoustic signals important for detecting predator, prey, conspecific signals, and environmental features associated with spatial orientation (Clark et al., 2009). This phenomenon is defined as auditory masking, where a reduction in the detectability of a sound signal of interest (e.g., communication calls, echolocation) occurs due to the presence of another sound, which is usually part of ambient noise in the environment, that often occurs for sounds with similar frequency ranges. Under normal circumstances, in the absence of high ambient noise levels, an animal would hear a sound signal if it is above its absolute hearing threshold. Auditory masking prevents part or all of a sound signal from being heard and decreases the distances over which sounds can be detected by an animal (i.e., reduction in communication space). These effects could cause a long-term decrease in an animal's efficiency at foraging, navigating, or communicating (International Council for the Exploration of the Sea [ICES], 2005). For some marine mammal species, specifically common bottlenose dolphins, beluga whales (*Delphinapterus leucas*), and killer whales (*Orcinus orca*), empirical evidence confirms that the degree of masking depends strongly on the relative directions at which noise arrives and the characteristics of the masking noise (Bain et al., 1993; Bain and Dahlheim, 1994; Dubrovskiy, 1990; Penner et al., 1986).

Ambient noise from natural and anthropogenic sources can result in masking for marine animals, effectively interfering with the ability of an animal to detect a sound signal that it otherwise would hear. Spectral, temporal, and spatial overlap between the masking sound and the signal of interest determines the extent of interference, the greater the spectral and temporal overlap, the greater the potential for masking. As discussed in **Section 2.1**, naturally occurring ambient noise is produced by various sources, including environmental noise from wind, waves, and precipitation; thermal noise resulting from molecular agitation (at frequencies above 30 kHz); and biological noise produced by animals (Richardson et al., 1995). Biological sounds are commonly produced by fish, for example, which create LF sounds (50 to 2,000 Hz, most often from 100 to 500 Hz) that can be a significant component of local acoustic habitats (Martin et al., 2014; Zelick et al., 1999). Anthropogenic sources known to contribute to ambient noise levels can include vessels, sonar (military and commercial), geophysical surveys, acoustic deterrent devices, construction noise, and scientific research sensors. Ambient noise is highly variable in the shallower waters over continental shelves where many anthropogenic activities occur, effectively enabling anthropogenic noise to cover a wide range of sound levels and frequencies in these habitats (Desharnais and Hazen, 1999).

In coastal waters, noise from boats and ships, particularly commercial vessels, is the predominant source of anthropogenic noise (Parks et al., 2011). Over the past 50 years, commercial shipping, the largest contributor of anthropogenic noise (McDonald et al., 2008), has increased the ambient noise levels in the deep ocean at LFs by 10 to 15 dB re 1 µPa (Hatch and Wright, 2007). This increase in LF ambient noise coincides with a significant increase in the number and size of vessels making up the world's commercial shipping fleet (Hildebrand, 2009). Tournadre (2014) estimated from satellite altimetry data that, globally, vessel traffic grew by approximately 60% from 1992 to 2002 at a nearly constant rate of approximately 6% per year; however, after 2002, the rate of increase in vessel traffic rose steadily to more than 10% by 2011, except in 2008 and 2009 when traffic remained steady. The highest estimated rate of growth in vessel traffic was in the Indian and western North Pacific Oceans, especially in the continental seas along China; the rate of growth in shipping in the Atlantic Ocean and Mediterranean Sea, however, decreased after 2008.

2.3.4 Stress and Behavioral Responses

Stress and behavioral changes are the result of marine animals responding to extreme or excessive disturbances in their environment, either of natural or anthropogenic origin. Stress responses can be manifested as a physiological reaction such as changes in an animal's blood chemistry while behavioral responses involve changes in an animal's normal actions.

Marine mammals have been shown to respond to environmental stress by releasing hormones into their bloodstream and measuring changes in an animal's blood chemistry can determine whether there is a

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stress response. Stress responses in marine mammals are immediate, acute, and characterized by the release of neurohormones such as norepinephrine, epinephrine, and dopamine (Office of Naval Research, 2009). The NRC (2003) examined acoustically induced stress in marine mammals and determined that a one-time exposure to noise was less likely to have detrimental population-level effects than repeated exposure over extended periods of time. Various researchers have summarized the available evidence regarding stress induced events in marine mammals (e.g., Cowan and Curry, 2008; Eskesen et al., 2009; Mashburn and Atkinson, 2008; Romano et al., 2004).

Romano et al. (2004) examined the levels of three stress-related blood hormones (norepinephrine, epinephrine, and dopamine) in a beluga whale after exposure to varying PK signals produced by a seismic water gun between 198 and 226 dB re 1 µPa. Hormone levels were measured after a control, low-level sound, and a high-level sound exposure. No significant differences in the hormone blood concentrations were found between the control and low-level sound exposure, but elevated levels of all three hormones were measured in response to the high-level sound exposure. Furthermore, a regression analysis demonstrated a linear trend between increased hormone levels in the blood and sound levels. They also noted that no quantitative approach to estimating changes in mortality or fecundity due to stress has been identified, but qualitative effects may include increased susceptibility to disease and early termination of pregnancy.

Following the terrorist attacks of September 11, 2001, shipping traffic dramatically decreased in the Bay of Fundy, Canada, resulting in a 6-dB decrease in ambient underwater noise levels, including a significant reduction in frequencies below 150 Hz associated with vessel traffic. Decreased baseline levels of stress-related hormone metabolites in North Atlantic right whales were also observed during this period, which was thought to be the result of reduced noise levels (Rolland et al., 2012). This reduction in ambient noise levels associated with shipping was the first evidence that exposure to LF noise from shipping may be associated with chronic stress in whales, particularly North Atlantic right whales (Rolland et al., 2012).

Anthropogenic noise in aquatic environments has also been demonstrated to elicit a stress response in fish. This response has been measured in terms of short-term (i.e., <1 h) indicators such as a startle response, increased gill ventilation, increased heart rate and blood pressure, increased plasma cortisol and glucose levels, and increased oxygen intake, as well as long-term (i.e., days to months) indicators including reduced foraging, growth and reproductive fitness, diminished immune response, and increased vulnerability to predation (Bruintjes et al., 2016a,b; Sierra-Flores et al., 2015; Simpson et al., 2016; Smith et al., 2004). Increased levels of cortisol have been reported in giant kelpfish (*Heterostichus rostratus*) in response to vessel noise, and cod (*Gadus* spp.) exposed to linear frequency sweeps of sufficient amplitude (Slabbekoorn et al., 2019). Temporary stressors such as impact pile driving and vessel noise may cause a short-term stress response in fish, but the potential for these activities to cause longer term growth and fitness consequences has not been demonstrated in a field setting. In general, fish may acclimate to long-term exposure to acoustic stressors (Schreck, 2000). Goldfish (*Carassius auratus*) exposed to long-term, continuous noise sources, such as the hum or vibration of vessel traffic at SPL of 160 to 170 dB re 1 µPa, exhibited a short-term stress response characterized by increased cortisol and glucose levels, but they did not exhibit a long-term stress response (Smith et al., 2004). Additionally, Neo et al. (2014) indicated that the temporal nature of the noise may influence the rate of recovery following behavioral disturbance. Both intermittent (e.g., pile driving) and continuous (e.g., vessel traffic, drilling) noises elicited behavioral changes in fish, but the time it took to return to normal baseline behavior was longer in response to intermittent noises compared to continuous noises (Neo et al., 2014).

Disturbances can also cause subtle to extreme changes in normal behavior, with some behavioral responses resulting in biologically significant consequences. Behavioral responses including startle, avoidance (i.e., changes in swim speed and direction), displacement, diving, and vocalization alterations have been observed in marine animals. In some cases, these have occurred at ranges of tens to hundreds of kilometers from the noise source (Gordon et al., 2004; Miller et al., 2014; Tyack, 2008). However, behavioral observations are variable, some findings are contradictory, and the biological significance of the effects are not fully quantified (Gordon et al., 2004). Behavioral reactions of animals to noise are difficult to

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predict because reactions depend on numerous factors, including the species being evaluated; the animal's state of maturity, prior experience with or exposure to anthropogenic noises, current activity patterns, and reproductive state; time of day; and weather state (Wartzok et al., 2004). There is also the potential for differences in observed responses among individuals of the same species (Castellote et al., 2014). If a marine mammal reacts to underwater noise by changing its behavior or moving to avoid the noise, the impacts of that change may not be important to the individual, the stock, or the population as a whole. However, if a noise source displaces animals from an important feeding or breeding area, impacts on individuals and the population could be significant.

For marine mammals, assessing the severity of behavioral effects associated with anthropogenic noise exposure presents unique challenges due to the inherent complexity of behavioral responses and the contextual factors affecting them, both within and between individuals and species. Severity of responses can vary depending on characteristics of the noise source including whether it is moving or stationary, the number and spatial distribution of noise source(s), its similarity to predator sounds, and other relevant factors (Barber et al., 2010; Bejder et al., 2009; Ellison et al., 2012; NRC, 2005; Richardson et al., 1995; Southall et al., 2007).

Many examples have been reported of individuals of the same species exposed to the same noise reacting differently (Nowacek et al., 2004), as well as different species reacting differently to the same noises (Bain and Williams, 2006). Odontocetes appear to exhibit a greater variety of reactions to anthropogenic noise than mysticetes. Odontocete reactions can vary from approaching vessels (e.g., bow riding) to strong avoidance. Richardson et al. (1995) noted that most small and medium-sized odontocetes exposed to prolonged or repeated underwater noises are unlikely to be displaced unless the overall received SPL is at least 140 dB re 1 µPa.

Limited data exist on sound levels that may induce stress or behavioral changes in sea turtles, and no data exist on population impacts from acoustic disturbance in sea turtles (Nelms et al., 2016). Lavender et al. (2011) collected behavior audiograms from sea turtles and found that loggerheads (*Caretta caretta*) may be more sensitive to behavioral disturbance from underwater noise than electrophysiological studies suggest. Avoidance responses by sea turtles to seismic signals have been observed at received SPL between 166 and 179 dB re 1 µPa (McCauley et al., 2000); however, these studies were done in a caged environment, so the extent of avoidance could not be fully monitored. During experiments using airguns to repel sea turtles from dredging operations, Moein et al. (1995) observed a habituation effect to seismic noises; the animals stopped responding to the signal after three presentations, although it was not clear whether this was a result of behavioral habituation or physical effects from TTS or PTS. The potential effects of impulsive noise on sea turtles are likely to be varied and sometimes cryptic (Nelms et al., 2016). The frequency and duration of exposure are not discussed in the available literature; however, this topic is important when determining the level of risk to sea turtles.

2.3.5 Reduction of Prey Availability

There are limited data on hearing mechanisms and potential effects of noise on prey species of marine mammals and sea turtles (i.e., crustaceans, cephalopods, fish). These species have been increasingly researched as concern has grown related to noise impacts on the food web. Invertebrates appear to be able to detect both sound pressure and particle motion (André et al., 2016; Budelmann, 1992; Solé et al., 2016, 2017) and are most sensitive to LF noises (Budelmann and Williamson, 1994; Lovell et al., 2005a,b; Mooney et al., 2010; Packard et al., 1990). Reduction of prey fish availability could affect marine mammals and sea turtles if rising sound levels affect fish populations and alter prey abundance, behavior, and distribution (McCauley et al., 2000; Popper and Hastings, 2009; Slabbekoorn et al., 2010).

Cephalopods (i.e., octopus, squid) and decapods (i.e., lobsters, shrimps, crabs) are capable of sensing both particle motion and sound pressure at lower frequencies. Packard et al. (1990) showed that three species of cephalopod (common cuttlefish [*Sepia officinalis*], common octopus [*Octopus vulgaris*], and European squid [*Loligo vulgaris*]) were sensitive to particle motion rather than sound pressure, with the highest sensitivity to particle motion reported at 1 to 2 Hz. In longfin squid (*Loligo pealeii*), Mooney et al.

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(2010) also observed responses to particle motion at lower frequencies between 100 and 300 Hz and also observed responses to sound pressure at 200 Hz. These data indicate that some prey species may be responding to both the particle motion and pressure component of LF noises, but thresholds for physiological or behavioral responses to particle motion in invertebrates are not currently available.

Potential onset thresholds for both physiological and behavioral respones to the pressure component of underwater noise are available in published literature. Solé et al. (2017) showed that SPL ranging from 139 to 142 dB re 1 µPa at one-third octave bands centered at 315 Hz and 400 Hz may be suitable threshold values for trauma onset from sound pressure in cephalopods. Hearing thresholds for sound pressure at higher frequencies have been reported, such as 134 and 139 dB re 1 µPa at 1,000 Hz for the oval squid (*Sepioteuthis lessoniana*) and the common octopus, respectively (Hu et al., 2009). Cephalopods have also exhibited behavioral responses to low frequency noises (<1,000 Hz) including inking, locomotor responses, body pattern changes, and changes in respiratory rates (Kaifu et al., 2008; Hu et al., 2009). McCauley et al. (2000) reported that of caged squid exposed to seismic airguns showed behavioral responses such as inking. Wilson et al. (2007) exposed two groups of longfin squid in a tank to killer whale echolocation clicks at SPL from 199 to 226 dB re 1 µPa, which resulted in no apparent behavioral effects or any acoustic debilitation. However, both the McCauley et al. (2000) and Wilson et al. (2007) experiments used caged squid, so it is unclear how unconfined animals would react. André et al. (2011) exposed four cephalopod species (European squid, common cuttlefish, common octopus, and Southern shortfin squid [*Illex coindetii*]) to 2 h of continuous noise from 50 to 400 Hz at received SPL of 157 dB re 1 µPa, and reported lesions occurring on the sensory hair cells of the statocyst that increased in severity with time, suggesting that cephalopods are particularly sensitive to LF noise. Similarly, Solé et al. (2013) conducted an LF (50 to 400 Hz) controlled exposure experiment on two deep-diving squid species (Southern shortfin squid and European squid), which resulted in lesions on the statocyst epithelia. Solé et al. (2013) described their findings as “morphological and ultrastructural evidence of a massive acoustic trauma induced by…low-frequency sound exposure.” In experiments conducted by Samson et al. (2014), common cuttlefish exhibited escape responses (i.e., inking, jetting) when exposed to frequencies between 80 and 300 Hz with SPL above 140 dB re 1 µPa, and they habituated to repeated 200 Hz noises. The intensity of the cuttlefish response with the amplitude and frequency of the noise stimulus suggest that cuttlefish possess loudness perception with a maximum sensitivity of approximately 150 Hz (Samson et al., 2014). Jones et al. (2020) exposed longfin inshore squid (*Doryteuthis pealeii*) to playbacks of impact pile driving recorded at the Block Island Wind Farm ranging from approximately 190 to 194 dB re 1 µPa, which were meant to match sound levels recorded 500 m from the piles. Most of the squid tested showed alarm behavior (e.g., inking, jetting, body pattern change), but the proportion of the trial in which squid exhibited these behaviors decreased substantially following the first 30 impulses of the playback, indicating the squid may become habituated to the noise (Jones et al., 2020).

Several species of aquatic decapod crustaceans are also known to produce sounds. Popper et al. (2001) reviewed behavioral, physiological, anatomical, and ecological aspects of noise and vibration detection by decapod crustaceans and noted that many decapods also have an array of hair-like receptors within and upon the body surface that potentially respond to water- or substrate-borne displacements as well as proprioceptive organs that could serve secondarily to perceive vibrations. They concluded that many are able to detect substratum vibrations at sensitivities sufficient to tell the proximity of mates, competitors, or predators (Popper et al., 2001). However, the acoustic sensory system of decapod crustaceans remains poorly studied (Popper et al., 2001). Lovell et al. (2005a,b, 2006) reported potential auditory-evoked responses from prawns (*Palaemon serratus*) that showed auditory sensitivity of noises from 100 to 3,000 Hz. Filiciotto et al. (2016) also reported behavioral responses to vessel noise within this frequency range. Lovell et al. (2005b) found that the greatest sensitivity for prawns was an SPL of 106 dB re 1 µPa at 100 Hz, noting that this was the lowest frequency at which they tested and that prawns might be more sensitive at frequencies below this.

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Marine fish are typically sensitive to the 100 to 500 Hz range, which is within the range of noise produced by impact pile driving, and several studies have demonstrated that seismic airguns and impulsive sources might affect the behavior of at least some species of fish. For example, field studies by Engås et al. (1996) and Løkkeborg et al. (2012) showed that the catch rate of haddock (*Melanogrammus aeglefinus*) and Atlantic cod (*Gadus morhua*) significantly declined over 5 days immediately following seismic surveys, after which the catch rate returned to normal. Other studies found only minor responses by fish to noise created during or following seismic surveys, such as a small decline in lesser sand eel (*Ammodytes marinus*) abundance that quickly returned to pre-seismic levels (Hassel et al., 2004) or no permanent changes in the behavior of marine reef fishes (Wardle et al., 2001). However, both Hassel et al. (2004) and Wardle et al. (2001) noted that when fish sensed the airgun firing, they performed a startle response and sometimes fled.

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3.0 DESCRIPTION OF AFFECTED RESOURCES

The expected occurrence of each species in the Project Area is based on information provided in EAs conducted by BOEM offshore Rhode Island and Massachusetts (BOEM, 2013, 2014); regional surveys such as the Northeast Large Pelagic Survey, the Atlantic Marine Assessment Program for Protected Species (AMAPPS), or the Cetacean and Turtle Assessment Program (CETAP) (CETAP, 1982; Kraus et al., 2016; Palka et al., 2017); stock information from NMFS and USFWS available for the region; density and other available information from published literature. Vulnerability of each species to potential impacts is determined based on the status of the stock (i.e., ESA- or MMPA-listing) and relevant publications indicating responses from previous exposures to similar activities. Available information was applicable to both the RWF and RWEC (including both the RWEC – OCS and RWEC – RI), so assessment methods did not differ between to the two Project Components. As discussed in the Project's COP (**Sections 4.3.3.1**, **4.3.4.1**, and **4.3.5.1**), impacts associated with the Onshore Facilities are not expected to occur to affected resources, and this Project Component will not be discussed further.

3.1 Marine Mammals

There are 36 marine mammal species in the Western North Atlantic OCS Region whose ranges include the Northeastern U.S. region where the Project will be located (BOEM, 2013, 2014). The marine mammal assemblage comprises cetaceans (whales, dolphins, and porpoises), pinnipeds (seals), and sirenians (manatee).

There are 31 cetacean species, including 25 members of the suborder Odontoceti (toothed whales, dolphins, and porpoises) and 6 of the suborder Mysticeti (baleen whales) within the region.

Along with cetaceans, there are also four phocid species (true seals) that are known to occur in the region, including harbor seals (*Phoca vitulina*), gray seals (*Halichoerus grypus*), harp seals (*Pagophilus groenlandica*), and hooded seals (*Cystophora cristata*) (Hayes et al., 2020). Finally, one species of sirenian, the Florida manatee (*Trichechus manatus latirostris*), is an occasional visitor to the region during the summer months (USFWS, 2019).

The protection status, stock identification, and abundance estimates of each marine mammal species with geographic ranges that include the Northeastern U.S. region are provided in **Table 3.1-1**. Density data are also available from Roberts et al. (2018) and Roberts (2020) for this region, but are not provided at this time because these data may be updated between now and final submission of the COP used by BOEM to prepare the EIS. Density estimates for the Project Area will be provided prior to this final COP submission. **Table 3.1-1** evaluates the potential occurrence of marine mammals in the Project Area based on five categories defined as follows:

- **Common** – Occurring consistently in moderate to large numbers;
- **Regular** – Occurring in low to moderate numbers on a regular basis or seasonally;
- **Uncommon** – Occurring in low numbers or on an irregular basis;
- **Rare** – Records for some years but limited; and
- **Not expected** – Range includes the Project Area, but due to habitat preferences and distribution information, species are not expected to occur in the Project Area although records may exist for adjacent waters.

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Table 3.1-1. Marine mammals with geographic ranges that include the Northeastern U.S. region and their relative occurrence in the Project Area (Bureau of Ocean Energy Management, 2013, 2014; U.S. Fish and Wildlife Service [USFWS], 2019; National Marine Fisheries Service [NMFS], 2020a).

Common Name	Scientific Name	Stock	Current Population Status	Relative Occurrence in the RWF	Relative Occurrence in the RWEC – OCS	Relative Occurrence in the RWEC – RI	Best Abundance Estimate[1]
Order Cetacea							
Suborder Mysticeti (baleen whales)							
Fin whale	*Balaenoptera physalus*	Western North Atlantic	ESA Endangered MMPA Depleted and Strategic RI State Endangered	Common	Common	Common	6,802
Sei whale	*Balaenoptera borealis*	Nova Scotia	ESA Endangered MMPA Depleted and Strategic	Regular	Uncommon	Uncommon	6,292
Blue whale	*Balaenoptera musculus*	Western North Atlantic	ESA Endangered MMPA Depleted and Strategic	Rare	Not Expected	Not Expected	402
North Atlantic right whale	*Eubalaena glacialis*	Western North Atlantic	ESA Endangered MMPA Depleted and Strategic RI State Endangered	Common	Common	Common	412
Minke whale	*Balaenoptera acutorostrata*	Canadian East Coast	MMPA Non-strategic	Common	Common	Common	21,968
Humpback whale[2]	*Megaptera novaeangliae*	Gulf of Maine	MMPA Non-strategic[2] RI State Endangered	Common	Common	Common	1,393
Suborder Odontoceti (toothed whales, dolphins, and porpoises)							
Sperm whale	*Physeter macrocephalus*	North Atlantic	ESA Endangered MMPA Depleted and Strategic	Common	Common	Regular	4,349
Pygmy sperm whale	*Kogia breviceps*	Western North Atlantic	MMPA Non-strategic	Rare	Rare	Rare	7,750
Dwarf sperm whale	*Kogia sima*	Western North Atlantic	MMPA Non-strategic	Rare	Rare	Rare	7,750
Northern bottlenose whale	*Hyperoodon ampullatus*	Western North Atlantic	MMPA Non-strategic	Not Expected	Not Expected	Not Expected	Unknown
Cuvier's beaked whale	*Ziphius cavirostris*	Western North Atlantic	MMPA Non-strategic	Rare	Rare	Rare	5,744
Mesoplodont beaked whales	*Mesoplodon spp.*	Western North Atlantic	MMPA Depleted	Rare	Rare	Rare	10,107
Killer whale	*Orcinus orca*	Western North Atlantic	MMPA Non-strategic	Rare	Rare	Rare	Unknown

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Common Name	Scientific Name	Stock	Current Population Status	Relative Occurrence in the RWF	Relative Occurrence in the RWEC – OCS	Relative Occurrence in the RWEC – RI	Best Abundance Estimate[1]
False killer whale	*Pseudorca crassidens*	Western North Atlantic	MMPA Strategic	Rare	Rare	Rare	1,791
Pygmy killer whale	*Feresa attenuata*	Western North Atlantic	MMPA Non-strategic	Not Expected	Not Expected	Not Expected	Unknown
Short-finned pilot whale	*Globicephala macrorhynchus*	Western North Atlantic	MMPA Strategic	Rare	Rare	Rare	28,924
Long-finned pilot whale	*Globicephala melas*	Western North Atlantic	MMPA Strategic	Common	Uncommon	Uncommon	39,215
Melon-headed whale	*Peponocephala electra*	Western North Atlantic	MMPA Non-strategic	Not Expected	Not Expected	Not Expected	Unknown
Risso's Dolphin	*Grampus griseus*	Western North Atlantic	MMPA Non-strategic	Common	Uncommon	Uncommon	35,493
Common dolphin	*Delphinus delphis*	Western North Atlantic	MMPA Non-strategic	Common	Common	Common	172,974
Fraser's dolphin	*Lagenodelphis hosei*	Western North Atlantic	MMPA Non-strategic	Rare	Rare	Rare	Unknown
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	Western North Atlantic	MMPA Non-strategic	Common	Common	Common	93,233
White-beaked dolphin	*Lagenorhynchus albirostris*	Western North Atlantic	MMPA Non-strategic	Rare	Rare	Rare	536,016
Pantropical spotted dolphin	*Stenella attenuata*	Western North Atlantic	MMPA Non-strategic	Rare	Rare	Rare	6,593
Clymene dolphin	*Stenella clymene*	Western North Atlantic	MMPA Non-strategic	Not Expected	Not Expected	Not Expected	4,237
Striped dolphin	*Stenella coeruleoalba*	Western North Atlantic	MMPA Non-strategic	Rare	Rare	Rare	67,036
Atlantic spotted dolphin	*Stenella frontalis*	Western North Atlantic	MMPA Non-strategic	Uncommon	Uncommon	Uncommon	39,921
Spinner dolphin	*Stenella longirostris*	Western North Atlantic	MMPA Non-strategic	Rare	Rare	Rare	4,102
Rough toothed dolphin	*Steno bredanensis*	Western North Atlantic	MMPA Non-strategic	Rare	Rare	Rare	136
Common bottlenose dolphin	*Tursiops truncatus*	Western North Atlantic, offshore	MMPA Non-strategic	Common	Common	Common	62,851
		Western North Atlantic, northern migratory coastal	MMPA Depleted and strategic	Rare	Rare	Rare	6,639
Harbor Porpoise	*Phocoena*	Gulf of Maine/Bay of Fundy	MMPA Non-strategic RI State SGCN	Common	Common	Common	95,543

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Common Name	Scientific Name	Stock	Current Population Status	Relative Occurrence in the RWF	Relative Occurrence in the RWEC – OCS	Relative Occurrence in the RWEC – RI	Best Abundance Estimate[1]
Order Carnivora							
Suborder Pinnipedia							
Harbor seal	*Phoca vitulina*	Western North Atlantic	MMPA Non-strategic RI State SGCN	Regular	Regular	Regular	75,834
Gray seal	*Halichoerus grypus*	Western North Atlantic	MMPA Non-strategic	Regular	Regular	Regular	27,131
Harp seal	*Pagophilus groenlandica*	Western North Atlantic	MMPA Non-strategic	Rare	Rare	Rare	Unknown
Hooded seal	*Cystophora cristata*	Western North Atlantic	MMPA Non-strategic	Rare	Rare	Rare	Unknown
Order Sirenia							
Florida manatee[3]	*Trichechus manatus latirostris*	-	ESA Threatened MMPA Depleted and Strategic	Rare	Rare	Rare	13,000[4]

- = not applicable; ESA = Endangered Species Act; MMPA = Marine Mammal Protection Act; Project Area = includes the Revolution Wind Farm (RWF), Revolution Wind Export Cable (RWEC) – Outer Continental Shelf (OCS) and RWEC – Rhode Island (RI) state waters, and Onshore Facilities; SGCN = Species of Greatest Conservation Need.
[1]Best abundance estimate from the Draft 2020 Marine Mammal Stock Assessment Report, published by NMFS (NMFS, 2020a).
[2]Globally there are 14 Distinct Population Segments of humpback whale, four of which are listed as Endangered under the ESA. The Gulf of Maine population which is expected to occur in the Project Area is not listed under the ESA.
[3]Under management jurisdiction of USFWS rather than NMFS and therefore not included in Draft 2020 Stock Assessment Report.
[4]Current range-wide estimate from USFWS (2019).

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Of the 36 marine mammal species with geographic ranges that include the Northeastern U.S. region, 15 species can be reasonably expected to reside, traverse, or routinely visit the Project Area in densities that could result in impacts from Proposed Activities, and therefore, be considered *potentially affected species*. Species not expected or rare are not carried forward in this Technical Report. The following affected species are those that have a common, uncommon, or regular relative occurrence in the Project Area, or have a very wide distribution with limited distribution or abundance details.

- Fin whale;
- Sei whale;
- North Atlantic right whale;
- Minke whale;
- Humpback whale;
- Sperm whale;
- Long-finned pilot whale
- Atlantic spotted dolphin;
- Atlantic white-sided dolphin;
- Common dolphin;
- Risso's dolphin;
- Common bottlenose dolphin;
- Harbor porpoise;
- Harbor seal; and
- Grey seal.

The following subsections summarize data on the status and trends, distribution and habitat preferences, behavior and life history, and auditory capabilities of ESA-listed and non-listed marine mammals expected to occur in the Project Area as available in published literature and reports, including NMFS marine mammal stock assessment reports (SARs). Expected occurrence for each species within the RWF area and RWEC corridor, including both the RWEC – OCS and RWEC – RI areas, was assessed separately.

3.1.1 ESA-listed Species

Six species known to occur in the Western North Atlantic are listed under the ESA; these include the fin whale (Endangered), sei whale (Endangered), blue whale (Endangered), North Atlantic right whale (Endangered), sperm whale (Endangered), and Florida manatee (Threatened). Of these six species, only the fin whale, sei whale, North Atlantic right whale, and sperm whale are expected to occur in the Project Area and are considered potentially affected species. These species are highly migratory and do not spend extended periods of time in a localized area. The following sections provide further information regarding species behavior and expected occurrence in the RWF and two RWEC areas (RWEC – OCS and RWEC – RI).

Fin Whale

Fin whales have a wide distribution and can be found in the Atlantic and Pacific Oceans in both the Northern and Southern Hemisphere (NMFS, 2020a). The population is divided by ocean basins; however, these boundaries are arbitrary as they are based on historical whaling patterns rather than biological evidence (NMFS, 2020a). In the Northeastern U.S., fin whales are the most commonly sighted species and account for 47% of the large whale sightings in the region (CETAP, 1982). They have been observed in all four seasons, and their distribution ranges from the Mid-Atlantic coast to Nova Scotia in Western North Atlantic OCS waters (Kenney and Vigness-Raposa, 2010).

Fin whales are often confused with other balaenopterid whales (e.g., blue whale, sei whale) during field surveys, but can be distinguished by the white, v-shaped patterns on their back behind the head (Jefferson et al., 1993). Fin whales also produce characteristic vocalizations that can be distinguished

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during passive acoustic monitoring (PAM) surveys (BOEM, 2013; Erbe et al., 2017). The most commonly observed calls are the "20-Hz signals," a short downsweep falling from 30 to 15 Hz over a 1-sec period. Fin whales can also produce higher frequency sounds up to 310 Hz, and SLs as high as 195 dB re 1 µPa m have been reported, making it one of the most powerful biological sounds in the ocean (Erbe et al., 2017). Anatomical modeling based on fin whale ear morphology suggests their greatest hearing sensitivity is between 20 Hz and 20 kHz (Cranford and Krysl, 2015; Southall et al., 2019).

Fin whales are listed as Endangered under the ESA and by the state of Rhode Island, and are listed as Vulnerable by the International Union for Conservation of Nature (IUCN) Red List (NMFS, 2020a; Rhode Island Department of Environmental Management [RI DEM], 2020; IUCN, 2021). The best abundance estimate available for the Western North Atlantic stock is 6,802 based on data from 2016 NOAA shipboard and aerial surveys and the 2016 Canadian Northwest Atlantic International Sightings Survey (NAISS) that extended from Newfoundland to Florida (NMFS, 2020a). A population trend analysis does not currently exist for this species because of insufficient data; however, based on photographic identification, the gross annual reproduction rate is 8% with a mean calving interval of 2.7 years (Agler et al., 1993; NMFS, 2020a). This stock is listed as strategic and depleted under the MMPA due to its Endangered status (NMFS, 2020a). Potential biological removal (PBR) for this stock is 11, and annual human-caused mortality and serious injury for the period between 2014 and 2018 was estimated to be 2.35 per year. This estimate includes incidental fishery interactions (i.e., bycatch/entanglement) and vessel collisions, but other threats to fin whales include contaminants in their habitat and potential climate-related shifts in distribution of prey species (NMFS, 2020a). There is no designated critical habitat for this species in or near the Project Area.

RWF

Two well-known feeding grounds for fin whales are present near the RWF. These include the Great South Channel and Jeffrey's Ledge and waters directly east of Montauk, New York (Kenney and Vigness-Raposa, 2010; NMFS, 2020a). The highest occurrences of fin whales in this region are identified south of Montauk Point, New York to south of Nantucket, Massachusetts (Kenney and Vigness-Raposa, 2010). **Figure 3.1-1** shows visual detections by month in the RI-MA WEA (Kraus et al., 2016), and **Figure 3.1-2** shows the number of detections of fin whales Southern New England based on 10 years of passive acoustic data (Davis et al., 2020). Results of data collected in region 7 (Southern New England where the Project Area is located) indicate the greatest number of detections from August through April with a decrease in fin whale presence in the summer (Davis et al., 2020), whereas visual detections are greatest in the summer (Kraus et al., 2020). Because of these high occurrences within the OCS waters and offshore near the OCS break where surveys occurred, it is likely that fin whales will be present within the RWF area, potentially occurring during all seasons.

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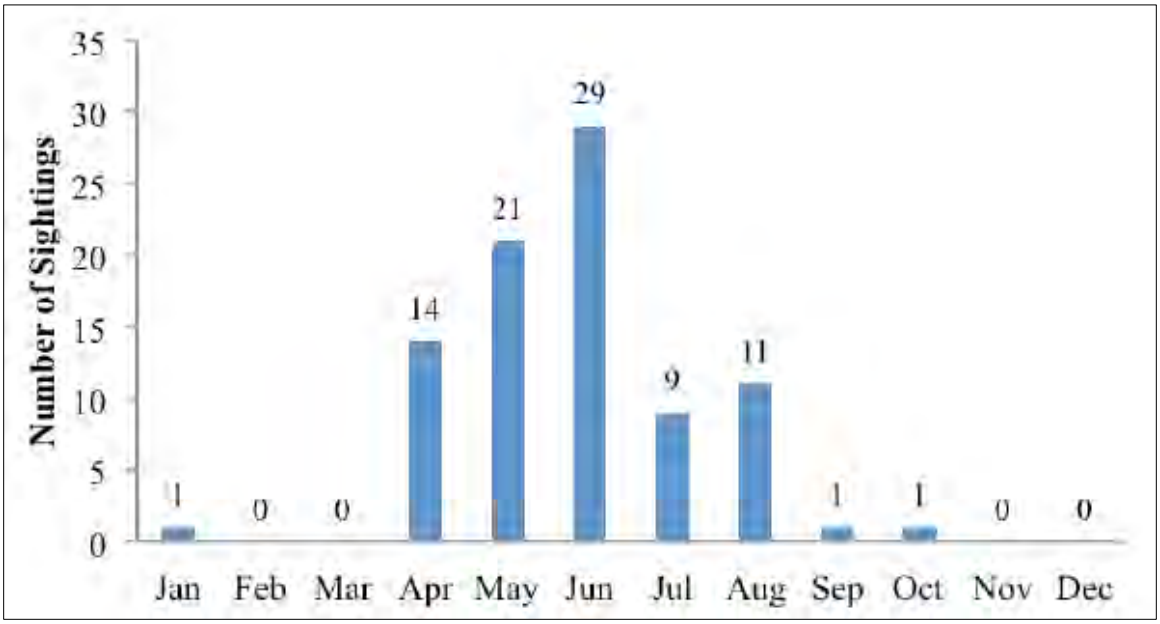

Figure 3.1-1. Visual detections of fin whales by month for all survey years between October 2011 and June 2015. From: Kraus et al. (2016).

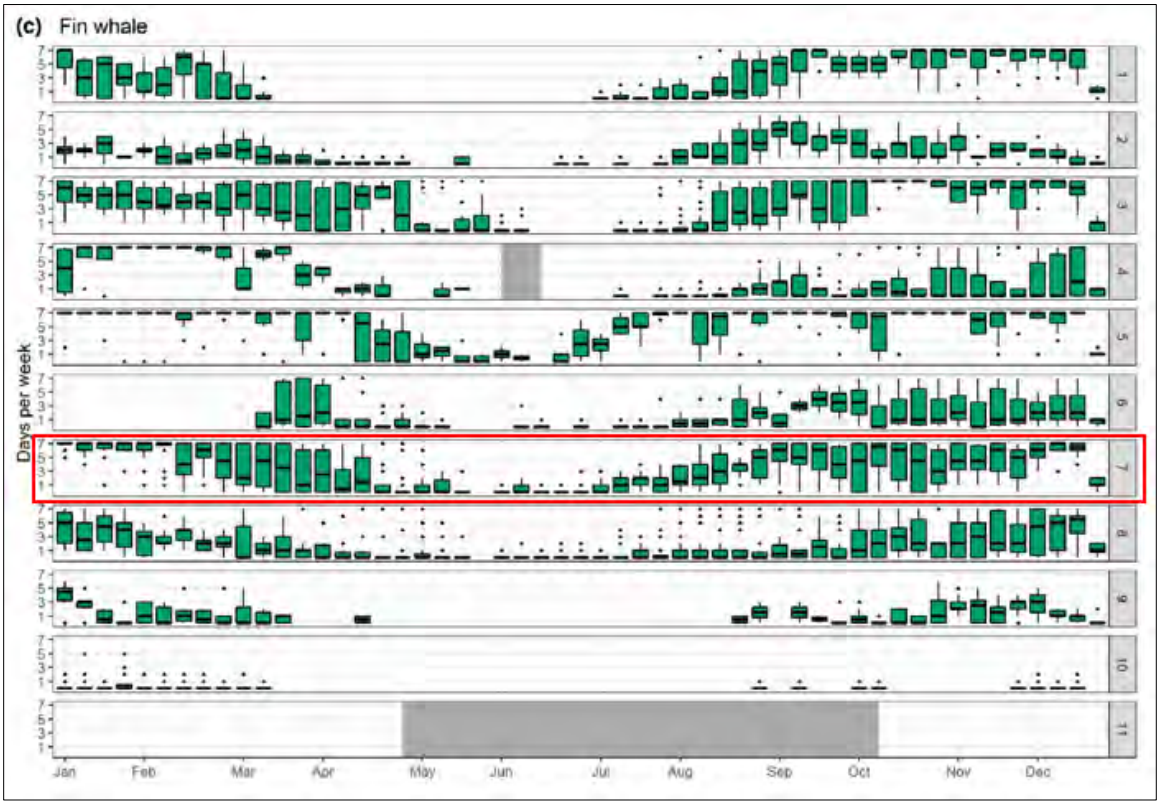

Figure 3.1-2. Acoustic detections of fin whales from 10 years of passive acoustic data collected along the U.S. East Coast. Region 7 (red box) is Southern New England which contains the Project Area. Gray blocks indicate weeks where no data were collected. Adapted from: Davis et al. (2020).

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RWEC

Fin whales are common in Rhode Island state waters and adjacent OCS waters in this area, and aggregations of fin whales are often reported between Block Island, Rhode Island, and Montauk Point, New York (Kenney and Vigness-Raposa, 2010). They are typically centered along the 100-m isobath off the U.S. East Coast, but sightings have occurred in both shallower and deeper waters and they have been observed in Rhode Island state waters (Kenney and Vigness-Raposa, 2010; RI DEM, 2020). Because of their regular occurrence in this area, a large number of whale watching boats also frequent this area (Kenney and Vigness-Raposa, 2010). Fin whale sightings are greatest in the spring and summer, but they are known to occur in all four seasons in inner shelf waters (Kenney and Vigness-Raposa, 2010). Therefore, it is highly likely that fin whales will be encountered within the RWEC – OCS and RWEC – RI.

Sei Whale

Sei whales occur in all the world's oceans and migrate between feeding grounds in temperate and sub-polar regions to winter grounds in lower latitudes (Kenney and Vigness-Raposa, 2010; NMFS, 2020a). In the Western North Atlantic, most of the population is concentrated in northerly waters along the Scotian Shelf. Sei whales are observed in the spring and summer, utilizing the northern portions of the U.S. Atlantic Exclusive Economic Zone (EEZ) as feeding grounds, including the Gulf of Maine and Georges Bank. The highest concentration is observed during the spring along the eastern margin of Georges Bank and in the Northeast Channel area along the southwestern edge of Georges Bank. The winter habitat for this population remains unknown, but recent PAM data detected sei whale vocalizations from late fall through winter in Southern George's Bank region, with sporadic detections in the Southeast U.S. around Cape Hatteras and Blake Plateau (NMFS, 2020a). In general, sei whales are observed offshore with periodic incursions into more shallow waters for foraging (NMFS, 2020a).

Sei whales can often be confused with fin whales during field surveys; however, they do not have the characteristic v-shaped patterns on their backs that are present on fin whales, and their skin is often mottled with scars thought to be caused by lamprey bites (Jefferson et al., 1993). Although uncertainties still exist with distinguishing sei whale vocalizations during PAM surveys, they are known to produce short duration (0.7 to 2.2 sec) upsweeps and downsweeps between 20 and 600 Hz. SLs for these calls can range from 147 to 183 dB re 1 µPa m (Erbe et al., 2017). No auditory sensitivity data are available for this species (Southall et al., 2019).

Sei whales are listed as Endangered under the ESA and by the IUCN Red List (NMFS, 2020a; IUCN, 2021). Prior to 1999, sei whales in the Western North Atlantic were considered a single stock, but following the suggestion of the Scientific Committee of the International Whaling Commission (IWC), two separate stocks were identified for this species; a Nova Scotia stock and a Labrador Sea stock. Only the Nova Scotia stock can be found in U.S. waters, and the current abundance estimate for this population is 6,292 derived from recent surveys conducted between Halifax, Nova Scotia and Florida (NMFS, 2020a). Population trends are not available for this stock because of insufficient data (NMFS, 2020a). This stock is listed as strategic and depleted under the MMPA due to its Endangered status (NMFS, 2020a). The PBR for this stock is 6.2, and annual human-caused mortality and serious injury from 2014 to 2018 was estimated to be 1.20 per year (NMFS, 2020a). Like fin whales, major threats to sei whales include fishery interactions, vessel collisions, contaminants, and climate-related shifts in prey species (NMFS, 2020a). There is no designated critical habitat for this species in or near the Project Area.

RWF

CETAP surveys observed sei whales along the OCS edge only during the spring (237 sightings) and summer (101 sightings) (CETAP, 1982). This agrees with the Kraus et al. (2016) study, where sei whales were also only observed in the RI-MA WEA during the spring and summer (**Figure 3.1-3**). No sightings were reported during the fall and winter. A small cluster of five individuals was reported south of Montauk Point, New York, and Block Island, Rhode Island, in July 1981, August 1982, and May 2003 (Kenney and Vigness-Raposa, 2010). Davis et al. (2020) found detections of sei whales nearly year-round in Southern

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New England, but the greatest number of detections were observed between March and July (**Figure 3.1-4**). Therefore, sei whales may be present seasonally in the RWF, primarily in the spring and summer.

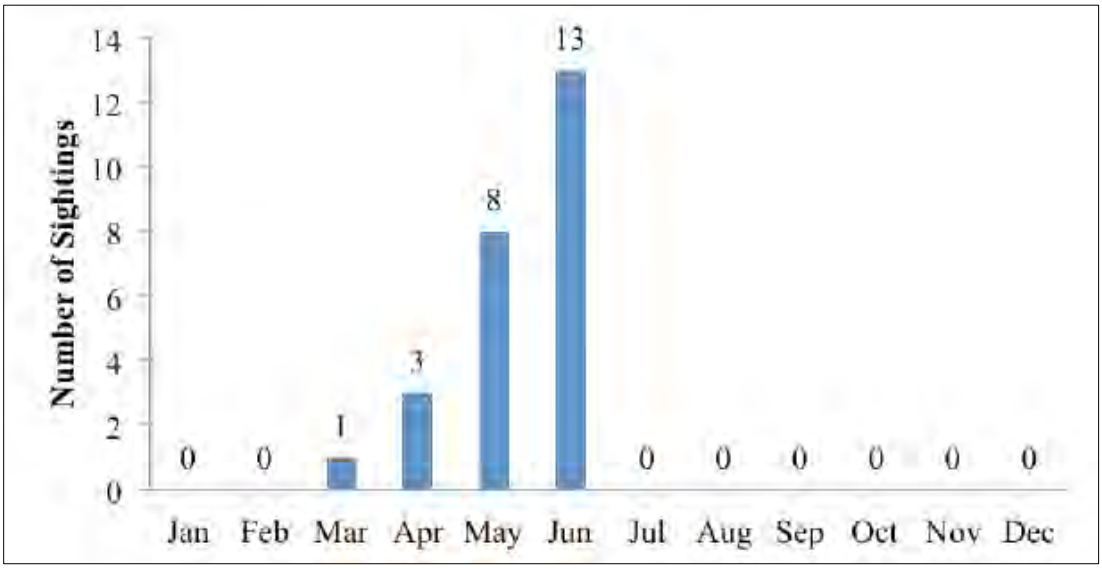

Figure 3.1-3. Visual detections of sei whales by month for all survey years between October 2011 and June 2015. From: Kraus et al. (2016).

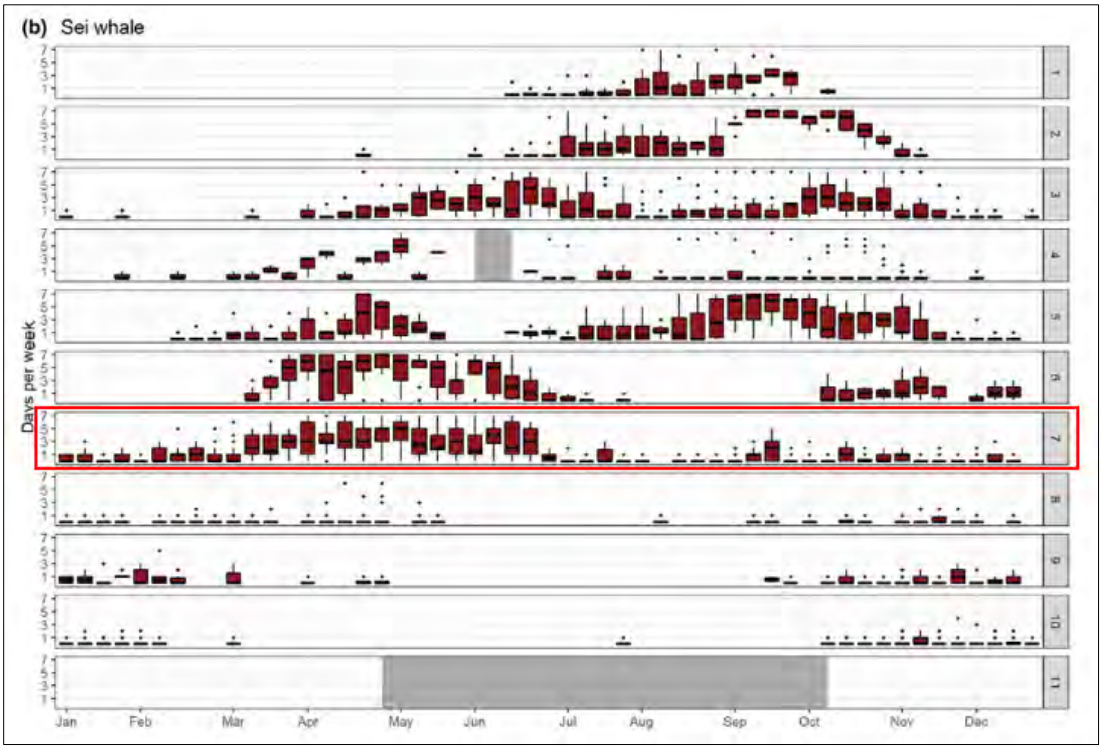

Figure 3.1-4. Acoustic detections of sei whales from 10 years of passive acoustic data collected along the U.S. East Coast. Region 7 (red box) is Southern New England which contains the Project Area. Gray blocks indicate weeks where no data were collected. Adapted from: Davis et al. (2020).

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RWEC

Sei whales are associated with the deeper waters along the continental shelf edge and are observed in shallower waters when foraging. In the spring and summer, sei whales are seen in feeding habitats in Nova Scotia and Cape Cod north of the RWEC corridor (NMFS, 2020a). Sei whales are therefore not likely to enter shallower waters off Rhode Island and are not expected to occur in the RWEC - OCS or RWEC – RI.

North Atlantic Right Whale

The North Atlantic right whale occurs in all the world's oceans from temperate to subpolar latitudes. The primary habitat for this species is coastal or continental shelf waters ranging from calving grounds in the Southeastern U.S. to feeding grounds in the Northeastern U.S. (NMFS, 2020a). Acoustic surveys have also demonstrated their presence year-round in the Gulf of Maine, off New Jersey, and off Virginia (NMFS, 2020a). Important feeding habitats include coastal waters off Massachusetts, Georges Bank, the Great South Channel, Gulf of Maine, Bay of Fundy, and the Scotian Shelf. All waters within the Gulf of Maine are designated as a Foraging Area Critical Habitat (NMFS, 2020a).

One of the most distinguishing features of the right whale is the whitish callosities, or areas of roughened skin, covering their head, which can be up to one-third of their body length and their prominently curved jawline (Jefferson et al., 1993). Right whale vocalizations most frequently observed during PAM studies include upsweeps rising from 30 to 450 Hz, often referred to as "upcalls," and broadband (30 to 8,400 Hz) pulses, or "gunshots," with SLs between 172 and 187 dB re 1 µPa m (Erbe et al., 2017). However, recent studies have shown that mother-calf pairs reduce the amplitude of their calls in the calving grounds, possibly to avoid detection by predators (Parks et al. 2019). Modeling conducted using right whale ear morphology suggest that the best hearing sensitivity for this species is between 16 Hz and 25 kHz (Southall et al., 2019; Ketten et al., 2014).

The North Atlantic right whale is listed as Endangered under the ESA and by the state of Rhode Island, and are listed as Critically Endangered by the IUCN Red List (NMFS, 2020a; RI DEM, 2020; IUCN, 2021). Right whales are considered to be the most critically Endangered large whales in the world (NMFS, 2020a). The Western North Atlantic population size was estimated to be 412 individuals in the most recent draft 2020 SAR, which used data from the photo-identification database maintained by the New England Aquarium that were available in October 2019 (NMFS, 2020a). A population trend analysis conducted on the abundance estimates from 1990 to 2011 suggest an increase at about 2.8% per year from an initial abundance estimate of 270 individuals in 1998 (NMFS, 2020a). However, modeling conducted by Pace et al. (2017) showed a decline in annual abundance after 2011, further evidenced by the decrease in the abundance estimate from 451 in 2018 (NMFS, 2020a) to the current 2020 estimate of 412 (NMFS, 2020a). Highly variable data exists regarding the productivity of this stock. Over time, there have been periodic swings of per capita birth rates (NMFS, 2020a). Net productivity rates do not exist as the Western North Atlantic stock lacks any definitive population trend (NMFS, 2020a). The average annual human-related mortality/injury rate exceeds that of the calculated PBR of 0.8, and due to its listing as Endangered under the ESA this population is classified as strategic and depleted under the MMPA (NMFS, 2020a). Estimated human-caused mortality and serious injury between 2014 and 2018 was 8.15 whales per year (NMFS, 2020a). The predominant threats to North Atlantic right whales are entanglement and vessel collisions. Available data from 2000 to 2017 suggest an increase in the percent of injuries and mortalities (per capita) caused by entanglement, and while there no discernible trend in vessel strikes over the years, the annual rate of mortality and serious injury from 2014 to 2018 due to vessel strikes was 1.3 whales per year (NMFS, 2020a). There have been elevated numbers of mortalities reported since 2017 and continuing to through 2020 totaling 34 dead North Atlantic right whales which prompted NMFS to designate an Unusual Mortality Event (UME) for North Atlantic right whales (NMFS, 2021a). Although the majority (62%) of the mortalities occurred in Canadian waters, the U.S. population is not separated from those in Canada, and therefore the effects of mortality affect the population considered in the assessment process. Of these documented mortalities, 41% were of undetermined cause; however, of the remainder of the mortalities (59%) were

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determined to be the result of human interaction with ten mortalities resulting from vessel strikes and eight resulting from gear entanglement (NMFS, 2021a).

RWF

Kraus et al. (2016) only observed North Atlantic right whales in the RI-MA WEA during the winter and spring (**Figure 3.1-5**). Davis et al. (2017) analyzed 10 years of passive acoustic data and found a similar trend in the data collected in Southern New England where North Atlantic right whale detections began to increase in the winter through early summer (**Figure 3.1-6**).However, the North Atlantic right whale has the potential to occur within the waters off Rhode Island and Massachusetts any time of the year. Typically, right whale sightings begin in December and continue through April. A total of 77 individuals were sighted in the WEA from October 2011 to June 2015. The greatest numbers are seen in March. The Muskeget Channel and south of Nantucket, both located within the RI-MA WEA, were also identified as right whale hotspots during the spring (Kraus et al., 2016).

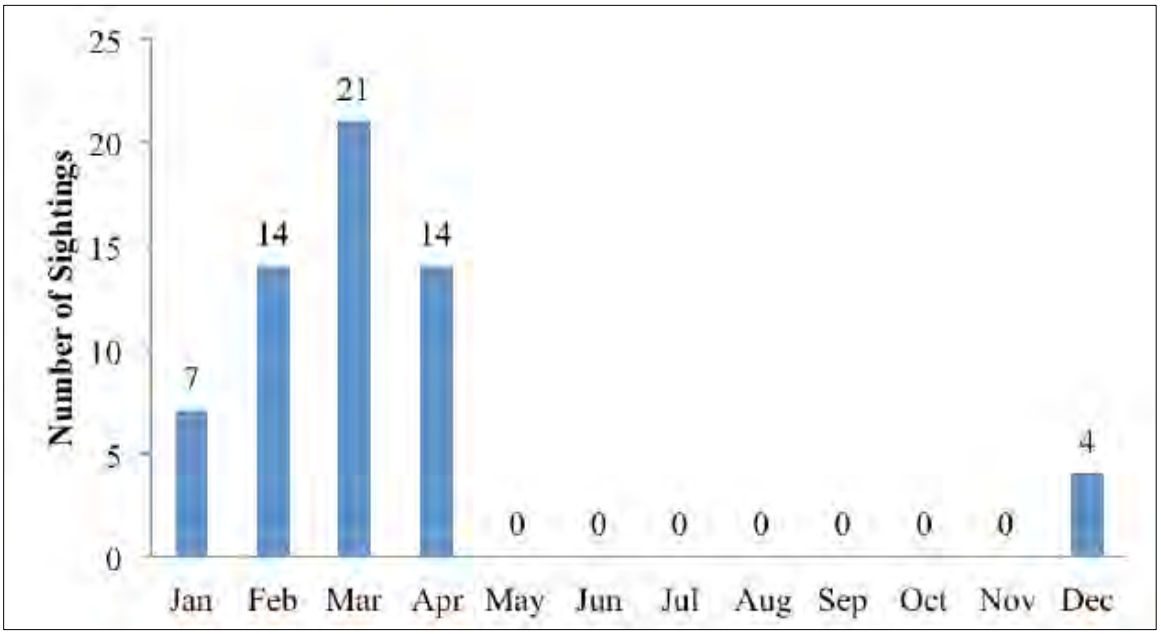

Figure 3.1-5. Visual detections of North Atlantic right whales by month for all survey years between October 2011 and June 2015. From: Kraus et al. (2016).

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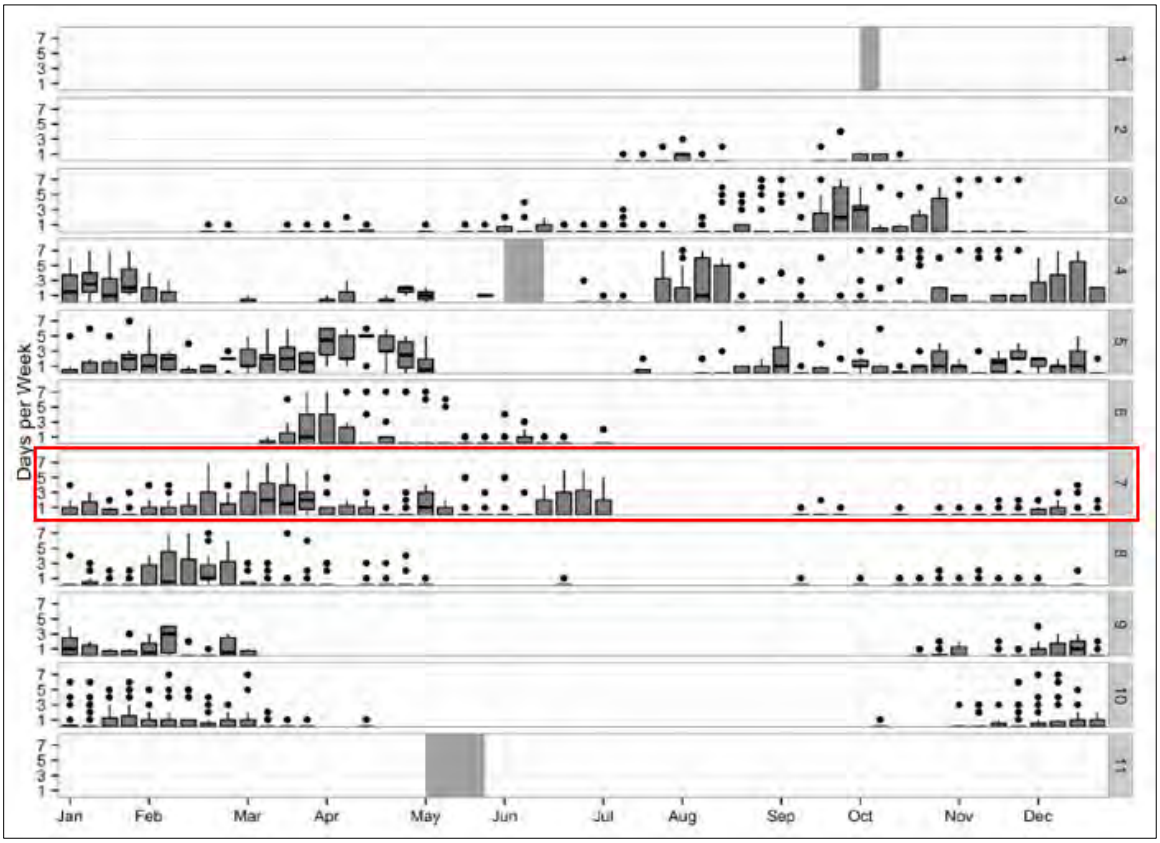

Figure 3.1-6. Acoustic detections of North Atlantic right whales from 10 years of passive acoustic data collected along the U.S. East Coast. Region 7 (red box) is Southern New England which contains the Project Area. Gray blocks indicate weeks where no data were collected. Adapted from: Davis et al. (2017).

Kraus (2018) provided recent right whale survey information for crew training prior to the 2017 South Fork Wind Farm site characterization surveys. North Atlantic right whale sighting results from 2011 to 2015 are presented in **Figure 3.1-7**. Kraus (2018) also presented the sighting locations from 2017 that reported skim (surface) feeding activity by right whales (**Figure 3.1-8**). Skim feeding is an important activity identified in impact assessments because first, it demonstrates a critical behavior (feeding) that could be disrupted by introduced noise; and second, it represents a vulnerable time for right whales to be exposed to ship strikes because they are active at or near the surface.

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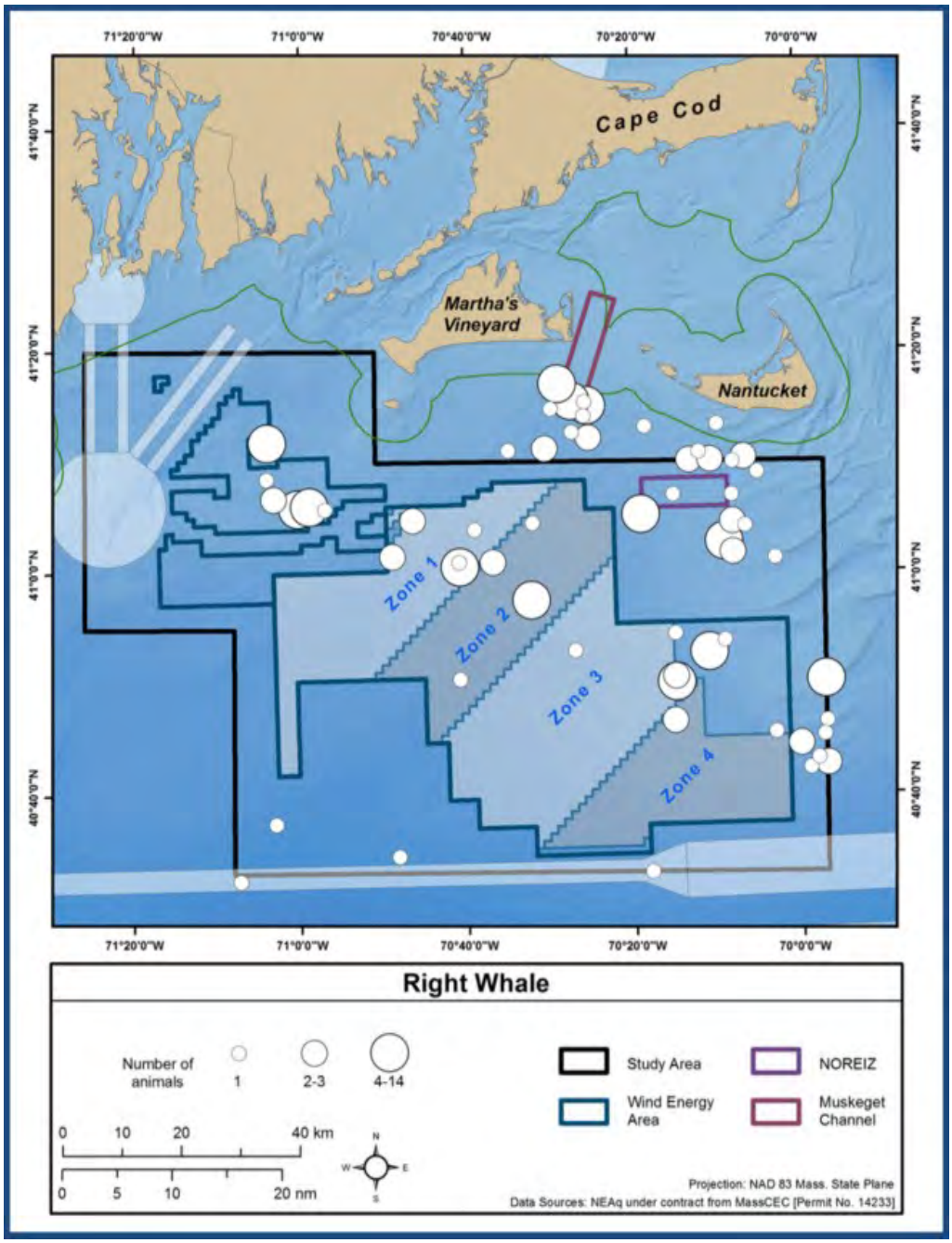

Figure 3.1-7. North Atlantic right whale sighting data from 2011 to 2015. Figure and data from Kraus (2018). NOREIZ = Northeast Offshore Renewable Energy Innovation Zone.

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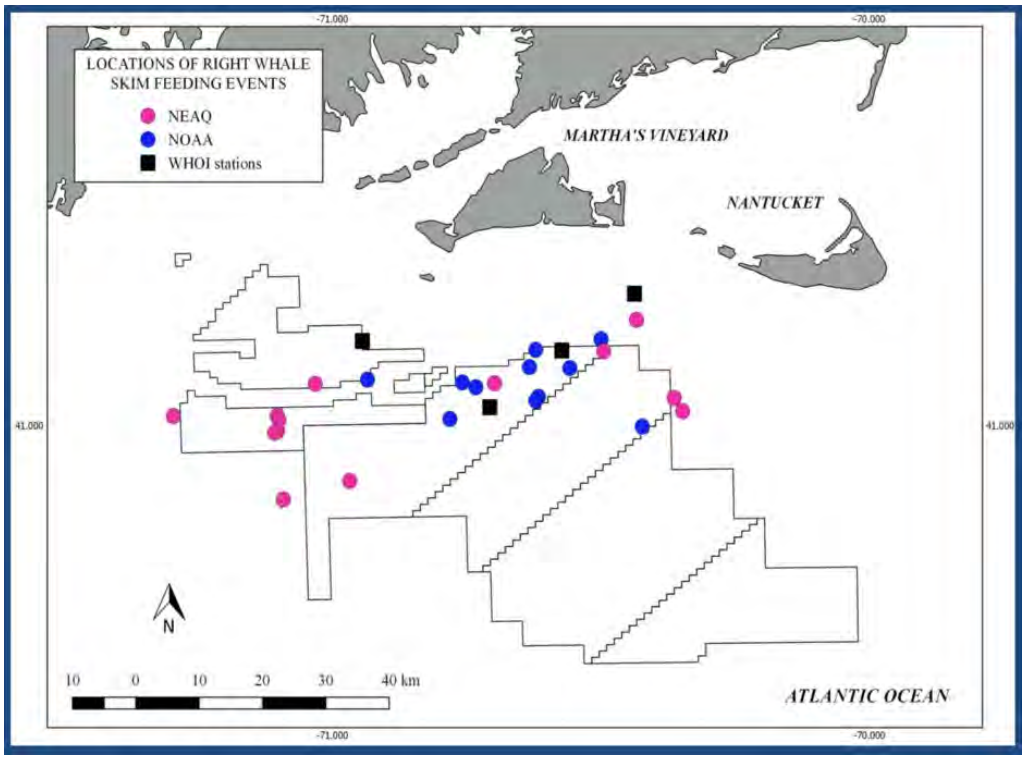

Figure 3.1-8. The 2017 North Atlantic right whale sightings that reported skim (surface) feeding activity. Figure from Kraus (2018). NEAQ = New England Aquarium; NOAA = National Oceanic and Atmospheric Administration.

Seasonal management areas (SMAs) also exist within the vicinity of the RWF, including the Great South Channel SMA (April 1–July 31), Cape Cod Bay SMA (January 1–May 15), Off Race Point SMA (March 1-April 30), and Block Island SMA (November 1–April 30) (NMFS, 2021b); therefore, right whales are likely to occur within the RWF.

RWEC

North Atlantic right whales are known to occur within both Rhode Island state and adjacent OCS waters year-round. The Gulf of Maine has been designated as a critical habitat area; therefore, they may migrate through the RWEC corridor as they travel to this feeding habitat. Kraus et al. (2016) reported a seasonal cluster of right whales south of Martha's Vineyard, Massachusetts, and east of Nantucket, Massachusetts, during the winter. This area is also designated as the Block Island SMA from November 1 through April 20, which contains the RWEC corridor. Therefore, it is likely right whales would occur within both the RWEC – OCS and RWEC – RI.

Sperm Whale

Sperm whales can be found throughout the world's oceans. They can be found near the edge of the ice pack in both hemispheres and are also common along the equator. The North Atlantic stock is distributed mainly along the continental shelf-edge, over the continental slope, and mid-ocean regions, where they prefer water depths of 600 m or more and are less common in waters <300 m deep (Waring et al., 2015; Hayes et al., 2020). In the winter, sperm whales are observed east and northeast of Cape Hatteras. In the spring, sperm whales are more widely distributed throughout the Mid-Atlantic Bight and southern portions of George's Bank (Hayes et al., 2020). In the summer, sperm whale distribution is similar to the spring, but they are more widespread in Georges Bank and the Northeast Channel region and are also observed

inshore of the 100-m isobath south of New England (Hayes et al., 2020). Sperm whale occurrence on the continental shelf in areas south of New England is at its highest in the fall (Hayes et al., 2020).

Sperm whales can easily be distinguished in visual surveys by their large, blunt head, narrow underslung jaw, and characteristic blow shape resulting from the S-shaped blowhole set at the front-left of the head (Jefferson et al., 1993). Unlike mysticete whales that produce various types of calls used solely for communication, sperm whales produce clicks that are used for echolocation and foraging as well as communication (Erbe et al., 2017). Sperm whale clicks have been grouped into five classes based on the click rate, or number of clicks per second; these include “squeals,” “creaks,” “usual clicks,” “slow clicks,” and “codas.” In general, these clicks are broadband sounds ranging from 100 Hz to 30 kHz with peak energy centered around 15 kHz. Depending on the class, SLs for sperm whale calls range between approximately 166 and 236 dB re 1 µPa m (Erbe et al., 2017). Hearing sensitivity data for this species are currently unavailable (Southall et al., 2019).

The Western North Atlantic stock is considered strategic under the MMPA due to its listing as Endangered under the ESA, and the global population is listed as Vulnerable on the IUCN Red List (Hayes et al., 2020; IUCN, 2021). The best and most recent abundance estimate based on 2016 surveys conducted between the lower Bay of Fundy and Florida is 4,349 (Hayes et al., 2020). No population trend analysis is available for this stock. Thousands of sperm whales were killed during the early 18th Century. A moratorium on sperm whale hunting was adopted in 1986 and currently no hunting is allowed for any purposes in the North Atlantic. Occasionally, sperm whales will become entangled in fishing gear or be struck by ships off the east coast of the U.S. However, this rate of mortality is not believed to have biologically significant impacts. The current PBR for this stock is 6.9, and because the total estimated human-caused mortality and serious injury is <10% of this calculated PBR, it is considered insignificant (Hayes et al., 2020). Between 2013 and 2017, 12 sperm whale strandings were documented along the U.S. East Coast, but none of the strandings showed evidence of human interactions (Hayes et al., 2020). Other threats to sperm whales include contaminants, climate-related changes in prey distribution, and anthropogenic noise, although the severity of these threats on sperm whales is currently unknown (Hayes et al., 2020). There is no designated critical habitat for this population in the Project Area.

RWF

Sperm whales were the fifth most commonly sighted large whale in the CETAP study area and were observed in all four seasons. The study sighted 341 individuals, which accounted for only 8% of the total large whale sightings during their survey period (CETAP, 1982). Kraus et al. (2016) reported sightings of sperm whales in the RI-MA WEA during the summer and fall months; five individuals in August 2012, one in September 2012, and three in June 2015. There have also been occasional strandings in Massachusetts and Long Island (Kenney and Vigness-Raposa, 2010). Although accounts of sperm whales in the area are low, their occurrence within the RWF and surrounding waters is possible.

RWEC

CETAP reported that the distribution of sperm whales primarily centers at about the 1,000-m depth contour. However, their distribution can also extend shoreward, inshore of the 100-m contour, particularly in the summer and fall (CETAP, 1982; Hayes et al., 2020). Although relatively infrequent, sightings have been reported in waters as shallow as 60 m. Southern New England is one of the few locations in the world in which sperm whales frequent inshore areas (Kenney and Vigness-Raposa, 2010). Many reported sightings take place in a narrow band just south of Block Island, Rhode Island, Martha’s Vineyard, Massachusetts, and Nantucket, Massachusetts, from May through November, in which the RWEC corridor would intersect. This high occurrence of sperm whales is believed to be related to the presence of spawning squid (CETAP, 1982). Therefore, given their preference for deeper waters sperm whales are likely to occur in the RWEC – OCS, but may also occur seasonally within the RWEC – RI in the summer and fall when they enter shallower state waters in search of food.

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3.1.2 Non-ESA listed Species

Of the 30 non-listed species whose ranges include the Northeastern U.S., 11 are expected to be present in the Project Area and are considered potentially affected species. The following sections provide further information regarding species behavior and expected occurrence in the RWF and two RWEC areas (RWEC – OCS and RWEC – RI).

Minke Whale

Minke whales prefer the colder waters in northern and southern latitudes, but they can be found in every ocean in the world. Available data suggest that minke whales are distributed in shallower waters along the continental shelf between the spring and fall and are located in deeper oceanic waters between the winter and spring (NMFS, 2020a). They are most abundant in New England waters in the spring, summer, and early fall (NMFS, 2020a).

A prominent morphological feature of the minke whale is the large, pointed median ridge on top of the rostrum. The body is dark gray to black with a pale belly, and frequently shows pale areas on the sides that may extend up onto the back. The flippers are smooth and taper to a point, and the middle third of each flipper has a conspicuous bright white band that can be distinguished during visual surveys (Kenney and Vigness-Raposa, 2010). In the North Atlantic, minke whales commonly produce pulse trains lasting 10 to 70 sec with a frequency range between 10 and 800 Hz. SLs for this call type have been reported between 159 and 176 dB re 1 µPa m (Erbe et al., 2017). Some minke whales also produce a unique “boing” sound which is a train of rapid pulses often described as an initial pulse followed by an undulating tonal (Erbe et al., 2017; Rankin and Barlow, 2005). The “boing” ranges from 1 to 5 kHz with an SLs of approximately 150 dB re 1 µPa m (Erbe et al., 2017). Auditory sensitivity for this species based on anatomical modeling of minke whale ear morphology is best between 10 Hz and 34 kHz (Southall et al., 2019; Ketten et al., 2014).

Minke whales are not listed under the ESA or classified as strategic under the MMPA and are list as Least Concern on the IUCN Red List (NMFS, 2020a; IUCN, 2021). The best available current global abundance estimates for the common minke whale, compiled by the IUCN Red List, is around 200,000 (Cooke, 2018). The most recent population estimate for the Canadian East Coast stock which occurs in the Project Area is 24,202 minke whales, derived from surveys conducted by NOAA and the Department of Fisheries and Oceans Canada between Labrador and central Virginia (NMFS, 2020a). There are no current population trends or net productivity rates for this species due to insufficient data. The PBR for this stock is estimated to be 170 (NMFS, 2020a). The estimated annual human-caused mortality and serious injury from 2014 to 2018 was 10.55 per year attributed to fishery interactions, vessel strikes, and non-fishery entanglement in both the U.S. and Canada (NMFS, 2020a), and a UME was declared for this species in January 2017 (NMFS, 2021c). Minke whales may also be vulnerable to climate-related changes in prey distribution, although the extent of this effect on minke whales remains uncertain (NMFS, 2020a). No designated critical habitat for this stock currently exists in the Project Area.

RWF

During previous studies conducted in the RI-MA WEA, 103 minke whales were sighted within the area (Kraus et al., 2016). Spring observations included the most individuals followed by summer, and fall (**Figure 3.1-9**). Minke whales are therefore likely to occur in the spring and summer within the RWF area.

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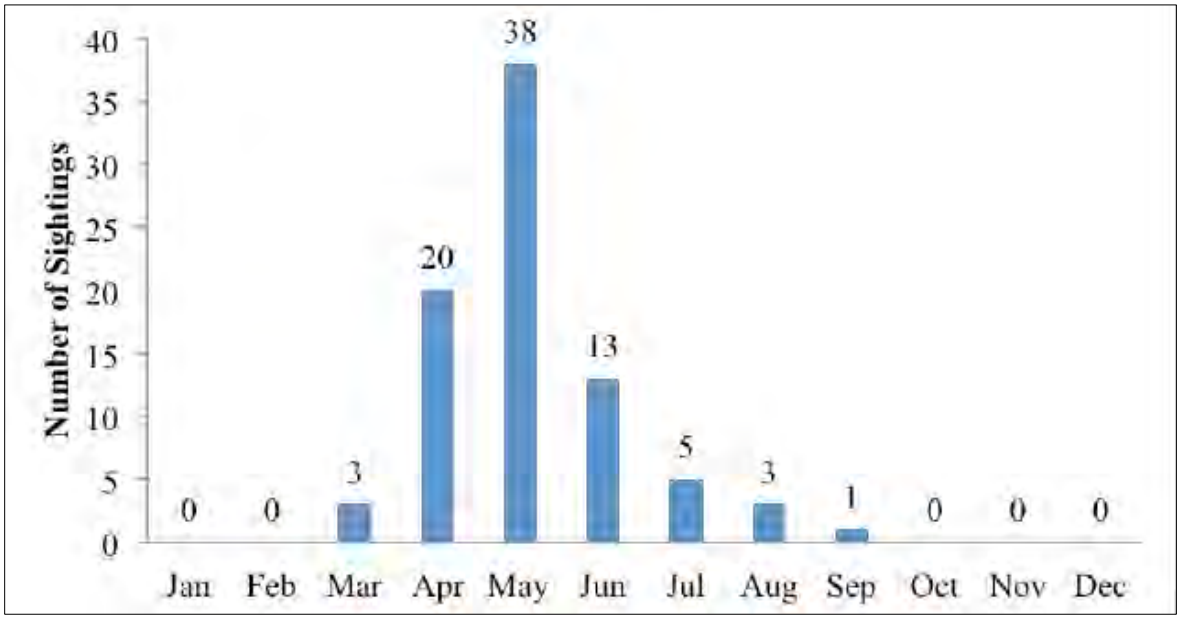

Figure 3.1-9. Visual detections of minke whales by month for all survey years between October 2011 and June 2015. From: Kraus et al. (2016).

RWEC

Minke whales have been sighted offshore Rhode Island in both state and OCS waters in all four seasons (Kenney and Vigness-Raposa, 2010). A large proportion of these sightings were reported from whale watching boats. A dense concentration was seen between Block Island, Rhode Island, and Montauk Point, New York, in the spring and summer (Kenney and Vigness-Raposa, 2010), making it likely that this species could occur within both the RWEC – OCS and RWEC – RI.

Humpback Whale

The humpback whale can be found worldwide in all major oceans from the equator to sub-polar latitudes. In the summer, humpbacks are found in higher latitudes feeding in the Gulf of Maine and Gulf of Alaska. During the winter months, humpbacks migrate to calving grounds in subtropical or tropical waters, such as the Dominican Republic in the Atlantic and Hawaiian Islands in the Pacific (Hayes et al., 2020). Humpback whales from the North Atlantic feeding areas mate and calve in the West Indies (Hayes et al., 2020). In the summer, humpback whales in the Western North Atlantic are typically observed in the Gulf of Maine and along the Scotian Shelf, and there have also been numerous winter sightings in the Southeastern U.S. (NMFS, 2020a). Feeding behavior has also been observed in New England off Long Island, New York, and survey data from NOAA suggests a potential increase in humpback whale abundance off New Jersey and New York (NMFS, 2020a).

Humpback whales are easily identified in field surveys by their long flippers, which can be up to one-third of their total body length, as well as the bumps covering their head and flippers (Jefferson et al., 1993). During migration and breeding seasons, male humpback whales are often recorded producing vocalizations arranged into repetitive sequences termed “songs” that can last for hours or even days. These songs have been well studied in the literature to document changes over time and geographic differences; generally, the bandwidth of these songs range from 20 Hz to over 24 kHz. Most of the energy is focused between 50 and 1,000 Hz and reported SLs range from 151 to 189 dB re 1 µPa m (Erbe et al., 2017). Other calls produced by humpbacks, both male and female, include pulses, moans, and grunts used for foraging and communication. These calls are lower frequency (under 2 kHz) with SLs ranging from 162 to 190 dB re 1 µPa m (Erbe et al., 2017; Thompson et al., 1986). Anatomical modeling based on humpback

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whale ear morphology indicate that their best hearing sensitivity is between 18 Hz and 15 kHz (Southall et al., 2019; Ketten et al., 2014).

NMFS revised the listing status for humpback whales under the ESA in 2016 (81 FR 62259). Globally, there are 14 distinct population segments (DPSs) recognized for humpback whales, four of which are listed as Endangered. The Gulf of Maine stock (formerly known as the Western North Atlantic stock) which occurs in the Project Area is not considered strategic under the MMPA and does not coincide with any ESA-list DPS (NMFS, 2020a). The global population is listed as Least Concern under the IUCN Red List, and are considered endangered by the state of Rhode Island given the previous status under the ESA and the current status of some DPSs (RI DEM, 2020; IUCN, 2021). The best available abundance estimate of the Gulf of Maine stock is 1,393, derived from modeled sighting histories constructed using photo-identification data collected through October 2016 (NMFS, 2020a). Available data indicate that this stock is characterized by a positive population trend, with an estimated increase in abundance of 2.8% per year (NMFS, 2020a). The PBR for this stock is 22, and the estimated annual human-caused mortality and serious injury between 2014 and 2018 was 15.25 whales per year (NMFS, 2020a). While the current annual mortality and serious injury is below the calculated PBR, this estimate only includes detected mortalities and serious injuries. Detected mortality is estimated to only be 20% of all mortality, which could indicate the total mortality in humpbacks has or will exceed PBR, a prediction further supported by the UME declared for this species in 2016 (NMFS, 2020a; NMFS, 2021d). Major threats to humpback whales include vessel strikes, entanglement, and climate-related shifts in prey distribution (NMFS, 2020a). There is no designated critical habitat for this stock in the Project Area.

RWF

Kraus et al. (2016) reported humpback whale sightings in the RI-MA WEA during all seasons, with peak abundance during the spring and early summer, but their presence within the region varies between years. Increased stocks of sand lance (*Ammodytes* spp.) appear to correlate with the years in which most whales were observed, suggesting that humpback whale distribution and occurrences could largely be influenced by prey availability (Kenney and Vigness-Raposa, 2010). The greatest number of sightings of humpbacks in the RI-MA WEA occurred during April (33 sightings); their presence increased starting in March and continued through July. Seasonal abundance estimates of humpback whales in the RI-MA WEA range from 0 to 41 (Kraus et al., 2016), with higher estimates observed during the spring and summer (**Figure 3.1-10**). Acoustic detections within Southern New England analyzed by Davis et al. (2020) found the greatest number of acoustic detections in the winter and spring with a similar increase in detection in March which continues through July (**Figure 3.1-11**). Based on these data, humpback whales are likely to occur in the RWF area, predominantly during winter, spring, and early summer.

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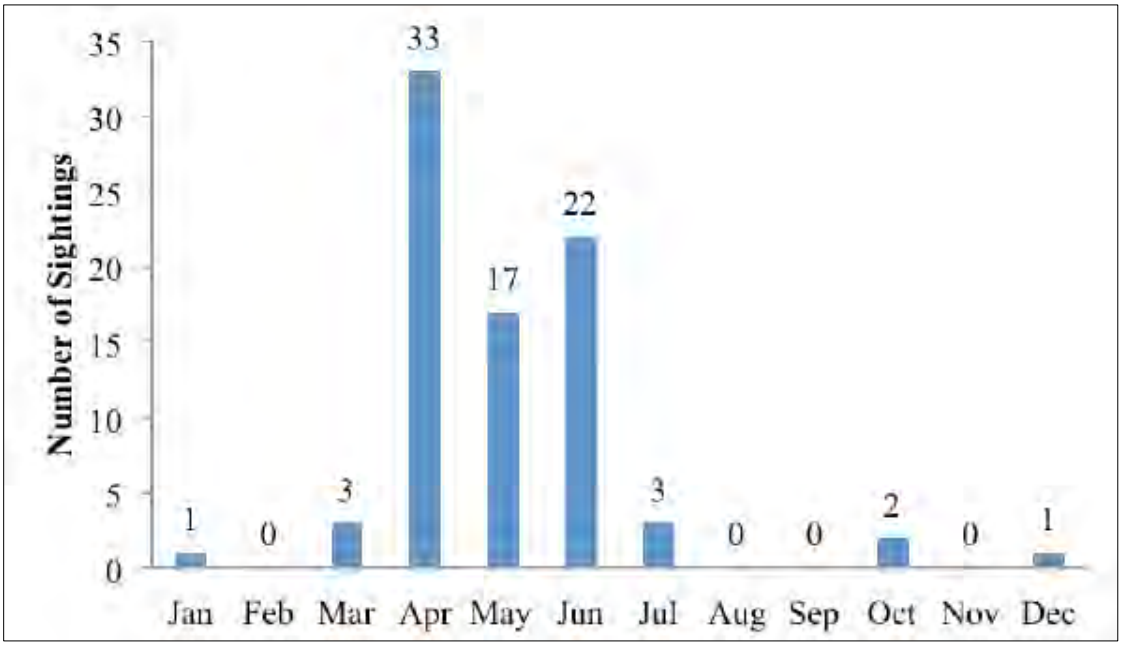

Figure 3.1-10. Visual detections of humpback whales by month for all survey years between October 2011 and June 2015. From: Kraus et al. (2016).

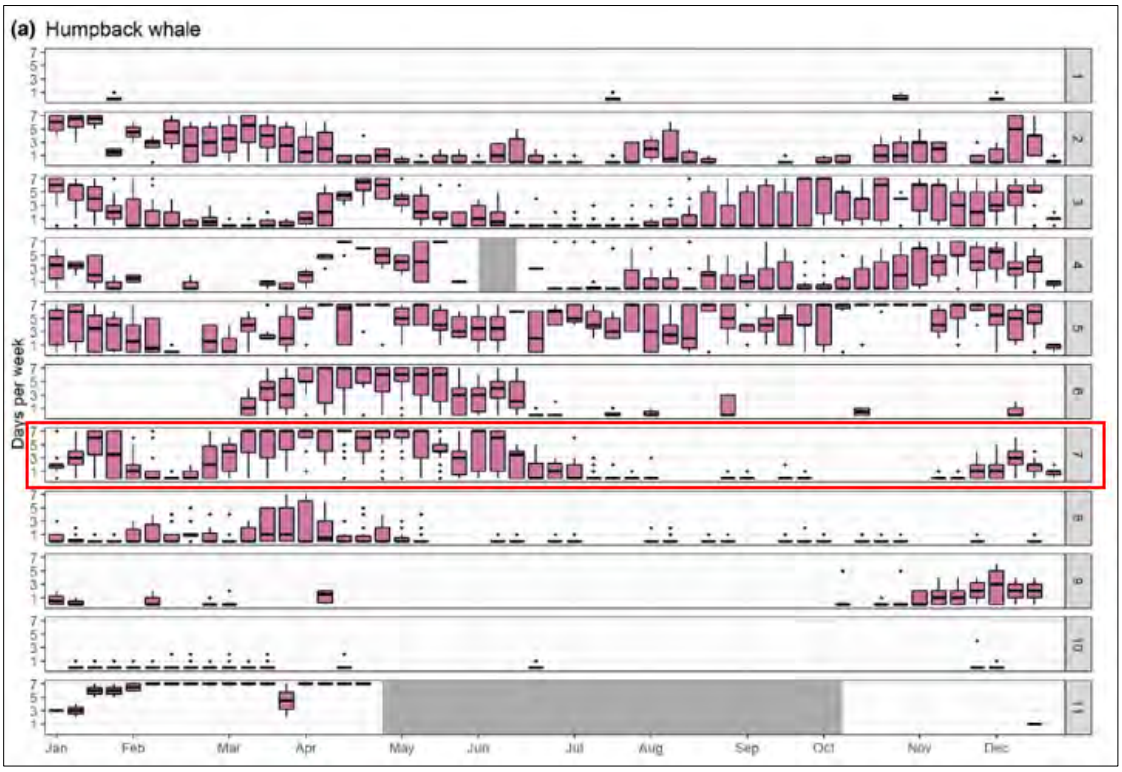

Figure 3.1-11. Acoustic detections of humpback whales from 10 years of passive acoustic data collected along the U.S. East Coast. Region 7 (red box) is Southern New England which contains the Project Area. Gray blocks indicate weeks where no data were collected. Adapted from: Davis et al. (2020).

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RWEC

In the 1980s, numerous sightings of humpbacks were reported between Long Island, New York, and Martha's Vineyard, Massachusetts, by Montauk and Galilee whale watching boats. Montauk boats reported 2 sightings in 1986 and 63 sightings in 1987 (Kenney and Vigness-Raposa, 2010). Recently, multiple humpbacks were reported feeding off Long Island, New York, during July 2016 and near New York City during November and December 2016 (Hayes et al., 2020). Humpback strandings were also reported along the southern shore of eastern Long Island, New York, in February 1992, November 1992, October 1993, August 1997, and April 2004.

Humpbacks are known occur within Rhode Island state and adjacent OCS waters; however, their presence is relatively unpredictable and may be strongly influenced by prey availability (Kenney and Vigness-Raposa, 2010). They are expected to have a greater presence in the RWEC – OCS compared to the RWEC – RI, but have been observed in state waters and are therefore likely to be encountered in the RWEC – RI. During most years, their occurrence within the RWEC - RI would be uncommon; however, they may become locally abundant in certain years.

Long-finned Pilot Whale

There are two species of pilot whale in the Western North Atlantic, long-finned and short-finned (*Globicephala macrorhynchus*). Because it is difficult to differentiate between these two species in the field, sightings are usually reported to genus level only (CETAP, 1982; Hayes et al., 2020). However, short-finned pilot whales are a southern or tropical species and pilot whale sightings above approximately 42° N are most likely long-finned pilot whales. Short-finned pilot whale occurrence in the Project Area is considered rare (CETAP, 1982; Hayes et al., 2020). Long-finned pilot whales are distributed along the continental shelf waters off the Northeastern U.S. in the winter and early spring. By late spring, pilot whales migrate into more northern waters including Georges Bank and the Gulf of Maine and will remain there until fall.

Both short-finned and long-finned pilot whales are similar in coloration and body shape; however, long-finned pilot whales can be distinguished by their long flippers, which are 18 to 27% of the body length with a pointed tip and angled leading edge (Jefferson et al., 1993). Like dolphin species, long-finned pilot whales can produce whistles and burst-pulses used for foraging and communication. Whistles typically range in frequency from 1 to 11 kHz while burst-pulses cover a broader frequency range from 100 Hz to 22 kHz (Erbe et al., 2017). Auditory evoked potential (AEP) measurements conducted by Pacini et al. (2010) indicate that the hearing sensitivity for this species ranges from <4 kHz to 89 kHz.

Long-finned pilot whales are not listed under the ESA and are classified as Least Concern by the IUCN Red List (Hayes et al., 2020; IUCN, 2021). The best available estimate of long-finned pilot whales in the Western North Atlantic is 39,215 based on recent surveys covering waters between Labrador and Central Virginia (Hayes et al., 2020). A trend analysis has not been conducted for this stock due to the relatively imprecise abundance estimates (Hayes et al., 2020). The PBR for this stock is 306, and the annual human-caused mortality and serious injury was estimated to be 21 whales between 2013 and 2017 (Hayes et al., 2020). Long-finned pilot whales have a propensity to mas strand in U.S. waters, although the role of human activity in these strandings remains unknown (Hayes et al., 2020). Threats to this population include entanglement in fishing gear, contaminants, climate-related shifts in prey distribution, and anthropogenic noise (Hayes et al., 2020). There is no designated critical habitat for this stock in the Project Area.

RWF

CETAP surveys reported long-finned pilot whales as the third most commonly sighted small whale in their study area with 12,438 individuals (CETAP, 1982). Long-finned pilot whales have been observed in OCS waters off Rhode Island in all four seasons, with peak occurrences in the spring. There are 43 records of long-finned pilot whales and 226 records of non-specific pilot whales in this area. Nine sightings during the

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summer and three sightings in the spring were reported from whale watching data for pilot whales (Kenney and Vigness-Raposa, 2010).

Within the RI-MA WEA, no sightings of pilot whales were observed during the summer, fall, or winter (Kraus et al., 2016). Long-finned pilot whales are relatively common in the area; therefore, they may potentially occur in the RWF area. However, the likelihood of occurrences would only be in the spring.

RWEC

Long-finned pilot whales prefer deep pelagic temperate to subpolar oceanic waters; therefore, they are not likely to occur within the RWEC – OCS or RWEC – RI (Hayes et al., 2020).

Atlantic Spotted Dolphin

Atlantic spotted dolphins are found in tropical and warm temperate waters. In the Western North Atlantic, their distribution ranges from the Northeastern U.S. to the Gulf of Mexico and the Caribbean to Venezuela (Hayes et al., 2020). They are regularly seen in continental shelf and slope waters. There are two Atlantic spotted dolphin ecotypes which may be distinct sub-species. The larger heavily spotted ecotype inhabits OCS waters inside or near the 200-m isobath south of Cape Hatteras. The smaller form is less spotted and is found further offshore and only occurs in the Atlantic. Recent genetic data also suggests that they may be genetically distinct populations (Hayes et al., 2020). Both ecotypes can occur in the Northeastern U.S.; however, they are difficult to differentiate at sea and are therefore not distinguished in this assessment.

Young Atlantic spotted dolphins start out with no spotting and resemble slender bottlenose dolphins. Large spotting develops as the animals age making it easier to distinguish them in visual surveys (Jefferson et al., 1993). Atlantic spotted dolphins have an estimated auditory bandwidth of 150 Hz to 160 kHz and vocalizations typically range from 100 Hz to 130 kHz (Department of the Navy, 2007; Southall et al., 2007). No auditory sensitivity data are available for this species (Southall et al., 2019).

Atlantic spotted dolphins are not listed under the ESA and are classified as Least Concern by the IUCN Red List (Hayes et al., 2020; IUCN, 2021). The best population estimate available for this species is 39,921 based on surveys conducted in summer 2016 between the lower Bay of Fundy and Florida (Hayes et al., 2020). A population trend analysis of available abundance estimates from 2004, 2011, and 2016 indicate a linear decrease in abundance, however interannual variability in abundance is a key uncertainty in this trend analysis (Hayes et al., 2020). The PBR for this stock is 320, and the estimated annual human-caused mortality and serious injury from 2013 to 2017 was presumed to be zero (Hayes et al., 2020). Twenty-one Atlantic spotted dolphins were reported stranded between North Carolina and Florida during this period; however, no definitive evidence of human interaction was found (Hayes et al., 2020). Major threats to this population include anthropogenic noise; offshore development, particularly south of Cape Hatteras where this species inhabits inshore shelf waters; contaminants; and climate-related shifts in prey distribution (Hayes et al., 2020). There is no designated critical habitat for this stock in the Project Area.

RWF

There are few reported occurrences of general spotted dolphins (*Stenella* spp.) in the Project Area. CETAP described spotted dolphins as the seventh most commonly sighted cetaceans in the study area, with 126 sightings over the course of a 3-year study. The 1982 CETAP data observed 40 individuals south of Block Island, Rhode Island (CETAP, 1982). NMFS shipboard surveys conducted during June to August between central Virginia and the Lower Bay of Fundy reported 542 to 860 individual sightings from two separate visual teams (Palka et al., 2017). Atlantic spotted dolphins tend to be a more subtropical and offshore species, so while they may be encountered in the RWF area, this would be an uncommon occurrence.

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RWEC

Atlantic spotted dolphins north of Cape Hatteras tend to be observed offshore over and beyond the continental slope; therefore, their presence in the RWEC – OCS or RWEC – RI would be uncommon.

Atlantic White-sided Dolphin

Atlantic white-sided dolphins migrate between the temperate and polar waters of the North Atlantic Ocean, but usually maintain migration routes over the deeper-sloped continental shelves. This is the most abundant dolphin in the Gulf of Maine and the Gulf of St. Lawrence; they are rarely seen off the coast of Nova Scotia (Kenney and Vigness-Raposa, 2010). Behaviorally, this species is highly social, but not as demonstrative as some other common dolphins. They typically form pods of around 30 to 150 individuals but have also been seen in very large pods of 500 to 2,000 individuals (Hayes et al., 2020). It is common to find these pods associated with the presence of other white-beaked dolphins, pilot whales, fin whales, and humpback whales.

The Atlantic white-sided dolphin gets its name from the distinctive white stripe on its side, which starts just below the dorsal fin and runs into a yellow/ochre blaze continuing onto the tailstock, which is easily seen when the animal is bow-riding or porpoising. It has a whitish lower jaw, throat, and belly to genital region, with a dark eye patch and face-flipper stripe (Cipriano, 2002; Jefferson et al., 1993). Like most dolphin species, Atlantic white-sided dolphins produce clicks, buzzes, calls, and whistles. Their clicks are broadband sounds ranging from 30 to 40 kHz that can contain frequencies over 100 kHz and are often produced during foraging and for orientation within the water column. Buzzes and calls are not as well studied, and they may be used for socialization as well as foraging. Whistles are primarily for social communication and group cohesion and are characterized by a downsweep followed by an upsweep with an approximate starting frequency of 20 kHz and ending frequency of 17 kHz (Hamran, 2014). No hearing sensitivity data are currently available for this species (Southall et al., 2019).

Atlantic white-sided dolphins are not listed under the ESA or considered a strategic stock under the MMPA and are classified as Least Concern on the IUCN Red List (Hayes et al., 2020; IUCN, 2021). The best abundance estimate currently available for the Western North Atlantic stock is 93,233 based on surveys conducted between Labrador to Florida (Hayes et al., 2020). A trend analysis is not currently available for this stock due to insufficient data (Hayes et al., 2020). The PBR for this stock is 544 and the annual rate of human-caused mortality and serious injury from 2013 to 2017 was estimated to be 26 dolphins. This estimate is based on observed fishery interactions, but Atlantic white-sided dolphins are also threatened by contaminants in their habitat, and climate-related shifts in prey distribution (Hayes et al., 2020). There is no designated critical habitat for this stock in the Project Area.

RWF

Seasonal abundances off the Northeast U.S. in spring through fall are estimated to be 38,000 to 42,000 animals (CETAP, 1982; Kenney and Vigness-Raposa, 2010). Over the course of BOEM's study in the RI-MA WEA, 185 individual Atlantic white-sided dolphins were sighted within the Lease Area; most were observed during summer (112 sightings) followed by fall (70 sightings) (Kraus et al., 2016). Atlantic white-sided dolphins are one of the most likely delphinids that would occur seasonally within the RWF area.

RWEC

Atlantic white-sided dolphins are one of the three odontocetes primarily inhabiting OCS waters shoreward of the 100-m depth contour (CETAP, 1982; Hayes et al., 2020). Most of the sightings (90%) were seen within an estimated depth range of 38 to 271 m. Sightings are concentrated in coastal waters near Cape May, New Jersey, and in shallow waters within the Gulf of Maine (CETAP, 1982). The Gulf of Maine population is commonly seen from the Hudson Canyon to Georges Bank. Sightings south of Georges Bank and Hudson Canyon occur year-round; however, at lower densities (Hayes et al., 2020).

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Offshore Rhode Island, Atlantic white-sided dolphins are common in OCS waters, with a slight tendency to occur in shallower state waters in the spring (Kenney and Vigness-Raposa, 2010). Records indicate that there is an aggregation of sightings southeast of Montauk Point, New York, during the spring and summer. Strandings of white-sided dolphins in Rhode Island are relatively rare; from 2001 to 2005, there was an average of 1.2 strandings per year (Kenney and Vigness-Raposa, 2010). Atlantic white-sided dolphins occur in seasonably high numbers in nearshore areas during the spring and summer; therefore, they could potentially occur within the RWEC – OCS and RWEC – RI.

Common Dolphin

The common dolphin has a wide distribution and can be found in both tropical and temperate areas of the Pacific and Atlantic Oceans in both nearshore and offshore waters (Perrin, 2002). Two common dolphin species were previously recognized: the long-beaked common dolphin (*Delphinus capensis*) and the short-beaked common dolphin (*Delphinus delphis)*; however, Cunha et al. (2015) summarized the relevant data and analyses along with additional molecular data and analysis, and recommended that the long-beaked common dolphin not be further used for the Atlantic Ocean. This taxonomic convention was adopted by the Society or Marine Mammalogy. This highly social and energetic species usually travels in large pods consisting of 50 to >1,000 individuals (Hammond et al., 2008b). The common dolphin can frequently be seen performing acrobatics and interacting with large vessels and other marine mammals.

Common dolphins have a very distinct color pattern that takes the form of an hourglass on its side, and most individuals also have a prominent white patch on the dorsal fin (Jefferson et al., 2008). Common dolphin clicks are broadband sounds between 17 and 45 kHz with peak energy between 23 and 67 kHz. Burst-pulse sounds are typically between 2 and 14 kHz while the key frequencies of common dolphin whistles are between 3 and 24 kHz (Erbe et al., 2017). No hearing sensitivity data are available for this species (Southall et al., 2019).

The common dolphin is not listed under the ESA and is classified as Least Concern by the IUCN Red List (NMFS, 2020a; IUCN, 2021). The current best abundance estimate for the Western North Atlantic stock is 172,947 based on recent surveys conducted between Newfoundland and Florida (NMFS, 2020a). A trend analysis was not conducted for this stock because of the imprecise abundance estimate and long survey intervals (NMFS, 2020a). The common dolphin faces anthropogenic threats because of its utilization of nearshore habitat and highly social nature, but it is not considered a strategic stock under the MMPA because the average annual human-caused mortality and serious injury does not exceed the calculated PBR of 1,452 for this stock (NMFS, 2020a). Historically, this species was hunted in large numbers for food and oil. Currently, they continue to suffer incidental mortality from vessel collisions and Eastern North American fishing activities within the Atlantic, most prominently yellowfin tuna (*Thunnus albacares*) nets, driftnets, and bottom-set gillnets (Kraus et al., 2016; NMFS, 2020a). The annual estimated human-caused mortality and serious injury for 2014 to 2018 was 399, which included fishery-interactions and research takes (NMFS, 2020a). Other threats to this species include contaminants in their habitat and climate-related changes in prey distribution (NMFS, 2020a). There is no designated critical habitat for this stock in the Project Area.

RWF

Kraus et al. (2016) observed 3,896 common dolphins within the RI-MA WEA. Most were observed during summer surveys followed by fall, winter, then spring (**Figure 3.1-12**). This was the highest number of individual sightings of all the small cetaceans; therefore, it is anticipated to be one of the most frequent delphinids to occur seasonally within the RWF area.

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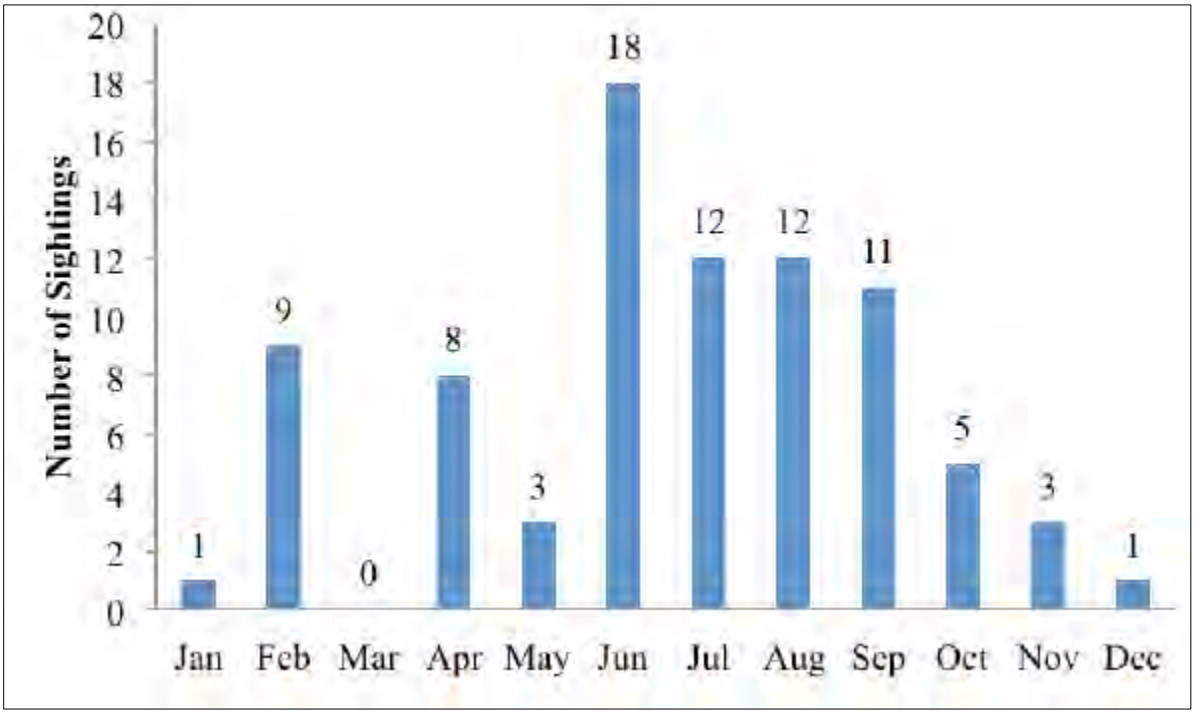

Figure 3.1-12. Visual detections of common dolphin by month for all survey years between October 2011 and June 2015. From: Kraus et al. (2016).

RWEC

Since the common dolphin has a wide distribution and can be found in both nearshore and offshore waters of the Pacific and Atlantic Oceans, they could potentially occur within both the RWEC – OCS and RWEC –-RI (Perrin, 2002).

Risso's Dolphin

Risso's dolphins are found in temperate, subtropical, and tropical waters. In the Western North Atlantic, their range extends from Florida to Eastern Newfoundland. Off the Northeastern U.S. Coast, Risso's dolphins are primarily concentrated along the continental shelf edge, but they can also be found swimming in shallower waters to the mid-shelf (Hayes et al., 2020).

Unlike most other dolphins, Risso's dolphins have blunt heads without distinct beaks. Coloration for this species ranges from dark to light grey. Adult Risso's dolphins are typically covered in white scratches and spots that can be used to identify this species in field surveys (Jefferson et al., 1993). Whistles for this species have frequencies ranging from around 4 kHz to over 22 kHz with estimated SLs between 163 and 210 dB re 1 µPa m (Erbe et al., 2017). Studies using both behavioral and AEP methods have been conducted for this species, which show greatest auditory sensitivity between <4 kHz to >100 kHz (Nachtigall et al., 1995; Nachtigall et al., 2005).

Risso's dolphins are not listed under the ESA and are classified as a species of Least Concern on the IUCN Red List (Hayes et al., 2020; IUCN, 2021). The best abundance estimate in the Western North Atlantic is 35,493 based on surveys conducted from Newfoundland and Florida (Hayes et al., 2020). A trend analysis was not conducted on this species, because there are insufficient data to generate this information. PBR for this stock is 303, and the annual human-caused mortality and injury for 2013 to 2017 was estimated to be 54.3 (Hayes et al., 2020). This stock is not classified as strategic under the MMPA because mortality does not exceed the calculated PBR. Threats to this stock include fishery interactions, non-fishery related

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human interaction, contaminants in their habitat, and climate-related shifts in prey distribution (Hayes et al., 2020). There is no designated critical habitat for this stock in the Project Area.

RWF

Risso's dolphins have been observed in OCS waters offshore Rhode Island year-round, with most sightings during the summer. Sighting data primarily shows that this species is found along the shelf break, with only few species seen in waters shallower than 100 m. Only one sighting in the Rhode Island Ocean Special Area Management Plan study area was reported in the spring (Kenney and Vigness-Raposa, 2010). Kraus et al. (2016) only observed two Risso's dolphins in the RI-MA WEA during the spring. Risso's dolphins do occur in the area; however, because of the infrequent sightings in shallower waters and more concentrated distribution along the continental shelf, the likelihood of encountering Risso's dolphins in the RWF area is relatively low.

RWEC

Risso's dolphins are unlikely to occur within the RWEC – OCS or RWEC – RI due to their primary occurrence in deeper waters along the OCS edge (Hayes et al., 2020).

Common Bottlenose Dolphin

In the Western North Atlantic, there are two morphologically and genetically distinct common bottlenose morphotypes, the Western North Atlantic Northern Migratory Coastal stock and the Western North Atlantic Offshore stock. The offshore stock is primarily distributed along the OCS and slope from Georges Bank to Florida (Hayes et al., 2020), whereas the northern migratory coastal stock is distributed along the coast between southern Long Island, New York and Florida (NMFS, 2020a). Given their distribution, only the offshore stock is likely to occur in the Project Area and is the only stock included in this assessment.

Common bottlenose dolphins are large, relatively robust animals. The snout is stocky and set off from the head by a crease. They are typically light to dark grey in color with a white underside (Jefferson et al., 1993). Whistles produced by bottlenose dolphins can vary over geographic regions, and newborns are thought to develop "signature whistles" within the first few months of their lives that are used for intraspecific communication. Whistles generally range in frequency from 300 Hz to 39 kHz with SLs between 114 and 163 dB re 1 µPa m (Erbe et al., 2017). Bottlenose dolphins also make burst-pulse sounds and echolocation clicks, which can range from a few kHz to over 150 kHz. As these sounds are used for locating and capturing prey, they are directional calls; the recorded frequency and sound level can vary depending on whether the sound was received head-on or at an angle relative to the vocalizing dolphin. SLs for burst-pulses and clicks range between 193 and 228 dB re 1 µPa m (Erbe et al., 2017). There are sufficient available data for bottlenose dolphin hearing sensitivity using both behavioral and AEP methods as well as anatomical modeling studies, which show hearing for the species is greatest between approximately 400 Hz and 169 kHz (Southall et al., 2019).

Common bottlenose dolphins are not listed under the ESA and are classified as Least Concern on the IUCN Red List (Hayes et al., 2020; IUCN, 2021). The best abundance estimate for the Western North Atlantic offshore stock is 62,851 based on recent surveys between the lower Bay of Fundy and Florida (Hayes et al., 2020). A population trend analysis for this stock was conducted using abundance estimates from 2004, 2011, and 2016, which show no statistically significant trend (Hayes et al., 2020). The PBR for this stock is 519, and the average annual human-cause mortality and serious injury from 2013 to 2017 was estimated to be 28, attributed to fishery interactions (Hayes et al., 2020). Because annual mortality does not exceed PBR, this stock is not classified as strategic under the MMPA. In addition to fisheries, threats to common bottlenose dolphins include non-fishery related human interaction; anthropogenic noise; offshore development; contaminants in their habitat; and climate-related changes in prey distribution (Hayes et al., 2020). There is no designated critical habitat for either stock in the Project Area.

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RWF

Common bottlenose dolphins were reported in the RI-MA WEA in all seasons; highest seasonal abundance estimates were during the fall, summer, and spring (**Figure 3.1-13**). Kraus et al. (2016) reports the offshore stock as only be sighted in the RI-MA WEA during the summer months. The greatest concentrations of common bottlenose dolphins were observed in the southernmost portion of the RI-MA WEA study area in the fall (Kraus et al., 2016). Therefore, common bottlenose dolphins are likely to occur in the RWF.

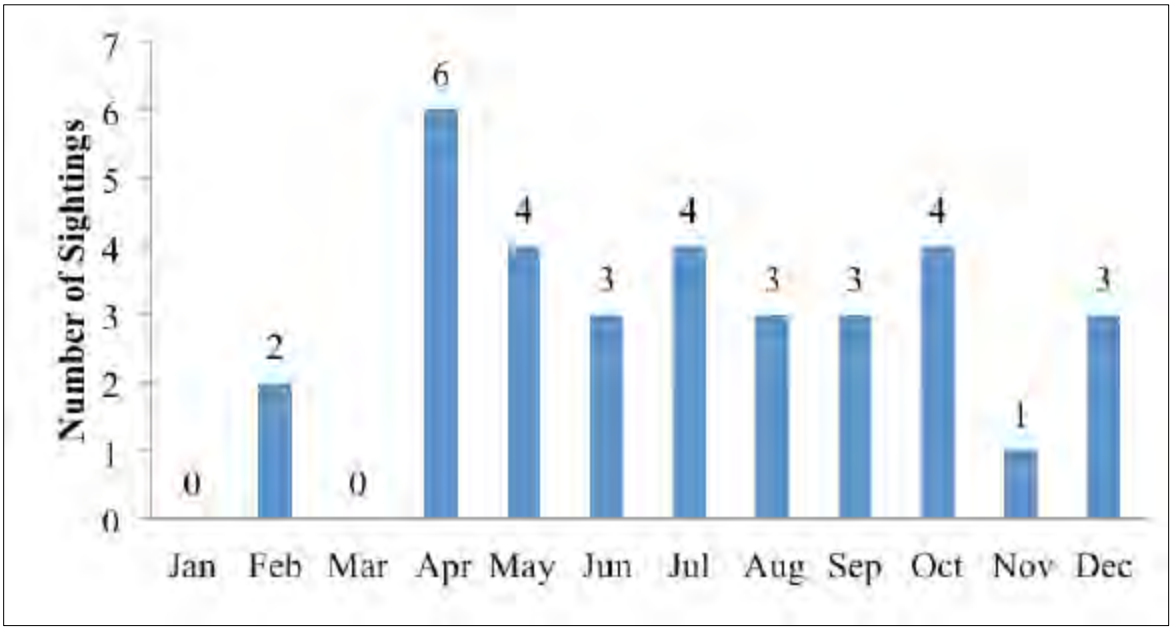

Figure 3.1-13. Visual detections of common bottlenose dolphin by month for all survey years between October 2011 and June 2015. From: Kraus et al. (2016).

RWEC

As previously discussed, common bottlenose dolphins that occur within the nearshore areas of the Project Area are likely to come from the offshore stock, despite its predominantly offshore distribution, as the seasonal stranding records match the temporal patterns of the offshore stock rather than the coastal stock (Kenney and Vigness-Raposa, 2010). Therefore, the offshore stock can be expected to occur in both the RWEC – OCS and RWEC – RI.

Harbor Porpoise

The harbor porpoise is mainly a temperate, inshore species that prefers to inhabit shallow, coastal waters of the North Atlantic, North Pacific, and Black Sea. Harbor porpoises mostly occur in shallow OCS and coastal waters. In the summer, they tend to congregate in the Northern Gulf of Maine, Southern Bay of Fundy, and around the southern tip of Nova Scotia (NMFS, 2020a). In the fall and spring, harbor porpoises are widely distributed from New Jersey to Maine (NMFS, 2020a). In the winter, intermediate densities can be found from New Jersey to North Carolina, with lower densities from New York to New Brunswick, Canada (Kenney and Vigness-Raposa, 2010). In cooler months, harbor porpoises have been observed from the coastline to deeper waters (>1,800 m), although the majority of sightings are over the continental shelf (NMFS, 2020a).

This species is among the smallest of the toothed whales and is the only porpoise species found in Northeastern U.S. waters. A distinguishing physical characteristic is the dark stripe that extends from the flipper to the eye. The rest of its body has common porpoise features; a dark gray back, light gray sides, and small, rounded flippers (Jefferson et al., 1993). Harbor porpoises produce high frequency clicks with a

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peak frequency between 129 and 145 kHz and an estimated SLs that ranges from 166 to 194 dB re 1 µPa m (Villadsgaard et al., 2007). Available data estimating auditory sensitivity for this species suggest that they are most receptive to noise between 300 Hz and 160 kHz (Southall et al., 2019).

This species not listed under the ESA, is listed as Least Concern by the IUCN Red List, and is considered non-strategic under the MMPA (NMFS, 2020a; IUCN, 2021). They are also not considered Endangered or Threatened by the state of Rhode Island, but they are considered a Species of Greatest Conservation Need (RI DEM, 2020). The best available abundance estimate for the Gulf of Maine/Bay of Fundy stock occurring in the Project Area is 95,543 based on combined survey data from NOAA and the Department of Fisheries and Oceans Canada between the Gulf of St. Lawrence/Bay of Fundy/Scotian Shelf and Central Virginia (NMFS, 2020a). A population trend analysis is not available because data are insufficient for this species (NMFS, 2020a). The PBR for this stock is 851, and the estimated human-caused annual mortality and serious injury from 2014 to 2018 was 150 (NMFS, 2020a). This species faces major anthropogenic effects because of its nearshore habitat. Historically, Greenland populations were hunted in large numbers for food and oil. Currently, they continue to suffer incidental mortality from Western North Atlantic fishing activities such as gillnets and bottom trawls (NMFS, 2020a). Harbor porpoises also face threats from contaminants in their habitat, vessel traffic, habitat alteration due to offshore development, and climate-related shifts in prey distribution (NMFS, 2020a). There is no designated critical habitat for this species near the Project Area.

RWF

Over the course of the study, Kraus et al. (2016) observed 121 individual harbor porpoises within the RI-MA WEA. Fall observations included the most individuals, followed by winter, spring, and summer (**Figure 3.1-14**). Vertical camera detections of all small cetaceans showed that the most commonly detected species over time was the harbor porpoise (Kraus et al., 2016). The preferred habitat of the harbor porpoise further increases the likelihood of encountering them seasonally in fall, winter, and spring within the RWF area (BOEM, 2013; NMFS, 2020a).

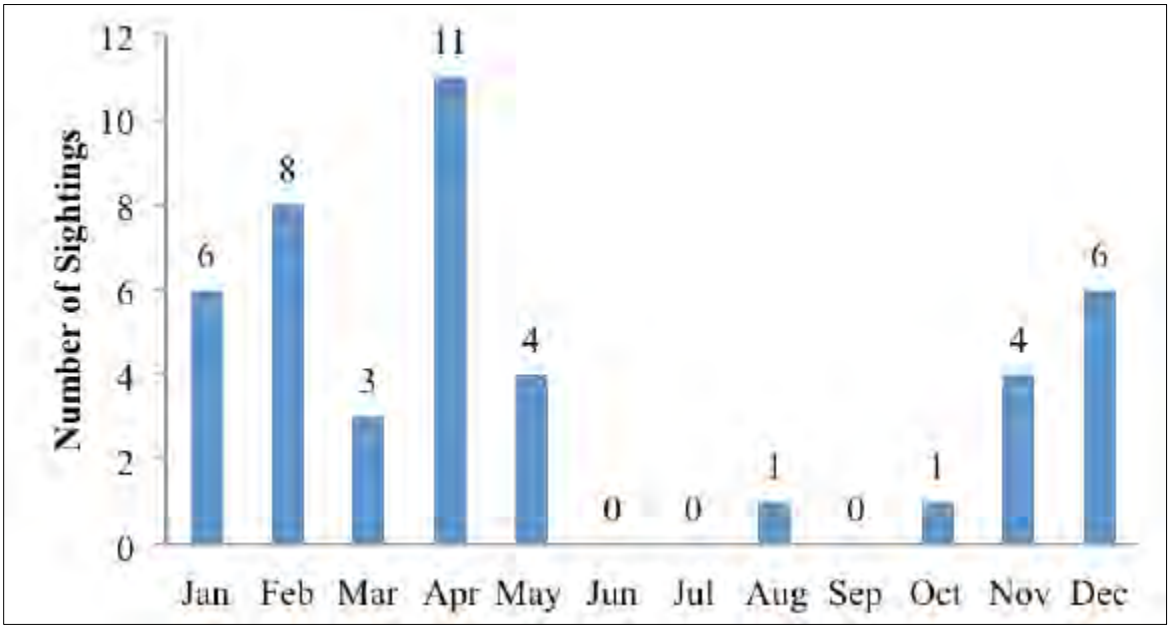

Figure 3.1-14. Visual detections of harbor porpoise by month for all survey years between October 2011 and June 2015. From: Kraus et al. (2016).

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RWEC

Harbor porpoise occurrence offshore Rhode Island is highly seasonal with most sightings occurring in winter and spring and relatively few in summer and fall (Kenney and Vigness-Raposa, 2010). Strandings are reported all along the southern shore of Long Island, New York, and along both sides of Long Island Sound. They are most commonly reported in Eastern Long Island Sound, Gardiner's Bay, and Peconic Bay during the winter, west of the RWEC corridor. They have the greatest abundance in Rhode Island waters during the spring when they are known to migrate from their offshore wintering habitat in the mid-Atlantic to their summer feeding grounds in the Gulf of Maine (Kenney and Vigness-Raposa, 2010). Therefore, harbor porpoises are likely to occur within both the RWEC – OCS and RWEC – RI.

Harbor Seal

Harbor seals, also known as common seals, are one of the most widely distributed seal species in the Northern Hemisphere. They can be found inhabiting coastal and inshore waters from temperate to polar latitudes. Genetic variability from different geographic populations has led to five subspecies being recognized. Harbor seals are found in the Western Atlantic from the Mid-Atlantic U.S. to the Canadian Arctic and east to Greenland and Iceland (Rice, 1998). Peak breeding and pupping times range from February to early September, and breeding occurs in open water (Temte, 1994).

The harbor seal is one of the smaller pinnipeds, and adults are often light to dark grey or brown with a paler belly and dark spots covering the head and body (Jefferson et al., 1993; Kenney and Vigness-Raposa, 2010). Male harbor seals have been documented producing an underwater roar call which is used for competition with other males and attracting mates. These are relatively short calls with a duration of about 2 sec and a peak frequency between 1 and 2 kHz (Van Parijs et al., 2003). Behavioral audiometric studies for this species estimate peak hearing sensitivity between 100 Hz and 79 kHz (Southall et al., 2019).

Harbor seals are not listed under the ESA, are listed as Least Concern by the IUCN Red List, and are considered non-strategic because anthropogenic mortality does not exceed PBR (NMFS, 2020a; IUCN, 2021). Like the harbor porpoise they are also not listed as endangered or threatened by the state of Rhode Island but are listed as a Species of Greatest Conservation Need (RI DEM, 2020). The best available abundance estimate for harbor seals in the Western North Atlantic is 75,834, with global population estimates reaching 610,000 to 640,000 (Bjørge et al., 2010; Lowry, 2016; NMFS, 2020a). There is no population trend analysis currently available, however one is underway using 2018 survey data (NMFS, 2020a). The PBR for this population is 2,006, and the annual human-caused mortality and serious injury from 2014 to 2018 was estimated to be 365.2 seals per year. This mortality and serious injury was attributed to fishery interactions, non-fishery related human interactions, and research activities (NMFS, 2020a). Until 1972, harbor seals were commercially and recreationally hunted. Currently, only Alaska natives can hunt harbor seals for sustenance and the creation of authentic handicrafts. Other threats to harbor seals include disease and predation (NMFS, 2020a). There is no designated critical habitat for this species in the Project Area.

RWF

Harbor seals can be found along the coast of Rhode Island and the RI-MA WEA, as well as in surrounding waters. Several haul-out sites are located on Block Island, Rhode Island, which is close to the western end of the RWF area (BOEM, 2013). Survey data collected from NMFS and the Provincetown Center for Coastal Research reported 151 harbor seal sightings, a large concentration of which were observed near the coast from eastern Long Island, New York, to Buzzards Bay and Vineyard Sound. There were occurrences of harbor seal offshore; however, the level of abundance was lower than what was observed near haul-out sites (Kenney and Vigness-Raposa, 2010). Therefore, harbor seals could be potentially encountered in the RWF area.

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RWEC

Harbor seals are regularly observed in coastal areas; however, there are few records from shipboard and aerial surveys. Harbor seals are difficult to detect as the only sighting cue available would be seeing the seal's head above the water. CETAP excluded seals from their data collection efforts specifically for this reason (CETAP, 1982). Most available records are of strandings and haul-out counts. Harbor seals are known to inhabit Southern New England waters year-round, although the population steadily increases in April and then abruptly declines in May.

Harbor seals are regularly observed around coastal areas throughout Rhode Island. While there are no known pupping grounds in this area, six haul-out sites have been identified in Narragansett Bay. They are most commonly observed at the Dumplings off Jamestown at Rome Point in North Kingstown, Rhode Island (Kenney and Vigness-Raposa, 2010). Nearly all the haul-outs within Narragansett Bay are rocky ledges or isolated rocks with the exception of Spar Island, which is a man-made dredge spoil (Kenney and Vigness-Raposa, 2010). Harbor seals can likely be found in the nearshore areas around the proposed RWEC corridor. Harbor seals are likely to be one of the most frequent and densely occurring marine mammal that could occur annually within both the RWEC – OCS and RWEC – RI.

Grey Seal

Gray seals inhabit temperate to sub-Arctic waters of the North Atlantic, in both nearshore and deeper OCS waters (Hall, 2002). Three different geographic populations occur; Western North Atlantic, Eastern North Atlantic, and Baltic populations (Kenney and Vigness-Raposa, 2010). Peak breeding and pupping times are January to late March, and breeding occurs in open water (Baker et al., 1995).

Gray seals are among the larger phocids found in the Western North Atlantic (Jefferson et al., 1993). Two types of underwater vocalizations have been recorded for male and female gray seals; clicks and hums. Clicks are produced in a rapid series resulting in a buzzing noise with a frequency range between 500 Hz and 12 kHz. Hums, which is described as being similar to that of a dog crying in its sleep, are lower frequency calls, with most of the energy <1 kHz (Schusterman et al., 1970). AEP studies indicate that hearing sensitivity for this species is greatest between 140 Hz and 100 kHz (Southall et al., 2019).

This species is not listed under the ESA, is listed Least Concern by the IUCN Red List, and is non-strategic because anthropogenic mortality does not exceed PBR (NMFS, 2020a; IUCN, 2021). Estimates of the entire Western North Atlantic gray seal population are not available, only estimated portions of the stock are available, although recent genetic evidence suggests that all Western North Atlantic gray seals may actually comprise a single stock (NMFS, 2020a). The best available current abundance estimate for gray seals of the Canadian gray seal stock is 424,300 and the current U.S. population estimate is 27,131 (NMFS, 2020a). The population of gray seals is likely increasing in the U.S. Atlantic EEZ; recent data show approximately 28,000 to 40,000 gray seals were observed in Southeastern Massachusetts in 2015 (NMFS, 2020a). The population trend for grey seals in the U.S. differs across all the pupping colonies, ranging from -0.2% on Green Island to 26.3% on Monomoy Island from 1988 to 2019 (NMFS, 2020a). In Canada, the total population was estimated to be increasing by 4.4% per year from 1960 to 2016. The PBR for this population is 1,389, and the annual human-caused mortality and serious injury between 2014 and 2018 was estimated to be 4,729 in both the U.S. and Canada (NMFS, 2020a). Like harbor seals, the gray seal was commercially and recreationally hunted until 1972. Mortality was attributed to fishery interactions, non-fishery related human interactions and hunting, research activities, Canadian commercial harvest, and removals of nuisance animals in Canada (NMFS, 2020a). Other threats to this population include predation, natural phenomena like storms, and disease prompting NMFS to declare a UME for pinnipeds due to phocine distemper virus in 2018 (NMFS, 2020a,b). There is no designated critical habitat for this species in the Project Area.

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RWF

Overall, individuals within the RWF are relatively low; occasionally young pups have been found stranded off Long Island, New York, and Rhode Island beaches. The AMAPPS surveys identified 11 individuals during their winter aerial surveys (Palka et al., 2017). Two breeding and pupping grounds are located in Nantucket Sound at Monomoy and Muskeget Island. Gray seals live there year-round and exhibit minimal migration patterns; however, recent tagging studies observed increased movement between the U.S. and Canada. The overall time spent in U.S. waters remains uncertain, but the updated U.S. population estimates make it possible that these seals will be seen around the RWF area (NMFS, 2020a).

RWEC

Historically, gray seals were relatively absent from Rhode Island and nearby OCS waters. However, with the recent recovery of the Massachusetts and Canadian populations, their occurrence has increased in Southern New England and the Mid-Atlantic U.S. (Kenney and Vigness-Raposa, 2010). Records of gray seal strandings are primarily observed in the spring and are distributed broadly along ocean-facing beaches in Long Island, New York, and Rhode Island. In New York, gray seals are typically seen alongside harbor seal haul-outs. Two frequent sighting locations include Great Gull Island and Fisher's Island, New York (Kenney and Vigness-Raposa, 2010). Even though sightings are not as frequent as harbor seals, gray seals do occur in Rhode Island waters; therefore, these seals may be present in both the RWEC – OCS and RWEC – RI.

3.2 Sea Turtles

Four sea turtle species could potentially be present in the Project Area: green sea turtles (*Chelonia mydas*), Kemp's Ridley sea turtles (*Lepidochelys kempii*), loggerhead sea turtles, and leatherback sea turtles (*Dermochelys coriacea*). Regional Kemp's ridley and leatherback sea turtle populations are listed as Endangered under the ESA, while the green and loggerhead populations are listed as Threatened (**Table 3.2-1**). Densities for sea turtles are available from the U.S. Navy OPAREA Density Estimate database on the Strategic Environmental Research and Development Program Spatial Decision Support System (Department of the Navy, 2007, 2012) and Northeast Large Pelagic Survey Collaborative Aerial and Acoustic Surveys for Large Whales and Sea Turtles (Kraus et al., 2016) for Kemp's Ridley, loggerhead, and leatherback sea turtles for spring, summer, fall, and winter.

Table 3.2-1. Sea turtles with geographic ranges that include the Northeastern U.S. region, and the relative occurrence in the Project Area.

Common Name	Scientific Name	Stock	Current Population Status	Relative Occurrence in the RWF	Relative Occurrence in the RWEC – OCS	Relative Occurrence in the RWEC – RI
Green sea turtle	*Chelonia mydas*	North Atlantic DPS	ESA Threatened RI State Endangered	Uncommon	Uncommon	Uncommon
Kemp's Ridley sea turtle	*Lepidochelys kempii*	-	ESA Endangered RI State Endangered	Uncommon	Regular	Regular
Loggerhead sea turtle	*Caretta*	Northwest Atlantic Ocean DPS	ESA Threatened RI State Endangered	Common	Common	Common
Leatherback sea turtle	*Dermochelys coriacea*	-	ESA Endangered RI State Endangered	Common	Common	Common

DPS = Distinct Population Segment; ESA = Endangered Species Act; Project Area = includes the Revolution Wind Farm (RWF), Revolution Wind Export Cable (RWEC) – Outer Continental Shelf (OCS) and RWEC – Rhode Island (RI) state waters, and Onshore Facilities.
[1]Information based on available survey data for the region and the Wind Energy Area where Project will be located.

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Sea turtle life history stages are similar in all species and include eggs, hatchling, juvenile, and adult stages. In general, sea turtles nest in tropical, subtropical, and warm-temperate beaches (Davenport, 1997). In the U.S., common nesting colonies are located in the Gulf of Mexico and Western South Atlantic Ocean; however, specific nesting distributions are described in the species-specific discussions that follow. Females mate in nearshore waters and then lay their eggs on the beach. Hatchling sea turtles move offshore in a swimming frenzy immediately after hatching (Davenport, 1997). At the surface-pelagic juvenile stage, sea turtles move to convergence zones or to *Sargassum* spp. mats and undergo passive oceanic migrations (Witherington et al., 2012). Juvenile sea turtles actively recruit to nearshore nursery habitats and move into adult foraging habitats when approaching sexual maturity. At maturity, sea turtles return to their natal beaches to lay their eggs (Davenport, 1997).

The following subsections summarize data on the status and trends, distribution and habitat preferences, behavior, and life history of sea turtles that may be found in the Project Area as available in published literature and reports, including USFWS species fact sheets.

3.2.1 Green Sea Turtle

Green sea turtles have a worldwide distribution and can be found in both tropical and subtropical waters (NatureServe, 2019; NMFS and USFWS, 1991). In the Western North Atlantic Ocean, they can be found from Massachusetts to Texas, as well as in waters off Puerto Rico and the U.S. Virgin Islands (NMFS and USFWS, 1991). Depending on the life stage, green sea turtles inhabit high-energy oceanic beaches, convergence zones in pelagic habitats, and benthic feeding grounds in shallow protected waters (NMFS and USFWS, 1991). Green sea turtles are known to make long-distance migrations between their nesting and feeding grounds. Hatchlings occupy pelagic habitats and are omnivorous. Juvenile foraging habitats include coral reefs, emergent rocky bottoms, *Sargassum* spp. mats, lagoons, and bays (USFWS, 2018a). Once mature, green sea turtles leave pelagic habitats and enter benthic foraging grounds, primarily feeding on seagrasses and algae (Bjorndal, 1997).

Major green sea turtle nesting beaches occur on Ascension Island, Aves Island, Costa Rica, and Suriname. In the U.S., green sea turtles nests in North Carolina, South Carolina, Georgia, Florida, the U.S. Virgin Islands, and Puerto Rico (USFWS, 2018a). Nesting seasons vary by region. On average, individual females nest every 2 to 4 years, laying an average of 3.3 nests per season at approximately 13-day intervals. The average clutch size is approximately 136 eggs and incubation ranges from 45 to 75 days (USFWS, 2018a).

Bartol and Ketten (2006) measured the AEPs of two Atlantic green sea turtles and six sub-adult Pacific green sea turtles. Sub-adults were found to respond to stimuli between 100 and 500 Hz, with a maximum sensitivity of 200 and 400 Hz. Juveniles responded to stimuli between 100 and 800 Hz, with a maximum sensitivity between 600 and 700 Hz. Piniak et al. (2016) confirmed similar levels, as juvenile green sea turtles responded to underwater stimuli between 50 and 1,600 Hz with maximum sensitivity between 200 and 400 Hz. Dow Piniak et al. (2012a) found that the AEPs of juvenile green sea turtles were between 50 and 1,600 Hz in water and 50 and 800 Hz in air; with ranges of maximum sensitivity between 50 and 400 Hz in water and 300 and 400 Hz in air.

There are 11 listed DPSs for green sea turtles, all of which are listed as Threatened or Endangered. The North Atlantic DPS, which is likely to occur in the Project Area, was listed as Threatened in 1978 (NMFS, 2020c). The global population is listed as Endangered under the IUCN Red List (IUCN, 2021). They are also listed as endangered by the state of Rhode Island (RI DEM, 2020). Worldwide, green sea turtle populations have declined due to past harvesting for eggs and meat (USFWS, 2018a). Currently, major risks to green sea turtles include loss of nesting and foraging habitat, nest predation, marine pollution, vessel strikes, and anthropogenic activity such as offshore dredging or fishing (USFWS, 2018a). Critical habitat was designated by NMFS for the green sea turtles in 1998 in the coastal waters of Culebra Island, Puerto Rico, and its outlying Keys (USFWS, 2018a). There is no designated critical habitat for green sea turtles in the Project Area.

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RWF

There are few records of green sea turtle sightings in the RWF area. Only one confirmed sighting was reported in March 2005 south of Long Island, New York, between the 40- and 50-m isobaths (Kenney and Vigness-Raposa, 2010). NOAA's Northeast Fisheries Science Center conducted a combination of AMAPPS along the Northeast U.S. Coast from 2010 through 2015 (Palka et al., 2017). Survey waters spanned from Cape May, New Jersey, to the mouth of the Gulf of St. Lawrence, Canada. Out of five surveys that were conducted, green sea turtles were spotted only during 2010 and 2011. Six individuals were sighted south of Long Island, New York, and within the Nantucket Shoals during summer aerial surveys (17 August through 26 September 2010). Five green sea turtles were also sighted off the southern coast of Long Island, New York, during the summer aerial surveys (7 August through 26 August 2011) (Palka et al., 2017).

Digital aerial surveys conducted by the New York State Energy Research and Development Authority (NYSERDA) to gather baseline data on birds, marine mammals, turtles, and fish reported only one green sea turtle during summer 2016 surveys, and no confirmed green sea turtle sightings have been reported during 2017 or 2018 surveys (Normandeau and APEM, 2019). Based on the available sighting information of green sea turtles in this region, their occurrence would be infrequent in the RWF.

RWEC

In Southern New England, green sea turtles are known to occur in the waters around Cape Cod Bay and Block Island and Long Island Sounds (CETAP, 1982). In 2005, there was one confirmed green sea turtle sighting southwest of the RWEC corridor offshore Long Island, New York (Kenney and Vigness-Raposa, 2010). Stranding data from NMFS Sea Turtle Stranding and Salvage Network indicate that only two green sea turtles have been found stranded on Rhode Island between 2000 and 2018 (NMFS, 2019a). This species is considered uncommon in both the RWEC – OCS and RWEC – RI, and if they were to occur, it would primarily be during summer months as water temperature is a limiting factor in their distribution (BOEM, 2013).

3.2.2 Kemp's Ridley Sea Turtle

Kemp's ridley sea turtles occur off the coast of the Gulf of Mexico and along the U.S. Atlantic Coast (Turtle Expert Working Group [TEWG], 2000). Juveniles inhabit the U.S. Atlantic Coast from Florida to the Canadian Maritime Provinces. In late fall, Atlantic juveniles/sub adults travel northward to forage in the coastal waters off Georgia through New England, then return southward for the winter (New York State Department of Environmental Conservation [NYSDEC], 2019; Stacy et al., 2013). Preferred habitats include sheltered areas along the coastline, including estuaries, lagoons, and bays (NMFS, 2020d). Sixty percent of Kemp's ridley nesting occurs on beaches near Rancho Nuevo, Tamaulipas, Mexico. The nesting season spans from April through July (NMFS and USFWS, 2007). On average, individual females nest every 1 to 2 years, with an average of 1 to 3 clutches every season and an average clutch size of 110 eggs per nest (NMFS and USFWS, 2007).

Data are limited on Kemp's ridley hearing capability; however, available studies show that all sea turtle species can likely detect lower frequency noises below approximately 1 to 2 kHz. Generally, sea turtle hearing is thought to more closely resemble that of fish rather than marine mammals given their inner ear morphology and the lower frequency ranges over which sea turtle hearing has been reported (Bartol and Ketten, 2006; Dow Piniak et al., 2012a; Martin et al., 2012; Popper et al., 2014).

The Kemp's ridley sea turtle was listed as Endangered under the ESA throughout its range in 1970, and is currently listed as Critically Endangered under the IUCN Red List (IUCN, 2021; NMFS, 2020d). They are also listed as endangered by the state of Rhode Island (RI DEM, 2020). The decline in global kemp's ridley populations is the result of human activity, such as harvesting adults and eggs for food and as fisheries bycatch (USFWS, 2018b). There is no designated critical habitat for this species in the Project Area (NMFS, 2020d).

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RWF

Kemp's ridley sea turtles are more common in the New York Bight region and along the Long Island, New York, coastline; there are few visual sighting data for Kemp's ridley sea turtles in the RWF (Normandeau and APEM, 2019). This could be partly be due to Kemp's ridley sea turtles' small size, which makes them difficult to detect during aerial surveys. AMAPPS surveys documented five Kemp's ridley sea turtles during aerial surveys conducted from August through September, 2010, in waters from Cape May, New Jersey, to the Gulf of St. Lawrence, Canada. No confirmed sightings were reported from 2011 through 2014 (Palka et al., 2017). Kraus et al. (2016) detected Kemp's ridley sea turtles in the RI-MA WEA using vertical camera photographs. However, only four photographic detections were confirmed in 2012 (Kraus et al., 2016). Kenney and Vigness-Raposa (2010) reported 14 observations of Kemp's ridley offshore Rhode Island around Block Island in the summer and fall. Given the available data for Kemp's ridley turtle presence in the RI-MA WEA, it is not likely that they would be encountered in the RWF area.

RWEC

Kemp's ridley sea turtles that occur in Southern New England can be seen in Long Island Sound, along the Rhode Island coastline, and in Cape Cod Bay (CETAP, 1982; Waring et al., 2012). Beginning in July, Kemp's ridley turtles begin inhabiting the Long Island Sound area. To date, all Kemp's Ridley turtles encountered in Long Island Sound have been juveniles. Between July and early October, juveniles occupy estuarine waters of the Long Island Sound, Peconic Bay, and other bays along the south shore of Long Island, New York. During this time, growth rates increase by approximately 25% per month, indicating that these waters provide an abundant food source for these turtles. The Long Island Sound has not been formally identified as critical habitat; however, research has inferred that this area could potentially provide a critical coastal developmental habitat for immature Kemp's ridley sea turtles during the early turtle life stages (2 to 5 years) (Morreale et al., 1992; NYSDEC, 2019). The main characteristics of developmental habitats are coastal areas sheltered from high winds and waves such as embayments, estuaries, and nearshore temperate waters shallower than 50 m (NMFS, 2020d).

In October, Kemp's ridley sea turtles begin to migrate out of the estuaries and back into pelagic environments. If they do not migrate out by late November, they are likely to become cold-stunned. There are many records of cold-stunned Kemp's ridley sea turtles washing ashore on Long Island, New York (Burke et al., 1993). Cold-stunned Kemp's ridley sea turtles are often found stranded on beaches of Rhode Island and Massachusetts beginning in autumn when water temperatures drop below 50°F (Stacy et al., 2013). However, strandings are more common in Massachusetts; 929 reported Kemp's ridleys between 2000 and 2018 along Massachusetts coasts versus only 8 reported for Rhode Island (NMFS, 2019a). Therefore, Kemp's ridley sea turtles may be present in low numbers in the RWEC - OCS and RWEC – RI in the spring and summer.

3.2.3 Loggerhead Sea Turtle

Loggerhead sea turtles have a worldwide distribution and inhabit temperate and tropical waters, including estuaries and continental shelves of both hemispheres. Five populations of loggerhead sea turtles exist worldwide in the Atlantic Ocean, Pacific Ocean, Indian Ocean, Caribbean Sea, and Mediterranean Sea. In the Western Atlantic Ocean, the five major nesting aggregations are: (1) a northern nesting aggregation from North Carolina to northeast Florida, approximately 20° N latitude; (2) a south Florida nesting aggregation from 29° N latitude on the east coast to Sarasota on the west coast; (3) a Florida Panhandle nesting aggregation at Eglin Air Force Base and the beaches near Panama City, Florida; (4) a Yucatán nesting aggregation on the eastern Yucatán Peninsula, Mexico; and (5) a Dry Tortugas nesting aggregation on the islands of the Dry Tortugas, near Key West, Florida (TEWG, 2000).

Female loggerhead sea turtles mate from late April through early September. Individual females might nest several times within one season and usually nest at intervals of every 2 to 3 years. For their first 7 to 12 years, loggerhead sea turtles inhabit pelagic waters near the North Atlantic Gyre and are called pelagic immatures. When loggerhead sea turtles reach 40 to 60 cm straight-line carapace length, they begin

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recruiting to coastal inshore and nearshore waters of the continental shelf through the U.S. Atlantic and Gulf of Mexico and are referred to as benthic immatures. Benthic immature loggerheads have been found in waters from Cape Cod, Massachusetts, to southern Texas. Loggerhead sea turtles forage off the Northeastern U.S. and migrate south in the fall as temperatures drop. Most recent estimates indicate that the benthic immature stage ranges from ages 14 to 32 years and they mature at around ages 20 to 38 years. Prey species for omnivorous juveniles include crab, mollusks, jellyfish, and vegetation at or near the surface. Coastal subadults and adults feed on benthic invertebrates, including mollusks and decapod crustaceans (TEWG, 2000).

Based on Bartol et al. (1999), juvenile loggerhead sea turtles respond to click stimuli from tone bursts of 250 to 750 Hz. Martin et al. (2012) recorded the AEPs of one adult loggerhead sea turtle, which responded to frequencies between 100 and 1,131 Hz, with greatest sensitivity between 200 and 400 Hz.

There are nine listed DPSs for loggerhead sea turtles; the Northwest Atlantic Ocean DPS, which occurs in the Project Area, was listed as Threatened in 2011 (NMFS, 2020e). The global population is listed as Vulnerable by the IUCN Red List (IUCN, 2021). They are also listed as endangered by the state of Rhode Island (RI DEM, 2020). Major threats to this population include loss of nesting and foraging habitat, nest predation, marine pollution, vessel strikes, disease, and fisheries bycatch (USFWS, 2018c). In 2014, NMFS designated critical habitat for the Northwest Atlantic Ocean DPS in multiple locations along the U.S. East Coast and in the Gulf of Mexico. These areas include *Sargassum* spp. habitat, nearshore reproductive habitat, overwintering areas, breeding habitat, and migratory corridors located between North Carolina and Florida in the Atlantic Ocean (79 *FR* 39855). No designated critical habitat exists in the Project Area.

RWF

Loggerhead sea turtles are frequently seen in waters off the coast of Rhode Island, Massachusetts, and New York. AMAPPS surveys reported loggerhead sea turtles as the most commonly sighted sea turtles on OCS waters from New Jersey to Nova Scotia, Canada. During the December 2014 to March 2015 aerial abundance surveys, 280 individuals were recorded (Palka et al., 2017). Kraus et al. (2016) reported that loggerhead occurrence in the RI-MA WEA was highest during August and September (**Figure 3.2-1**). Across all four survey years, there were 27 sightings in August and 45 sightings in September within the RI-MA WEA. During the NYSERDA Digital Aerial Baseline Surveys, sightings were dispersed across the continental shelf offshore Long Island past Montauk, New York, and there were 649 loggerhead detections during summer 2017 surveys. Fewer individuals were observed during fall surveys, and no turtles were detected during winter surveys (Normandeau and APEM, 2019).

Because of their documented occurrence, it is likely that loggerhead sea turtles could occur within the RWF area during the summer and fall. However, it is unlikely there would be a high concentration of turtles within the RWF, because most of these observations were reported as single sightings widely distributed throughout the RI-MA WEA (Kraus et al., 2016; Palka et al., 2017).

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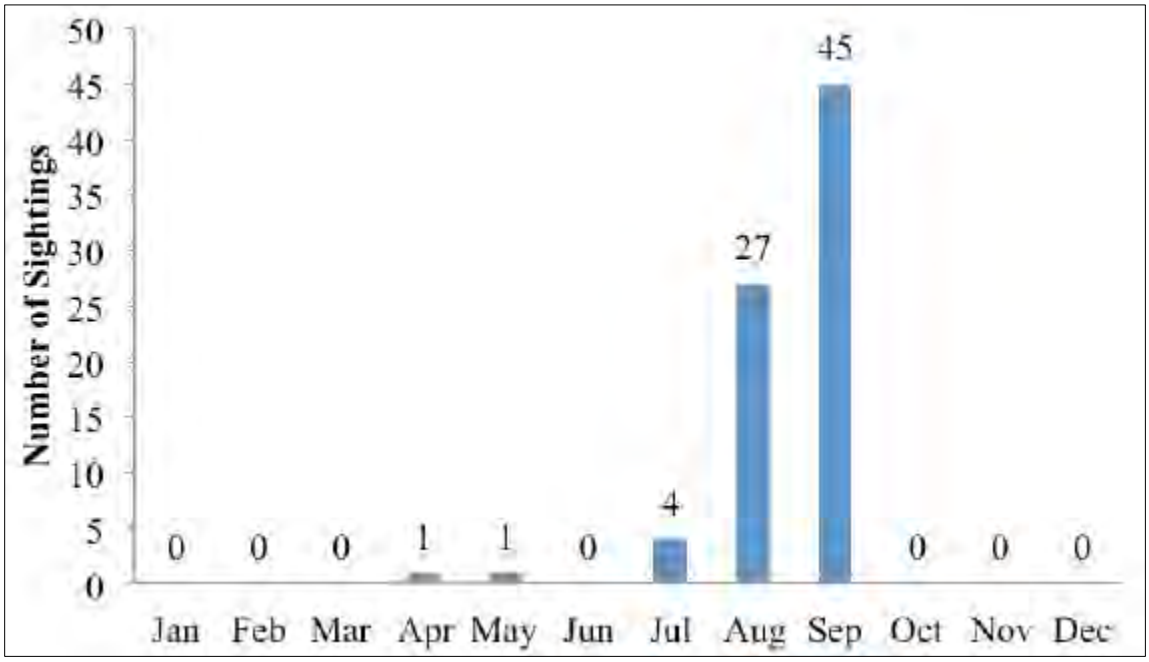

Figure 3.2-1. Visual detections of loggerhead sea turtle by month for all survey years between October 2011 and June 2015. From: Kraus et al. (2016).

RWEC

Loggerhead sea turtles are commonly seen off the coasts of New York and Rhode Island. CETAP conducted extensive aerial surveys from 1978 through 1982 along the coast from Cape Hatteras, North Carolina to Long Island, New York. Many loggerhead sea turtles were sighted along the continental shelf waters between Cape Hatteras, North Carolina, and Long Island, New York. A high density of loggerhead sea turtles was seen near the shore of central Long Island, New York. Loggerhead sea turtles show a northern limit at approximately 41° N latitude (CETAP, 1982), and few sightings were reported past that northern limit (Shoop and Kenney, 1992). Loggerheads are most commonly seen in June, they then begin to decrease until October as they migrate to warmer waters (Shoop and Kenney, 1992). Turtles that fall behind may succumb to cold-stunning, which usually occurs during the fall when water temperatures begin to fall. Between 1986 and 1988, 28 cold-stunned turtles were stranded in eastern Long Island, New York (Kenney and Vigness-Raposa, 2010), and recent stranding data from NMFS reported 68 loggerhead strandings in Rhode Island between 2000 and 2018 (NMFS, 2019a). Loggerhead sea turtle occurrence within both the RWEC – OCS and RWEC – RI is therefore expected to be relatively common.

3.2.4 Leatherback Sea Turtle

The leatherback sea turtle is primarily a pelagic species and is distributed in temperate and tropical waters worldwide. The leatherback is the largest, deepest diving, most migratory, widest ranging, and most pelagic of the sea turtles (NMFS, 2020f). In 2017, NMFS received a petition to identify the Northwest Atlantic subpopulation as a DPS and list it as Threatened under the ESA. In response to this petition, NMFS initiated a status review for the leatherback sea turtle to review the new information available since the original listing (82 FR 57565). This change has not yet been adopted so the global population listing remains as-is for this species. Adult leatherback sea turtles forage in temperate and subpolar regions in all oceans. Jellyfish are the major component of the leatherback diet; they are also known to feed on sea urchins, squid, crustaceans, tunicates, fish, blue-green algae, and floating seaweed (USFWS, 2018d; NMFS, 2020f).

Historically, the most important nesting ground for the leatherback was the Pacific coast of Mexico. However, because of exponential declines in leatherback nesting, French Guiana in the Western Atlantic

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now has the largest nesting population. Other important nesting sites for the leatherback include Papua New Guinea, Papua-Indonesia, and the Solomon Islands in the Western Pacific. In the U.S., nesting sites include the Florida east coast; Sandy Point, U.S. Virgin Islands; and Puerto Rico. U.S. nesting occurs from March through July. On average, individual females nest every 2 to 3 years, laying an average of 5 to 7 nests per season with an average clutch size of 70 to 80 eggs. Critical habitat has been designated for the leatherback sea turtle in the U.S. Virgin Islands at Sandy Point Beach, St. Croix, and the water adjacent to Sandy Point Beach (44 *FR* 17710).

Dow Piniak et al. (2012b) found that hatchling leatherback sea turtles responded to stimuli between 50 and 1,200 Hz in water and 50 and 1600 Hz in air. The maximum sensitivity was between 100 and 400 Hz in water and 50 and 400 Hz in air.

The leatherback sea turtle has been federally listed as Endangered under the ESA since 1970 and is considered Vulnerable by the IUCN Red List (IUCN, 2021; NMFS, 2020f). They are also listed as endangered by the state of Rhode Island (RI DEM, 2020). Threats to this population include fisheries bycatch, habitat loss, nest predation, and marine pollution (USFWS, 2018d). Critical habitat for this species was designated in waters adjacent to Sandy Point Beach, U.S. Virgin Islands in 1979 (44 *FR* 17710) and along the U.S. West Coast between Point Arena and Point Arguello, California, and between Cape Flattery, Washington, and Cape Blanco, Oregon, in 2012 (77 *FR* 4169).

RWF

Leatherback sea turtles were the most frequently sighted turtle species by Kraus et al. (2016) in the RI-MA WEA and were mostly observed from May through November (**Figure 3.2-2**). Leatherback sea turtles are rarely detected in the spring and not detected at all during the winter. A strong peak in leatherback sea turtle sightings is seen during August, with 71 reported sightings from Kraus et al. (2016). In the fall, there is a high concentration of sightings south of Nantucket, Massachusetts (Kraus et al., 2016). NYSERDA reported one leatherback in the RI-MA WEA during fall 2016 aerial surveys. While there were a few detections in the New York Bight region, none were detected offshore Rhode Island near the RWF during summer 2016 surveys (Normandeau and APEM, 2019). The AMAPPS surveys reported four leatherback sea turtle sightings during the summer 2011 shipboard abundance surveys (Palka et al., 2017). Because of the documented occurrence and use of Southern New England waters and within the vicinity of the RI-MA WEA, it is likely that leatherback sea turtles could occur in the RWF area during the summer and fall months. However, it is unlikely that large concentrations of these animals would be found in the RWF because observations show that their distribution is widespread, and the only concentrated occurrence was documented south of Nantucket, Massachusetts, east of the RWF.

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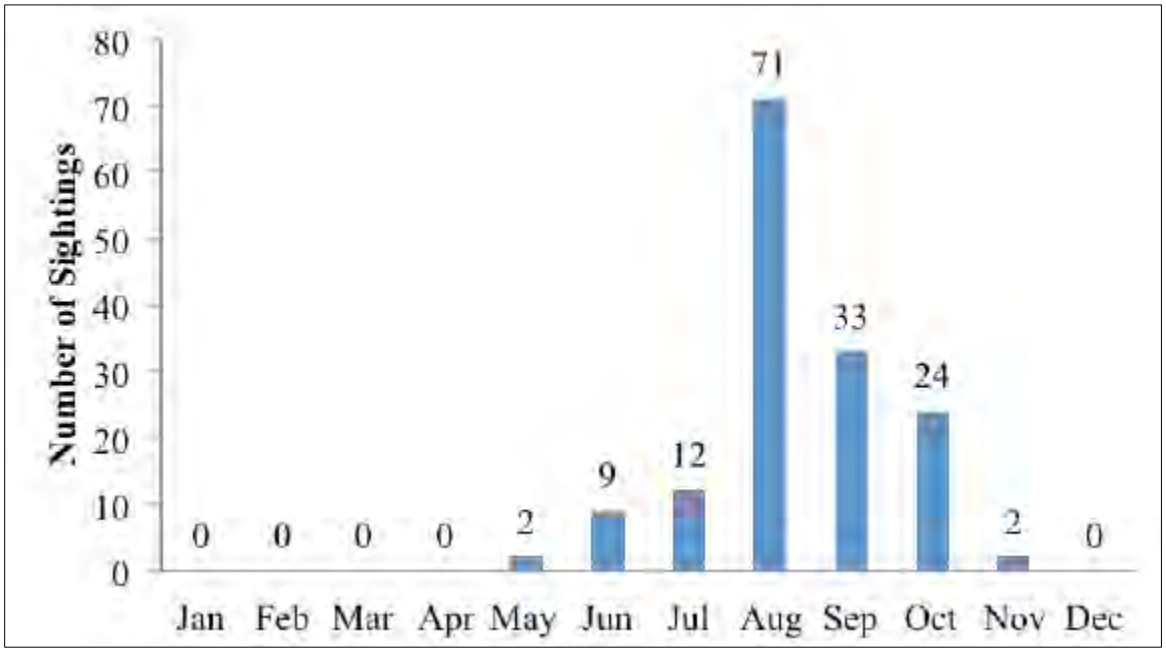

Figure 3.2-2. Visual detections of leatherback sea turtle by month for all survey years between October 2011 and June 2015. From: Kraus et al. (2016).

RWEC

Leatherback sea turtle strandings on U.S. shores are mostly of adult or near-adult size turtles (NMFS and USFWS, 1992). In relation to species occurrence, leatherback sea turtle sightings generally are fewer in number compared to loggerheads and Kemp's ridleys. Leatherback sea turtle distribution is similar to loggerhead sea turtles with occurrences from Cape Hatteras, North Carolina, to Long Island, New York, but leatherbacks are more frequently observed in the Gulf of Maine, southwest of Nova Scotia, Canada. Boaters fishing within 10 miles (16 km) of the south shore of Long Island, New York, frequently report leatherback sightings (NMFS and USFWS, 1992). Aggregations of leatherback sea turtles have been observed around Block Island, Rhode Island, and south of Long Island, New York, and strandings of this species are relatively common in Rhode Island (Kenney and Vigness-Raposa, 2010; NMFS, 2019a). Between 2000 and 2018, NMFS reported 76 leatherback sea turtle strandings in Rhode Island, the highest of the four expected sea turtle species (NMFS, 2019a). Leatherback sea turtle occurrence in both the RWEC – OCS and RWEC – RI is therefore expected to be common.

3.3 ESA-Listed Fish Species

There are three ESA-listed fish species that could potentially occur within the shelf and coastal waters of the Western North Atlantic: Atlantic sturgeon (*Acipenser oxyrhynchus*), shortnose sturgeon (*Acipenser brevirostrum*), and giant manta ray (*Mobula birostris*) (**Table 3.3-1**). These three species are listed as Endangered under the ESA so further detail is provided on their distribution, behavior, and relevant life history traits in this report.

While all three species have ranges that include the Project Area, the Atlantic sturgeon is the only species whose occurrence is common enough that they are at risk of potential impacts from Project Activities. Therefore, only this species is included in the impact assessment (**Section 5.0**). Species information and justification for excluding the shortnose sturgeon and giant manta ray from this assessment are provided in the following sections.

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Table 3.3-1. Protected fish species that could potentially occur in the Project Area and their relative occurrence in the Project Area.

Common Name	Scientific Name	Stock	Federal ESA Status	Relative Occurrence in the RWF	Relative Occurrence in the RWEC – OCS	Relative Occurrence in the RWEC – RI
Atlantic sturgeon	*Acipenser oxyrhynchus*	NY Bight DPS	Endangered RI State Historical	Common	Common	Common
Shortnose sturgeon	*Acipenser brevirostrum*	-	Endangered	Rare	Rare	Rare
Giant manta ray	*Mobula birostris*	-	Endangered	Rare	Rare	Rare

DPS = Distinct Population Segment; ESA = Endangered Species Act Project Area = includes the Revolution Wind Farm (RWF), Revolution Wind Export Cable (RWEC) – Outer Continental Shelf (OCS) and RWEC – Rhode Island (RI) state waters.
[1]Information based on finfish assessment conducted in Section 4.3.3 and the Essential Fish Habitat Assessment (Inspire Environmental, 2020) provided with the Revolution Wind Construction and Operations Plan.

3.3.1 Atlantic Sturgeon

Atlantic sturgeon are found from Canada to Florida in estuarine habitats and rivers as well as in coastal and shelf marine environments. Subadults move out to estuarine and coastal waters in the fall; and adults inhabit fully marine environments and migrate through deep water when not spawning (Atlantic Sturgeon Status Review Team [ASSRT], 2007). The most recent status review for the Atlantic sturgeon was conducted in 2007. In this review, commercial bycatch was assessed, which showed that the majority (61%) of tagged sturgeon recaptures came from ocean waters within 4.8 km of shore, with the lowest ocean bycatch occurring in the summer months (July to September) (ASSRT, 2007). Atlantic sturgeon occurring within the Project Area are part of the New York Bight DPS. The Atlantic Sturgeon benchmark (SAR) (Atlantic States Marine Fisheries Commission [ASMFC], 2017) indicates that all DPS stocks are depleted but recovering. It is estimated that biomass and abundance are currently higher than that in 1998 (last year of available survey data) for the New York Bight DPS (75% average probability). The estimated abundance of age-0 to -1 Atlantic sturgeon in the Delaware River in 2014 was 3,656 individuals (Hale et al., 2016), which is similar to the age-1 estimate of 4,314 for the Hudson River in 1995 (Peterson et al., 2000). Similar estimates from the 2007 status review suggest that the Hudson River population consists of approximately 4,600 wild juveniles with a spawning stock of 870 adults.

The Atlantic sturgeon is a large (up to 4 m long), long-lived, anadromous fish that feeds on benthic invertebrates (NMFS, 2020g). Their primary hearing range falls within lower frequencies (under approximately 1 kHz), and while they do have a swim bladder, it is not involved in hearing (Popper et al., 2014).

NMFS listed the New York Bight DPS as Endangered in 2012 (77 *FR* 5879) and the critical habitat designation was finalized in 2017 (82 *FR* 3916). The IUCN lists the Atlantic sturgeon as Near Threatened (IUCN, 2021) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora lists the species under *Appendix II*, which lists species that are not necessarily now threatened with extinction, but that may become so unless trade is closely controlled. Current threats to Atlantic sturgeon within critical habitat include dams and turbines, dredging, water quality, and climate change. There is critical habitat designated for the New York Bight DPS within the Connecticut, Housatonic, Hudson, and Delaware Rivers, but no offshore critical habitat designation.

RWF

Historically, this population of Atlantic sturgeon spawned in several rivers between Massachusetts and the Chesapeake Bay; currently, however, the New York Bight DPS is known to consistently spawn only within the Hudson and Delaware rivers between April and May (ASSRT, 2007). During the spring and early summer, adult Atlantic sturgeon travel upstream in spawning rivers along Southern New England and New York. Throughout the rest of the year, spawning age adults can be found in both coastal and offshore

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waters in this region (ASMFC, 1990). Using commercial bycatch data, Stein et al. (2004) reported numerous juvenile and adult Atlantic sturgeon caught in waters offshore Massachusetts and Rhode Island near the RWF, and therefore they can be expected to occur in the RWF area, with a peak presence between November and May.

RWEC

Atlantic sturgeon are not likely to use any rivers in Narragansett Bay, Rhode Island for spawning; therefore, while their occurrence within the RWEC – OCS and RWEC – RI could be expected, it would be less than that expected in the RWF area.

3.3.2 Shortnose Sturgeon

Much of the distribution information is the same for the two sturgeon species, which co-occur in habitats along the U.S. Atlantic coast. Shortnose sturgeon occurring in the Project Area are from the Northeast spawning population encompassing the Connecticut, Hudson, and Delaware Rivers.

Morphologically, the shortnose sturgeon is smaller overall with a less pronounced snout than other sturgeon species, but their hearing capabilities would be similar to those described for the Atlantic sturgeon (**Section 3.3.1**). Like the Atlantic sturgeon, the shortnose sturgeon is listed as Endangered under the ESA but is classified as Vulnerable on the IUCN Red List (IUCN, 2021; NMFS, 2020h).

RWF

In a 2010 Biological Assessment (Shortnose Sturgeon Status Review Team, 2010), shortnose sturgeon were described as spending less time in open ocean habitats and spawning farther upriver than Atlantic sturgeon. The Northeast spawning population in particular uses freshwater habitats more than any of the other shortnose sturgeon populations (Kynard et al., 2016). They are considered more of an amphidromous species (defined as a species that spawns and remains in freshwater for most of its lifecycle but spends some time in saline water) rather than fully anadromous. Marine migrations do occur, and individuals have been recorded traveling 140 km in 6 days when moving between rivers (Kynard et al., 2016). However, because of the shortnose sturgeon proclivity to freshwater and estuarine habitats, the potential for shortnose sturgeon to be present in both the RWF area would be considered rare.

RWEC

As described for the RWF, this species' preference for freshwater habitat and the fact that primary spawning rivers are located in New York and Connecticut make it unlikely that this species will occur in either the RWEC – OCS or RWEC – RI.

3.3.3 Giant Manta Ray

The giant manta ray occurs in tropical, sub-tropical, and temperate waters (NMFS, 2020i). Their distribution in the Atlantic ranges from the Carolinas to Brazil and they are very rarely found in colder waters of the Western North Atlantic. Giant manta rays undergo seasonal migrations, which are thought to coincide with the movement of zooplankton, current circulation and tidal patterns, seasonal upwelling, seawater temperature, and possibly mating behavior. The giant manta ray is a seasonal visitor to productive coastlines, oceanic island groups, and offshore pinnacles and seamounts. They are generally found at depths below 10 m and tagging studies indicate dives of up to 200 to 450 m (NMFS, 2020i). They are slow-growing, highly migratory animals with sparsely distributed and fragmented populations throughout the world. Giant manta rays may reach disc widths of over 7 m (NMFS, 2020i). Regional population sizes are small (between 100 to 1,500 individuals) (Marshall et al., 2018; NMFS, 2020i).

The giant manta ray is listed as Threatened under the ESA and Vulnerable on the IUCN Red List (IUCN, 2021; NMFS, 2020i). Commercial fishing is the primary threat to the giant manta ray (NMFS, 2020i) as it is targeted and caught as bycatch in several global fisheries throughout its range.

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RWF

Giant manta rays are often observed in estuarine waters and near oceanic inlets, potentially using these habitats as nursery grounds. The giant manta ray is commonly encountered on shallow reefs and is also occasionally observed in sandy bottom areas and seagrass beds (Marshall et al., 2018). Mantas have been reported as far north as Canada in the Western North Atlantic; however, its propensity for warmer waters makes its presence unlikely in the RWF area.

RWEC

Although the giant manta ray is often observed in shallow coastal waters and estuaries, they are unlikely to occur in either the RWEC – OCS or RWEC – RI given their preference for warmer waters.

3.4 Summary

Species distribution and life history information were obtained from surveys conducted in and around the RI-MA WEA and available published literature in order to determine baseline conditions for the Project Area. This information helps determine what species are most likely to occur in the RWF and the RWEC – OCS and RWEC – RI and when they can be expected to occur. Information about their movement, behavior, feeding preferences, and reproductive characteristics help predict how vulnerable species may be to Project-related impacts, which helps determine the impact severity presented in **Sections 4.3.3.2**, **4.3.4.2**, and **4.3.5.2** of the Project's COP. Species that may occur in the Project Area include both ESA-listed Endangered and Threatened species and non-listed species. Listed species may be more vulnerable to potential population-level impacts given their lower overall abundance and thus warrants further consideration in the impact assessment process.

All 36 marine mammal species presented in **Table 3.1-1** are protected under the MMPA and have reported geographic distributions that include the Project Area. Of these species, only 15 are reasonably expected to occur in the Project Area. Four of the 15 expected species are also listed as Endangered under the ESA: the fin whale, North Atlantic right whale, sei whale, and sperm whale. The four species of sea turtle likely to occur in the Project Area are all listed as either Endangered or Threatened under the ESA. Of the three ESA-listed fish species whose ranges include the Project Area, only the Atlantic sturgeon is likely to occur in the RWF, RWEC – OCS, and RWEC – RI. The current status of these resource populations as well as the protection given to ESA- and MMPA-protected species warrants further consideration in this assessment. Using the expected distribution and known vulnerability of these species provided in the previous section, the severity of potential impacts is discussed in **Section 5.0**.

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4.0 ACOUSTIC RISK ASSESSMENT

Marine mammals, sea turtles, and fish use sound for social and reproductive communication, foraging, and situational awareness which makes them susceptible to impacts from underwater noise. As discussed in **Section 2.2**, various natural and anthropogenic activities contribute to noise in the ocean creating a complex acoustic habitat. Changes in the acoustic habitat can change an animal's ability to function within its given acoustic habitat.

Marine animals can perceive underwater noise over a broad range of frequencies from about 10 Hz to more than 200 kHz, and the primary acoustic habitat for a species will be focused within their specific vocal and hearing ranges. Given the acoustic specificity of each species, noise sources present different potential impacts. Additionally, impacts will vary due to differences in the acoustic properties of the source and how it propagates through the water.

For the purposes of this acoustic assessment, noise produced by Project Activities are classified as impulsive or non-impulsive. Impulsive noises are characterized as a distinct energy pulse that has a rapid rise time and relatively high PK. Most impulsive noises are broadband and are generated by sources such as airguns, impact pile driving, and some commercial sub-bottom profilers. Non-impulsive noises do not have the characteristic energy pulse or rapid rise times seen in impulsive sources; non-impulsive sources include vessels, drilling, and vibratory pile driving (Southall et al., 2007).

Impact pile driving during Project construction is expected to pose the greatest risk of potential impact relative to other noise-producing activities. Impact pile driving could result in physiological impacts (i.e., injury in sea turtles and fish, PTS in marine mammals) for some species given the acoustic and spectral characteristics of the noise produced by the activity. However, for most noise-producing Project Activities, temporary behavioral responses by marine mammals, sea turtles, and Atlantic sturgeon are the most likely impact during construction and operation of the RWF and RWEC. The magnitude and probability of most effects generally decreases with increasing distance from a source. The potential for physiological impacts (i.e., injury, PTS,) or biologically significant behavioral impacts is further reduced by implementing active operational environmental protection measures such as use of noise mitigation systems (NMS).

The underwater acoustic analysis report (Denes et al., 2020) provides a thorough compilation of the estimated propagation distances to regulatory acoustic criteria for multiple RWF impact pile driving scenarios. Regulatory criteria are based on impact thresholds that are either regulated under the MMPA or have substantial science-based criteria and have been applied in regulatory or impact assessment under the MMPA or ESA (Fisheries Hydroacoustic Working Group [FHWG], 2008; Popper et al., 2014; Blackstock et al., 2018; NMFS, 2018, 2019b). All thresholds are based on the most current accepted threshold levels for both physiological (i.e., PTS or auditory injury) and behavioral impacts (**Section 4.1**).

For this Technical Report, noise related to Project Activities was described in detail based on Denes et al. (2020) and published literature (**Section 2.1**). A compilation of available data regarding potential impacts of underwater noise produced by sources similar to those expected during Project Activities is summarized for marine mammals, sea turtles, and Atlantic sturgeon (**Section 2.3**). Results of the underwater acoustic analysis report (Denes et al., 2020) are also summarized in this Section to further assess potential impacts that may result from Project Activities.

The following subsections provide an overview of the acoustic threshold criteria and modeling parameters used to estimate the distances to physiological and behavioral acoustic thresholds which are also summarized for reference. This information provides the basis for the impact assessment of noise-producing Project Activities (**Section 5.0**).

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4.1 Acoustic Threshold Criteria

Acoustic thresholds are received sound levels that meet current scientific criteria as sufficient for eliciting the onset of a physiological effect (e.g., auditory injury, PTS) or behavioral response in a given marine species. Threshold criteria are used to identify the acoustic metrics and sound levels that may constitute an impact to a particular species and thus may require regulatory action. Acoustic threshold criteria are defined for the three faunal groups (i.e., marine mammals, sea turtles, and fish) considered in this assessment. The thresholds for each faunal group are defined with different metrics and therefore may have a different regulatory context and application.

Acoustic threshold criteria were established using two primary evaluators: 1) species' hearing sensitives; and 2) noise source characteristics. Marine mammals are divided into multiple hearing groups based on frequency-dependent hearing sensitivities (**Section 4.1.1**). Acoustic threshold criteria are the same for all sea turtle species, although there may be some distinction between hatchling and adult hearing capabilities (Lavender et al., 2014; Piniak et al., 2016) (**Section 4.1.2**). Accepted criteria for fish are dependent upon hearing mechanisms involving the swim bladder as well as the size of the fish (**Section 4.1.2**).

As discussed previously, Southall et al. (2007) identified two main types of noise sources: impulsive and non-impulsive. Non-impulsive sources can be further classified into operational categories of continuous or intermittent. Impulsive source criteria are typically presented using three metrics; PK and SEL_{24h}, which reflect the different potential exposure characteristics of the source which may cause physiological impacts; and SPL, which is used in behavioral impact assessments. Non-impulsive source criteria typically use SEL_{24h} and SPL as they do not have the characteristic peak in intensity (represented by the PK metric) that impulsive sources do. Throughout this assessment, modeling results used the most applicable physiological and behavioral threshold criterion for each affected resource for both impulsive and non-impulsive noise sources.

The noise sources of potential concern during proposed Project Activities include impact pile driving (impulsive source), geophysical surveys (both impulsive and non-impulsive sources), DP vessel thrusters, aircrafts, vibratory pile driving, and operational WTGs (non-impulsive sources). Acoustic thresholds, as defined in the following subsections, were used to establish the total ensonified area of noise received by the animal at levels that may result in either physiological or behavioral impacts, depending on the animals' hearing capability and source type.

4.1.1 Marine Mammals

Recognizing that marine mammal species do not have equal hearing capabilities, marine mammals are separated into hearing groups (Southall et al., 2007, 2019; NMFS, 2018). To account for these hearing groups, frequency weighting functions were applied when determining physiological (i.e., PTS) thresholds to scale species' sensitivities to a received noise depending on the spectral content of that noise. In effect, the sound energy contained within the frequency hearing range of an animal has the potential to affect hearing while sound energy outside an animal's frequency hearing range is unlikely to affect its hearing. The overall objective in defining hearing groups and deriving frequency weighting functions was to better define the role that frequency content plays in potential PTS.

Regulatory marine mammal hearing groups, originally identified by Southall et al. (2007) then later modified by Finneran (2016) and adopted by NMFS (2018), are categorized as LF cetaceans, mid-frequency (MF) cetaceans, HF cetaceans, phocid pinnipeds in water (PPW), and otariid pinnipeds in water (OW). Each category has a defined auditory weighting function and estimated acoustic threshold for the onset of PTS. No species from the OW hearing group (i.e., eared seals) are expected to occur in the Project Area and are not discussed further.

More recently, Southall et al. (2019) conducted a broad, structured assessment of the audiometric and physiological basis for the categorization of marine mammal hearing groups. Southall et al. (2019) kept the same frequency responses (i.e., hearing sensitivities) but re-categorized the LF, MF, and HF hearing

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groups to LF, HF (previously MF), and very high-frequency (VHF) (previously HF) hearing groups, and distinguished between phocid carnivores (i.e., pinnipeds) in water (PCW) and in air. Their assessment also indicated a probable distinction among baleen whales to include a very-low frequency (VLF) and a LF group, and an additional distinction among many of the odontocetes to include a distinction between an MF group containing the beaked, killer, and sperm whales and other HF cetaceans. There is insufficient evidence to support these distinctions, so the broader LF and HF hearing group categories are currently used resulting in a total of five possible groups (**Table 4.1-1**).

Southall et al. (2019) further acknowledge that there are presently insufficient direct data within the HF and VHF groups to explicitly derive distinct thresholds and weighting functions. They thus propose retaining the thresholds and functions developed by Finneran (2016) and adopted by NMFS (2018), but with slightly different categorical identifiers. The results of Southall et al. (2019) remain congruent with the current existing regulatory guidance (NMFS, 2018). A comparison of the two categorical terminologies and the general hearing ranges for each hearing group is provided in **Table 4.1-1**.

Table 4.1-1. Marine mammal hearing groups and general hearing frequency ranges as designated by the National Marine Fisheries Service (NMFS) (2018) and new hearing groups developed by Southall et al. (2019) with species that may occur in the Project Area included in each hearing group.

NMFS (2018) Hearing Group Designation and Generalized Hearing Range[1]	Southall et al. (2019) Hearing Group Designation	Species or Taxonomic Groups (species potentially occurring in the Project Area)
LF Cetacean (7 Hz to 35 kHz)	LF Cetaceans	Baleen whales (e.g., fin whale, sei whale, North Atlantic right whale, minke whale, humpback whale)
MF Cetacean (150 Hz to 160 kHz)	HF Cetaceans	Dolphins (e.g., Atlantic spotted dolphin, Atlantic white-sided dolphin, common dolphin, Risso's dolphin, common bottlenose dolphin) and toothed whales (e.g., sperm whale, long-finned pilot whale)
HF Cetacean (275 Hz to 160 kHz)	VHF Cetaceans	True porpoises (e.g., harbor porpoise)
PPW (50 Hz to 86 kHz)	PCW	True seals (e.g., harbor seal, gray seal)

HF = high-frequency; LF = low-frequency; MF = mid-frequency; PCW = phocid carnivores in water; PPW = phocid pinnipeds in water; VHF = very high-frequency.
[1]Represents the generalized hearing range for the entire group as a composite (i.e., all species within the group), where individual species' hearing ranges are typically not as broad. Generalized hearing range chosen based on an approximate 65 dB threshold from normalized composite audiogram, with the exception for lower limits for LF cetaceans (Southall et al., 2007) and PPW (approximation).

In addition to variability in marine mammal hearing sensitivities, science recognizes that different noise source types do not equally affect species in the same manner, particularly when considered in the context of accumulated sound levels. Repeated exposure to noise is potentially more damaging as it increases the accumulation of received sound necessary to elicit TTS or PTS. Within each noise source and hearing group, threshold levels are identified depending on the group-specific hearing capabilities and how they relate to the potential onset of TTS and PTS. Impulsive noise exposures result in TTS and PTS at lower accumulated sound levels than non-impulsive noises given their rapid onset and broadband nature. Consequently, they are also subject to dual thresholds (Southall et al., 2007 [adopted by Finneran (2016) and by NMFS (2018)]).

For marine mammals, acoustic thresholds are used within the context of harassment under the MMPA. The MMPA defines harassment in two levels: Level A (PTS) and Level B (behavioral). The marine mammal threshold criteria used in this assessment comprises NMFS (2018) technical guidance criteria for Level A and Level B exposure thresholds recommended by NMFS (2019b). Marine mammal species will not be equally affected by the Proposed Activities due to individual exposure patterns, the context in which noise is received, and, most prominently, individual hearing sensitivities.

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Marine mammal PTS onset thresholds are frequency weighted to account for differences in hearing sensitivities among these hearing groups. Current marine mammal behavioral onset thresholds do not used frequency weighting functions to distinguish between hearing groups. However, it is common practice to apply frequency weighting functions to behavioral thresholds as they can provide valuable information regarding marine mammal behavioral responses. Therefore, to provide a more comprehensive assessment of behavioral impacts, the frequency weighted ranges to behavioral thresholds calculated by JASCO (Denes et al., 2020) were used in this assessment. The ranges in Denes et al. (2020) are provided for both the step function currently recommended by NMFS (2019b) based on work by High Energy Seismic Survey (HESS, 1999) and a range of isopleths following the probabilities of response adapted from Wood et al. (2012); however, this assessment only shows ranges to the single step function threshold of SPL 160 dB re 1 µPa following recommendation from NMFS (2019b).

4.1.2 Sea Turtles and Fish

There are three accepted references for defining acoustics thresholds in sea turtles and Atlantic sturgeon: Popper et al. (2014), criteria developed by the FHWG (2008), and a recent analysis of acoustic impacts to marine mammals and sea turtles published by the U.S. Navy (Blackstock et al., 2018). These sources present criteria for physiological effects that are categorized as injury; however, Popper et al. (2014) concedes that injury includes a very wide spectrum of physiological effects, and even those sources that have the potential for mortal injury will likely vary by context and biological conditions. The physiological thresholds indicate the received sound levels at amplitudes expected to cause physiological changes in the animal.

For sea turtles, Popper et al. (2014) provides thresholds for mortal injury or potential mortal injury only for impulsive noises, which were used in this assessment. They provide subjective criteria for recoverable injury and TTS (e.g., near, intermediate, far) rather than discrete values. The subjective nature of these criteria is not applicable to the acoustic assessment and would be highly dependent on the context of the activity. For non-impulsive noises, the only available physiological threshold criteria are from FHWG (2008). Two options are available for behavior criteria in sea turtles; FHWG (2008) and Blackstock et al. (2018). Both references base the onset of disturbed behavior on caged sea turtle studies conducted by McCauley et al. (2000) during an active seismic survey, with the difference being the assessment of the sea turtles at various received levels. Blackstock et al. (2018) noted that due to the potential caging influence, the SPL threshold of 175 dB re 1 µPa was likely a more appropriate threshold to use for the onset of behavioral disturbance in sea turtles in open water; and this threshold was used for sea turtles in this assessment.

The Popper et al. (2014) PK physiological threshold value (207 dB re 1 µPa) for fish is nearly identical to the PK physiological threshold value (206 dB re 1 µPa) for fish used by FHWG (2008). However, their reported SEL_{24h} physiological thresholds for fish differs by 27 dB, demonstrating the continued uncertainty in the understanding of acoustic criteria in fish. The fish species of primary concern in this assessment is the Atlantic sturgeon, which have a relatively primitive swim bladder with no known connection between the swim bladder and inner ear. Atlantic sturgeon are not expected to be found close enough to be impacted by pile driving activities to sustain mortal injuries; therefore, this acoustic assessment presents the Popper et al. (2014) thresholds for potential recoverable injury in fish. For impulsive sources, the threshold used in this assessment is for fish with swim bladders not involved with hearing, which is applicable to Atlantic sturgeon. For non-impulsive sources, the selected threshold was for fish with swim bladders that are involved with hearing because this is the only threshold available from Popper et al. (2014) for that source type. Popper et al. (2014) also does not provide thresholds for behavior criteria, and instead uses TTS as the onset threshold for a behavioral reaction. In order to better summarize potential injury verses behavioral impacts, the TTS criteria were not considered in this report, but are presented in the underwater acoustic analysis report (Denes et al., 2020). This assessment used the FHWG (2008) behavior criteria for sturgeon/salmon. The FHWG (2008) behavioral threshold of SPL 150 dB re 1 µPa has not been tested for biologically significant behavioral reactions in fish, and behavioral responses in fish may range from a heightened awareness of the noise to changes in movement or feeding activity (Popper and Hastings,

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2009); therefore, it should be considered a highly conservative estimate for the onset of behavioral responses in Atlantic sturgeon.

The impulsive and non-impulsive thresholds used in this assessment based on the previously referenced publications are provided in the following sections. As discussed in **Section 2.3**, fish are known to be sensitive to both sound pressure and particle motion. However, there are currently no accepted thresholds for the onset of impact related to particle motion. Therefore, the thresholds and acoustic assessment provided in this Technical Report focus only on the pressure component of underwater noise.

4.1.3 Acoustic Criteria for Impulsive Sources

For impulsive sources, PK or SEL_{24h} criteria are used as the metric necessary for determining if an animal exceeds physiological auditory thresholds. These thresholds apply to impact pile driving and some equipment used during geophysical surveys. Physiological thresholds have frequency weighting functions applied for marine mammals but not for fish or sea turtles.

Impulsive sources have only a single SPL metric for behavioral criteria in each faunal group. The acoustic criteria for physiological impacts and behavioral disturbance for each faunal group are provided in **Table 4.1-2**.

Table 4.1-2. Acoustic criteria for impulsive sources used in the acoustic assessment for the Project construction scenarios.

Faunal Group	Physiological Thresholds[1]		Behavioral Thresholds[2]	
	Acoustic Metric	Threshold Value	Acoustic Metric	Threshold Value
LF Cetaceans	SEL_{24h}	183 dB re 1 μPa^2 s	SPL	160 dB re 1 µPa
	PK	219 dB re 1 µPa		
MF Cetaceans	SEL_{24h}	185 dB re 1 μPa^2 s	SPL	160 dB re 1 µPa
	PK	230 dB re 1 µPa		
HF Cetaceans	SEL_{24h}	155 dB re 1 μPa^2 s	SPL	160 dB re 1 µPa
	PK	202 dB re 1 µPa		
PPW	SEL_{24h}	185 dB re 1 μPa^2 s	SPL	160 dB re 1 µPa
	PK	218 dB re 1 µPa		
Sea Turtles	SEL_{24h}	210 dB re 1 μPa^2 s	SPL	175 dB re 1 µPa
	PK	207 dB re 1 µPa		
Fish	SEL_{24h}	210 dB re 1 μPa^2 s	SPL	150 dB re 1 µPa
	PK	207 dB re 1 µPa		

dB = decibel; HF = high-frequency; LF = low-frequency; µPa = micropascal; MF = mid-frequency; PPW = phocid pinnipeds in water; re = referenced to; SEL_{24h} = cumulative 24-h sound exposure level; PK = zero-to-peak sound pressure level; SPL = root-mean-square sound pressure level;
[1]Physiological thresholds are defined here as onset of permanent threshold shift in marine mammals (National Marine Fisheries Service [NMFS], 2018); onset of potential mortal injury in sea turtles (Popper et al, 2014); and onset of recoverable injury in fish with a swim bladder not involved in hearing (Popper et al., 2014).
[2]Behaviorial thresholds derived from the following sources: marine mammals = NMFS (2019b); sea turtles = Blackstock et al. (2018); fish = Fisheries Hydroacoustic Working Group (2008).

4.1.4 Acoustic Criteria for Non-impulsive Sources

The criteria for non-impulsive sources is somewhat simplified due to it being a singular rather than dual criteria. Non-impulsive sources are applicable for the vessels, aircrafts, some equipment used during geophysical surveys, WTG noise, and potential vibratory pile driving required for cofferdam installation in the near shore components of the RWEC. Activities with non-impulsive sources (and geophysical survey equipment, including impulsive sources) were not modeled in the underwater acoustic analysis report (Denes et al., 2020). Although non-impulsive sources were not modeled for this Project, acoustic criteria for the affected resources are available for non-impulsive sources and therefore are discussed in the context of impact assessment in this Technical Report, allowing a qualitative assessment of potential impacts relative to expected sound levels produced by these activities (**Section 2.1**).

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In addition to the difference in source type, the threshold values for non-impulsive sources are different from those for impulsive sources for both physiological and behavioral impacts. Non-impulsive thresholds values are provided in **Table 4.1-3**.

Table 4.1-3. Acoustic threshold criteria for non-impulsive sources used in the acoustic assessment for Project Activities.

Faunal Group	Physiological Thresholds[1]		Behavioral Thresholds[2]	
	Acoustic Metric	Threshold Value	Acoustic Metric	Threshold Value
LF Cetaceans	SEL_{24h}	199 dB re 1 μPa^2 s	SPL	120 dB re 1 µPa
MF Cetaceans	SEL_{24h}	198 dB re 1 μPa^2 s	SPL	120 dB re 1 µPa
HF Cetaceans	SEL_{24h}	173 dB re 1 μPa^2 s	SPL	120 dB re 1 µPa
PPW	SEL_{24h}	201 dB re 1 μPa^2 s	SPL	120 dB re 1 µPa
Sea Turtles	SPL	180 dB re 1 µPa	SPL	175 dB re 1 µPa
Fish	$SPL_{,48h}$[3]	170 dB re 1 µPa	SPL	150 dB re 1 µPa

dB = decibel; HF = high-frequency; LF = low-frequency; µPa = micropascal; MF= mid-frequency; PPW = phocid pinnipeds in water; re = referenced to; SEL_{24h} = cumulative 24-h sound exposure level; SPL = root-mean-square sound pressure level;
[1]Physiological thresholds are defined here as onset of permanent threshold shift in marine mammals (National Marine Fisheries Service [NMFS],2018); onset of potential mortal injury in sea turtles (Fisheries Hydroacoustic Working Group [FHWG], 2008); and onset of recoverable injury in fish (Popper et al., 2014).
[2] Behavioral thresholds derived from the following sources: marine mammals = NMFS (2019b); sea turtles = Blackstock et al. (2018); fish = FHWG (2008).
[3]Recoverable injury threshold reported for fish with swim bladders involved in hearing. Popper et al., (2014) does not provide thresholds for fish with swim bladder not involved with hearing. Threshold assumes that the fish is exposed to the SPL value for 48 continuous hours.

4.2 Underwater Acoustic Modeling

Modeled sound fields were used to determine potential impacts to marine species based on the corresponding threshold criteria (**Section 4.1**); the methodology used for underwater acoustic modeling is fully described in Denes et al. (2020) and summarized here for reference.

Hammer energy and strikes required to reach the target pile depth are not equal throughout the period of installation of a pile. Therefore, the modeling takes into account the sequence of hammer energy and pile strikes during the course of pile installation. Modeling also considers an NMS in the form of a big bubble curtain (BBC) or similar device, which is expected to be employed during all impact pile driving events for this Project to minimize potential impact to marine species. Use of an NMS represents a measure that achieves an overall reduction of in-water sound energy resulting in smaller distances to acoustic thresholds (Denes et al., 2020). For all species, the NMS reduces the risk of impacts in two ways. First, by reducing the radial distance to a predicted threshold, the probability of an animal entering the impact area is reduced. Second, by reducing the distance to a predicted threshold level, the ability to monitor and mitigate an area of impact is improved. Based on recent information regarding the efficacy of NMSs, broadband noise attenuation of up to 10 dB is expected to be achieved during impact pile driving activities in RWF; however, attenuation levels will be dependent upon frequency (Bellman, 2014, 2020). Ranges using 0-, 6-, 10-, and 15-dB broadband attenuation are presented in the summary tables for reference (**Section 4.4**), but for the impact assessment, 10-dB attenuation is assumed. Additionally, mitigation, such as reduction in hammer energy and operational shutdowns, or aversion behavior by animals were not included in the modeling scenarios, although they warrant consideration when conducting the impact assessment.

Factors relating to the acoustic properties of the noise source and operational variables will also influence noise propagation through the water column and are described further in the following section. More importantly, certain combinations of variables will affect the distance calculations more than others. The combination of parameters to assess expected ranges to the specified threshold distances for individual faunal groups to serve as the basis for the acoustic impact assessment.

Several assumptions were applied to the presented data in order to streamline the viewing of the underwater acoustic model results (Denes et al., 2020) for use in an assessment framework. The environmental propagation conditions used in the modeled scenarios consider seasonal and geographic

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location variability. Generally, modeled threshold distances were larger during the winter versus summer. The actual distances created during construction are likely further influenced by *in situ* environmental conditions at different locations during construction, as seen in the variability in the model results for the two locations for the WTG and OSS foundations (Denes et al., 2020). However, for the purposes of this impact assessment, ranges modeled for each season and location are combined, and are provided as mean threshold ranges for each modeled activity. This Technical Report, where appropriate to understand the impact assessment, provides results and assumptions that are also found in Denes et al. (2020). However, fine-scale environmental as well as operational variability cannot be captured in the summary provided in this Technical Report, and readers should refer to Denes et al. (2020) for detailed modeling results and methods.

4.2.1 Impact Pile Driving Parameters

A maximum of 100 WTG monopile foundations may be installed along with two foundations for the OSSs, which may use either monopile or jacket foundations. For the WTG foundations, 12-m diameter steel monopiles were modeled at two representative locations within the RWF Lease Area (Denes et al., 2020). For the OSSs, 15-m diameter steel monopiles and 4-m diameter jacket pin piles were included in the modeling assessment, modeled at three representative locations within the RWF Lease Area. The impact pile driving parameters used in this model to calculate the ranges to prescribed physiological and behavior thresholds were based on engineering and Project design assumptions. While not expected, some of the assumptions and design criteria may change slightly up to the point of RWF construction. Modeling used the most accurate and current parameters expected for the Project, and where there is uncertainty, a conservative approach was used (Denes et al., 2020).

Operational variables specific to impact pile driving that my influence noise propagation include hammer type, pile type, pile schedule (hammer energy/number of strikes), and geographic location. To account for current uncertainty in the Project design criteria, multiple scenarios were modeled to account for variability in the anticipated pile schedule and hammer energy.

For the monopile foundations, three piling schedules were used to estimate threshold distances for each of the three foundation types proposed for this Project (Denes et al., 2020). For the modeling assessment, it was assumed that WTG monopile foundations will require up to 6,500 strikes to install, the OSS monopile foundations will require 11,500 strikes to install, and the OSS jacket foundation, which consist of four pin piles, will require 11,000 strikes to install (Denes et al., 2020). Modeling accounted for the inclusion of a soft start at the beginning of each pile. The piling scenarios for each pile type are provided in **Tables 4.2-1** through **4.2-3**.

Table 4.2-1. Piling schedule for the 12-m wind turbine generator monopile foundations (Denes et al., 2020).

Energy Level (kJ)	Strike Count	Pile Penetration (m)	Modeled strike rate (min^{-1})
1,000	500	8	30
2,000	1,000	5	
3,000	2,000	12	
4,000	3,000	15	

kJ = kilojoule.

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Table 4.2-2. Piling schedule for the 15-m offshore substations monopile foundations (Denes et al., 2020).

Energy Level (kJ)	Strike Count	Pile Penetration (m)	Modeled strike rate (min^{-1})
1,000	500	12	30
2,000	1,000	8	
3,000	2,000	10	
4,000	8,000	20	

kJ = kilojoule.

Table 4.2-3. Piling schedule for the offshore substations jacket foundation consisting of four 4 m pin piles (Denes et al., 2020).

Energy Level (kJ)	Strike Count	Pile Penetration (m)	Modeled strike rate (min^{-1})
500	500	15	30
1,000	1,000	10	
1,500	1,500	13	
2,000	8,000	32	

kJ = kilojoule.

The energy output and number of blows at different pile schedules (e.g., soft-start, full driving, end set) will produce different threshold distances for each energy level. In order to better summarize the details of the model into an assessment of the installation activities, the mean threshold distances produced by all potential pile schedules and across all four hammer energies are provided in this Technical Report, representing the potential impacts produced over the course of a full pile installation (i.e., start to completion of driving a pile foundation). Multiple scenarios were modeled to estimate the linear ranges to regulatory acoustic thresholds (**Section 4.1**) for the complete pile schedule.

4.2.2 Acoustic Ranges and Exposure Ranges

Acoustic propagation through the water was modeled to produce three-dimensional sound fields around each source radiating out to a point at which sound levels reached expected ambient conditions. Noise is generally assumed to propagate out from the source to create an even spherical sound field; however, influence from local physical and oceanographic features results in sound propagating unevenly in all directions. Therefore, the radial distance that encompasses 95% of the modeled sound field is used to define the *acoustic range* from the source within which noise at or above acoustic thresholds for a marine species may be exceeded. An animal located within that range for a defined period of time is said to be exposed to the corresponding threshold. The radial distance, or acoustic range, thus relies solely on noise propagation through the environment and assumes a stationary receiver (i.e., animal) to predict the maximum distance at which that receiver could receive enough acoustic energy over the time period determined by the metric (e.g., 24-h for marine mammal SEL thresholds).

The acoustic ranges are traditionally used in the regulatory context of impact assessment and, in the case of marine mammals, are used to estimate takes as defined by the MMPA. The acoustic range can also help assess whether standard mitigation methods (e.g., visual observation) adequately reduce the risk of potential impacts from noise to a given marine species.

However, it is recognized that modeled acoustic ranges to threshold levels may overestimate the actual distances at which animals receive exposures meeting the threshold criteria and are likely not realistic, particularly for accumulating metrics like SEL. Applying animal movement and exposure models provides a more realistic indication of the distances at which acoustic thresholds are met. For this reason, *exposure ranges* were modeled to provide a realistic estimate of the ranges at which moving animals exceed the

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given acoustic thresholds. Notably, the exposure ranges are species-specific rather than categorized only by faunal group which affords more biological context to be considered when assessing impacts.

To determine exposure ranges, pile strikes are propagated to create an ensonified environment (**Section 4.2.1**) while simulated animals (i.e., animats) are moved about the ensonified area following known species-specific behaviors. Modeled animats that have received sound energy that exceeds the acoustic threshold criteria are registered, and the closest point of approach (CPA) recorded at any point in that animal's movement is then reported as its exposure range. This process is repeated multiple times for each animat to produce and the exposure-based ranges which comprise 95% of the CPAs for animats that exceeded the threshold (i.e., $ER_{95\%}$). The exposure range approach is used as the basis for the impact assessment in **Section 5.0**, for developing environmental protection measures, and for future MMPA assessments due to the incorporation of animal movement and behavior in the development of these ranges.

An animal being exposed to a specific threshold or occupying the waters within the propagated sound field does not alone constitute an impact for a particular species. Assessing the potential for impact needs to simultaneously consider the source, activity, environmental factors influencing propagation, frequency weighting factors, mitigation factors, and autecological characteristics of an at-risk species. Variability in each of these factors will, in turn, vary the potential risk to each species. Therefore, modeled exposure ranges are one component of the overall impact assessment process in this Technical Report.

Because accurate animal movement information is not currently available for Atlantic sturgeon to use in the model, the traditional acoustic range approach was used for the impact assessment for this species. However, it should be recognized that these are likely overestimates since Atlantic Sturgeon are not expected to remain in one location long enough to elicit potential physiological impacts or biologically significant disturbances.

The results of the modeling are summarized in **Sections 4.3** and **4.4** for acoustic ranges and exposure ranges, respectively. A wider selection of acoustic threshold criteria were modeled in the underwater acoustic analysis report (Denes et al., 2020); however, only the ranges to the threshold criteria presented in **Section 4.1.3** were summarized in the following sections and applied to the impact assessment (**Section 5.0**).

4.3 Summary of Modeled Acoustic Ranges

Summarized modeling results for acoustic ranges to physiological and behavioral thresholds are provided in **Tables 4.3-1** through **4.3-3** for each foundation type. As discussed previously, modeling was conducted for two locations for each pile type and two seasons, winter and summer (Denes et al., 2020). Ranges are provided separately for each location and season in Denes et al. (2020); however for the purposes of this report, the minimum, maximum, and mean values of the modeled ranges with 10 dB applied for both seasons and all locations are provided.

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Table 4.3-1. Mean acoustic ranges (m) to physiological thresholds and frequency weighted[1] behavioral thresholds for each faunal group for a 12-m wind turbine generator monopile foundation with 10 dB noise attenuation applied (Denes et al., 2020).

Faunal Group	Physiological Threshold Ranges						Behavioral Threshold Ranges		
	PK			SEL_{24h}			SPL		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean
LF Cetaceans	5	5	5	4,476	8,663	6,476	3,825	4,260	4,043
MF Cetaceans	-	-	-	80	102	90	2,235	3,240	2,738
HF Cetaceans	178	200	189	3,420	5,404	4,379	1,771	2,772	2,272
PPW	6	6	6	810	1,165	988	3,282	3,785	3,534
Sea Turtles[2]	95	101	98	330	512	423	481	2,741	1,465
Atlantic Sturgeon	95	101	98	330	512	423	5,805	9,758	7,782

- = threshold not reached; LF= low frequency; MF= mid frequency; HF= high frequency; PPW= phocid pinnipeds in water; SEL_{24h} = cumulative 24-h sound exposure level; PK = peak sound pressure level; SPL = root-mean-square sound pressure level.
[1]Frequency weighting applied to marine mammals only. Sea turtle and fish results are unweighted.
[2]Modeling results for SPL are only available at 170 and 180 decibels (dB) referenced to 1 micropascal; therefore, the range to the SPL 175 dB sea turtle threshold was estimated from those values.

Table 4.3-2. Mean acoustic ranges to physiological thresholds and frequency weighted[1] behavioral thresholds for each faunal group for a 15-m offshore substation monopile foundation with 10 dB noise attenuation applied (Denes et al., 2020).

Faunal Group	Physiological Threshold Ranges						Behavioral Threshold Ranges		
	PK			SEL_{24h}			SPL		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean
LF Cetaceans	6	6	6	5,324	11,121	7,976	4,093	4,671	4,382
MF Cetaceans	-	-	-	90	142	110	2,379	3,216	2,798
HF Cetaceans	260	260	260	3,846	6,475	5,078	1,843	2,597	2,220
PPW	7	7	7	1,141	1,583	1,356	3,545	3,838	3,692
Sea Turtles[2]	90	95	93	840	1,054	945	764	3,024	1,777
Atlantic Sturgeon	90	95	93	840	1,054	945	6,921	10,888	8,905

- = threshold not reached; LF= low frequency; MF= mid frequency; HF= high frequency; PPW= phocid pinnipeds in water; SEL_{24h} = cumulative 24-h sound exposure level; PK = peak sound pressure level; SPL = root-mean-square sound pressure level.
[1]Frequency weighting applied to marine mammals only. Sea turtle and fish results are unweighted.
[2]Modeling results for SPL are only available at 170 and 180 decibels (dB) referenced to 1 micropascal; therefore, the range to the SPL 175 dB sea turtle threshold was estimated from those values.

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Table 4.3-3. Mean acoustic ranges to physiological thresholds and frequency weighted[1] behavioral thresholds for each faunal group for a 4-m offshore substation jacket foundation with 10 dB noise attenuation applied (Denes et al, 2020).

Faunal Group	Physiological Threshold Ranges						Behavioral Threshold Ranges		
	PK			SEL_{24h}			SPL		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean
LF Cetaceans	4	4	4	5,639	15,426	10,215	3,732	4,092	3,912
MF Cetaceans	-	-	-	165	277	223	2,356	3,360	2,858
HF Cetaceans	87	88	88	4,732	9,558	7,132	1,947	3,029	2,488
PPW	5	5	5	1,604	2,470	2,019	3,205	3,774	3,490
Sea Turtles[2]	42	42	42	682	888	781	368	2,253	1,187
Atlantic Sturgeon	42	42	42	682	888	781	5,871	11,345	8,608

- = threshold not reached; LF= low frequency; MF= mid frequency; HF= high frequency; PPW= phocid pinnipeds in water; SEL_{24h} = cumulative 24-h sound exposure level; PK = peak sound pressure level; SPL = root-mean-square sound pressure level.
[1]Frequency weighting applied to marine mammals only. Sea turtle and fish results are unweighted.
[2]Modeling results for SPL are only available at 170 and 180 decibels (dB) referenced to 1 micropascal; therefore, the range to the SPL 175 dB sea turtle threshold was estimated from those values.

4.4 Summary of Modeled Exposure Ranges

Applying animal movement and exposure models (Denes et al., 2020) provides a more realistic indication of the distances at which acoustic thresholds are met. As previously described, modeled exposure ranges are species-specific; however, the exposure ranges are grouped by hearing group in this report to be consistent with the approach taken for the impact assessment (**Section 5.0**).

The exposure ranges to marine mammals and sea turtle physiological and behavioral thresholds are provided in **Tables 4.4-1** through **4.4-3** for the three pile types proposed for the RWF WTG and OSS. As mentioned previously, exposure ranges are not provided for the Atlantic sturgeon because accurate animal movement information is not available to apply to the model.

Similar to the acoustic ranges (**Section 4.3**), results were provided separately for both seasons modeled (Denes et al., 2020); however, for the purposes of this report, the mean of both seasons is provided in the following tables for each level of noise attenuation modeled (0, 6, 10, and 15 dB). All levels of noise attenuation are provided for reference, but the impact assessment in **Section 5.0** only considers the ranges with 10 dB attenuation applied.

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Table 4.4-1. Mean exposure ranges ($ER_{95\%}$) (m) to marine mammal and sea turtle physiological and behavioral thresholds resulting from installation of 12-m wind turbine generator monopile foundations with 0, 6, 10, and 15 dB broadband attenuation (Denes et al., 2020).

Faunal Group	Physiological Threshold Ranges								Behavioral Threshold Ranges			
	PK				SEL_{24h}				SPL			
	0 dB	6 dB	10 dB	15 dB	0 dB	6 dB	10 dB	15 dB	0 dB	6 dB	10 dB	15 dB
LF Cetaceans	89	12	5	2	7,465	3,409	1,916	770	7,650	4,928	3,891	3,169
MF Cetaceans	4	2	0	0	45	6	5	0	7,897	5,080	3,972	3,204
HF Cetaceans	850	390	205	118	5,845	3,210	2,035	955	7,830	5,040	3,960	3,225
PPW	99	15	6	3	2,453	768	195	23	7,990	5,120	4,048	3,285
Sea Turtles	460	164	110	55	688	127	17	13	3,178	1,990	1,187	520

dB=decibel; LF= low frequency; MF= mid frequency; HF= high frequency; PPW= phocid pinnipeds in water; SEL_{24h} = cumulative 24-h sound exposure level; PK = zero-to-peak sound pressure level; SPL = root-mean-square sound pressure level.
[1]Frequency weighting applied to marine mammals only. Sea turtle results are unweighted.

Table 4.4-2. Mean exposure ranges ($ER_{95\%}$) (m) to marine mammal and sea turtle physiological and behavioral thresholds resulting from installation of 15-m offshore substation monopile foundations with 0, 6, 10, and 15 dB broadband attenuation (Denes et al., 2020).

Faunal Group	Physiological Threshold Ranges								Behavioral Threshold Ranges			
	PK				SEL_{24h}				SPL			
	0 dB	6 dB	10 dB	15 dB	0 dB	6 dB	10 dB	15 dB	0 dB	6 dB	10 dB	15 dB
LF Cetaceans	77	13	6	3	7,449	3,666	2,149	868	8,530	5,519	4,196	3,436
MF Cetaceans	5	2	0	0	21	2	2	0	8,503	5,507	4,260	3,466
HF Cetaceans	580	320	260	93	5,805	3,010	1,865	885	8,640	5,585	4,260	3,470
PPW	85	88	7	4	2,395	800	305	28	8,728	5,630	4,293	3,605
Sea Turtles	360	149	81	308	1,048	273	13	0	3,417	2,317	1,500	802

dB=decibel; LF= low frequency; MF= mid frequency; HF= high frequency; PPW= phocid pinnipeds in water; SEL_{24h} = cumulative 24-h sound exposure level; PK = zero-to-peak sound pressure level; SPL = root-mean-square sound pressure level.
[1]Frequency weighting applied to marine mammals only. Sea turtle results are unweighted.

Table 4.4-3. Mean exposure ranges ($ER_{95\%}$) (m) to marine mammal and sea turtle physiological and behavioral thresholds resulting from installation of 4-m offshore substation jacket foundations with 0, 6, 10, and 15 dB broadband attenuation (Denes et al., 2020).

Faunal Group	Physiological Threshold Ranges								Behavioral Threshold Ranges			
	PK				SEL_{24h}				SPLSPL			
	0 dB	6 dB	10 dB	15 dB	0 dB	6 dB	10 dB	15 dB	0 dB	6 dB	10 dB	15 dB
LF Cetaceans	16	3	0	0	14,581	7,090	3,794	1,563	8,398	4,979	3,765	3,004
MF Cetaceans	0	0	0	0	235	41	10	2	8,511	5,106	3,824	3,041
HF Cetaceans	240	78	48	24	10,885	5,925	3,690	1,975	8,790	5,130	3,865	3,040
PPW	21	4	0	0	6,280	2,310	1,068	253	8,825	5,115	3,878	3,075
Sea Turtles	87	42	24	33	1,017	232	57	0	2,955	1,710	1,030	480

dB=decibel; LF= low frequency; MF= mid frequency; HF= high frequency; PPW= phocid pinnipeds in water; SEL_{24h} = cumulative 24-h sound exposure level; PK = zero-to-peak sound pressure level; SPLSPL = root-mean-square sound pressure level.
[1]Frequency weighting applied to marine mammals only. Sea turtle results are unweighted.

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5.0 IMPACT ASSESSMENT FOR RWF AND RWEC

All potential IPFs resulting from Project Activities were assessed for marine mammals, sea turtles, and ESA-listed fish species (i.e. Atlantic Sturgeon) in **Sections 4.3.3.2**, **4.3.4.2**, and **4.3.5.2** of the Project's COP. IPFs that have the potential to have greater than negligible impacts on marine mammals, sea turtles, and Atlantic sturgeon (as defined in **Section 1.1**) include habitat alteration, underwater noise, and vessel traffic. Using the baseline information provided in **Section 3.0**, the potential for impacts from Project Activities was assessed for all affected resources and characterized as either direct or indirect, and short-term or long-term (**Sections 5.1**, **5.2**, and **5.3**) using the parameters identified in **Section 1.2** (detectability, duration, spatial extent, and severity).

The detectability of an IPF referred to whether it would be perceptible to a marine mammal, sea turtle, or fish based on published literature that documented responses to these or comparable IPFs. The duration of an impact was determined to be either short-term or long-term, and considered both the duration of the impact-producing activities (**Sections 2.0** and **3.0** of the Project's COP) and how quickly an animal would recover once the activity ceased, based on available publications. The spatial extent of the IPF was estimated using Project-specific modeling (as applicable), and information provided in **Sections 2.0** and **3.0** of the Project's COP. The severity of the potential impact was then determined based on the other three parameters, the current status of the populations under consideration, and the likelihood for population-level impacts based on published literature. These four parameters combined were used to determine if a potential impact exceeded a negligible determination. For example, a potential impact would be considered greater than negligible if it was determined an IPF was detectable to a resource, resulted from an activity occurring over a longer period or resulted in an impact that took longer for the resource to recover, and occurred over a broader spatial area which increased the risk of overlap between the IPF and the resources' geographic range.

Additionally, Project-specific modeling was conducted by JASCO to assess the potential for impact for the underwater noise IPF (Denes et al., 2020). Denes et al. (2020) defines and characterizes acoustic propagation resulting from impact pile driving activity associated with the Project for all scenarios included in the Project Envelope (**Section 3.0** of the Project's COP) and results applicable to this assessment are provided for reference. Results of the modeling provided a more quantitative estimate of the spatial extent of this IPF as it pertains to impact pile driving. Noise from DP vessels, aircraft, vibratory pile driving, geophysical survey, and WTG operations were not modeled for this Project, so the potential for impact was based predominantly on published literature and modeling conducted for other similar projects. Detectability of this IPF was based on accepted acoustic thresholds for each faunal group (**Section 4.1**), estimated source levels for each noise-producing activity (**Section 2.1**), and the description of the existing underwater acoustic habitat of the Project Area (**Section 2.0**). As stated above, the duration is based on information provided in **Sections 2.0** and **3.0** of the Project's COP. These criteria, combined with the current status of the affected populations, helped determine the severity of potential impacts. Results of the modeling, including acoustic and exposure ranges for impact pile driving are summarized in **Section 4.0** for reference.

The information provided in the following sections is intended to provide a more detailed explanation of the underwater noise IPF and any IPFs that may result in greater than negligible impacts on marine mammals, sea turtles, and ESA-listed fish, specifically Atlantic sturgeon.

5.1 Summary of Impacts

Based on the list of affected species identified in **Section 2.2**, the potential for impacts resulting from Project activities during construction, O&M, and decommissioning were assessed using the methodology described in **Section 1.2**. All potential IPFs are discussed in **Section 4.1** of the COP; only habitat alteration, underwear noise, and vessel traffic were discussed in this Technical Report as they are the only IPFs with

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the potential to result in greater than negligible impacts to affected resources (**Section 1.3**). As previously discussed in **Section 3.3**, the only ESA-listed fish species likely to occur in the Project Area is the Atlantic sturgeon, so potential impacts were only assessed for this species. A summary of anticipated impacts to marine mammals, sea turtle, and Atlantic sturgeon discussed in this report is provided in **Table 5.1-1**.

Table 5.1-1. Summary of anticipated impacts on marine mammals, sea turtles, and Atlantic sturgeon from underwater noise, vessel traffic, and habitat alteration resulting from Project Activities during construction, operation and maintenance (O&M), and decommissioning.

IPF	Marine Mammals	Sea Turtles	Atlantic Sturgeon
DP Vessel Noise	Direct, Short-term	Direct, Short-term	Direct, Short-term
Aircraft Noise	Direct, Short-term	Direct, Short-term	Direct, Short-term
Geophysical Surveys	Direct, Short-term	Direct, Short-term	Direct, Short-term
Impact Pile Driving	Direct, Short-term	Direct, Short-term	Direct, Short-term
Vibratory Pile Driving	Direct, Short-term	Direct, Short-term	Direct, Short-term
WTG Noise	Direct, Long-term	Direct, Long-term	Direct, Long-term
Vessel Traffic	Direct, Short-term (construction/decommissioning) and Long-term (O&M)	Direct, Short-term (construction/decommissioning) and Long-term (O&M)	Direct, Short-term (construction/decommissioning) and Long-term (O&M)
Habitat Alteration	Direct, Short-term (construction and decommissioning) and Long-term (O&M)	Direct (construction and decommissioning), Direct and Indirect (O&M), Short-term (construction and decommissioning) and Long-term (O&M)	-

- indicates no impact expected; DP = dynamic positioning; ESA = Endangered Species Act; IPF = impact producing factor; WTG = wind turbine generator.

The primary IPF expected to impact all potentially affected resources is underwater noise. Project Activities that will produce noise include impact pile driving during construction, the use of DP vessels and aircraft, vibratory pile driving used for the installation of a cofferdam, geophysical surveys, and WTG operations. Impact pile driving is likely to have the greatest risk of impact due to the impulsive characteristics and high noise levels produced by this source (**Section 4.2**). No injury is anticipated for any resource with the application of the environmental protection measures outlined in **Section 5.5**, but some level of behavioral response is anticipated for all resources (**Section 5.0**).

Project-related vessel traffic will contribute a nominal amount to the overall volume of existing traffic in this region. Although the risk of a strike is low, in the unlikely event a strike were to occur, the consequences of an individual mortality in a population that is listed as Threatened or Endangered is countered by their overall resilience to population-level impacts. The implementation of vessel strike avoidance measures (**Section 5.5**) will reduce the risk of strikes for potentially affected species.

Marine mammals and sea turtles are the only resources expected to receive greater than negligible impacts as a result of habitat alteration caused by the presence of the RWF foundations and associated scour protection. Studies have shown that marine mammals may forage around the foundations (**Section 5.1.3**) and sea turtles use artificial structures offshore for foraging and shelter from ocean currents and vessel traffic (**Section 5.2.3**). However, the habitat alteration resulting from the installation of the foundations and scour protection may have inadvertent impacts on these resources, such as wakes disrupting zooplankton prey species and increased susceptibility of sea turtles to cold stunning if they remain in the RWF area longer than typically expected (**Sections 5.1.3** and **5.2.3**). Sea turtles may also become habituated to the habitat created by the foundations and scour protection and may be impacted by the removal of foraging and sheltering habitat when the RWF is decommissioned (**Section 5.2.3**).

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5.2 Marine Mammals

As shown in **Table 1.2-1**, IPFs that could have greater than negligible impacts on marine mammals include underwater noise, vessel traffic, and habitat alteration. These IPFs are discussed further in the following subsections.

5.2.1 Underwater Noise

As discussed in **Section 2.3**, the range of potential effects from noise includes hearing threshold shift; auditory injury; masking; and stress and disturbance, including behavioral responses (NRC, 2003; 2005; Nowacek et al., 2004; Richardson et al., 1995; Southall et al., 2007). The severity of potential impacts increases when the exposure occurs close to a noise source and with the duration of the exposure. Impact pile driving was identified as the activity that would likely have the greatest potential for auditory impact, including PTS, on marine mammals; however, through the use of NMSs and other mitigation measures, no acoustic injury is expected to any marine mammal species. DP vessel noise, aircraft activities, vibratory pile driving, geophysical surveys, and WTG noise may also affect the acoustic habitat of marine mammals and in some cases result in behavioral disturbance. Impact and vibratory pile driving, geophysical surveys, and aircraft activities would occur during construction of the RWF and RWEC, WTG noise would occur during RWF operations, and DP vessel activity could occur during any Project phase.

5.2.1.1 DP Vessel Noise

Impacts on marine mammals from vessel noise have been documented and include temporary disruptions of communication or echolocation from auditory masking; behavior disruptions of individual or localized groups of marine mammals; and limited, localized, and short-term displacement of individuals of any species, including strategic stocks, from localized areas around the vessels. Aguilar-Soto et al. (2006) reported that the noise from a passing vessel masked ultrasonic vocalizations of a Cuvier's beaked whale (*Ziphius cavirostris*) and reduced the maximum communication range by 82% when exposed to a 15-dB increase in ambient noise levels at the vocalization frequencies, resulting in a 58% reduction in the effective detection distance of the Cuvier's beaked whale's echolocation clicks. Hatch et al. (2012) estimated that calling North Atlantic right whales may have lost 63% to 67% of their communication "space" due to shipping noise. LF (20 to 200 Hz) noise from large ships overlaps the frequency range of some mysticete vocalizations, and increased levels of ambient noise have been documented in areas with high shipping traffic, causing responses in some mysticetes that have included habitat displacement; changes in behavior; and alterations in the intensity, frequency, and intervals of their calls (Rolland et al., 2012).

Marine mammals are able to compensate, to a limited extent, for auditory masking through a variety of mechanisms, including increasing SLs (i.e., the Lombard effect) or durations of their vocalizations or by changing spectral and temporal properties of their vocalizations (Hotchkin and Parks, 2013; Parks et al., 2010). North Atlantic right whales in high-noise conditions have been documented to lower their call rate and produce calls with a higher average fundamental frequency (Parks et al., 2007). In the presence of ship noise, beluga whales produced whistles at higher frequencies and longer durations (Lesage et al., 1999). Di Iorio and Clark (2009) found that blue whales increased their rate of social calling in the presence of sub-bottom exploration equipment, which was presumed to represent a compensatory behavior to elevated ambient noise levels during the surveys. Several marine mammal species are also known to increase the SLs of their calls in the presence of elevated noise levels (Dahlheim, 1987; Lesage et al., 1999; Terhune, 1999). Holt et al. (2008) studied the effects of anthropogenic noise exposure on Endangered southern resident killer whales in Puget Sound, reporting that they increased their call amplitude by 1 dB for every 1 dB increase in ambient noise in the 1 to 40 kHz frequency band. Castellote et al. (2012) reported that male fin whales from two different subpopulations not only modified their song characteristics during increased ambient noise conditions, but also left the area and did not return for 14 days. Castellote et al. (2012) hypothesized that the fin whales modified their acoustic communications to compensate for the

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increased ambient noise levels and that the animals had a lower tolerance for seismic airgun noise than for shipping noise.

Modeling was not conducted for DP vessel noise for this Project, but a qualitative discussion of noise produced by DP vessels can be found in Denes et al. (2020). No acoustic injury impacts are expected to occur to marine mammals as a result of vessel noise due to the non-impulsive nature of the sources and relatively low SLs produced (BOEM, 2013; McPherson et al., 2016). Because vessel noise is perceptible and can temporarily alter a mammal's acoustic habitat, it has the potential for disrupting or interfering with normal biological activities that could constitute behavioral disturbance. Behavioral impacts resulting from vessel noise would be expected only from vessels that use DP thrusters. DP vessels will predominately be used during the approximate 18-month construction period and during the decommissioning phase. During the 20 to 35 year O&M period, DP vessels operating in a station-keeping mode, which produce the greatest sound levels, will be used intermittently; however, DP thrusters may also be used for propulsion on some vessels during transits between ports and the RWF and RWEC. For those few individuals that are present in the region during DP vessel operations, behavioral disturbances may be consequential if the response results in the interruption of critical behavior. However, the anticipated noise associated with DP vessel operations throughout the Project would be temporary and is not expected to be a significant contribution to cumulative vessel noise already present in the region. With the added presumption that individual or groups of marine mammals in the Project Area are familiar with vessel-related noises, particularly within trafficked areas around the RWF and nearby shipping lanes, behavioral impacts on marine mammals from Project-related DP vessel noise are expected but would not be extensive or biologically significant. Impacts are expected to be temporary, and marine mammal behavior would return to baseline conditions when DP vessel activity ceases. Therefore, the effects of Project-related DP vessel noise on marine mammals are considered ***direct*** and ***short-term***.

5.2.1.2 Aircraft Noise

Noise produced from aircrafts used during Project construction have the potential to propagate underwater at levels that could be detectable to marine mammals. Received SPL measured from a helicopter at 18 m depth were approximately 106 dB re 1 µPa and were shown to generally increase with decreasing water depth, decreasing altitude of the aircraft, and increasing flight speed (Patenaude et al., 2002). Additionally, behavioral responses to aircraft noise have been observed in bowhead whales (*Balaena mysticetus*) in response to both helicopters and planes (Patenaude et al., 2002). However, helicopters would only be used intermittently to support crew transfers during construction and O&M (**Section 4.1.4.1** of the Project's COP), and given the relatively short duration of construction activities (approximately 18 months), only temporary changes in behavior are expected to occur. Impacts from aircraft noise are considered ***direct*** and ***short-term***.

5.2.1.3 Geophysical Surveys

As discussed in **Section 2.1.5**, geophysical surveys will be conducted prior to construction of the RWF and RWEC to identify any seabed obstructions or potential MEC/UXOs. The likelihood of encountering MEC/UXOs within the Project Area is low, and should one be identified it will be disposed of using methods designed to avoid potential detonation of the device. The preferred approach for MEC/UXO is avoidance, but in a situation where avoidance is not possible, low-noise methods of removal or relocation will be employed (**Section 3.3.3.2** of the Project's COP). Therefore, explosive decommissioning of MEC/UXOs is not considered in this assessment, and only noise from the geophysical survey equipment used to locate potential obstructions was analyzed.

Equipment used during these surveys has the potential to produce noise that would exceed physiological and behavioral thresholds for marine mammals (**Section 4.1**). However, previous assessments estimated ranges to physiological thresholds of <50 m, and ranges to behavioral thresholds were all <200 m (CSA Ocean Sciences Inc., 2018, 2020). With the implementation of the environmental protection

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measures outlined in **Section 5.5**, the risk of impact is low and would be limited to temporary disturbances. Furthermore, due to the relatively short duration of these activities which would only occur during a portion of the full 18-month construction period, impacts are considered ***direct*** and ***short-term***.

5.2.1.4 Impact Pile Driving

Potential acoustic impacts from impact pile driving include noise levels that can elicit direct injury to or behavioral responses in marine mammals and have the potential to cause displacement from critical habitat (Brandt et al., 2011; Bailey et al., 2010), alteration of acoustic habitat availability, and masking (Madsen et al., 2006). Within 10 m of the source, impact pile driving can generate SLs expressed as PK ranging from 233 to 245 dB re 1 µPa m and SLs expressed as SEL_{24h} ranging from 218 to 249 dB re 1 μPa^2 m^2 s with a predominant frequency content below 1,000 Hz (Amaral et al., 2018). During the 2015 Block Island impact pile driving activities, distances to measured behavior SPL threshold isopleths (160 dB re 1 µPa, unweighted) ranged from 2.7 to 4.6 km from the pile source (Amaral et al., 2018). However, physiological threshold distance calculations during the 2015 Block Island impact pile driving measurements used pre-2016 NOAA acoustic guidance criteria (SPL of 180 dB re 1 µPa, unweighted). Recently, BOEM (2018) detailed best management practices designed to minimize pile driving impacts on marine mammals, which will be applied during RWF WTG and OSS installation activities. The application of these practices will minimize the potential for impact ranges by reducing the distances to physiological and behavioral thresholds, and by allowing for the effective application of environmental protection measures (**Section 5.4**).

Results of acoustic modeling conducted for this Project are fully described in Denes et al. (2020) and summarized in **Sections 4.3** and **4.4** for reference. Modeled impact pile driving was conducted for three pile types; 12-m monopile foundations used for the RWF WTGs, 15-m monopile foundations being considered for the RWF OSS, and 4-m jacket pin pile foundations also being considered for the RWF OSS (**Section 3.0** of the Project's COP). Results of the exposure range modeling (**Section 4.4**) indicate that sound levels generated during impact pile driving for all pile types and scenarios with 10 dB attenuation applied will exceed the biological thresholds associated with behavioral disturbance in marine mammals; and could exceed thresholds for the potential onset of physiological effects in some species beyond 3 km if the duration of exposure approached 24 h (**Section 4.4**). The $ER_{95\%}$ for PK physiological thresholds for all pile types and scenarios were generally small (<10 m) with 10 dB attenuation applied for all marine mammal hearing groups except HF cetaceans whose $ER_{95\%}$ for PK reached up to 260 m (**Section 4.4**). $ER_{95\%}$ for SEL_{24h} with 10 dB attenuation for all pile types and scenarios ranged from 1,916 to 3,794 m for LF cetaceans; 0 to 10 m for MF cetaceans; 1,865 to 3,690 for HF cetaceans; and 195 to 1,068 for PPW for all pile types and scenarios (**Section 4.4**). Estimated $ER_{95\%}$ to behavioral thresholds ranged from approximately 3 to 4 km for all hearing groups (**Section 4.4**).

Physiological exposures based on the PK metric are not expected for any marine mammal hearing group due to the small propagation distances and use of an NMS that not only reduces propagation ranges but acts as a physical barrier excluding many species from PK threshold exposures. Based on the modeled $ER_{95\%}$ for SEL_{24h}, only LF and HF cetaceans have large enough ranges to result in a reasonable potential to receive sound levels that exceed physiological thresholds; and this potential primarily exists during periods when species presence is greatest (**Section 3.1**). Additionally, receiving sound levels that exceed thresholds does not equate to PTS, and auditory injury is not expected to occur from impact pile driving activities. Implementation of environmental protection measures in the form of an NMS and monitoring programs (**Section 5.5**) applied during impact pile driving will further reduce the risk of physiological exposures. However, because the potential for PTS exists it is necessary to assess the effect of such an impact should it occur. PTS occurring to species with very low populations such as the North Atlantic right whale has the potential to cause population-level effects should an individual be functionally removed from that population (e.g., loss of communication with conspecifics). Therefore, ESA-listed species with already low population estimates would face a higher risk of population-level effects compared to non-ESA-listed

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species that have a greater capacity to absorb and recover from potential impact without incurring population-level effects.

There is a greater likelihood of behavioral disturbances to all marine mammal species because the metric for such exposures is based on an instantaneous received SPL, rather than an accumulated metric (e.g., SEL_{24h}). The $ER_{95\%}$ to behavioral thresholds range from approximately 3 to 4 km for all hearing groups. At these ranges, the ability to monitor and mitigate becomes challenging in an operational setting. As discussed in **Section 2.3**, behavioral disturbances are contextual, and disturbance from the relatively short pile installation period is not expected to have any population-level effects and would likely result in only brief disruptions in species' activities. Because impacts would only occur during the 18-month duration of construction activities, impacts from impact pile driving are considered ***direct*** and ***short-term*** for all marine mammal species.

5.2.1.5 Vibratory Pile Driving

Based on previous assessments of vibratory pile driving, sound levels may reach physiological threshold criteria for marine mammals at relatively small distances. *In situ* measurements conducted by the California Department of Transportation during bridge construction vibratory pile driving of sheet piles along the U.S. West Coast and Alaska reported a 162 dB re 1 μPa^2 s SEL over 1 s of vibratory pile driving measured 10 m from the source (Buehler et al., 2015). However, given the relatively short duration of vibratory pile driving activities (up to 3 days) and the location of the proposed cofferdam installation in Narragansett Bay, Rhode Island (**Section 3.0** of the Project's COP), it is unlikely species will be present within proximity of this noise source for durations sufficient to result in the onset of PTS in marine mammals.

While physiological thresholds consider exposure time, current behavioral metrics do not consider the duration of the animal's exposure to noise above the threshold. Therefore, the traditional assessment for behavioral exposures is dependent solely on the presence or absence of a species within the ensonified area. Animals are less likely to respond to sound levels when distant from a source, even when those levels elicit responses at closer ranges; both proximity and received levels are important factors in aversion responses (Dunlop et al., 2017). While vibratory pile driving activities may produce noise which exceeds the behavioral thresholds for marine mammals (**Section 2.1.4**), exposure to an SPL at a specified threshold level does not equate to a behavioral response or a biological consequence. Furthermore, the low abundance of marine mammal species in the nearshore location of the proposed cofferdam and the short period of vibratory pile driving activities significantly reduces the risk of behavioral exposures. There is a low potential for some dolphin, porpoise, and seal species to be present in the region around the cofferdam in Narragansett Bay (**Section 3.1**), and for those species vibratory pile driving presents a behavioral disturbance risk but not a physiological risk. Because impacts would only occur during the approximate 3-day installation period over which vibratory pile driving will occur, impacts to all marine mammals are considered ***direct*** and ***short-term***.

5.2.1.6 WTG Operations

WTGs primarily produce two types of noise: aerodynamic WTG blade noise and mechanical noise. The mechanical noise type can be transmitted underwater via the WTG towers and foundations. As described in **Section 2.1.4**, underwater noise generated by WTGs is concentrated below 500 Hz (Tougaard et al., 2009); and therefore, poses the greatest risk to the LF cetacean hearing group. However, Tougaard et al. (2009) stated that it was unlikely that auditory masking would occur due to the low noise levels produced by operational WTGs. They showed that WTG produced SPL ranging from 100 to 120 dB re 1 µPa at roughly 100 m from the foundation, although the MW size was not identified. Noise measurements taken at 50 m away from a 3.6 MW WTG reported peak power spectral density levels of 126 dB re 1 $\mu Pa^2\ Hz^{-1}$ with frequencies centered at 162 Hz and noise levels that varied by wind speed. Acoustic monitoring at the Block Island Wind Farm showed that WTG blades turning at maximum speed (12 rpm) increased noise in lower frequency bands by 3 to 10 dB (HDR, 2019). However, the WTG proposed for the RWF range in size

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from 8 to 12 MW, and measurements of operational noise for WTGs above 6 MW are not available in the published literature. Madsen et al. (2006) noted that there seemed to be only a weak relationship between the size of the WTG and the emitted noise levels, but cautions that this may not be valid for large WTGs of several megawatts.

Even with the larger WTGs proposed for this Project, noise levels are unlikely to exceed physiological onset thresholds, and impacts would be limited to audibility and perhaps some degree of responsiveness, such as avoidance (MMS, 2007). There is no published information about long term sound exposures to marine mammals from offshore wind farms. Animals such as seals and dolphins display some attraction to prey increases at wind farms, which may suggest that noise levels produced are insufficient to elicit behavioral disturbances in those groups (Teilmann and Carstensen, 2012). There is no published literature assessing long-term movement or acoustic exposure of LF cetaceans in or around offshore wind farms. Additionally, WTG noise will persist for longer periods of time and could impact more species compared to noise produced by construction and installation activities (MMS, 2007).

LF cetaceans are the most likely to perceive and potentially react to the LF noise produced by the WTGs; however, such responses have not been documented. However, due to the large uncertainty regarding the noise propagated by large-scale wind farms with >6 MW WTGs, additional considerations were made for LF cetaceans. Should avoidance behaviors due to noise produced by the wind farm result in reduced access to feeding areas that intersect or are adjacent to the RWF, impact severity could be greater for these species. While this impact is not anticipated, the lack of documented activity of LF cetaceans around operational wind farms requires that such impacts be considered a possibility.

Given the relatively low sound levels that would be produced during WTG operations, only temporary changes in marine mammal behavior would be expected to occur, and no measurable impacts are expected to MF and HF cetaceans or PPW. Due to the anticipated operation of the RWF of 20 to 35 years, impacts to marine mammals are considered ***direct*** and ***long-term***.

5.2.2 Vessel Traffic

Marine mammals may be vulnerable to collisions with moving vessels (Douglas et al., 2008; Laist et al., 2001; Pace, 2011). Vessel strikes happen when either marine mammals or vessels fail to detect one another in time to avoid the collision. Variables that contribute to the likelihood of a vessel strike include vessel speed, vessel size and type, and visibility. Marine mammal strikes have been reported at vessel speeds of 2 to 51 kn, and lethal or severe injuries are most likely to occur at speeds of 14 kn or more (MMS, 2007). Most reports of collisions involve large whales, but collisions with smaller species have also been reported (Van Waerebeek et al., 2007). Laist et al. (2001) provided records of the vessel types associated with collisions with marine mammals; most severe and lethal marine mammal injuries involved large ships (80 m or more in length). Vessel speed was found to be a significant factor as well, with 89% of the records involving vessels moving at 14 kn or more (MMS, 2007).

All large marine mammals are potentially at risk of a vessel strike. Whale species that are most frequently involved in vessel collisions include the fin whale, North Atlantic right whale, humpback whale, minke whale, sperm whale, sei whale, gray whale (*Eschrichtius robustus*), and blue whale (Dolman et al., 2006). Smaller cetaceans and pinnipeds are also at risk of vessel strikes; however, these species tend to be more agile, power swimmers and are more capable of avoiding collisions with oncoming vessels (MMS, 2007).

For some species, like the North Atlantic right whale, vessel strikes pose a significant risk mainly due to behavioral characteristics and habitat preferences. Vessel strikes are consistently one of the most common causes of North Atlantic right whale mortality annually (Hayes et al., 2020). Slow-moving and deep diving species that rest while on the surface or species that traverse or occupy shipping lanes are at highest risk.

Annual large whale mortality records include a vessel strike assessment. A high number of mortalities prompted NMFS to declare a UME from January 2016 through September 2020 for Atlantic coast

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humpbacks (NMFS, 2020d); from January 2017 through September 2020 for minke whales (NMFS, 2020c); and from January 2017 through October 2020 for North Atlantic right whales (NMFS, 2020a). A total of 133 humpback whales and 97 minke whales were found dead between Maine and North Carolina since 2016, and 42 North Atlantic right whales were found dead or seriously injury between Newfoundland and North Carolina (NMFS, 2020a,c,d). Necropsy examinations were conducted on approximately half the humpback whales observed, of which 50% showed evidence of human interaction such as a vessel strike (NMFS, 2020d). More than 60% of the mink whales were able to be examined, of which several showed signs of human interaction, but findings were not consistent and further research is needed (NMFS, 2020c). Necropsies were able to be conducted on 20 of the 31 dead North Atlantic right whales, and although results are still pending approximately 50% of the whales examined showed evidence of vessel strikes (NMFS, 2020a). Between 2013 through 2017, there was 0.8 records of annual vessel strikes of fin whales and 0.8 records annual vessel strikes of sei whales which resulted in serious injury or mortality (Hayes et al., 2020).

Most fast-moving cetacean species, including several delphinids such as the bottlenose and common dolphin, actively approach vessels to swim within the pressure wave produced by the vessel's bow and are at lower risk of vessel strike (Glass et al., 2009; Jensen and Silber, 2003; Laist et al., 2001; van der Hoop et al., 2015).

Project vessel traffic will result in a relatively short-term increase in the volume and movement of vessels in the Project Area during construction and decommissioning. Larger work vessels will generally transit to the work location and remain in the area until installation is complete. These large vessels will move slowly over a short distance between work locations. Transport vessels will travel between ports in Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Virginia, and Maryland and the offshore construction area (**Section 3.0** of the COP). During O&M, Project vessel traffic will be present over a longer duration, but the general size and number of vessels used for routine maintenance will be smaller than that of construction and decommissioning, except in the event major maintenance is required in which case traffic will be similar to construction and decommissioning. Depending on the time of year, the Project-related increase in vessel traffic would be nominal compared to other vessel operations within the area. For this analysis, it is expected that the proposed additional volume of vessel traffic associated with Project Activities would not constitute a significant increase to existing vessel traffic within the relatively heavy trafficked RI-MA WEA due to the close proximity of shipping lanes. To mitigate marine mammal vessel strikes, BOEM and NOAA require vessel strike avoidance measures that are based on NMFS's Vessel Strike Avoidance Measures and Reporting for Mariners (NMFS, 2008). Adherence to these provisions would further reduce the risk of associated vessel strikes or disturbance to marine mammals that might result from the proposed RWF construction activities or subsequent decommissioning activities.

The temporary increase in traffic during the construction and decommissioning phases pose the highest risk of vessel strikes to marine mammals. As previously discussed, not all marine mammal species are uniformly affected by vessel strikes. Some species have a higher risk of collision with vessels given their size, mobility, and surface behavior. Due to the low populations estimates for Endangered whale species, vessel strikes that may result in injury or mortality would result in the removal of that animal from the population; however, the severity of a mortality in a population that is listed as Endangered is countered by their overall resilience to population-level impacts. Vessel traffic during the activity is not expected to result in vessel strikes. Adherence to all NOAA and lease-stipulated speed restrictions and watch requirements by Project-related vessels reduces the risk of vessel strikes. Due to the relatively short duration of construction and decommissioning activities (approximately 18 months each), only ***direct***, ***short-term*** impacts are anticipated for all marine mammals. Vessel traffic during O&M will use vessels which will be generally smaller in size but will make more transits between the port and the RWF on a regular basis for maintenance and repairs throughout the operational life of the Project; therefore, impacts on all marine mammal species during this phase are therefore considered ***direct*** and ***long-term***.

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5.2.3 Habitat Alteration

As introduced in **Section 4.3.4.2** of the Project's COP, impacts of habitat alteration on marine mammals during construction of the RWF are expected to be ***direct*** and ***short-term***. Seafloor preparation, installation of the foundations, vessel anchoring, and installation of the IAC and OSS-Link Cable will temporarily displace existing communities both on and in the sediment in the RWF, which is expected to alter the existing benthic habitat. Marine mammals foraging in the RWF area may experience a temporary loss in prey availability, and those species that forage on benthic species will encounter reduced foraging opportunities where soft-bottom communities are displaced by the placement of the foundations and scour protection. This is not anticipated to produce measurable impacts on marine mammals because the area altered by the RWF foundations represent a portion of available habitat for benthic communities in the region, and pelagic species are expected to return to the area following construction.

Impacts on marine mammals due to habitat alteration are expected to occur primarily during the O&M phase. During O&M the presence of the WTG and OSS foundations and scour protection, and the IAC and OSS-Link Cable protection in the RWF will alter the existing sandy-bottom habitat and provide structural relief that may act as an artificial reef, a phenomenon termed the "reef effect." The reef effect caused by the introduction of a new hard bottom habitat in this area is expected to attract numerous species of algae, shellfish, and finfish to this site (Langhamer, 2012; Reubens et al., 2013; Wilhelmsson et al., 2006). Colonization of these structures often follows a characteristic sequence, starting with settlement of smaller planktonic organisms such as algae and zooplankton followed by barnacles and other organisms that live on the seafloor or on structures in the water column (Langhamer, 2012). Fish and invertebrate species are also likely to aggregate around the foundations and scour protection, which could provide increased prey availability and structural habitat (Boehlert and Gill, 2010; Bonar et al., 2015). This can have a positive side effect, by creating a sanctuary area for trawled organisms where higher survival of larger fish species is an expected outcome that can extend to outer areas (Langhamer, 2012).

Long-term studies of artificial reefs in European seas indicate that it takes approximately 5 years before stable communities are established (Jensen et al., 2000; Petersen and Malm, 2006). The Project is anticipated to operate over a 20- to 35-year period, making it likely that colonization of the foundations and scour protection will occur. This will result in an increase in the availability of marine mammal prey species, thus providing beneficial foraging opportunities for some marine mammals in this region. Projects to restore artificial reefs noted an increase in the presence of harbor porpoises at the new artificial reef site compared to surrounding habitats, and it was hypothesized they were following prey species (Mikkelsen et al., 2013). Other studies have observed seals concentrating their foraging efforts around wind farms and oil and gas platforms, often returning to these areas, which suggests successful foraging behavior around the foundations (Arnould et al., 2015; Russell et al., 2014). Another benefit for some species is that windfarms are not just a single structure, but a series of many located relatively closely to each other. This presents many feeding opportunities for smaller species of dolphins with low body fat percentages (that require multiple feedings) or mother/calf pairs (that have been observed repeatedly at structures in the literature) (Lindeboom et al., 2011; Hammar et al., 2010).

However, this effect will not be universal across marine mammal species. Currently, there are no quantitative data on the responses of large whale species (i.e., mysticete species) to the presence of offshore wind farms. It is uncertain whether large whale species will avoid or be attracted to the RWF structures, and Kraus et al. (2019) indicated that this potential shift in large whale distribution is a critical issue to consider as offshore wind farms are developed. It is possible that they may face similar beneficial foraging opportunities as smaller odontocetes and seals; however, differences in prey preference will result in differences in impacts on marine mammal species. The presence of the foundations in the water column could create wakes that may disrupt aggregations of zooplankton prey species within the RWF. This could impact species such as the North Atlantic right whale who primarily feed on zooplankton, but benthic and

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pelagic fish and shellfish would not be affected by the wakes, so whales foraging on these prey species would not be impacted (Kraus et al., 2019).

Large whale species could also be impeded by the presence of the foundations in the water column. As discussed in **Section 3.0** of the Project's COP, up to 100 foundations spaced approximately 1.85 km may be installed. Larger marine mammal species and those that engage in foraging behaviors, such as bubble-net feeding performed by humpback whales or surface active groups observed for North Atlantic right whales, may be affected by the foundations in the water column compared to smaller species or species that forage independently.

While limited data are available on the long-term effects of habitat alteration due to the installation of an offshore wind farm, the primary impact on marine mammals would be from altered prey distribution. For some species, this impact could be beneficial due to increase foraging opportunities, while other species may experience difficulties foraging within the RWF area due to the presence of the foundations. Because the three-dimensional habitat introduced by the RWF foundation will be present throughout the 20-35 year life of the Project, impacts from habitat alteration due to the installation of the RWF are considered ***direct*** and ***long-term*** for marine mammals during O&M.

5.3 Sea Turtles

Sea turtles are primarily present in the Project Area during summer and fall months and can occur in the RWF and RWEC corridor depending on the species and age class. As shown in **Table 1.2-1**, IPFs for sea turtles include underwater noise, vessel traffic (i.e., physical disturbance, risk of strikes), and habitat alteration due to the presence of RWF foundations and scour protection.

5.3.1 Underwater Noise

Few studies have examined the role of acoustic cues in relation to sea turtle ecology (Cook and Forrest, 2005; Mrosovsky, 1972; Samuel et al., 2005). Sea turtles may use noise for navigation, locating prey, avoiding predators, and environmental awareness (Dow Piniak et al., 2012a). The few vocalizations described for sea turtles are restricted to the grunts and gular (throat) pumps of nesting females, which are LF sounds and are relatively loud when compared to ambient noise, leading to speculation that nesting females may use these sounds to communicate within species (Cook and Forrest, 2005; Mrosovsky, 1972). Very little is known about the extent to which sea turtles use their auditory environment ("soundscape") for navigation, assessment of their environment, or identification of predators and prey, and the acoustic habitat for sea turtles change with each life stage as the preferred habitat shifts (**Section 3.2**). For example, the inshore acoustic habitat where juvenile and adult sea turtles generally reside is dominated by LF noise and generally has higher ambient noise levels than the open ocean environment where hatchlings reside (Hawkins and Myrberg, 1983). Moreover, in highly trafficked inshore areas, nearly constant LF noises from shipping, recreational boating, and seismic surveys increase the potential for acoustic impact (Hildebrand, 2005, 2009) and masking of biologically important sounds (Fay, 2009).

Popper et al. (2014) made a distinction between "mortal injury" and "recoverable injury," with the latter defined as an injury that is not likely to result in mortality such as sensory hair cell damage, minor internal or external hematoma. The definition of "recoverable injury" in this context implicitly includes PTS due to permanent inner-ear hair cell damage because the term "recoverable injury" is defined as any injury that is not a mortal injury. Therefore, PTS could be considered a threshold for injury, as it has been used for marine mammals (NMFS, 2018).

Due to the lack of data on sea turtle hearing and auditory impacts, no quantitative TTS criteria for sea turtles have been developed. Some previous environmental analyses have applied cetacean TTS criteria to sea turtles (BOEM, 2013; U.S. Department of the Navy, 2001). Finneran and Jenkins (2012) developed TTS criteria for sea turtles based on criteria for LF cetaceans, with the inclusion of an auditory weighting function for sea turtles. However, Popper et al. (2014) concluded that sea turtle hearing is better

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represented by data from fishes than from marine mammals because the functioning of the inner ear of sea turtles is dissimilar to that of mammals. Popper et al. (2014) used data from fishes exposed to impact pile driving to develop criteria for death or mortal injury of sea turtles exposed to impulsive noises.

The potential for masking impacts on sea turtles is difficult to evaluate because the role of noise in their ecology is not known. Sea turtles can hear LF noises. It has been hypothesized that the natural noise of the surf zone may help nesting sea turtles find their nesting site (Nunny et al., 2011) and that grunts made by nesting sea turtles may be for terrestrial communication (Cook and Forrest, 2005). Ferrara et al. (2014) identified four types of sounds in leatherback sea turtle nests during incubation and hypothesized that sounds are used to coordinate group behavior in hatchlings. Recent studies of a freshwater turtle species identified 11 types of sounds that are used to synchronize behavior among hatchlings and coordinate the movements of hatchlings and adult females (Ferrara et al., 2013).

Sources of noise resulting from Project Activities that have the potential to impact sea turtles include both impact and vibratory pile driving during the construction phase, DP vessel thrusters throughout all Project phases, and WTG noise during the O&M phase. Construction activities, specifically impact pile driving, are likely to generate the greatest noise levels, which can result in physiological injury or behavioral disturbances to sea turtles. Severity of impacts depends on the level and frequency characteristics of the noise as well as anticipated presence of sea turtle species.

5.3.1.1 DP Vessel Noise

Underwater noise generated by Project-related vessels, including those using DP thrusters, and equipment noise could disturb sea turtles or contribute to auditory masking throughout all phases of the Project. The intensity of this noise is largely related to vessel size and speed as well as thruster operations on DP vessels. Quantitative modeling was not conducted for this Project, a qualitative discussion of DP vessel noise is provided in Denes et al. (2020).

The most likely effects of vessel noise on sea turtles would include behavioral changes and auditory masking. Vessel noise is transitory, and the SLs are too low to cause death or injuries such as auditory threshold shifts. Based on existing studies on the role of hearing in sea turtle ecology, it is unclear whether masking resulting from vessel noise would have biologically significant impacts on sea turtles. Behavioral responses to vessels have been observed but are difficult to attribute exclusively to noise rather than to visual or other vessel cues. Studies of sea turtles are also inconclusive as to whether they may habituate to a continuous noise source. Nevertheless, it is conservative to assume that noise associated with Project DP vessels may elicit behavioral changes in individual sea turtles near the vessels. It is assumed that these behavioral changes would be limited to evasive maneuvers such as diving, changes in swimming direction, or changes in swimming speed to distance themselves from vessels. Also, as indicated in **Section 5.1.2**, the low volume of Project-related vessel traffic relative to existing traffic would contribute a nominal amount to the overall noise levels in an already heavily trafficked area. Given that impacts would only occur while the limited number of DP vessels are operating during construction and decommissioning, and DP vessels operating in a station-keeping mode, which produces the greatest sound levels, are expected to occur infrequently during O&M, it is expected that impacts to sea turtles from vessel noise are considered ***direct*** and ***short-term***.

5.3.1.2 Aircraft Noise

Noise produced from aircrafts used during Project construction have the potential to propagate underwater at levels that could be detectable to sea turtles. Received SPL measured from a helicopter at 18 m depth were approximately 106 dB re 1 µPa and were shown to generally increase with decreasing water depth, decreasing altitude of the aircraft, and increasing flight speed (Patenaude et al., 2002). Additionally, sea turtles are known to be able to detect lower frequency noises and recordings of helicopter noise show primary frequencies below approximately 400 Hz (Patenaude et al., 2002; Dow Piniak et al., 2012a; Dow Piniak et al., 2012b; Martin et al., 2012; Popper et al., 2014). However, helicopters would only be used

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intermittently to support crew transfers during construction and O&M (**Section 4.1.4.1** of the Project's COP), and given the relatively short duration of construction activities (approximately 18 months), only temporary changes in behavior are expected to occur. Impacts from aircraft noise are considered ***direct*** and ***short-term***.

5.3.1.3 Geophysical Surveys

As discussed in **Section 2.1.5**, geophysical surveys will be conducted prior to construction of the RWF and RWEC to identify any seabed obstructions or potential MEC/UXOs. The likelihood of encountering MEC/UXOs within the Project Area is low, and should one be identified it will be disposed of using methods designed to avoid potential detonation of the device. The preferred approach for MEC/UXO is avoidance, but in a situation where avoidance is not possible, low-noise methods of removal or relocation will be employed (**Section 3.3.3.2** of the Project's COP). Therefore, explosive decommissioning of MEC/UXOs is not considered in this assessment, and only noise from the geophysical survey equipment used to locate potential obstructions was analyzed.

Equipment used during these surveys has the potential to produce noise that would exceed physiological and behavioral thresholds for sea turtles (**Section 4.1**). However, based on previous assessments conducted for marine mammals (CSA Ocean Sciences Inc., 2018, 2020) estimated ranges to physiological thresholds are not expected to exceed more than a few meters, and behavioral thresholds would be <200 m. With the implementation of the environmental protection measures outlined in **Section 5.5**, the risk of impact is low and would be limited to temporary disturbances. Furthermore, due to the relatively short duration of these activities which would only occur during a portion of the full 18-month construction period, impacts are considered ***direct*** and ***short-term***.

5.3.1.4 Impact Pile Driving

Available data indicate that adult sea turtles in water can hear frequencies ranging from 50 Hz to 1,200 Hz and juveniles can hear frequencies up to 1,600 Hz, a range that overlaps with the main energy output from impact pile driving (Bartol and Ketten, 2006; Bartol et al., 1999; Dow Piniak et al., 2012a; Lavender et al., 2014; Martin et al., 2012; Ridgway et al., 1969). Reported hearing ranges and thresholds differ somewhat among species and life stages, but the data are too limited to be definitive because of the small numbers of individuals tested. Death or injury can occur from exposure to high intensity impulsive noises (Popper et al., 2014). Sea turtle deaths and injuries have been documented in proximity to underwater explosions (Gitschlag and Herczeg, 1994; Klima et al., 1988; Viada et al., 2008), but those impacts were attributed primarily to barotrauma resulting from exposure to the high energy of the shock wave generated by the explosions. Based on an extensive review of current scientific literature and studies, no sea turtle deaths or injuries are documented to have been caused by impact pile driving. Because of their rigid external anatomy, it is possible that sea turtles may be protected to some degree from the impacts of lower energy impulsive noises (Ketten and Bartol, 2005; Popper et al., 2014).

Avoidance of impulsive noise sources by sea turtles has also been inferred from field observations of sea turtle behavior during seismic surveys (DeRuiter and Doukara, 2012; Holst et al., 2006; Weir, 2007). Based on the best available data, it is assumed that sea turtle behavioral responses to impulsive noise may begin to occur at a received SPL between 166 and 175 dB re 1 µPa (Blackstock et al., 2018; FHWG, 2008; Popper et al., 2014).

Modeled impact pile driving at RWF WTG for the 12-m WTG monopiles with 10 dB attenuation resulted in a $ER_{95\%}$ distance of 110 m to the sea turtle PK physiological threshold and 20 m to the SEL_{24h} threshold (**Table 4.4-1**). For the 15-m monopiles used in the RWF OSS, mean $ER_{95\%}$ were 81 m to the PK physiological thresholds and 13 m to the SEL_{24h} thresholds, and for the 4-m jacket foundations, mean modeled distances were 24 and 57 m for the PK and SEL_{24h} thresholds, respectively (**Tables 4.4-2** and **4.4-3**). Sea turtles are not expected to linger within this distance for durations that would elicit a physiological

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impact. The maximum distance to PK thresholds represents the greatest potential for instantaneous injury to sea turtles and would be reached only at the highest hammer energy near the end of pile installation (Denes et al., 2020). Due to the placement of noise attenuation devices and general construction activities combined with smaller impact isopleths for the majority of hammer strikes, sea turtles are not expected to encroach any of the PK isopleths and, therefore, no physiological exposures are expected for sea turtles from impact pile driving.

Modeled $ER_{95\%}$ for sea turtle behavioral thresholds ranged from 1,030 to 1,500 m for all pile types and scenarios (**Section 4.4**). There is a likelihood of behavioral threshold exposure and general activity in the area that could result in sea turtles temporarily vacating the RWF construction area. Exposures to behavioral thresholds are expected to be temporary and not biologically significant. Because impacts are only expected during the 18-month duration of construction activities, it is expected that impact pile driving will result in ***direct***, ***short-term*** impacts on sea turtles.

5.3.1.5 Vibratory Pile Driving

Vibratory pile driving associated with RWEC construction, while within the estimated hearing range of sea turtles, is expected to produce lower noise levels relative to impact pile driving. Modeling was not conducted for cofferdam installation for RWEC; however, no injury or mortality is expected, and behavioral exposures are unlikely due to the relatively low SLs produced by this activity (**Section 2.1.4**) and the nearshore location of the proposed cofferdam installation (**Section 3.0** of the Project's COP). If behavioral exposures were to occur, behavioral responses are expected to be temporary, short-term, and would not affect the reproduction, survival, or recovery of Threatened or Endangered species. Additionally, vibratory pile driving would only occur during a 3-day period between October and January, and winter and spring have very low densities of sea turtles in the area (**Section 3.2**) and would have a lower potential for any exposure risk. Vibratory pile driving is therefore anticipated to have ***direct***, ***short-term*** impacts on sea turtles.

5.3.1.6 WTG Operations

Sea turtle hearing is within the frequency range (<1,200 Hz) for operational WTG (Popper et al., 2014; Thomsen et al., 2006). Thus, it is possible that WTG noise may influence sea turtle behavior. Potential responses to WTG noise generated during normal operations may be expected to be behavioral and include avoidance of the noise source, disorientation, and disturbance of normal behaviors such as feeding (MMS, 2007). Noise generated during normal operations might affect many individuals and for a much longer time period (MMS, 2007). As discussed in **Section 5.1.1.4**, operational WTGs can produce SPL ranging from 100 to 120 dB re 1 µPa at roughly 100 m from the foundation, which is higher than the ambient levels measured within the RI-MA WEA (Kraus et al., 2016; Tougaard et al., 2009).

Although operational WTGs could potentially increase ambient noise levels around the RWF, the sound levels produced are not high enough to result in potential injury to sea turtles. Only behavioral disturbances such as long-term avoidance of the RWF and surrounding vicinity are likely to occur. Sea turtles are known to occur in areas of higher ambient noise given their preference for coastal habitats, and therefore are more likely to habituate to increases in ambient noise. Additionally, as discussed in **Section 5.2.3**, sea turtles will likely be attracted to the RWF foundations due to beneficial foraging and sheltering opportunities, which further indicate the potential effects of operation WTG noise will not be biologically significant. Based on this, the anticipated behavioral impacts on to sea turtles from WTG noise is not expected to be biologically significant, but will be present throughout the 20 to 35-year life of the Project and are therefore considered ***direct*** and ***long-term***.

5.3.2 Vessel Traffic

Sea turtles may be able to actively maneuver within the water column to avoid collisions with approaching slow-moving (<5 kn) construction vessels; however, construction support vessels may travel at faster

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speeds and sea turtles may not be able to avoid them. Based on knowledge of their sensory biology (Bartol and Ketten, 2006; Bartol and Musick, 2003; Levenson et al., 2004), sea turtles may detect objects such as vessels, prey, and predators in the water column by means of auditory and visual cues. However, research examining the ability of sea turtles to avoid collisions with vessels shows that they may rely more on visual than auditory cues (Hazel et al., 2007). Sea turtle collisions with commercial vessels are not well-documented, but many rescued or stranded sea turtles show evidence of vessel strikes (Singel et al., 2007). From 1997 to 2005, 14.9% of all stranded loggerhead turtles in the U.S. Atlantic and Gulf of Mexico were documented as having sustained some type of propeller or collision injury. This study did not indicate what proportion of these injuries was post- or ante-mortem (NMFS and USFWS, 2008). It is likely that collisions with small or submerged sea turtles, or collisions during nighttime or periods of poor visibility, may go undetected and undocumented. Sea turtles are negatively buoyant and remains will sink in deep water, making them very unlikely to drift to shore or be recovered.

The potential for collisions between vessels and sea turtles increases at night and during inclement weather. Sea turtles spend at least 20% to 30% of their time at the surface for respiration, basking, feeding, orientation, and mating, during which time they are more susceptible to vessel strikes (Lutcavage et al., 1997). Temporary vessel traffic during all Project phases would slightly increase vessel traffic within the area; however, it represents a very small contribution in overall vessel traffic in the already heavily trafficked region. Large construction and decommissioning vessels will generally transit to the work location and remain in the area until installation is complete. These large vessels will move slowly and over short distance between work locations. Transport vessels will travel between ports in Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Virginia, and Maryland and the RWF throughout all Project phases (**Section 3.0** of the COP). These vessels will range in size from smaller crew transport boats to tug and barge vessels.

While mortality from vessel collision is frequently documented in sea turtle stranding data, the issue is most prevalent in shallow inshore and near-coastal waters where there are high densities of high-speed vessel traffic (Singel et al., 2007). In the unlikely event of a sea turtle vessel strike that results in injury or mortality, the risk of population-level consequences would be greater due to the removal of an individual(s) from a population or DPS that is considered already at risk**.** However, considering that Project-related vessel traffic will comprise slower moving work vessels and a relatively low volume of support vessels, and that vessel strike avoidance measures including speed restrictions and minimum separation distances following guidance from NMFS (2008) will be implemented for all Project vessels, the risk of a strike is expected to be low. Therefore, potential impacts on sea turtles from vessel traffic during construction and decommissioning are considered ***direct*** and ***short-term*** due to the relatively short duration of these activities (approximately 18 months each). As discussed briefly in **Section 5.2.2**, vessel traffic during the O&M phase is expected to comprise smaller vessels but a higher number of transits compared to the construction and decommissioning phases throughout the 20-35 year life of the Project, and impacts are therefore considered ***direct*** and ***long-term***.

5.3.3 Habitat Alteration

The presence of the RWF foundations and scour protection and IAC and OSS-Link Cable protection throughout the 20 to 35 year life of the Project will alter the existing sandy-bottom habitat and structural relief that may act as an artificial reef, a phenomenon termed the “reef effect”. The reef effect caused by the introduction of a new hard bottom habitat in this area is expected to attract numerous species of algae, shellfish, finfish, and sea turtles to this site (Langhamer, 2012; Reubens et al., 2013; Wilhelmsson et al., 2006). For sea turtles, artificial reefs have been shown to provide a number of ecological functions such as foraging and sheltering habitat and structures are used to remove biological build-up from their carapace (Barnette, 2017; NRC, 1996). In the Gulf of Mexico, both loggerhead and leatherback turtles were often observed resting at oil and gas platforms, making it likely that these species will behave similarly at the proposed windfarm structures (Gitschlag and Herczeg, 1994; NRC, 1996). The increased abundance of

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benthic species such as mussels and crabs, as well as the pelagic fish species attracted to this site would provide foraging opportunities for sea turtles transiting this site. Colonization of offshore structures often follows a characteristic succession starting with lower trophic level species such as diatoms and algae followed by upper trophic level species (Langhamer, 2012). Long-term studies indicate that it takes approximately 5 years for a stable community to be established, but biomass coverage of mussel species at these artificial structures has been shown to dramatically increase within the first 2 years (Joschko et al., 2008; Petersen and Malm, 2006). Particularly in areas with minimal hard bottom habitat or structural relief, these artificial reefs may supply important inter-nesting habitats for sea turtles (Barnette, 2017). Multiple species like green, hawksbill (*Eretmochelys imbricata*), and loggerhead sea turtles have also been observed using anthropogenic structures and submerged rocks to clean their flippers and carapace (Barnette, 2017). With the proposed foundations and scour protection, it is likely this will be result in a beneficial impact to sea turtles due to increased structural habitat and foraging opportunities.

The habitat conversion is also expected to attract commercial and recreational fishing to the area, which could pose a threat to sea turtles through entanglement or ingestion of fishing gear. Greater fishing effort around RWF area would increase the amount of equipment in the water, particularly monofilament line, which has been identified as a major hazard for all sea turtle species. Additionally, the beneficial foraging and sheltering opportunities for sea turtles could cause them to remain in the area longer than they typically would, making them more susceptible to cold stunning. Wakes created by the presence of the foundations may also influence distributions of drifting jellyfish aggregations; however, since other prey species available to sea turtles will not be affected by these wakes, impacts on sea turtle foraging are not expected to be substantial (Kraus et al., 2019). Given the available data that suggests an attraction of sea turtles to offshore structures and because the newly created habitat by the RWF foundations will be present throughout the 20-35 year life of the Project, impacts on sea turtles are considered ***direct*** and ***indirect***, and ***long-term*** during O&M.

Limited information is available related to the effect of decommissioning these structures after artificial reef habitat has been formed. The majority of research examining the impacts of decommissioning offshore structures focuses on methods involving explosives, which will not be used for this Project. Revolution Wind plans to fully dismantle the RWF components and either remove them from the seabed completely or cut the foundations at an appropriate depth below the mudline, enabling the environment to return to near baseline conditions. Sea turtles using these structures for foraging and shelter will be negatively impacted; however, the level of impact from removal of this habitat is uncertain. Studies of manatees at power plants in Florida indicate that they become dependent on these structures as habitat and struggle to adapt when they are decommissioned (Laist, 2005; Sattelberger, 2017). Given the propensity for sea turtles to utilize artificial reef habitats created by offshore structures, the current listing status of local sea turtles, and the expected loss of beneficial habitat used for foraging and shelter, potential negative impacts from decommissioning of the RWF are expected. However, because of the relatively short duration of decommissioning activities, and the anticipated return to baseline once the Project components are removed, impacts would be considered ***direct*** and ***short-term***.

5.4 Atlantic Sturgeon

Potential impacts on the Atlantic sturgeon would not be substantially different from impacts on other fish species and species with designated Essential Fish Habitat. No spawning habitat will be affected as Atlantic surgeon spawn in hard-bottom, freshwater habitats. Seasonal migratory patterns present the potential for Atlantic sturgeon to be present in the RWF area; however, it is not expected to be a regular visitor or occupant in large numbers. As shown in **Table 1.2-1**, IPFs for Atlantic sturgeon that could reach greater than negligible determinations include underwater noise and vessel traffic (i.e., physical disturbance, risk of strikes).

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5.4.1 Underwater Noise

Atlantic sturgeon have a primitive swim bladder that is not connected to the inner ear. Anatomical and physiological variations make it difficult to generalize about the impacts of noise on individual species (Thomsen et al., 2006). There are few studies specific to sturgeon hearing; however, Popper (2005) estimated that noise detection in sturgeon ranged from <100 Hz up to 1,000 Hz and indicated that sturgeon may be able to localize noise sources (i.e., determine the direction from which it comes). Sturgeon produce vocalizations during spawning, indicating some level of acoustic dependence for critical biological functions.

A workshop report is available, which contains a summary of research on fish hearing and physiology and presents audiograms for fish that have been measured under appropriate acoustic conditions (Normandeau, 2011). However, as discussed in **Section 2.3.2**, there is a gap in the understanding of particle motion sensitivity in fish, as few studies examined both the effects of pressure and particle motion simultaneously. It is expected that particle motion associated with impulsive noise sources such as impact pile driving will have similar effects as pressure waves with fish exhibiting behavioral responses such as temporarily vacating the impact area. Excess particle motion may also mask communication and could cause permanent or temporary damage to sensory structures.

There are only limited data on mortality in response to anthropogenic noise, and it is not clear whether death or injury only occurs in close proximity to a noise source (Hawkins et al., 2014). Overall, it is more likely that fish will experience sub lethal impacts that increase the possibility for delayed mortality when exposure occurs near a source (Hawkins et al., 2014). Because the majority of Project activities produce non-impulsive LF noise that is within the sensitive hearing range of most fish, the potential for fish to experience TTS, masking, and behavioral impacts are a higher likelihood than auditory injury or mortality.

Behavioral responses (e.g., fleeing, avoidance) to active acoustic noise sources are the most likely direct effect for Atlantic sturgeon exposed to noise during Project activities. Fewtrell and McCauley (2012) found that fish exhibited alarm responses to airgun noises exceeding SEL_{24h} between 147 and 151 dB re 1 μPa^2 s. The potential for masking or behavioral response may exist at a distance of many kilometers from a noise source, depending on the ambient noise levels in the region and the frequency and amplitude characteristics of the noise source.

5.4.1.1 DP Vessel Noise

Research indicates that the direct effects of DP vessel noise will not cause mortality or barotraumatic injuries in adult fish (Hawkins et al., 2014). DP vessel SLs have been shown to cause several different behavioral responses, TTS, auditory masking, and changes in blood chemistry. The most common behavioral responses are avoidance, alteration of swimming speed and direction, and alteration of schooling behavior (Becker et al., 2013; Handegard and Tjøstheim, 2005; Sarà et al., 2007; Vabø et al., 2002).

Laboratory and field studies have demonstrated several other behaviors that are influenced by DP vessel noise. For example, several studies noted changes in the time spent burrowing or using a refuge, time spent defending or tending to nests and eggs (Bruintjes and Radford, 2013; Picciulin et al., 2010), intraspecific aggression and territoriality interactions (Bruintjes and Radford, 2013; Sebastianutto et al., 2011), foraging behavior (Bracciali et al., 2012; Purser and Radford, 2011; Voellmy et al., 2014a,b), vocalization patterns (Picciulin et al., 2008, 2012), and overall frequency of movement (Buscaino et al., 2010). These studies also demonstrated that behavioral changes were generally temporary or that fish habituated to the noises. Some studies noted changes in the blood chemistry of several fish species (e.g., European sea bass [*Dicentrarchus labrax*], gilthead seabream [*Sparus aurata*], red drum [*Sciaenops ocellatus*], spotted sea trout [*Cynoscion nebulosus*]) in response to vessel noise (Buscaino et al., 2010; Spiga et al., 2012).

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Auditory masking and TTS in fish exposed to vessel noise has been demonstrated in a few studies. Auditory thresholds have been shown to increase by as much as 40 dB when fish are exposed to vessel noise playbacks (Codarin et al., 2009; Wysocki and Ladich, 2005; Vasconcelos et al., 2007). The degree of auditory masking or TTS generally depends on the hearing sensitivity of the fish, the frequency, and the noise levels tested (Wysocki and Ladich, 2005). The impact of auditory masking and TTS indicate that vessel noise can lower the ability of fish to detect biologically relevant sounds, but the effects were found to be temporary and hearing abilities returned to normal after cessation of the vessel noise.

Modeling was not conducted for DP vessel noise for this Project, but a qualitative discussion of noise produced by DP vessels can be found in Denes et al., 2020. It is unlikely that Atlantic sturgeon would be exposed to DP vessel noise associated with the Project because of their sparse spatial distribution in the Project Area and habitat preference of estuaries and rivers adjacent to, and occasionally in, coastal and shelf waters. Given these factors, and because impacts would only occur while the limited number of DP vessels are operating during construction and decommissioning, and DP vessels operating in a station-keeping mode, which produces the greatest sound levels, are expected to occur infrequently during O&M, impacts of DP vessel noise on Atlantic sturgeon are considered ***direct*** and ***short-term***.

5.4.1.2 Aircraft Noise

Noise produced from aircrafts used during Project construction have the potential to propagate underwater at levels that could be detectable to Atlantic sturgeon. Received SPL measured from a helicopter at 18 m depth were approximately 106 dB re 1 µPa and were shown to generally increase with decreasing water depth, decreasing altitude of the aircraft, and increasing flight speed (Patenaude et al., 2002). Additionally, most fish species are known to be able to detect lower frequency noises and recordings of helicopter noise show primary frequencies below approximately 400 Hz (Patenaude et al., 2002; Dow Piniak et al., 2012a,b; Martin et al., 2012; Popper et al., 2014). However, helicopters would only be used intermittently to support crew transfers during construction and O&M (**Section 4.1.4.1** of the Project's COP), and given the relatively short duration of construction activities (approximately 18 months), only temporary changes in behavior are expected to occur. Impacts from aircraft noise are considered ***direct*** and ***short-term***.

5.4.1.3 Geophysical Surveys

As discussed in **Section 2.1.5**, geophysical surveys will be conducted prior to construction of the RWF and RWEC to identify any seabed obstructions or potential MEC/UXOs. The likelihood of encountering MEC/UXOs within the Project Area is low, and should one be identified it will be disposed of using methods designed to avoid potential detonation of the device. The preferred approach for MEC/UXO is avoidance, but in a situation where avoidance is not possible, low-noise methods of removal or relocation will be employed (**Section 3.3.3.2** of the Project's COP). Therefore, explosive decommissioning of MEC/UXOs is not considered in this assessment, and only noise from the geophysical survey equipment used to locate potential obstructions was analyzed.

Equipment used during these surveys has the potential to produce noise that would exceed physiological and behavioral thresholds for fish (**Section 4.1**). However, based on previous assessments conducted for marine mammals (CSA Ocean Sciences Inc., 2018, 2020) estimated ranges to physiological thresholds are not expected to exceed more than a few meters, and behavioral thresholds would be <200 m. With the implementation of the environmental protection measures outlined in **Section 5.5**, the risk of impact is low and would be limited to temporary disturbances. Furthermore, due to the relatively short duration of these activities which would only occur during a portion of the full 18-month construction period, impacts are considered ***direct*** and ***short-term***.

5.4.1.4 Impact Pile Driving

Impact pile driving is an impulsive noise source that has the potential to cause barotrauma at close ranges (Halvorsen et al., 2012a,b). Because the effect of changing pressure on the swim bladder is the underlying

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cause of barotrauma, fish without swim bladders like elasmobranchs (i.e., sharks, skates, rays) and flatfish are not as vulnerable to underwater noise impacts as those with swim bladders. Atlantic sturgeon have a relatively small swim bladder which is not directly connected to the inner ear, and they are able to voluntarily release gas from their swim bladder. Therefore, the risk of barotrauma due to exposure to impulsive signals from impact pile driving is lower relative to fish species that cannot release swim bladder gas.

Anticipated noise levels during RWF construction may exceed behavioral thresholds for fish, including Atlantic sturgeon, and may elicit a behavioral avoidance response as observed for some fish species (Becker et al., 2013). A physiological stress response or TTS may also occur due to exposure to impact pile driving noise. The stress response may involve elevated levels of stress hormones (i.e., corticosteroids) as documented for fish exposed to continuous SPL of 153 to 170 dB re 1 µPa (Smith et al., 2004; Wysocki et al., 2006) or increased heart rate following exposure to elevated SPL (Graham and Cooke, 2008).

Elevated noise levels are expected to cause Atlantic sturgeon to temporarily vacate the area (Krebs et al., 2016), resulting in a temporary disruption of feeding, mating, and other essential activities. Atlantic sturgeon have been shown to avoid impact pile driving activities in the Hudson River, and based on this, they were not expected to be exposed to the SEL_{24h} produced by this activity (Krebs et al., 2016). The same avoidance response is expected should Atlantic sturgeon be present during impact pile driving activities at the RWF given the highly mobile nature of this species.

Mean modeled acoustic ranges to Atlantic sturgeon SEL_{24h} thresholds with 10 dB attenuation were approximately 423 m for the 12-m WTG monopile foundations, 945 m for the 15-m OSS monopile foundations, and 781 m for the 4-m OSS jacket foundations (**Section 4.3**). PK ranges were generally smaller, ranging from 42 to 98 m for all pile types and scenarios with 10 dB attenuation applied (**Section 4.3**). Average acoustic ranges for behavioral thresholds were 7 to 8 km for all pile types and scenarios (**Section 4.3**). As discussed in earlier sections, exposure to behavioral thresholds does not constitute behavioral responses, nor are they expected to create any biologically significant consequences.

Atlantic sturgeon are an anadromous species that primarily utilize rivers, bays, estuaries, coastal, and shallow continental shelf waters. However, since Atlantic sturgeon are a demersal species that could potentially be present in the RWF area during impact pile driving activities, behavioral impacts could occur. Because impacts to Atlantic sturgeon from impact pile driving would only occur during the approximate 18-month construction period, impacts are considered ***direct*** and ***short-term***.

5.4.1.5 Vibratory Pile Driving

Vibratory pile driving generally poses less risk of an acoustic impact to fish than impact pile driving because of the non-impulsive nature of the noise produced by vibratory hammers. Unlike impact hammers, which are classified as an impulsive noise source, the sound energy produced by vibratory hammers rises more gradually and SLs are typically 10 to 20 dB lower than those for impact hammers (Buehler et al., 2015).

Vibratory pile driving is not known to produce noise levels that cause mortality in fish due to the non-impulsive nature of this noise source. As such, there are no biological thresholds for mortality associated with non-impulsive noise sources. Modeling was not conducted for cofferdam installation for RWEC; however, information regarding the acoustic properties of DP vessels is provided in Denes et al. (2020). Atlantic sturgeon that are present within the area ensonified at levels exceeding the behavioral threshold are expected to move away from the noise source and avoid the area where the physiological threshold would be exceeded during vibratory pile driving.

Underwater noise produced during vibratory pile driving for the installation and removal of temporary cofferdams would be intermittent and short term, after which, the potential acoustic impacts to Atlantic sturgeon posed by cofferdam installation would no longer be present. Based on these factors and the results of previous acoustic modeling for the South Fork Wind Farm, which demonstrate the relatively small

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spatial extent of acoustic impacts as well as the likely avoidance of this activity by Atlantic sturgeon, there is a low risk of acoustic impacts to this species. Because impacts are only expected during the approximate 3-day period anticipated for vibratory pile driving for installation of temporary cofferdams at RWEC, impacts are considered ***direct*** and ***short-term***.

5.4.1.6 WTG Operations

Noise produced by WTGs is within the hearing range of Atlantic sturgeon. Depending on the noise intensity, such noises could disturb or displace fish within the surrounding area or cause auditory masking (MMS, 2007). However, with generally low noise levels, fish would be impacted only at close ranges (within 100 m) (Thomsen et al., 2006). Thomsen et al. (2006) reviewed the observations of fish behaviors in proximity to an operational WTG and found varying results, from no perceived changes in swimming behavior of European eels (*Anguilla anguilla*) and both increased and decreased catch rates of cod within 100 m of the operational WTGs. Additionally, Atlantic sturgeon are an anadromous species that primarily utilize rivers, bays, estuaries, coastal, and shallow continental shelf waters, and their occurrence in the RWF is expected to be seasonal in very low numbers (**Section 3.3.1**). While there may be some behavioral modifications, these would be localized and would not represent any population-level changes. Therefore, impacts from WTG noise on Atlantic sturgeon are considered ***direct*** and ***long-term***, given the anticipated 20 to 35-year life of the Project.

5.4.2 Vessel Traffic

The potential for Atlantic sturgeon to be struck by a vessel is high and vessel strikes are a fairly common occurrence. Between 2005 and 2008, surveys in the Delaware estuary reported a total of 28 Atlantic sturgeon mortalities, of which 50% were the result of an apparent vessel strike (Brown and Murphy, 2010). Similarly, five Atlantic sturgeon were reported to have been struck by commercial vessels within the James River, Virginia, in 2005, and one strike per 5 years is reported for the Cape Fear River, North Carolina. The majority of strikes occurred near busy ports where entrance channels narrow, or a significant portion of estuary and river habitat is transited by commercial vessels entering a port (Brown and Murphy, 2010).

As previously mentioned, vessel traffic during construction and decommissioning of the RWF would result in a temporary increase vessel traffic within the area; however, it represents a very small contribution in overall vessel traffic in the already heavily trafficked region. Larger construction vessels will generally transit to the work location and remain in the area until installation is complete. These large vessels will move slowly and over short distances between work locations.

Transport vessels will travel between several ports and the RWF over the course of Project construction and decommissioning. These vessels will range in size from smaller crew transport boats to tug and barge vessels. Smaller vessels will also be used for routine maintenance trips during the O&M phase.

The Project-related increase in vessel traffic during all phases is not expected to be significant when compared to other vessel traffic within the region, and most vessels will be slow moving. Additionally, the implementation of vessel strike avoidance measures such as speed restrictions will further reduce the risk of collisions with Atlantic sturgeon. In the unlikely event that an Atlantic sturgeon is struck and injury or mortality occurs, the risk of population-level impacts would be greater given the Endangered status of this population. However, as previously stated, Atlantic sturgeon occurrence in the RWF is expected to be seasonal, and occurrence in the RWEC would be less common than the RWF (**Section 3.3.1**), making it unlikely they would incur population-level impacts due to vessel strikes. Impacts from vessel strikes are considered ***direct*** and ***short-term*** for Atlantic sturgeon during the construction and decommissioning phases, given the relatively short, 18-month duration anticipated for each. As discussed in **Sections 5.2.2** and **5.3.2**, vessels used during the O&M phase will be generally smaller, but will require more trips between the port and the RWF throughout the 20-35 year operational life of the Project, so impacts during this phase are considered ***direct*** and ***long-term***.

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5.5 Avoidance, Minimization and Mitigation

Revolution Wind will implement the avoidance, minimization, and environmental protection measures considered to reduce potential impacts resulting from exposure to underwater noise and vessel traffic during construction and operation of the RWF and RWEC. Revolution Wind, through Orsted NA, is developing a comprehensive Protected Species Mitigation and Monitoring Plan (PSMMP) across all Orsted NA wind leases. The RWF PSMMP will align with all regulatory requirements from BOEM and NMFS by the time necessary for approval of the mitigation and monitoring plans. Details and implementation parameters of each mitigation measure will be provided in the final PSMMP. Additional environmental protection measures beyond those summarized here may be implemented during construction and operations of the RWF and RWEC; and those will be fully detailed in the PSMMP. The mitigation categories that will be used for RWF and REC construction include:

- Noise attenuation through use of a noise mitigation system;
- Establishment of exclusion zones;
- Visual and passive acoustic monitoring;
- Area clearance prior to start of hammer;
- Operational shutdowns and delays;
- Soft start procedures; and
- Vessel strike avoidance and other precautionary procedures.

Project-specific training will be conducted for all Project crews prior to the start of construction activities. Confirmation of the training and understanding of the requirements will be documented on a training course log sheet. Signing the log sheet will certify that the crew members understand and will comply with the necessary requirements throughout the construction activities.

5.5.1 Noise Attenuation

A noise mitigation system is any device or suite of devices that reduces pile driving sound levels that are transmitted through the water. Primary systems reduce the source levels produced by the pile and secondary systems reduce the propagated sound levels of the piling. A noise mitigation system, such as a bubble curtain, hydro damper, or similar, will be used during impact pile driving to decrease the sound levels in the water near the source and thus reduce the impact on marine mammals. Attenuation levels vary by type of system, frequency band, and location. Small bubble curtains have been measured to reduce sound levels from approximately 10 dB to more than 20 dB, but they are highly dependent on water depth, current, and configuration and operation of the curtain (Austin et al., 2016; Bellmann, 2014; Koschinksi and Lüdemann, 2013; Bellmann et al., 2020).

No noise attenuation will be used at the cofferdam due to its location, the activities occurring at the cofferdam, the short time period involved with installation and removal, and very low risk of physiological exposures when other mitigations, as descried in the following sections, are employed.

5.5.2 Establishment of Exclusion Zones

Exclusion zones (EZs) and monitoring zones (MZs) will be established within which Protected Species Observers (PSOs) will monitor for the presence of marine protected species in the vicinity of activities. The size of the EZs and MZs will be based on the type of activity being conducted and the various protected species or species groups expected within the region.

5.5.3 Visual and Acoustic Monitoring

Visual and acoustic monitoring of the established MZs will be performed by qualified and NMFS-approved PSOs. PSOs will be responsible for detecting and identifying marine mammals and sea turtles approaching the established EZs; notifying Project personnel to the presence of species as well as communicating and

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enforcing the action(s) that are necessary to ensure mitigation and monitoring requirements are implemented as appropriate.

5.5.4 Area Clearance

At the start of each impact pile driving activity, PSOs (and/or PAM operators) will clear the EZ before initiation of soft start procedures. A soft start may not be initiated if any marine mammal or sea turtle is observed within the EZ. If a marine mammal or sea turtle is observed within the EZ during the pre-clearance period, a soft start may not begin until the animal(s) has been observed exiting its respective zone or until a designated time period has elapsed with no further sightings.

5.5.5 Soft Start Procedures

Soft start procedures are applicable to impact pile driving only. Every pile installation will begin with a soft start procedure. The soft start procedure is detailed in **Section 3.2.4.2**. A soft start procedure is used to allow animals potentially in the Project Area to detect the presence of the noise-producing activities and depart the area before full power impact pile driving activity begins. A soft start of impact pile driving will not begin until the EZ has been cleared by the PSOs (and PAM operators when applicable), as described above.

5.5.6 Vessel Strike Avoidance and Other Protective Measures

Vessel operators and crew will maintain a vigilant watch for marine mammals and sea turtles, and slow down or stop their vessels if either are sighted to minimize the potential for a vessel strike. Survey vessel crew members responsible for navigation duties will receive site-specific training on marine mammal sighting/reporting and vessel strike avoidance measures. All vessel crew members will undergo Project-specific marine mammal and compliance training and all vessels will adhere to NOAA vessel guidelines, Lease stipulations, and additional restrictions in management areas as necessary. Vessels will maintain Lease-stipulated separation distances and safe maneuvering when in the proximity of marine mammals. Vessels will monitor NMFS North Atlantic right whale reporting systems daily. Additional measures will also be implemented to minimize non-acoustic impacts including:

- Vessels will follow NOAA guidelines for marine mammal strike avoidance measures, including vessel speed restrictions;
- All personnel working offshore will receive training on marine mammal awareness and marine debris awareness;
- All construction and operations vessels will comply with regulatory requirements related to the prevention and control of spills and discharges;
- Accidental spill or release of oils or other hazardous materials will be managed through and Oil Spill Response Plan (OSRP); and
- The IAC, OSS-Link Cable, and RWEC will be buried to a target depth of 1.2 to 1.8 m to the extent feasible. Actual burial depths and the potential need for cable protection measures will be based on a Cable Burial Risk Assessment, which will evaluate seabed conditions, seabed mobility, and risk of interaction with external hazards such as fishing gear and vessel anchors.

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Appendix F: Preliminary Cable Burial Feasibility Assessment

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Appendix G: Emergency Response Plan/Oil Spill Response Plan

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Appendix H: Technical Report Hydrodynamic and Sediment Transport Modeling Report – Rhode Island State Waters

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Final Technical Report

Hydrodynamic and Sediment Transport Modeling Report – Rhode Island State Waters

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List of Abbreviations

CFE	Controlled Flow Excavator
CFL	Courant-Friedrichs-Lewis
cm	Centimeter
COP	Construction and Operations Plan
CT	Connecticut
cy	Cubic Yard
DOER	Dredging Operations and Environmental Research
ENC	Electronic Navigational Chart
ERDC	Environmental Research and Development Center
ESRI	Environmental Systems Research Institute
ft	Foot
GEBCO	General Bathymetric Chart of the Oceans
HDD	Horizontal Directional Drilling
hr	Hour
in	Inch
km	Kilometer
L	Liter
m	Meter
m/s	Meter/Second
MA	Massachusetts
mg	Milligram
mi	Mile
mm	Millimeter
NDBC	National Data Buoy Center
NOAA	National Oceanic and Atmospheric Administration
NY	New York
OCS	Outer Continental Shelf
OSAMP	Ocean Special Management Plan
OSS	Offshore Substation
OSU	Oregon State University
ppm	Parts per Million
RI	Rhode Island
RWEC	Revolution Wind Export Cable
SCVR	Step-Wise-Continuous-Variable Rectangular
SSFATE	Suspended Sediment FATE
SSH	Sea Surface Height
TSHD	Trailing Suction Hopper Dredge
TSS	Total Suspended Solids
USACE	U.S. Army Corps of Engineers
WDPA	World Database on Protected Areas
WTG	Wind Turbine Generator

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EXECUTIVE SUMMARY

This technical report provides details of the sediment effects from the offshore cable burial activities associated with the construction phase of the Revolution Wind Farm Project (Project). The details of the Project are described in Section 3.0 of the Construction and Operations Plan (COP). A description of the Project components is briefly reiterated in this document as they are vital to the cable burial assessment. The Project will include buried cables for the offshore components:

- Up to two high-voltage alternating current submarine cables, located within an approximate 23 mi (37 km)-long corridor within Rhode Island (RI) state waters, to convey power to shore (herein referred to as the Revolution Wind Export Cable [RWEC])

The RWEC will traverse both federal waters and RI state waters, and the modeling of this project was done for activities in both regions. However, this report is specific to state waters and some model results for the sediment-disturbing activities within federal waters are shown in figures but not discussed in this report.

The RWEC will be buried beneath the seabed to the extent feasible as determined necessary by the Cable Burial Risk Assessment and other supporting engineering documents. Burial of the cables may be accomplished using a variety of installation methods (e.g., jet plow, controlled flow excavation [CFE], trailing suction hopper dredge [TSHD]). The resuspension of sediments from the various construction activities may cause a localized sediment plume. A sediment plume is a portion of the water column that experiences a temporary increase in the total suspended solids (TSS) concentration above ambient levels. Over time the plume settles and deposits sediment on the seabed, a process referred to as sedimentation, which is estimated as excess (i.e., above ambient) thickness of sediment accumulated on the seabed.

The objective of this assessment is to characterize the effects of the anticipated sediment-disturbing construction activities proposed to install the Project components. Based on the potential installation methods, conservative assumptions were made to complete this modeling assessment. In support of this objective, RPS performed a hydrodynamic and sediment transport modeling study to simulate the installation activities. The modeling was designed to provide results that characterize the effects of the cable burial in terms of the suspended sediment plume in the water column and the eventual seabed deposition associated with the construction methods. At the time of the modeling study, an export cable route, within the RWEC corridor, and the nearshore landing location were selected as representative locations to be evaluated.

This study assessed the installation of cables which are presented as three distinct study components: (1) the RWEC seabed preparation alternatives, (2) the RWEC installation, and (3) the RWEC landfall. This report is focused on the RI state waters portion of the project, and as such will not discuss the construction activities conducted in federal waters. The modeling associated with the activities in federal waters will be discussed in detail in the COP. A brief description of each study component is provided below.

1. RWEC seabed preparation alternatives – The Project anticipates the potential need for seabed preparation of deeper sediment areas along the RWEC. The evaluation included two different methods: CFE and TSHD. For the TSHD, two disposal methods were evaluated: split bottom barge and continuous overflow.
2. Installation of the RWEC – The RWEC modeling included simulation of installation of one cable (referred to as “circuit”) from the landfall to OSS 1 (Circuit 1). While there is another cable planned from the landfall to OSS 2, the routes follow a similar path and are in proximity to one another. Therefore, the modeled route (Circuit 1) and associated results are considered representative of both routes. Within RI state waters, a 21.4 mi (34.4 km)-long cable was modeled.
3. RWEC landfall – The Project is considering the use of horizontal directional drilling (HDD) for the last segment of the RWEC for its onshore landfall. While two HDD exit pits are anticipated, it is expected that the excavation of each will occur on the order of days apart. Therefore, due to the timing of the excavation, the modeled HDD exit pit is considered representative of both exit pits. The evaluation included two different

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landfall equipment types to excavate the HDD exit pit, which are anticipated to be implemented consecutively: a backhoe excavator and a Venturi eductor device.

This assessment was carried out using hydrodynamic and sediment transport models. Specifically, the analysis included two related modeling tasks:

1. Hydrodynamic Model – Using the HYDROMAP modeling system, develop a three-dimensional hydrodynamic model application for the southern New England OCS. The present study focused on validation of model predictions local to the RWEC and Lease Area. Current fields developed using the HYDROMAP model were used as the primary forcing for the sediment transport and dispersion model.

2. Sediment Transport Model – Using the SSFATE modeling system, model the suspended sediment fate and transport. SSFATE was applied to simulate cable burial construction activities to predict the potential sediment plumes and subsequent sedimentation. The resulting effects were presented in terms of excess TSS or sedimentation introduced from the construction activities. Therefore, the effects are associated only with the modeled construction actives and would be in addition to the natural conditions.

The hydrodynamic model produced spatially- and time-varying predictions of currents across the study area and vertically in the water column throughout the modeling domain. Currents along the RWEC are primarily dominated by tides, particularly near the seabed. The tidal currents continuously change speed and direction, with speeds ramping up and down in magnitude, as it cycles through the flood (move offshore to onshore), slack (minimal movement as currents shift direction) and ebb (move onshore to offshore) stages.

The sediment transport model scenarios were designed to reflect each respective construction method and installation activity. The model input parameters included scenario-specific values for the location of the sediment resuspension in the water column, the rate of resuspension, and the sediment types being resuspended. The sediment transport was simulated for an extended period to evaluate the cumulative impacts throughout the duration of the activity and to ensure sufficient time for sedimentation. The burial depth was based on an assumption which conservatively estimated the volume of sediment resuspended. The simulations produced spatially- and time-varying predictions of water column TSS and seabed deposition for each scenario. The output was post-processed to provide (1) a map of instantaneous concentration, (2) a map of the maximum concentration experienced throughout the entire simulation, (3) a map of the cumulative seabed deposition from the entire simulation, (4) tables that summarized volumes resuspended, (5) tables that summarized the area of deposition over specific thresholds, (6) tables that summarized the maximum extent of deposition thickness over specific thresholds, (7) tables that summarized the maximum extent of TSS above specific thresholds, and (8) the duration of plume exposure over specific thresholds.

The modeling predicted that the cable burial activities will result in plumes of excess TSS in the water column and seabed deposition. The term “excess” refers to above background levels. The TSS plumes are limited to the bottom of the water column for the CFE seabed preparation method and RWEC Circuit 1 burial. The TSS plumes for TSHD seabed preparation and landfall are present throughout the majority of the water column due to the location of sediment introduction and, for the landfall, shallow depths. Each plume is temporary in any given location and will change based on the sediment-disturbing activities and environmental conditions present at the time of construction.

Parameters influencing seabed deposition and TSS water column concentrations include volume and grain size distribution of disturbed sediment, local currents, installation rate, local depth, and location of sediment introduction into the water column. The bullets below describe the summary tables and key results.

Seabed Deposition

- For the seabed preparation segments within RI state waters, deposition exceeding 10 mm is predicted to remain within 688.8 ft (210 m), 1033.2 ft (315 m), and 852.8 ft (260 m) from the route centerline for CFE, TSHD split bottom, and TSHD continuous overflow seabed preparation activities, respectively.

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- For jet plow installation along the RWEC within RI state waters, deposition thickness is not predicted to reach 10 mm. Deposition exceeding 1.0 mm is predicted to remain within 787.2 ft (240 m) from the route centerline.
- Evaluation of the landfall showed that deposition exceeding 10 mm may extend up to 738 ft (225 m) from the exit pit location.

Water Column Concentrations

- For the seabed preparation segments within RI state waters, the predicted concentrations above background (> 0 mg/L) do not persist in any given location (grid cell) for greater than 3.5 hours, 47.8 hours, and 46 hours for CFE, TSHD split bottom, and TSHD continuous overflow seabed preparation activities, respectively. In most locations (> 75% of the affected area within RI state waters) concentrations return to ambient within approximately 2.5 hours for CFE and approximately 16 hours for both TSHD methods. Predicted concentrations greater than 100 mg/L do not persist in RI state waters for greater than 2.3 hours, 13.5 hours, and 13.8 hours for CFE, TSHD split bottom, and TSHD continuous overflow seabed preparation activities, respectively.
- For jet plow installation along the RWEC within RI state waters, predicted concentrations above background (> 0 mg/L) do not persist in any given location (grid cell) for greater than 69.7 hours. In most locations (> 75% of the affected area within RI state waters) concentrations return to ambient within approximately 26 hours. Predicted concentrations greater than 100 mg/L do not persist in RI state waters for greater than 4.5 hours.
- Evaluation of the landfall showed that predicted concentrations above background (> 0 mg/L) do not persist in any given location (grid cell) for greater than 70.3 hours. In most locations (> 75% of the affected area within RI state waters) concentrations return to ambient within approximately 6 hours. Predicted concentrations greater than 100 mg/L do not persist in RI state waters for greater than 70.2 hours.

SSFATE was used to effectively simulate three representative study components of the types of activities that are expected with the Project. The modeling predicted the potential TSS concentrations, deposition thicknesses, exposure durations, and corresponding areas and distances associated with each Project-related construction activity.

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1.0 INTRODUCTION

This technical report provides the details of the sediment effects from offshore cable burial activities associated with the construction phase of the Revolution Wind Farm Project (Project). The details of the Project are described in Section 3.0 of the Construction and Operations Plan (COP). A brief description of the Project components is presented here as they are vital to the cable burial assessment. The Project will include the following components:

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The RWEC will be buried beneath the seabed to the extent feasible as determined necessary by the Cable Burial Risk Assessment and other supporting engineering documentation. Burial of the cables may be accomplished using a variety of installation methods (e.g., jet plow, controlled flow excavation [CFE], trailing suction hopper dredge [TSHD]). The resuspension of sediments from the various construction activities may cause a localized sediment plume. A sediment plume is a portion of the water column that experiences a temporary increase in the total suspended solids (TSS) concentration above ambient levels. Over time the plume settles and deposits sediment on the seabed, a process referred to as sedimentation, which is estimated as excess (i.e., above ambient) thickness of sediment accumulated on the seabed.

The objective of this assessment is to characterize the effects of the anticipated sediment-disturbing construction activities proposed to install the Project components. Based on the potential installation methods, conservative assumptions were made to complete this modeling assessment. In support of this objective, RPS performed a hydrodynamic and sediment transport modeling study to simulate the installation activities. The modeling was designed to provide results that characterize the effects of the cable burial in terms of the suspended sediment plume in the water column and the eventual seabed deposition associated with the construction methods.

This study assessed the installation of cables which are presented as three distinct study components: (1) the RWEC seabed preparation alternatives, (2) the RWEC installation, and (3) the RWEC landfall. This report is focused on the RI state waters portion of the project, and as such will not discuss the construction activities in federal waters. The modeling associated with the activities in federal waters will be discussed in detail in the COP. A brief description of each study component is provided below.

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landfall equipment types to excavate the HDD exit pit, which are anticipated to be implemented consecutively: a backhoe excavator and a Venturi eductor device.

At the time of the modeling study, an export cable route, within the RWEC corridor, and the nearshore landing location were selected as representative locations to be evaluated. The indicative route is within the RWEC corridor as can be seen in Figure 1.1-1, which gives an overview of the RWEC areas within RI state waters. The map shows the RWEC corridor in yellow and the modeled RWEC route in black.

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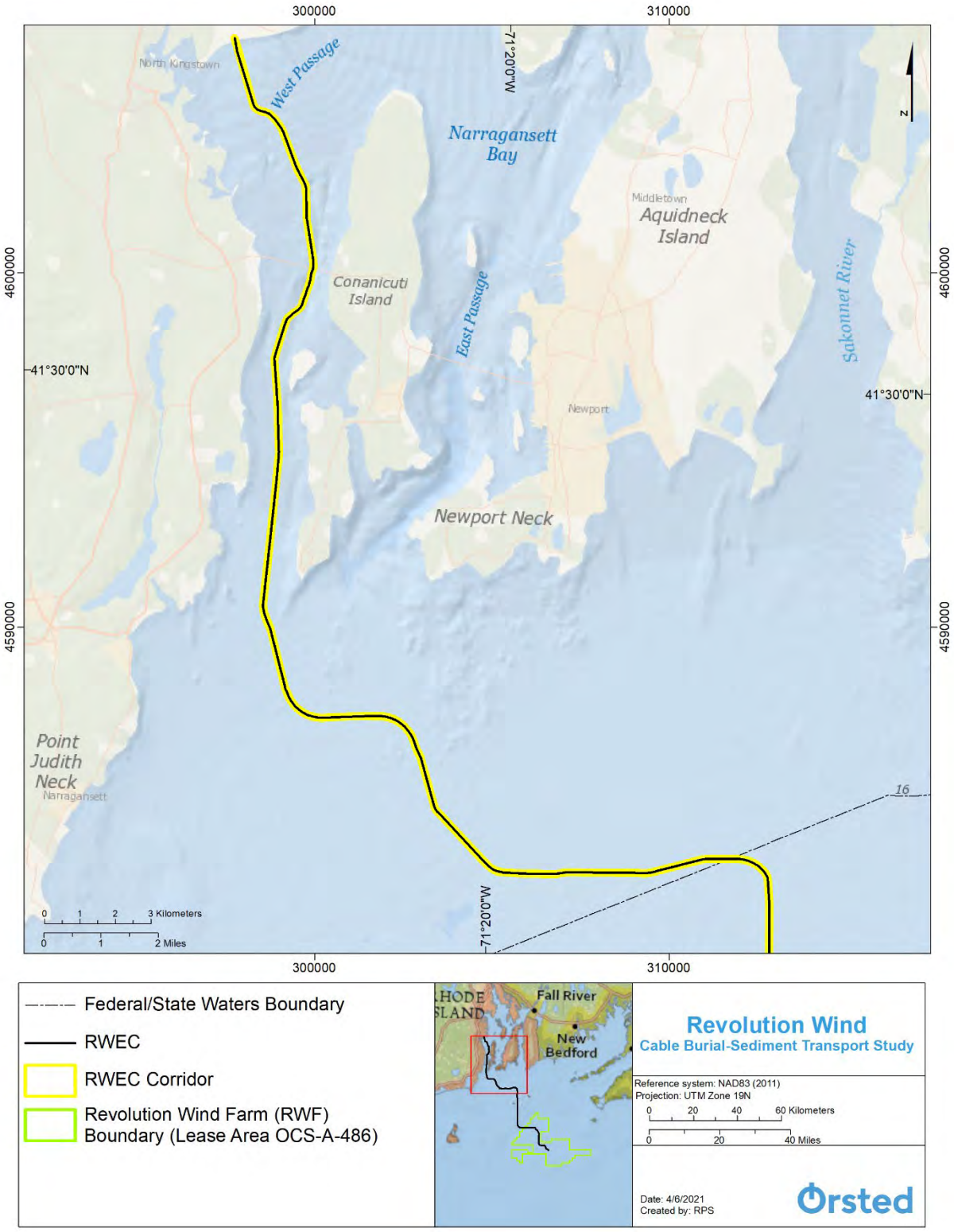

Figure 1.1-1 Location of the Indicative Export Cable Route in the RWEC Corridor within RI State Waters.

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1.1 Study Area

While this report focuses on activities within RI state waters, due to the complex nature of the regional hydrodynamics and its influence on RI state waters, the model domain included the southern New England Outer Continental Shelf (OCS), which lies south of Massachusetts, Rhode Island, and Long Island, New York, and extends from the Hudson Shelf Canyon in the west to Nantucket Shoals in the east. Components of the Project that have potential for sediment disturbance span a relatively large distance, with the RWEC route extending from the Lease Area, which is located between approximately 16 – 28 mi (26 – 46 km) offshore, to a proposed landfall at Quonset Point in North Kingstown, Rhode Island. The currents vary spatially and temporally throughout the domain. The general ocean circulation (currents) across the study area is complex and influenced to some extent by wind-driven processes, tides, and density gradients that arise from combined interaction with adjacent estuaries, solar effects, and heat flux through the air-sea interface (Codiga and Ullman, 2010). Yet, over most of the region, tidal currents are the dominant form of circulation (Spaulding and Gordon, 1982), with wind and density variations playing a smaller role.

Tides in the study area are predominately semi-diurnal (twice per day) with influences from diurnal (once per day) constituents. This results in approximately two high tides and two low tides daily, which cause the ocean currents to flood and ebb in response to the changing water levels. The current direction changes as it floods (moves offshore to onshore) and ebbs (moves onshore to offshore), with a semidiurnal tide resulting in approximately four changes in direction per day in response to the tides. While tidal currents are always present, at some locations they may be overcome by wind or density driven currents. However, tidal circulation dominates in nearshore environments and in Narraganset Bay. Sediments in the study area are characterized by modern marine deposits and reworked glacial and post-glacial outwash deposits. Marine deposits in this region are typically comprised of silty fine sand and are typically up to 6.6 – 9.8 ft (2 – 3 m) thick.

1.2 Regulatory Context and Resource Definition

This assessment has been performed to provide a characterization of the physical effects of the cable burial in terms of the associated suspended sediment plume in the water column and the seabed deposition of sediments disturbed during construction. This study has been performed to provide information that describes impacting factors with respect to activities that disturb the sea bottom and increase turbidity, as required by BOEM guidelines (30 CFR § 585.626(a), (2), and (4) and 30 CFR § 585.627(a), (1), and (2)) for inclusion within the Project's COP.

1.3 Significance Threshold

There are no thresholds of significance for which the effects were evaluated to determine compliance or impact. The results are presented in a manner that allows the reader to view the order of magnitude of the predicted effects. The sediment transport modeling produced predictions of excess TSS and cumulative seabed deposition. The term "excess" refers to above background levels. From this point herein all concentrations refer to excess concentrations. The term "cumulative" with respect to deposition refers to the fact that the deposition in any location may build over time during the cable installation and is the sum of deposition from the modeled activity. The thresholds used to demonstrate the results for TSS and seabed deposition are presented in Table 1.3-1 and Table 1.3-2, respectively.

Table 1.3-1. TSS Concentration Thresholds used for Presentation of Modeling Results.

Concentration Bin Ranges		
Threshold Bin	Parts per Million (ppm)	Milligram/Liter (mg/L)
1	10 - 50	10 - 50
2	50 - 100	50 - 100
3	100 - 200	100 - 200
4	200 - 500	200 - 500
5	> 500	> 500

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Table 1.3-2. Seabed Deposition Thresholds used for Presentation of Modeling Results.

Deposition Bin Ranges		
Threshold Bin	Inches (in)	Millimeter (mm)
1	0.0039 – 0.039	0.1 - 1
2	0.039 – 0.39	1 - 10
3	0.39 – 3.14	10-80
4	> 3.14	> 80

1.4 Regulatory Coordination and Required Permits

This study did not include considerations of regulatory coordination or required permits. It is a stand-alone study characterizing the physical effects of the cable burial activities. The results may be referenced by other components of the Project, which may have regulatory coordination and required permits.

This study has been performed to provide information on impact-producing activities that may disturb the seabed and increase turbidity for consideration in the regulatory process.

1.5 Note on Units and Figures

The text and supporting tables and graphics are presented primarily in Imperial units (e.g., inches, feet, miles, knots) and secondarily in Metric units (e.g., meters, kilometers, meters per second) with the following exceptions:

- In figures where a parameter is presented at a set of round monotonically increasing levels that were established with respect to metric increments.
- Figures and reference to the TSS plume have been made with respect to metric units of mg/L due to this being the most widely use measurement to evaluate TSS plumes.
- Figures and reference to the sediment deposition have been made with respect to metric units of mm due to this being the most widely use measurement to evaluate sedimentation.

Map-based figures in this report have been made primarily using the Environmental Systems Research Institute (ESRI) ArcMap software and incorporate a basemap provided through the application. The map service layer credits do not easily fit on the images and are provided below.

- Main figures use the World Ocean Basemap; the service layer credits are listed below.
  - General Bathymetric Chart of the Oceans (GEBCO) GEBCO_08 Grid version 20100927 and IHO-IOC GEBCO Gazetteer of Undersea Feature Names August 2010 version (https://www.gebco.net), National Oceanic and Atmospheric Administration (NOAA) and National Geographic for the oceans; and DeLorme, HERE, and Esri for topographic content
- Main figures and insets showing figure location use the National Geographic World Map; the service layer credits are bulleted below.
  - Reference Data: National Geographic, ESRI, Garmin, HERE, INCREMENT P, NRCAN, METI
  - Land Cover Imagery: NASA Blue Marble, ESA GlobCover 2009 (Copyright notice: © ESA 2010 and UCLouvain)
  - Protected Areas: IUCN and UNEP-WCMC (2011), The World Database on Protected Areas (WDPA) Annual Release. Cambridge, UK: UNEP-WCMC. Available at: www.protectedplanet.net.
  - Ocean Data: GEBCO, NOAA

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2.0 METHODOLOGY

RPS applied customized hydrodynamic and sediment transport and dispersion models to assess potential effects from sediment resuspension related to cable burial activities expected to take place during the construction phase of the Project. Specifically, the analysis included two interconnected modeling tasks:

- Develop a three-dimensional hydrodynamic model application for the southern New England OCS using the HYDROMAP modeling system. The present study focused on validation of model predictions local to the RWEC and Lease Area. Current fields developed using the HYDROMAP model were used as the primary forcing for the sediment transport and dispersion model.
- Model the suspended sediment fate and transport using the SSFATE modeling system. SSFATE was applied to simulate cable burial construction activities to produce predictions of sediment plumes and sedimentation.

This study was performed in a manner such that the results were produced in terms of the effects as excess, referring to in excess of natural conditions. Therefore, the effects are presented as isolated effects of the construction that occur which would be added to the natural conditions.

2.1 Hydrodynamic Modeling Approach

The Project will include construction activities that disturb the seabed and result in sediment resuspension. In order to evaluate potential sediment resuspension, circulation patterns in the bottom waters were modeled using a three-dimensional hydrodynamic model application. RPS's HYDROMAP hydrodynamic model system (Isaji et al., 2001) was used to develop the model application for the southern New England OCS. The model was used to simulate water levels, circulation patterns, and water volume flux through the study area and to provide the hydrodynamic input (spatially- and temporally-varying currents) for the sediment transport model.

The hydrodynamic modeling included gathering and analyzing environmental data, development of the model grid and boundary conditions, validation of model performance for a period coincident with observations of water levels and currents, and development of currents for scenario timeframes relevant to the sediment transport simulations.

2.1.1 HYDROMAP Model Description

HYDROMAP is a globally re-locatable hydrodynamic model capable of simulating complex circulation patterns due to tidal forcing, wind stress, and freshwater flows, quickly and efficiently, anywhere on the globe. HYDROMAP employs a novel step-wise-continuous-variable rectangular (SCVR) gridding strategy with up to six levels of resolution. The term "step-wise-continuous" implies that the boundaries between successively smaller and larger grids are managed in a consistent integer step. The advantage of this approach is that large areas of widely differing spatial scales can be addressed within one consistent model application. Grids constructed by the SCVR are still "structured," so that arbitrary locations can be easily located to corresponding computational cells. This mapping facility is particularly advantageous when outputs of the hydrodynamic model are used in subsequent application programs (e.g., Lagrangian particle transport model) that use another grid or grid structure.

The hydrodynamic model solves the three-dimensional conservation equations in spherical coordinates for water mass, density, and momentum, with the Boussinesq and hydrostatic assumptions applied. These equations are solved subject to the following boundary conditions:

- At land boundaries, the normal component of velocity is set to zero;

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- At the open boundaries, the sea surface elevation is specified by the dominant tidal constituents, each with its own amplitude and phase from a reference time zone, or as a time series of total surface elevation defined relative to the local surface elevation;

- At the sea surface, the applied stress due to the wind is matched to the local stress in the water column and the kinematic boundary condition is satisfied; and

- At the sea floor, a quadratic stress law, based on the local bottom velocity, is used to represent frictional dissipation and a friction coefficient parameterizes the loss rate.

The numerical solution methodology follows that of Davies (1977) and Owen (1980). The vertical variations in horizontal velocity are described by an expansion of Legendre polynomials. The resulting equations are then solved by a Galerkin-weighted residual method in the vertical and by an explicit finite difference algorithm in the horizontal. A space staggered grid scheme in the horizontal plane is used to define the study area. Sea surface elevation and vertical velocity are specified in the center of each cell, while the horizontal velocities are given on the cell face. To increase computational efficiency, a "split-mode" or "two mode" formulation is used (Owen, 1980; Gordon, 1982). In the split-mode, the free-surface elevation is treated separately from the internal, three-dimensional flow variables. The free-surface elevation and vertically integrated equations of motion (external mode), for which the Courant-Friedrichs-Lewis ("CFL") limit must be met, is solved first. The vertical structure of the horizontal components of the current then may be calculated such that the effects of surface gravity waves are separated from the three-dimensional equations of motion (internal mode). Therefore, surface gravity waves no longer limit the internal mode calculations and much longer time steps are possible. Isaji et al. (2001), and Isaji and Spaulding (1984) provide a detailed description of the model physics and numerical implementation.

HYDROMAP output includes spatially- and temporally-varying fields of current speed and direction. This output is seamlessly integrated as input in RPS' transport models, including SSFATE (sediment transport and fates model).

2.2 Sediment Transport Modeling Approach

Sediment transport associated with the cable burial activities was simulated using RPS's Suspended Sediment FATE (SSFATE) model. The model requires inputs defining the environment (e.g., water depths, currents) and the construction activity loading (e.g., sediment grain size, resuspended volume) to predict the associated sediment plume and seabed deposition. Details of the model and theory are provided in the following sections.

2.2.1 SSFATE Model Description

The Suspended Sediment FATE model (SSFATE) is a three-dimensional Lagrangian (particle) model developed jointly by the U.S. Army Corps of Engineers (USACE) Environmental Research and Development Center (ERDC) and Applied Science Associates (now part of the RPS Group) to simulate sediment resuspension and deposition from marine dredging operations. Model development was documented in a series of USACE Dredging Operations and Environmental Research (DOER) Program technical notes (Johnson et al., 2000; Swanson et al., 2000); at previous World Dredging Conferences (Anderson et al., 2001) and a series of Western Dredging Association Conferences (Swanson and Isaji, 2004). Following dozens of technical studies which demonstrated successful application to dredging, SSFATE was further developed to include the simulation of cable and pipeline burial operations using water jet trenchers (Swanson et al., 2007), and mechanical plows, as well as sediment dumping and dewatering operations. The current modeling system includes a GIS-based interface for visualization and analysis of model output.

SSFATE computes TSS concentrations and sedimentation patterns resulting from sediment disturbing activities. The model requires a spatial- and time-varying circulation field (typically from hydrodynamic model output), definition of the water column bathymetry, and parameterization of the sediment disturbance (source), and predicts the transport, dispersion, and settling of suspended sediment released to the water column. The focus of the model is on the far-field (i.e., beyond the initial disturbance) processes affecting the fate of suspended sediment. The model uses specifications for the suspended sediment source strengths (i.e., mass flux), vertical distributions of

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sediments and sediment grain-size distributions to represent losses (loads) to the water column from different types of mechanical or hydraulic dredges, sediment dumping practices, or other sediment disturbing activities such as jetting or mechanical plowing for cable or pipeline burial. Multiple sediment types or fractions can be simulated simultaneously; as can discharges from moving sources.

2.2.2 SSFATE Model Theory

SSFATE addresses the short-term movement of sediments that are disturbed during processes (e.g., mechanical plowing, hydraulic jetting, dredging) where sediment is resuspended into the water column. The model predicts the path and fate of the sediment particles based on sediment properties, sediment loading characteristics and environmental conditions (bathymetry and currents). The computational model utilizes a Lagrangian (or particle-based) scheme to represent the total mass of sediments suspended over time. The particle-based approach provides a method to track suspended sediment without any loss of mass as compared to Eulerian (continuous) models due to the nature of the numerical approximation used for the conservation equations. Thus, the method is not subject to artificial diffusion near sharp concentration gradients and can easily simulate all types of sediment sources.

The model uses Lagrangian particles to represent the resuspended sediments. Sediment particles in SSFATE are divided into five size classes (Table 2.2-1) based on grain size, each having unique behaviors for transport, dispersion, and settling. The model releases a minimum of one particle per time step per sediment class, though a particle multiplier can be used to release multiple particles per sediment class per time step. The total mass of sediment in each particle reflects the operations and sediment grain size distribution. The mass reflects the amount of sediment that is expected to be resuspended for a given time interval based on sediment production rate and resuspension rate of the equipment, and this mass is further proportioned within each sediment size class based on the characterization of the sediment data at a given location.

Table 2.2-1. Sediment Size Classes used in SSFATE.

Sediment Size Classes in SSFATE			
Class	Type	Size Range Imperial Units (thou)	Size Range Metric Units (microns)
1	Clay	0 – 0.3	0-7
2	Fine silt	0.3 – 1.4	7-35
3	Coarse silt	1.4 – 2.9	35-74
4	Fine sand	2.9 – 5.1	74-130
5	Coarse sand	> 5.1	>130

Horizontal transport, settling, and turbulence-induced suspension of each particle is computed independently by the model for each time step. Particle advection is based on the relationship that a particle moves linearly (in three-dimensions) with a local velocity obtained from the hydrodynamic field for a specified model time step. Diffusion is assumed to follow a simple random walk process. The diffusion distance is defined as the square root of the product of an input diffusion coefficient and the time step is decomposed into X and Y displacements via a random direction function. The vertical Z diffusion distance is scaled by a random positive or negative direction.

Particle settling rates are calculated using Stokes equations based on the size and density of each particle class. Settling of particles mixtures is a complex process due to interaction of the different size classes, some of which tend to be cohesive and thus clump together to form larger particles that have different settling rates than would be expected from their individual sizes. Enhanced settlement rates due to flocculation and scavenging are particularly important for clay and fine-silt sized particles (Swanson et al., 2007; Teeter, 2000) and these processes have been implemented in SSFATE. These processes are bound by upper and lower concentrations limits, defined through empirical studies, which contribute to flocculation for each size class of particles. Outside these limits, particle collisions are either too infrequent to promote aggregation, or so numerous that the interactions hinder settling.

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Deposition is calculated as a probability function of the prevailing bottom stress and local sediment concentration and size class. The bottom shear stress is based on the combined velocity due to waves (if used) and currents using the parametric approximation (Soulsby,1998). Matter that is deposited may be subsequently resuspended into the lower water column if critical levels of bottom stress are exceeded, and the model employs two different resuspension algorithms. The first applies to material deposited in the last tidal cycle (Lin et al., 2003). This accounts for the fact that newly deposited material will not have had time to consolidate and will be resuspended with less effort (lower shear force) than consolidated bottom material. The second algorithm is the established Van Rijn method (Van Rijn, 1989) and applies to all other material that has been deposited prior to the start of the last tidal cycle. Swanson et al. (2007) summarizes the justifications and tests for each of these resuspension schemes. Particles initially released by operations are continuously tracked for the length of the simulation, whether suspended or deposited.

For each model time step the suspended concentration of each sediment class as well as the total concentration is computed on a concentration grid. The concentration grid is a uniform rectangular grid with user-specified cell size that is independent of the resolution of the hydrodynamic data used to calculate transport, thus supporting finer spatial differentiation of plume concentrations and avoiding underestimation of concentrations caused by spatial averaging over larger volumes/areas. Model outputs include water-column concentrations in both horizontal and vertical planes, time-series plots of suspended sediment concentrations at points of interest, and thickness contours of sediment deposited on the sea floor. Deposition is calculated as the mass of sediment particles that accumulate over a unit area. Because the amount of water in the sediment deposited is not known, SSFATE by default converts deposition mass to thickness by assuming no water content.

For detailed description of the SSFATE model equations governing sediment transport, settling, deposition, and resuspension, the reader is directed to Swanson et al. (2007).

3.0 HYDRODYNAMIC MODELING

This section describes the environmental data used to develop the hydrodynamic model application and details of the hydrodynamic model application including model setup, the validation of the hydrodynamic model performance, and the use of the hydrodynamic model application to generate current fields for use in the sediment dispersion modeling.

3.1 Environmental Data

Environmental data including shoreline, bathymetry, winds, tidal elevations, and currents were acquired in order to understand and characterize the circulation local to the Project components in marine waters. The data were used both in developing model forcing as well as for validating the model predictions. The locations of various data sources in relation to the Project components are shown in Figure 3.1-1. Further details on the data sources are provided below. Analysis and presentation of the data used for the study are presented in subsequent sections as appropriate.

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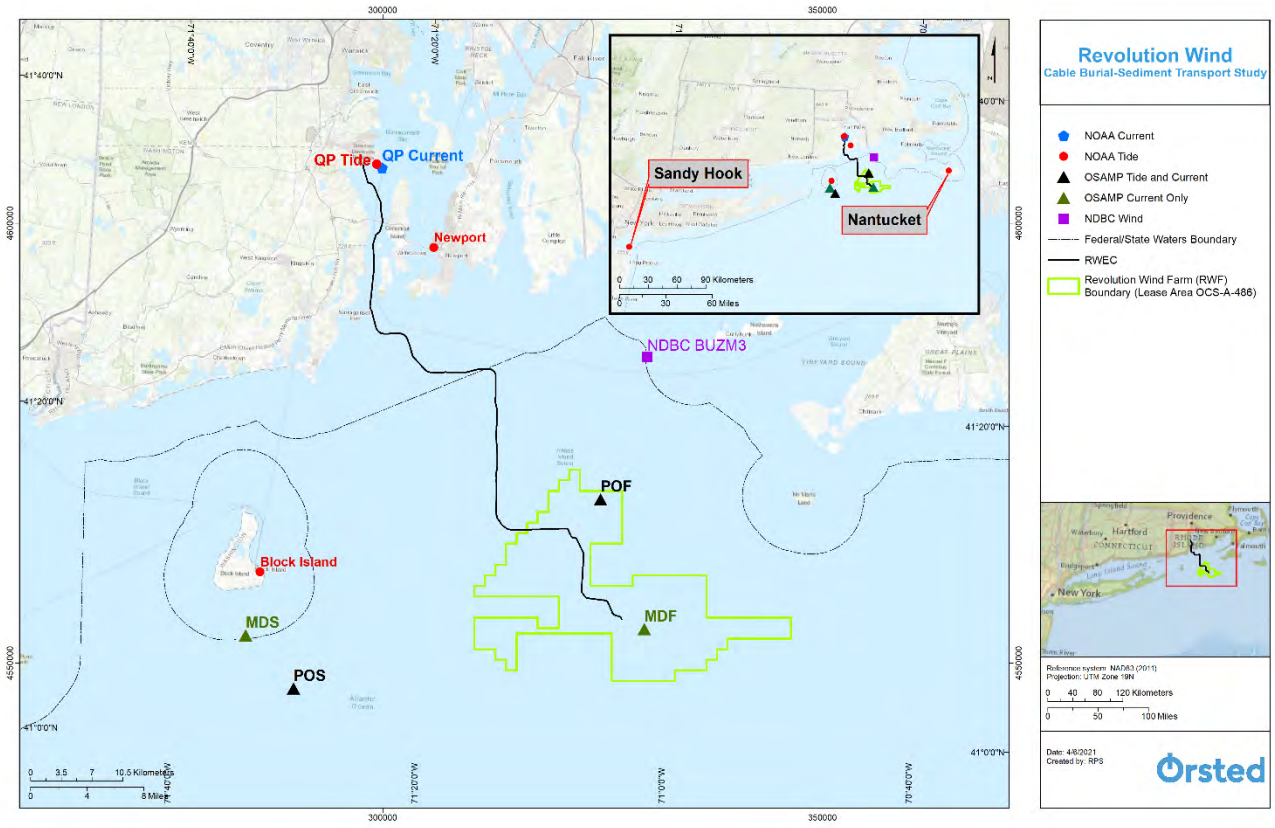

Figure 3.1-1. Location of Environmental Data Observations and Project Components.

3.1.1 Shoreline and Bathymetry

The hydrodynamic model domain extends from New York Harbor to Cape Cod and is significantly larger than the Project footprint. This extent was necessary to accurately locate and define open boundary conditions. The shoreline for the domain was developed based on merging shoreline data from each of the relevant states (Massachusetts [MA; MassGIS, 2017], RI [RIGIS, 2010], Connecticut [CT; CT DEEP, 2017], and New York [NY; NY GIS, 2017]). Bathymetry data was gathered from publicly available data provided by the National Oceanic and Atmospheric Administration (NOAA) for coastal and offshore waters of MA, CT, RI, and NY. NOAA soundings (water depth measurements) were downloaded from the NOAA's Electronic Navigational Chart (ENC) Direct to GIS portal (NOAA, 2019a) and were obtained for the harbor, coastal, and approach ENC band levels. Soundings are available from their native positioning, which is irregular in spacing. The irregular spaced soundings were interpolated to the hydrodynamic grid to provide a complete coverage of water depths within the study area.

3.1.2 Sea Surface Height (Tide) and Current Data

Sea surface height (SSH) and current data were gathered and analyzed for this study. SSH data was used for both developing model forcing and for verification of the hydrodynamic model predictions. Current data was used solely to validate the model predictions.

Sea Surface Height

Multiple sources of SSH data were used in this study. The data were available either as time histories of observations of water surface elevation or in the form of harmonic constituents from either a global model or analysis

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of observational data. Harmonic constituents represent the amplitude and phase of defined periodic constituents of the tidal signal (sine waves with different wave lengths), where the tidal signal is the sum of all constituents added together by superposition. The amplitude describes the difference between a mean sea level datum and the peak water level for a constituent, and the phase describes the timing of the signal relative to a time datum. The constituent period determines the time for one full oscillation of the signal. Tidal harmonic constituents' names indicate the approximate period (e.g., M2 is approximately twice daily and O1 is approximately once daily).

Output from the TPXO7 global tidal model developed by Oregon State University (OSU) was used to characterize the tides at the hydrodynamic model open boundaries. The TPX07 model output contains tidal harmonic constituent data on a ¼ degree resolution across the globe. The model is based on data from the TOPEX/Poseidon and Jason satellites, and the model methodology is documented in Egbert et al. (1994) and Egbert and Erofeeva (2002). A summary of the constituents obtained, and their specific periods, is provided in Table 3.1-1. Details on the spatially-varying amplitude and phase used as boundary forcing are provided in Section 3.2.2.

Table 3.1-1. Tidal Constituents Used at Hydrodynamic Model Boundaries.

Tidal Boundary Characteristics			
Name	Constituent	Speed (Degrees/Hour)	Period (Hours)
M2	Principal lunar semidiurnal constituent	28.98	12.42
S2	Principal solar semidiurnal constituent	30.00	12.00
N2	Larger lunar elliptic semidiurnal constituent	28.44	12.66
K1	Lunar diurnal constituent	15.04	23.93
O1	Lunar diurnal constituent	13.94	25.82

Observational based tide data was obtained from NOAA Center for Operational Oceanographic Products and Services (CO-OPS) or from activities associated with the Rhode Island Ocean Special Management Plan (OSAMP). The location of observation stations used in this study are shown in Figure 3.1-1.The NOAA CO-OPS program provides historical observations of water level, along with published harmonic constituents of the tides based on their analysis of the observations. The OSAMP included a temporary field program during which four buoys (POF, POS, MDS, MDF) were deployed to collect metocean observation data. Two of those buoys (POF and POS) included observations of pressure which was converted to water depth; the oscillating water depth was used to determine the tidal characteristics at these locations. The harmonic constituents of these stations were published in Grilli et al. (2010). The time history of observations from the OSAMP stations had also been previously provided to RPS through the researches working on the OSAMP. The observations of water levels were used to evaluate the model predictions (Section 3.2.3.1).

Current Data

Observations of currents were obtained from four OSAMP stations (MDF, MDS, POF, POS) and from one NOAA CO-OPS station (NOAA station nb0301 located offshore Quonset Point [QP]). The location of these stations are shown in Figure 3.1-1. The OSAMP buoys included observations at multiple depths throughout the water column processed to provide a value in discrete bins. The NOAA CO-OPS station has only one point of measurement in the upper water column (12 ft [3.6 m] below the surface). A summary of metrics for each station is provided in Table 3.1-2. Further details and discussions on the OSAMP oceanographic instrumentation and observations can be found in Codiga and Ullman (2010). The current observations were used for verification of model predictions. These are presented in Section 3.2.3.1.

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Table 3.1-2. Current Observations.

Current Observation Data				
Source	Location	Point or Profile	Bin Resolution, Feet (ft) (Meters [m])	Time Step (Hours)
NOAA	Quonset Point, RI	Point – Upper Water Column	NA	0.10
OSAMP	POS	Profile	2.46 (0.75)	2.00
OSAMP	POF	Profile	2.46 (0.75)	2.00
OSAMP	MDF	Profile	3.28 (1.00)	1.00
OSAMP	MDS	Profile	3.28 (1.00)	1.00

Wind Data

The hydrodynamic model forcing also includes surface winds, and thus a record describing the wind speed and direction during the simulation period was needed. Additionally, wind data was used to select representative timeframes with typical wind characteristics for running the model to develop currents for use in the sediment transport modeling. Winds observed at the National Data Buoy Center (NDBC) Buzzards Bay station BUZM3 were obtained and used in this study. This data was available at an hourly time step and the most recent ten years of data (2009 – 2018) was obtained for analysis (NDBC, 2019).

3.2 HYDROMAP Hydrodynamic Model Application

A model application of the study area was developed using the HYDROMAP hydrodynamic model system. This included development of a model grid and grid bathymetry, development of boundary forcing (tides and wind), and selection of numerical parameters. The model set-up allows for three-dimensional simulations, which were utilized for this study. The vertical structure is represented by Legendre polynomials; in this instance four polynomials were used to represent the vertical variability in the currents from tidal and wind forcing. The model application was first verified against observations for a period of November 25 – December 25, 2009 and then subsequently run for a period of time identified as having typical winds that was sufficient for model simulations of cable installation (April 1 – May 15, 2016).

3.2.1 Model Grid

The complete model domain extends from New York Harbor at the westernmost extent, to Cape Cod at the eastern extent. Although this domain is significantly larger than the study area, the extent was chosen to best locate and define open boundary conditions. The computational grid for the entire domain, consisting of 24,506 active water cells, is shown in Figure 3.2-1. The hydrodynamic model grid was mapped to the shoreline with grid cell resolution ranging from approximately 3,281 – 820 ft. (1.0 km – 250 m); the resolution is coarse further from the shore and becomes finer in the areas closest to the shore to capture the physical characteristics of the shoreline/bathymetry. The model grid bathymetry was assigned by interpolating a set of individual data points onto the model grid. For grid cells that contain multiple soundings, the values are averaged; grid cells without soundings are interpolated based on the closest soundings. The final gridded bathymetry is shown in Figure 3.2-2 and a zoomed-in view of the grid is presented in Figure 3.2-3.

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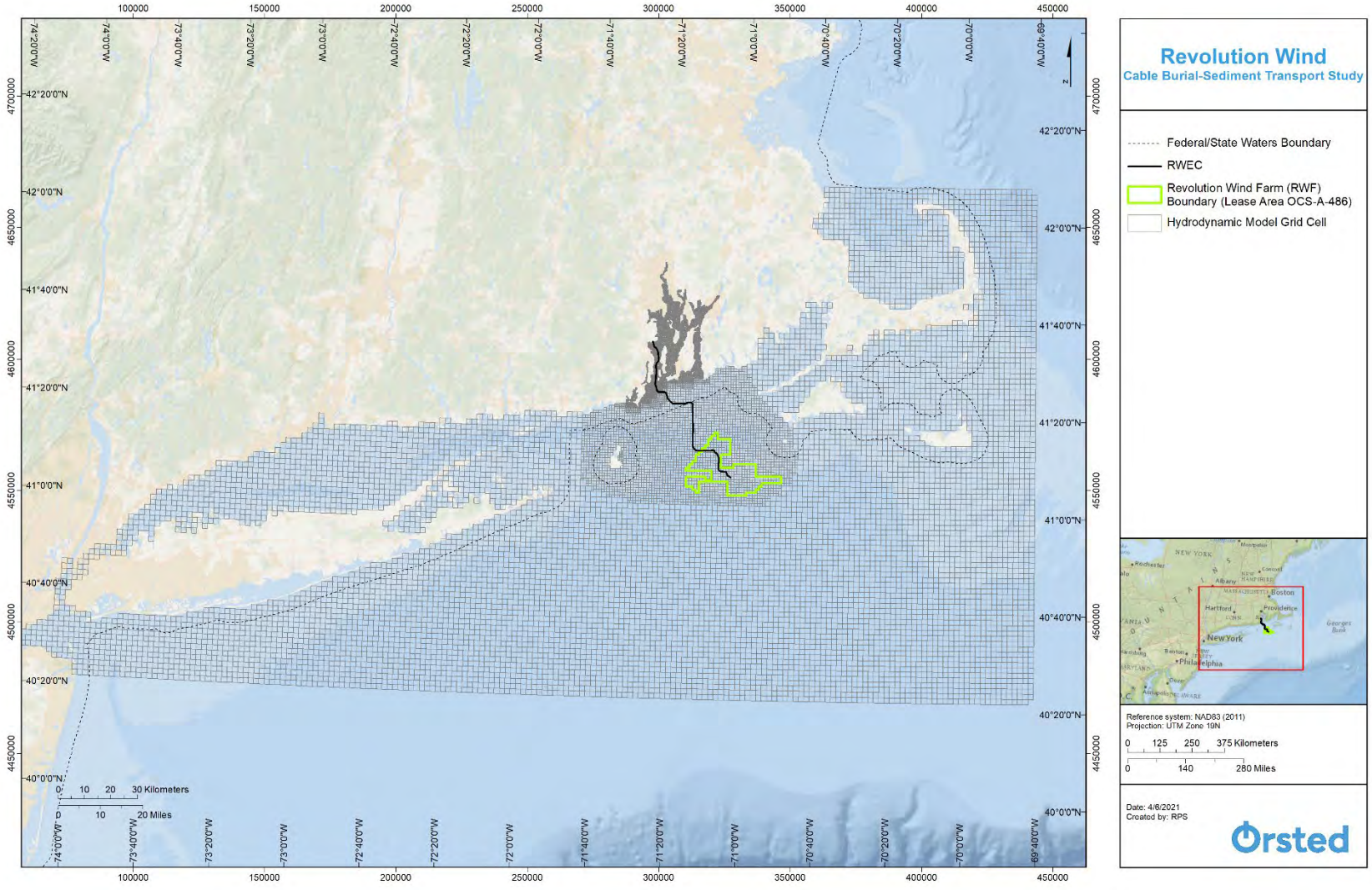

Figure 3.2-1. Hydrodynamic Model Grid.

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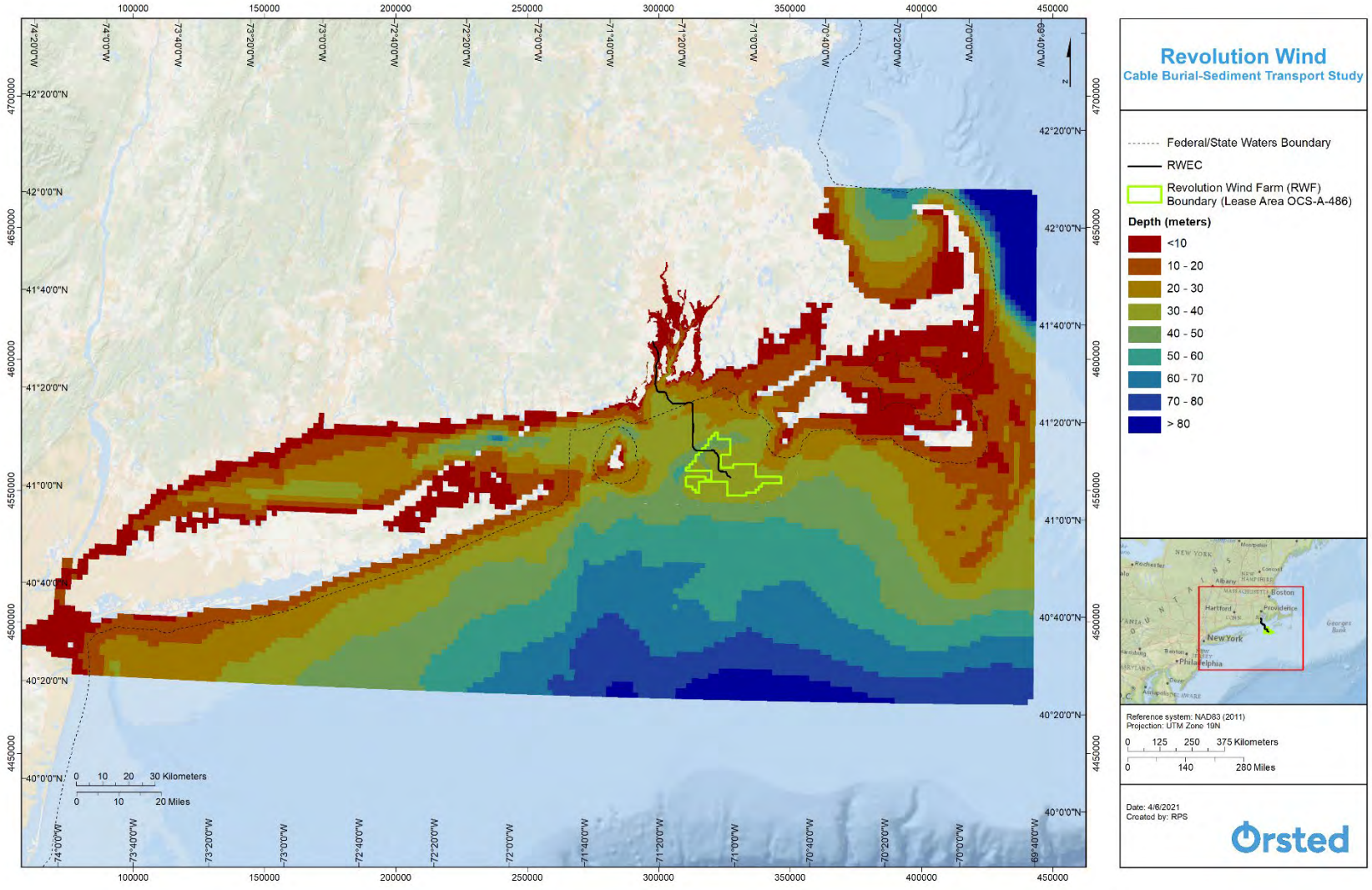

Figure 3.2-2. Hydrodynamic Model Grid Bathymetry.

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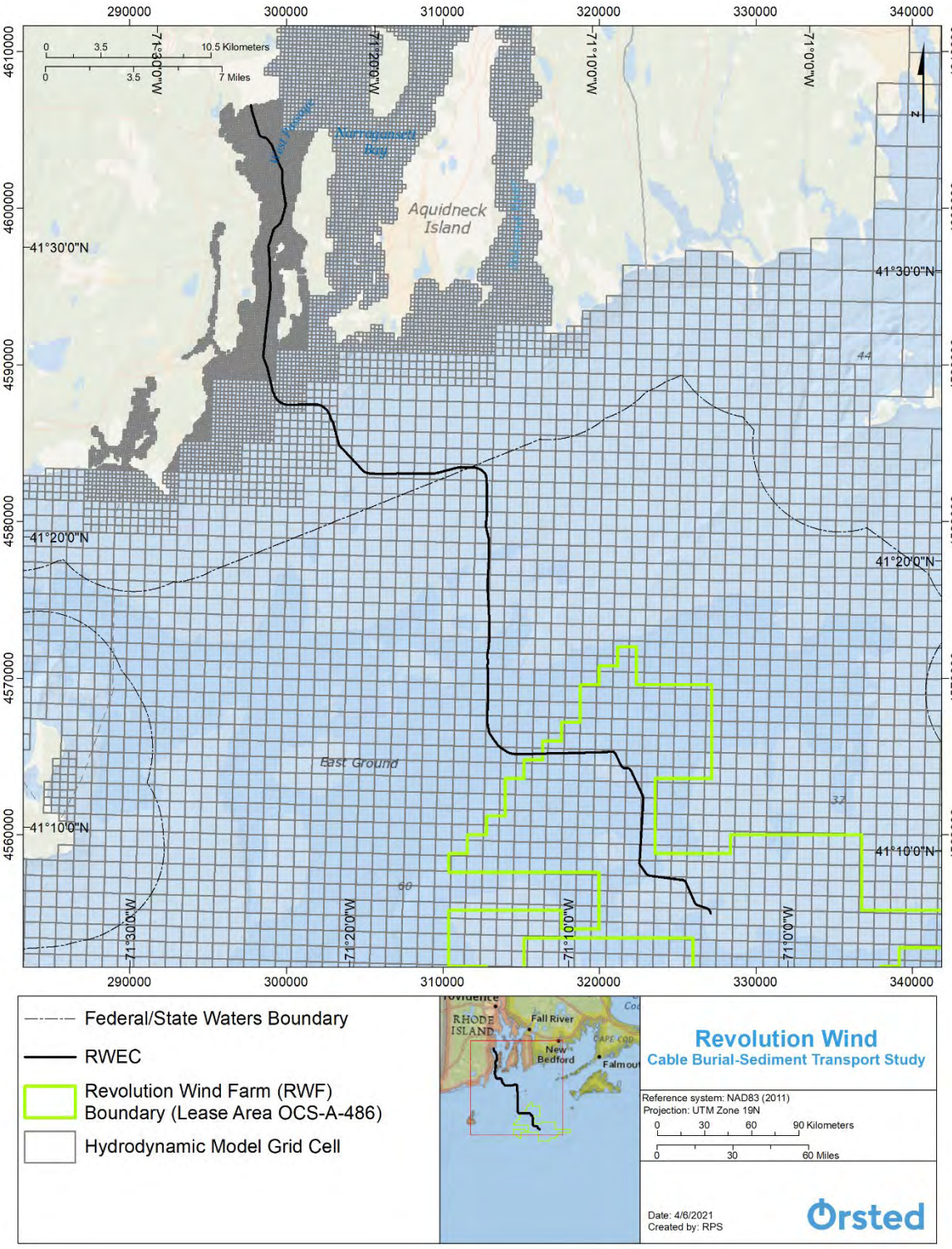

Figure 3.2-3. Zoomed-in View of Hydrodynamic Model Grid Focused on Project Components.

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3.2.2 Model Boundary Conditions

Model boundary conditions for this application included specification of tidal characteristics at open boundary water cells at the edge of the domain and surface winds applied to all cell surfaces.

Tidal Boundary Conditions

The circulation in the study area is tidally dominated, and therefore an important feature of the model application is the characterization of tidal boundary conditions. Harmonic constituent data extracted from the TPXO global tidal model was used at the model open boundaries. Each boundary cell was assigned a unique set of the harmonic constituent amplitudes and phases, interpolated from the TOPEX model predictions. In total, the open boundary was specified for the five predominant tidal constituents in the area: three semi-diurnals (M2, N2, and S2) and two diurnals (K1 and O1). The dominant tidal constituent in this region is the M2-principal lunar semi-diurnal (twice daily) constituent. Illustrations of amplitude and phase of the M2 constituent along the model grid open boundaries are shown in Figure 3.2-4 and Figure 3.2-5, respectively. Figure 3.2-4 illustrates that the M2 amplitude is greater than 1.31 ft (0.4 m) in most places, with the exception of the southeast region of the domain. Figure 3.2-5 illustrates how the M2 phase is generally similar parallel to Long Island and Narragansett Bay.

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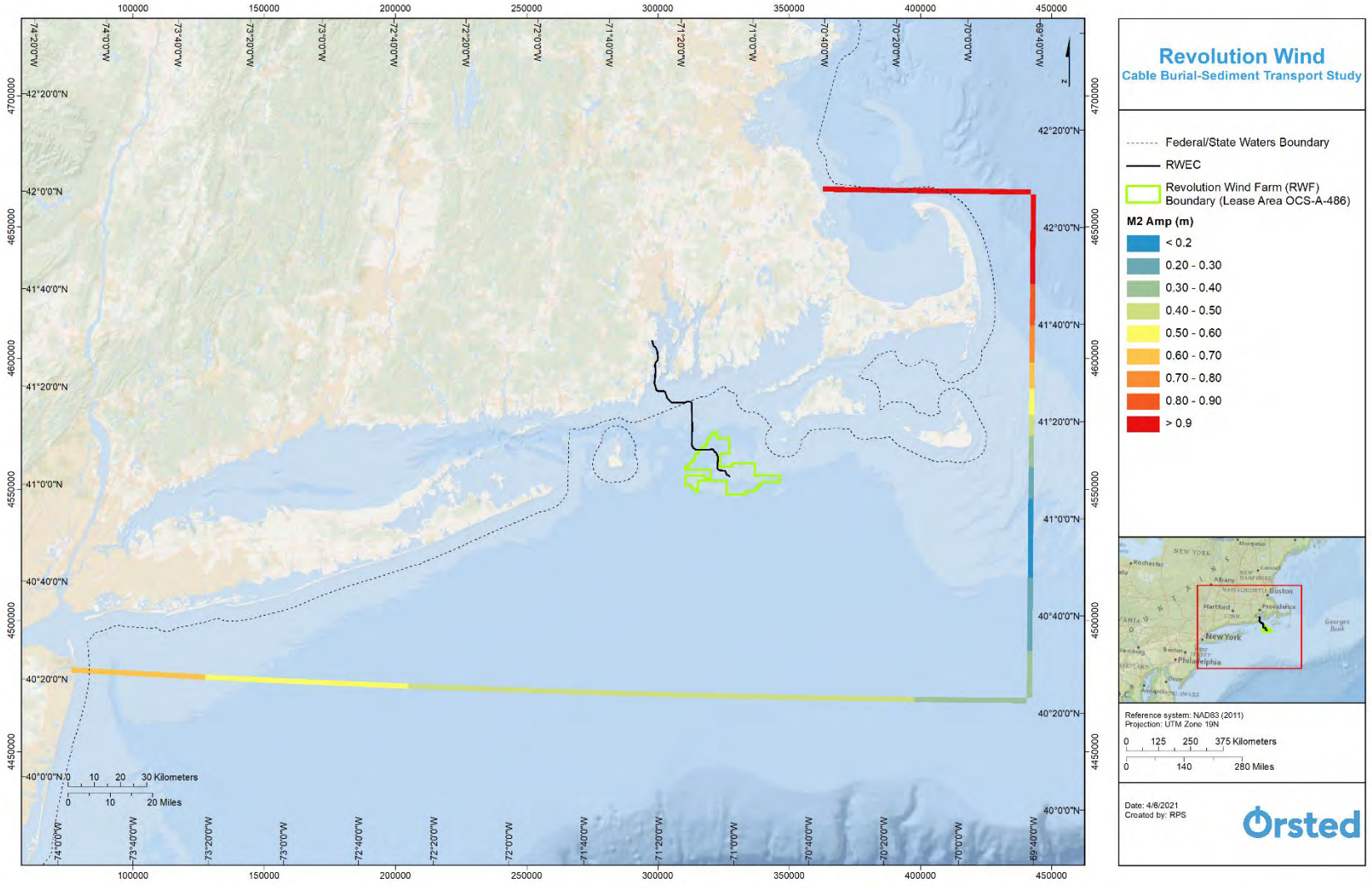

Figure 3.2-4. Tidal Boundary Forcing: M2 Amplitude.

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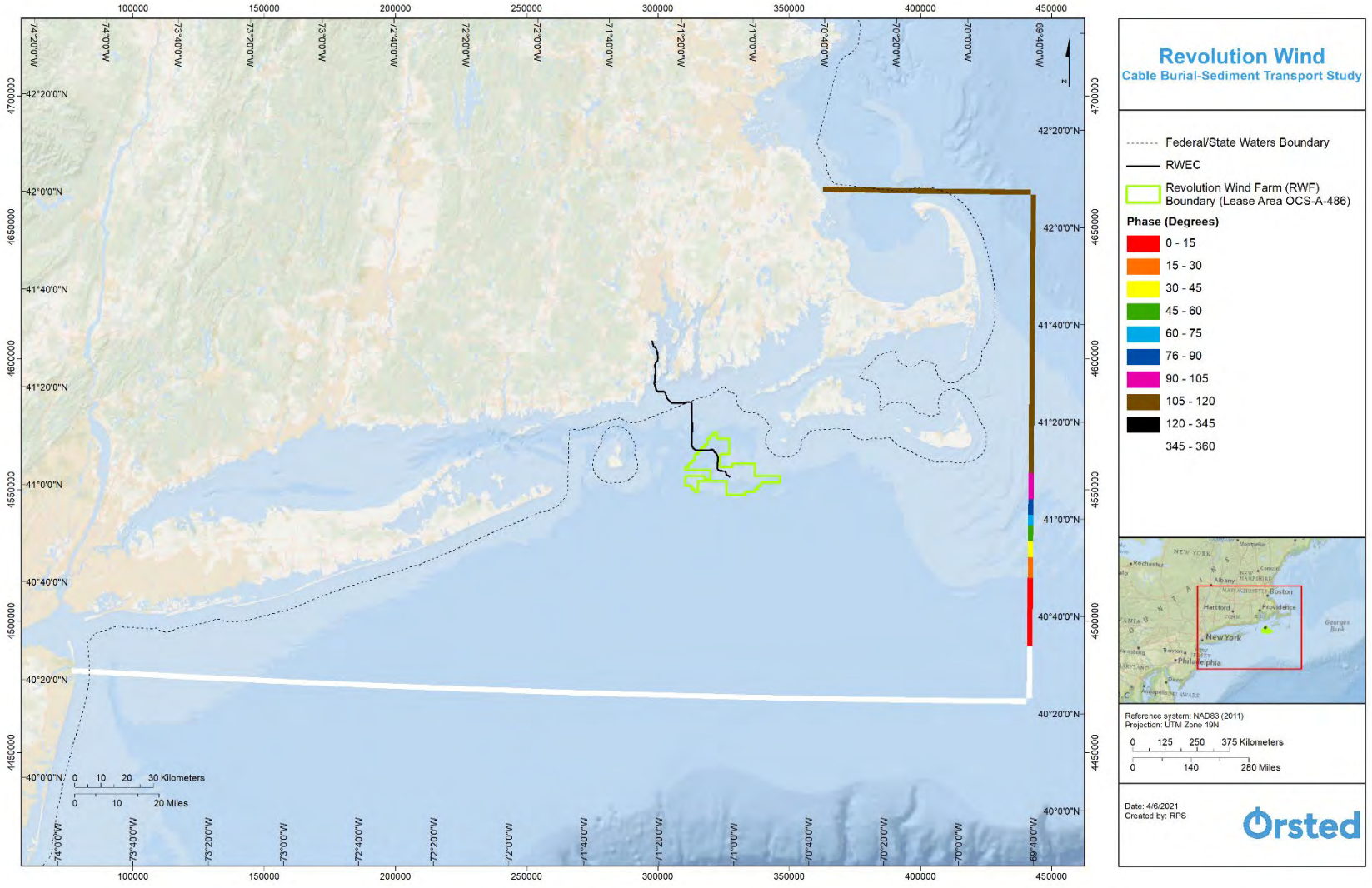

Figure 3.2-5. Tidal Boundary Forcing: M2 Phase.

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Meteorological Boundary Conditions

The water surface boundary covers the entire gridded area and is influenced by wind speed and direction. Meteorological data was obtained from the NDBC Buzzards Bay Station (NDBC, 2019) and was applied to the entire grid surface. The wind rose from the validation period is shown in Figure 3.2-6. The wind rose generated from the record of winds within the most recent ten (2009-2018) is presented in Figure 3.2-7. The wind rose represents speed with colors and direction by the size of the rose 'petals', with each petal representing a directional field (e.g., Northeast) and located within the compass rose in accordance with the direction from which the wind is coming. The winds at this location come predominantly from the southwest. Details of the winds used for the different modeling periods are presented in Section 3.2.1.4.2.

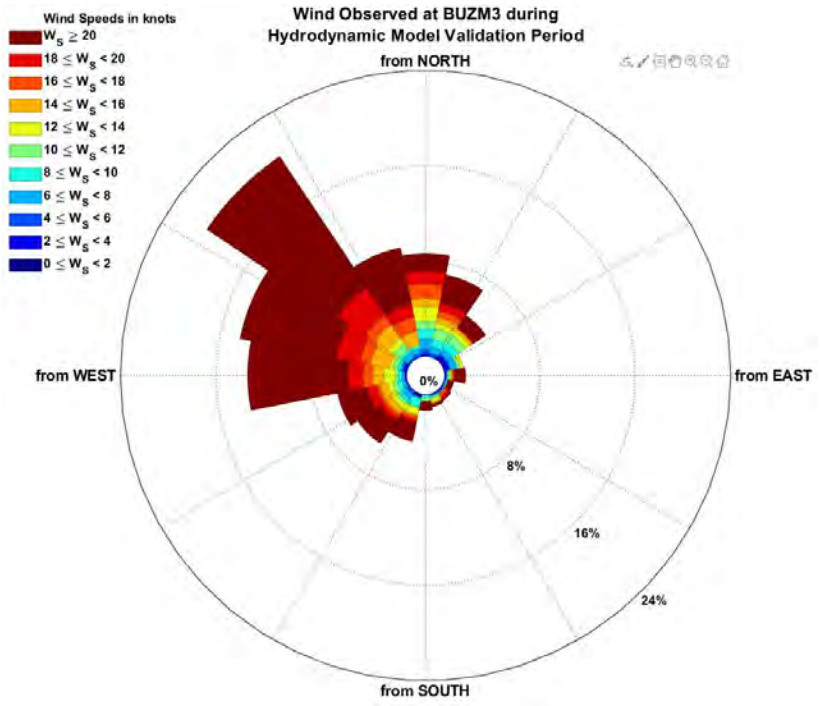

Figure 3.2-6. Wind Rose from Observed NDBC Station BUZM3 from the Hydrodynamic Model Validation Period of November 25, 2009 – December 25, 2009.

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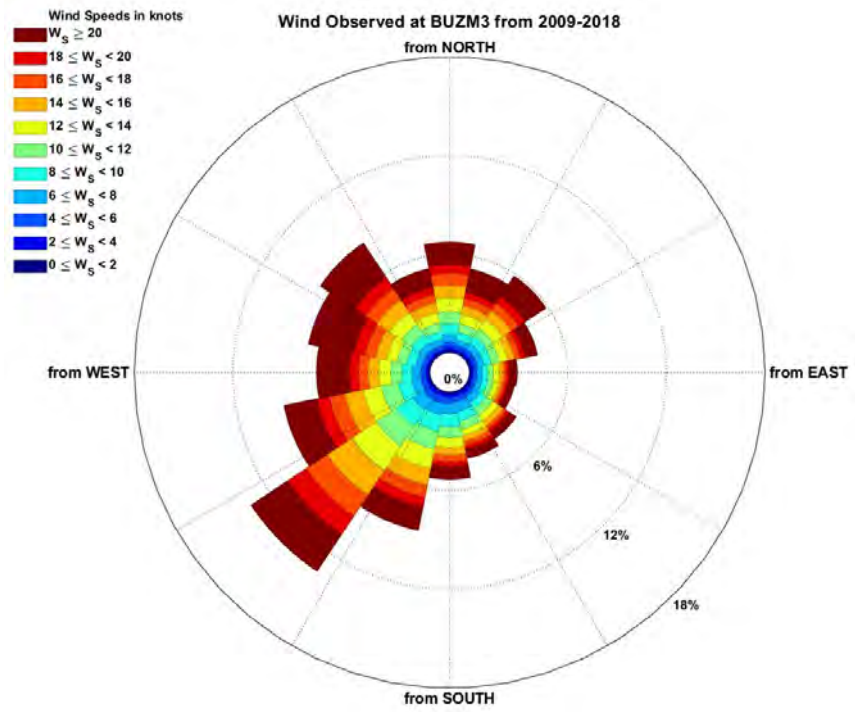

Figure 3.2-7. Wind Rose from Observed NDBC Station BUZM3 from 2009-2018.

Selection of Representative Periods for Sediment Transport Modeling Based on Wind

The exact timing of the Project cable burying activities is not known at this time. The approach for the cable burial modeling is to use currents that reflect a typical timeframe. Currents local to the planned cable burial activities vary primarily due to tides and winds. Since tides do not vary seasonally, an analysis of monthly wind records was conducted to define the scenario timeframes.

The most recent ten-year record of winds at BUZM3 (2009-2018) was analyzed to evaluate the wind characteristics and to select a typical timeframe. Monthly average speeds were calculated for the full record and were assessed quantitatively and qualitatively to determine which year had monthly averages that most closely represented the full record. The monthly average wind speed ranges from 7.45 knots (3.8 m/s) to 20 knots (10.3 m/s) and the annual speed at this location is 14.9 knots (7.6 m/s). The trends of individual years were investigated through analysis of the monthly average wind speeds. A two-plot figure showing (1) the differences in monthly average wind speed from the full 10-year record, and (2) the selected typical year (2016) along with the record average, is presented in Figure 3.2-8.

As shown in Figure 3.2-9, the monthly averages during 2016 remain close to the record averages throughout the year with no extreme outliers. It can also be seen that April 2016 has winds close to the annual average from the 10-year record. Based on this analysis, a scenario simulation period used to develop currents for the sediment transport modeling of April 1, 2016 – May 15, 2016 was established to generate currents for use in the sediment transport modeling. The wind roses for the long term ten-year record and this scenario simulation period are shown in Figure 3.2-9. The long term record shows that winds are predominately from the southwest followed by a relatively high frequency of occurrences from the northwest (though the wind rose indicates that the winds blow from all directions for some portions of the year). The scenario simulation period captures the southwest predominance, though it does have a relatively greater fraction of winds from the northeast.

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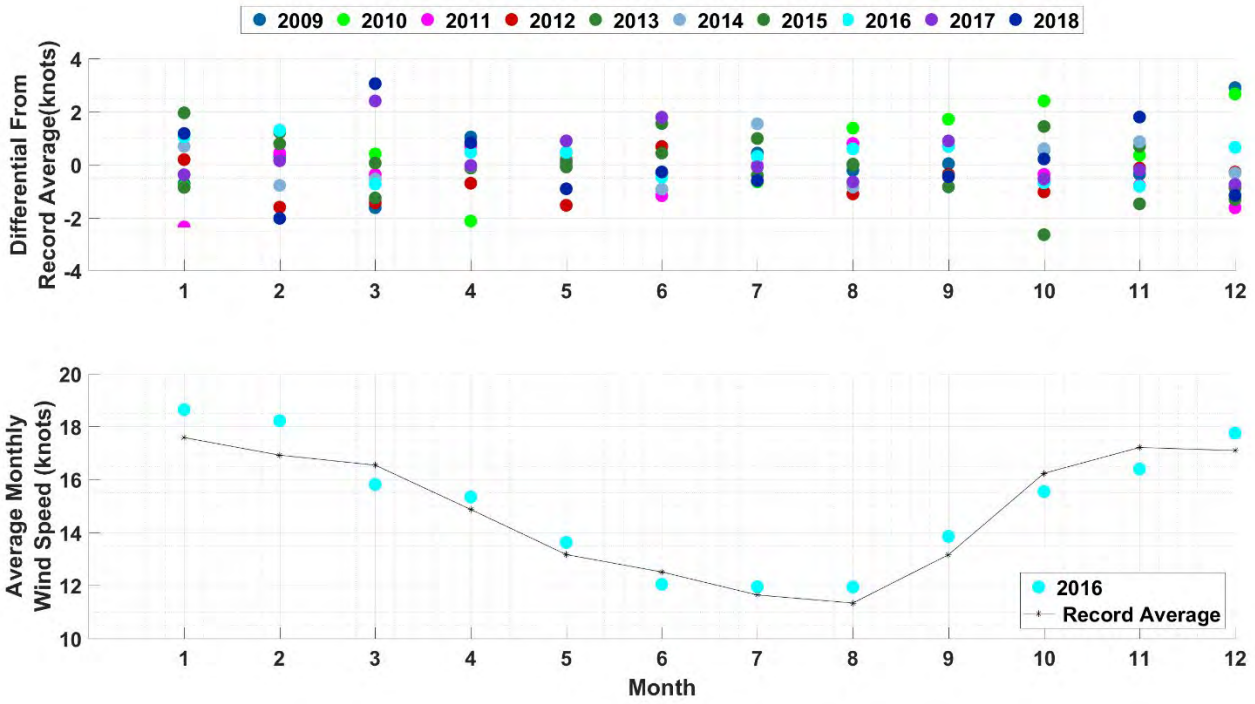

Figure 3.2-8. Monthly Average Wind Speeds. Differential Between Monthly Average Wind Speed for a Given Year and the Record Monthly Average (Top) and Monthly Average Wind Speeds for the Selected Typical Year (2016) as well as the Record Average (Bottom).

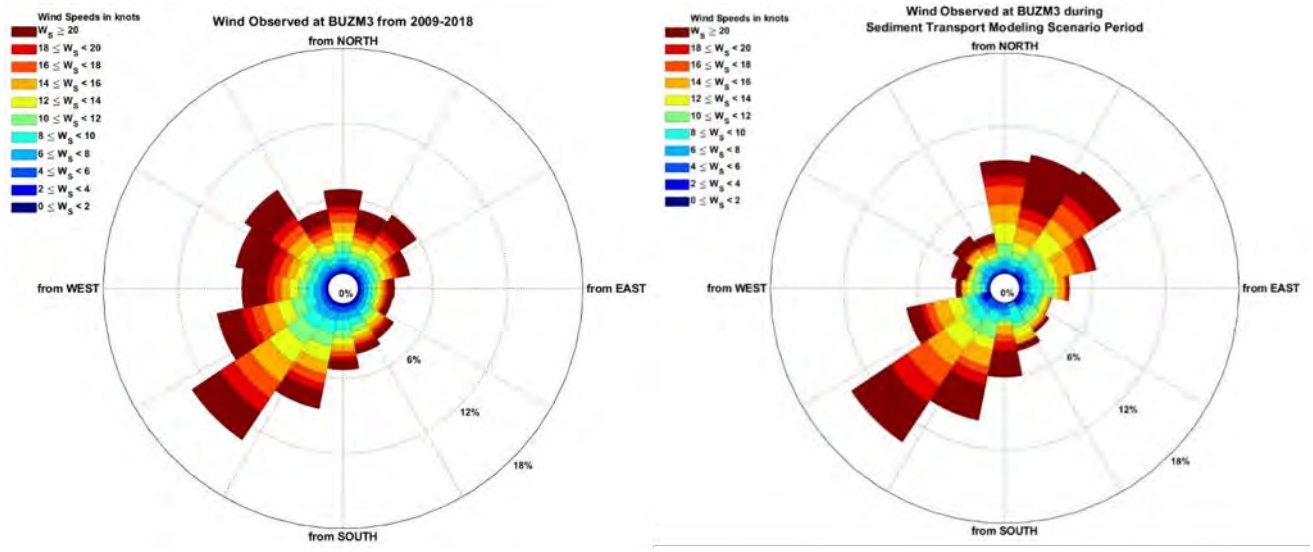

Figure 3.2-9. Wind Rose from Observed NDBC Station BUZM3 from the Most Recent 10 Year Record of 2009-2018 (Left) and the Scenario Period of April 1, 2016 – May 15, 2016 (Right).

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3.2.3 HYDROMAP Hydrodynamic Model Results

The hydrodynamic model application was first run to verify model performance and subsequently to generate currents for use in the sediment transport model simulations. The following sections provide the results from both simulations.

3.2.3.1 Model Validation Results

The model was run from November 25, 2009 through December 25, 2009 to verify model performance. This period was chosen because it lies within the time period of available tide and current observations from the OSAMP.

HYDROMAP predictions of water elevation are shown along with observations of water levels in Figure 3.2-10 and Figure 3.2-11. Note that the Block Island station did not have observations available for this time period. However, a record of expected water level was generated based on the harmonic constituents using the publicly available T_Tide Matlab Toolbox and the NOAA published data. Methodologies of the T_Tide toolbox are described in Pawlowicsz et al. (2002). The generated time history was used for comparisons of the model predictions of water level at these locations. Figure 3.2-10 and Figure 3.2-11 show that the model was able to recreate the spatial and temporal variability in the tide across the domain. The model recreated the semidiurnal nature of the tides and further was able to reproduce the spring/neap cycle of changing tidal amplitude. The model response to wind driven setup and surge is less pronounced. However, the daily variations in tidal energy is captured well.

HYDROMAP predictions of currents were compared to observed currents at five locations through comparison of current roses; these are presented in Figure 3.2-12 through Figure 3.2-16. The OSAMP stations had observations throughout the water column and therefore comparisons of surface, mid, and bottom currents were made (Figure 3.2-12 - Figure 3.2-15). The NOAA CO-OPS station measures only upper water column currents near Quonset Point, therefore a comparison of only surface current roses were made (Figure 3.2-16). These figures show that the model was able to recreate general circulation patterns. The order of magnitude of the speeds was recreated, and the spatial variability was captured. For example, both the model and observations showed that current speeds were stronger at the OSAMP MDS and MDF stations compared to the OSAMP POS and POF stations. The model was able to recreate the trend in variability in current direction. For example, with respect to bottom currents, the model recreated the predominate northeast current at OSAMP POS, the predominate southeast current at OSAMP MDF, the less singularly predominate direction of OSAMP MDS, and the predominately eastern current at OSAMP POF. Similarly, at the surface, the Quonset Point station the model was able to recreate the predominately rectilinear nature of the currents that oscillate between northeast and southwest, though the observations showed a southern residual that was not captured in the model. Differences in predicted directions are likely due to influences from larger scale circulation features in the region at large that are not simulated with this model application.

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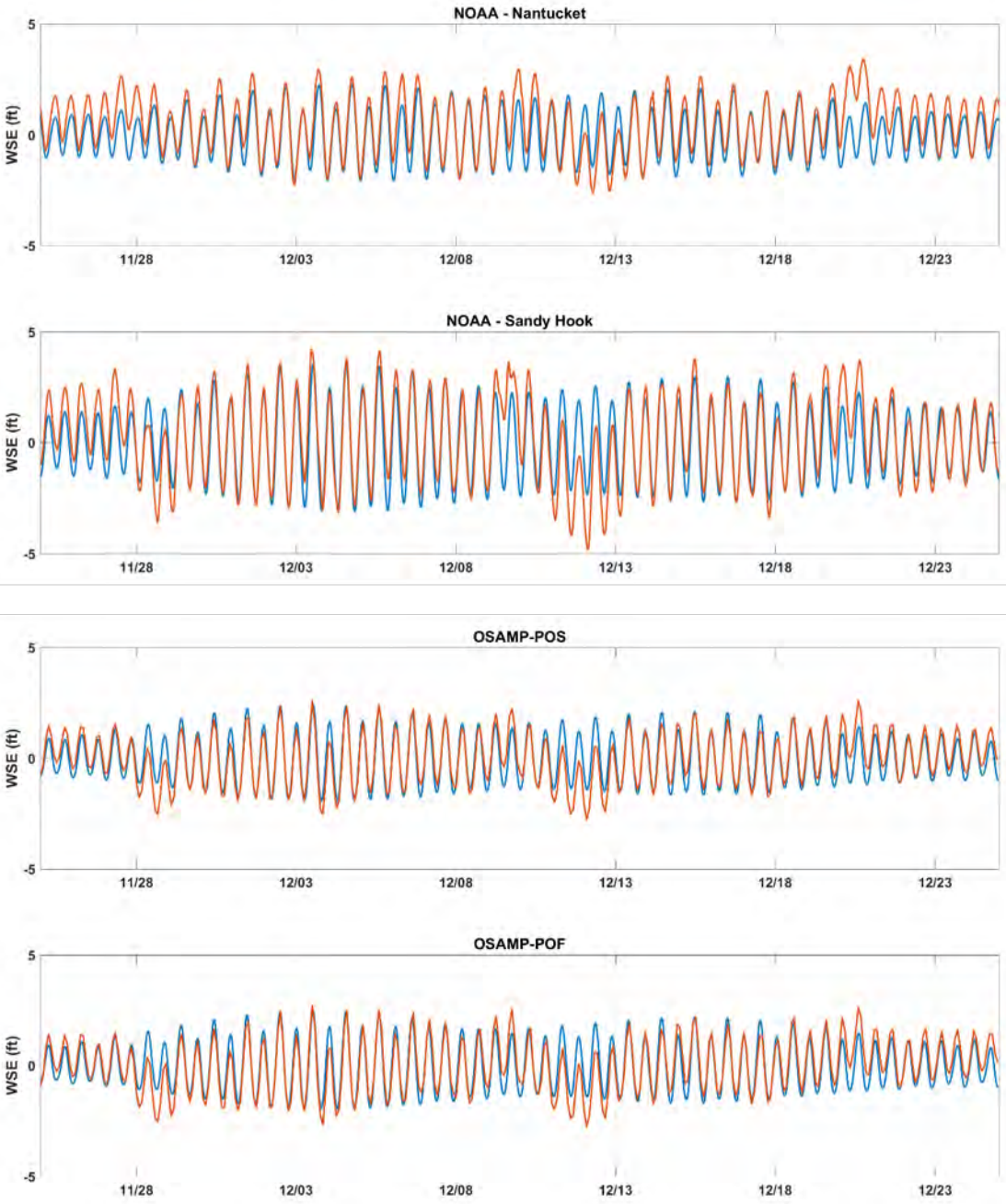

Figure 3.2-10. Model-Predicted (Blue) vs. Observed (Orange) Surface Water Elevations at Locations within the Model Domain (1 of 2).

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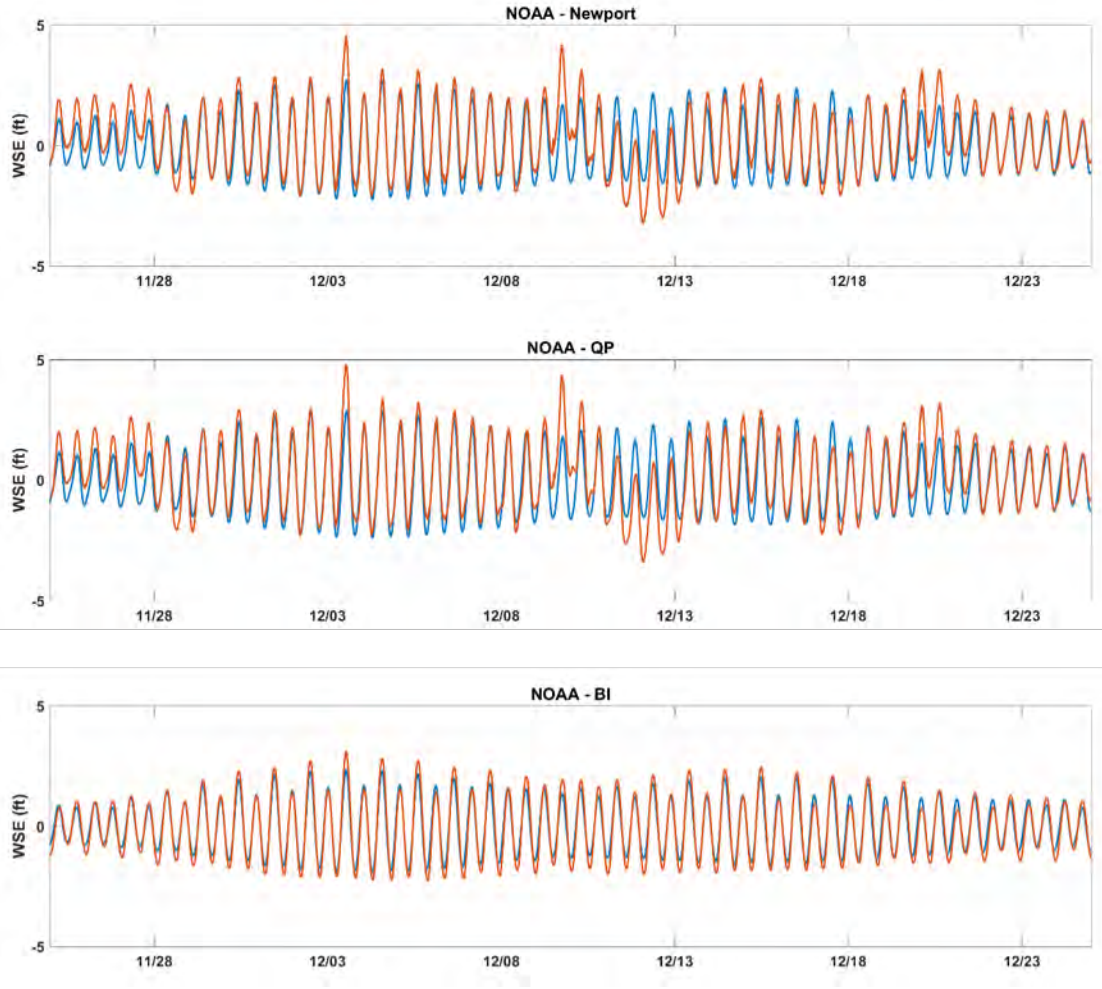

Figure 3.2-11. Model-Predicted (Blue) vs. Observed (Orange) Surface Water Elevations at Locations within the Model Domain (2 of 2).

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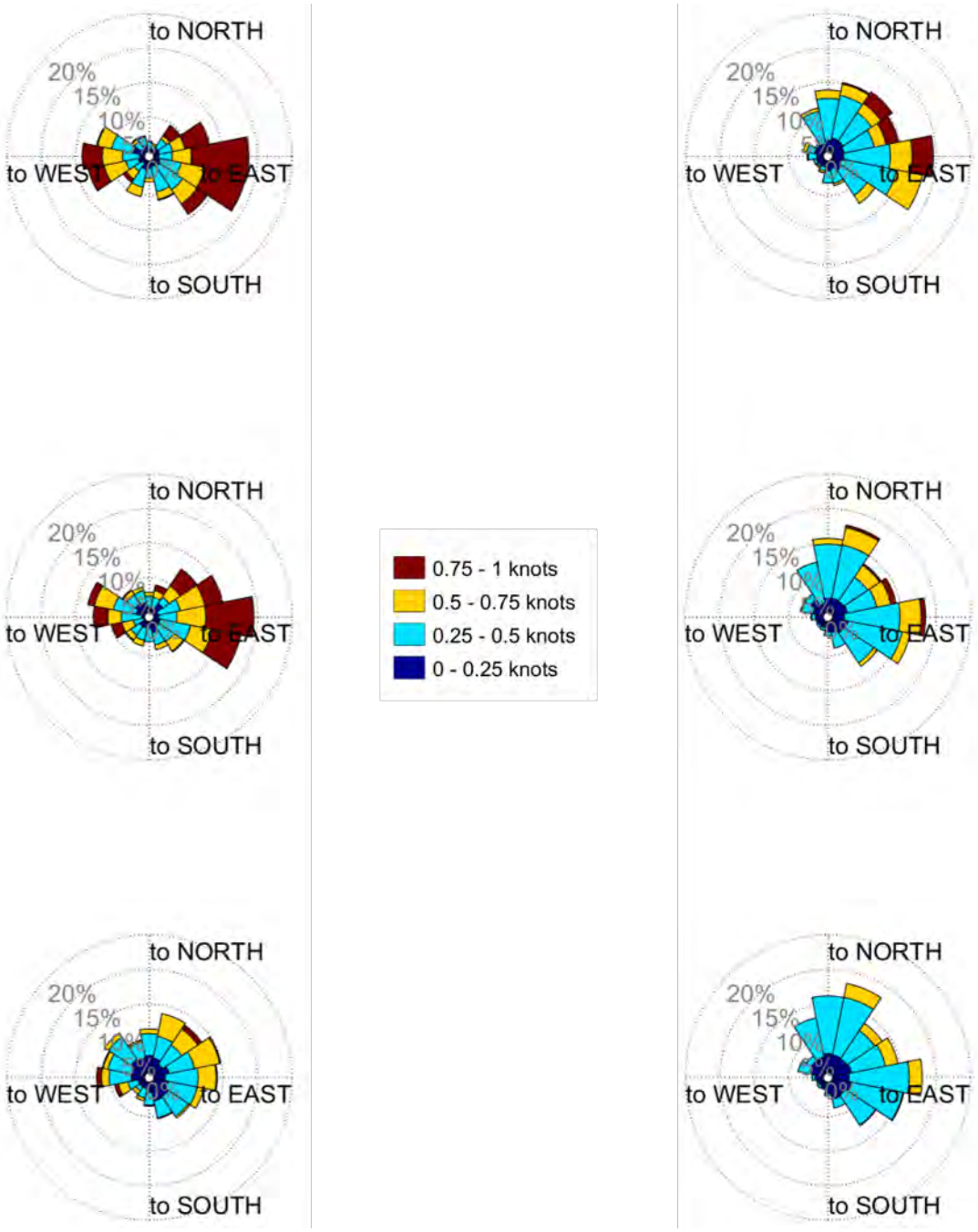

Figure 3.2-12. Model-Predicted (Right) vs Observed Currents (Left) at OSAMP MDS Station Location for Surface (Top), Mid (Middle) and Bottom (Bottom) of the Water Column.

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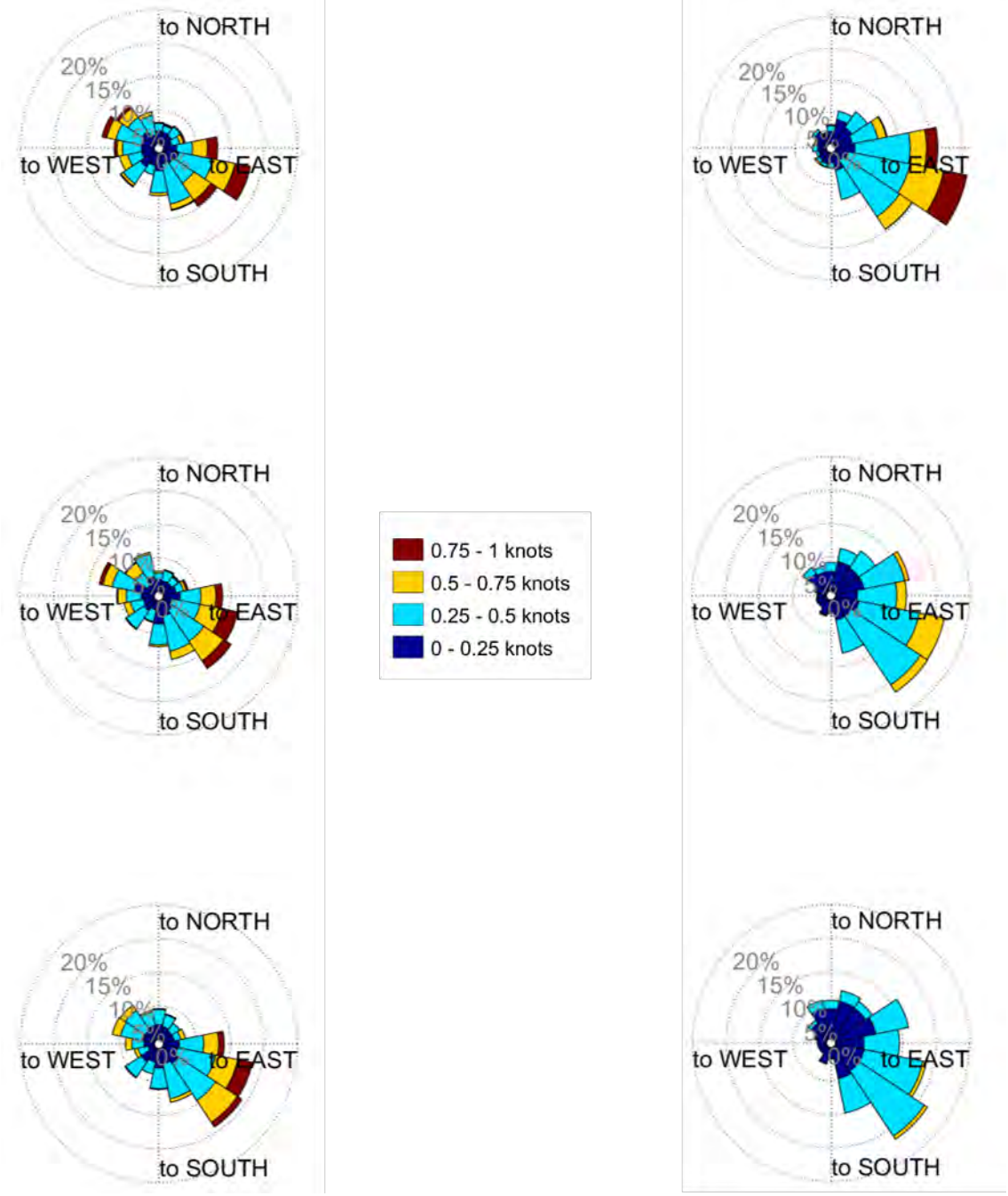

Figure 3.2-13. Model-Predicted (Right) vs. Observed (Left) Currents at OSAMP MDF Station Location for Surface (Top), Mid (Middle) and Bottom (Bottom) of the Water Column.

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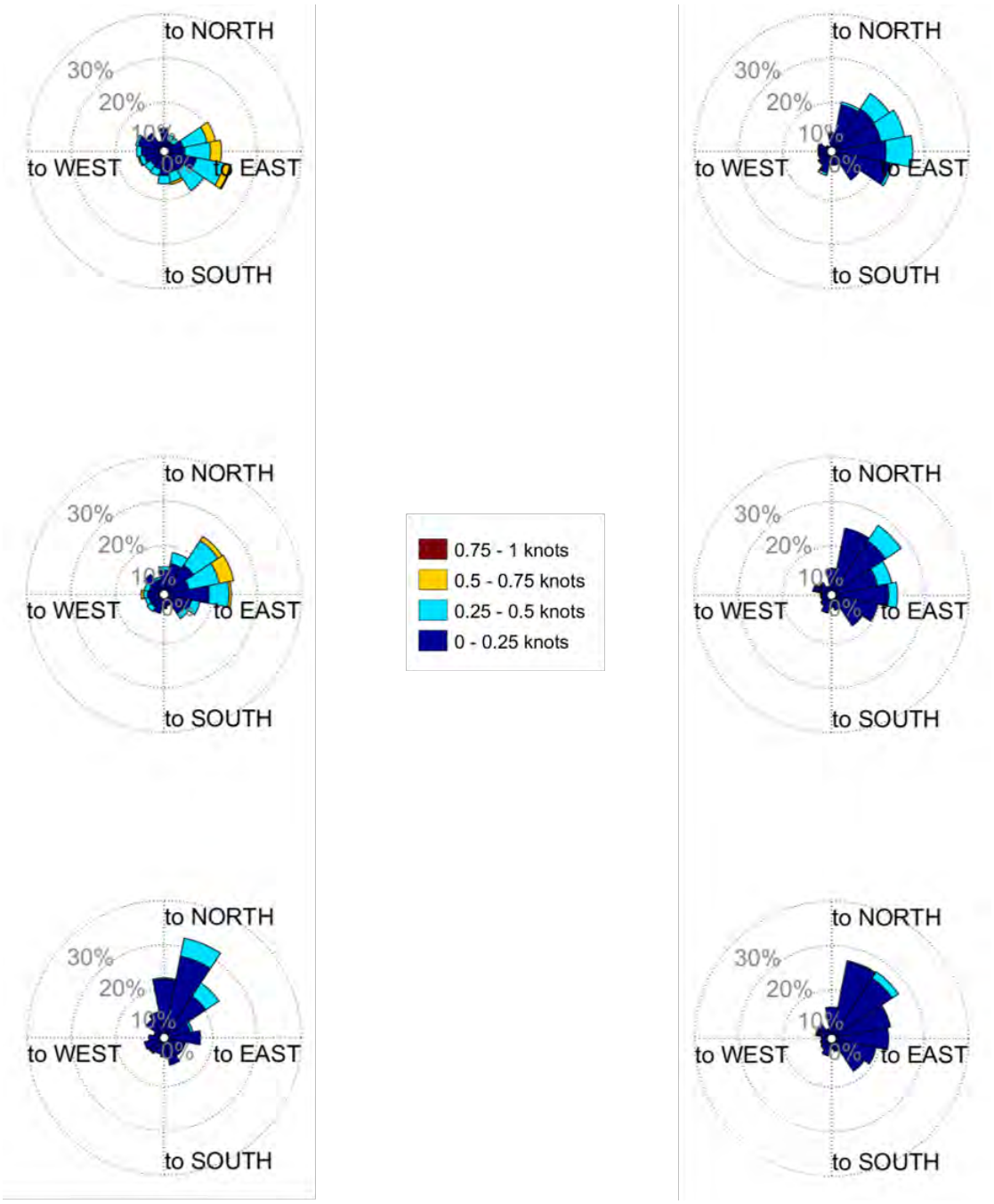

Figure 3.2-14. Model-Predicted (Right) vs. Observed (Left) Currents at OSAMP POS Station Location for Surface (Top), Mid (Middle) and Bottom (Bottom) of the Water Column.

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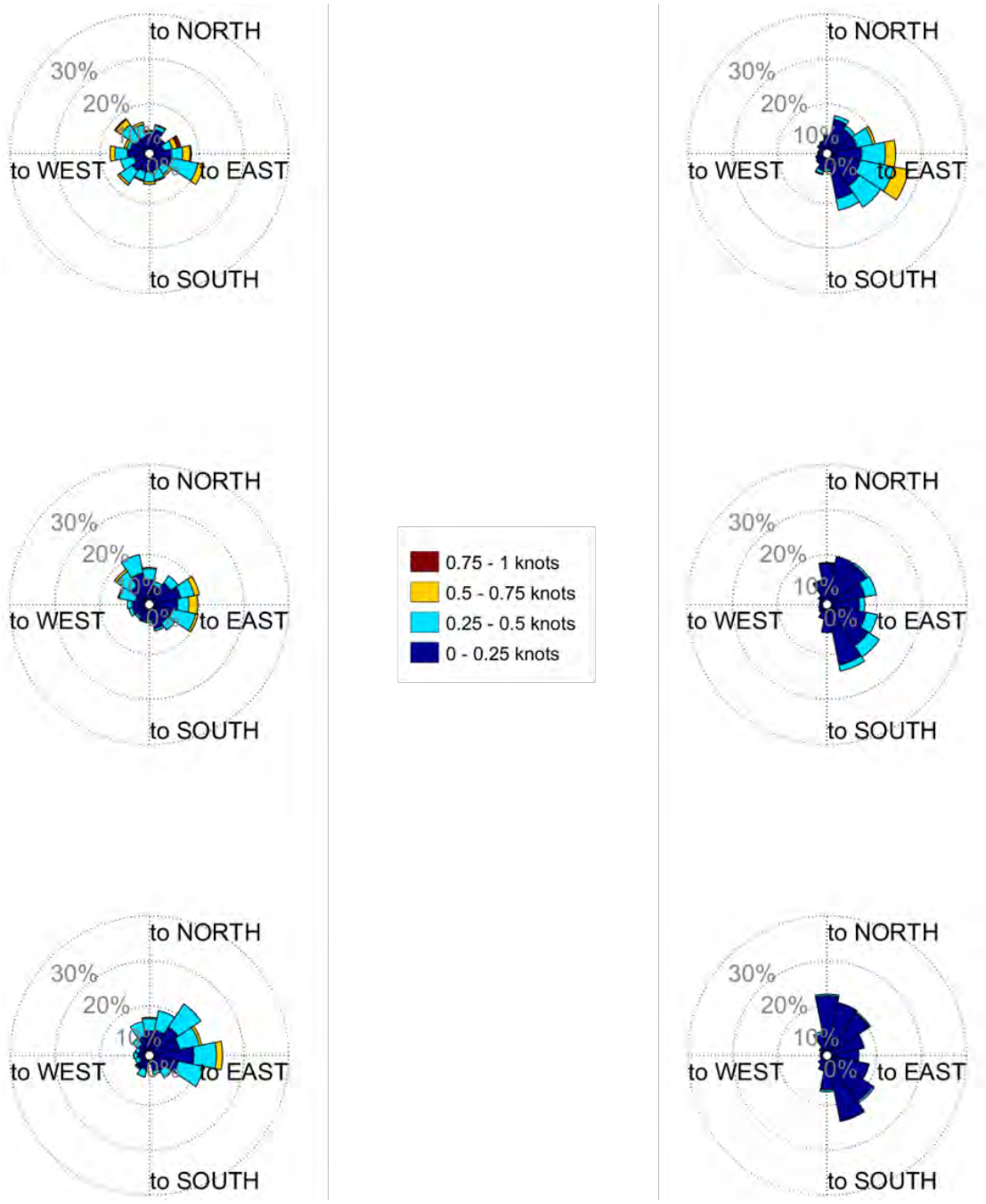

Figure 3.2-15. Model-Predicted (Right) vs Observed (Left) Currents at OSAMP POF Station Location for Surface (Top), Mid (Middle) and Bottom (Bottom) of the Water Column.

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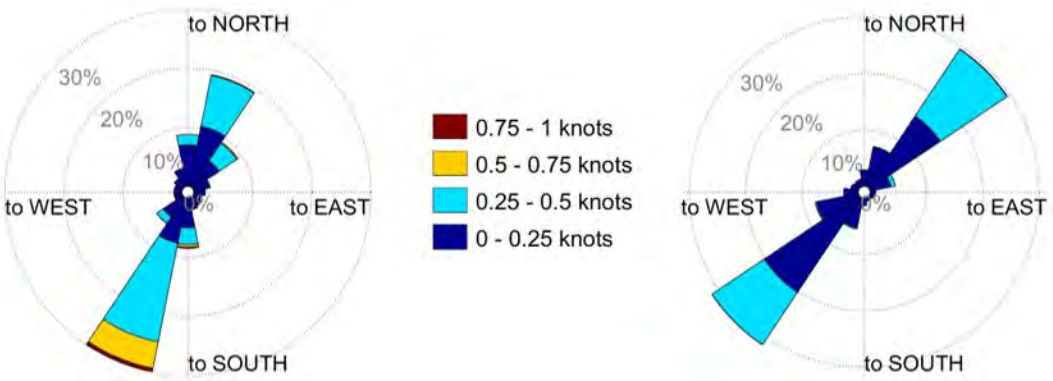

Figure 3.2-16. Model-Predicted (Right) vs Observed (Left) Currents at NOAA nb0301 Station Location for Upper Water Column Currents.

3.2.3.2 Model Results for Use in Sediment Transport Modeling Scenarios

Following model validation, HYDROMAP was used to develop currents for a scenario time period with typical winds established as April 1, 2016 through May 15, 2016. The purpose of this application was to generate a window of time that could be used as forcing for the sediment dispersion modeling. Snapshots of the bottom currents during ebb and flood from this time period are shown in Figure 3.2-17 and Figure 3.2-18, respectively. These figures have color coded arrows where the color represents the speed in knots and the orientation represents the direction the current is moving. These figures are taken at moments of near peak speeds, and do not reflect the speeds at all times. The currents oscillate in and out of the domain, with lower speeds offshore (peaking at approximately 0.4 knots [0.2 m/s] in these snapshots) and along the RWEC until it enters Narragansett Bay where currents increase (approaching approximately 0.8 knots [0.4 m/s] at these snapshots).

Based on the cable installation parameters, the total duration for installation of the cables was known. For the simulation of the RWEC burial, the duration of construction is sufficient to adequately capture variability of the tides and currents in the region since the activities will take place over multiple weeks.

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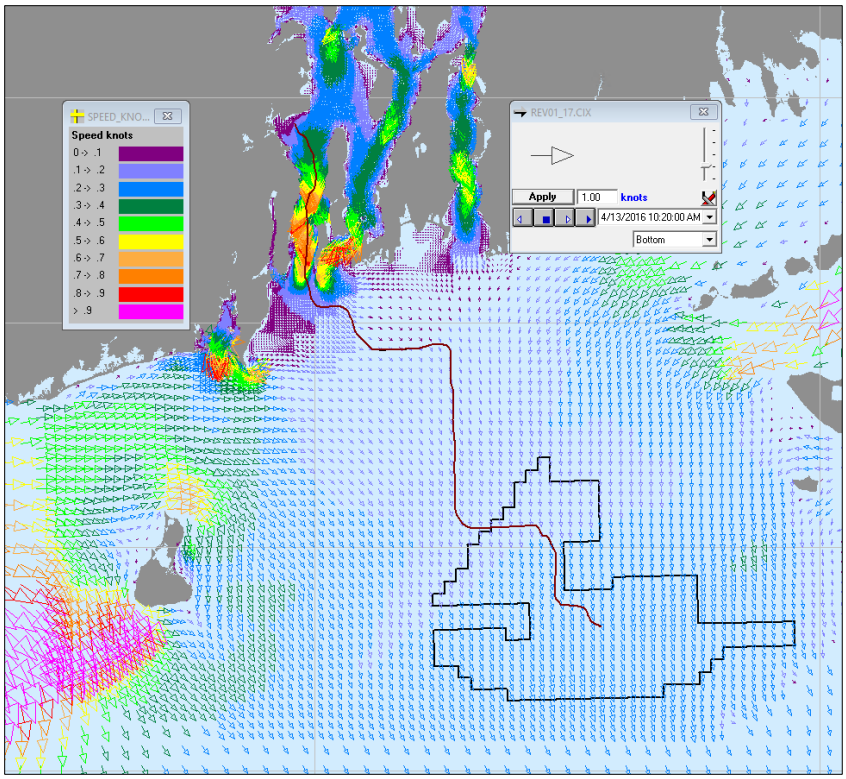

Figure 3.2-17. Example Snapshot of Ebb Bottom Currents Local to Project Boundaries.

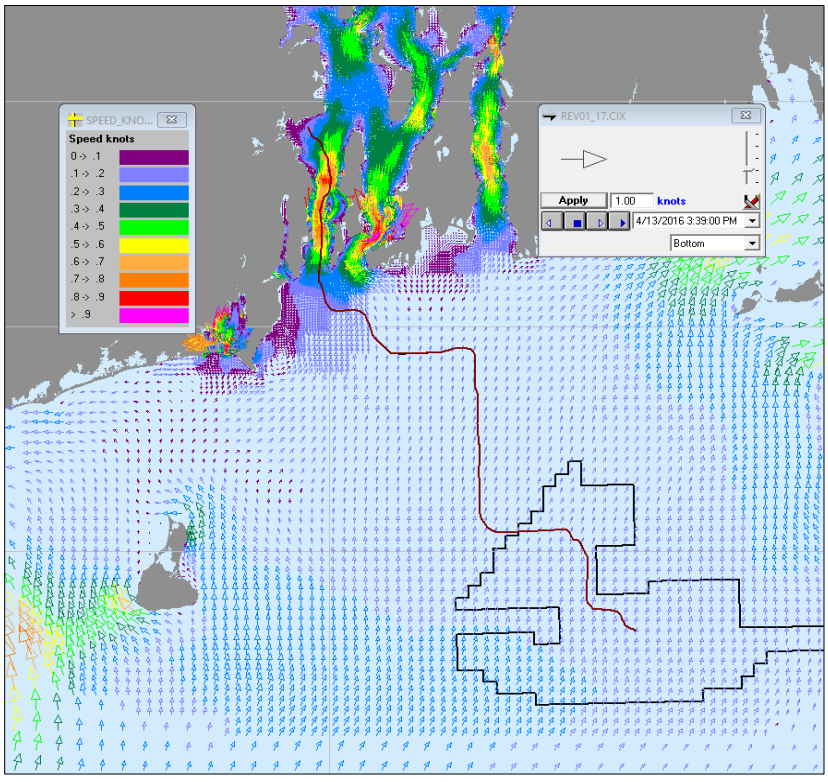

Figure 3.2-18. Example Snapshot of Flood Bottom Currents Local to Project Boundaries.

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4.0 SEDIMENT TRANSPORT MODELING

SSFATE was used to perform a series of simulations to assess suspended sediment concentration and seabed deposition resulting from anticipated cable burial activities. This study has three components: (1) seabed preparation alternatives, (2) RWEC Circuit 1, and (3) landfall. This section includes details of the study components, the model application, and the model results.

4.1 SSFATE Model Components and Scenario Descriptions

A set of scenarios was developed to capture the various activities. Figure 4.1-1 depicts the study components associated with each modeling scenario within RI state waters, and Table 4.1-1 provides a summary of each modeling scenario and associated methods modeled. The model scenarios along with their key parameters are described below.

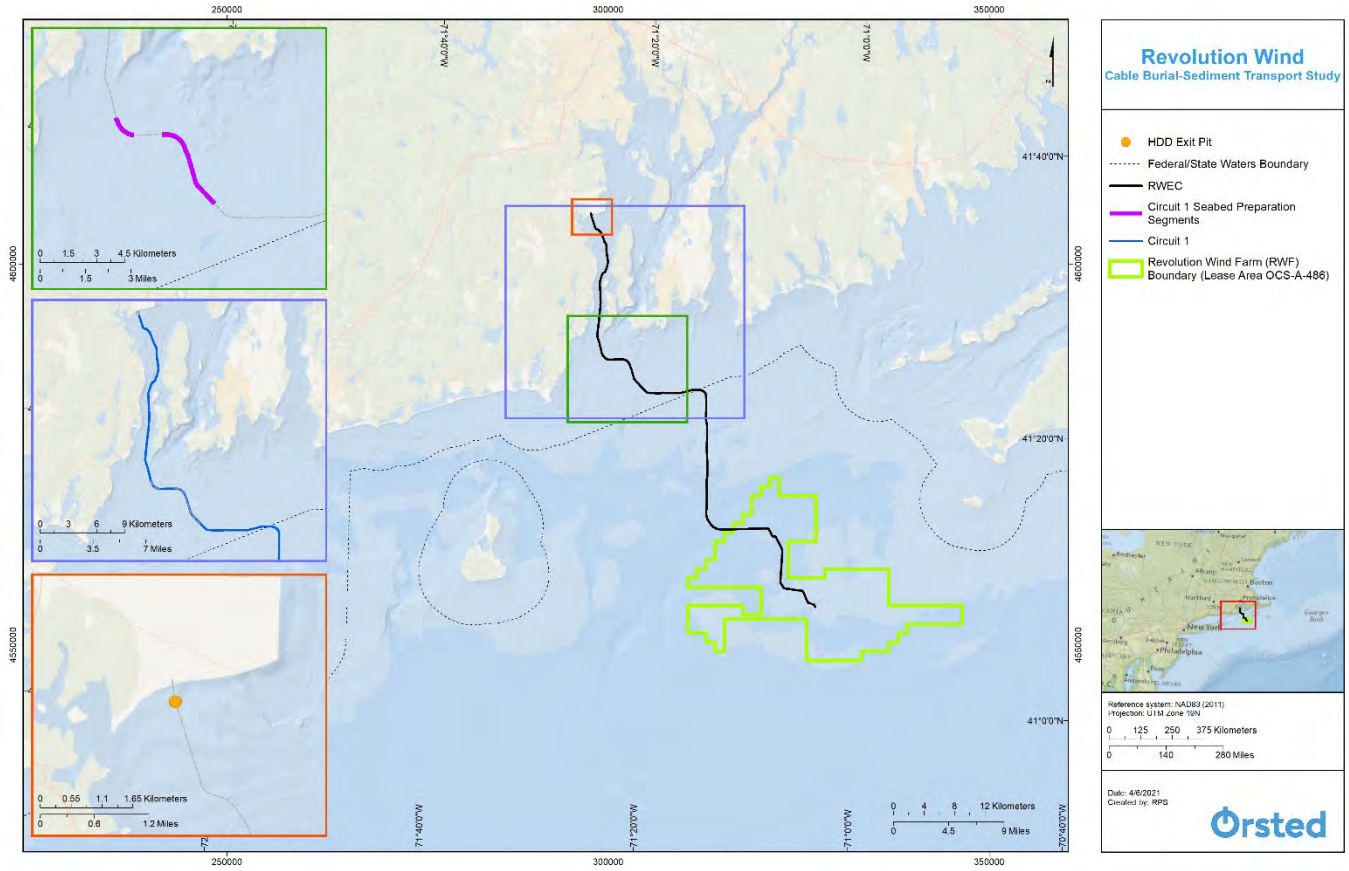

Figure 4.1-1. Study Components within RI State Waters.

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Table 4.1-1. Description of Activities Being Simulated.

RWEC Modeling Scenarios		
Project Component	Description of Scenario	Methods Modeled
RWEC Seabed Preparation	Circuit 1 – Seabed Preparation Segments	CFE
	Circuit 1 – Seabed Preparation Segments	TSHD – Split Bottom
	Circuit 1 – Seabed Preparation Segments	TSHD – Continuous Overflow
RWEC	Circuit 1	Jet Plow
Landfall	HDD Exit Pit	Backhoe Excavator followed by Venturi Eductor Device

4.1.1 Study Component 1: Seabed Preparation Alternatives, Segments of the RWEC Circuit 1

Prior to cable burial, two segments along the RWEC route within RI state waters (approximately 4.0 mi [6.4 km]) may require seabed preparation. Seabed preparation may be necessary in regions where the sediment is deeper to ensure that the sediment clearance is sufficient before commencing the cable burial process. If required, it is assumed that the seabed preparation will occur consecutively and be completed along the segments before cable burial begins. This assessment evaluated three different modeling scenarios which reflect alternative seabed preparation equipment types and parameters: (1) CFE, (2) TSHD using periodic overflow and split bottom barge disposal, and (3) TSHD using continuous overflow. Note that the seabed preparation equipment types were modeled separately to compare the potential impacts from each alternative method, and all methods are not anticipated to be used.

The CFE method mobilizes the cross-sectional area of the trench and introduces sediment along the route centerline near the seabed. Alternatively, the TSHD method removes sediment and introduces it along the route centerline at, and/or near, the water surface. The two TSHD simulations, split bottom and continuous overflow, differed in the way sediment was introduced to the water column. The split bottom method includes periodic overflow and split bottom barge disposal, which would occur as the hopper becomes full. It was assumed that overflow and disposal occurred along the RWEC with overflow composed primarily of fine sediment and split bottom disposal consisting of primarily coarse sediment. This difference in grain size is due to the settlement of coarse sediment within the hopper. Sediment was introduced as overflow at the water surface, and a few meters below the water surface as split bottom disposal. The continuous overflow method conservatively assumed the dredged sediments were immediately introduced to the water column at the surface, bypassing hopper storage. Therefore, the grain size distribution entering the water from the continuous overflow was representative of *in-situ* material. An overview of the scenarios associated with the seabed preparation modeling is presented in Table 4.1-2. Figure 4.1-2 depicts the two seabed preparation segments within RI state waters.

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Table 4.1-2. Description of Activities Modeled for RWEC Seabed Preparation.

RWEC Seabed Preparation Modeling Scenarios				
Project Component	Description of Scenario	Methods Modeled	State Length Modeled, Miles (mi) (Kilometers [km])	State Dredge Duration (Days)
RWEC Seabed Preparation	Circuit 1 – Seabed Preparation Segments	CFE	4.0 (6.4)	0.67
	Circuit 1 – Seabed Preparation Segments	TSHD – Split Bottom	4.0 (6.4)	5.16
	Circuit 1 – Seabed Preparation Segments	TSHD – Continuous Overflow	4.0 (6.4)	4.12

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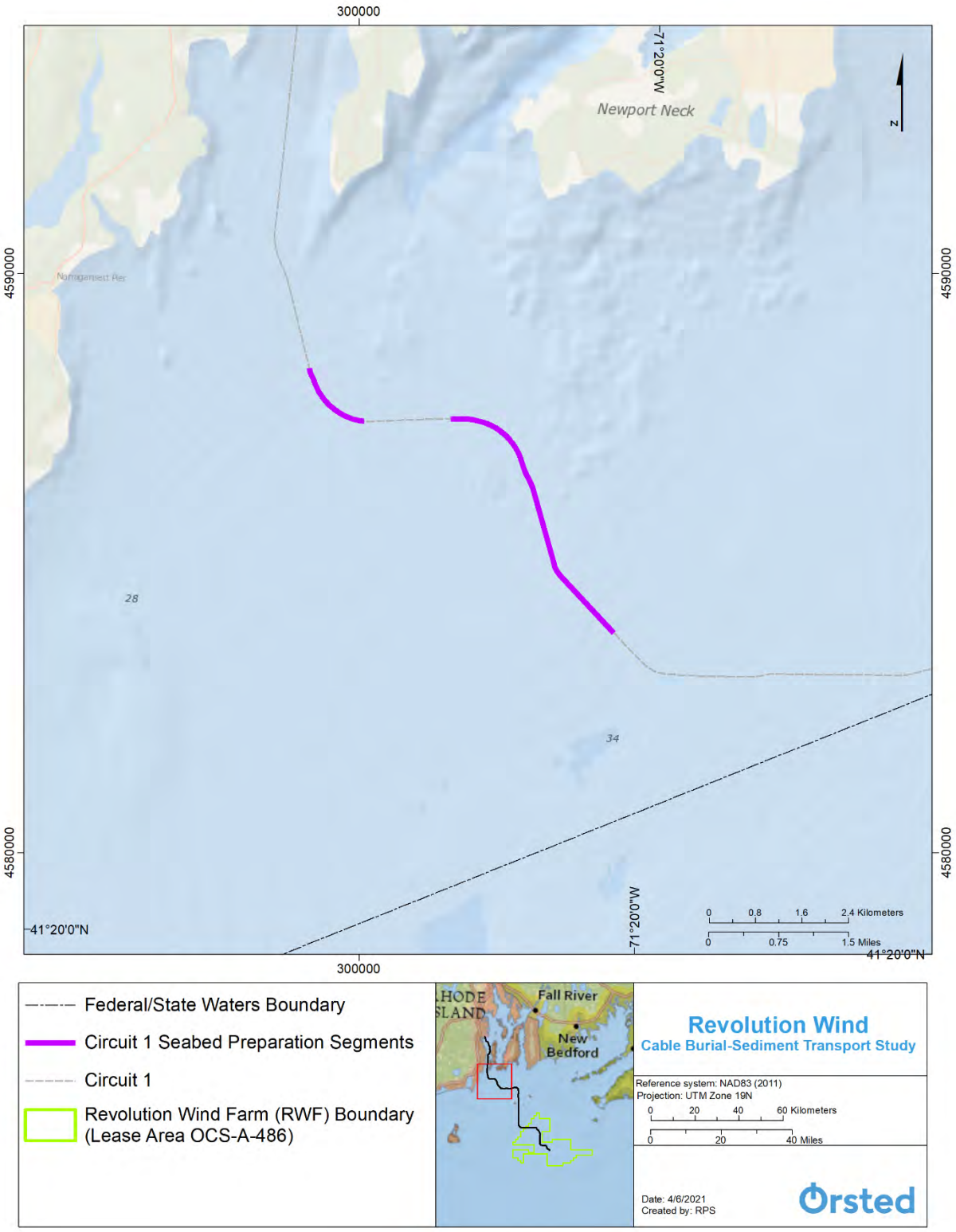

Figure 4.1-2. Seabed Preparation Segments of RWEC Circuit 1 Route within RI State Waters.

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4.1.2 Study Component 2: RWEC Circuit 1 Cable Burial

The Project includes approximately 21.4 mi (34.4 km) of RWEC corridor within RI state waters. The RWEC may include up to two circuits, but because the circuits follow a similar path and are in proximity to one another, only Circuit 1 was modeled as a representative case. An overview of the scenarios associated with the RWEC modeling is presented in Table 4.1-3. Figure 4.1-3 depicts the modeled RWEC Circuit 1 within RI state waters.

Table 4.1-3. Description of Activities Modeled for RWEC Circuit 1 Cable Burial.

RWEC Circuit 1 Modeling Scenarios				
Project Component	Description of Scenario	Methods Modeled	State Length Modeled, mi (km)	State Dredge Duration (Days)
RWEC	Circuit 1	Jet Plow	21.4 (34.4)	3.53

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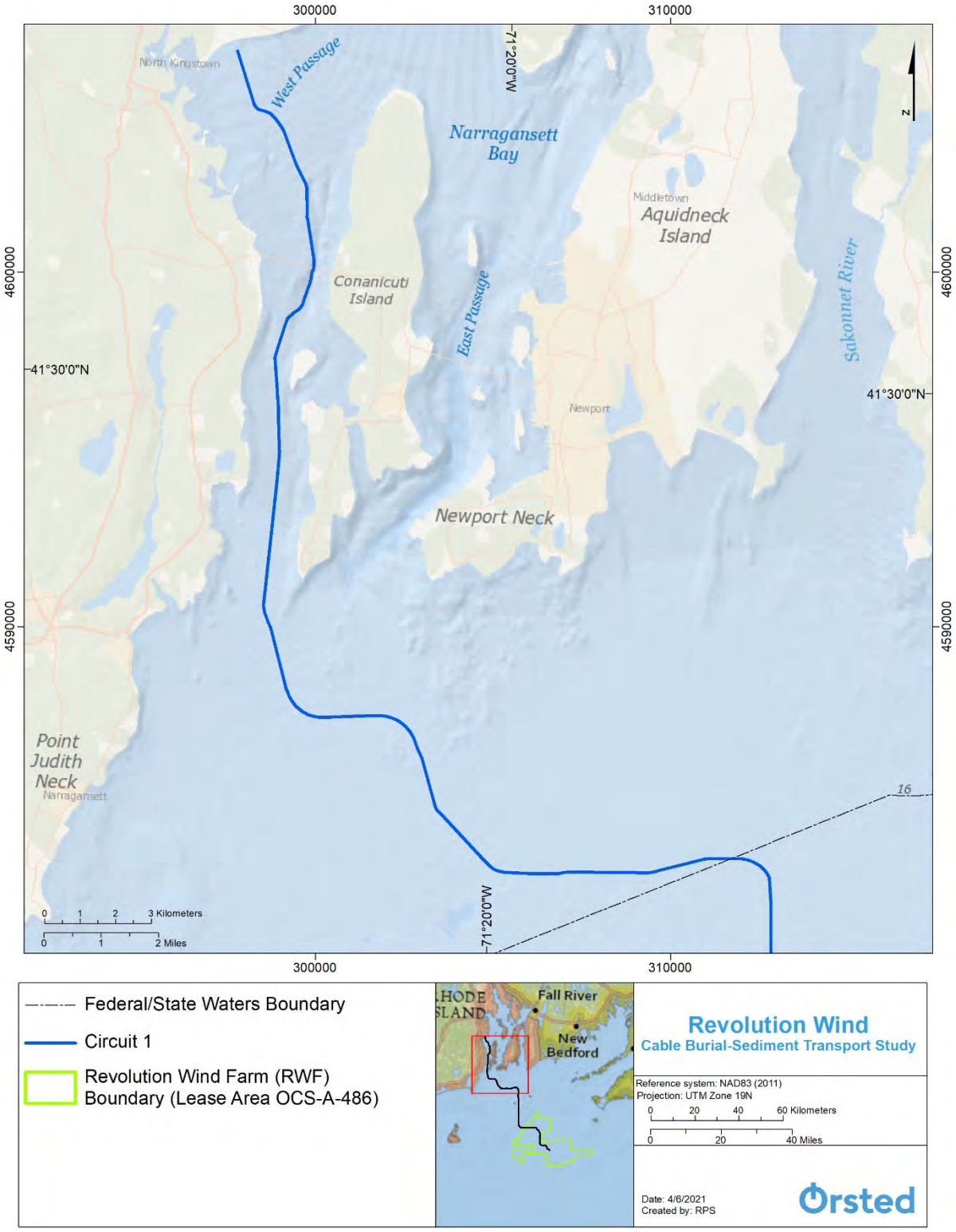

Figure 4.1-3. RWEC Circuit 1 Route within RI State Waters.

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4.1.3 Study Component 4: RWEC Landfall

The RWEC study evaluated two different landfall equipment types to excavate the HDD exit pit, which are anticipated to be implemented consecutively: a backhoe excavator to clear the majority of the material and a Venturi eductor device for more precise clearing. The pit would be cleared and subsequently backfilled after tie-in. Although the volume cleared is expected to be the same as the volume backfilled, it is anticipated that the backfilling process will begin on the order of hours to days after the pit has been cleared, thus allowing sufficient time for sediment to disperse and settle. Therefore, only the clearance was modeled and is considered representative of the backfill process. A summary of the scenarios is presented in Table 4.1-4. Figure 4.1-4 depicts the HDD exit pit location along the RWEC.

Table 4.1-4. Description of Activities Modeled for Landfall.

Landfall Scenario			
Project Component	Description of Scenario	Methods Modeled	Total Dredge Duration (Days)
Landfall	HDD Exit Pit	Backhoe Excavator followed by Venturi Eductor Device	2.9

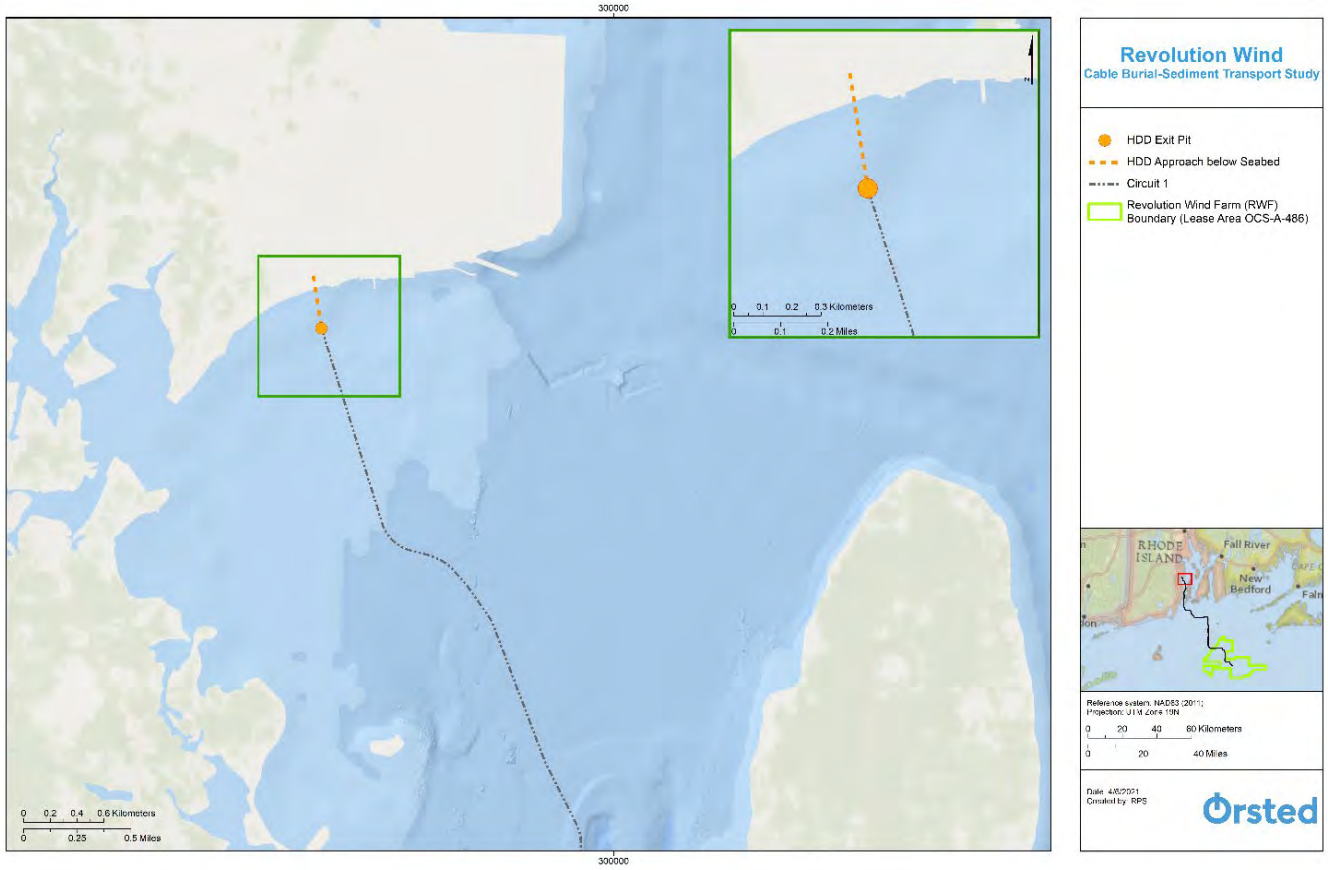

Figure 4.1-4. RWEC Landfall HDD Exit Pit Location.

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4.2 SSFATE Sediment Transport Model Application

Setup of the SSFATE model consists of defining the environmental conditions, the construction scenario, and computational parameters. For each scenario, this includes:

- The study area environmental conditions
    - Shoreline and bathymetry
    - Tides and currents
- The construction activity source terms
    - The geographic extent of the activity (point release vs. line source)
    - The dates and duration of the activity
    - The volumes and cross-sectional areas of the trench or excavation pit
    - The production rate for each dredge/trenching method
    - Loss rates for each dredge/trench method
    - The grain size distribution along the route
    - The vertical distribution of sediments as they are initially released to the water column
- Specification of model run parameters
    - The concentration and deposition grid resolution
    - Model calculation and output timesteps

4.2.1 Environmental Conditions in SSFATE

The SSFATE model uses hydrodynamics and bathymetry sources from the HYDROMAP application described in Section 3. Concentration and deposition gridding in SSFATE is independent of the resolution of the hydrodynamic data used to calculate sediment transport.

4.2.2 Sediment Source Terms

The sediment loading was developed for each scenario based on conservative assumptions about the construction activities and the associated trench size (i.e., the disturbed sediment volume). A summary of the trench dimensions, installation rate, production rate, and 'loss rate' for each trench type associated with seabed preparation and installation of the RWEC is presented in Table 4.2-1. The loss rate is the percentage of the trench volume that is assumed to be resuspended into the water column. A 30% loss rate was assumed for jet plow installation, while a loss rate of 100% was assumed for all other construction methods (i.e., CFE, TSHD). For both the CFE and jet plow it was assumed that the resuspension would be evenly distributed within the bottom 8.2 ft (2.5 m) of the water column. For the TSHD split bottom method, it was assumed 20% of the resuspension would occur at the water surface as periodic overflow, and 80% would occur 16.4 ft (5 m) below the water surface as periodic disposal from the split bottom. For the TSHD continuous overflow method, it was assumed that 100% of the dredged sediment would be introduced at the water surface.

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Table 4.2-1. Installation Details Assumed for the RWEC Modeling.

	Trenching Parameters for RWEC					
Project Component	Equipment	State Length Modeled, mi (km)	Disturbance Depth, ft (m)	Disturbance Cross-Sectional Area, ft^2 (m^2)	Installation Rate, ft/hr (m/hr)	Loss Rate
RWEC Seabed Preparation	CFE	4.0 (6.4)	6.6 (2.0)	301.4 (28.0)	1312 (400)	100%
	TSHD – Split Bottom	4.0 (6.4)	6.6 (2.0)	301.4 (28.0)	215 (65.5)	100%
	TSHD – Continuous Overflow	4.0 (6.4)	6.6 (2.0)	301.4 (28.0)	215 (65.5)	100%
RWEC	Jet Plow	21.4 (34.4)	9.8 (3.0)	88.3 (8.2)	1312 (400)	30%

Two construction methods to clear the HDD exit pit were modeled for the landfall simulations: a backhoe excavator and a Venturi eductor device. The landfall approach includes drilling underneath the seabed, from the shore to the HDD exit pit, eliminating sediment resuspension to the water column. The pit would be cleared and subsequently backfilled after tie-in. However, as previously discussed in Section 4.1, only the clearance was modeled and is considered representative of the backfill process. A summary of scenario parameters for the landfall simulation is presented in Table 4.2-2. It was assumed that 100% of the sediments excavated by the backhoe were introduced near the surface and 30% of the sediments removed by the Venturi eductor device were evenly distributed within the bottom 3.28 ft (1 m) of the water column.

Table 4.2-2. Installation Details Assumed for the Landfall Modeling.

Sediment Transport Modeling Scenarios Overview				
Project Component	Equipment	Trench or Pit Volume Excavated, Cubic Yards (cy) (Meters Cubed [m^3])	Production Rate, cy/hr (m^3/hr)	Loss Rate
Landfall	HDD Exit Pit – Backhoe Excavator followed by Venturi Eductor Device	4,901 (3,750)	78 (60)	100%
		980 (750)	131 (100)	30%

4.2.2.1 Sediment Grain Size Distribution

The sediment characteristics and grain size distribution are key input parameters in the SSFATE model when predicting sediment transport. Based on the sediment samples (e.g., vibracores, grab samples) collected during multiple offshore surveys, the spatial variability of the sediment characteristics and grain size distribution were captured in the modeled scenarios. Once collected, the samples underwent further laboratory analysis, as documented in Section 4.3.2 of the COP, and results from these analyses were then refined by RPS as it pertained to the sediment characterization used in the SSFATE model. Sediment data was divided into classes based on the grain size, and the depth-dependent samples were weighted to represent *in-situ* conditions for the various installation activities. Specifically, the objective was to determine the distribution within the five delineated classes used in SSFATE (Table 2.2-1) and the percentage of the upper seabed that is solid based on the measure of sediment water content, a measure of the interstitial pore waters in the sediments.

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The sediment characteristics along the RWEC within RI state waters, as used in the modeling, are presented in Figure 4.2-1 and Figure 4.2-2. As shown in these figures, the sediments have a relatively larger fraction of fine-grained sediments closer to shore.

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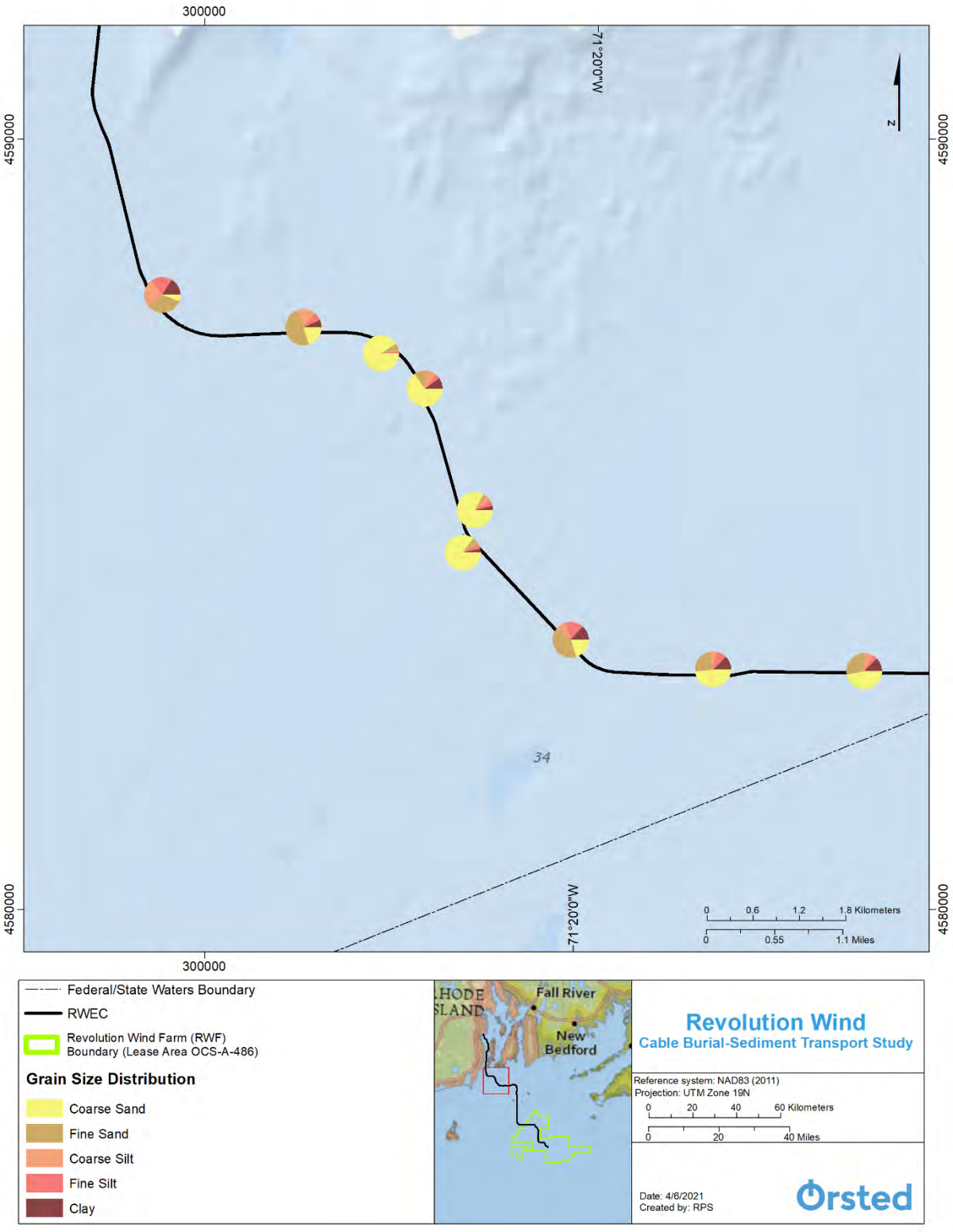

Figure 4.2-1. Sediment Grain Size Distributions for Seabed Preparation Modeling within RI State Waters.

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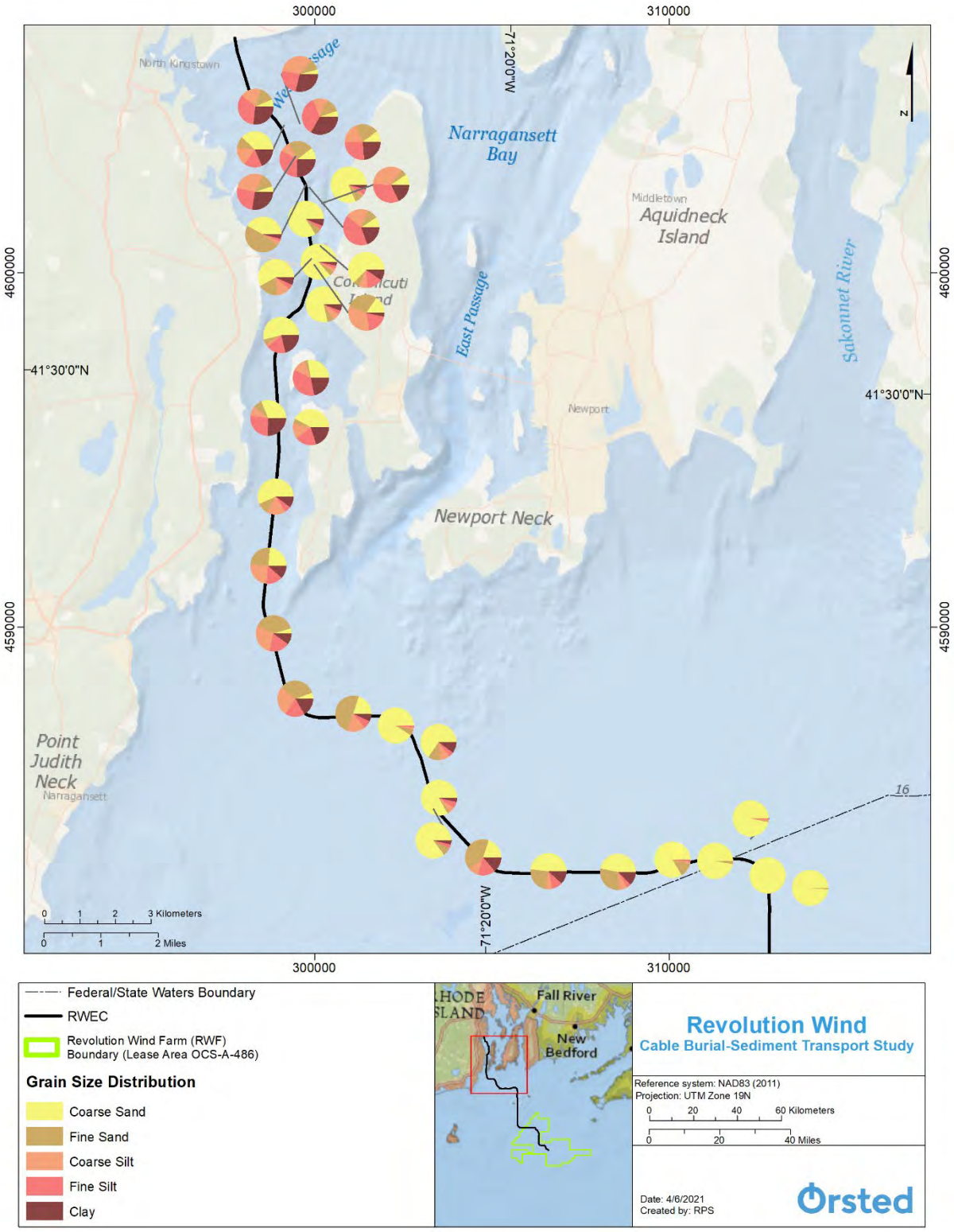

Figure 4.2-2. Sediment Grain Size Distributions for Modeling along the RWEC within RI State Waters.

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4.2.3 Model Run Parameters

For the entire RWEC and associated cable burial activities, model computations were performed every 10 minutes, with output saved at a 10-minute time step. For the seabed preparation and landfall activities, model computations were performed every 5 minutes and model output was saved every 10 minutes. Sediment concentrations were computed on a grid with resolution of 197 ft x 197 ft (50 m x 50 m) in the horizontal dimension and 3.3 ft (1.0 m) in the vertical dimension for the entire RWEC cable burial activities and 66 ft x 66 ft (20 m x 20 m) in the horizontal dimension and 1.6 ft (0.5 m) in the vertical dimension for landfall activities. Seabed preparation activities were computed on a grid with resolution of 82 ft x 82 ft (25 m x 25 m) in the horizontal dimension and 1.6 ft (0.5 m) in the vertical dimension.

4.3 SSFATE Model Results

SSFATE simulations were performed for each construction activity. All modeling assumed continuous operation for each phase of the construction. Note that reported concentrations are those predicted above the background concentration in the study area.

The results from the model runs are presented below in maps showing the predicted TSS concentrations and subsequent deposition for each activity. Specifically, three sets of graphics were developed for each scenario:

- **Maps of Instantaneous TSS Concentrations**: These figures present the predicted instantaneous excess TSS concentrations at a moment in time for line sources. The concentrations are depicted as contours using mg/L. The plan view shows the maximum concentration throughout the water column (i.e., maximum value at any depth).

- **Maps of Time-integrated Maximum TSS Concentrations**: These figures present the predicted maximum time-integrated excess water column concentration from the entire water column (i.e., maximum value at any point in time at any depth). The concentrations are depicted as contours using mg/L. The entire area within the contour was predicted to be at or above the concentration defined by the contour itself. Most importantly, it should be noted that these maps portray the maximum TSS concentration that occurred throughout the entire simulation at all depths and that: (1) these concentrations do not persist throughout the entire simulation and may be just one time step; and (2) these concentrations do not occur concurrently throughout the entire modeled area. Therefore, results are time-integrated spatial views of maximum predicted concentrations.

- **Maps of Seabed Deposition**: These figures present the predicted deposition on the seabed that would occur following completion of the construction activity and after suspended sediments settled out of the water column. The thickness levels are shown as contours (in mm) and the entire area within the contour is at or above the thickness defined by the contour itself.

4.3.1 Study Component 1: Seabed Preparation Alternatives, Segments of the RWEC Circuit 1

Seabed Preparation – CFE

A snapshot of the instantaneous concentration from the modeled CFE seabed preparation illustrates that highest concentrations are predicted to be adjacent to the route centerline, with lower concentrations extending further towards the northwest due to transport from local currents (Figure 4.3-1). The inset shows the instantaneous plume along the first segment, with the cross-section showing the introduction of sediment near the seabed. Figure 4.3-2 shows the time-integrated maximum TSS for seabed preparation using the CFE method. The plume footprint tends to remain close to the route due to the resuspension of the entire cross-sectional area near the bottom of the water column and a relatively quick installation rate. The cumulative deposition along the seabed preparation segments is presented in Figure 4.3-3, which depicts a similar footprint to the time-integrated maximum TSS.

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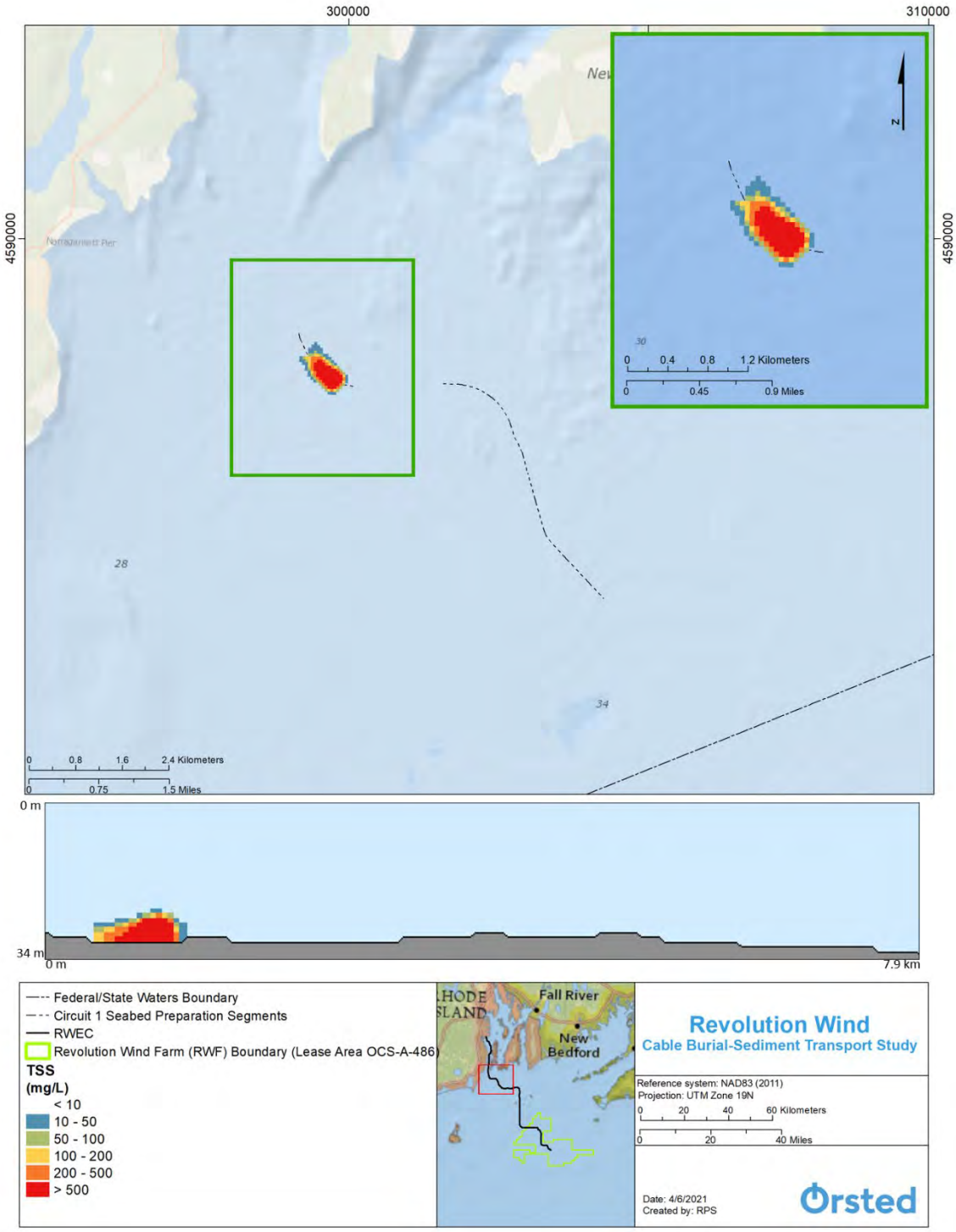

Figure 4.3-1 Snapshot of Predicted Instantaneous TSS Concentrations Associated with CFE Seabed Preparation.

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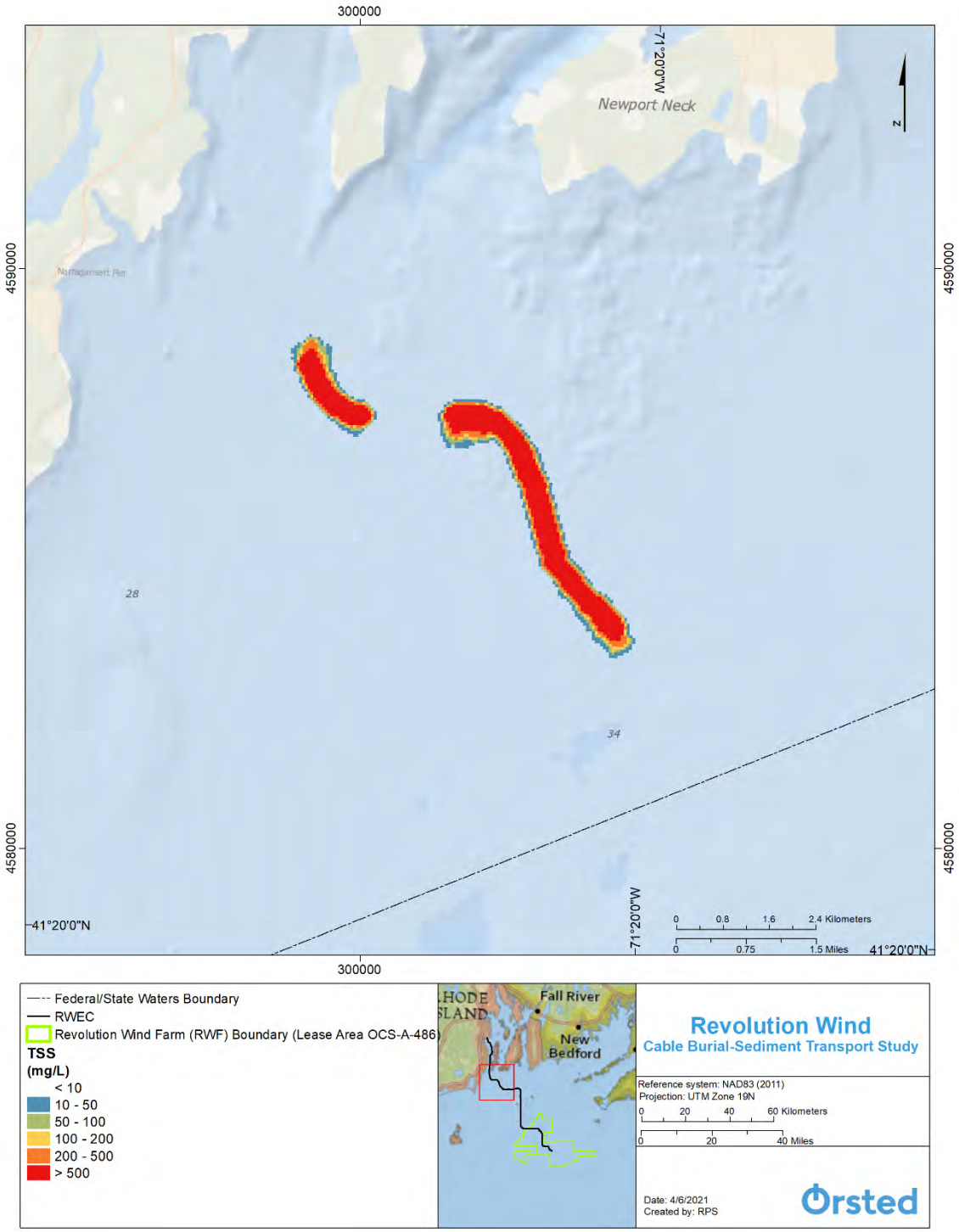

Figure 4.3-2 Map of Predicted Time-Integrated Maximum TSS Concentrations Associated with CFE Seabed Preparation.

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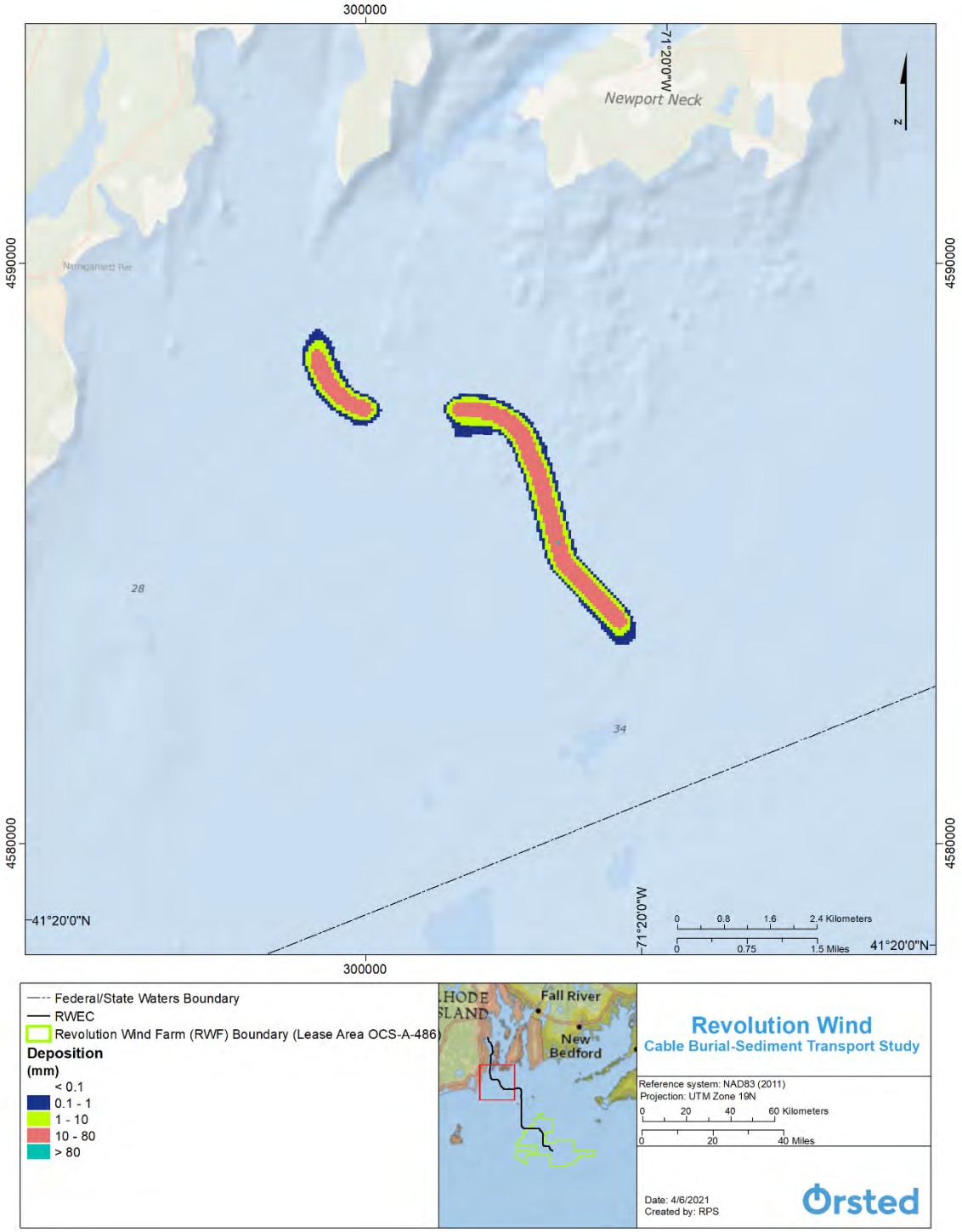

Figure 4.3-3 Map of Predicted Deposition Thickness Associated with CFE Seabed Preparation.

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Seabed Preparation – TSHD, Split Bottom

A snapshot of the instantaneous concentration from the modeled TSHD split bottom seabed preparation illustrates that highest concentrations are predicted to be directly adjacent to the route centerline, with lower concentrations extending further south due to transport from local currents (Figure 4.3-4). The inset shows the instantaneous plume along the first segment, with the cross-section showing the introduction of sediment at, and just below, the water surface. The plume footprint is reflective of the periodic overflow and split bottom disposal. Figure 4.3-5 shows the time-integrated maximum TSS for seabed preparation using the TSHD split bottom method. Because sediment is introduced at or near the water surface with a relatively slow installation rate, the plume footprint experiences multiple tidal cycles and tends to oscillate with the currents. The cumulative deposition along the seabed preparation segments is presented in Figure 4.3-6, which depicts a similar footprint to the time-integrated maximum TSS.

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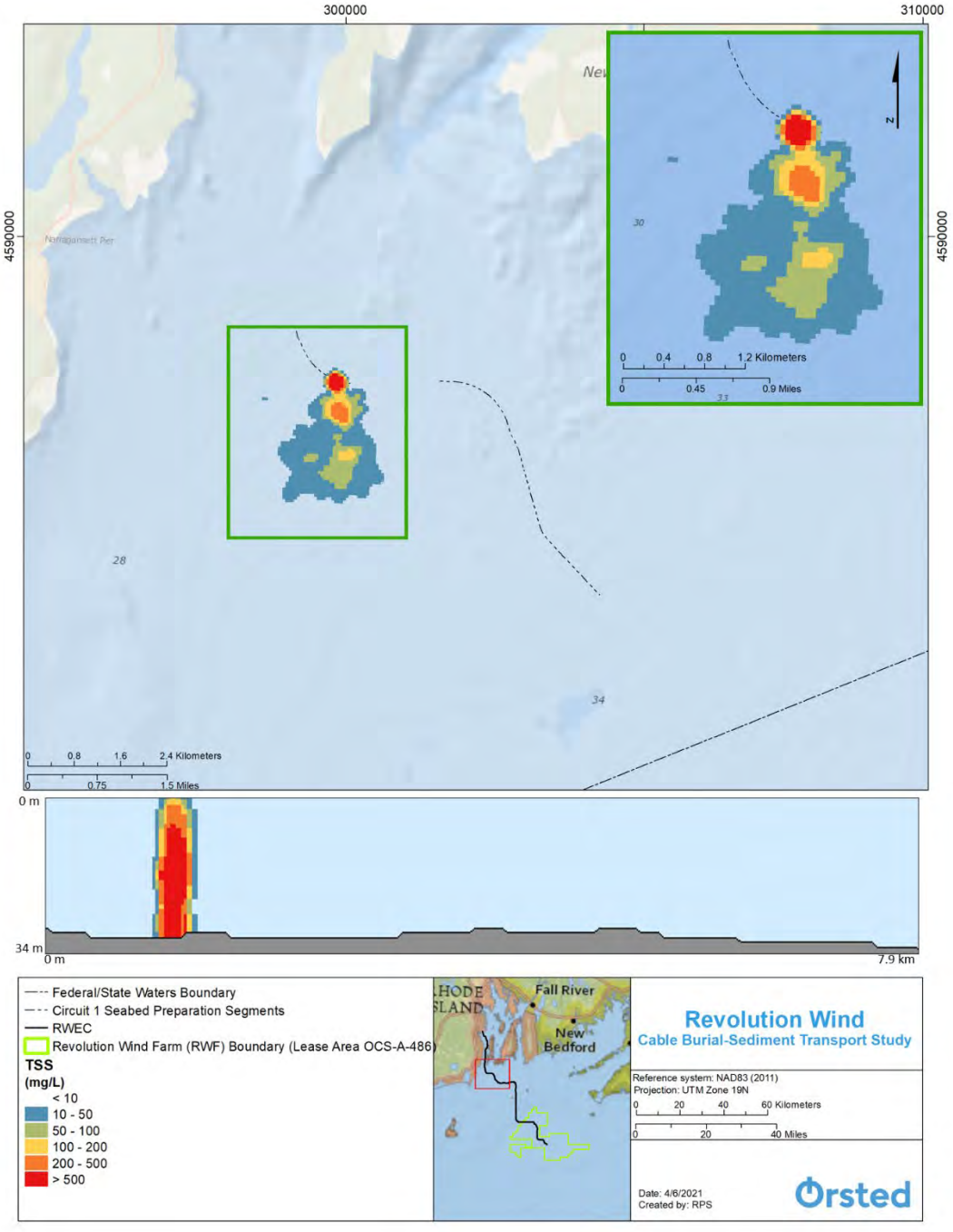

Figure 4.3-4 Snapshot of Predicted Instantaneous TSS Concentrations Associated with TSHD, Split Bottom Seabed Preparation.

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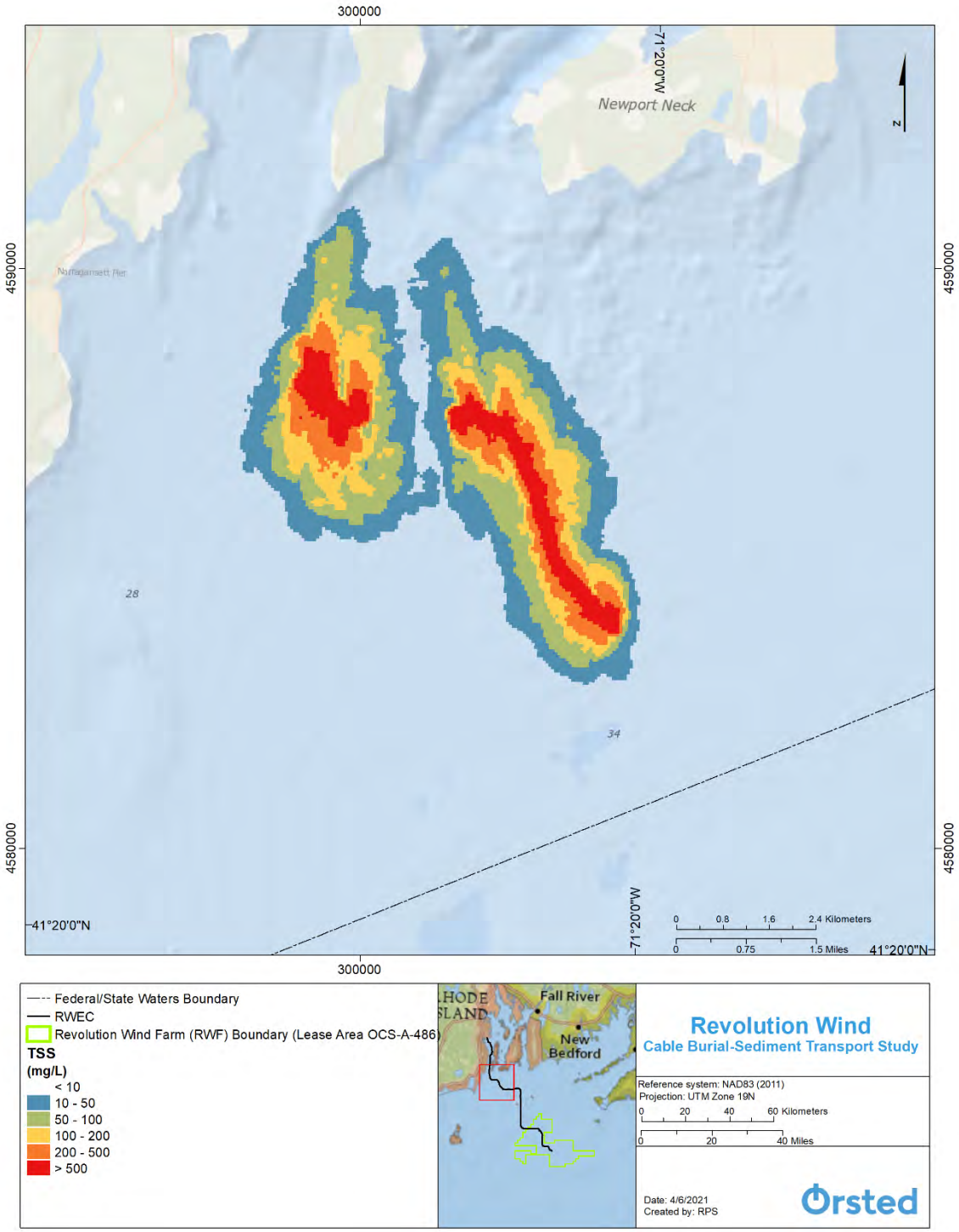

Figure 4.3-5 Map of Predicted Time-Integrated Maximum TSS Concentrations Associated with TSHD, Split Bottom Seabed Preparation.

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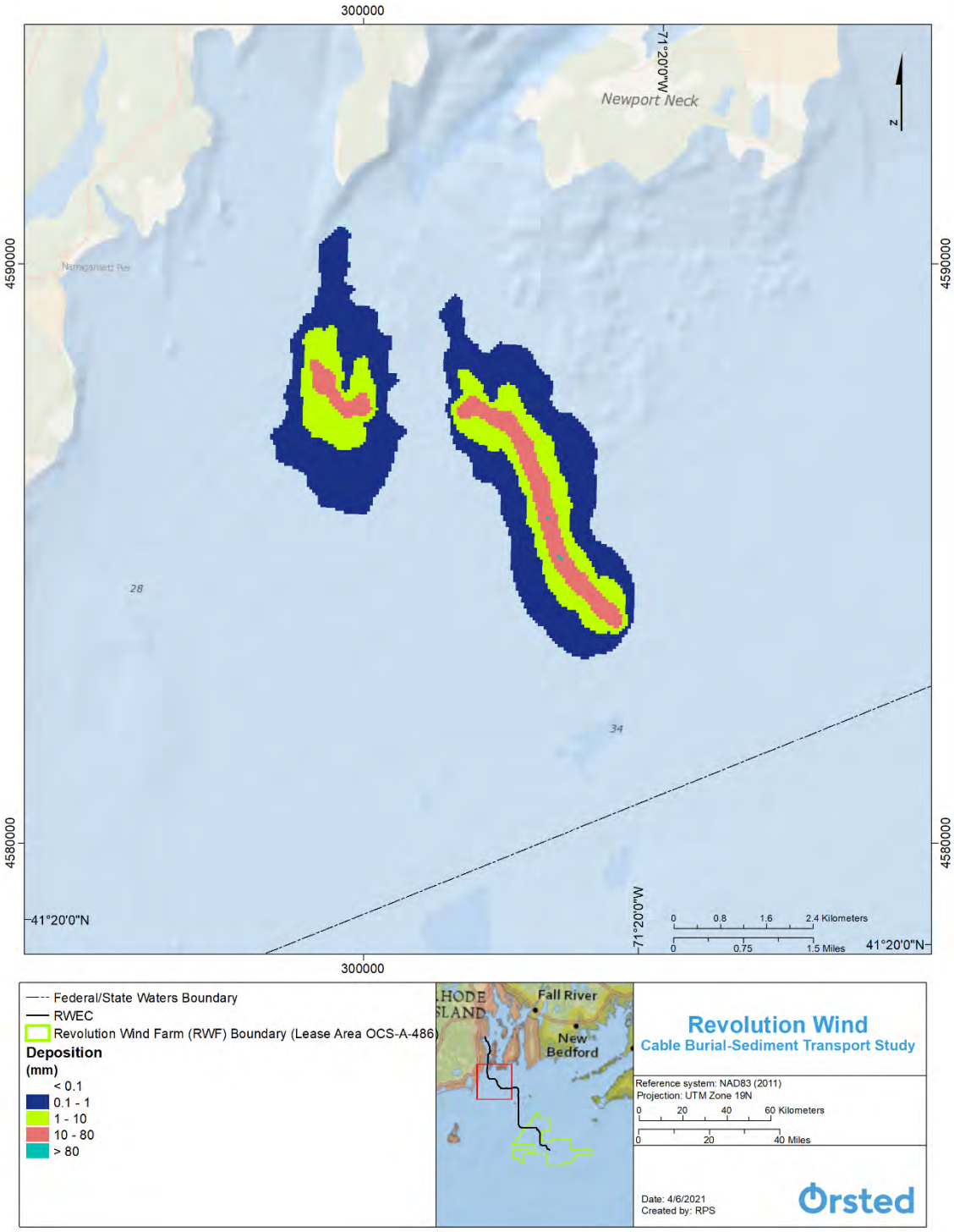

Figure 4.3-6 Map of Predicted Deposition Thickness Associated with TSHD, Split Bottom Seabed Preparation.

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Seabed Preparation – TSHD, Continuous Overflow

A snapshot of the instantaneous concentration from the modeled TSHD continuous overflow seabed preparation illustrates that highest concentrations are predicted to be directly adjacent to the route centerline, with lower concentrations extending further towards the south due to transport from local currents (Figure 4.3-7). The inset shows the instantaneous plume along the first segment, with the cross-section showing the introduction of sediment at the water surface. Figure 4.3-8 shows the time-integrated maximum TSS for seabed preparation using the TSHD continuous overflow method. Because sediment is introduced at the water surface with a relatively slow installation rate, the plume footprint experiences multiple tidal cycles and tends to oscillate with the currents. The cumulative deposition along the seabed preparation segments is presented in Figure 4.3-9, which depicts a similar footprint to the time-integrated maximum TSS.

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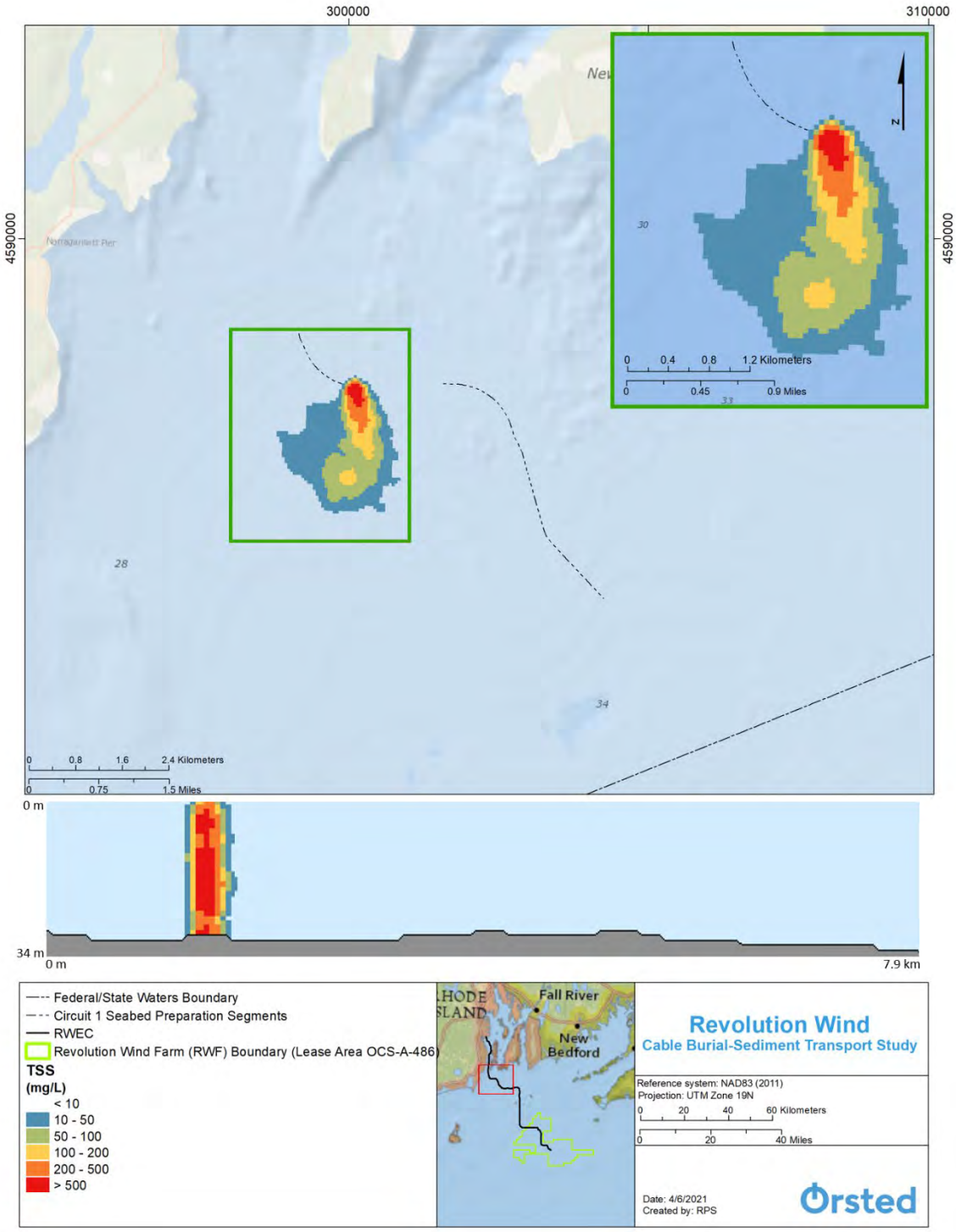

Figure 4.3-7 Snapshot of Predicted Instantaneous TSS Concentrations Associated with TSHD, Continuous Overflow Seabed Preparation.

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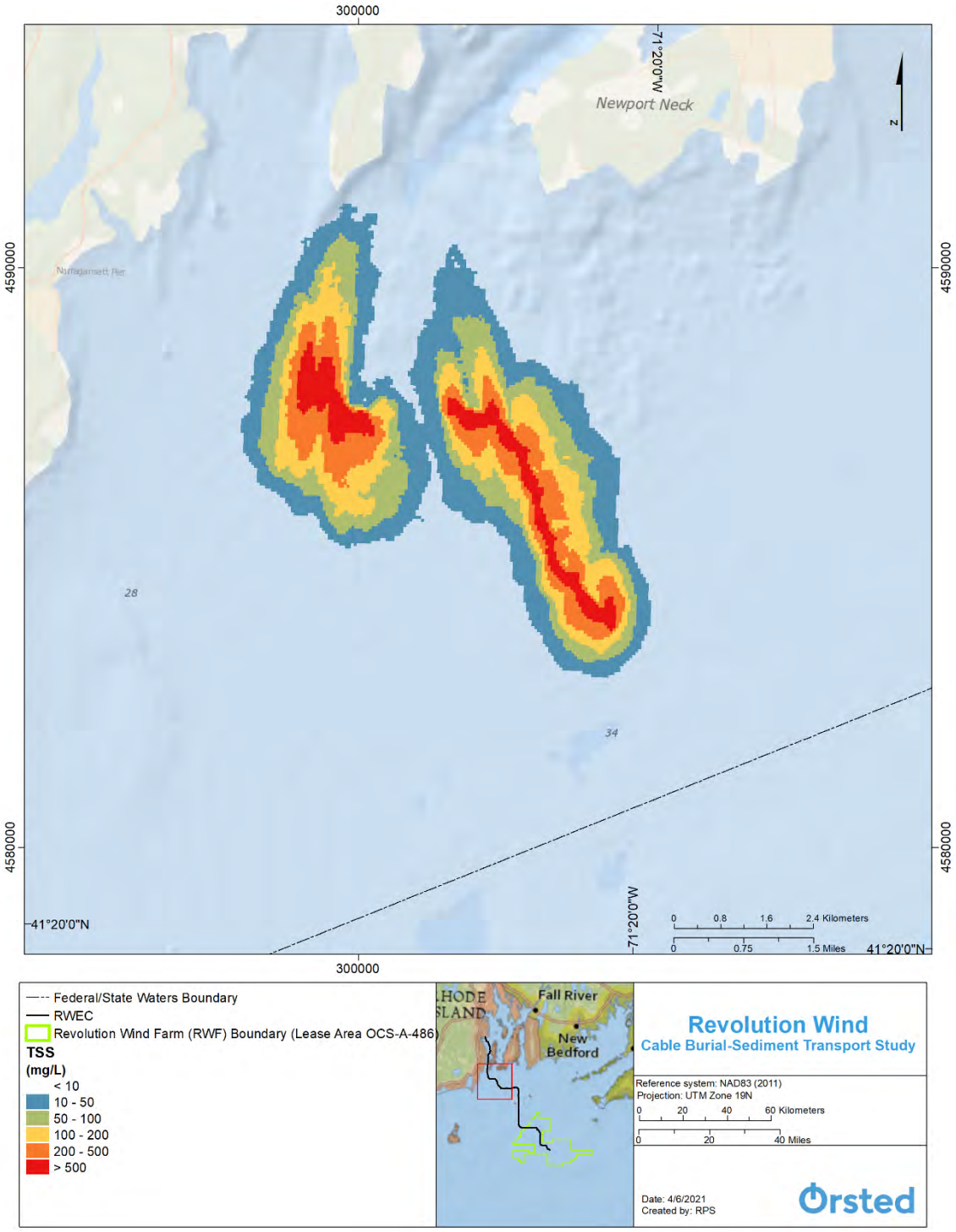

Figure 4.3-8 Map of Predicted Time-Integrated Maximum TSS Concentrations Associated with TSHD, Continuous Overflow Seabed Preparation.

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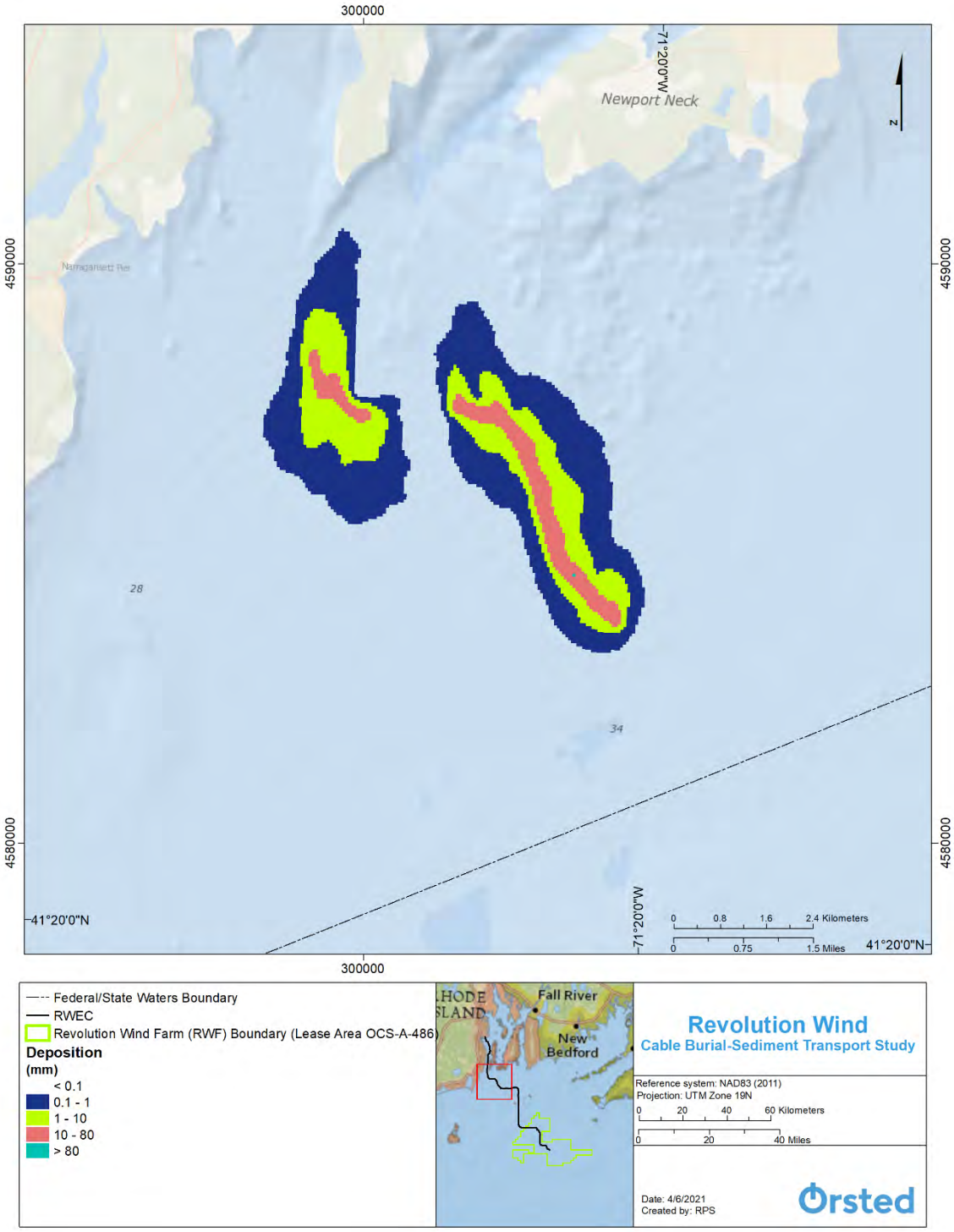

Figure 4.3-9 Map of Predicted Deposition Thickness Associated with TSHD, Continuous Overflow Seabed Preparation.

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Seabed Preparation – Alternatives Comparison

Comparisons of instantaneous TSS concentration, time-integrated maximum TSS concentration, and deposition thickness for each seabed preparation alternative are provided in Figure 4.3-10, Figure 4.3-11, and Figure 4.3-12, respectively. Predictions show the plume of the CFE method tends to remain closer to the route centerline, with relatively higher concentrations than the TSHD methods. The localization of sediment plumes for the CFE method is likely due to the introduction of sediment closer to the seabed and faster installation rate. The TSHD split bottom method instantaneous plume reflects the periodic overflow and split bottom disposal in comparison to the TSHD continuous overflow. However, the footprints of both TSHD methods appear alike due to the similar disposal locations within the water column and same installation speed. The slight differences are most likely due to the periodic introduction of finer sediment at the surface and coarser sediment a few meters below the surface for the split bottom method, whereas all sediment is disposed of at the surface for the continuous overflow method. These differences are evident in the results tables presented in Section 4.4.

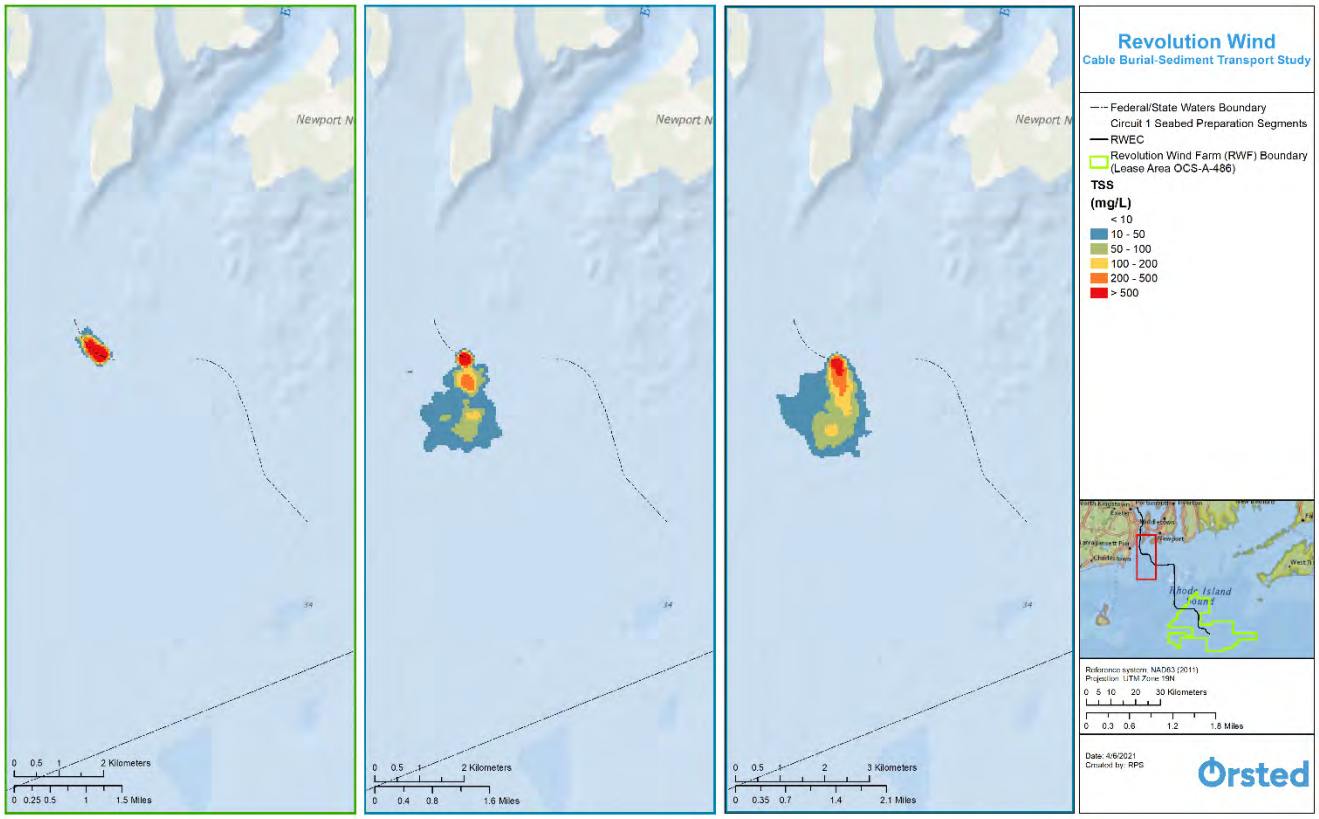

Figure 4.3-10 Snapshot of Predicted Instantaneous TSS Concentrations Associated with (A) CFE, (B) TSHD, Split Bottom, and (C) TSHD, Continuous Overflow Seabed Preparation.

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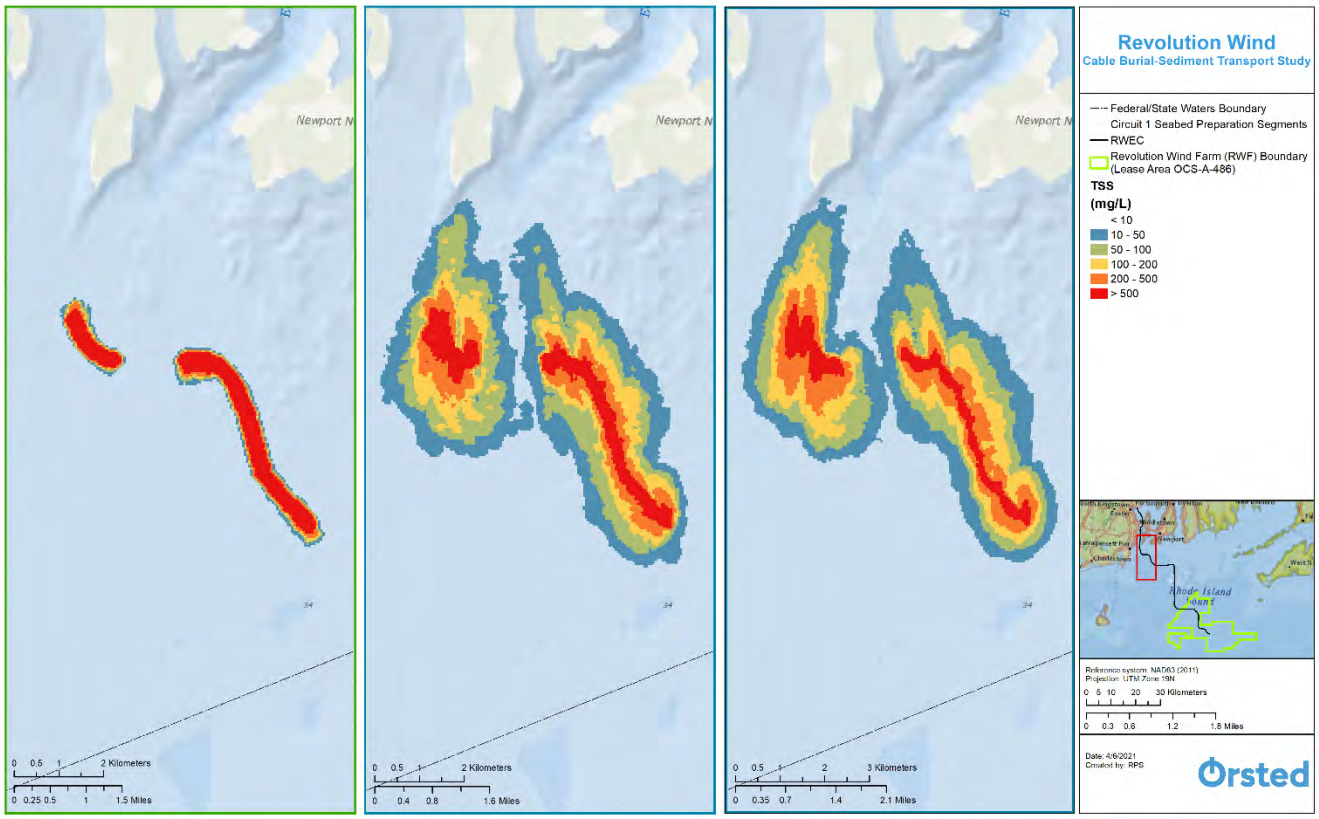

Figure 4.3-11 Map of Predicted Time-Integrated Maximum TSS Concentrations Associated with (A) CFE, (B) TSHD, Split Bottom, and (C) TSHD, Continuous Overflow Seabed Preparation.

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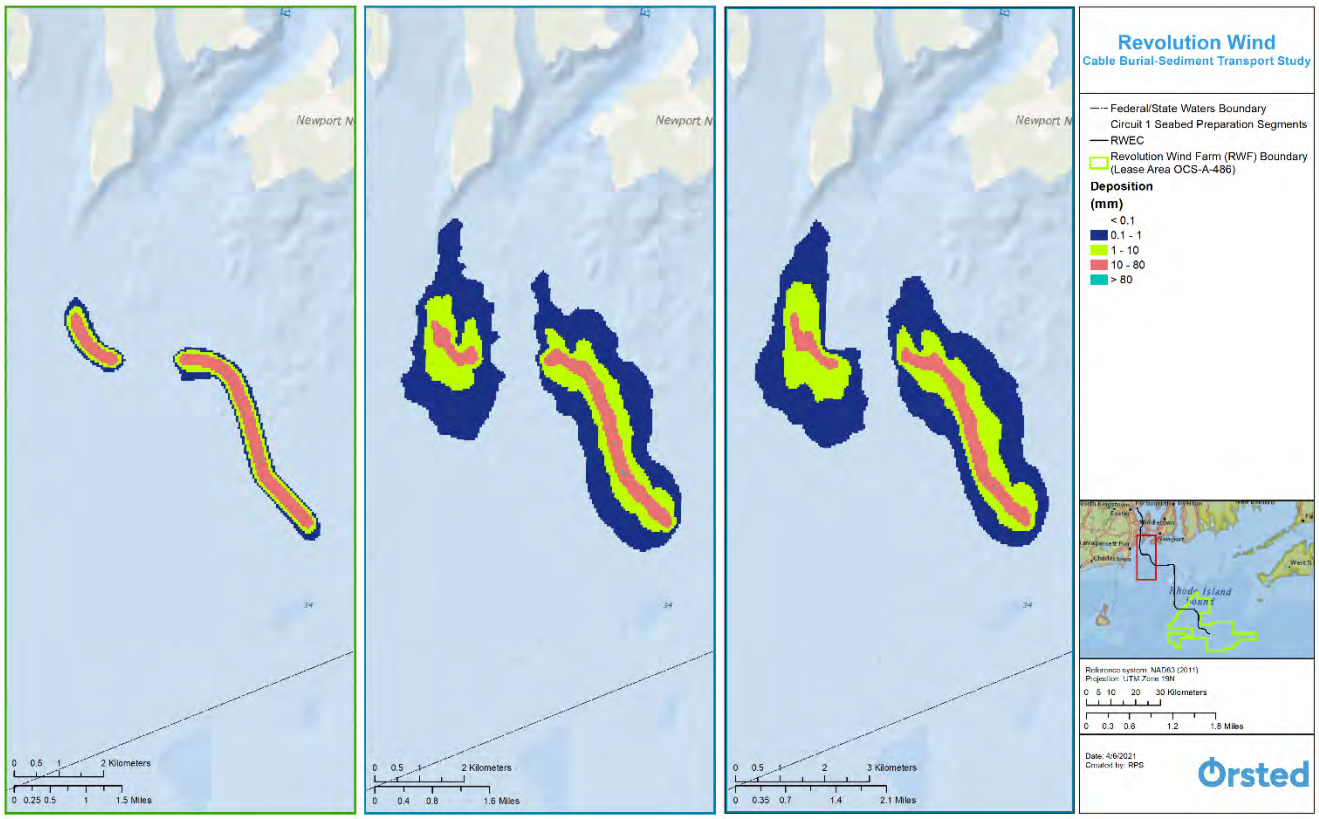

Figure 4.3-12 Map of Predicted Deposition Thickness Associated with (A) CFE, (B) TSHD, Split Bottom, and (C) TSHD, Continuous Overflow Seabed Preparation.

4.3.2 Study Component 2: RWEC Circuit 1 Cable Burial

A snapshot of the instantaneous concentration from the modeled RWEC Circuit 1 cable burial illustrates that highest concentrations are predicted to be directly adjacent to the route centerline, with lower concentrations extending further towards the south due to transport from local currents (Figure 4.3-13). The cross-section, which spans the section of Circuit 1 within RI state waters, shows sediment is introduced and remains near the seabed.

The results from the entire simulation are provided in Figure 4.3-14 and Figure 4.3-15. Figure 4.3-14 shows the time-integrated maximum TSS for installation within RI state waters. The response of the plume to the oscillating currents is evident in the footprint, particularly in sections where the route is perpendicular to the predominate current direction. It is also evident that, in areas of almost all coarse sand, the plume is smaller and the footprint does not extend as far from the route centerline. The cumulative deposition along the circuit is presented in Figure 4.3-15.

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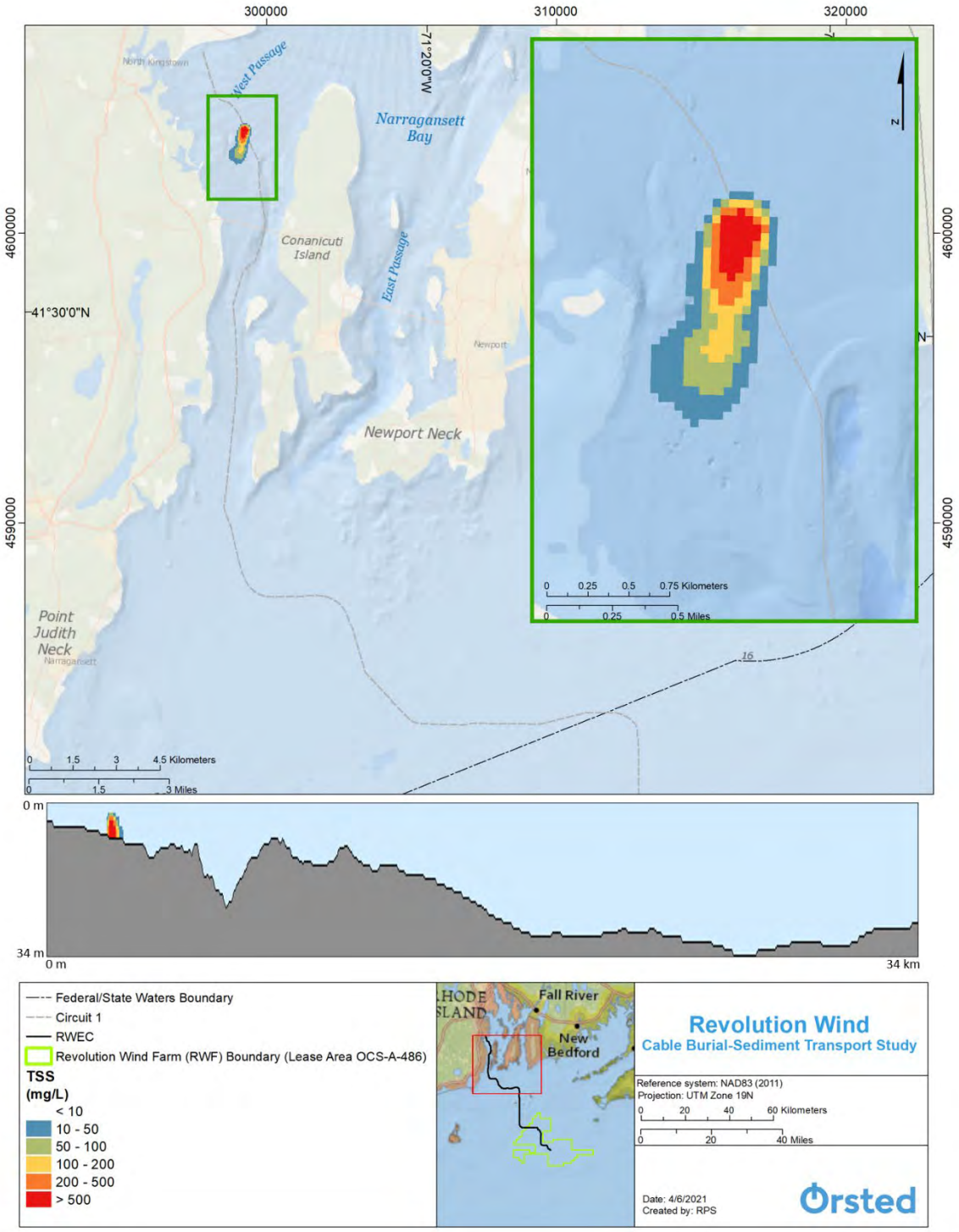

Figure 4.3-13 Snapshot of Predicted Instantaneous TSS Concentrations Associated with RWEC Circuit 1 Cable Burial.

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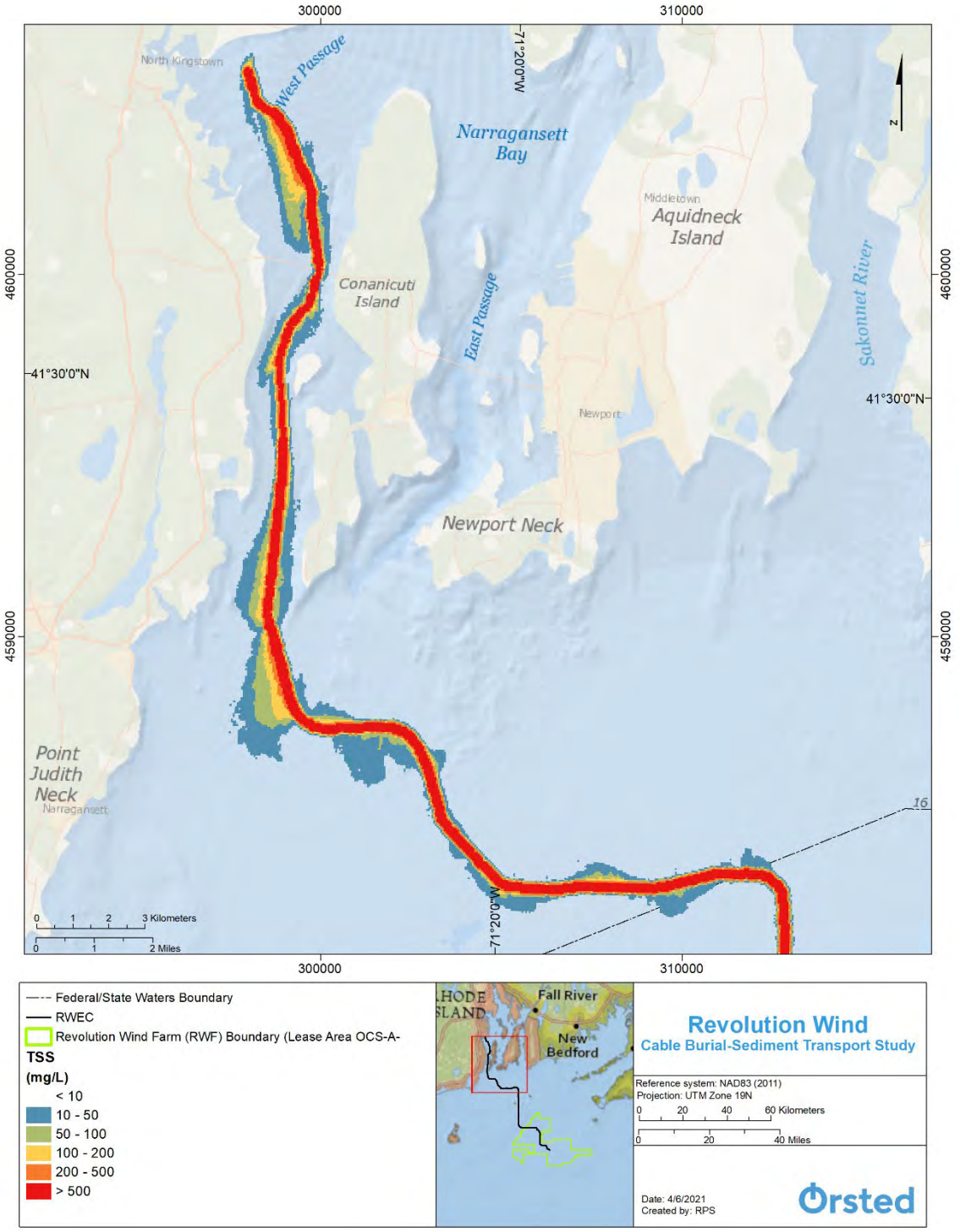

Figure 4.3-14 Map of Predicted Time-Integrated Maximum TSS Concentrations Associated with RWEC Circuit 1 Cable Burial.

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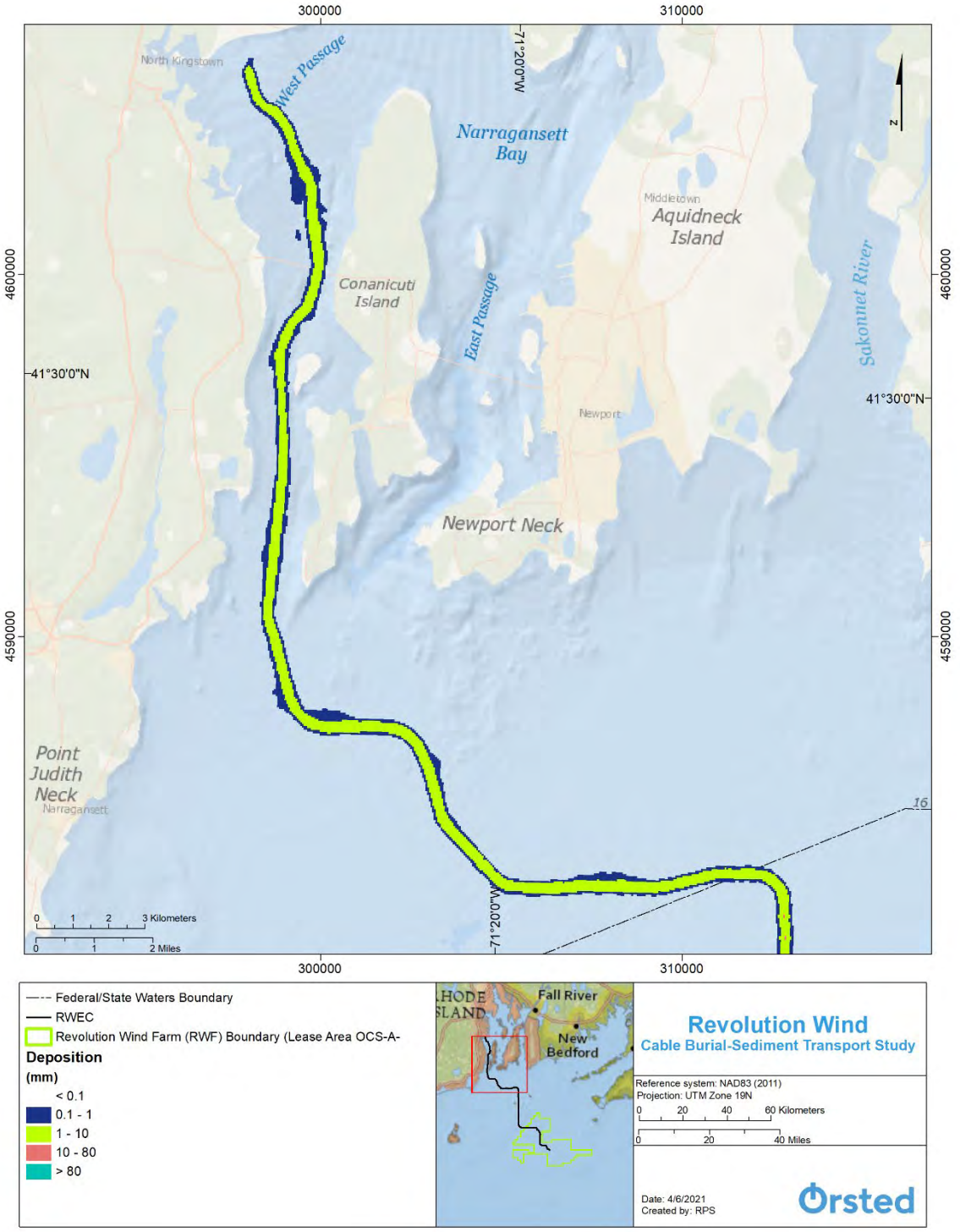

Figure 4.3-15 Map of Predicted Deposition Thickness Associated with RWEC Circuit 1 Cable Burial.

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4.3.3 Study Component 4: RWEC Landfall

A snapshot of the instantaneous concentration from the RWEC landfall simulation is provided in Figure 4.3-16. The snapshot illustrates that highest concentrations are predicted to be directly adjacent to the route centerline, with lower concentrations extending further towards the northeast due to transport from local currents. The cross-sections, extending from the shoreline to just past the HDD exit pit, show sediment is introduced near the surface.

The time-integrated maximum TSS concentrations and deposition thickness results from the RWEC landfall simulation are presented in Figure 4.3-17 and Figure 4.3-18, respectively. Since the landfall analysis only includes clearance of the HDD exit pit, the concentration footprint is small, though exhibits fairly high concentrations due to the shallow depth and low currents of the site which reduce sediment transport extents.

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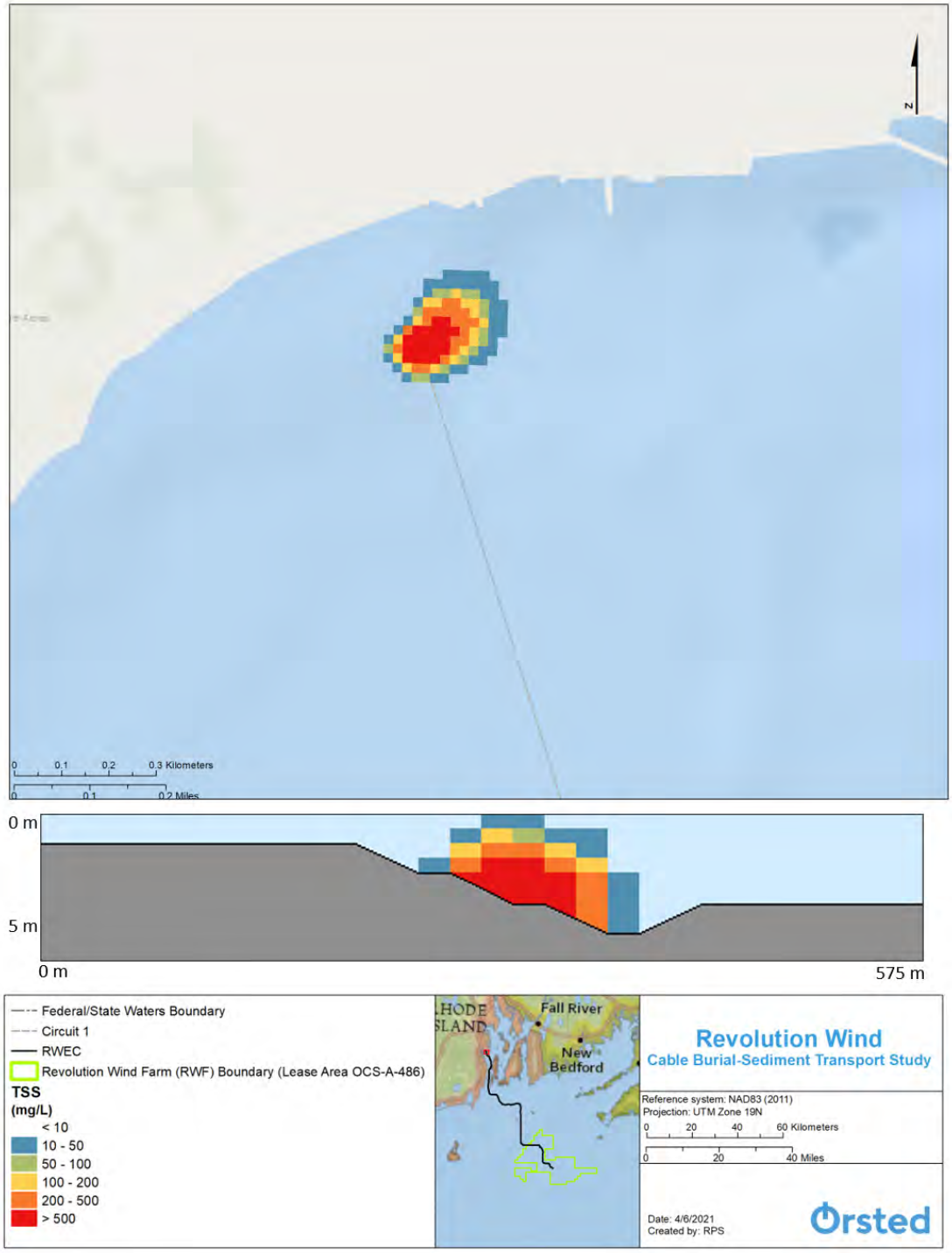

Figure 4.3-16 Snapshot of Predicted Instantaneous TSS Concentrations Associated with RWEC Landfall.

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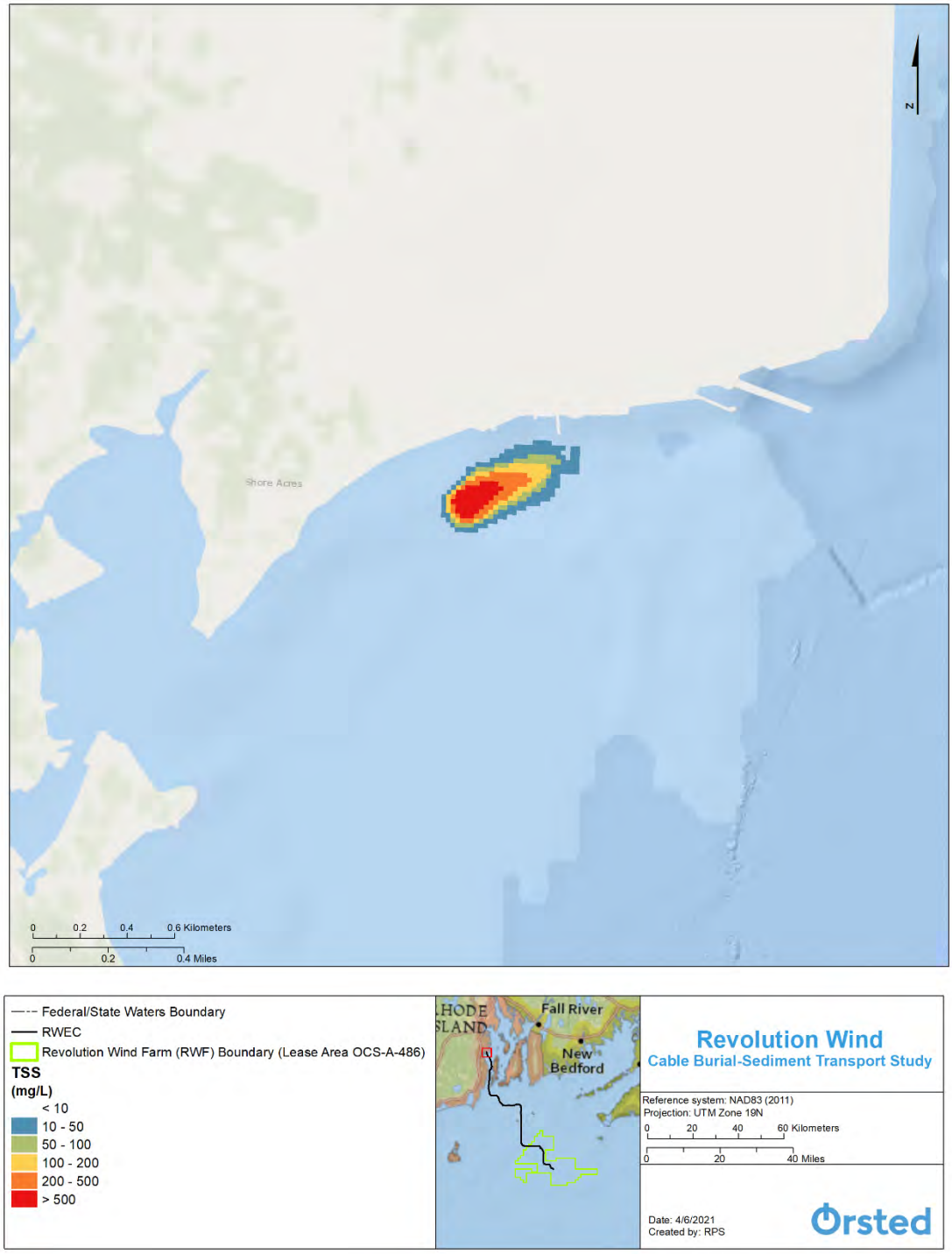

Figure 4.3-17 Map of Predicted Time-Integrated Maximum TSS Concentrations Associated with RWEC Landfall.

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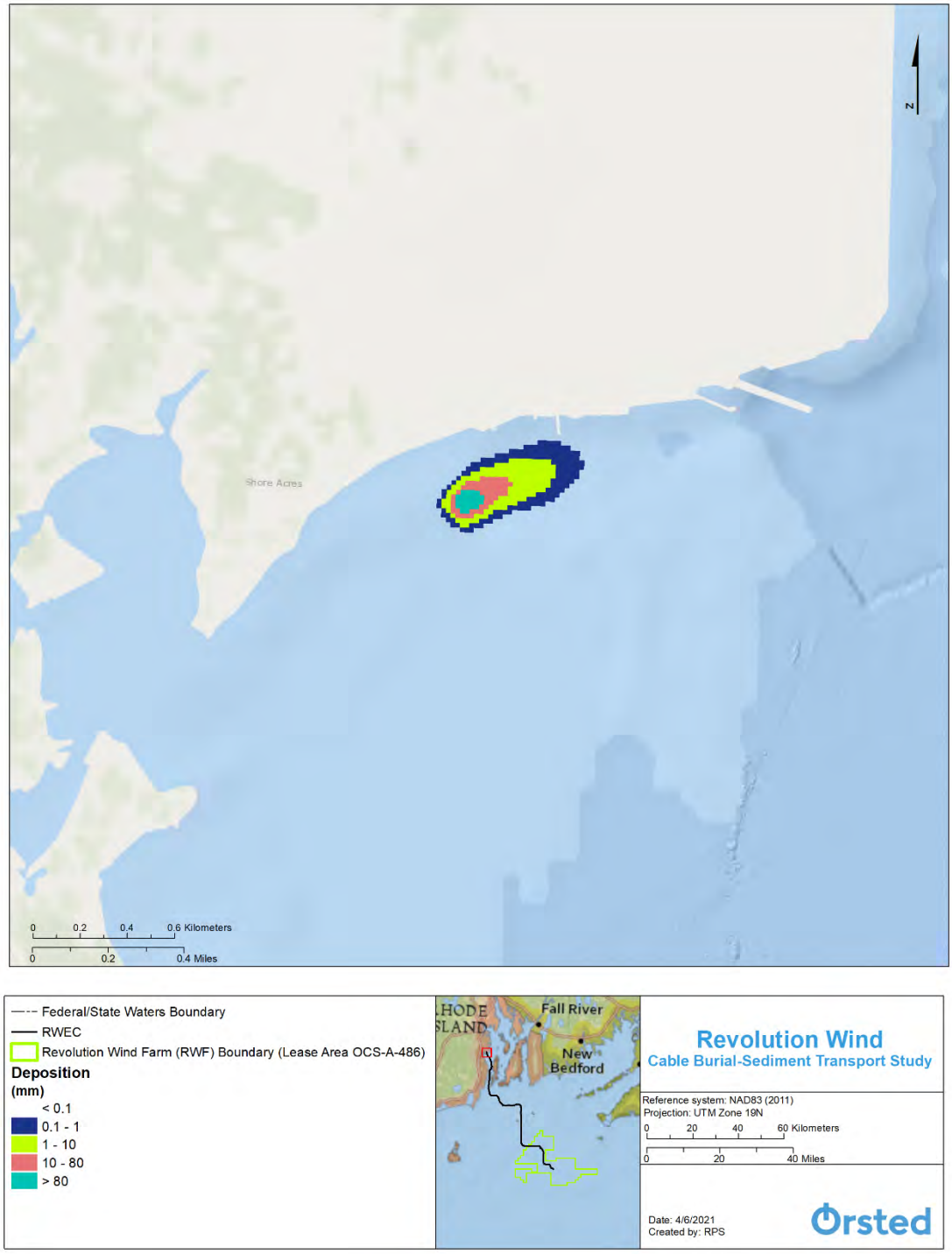

Figure 4.3-18 Map of Predicted Deposition Thickness Associated with RWEC Landfall.

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4.4 Results Summary Tables

The results of the modeling showed that the cable burial activities will result in plumes of excess TSS in the water column and seabed deposition. The TSS plumes are limited to the bottom of the water column for the CFE seabed preparation method and RWEC Circuit 1 burial because the construction methods modeled for these scenarios introduce sediment near the seabed. The TSS plumes for TSHD seabed preparation and the landfall are present throughout the majority of the water column due to sediment introduction at or near the water surface and, for the landfall, shallow depths. Each plume is temporary in any given location and was transported by local currents. Key metrics of each scenario are compiled and presented in the tables below. The bullets below describe the summary tables and discuss key results.

- Table 4.4-1 summarizes the total volumes resuspended for each scenario and the amount resuspended within RI state waters.
- Table 4.4-2 and Table 4.4-3 summarize the total area over different deposition thickness thresholds (0.1 mm, 1.0 mm, and 10 mm). The two tables present the same information (i.e., total area and area within RI state waters above each threshold) as acres and hectares.
- Table 4.4-4 summarizes the maximum extent of deposition over three thickness thresholds (0.1 mm, 1.0 mm, and 10 mm). The extents were measured perpendicular to the modeled route centerline. The results are provided for RI state waters, as applicable. Note that while the maximum extent is presented, the typical extent is often less than the scenario-specific maximum.
    - For the seabed preparation segments within RI state waters, deposition exceeding 10 mm is predicted to remain within 688.8 ft (210 m), 1,033.2 ft (315 m), and 852.8 ft (260 m) from the route centerline for CFE, TSHD split bottom, and TSHD continuous overflow seabed preparation activities, respectively.
    - For jet plow installation along the RWEC within RI state waters, deposition thickness is not predicted to reach 10 mm. Deposition exceeding 1.0 mm is predicted to remain within 787.2 ft (240 m) from the route centerline.
    - Evaluation of the landfall showed that deposition exceeding 10 mm may extend up to 738 ft (225 m) from the exit pit location.
- Table 4.4-5 summarizes the maximum extent of the TSS plume over two different thresholds (50 mg/L and 100 mg/L). The extents were measured perpendicular to the modeled route centerline. The results are provided for RI state waters. Note that while the maximum extent is presented, the typical extent is often less than the scenario-specific maximum. The persistence of concentrations associated with the activities was investigated and the following points summarize those findings.
    - For the seabed preparation segments within RI state waters, the predicted concentrations above background (> 0 mg/L) do not persist in any given location (grid cell) for greater than 3.5 hours, 47.8 hours, and 46 hours for CFE, TSHD split bottom, and TSHD continuous overflow seabed preparation activities, respectively. In most locations (> 75% of the affected area within RI state waters) concentrations return to ambient within approximately 2.5 hours for CFE and approximately 16 hours for both TSHD methods. Predicted concentrations greater than 100 mg/L do not persist in RI state waters for greater than 2.3 hours, 13.5 hours, and 13.8 hours for CFE, TSHD split bottom, and TSHD continuous overflow seabed preparation activities, respectively.
    - For jet plow installation along the RWEC within RI state waters, predicted concentrations above background (> 0 mg/L) do not persist in any given location (grid cell) for greater than 69.7 hours. In most locations (> 75% of the affected area within RI state waters) concentrations return to

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ambient within approximately 26 hours. Predicted concentrations greater than 100 mg/L do not persist in RI state waters for greater than 4.5 hours.

- Evaluation of the landfall showed that predicted concentrations above background (> 0 mg/L) do not persist in any given location (grid cell) for greater than 70.3 hours. In most locations (> 75% of the affected area within RI state waters) concentrations return to ambient within approximately 6 hours. Predicted concentrations greater than 100 mg/L do not persist in RI state waters for greater than 70.2 hours.

Table 4.4-1. Summary of Volume Resuspended for Modeling Scenarios.

Volumes Resuspended		
Study Component	Description of Scenario	Volume Resuspended within RI State Waters, cy (m^3)
RWEC Seabed Preparation	Circuit 1 – Seabed Preparation, CFE	103,875.3 (79,418.4)
	Circuit 1 – Seabed Preparation, TSHD Split Bottom	103,163.2 (78,873.9)
	Circuit 1 – Seabed Preparation, TSHD Continuous Overflow	103,875.3 (79,418.4)
RWEC	Circuit 1 – Jet Plow	46,287.1 (35,388.9)
Landfall	HDD Exit Pit – Backhoe Excavator followed by Venturi Eductor Device	3,097.8 (2,368.4)

Table 4.4-2. Summary of Areas (ac) Exceeding Deposition Thickness Thresholds.

Deposition Results: Area in Acres Exceeding Thickness Thresholds				
		Area (Acres [ac]) within RI State Waters of Deposition Exceeding Threshold		
Study Component	Description of Scenario	0.1 mm	1.0 mm	10 mm
RWEC Seabed Preparation	Circuit 1 – Seabed Preparation, CFE	992.1	727.1	453.4
	Circuit 1 – Seabed Preparation, TSHD Split Bottom	4,056.9	1,498.1	481.9
	Circuit 1 – Seabed Preparation, TSHD Continuous Overflow	4,270.0	1,677.8	480.0
RWEC	Circuit 1 – Jet Plow	4,017.3	2,335.8	0
Landfall	HDD Exit Pit – Backhoe Excavator followed by Venturi Eductor Device	35.4	20.4	7.4

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Table 4.4-3. Summary of Areas (ha) Exceeding Deposition Thickness Thresholds.

Deposition Results: Area in Hectares Exceeding Thickness Thresholds				
		Area (Hectare [ha]) within RI State Waters of Deposition Exceeding Threshold		
Study Component	Description of Scenario	0.1 mm	1.0 mm	10 mm
RWEC Seabed Preparation	Circuit 1 – Seabed Preparation, CFE	401.5	294.3	183.5
	Circuit 1 – Seabed Preparation, TSHD Split Bottom	1641.8	606.3	195.0
	Circuit 1 – Seabed Preparation, TSHD Continuous Overflow	1,728.0	679.0	194.3
RWEC	Circuit 1 – Jet Plow	1,625.8	945.3	0
Landfall	HDD Exit Pit – Backhoe Excavator followed by Venturi Eductor Device	14.3	8.2	3.0

Table 4.4-4. Summary of Extent of Deposition Exceeding Thickness Thresholds as Measured Perpendicular from the Modeled Cable Centerline.

Deposition Extent				
		Maximum Extent of Deposition Exceeding Threshold within RI State Waters, ft (m)		
Study Component	Description of Scenario	0.1 mm	1.0 mm	10 mm
RWEC Seabed Preparation	Circuit 1 – Seabed Preparation, CFE	1,587.5 (484)	1,049.6 (320)	688.8 (210)
	Circuit 1 – Seabed Preparation, TSHD Split Bottom	6,553.4 (1998)	3,017.6 (920)	1033.2 (315)
	Circuit 1 – Seabed Preparation, TSHD Continuous Overflow	6,510.8 (1985)	3,755.6 (1145)	852.8 (260)
RWEC	Circuit 1 – Jet Plow	1,869.6 (570)	787.2 (240)	0.0 (0)
Landfall	HDD Exit Pit – Backhoe Excavator followed by Venturi Eductor Device	1,771.2 (540.0)	1,377.6 (420.0)	738.0 (225.0)

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Table 4.4-5. Summary of Extent of Plume Exceeding TSS Thresholds as Measured Perpendicular from the Modeled Cable Centerline

Plume Concentration Extent			
		Maximum Extent of Plume Concentration Perpendicular to Route Exceeding TSS Threshold within RI State Waters, ft (m)	
Study Component	Description of Scenario	50 mg/L	100 mg/L
RWEC Seabed Preparation	Circuit 1 – Seabed Preparation, CFE	1,754.8 (535)	1,443.2 (440)
	Circuit 1 – Seabed Preparation, TSHD Split Bottom	6,888.0 (2100)	4,690.4 (1430)
	Circuit 1 – Seabed Preparation, TSHD Continuous Overflow	6,560.0 (2000)	5,838.4 (1780)
RWEC	Circuit 1 – Jet Plow	3,673.6 (1120)	2,345.2 (715)
Landfall	HDD Exit Pit – Backhoe Excavator followed by Venturi Eductor Device	1,459.6 (445)	1,312.0 (400)

4.5 Results Discussion and Conclusions

Based on conservative assumptions for the modeled study components, the goal of this assessment was to bound the range of predicted movement, behavior, and potential for effects that may be expected during and following sediment-disturbing activities anticipated for the Project. Using SSFATE, developed jointly by the USACE ERDC and Applied Science Associates (now part of RPS), sediment transport modeling was conducted to predict the extent, magnitude, and duration of sediment plumes above background values.

Simulations of CFE seabed preparation predict a plume that is localized to the seabed due to the introduction of sediment near the bottom of the water column. Predictions show the plume of the CFE method tends to remain closer to the route centerline, with relatively higher concentrations, than the TSHD methods. The localization of sediment plumes for the CFE method is likely due to the introduction of sediment closer to the seabed and a faster installation rate. For CFE, the maximum extent of deposition exceeding 10 mm is predicted to remain within 688.8 ft (210 m) from the route centerline. In comparison, this maximum extent was approximately 344.4 ft (105 m) and 164 ft (50 m) smaller than the TSHD split bottom and TSHD continuous overflow, respectively. For the TSHD seabed preparation simulations, the predicted plume was present throughout the water column due to the introduction of sediment at or near the water surface. While the TSHD split bottom's instantaneous plume reflects the periodic overflow and split bottom disposal compared to the TSHD continuous overflow, the footprints of both TSHD methods appear alike. For example, the total area of deposition exceeding 10 mm in RI state waters differed by approximately 1.9 acres (0.7 ha). These similarities are due to the similar disposal locations within the water column and identical installation speed. The slight differences are most likely due to the periodic introduction of finer sediment at the surface and coarser sediment a few meters below the surface for the split bottom method, whereas all sediment was disposed of at the surface for the continuous overflow method. The influence of the location where sediment is introduced to the water column (e.g., seabed vs. water surface) was highlighted by the TSHD methods larger duration of predicted concentrations above background (> 0 mg/L). For example, the predicted concentration above background for CFE was estimated to subside 44.3 hours and 42.5 hours before the TSHD split bottom and TSHD continuous overflow activities, respectively. Additionally, in > 75% of the affected area within RI state waters, concentrations are predicted to return to ambient within approximately 2.5 hours for CFE and approximately 16 hours for both TSHD methods.

Simulations of RWEC Circuit 1 cable installation using jet plow installation parameters predict a plume that is localized to the seabed due to the introduction of sediment near the bottom of the water column. The response of the plume to the oscillating currents is evident in the footprint, particularly in sections where the route is

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perpendicular to the predominate current direction. Along the RWEC within RI state waters, deposition thickness is not predicted to reach 10 mm. The maximum deposition exceeding 1.0 mm is predicted to remain within 787.2 ft (240 m) from the route centerline. The predicted concentrations above background (> 0 mg/L) within RI state waters do not persist in any given location (grid cell) for greater than 69.7 hours. In most locations (> 75% of the affected area within RI state waters) concentrations return to ambient within approximately 26 hours.

The landfall simulation predicts the concentration footprint is relatively small, though exhibits fairly high concentrations due to the shallow depth and low currents of the site which reduce sediment transport extents. Deposition greater than 10 mm may extend up to 738 ft (225 m) from the exit pit location. The predicted concentrations above background (> 0 mg/L) do not persist in any given location (grid cell) for greater than 70.3 hours. In most locations (> 75% of the affected area within RI state waters) concentrations return to ambient within approximately 6 hours.

SSFATE was used to effectively simulate three representative study components of the types of activities that are expected with the Project. The modeling predicted the potential TSS concentrations, deposition thicknesses, exposure durations, and corresponding areas and distances associated with each Project-related construction activity.

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Appendix I: Commercial and Recreational Fisheries Technical Report Revolution Wind Offshore Wind Farm

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Technical Report

Commercial and Recreational Fisheries Technical Report

Revolution Wind Offshore Wind Farm

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March 2021

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List of Acronyms

ACCSP	Atlantic Coastal Cooperative Statistics Program
BMP	Best Management Practice
COP	Construction and Operations Plan
CT DEEP	Connecticut Department of Energy and Environmental Protection
EEZ	exclusive economic zone
EFH	essential fish habitat
GARFO	Greater Atlantic Regional Fisheries Office
GIS	geographic information system
IPF	impact-producing factor
Lease	Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf OCS-A 0486
Lease Area	BOEM-designated Renewable Energy Lease Area OCS-A 0486
MADMF	Massachusetts Division of Marine Fisheries
MRIP	Marine Recreational Information Program
NOAA Fisheries	National Marine Fisheries Service
NROC	Northeast Regional Ocean Council
NYSDEC	New York State Department of Environmental Conservation
O&M	operations and maintenance
OCS	Outer Continental Shelf
OnSS	onshore substation
OSS	offshore substation
Project	Revolution Wind Offshore Wind Farm Project
Project Area	Proposed Wind Farm Area, Export Cable Corridor, and all onshore Project facility locations including the Onshore Transmission Cable Corridor, and Onshore Substation
RIDEM	Rhode Island Department of Environmental Management
RI-MA WEA	Rhode Island-Massachusetts Wind Energy Area
RWEC	Revolution Wind Farm Export Cable
RWEC-RI	Revolution Wind Farm Export Cable-Rhode Island State Waters
RWEC-OCS	Revolution Wind Farm Export Cable-Outer Continental Shelf
RWF	Revolution Wind Farm

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SPCC	Spill Prevention, Control, and Countermeasure
TJB	transition joint bay
TSS	total suspended solids
VTR	Vessel Trip Report
VMS	Federal Vessel Monitoring System
WTG	wind turbine generator

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1.0 INTRODUCTION

1.1 Description of the Proposed Action

Revolution Wind, LLC (Revolution Wind), a 50/50 joint venture between Orsted North America Inc. (Orsted NA) and Eversource Investment LLC (Eversource), proposes to construct and operate the Revolution Wind Farm Project (hereinafter referred to as the Project). The wind farm portion of the Project will be located in federal waters on the Outer Continental Shelf (OCS) in the designated Bureau of Ocean Energy Management (BOEM) Renewable Energy Lease Area OCS-A 0486 (Lease Area). The Lease Area is approximately 20 statute miles (mi) (17.4 nautical miles [nm], 30 kilometers [km]) south of the coast of Rhode Island (Figure 1.1-1). The Project consists of the Revolution Wind Farm (RWF), located within the Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf -A 0486 Lease Area (Lease Area) and the Revolution Wind Farm Export Cable (RWEC), traversing federal (RWEC-OCS) and Rhode Island state waters (RWEC-RI) to potential landfall options at Quonset Point in North Kingstown, Rhode Island.

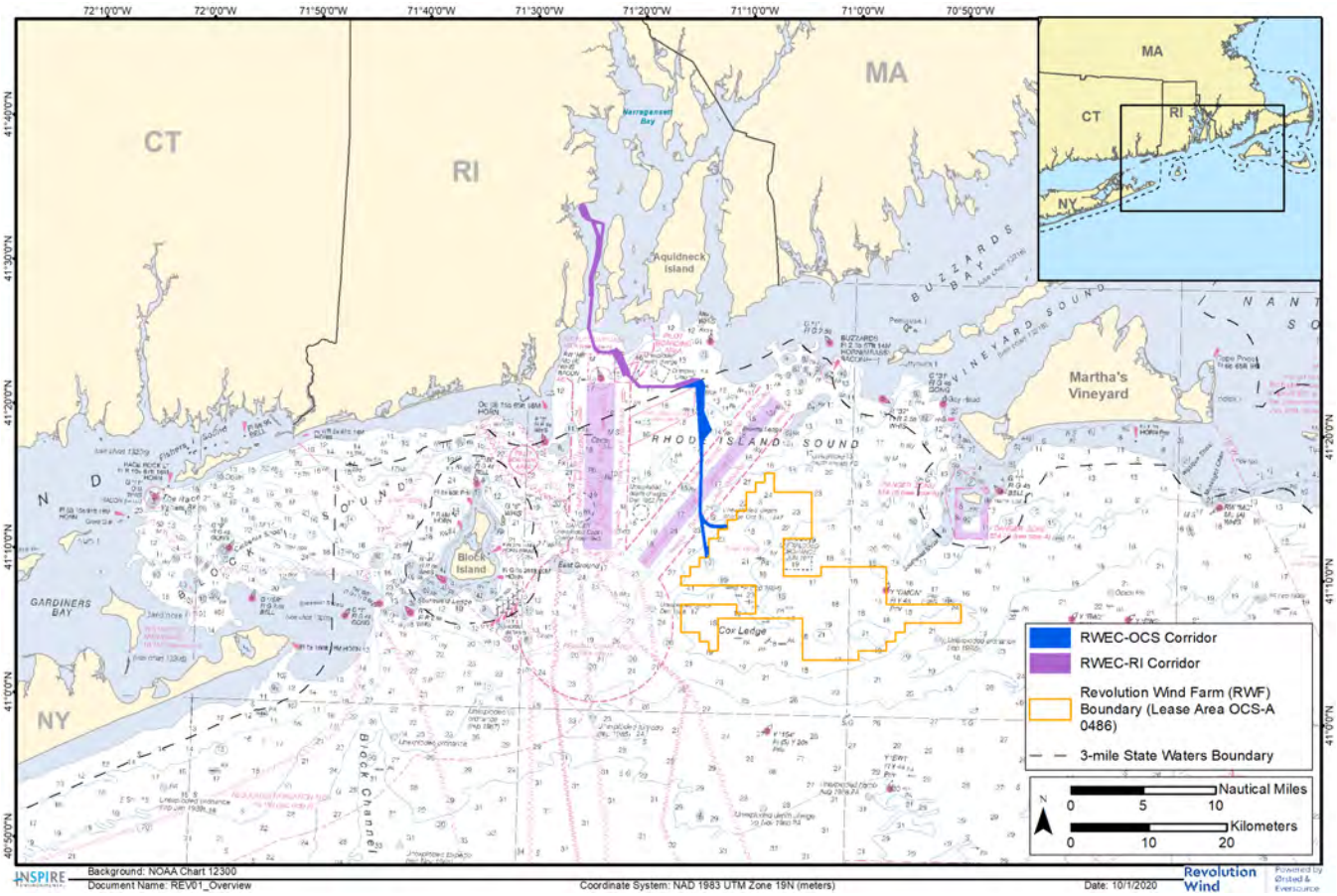

Figure 1.1-1 Map of the Project Area, including the Potential Export Cable Route and Revolution Wind Farm.

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The Project will be comprised of both offshore and onshore components, which are described in detail in Section 3 of the Construction and Operations Plan (COP). This Technical Report focuses on evaluation of the Project's offshore components, which include the following:

- up to 100 Wind Turbine Generators (WTGs) connected by a network of Inter-Array Cables (IAC);
- up to two Offshore Substations (OSSs) connected by an OSS-Link Cable; and
- up to two submarine export cables (referred to as the RWEC), generally co-located within a single corridor.

1.2 Regulatory Context and Resource Definition

The National Oceanic Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries) requires all federally permitted commercial fishing vessels (with the exception of those vessels that only have a lobster permit) to submit vessel trip reports (VTRs) for every fishing trip (50 Code of Federal Regulations [CFR] 648.7). The VTR data provide a broad census of fishing activity that encompasses the majority of commercial fisheries active near the RWF and RWEC fisheries study corridor (see Section 2.1.1.1). VTRs include a single fishing location (reported in latitude and longitude coordinates) for where "the majority of fishing effort occurred" on each trip, gear type, and species targeted (NOAA Fisheries, 2018).

NOAA Fisheries also monitors the location and movement of commercial fishing vessels for certain fisheries via a vessel monitoring system (VMS). VMS data are maintained by the Northeast Regional Ocean Council (NROC) and the Mid-Atlantic Regional Council on the Ocean for fishing vessel activity of select fisheries (see Section 2.1.1.2) in the northeast and mid-Atlantic regions of the US, which encompasses the RWF and RWEC locations,

The lobster and Jonah crab fisheries do not have VTR or VMS requirements. VMS data for lobster and Jonah crab likely come from fishermen with lobster permits that also participate in other fisheries that require VTRs or VMS (RIDEM, 2017). The American lobster fishery is active in the marine portions of the Project Area and is managed cooperatively by the states and NOAA Fisheries under the framework of the Atlantic States Marine Fisheries Commission. Jonah crab was once considered bycatch of the lobster fishery, but since 2011 (Truesdale et al., 2019) has increasingly been targeted as a commercial fishery. Landings in the fishery come predominantly from Massachusetts (70%) and Rhode Island (24%) and the fishery has only recently (2015) been managed through an interstate Fishery Management Plan (FMP; ASMFC, 2015).

1.3 Contents of This Technical Report

This technical report provides a detailed explanation of the data and analyses used to assess commercial and recreational fisheries resources in the RWF and RWEC fisheries study corridor. The information presented herein supports the summary-level data and analysis presented in Section 4.6.5 of the COP. Section 2 of this technical report describes the data sources and analysis used to characterize commercial and recreational fishing activity in the RWF and RWEC areas. Data analyzed in this technical report were requested from NOAA Fisheries and obtained from publicly available data sources. All data requested were subject to strict confidentiality requirements set forth by the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006. These requirements prevent the government from making any data public that can be linked to individual people or businesses. This is achieved by applying the "Rule of Three," where any data presented to the public must have been reported by at least three fishermen, vessels, dealers, etc. Any data that can only be attributed to two or fewer entities must be aggregated to a higher level. Section 2.2 of this report provides detailed summaries of the data requested from state and federal agencies, as well as supplementary maps for data sets referenced in Section 4.6.5 of the COP. Potential impacts and mitigation are discussed in Section 3.0.

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2.0 AFFECTED ENVIRONMENT

2.1 Methodology

2.1.1 Federal Data

2.1.1.1 Federal Vessel Trip Report (VTR) Data

The RWF and RWEC fisheries study corridor occur within the larger Rhode Island-Massachusetts Wind Energy Area (RI-MA WEA). The VTR data used for characterizing commercial fisheries in the RWF and RWEC fisheries study corridor as summarized in this report were requested from and processed by NOAA Fisheries following the methods described by Kirkpatrick et al. (2017). Also, included was the application of the statistical model as described by DePiper (2014) that assesses the VTR self-reported fishing locations compared to observed haul locations. NOAA Fisheries also provided nonconfidential data on commercial fishing activity (2008 to 2017) in terms of revenue and landings, for fishing activity reported to occur within the RWF, as well as within a 46-mi (74-km)-long, 6.2-mi (10-km)-wide RWEC fisheries study corridor (Figure 2.1-1) that was established as an approximate buffer around a preliminary RWEC corridor. The RWEC fisheries study corridor was not established for the cable corridor that occurs within the RWF, therefore VTR data collected near the RWEC within the RWF are attributed to the RWF in tables below. The RWEC fisheries study corridor was defined to provide a reasonable geographic extent for fisheries activity that may occur near the RWEC fisheries study corridor, and may, therefore, be affected in some way by the installation and operations of the RWEC. The RWEC fisheries study corridor was created based on a preliminary RWEC corridor and was defined to be wide enough to accommodate changes over time to the RWEC centerline. To add context, the data were provided alongside the overall VTR data available for commercial fishing activity in the Greater Atlantic Region, which extends from Maine to North Carolina.

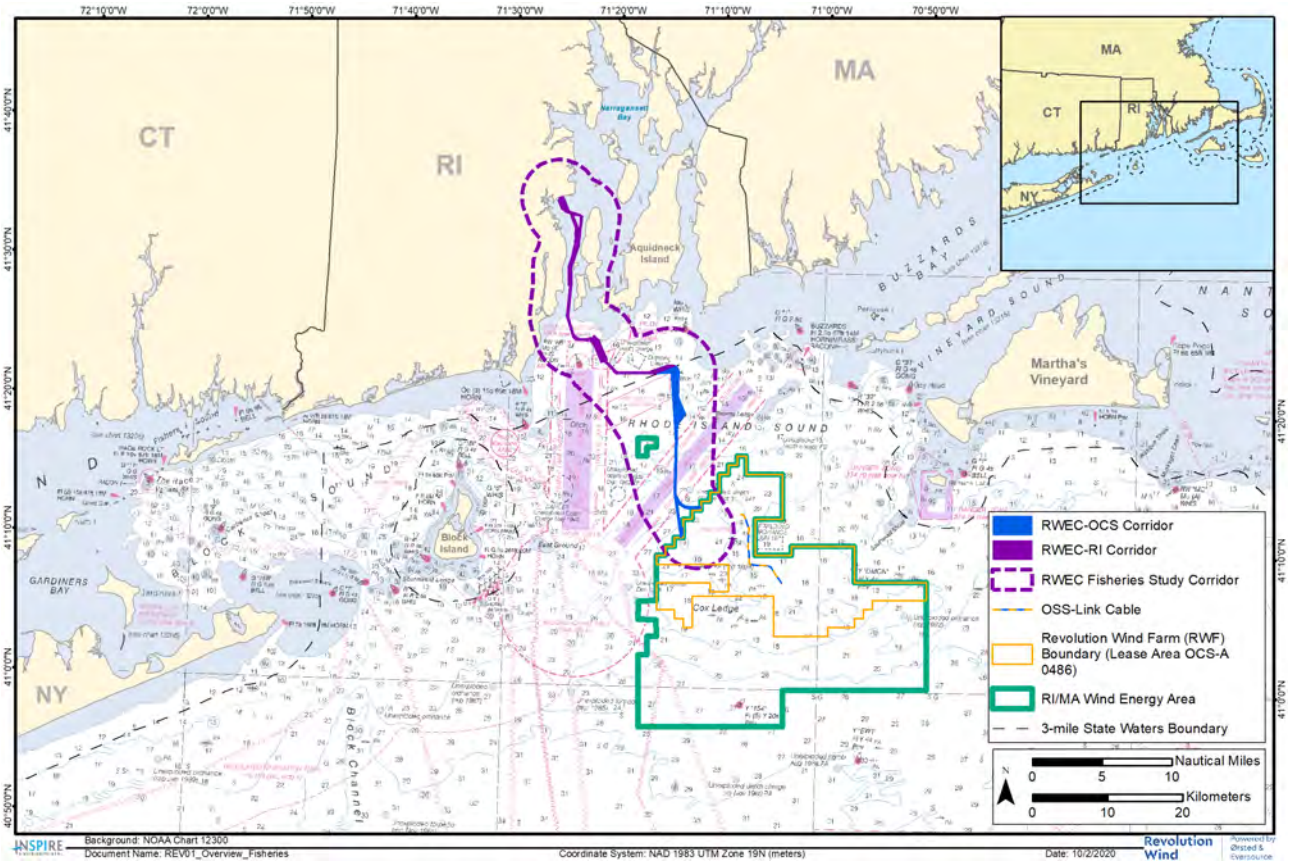

Figure 2.1-1 Map of the Revolution Wind Farm, the RI-MA WEA, and the RWEC Fisheries Study Corridor

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The data provided by NOAA Fisheries represent fishing activity for federally permitted vessels that fish in either federal (defined as: 3 nm to 200 nm [3.5 to 345 mi; 5.6 to 556 km]) or state (within 3 nm) waters. Fishermen with federal and state permits (including those who also hold state permits) are required to submit VTRs to NOAA Fisheries. VTR data for fishermen who fish only in state waters were requested and obtained from the Atlantic Coastal Cooperative Statistics Program (ACCSP, 2020). To avoid duplicate records of fishing activity in state waters, fishermen who hold federal permits, but fished in state waters, were excluded from the ACCSP Fisheries VTR data set.

The VTR data provided by NOAA Fisheries provide a context for characterizing both revenue and biomass (pounds landed) from high-volume and high-value fisheries. A limitation of the data set is that it is most accurate when used to describe the general geographical characteristics of the commercial fishing industry in aggregate and does not provide information on precise fishing locations.

2.1.1.2 Federal Vessel Monitoring System (VMS)

VMS data are collected through a satellite surveillance system that primarily is the primary means used by NOAA Fisheries for monitoring the location of certain commercial fishing vessels working in federal waters. Vessels holding the following permits are required to have an operational VMS unit installed:

- Full-time or part-time limited access Atlantic sea scallop (*Placopecten magellanicus*), or limited access general category scallop permit;
- Occasional limited access scallop permit when fishing under the Scallop Area Access Program;
- Limited access monkfish (*Lophius americanus*), occasional scallop, or combination permit electing to provide VMS notifications;
- Limited access multispecies permit when fishing on a category A or B day at sea (DAS);
- Atlantic surfclam (*Spisula solidissima*) or ocean quahog (*Arctica islandica*) open access permit;
- Limited access monkfish vessel electing to fish in the Offshore Fishery Program;
- Limited access Atlantic herring (*Clupea harengus*) permit;
- Open access Atlantic herring Areas 2 and 3 permit;
- Limited access Atlantic mackerel (*Scomber scombrus*) permit; and
- Longfin squid (*Doryteuthis pealeii*) / butterfish (*Peprilus triacanthus*) moratorium permit.

The VMS location data are sent at least once an hour to NOAA Fisheries Office of Law Enforcement via transceiver units on the fishing vessels. The data include vessel identification, time, date, and the location at sea (NOAA Fisheries, 2019a). This information makes it possible for NOAA Fisheries to calculate the approximate speed that the vessel is travelling between vessel transmissions. The data are then filtered by estimated vessel-speed, depending on the gear and fishery, to indicate areas where it is likely that fishing is occurring (and not vessel transit locations). The benefit of VMS data is the geographical specificity of the fishing locations; one limitation of the data is that the “speed rule” used to filter the fishing locations from the vessel’s path of transit does not perfectly isolate fishing locations. In addition, VMS data do not provide complete coverage for all FMPs, i.e., there is not 100% reporting for some FMPs for some years. For instance, from 2017 to 2019, the percentage of FMPs using VMS ranged from 24 percent (American lobster) to 95 percent (Mackerel/Squid/Butterfish) (Douglas Christel, NOAA Fisheries, pers. comm. 5/18/2020).

To characterize fisheries active in the RWF and RWEC fisheries study corridor, spatial VMS data from the years 2011 through 2016 (where available) were overlaid with the RWF and RWEC fisheries study corridor to assess the relative intensity of fishing activity for multiple fisheries within and surrounding the Project Area. General fisheries categories with available data included in this analysis were:

- Large-mesh multispecies (groundfish);
- Monkfish;
- Pelagics (herring, mackerel, and squid);
- Atlantic herring;

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- Atlantic surfclam/ocean quahog;
- Atlantic sea scallop; and
- Squid

Squid are listed twice above because this fishery was designated a specific fisheries code by NOAA Fisheries in 2014. Metadata about the VMS data are available at the Mid-Atlantic Ocean Data Portal (http://portal.midatlanticocean.org/), the Northeast Ocean Data portal (www.northeastoceandata.org), and in a report by Fontenault (2018) detailing how VMS data were prepared for the NROC. The VMS maps were qualitatively assessed for intensity of fishing activity in the RWF and RWEC fisheries study corridor. As there is no catch or revenue information attached to VMS locations, the intensity of fishing location should be considered in conjunction with other available data and stakeholder input. The VMS data overlaid with the RWF and RWEC fisheries study corridor are illustrated in Section 2.2.2.

This Technical Report also includes a review of the results of the 2017 report published by Rhode Island Department of Environmental Management (RIDEM) that linked together fishing location from VMS data, trip identification information from VTR data, and additional information from dealer landings data (RIDEM, 2017). This analysis worked with multiple sources of data on federal fishing activity to attach revenue and landings data to VMS point locations from within each of the WEAs, and created fishing-intensity maps based on those data sets for the southern New England region. The results of this analysis describe the fisheries active in the RI-MA WEA and take advantage of the VMS data spatial resolution for describing fishing locations. RIDEM also produced smoothed (i.e., outliers were removed) relative vessel density maps for the fisheries reporting with VMS between 2011 and 2016; which are similar to the maps produced from the data obtained from the data from the Northeast Ocean Data Portal, and therefore, are not included here to avoid repetition.

2.1.2 VTR Data as Rasters

Observed fishing locations may occur far from the VTR reported coordinates, with departures that vary based on gear type and other trip characteristics (DePiper, 2014). NOAA Fisheries, therefore, developed a fishing-intensity raster dataset to improve the spatial representation of self-reported VTR fishing locations (Benjamin et al., 2018). This raster dataset includes the VTR data, the statistical model estimated by DePiper 2014, and spatial data describing closures gathered from GARFO's GIS portal, the Federal Register, and the Code of Federal Regulations (Benjamin et al., 2018). As described in Benjamin et al. (2018), the model developed by DePiper (2014) constructs the great circle distance between the VTR coordinate and all observed hauls on that trip. A duration model is then estimated to explain distance from the self-reported VTR to observed fishing locations as a function of VTR characteristics, finding that gear, trip length, and broad ocean area are the variables that best explain this distance. Confidence intervals are then generated that estimate the smallest distances in which to expect a percent of observed hauls around a VTR point.

This modeling approach can be applied to historical fishery data and aggregated as a metric of fishing effort by target fishery (e.g., herring) and time period (e.g., fishing year 2010). After constructing these raster datasets, maps of fishing effort for various variables (e.g., revenue) can be produced using a heat map visualization of fishing intensity (Benjamin et al., 2018).

2.1.3 State Vessel Trip Reports

The ACCSP holds records for fishing activity reported to occur in state waters by those fishermen who hold state permits, federal permits, or both state and federal permits. The fishing activity in state waters by those fishermen with both federal and state permits is reported to NOAA Fisheries, and was included in the activity summary of commercial fisheries (Section 2.1). The federal VTR data were used to summarize fishing within the RWF and RWEC fisheries study corridor and include fishing by vessels with federal permits in those areas. Thus, to avoid reporting fishing activity in state waters twice, data on fishing in state waters were filtered to include records for vessels that only fish in each states' waters. Many fishermen fish in both state and federal waters; however, those fishermen were not included in the state-waters-only data. For this reason, the data seem to indicate that certain species were not caught and landed from the statistical areas every year, or at all. Landings of those species were

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reflected in the federal VTR data summary. These caveats apply to all state VTR data described in this report. The state data should be considered in the broader context of fishing activity reported to the federal VTR database, and in conjunction with stakeholder input provided through the communication and engagement program that Revolution Wind has developed for this purpose (Section 2.1.5).

State VTR data are assessed for Connecticut, Massachusetts, New York, and Rhode Island. Connecticut, Massachusetts, and New York were included in the state VTR request because Revolution Wind may use New London and multiple RI ports for construction staging and operations and maintenance (O&M) activities. Vessels leaving and returning to these ports to support Project activities will potentially be transiting through state waters of all these states and, therefore, their impacts are considered and included. An expanded port plan (see Section 3) includes New Jersey, Virginia, and Maryland. The state VTR data were obtained for fishing activity within and around the immediate vicinity of the RWF and RWEC fisheries study corridor, where infrastructure will be located and long-term vessel activity will occur. Transit to and from remote ports will be limited to short-term use of these ports during the construction phase only, therefore Project-generated transit will not add significantly more traffic beyond existing levels. State VTR regions are depicted relative to the RWF and RWEC fisheries study corridor in Figure 2.1-2 and relevant federal statistical areas are depicted in Figure 2.1-3.

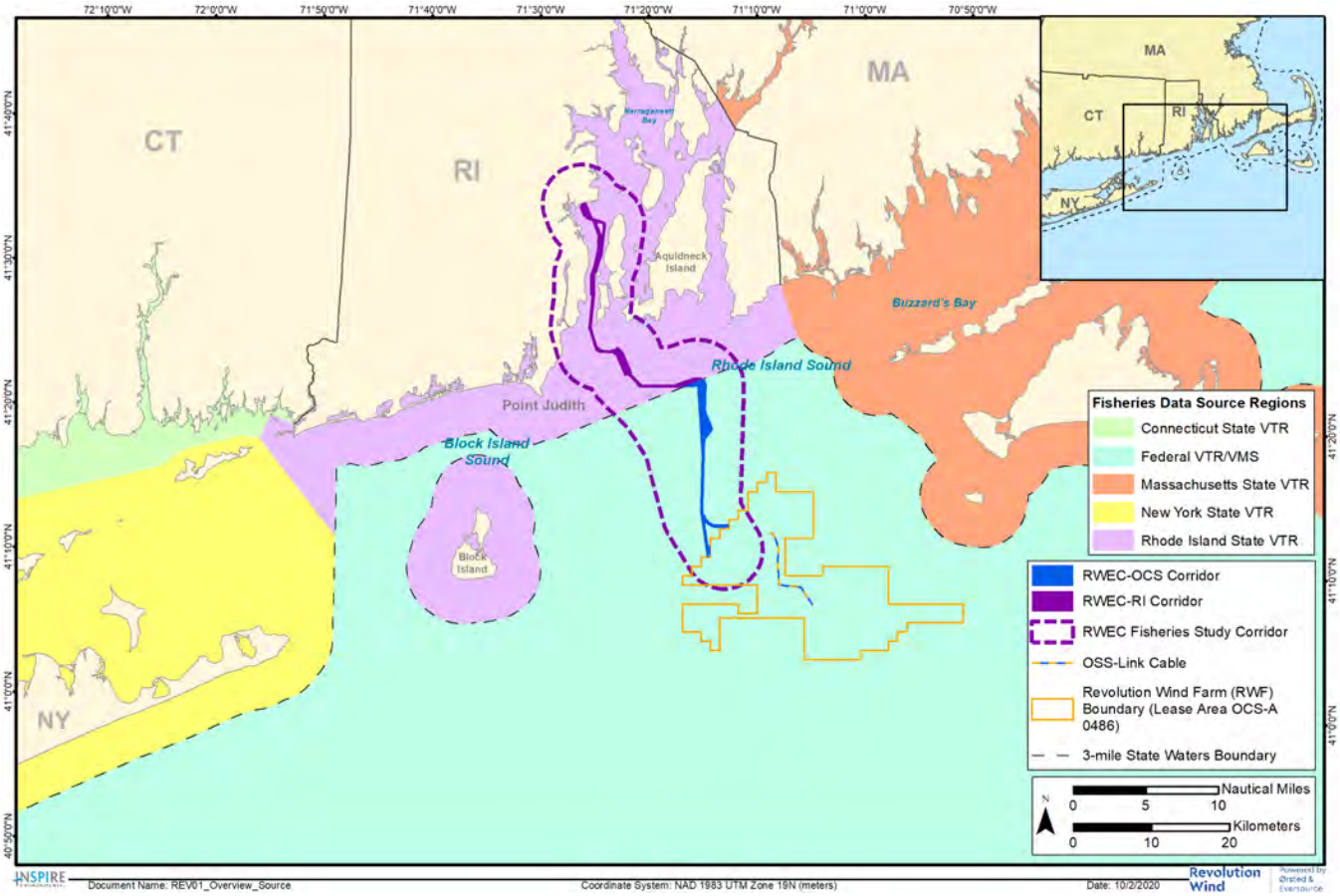

Figure 2.1-2 Map of the Revolution Wind Farm and State VTR Regions

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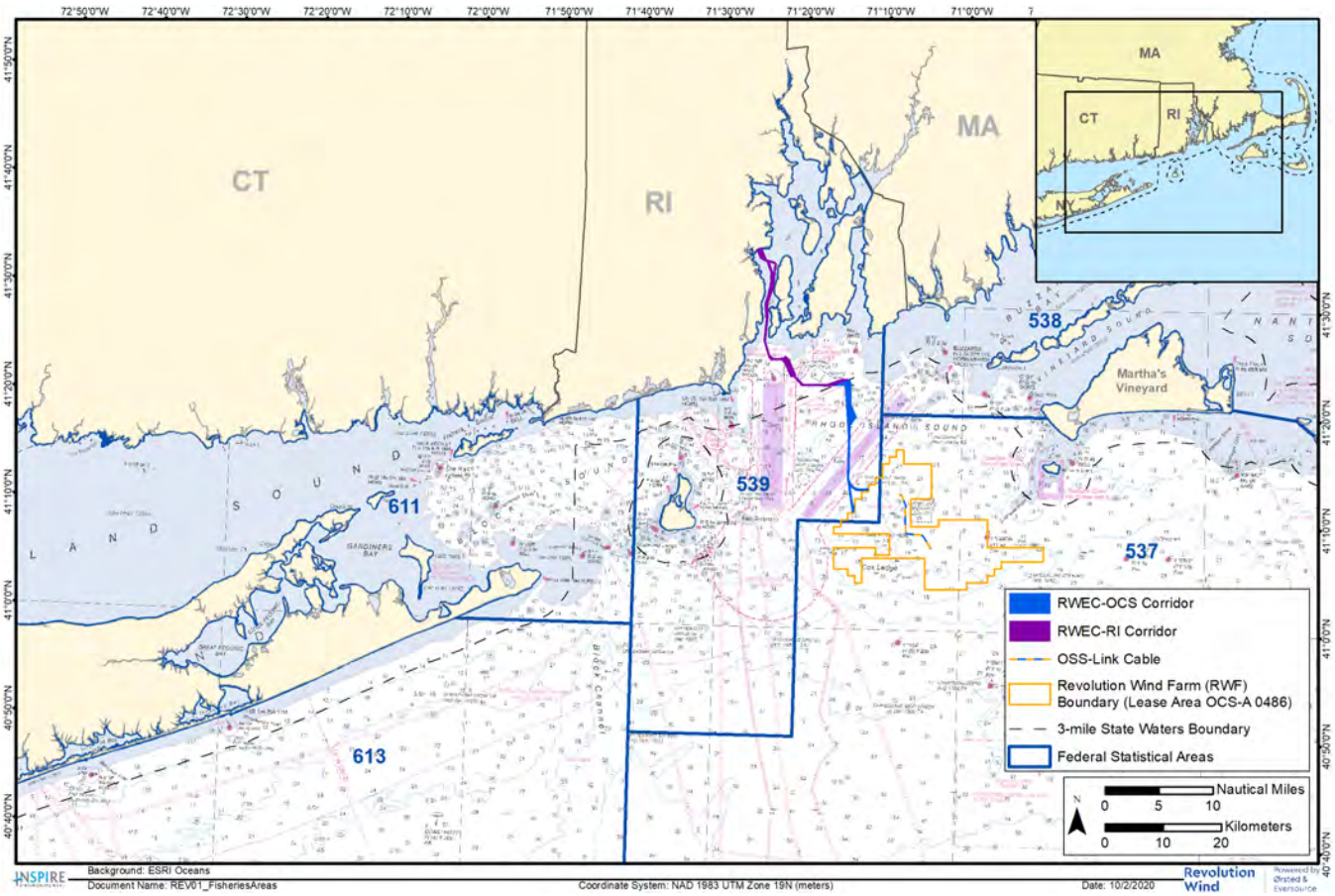

Figure 2.1-3 Map of the Revolution Wind Farm and Federal Statistical Fishing Areas

2.1.3.1 Connecticut State Vessel Trip Reports

Federal VTR data describe most commercial fishing activity in both state and federal waters by vessels that have a federal permit or, both a state and federal fishing permit. However, those vessels that only have state commercial fishing permits are not included in the federal VTR data set. Landing permits allow a vessel to land catch in its home state even though fishing may have occurred outside of the home state's jurisdictional waters. State-permitted vessels must report their catch, including the statistical area within which fishing occurred (Figure 2.1-3), to the Connecticut Department of Energy and Environmental Protection (CT DEEP). Data on fishing in state waters by state-permitted vessels can be accessed by the public through data requests to the ACCSP.

State commercial fishing data for Connecticut were requested from statistical areas 539 and 611 to characterize those fisheries that could be affected by the RWF and RWEC (Figure 2.1-3). Fishing activity was characterized in terms of landed pounds of target species, the landing port, and the gear category. The data were presented in the units of landed pounds of catch because the landing price was not readily available. The "average" of pounds landed reflects the sum of pounds landed during the 2009 to 2018 period, divided by the number of years with data available (in this way, 0-value years were excluded).

2.1.3.2 Massachusetts State Vessel Trip Reports

State-permitted vessels must report their catch, including the statistical area within which fishing occurred (Figure 2.1-3), to the Massachusetts Division of Marine Fisheries (MADMF). Massachusetts State commercial fishing data

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for this report include statistical areas 537, 538, 539, and 613 to characterize those fisheries that could be affected by the RWF and RWEC (Figure 2.1-3).

2.1.3.3 New York State Vessel Trip Reports

State-permitted vessels must report their catch, including the statistical area within which fishing occurred (Figure 2.1-3), to the New York State Department of Environmental Conservation (NYSDEC). New York State commercial fishing data for this report include statistical areas 537, 539, 611, and 613 to characterize those fisheries that could be affected by the RWF and RWEC (Figure 2.1-3).

2.1.3.4 Rhode Island State Vessel Trip Reports

State-permitted vessels must report their catch, including the statistical area within which fishing occurred (Figure 2.1-3), to the Rhode Island Department of Environmental Management (RIDEM). Rhode Island State commercial fishing data for this report include statistical areas 537, 538, 539, and 611 to characterize those fisheries that could be affected by the RWF and RWEC (Figure 2.1-3).

2.1.4 Marine Recreational Information Program

The NOAA Fisheries Marine Recreational Information Program (MRIP) is a collection of regional surveys organized to produce recreational fisheries statistics. The data are collected through angler-intercept surveys after a fishing trip by boat returns to shore. This integrated series of surveys provides estimates of marine recreational catch, effort, and participation across states, fishing locations, and fishing modes. To describe the affected environment of recreational fisheries in the RWF and RWEC fisheries study corridor, this Technical Report used the NOAA Fisheries MRIP estimates for shoreside and private fishing modes occurring in inland, state territorial sea, and federal exclusive economic zone (EEZ) fishing locations. MRIP data used for this report were provided by NOAA Fisheries, and are available through queries at the Fisheries Statistics Division website (NOAA Fisheries, 2019b).

One of the limitations of the MRIP data set is that it does not include a spatial component; the only location information available is the categorization of fishing location into state or federal waters. An additional limitation of this data set is that the survey program was designed to estimate fishing effort by recreational anglers at the state level. When the data are disaggregated to the county level or lower, the percent standard error increases and the information is less reliable (NOAA Fisheries, 2019b). Given that we cannot assign estimated angler effort to any location in the ocean, it is impossible to estimate recreational effort near the RWF using the MRIP data alone. For this reason, the MRIP data must be considered in conjunction with stakeholder input provided by recreational for-hire boat captains in the Ocean SAMP data set (RICRMC, 2010).

2.1.5 Revolution Wind Stakeholder Communication and Engagement

Revolution Wind has committed to engaging with stakeholders in the commercial and recreational fishing communities that are active in the RWF and RWEC fisheries study corridor. This stakeholder outreach program was formulated by Revolution Wind to gather local knowledge from the region's fishermen and to establish open and reliable communication with the fishing industry. Revolution Wind has established an experienced team of Fisheries Liaisons and Fisheries Representatives to facilitate a two-way process of communication through individual outreach via email, text message, or in person, and that also includes, but is not limited to, public presentations, listening sessions, Notices to Mariners, and updates to websites and social media. Revolution Wind has also extended these outreach efforts to include state and federal fisheries agencies, working groups, and regulatory bodies by soliciting input through joint meetings and webinars. The outreach program will be conducted throughout all phases of the Project and is designed to evolve as needs change and the Project progresses. Detailed information about the communication and outreach plan implemented by Revolution Wind is provided in the Fisheries Communication and Outreach Plan (Orsted, 2020).

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2.1.6 Aquaculture

Aquaculture in Rhode Island waters includes the cultivation of oysters, kelp, hard-shell clams, and mussels. Oysters are the main crop, with nearly 296 acres under cultivation worth more than 5.7 million dollars in 2017 (Liberman, 2018).

Locations of Rhode Island aquaculture sites were mapped based on data accessed from the NROC (NROC, 2019) and from the RIDEM Division of Fish and Wildlife, Marine Fisheries Section (RIDEM, 2019). Maps were created based on shapefiles provided by RIDEM with information on site ID, location, and status last updated July 20, 2018.

2.2 Baseline Conditions

Species that are targeted for commercial and recreational fishing in Southern New England are managed through Fishery Management Plans (FMPs) by the New England Fishery Management Council, the Mid-Atlantic Fishery Management Council (50 CFR 600.105), the Atlantic States Marine Fisheries Commission, or some combination of these (NOAA Fisheries, 2017). Some FMPs include multiple species because they share habitat and are often fished or collected as marketable bycatch using the same gear type. Commercial fisheries that target certain species can be grouped into broad categories by the gear used. Mobile-gear is used while the vessel is in motion, and includes gear such as trawls and dredges. Fixed-gear is set and retrieved later, such as lobster pots and gill nets. Recreational fishing activity can be categorized by fishing mode (charter boat, party boat, private boat, or shore) and by fishing location (inland, state territorial sea, and federal EEZ) (NOAA Fisheries, 2019b).

The RWEC-OCS will traverse federal waters located within a study area previously examined for potential wind farm development effects on fish and fisheries by the New York State Energy and Development Authority (NYSERDA, 2017; Scotti et al., 2017). These studies examined fishery dependent data sources, such as federal VTR and VMS data for the most recent years available at the time the studies were conducted. For this technical report, more recent data were obtained from these sources. Other data sources that were reviewed include fishery independent trawl data from the Northeast Fisheries Science Center (NEFSC) and the Northeast Areas Monitoring and Assessment Program (NEAMAP). These sources provide information on a diverse assemblage of fish and invertebrates in the area that can be used for stock assessments for those species targeted in commercial and recreational fisheries. The study area examined by NYSERDA (2017) and Scotti et al. (2017) contains fishing grounds for boats that land their catch in New Jersey, New York, Rhode Island, and Massachusetts.

Vessels originating from New England and Mid-Atlantic states catch a diverse range of pelagic, demersal, and benthic species using various types of gear. Commercially and recreationally valuable saltwater species populations are highly dynamic, both spatially and temporally. Many species undertake seasonal migrations, which are often correlated with seasonal variation in water temperature and prey availability. Interannual fluctuations in population sizes can occur in response to climate change, fishing, and other ecological pressures (Friedland et al., 2018, McManus et al., 2018). Fish and macroinvertebrate populations supporting commercial and recreational fisheries along the Northeast Continental Shelf are diverse (Malek et al., 2014). Some fisheries are experiencing a regional decline and others an increase (Collie et al., 2008), whereas the location of some fisheries has shifted to the northeast in association with climate-related changes (Friedland et al., 2018).

Benthic communities have experienced increased water temperatures in the region in the past several decades, and average pH is expected to continue to decline as seawater becomes more saturated with carbon dioxide (Saba et al., 2016). Acidification of seawater is associated with decreased survival and health of organisms with calcareous shells (such as the Atlantic scallop, blue clam, and hard clam), but less is known about direct effects of acidification on cartilaginous and bony fishes. The ranges of dozens of groundfish species in New England waters have shifted northward and into deeper waters in response to increasing water temperatures (Pinsky et al., 2013; Nye et al., 2009) and more species are predicted to follow (Selden et al., 2018; Kleisner et al., 2017). Predicted range shifts include a northward extension for sea scallops and offshore movement for American lobster (Tanaka et al., 2020). The black sea bass, identified as particularly sensitive to habitat alteration (Guida et al., 2017), has been increasing in abundance over the past several years, and is expected to continue its expansion in southern New England as water temperatures increase (McBride et al., 2018). Several pelagic forage species have been increasing in the

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region, including butterfish, scup, squid (Collie et al., 2008) and Atlantic mackerel (McManus et al., 2018). Distributions of other species are reported to be shifting southward, including spiny dogfish, little skate, and silver hake (Walsh et al., 2015), or alternatively, shifting offshore (e.g., surfclams; Timbs et al., 2019). It has been suggested that the spiny dogfish may replace the Atlantic cod as a major predator in southern New England as the cod is driven north by warm waters that the spiny dogfish tolerates more readily (Selden et al., 2018). Further temperature increases in southern New England are expected to exceed the global ocean average by at least a factor of two and ocean circulation patterns are projected to change (Saba et al., 2016). Distributional shifts are occurring in both demersal and pelagic species, perhaps mediated by changes in spawning locations and dates (Walsh et al., 2015). Southern species, including some highly migratory species such as mahi that prefer warmer waters, are expected to follow the warming trend and become more abundant in the area (Walsh et al., 2015; South Atlantic Fishery Management Council, 2003). Climate change may also be affecting the migrations of anadromous fish in the region. The herrings, shad, and sturgeon were identified as having high biological sensitivity to adverse effects of climate change (Hare et al., 2016). In addition to physiological effects of temperature and pH, anadromous fishes face a physical risk caused by flooding in their spawning rivers.

The following sections present an assessment of the relative intensity of several fisheries active in the RWF and RWEC, organized based on the data source.

2.2.1 Federal Vessel Trip Report (VTR) Data

VTR data were provided by NOAA Fisheries and the ACCSP for the RWF and for the RWEC fisheries study corridor, and are summarized in the following section. The data are presented based on the subset (defined by the gear used), the targeted species, and the state in which the fisheries' landings occurred. Data for the species and state fishery subsets include estimates for the decade 2009-2018, whereas the gear type fishery subset is based on a nine-year period (2009 to 2017) due to confidentiality rules. Each fishery subset includes estimates for the respective time periods for the:

- Annual average values of revenue and landings sourced from within the RWF or the RWEC fisheries study corridor.
- Annual average revenue and landings for all fishing activity from Maine to North Carolina sourced from NOAA Fisheries' Greater Atlantic Region Fisheries Office (GARFO).
- Percent of revenue and landings sourced from within the RWF or the RWEC fisheries study corridor out of total regional landings reported to GARFO.

Revenue units are United States dollars (USD) deflated to January 2010 for consistency; landings are reported in landed pounds.

2.2.1.1 Revolution Wind Farm

In the RWF, the top fisheries reported on VTRs by federally permitted vessels in terms of average annual revenue were caught using bottom trawl, pot, sink gillnet, and dredge. In terms of average pounds landed from within the RWF, the top gears were the bottom trawl, sink gillnet, and mid-water trawl (Table 2.2-1). The greatest percentage of Greater Atlantic revenue sourced from within the RWF was caught using sink gill net (5.75 percent), followed by bottom trawl (3.20 percent), and midwater trawl (1.08 percent).

Table 2.2-1 Summary of Federal VTR Fishing Data in RWF, by Gear, for 2009 to 2017

	Annual Average Revenue and Landings from within RWF		Annual Average of Total Revenue and Landings		Percent of Total Gear Values from RWF	
Gear	Revenue	Landings	Revenue	Landings	% of Revenue	% of Landings
Bottom Trawl	330,811	805,298	10,345,534	17,650,034	3.20	4.56
Pot	309,044	97,245	45,170,421	23,622,011	0.68	0.41
Sink Gillnet	263,817	383,264	4,587,604	6,446,946	5.75	5.95
Dredge	174,324	20,636	35,344,833	15,083,131	0.49	0.14
All Others	45,641	380,191	1,630,016,690	1,281,322,761	<0.01	0.03
Midwater Trawl	25,900	259,659	2,388,786	19,750,762	1.08	1.32

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	Annual Average Revenue and Landings from within RWF		Annual Average of Total Revenue and Landings		Percent of Total Gear Values from RWF	
Gear	Revenue	Landings	Revenue	Landings	% of Revenue	% of Landings
By Hand	5,776	1,652	566,211	236,037	1.02	0.70

Source: NOAA Fisheries, 2019c.
Notes:
Values are sorted from largest to smallest revenue values for landings data.
Landings are reported in landed pounds.
Revenue is in USD deflated to 2010 for consistency.
"Total" revenue and landings values refer to all fishing activity as reported by VTRs for fisheries active in state and federal waters from Maine to North Carolina.
% = percent

Federally permitted vessels target many species in the RWF. The top species-groups reported on VTRs in terms of average annual revenue were lobster, flounders, hakes, Atlantic herring, scup, squid, black sea bass, and channeled whelk. In terms of pounds landed, the top species-groups in the RWF were Atlantic herring, Atlantic mackerel, and hakes. Scallops, surf clams, and quahogs are included in the All Others category due to the way data were provided. Table 2.2-2 provides the full species summary. For all of the species-groups listed, the average annual landings and revenue from within the RWF make up a very small percentage of the average annual landings and revenue from the Greater Atlantic region. For instance, the species with the greatest proportion of Greater Atlantic total revenue that was sourced from within the RWF were cunner (0.68 percent), Atlantic mackerel (0.51 percent) and channeled whelk (0.44 percent).

Table 2.2-2 Summary of Federal VTR Fishing Data in RWF, by Species, for 2009 to 2018

	Annual Average Revenue and Landings from within RWF		Annual Average of Total Revenue and Landings		Percent of Total Species Values in RWF	
Species	Revenue	Landings	Revenue	Landings	% of Revenue	% of Landings
Lobster, America	214,904	50,374	507,710,672	138,232,706	0.04	0.04
Flounders	88,240	33,976	53,080,045	23,015,911	0.17	0.15
Hakes	60,136	141,855	15,760,216	20,652,426	0.38	0.69
Herring, Atlantic	42,852	455,959	26,499,546	166,320,214	0.16	0.27
Scup	36,987	63,108	9,280,444	14,364,599	0.40	0.44
Squids	34,084	30,416	38,571,711	48,152,606	0.09	0.06
Sea Bass, Black	32,211	7,547	8,045,522	2,477,656	0.40	0.31
Whelk, Channeled	31,673	4,512	7,175,012	1,232,408	0.44	0.37
Mackerel, Atlantic	20,008	198,560	3,889,243	16,596,797	0.51	1.20
Dogfish, Spiny	14,296	81,592	3,619,191	18,787,974	0.40	0.43
Crab, Jonah	14,121	23,578	10,983,269	14,424,939	0.13	0.16
All Others	11,886	21,067	946,435,275	407,953,101	0.00	0.01
Butterfish	9,141	16,100	2,180,724	3,340,689	0.42	0.48
Bass, Striped	4,425	1,131	18,797,974	5,984,307	0.02	0.02
Bluefish	2,811	5,382	2,796,095	4,627,112	0.10	0.12
Tautog	381	128	926,176	273,651	0.04	0.05
Weakfish	263	142	319,712	207,805	0.08	0.07
Dogfish, Smooth	231	464	976,231	2,039,068	0.02	0.02
Bonito	191	86	112,986	53,480	0.17	0.16
Cunner	138	97	20,410	6,394	0.68	1.52
Spot	88	175	3,139,254	2,828,116	<0.01	0.01
Eel, Conger	40	61	49,241	68,105	0.08	0.09
Sea Robins	13	33	20,812	124,470	0.06	0.03
Whiting, King	1	1	902,941	810,033	<0.01	<0.01

Source: NOAA Fisheries, 2019c. ACCSP, 2019.
Notes:
Values are sorted from largest to smallest revenue values for landings data.
Landings are reported in landed pounds.
Revenue is in USD deflated to 2010 for consistency.
"Total" revenue and landings values refer to all fishing activity as reported by VTRs for fisheries active in state and federal waters from Maine to North Carolina.
% = percent

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Vessels hailing from Rhode Island, Massachusetts, New York, and Connecticut conducted the most federally permitted fishing activities within the RWF (Table 2.2-3). The greatest average annual revenue generated by federally permitted vessels in the RWF were from landings in Rhode Island ($613,467), followed by Massachusetts ($398,575), and New York ($41,704). These values were put in context by including the total revenue landed in that state from all fishing activity during 2009 to 2018. The greatest percentage of revenue sourced from within the RWF is by Rhode Island (0.73 percent), followed by New York (0.08 percent) and Massachusetts (0.07 percent; Table 2.2-3). Data cannot be reported by port due to confidentiality rules. Further analysis of detailed landings data as reported by individual port is unavailable for all listed states due to confidentiality rules.

Table 2.2-3 Summary of Federal VTR Fishing Data in RWF, by State, for 2009 to 2018

	Annual Average Revenue and Landings from within RWF		Annual Average of Total Revenue and Landings		Percent of Total State Values in RWF	
State	Revenue	Landings	Revenue	Landings	% of Revenue	% of Landings
Rhode Island	613,467	949,843	83,808,376	83,061,985	0.73	1.14
Massachusetts	398,575	811,785	547,819,893	272,427,302	0.07	0.30
New York	41,704	24,420	53,395,207	30,909,690	0.08	0.08
All Others	16,773	9,274	558,828,937	725,429,171	<0.01	<0.01
Connecticut	9,138	7,218	16,183,340	8,793,496	0.06	0.08

Source: NOAA Fisheries, 2019c. ACCSP, 2019.
Notes:
Values are sorted from largest to smallest revenue values for landings data.
Landings are reported in landed pounds.
Revenue is in USD deflated to 2010 for consistency.
"Total" revenue and landings values refer to all fishing activity as reported by VTRs for fisheries active in state and federal waters from Maine to North Carolina.
% = percent

2.2.1.2 Revolution Wind Export Cable Fisheries Study Corridor

Among the fisheries that are active within the 46-mile (74-km) RWEC fisheries study corridor, the top fisheries reported on VTRs by federally permitted vessels by revenue were caught using bottom trawl, mid-water trawl, pot, sink gillnet, dredge, and by hand (Table 2.2-4). In terms of pounds landed, the top gears in the RWEC fisheries study corridor were the mid-water trawl, bottom trawl, sink gillnet, and pot. The gear categories with the greatest proportion of total revenue that was sourced from within the RWEC fisheries study corridor were mid-water trawl (16.3 percent), bottom trawl (7.6 percent), and sink gillnet (2.2 percent). Table 2.2-4 summarizes the gears used to fish in the RWEC fisheries study corridor, which traverses Federal Statistical Fishing Area 539.

Table 2.2-4 Summary of Federal VTR Fishing Data in RWEC Fisheries Study Corridor, by Gear, for 2009 to 2017

	Annual Average Revenue and Landings from within RWEC Fisheries Study Corridor		Annual Average of Total Revenue and Landings		Percent of Total Gear Values in RWEC Fisheries Study Corridor	
Gear	Revenue	Landings	Revenue	Landings	% of Revenue	% of Landings
Bottom Trawl	781,301	2,186,189	10,345,534	17,650,034	7.55	12.39
Midwater Trawl	389,676	3,969,291	2,388,786	19,750,762	16.31	20.10
Pot	314,797	136,028	45,170,421	23,622,011	0.70	0.58
All Others	110,642	464,104	1,630,016,690	1,281,322,761	0.01	0.04
Sink Gillnet	99,834	213,070	4,587,604	6,446,946	2.18	3.31
Dredge	27,746	9,072	35,344,833	15,083,131	0.08	0.06
By Hand	3,293	1,356	566,211	236,037	0.58	0.57

Source: NOAA Fisheries, 2019c.
Notes:
Values are sorted from largest to smallest revenue values for landings data.
Landings are reported in landed pounds.
Revenue is in USD deflated to 2010 for consistency.
"Total" revenue and landings values refer to all fishing activity as reported by VTRs for fisheries active in state and federal waters from Maine to North Carolina.

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% = percent

In the RWEC fisheries study corridor, the top individual species reported on VTRs by federally permitted vessels in terms of revenue were Atlantic herring, lobster, squid, flounders, scup, butterfish, hakes, black sea bass, and spiny dogfish (Table 2.2-5). In terms of pounds landed, the top species in the RWEC fisheries study corridor included Atlantic herring, scup, squid, spiny dogfish, hakes and Atlantic mackerel. The species with the greatest proportion of Greater Atlantic total revenue that was sourced from within the RWEC fisheries study corridor were eel (40.00 percent), bonito (4.30 percent), sea robins (2.39 percent), Atlantic herring (1.95 percent), and butterfish (1.93 percent). Table 2.2-5 provides a full summary of the species caught in the RWEC fisheries study corridor.

Table 2.2-5 Summary of Federal VTR Fishing Data in RWEC Fisheries Study Corridor, by Species, for 2009 to 2018

	Annual Average Revenue and Landings from within RWEC Fisheries Study Corridor		Annual Average of Total Revenue and Landings		Percent of Total Species Values in RWEC Fisheries Study Corridor	
Species	Revenue	Landings	Revenue	Landings	% of Revenue	% of Landings
Herring, Atlantic	516,170	4,870,454	26,499,546	166,320,214	1.95	2.93
Lobster, America	253,817	63,112	507,710,672	138,232,706	0.05	0.05
Squids	168,823	157,838	38,571,711	48,152,606	0.44	0.33
Flounders	157,876	49,611	53,080,045	23,015,911	0.30	0.22
Scup	144,737	280,427	9,280,444	14,364,599	1.56	1.95
All Others	46,271	30,389	946,435,275	407,953,101	0.01	0.01
Butterfish	42,181	62,394	2,180,724	3,340,689	1.93	1.87
Hakes	37,112	86,198	15,760,216	20,652,426	0.24	0.42
Sea Bass, Black	27,692	7,820	8,045,522	2,477,656	0.34	0.32
Dogfish, Spiny	24,007	116,148	3,619,191	18,787,974	0.66	0.62
Bluefish	19,697	41,793	2,796,095	4,627,112	0.70	0.90
Mackerel, Atlantic	18,040	70,893	3,889,243	16,596,797	0.46	0.43
Whelk, Channeled	15,139	2,050	7,175,012	1,232,408	0.21	0.17
Crab, Jonah	14,732	28,633	10,983,269	14,424,939	0.13	0.20
Bass, Striped	12,950	3,528	18,797,974	5,984,307	0.07	0.06
Bonito	4,859	2,128	112,986	53,480	4.30	3.98
Tautog	3,728	1,495	926,176	273,651	0.40	0.55
Dogfish, Smooth	1,947	4,051	976,231	2,039,068	0.20	0.20
Weakfish	1,291	735	319,712	207,805	0.40	0.35
Whiting, King	986	1,132	902,941	810,033	0.11	0.14
Sea Robins	498	1,724	20,812	124,470	2.39	1.39
Tuna, Little	425	944	131,168	233,801	0.32	0.40
Eel, Conger	220	421	49,241	68,105	0.45	0.62
Cunner	106	49	20,410	6,394	0.52	0.77
Mackerel, Spanish	103	200	1,192,684	816,845	0.01	0.02
Whelk, Knobbed	101	64	1,041,479	647,789	0.01	0.01
Menhaden	51	309	35,974,035	410,014,306	<0.01	<.01
Sea Raven	45	37	2,734	2,213	1.65	1.67
Triggerfish	41	41	376,831	184,225	0.01	0.02
Eel, Species Not Specified	10	12	25	32	40.00	37.50
Sea Trout, Species Not Specified	0	141	592,033	273,277	0.00	0.05

Source: NOAA Fisheries, 2019c. ACCSP, 2019.
Notes:
Values are sorted from largest to smallest revenue values for landings data.
Landings are reported in landed pounds.
Revenue is in USD deflated to 2010 for consistency.
"Total" revenue and landings values refer to all fishing activity as reported by VTRs for fisheries active in state and federal waters from Maine to North Carolina.
% = percent

The data indicate that the top states reported by federally permitted vessels for revenue sourced from within the RWEC fisheries study corridor were Rhode Island ($1.22 million), Massachusetts ($329,573), and Maine ($22,593). Top states for pounds landed from within the RWEC fisheries study corridor were Massachusetts ($3.20 million) and Rhode Island ($2.93 million). The greatest percentage of Greater Atlantic revenue sourced from within the

RWEC fisheries study corridor is by Rhode Island (1.45 percent), followed by Massachusetts (0.06 percent). Table 2.2-6 provides a full summary of states used by federally permitted vessels in the RWEC fisheries study corridor.

Table 2.2-6 Summary of Federal VTR Fishing Data in RWEC Fisheries Study Corridor, by State, for 2009 to 2018

	Annual Average Revenue and Landings from within RWEC Fisheries Study Corridor		Annual Average of Total Revenue and Landings		Percent of Total State Values in RWEC Fisheries Study Corridor	
State	Revenue	Landings	Revenue	Landings	% of Revenue	% of Landings
Rhode Island	1,216,027	2,928,234	83,808,376	83,061,985	1.45	3.53
Massachusetts	329,573	3,203,699	547,819,893	272,427,302	0.06	1.18
All Others	55,981	74,826	558,828,937	725,429,171	0.01	0.01
Maine	22,593	141,941	540,523,922	252,863,406	<0.01	0.06
New York	357	137	53,395,207	30,909,690	<0.01	<0.01

Source: NOAA Fisheries, 2019c. ACCSP, 2019.
Notes:
Values are sorted from largest to smallest revenue values for landings data.
Landings are reported in landed pounds.
Revenue is in USD deflated to 2010 for consistency.
"Total" revenue and landings values refer to all fishing activity as reported by VTRs for fisheries active in state and federal waters from Maine to North Carolina.
% = percent

2.2.2 Federal Vessel Monitoring System (VMS)

Federal VMS data can be used to provide additional qualitative information on fishing location for a particular gear type or target species, by filtering data by estimated vessel speed to eliminate those vessels in transit and not fishing. The methods used by NOAA Fisheries to rank vessel density into relatively "low" to "very high" fishing intensity categories are described in detail in the spatial metadata (NOAA Fisheries, 2019a). In addition to discussing VMS intensity as presented on Figures 2.2-1 through 2.2-14, this section also incorporates information about some fisheries as described in RIDEM (2017), which were highlighted as the fisheries that had the most activity in the RI-MA WEA (i.e., fisheries in the Atlantic herring, sea scallop, squid/mackerel/butterfish, monkfish, and northeast multispecies Fishery Management Plans [FMPs]).

The VMS data map of vessel intensity for the groundfish (large-mesh multispecies or northeast multispecies) fleet for the years 2011 to 2014 indicates there was high density of fishing vessels along portions of the RWEC fisheries study corridor, and medium-high, medium-low, and low density in the RWF, as indicated in Figure 2.2-1. In 2015-2016, the vessel activity for the groundfish fishery was high along portions of the RWEC fisheries study corridor (Figure 2.2-2). On the northeastern portion of the RWF, high, medium-high and medium-low fishing vessel intensity was reported. In addition, RIDEM (2017) indicated that there was medium-low and low relative density of fishing activity near the RWEC fisheries study corridor (Figure 88 in RIDEM, 2017). Over the years 2011 to 2016, the total non-confidential landings revenue for groundfish activity in the RI-MA WEA (depicted in Figure 2.1-1) overall was over $1 million (Section 10.1.4, Table 23 in RIDEM, 2017).

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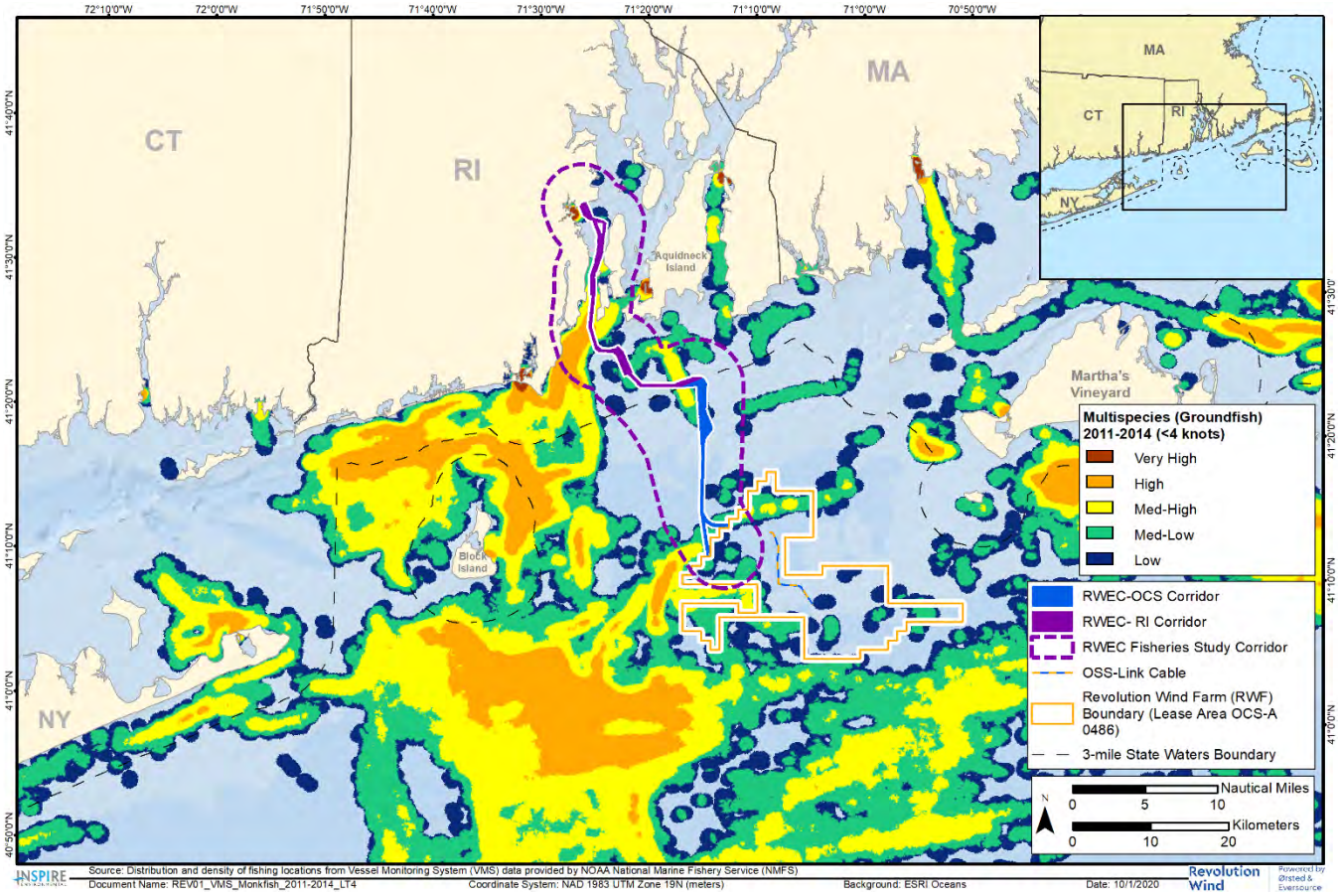

Figure 2.2-1 VMS Map of Vessel Intensity for Large-mesh Multispecies Fishing, 2011 to 2014

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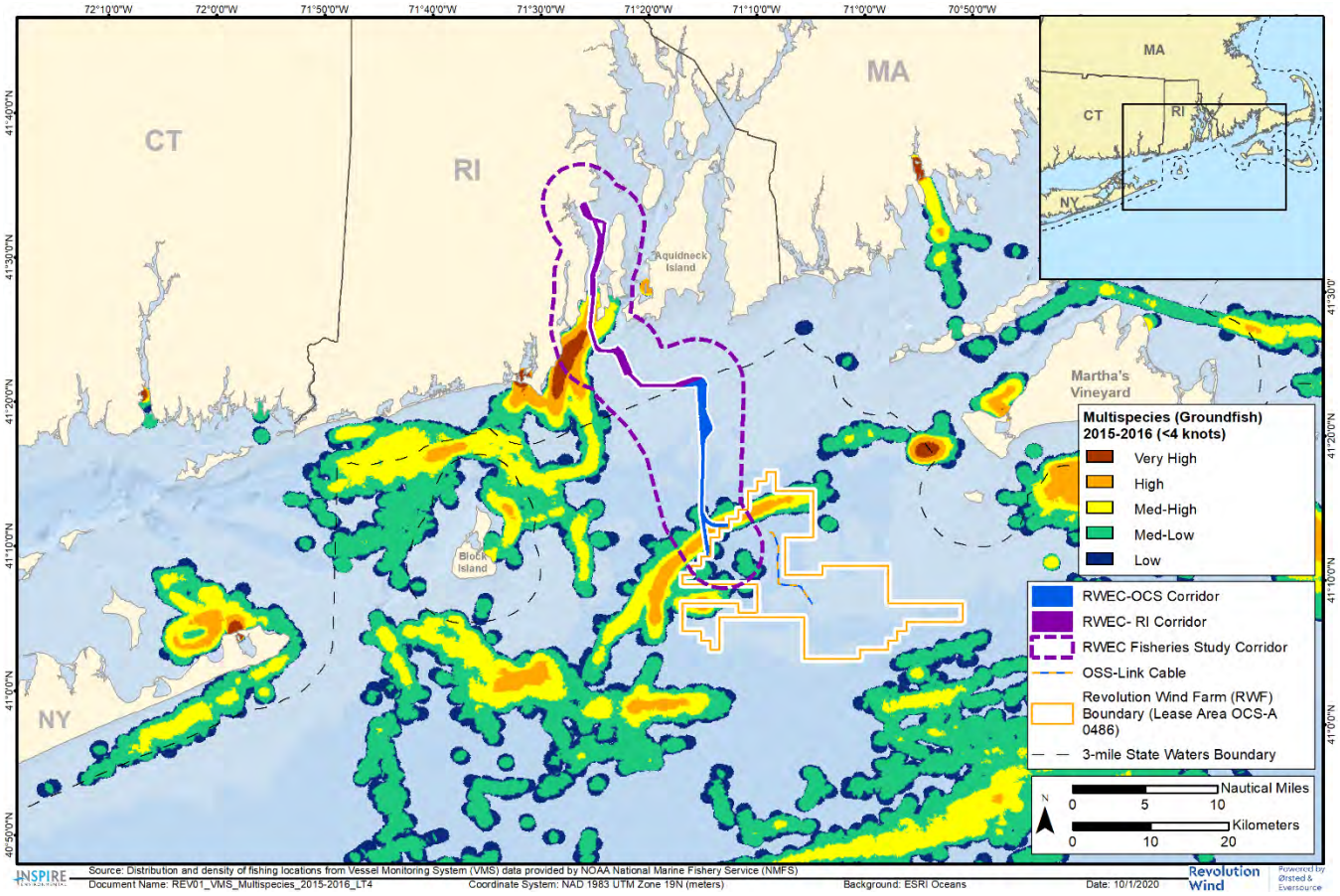

Figure 2.2-2 VMS Map of Vessel Intensity for Large-mesh Multispecies Fishing, 2015 to 2016

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The map of vessel intensity for the Atlantic herring fleet for the years 2011-2014 indicates very high, high, medium-high, medium-low and low intensity in areas along the RWEC fisheries study corridor. Vessel activity within the RWF was restricted to the northern portion of the area at medium-high and medium-low intensities (Figure 2.2-3). For the years 2015-2016, the map of vessel intensity indicates medium-high, medium-low, and low intensity on the northern to northwestern portion of the RWF. The RWEC fisheries study corridor borders an area of very-high intensity and traverses high, medium-high, and medium low intensity areas (Figure 2.2-4). There is no map available of smoothed federal fishing activity for Atlantic herring from RIDEM (2017).

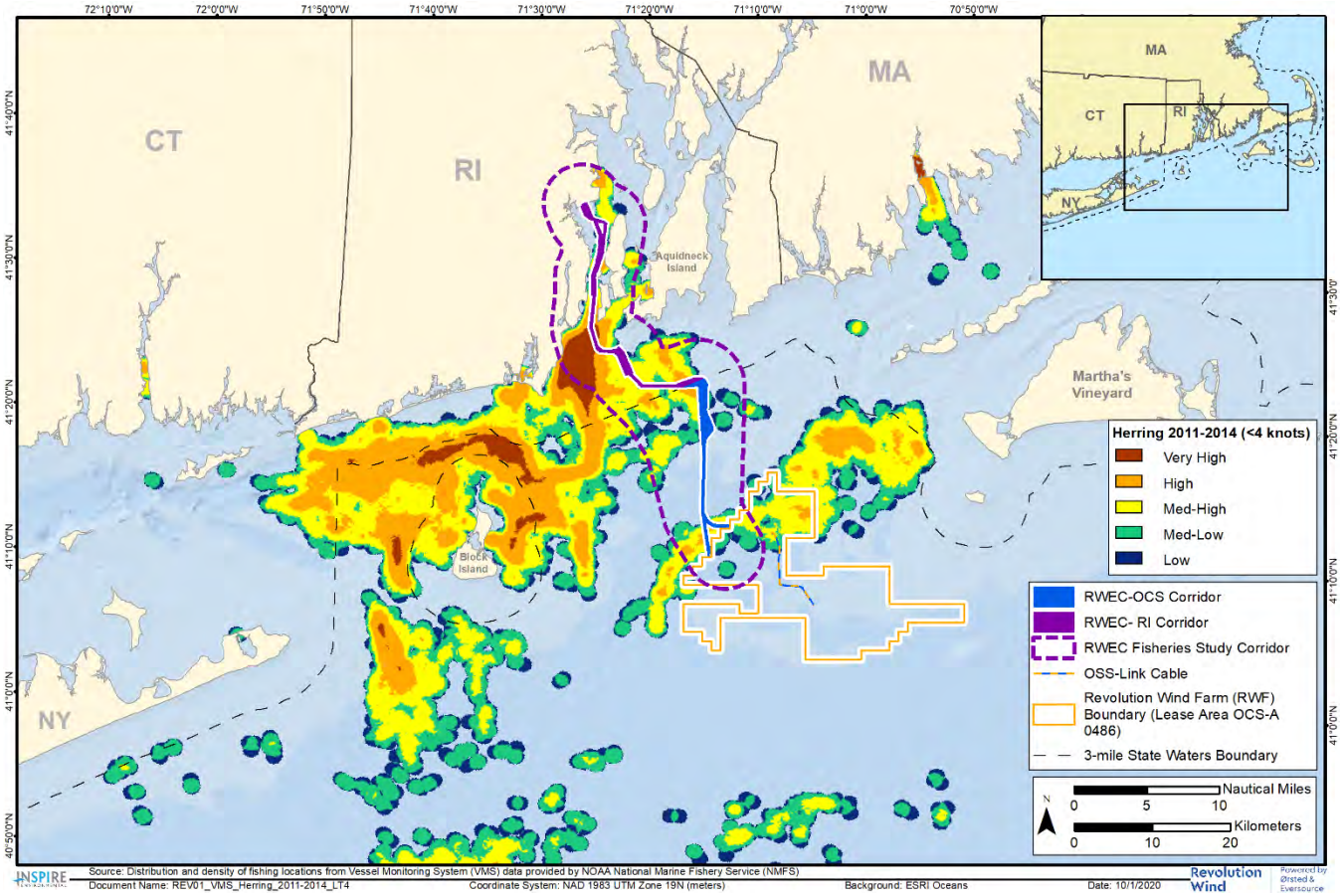

Figure 2.2-3 VMS Map of Vessel Intensity for Atlantic Herring Fishing, 2011 to 2014

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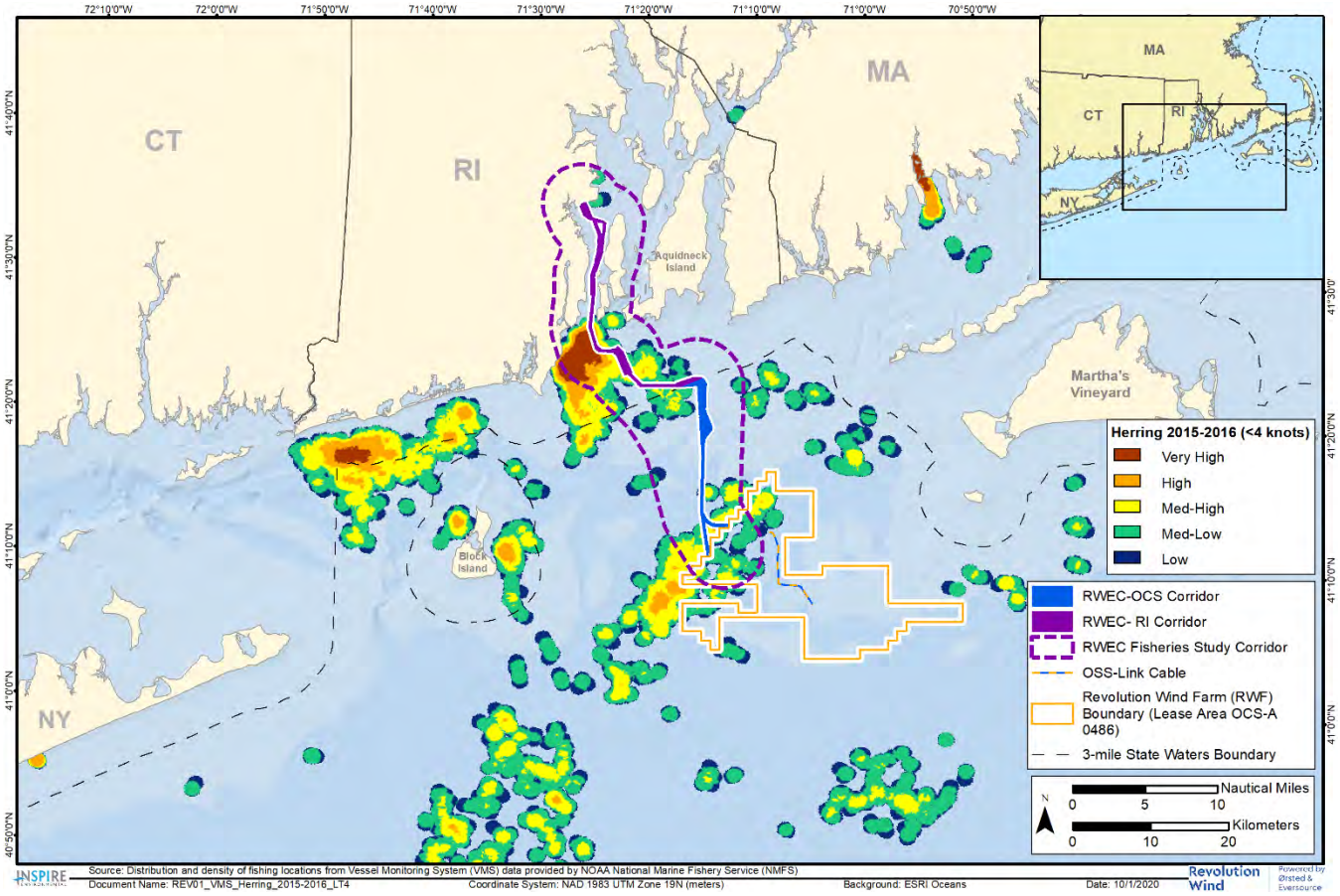

Figure 2.2-4 VMS Map of Vessel Intensity for Atlantic Herring Fishing, 2015 to 2016

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The VMS data for vessels targeting pelagic species (herring/mackerel/squid) for 2014 include areas of very-high, high, medium-high, medium-low, and low intensity in the northern portion of the RWF. Along the RWEC fisheries study corridor, all levels of intensity also were encountered (Figure 2.2-5). During 2015 to 2016, vessel intensity targeting these species was concentrated in the northwestern portion of the RWF, ranging from high to low intensity levels (Figure 2.2-6). The RWEC fisheries study corridor traverses the edge of an area of very-high vessel intensity and crosses areas of high, medium-high, medium-low, and low intensity. These data are for several target species combined for a 2-year period, so it is not possible to separate which species is targeted in a specific location from this map. In addition, RIDEM (2017) indicated that there was low relative density of fishing activity for the RWF and the RWEC fisheries study corridor for the squid/mackerel/butterfish FMP (Figure 142 in RIDEM, 2017) over the years 2011-2016. The total non-confidential landings revenue for fishing under the squid/mackerel/butterfish FMP in the RI-MA WEA (depicted in Figure 2.1-1) overall was over $397,000 (Section 10.1.4; Table 23 in RIDEM, 2017).

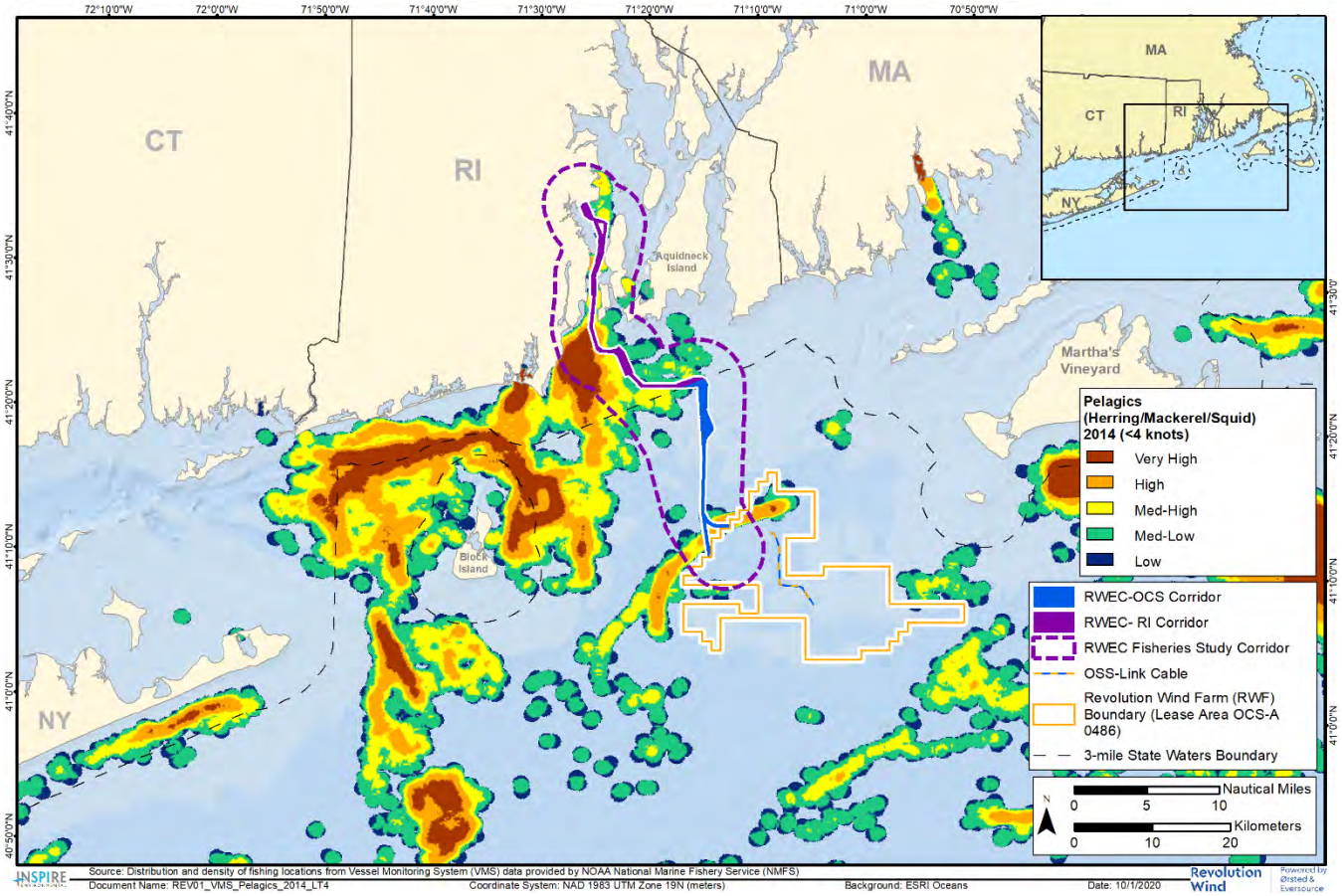

Figure 2.2-5 VMS Map of Vessel Intensity for Pelagic Species (Herring/Mackerel/Squid) Fishing, 2014

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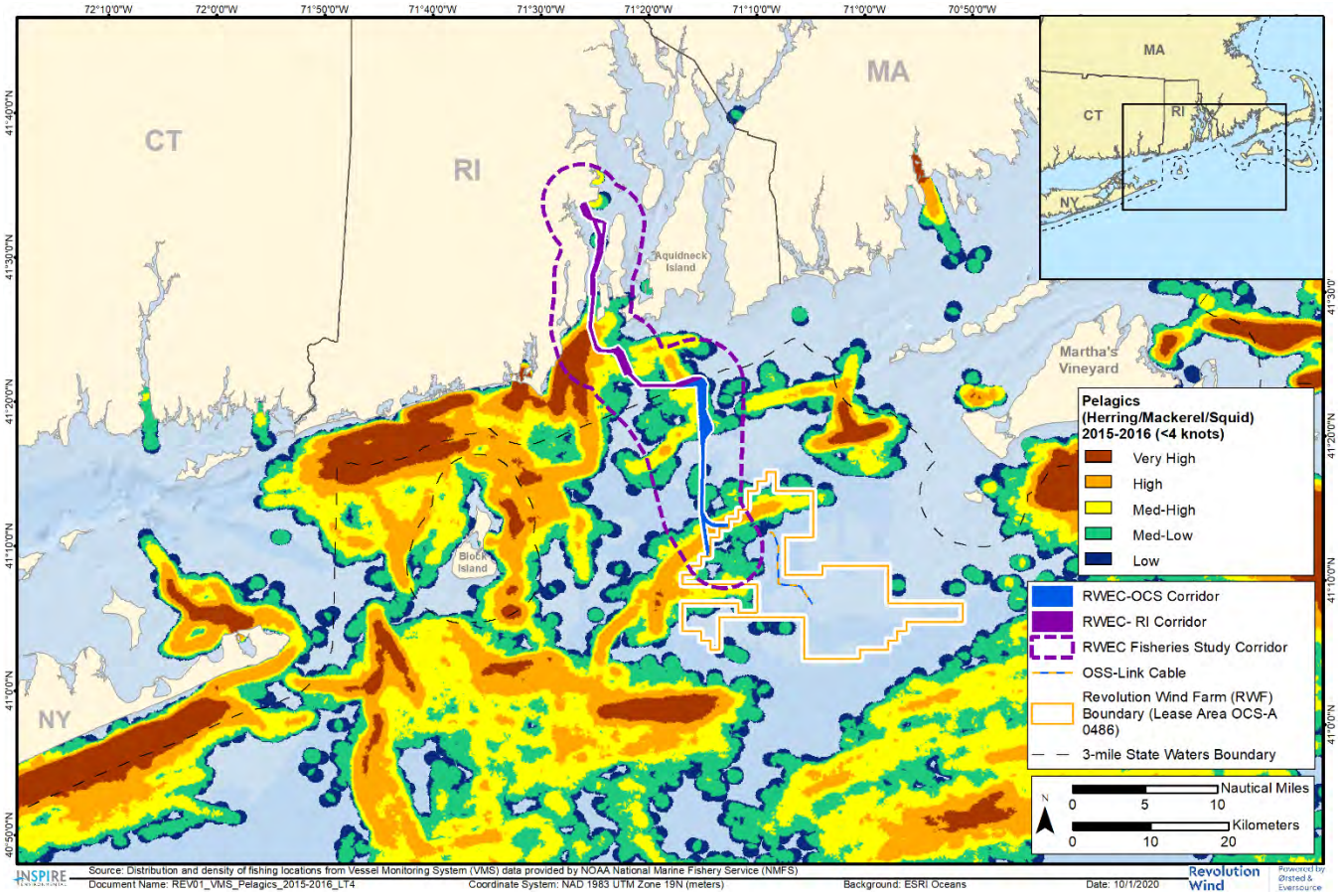

Figure 2.2-6 VMS Map of Vessel Intensity for Pelagic Species (Herring/Mackerel/Squid) Fishing, 2015 to 2016

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The map of vessel intensity for the monkfish fleet for the years 2011 to 2014 indicates medium-high, and medium-low intensity activity in areas along the RWEC fisheries study corridor (Figure 2.2-7). It also indicates high, medium-high, and medium-low activity within the RWF. The vessel intensity map for monkfish for 2015 to 2016 indicates high, medium-high, and medium-low activity along the RWEC fisheries study corridor and within the RWF (Figure 2.2-8). Additionally, RIDEM (2017) indicated there was low relative density of fishing activity in the RWF, with medium to very high densities to the southwest of the RWF. Low density fishing activity was indicated for the RWEC fisheries study corridor (Figure 87 in RIDEM, 2017). Over the years 2011 to 2016, the total non-confidential landings revenue for monkfish activity in the RI-MA WEA (depicted in Figure 2.1-1) overall was more than $1.27 million (Section 10.1.4; Table 23 in RIDEM, 2017).

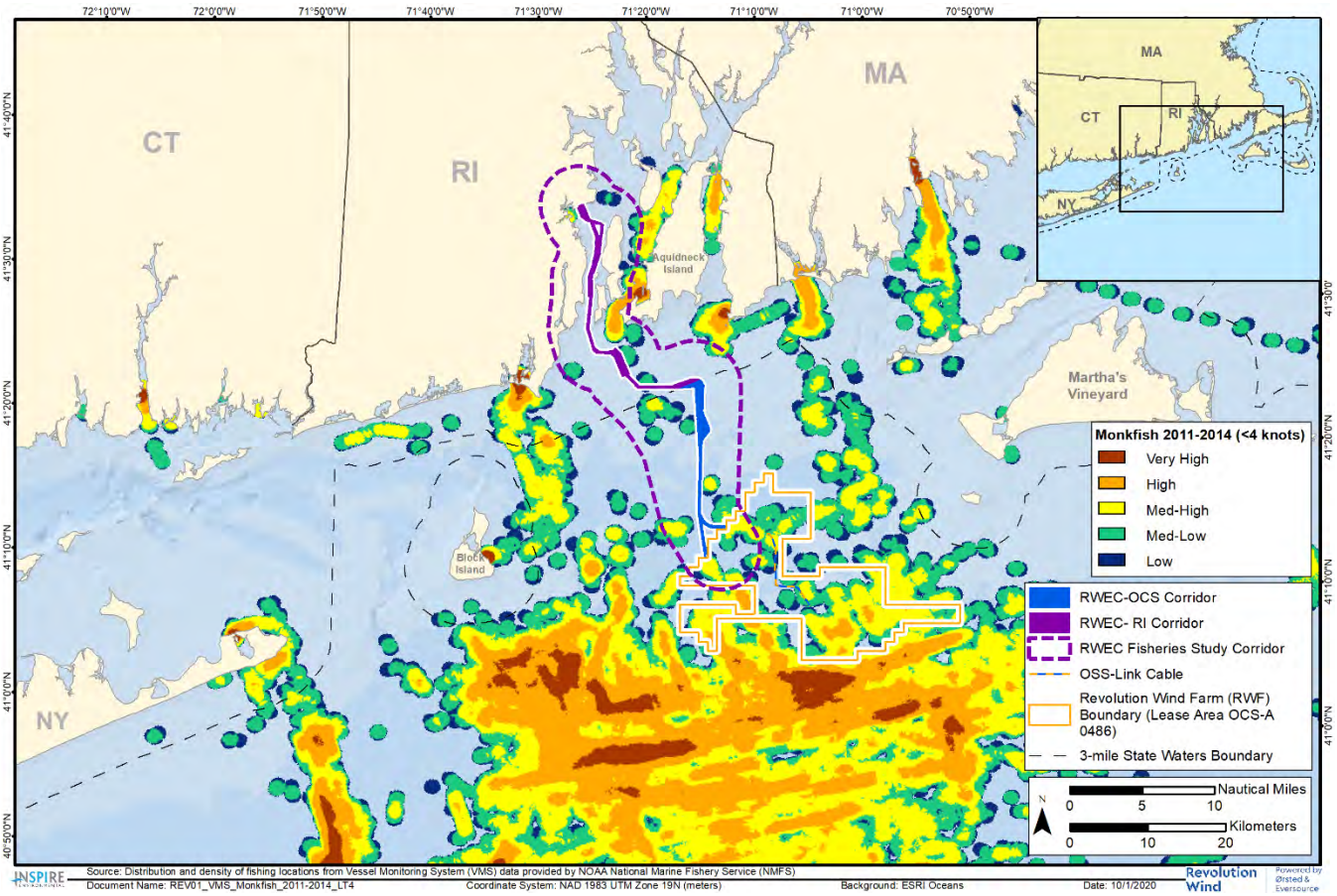

Figure 2.2-7 VMS Map of Vessel Intensity for Monkfish Fishing, 2011 to 2014

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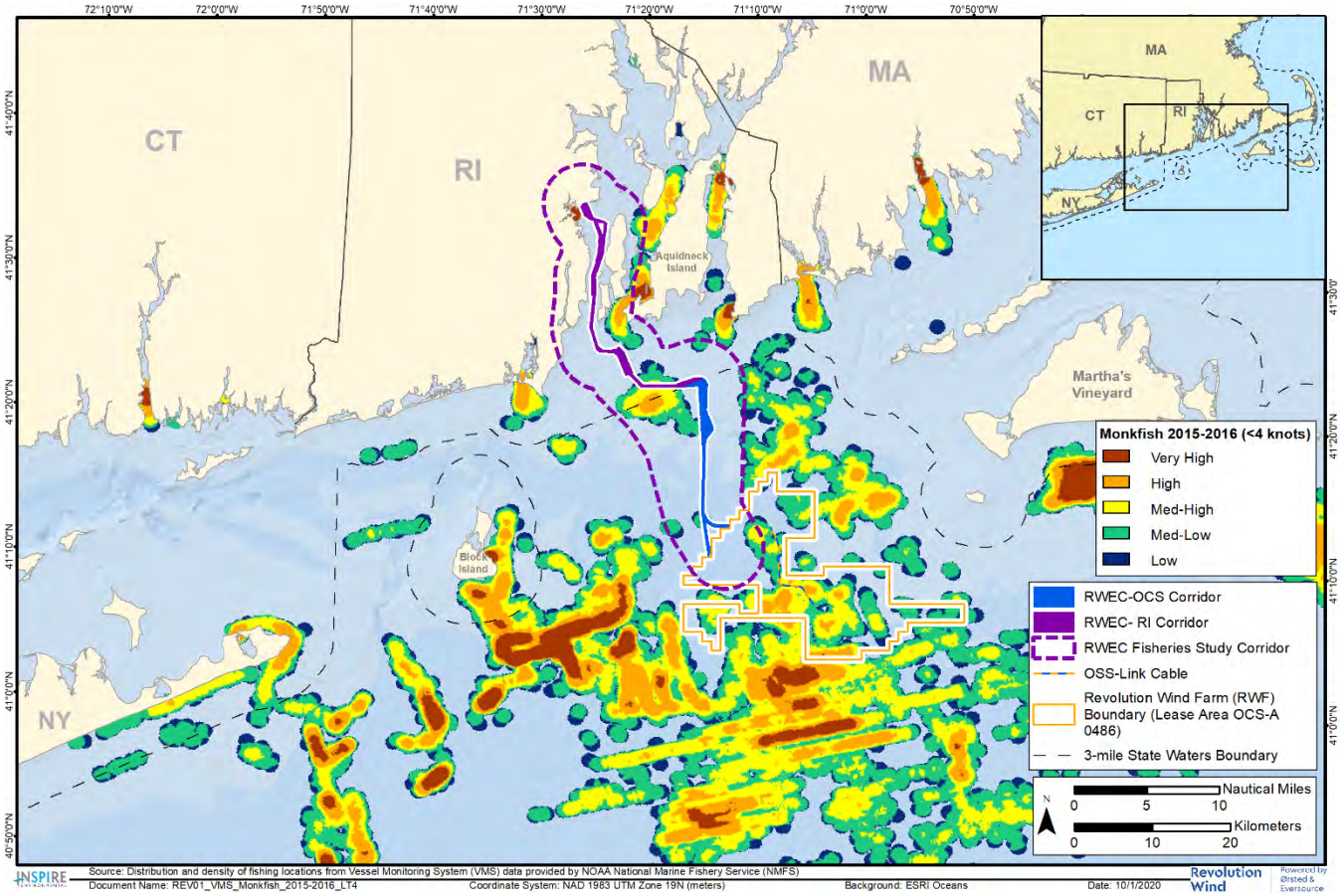

Figure 2.2-8 VMS Map of Vessel Intensity for Monkfish Fishing, 2015 to 2016

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The map of vessel intensity for vessels fishing under a surfclam/ocean quahog permit, for the years 2012 to 2014, shows low intensity vessel activity at one location along the RWEC fisheries study corridor and within the northern portion of the RWF, high, medium-high, medium-low, and low fishing vessel intensity is depicted (Figure 2.2-9). The vessel intensity map for surfclam/ocean quahog for 2015 to 2016 indicates very high, high, medium-high, medium-low, and low vessel activity on the northwestern portion of the RWF. The RWEC fisheries study corridor does not overlap surfclam/ocean quahog vessel activity upon exiting the RWF (Figure 2.2-10). RIDEM (2017) indicated that for surfclam/ocean quahog fishing with dredge gear (Figure 59 in RIDEM, 2017), there was some scattered medium and medium-low smoothed relative density of fishing activity in the RWF and RWEC fisheries study corridor over the years 2011 to 2016. Landings revenue for surfclam/ocean quahog dredge activity in the RI-MA WEA (depicted in Figure 2.1-1) overall was confidential for the years 2011-2016 (Section 10.1.3; Table 16 in RIDEM, 2017).

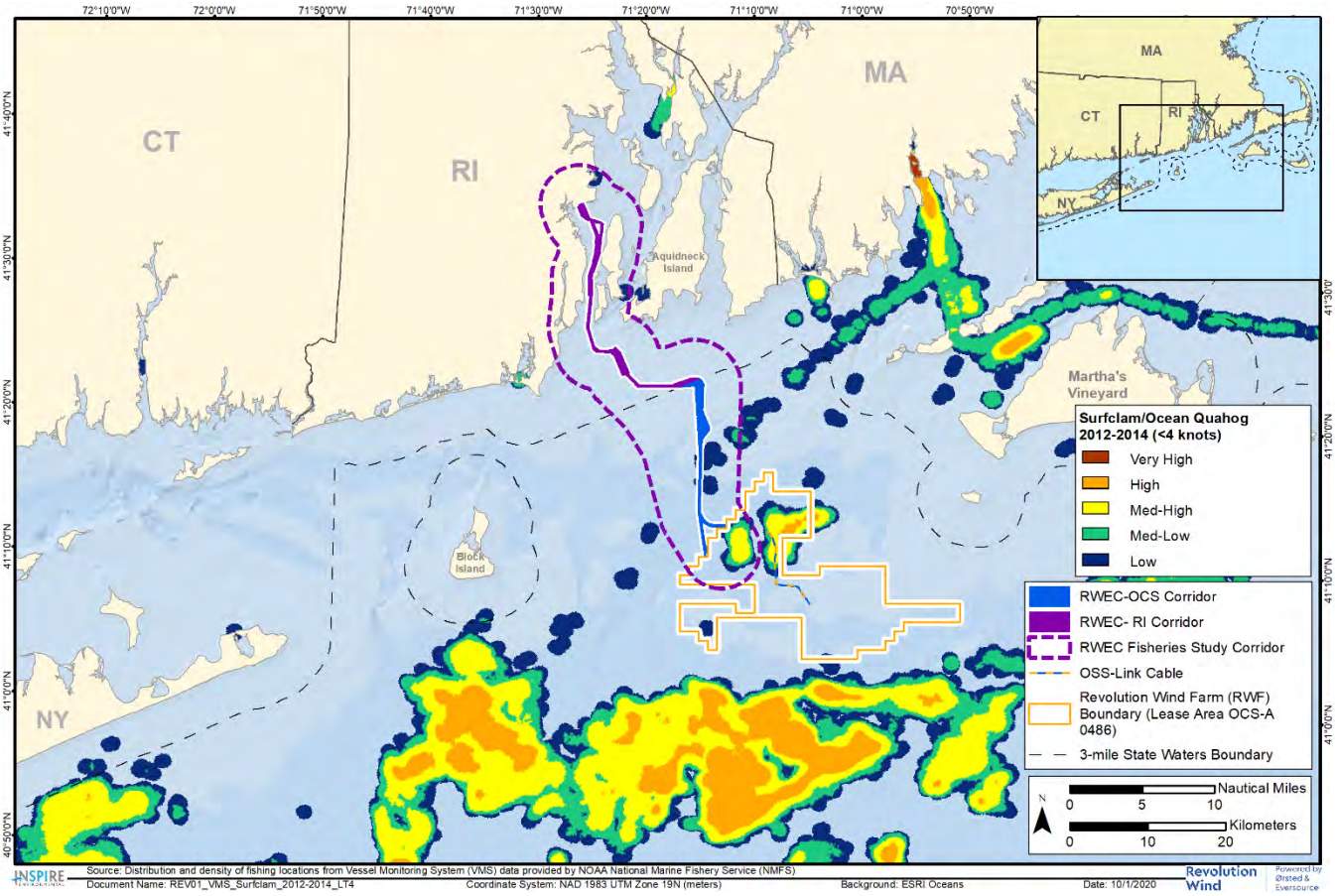

Figure 2.2-9 VMS Map of Vessel Intensity for Surfclam/Ocean Quahog Fishing, 2012 to 2014

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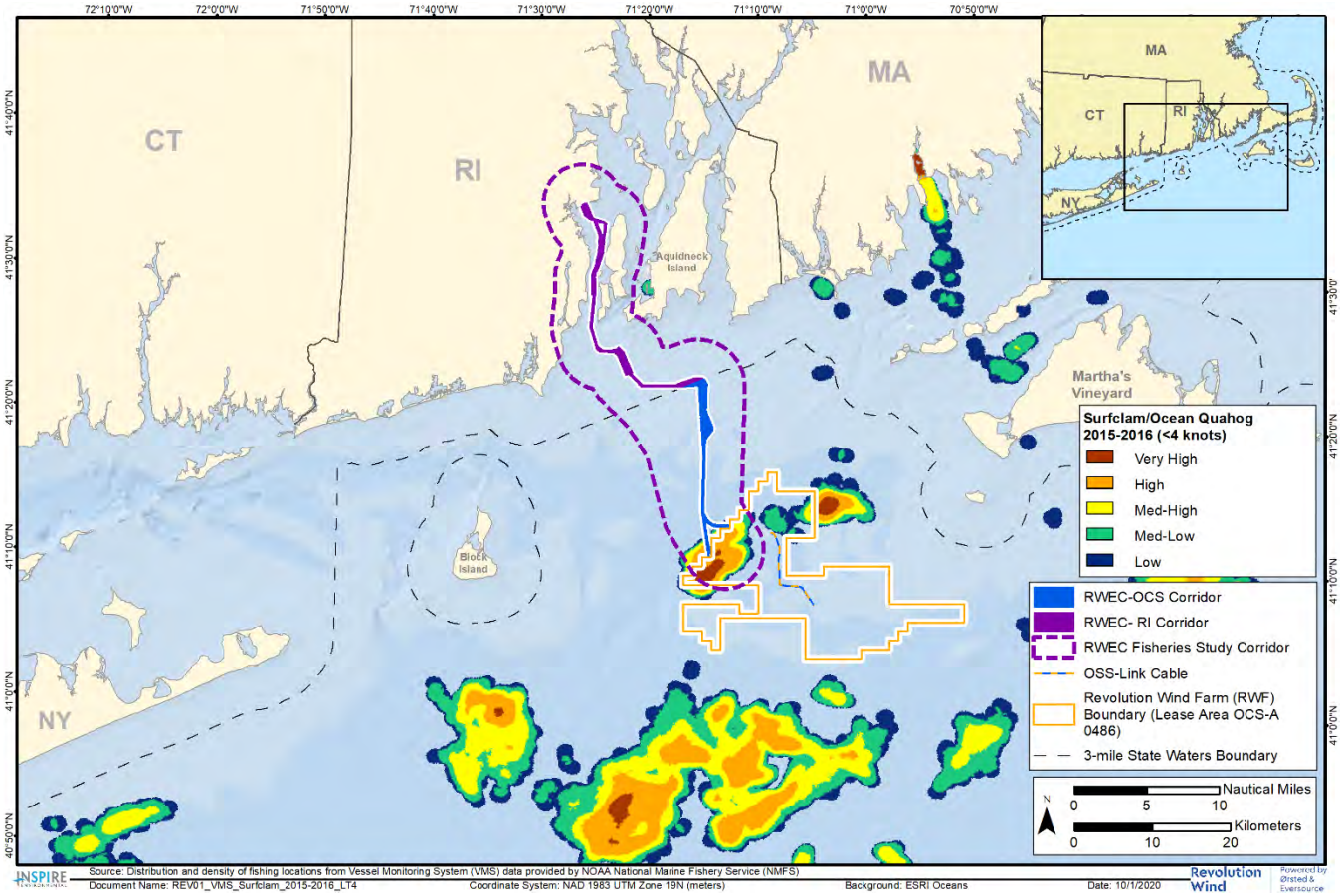

Figure 2.2-10 VMS Map of Vessel Intensity for Surfclam/Ocean Quahog Fishing, 2015 to 2016

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The intensity map for vessels fishing for sea scallops for the years 2011 to 2014 indicates a medium-low and low intensity for vessels targeting scallops within the RWF, with the exception of high vessel activity in a small portion of the western RWF (Figure 2.2-11). The RWEC fisheries study corridor traverses areas of medium-low and low vessel activity. The 2015-2016 intensity map for scallop fishery vessels indicates high, medium-high, and low vessel activity in southern portions of the RWF and medium-low to low vessel intensity along the RWEC fisheries study corridor (Figure 2.2-12). In addition, RIDEM (2017) indicated low relative density of fishing activity near the RWF and the RWEC fisheries study corridor (Figure 95 in RIDEM, 2017). Over the years 2011 to 2016, the total nonconfidential landings revenue for sea scallop FMP activity in the RI-MA WEA (depicted in Figure 2.1-1) overall was more than $2.9 million (Section 10.4.1; Table 23 in RIDEM, 2017).

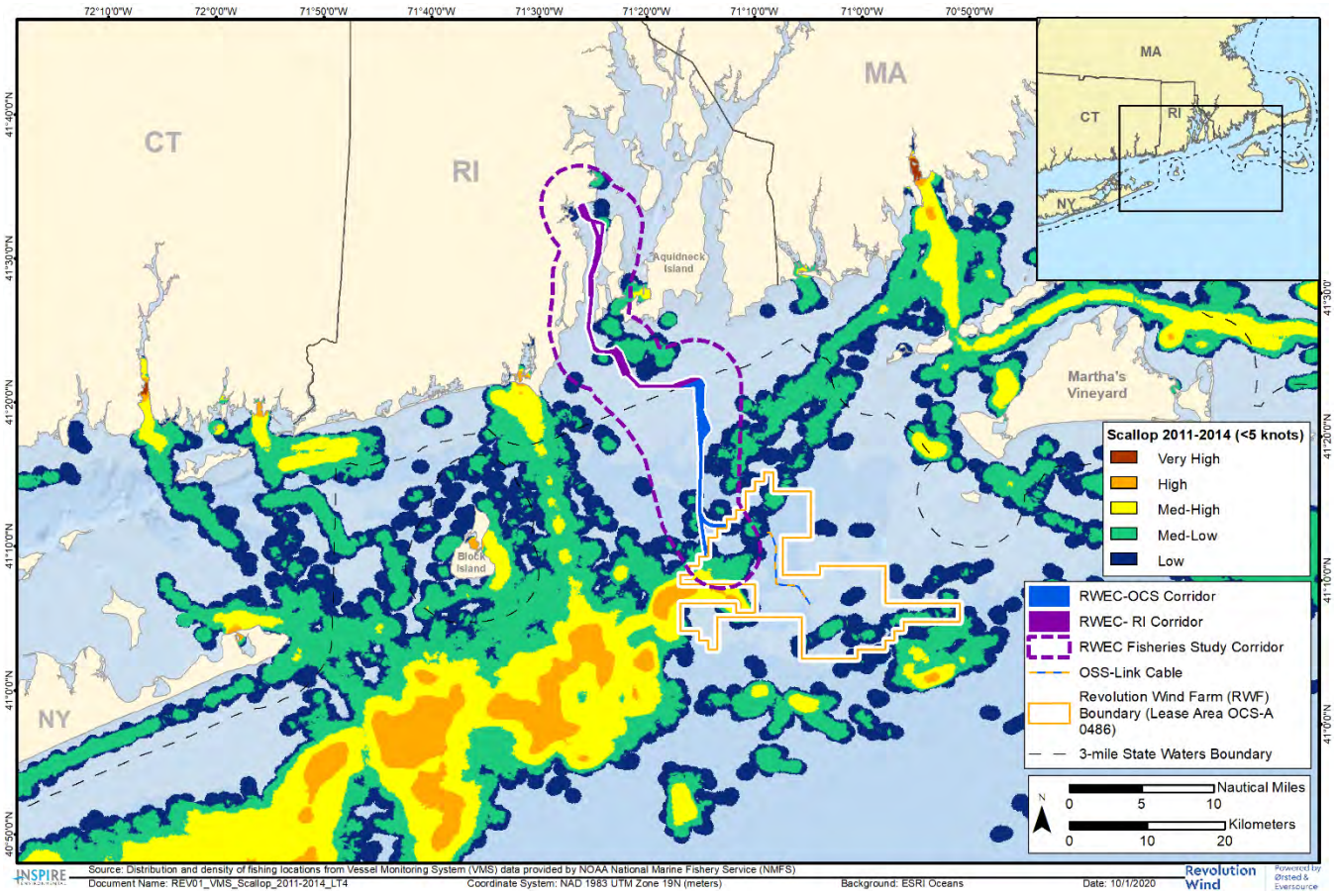

Figure 2.2-11 VMS Map of Vessel Intensity for Sea Scallop Fishing, 2011 to 2014

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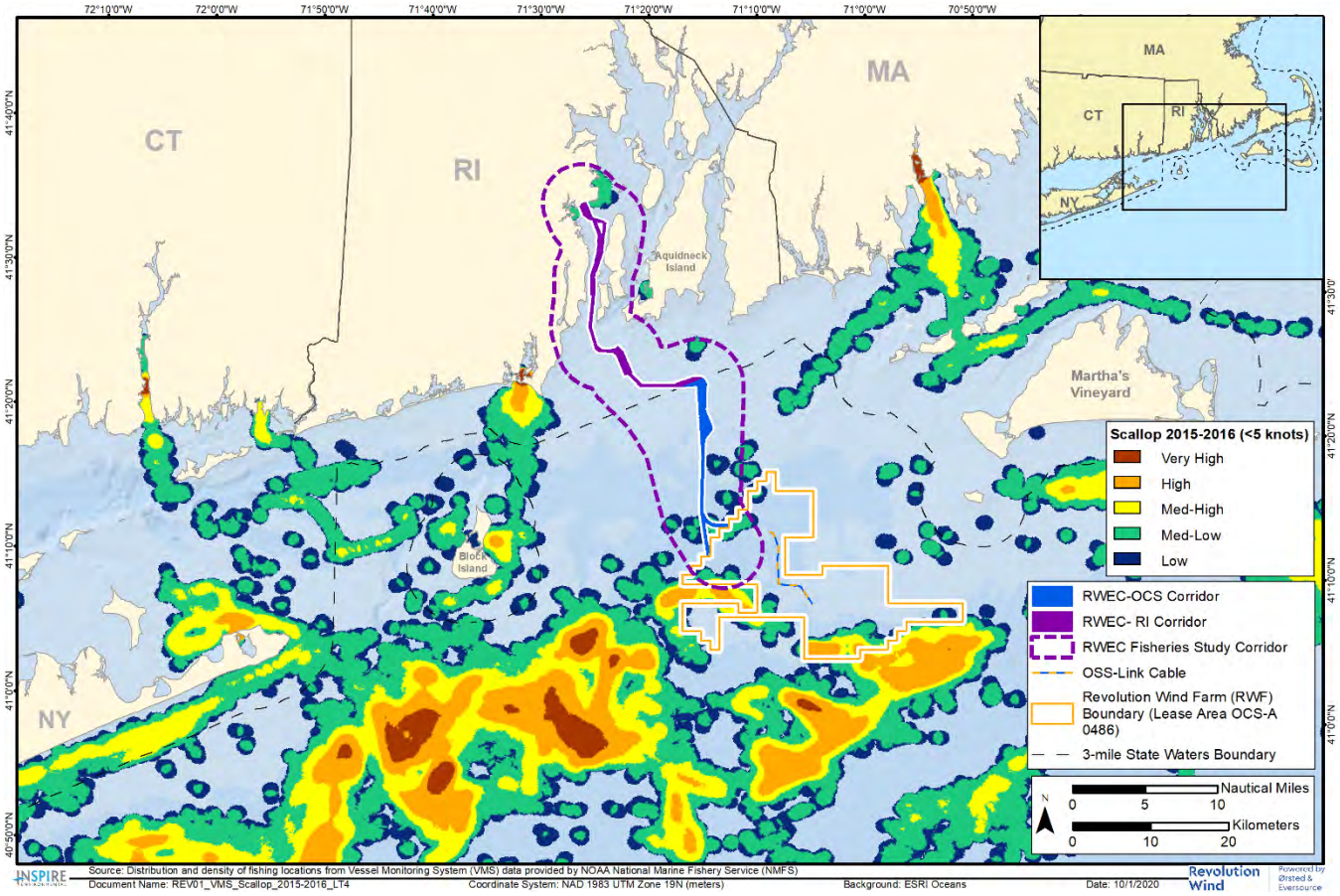

Figure 2.2-12 VMS Map of Vessel Intensity for Sea Scallop Fishing, 2015 to 2016

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The intensity map for vessels fishing for squid in the year 2014 indicates medium-low and low vessel intensity occurred on the western edge of the RWF and the RWEC fisheries study corridor traverses areas of high, medium-high, and medium-low intensity (Figure 2.2-13). The 2015-2016 intensity map indicates high, medium-high, and low intensity vessel activity within the RWF, with most activity located in the northern portion of the RWF (Figure 2.2-14). The RWEC fisheries study corridor traverses areas of high, medium-high, medium-low, and low intensity vessel activity along the RWEC fisheries study corridor for 2015-2016. As noted previously, RIDEM (2017) indicated that there was low relative density of fishing activity for the RWF and RWEC fisheries study corridor for the squid/mackerel/butterfish FMP (Figure 142 in RIDEM, 2017) over the years 2011-2016. The total non-confidential landings revenue for fishing under the squid/mackerel/butterfish FMP in the RI-MA WEA (depicted in Figure 2.1-1) overall was over $397,000 (Table 23 in RIDEM, 2017).

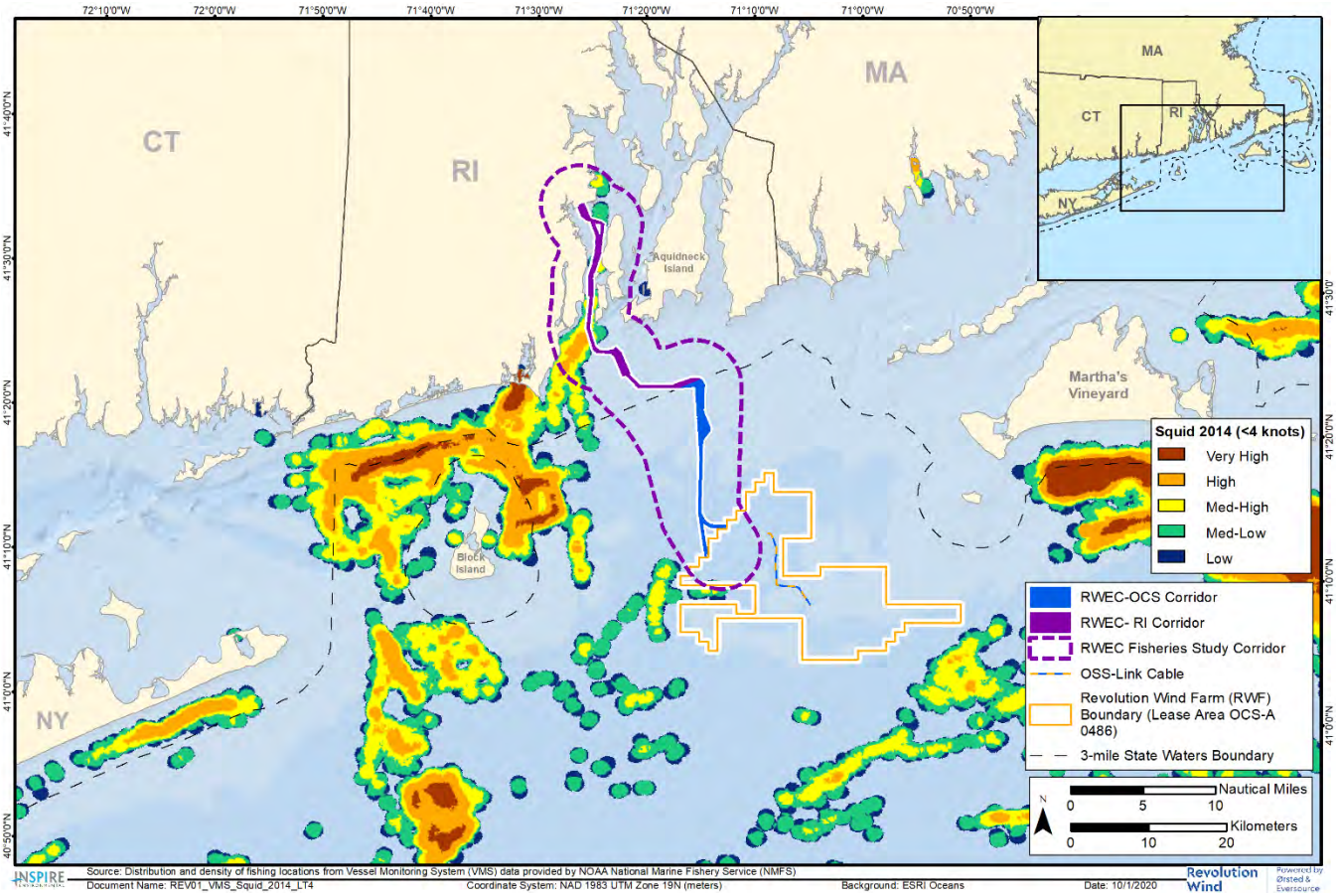

Figure 2.2-13 VMS Map of Vessel Intensity for Squid Fishing, 2014

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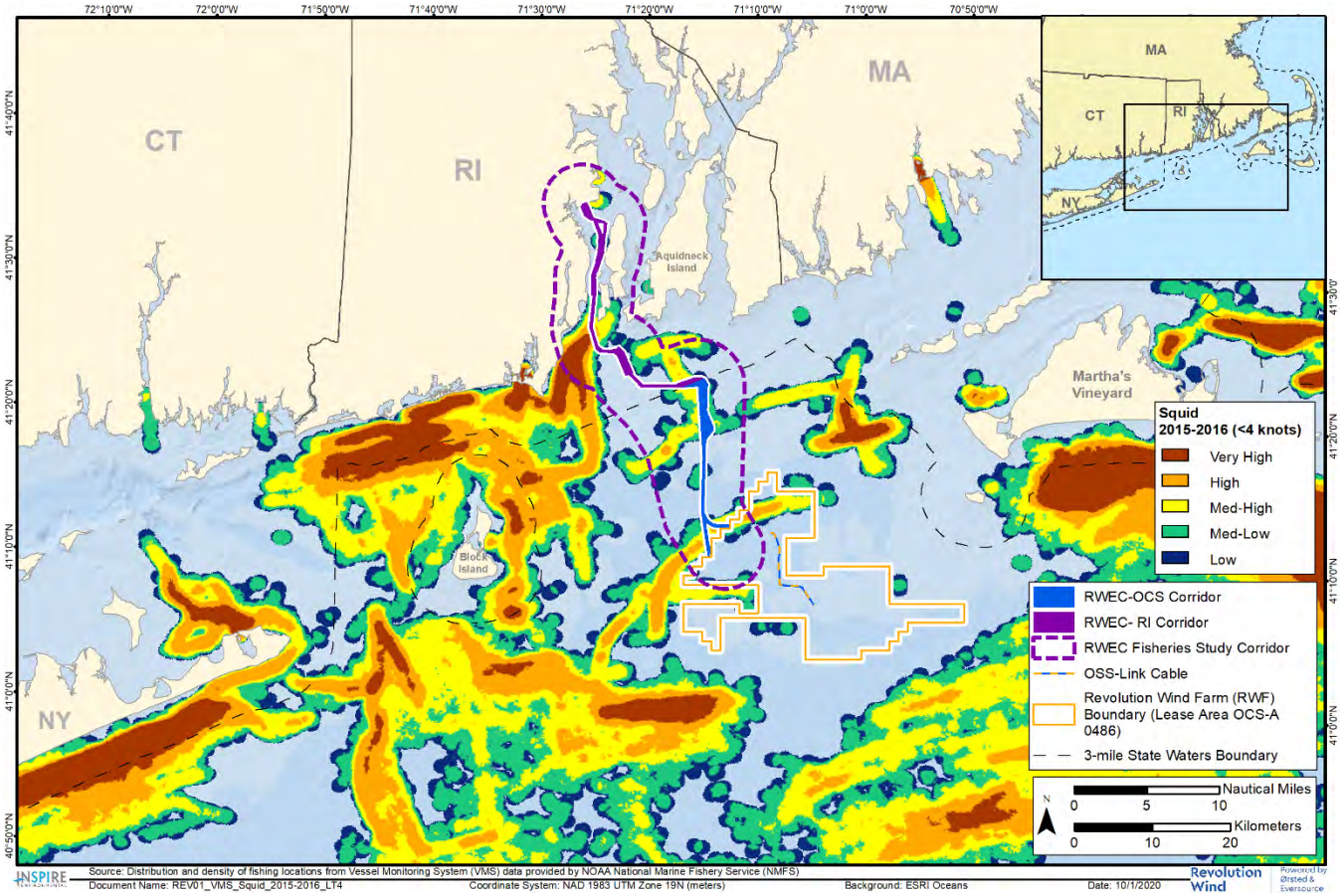

Figure 2.2-14 VMS Map of Vessel Intensity for Squid Fishing, 2015 to 2016

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2.2.3 VTR Data as Rasters

Fishing-intensity rasters aggregated by port group were summed to indicate the revenue-intensity of fishing activity in offshore areas being considered as locations for wind turbine facilities (Benjamin et al., 2018). Revenue intensity of fishing activity for 2013 to 2017 is presented on Figures 2.2-15 through 2.2-21 for the fisheries with revenue recorded in the RI-MA WEA (i.e., large-mesh multispecies or northeast multispecies, Atlantic herring, pelagic species by midwater trawl, monkfish, surfclam/ocean quahog, sea scallops, and lobsters).

The revenue-intensity raster map for groundfish (large-mesh multispecies or northeast multispecies) indicates an area of relatively high-revenue fishing activity south of the RWF and an area of moderate-revenue fishing activity southwest of the RWF. Low-revenue fishing activity is depicted in the western portion of the RWF, with no revenue generated by groundfish fishing depicted for the rest of the RWF or adjacent to the RWEC fisheries study corridor (Figure 2.2-15). Maximum groundfish (large-mesh multispecies or northeast multispecies) mean annual revenue per 0.25 km^2 was $4,609 (Figure 2.2-15).

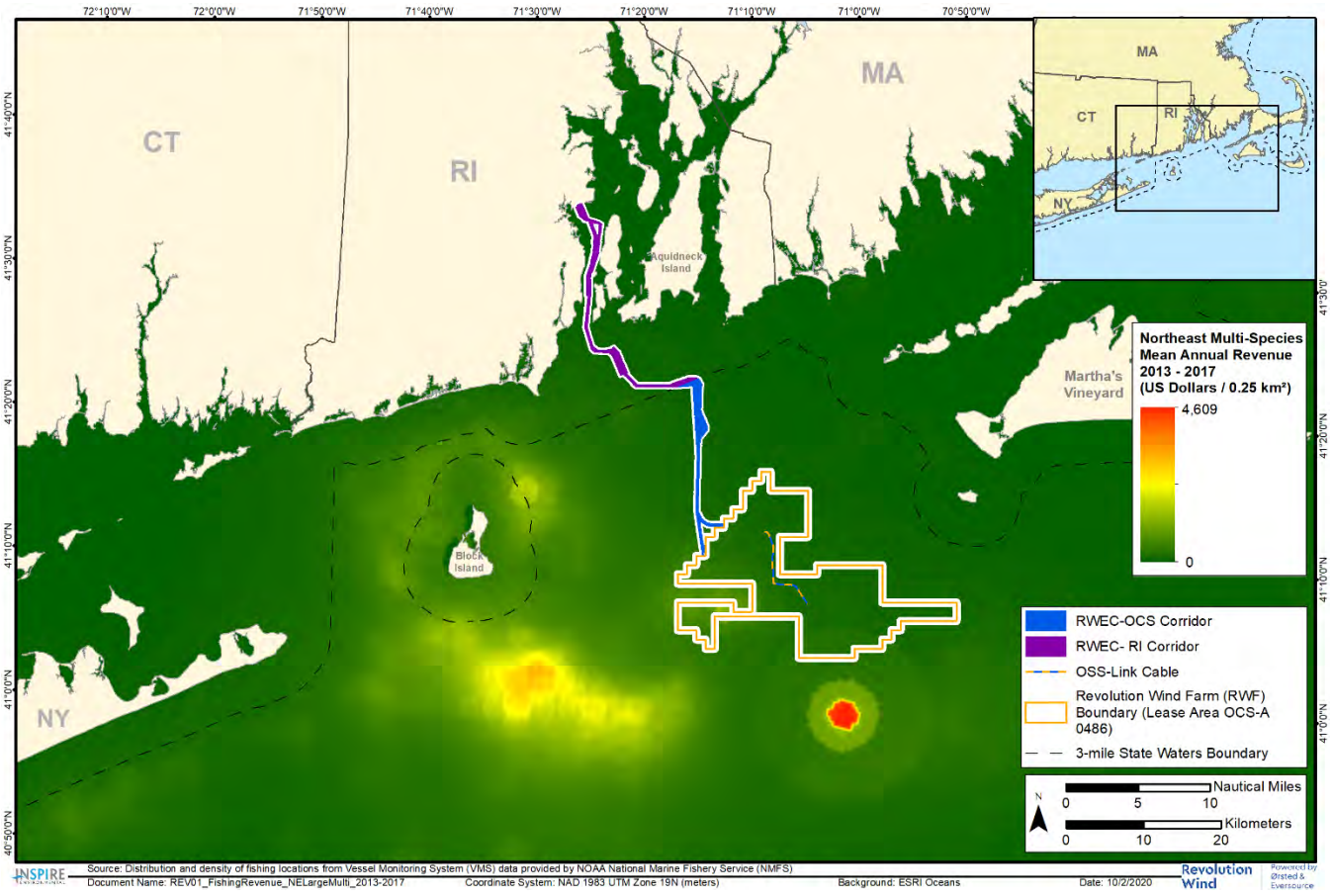

Figure 2.2-15 Revenue-intensity raster map for Large-mesh Multispecies Fishing, 2013-2017

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The revenue-intensity raster map for Atlantic herring indicates an area of relatively high-revenue fishing activity southwest of the RWEC fisheries study corridor within RI state waters (Figure 2.2-16). Low-revenue fishing activity is depicted in the northern portion of the RWF, with most of the RWF showing no revenue generated by Atlantic herring fishing activity (Figure 2.2-16). Maximum Atlantic herring mean annual revenue per 0.25 km^2 was $11,482 (Figure 2.2-16).

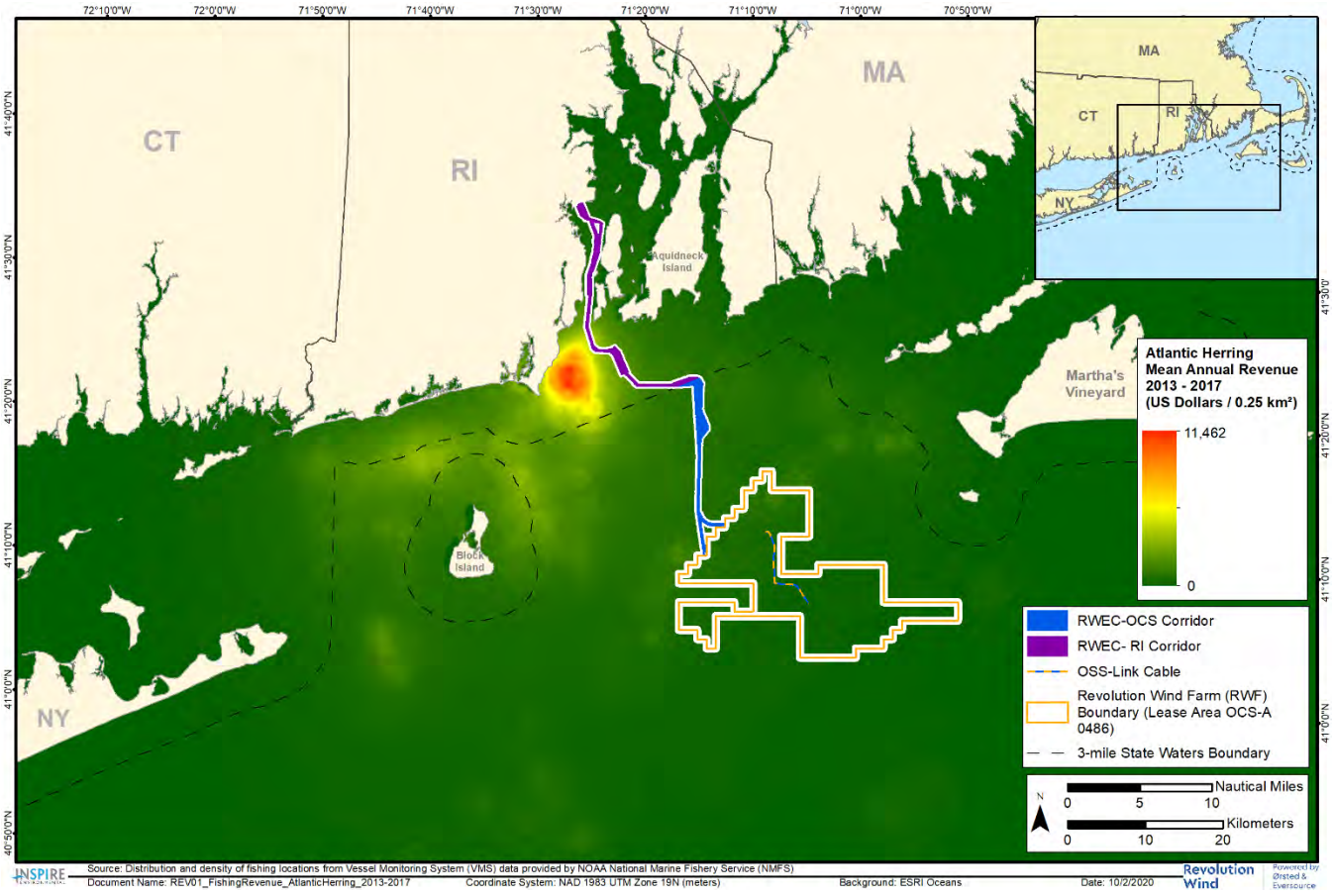

Figure 2.2-16 Revenue-intensity raster map for Atlantic Herring Fishing, 2013-2017

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The revenue-intensity raster map for pelagic species (midwater trawl) indicates an area of relatively high-revenue fishing activity southwest of the RWEC fisheries study corridor within RI state waters (Figure 2.2-17). Low-revenue fishing activity is depicted in the northern portion of the RWF, with most of the RWF showing no revenue generated by midwater trawl fishing activity (Figure 2.2-17). Maximum pelagic species mean annual revenue per 0.25 km^2 was $1,634 (Figure 2.2-17).

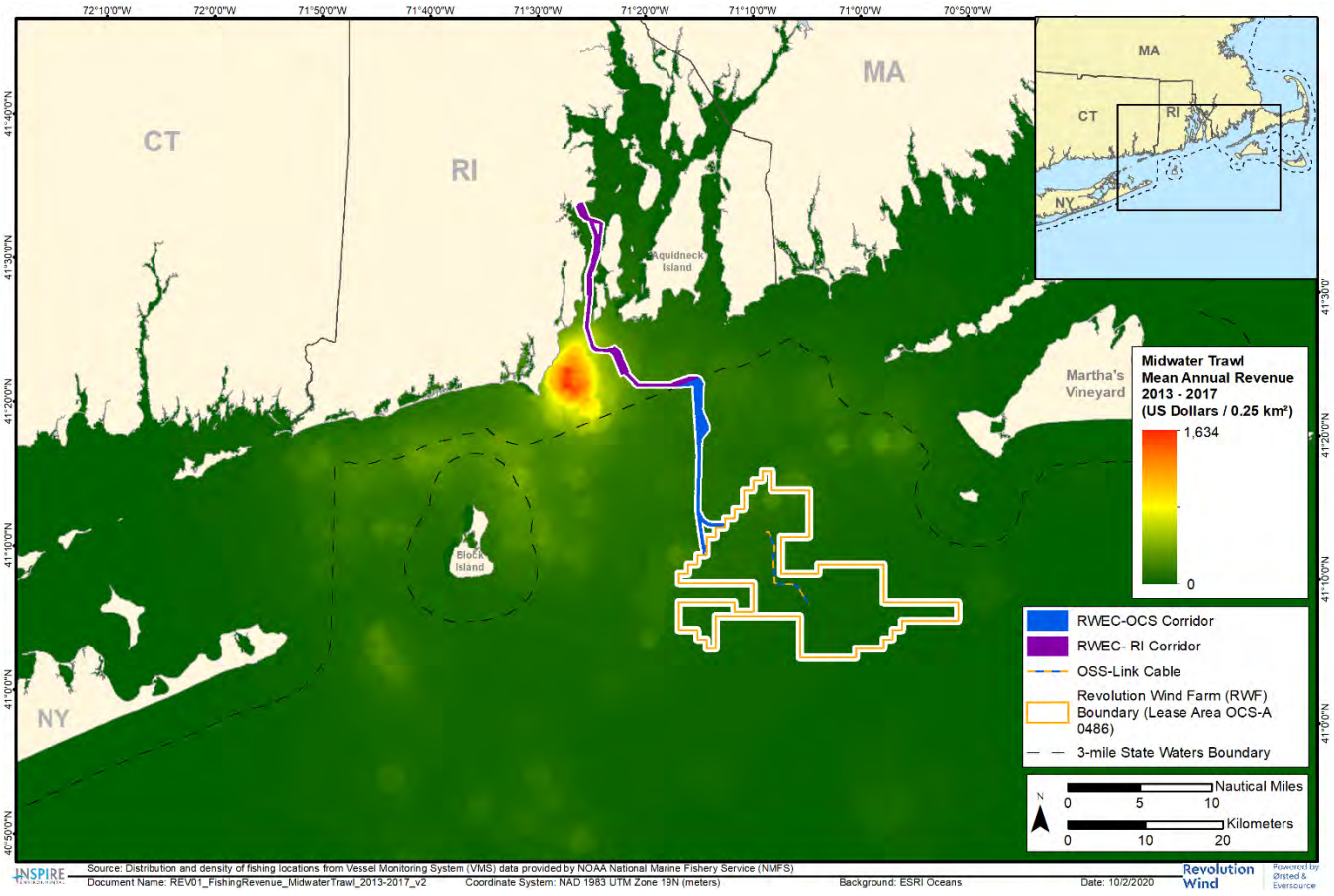

Figure 2.2-17 Revenue-intensity raster map for Pelagic Species (midwater trawl) Fishing, 2013-2017

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The revenue-intensity raster map for monkfish indicates an area of relatively high-revenue fishing activity south of the RWF and an area of moderate-revenue fishing activity within the RWF (Figure 2.2-18). There is no indication of revenue-producing fishing activity adjacent to the RWEC fisheries study corridor (Figure 2.2-18). Maximum monkfish mean annual revenue per 0.25 km^2 was $10,729 (Figure 2.2-18).

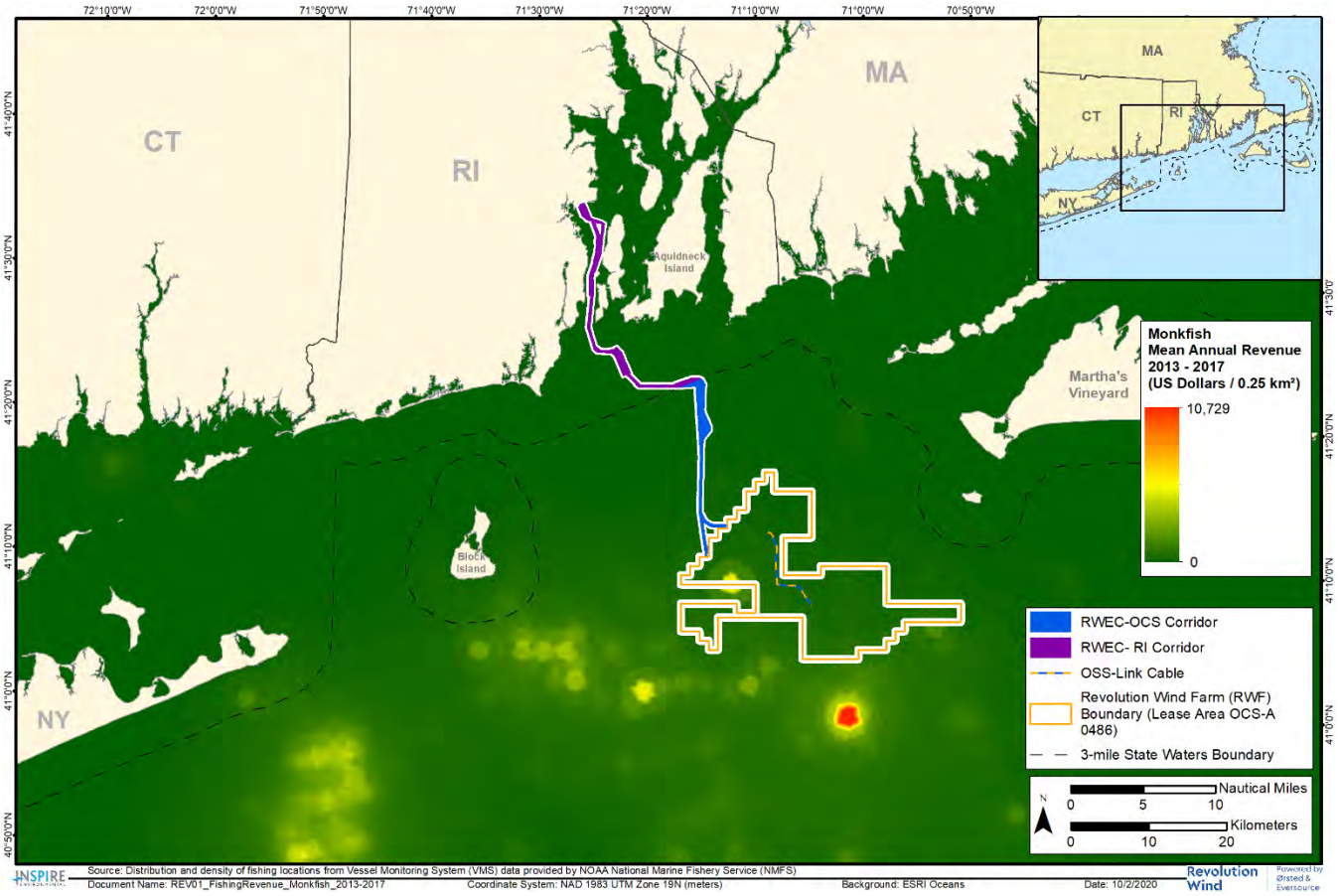

Figure 2.2-18 Revenue-intensity raster map for Monkfish Fishing, 2013-2017

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The revenue-intensity raster map for surfclam/ocean quahog indicates areas of relatively moderate to low-revenue fishing activity within the RWF and no revenue-producing fishing activity adjacent to the RWEC fisheries study corridor (Figure 2.2-19). Maximum surfclam/ocean quahog mean annual revenue per 0.25 km^2 was $12,358 (Figure 2.2-19).

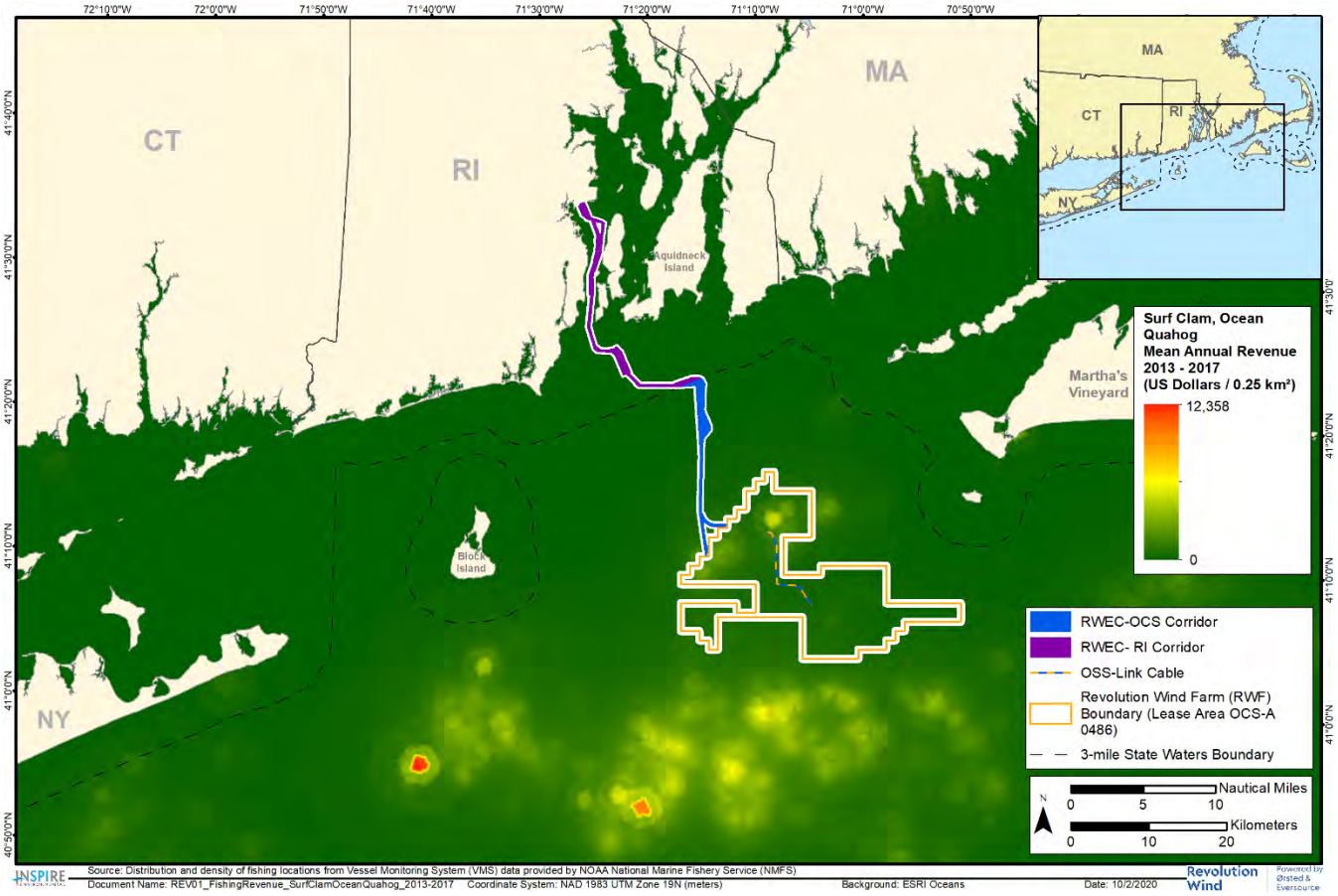

Figure 2.2-19 Revenue-intensity raster map for Surfclam/Ocean Quahog Fishing, 2013-2017

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The revenue-intensity raster map for sea scallops indicates an area in the southern RWF of relatively low-revenue fishing activity and no revenue-producing fishing activity adjacent to the RWEC fisheries study corridor (Figure 2.2-20). Maximum sea scallops mean annual revenue per 0.25 km^2 was $19,780 (Figure 2.2-20).

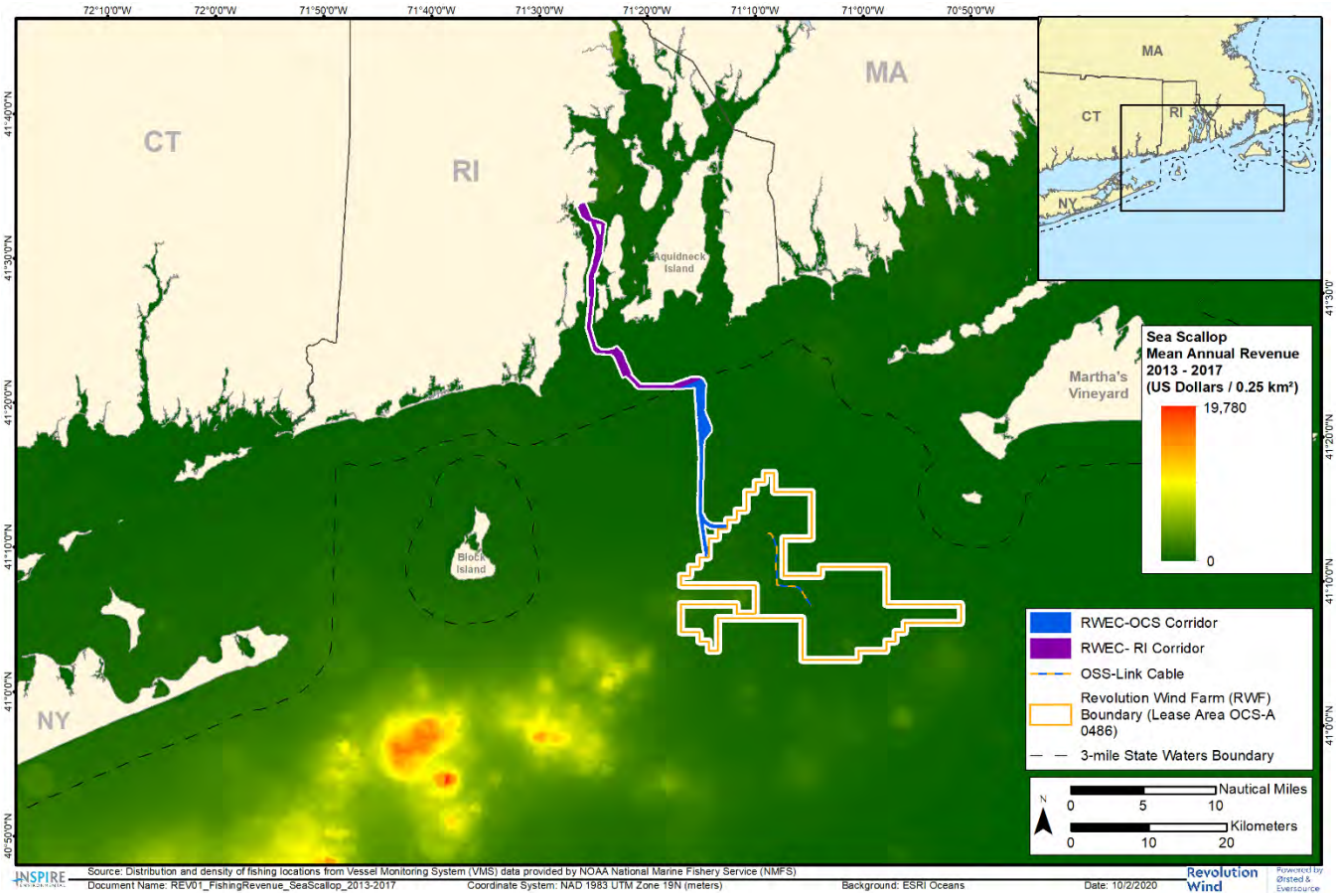

Figure 2.2-20 Revenue-intensity raster map for Sea Scallops, 2013-2017

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The revenue-intensity raster map for lobsters indicates relatively low-revenue fishing activity in RWF and adjacent to the RWEC fisheries study corridor (Figure 2.2-21). An area of moderate-revenue fishing activity occurs west of RWF (Figure 2.2-21). Maximum lobster mean annual revenue per 0.25 km^2 was $1,044 (Figure 2.2-21).

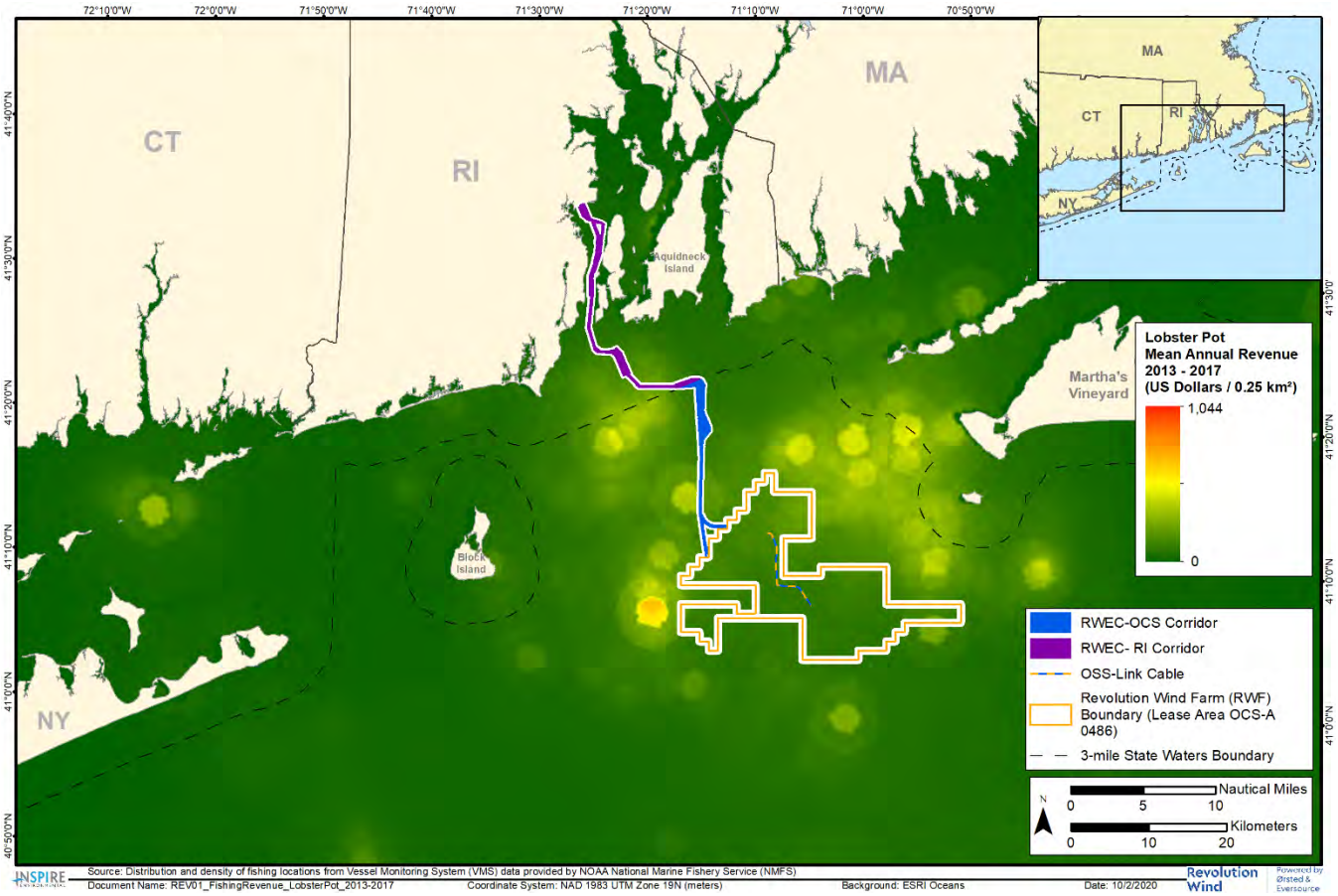

Figure 2.2-21 Revenue-intensity raster map for Lobsters, 2013-2017

2.2.4 Connecticut State Vessel Trip Reports

Commercial fisheries in Connecticut state waters may be categorized similarly to those in federal waters. The largest fishery by gear category in statistical area 611 for the years 2009 to 2018 used pots and traps, where an average of 144,296 pounds were landed per year, representing 100 percent of all landings caught by pots and traps in all Connecticut state waters. The next largest fishery in statistical area 611 used otter trawls, which averaged 106,572 pounds each year, representing all of the state catch. The third largest fishery by gear type was lobster pots and traps, averaging 89,877 pounds per year and also representing all of the lobster pot activity in Connecticut state waters. Table 2.2-7 provides an overview of the gears used in Connecticut state waters (ACCSP, 2019).

From 2009 to 2018, commercial fishermen permitted to fish in Connecticut state waters landed a diverse array of species, including conch, menhaden, lobster, scup, horseshoe crabs, summer flounder, American shad, bluefish, green crabs, and white perch. A complete summary of all species landed in these statistical areas is provided in Table 2.2-8. Statistical area 611 was an important fishing area for conch and menhaden. The greatest average pounds landed for the years 2009 to 2018 include conch (120,204 pounds), menhaden (100,026 pounds), lobster (84,601 pounds), scup (78,320 pounds), horseshoe crabs (58,108 pounds), and summer flounder (47,779 pounds).

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The top ports where fishermen landed their catch from fishing in Connecticut state waters were Stonington, Old Saybrook, New London, Guilford, and Clinton. Stonington was the port with the highest average annual landings (82,034 pounds) and the largest number of active fishing permits (58 permits; Table 2.2-9).

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Table 2.2-7 Categories of Gear Used by Connecticut State-only Permitted Vessels during 2009-2018 in Statistical Area 611

Gear Category	Average Pounds Landed per Year (2009-2018) Statistical Areas 611	Total Pounds Landed (2009-2018) Statistical Areas 611	Total Pounds Landed in Connecticut State Waters (2009-2018)	% Pounds Landed out of Total Connecticut State Waters, by Gear Statistical Areas 611
By Hand, No Diving Gear	57,939	579,389	579,389	100.0
Dip Nets	2,924	29,241	29,241	100.0
Gill Nets	85,978	859,780	859,920	100.0
Hand Line	52	209	209	100.0
Haul Seines	2,227	22,272	22,272	100.0
Hook and Line	56,702	567,023	577,950	98.1
Otter Trawls	106,572	1,065,717	1,065,632	100.0
Pots and Traps, Lobster	89,877	898,767	898,767	100.0
Pots and Traps, Other	12,427	124,269	124,269	100.0
Pots and Traps	144,296	1,442,964	1,443,053	100.0

Source: ACCSP, 2019.
Notes:
Values reflect pounds landed caught in statistical subareas relevant to RWF and the RWEC.
Confidential information was redacted from the ACCSP data set.
Blank cells indicate those years when the fishing area had no reported landings or redacted confidential landings.
Average pounds landed were calculated as an arithmetic mean, using the sum of pounds landed and the count of distinct years, ignoring zero years.

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Table 2.2-8 Species Landed by Connecticut State-only Permitted Vessels during 2009-2018 in Statistical Area 611

Species	Average Pounds Landed per Year (2009-2018)	Total Pounds Landed (2009-2018)	Total Pounds Landed in Connecticut State Waters (2009-2018)	% Pounds Landed out of Total Connecticut State Waters, by Species
	Statistical Areas	Statistical Areas		Statistical Areas
	611	611		611
Conch - Family	120,204	1,202,040	1,202,040	100.0
Menhadens	100,026	1,000,262	1,000,322	100.0
Lobster, American	84,601	846,013	846,008	100.0
Scup	78,320	783,205	785,525	99.7
Crab, Horseshoe	58,108	581,081	581,081	100.0
Flounder, Summer	47,779	477,792	482,543	99.0
Shad, American	43,513	435,132	435,132	100.0
Bluefish	20,461	204,605	204,784	99.9
Crab, Green	12,559	125,586	125,586	100.0
Perch, White	10,308	103,084	103,084	100.0
Bass, Black Sea	8,210	82,100	83,013	98.9
Tautog	7,838	78,382	78,467	99.9
Whelk, Channeled	7,182	28,728	28,728	100.0
Bass, Striped	2,918	29,179	29,179	100.0
Eel, American	2,251	22,510	22,510	100.0
Skates, Rajidae (Family)	2,012	20,124	20,059	100.3
Dogfish, Smooth	1,942	19,418	19,418	100.0
Flounder, Winter	1,719	17,190	17,190	100.0
Windowpane	1,662	16,622	16,622	100.0
Sea robins	1,436	14,359	14,359	100.0
Crab, Blue	882	8,815	8,815	100.0
Squid, Longfin Loligo	827	8,269	8,268	100.0
Butterfish	821	8,211	8,211	100.0
Silverside, Atlantic	458	4,580	4,580	100.0
Crabs, Hermit, Pagurus (Genus)	444	2,219	2,219	100.0
Hake, Red	412	2,470	2,475	99.8
Mummichog	370	3,330	3,330	100.0
Mullets	353	1,764	1,764	100.0
Shad, Gizzard	295	1,178	1,178	100.0
Shad, Hickory	293	2,346	2,346	100.0
Crab, Atlantic Rock	206	1,238	1,238	100.0
Weakfish	206	2,055	2,055	100.0
Shiner, Golden	138	415	415	100.0
Triggerfishes	50	502	502	100.0
Cod, Atlantic	26	181	225	80.4
Dogfish, Spiny	22	217	356	61.0
Sculpins	15	61	61	100.0
Tuna, Little Tunny	13	39	39	100.0
Hake, Silver	12	99	98	101.0
Bonito, Atlantic	12	60	60	100.0
Puffers, Tetraodontidae (Family)	8	24	24	100.0

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Species	Average Pounds Landed per Year (2009-2018)	Total Pounds Landed (2009-2018)	Total Pounds Landed in Connecticut State Waters (2009-2018)	% Pounds Landed out of Total Connecticut State Waters, by Species
	Statistical Areas	Statistical Areas		Statistical Areas
	611	611		611
Cunner	3	16	16	100.0
Mackerel, Atlantic	2	5	4	125.0

Source: ACCSP, 2019.
Notes:
Values reflect average pounds landed by species and by statistical subarea.
Confidential information was redacted from the requested data set.
Species are sorted by average pounds caught each year in statistical subarea 611.
Blank cells indicate those years when the fishing area had no reported landings or redacted confidential landings.

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Table 2.2-9 Landing Ports Used by Connecticut State-only Permitted Vessels during 2009-2018 in Statistical Area 611

Landing Port	Average Pounds Landed per Year by Subarea (2009-2018)	Total number of Active Fishing Permits	Total Pounds Landed by Subarea (2009-2018)	Total Pounds Landed in Connecticut State Waters (2009-2018)	% of Total Catch from Connecticut State Waters, by Port
	Statistical Areas	Statistical Areas	Statistical Areas		Statistical Areas
	611	611	611		611
Branford	12,771	18	127,709	127,849	99.9
Bridgeport	13,775	17	137,755	137,755	100.0
Chester (Town of)	3,642	4	25,493	25,493	100.0
Clinton	56,789	22	567,888	567,888	100.0
Darien	10,158	3	71,106	71,106	100.0
East Lyme (Flanders)	1,665	3	6,660	6,660	100.0
Greenwich	1,617	8	16,175	16,175	100.0
Groton	52,746	24	527,465	527,465	100.0
Guilford	67,723	21	677,231	677,231	100.0
Haddam	660	6	4,623	4,623	100.0
Middletown	3,757	3	11,272	11,272	100.0
Milford	31,474	12	314,740	314,740	100.0
Mystic	1,267	9	12,671	12,671	100.0
New Haven	36,729	10	367,288	367,288	100.0
New London	70,880	22	708,800	708,733	100.0
Niantic (East Lyme (sta.))	21,415	31	214,149	215,879	99.2
Noank	8,389	9	83,893	83,893	100.0
Norwalk	10,832	8	108,318	108,318	100.0
Old Lyme	6,340	10	57,057	57,057	100.0
Old Saybrook (Town of)	80,805	52	808,047	808,047	100.0
Pawcatuck	243	4	973	1,057	92.1
Stamford	2,778	8	22,221	22,221	100.0
Stonington	82,034	58	820,341	828,711	99.0
Stratford	2,250	8	20,251	20,251	100.0
Waterford	14,223	14	142,234	142,370	99.9
West Haven	3,685	4	11,055	11,055	100.0
Westbrook (Town of)	14,007	15	140,071	140,071	100.0

Source: ACCSP, 2019.

Notes:

Values reflect pounds landed caught in statistical subareas relevant to RWF.

Confidential information was redacted from the ACCSP data set.

Blank cells indicate those years when the fishing area had no reported landings or redacted confidential landings.

Average pounds landed were calculated as an arithmetic mean, using the sum of pounds landed and the count of distinct years, ignoring zero years.

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2.2.5 Massachusetts State Vessel Trip Reports

The largest fishery by gear category in Massachusetts state waters in statistical areas 537 and 538 for the years 2009 to 2018 used pots and traps, yielding average annual landings of 740,978 pounds, accounting for 49 percent of the statewide landings for this gear type. Total annual landings from hook and line averaged 608,431 pounds, accounting for approximately 45 percent of landings from hook and line within state waters. Landings using lobster pots and traps averaged 522,764 pounds landed per year in both statistical areas combined, representing 12 percent of all lobster trap landings in all Massachusetts state waters. Table 2.2-10 provides an overview of the gears used in Massachusetts state waters (ACCSP, 2019).

From 2009 to 2018, commercial fishermen permitted to fish in Massachusetts state waters landed a diverse array of species, including brachyuran crabs, menhaden, ocean quahog, channeled whelk, northern quahog clam, scup, striped bass, bay scallop, black sea bass, horseshoe crabs, eastern oysters, and soft clams. A complete summary of all species landed in these statistical areas is provided in Table 2.2-11. The majority of species came from area 538, with the exception of brachyuran crabs, which had high landings in area 537. Brachyuran crab landings averaged over 3.0 million pounds per year for all statistical areas combined and accounted for 62 percent of statewide crab landings. Channeled whelk landings averaged 563,513 pounds annually in statistical areas 537 and 538 combined and accounted for 95 percent of channeled whelk landings statewide. Species with high landings in area 538 for the years 2009 to 2018 include channeled whelk (551,351 pounds), northern quahog (415,349 pounds), and scup (290,480 pounds).

The top ports where fishermen landed their catch from fishing in all Massachusetts state waters were New Bedford, Chatham, Edgartown, Falmouth, and Westport. New Bedford was the port with the highest average annual landings in statistical areas 537 and 538 combined (701,301 pounds) and the largest number of active fishing permits (626 permits; Table 2.2-12).

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Table 2.2-10 Categories of Gear Used by Massachusetts State-only Permitted Vessels during 2009-2018 in Statistical Areas 537 and 538

	Average Pounds Landed per Year (2009-2018)		Total Pounds Landed (2009-2018)		Total Pounds Landed in Massachusetts State Waters (2009-2018)	% Pounds Landed out of Total Massachusetts State Waters, by Gear	
	Statistical Areas		Statistical Areas			Statistical Areas	
Gear Category	537	538	537	538		537	538
By Hand, Diving Gear	210	25,662	839	230,956	527,341	0.2	43.8
By Hand, No Diving Gear	736	74,480	2,207	670,319	1,991,792	0.1	33.7
Dip Nets		16,679		150,107	215,101		69.8
Dredge	60,667	178,442	606,669	1,784,420	22,268,013	2.7	8.0
Gill Nets		7,411		51,879	5,524,403		0.9
Hand Line	68,050	69,044	612,454	690,442	1,740,763	35.2	39.7
Harpoons		780		6,241	71,863		8.7
Hook and Line	111,829	496,602	1,006,460	4,966,017	13,228,436	7.6	37.5
Long Lines		1,352		6,761	3,908,859		0.2
Not Coded	11,511	10,003	11,511	80,023	2,871,527	0.4	2.8
Other Fixed Nets		35,700		285,603	574,627		49.7
Other Gears	112	143,874	335	1,294,864	5,786,102	<0.1	22.4
Otter Trawls	9,807	124,842	49,034	1,123,580	1,716,517	2.9	65.5
Pots and Traps, Lobster	482,902	39,862	3,863,217	358,762	33,966,462	11.4	1.1
Pots and Traps, Other	83,124	62,518	166,247	375,109	1,339,713	12.4	28.0
Pots and Traps	21,237	719,741	148,658	7,197,414	15,063,126	1.0	47.8
Purse Seine					13,880,167		
Rakes	695	488,807	4,170	4,888,075	31,134,543	<0.1	15.7
Suction Pumps		748		4,490	4,494		99.9

Source: ACCSP, 2019.

Notes:

Values reflect pounds landed caught in statistical subareas relevant to RWF and RWEC.

Confidential information was redacted from the ACCSP data set.

Blank cells indicate those years when the fishing area had no reported landings or redacted confidential landings.

Average pounds landed were calculated as an arithmetic mean, using the sum of pounds landed and the count of distinct years, ignoring zero years.

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Table 2.2-11 Species Landed by Massachusetts State-only Permitted Vessels during 2009-2018 in Statistical Areas 537 and 538

Species	Average Pounds Landed per Year (2009-2018)		Total Pounds Landed (2009-2018)		Total Pounds Landed in Massachusetts State Waters (2009-2018)	% Pounds Landed out of Total Massachusetts State Waters, by Species	
	Statistical Areas		Statistical Areas			Statistical Areas	
	537	538	537	538		537	538
Whelk, Channeled	12,162	551,351	72,973	5,513,507	5,846,715	1.2	94.3
Clam, Northern Quahog		415,349		4,153,491	6,682,378		62.2
Scup	117,953	290,480	1,061,578	2,904,798	4,106,087	25.9	70.7
Bass, Striped	19,160	151,721	172,440	1,517,212	6,271,230	2.7	24.2
Scallop, Bay	2,644	122,538	23,794	1,225,379	1,275,687	1.9	96.1
Bass, Black Sea	24,744	122,256	222,698	1,222,563	1,543,660	14.4	79.2
Crab, Horseshoe	397	120,109	1,191	1,080,983	2,655,523	<0.1	40.7
Oyster, Eastern	115	118,652	345	1,186,521	4,457,611	<0.1	26.6
Clam, Soft	454	111,632	2,272	1,004,692	22,334,558	<0.1	4.5
Menhadens		104,916		944,245	14,455,094		6.5
Flounder, Summer	15,615	96,401	140,535	964,005	1,138,208	12.3	84.7
Bluefish	4,663	68,860	41,966	688,603	1,412,892	3.0	48.7
Lobster, American	80,755	45,910	807,547	459,102	39,211,503	2.1	1.2
Whelk, Knobbed	675	42,517	2,025	382,649	440,597	0.5	86.8
Crab, Green		41,999		419,994	1,238,936		33.9
Squid, Longfin Loligo	241	36,232	964	326,087	374,995	0.3	87.0
Tautog	2,008	35,090	18,068	350,897	389,325	4.6	90.1
Mussel, Sea		26,987		134,936	11,656,534		1.2
Surfclam, Atlantic		11,013		99,115	6,604,278		1.5
Crabs, Brachyura	3,073,922	5,398	3,073,922	5,398	4,936,562	62.3	0.1
Snail, Moon		5,287		15,860	17,238		92.0
Mackerel, Atlantic	3,560	4,650	17,801	41,853	496,128	3.6	8.4
Quahog, Ocean	281,280	4,462	562,560	40,162	1,833,700	30.7	2.2
Clam Atlantic Razor		4,050		32,403	3,345,259		1.0
Butterfish		3,427		30,846	32,312		95.5
Tuna, Bluefin	1,240	1,839	9,918	14,713	766,324	1.3	1.9
Skates, Rajidae (Family)		1,524		6,095	1,552,660		0.4
Triggerfishes	417	1,458	2,500	13,125	15,634	16.0	84.0
Ark, Blood		1,402		9,816	187,497		5.2
Crab, Jonah		1,217		7,300	448,928		1.6
Eel, American		1,163		10,468	12,061		86.8
Quahog, False		1,124		4,497	4,957		90.7
Flounder, Winter	435	1,076	2,610	9,680	234,000	1.1	4.1
Tuna, Yellowfin	2,188	855	17,501	4,276	51,015	34.3	8.4
Cusk		768		1,535	2,823		54.4
Clam, Stout Tagelus (Stubby Razor/Bamboo)		705		2,818	2,818		100.0
Scallop, Sea		635		3,807	575,015		0.7
Dogfish, Spiny		347		1,735	7,306,603		<0.1

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Species	Average Pounds Landed per Year (2009-2018)		Total Pounds Landed (2009-2018)		Total Pounds Landed in Massachusetts State Waters (2009-2018)	% Pounds Landed out of Total Massachusetts State Waters, by Species	
	Statistical Areas		Statistical Areas			Statistical Areas	
	537	538	537	538		537	538
Bonito, Atlantic	130	344	1,042	3,097	4,201	24.8	73.7
Goosefish	2,299	257	13,796	2,054	165,789	8.3	1.2
Flounder, American Plaice		218		655	61,911		1.1
Cod, Atlantic	419	194	1,258	968	585,844	0.2	0.2
Snail, Slipper Limpet		187		373	373		100.0
Basses, Mixed Sea		140		279	565		49.4
Squid, Shortfin Illex		126		753	1,028		73.3
Hake, Silver		89		356	188,840		0.2
Tuna, Albacore	314	32	1,257	97	4,691	26.8	2.1
Searobins		29		116	154		75.3
Sharks, Chondrichthyes (Class)		10		10			
Dolphinfish	352		2,465		5,797	42.5	
Sharks, Mako	421		2,528		4,029	62.7	
Tuna, Bigeye	864		6,050		20,315	29.8	
Wahoo	55		166		312	53.2	

Source: ACCSP, 2019.
Notes:
Values reflect average pounds landed by species and by statistical subarea.
Confidential information was redacted from the requested data set.
Species are sorted by average pounds caught each year in statistical subarea 538.
Blank cells indicate those years when the fishing area had no reported landings or redacted confidential landings.
Average pounds landed were calculated as an arithmetic mean, using the sum of pounds landed and the count of distinct years, ignoring zero years.

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Table 2.2-12 Landing Ports Used by Massachusetts State-only Permitted Vessels during 2009-2018 in Statistical Areas 537 and 538

Landing Port	Average Pounds Landed per Year by Subarea (2009-2018)		Total number of Active Fishing Permits		Total Pounds Landed by Subarea (2009-2018)		Total Pounds Landed in Massachusetts State Waters (2009-2018)	% of Total Catch from Massachusetts State Waters, by Port	
	Statistical Areas		Statistical Areas		Statistical Areas			Statistical Areas	
	537	538	537	538	537	538		537	538
Barnstable	1,940	137,841	3	127	3,879	1,378,409	4,893,066	0.1	28.2
Barnstable (County)		2,290		26		18,319	1,555,775		1.2
Bass River		53,229		80		479,064	579,929		82.6
Boston		200		5		601	2,404,824		<0.1
Bourne	572	48,501	10	304	5,150	485,006	620,206	0.8	78.2
Chatham (census name for Chatham Center)	1,192	256,396	9	387	9,536	2,563,959	14,079,050	0.1	18.2
Chilmark	17,687	3,982	26	48	123,807	39,823	163,782	75.6	24.3
Cotuit		16,157		31		145,414	1,425,767		10.2
Cuttyhunk		841		7		7,565	7,565		100.0
Dartmouth	15,141	85,977	47	180	136,270	859,767	1,033,194	13.2	83.2
Dennis	388	51,917	4	103	1,163	519,169	6,696,570	<0.1	7.8
Dukes (County)		51		3		102	100		102.0
Eastham		679		8		4,074	625,189		0.7
Edgartown	4,334	215,384	23	113	39,006	2,153,842	2,257,956	1.7	95.4
Fairhaven	50,689	100,555	41	196	506,893	1,005,551	3,725,925	13.6	27.0
Fall River	1,262	61,590	6	46	6,309	554,306	12,279,208	0.1	4.5
Falmouth (census name for Falmouth Center)	6,422	192,888	47	282	64,221	1,928,881	2,118,923	3.0	91.0
Gay Head	432	3,161	6	17	2,162	22,130	25,049	8.6	88.3
Gloucester	432		4		2,592		9,822,240	<0.1	
Harwich Port	351	20,465	8	115	2,108	204,649	591,445	0.4	34.6
Hyannis	1,201	120,164	9	93	7,204	1,081,480	1,257,080	0.6	86.0
Hyannis Port (Hyannisport)		850		8		5,948	7,350		80.9
Lynn		472		4		1,886	109,551		1.7
Marion	588	54,691	3	49	2,351	546,907	558,563	0.4	97.9
Marshfield (census name for Marshfield Compact)		2,489		17		22,402	3,247,865		0.7
Mashpee	688	24,094	6	57	4,131	216,842	256,370	1.6	84.6
Mattapoisett	8,707	60,733	12	102	87,073	607,328	697,571	12.5	87.1
Menemsha	17,450	50,493	50	96	157,051	454,433	620,787	25.3	73.2
Nantucket (census name for Nantucket Center)	8,863	125,468	34	157	79,766	1,254,679	1,495,430	5.3	83.9
New Bedford	481,370	219,931	170	456	4,813,697	2,199,312	11,992,064	40.1	18.3
Oak Bluffs	705	61,221	10	43	5,637	550,990	569,643	1.0	96.7

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Landing Port	Average Pounds Landed per Year by Subarea (2009-2018)		Total number of Active Fishing Permits		Total Pounds Landed by Subarea (2009-2018)		Total Pounds Landed in Massachusetts State Waters (2009-2018)	% of Total Catch from Massachusetts State Waters, by Port	
	Statistical Areas		Statistical Areas		Statistical Areas			Statistical Areas	
	537	538	537	538	537	538		537	538
Onset		16,699		28		166,986	173,572		96.2
Orleans		6,263		19		56,367	4,085,400		1.4
Osterville		888		9		5,330	18,818		28.3
Plymouth (census name for Plymouth Center)		5,926		25		53,332	8,237,380		0.6
Provincetown Wharf		510		7		3,572	6,146,964		0.1
Sandwich (census name for Sandwich Center)	36,918	19,569	14	235	369,183	195,689	5,163,988	7.1	3.8
Somerset		1,913		3		9,565	11,173		85.6
Swansea (Swansea Village)		1,313		10		9,190	564,218		1.6
Tisbury (Town of)	1,914	36,173	9	56	17,223	361,731	379,742	4.5	95.3
Truro		400		4		1,200	364,797		0.3
Unknown		39,970		21		113,956	2,131,392		5.3
Vineyard Haven (Town name Tisbury)	665	57,868	12	64	5,989	578,676	587,324	1.0	98.5
Wareham	907	134,526	7	140	4,535	1,345,262	1,361,384	0.3	98.8
Wellfleet		63		6		444	2,121,695		<0.1
West Tisbury		6,142		22		49,133	49,239		99.8
Westport	26,159	163,416	39	314	261,593	1,634,162	1,929,828	13.6	84.7
Woods Hole	1,727	25,804	9	27	13,815	232,237	262,334	5.3	88.5
Yarmouth	339	70,366	4	112	1,697	703,657	917,816	0.2	76.7

Source: ACCSP, 2019.
Notes:
Values reflect pounds landed caught in statistical subareas relevant to RWF and RWEC.
Confidential information was redacted from the ACCSP data set.
Blank cells indicate those years when the fishing area had no reported landings or redacted confidential landings.
Average pounds landed were calculated as an arithmetic mean, using the sum of pounds landed and the count of distinct years, ignoring zero years.

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2.2.6 New York State Vessel Trip Reports

The largest fishery by gear category in New York state waters for the years 2009 to 2018 in statistical areas 611 and 613 used otter trawls, yielding average annual landings of 576,114 pounds and accounting for 98 percent of the statewide landings for this gear type. The second largest fishery by gear type used other fixed nets, followed by gill nets, and pots and traps. Table 2.2-13 provides an overview of the gears used in New York state waters (ACCSP, 2019).

Commercial fishermen permitted to fish in New York state waters landed many species from 2009 to 2018. Species with the highest average annual landings by weight in statistical areas 611 and 613 combined included striped bass (540,306 pounds), menhaden (439,932 pounds), and scup (429,999 pounds). A complete summary of all species landed in each statistical area is provided in Table 2.2-14. For several species, landings from the two statistical areas account for over 90 percent of statewide landings; these species include scup, bluefish, whelk, conch, butterfish, black sea bass, bay scallop, smooth dogfish, squid, Atlantic herring, northern sea robins, weakfish, and windowpane.

For the state of New York, the category “unknown” for a port designation claimed the highest landings and total number of active fishing permits, accounting for 45 percent of total statewide landings from statistical areas 611 and 613. Among known ports, Oceanside (620,485 pounds) had the highest average annual landings followed by Shinnecock Indian Reservation (474,331 pounds), Mattituck (290,548 pounds), East Hampton (251,866 pounds) and Greenport (192,106 pounds). The top ports based on the number of active fishing permits were Montauk (145 permits), Shinnecock Indian Reservation (135 permits), Moriches (93 permits), and Hampton Bays (82 permits; Table 2.2-15).

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Table 2.2-13 Categories of Gear Used by New York State-only Permitted Vessels during 2009-2018 in Statistical 611 and 613

Gear Category	Average Pounds Landed per Year (2009-2018)		Total Pounds Landed (2009-2018)		Total Pounds Landed in New York State Waters (2009-2018)	% Pounds Landed out of Total New York State Waters, by Gear	
	Statistical Areas		Statistical Areas			Statistical Areas	
	611	613	611	613		611	613
Beam Trawls	6,787		13,574		13,574	100.0	
By Hand, Diving Gear	876	1,618	5,257	14,565	25,316	20.8	57.5
By Hand, No Diving Gear	91,314	70,700	913,140	707,002	3,479,728	26.2	20.3
Dip Nets	82,635	886	743,711	7,971	2,023,753	36.7	0.4
Dredge	10,053	357,574	100,533	3,218,166	5,469,876	1.8	58.8
Fyke Nets	879	6,281	3,515	56,532	74,223	4.7	76.2
Gill Nets	117,432	408,656	1,174,322	4,086,556	6,637,888	17.7	61.6
Hand Line	325	701	2,276	2,802	7,229	31.5	38.8
Hook and Line	237,069	69,499	2,370,687	694,994	3,881,334	61.1	17.9
Not Coded		321,497		2,250,477	35,378,232		6.4
Other Fixed Nets	482,500	51,744	4,342,501	413,955	4,778,619	90.9	8.7
Other Gears	27,100	8,632	81,300	17,264	150,444	54.0	11.5
Other Seines	148,133	28,469	1,333,197	256,217	1,767,286	75.4	14.5
Other Trawls	12,873	27,159	90,109	81,478	179,240	50.3	45.5
Otter Trawls	407,198	168,916	4,071,983	1,689,163	5,858,347	69.5	28.8
Pots and Traps, Lobster	62,870		628,697		641,516	98.0	
Pots and Traps	344,556	92,863	3,445,564	928,627	9,832,402	35.0	9.4
Pound Nets	145,258	17,837	1,452,583	142,693	1,595,876	91.0	8.9
Rakes		7,817		31,267	75,343		41.5

Source: ACCSP, 2019.
Notes:
Values reflect pounds landed caught in statistical subareas relevant to RWF and RWEC.
Confidential information was redacted from the ACCSP data set.
Blank cells indicate those years when the fishing area had no reported landings or redacted confidential landings.
Average pounds landed were calculated as an arithmetic mean, using the sum of pounds landed and the count of distinct years, ignoring zero years.

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Table 2.2-14 Species Landed by New York State-only Permitted Vessels during 2009-2018 in Statistical Areas 611 and 613

Species	Average Pounds Landed per Year (2009-2018)		Total Pounds Landed (2009-2018)		Total Pounds Landed in New York State Waters (2009-2018)	% Pounds Landed out of Total New York State Waters, by Species	
	Statistical Areas		Statistical Areas			Statistical Areas	
	611	613	611	613		611	613
Scup	403,200	26,799	4,032,000	267,988	4,343,179	92.8	6.2
Menhadens	390,071	49,861	3,510,635	498,614	5,727,713	61.3	8.7
Bluefish	276,531	89,047	2,765,306	890,466	3,847,249	71.9	23.1
Bass, Striped	216,413	323,893	2,164,129	3,238,933	5,959,928	36.3	54.3
Lobster, American	202,433	34,636	2,024,332	242,449	2,589,209	78.2	9.4
Flounder, Summer	127,173	24,549	1,271,728	245,492	1,703,933	74.6	14.4
Whelk - Family	123,769	3,562	1,237,685	28,493	1,344,794	92.0	2.1
Crab, Horseshoe	114,738	97,782	1,147,379	977,816	4,063,670	28.2	24.1
Clam, Soft	101,912	15,194	713,387	106,355			
Conch - Family	79,180	320	79,180	320	79,500	99.6	0.4
Whelk, Channeled	66,219	13,546	662,186	108,367	1,021,185	64.8	10.6
Butterfish	56,686	4,402	566,862	44,022	621,550	91.2	7.1
Bass, Black Sea	51,225	11,779	512,250	117,788	671,627	76.3	17.5
Tautog	46,869	1,761	468,685	17,607	680,481	68.9	2.6
Scallop, Bay	30,858	4,927	308,578	44,344	352,981	87.4	12.6
Dogfish, Smooth	22,680	5,648	226,803	56,484	293,642	77.2	19.2
Squid, Longfin Loligo	20,892	105,061	208,918	945,545	1,156,323	18.1	81.8
Herring, Atlantic	11,874	7,152	118,736	35,761	158,697	74.8	22.5
Searobins, North American	10,538	2,832	73,769	19,824	94,961	77.7	20.9
Crabs, Hermit, Pagurus (Genus)	8,995	1,980	35,981	5,941	59,821	60.1	9.9
Crabs, Spider	8,224	3,471	57,567	20,824	176,411	32.6	11.8
Weakfish	7,991	6,678	79,906	66,778	157,927	50.6	42.3
Windowpane	6,895	2,475	68,950	24,747	94,562	72.9	26.2
Crab, Atlantic Rock	6,329	1,601	56,960	8,006	291,367	19.5	2.7
Surfclam, Atlantic	6,282	768,913	12,563	4,613,477	22,139,355	0.1	20.8
Searobins	6,089	187	54,803	1,123	56,563	96.9	2.0
Silversides, Atherinidae (Family)	5,995	4,638	35,968	41,741	185,827	19.4	22.5
Crab, Blue	5,931	17,595	59,306	175,953	4,065,251	1.5	4.3
Skates, Raja (Genus)	5,516	23,667	55,156	213,006	268,170	20.6	79.4
Crab, Green	5,319	6,368	31,913	50,942	510,966	6.2	10.0
Whelk, Knobbed	4,864	1,498	48,640	7,491	59,150	82.2	12.7
Perch, White	4,003	432	36,024	4,324	40,377	89.2	10.7
Skates, Rajidae (Family)	3,848	33,125	38,475	298,127	336,795	11.4	88.5
Spot	3,816	931	34,345	8,375	43,716	78.6	19.2
Eel, American	3,549	4,208	35,490	42,078	212,649	16.7	19.8
Crab, Jonah	2,775	24,882	16,647	223,937	1,086,936	1.5	20.6
Mussel, Sea	2,038	3,051	14,267	21,356	38,373	37.2	55.7
Flounder, Winter	1,821	2,374	18,212	23,740	44,782	40.7	53.0
Flounder, American Plaice	1,079	405	10,790	2,832	13,622	79.2	20.8
Puffer, Northern	995	266	7,962	2,663	15,780	50.5	16.9
Clam Atlantic Razor	989	17,646	4,946	123,523	3,525,195	0.1	3.5

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Species	Average Pounds Landed per Year (2009-2018)		Total Pounds Landed (2009-2018)		Total Pounds Landed in New York State Waters (2009-2018)	% Pounds Landed out of Total New York State Waters, by Species	
	Statistical Areas		Statistical Areas			Statistical Areas	
	611	613	611	613		611	613
Mackerel, Atlantic	871	768	6,965	5,373	13,707	50.8	39.2
Goosefish	864	8,257	7,780	82,568	90,452	8.6	91.3
Silverside, Atlantic	698	1,448	4,883	8,690	20,963	23.3	41.5
Jack, Crevalle	619	91	5,570	548	6,118	91.0	9.0
Crab, Lady	607		1,821		10,073	18.1	
Tuna, Little Tunny	570	971	4,560	8,739	13,847	32.9	63.1
Tuna, Albacore	557	1,173	3,897	5,867	10,496	37.1	55.9
Bonito, Atlantic	402	1,155	4,021	9,243	13,365	30.1	69.2
Shad, Hickory	400	642	3,196	6,421	9,618	33.2	66.8
Kingfish, Northern	387	400	3,485	3,196	7,301	47.7	43.8
Whelk, Waved	357		2,497		46,447	5.4	
Mackerel, Spanish	354	251	3,536	2,515	7,065	50.0	35.6
Hake, Red	292	833	2,920	8,326	17,764	16.4	46.9
Tuna, Skipjack	240		2,163		2,175	99.4	
Dogfish, Spiny	218	1,877	1,306	16,892	30,474	4.3	55.4
Toadfish, Oyster	206		1,850		1,968	94.0	
Herring, Blueback	195		780		5,460	14.3	
Squid, Shortfin Illex	190		1,141		1,205	94.7	
Triggerfishes	190	172	1,901	1,550	4,155	45.7	37.3
Shad, Gizzard	139		1,253		1,545	81.1	
Amberjacks	122		854		855	99.9	
Shrimps, Mantis	121		1,088		1,088	100.0	
Shad, American	120	474	838	3,791	10,355	8.1	36.6
Four spot Flounder, American	118		705		1,663	42.4	
Cod, Atlantic	114	558	916	5,581	8,172	11.2	68.3
Cunner	97	20	778	121	913	85.2	13.3
Mackerel, Atlantic Chub	96	4	288	11	299	96.3	3.7
Drum, Black	96	42	862	250	1,112	77.5	22.5
Cobia	94	28	658	85	767	85.8	11.1
Mackerel, King	70	8	417	34	456	91.5	7.4
Searobin, Northern	63	473	125	473	598	20.9	79.1
Herrings	53	111	106	221	327	32.4	67.6
Garfishes	53	5	423	18	441	95.9	4.1
Snappers, Lutjanidae (Family)	51		204		205	99.5	
Sculpins	44		131		131	100.0	
Hake, White	42		250		388	64.4	
Hake, Silver	35	613	242	5,516	8,135	3.0	67.8
Runner, Blue	25		101		101	100.0	
Croaker, Atlantic	23	27	181	165	655	27.7	25.1
Raven, Sea	22		110		110	100.0	
Pompano, Florida	18		53		56	94.6	
Eel, Conger	13		94		276	34.0	
Pollock	12		24		323	7.4	

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Species	Average Pounds Landed per Year (2009-2018)		Total Pounds Landed (2009-2018)		Total Pounds Landed in New York State Waters (2009-2018)	% Pounds Landed out of Total New York State Waters, by Species	
	Statistical Areas		Statistical Areas			Statistical Areas	
	611	613	611	613		611	613
Ladyfish	10		41		46	89.1	
Mullets	6		31		55	56.4	
Toadfishes, Batrachoididae (Family)	6		18		18	100.0	
Spadefish, Atlantic	5		21		23	91.3	
Kingfishes	2		6		159	3.8	
Ark, Blood		870		2,610	6,395		40.8
Clam, Northern Quahog		53,201		425,608	10,696,504		4.0
Flounder, Yellowtail		208		831	831		100.0
Oyster, Eastern		7,446		52,125			
Pitar		2,791		13,953	13,953		100.0
Puffers, Tetraodontidae (Family)		30		61	401		15.1
Shark, Thresher		203		1,014	5,693		17.8

Source: ACCSP, 2019.

Notes:

Values reflect average pounds landed by species and by statistical subarea.

Confidential information was redacted from the requested data set.

Species are sorted by average pounds caught each year in statistical subarea 611.

Blank cells indicate those years when the fishing area had no reported landings or redacted confidential landings.

Average pounds landed were calculated as an arithmetic mean, using the sum of pounds landed and the count of distinct years, ignoring zero years.

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Table 2.2-15 Landing Ports Used by New York State-only Permitted Vessels during 2009-2018 in Statistical Areas 611 and 613

Landing Port	Average Pounds Landed per Year by Subarea (2009-2018)		Total number of Active Fishing Permits		Total Pounds Landed by Subarea (2009-2018)		Total Pounds Landed in New York State Waters (2009-2018)	% of Total Catch from New York State Waters, by Port	
	Statistical Areas		Statistical Areas		Statistical Areas			Statistical Areas	
	611	613	611	613	611	613		611	613
Amagansett	98,953	12,561	35	24	989,528	125,612	1,115,432	88.7	11.3
Babylon		4,090		5		20,450	678,556		3.0
Bronx (Borough of New York)	17,748		2		53,244		53,813	98.9	
Bronx (County)	10,338		6		72,363		72,363	100.0	
Brooklyn (Borough of New York)	210		4		631		693,732	0.1	
Center Moriches		9,209		18		82,883	154,246		53.7
City Island	7,273		7		72,729		74,549	97.6	
East Hampton	242,505	9,361	49	27	2,425,047	93,607	2,518,784	96.3	3.7
East Moriches	390	26,458	3	28	1,171	264,577	334,774	0.3	79.0
Freeport	635	60,272	3	6	3,173	482,173	2,477,408	0.1	19.5
Glen Cove	3,477		9		34,770		37,440	92.9	
Greenport	192,106		47		1,921,063		1,923,573	99.9	
Hampton Bays	16,239	100,958	18	64	162,391	1,009,584	1,196,841	13.6	84.4
Huntington	10,456		13		94,101		94,186	99.9	
Islip		2,959		5		8,876	547,025		1.6
Mastic		523		4		1,047	1,068		98.0
Mattituck	271,813	18,735	53	10	2,718,130	187,349	2,942,341	92.4	6.4
Montauk	172,390	57,132	145	128	1,723,900	571,320	2,311,777	74.6	24.7
Moriches	3,060	82,883	16	77	21,422	828,826	1,066,133	2.0	77.7
Mount Sinai	131,071	1,341	45	6	1,310,709	10,724	1,328,395	98.7	0.8
Nassau (County)		12,604		2		63,021	687,651		9.2
New Suffolk	3,856	614	11	5	34,705	3,070	37,775	91.9	8.1
Northport	48,621		18		486,211		486,969	99.8	
Oceanside		620,485		8		2,481,939	2,992,157		82.9
Orient	22,633	473	41	3	226,328	1,419	228,303	99.1	0.6
Oyster Bay	4,523		7		45,232		45,232	100.0	
Patchogue	4,216	8,159	5	9	16,865	65,274	780,273	2.2	8.4
Port Jefferson	6,377		17		63,768		63,841	99.9	
Port Washington	23,214		8		185,714		186,224	99.7	
Queens (County)	22,231		11		222,311		1,049,840	21.2	
Riverhead	100,390	3,533	20	7	1,003,903	31,797	1,036,000	96.9	3.1
Sag Harbor	34,298		10		342,976		344,185	99.6	
Setauket	1,359		3		6,796		6,796	100.0	
Shelter Island	101,235	849	12	3	708,647	1,698	710,445	99.7	0.2
Shinnecock Indian Reservation	101,556	372,775	29	106	1,015,557	3,727,751	4,816,517	21.1	77.4
Smithtown	959		4		6,713		7,484	89.7	
South Jamesport	4,200		7		25,200		25,200	100.0	
Southampton	18,168	31,667	9	6	54,503	63,335	120,094	45.4	52.7
Southold	22,343	5,251	28	4	223,426	21,006	276,423	80.8	7.6
Springs	25,956		3		51,912		54,055	96.0	
Stony Brook	9,143		19		91,425		92,458	98.9	

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Landing Port	Average Pounds Landed per Year by Subarea (2009-2018)		Total number of Active Fishing Permits		Total Pounds Landed by Subarea (2009-2018)		Total Pounds Landed in New York State Waters (2009-2018)	% of Total Catch from New York State Waters, by Port	
	Statistical Areas		Statistical Areas		Statistical Areas			Statistical Areas	
	611	613	611	613	611	613		611	613
Suffolk (County)	38,018	4,757	7	11	380,181	23,784	496,486	76.6	4.8
Unknown	1,579,150	631,070	477	413	15,791,503	4,417,490	45,281,089	34.9	9.8
Wainscott	57,218		5		572,182		576,454	99.3	

Source: ACCSP, 2019.

Notes:

Values reflect pounds landed caught in statistical subareas relevant to RWF and RWEC.

Confidential information was redacted from the ACCSP data set.

Blank cells indicate those years when the fishing area had no reported landings or redacted confidential landings.

Average pounds landed were calculated as an arithmetic mean, using the sum of pounds landed and the count of distinct years, ignoring zero years.

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2.2.7 Rhode Island State Vessel Trip Reports

The largest fishery by landings in Rhode Island state waters in statistical areas 538, 539, and 611 combined for the years 2009 to 2018 used pots and traps (792,343 pounds) and was concentrated in statistical area 539. Other top gear type categories by landings included other fixed nets (540,644 pounds), hook and line (401,508 pounds) and otter trawls (324,192 pounds). Landings for each gear type fished within statistical areas 538, 539, and 611 accounted for over 90% of the statewide landings for that gear type. Table 2.2-16 provides an overview of the gears used in Rhode Island state waters (ACCSP, 2019).

From 2009 to 2018, commercial fishermen permitted to fish in Rhode Island state waters landed many different species, including in order of highest landings from statistical areas 538, 539, and 611 combined by weight, scup (816,584 pounds), channeled whelk, (358,510), summer flounder (255,120 pounds), menhaden (250,306 pounds), and striped bass (135,556 pounds). A complete summary of all species landed in these statistical areas is provided in Table 2.2-17. The majority of species came from area 539, and the landings from the three statistical areas accounted for over 90 percent of the statewide landings for most species.

The top ports where fishermen landed their catch from fishing in all Rhode Island state waters were Point Judith, Little Compton, Newport, Bristol, and North Kingstown. Point Judith was the port with the highest average annual landings (680,126 pounds) and the largest number of active fishing permits (469 permits; Table 2.2-18).

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Table 2.2-16 Categories of Gear Used by Rhode Island State-only Permitted Vessels during 2009-2018 in Statistical Areas 538, 539, and 611

Gear Category	Average Pounds Landed per Year (2009-2018)			Total Pounds Landed (2009-2018)			Total Pounds Landed in Rhode Island State Waters (2009-2018)	% Pounds Landed out of Total Rhode Island State Waters, by Gear		
	Statistical Areas			Statistical Areas				Statistical Areas		
	538	539	611	538	539	611		538	539	611
By Hand, Diving Gear		5,345			42,759		44,209		96.7	
By Hand, No Diving Gear		45,760			366,078		366,559		99.9	
Dip Nets		7,866			62,925		64,272		97.9	
Dredge		130			520		520		100.0	
Gill Nets		202,887			1,623,097		1,635,066		99.3	
Hand Line		2,242			17,939		18,297		98.0	
Hook and Line	359	388,116	13,033	1,795	3,881,157	117,301	4,013,013	<0.1	96.7	2.9
Long Lines		1,880			13,158		13,177		99.9	
Other Fixed Nets		540,644			4,325,156		4,325,177		100.0	
Other Trawls		32,655			195,930		195,930		100.0	
Otter Trawls		324,192			2,593,534		2,600,214		99.7	
Pots and Traps, Lobster		58,494	2,413		526,445	19,302	546,357		96.4	3.5
Pots and Traps, Other		14,249			128,238		128,274		100.0	
Pots and Traps		757,048	35,295		6,813,434	317,659	7,138,933		95.4	4.4
Rakes		4,629			32,405		32,428		99.9	
Spears		3,217			25,735		26,095		98.6	

Source: ACCSP, 2019.

Notes:

Values reflect pounds landed caught in statistical subareas relevant to RWF and RWEC.

Confidential information was redacted from the ACCSP data set.

Blank cells indicate those years when the fishing area had no reported landings or redacted confidential landings.

Average pounds landed were calculated as an arithmetic mean, using the sum of pounds landed and the count of distinct years, ignoring zero years.

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Table 2.2-17 Species Landed by Rhode Island State-only Permitted Vessels during 2009-2018 in Statistical Areas 538, 539, and 611

Species	Average Pounds Landed per Year (2009-2018)			Total Pounds Landed (2009-2018)			Total Pounds Landed in Rhode Island State Waters (2009-2018)	% Pounds Landed out of Total Rhode Island State Waters, by Species		
	Statistical Areas			Statistical Areas				Statistical Areas		
	538	539	611	538	539	611		538	539	611
Scup		781,887	34,697		7,818,873	312,277	8,135,213		96.1	3.8
Whelk, Channeled		354,286	4,224		3,188,578	16,895	3,209,786		99.3	0.5
Menhadens		250,306			2,002,448		2,219,066		90.2	
Flounder, Summer		248,476	6,644		2,236,288	59,793	2,298,164		97.3	2.6
Skates, Rajidae (Family)		134,682			1,077,456		1,077,613		100.0	
Bass, Striped	448	132,481	2,627	1,790	1,192,327	21,018	1,218,776	0.1	97.8	1.7
Bass, Black Sea		97,625	2,360		781,003	21,242	803,422		97.2	2.6
Searobins		57,726	6		461,807	23	461,843		100.0	<0.1
Bluefish	38	47,408	218	115	379,263	1,523	388,506	<0.1	97.6	0.4
Conch - Family		45,035			225,176		225,199		100.0	
Crab, Horseshoe		40,325			322,601		815,188		39.6	
Lobster, American		37,259	2,238		335,327	17,904	353,841		94.8	5.1
Butterfish		34,970			279,760		279,966		99.9	
Squid, Longfin Loligo		33,490			267,923		268,256		99.9	
Tautog		32,624	569		260,990	4,552	266,886		97.8	1.7
Crab, Atlantic Rock		23,549			211,937		211,973		100.0	
Whelk, Knobbed		20,613			144,292		144,702		99.7	
Skate, Little		16,229			113,600		113,600		100.0	
Tuna, Little Tunny		13,353			93,473		94,710		98.7	
Crab, Green		12,834			102,668		102,668		100.0	
Herring, Atlantic		12,628			88,394		88,394		100.0	
Eel, Conger		7,823			62,583		62,710		99.8	
Crab, Jonah		7,590			60,716		60,716		100.0	
Shrimps, Mantis		6,798			27,190		30,827		88.2	
Flounder, Winter		6,692			53,535		53,556		100.0	
Bonito, Atlantic		6,303			50,422		50,634		99.6	
Quahog, Ocean		5,708			17,124		17,124		100.0	
Dogfish, Spiny		5,179			41,435		41,435		100.0	
Cod, Atlantic		4,864			38,916		38,977		99.8	
Dogfish, Smooth		4,529			36,232		37,040		97.8	
Shad, Hickory		4,298			12,893		12,893		100.0	
Eel, American		3,708			29,666		30,000		98.9	
Hake, Silver		2,973			23,784		23,784		100.0	
Triggerfish, Gray		2,613			20,904		20,910		100.0	
Crustaceans		2,163			4,325		4,325		100.0	
Clam, Northern Quahog		2,140			10,698		10,698		100.0	
Goosefish		2,090			16,722		16,722		100.0	
Hake, Red		1,701			13,610		13,610		100.0	
Skate, Winter		1,691			13,526		13,526		100.0	
Triggerfishes		1,663			13,301		13,307		100.0	
Mackerel, Atlantic		1,568			12,545		12,545		100.0	

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Species	Average Pounds Landed per Year (2009-2018)			Total Pounds Landed (2009-2018)			Total Pounds Landed in Rhode Island State Waters (2009-2018)	% Pounds Landed out of Total Rhode Island State Waters, by Species		
	Statistical Areas			Statistical Areas				Statistical Areas		
	538	539	611	538	539	611		538	539	611
Searobin, Striped		1,415			7,077		7,077		100.0	
Crabs, Spider		1,393			5,573		5,573		100.0	
Mollusks		1,378			2,756		2,755		100.0	
Tuna, Yellowfin		1,318			10,543		14,358		73.4	
Spot		904			2,711		2,711		100.0	
Weakfish		757			6,055		6,135		98.7	
Crabs, Brachyura		710			2,841		2,841		100.0	
Searobin, Northern		578			2,888		2,888		100.0	
Hake, White		514			3,084		3,084		100.0	
Cunner		449	6		3,590	18	3,710		96.8	0.5
Tuna, Bigeye		441			2,646		4,480		59.1	
Squid, Shortfin Illex		338			2,367		2,367		100.0	
Clam, Soft		326			1,631		1,631		100.0	
Oyster, Eastern		274			547		547		100.0	
Cobia		206			1,651		1,651		100.0	
Windowpane		205			1,638		1,638		100.0	
Kingfish, Northern		198			1,587		1,587		100.0	
Skate, Big		187			1,124		1,124		100.0	
Shark, Sandbar		180			541		541		100.0	
Dolphinfish		178			1,066		1,377		77.4	
Raven, Sea		166			1,330		1,401		94.9	
Crab, Blue		148			738		738		100.0	
Tuna, Bluefin		144			866		2,066		41.9	
Tuna, Albacore		139			836		943		88.7	
Mullet, Striped		119			119		119		100.0	
Grouper, Yellowedge		83			83		83		100.0	
Snapper, Gray		77			153		153		100.0	
Amberjacks		73			219		219		100.0	
Flounder, Southern		55			111		111		100.0	
Flounder, American Plaice		43			85		85		100.0	
Shad, American		37			223		223		100.0	
Kingfishes		33			132		132		100.0	
Hakes, Red and White		25			126		126		100.0	
Flounder, Yellowtail		23			163		163		100.0	
Pollock		13			26		26		100.0	
Runner, Blue		5			16		16		100.0	

Source: ACCSP, 2019.

Notes:

Values reflect average pounds landed by species and by statistical subarea.

Confidential information was redacted from the requested data set.

Species are sorted by average pounds caught each year in statistical subarea 539.

Blank cells indicate those years when the fishing area had no reported landings or redacted confidential landings.

Average pounds landed were calculated as an arithmetic mean, using the sum of pounds landed and the count of distinct years, ignoring zero years.

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Table 2.2-18 Landing Ports Used by Rhode Island State-only Permitted Vessels during 2009-2018 in Statistical Areas 538, 539, and 611

	Average Pounds Landed per Year by Subarea (2009-2018)			Total number of Active Fishing Permits			Total Pounds Landed by Subarea (2009-2018)			Total Pounds Landed in Rhode Island State Waters (2009-2018)	% of Total Catch from Rhode Island State Waters, by Port		
	Statistical Areas			Statistical Areas			Statistical Areas				Statistical Areas		
Landing Port	538	539	611	538	539	611	538	539	611		538	539	611
Barrington		5,251			12			42,005		42,005		100.0	
Bristol		196,716			61			1,573,730		1,576,268		99.8	
Bristol (County)		329			5			987		987		100.0	
Charlestown		26,190	806		38	3		209,519	6,450	216,077		97.0	3.0
Davisville		248			6			1,240		1,240		100.0	
East Greenwich		7,056			35			56,447		56,470		100.0	
Jamestown		24,367			32			194,932		194,932		100.0	
Little Compton		605,416			51			4,843,330		4,854,883		99.8	
Middletown		2,183			3			10,914		10,914		100.0	
Narragansett (census name Narragansett Pier)		381			6			1,144		1,392		82.2	
New Shoreham		2,170			9			17,362		17,362		100.0	
Newport		426,256			80			3,836,305		4,017,574		95.5	
Newport (County) (in PMSA 2480,6480)		11,869			4			59,347		59,445		99.8	
North Kingstown (local name Wickford)		145,080			97			1,160,644		1,167,684		99.4	
Point Judith	128	672,982	7,016	3	459	7	128	6,056,834	42,098	6,103,311	<0.1	99.2	0.7
Portsmouth		82,392			37			659,140		668,046		98.7	
Providence		27,182			13			244,640		244,818		99.9	
Providence (County) (in PMSA 6060,6480)		2,289			10			13,735		13,735		100.0	
South Kingstown (Town of)		19,535			69			156,279		156,422		99.9	
Tiverton		106,842			49			854,738		854,770		100.0	
Unknown		35,798	1,884		64	4		322,183	5,652	327,847		98.3	1.7
Wakefield		3,306			21			26,446		26,446		100.0	
Warren		26,374			38			210,993		211,061		100.0	
Warwick (RR name Apponaug)		144,786			97			1,158,290		1,158,563		100.0	
Westerly (census name Westerly Center)		57,985	55,330		78	29		463,884	442,639	906,523		51.2	48.8

Source: ACCSP, 2019.
Notes:
Values reflect pounds landed caught in statistical subareas relevant to RWF and RWEC.
Confidential information was redacted from the ACCSP data set.
Blank cells indicate those years when the fishing area had no reported landings or redacted confidential landings.
Average pounds landed were calculated as an arithmetic mean, using the sum of pounds landed and the count of distinct years, ignoring zero years.

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2.2.8 Marine Recreational Information Program (MRIP)

The MRIP integrates a coast-wide intercept survey throughout the year to estimate recreational fishing effort. The following section presents data provided by NOAA Fisheries through a custom data request and data accessed from the MRIP online data portal (NOAA Fisheries, 2019b). The effort and catch data from Connecticut, Massachusetts, New York, and Rhode Island comprise all of the states of origin identified for recreational anglers, accessed from a custom request and the online MRIP data portal. MRIP data indicated that recreational fishing effort seasonally increased in frequency from March through August, reaching its peak intensity by shore (e.g., surfcasting) and in both federal and state waters by private or for-hire/charter vessel in July and August (Figure 2.2-22).

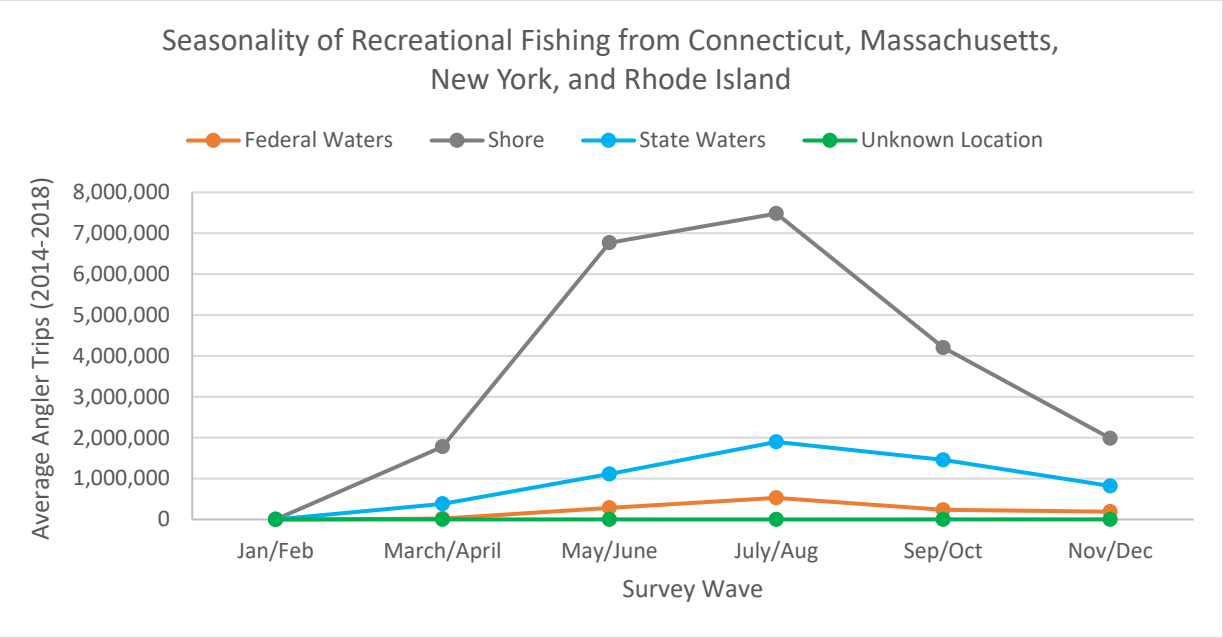

Figure 2.2-22 Average of Estimated Fishing Effort by Recreational Anglers for the Years 2014 to 2018 in Connecticut, Massachusetts, New York, and Rhode Island

Notes: Angler-trip survey data includes trips where fishing location is not recorded, noted as "unknown location" in the figure.

State waters includes water from shore to 3 miles (4.8 kilometers, 2.6 nautical miles); federal waters include waters greater than 3 miles (4.8 kilometers, 2.6 nautical miles) from shore.

Source: NOAA Fisheries, 2019b.

MRIP data were used to estimate relative angler effort for those states with coastlines relatively close to the RWF. Angler effort was categorized by mode (for-hire or charter, private, shore) and by location (federal waters, state waters, and shoreside). There was no spatial information associated with MRIP data; thus, there was no way to determine where fishing trips took place in state or federal waters. These values, therefore, were meant to provide a qualitative overview of angler effort and seasonal changes in activity.

The MRIP survey methods were designed to estimate recreational fishing effort aggregated at the state and regional level. For this reason, the standard error for estimates disaggregated to smaller units than the state level (i.e., county) was very high and indicates weak estimates for fishing activity.

Based on estimates of recreational angler effort disaggregated to the state level, New York state had the greatest average estimated number of angler trips each year (about 14.9 million) for the years 2014 to 2018, most of which

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visited New York state waters (Table 2.2-19). Of the recreational trips out of New York state that visited New York state waters, 41 percent used private fishing vessels, and 57 percent were shoreside fishing trips (Table 2.2-20).

Of the approximately 7.6 million recreational fishing trips leaving from Massachusetts for the years 2014-2018 (Table 2.2-19), most trips were to fish in Massachusetts state waters. Of the trips to Massachusetts state waters leaving from Massachusetts, 39 percent were on a private fishing vessel, and 59 percent were shoreside fishing trips (Table 2.2-20). Out of approximately 3.8 million recreational fishing trips leaving from Connecticut during this period, the vast majority of trips were to fish in Connecticut state waters (Table 2.2-19). Of the trips to Connecticut state waters leaving from Connecticut, 39 percent were on a private fishing vessel, and 59 percent were shoreside fishing trips (Table 2.2-20). Connecticut recreational fishermen mostly remained in Connecticut state waters for recreational fishing trips.

Out of the nearly 2.9 million recreational fishing trips leaving from Rhode Island, most of the trips were to fish in Rhode Island state waters (Table 2.2-19), with 32 percent of these trips on a private fishing vessel and 67 percent as shoreside fishing trips. For Massachusetts, New York, Connecticut, and Rhode Island, the majority of trips to federal waters were on private vessels, as opposed to charter vessels.

Table 2.2-19 Average Annual Fishing Effort for Recreational Fishing by Mode (Charter Vessel, Private, and Shore Fishing) and by Fishing Area based on MRIP Data (2014-2018)

State	Fishing Area	Average Fishing Effort (Value/5 years)			
		Charter	Private	Shore	Total
Connecticut					
	Federal	4,670	28,693	-	33,364
	State	45,389	1,502,689	2,257,479	3,805,557
	Unknown	-	-	-	-
Connecticut Totals		50,059	1,531,382	2,257,479	3,838,920
Massachusetts					
	Federal	48,612	387,804	-	436,416
	State	111,956	2,790,270	4,224,112	7,126,337
	Unknown	125	-	-	125
Massachusetts Totals		160,693	3,178,074	4,224,112	7,562,879
New York					
	Federal	71,834	609,818	-	681,652
	State	295,414	5,749,305	8,136,501	14,181,220
	Unknown	26	-	-	26
New York Totals		367,274	6,359,123	8,136,501	14,862,898
Rhode Island					
	Federal	12,561	96,011	-	108,572
	State	32,786	892,361	1,836,805	2,761,952
	Unknown	327	-	-	327
Rhode Island Totals		45,674	988,372	1,836,805	2,870,851

Source: NOAA Fisheries, 2019b
Notes:
Unknown location indicates missing data in trip report.
Trips to federal waters cannot take place onshore; therefore, the table cells are marked with "-" because there is no number of trips available.
Trips to state waters include trips that take place onshore, and in charter or private fishing vessels.
Charter boats include party boat and charter boat trips.

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Federal waters include waters greater than 3 miles [4.8 kilometers, 2.6 nautical miles]) from shore, state waters include trips that take place inland (onshore and inshore bodies of saltwater or brackish water) and in water less than 3 miles [4.8 kilometers, 2.6 nautical miles] from shore.

Table 2.2-20 Percent of Average Annual Fishing Effort by Mode and Fishing Area, Out of State Totals based on MRIP Data (2014-2018)

State	Fishing Area	% of Total State Angler Trips (based on average values)		
		Charter	Private	Shore
Connecticut				
	Federal	14	86	0
	State	1	39	59
	Unknown	0	0	0
Connecticut Totals		1	40	59
Massachusetts				
	Federal	11	89	0
	State	2	39	59
	Unknown	100	0	0
Massachusetts Totals		2	42	56
New York				
	Federal	11	89	0
	State	2	41	57
	Unknown	100	0	0
New York Totals		2	43	55
Rhode Island				
	Federal	12	88	0
	State	1	32	67
	Unknown	100	0	0
Rhode Island Totals		2	34	64

Source: NOAA Fisheries, 2019b
Notes:
Unknown location indicates missing data in trip report.
Trips to federal waters cannot take place onshore; therefore, shore trips comprise 0% of all trips to federal waters.
Trips to state waters include trips that take place onshore, and in charter or private fishing vessels.
Charter boats include party boat and charter boat trips.
Federal waters include waters greater than 3 miles [4.8 kilometers, 2.6 nautical miles]) from shore, state waters include trips that take place inland (onshore and inshore bodies of saltwater or brackish water) and in water less than 3 miles [4.8 kilometers, 2.6 nautical miles] from shore.

2.2.9 Aquaculture

Aquaculture sites in the area of interest occur along the Rhode Island shoreline, Block Island, and throughout Narragansett Bay (Figure 2.2-23). The proposed RWEC cable corridor is within the geographic range of aquaculture sites depicted in Figure 2.2-24. The RWEC fisheries study corridor to Quonset Point in North Kingstown, Rhode Island overlaps several aquaculture sites in Narragansett Bay; however, the RWEC centerline does not intersect any of these sites (Figure 2.2-24). The closest aquaculture site to the RWEC centerline is located on Conanicut Island, approximately 425 m from the centerline (Figure 2.2-24).

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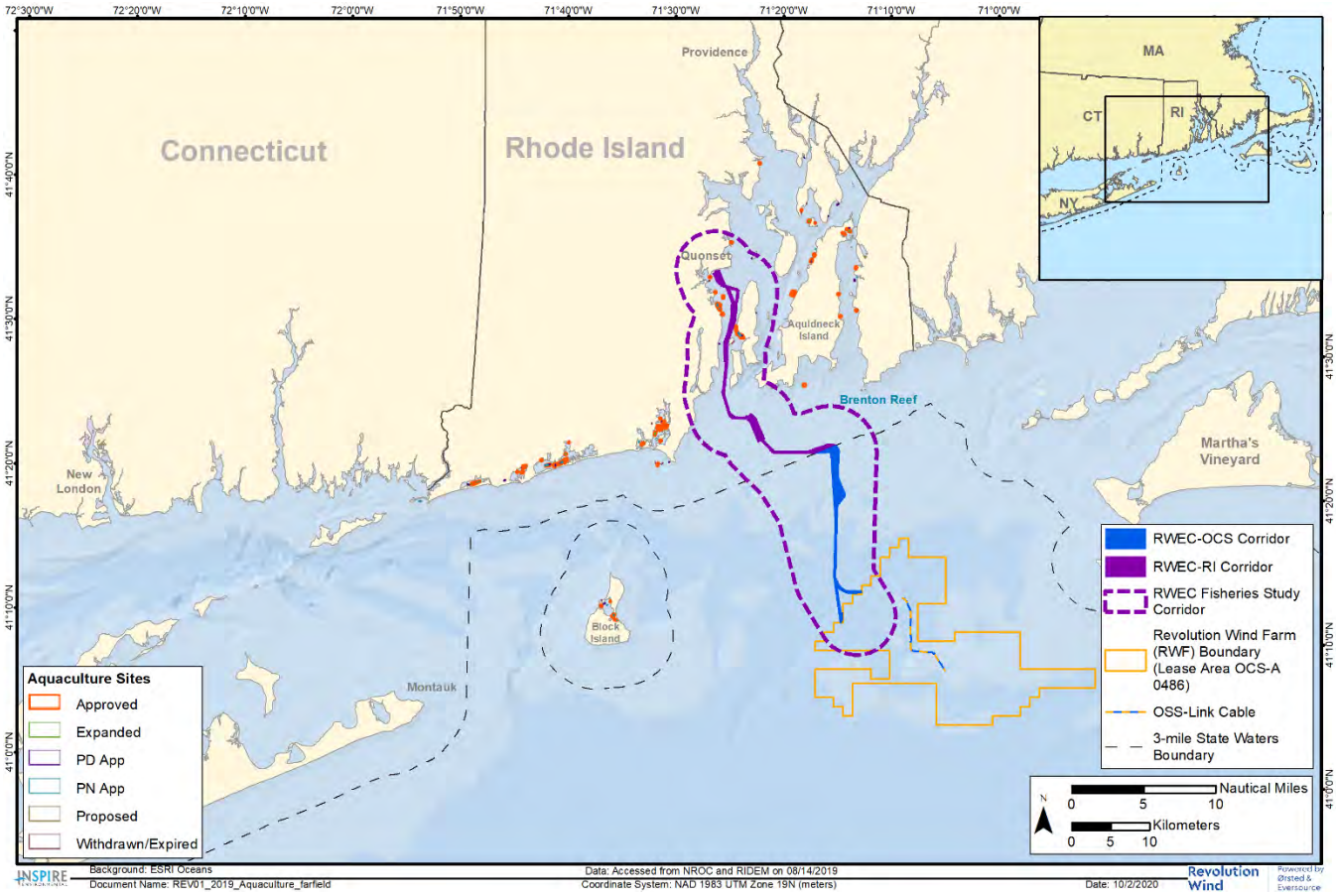

Figure 2.2-23 Map of the OCS-A-0486 Lease Area, Proposed RWEC Corridor, Fisheries Study Corridor, and Aquaculture Sites

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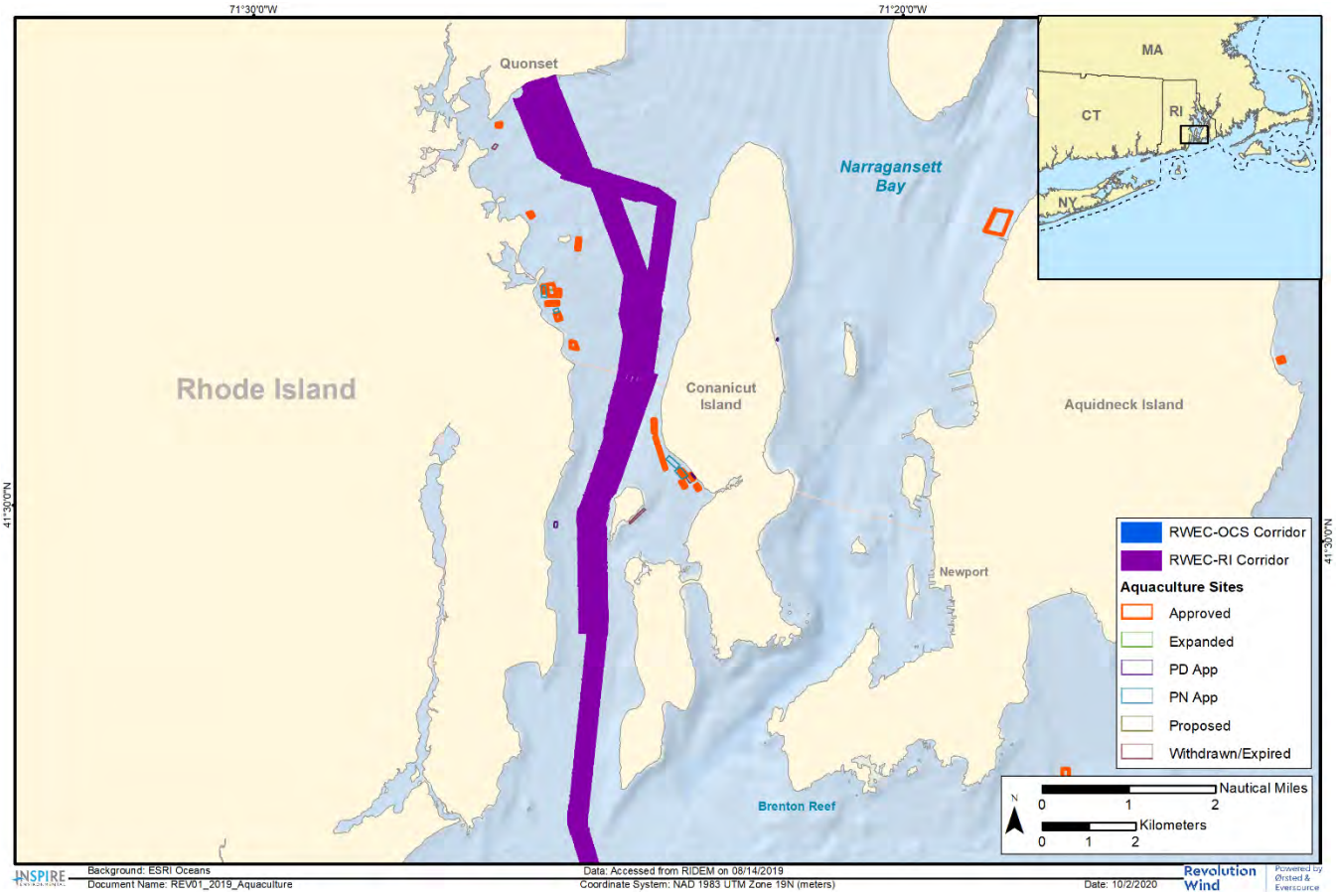

Figure 2.2-24 Map of Proposed RWEC Corridor and the Location of Aquaculture Sites in Narragansett Bay

2.3 Summary

Multiple data sources were used to assess commercial and recreational fisheries activity in the RWF and RWEC fisheries study corridor. Federal (VTR and VMS), state VTR, MRIP, and aquaculture data sources allowed an evaluation of the relative intensity of these fisheries, along with their economic value in the area. Fisheries activities are summarized separately below for the RWF and RWEC fisheries study corridor and by data source. For the VMS data, the highest fishing density category reported for any year analyzed is used in this summary and it should be noted that only the intensity level is summarized, not spatial coverage.

Federal VTR - RWF

- The top fisheries in terms of revenue used bottom trawl, pot, sink gillnet, and dredge.
- In terms of pounds landed, the top gears by revenue were the bottom trawl, sink gillnet, and mid-water trawl.
- The top species in terms of revenue were lobster, flounders, hakes, Atlantic herring, scup, squid, black sea bass, and channeled whelk.
- The top species in terms of pounds landed were Atlantic herring, Atlantic mackerel, and hakes.
- In order of descending percent of total state landings from the RWF, Rhode Island (1.14%), Massachusetts (0.30%), New York (0.08%), and Connecticut (0.08%) had vessels with fishing activity in the RWF.

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Federal VTR - RWEC Fisheries Study Corridor

- The top fisheries in terms of revenue used bottom trawl, mid-water trawl, pot, and sink gillnet.
- In terms of pounds landed, the top gears by revenue were the mid-water trawl, bottom trawl, sink gillnet, and pot.
- The top species in terms of revenue were Atlantic herring, lobster, squid, flounders, scup, butterfish, hakes, black sea bass, and spiny dogfish.
- The top species in terms of pounds landed were Atlantic herring, scup, squid, spiny dogfish, hakes, and Atlantic mackerel.
- In order of descending percent of total state landings from the RWEC, Rhode Island (3.53%), Massachusetts (1.18%), and Maine (0.06%) had vessels with fishing activity in the RWF fisheries study corridor.

Federal VMS - RWF

- Fisheries that had the most activity in the RWF were Atlantic herring, surfclam/ocean quahog, sea scallop, squid/mackerel/butterfish, monkfish, and groundfish (large-mesh multispecies or northeast multispecies FMPs).
- Very-high or high-density fishing activity was reported for groundfish, pelagic species (herring/mackerel/squid), monkfish, surfclam/ocean quahog, sea scallops, and squid.
- Medium-high density fishing activity was reported for Atlantic herring.

Federal VMS - RWEC Fisheries Study Corridor

- Fisheries that had the most activity in the RWEC fisheries study corridor were Atlantic herring, surfclam/ocean quahog, sea scallop, squid/mackerel/butterfish, monkfish, and groundfish (large-mesh multispecies or northeast multispecies FMPs).
- Very-high or high-density fishing activity occurred within the RWEC fisheries study corridor for groundfish, Atlantic herring, pelagic species (herring/mackerel/squid), monkfish, squid.
- Medium-low to low density fishing activity was reported for surfclam/ocean quahog, sea scallops.

VTR Data as Rasters - RWF

- Relatively moderate-revenue fish activity occurred in the RWF for monkfish and surfclam/quahog.
- Relatively low-revenue fishing activity occurred in the RWF for groundfish, Atlantic herring, pelagics (midwater trawl), sea scallops, and lobsters.

VTR Data as Rasters - RWEC Fisheries Study Corridor

- Relatively high-revenue fishing activity within the RWEC fisheries study corridor occurred for Atlantic herring and pelagic species (midwater trawl),
- Relatively moderate- to low-revenue fishing activity occurred for lobsters along the RWEC fisheries study corridor.
- No revenue generating fishing activity within the RWEC fisheries study corridor was recorded for groundfish, monkfish, surfclam/quahog, or sea scallops.

State VTRs

Connecticut

- The top gear types by pounds landed were pots and traps, otter trawls, and lobster pots and traps.

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- The top species by average annual pounds landed were conch, menhaden, lobster, scup, horseshoe crabs, summer flounder, and American shad.
- The top ports by pounds landed were Stonington, Old Saybrook, New London, Guilford, and Clinton.

Massachusetts

- The top gear types by pounds landed were pots and traps, hook and line, and lobster pots and traps.
- The top gear species by average annual pounds landed were brachyuran crabs, channeled whelk, northern quahog clam, scup, striped bass, bay scallop, black sea bass, whelk, horseshoe crab, eastern oysters, and soft clams.
- The top ports by landed by state-only, permitted vessels were New Bedford, Chatham, Edgartown, Falmouth, and Westport.

New York

- The top gear types by pounds landed were otter trawls, other fixed nets, gill nets, and pots and traps.
- The top species by average annual pounds landed were striped bass, menhaden, scup, bluefish, lobster, horseshoe crab, and summer flounder.
- The top ports by pounds landed were Oceanside, Shinnecock Indian Reservation, Mattituck, East Hampton, and Greenport.

Rhode Island

- The top gear types by pounds landed were pots and traps, fixed nets, hook and line, and otter trawls.
- The top gear species by average annual pounds landed were scup, channeled whelk, summer flounder, menhaden, and striped bass.
- The top ports by pounds landed were Point Judith, Little Compton, Newport, Bristol, and North Kingstown.

MRIP

- Recreational fishing effort seasonally increased in frequency from March through August, reaching its peak intensity by shore (i.e., fishing from shore such as surfcasting) and in both federal and state waters by private and for-hire/charter vessels in July and August.
- For all states surveyed (Connecticut, Massachusetts, New York, Rhode Island), most recreational fishing occurred within the respective state waters.

Aquaculture

- Aquaculture sites occur along the Rhode Island shoreline, Block Island, and throughout Narragansett Bay. No known aquaculture sites are intersected by the proposed RWEC corridor. The closest aquaculture site to the RWEC centerline is located on Conanicut Island, approximately 425 m from the centerline.
- Oysters are the main species cultivated by the aquaculture industry.

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3.0 ENVIRONMENTAL CONSEQUENCES AND PROTECTION MEASURES

Potential impacts are characterized as direct or indirect and whether they result from construction, operations and maintenance (O&M), and/or decommissioning of the Project. Anticipated impacts also are characterized as direct or indirect; or as short-term or long-term. Consistent with NEPA (40 C.F.R. § 1508.8.), evaluations in this COP consider both detrimental (or negative) and beneficial impacts of the Project.

- *Direct or Indirect*: Direct effects are those occurring at the same place and time as the initial cause or action. Indirect effects are those that occur later in time or are spatially removed from the activity.
- *Short-term or Long-term Impacts:* Short- or long-term impacts do not refer to any defined period. In general, short-term impacts are those that occur only for a limited period or only during the time required for construction activities. Impacts that are short-lived, such as noise from routine maintenance work during operations, may also be short-term if the activity is short in duration and the impact is restricted to a short, defined period. Long-term impacts are those that are likely to occur on a recurring or permanent basis or impacts from which a resource does not recover quickly. In general, direct impacts associated with construction and decommissioning are considered short-term because they will occur within the approximate 1-year construction phase. Indirect impacts are determined to be either short-term or long-term depending on if resource recovery may take several years. Impacts associated with O&M are considered long-term because they occur over the life of the Project (i.e., 25 years per the Lease but could be extended up to 35 years [see Section 3.5 of the COP]).
- *Proposed Environmental Protection Measures*: If measures are proposed to avoid or minimize potential impacts, the impact evaluation included consideration of these environmental protection measures.

Different impact-producing factors (IPFs) may result in varying levels of impact on commercial and recreational fisheries. IPFs that could commercial and recreational fisheries include seafloor disturbance, sediment suspension and deposition, habitat alteration, noise, traffic, visible structures, EMF, discharges and releases, and trash and debris.

3.1 Impact Assessment

Potential impacts are characterized as direct or indirect and as short-term or long-term. Different impact-producing factors (IPFs) may result in varying levels of impact on commercial and recreational fisheries. IPFs that could impact commercial and recreational fisheries include seafloor disturbance, habitat alteration, sediment suspension and deposition, noise, traffic, EMF, visible structures, discharges and releases, and trash and debris. Impacts that affect fishing activity are considered to be direct impacts and impacts on commercial and recreational fisheries that are mediated by impacts on fishery resources (i.e., targeted finfish and invertebrate species) are considered indirect.

The analysis of impacts on commercial and recreational fisheries are discussed separately for the RWF and RWEC in the following sections. The IPFs are further subdivided into IPFs during the construction and decommissioning phases of the Project and the O&M phase of the Project. Potential impacts on fishery resources are discussed in more detail in the Finfish and Essential Fish Habitat (EFH) Assessment (INSPIRE Environmental, 2020). Potential impacts to navigation are discussed in the Navigation Safety Risk Assessment (NRSA)
(DNV GL, 2020).

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3.1.1 Revolution Wind Farm

IPFs resulting in potential impacts on commercial and recreational fisheries in the RWF area are described in Table 3.1-1 for the construction and decommissioning phases and in Table 3.1-2 for the O&M phase.

Table 3.1-1 IPFs and Characterizations of Potential Impacts on Commercial and Recreational Fisheries within the RWF during Construction and Decommissioning

Table 3.1-1			
IPF	**Project Activity**	**Impact Characterization for Commercial and Recreational Fisheries**	**Discussion**
Seafloor Disturbance	Seafloor preparation	**Direct, short-term** **Indirect, short-term**	Direct Impacts: Seafloor preparation during construction is expected to result in short-term disruption of access to fishing areas for commercial and recreational fisheries. Fishing activity will be temporarily restricted in the immediate area of seafloor preparation operations due to a short-term 500-yard-radius safety zone established around construction operations, based on engagement with the USCG, USCG regulations (33 CFR § 147), as well as recent precedent set by an offshore renewable energy project constructed in the United States. It is expected that the USCG will also provide moving safety zones centered on cable laying vessels. Indirect Impacts: Indirect impacts on fisheries may occur as a result of the impacts of seafloor preparation on fishery resources. Impacts on fishery resources associated with seafloor preparation will primarily be associated with species that have benthic/demersal life stages and prefer the types of habitats that will be disturbed by seafloor preparation. These activities could cause injury or mortality to benthic/demersal species. Negative effects are expected to be short-term as the effects will cease after seafloor preparation are completed in a given area. Impacts on fishery resources that have pelagic early and/or later life stages are not expected, as pelagic habitats will not be directly affected by seafloor preparation. However, these species may temporarily vacate the area of disturbance. Decommissioning activities are expected to cause similar impacts as construction, but these impacts would be shorter in duration.
	Impact pile driving and/or vibratory pile driving/foundation installation	**Direct, short-term** **Indirect, short-term**	Direct Impacts: Impact pile driving and/or vibratory pile driving/foundation installation and/or associated scour protections (if necessary) will temporarily disrupt access to some fishing areas. Fishing activity will be temporarily restricted in the immediate area of seafloor preparation operations due to a short-term 500-yard safety zone established around construction operations. Indirect Impacts: Indirect impacts on commercial and recreational fisheries from impact pile driving and/or vibratory pile driving and foundation installation are similar to those discussed for seafloor preparation.
	RWF IAC and OSS-Link Cable installation	**Direct, short-term** **Indirect, short-term**	Direct Impacts: Direct impacts on commercial and recreational fisheries associated with the IAC and OSS-Link Cable installation are expected to result in similar negative impacts as those discussed for seafloor preparation, as the IAC will be installed in the same area that was disturbed during seafloor preparation. Decommissioning activities are expected to cause similar impacts as construction, but these impacts would be shorter in duration. Indirect Impacts: Indirect impacts on commercial and recreational fisheries associated with the IAC and OSS-Link Cable installation are expected to result in similar impacts as those discussed for seafloor preparation.
	Vessel anchoring (including spuds)	**Direct, short-term** **Indirect, short-term**	Direct Impacts: Direct impacts on commercial and recreational fisheries associated with vessel anchoring (including spuds) are similar to those discussed in seafloor preparation. Indirect Impacts: Indirect impacts on commercial and recreational fisheries associated with vessel anchoring (including spuds) are similar to those discussed in seafloor preparation, though lesser in spatial extent.

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Habitat Alteration	Seafloor preparation Impact pile driving and/or vibratory pile driving/foundation installation RWF IAC and OSS-Link Cable installation Vessel anchoring (including spuds)	**Indirect, long-term**	Indirect Impacts: In areas of sediment disturbance and/or increased sedimentation, benthic habitat recovery and benthic infaunal and epifaunal species abundances may take up to 1 to 3 years to recover to pre-impact levels, based on the results of a number of studies on benthic recovery (e.g., AKRF, Inc. et al., 2012; Germano et al., 1994; Hirsch et al., 1978; Kenny and Rees, 1994). Recolonization rates of benthic habitats are driven by the benthic communities inhabiting the area surrounding the impacted region. Communities well adapted to disturbance within their habitats (e.g., sand sheets) are expected to quickly recolonize a disturbed area, while communities not well adapted to frequent disturbance (e.g., cobble and boulder habitats) may take upwards of a year to begin recolonization and several years to become substantially re-established to pre-disturbance levels. This recovery time would result in a long-term loss of productivity in the disturbed area and a subsequent indirect, long-term impact on commercial and recreational fisheries. During decommissioning, foundations and other facilities will be removed to a depth of 15 ft (4.6 m) below the mudline, unless otherwise authorized by BOEM (30 CFR § 585.910(a). Recovery from decommissioning activities is expected to be similar that experienced during seafloor preparation, resulting in an indirect, long-term impact on commercial and recreational fisheries.
Sediment Suspension and Deposition	Seafloor preparation Impact pile driving and/or vibratory pile driving/foundation installation RWF IAC and OSS-Link Cable installation Vessel anchoring (including spuds)	**Indirect, short-term**	Indirect Impacts: Seafloor-disturbing activities will result in temporary increases in sediment suspension and deposition and may result in indirect, short-term, limited impacts on fisheries due to impacts on fishery species that have preferred habitat in the RWF. As discussed in Section 4.3.3.2 of the COP, sediment transport modeling was conducted to evaluate the concentrations of suspended sediments, spatial extent and duration of sediment plumes, and the seafloor deposition resulting from cable burial activities. For the RWF IAC, a representative segment of 7,392 ft (2,253 m) of installation was simulated and the modeling results indicate that sediment plumes with total suspended solids (TSS) concentrations exceeding the ambient conditions by 100 mg/L could extend up to 853 feet (260 m) from the cable centerline. The plume is expected to be mostly contained within the bottom of the water column. The model estimated that the elevated TSS concentrations would be of short duration and expected to return to ambient conditions in less than 4.8 hours following the cessation of cable burial activities. The modeling results indicate that sedimentation from IAC burial may exceed 0.4 inch (10 mm) of deposition up to 197 feet (60 m) from the cable centerline and could cover up to 47 acres (190,202 m^2). Sediment suspension and deposition associated with decommissioning activities are expected to be similar, but slightly lower in magnitude. Increases in sediment suspension and deposition associated with construction/decommissioning may cause short-term, limited impacts on benthic species and species with limited mobility, and short-term impacts on pelagic species. Commercial fisheries that target species affected by sediment suspension and deposition may experience indirect, short-term impacts due to losses in productivity.
Noise	Impact pile driving and/or vibratory pile driving	**Indirect, short-term**	Indirect Impacts: Potential impacts on benthic and demersal species that are targeted by commercial and recreational fisheries may cause indirect, short-term impacts on the fisheries. Underwater noise can elicit avoidance behavior; therefore, fisheries targeting more mobile species may be affected. See Section 4.3.3.2 of the COP for a detailed discussion of potential noise impacts on fishery resources.
	Vessel noise, construction equipment noise, aircraft noise	**Indirect, short-term**	Indirect Impacts: Indirect, short-term impacts on commercial and recreational fisheries could occur due to avoidance behavior of fishery resources caused by vessel noise, construction and decommissioning equipment noise, and/or aircraft noise. Sounds created by mechanical/hydro-jet plows, vessels, or aircraft during construction and decommissioning are continuous or non-impulsive sounds, which have different characteristics underwater and impacts on marine life. The noise from mechanical/hydro-jet plows is expected to be masked by louder sounds from vessels. The duration of construction equipment and vessel noise at a given location will be short, as the installation vessel will only be present for a short period at any given location along the cable corridor. Underwater noise associated with helicopters is generally brief as compared with the duration of

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			audibility in the air (Richardson et al., 1995). Because of this, impacts on fishery resources from aircraft noise are expected to be short-term. Impacts on fishery resources may result from a temporary degradation of habitat quality due to elevated noise levels. However, the noise generated by vessel and aircrafts will be similar to the range of noise from existing vessel and aircraft traffic in the region, and are not expected to substantially affect the existing underwater noise environment.
Discharges and Releases	Hazardous materials spills Wastewater discharge	**Direct, short-term** **Indirect, short-term**	Direct and Indirect Impacts: Routine discharges of wastewater (e.g., gray water or black water) or liquids (e.g., ballast, bilge, deck drainage, stormwater) may occur from vessels, WTGs, or the OSS during construction and decommissioning; however, those discharges and releases are not anticipated to have impacts because all vessel waste will be offloaded, stored, and disposed of in accordance with all applicable local, state and federal regulations. In addition, compliance with applicable Project-specific management practices and requirements will minimize the potential for negatively impacting water quality and marine life. The construction/decommissioning of the RWF is not anticipated to lead to any spills of hazardous materials into the marine environment. All vessels participating in the construction and decommissioning of the RWF will comply with USCG requirements for management of onboard fluids and fuels, including maintaining and implementing spill prevention, control, and countermeasure (SPCC) plans. Vessels will be navigated by trained, licensed vessel operators who will adhere to navigational rules and regulations and vessels will be equipped with spill handling materials adequate to control or clean up an accidental spill. Best management practices (BMPs) for fueling and power equipment servicing will be incorporated into the Project's Emergency Response Plan and Oil Spill Response Plan (ERP/OSRP). Accidental releases are minimized by containment and clean-up measures detailed in the OSRP. Given these measures and the very low likelihood of an inadvertent release, potential impacts of a hazardous material spill on commercial and recreational fisheries and fishery resources are not anticipated.
Marine Trash and Debris		**Direct, short-term**	Direct Impacts: Vessels will adhere to USCG and EPA regulations that require operators to develop waste management plans, to post informational placards, to manifest trash sent to shore, and to use special precautions such as covering outside trash bins to prevent accidental loss of solid materials. Also, BOEM lease stipulations require adherence to Notice to Lessee (NTL) 2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, which requires the posting of placards at prominent locations on offshore vessels and structures, and which mandates a yearly marine trash and debris awareness training and certification process. As such, measures will be implemented prior to and during construction and decommissioning to avoid, minimize, and mitigate impacts related to trash and debris disposal. Given these measures, impacts from trash and debris on commercial and recreational fisheries and fishery resources are not expected.
Traffic		**Direct, short-term**	Direct Impacts: Commercial and recreational fisheries may experience short-term impacts due to increased vessel traffic during the construction and decommissioning phases of the RWF, as fisherman may avoid areas of increased vessel activity. Potential impacts on navigation are discussed in the Navigational Safety Risk Assessment (NRSA) (DNV GL, 2020). Primary conclusions of the NSRA included that vessel traffic near the project area is light, recreational/pleasure vessels represent the greatest proportion of vessel tracks in the study area, and deep draft vessel traffic in the wind farm area is expected to be limited to emergency circumstances.
Visible Structures		**Direct, short-term**	Direct Impacts: The physical presence of installation and decommissioning vessels and RWF components may affect fishing activity because there will be a minimum safety perimeter around installation and decommissioning vessels and locations where the RWF components will be installed and removed. This temporarily restricted area will consist of a 500-yard radius safety zone.

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Table 3.1-2 IPFs and Characterizations of Potential Impacts on Commercial and Recreational Fisheries within the RWF during Operations and Maintenance

Table 3.1-2			
IPF	**Project Activity**	**Impact Characterization for Commercial and Recreational Fisheries**	**Discussion**
Seafloor Disturbance	Foundations (WTG and OSS) RWF IAC and OSS-Link Cable non-routine O&M	**Direct, short-term** **Indirect, short-term**	Direct Impacts: Seafloor disturbance during O&M of the RWF will be limited to non-routine maintenance of bottom-founded infrastructure (e.g., foundations, scour protection, cable protection). These maintenance activities may result in direct, short-term impacts on fishing activity, as fishing access would be temporarily disrupted. However, the extent of the disturbance would be limited to specific areas. Indirect Impacts: Seafloor-disturbing maintenance activities are expected to result in similar indirect impacts on fisheries as those discussed for construction/decommissioning (Table 3.1-1), as fishery resources would be temporarily affected. However, the extent of disturbance would be limited to specific areas.
	Vessel anchoring (including spuds)	**Direct, short-term** **Indirect, short-term**	Direct Impacts: During O&M, anchoring will be limited to vessels required to be onsite for an extended duration. Impacts on commercial and recreational fisheries resulting from potential vessel anchoring during O&M activities are expected to be similar to those discussed in Table 3.1-1. Indirect Impacts: Indirect impacts on commercial and recreational fisheries due to impacts on fishery resources associated with vessel anchoring (including spuds) are expected to be short-term impacts.
Habitat Alteration	Foundations (WTG and OSS) RWF IAC and OSS-Link Cable	**Direct, long-term** **Indirect, long-term**	Direct Impacts: Minimal impacts on commercial and recreational fisheries are expected from operation of the IAC and OSS-Link Cable themselves, as they will be buried beneath the seabed. The USCG's stated policy is that "in the United States vessels will have the freedom to navigate through [wind farms], including export cable routes." (See Coast Guard Navigation and Vessel Inspection Circular 01-19 dated 1 August 2019.) Therefore, commercial fishermen will have the freedom to continue to fish within the Lease Area and near cable corridors. Further, the NSRA prepared for the Project, which is based on a very conservative potential layout (i.e., up to 144 WTGs), did not identify major areas of concern regarding safe marine navigation through the RWF. The Project's 1.15 mi (1 nm) by 1.15 mi (1 nm) layout allows for safe navigation by fishing vessels, and, therefore potential impacts on fishing grounds are considered direct and long-term. Indirect Impacts: Presence of the foundations, associated scour protection, and cable protection may result in both negative and beneficial indirect impacts on commercial and recreational fisheries due to conversion of primarily soft-bottom habitat to hard-bottom habitat and the subsequent effects on fishery resources. Fishery resources associated with soft-bottom habitats may experience long-term impacts, as available habitat will be slightly reduced. Fishery resources that inhabit hard bottom habitats may experience a beneficial effect, depending on the quality and type of habitat created by the foundations, scour protection, and cable protection, and the quality and type of the benthic community that colonizes that habitat. Commercial fisheries that target species with limited mobility may have indirect, long-term impacts from the presence of the WTG foundations (due to the impact on benthic and demersal species such as ocean quahog clam, Atlantic surfclam, and Atlantic sea scallop). An indirect, long-term benefit of the WTGs' physical presence is that the new structures may attract recreationally important species. The physical presence of these structures may result in direct benefits to recreational fisheries due to the WTG marking the location with a hardened structure and attracting fishermen. While this is a potentially beneficial impact of the physical presence of the WTGs, it also may be considered a negative impact for recreational fishermen who previously utilized the location as a secluded fishing location because, during operation, the RWF WTGs could potentially become a recreational fishing destination. In addition, increased fishing pressure on fish aggregations at the WTGs may result

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Table 3.1-2			
IPF	**Project Activity**	**Impact Characterization for Commercial and Recreational Fisheries**	**Discussion**
			in increased recreational fishing mortality rates. If these circumstances arise, then indirect, long-term impacts are expected.
Sediment Suspension and Deposition	RWF IAC and OSS-Link Cable non-routine O&M Vessel anchoring (including spuds)	**Indirect, short-term**	Indirect Impacts: Increases in sediment suspension and deposition during the O&M phase will result from vessel anchoring and non-routine maintenance activities that require exposing the IAC and/or OSS-Link Cable. Negative indirect impacts on commercial and recreational fisheries resulting from sediment suspension and deposition during the O&M phase are expected to be similar to those discussed for the construction and decommissioning phase (Table 3.1-1), but on a more limited spatial scale.
Noise	Vessel and aircraft noise	**Indirect, short-term**	Indirect Impacts: Negative impacts on commercial and recreational fisheries due to the impacts of ship and aircraft noise on fishery resources are expected to be similar to those discussed for the construction/decommissioning phase (Table 3.1-1), though lesser in extent. The noise generated by vessel and aircrafts will be similar to the range of noise from existing vessel and aircraft traffic in the region, and is not expected to substantially affect the existing underwater noise environment.
	WTG operational noise	**Indirect, long-term**	Indirect Impacts: The underwater noise levels produced by WTGs are expected to be within the hearing ranges of fish. Depending on the noise intensity, these noises could cause avoidance of the RWF area for some fishery species or their prey, resulting in indirect impacts on commercial and recreational fisheries. However, noise levels from operation of the RWF WTGs are not expected to result in injury or mortality, and finfish may become habituated to the operational noise (Thomsen et al., 2006; Bergström et al., 2014). Lindeboom et al. (2011) found no difference in the residency times of juvenile cod around monopiles between periods of WTG operation or when WTGs were out-of-order. This study also found that sand eels did not avoid the wind farm. In a similar study, the abundance of cod, eel, shorthorn sculpin, and goldsinny wrasse, were found to be higher near WTGs, suggesting that potential noise impacts from operation did not override the attraction of these species to the artificial reef habitat (Bergström et al., 2013). Based on the available literature, operational noise from the WTGs is expected to have an indirect, long-term impact on commercial and recreational fisheries.
Electric and Magnetic Fields	RWF IAC and OSS-Link Cable	**Indirect, long-term**	Indirect Impacts: A modeling analysis of the magnetic fields and induced electric fields anticipated to be produced during operation of the RWF IAC, OSS-Link Cable, and RWEC was performed and results are included in the Offshore Electric- and Magnetic-Field Assessment (Exponent, 2020). These modeling results were compared to existing scientific literature on the sensitivity of marine species to EMF. Based on the modeling results and existing evidence, behavioral effects and/or changes in species abundance and distributions are not expected (see section 4.3.3.2 of the COP for additional discussion). These conclusions are consistent with the findings of a previous comprehensive review of the ecological impacts of marine renewable energy projects, where it was determined that there has been no evidence demonstrating that EMF at the levels expected from marine renewable energy projects will cause an effect (negative or positive) on any species (Copping et al., 2016). Moreover, a 2019 BOEM report that assessed the potential for AC EMF from offshore wind facilities to affect marine populations concluded that, for the southern New England area, no negative effects are expected for populations of key commercial and recreational fish species (Snyder et al., 2019). Based on this information, it is not expected that fishery resources will be measurably affected by EMF from the cables, and thus indirect impacts on commercial and recreational fisheries are not expected.
Discharges and Releases	Hazardous materials spills Wastewater discharges	**Direct, short-term** **Indirect, short-term**	Direct and Indirect Impacts: As discussed for the construction/decommissioning phase, routine discharges of wastewater or liquids (e.g., ballast, bilge, deck drainage, stormwater) are not anticipated to have impacts because all vessel waste will be offloaded, stored, and disposed of in accordance with all applicable local, state and federal regulations. In addition, compliance with applicable Project-

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Table 3.1-2			
IPF	**Project Activity**	**Impact Characterization for Commercial and Recreational Fisheries**	**Discussion**
			specific management practices and requirements will minimize the potential for negatively impacting water quality and marine life. The operation of the RWF is not anticipated to introduce spills of hazardous material into the marine environment. Per the information requirements outlined in 30 CFR 585.626, a list of solid and liquid wastes generated, including disposal methods and locations, as well as federally regulated chemical products, is found in the Project's ERP/OSRP. The WTGs and OSSs will be designed for secondary levels of containment to prevent accidental discharges of hazardous materials to the marine environment. Most maintenance will occur inside the WTGs, thereby reducing the risk of a spill, and no oils or other wastes are expected to be discharged during maintenance activities. All vessels participating in O&M of the RWF will comply with USCG requirements for management of onboard fluids and fuels, including maintaining and implementing SPCC plans. Vessels will be navigated by trained, licensed vessel operators who will adhere to navigational rules and regulations and vessels will be equipped with spill handling materials adequate to control or clean up an accidental spill. Best management practices (BMPs) for fueling and power equipment servicing will be incorporated into the Project's ERP/OSRP. Accidental releases are minimized by containment and clean-up measures detailed in the OSRP. Given these measures and the very low likelihood of an inadvertent release, potential impacts of a hazardous material spill on commercial and recreational fisheries and fishery resources are not anticipated.
Marine Trash and Debris		**Direct, short-term** **Indirect, short-term**	Direct and Indirect Impacts: As discussed in Table 3.1-1, vessels will adhere to the USCG and EPA marine trash regulations, as well as BOEM guidance, and trash and debris generated during O&M of the RWF will be contained on vessels or at staging areas until disposal at an approved facility. Measures will be implemented prior to and during construction to avoid, minimize, and mitigate impacts related to trash and debris disposal. Given these measures, impacts from trash and debris on commercial and recreational fisheries and fishery resources are not expected.
Traffic		**Direct, long-term**	Direct Impacts: Impacts associated with traffic during O&M are expected to be similar to, but less frequent than, those discussed in the construction phase and may result in direct, long-term impacts.

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3.1.2 Revolution Wind Export Cable Corridor

IPFs resulting in potential impacts on commercial and recreational fisheries associated with the RWEC Corridor are described in Table 3.1-3 for the construction and decommissioning phases and in Table 3.1-4 for the O&M phase. At the end of the Project's operational life, the Project will be decommissioned in accordance with a detailed decommissioning plan to be developed in compliance with applicable laws, regulations, and best management practices at that time. All of these activities are anticipated to be similar to or less than those described for construction, unless otherwise noted. The impacts discussed in this section apply to both the RWEC-OCS and RWEC-RI, though the impacts would vary based on fishing activity. In RI state waters fishing activity primarily used pots and traps, followed by fixed nets and the top species landed were scup, channeled whelk and summer flounder. In federal waters, the top fisheries use bottom trawls, mid-water trawls, and pots, with Atlantic herring, lobster, and squid the highest landed species by pound.

Table 3.1-3 IPFs and Characterizations of Potential Impacts on Commercial and Recreational Fisheries for the RWEC Corridor during Construction and Decommissioning

Table 3.1-3			
IPF	**Project Activity**	**Impact Characterization for Commercial and Recreational Fisheries**	**Discussion**
Seafloor Disturbance	Seafloor preparation	**Direct, short-term** **Indirect, short-term**	Direct Impacts: As discussed in Table 3.1-1, the potential impacts on commercial and recreational fisheries from seafloor preparation are primarily associated with short-term disruption of access to fishing areas for commercial and recreational fisheries. Decommissioning activities are expected to cause similar impacts as construction, but these impacts would be shorter in duration Indirect Impacts: Indirect negative impacts on commercial and recreational fisheries associated with seafloor preparation for the RWEC are expected to be similar to those discussed in Table 3.1-1.
	RWEC installation	**Direct, short-term** **Indirect, short-term**	Direct Impacts: Direct impacts on commercial and recreational fisheries associated with the RWEC installation/decommissioning are expected to result in similar negative impacts as those for seafloor preparation. Indirect Impacts: Indirect impacts on commercial and recreational fisheries associated with RWEC installation/decommissioning are expected to result in similar negative impacts as those discussed in Table 3.1-1 for the IAC and OSS-Link Cable.
	Vessel anchoring (including spuds)	**Direct, short-term** **Indirect, short-term**	Direct Impacts: Direct impacts on commercial and recreational fisheries associated with vessel anchoring (including spuds) are similar to those discussed in seafloor preparation. Indirect Impacts: Indirect impacts to commercial and recreational fisheries associated with vessel anchoring (including spuds) are similar to those discussed in seafloor preparation
Habitat Alteration	Seafloor Preparation RWEC installation Vessel anchoring (including spuds)	**Indirect, long-term**	Indirect Impacts: In areas of sediment disturbance and/or increased sedimentation, benthic habitat recovery and benthic infaunal and epifaunal species abundances may take up to 1 to 3 years to recover to pre-impact levels, based on the results of a number of studies on benthic recovery (e.g., AKRF, Inc. et al., 2012; Germano et al., 1994; Hirsch et al., 1978; Kenny and Rees, 1994). Recolonization rates of benthic habitats are driven by the benthic communities inhabiting the area surrounding the impacted region. Communities well adapted to disturbance within their habitats (e.g., sand sheets) are expected to quickly recolonize a disturbed area, while communities not well adapted to frequent disturbance (e.g., cobble and boulder habitats) may take upwards of a year to begin recolonization and several years to become substantially re-established to pre-disturbance levels. This recovery time would result in a small, long-term loss of productivity in the disturbed area and a subsequent indirect, long-term impact on commercial and recreational fisheries. During decommissioning, foundations and other facilities will be removed to a depth of 15 ft (4.6 m) below the mudline, unless otherwise authorized by BOEM (30 CFR § 585.910(a). Recovery from

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Table 3.1-3			
IPF	**Project Activity**	**Impact Characterization for Commercial and Recreational Fisheries**	**Discussion**
			decommissioning activities is expected to be similar that experienced during seafloor preparation, resulting in an indirect, long-term impact on commercial and recreational fisheries.
Sediment Suspension and Deposition	Seafloor Preparation RWEC installation Vessel anchoring (including spuds)	**Indirect, short-term**	Indirect Impacts: As discussed in Table 3.1-1, seafloor-disturbing activities will result in temporary increases in sediment suspension and deposition. Sediment transport modeling results indicate that sediment plumes with TSS concentrations exceeding the ambient conditions by 100 mg/L could extend up to 4,528 feet (1,380 m) from the RWEC-RI centerline in state waters, and up to 1,542 feet (470 m) from RWEC-OCS centerline in federal waters. The plume is expected to be mostly contained within the bottom of the water column, though in shallower waters it may occupy most of the water column due to the water depth. For the RWEC-OCS, predicted TSS concentrations above ambient for any single circuit installation do not persist in any given location for greater than 24 hours, though in most locations (>75 % of the affected area) concentrations return to ambient within 8 hours. This maximum was predicted to occur along a part of the corridor that will only see one circuit installation. The maximum duration above ambient along the portion of the RWEC where two circuits will be installed was predicted to be 14 hours per circuit. This corresponds to a total of 28 hours above ambient, however the two 14-hour periods will likely be separated by time. For the installation of one circuit of the RWEC-RI, predicted TSS concentrations above ambient do not persist in any given location for greater than 16.3 hours, though in most locations (>75 % of the affected area) concentrations return to ambient within 4 hours). For installation of two circuits, the maximum plume exposure is doubled at 32.6 hours, however, the two 16.3-hour periods will likely be separated by time. The modeling results indicate that sedimentation from RWEC burial may exceed 0.4 inch (10 mm) of deposition up to 919 feet (280 m) from the cable centerline in state waters and up to 328 feet (100 m) in federal waters. This thickness of sedimentation could cover up to 1,126 acres (4,556,760 m^2) in state waters, and 1,020 acres (4,127,794 m^2) in federal waters. For the cable landfall, TSS concentrations exceeding ambient conditions by 100 mg/L could extend up 580 ft (177 m) from the centerline and plume concentrations above ambient could persist for 256 hours for the HDD. This duration is longer relative to the water jet assisted cable installation due to the slower installation rate of the activity and since trenching and backfilling for two circuits are included. Sedimentation greater than 0.4 in (10 mm) may extend up to 509 ft (155 m) from the centerline and could cover up to 19 acres (76,890 m^2). Sediment suspension and deposition associated with decommissioning activities are expected to be similar, but slightly lower in magnitude. Increases in sediment suspension and deposition associated with construction/decommissioning may cause short-term impacts on benthic species and species with limited mobility, and short-term impacts on pelagic species. Commercial fisheries that target species affected by sediment suspension and deposition may experience indirect, short-term impacts due to losses in productivity.
Noise	Vessel noise, equipment noise, aircraft noise	**Indirect, short-term**	Indirect Impacts: Negative indirect impacts on commercial and recreational fisheries resulting from vessel, construction/decommissioning equipment, and aircraft noise are expected to be similar to those discussed in Table 3.1-1.
	Vibratory pile driving (cofferdam) *RWEC-RI only	**Indirect, short-term**	Indirect Impacts: The cofferdam at the RWEC landfall, if required, may be installed as either a sheet piled structure into the sea floor or a gravity cell structure placed on the sea floor using ballast weight. Sheet pile installation would require the use of a vibratory hammer to drive the sidewalls and endwalls into the seabed, which may take approximately up to 3 days. For fishery resources exposed, noise from vibratory pile driving may temporarily reduce habitat quality, result in behavioral changes, or cause mobile species to temporarily vacate the area. As a result, noise impacts may result in indirect, short-term

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Table 3.1-3			
IPF	**Project Activity**	**Impact Characterization for Commercial and Recreational Fisheries**	**Discussion**
			impacts on fisheries. However, habitat suitability is expected to return to pre-pile driving conditions shortly after cessation of the pile driving activity.
Discharges and Releases	Hazardous materials spills Wastewater discharge	**Direct, short-term** **Indirect, short-term**	Direct and Indirect Impacts: Impacts associated with wastewater discharge or an inadvertent release of hazardous material during construction or decommissioning of the RWEC are expected to be similar to those discussed in Table 3.1-1.
Marine Trash and Debris		**Direct, short-term** **Indirect, short-term**	Direct and Indirect Impacts: Impacts associated with marine trash and debris are expected to be similar to those discussed in Table 3.1-1.
Traffic		**Direct, short-term**	Direct Impacts: Negative impacts on commercial and recreational fisheries resulting from sediment suspension and deposition are expected to be similar to those discussed in Table 3.1-1.

Table 3.1-4 IPFs and Characterizations of Potential Impacts on Commercial and Recreational Fisheries for the RWEC Corridor during Operations and Maintenance

Table 3.1-4			
IPF	**Project Activity**	**Impact Characterization for Commercial and Recreational Fisheries**	Discussion
Seafloor Disturbance	RWEC non-routine O&M	**Direct, short-term** **Indirect, short-term**	Direct Impacts: Seafloor disturbance during O&M of the RWEC will be limited to non-routine maintenance that may require uncovering and reburial of the cables, as well as maintenance of cable protection. These maintenance activities may result in direct, short-term impacts on fishing activity, as fishing access would be temporarily disrupted. However, the extent of the disturbance would be limited to specific areas along the cable corridor. Indirect Impacts: Indirect impacts on commercial and recreational fisheries associated with O&M activities for the RWEC are expected to result in similar negative impacts as those discussed for the IAC in Table 3.1-1, as fishery resources would be temporarily affected. However, the extent of disturbance would be limited to specific areas.
	Vessel anchoring (including spuds)	**Direct, short-term** **Indirect, short-term**	Direct Impacts: During O&M, anchoring will be limited to vessels required to be onsite for an extended duration. Negative impacts on commercial and recreational fisheries resulting from potential vessel anchoring during O&M activities are expected to be similar to those discussed in Table 3.1-1. Indirect Impacts: Indirect impacts on commercial and recreational fisheries due to impacts on fishery resources associated with vessel anchoring (including spuds) are expected to be short-term impacts.

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Table 3.1-4			
IPF	**Project Activity**	**Impact Characterization for Commercial and Recreational Fisheries**	Discussion
Habitat Alteration	RWEC O&M	**Direct, short-term** **Indirect, long-term**	Direct Impacts: Commercial and recreational fisheries are not expected to experience impacts from the presence of the RWEC-OCS because it will be buried beneath the seabed. The USCG's stated policy is that "in the United States vessels will have the freedom to navigate through [wind farms], including export cable routes." (See Coast Guard Navigation and Vessel Inspection Circular 01-19 dated 1 August 2019.) Therefore, commercial fishermen will have the freedom to continue to fish within the Lease Area and near cable corridors. Therefore, potential impacts on fishing grounds are not anticipated. Indirect Impacts: Cable protection (e.g., concrete mattresses) may be placed in select areas along the RWEC. As discussed in Table 3.1-2 for the RWF IAC and OSS-Link Cable, the presence of the cable protection may result in both negative and beneficial indirect impacts on commercial and recreational fisheries due to conversion of primarily soft-bottom habitat to hard-bottom habitat and the subsequent effects on fishery resources. The cable protection may have a long-term impact on fishery resources associated with soft-bottom habitats and a long-term beneficial impact on species associated with hard-bottom habitats, depending on the quality of the habitat created by the cable protection, and the quality of the benthic community that colonizes that habitat. Commercial dredgers and trawlers (e.g., surfclam/ocean quahog and scallop fisheries) potentially may lose fishing ground if additional cable protection is needed in areas that are fished. In fished areas where the substrate type necessitates additional cable protection, it is possible that commercial dredgers and trawlers (e.g., surfclam/ocean quahog and scallop fisheries) potentially may lose a small amount of fishing ground in association with the altered seabed structure. After recolonization, the cable protection locations may provide indirect, long-term benefits to recreational fisheries if they choose to target recreational species that may favor these hard-bottom habitats, depending on the quality and type of habitat created by the cable protection, and the quality and type of benthic community that colonizes that habitat.
Sediment Suspension and Deposition	RWEC non-routine O&M Vessel anchoring (including spuds)	**Indirect, short-term**	Indirect Impacts: Increases in sediment suspension and deposition during the O&M phase will result from vessel anchoring and non-routine maintenance activities that require exposing portions of the RWEC. Negative direct and indirect impacts on commercial and recreational fisheries resulting from sediment suspension and deposition during the O&M phase are expected to be similar to the limited impacts discussed for the O&M of the RWF IAC and OSS-Link Cable (Table 3.1-2).
Noise	Vessel and aircraft noise	**Indirect, short-term**	Indirect Impacts: Commercial and recreational fishery resources are not expected to experience impacts from vessel or aircraft noise during the RWEC O&M phase. Impacts from vessel and aircraft noise during O&M of the RWEC are expected to be similar to, but less frequent than those described for the construction phase.
Electric and Magnetic Fields	RWEC operations	**Indirect, long-term**	Indirect Impacts: EMF impacts on commercial and recreational fisheries from the RWEC during O&M are not expected.
Discharges and Releases	Hazardous materials spills Wastewater discharge	**Direct, short-term** **Indirect, short-term**	Direct and Indirect Impacts: Impacts associated with wastewater discharge or an inadvertent release of hazardous material during O&M of the RWEC are expected to be similar to those discussed in Table 3.1-1.
Marine Trash and Debris		**Direct, short-term**	Direct Impacts: Impacts associated with marine trash and debris are expected to be similar to those discussed in Table 3.1-1.
Traffic		**Direct, long-term**	Direct Impacts: Traffic during the O&M of the RWEC is expected to have similar direct, long-term impacts on commercial and recreational fisheries as those described for the RWF in Table 3.1-2.

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3.2 Proposed Environmental Protection Measures

To minimize impacts associated with the RWF and RWEC, Revolution Wind is proposing the following measures to avoid, minimize, or mitigate potential impacts on commercial and recreational species.

- Revolution Wind is committed to an indicative layout scenario with WTGs sited in a grid with approximately 1.15 mi (1 nm) by 1.15 mi (1 nm) spacing that aligns with other proposed adjacent offshore wind projects in the RI-MA WEA. This layout has been confirmed through expert analysis to allow for safe navigation without the need for additional designated transit lanes. This layout will also provide a uniform, wide spacing among structures to facilitate search and rescue operations.
- To the extent feasible, installation of the Inter-Array Cable, OSS Interconnector Cable, and RWEC will occur using equipment such as mechanical cutter, mechanical plow, or jet plow.
- To the extent feasible, the RWEC, IAC, and OSS-Link Cable will typically target a burial depth of 4 to 6 ft (1.2 to 1.8 m) below seabed. The target burial depth will be determined based on an assessment of seabed conditions, seabed mobility, the risk of interaction with external hazards such as fishing gear and vessel anchors, and a site-specific Cable Burial Risk Assessment.
- As appropriate and feasible, BMPs will be implemented to minimize impacts on fisheries, as described in the Guidelines for Providing Information on Fisheries Social and Economic Conditions for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585 (BOEM, 2015).
- Revolution Wind is committed to collaborative science with the commercial and recreational fishing industries pre-, during, and post-construction. Fisheries monitoring studies are being planned to assess the impacts associated with the Project on economically and ecologically important fisheries resources. These studies will be conducted in collaboration with the local fishing industry and will build upon monitoring efforts being conducted by affiliates of Revolution Wind at other wind farms in the region.
- Each WTG will be marked and lit with both USCG and approved aviation lighting. AIS will be installed at the RWF marking the corners of the wind farm to assist in safe navigation.
- Revolution Wind will require all construction and operations vessels to comply with regulatory requirements related to the prevention and control of spills and discharges.
- Accidental spill or release of oils or other hazardous materials offshore will be managed through the Project's ERP/OSRP.
- Communications and outreach with the commercial and recreational fishing industries will be guided by the Project-specific Fisheries Communication and Outreach Plan (Orsted, 2020).
- Project construction, O&M, and decommissioning activities will be coordinated with appropriate contacts at USCG and United States Department of Defense command headquarters.
- A comprehensive communication plan will be implemented during offshore construction to inform all mariners, including commercial and recreational fishermen, and recreational boaters of construction activities and vessel movements. Communication will be facilitated through a Fisheries Liaison, Project website, and public notices to mariners and vessel float plans (in coordination with USCG). Revolution Wind will submit information to the USCG to issue Local Notice to Mariners during offshore installation activities.

3.3 Summary of Characterizations of Impacts on Commercial Recreational Fisheries

3.3.1 RWF

Overall, construction and decommissioning activities of the RWF are expected to have limited impacts on commercial and recreational fisheries. Seafloor disturbance during construction and decommissioning of the RWF is expected to have direct, short-term, impacts on fishing areas for commercial and recreational fisheries due to an expected 1,640 ft (500 yd) radius temporary safety zone established around RWF components and indirect, short-term impacts because of seafloor disturbance and indirect, long-term impacts because of habitat alteration that

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would affect some commercially and recreationally targeted species. Sediment suspension and deposition are expected to have indirect, short-term impacts due to effects on targeted species with preferred habitat in the RWF. Noise during construction and decommissioning is expected to have indirect, short-term impacts primarily from behavioral responses of targeted fisheries species, such as avoidance behavior for mobile species. Traffic is expected to have direct, short-term impacts, as fisherman may avoid areas of increased vessel activity. Visible structures are expected to have direct, short-term impacts because installation vessels and RWF components will affect fishing activity via the safety zone. Impacts from discharges and releases and marine trash and debris are not expected because vessels will comply with state and federal regulations and implement BMPs.

Operations and Maintenance activities within the RWF are expected to have limited impacts on commercial and recreational fisheries. Seafloor disturbance during operation and maintenance of the RWF is expected to have direct and indirect, short-term impacts on commercial and recreational fisheries. Sediment suspension and deposition are expected to have indirect, short-term impacts due to effects on targeted species with preferred habitat in the RWF. Habitat alteration due to the presence of WTG foundations, scour protection, and cable protection of the IAC and OSS-Link Cable may result in direct, long-term impacts due to the presence of the wind farm structures and related impacts on the use of fishing grounds. Habitat alteration is also expected to result in indirect, long-term benefits that include potential increases in abundances of fishery species that utilize hard-bottom habitats, as well as the WTG marking the location of the fishery resource that was previously a secluded fishing location. Noise and EMF during operation and maintenance is expected to have indirect, long-term impacts. Traffic is expected to have direct, long-term impacts on commercial and recreational fisheries with less frequent disturbances than those discussed in the construction phase. Discharges and releases and marine trash and debris are not expected because the RWF is not anticipated to introduce spills or hazardous material or trash/debris into the marine environment.

3.3.2 RWEC Corridor

In general, RWEC installation and decommissioning activities along the RWEC-OCS and RWEC-RI corridors are expected to have limited impacts on commercial and recreational fisheries. Seafloor disturbance during construction and decommissioning of the RWEC-OCS and RWEC-RI is expected to have direct, short-term impacts on commercial and recreational fisheries because of temporarily restricted access to fishing grounds due to safety restrictions on entering the area, indirect, short-term impacts because of seafloor disturbance, and indirect, long-term impacts because of habitat alteration that would affect some commercially and recreationally targeted species. Sediment suspension and deposition are expected to have indirect, short-term impacts due to effects on targeted species with preferred habitat along the cable corridor. Noise during construction and decommissioning is expected to have indirect, short-term impacts primarily from behavioral responses of targeted fisheries species, such as avoidance behavior for mobile species. Traffic is expected to have direct, short-term impacts, as fisherman may avoid areas of increased vessel activity. Impacts from discharges and releases and marine trash and debris are not expected because vessels will comply with state and federal regulations and implement BMPs.

Operations and Maintenance activities of the RWEC are expected to have limited impacts on commercial and recreational fisheries. Seafloor disturbance during operation and maintenance of the RWEC is expected to have direct and indirect, short-term impacts on commercial and recreational fisheries. Sediment suspension and deposition are expected to have indirect, short-term impacts due to effects on targeted species with preferred habitat in the RWF. Habitat alteration due to the presence of cable protection of RWEC may result in limited impacts due to the presence of the cable protection and related impacts on the use of fishing grounds. Noise and EMF during operation and maintenance are expected to have indirect, long-term impacts. Traffic is expected to have direct, long-term impacts on commercial and recreational fisheries with less frequent disturbances than those discussed in the construction phase. Impacts of discharges and releases and marine trash and debris are not expected.

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