Sunrise Wind Farm Project

Appendix H
Sediment Transport Modeling Report

Prepared for:

Sunrise Wind | Powered by Ørsted & Eversource

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Revision 1 – October 28, 2021

Revision 2 – August 19, 2022

Hydrodynamic and Sediment Transport Modeling

Sunrise Wind Farm Project

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Date: August 2022

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Table of Contents

List of Figures

List of Tables

Acronyms and Abbreviations

Ac	acres
ADCP	Acoustic Doppler Current Profiler
BOEM	Bureau of Ocean Energy Management
CFE	controlled flow excavation
COP	Construction and Operations Plan
CPTU	cone penetrometer test with pore water pressure
cy	cubic yards
DC	direct current
DOER	Dredging Operations and Environmental Research Program
FRONT	Front-Resolving Observation Network with Telemetry
Ft	feet
FVCOM	Finite-Volume Community Ocean Model
Ha	Hectares
HDD	horizontal direction drilling
IAC	inter-array cable
in	inch
km	kilometer
KP	kilometer point
LIPA	Long Island Power Authority
m	meter
mg/L	milligrams per Liter
mi	statute miles
mm	millimeter
m/s	meters per second
nm	nautical miles
NCEI	National Center for Environmental Information
NECOFS	Northeast Coastal Ocean Forecast System
NERACOOS	Northeast Regional Association Coastal Ocean Observation System
NOAA	National Oceanic and Atmospheric Administration
NY	New York
NYS	New York State
NYSERDA	New York State Energy Research and Development Authority
OCS	Outer Continental Shelf
OCS-DC	Offshore Converter Station – direct current
OREC	Offshore Wind Renewable Energy Certificate
OSAMP	Ocean Special Area Management Plan
PDE	Project Design Envelope
PTM	Particle Tracking Model
Project	Sunrise Wind Farm Project
SMS	Surface-Water Modeling System
SRWF	Sunrise Wind Farm
SRWEC	Sunrise Wind Export Cable
SRWEC–NYS	Sunrise Wind Export Cable – NY State Waters
SRWEC–OCS	Sunrise Wind Export Cable – Outer Continental Shelf
TRT	thermal resistivity testing
TSHD	trailing suction hopper dredge
TSS	Total Suspended Solids
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
WEA	Wind Energy Areas
WTG	wind turbine generator

1 Executive Summary

Sunrise Wind LLC (Sunrise Wind), a 50/50 joint venture between Orsted North America Inc. (Orsted NA) and Eversource Investment LLC (Eversource), proposes to construct, own, and operate the Sunrise Wind Farm Project (the Project). The wind farm portion of the Project will be located on the Outer Continental Shelf (OCS) in the designated Bureau of Ocean Energy Management (BOEM) Renewable Energy Lease Area OCS-A-0487E-1 (Lease Area). The Lease Area is approximately 18.9 statute miles (mi) (16.4 nautical miles [nm], 30.4 kilometers [km]) south of Martha's Vineyard, Massachusetts, approximately 30 mi (26.1 nm, 48.2 km) east of Montauk, New York (NY), and 16.7 mi (14.5 nm, 26.8 km) from Block Island, Rhode Island.

The Project consists of up to 94 wind turbine generators (WTGs) at 102 potential locations, an offshore converter station (OCS-DC), Inter-Array cables (IACs) that form a network connecting the WTGs, and a cable bundle to convey power to shore (Sunrise Wind Export Cable [SRWEC]) located within an up to 104.6-mi (168.4-km)-long corridor.

The location of the WTGs, OCS-DC, and IACs is collectively referred to as the Sunrise Wind Farm (SRWF). Horizontal directional drilling (HDD) is also expected to connect the SRWEC to onshore Project transmission components at Smith Point County Park in the Town of Brookhaven, NY.

A reasonable range of offshore Project designs are being considered to allow for assessments of proposed activities and the flexibility to make development decisions prior to construction. The Project design envelope (PDE) involves several scenarios with potential sediment transport impacts that are associated with offshore construction activities.

Hydrodynamic and sediment transport modeling were conducted to assess the sediment suspension and resulting deposition from proposed construction activities associated with the SRWF and SRWEC. The hydrodynamic and sediment transport modeling assessment for the Project considers the information available at this time; the precise locations and schedule of the construction and operation scenarios may be subject to change as the engineering design progresses. Model scenarios were developed for each proposed construction activity. Where multiple installation methods are being considered, the model scenario assumed the method that would create the most sediment disturbance.

The sediment disturbance was evaluated for:

1) excavation of an HDD exit pit using a mechanical dredge (closed & open bucket) in NY state (NYS) waters,
2) installation of the SRWEC using jet-plowing in NYS (SRWEC–NYS) and Federal (SRWEC–OCS) waters,
3) installation of the IAC using jet-plowing in Federal waters,
4) sand wave leveling for seafloor preparation activities along the SRWEC–OCS using controlled flow excavation, and
5) sand wave leveling for seafloor preparation activities along the SRWEC–OCS using a trailing suction hopper dredge.

The hydrodynamic and sediment transport analysis utilized existing environmental data and models to assess sediment turbidity levels (presented as Total Suspended Sediment [TSS]) and resulting deposition (thickness above seafloor) at representative Project locations. The hydrodynamic and sediment transport model results are

[E-1] A portion of Lease Area OCS-A 0500 (Bay State Wind LLC) and the entirety of Lease Area OCS-A 0487 (formerly Deepwater Wind New England LLC) were assigned to Sunrise Wind LLC on September 3, 2020, and the two areas were merged and a revised Lease OCS-A-0487 was issued on March 15, 2021. Thus, within this report, the term "Lease Area" refers to the new merged Lease Area OCS-A 0487.

intended to provide the necessary information for the Project's Construction and Operation Plan (COP) as well as other federal and state permits.

For characterizing the hydrodynamics within the Project area, the hind-cast results of the Northeast Coastal Ocean Forecast System (NECOFS) model (NERACOOS, UMass Dartmouth Massachusetts Fishery Institution, and MIT Sea Grant College), which uses the numerical scheme of the FV-COM (Finite-Volume Coastal Ocean Model), was utilized. The NECOFS hydrodynamic model output was then used as input for sediment transport modeling within the Project construction area.

The sediment transport model chosen was the Particle Tracking Model (PTM) in the Surface-Water Modeling System (SMS), which uses the equations for the movement of fluid on a rotating earth and integrates the properties of particles within that fluid to simulate resultant transport. This model has been developed by the Coastal Inlets Research Program (CIRP) and the Dredging Operations and Environmental Research Program (DOER) at the United States Army Corps of Engineers (USACE) Research and Development Center for the transport and fate of suspended sediments surrounding dredging and sub-surface construction activity and is therefore suitable for this application.

The NECOFS model was first validated within the region of Project using comparisons made between the model output and available measurements. The model was first validated using measured currents from the University of Connecticut's National Oceanographic Partnership Front-Resolving Observation Network with Telemetry (FRONT) program. Three locations and two seasons were available for comparison between the measured current data and the NECOFS model output.

The NECOFS model was also evaluated using tidal constituents developed from available measurements within the region. Comparisons were made between the NECOFS model and tidal constituents from the Offshore Renewable Energy OSAMP buoys which collected data in 2009 -2010. Additional comparisons were made between the NECOFS model and tidal constituents developed from water level measurements at NOAA station 8510560 located in Montauk, NY.

Once the model was validated, it was desired to select a year from the 39-year hindcast that was representative of average annual conditions. To select a representative average year, bulk current statistics were computed using the NECOFS model output at five (5) representative sites along the SRWEC. A ranking process resulted in the selection of 1997 as being the most representative of average annual conditions.

Sediment characteristics along the SRWEC and in the SRWF were provided from sediment core samples collected from May 17 to August 23, 2020, in support of the Project. Sieve analyses conducted following sampling were used to determine the grain size distribution at each sample location. These data were used for all sediment transport model scenarios in NYS and Federal waters.

A summary of the sediment transport model results is given in Tables 1-1a and 1-1b. Below are some general findings from the sediment transport analysis:

- The suspended sediment plume from the proposed construction activities is transient and its location in relation to the sediment disturbance varies with the tidal cycles. The sediment plume is shown to be larger in areas where there are higher percentages of fine-grained surficial seafloor sediments.
- The excavation of the HDD exit pit using a mechanical (clamshell) dredge resulted in peak TSS concentrations of 30 milligrams per Liter (mg/L). This activity resulted in a 0.1 hectares (ha) (0.25 acres (ac)) area on the seafloor where the deposition thickness was greater than 10 millimeters (mm) (0.4 inches (in)), extending a maximum of 24 m (78 feet (ft)) from the source. The predicted time to return to ambient turbidity levels is 0.3 hours after completion.
- Using an open bucket dredge and higher production rate, the HDD exit pit excavation resulted in peak TSS concentrations of 379 mg/L. This activity resulted in a 0.1 ha (0.25 ac) area on the seafloor where

the deposition thickness was greater than 10 mm (0.4 in), extending a maximum of 39 m (128 ft) from the source. The predicted time to return to ambient turbidity levels is 0.3 hours after completion.

- The Project may include temporary placement of excavated HDD exit pit sediment on the seabed for a 45-day period. Model simulations show this placed sediment is subject to mobilization and resettlement during storm events (multi-day events with average winds in excess of 20 mph and gusts exceeding 35 mph). After a 45-day model simulation which included two mobilization events associated with storm activity, 89% of the excavated sediment is within 38 m (125 ft) of the initial placement.
- For the SRWEC–NYS installation, peak TSS concentrations reached 42 mg/L. The maximum deposition thickness was 191 mm (7.5 in) resulting in an area of deposition (21.5 ha) having a thickness greater than 10 mm with a maximum extent of 77 m (252 ft) from the route centerline. While the time to return to ambient turbidity levels will vary along the SRWEC–NYS route, the time to return to ambient levels was 0.3 hours after completion.
- The SRWEC–OCS installation showed results with peak TSS concentrations reaching 980 mg/L and concentrations exceeding 100 mg/L within 905 m (2,969 ft) of the SRWEC–OCS route centerline. The maximum deposition thickness was 289 mm (11.4 in) resulting in 336.8 ha (832 ac) having a thickness greater than 10 mm (0.4 in) with a maximum extent of 241 m (790 ft) from the route centerline. While the time to return to ambient turbidity levels will vary along the SRWEC–OCS route, the time to return to ambient levels was 0.4 hours after completion.
- Modeling of the IAC installation gave similar results to the SRWEC–OCS, however peak TSS concentrations were predicted to be lower (up to 376 mg/L) and concentrations exceeding 100 mg/L were shown to occur from 619 to 1,020 m (2,030 to 3,346 ft) of the route centerline depending on the sediment characteristics. Predicted sediment deposition had a maximum thickness of 61 to 73 mm (2.4 to 2.9 in) and the area with a thickness greater than 10 mm (0.4 in) ranged from 3.0 to 3.6 ha (7.4 to 8.9 ac).
- Using CFE for sand wave leveling results in a maximum suspended sediment concentration of 81 mg/L in Federal waters. This method is shown to produce deposition with a maximum thickness of 388 mm (15.3 in) in Federal waters. The area of deposition having a thickness greater than 10 mm is 70.5 ha (174.2 ac) within the SRWEC–OCS corridor.
- If a TSHD is used for sand wave leveling with bulk disposal, there will be a continuous release of sediment (primarily fines) at the surface due to overflow from the hopper. This overflow does not produce TSS concentrations greater than 100 mg/L and the resulting maximum deposition is relatively small (13 mm (0.5 in) in Federal waters). The area of deposition greater than 10 mm (0.4 in) is 0.5 ha (1.2 ac) in Federal waters.
- When conducting bulk disposal from the TSHD sand wave leveling, there are peak TSS concentrations in excess of 2,400 mg/L in Federal waters. This method of disposal also produces high levels of deposition (6.1 m (20 ft) in Federal waters), although this level of deposition is limited to small areas. The area of deposition greater than 1 m (3.3 ft) is 0.14 ha (0.3 ac) in Federal waters.
- Using a TSHD for sand wave leveling with hydraulic disposal at the surface produces peak TSS concentrations of 535 mg/L which exceed 100 mg/L within 250 m (820 ft) of the centerline). The maximum deposition from this activity in Federal waters is relatively small (32 mm (1.3 in)) and the area greater than 10 mm (0.4 in) in thickness is 10.4 ha (25.7 ac).

Table 1-1a Summary of sediment transport model results

Scenario	Total Sediment Volume Dispersed	Time for TSS to return to ambient	Max distance from source TSS plume exceeds ambient by		Height of TSS Plume above seafloor	Peak TSS concentration	Max deposition thickness	Max distance from source deposition > 10 mm	Area of deposition > 10 mm
			50 mg/L	100 mg/L					
	[m^3]	[hrs]	[m]	[m]	[m]	[mg/L]	[mm]	[m]	[ha/ac]
1 – Excavation of the HDD exit pit (clamshell bucket, NYS waters)	750	0.3	NA	NA	2.2	30	476	24	0.1/0.25
2 – Excavation of the HDD exit pit (open bucket, NYS waters)	1,313	0.3	1,258	367	4.0	379	768	39	0.1/0.25
3 – Temporary Placement for HDD exit pit	300	NA	NA	NA	NA	NA	2,200	41	0.3/0.8
4 – Installation of SRWEC–NYS	14,481	0.34	NA	NA	2.5	42	191	77	21.5/53.1
5 – Installation of SRWEC–OCS	254,360	0.40	2,742	905	3	980	289	241	336.8/832.3
6 – Installation of IAC (typical case)	1,800	0.43	1,153	619	2.9	157	73	47	3.6/8.9
7 – Installation of IAC (worst case)	2,750	0.49	2,382	1,020	3.9	376	61	67	3.0/7.4
8 – CFE Sand wave leveling (federal waters)	11,344	0.35	32	NA	1.25	81	388	435	70.5/174.2

Table 1-1b Summary of sediment transport model results

Scenario	Total Sediment Volume Dispersed	Time for TSS to return to ambient	Max distance from source TSS plume exceeds ambient by		Peak TSS concentration	Max deposition thickness	Max distance from source deposition > 10 mm	Area of deposition > 10 mm
			50 mg/L	100 mg/L				
	[m^3]	[hrs]	[m]	[m]	[mg/L]	[mm]	[m]	[ha/ac]
9 – TSHD Sand wave leveling –continuous overflow (federal waters)	2,269	0.4	NA	NA	28	13	27	0.5/1.2
10 – TSHD Sand wave bulk disposal (federal waters)	9,075	0.42	2,542	1,540	2,413	6103	72	1.3/3.2
11 – TSHD Sand wave hydraulic disposal (federal waters)	11,344	0.34	415	250	535	32	271	10.4/25.7

2 Project Background

Sunrise Wind LLC (Sunrise Wind), a 50/50 joint venture between Orsted North America Inc. (Orsted NA) and Eversource Investment LLC (Eversource), proposes to construct, own, and operate the Sunrise Wind Farm Project (the Project). The wind farm portion of the Project (i.e., the SRWF) will be located on the Outer Continental Shelf (OCS) in the designated Bureau of Ocean Energy Management (BOEM) Renewable Energy Lease Area OCS-A-0487[1] (Lease Area). The Lease Area is approximately 18.9 statute miles (mi) (16.4 nautical miles [nm], 30.4 kilometers [km]) south of Martha's Vineyard, Massachusetts, approximately 30.5 mi (26.1 nm, 48.2 km) east of Montauk, New York (NY), and 16.7 mi (14.5 nm, 26.8 km) from Block Island, Rhode Island.

The Lease Area contains portions of areas that were originally awarded through the BOEM competitive renewable energy lease auctions of the Wind Energy Areas (WEAs) off the shores of Rhode Island and Massachusetts. Other components of the Project will be located in federal waters on the OCS, in NY state (NYS) waters, and onshore in the Town of Brookhaven, Long Island, NY. The proposed interconnection location for the Project is the Holbrook Substation, which is owned and operated by Long Island Power Authority (LIPA). Sunrise Wind executed a contract with the New York State Energy Research and Development Authority (NYSERDA) for a 25-year Offshore Wind Renewable Energy Certificate (OREC) Agreement in October 2019.

The Project will be comprised of the following offshore infrastructure:

- up to 94 wind turbine generators (WTGs) at 102 potential locations;
- up to 95 foundations (for WTGs and an Offshore Converter Station [OCS-DC]);
- up to 180 mi (290 km) of Inter-Array Cables (IACs);
- one Offshore Converter Station with direct current (DC) electrical technology (OCS-DC); and
- one DC submarine export cable bundle (SRWEC) located within an up to 104.6-mi (168.4-km)-long corridor.

The location of the WTGs, OCS-DC, and IAC is collectively referred to as the Sunrise Wind Farm (SRWF). Horizontal directional drilling (HDD) is also expected to connect the SRWEC to onshore Project transmission components in the Town of Brookhaven, NY.

A reasonable range of offshore Project designs are being considered to allow for assessments of proposed activities and the flexibility to make development decisions prior to construction. The Project design envelope (PDE) involves several scenarios with potential sediment transport impacts that are associated with offshore construction activities. This Hydrodynamic and Sediment Transport Modeling assessment for the Project considers the information available at this time; the precise locations and schedule of the construction and operation scenarios may be subject to change as the engineering design progresses.

2.1 Study Area and Construction Activities

The majority of the SRWEC and SRWF will be wholly located within federal waters. A portion of the SRWEC, approximately 8.4 km (5.2 mi), will be installed within NYS waters (SRWEC–NYS).

[1] A portion of Lease Area OCS-A 0500 (Bay State Wind LLC) and the entirety of Lease Area OCS-A 0487 (formerly Deepwater Wind New England LLC) were assigned to Sunrise Wind LLC on September 3, 2020, and the two areas were merged and a revised Lease OCS-A 0487 was issued on March 15, 2021. Thus, in this report, the term "Lease Area" refers to the new merged Lease Area OCS-A 0487.

The SRWEC will be comprised of one distinct cable bundle. A typical cable target burial depth of 1.0 to 2.0 m (3 to 7 ft)[2] is applicable for the SRWEC and the IAC.

It is anticipated a cable laying vessel will move along the pre-determined SRWEC route within the established corridor towards the SRWF. The cable bundle will be laid on the seafloor and then trenched and installed post-lay. Alternatively, a trench may be pre-cut prior to cable installation.

As sediment conditions vary along the SRWEC and within the SRWF, several different seafloor preparation and cable installation methodologies may be required during installation. For the purposes of characterizing the most conservative (i.e., worst case) seafloor disturbance associated with the cable installation, jet-plowing was evaluated for the SRWEC and IAC installation. This technique involves the use of water jets to temporarily fluidize the sediment to create a trench that enables the cable to either be lowered under its own weight or be pushed to the bottom of the trench via a cable depressor. Similarly, controlled flow excavation (CFE) and Trailing Suction Hopper Dredge (TSHD) techniques were assessed to provide the most conservative estimate for seafloor preparation activities currently included in the PDE. CFE could also be used for remedial burial activities following installation if cable target burial depth is not met. These potential post installation activities are not included in this report, but the results presented herein are representative of this activity.

Prior to installation of the SRWEC, preparation of the seafloor is required to create a level bedform and achieve the target cable burial depth in a stable environment. Geophysical data collected for the Project indicate areas of bedform mobility along specific portions of the SRWEC–OCS. Seafloor preparation includes the clearance of the upper portion of these bedform mobility areas, or sand wave leveling.

The CFE technique involves the use of a non-contact dredging tool which utilizes thrust to direct waterflow into sediment, creating liquefaction and subsequent dispersal. The tool draws in seawater from the sides and then jets this water out from a vertical down pipe at a specified pressure and volume.

Use of a TSHD may also be employed for sand wave leveling. The TSHD involves the use of a drag arm which is pulled along the seafloor from the dredge and hopper vessel at the surface. The drag arm fluidizes sediment at the seafloor which is then hydraulically pumped to the hopper portion of the vessel where the sediment is able to settle out of suspension. During this operation, there is often a continuous overflow of water and any sediments remaining in suspension from the hopper at the water surface. Once the hopper is filled with sediment, disposal is made either hydraulically at the surface or the vessel transports to a designated disposal site and the sediment is released from the bottom of the hopper (referred to herein as bulk disposal).

Sand wave leveling using CFE and/or TSHD techniques is expected to occur within portion of 4 distinct segments of the SRWEC–OCS corridor. These four distinct segments include KP8.8 to KP19.8, KP33.3 to KP36.5, KP48.4 to KP49.9, and KP66.6 to KP70.7 which comprise 19.8 km (12.3 mi) of the total SRWEC–OCS length.

To support HDD installation for transition to landfall, an HDD exit pit may be excavated within the SRWEC–NYS corridor. The HDD exit pit would be located approximately 678 m (2,225 ft) from the Mean High Water Line at Smith Point County Park in the Town of Brookhaven, NY. The maximum HDD exit pit dimensions (length x width x depth) would be approximately 50 m x 15 m x 5 m (164 ft x 49 ft x 16 ft).

Hydrodynamics and sediment transport associated with the Project were assessed to understand the most conservative potential seafloor impacts associated with proposed offshore Project construction activities. The construction activities evaluated include:

[2] The Construction and Operations Plan (COP) describes the cable target burial depth as 1.0 to 2.0 m (3 to 7 ft) but for the purpose of this report the modeled burial depth was 2.0 m (6.6 ft).

1) the use of a jet plow for the SRWEC (NYS and OCS) and IAC installation (representative segments in Federal waters),
2) dredging of HDD exit pit using a mechanical dredge or alternate method (open bucket with higher production rate) with temporary placement of excavated sediment either on a barge at the surface or directly on the adjacent seabed (NYS waters)
3) sand wave leveling for seafloor preparation activities along the SRWEC–OCS using CFE (Federal waters), and
4) sand wave leveling for seafloor preparation activities along the SRWEC–OCS using a TSHD (Federal waters).

The hydrodynamic and sediment transport analysis utilized existing environmental data and models to assess sediment turbidity levels (presented as Total Suspended Sediment [TSS]) and resulting deposition (thickness above seafloor) at representative Project locations. The hydrodynamic and sediment transport model results are intended to provide the necessary information for the Project's Construction and Operation Plan (COP) as well as other federal and state permits.

3 Available Data

The following data and modeling sources were consulted and/or utilized for this study. The basis for selecting specific model assumptions from this available data to describe baseline conditions is presented in subsequent sections.

- National Oceanic and Atmospheric Administration (NOAA) Tides and Currents
- NOAA/National Center for Environmental Information (NCEI) hydrographic surveys
- Currents from University of Connecticut's National Oceanographic Partnership Front-Resolving Observation Network with Telemetry (FRONT) Program (Codiga and Houk, 2002)
- Northeast Coastal Ocean Forecast System (NECOFS) 3-D forecast and hindcast model (NERACOOS, Massachusetts Fishery Institution, and MIT Sea Grant College)
- Rhode Island Ocean Special Area Management Plan (OSAMP) (Codiga and Ullman, 2010), (Grilli et. al., 2010)
- U.S. Army Corps of Engineers (USACE) Regional Sediment Management Plan
- Deepwater Wind South Fork Wind Farm: Hydrodynamic and Sediment Transport Modeling Results, RPS (2018)
- U.S. Geological Survey (USGS) East Coast Sediment Texture Database (2014)
- Site-specific geotechnical and geophysical data collected as part of Project (2020)

4 Hydrodynamic and sediment transport modeling Approach

The evaluation of hydrodynamic and sediment transport plays a critical role in evaluating potential temporary and/or permanent impacts to sensitive ecological resources within the vicinity of the disturbance of sediments associated with Project construction activities. These disturbed sediments can transport, mix, settle, deposit, and become re-suspended; their transport and fate being determined by local hydrodynamics. For characterizing the hydrodynamics within the Project area, the hind-cast results of the NECOFS model, which uses the numerical scheme of the FV-COM (Finite-Volume Coastal Ocean Model), was utilized. The NECOFS hydrodynamic model output was then used as input for sediment transport modeling within the Project construction area. The sediment transport model chosen for this application was the Particle Tracking Model (PTM) in the Surface-Water Modeling System (SMS), which uses the equations for the movement of fluid on a rotating earth and integrates the properties of particles within that fluid to simulate resultant transport. This model has been developed for the transport and fate of suspended sediments surrounding dredging and sub-surface construction activity and is therefore suitable for this application.

4.1 Hydrodynamic Model Description

The NECOFS model is a forecast/hindcast coupled ocean and atmospheric forecasting model that covers the Northeast region from south of Nova Scotia to just south of Long Island (Beardsley and Chen, 2013). The modeling system is a coupling of the Weather Research and Forecasting model for atmospheric, Steady-State spectral WAVE for waves modeling and FV-COM for ocean modeling. NECOFS validation included the ability to reconstruct tidal constituents at 93 sites (Chen et al. 2011) as well as hind-cast experiments for water level, temperature, salinity, and currents covering the time-period of 1978 to present day (Chen et al., 2016). Model hindcast data from the regional FVCOM model covering the Gulf of Maine/Georges Bank/New England Shelf region (GOM3-FVCOM[3]) was utilized in this study. Further details of the model theory are given in the FV-COM user manual (Chen et al., 2013).

4.2 Sediment Transport Model Description

The PTM is a Lagrangian particle tracking model that uses hydrodynamics to simulate particle transport processes. PTM was developed by the Coastal Inlets Research Program (CIRP) and the Dredging Operations and Environmental Research Program (DOER) at the USACE Research and Development Center (Demirbilek et al, 2008, 2012). The module is operated through the SMS 13.0 interface. The model's development included applications to dredging and coastal projects involving the disruption and transport of materials. The model accurately simulates the sediment transport, settling, suspension and re-suspension, deposition, and mixing resulting from hydrodynamic and wave processes. The governing equations for the 2-D PTM Model are provided in Appendix A.

5 Hydrodynamic Model Validation

In order to further validate the NECOFS model within the region of Project, comparisons were made between the model output and available measurements. The sections below detail the comparisons made with measured currents and measured tidal conditions for different historical periods.

5.1 NECOFS Model vs. FRONT ADCP Data

The FRONT project (Codiga and Houk, 2002) was an effort to gain insight into the occurrence of surface frontal zones near the 50 m isobath at the eastern entrance to Long Island Sound. This was accomplished through the deployment of a moored array of Acoustic Doppler Current Profilers (ADCPs) in the Fall, Winter and Spring seasons of 2000, 2001, and 2002. The locations of the ADCPs are clustered between Montauk Point on Long Island and Block Island, and regions just to the south.

Surface and bottom currents were collected at each of the following sites: FA00-W (Fall 2000), FA01-LI (Fall 2001), and SP-02 DP (Spring 2002). The locations of the sites are presented in Figure 5.1-1.

Three locations and two seasons were available for comparison between the ADCP data and the NECOFS model output. The time-period chosen for comparison was the entire ADCP deployment time-period for each instrument. The model vertical layer used for comparison was the closest corresponding model layer depth (meters) to the ADCP bin depth for the surface and bottom. For surface comparisons, the ADCP bins closest to the surface were disregarded due to potential contamination from surface reflection. In addition, ADCP bins at the very bottom of the water column were also disregarded due to the possibility of data contamination from

[3] More information about the GOM3-FVCOM regional model structure and results at http://fvcom.smast.umassd.edu/necofs/. Accessed July 14, 2020.

bottom reflection. Unfiltered model and ADCP time-series data were used for the comparison of magnitude and direction of currents.

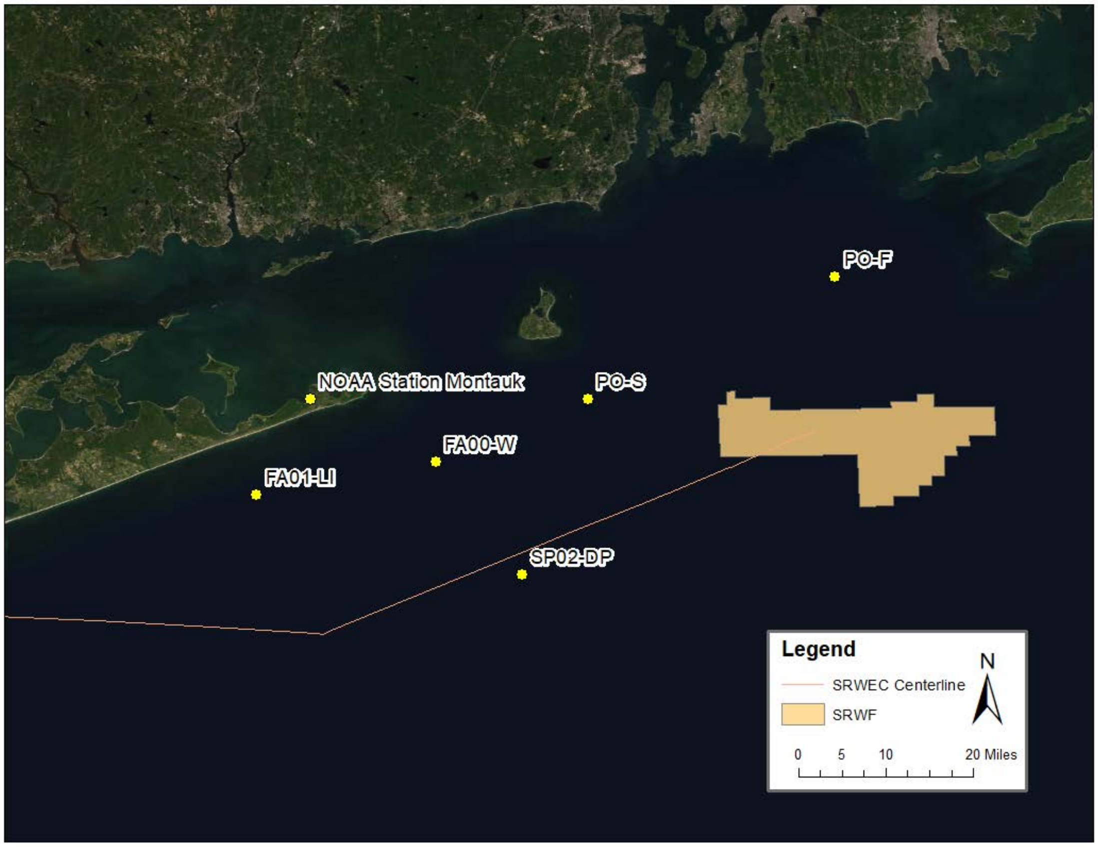

Figure 5.1-1 Locations of measured data available for model validation.

The comparisons are shown in Figures 5.1-2 through 5.1-4 in current roses for both the surface and bottom currents. Overall, the modeled currents are in close agreement with the measurements in terms of magnitude and directionality. The bottom current comparisons appear to be better aligned, particularly at station FA00-W where there are larger discrepancies seen in the surface currents. Since the bottom currents will be utilized from the model for the evaluation of sediment transport, these comparisons indicate the model does well at characterizing current speeds and directionality within the region and can be used to establish hydrodynamic conditions for this purpose.

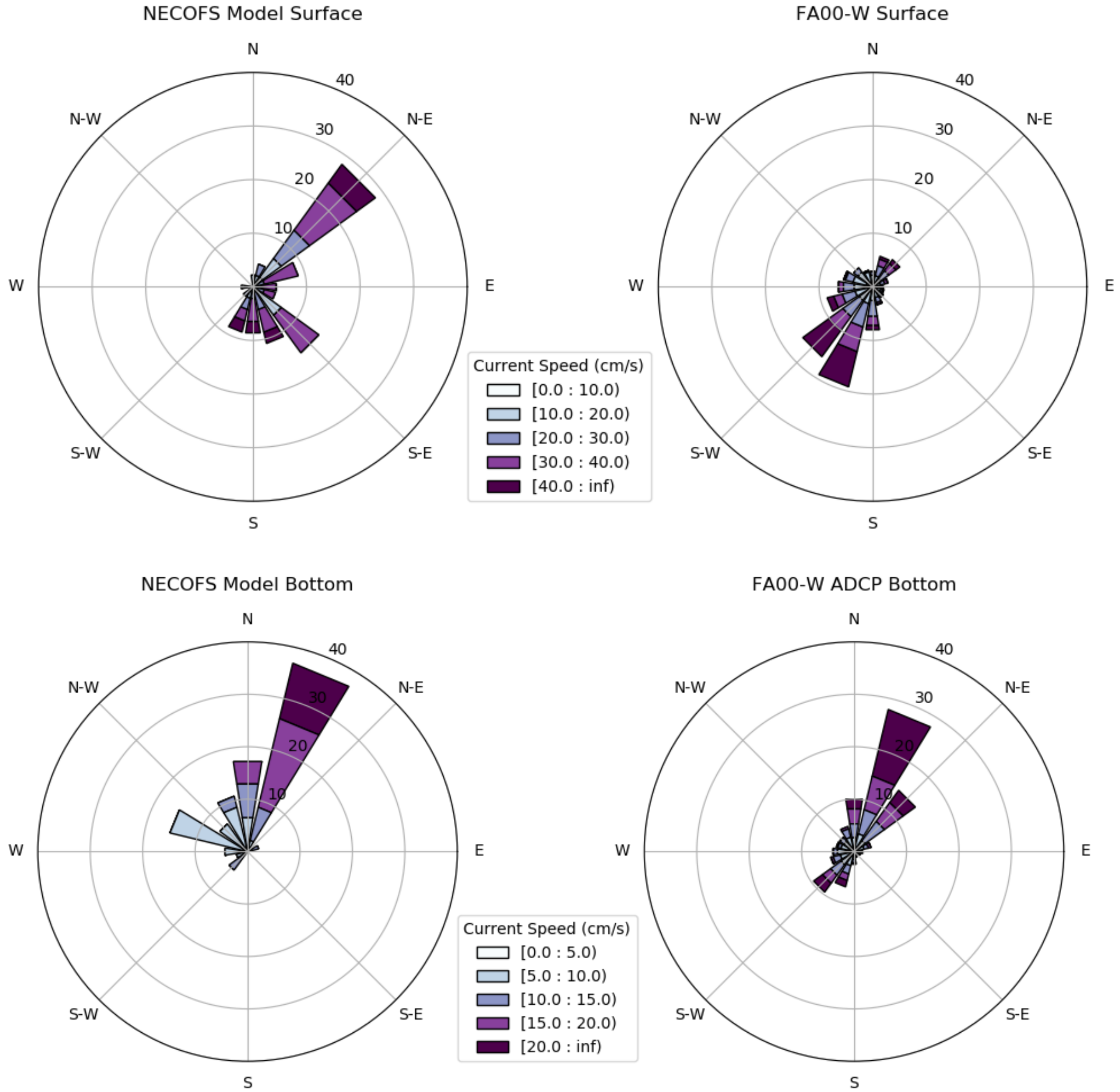

Figure 5.1-2 **Speed and direction of surface (top) and bottom (bottom) currents at the FA00-W ADCP. NECOFS model (left) and measurements (right).**

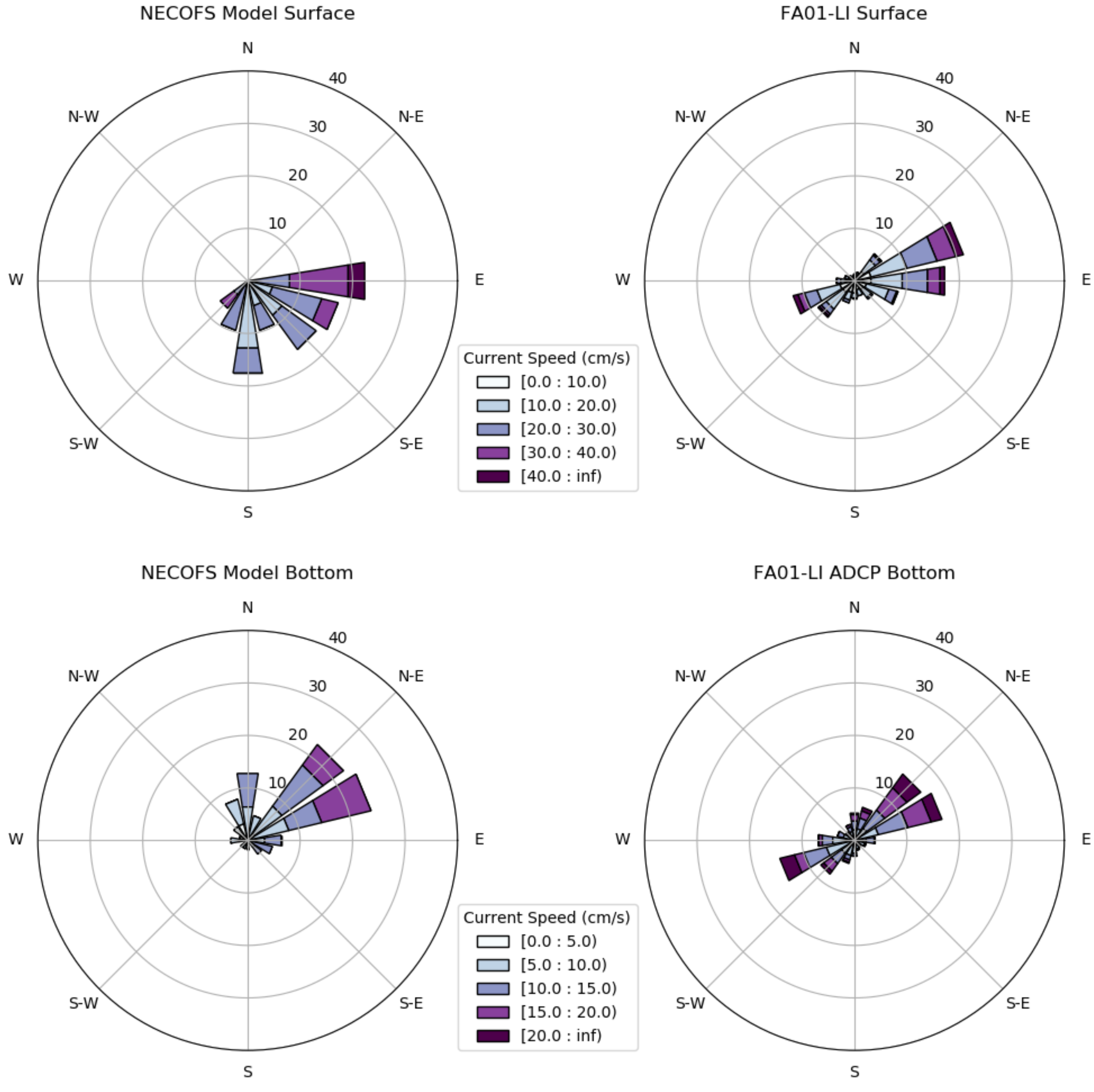

Figure 5.1-3 Speed and direction of surface (top) and bottom (bottom) currents at the FA01-LI ADCP. NECOFS model (left) and measurements (right).

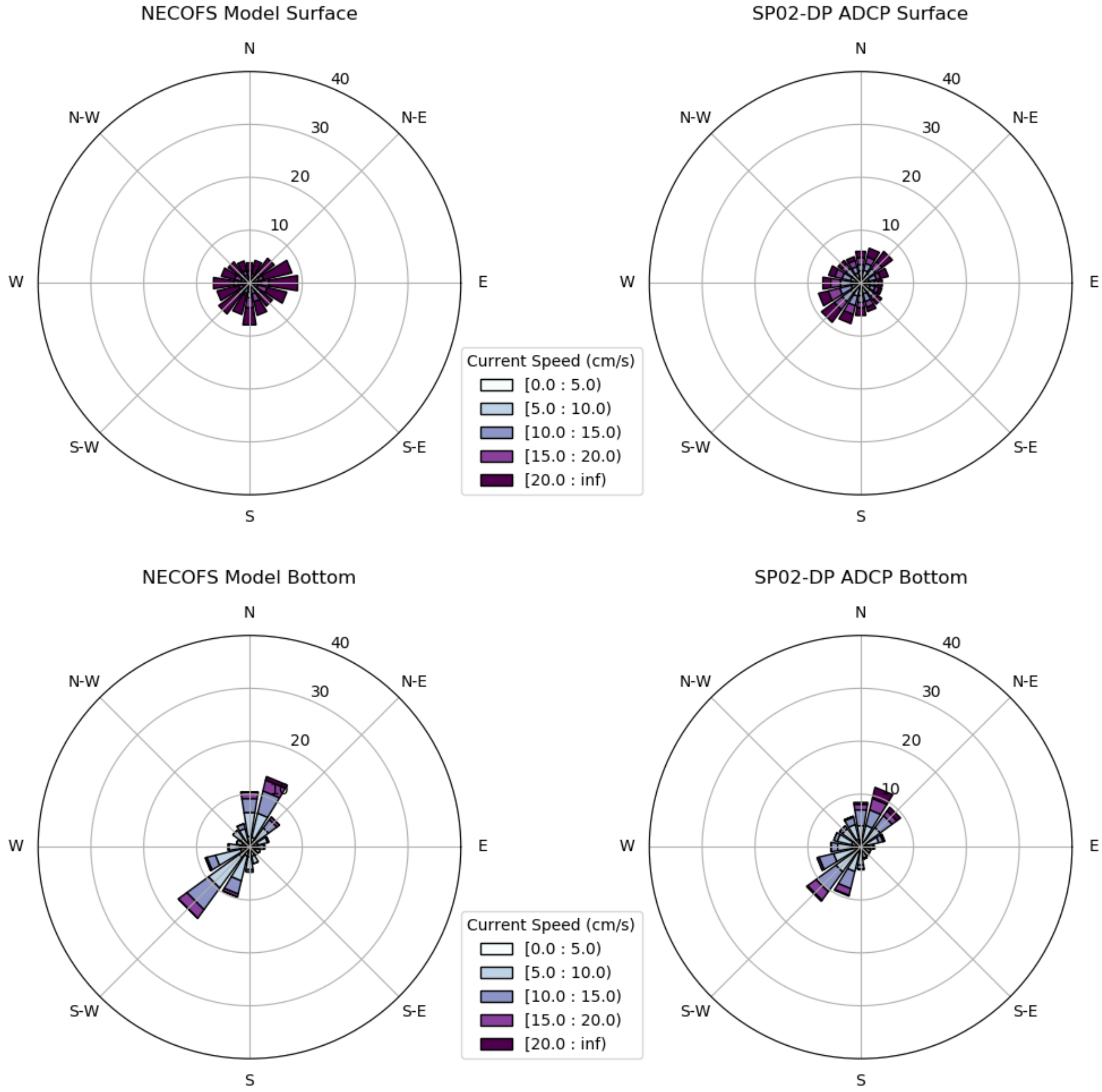

Figure 5.1-4 Speed and direction of surface (top) and bottom (bottom) currents at the SP02-DP ADCP from the FRONT Project. NECOFS model (left) and measurements (right).

5.2 NECOFS Model vs. Tidal Constituent Comparison

The NECOFS model was also evaluated using tidal constituents developed from available measurements within the region. Comparisons were made between the NECOFS model and tidal constituents from the Offshore Renewable Energy OSAMP buoys PO-S and PO-F which collected data in 2009 -2010. Additional comparisons were made between the NECOFS model and tidal constituents developed from water level measurements at NOAA station 8510560 located in Montauk, NY.

Modeled water levels for each time-period were analyzed using the T_tide program (Pawlowicz et al., 2002) to conduct a constituent analysis and determine the primary tidal harmonics. The harmonic amplitude and phase were then compared to amplitude and phase of constituents given in the OSAMP report completed for RI Coastal Resources Management Council (Grilli et al., 2010) and those computed from NOAA water levels at the Montauk station.

The OSAMP buoy locations and NOAA station are shown in Figure 5.1-1, and details on the data collection at PO-F and PO-S buoys are provided in Table 5.2-1.

Table 5.2-1 Locations and dates for field buoys deployed in OSAMP study area (Grilli et al. 2010)

Buoy	Latitude	Longitude	Deployment Dates
PO-S	41.0482^{o} N	71.5003^{o} W	9-15-2009—1-15-2010
PO-F	41.2500^{o} N	71.0917^{o} W	9-15-2009—1-15-2010

Comparisons between the modeled constituents and those developed from measurements are provided for amplitude and phase in Tables 5.2-2 and 5.2-3, respectively. Additionally, Figures 5.2-1 to 5.2-6 show graphical comparisons of the computed constituents together with the calculation uncertainty (shown as error bars).

The comparisons show general agreement between constituent amplitudes (modeled and measured) with most amplitude differences being within the computed error. The exceptions are the M2 constituent at the PO-F and PO-S buoys where the model amplitude is less by approximately 0.1 to 0.15 m. The constituent phases (modeled and measured) compare reasonably well but show larger differences at Montauk. This is somewhat expected given the Montauk tide station is located in a nearshore area that is rather complex and is not as well defined in the NECOFS model.

Table 5.2-2 Summary of the comparison between harmonic constituent amplitude (m) from the model and observations.

Location	Data Source	O1	K1	N2	M2	S2	M4	M6
Montauk	NOAA PORTS	0.0483	0.0577	0.0838	0.3037	0.0768	0.0181	0.0149
NECOFS	GOM3-FVCOM	0.0569	0.0994	0.0493	0.2706	0.0659	0.0350	0.0100

Location	Data Source	O1	K1	N2	M2	S2	M4	M6
POS	Grilli et al. 2010	0.0466	0.0725	0.1035	0.4427	0.0945	0.0218	0.0107
NECOFS	GOM3-FVCOM	0.0456	0.0776	0.0765	0.3356	0.0815	0.0134	0.0008

Location	Data Source	O1	K1	N2	M2	S2	M4	M6
POF	Grilli et al. 2010	0.0478	0.0684	0.1114	0.4517	0.0976	0.0335	0.0057
NECOFS	GOM3-FVCOM	0.0494	0.0600	0.0772	0.3228	0.0947	0.0252	0.0024

Table 5.2-3 Summary of the comparison between harmonic constituent phase (degrees) from the model and observations.

Location	Data Source	O1	K1	N2	M2	S2	M4	M6
Montauk	NOAA PORTS	98.52	156.14	184.08	289.88	43.75	105.48	161.33
NECOFS	GOM3-FVCOM	311.64	143.87	213.83	155.84	43.15	181.36	118.61

Location	Data Source	O1	K1	N2	M2	S2	M4	M6
POS	Grilli et al. 2010	193.33	166.82	350.54	3.92	18.70	16.31	201.29
NECOFS	GOM3-FVCOM	112.30	114.44	41.31	252.99	291.94	155.22	298.27

Location	Data Source	O1	K1	N2	M2	S2	M4	M6
POF	Grilli et al. 2010	194.82	167.2	334.74	0.92	18.23	7.41	180.12
NECOFS	GOM3-FVCOM	106.95	123.17	44.95	254.82	299.86	148.70	10.37

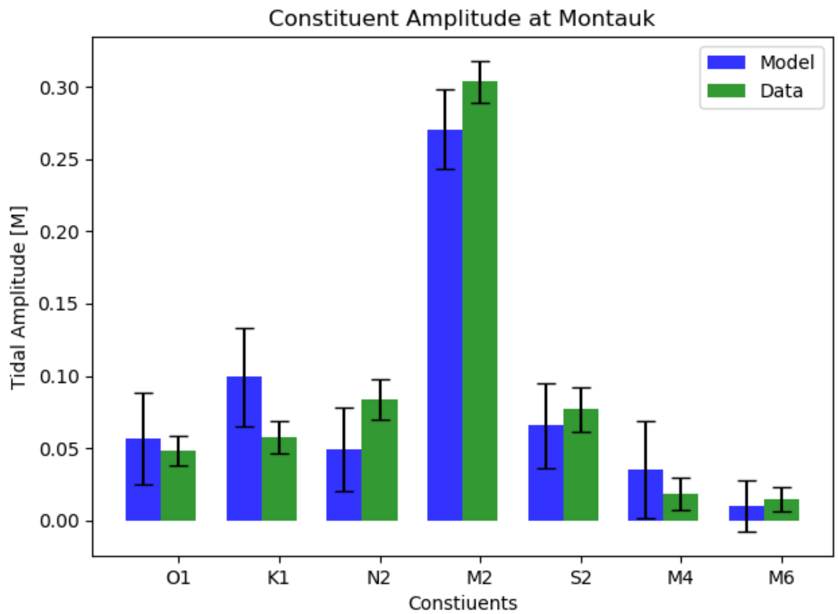

Figure 5.2-1 **Comparison of tidal amplitude (meters) for each of the major constituents extracted from the time-series 10/8/2001-11/7/2001 at Montauk. Modeled output is in blue, and observations are in green. The error bar represents the computed amplitude error.**

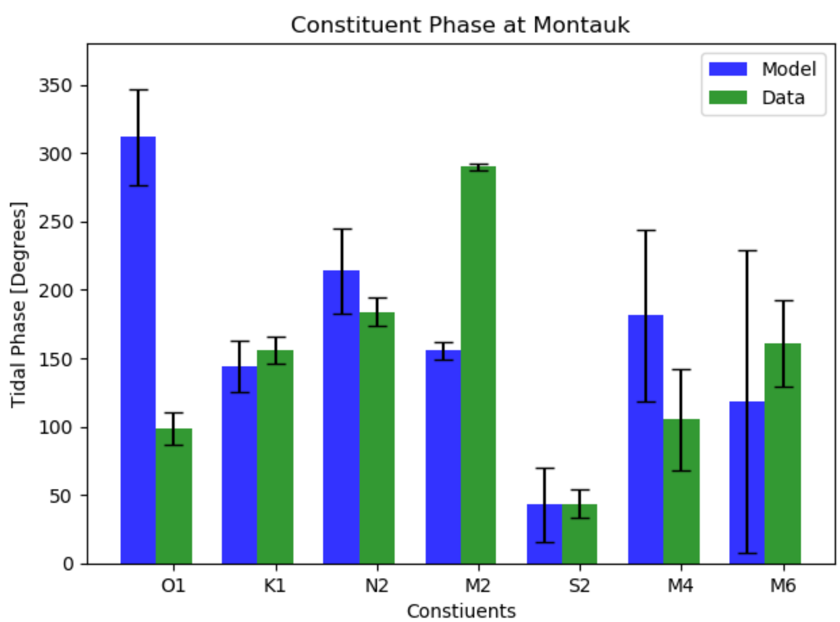

Figure 5.2-2 **Comparison of tidal phase (degrees) for each of the major constituents extracted from the time-series 10/8/2001-11/7/2001 at Montauk. Modeled output is in blue, and observations are in green. The error bar represents the computed tidal phase error.**

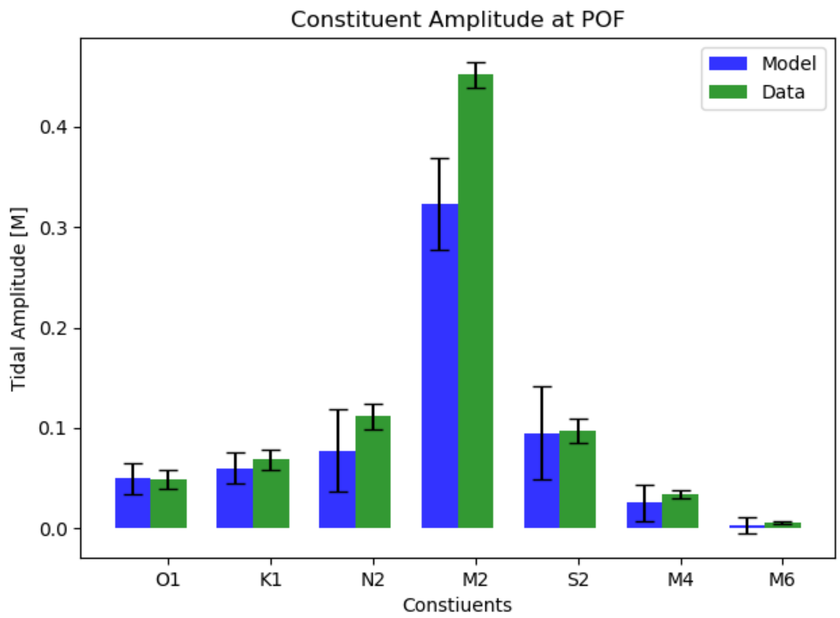

Figure 5.2-3 **Comparison of tidal amplitude (meters) for each of the major constituents extracted from the time-series 9/15/2009-1/15/2010 at observation buoy POF. Modeled output is in blue, and observations are in green. The error bar represents the computed amplitude error.**

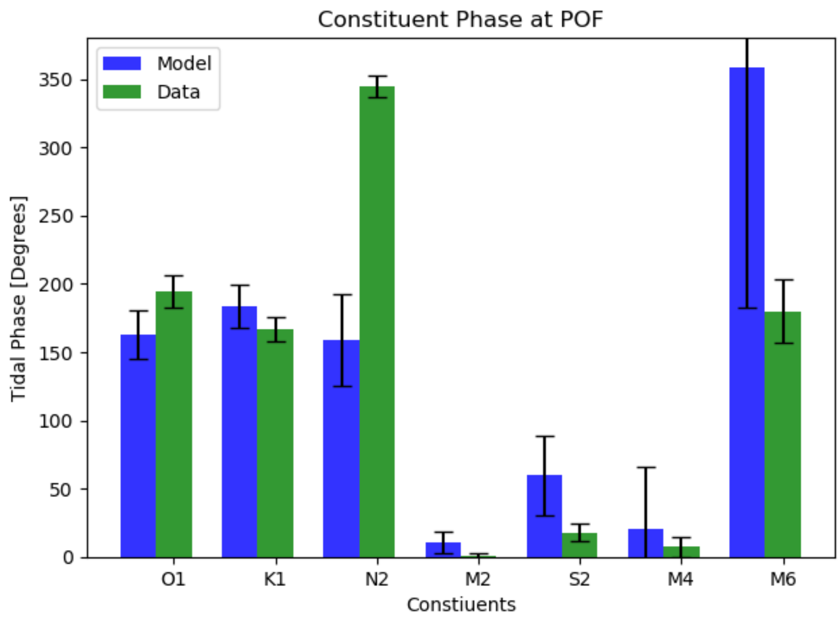

Figure 5.2-4 **Comparison of tidal phase (degrees) for each of the major constituents extracted from the time-series 9/15/2009-1/15/2010 at observation buoy POF. Modeled output is in blue, and observations are represented in green. The error bar represents the computed tidal phase error.**

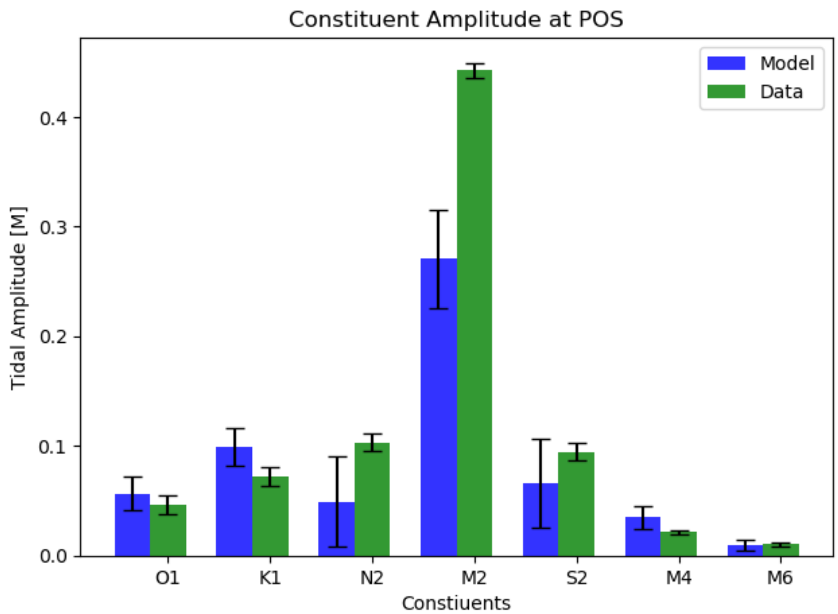

Figure 5.2-5 **Comparison of tidal amplitude (meters) for each of the major constituents extracted from the time-series 9/15/2009-1/15/2010 at observation buoy POS. Modeled output is in blue and observations are in green. The error bar represents the computed amplitude error.**

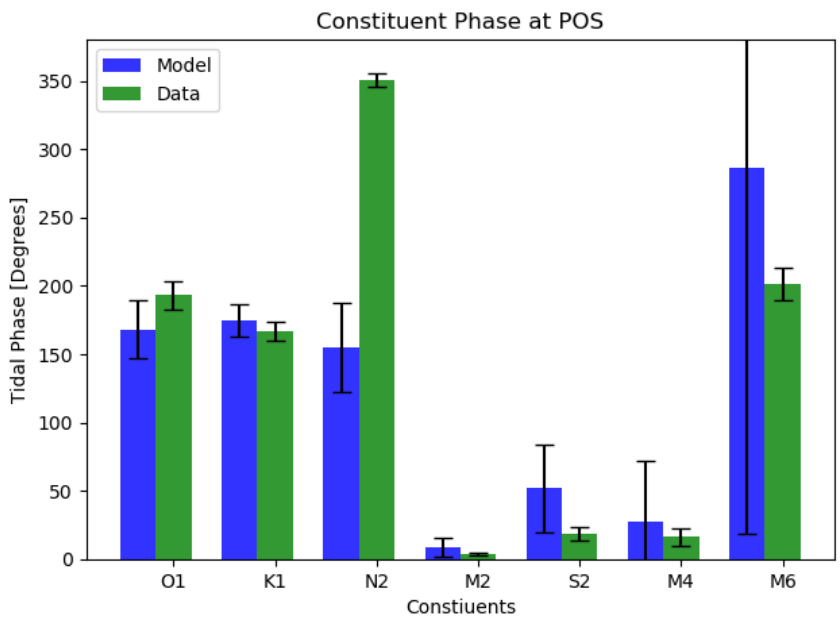

Figure 5.2-6 **Comparison of tidal phase (degrees) for each of the major constituents extracted from the time-series 9/15/2009-1/15/2010 at observation buoy POS. Modeled output is in blue and observations are represented in green. The error bar represents the computed tidal phase error.**

6 Selection of Representative Hydrodynamic Conditions

6.1 Average Year

A 39-year hourly hindcast product is available from the regional NECOFS model that provides both meteorological and oceanic model outputs. For this study, it was desired to select a year from the 39-year hindcast that was representative of average annual conditions.

To select a representative average year, bulk statistics were computed using the model current output at five (5) representative sites along the SRWEC shown in Figure 6.1-1. A short list of years (8 in total: 1978, 1991, 1992, 1994, 1997, 2012, 2013, 2015) were identified for which statistics were similar to statistics computed from 39-years of data. Current roses were developed for each shortlisted year at each site and the years were then ranked based on visual inspection/comparison with the 39-year period. Four (4) years were identified as being potential representative years between the different sites. The year rankings were compiled for each site and an overall ranking was developed based on the combined site rankings.

This process resulted in the selection of 1997 as being the most representative of average annual conditions. Comparisons of current roses developed from the 39-year dataset and the year 1997 for the five (5) sites are shown in Figures 6.1-2 and 6.1-3.

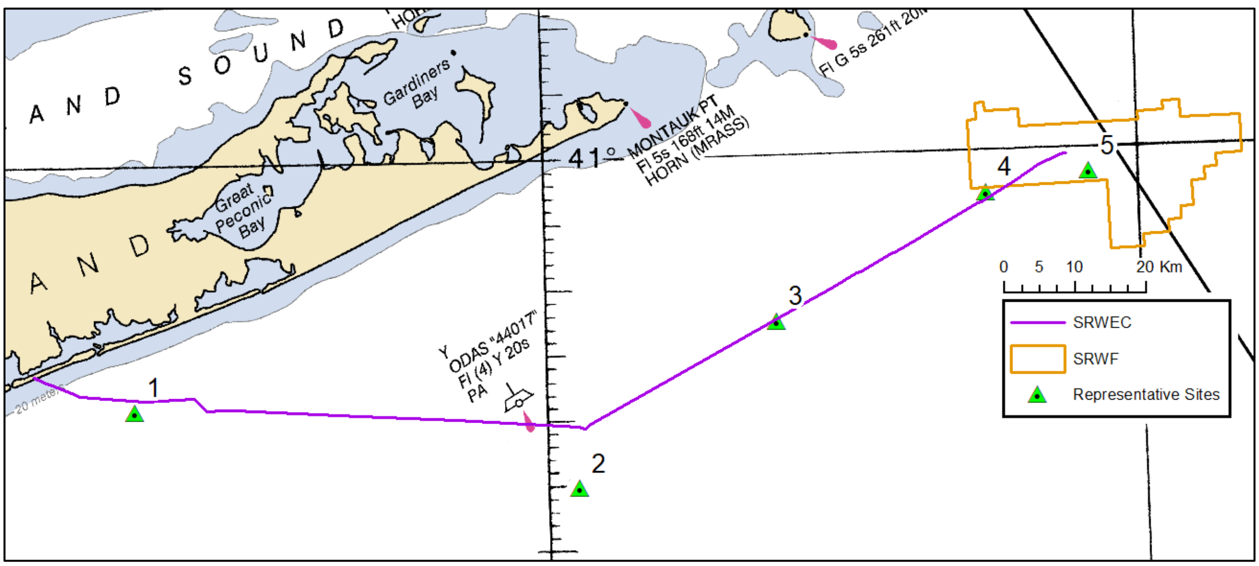

Figure 6.1-1 Sites selected along proposed SRWEC for evaluation of representative hydrodynamic conditions (average year).

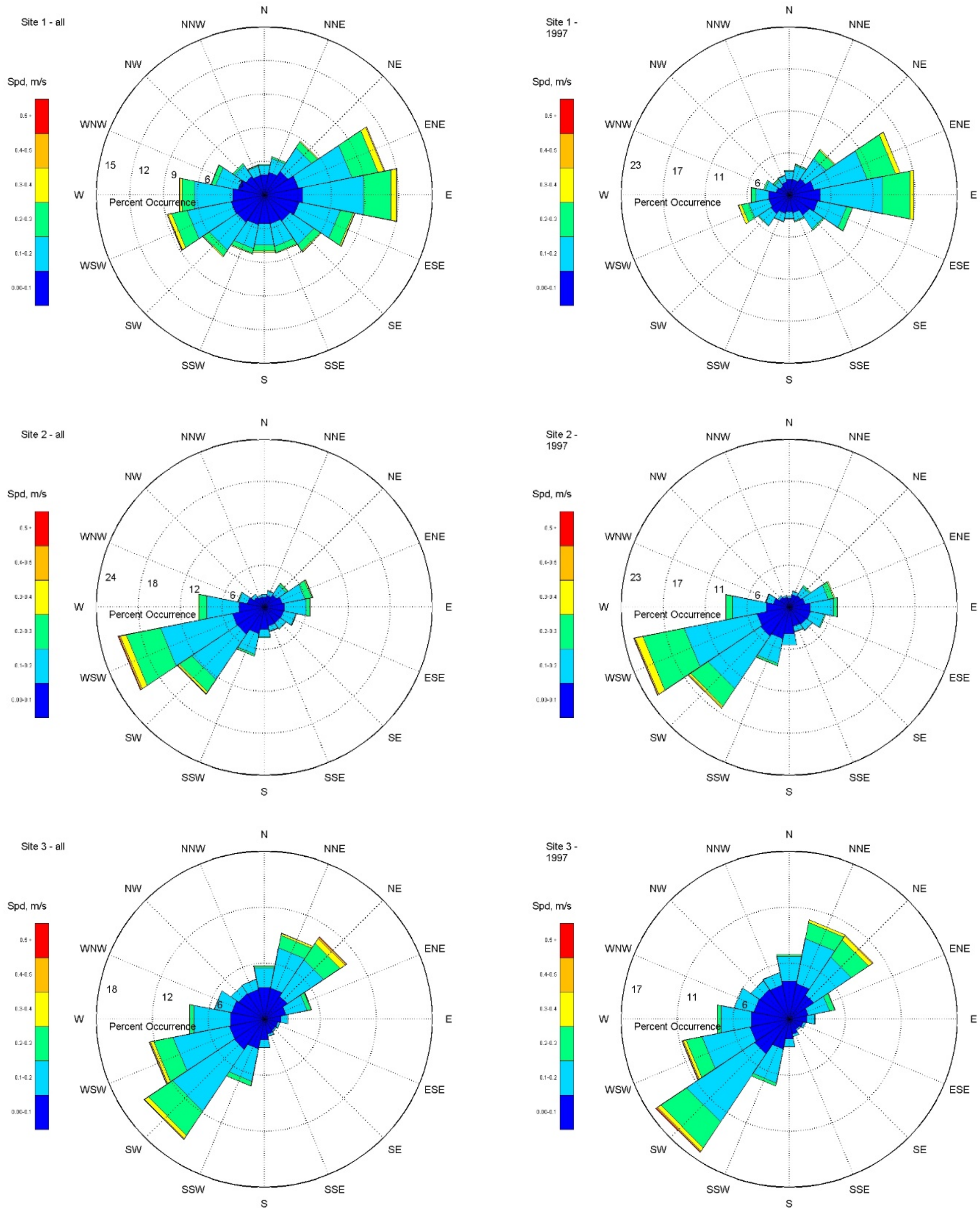

Figure 6.1-2 Current rose comparisons between 39-year dataset (left) and the representative year 1997 (right) at sites 1 (top), 2 (middle), and 3 (bottom).

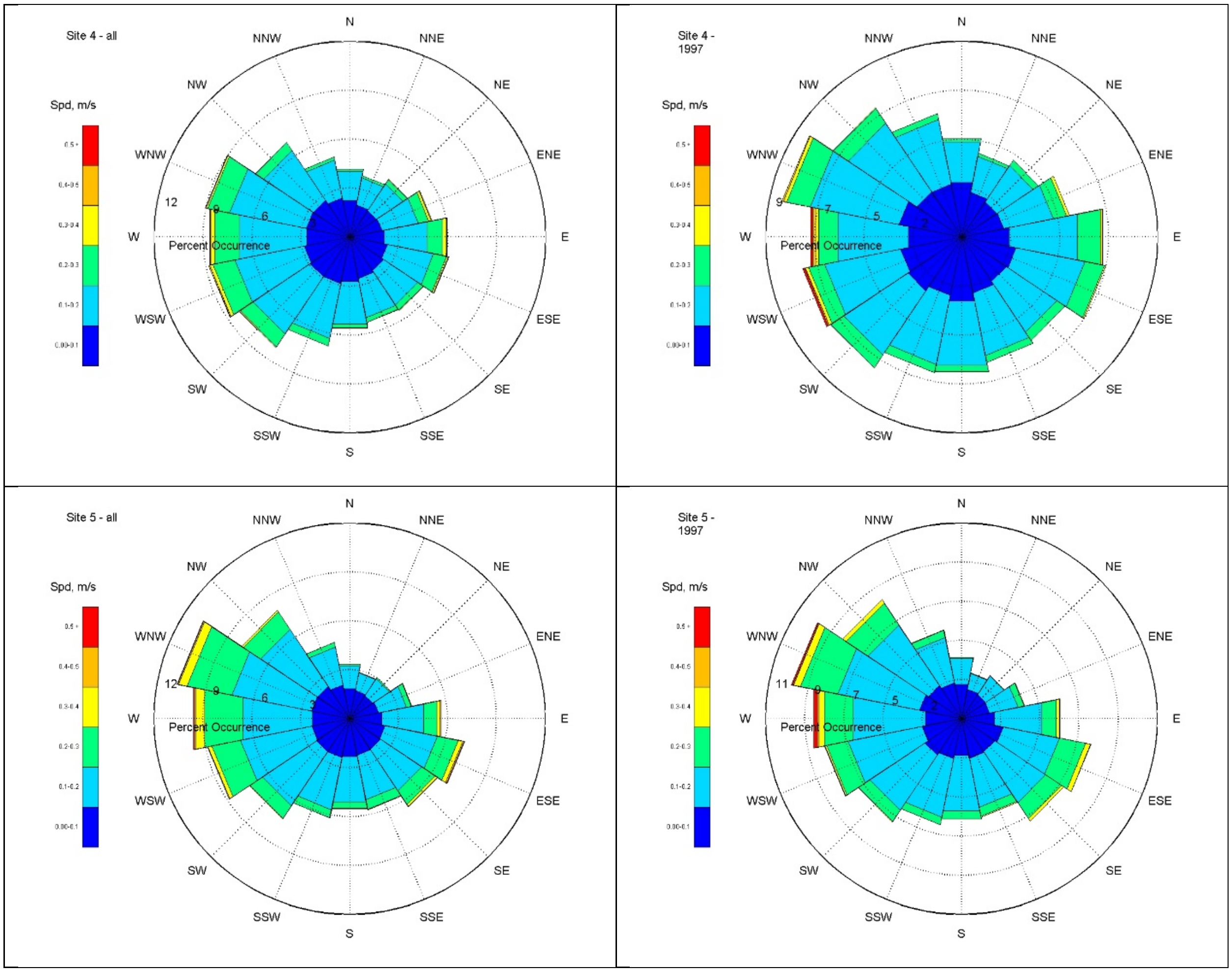

Figure 6.1-3 **Current rose comparisons between 39-year dataset (left) and the representative year 1997 (right) at sites 4 (top) and 5 (bottom).**

6.2 Characteristic Currents

The sediment transport model requires input bottom currents (velocity and direction) from the NECOFS hydrodynamic model. For the representative year of 1997, a 70-day period beginning on September 1st and ending on November 10th was selected for providing currents from NECOFS. This was based on most proposed construction activities having operations in the Fall season and the occurrence of meteorological events in the Fall season that produce higher currents. Currents were separated into u- and v- velocity components and extracted for the bottom portion of the water column. The bottom 15 sigma-layers from the NECOFS model were used to represent roughly the bottom one-third of the water column (total of 45 vertical layers). This was considered sufficient for the representative currents capable of initiating sediment transport along the SRWEC and at the SRWF.

7 Sediment Characteristics

Sediment characteristics along the SRWEC (NYS and federal waters) and within the SRWF were provided from core sampling collected from May 17 to August 23, 2020, in support of the Project. This sediment sampling included *in situ* cone penetrometer test with pore water pressure (CPTU) data acquisition and vibrocore sampling with and without VibroHeat thermal resistivity testing (TRT). Sieve analyses were conducted following sampling to determine the grain size distribution at each location.

Grain size distributions, median grain size, and *in-situ* bulk sediment densities were developed from the samples and used in the model scenarios for sediment transport at the HDD exit pit, along the SRWEC, and at representative IAC locations within the SRWF.

Core samples collected along SRWEC were matched to the nearest SRWEC Kilometer Point (KP) location, enabling varying sediment characteristics to be specified every 1000 meters along the SRWEC as model input data. Along the SRWEC–NYS, an average sediment classification from the KP sites (1 through 9) was determined with 94.4% of the sediment classified as sand, 3.3% classified as gravel, and 2.3% classified as fine-grained material. Along the SRWEC–OCS, an average sediment classification from the KP sites was determined with 83.1% of sediment classified as sand, 3.7% classified as gravel, and 13.2% classified as fine-grained material.

The sample locations used to model the SRWEC–NYS and SRWEC–OCS are listed in Tables 7-1 and 7-2, respectively, including the median grain size, standard deviation, and sediment distribution at each site. Figure 7-1 shows KP locations 1 through 9 along the SRWEC–NYS and Figure 7-2 shows the remaining KP locations along the SRWEC–OCS.

The sediment characteristics for the HDD exit pit were taken from KP site 1 and are displayed in Table 7-1. This is the closest point located within NYS waters to the HDD exit pit (within 200 m of the HDD exit pit location), as shown in Figure 7-2. The sediment samples utilized for this scenario provide representative sediment conditions.

Within the SRWF, 53 core samples were collected, and two locations were used to represent a worst case and a typical case for sediment transport modeling of the IACs. For the worst-case scenario, a sediment sample with a higher percentage of fines was selected (53.9% at Location ID SRW01_IAC_V027). The selected sediment sample locations are identified in Figure 7-3 and the sediment characteristics are listed in Table 7-3.

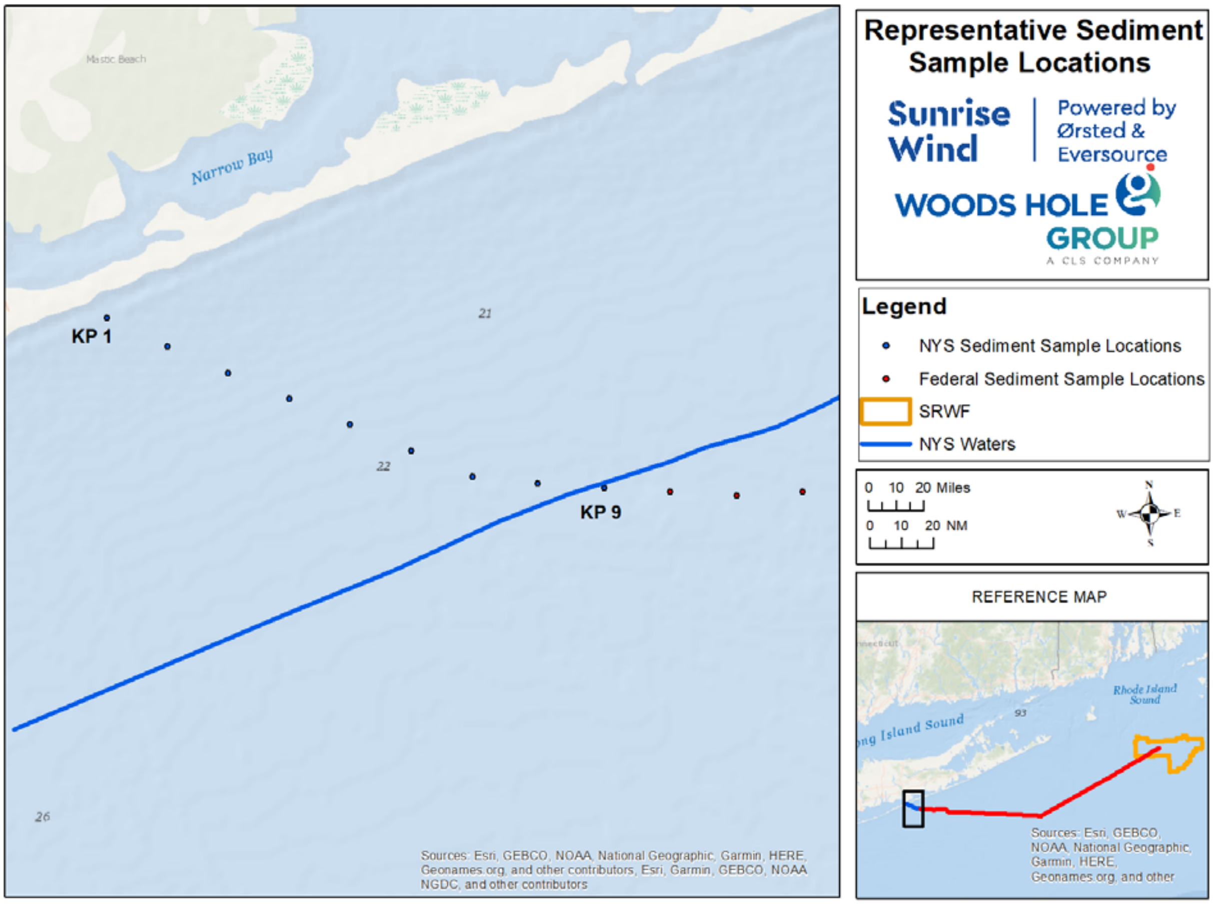

Figure 7-1 KP sediment sample locations 1 through 9 in NYS waters

Table 7-1 NYS water sediment grain size characteristics

Location				Grain Size			Grain Size Distribution		
KP	UTM-X (m)	UTM-Y (m)	Location ID	Density (kg/m³)	d50 (mm)	Standard Deviation	Gravel (%)	Sand (%)	Fines (%)
1	176431.03	4515462.3	SRW01_ECR_V002	1814.09	0.44	0.85	8.75	90.51	0.73
2	176431.03	4515462.3	SRW01_ECR_V002	1814.09	0.44	0.85	8.75	90.51	0.73
3	176431.03	4515462.3	SRW01_ECR_V002	1814.09	0.44	0.85	8.75	90.51	0.73
4	177326.98	4515021.4	SRW01_ECR_V003	1756.55	0.24	0.64	0.39	97.07	2.54
5	178089.2	4514639.6	SRW01_ECR_V004	1555.18	0.27	0.85	1.16	97.26	1.58
6	179118.41	4514132.7	SRW01_ECR_V005	1847.34	0.22	0.71	0.52	97.33	2.16
7	180013.95	4513688.2	SRW01_ECR_V006	1910.29	0.19	0.85	0.84	95.82	3.34
8	180961.56	4513408.2	SRW01_ECR_V007	1875.48	0.17	0.77	0.00	97.00	3.00
9	182332.54	4513228.6	SRW01_ECR_V008	1767.58	0.15	0.72	0.00	93.96	6.04

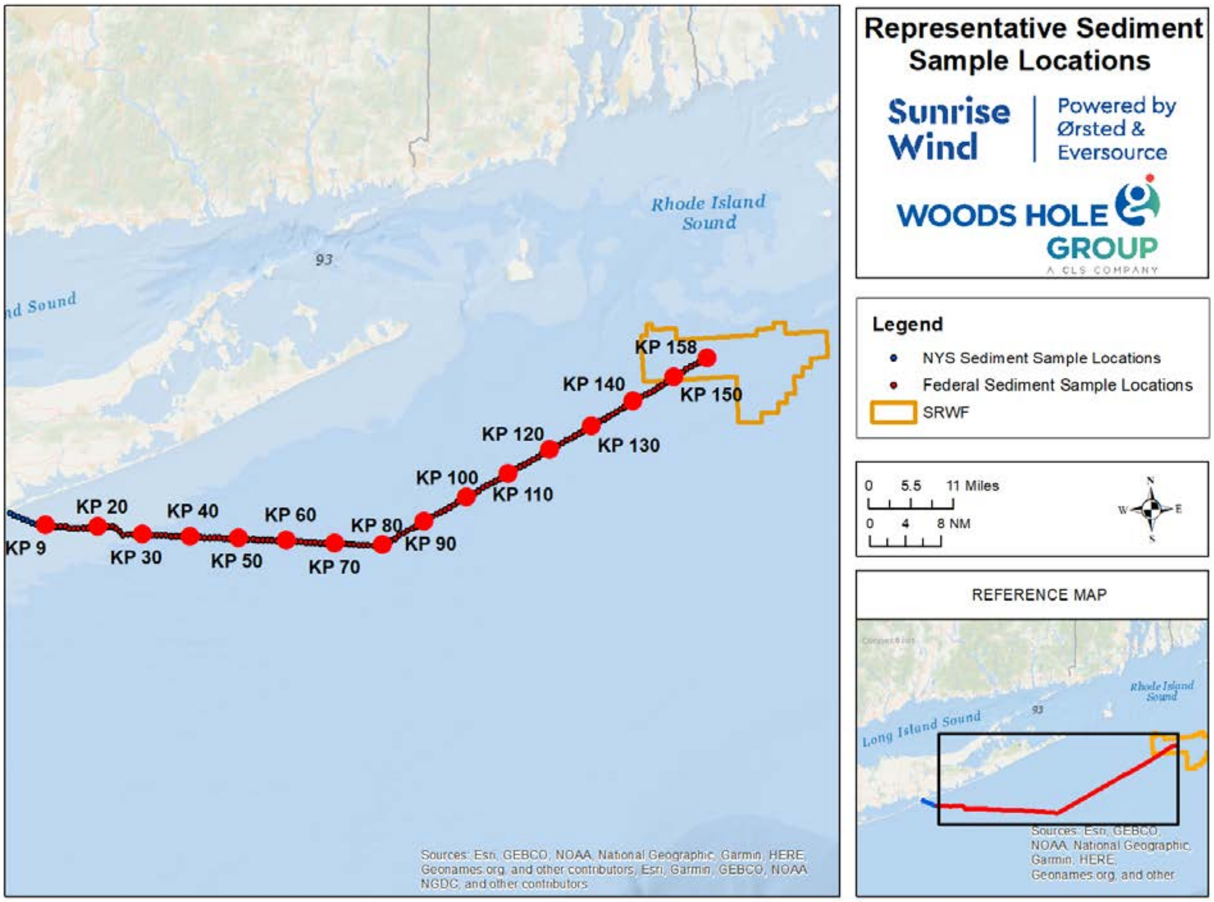

Figure 7-2 KP sediment sample locations along SRWEC–OCS in Federal waters

Table 7-2 Federal water sediment grain size characteristics

Location				Grain Size			Grain Size Distribution		
KP	UTM-X (m)	UTM-Y (m)	Location ID	Density (kg/m³)	d50 (mm)	Standard Deviation	Gravel	Sand	Fine
9	182332.5	4513229	SRW01_ECR_V008	1767.58	0.15	0.72	0	93.96	6.04
10	183500.4	4513087	SRW01_ECR_V009	1960.91	0.21	0.76	0	93.39	6.61
11	183936.7	4513046	SRW01_ECR_V010	1924.33	0.18	0.77	0.77	97	2.23
12	185657.3	4512823	SRW01_ECR_V012	1891.35	0.19	0.74	0.91	96.26	2.83
13	186914.6	4512681	SRW01_ECR_V013B	2120	0.7	1.06	9.5	86.5	4
14	186914.6	4512681	SRW01_ECR_V013B	2120	0.7	1.06	9.5	86.5	4
15	188132.5	4512519	SRW01_ECR_V014	2024.16	0.12	0.7	0	92.51	7.49
16	188900.3	4512437	SRW01_ECR_V015	1741.32	0.18	0.72	0	96.57	3.43
17	189893.2	4512317	SRW01_ECR_V016	1764.95	0.21	0.68	0	95.5	4.5
18	191474.2	4512604	SRW01_ECR_V328	1975.01	0.14	0.71	0	94.01	5.99
19	191474.2	4512604	SRW01_ECR_V328	1975.01	0.14	0.71	0	94.01	5.99

20	192773	4512451	SRW01_ECR_V329	1942.32	0.18	0.83	0	96.38	3.62
21	193782.8	4512317	SRW01_ECR_V330	1840.64	0.16	0.67	1.48	93.99	4.53
22	195498.2	4512654	SRW01_ECR_V331	1862.17	0.17	0.74	0.39	96.83	2.78
23	195498.2	4512654	SRW01_ECR_V331	1862.17	0.17	0.74	0.39	96.83	2.78
24	197646.4	4511395	SRW01_ECR_V333	1663.64	0.28	0.77	1.65	95.99	2.36
25	197646.4	4511395	SRW01_ECR_V333	1663.64	0.28	0.77	1.65	95.99	2.36
26	198224.7	4510656	SRW01_ECR_V025	1953.39	0.18	0.61	0.28	92.98	6.74
27	199027.5	4510573	SRW01_ECR_V026	1434.5	0.28	0.8	2.23	41.39	56.38
28	200341	4510451	SRW01_ECR_V027	1215.71	0.27	0.59	0.71	97.48	1.8
29	201332.3	4510352	SRW01_ECR_V028	1905	0.2	0.57	0.24	94.5	5.27
30	202330.1	4510254	SRW01_ECR_V029A	1651.71	0.33	0.58	1.14	97.05	1.81
31	203325.4	4510157	SRW01_ECR_V030	1391.44	0.28	0.52	1.29	97.71	1
32	204318.7	4510057	SRW01_ECR_V031	1642.53	0.36	0.72	6.3	91.34	2.36
33	205274.4	4509954	SRW01_ECR_V032	1608.9	0.29	0.54	1.94	96.06	2
34	206309.7	4509860	SRW01_ECR_V033	1680.37	0.21	0.54	1	96.6	2.4
35	206309.7	4509860	SRW01_ECR_V033	1680.37	0.21	0.54	1	96.6	2.4
36	208299.2	4509662	SRW01_ECR_V035	1913.61	0.11	0.55	0	93.67	6.33
37	209294.7	4509561	SRW01_ECR_V036	1915.84	0.26	0.84	0	96.5	3.5
38	210222.6	4509459	SRW01_ECR_V037	1680	0.14	0.8	1	91	8
39	211286.5	4509362	SRW01_ECR_V038	1510	0.4	0.91	2	96.5	1.5
40	212282.3	4509265	SRW01_ECR_V039A	1814.79	0.24	0.71	0.28	83.85	15.86
41	213273.3	4509165	SRW01_ECR_V040	1700	0.22	0.44	0	98.5	1.5
42	214270.1	4509064	SRW01_ECR_V041	1772.65	0.24	0.7	0.63	97.06	2.31
43	215266.2	4508967	SRW01_ECR_V042	1844.17	0.32	0.75	1.09	95.78	3.12
44	216262.6	4508868	SRW01_ECR_V043	1985.08	0.6	0.96	6.58	88.98	4.43
45	217255	4508770	SRW01_ECR_V044	1979.03	0.22	0.9	1.22	91.85	6.93
46	218252.2	4508669	SRW01_ECR_V045	1756.12	0.62	1.16	22.24	75.27	2.5
47	219245.8	4508570	SRW01_ECR_V046	1849.27	0.22	0.71	0	98	2
48	219245.8	4508570	SRW01_ECR_V046	1849.27	0.22	0.71	0	98	2
49	221237	4508373	SRW01_ECR_V048	1998.16	0.04	0.8	0.18	25.36	74.45
50	222233.4	4508275	SRW01_ECR_V049	1950	0.07	1.22	2.65	41.29	56.06
51	222905.9	4508206	SRW01_ECR_V050	1908.9	0.28	0.55	3.46	83.62	12.91
52	224221	4508077	SRW01_ECR_V051	1957.65	0.27	0.76	6.21	91.06	2.73
53	225152.8	4507976	SRW01_ECR_V052	1770.92	0.31	0.69	0.77	96.71	2.52
54	226211.7	4507881	SRW01_ECR_V053	1865.89	0.32	0.77	2.58	94.32	3.11
55	227207.4	4507781	SRW01_ECR_V054	1976.29	0.09	1.8	5.82	43.99	50.18
56	228200.7	4507680	SRW01_ECR_V055	1924.24	0.28	0.86	1.39	94.6	4
57	229198.7	4507584	SRW01_ECR_V056	2037.02	0.31	0.9	6.04	80.05	13.91
58	230150.4	4507484	SRW01_ECR_V057	2045.97	0.18	0.9	9	83.8	7.2
59	231186.7	4507383	SRW01_ECR_V058	1884.67	0.19	0.78	0.5	95.51	4
60	232182	4507285	SRW01_ECR_V059	2043.16	0.28	1	9.05	87.33	3.62

61	233177.3	4507185	SRW01_ECR_V060	1633.99	0.19	0.83	2.05	95.47	2.47
62	234170.5	4507075	SRW01_ECR_V061	1904.36	0.47	0.97	7.9	89	3.1
63	235109.6	4506956	SRW01_ECR_V062	2021.92	0.37	1.07	4.69	84.85	10.46
64	236157.7	4506846	SRW01_ECR_V063	2042.97	0.13	0.66	0.74	90.15	9.11
65	237150.6	4506731	SRW01_ECR_V064	1854.71	0.62	0.86	6.65	90.58	2.77
66	238145	4506618	SRW01_ECR_V065	2054.04	0.27	0.84	1	96.6	2.4
67	238732.5	4506531	SRW01_ECR_V066	2026.48	0.22	0.64	0.66	95.69	3.66
68	240097.3	4506378	SRW01_ECR_V067	2019.93	0.29	0.78	4	92	4
69	241125.6	4506273	SRW01_ECR_V068	1882.82	0.49	1.06	3.8	93.44	2.76
70	242118.6	4506155	SRW01_ECR_V069	1922.6	0.38	0.69	1.83	96.74	1.43
71	243223.6	4506017	SRW01_ECR_V070	1726.18	0.45	0.75	3.35	94.67	1.98
72	244103.7	4505924	SRW01_ECR_V071	1807.02	0.35	1.29	4.38	89.62	6
73	245058.8	4505803	SRW01_ECR_V072	1748.62	0.38	0.79	5.83	93.17	1
74	246091.1	4505694	SRW01_ECR_V073	1980.36	0.41	1.04	14.23	65.76	20.01
75	247084.1	4505579	SRW01_ECR_V074	1610	0.29	0.64	1	97	2
76	248079.6	4505467	SRW01_ECR_V075	1848.97	0.42	0.85	5.27	30.1	64.63
77	249072.9	4505351	SRW01_ECR_V076	2011.05	0.09	0.53	0.27	56.98	42.74
78	250004.3	4505230	SRW01_ECR_V077	1970.05	0.46	0.81	14.55	84.45	1
79	251458	4505064	SRW01_ECR_V078	1704.33	0.8	1.09	26.36	71.64	2
80	251819.6	4505241	SRW01_ECR_V079	1682.23	0.22	0.89	0	96	4
81	252897.9	4505731	SRW01_ECR_V080	1706.88	0.67	0.89	16.33	82.67	1
82	253794.4	4506173	SRW01_ECR_V081	1652.15	0.59	0.95	20.14	77.77	2.08
83	254690.4	4506618	SRW01_ECR_V082A	2075.23	0.21	3.39	4.07	39.21	56.72
84	254690.4	4506618	SRW01_ECR_V082A	2075.23	0.21	3.39	4.07	39.21	56.72
85	256482.6	4507508	SRW01_ECR_V084	2030	0.15	2.35	2	65.5	32.5
86	256899.1	4507762	SRW01_ECR_V085A	1965	0.13	2	4.67	31	64.33
87	258272.9	4508394	SRW01_ECR_V086	2085.54	0.33	1.85	7.97	81.09	10.94
88	258272.9	4508394	SRW01_ECR_V086	2085.54	0.33	1.85	7.97	81.09	10.94
89	260065.7	4509284	SRW01_ECR_V088	1905.04	0.23	1.38	0.65	90.95	8.4
90	260963.8	4509728	SRW01_ECR_V089	1870.7	0.18	0.78	1.71	56.06	42.23
91	261738.8	4510157	SRW01_ECR_V090	2020	0.1	2.23	1	64	35
92	262756.3	4510617	SRW01_ECR_V091	1900.18	0.12	0.62	0.45	56.7	42.86
93	263651.6	4511061	SRW01_ECR_V092	1943.64	0.17	0.9	1.29	87.36	11.36
94	264544.4	4511505	SRW01_ECR_V093	1781.95	0.33	1.02	1.75	92.07	6.18
95	265439.5	4511950	SRW01_ECR_V094	2160	0.31	1.27	0	91.5	8.5
96	266264.7	4512358	SRW01_ECR_V095	1855.51	0.33	2.09	10.94	77.86	11.19
97	267233.6	4512838	SRW01_ECR_V096	1808.12	0.07	1.99	0	63	37
98	268129.6	4513284	SRW01_ECR_V097	2059.37	0.08	1.54	0	65.88	34.12
99	269384	4513952	SRW01_ECR_V098	1946.95	0.14	2.63	11.86	54.7	33.44
100	269921.3	4514170	SRW01_ECR_V099	1746.49	0.06	1.45	0	52.44	47.56
101	271104.2	4514808	SRW01_ECR_V101	1634.65	0.57	0.93	9.11	88.55	2.34

102	271714.5	4515060	SRW01_ECR_V104	1818.09	0.12	2.34	0.99	70.76	28.25
103	271714.5	4515060	SRW01_ECR_V104	1818.09	0.12	2.34	0.99	70.76	28.25
104	273504.1	4515950	SRW01_ECR_V106	1975.42	0.1	1.93	0.82	66.62	32.56
105	273504.1	4515950	SRW01_ECR_V106	1975.42	0.1	1.93	0.82	66.62	32.56
106	275885.4	4517176	SRW01_ECR_V109	1778.97	0.11	1.07	0.24	84.93	14.84
107	275885.4	4517176	SRW01_ECR_V109	1778.97	0.11	1.07	0.24	84.93	14.84
108	277985.5	4518172	SRW01_ECR_V111	1763.97	0.33	1.17	7.09	86.73	6.18
109	277985.5	4518172	SRW01_ECR_V111	1763.97	0.33	1.17	7.09	86.73	6.18
110	278880.2	4518614	SRW01_ECR_V112	1902.72	0.45	1.15	4.31	90.99	4.7
111	279775.5	4519059	SRW01_ECR_V113	2004.06	0.23	0.73	1.48	93.09	5.43
112	280672.1	4519502	SRW01_ECR_V114	1611.87	0.27	1.18	7.75	86.23	6.02
113	281567.5	4519948	SRW01_ECR_V115	1809.27	0.37	1.13	11.72	44.7	43.58
114	282460.7	4520398	SRW01_ECR_V116	1715.85	0.18	1.26	0.57	90.99	8.44
115	283361	4520832	SRW01_ECR_V117	1937.55	0.24	2.84	5.43	74.75	19.81
116	284741.4	4521536	SRW01_ECR_V118	1916.79	0.34	2.11	9.51	76.4	14.1
117	284741.4	4521536	SRW01_ECR_V118	1916.79	0.34	2.11	9.51	76.4	14.1
118	285628.3	4521992	SRW01_ECR_V119	1899.32	0.43	1.41	1.27	92.23	6.49
119	286516.7	4522449	SRW01_ECR_V120	1765.91	0.29	1.2	0.3	93.39	6.31
120	287407	4522909	SRW01_ECR_V121	1985.57	0.25	1.37	2.77	91.29	5.94
121	288296.2	4523363	SRW01_ECR_V122	1807.55	0.36	0.83	9.29	86.9	3.82
122	289185.9	4523821	SRW01_ECR_V123	1819.64	1.05	1.58	23.15	71.04	5.81
123	290077.3	4524278	SRW01_ECR_V124	1758.79	0.43	0.74	7.1	90.92	1.98
124	290964.8	4524734	SRW01_ECR_V125	1775.45	0.33	2.03	1.65	87.26	11.09
125	292205.1	4525116	SRW01_ECR_V126	1928.7	0.18	2.21	1.69	74.71	23.61
126	292797.7	4525399	SRW01_ECR_V127	1784.04	0.24	1.6	1.74	85.38	12.87
127	293677	4525873	SRW01_ECR_V128	1925.73	0.32	0.91	2.71	93.01	4.28
128	294556.5	4526350	SRW01_ECR_V129	1874.38	0.51	0.81	6.25	91.75	2
129	295437.5	4526827	SRW01_ECR_V130	1737.92	0.4	1.49	2.46	89.56	7.98
130	296328.9	4527267	SRW01_ECR_V131	1615.82	0.78	1.16	8.96	86.7	4.34
131	297566.4	4527867	SRW01_ECR_V132	1895.18	0.08	2.23	0	66.35	33.65
132	298132.6	4528117	SRW01_ECR_V133	1893.75	0.1	2.63	0.64	66.36	33
133	299017.3	4528585	SRW01_ECR_V134	2068.5	0.12	1.04	4.16	64.75	31.09
134	299902.3	4529049	SRW01_ECR_V135	1816.11	0.28	0.69	0.06	95.12	4.82
135	301111.9	4529606	SRW01_ECR_V136	1795.69	0.27	0.71	0	98.26	1.74
136	301691.2	4529939	SRW01_ECR_V137	1854.17	0.18	1.4	1.26	76.69	22.05
137	302698.7	4530439	SRW01_ECR_V138	1822.78	0.28	0.78	0	97.24	2.76
138	303461.1	4530869	SRW01_ECR_V139	2012.02	0.26	1.1	8.81	85.54	5.65
139	304350.2	4531333	SRW01_ECR_V140	1985.14	0.1	1.31	0	83.81	16.19
140	305235.4	4531797	SRW01_ECR_V141	1823.16	0.2	0.74	0	97.05	2.95
141	306121.8	4532262	SRW01_ECR_V142	2123.44	0.14	0.98	1.84	72.93	25.22
142	307702	4533050	SRW01_ECR_V144	1803.72	0.4	2	8.2	56.43	35.36

143	308482.8	4533463	SRW01_ECR_V145	1917.94	0.33	1.29	0.57	94.59	4.84
144	309721.2	4533723	SRW01_ECR_V146	1532.76	0.57	0.99	5.47	86.11	8.42
145	310594.7	4534209	SRW01_ECR_V147	1740	0.69	1.23	13.5	84	2.5
146	311470.8	4534693	SRW01_ECR_V148	2030.45	0.34	1.81	4.98	84.52	10.5
147	311983.7	4534970	SRW01_ECR_V149	1996.23	0.14	1.48	0.26	82.28	17.46
148	312926.6	4535478	SRW01_ECR_V151	1938.97	0.16	0.7	5.89	83.47	10.64
149	313570.2	4536365	SRW01_ECR_V150	1947.11	0.14	0.76	0.68	91	8.32
150	314842.2	4536680	SRW01_ECR_V152B	1848.01	0.37	0.65	2.36	94.89	2.75
151	315603	4537363	SRW01_ECR_V321	1946.78	0.17	0.82	0.85	95.81	3.34
152	316601.1	4537856	SRW01_ECR_V322	2085.11	0.29	0.84	5.47	91.53	3.01
153	316601.1	4537856	SRW01_ECR_V322	2085.11	0.29	0.84	5.47	91.53	3.01
154	317996.1	4538560	SRW01_ECR_V323	1852.87	0.21	2.02	5.52	83	11.48
155	319106.8	4539104	SRW01_ECR_V324	1854.27	0.13	1.33	1.1	83.21	15.69
156	319106.8	4539104	SRW01_ECR_V324	1854.27	0.13	1.33	1.1	83.21	15.69
157	320601.5	4539852	SRW01_ECR_V326	1905.24	0.08	2.73	0.7	44.98	54.31
158	321441.2	4540261	SRW01_ECR_V327	2020.25	0.24	2.64	5.29	74.56	20.15

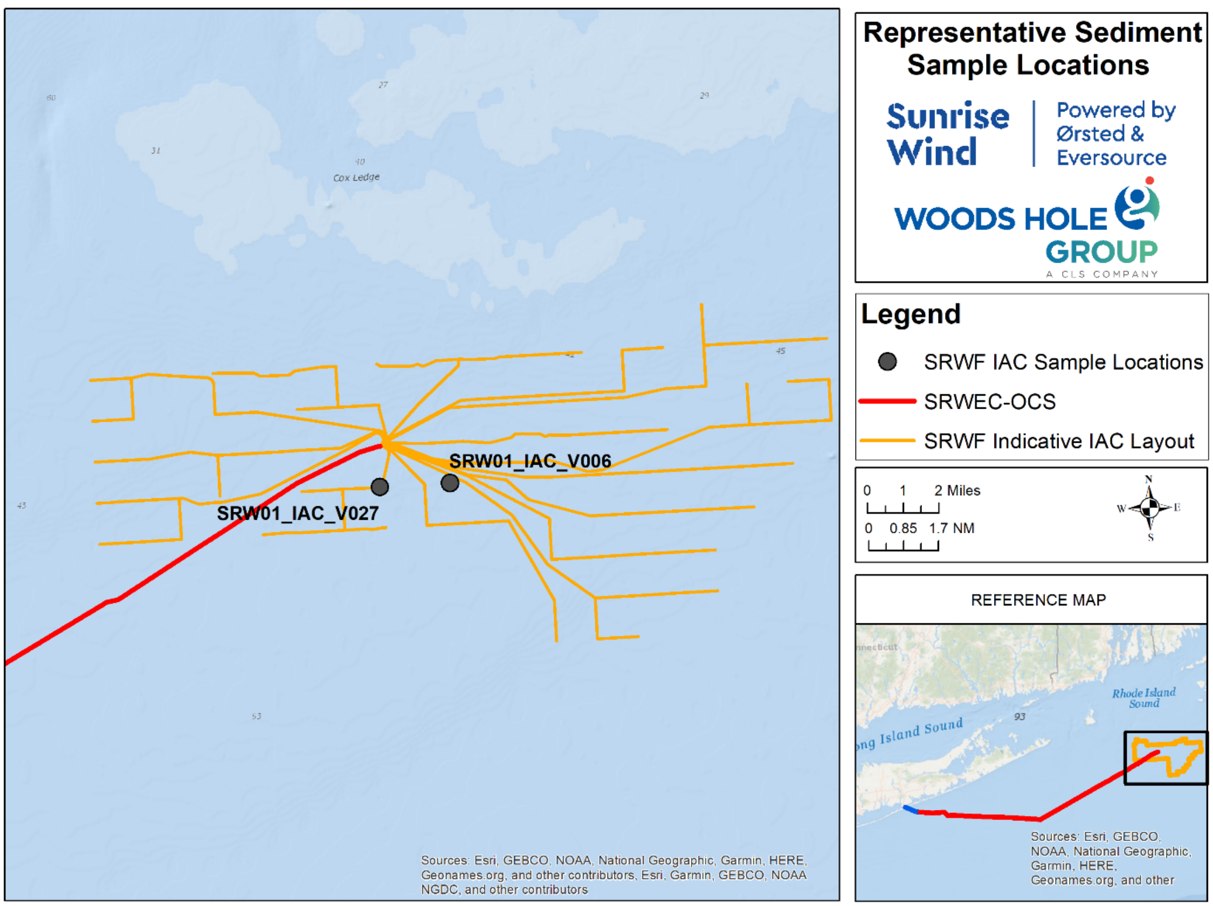

Figure 7-3 Representative IAC sediment sample locations in the SRWF

Table 7-3 Sediment grain size characteristics at representative IAC locations

Location			Grain Size			Grain Size Distribution		
UTM-X (m)	UTM-Y (m)	Location ID	Density (kg/m^3)	d50 (mm)	Standard Deviation	Gravel (%)	Sand (%)	Fine (%)
324582.92	4538339.1	SRW01_IAC_V006	1722.09	0.25	1.37	3.56	89.23	7.21
321420.63	4538333.4	SRW01_IAC_V027	1738.67	0.10	2.63	0.52	45.64	53.85

8 Model Scenarios and Configuration

As discussed in Section 2, multiple installation methods are being considered in the PDE and the model scenarios presented herein are representative of those that would create the most sediment disturbance.

Table 8-1 lists the model scenarios and the model duration. The model durations include the length of the activity and time for the system to return to ambient conditions. The start date for all the model scenarios is September 1, 1997. Model simulations for all scenarios were of sufficient duration to adequately characterize conditions expected over the anticipated duration of construction and were extended one day after construction to allow for sediment concentrations to return to ambient levels. For all scenarios, a continuous construction operation was assumed (7 days a week, 24 hours a day) for the activity duration.

Table 8-1 List of model scenarios and timing

Model Scenario	Model Duration (days)
1 – Excavation of the HDD exit pit with clamshell dredge and barge placement (NYS waters)	3.6
2 –Excavation of the HDD exit pit with open bucket dredge and barge placement (NYS waters)	1.8
3 – Temporary side placement of sediment excavated from HDD exit pit (NYS waters)	45
4 – Installation of SRWEC–NYS	1.85
5 – Installation of SRWEC–OCS	19.7
6 & 7– Installation of IAC (Federal waters)	1.16
8 through 11 – Sand Wave Leveling (Federal waters)	1.6 to 3.1

Table 8-2 summarizes the sediment transport model parameters for the different model scenarios and data sources used. These parameters were developed based on anticipated construction methods being considered within the PDE.

For the excavation of the HDD exit pit, the trench volume was estimated based on a 5.0 m (16 ft) depth and a dredging area of 750 m^2 (15 m by 50 m) giving a volume of approximately 3,750 m^3 (4,900 cubic yards [cy])[4] for the exit pit. The modeled HDD location was selected at a representative location in close proximity to the proposed HDD landfall approach route.

HDD exit pit Scenario 1 assumes a clamshell bucket size of 3 m^3 (4 cy) operating on a 3-minute cycle (20 cycles per hour) with sediment being stockpiled on a barge at the surface. This equates to a production rate of 60 m^3 (80 cy) per hour. The sediment loss percentage was set conservatively high at 20% (16 cy/hr) (Hayes and Wu, 2001) for this scenario.

HDD exit pit Scenario 2 simulates an open bucket size of 5 m^3 (6.5 cy) operating on a 1.5-minute cycle (40 cycles per hour) with sediment being stockpiled on a barge at the surface and a sediment loss percentage of 35% (70 cy/hr). This equates to a production rate of 200 m^3 (262 cy) per hour and represents a worst-case scenario due to the conservative sediment loss and production rate.

For the SRWEC–NYS installation using the jet-plow methodology (Scenario 4), a production rate of 2,444 m^3 (3200 cy) per hour was considered for a sled advance speed of 400 m/hr (1,312 ft/hr).

For the SRWEC–OCS installation using the jet-plow methodology (Scenario 5), two different production rates were considered based on the sediment characteristics: 1) 2,444 m^3 (3200 cy) per 1 m of SRWEC–OCS per hour for a tool advance speed of 400 m/hr (1,312 ft/hr) in sands, and 2) 800 m^3 (1046 cy) per 1 m of SRWEC–OCS per hour for a tool advance speed of 200 m/hr (656 ft/hr) in clays. The sediment loss percentage was also varied depending on the sediments with 30% adopted for sands and 15% for clays. The loss percentage is lower for clays as the jetting results in clumps of clay that readily settle back to the bottom of the trench. These sediment loss assumptions are conservative relative to similar studies which have applied 25% sediment loss for this installation method (RPS, 2018).

Two IAC installation scenarios were modeled using the jet-plow methodology (Scenarios 6 and 7), one representing typical conditions and one representing worst-case conditions. For the typical conditions scenario, a cable trench depth of 2.0 m (6.6 ft) and trench volume of 4.0 m^3 (5.2 cy) per 1 m of IAC was assumed giving a production rate of 1,600 m^3 (2093 cy) per hour for a tool advance speed of 400 m/hr (1,312 ft/hr) in sands. The worst-case conditions scenario assumed a cable trench depth of 2.5 m (8.2 ft) and trench volume of 6.1 m^3 (8.0 cy) giving a production rate of 2,444 m^3 (2093 cy) per hour for a tool advance speed of 400 m/hr (1,312 ft/hr) in fine sediments. Similar to the SRWEC, a 30% sediment loss rate was applied for both of these scenarios (RPS, 2018).

The sand wave leveling activities were modeled with the use of both CFE (Scenario 8) and TSHD (Scenarios 9 through 11) seafloor preparation methods. Model scenario 8 assumes the use of CFE where 100% of the sediment is mobilized to the water column in Federal waters. The production rate for the CFE sand wave leveling scenario was assumed to be 2,000 m^3 (2,616 cy) per hour based on clearing 5 m (16 ft) width of bedform that is 1 m (3.3 ft) high and an advance speed of 400 m/hr (1,312 ft/hr).

There are three (3) model scenarios defined for sand wave leveling with a TSHD. Use of a TSHD consists of a drag arm that extends to the seafloor where the seafloor preparation activity occurs, and sediments are hydraulically pumped to the surface hopper. The hopper capacity was assumed to be 2,294 m^3 (3000 cy). Negligible loss of sediments (1% or less) is expected at the drag arm due to the continuous vacuum pressure.

4 Actual volume will be less due to angled side slopes (not vertical sides)

As the hopper is being filled, there is a continuous overflow of water and sediment from the hopper at the water surface. It is assumed the overflow mixture is 80% water and 20% sediment (Vlasblom, 2007) and the sediment consists of a higher percentage of fines (50% of fine material) (BOEM, 2019). Model scenario 9 is representative of this continuous overflow at the surface in Federal waters. This continuous overflow would occur primarily with the bulk disposal method (filling of the hopper for later disposal), however, the surface overflow and bulk disposal would not occur concurrently.

Once the surface hopper is filled, bulk disposal of the sediments was simulated to occur within the surveyed corridor with disposal occurring 50 m inside the surveyed corridor boundary. The TSHD vessel will sail to the disposal location, dump the sediments through split-bottom hull-mounted door of the surface hopper, and then return to seafloor preparation activities. The sand wave volume along SRWEC–OCS was calculated directly from sand wave clearance charts developed based on geophysical survey data. Along the SRWEC–OCS, sand wave leveling is anticipated to require the leveling of approximately 11,344 m^3 (14,837 cy) of sediment and 5 bulk disposal events, which is represented by model scenario 10.

For scenario 10, it was assumed the hopper fill time is 0.75 hours and the disposal cycle (time to travel to and from disposal location) time is 0.5 hours.

Sand wave leveling with a TSHD may also be done with hydraulic disposal at the surface of the water column. Scenario 11 is representative of this disposal method in Federal waters. For these scenarios, 100% of the dredged sediment is released to the surface waters as the vessel moves along the cable route.

The construction parameters used in each modeling scenario are detailed in Table 8-2.

Table 8-2 Parameters used in sediment transport model scenarios

Model Scenario 1 – Excavation of the HDD exit pit (NYS waters), annual average conditions	
Location (UTM coordinates, m)	19 N 174421 E, 4515659 N
Sediment source	Point source
Equipment Type	Mechanical (clamshell) dredge
Trench Volume (m^3)	3750
Production Rate (m^3/hr)	60
Vertical distribution above seabed (m)	2
Sediment loss (%)	20
Anticipated construction season	Fall to Winter
Construction duration (hrs / days)	63.3 /2.6 days
Model Scenario 2 – Excavation of the HDD exit pit (NYS waters), annual average conditions	
Location (UTM coordinates, m)	19 N 174421 E, 4515659 N
Sediment source	Point source
Equipment Type	Mechanical (Open bucket) dredge
Trench Volume (m^3)	3750
Production Rate (m^3/hr)	200
Vertical distribution above seabed (m)	2
Sediment loss (%)	35
Anticipated construction season	Fall to Winter
Construction duration (hrs / days)	18.8 /0.8 days
Model Scenario 3 – Excavation of the HDD exit pit (NYS waters), annual average conditions	
Location (UTM coordinates, m)	19 N 174421 E, 4515659 N
Sediment source	Mounded sediment on seabed
Equipment Type	Mechanical dredge
Excavated Volume (m^3)	3750
Anticipated construction season	Fall to Winter
Temporary storage duration (days)	45
Model Scenario 4 – Installation of SRWEC–NYS, annual average conditions	
Location	Along cable route (approx. 7.9 km)
Sediment source	Moving point source
Equipment Type	Jet-plow

Trench Volume (m^3)	6.1 (2.5 m deep by 1.0 m wide at the bottom)
Production Rate (m^3/hr)	2,444
Advance Speed (m/hr)	400
Vertical distribution above seabed (m)	1
Sediment loss (%)	30
Anticipated construction season	Fall to Winter
Construction duration (hrs / days)	19.75 / 0.85

Model Scenario 5 – Installation of SRWEC–OCS, annual average conditions	
Location	Along cable route (approx. 149.3 km)
Sediment source	Moving point source
Equipment Type	Jet-plow
Trench Volume (m^3)	6.1 to 4.0 (2.5 m deep by 1.0 m wide at the bottom)
Production Rate (m^3/hr)	2,444 to 800 (depending on sediments)
Advance Speed (m/hr)	400 to 200 (depending on sediments)
Vertical distribution above seabed (m)	1
Sediment loss (%)	15 to 30 (depending on sediments)
Anticipated construction season	Spring to Summer
Construction duration (hrs / days)	450 / 18.7
Model Scenario 6 – Typical installation of inter-array cable (Federal waters), annual average conditions	
Location (UTM coordinates, m)	19 N 323832 E, 4538332 N to 325332 E, 4538332 N (approx. 1.5 km)
Sediment source	Moving point source
Equipment Type	Jet-plow
Trench Volume (m^3)	4.0 (2.0 m deep by 1.0 m wide at bottom)
Production Rate (m^3/hr)	1,600
Advance Speed (m/hr)	400
Vertical distribution above seabed (m)	1
Sediment loss (%)	30
Anticipated construction season	Summer to Fall
Construction duration (hrs / days)	3.75 / 0.16
Model Scenario 7 – Worst-case installation of inter-array cable (Federal waters), annual average conditions	
Location	19 N 323832 E, 4538332 N to 325332 E, 4538332 N (approx. 1.5 km)
Sediment source	Moving point source
Equipment Type	Jet-plow
Trench Volume (m^3)	6.1 (2.5 m deep by 1.0 m wide at bottom)
Production Rate (m^3/hr)	2,444
Advance Speed (m/hr)	400
Vertical distribution above seabed (m)	1

Sediment loss (%)	30
Anticipated construction season	Summer to Fall
Construction duration (hrs / days)	3.75 / 0.16

Model Scenario 8 – CFE Sand Wave Leveling (Federal waters), annual average conditions	
Location	Intermittent along cable route (4 distinct segments totaling 19.8 km)
Sediment source	Moving point source
Equipment Type	Controlled Flow Excavation
Excavation Volume (m^3)	5 (1.0 m high by 5 m wide)
Production Rate (m^3/hr)	2,000
Advance Speed (m/hr)	400
Vertical distribution above seabed (m)	1
Sediment loss (%)	100
Anticipated construction season	Fall to Winter
Construction duration (hrs / days)	49.5 / 2.1
Model Scenario 9 – TSHD Sand Wave Leveling (Federal waters), annual average conditions	
Location	Intermittent along cable route (4 distinct segments totaling 19.8 km)
Sediment source	Moving point source
Equipment Type	TSHD, continuous overflow
Hopper Volume (m^3)	2,294
Production Rate (m^3/hr)	1,835
Advance Speed (m/hr)	Variable
Vertical distribution	Below sea level surface
Sediment loss (%)	20
Anticipated construction season	Fall to Winter
Construction duration (hrs / days)	13.75 / 0.6
Model Scenario 10 – TSHD Sand Wave Bulk Disposal (Federal waters), annual average conditions	
Location	Intermittent along cable route (5 locations 50 m inside SRWEC–OCS survey corridor)
Sediment source	Point source (multiple)
Equipment Type	TSHD, bulk disposal
Hopper Volume (m^3)	2,294
Production Rate (m^3/hr)	1,835
Advance Speed (m/hr)	Variable
Vertical distribution (m)	5 (below sea level surface)

Sediment loss (%)	100
Anticipated construction season	Fall to Winter
Construction duration (hrs / days)	13.75 / 0.6
Model Scenario 11 – TSHD Sand Wave Hydraulic Disposal (Federal waters), annual average conditions	
Location	Intermittent along cable route (4 areas totaling 19.8 km)
Sediment source	Moving point source
Equipment Type	TSHD, hydraulic disposal
Hopper Volume (m^3)	2,294
Production Rate (m^3/hr)	1,835
Advance Speed (m/hr)	Variable
Vertical distribution	Below sea level surface
Sediment loss (%)	100
Anticipated construction season	Fall to Winter
Construction duration (hrs / days)	13.75 / 0.6

9 Modeling Results and Discussion

9.1 Sediment Transport Modeling Results

Scenario 1 – HDD Exit Pit in NYS Waters (clamshell bucket)

This scenario included the release of 750 m^3 (981 cy) of sediment to the water column over the duration of the HDD exit pit excavation using a mechanical clamshell dredge (duration of over 62 hrs). The modeling was conducted assuming a continuous operation. Maximum suspended sediment concentrations in excess of ambient levels (> 10 mg/L) occurring over the duration of the HDD exit pit excavation are shown in Figure 9.1-1. The sediment deposition that results from this activity are shown in Figure 9.1-2.

Scenario 1 assumes sediment excavated from the HDD exit pit are brought through the water column and temporarily stockpiled on a barge at the surface. The intent is that these stockpiled sediments would be used as backfill and placed back into the pit upon completion of work. As such, similar sediment concentrations and associated deposition presented herein for the excavation would be expected for this backfilling activity.

The results indicate maximum suspended sediment concentrations in excess of 100 mg/L do not occur with this dredging activity. The TSS plume is contained within the lower half of the water column approximately 2.2 m (7.2 ft) above the seafloor. TSS concentrations are predicted to return to ambient levels (<10 mg/L) at the HDD location within 0.3 hours after completing the excavation.

The maximum predicted deposition thickness is 476 mm (1.6 ft). Sedimentation at or above 10 mm (0.4 in) extends a maximum of 24 m (79 ft) from the HDD exit pit and covers an area of 0.1 hectare (ha) (0.25 acres) of the seafloor.

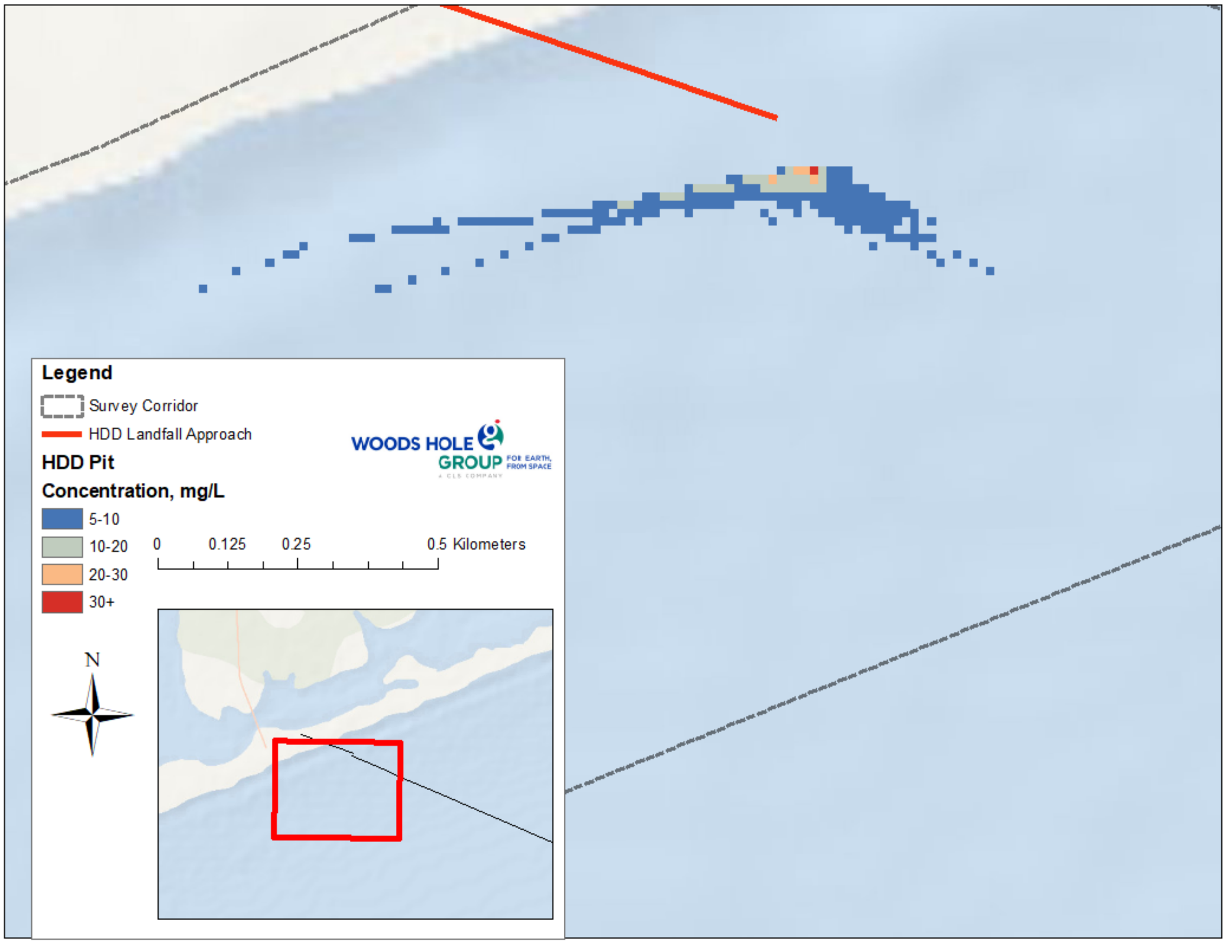

Figure 9.1-1 **Maximum TSS concentrations occurring during HDD exit pit excavation in NYS waters using a clamshell bucket**

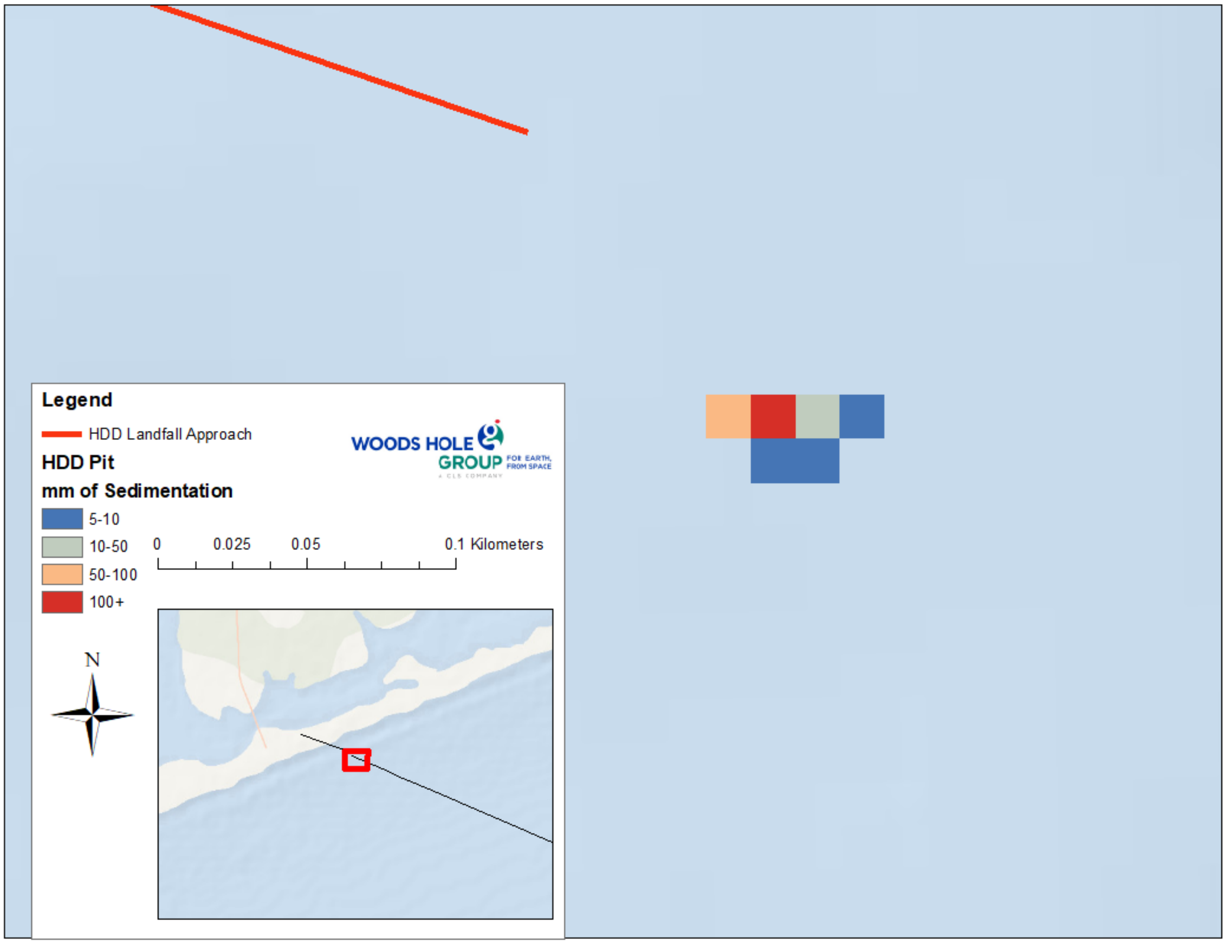

Figure 9.1-2 **Sediment deposition on seafloor after HDD exit pit excavation in NYS waters using a clamshell bucket**

Scenario 2 –HDD Exit Pit in NYS Waters (open bucket)

This scenario included the release of 1,313 m^3 (1,717 cy) of sediment to the water column over the duration of the HDD exit pit excavation using an open bucket dredge (duration of over 18 hrs). The modeling was conducted assuming a continuous operation. Maximum suspended sediment concentrations in excess of ambient levels (> 10 mg/L) occurring over the duration of the HDD exit pit excavation are shown in Figure 9.1-3. The sediment deposition that results from this activity are shown in Figure 9.1-4.

Consistent with Scenario 1, Scenario 2 also assumes that the sediments stockpiled on a barge would be subsequently used as backfill and placed back into the pit upon completion of work. As such, similar sediment concentrations and associated deposition presented herein for the excavation would be expected for this backfilling activity.

The results indicate maximum suspended sediment concentrations in excess of 100 mg/L occur within 367 m (1,204 ft) of the dredging activity. The TSS plume is contained within the lower half of the water column, approximately 4.0 m (13.1 ft) above the seafloor. TSS concentrations are predicted to return to ambient levels (<10 mg/L) at the HDD location within 0.3 hours after completing the excavation.

The maximum predicted deposition thickness is 768 mm (2.5 ft). Sedimentation at or above 10 mm (0.4 in) extends a maximum of 39 m (128 ft) from the HDD exit pit and covers an area of 0.1 hectare (ha) (0.25 acres) of the seafloor.

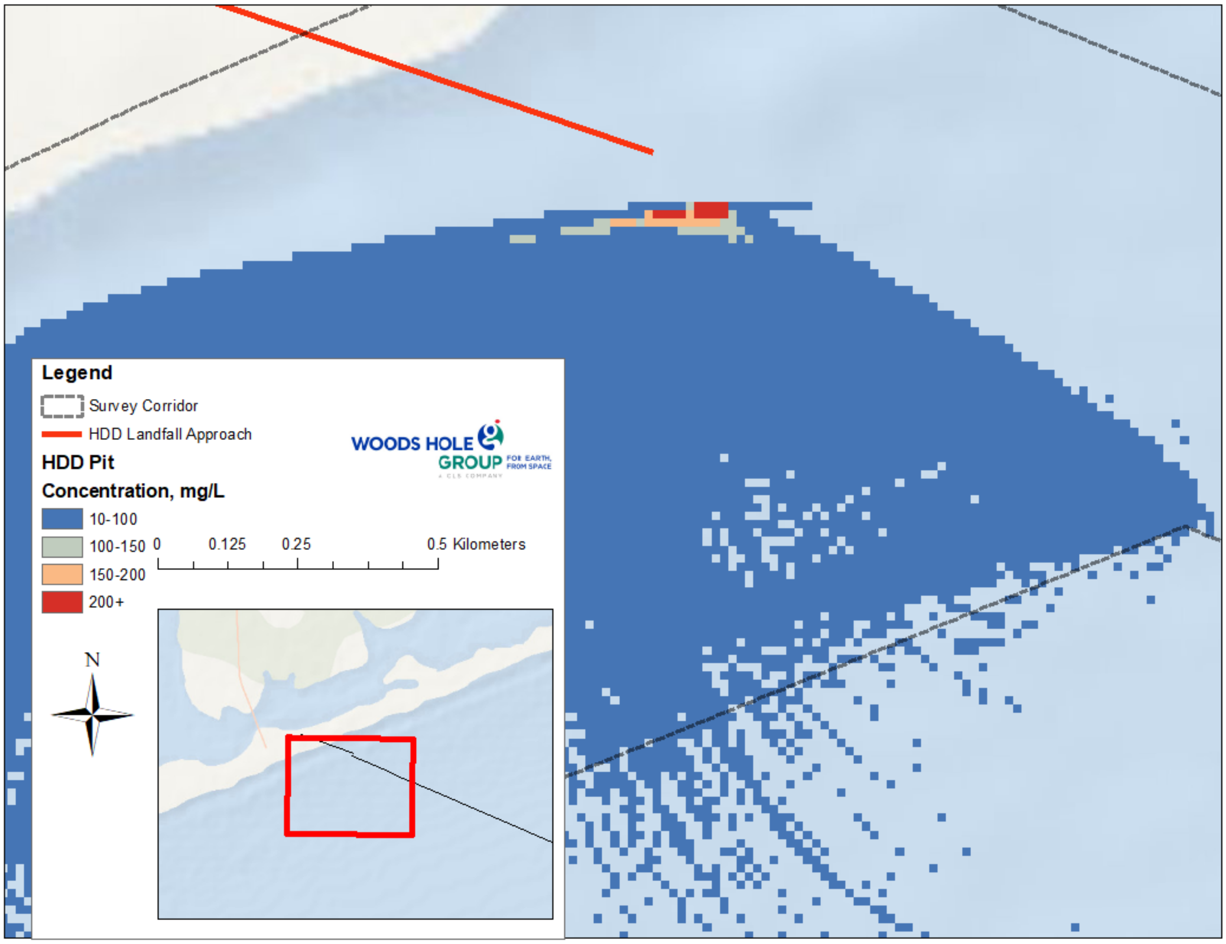

Figure 9.1-3 Maximum TSS concentrations occurring during HDD exit pit excavation in NYS waters using an open bucket

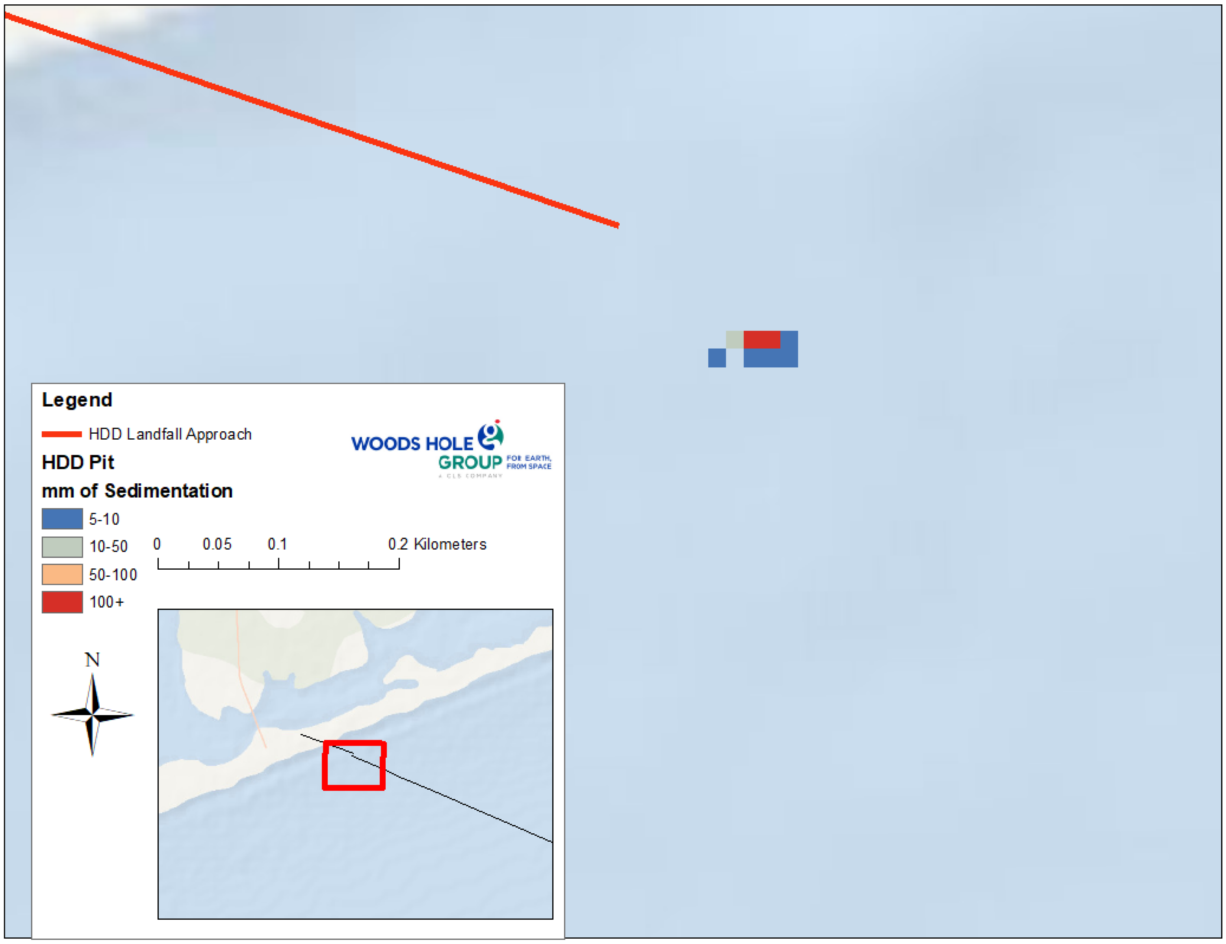

Figure 9.1-4 Sediment deposition on seafloor after HDD exit pit excavation in NYS waters using an open bucket

Scenario 3 – Temporary Sediment Placement for HDD exit pit

The Project is considering temporarily placing the sediment excavated from the HDD exit pit on the seafloor directly adjacent to the HDD exit pit. This activity does not involve transfer of the sediment through the water column to the surface. Rather, sediment would be placed on the seafloor by keeping the excavator bucket in the water and as close to the seafloor as possible. This option would therefore result in suspended sediment concentrations that are less than those presented for stockpiling the material on a barge (Scenarios 1 and 2).

It is expected the placed sediment will remain on the seafloor for a period of 45 days prior to the HDD exit pit being backfilled. This temporary mound of sediment primarily consists of coarse-grained material (99% sand and gravel) and will be subject to currents that will cause sediment movement along the seabed and resuspension.

A model scenario was developed to assess the potential mobilization and resettlement of the temporary sediment mound over a 45-day period following excavation of the HDD exit pit. For this scenario, the sediment was placed around half of the pit perimeter (most seaward half) as the strongest currents are shown to be directed offshore. This resulted in a placed berm of sediment approximately 110 m (361 ft) long, 20 m (66 ft) wide, and 2.2 m (7 ft) high[5]. Figure 9.1-5 shows the evolution of the placed sediment on the seafloor from day 3 (just after excavation) through day 45.

The results in Figure 9.1-5 show there is no significant movement of the placed sediment by day 30, however by day 45 there is some minor sediment displaced. Overall, there were two mobilization events associated with storm activity between day 30 and 45. The remobilized and deposited sediment is entirely within 305 m (1,000 ft) of the initial placement at the end of day 45.

To better quantify this sediment movement, Table 9.1-1 lists the percentage of material that remains within defined distances from the location of initial placement over the 45 days (two storm events). Through excavation and placement (at the end of day 3) 96% of the material remains within 38 m (125 ft). At the end of day 45, 89% of the material remains within 38 m (125 ft), 92% remains within 76 m (250 ft), and 95% of the material remains within 152 m (500 ft).

Suspended sediment concentrations were not determined for this model scenario, as this model accounts for the bed level movement of sediment (primarily sands) and suspended sediment in the water column is not expected to be significant.

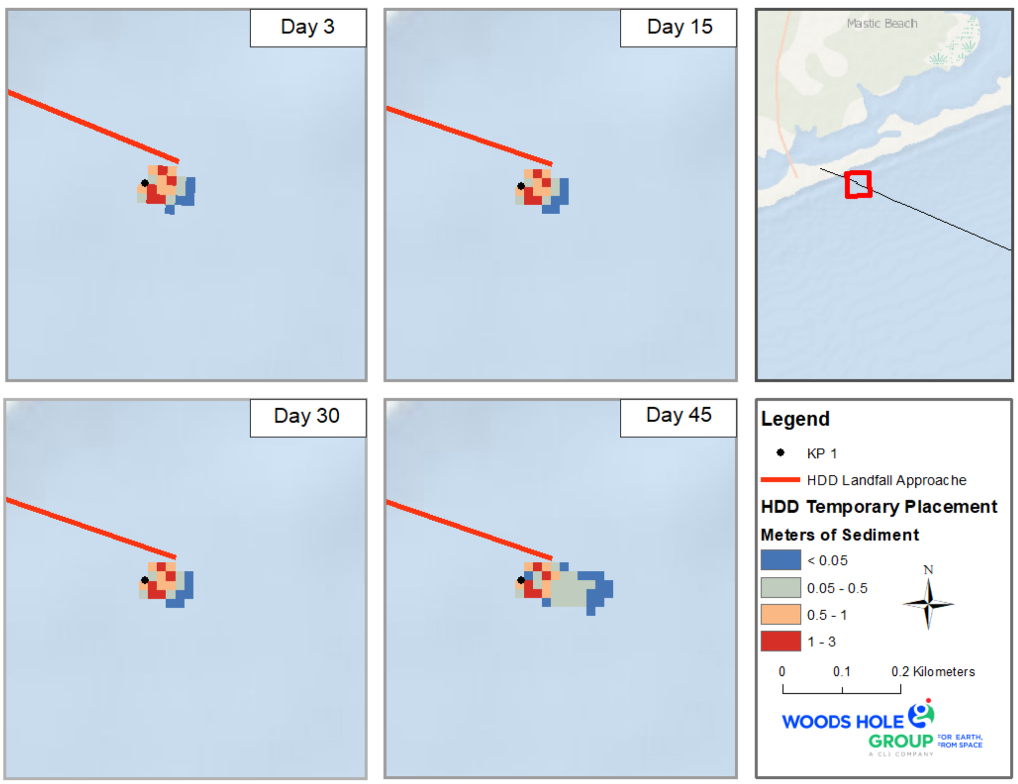

Figure 9.1-5 Progression of mobilization after temporary placement of excavated HDD exit pit sediment

[5] The specific berm geometry is not defined in the model. Deposited material approximately represents this shape.

Table 9.1-1 Percentage of sediment remaining within distances from initial temporary placement

Time	Percent (%) Remaining Within			
	38 m (125 ft)	76 m (250 ft)	152 m (500 ft)	305 m (1000 ft)
Day 3	96%	96%	96%	96%
Day 15	96%	96%	96%	96%
Day 30	96%	96%	96%	96%
Day 45	89%	92%	95%	95%

A review of the historical wind data over the same time period indicates there were meteorological events that occurred during the second month which led to this mobilization of the temporary placed sediment. The wind record for Westhampton, NY (Francis S. Gabreski Airport weather station data downloaded from the Iowa Environmental Mesonet) is shown in Figure 9.1-6. The wind record shows there was a multi-day event near day 30 when average winds exceeded 20 mph with gusts above 35 mph. This event initiated the mobilization of the placed sediment and another event with winds exceeding 20 mph close to day 40 induced sediment movement. Note the winds speeds shown in Figure 9.1-6 are from a land-based weather station and overwater winds are higher than those depicted in this figure. These events can be considered typical high wind events for this time of year.

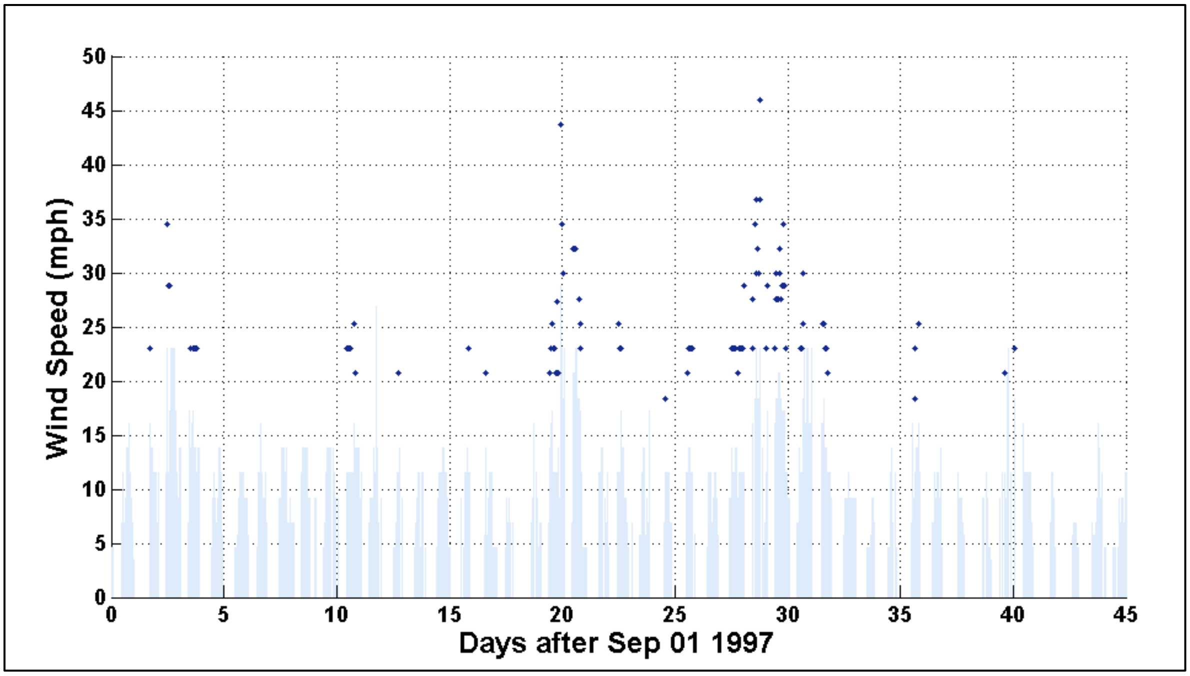

Figure 9.1-6 Wind speeds measured at Westhampton, NY from Sep 01, 1997 to Oct 15, 1997 (bars indicate average winds with gusts shown by dark blue markers).

Scenario 4 – SRWEC–NYS Installation

This scenario included the release of 14,481 m^3 (18,940 cy) of sediment to the water column over the SRWEC segment located in NYS waters (SRWEC–NYS). The duration of the SRWEC–NYS installation is 19.75 hours. Maximum suspended sediment concentrations in excess of 10 mg/L occurring over the duration of the SRWEC–NYS installation are shown in Figure 9.1-7. The sediment deposition that results from this activity is shown in Figure 9.1-8.

The results shown in Figure 9.1-7 indicate maximum suspended sediment concentrations in excess of 100 mg/L do not occur. The TSS plume is primarily contained within the lower portion of the water column, approximately 2.5 m (8.2 ft) above the seafloor. TSS concentrations are predicted to return to ambient levels (<10 mg/L) within 0.3 hours from completing the installation, giving an indication of how long it might take to return to ambient levels at any location along the SRWEC–NYS route after sediment suspension.

The maximum predicted deposition thickness is 191 mm (7.5 in). Sedimentation at or above 10 mm (0.4 in) extends a maximum of 77 m (253 ft) from the cable centerline and covers an area of 21.5 ha (53.1 acres) of the seafloor.

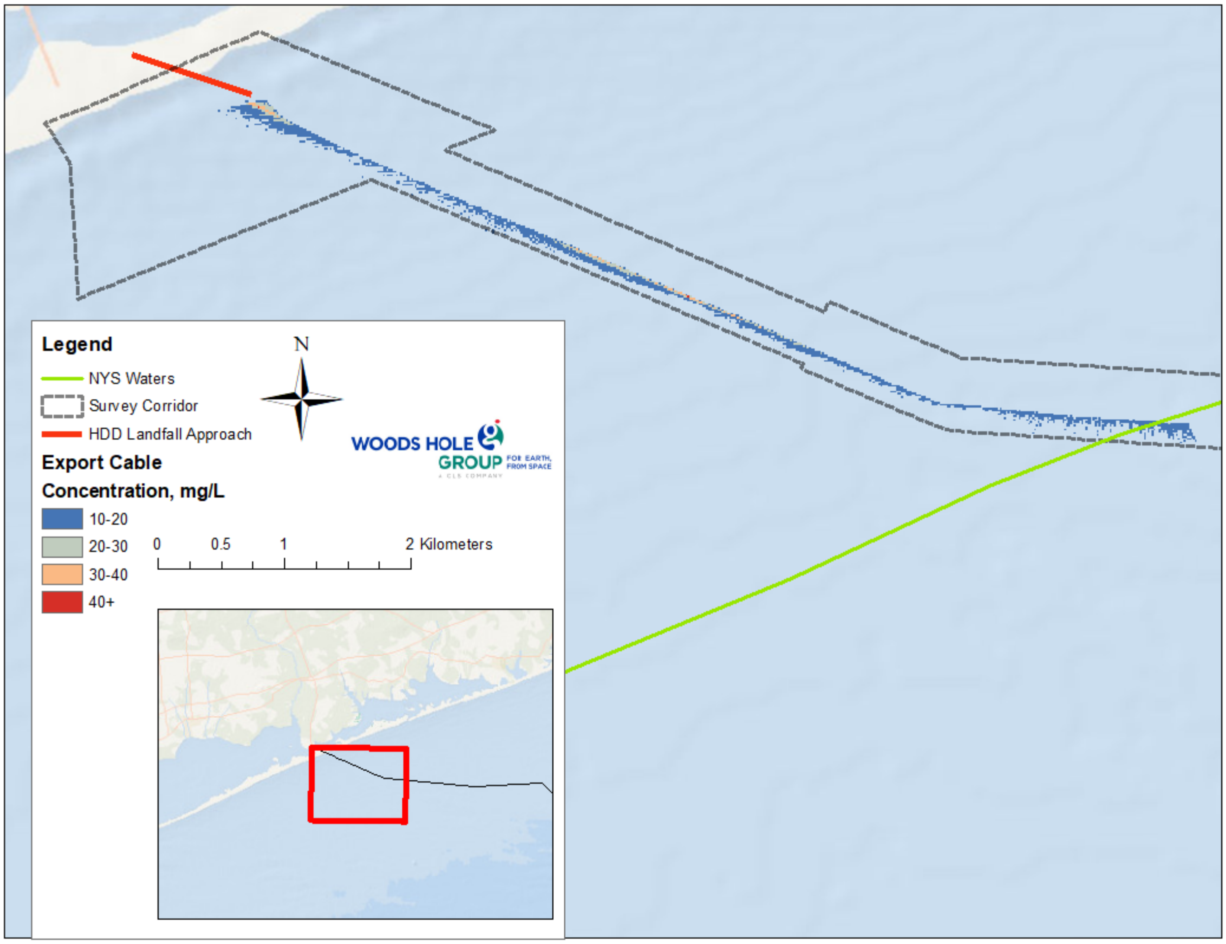

Figure 9.1-7 Maximum TSS concentrations occurring during SRWEC–NYS installation

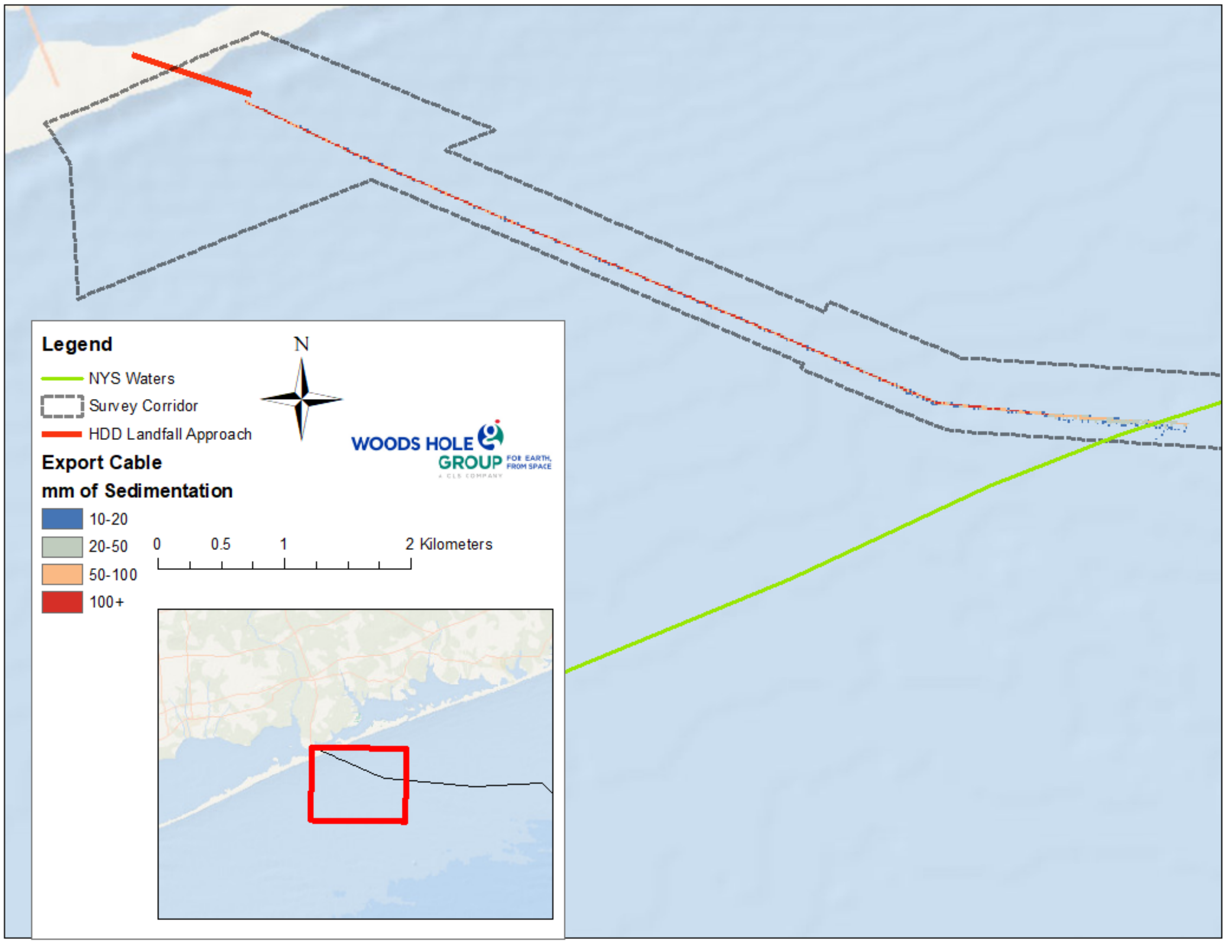

Figure 9.1-8 Sediment deposition on seafloor after SRWEC–NYS installation

Scenario 5 – SRWEC–OCS Installation

This scenario included the release of 254,360 m^3 (332,690 cy) of sediment to the water column over the approximate 149.3 km (92.8 mi) length of the SRWEC–OCS route located in Federal waters (SRWEC–OCS). The duration of the SRWEC–OCS installation is 18.7 days assuming a continuous operation. Maximum suspended sediment concentrations in excess of 10 mg/L occurring over the duration of the SRWEC–OCS cable installation are shown in Figures 9.1-9 through 9.1-21. The sediment deposition that results from this activity are shown in Figures 9.1-22 through 9.1-39.

The results shown in Figures 9.1-9 through 9.1-21 indicate maximum suspended sediment concentrations in excess of 100 mg/L occur within 905 m (2969 ft) of the cable centerline. The TSS plume is primarily contained within the lower portion of the water column, approximately 3.0 m (9.8 ft) above the seafloor. TSS concentrations are predicted to return to ambient levels (<10 mg/L) within 0.4 hours from completing the installation.

The maximum predicted deposition thickness is 289 mm (11.3 in). Sedimentation at or above 10 mm (0.4 in) extends a maximum of 241 m (791 ft) from the cable centerline and covers an area of 336.8 ha (832.3 acres) of the seafloor.

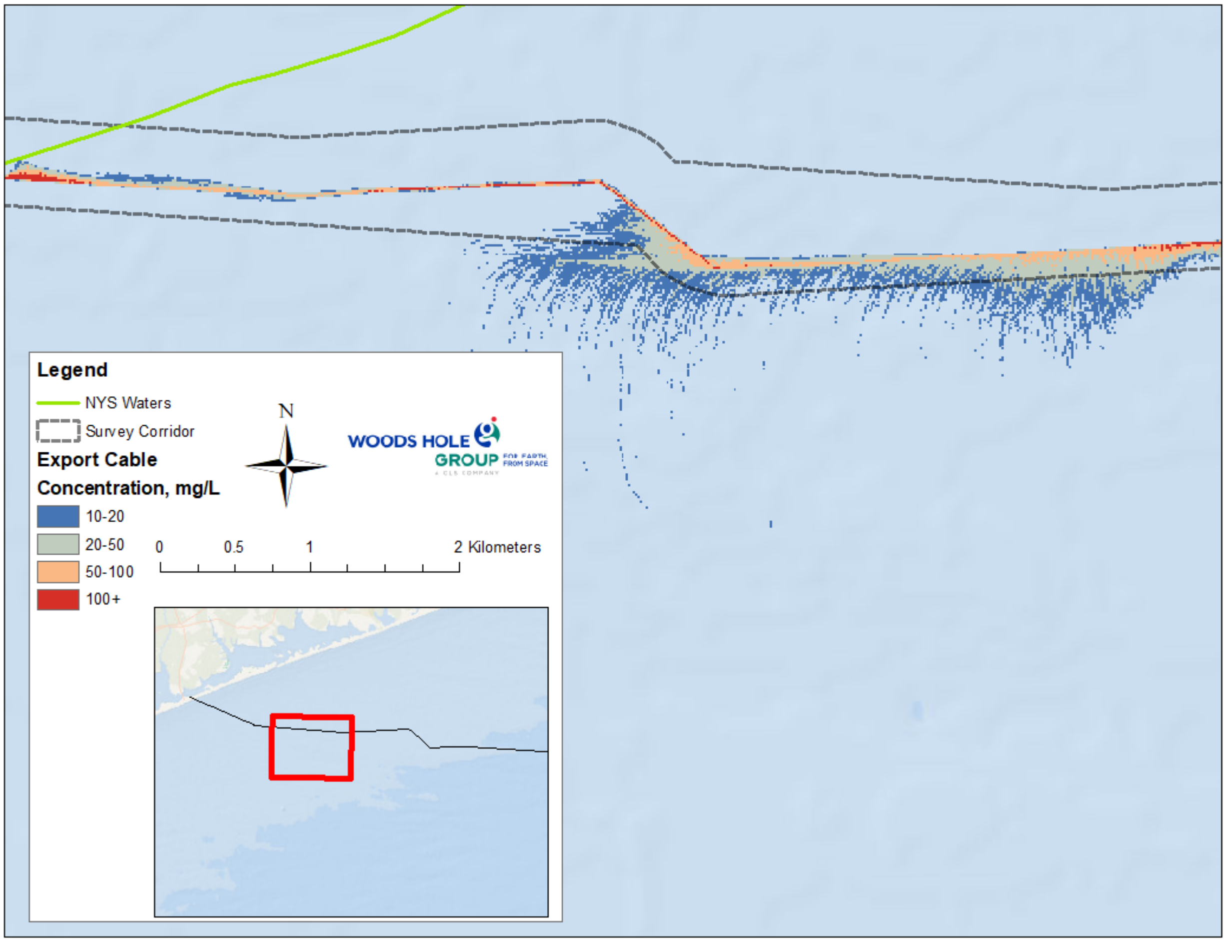

Figure 9.1-9 Maximum TSS concentrations occurring during SRWEC–OCS installation. Map 1 of 13 – refer to the inset for location relative to the full Project extent.

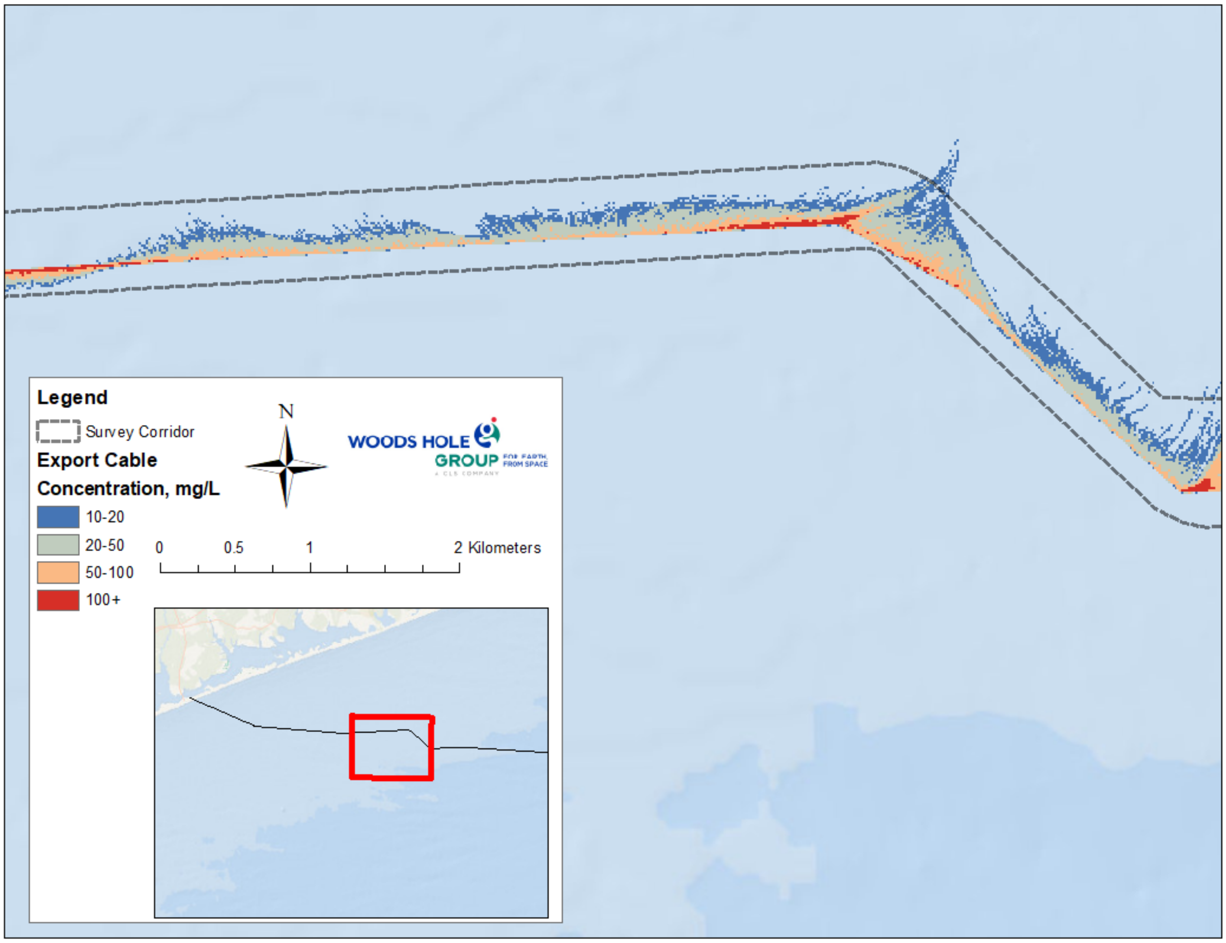

Figure 9.1-10 Maximum TSS concentrations occurring during SRWEC–OCS. Map 2 of 13 – refer to the inset for location relative to the full Project extent.

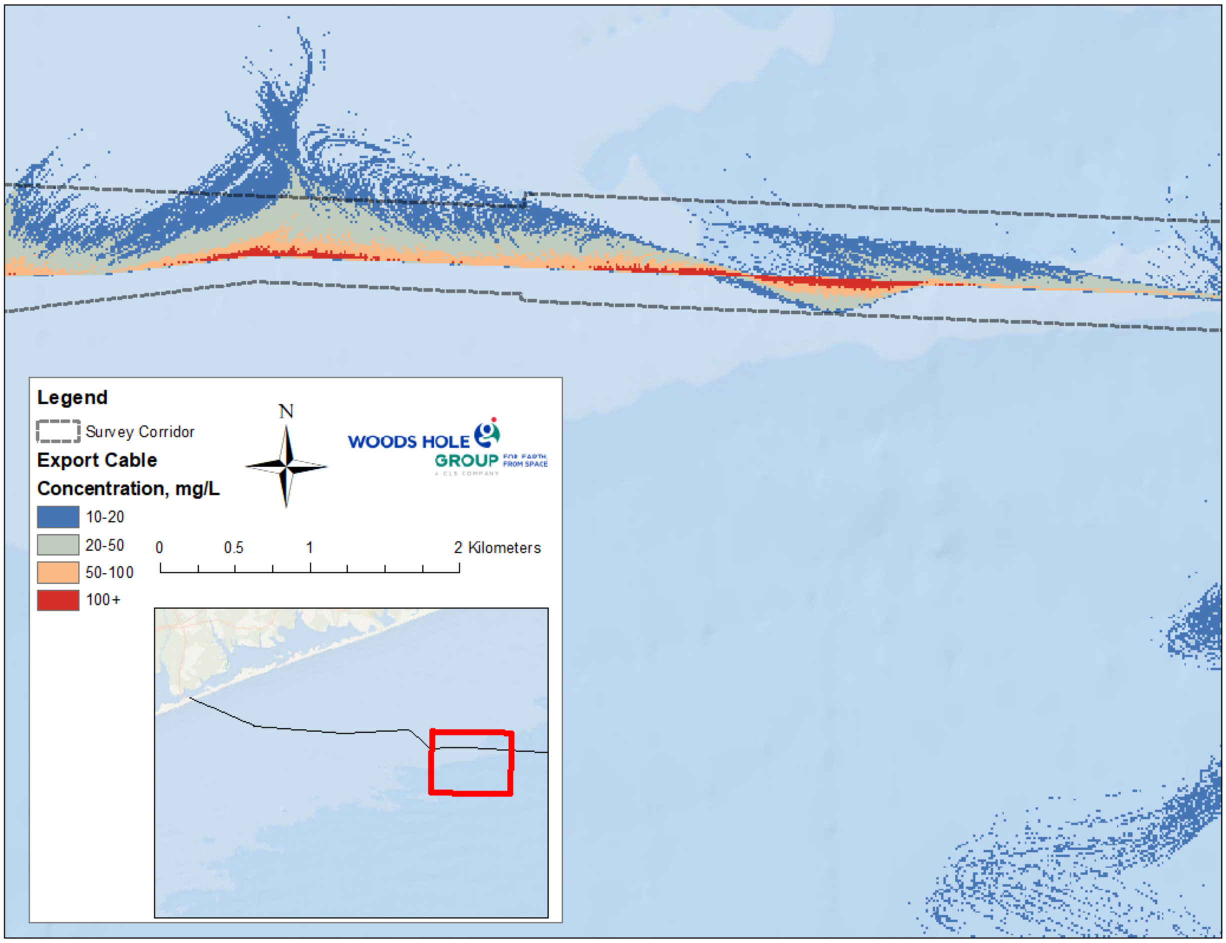

Figure 9.1-11 Maximum TSS concentrations occurring during SRWEC–OCS. Map 3 of 13 – refer to the inset for location relative to the full Project extent.

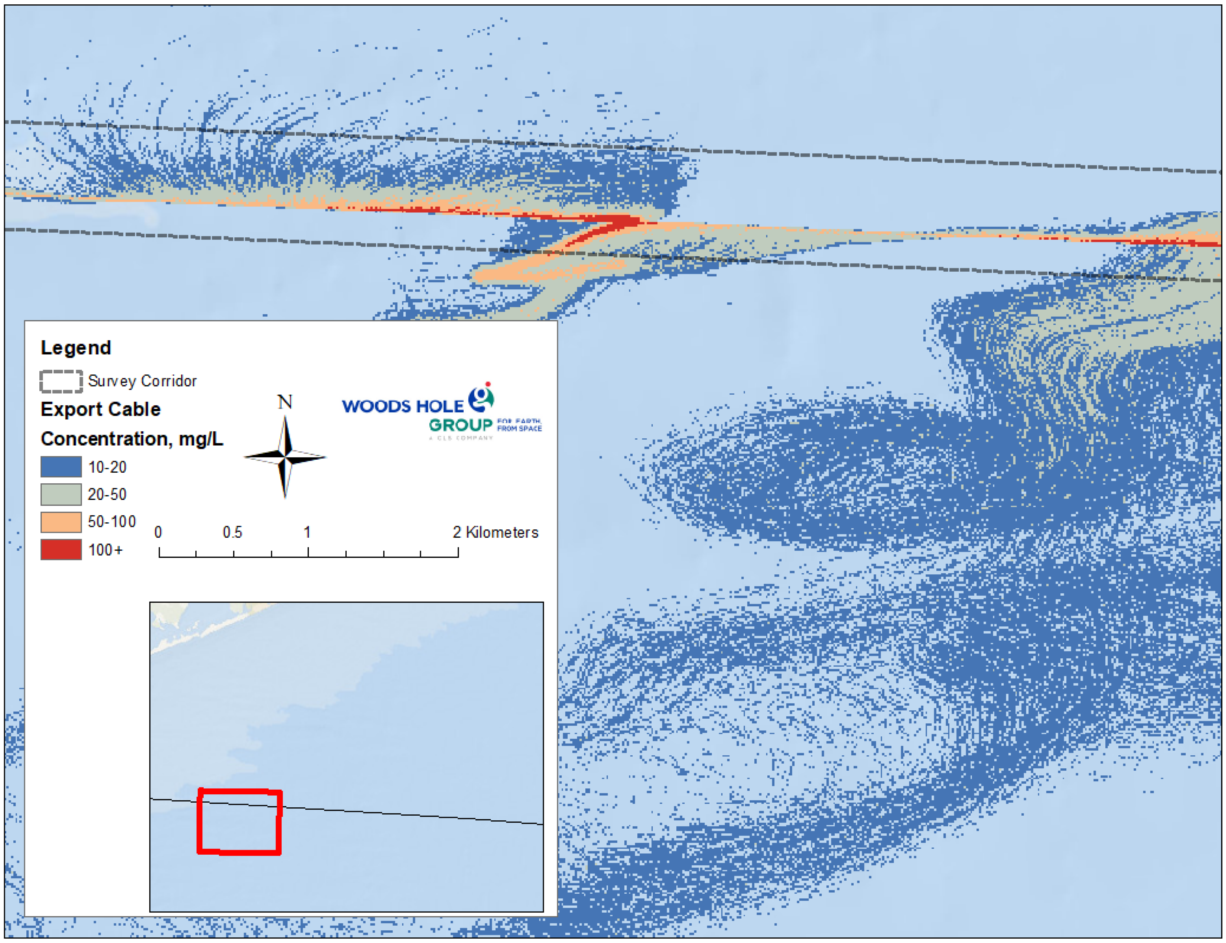

Figure 9.1-12 Maximum TSS concentrations occurring during SRWEC–OCS. Map 4 of 13 – refer to the inset for location relative to the full Project extent.

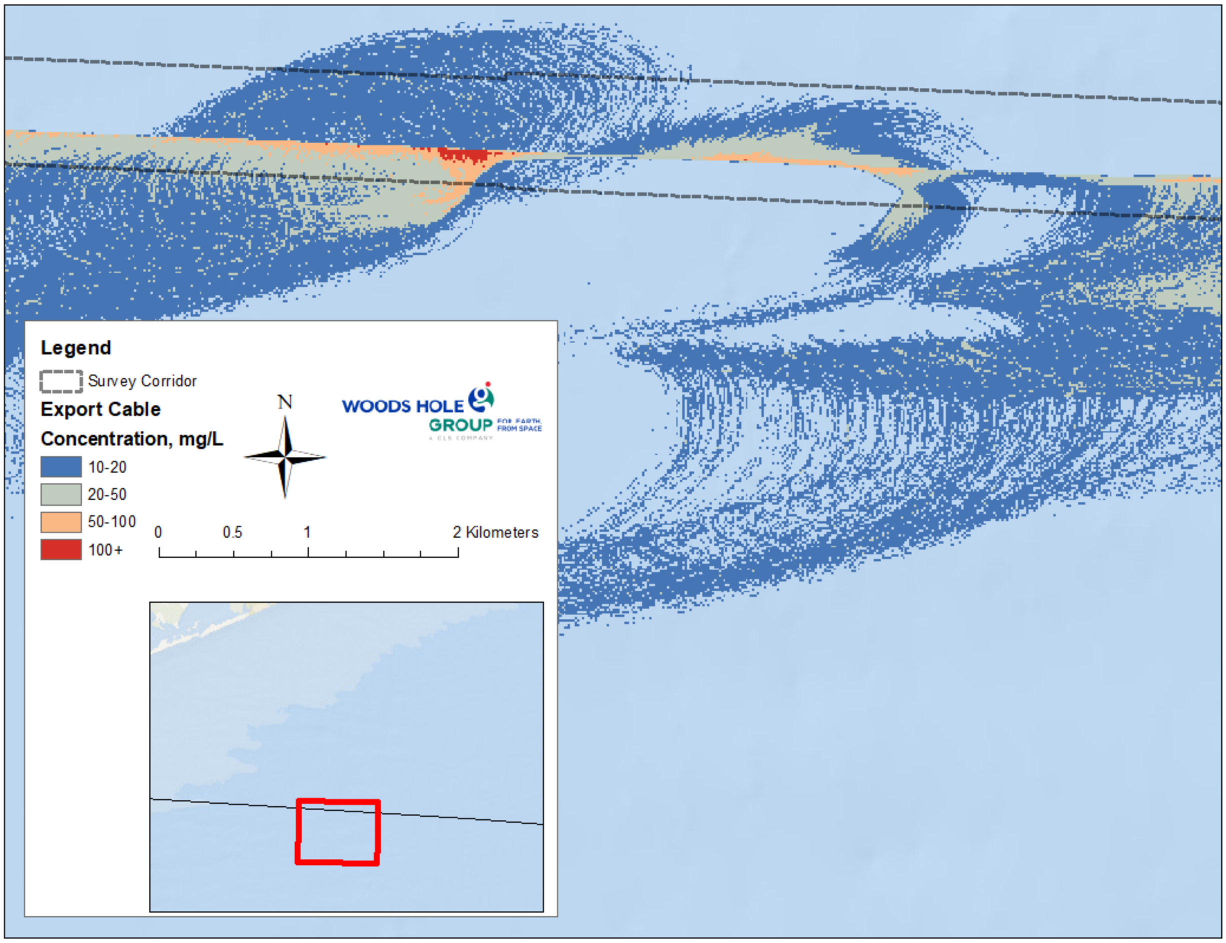

Figure 9.1-13 Maximum TSS concentrations occurring during SRWEC–OCS. Map 5 of 13 – refer to the inset for location relative to the full Project extent.

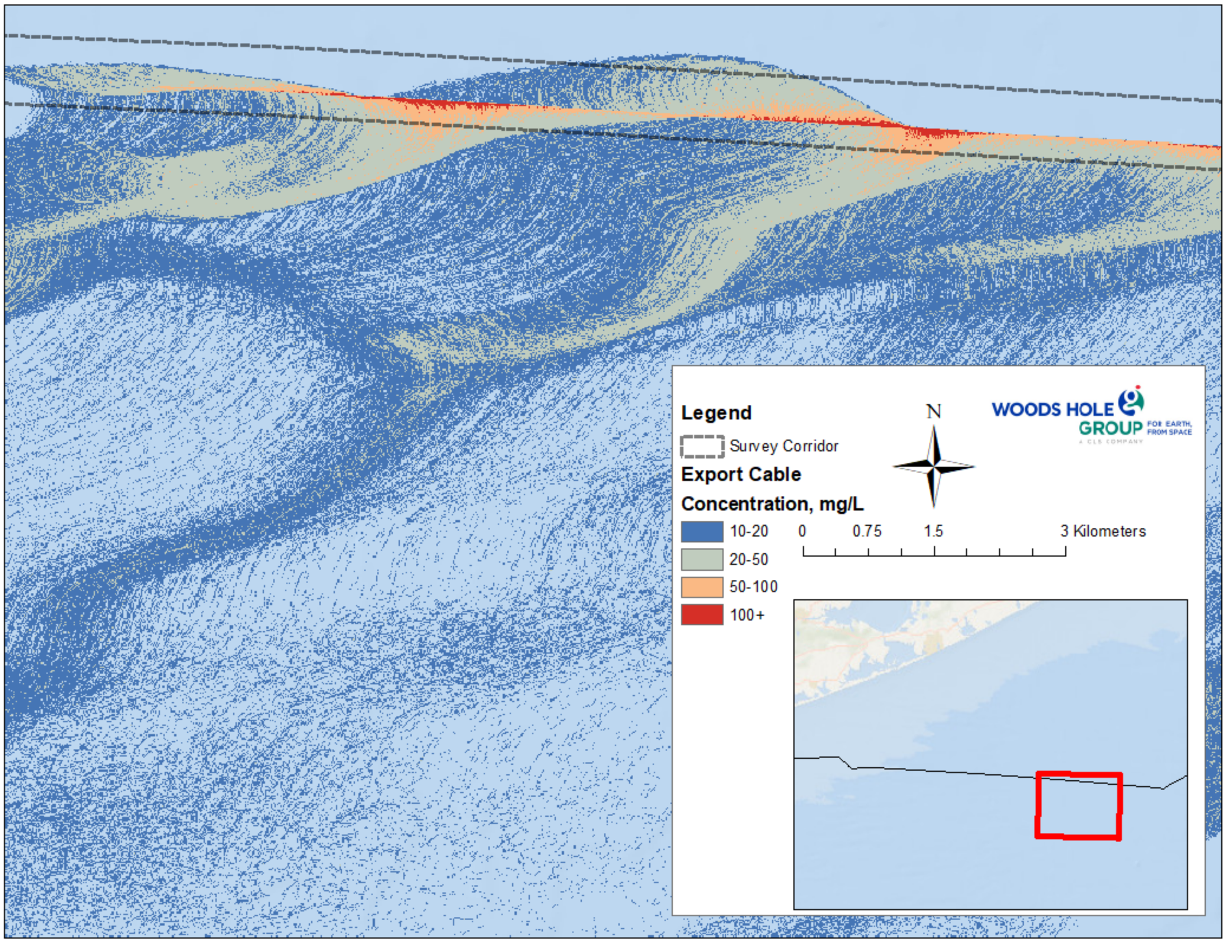

Figure 9.1-14 **Maximum TSS concentrations occurring during SRWEC–OCS. Map 6 of 13 – refer to the inset for location relative to the full Project extent.**

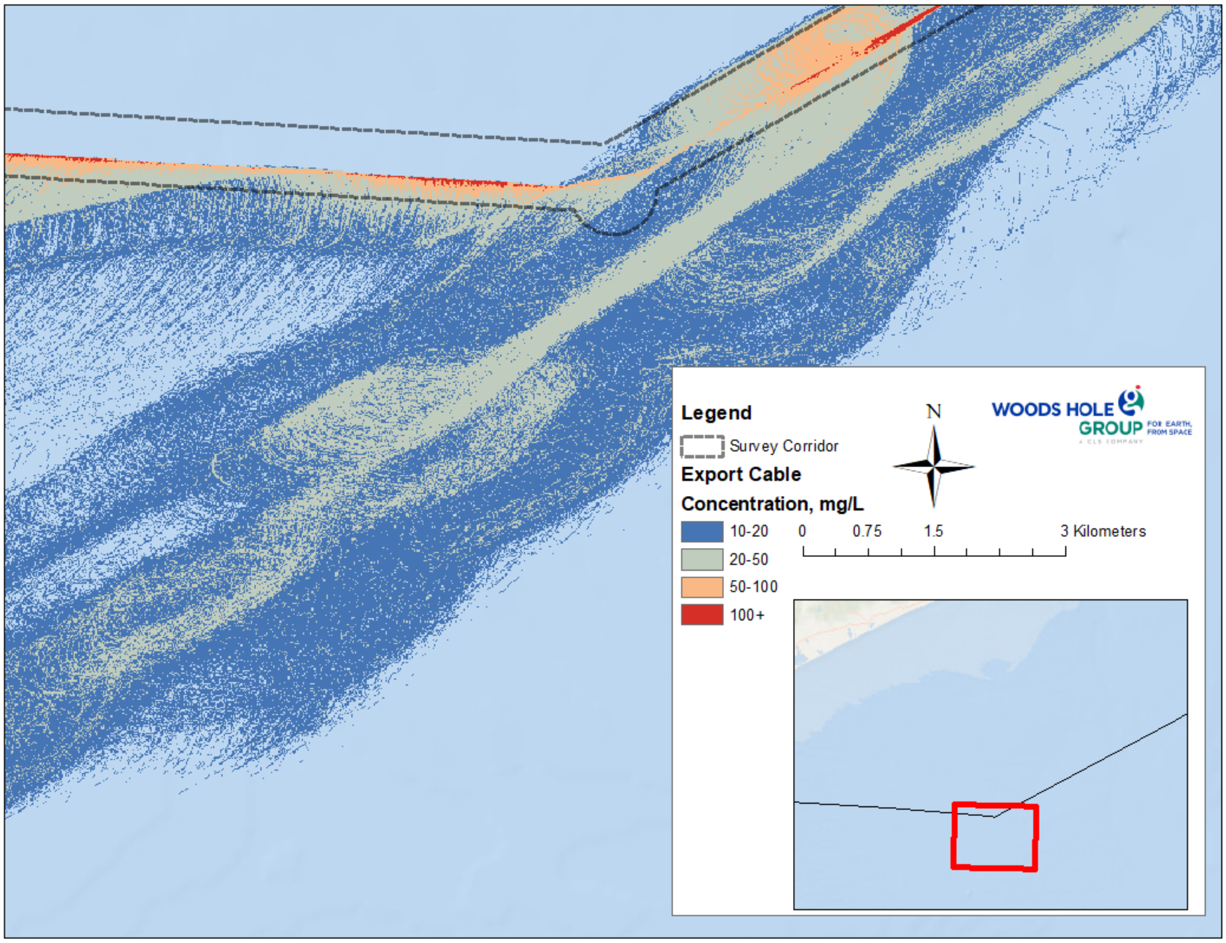

Figure 9.1-15 Maximum TSS concentrations occurring during SRWEC–OCS. Map 7 of 13 – refer to the inset for location relative to the full Project extent.

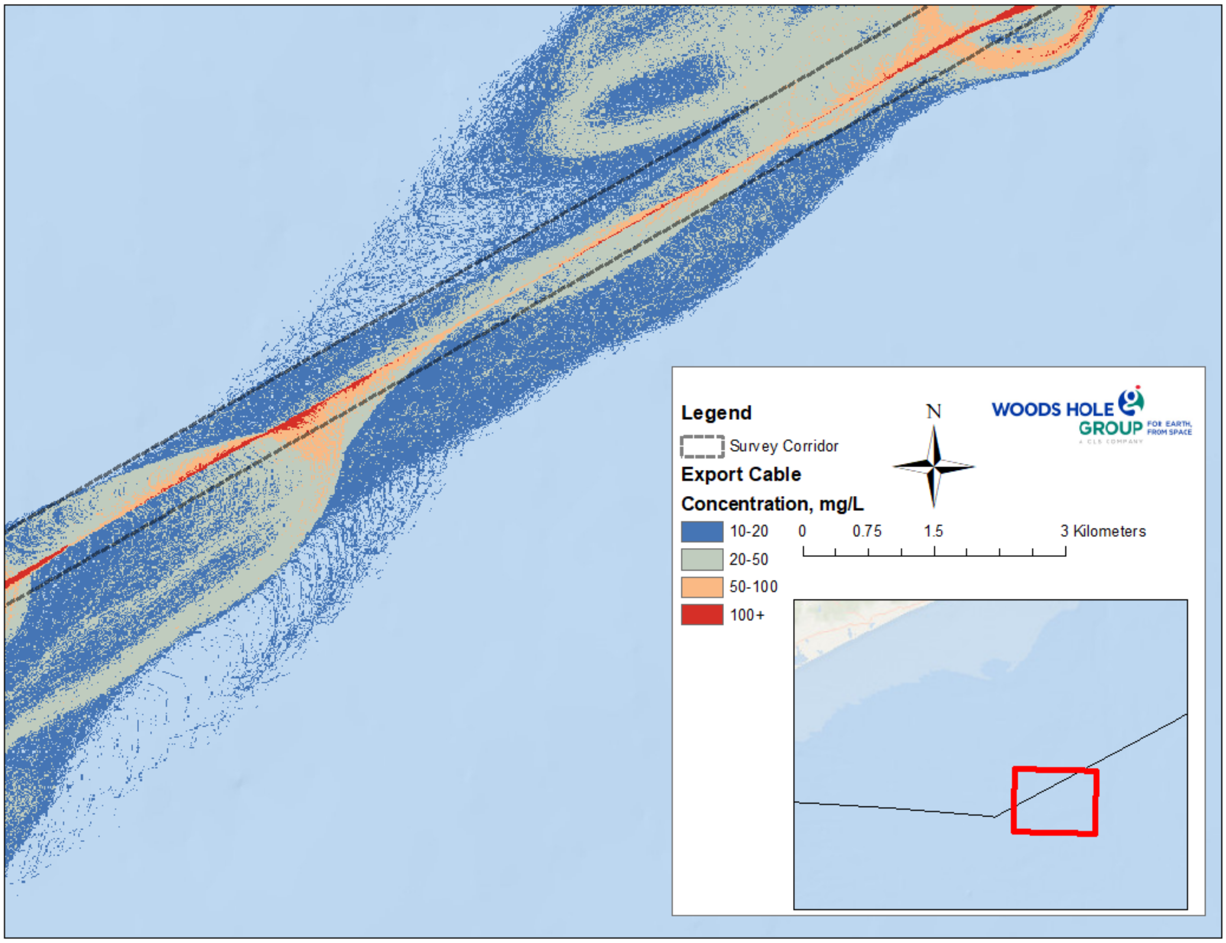

Figure 9.1-16 **Maximum TSS concentrations occurring during SRWEC–OCS installation high production rate (600 m3/hr). Map 8 of 13 – refer to the inset for location relative to the full Project extent.**

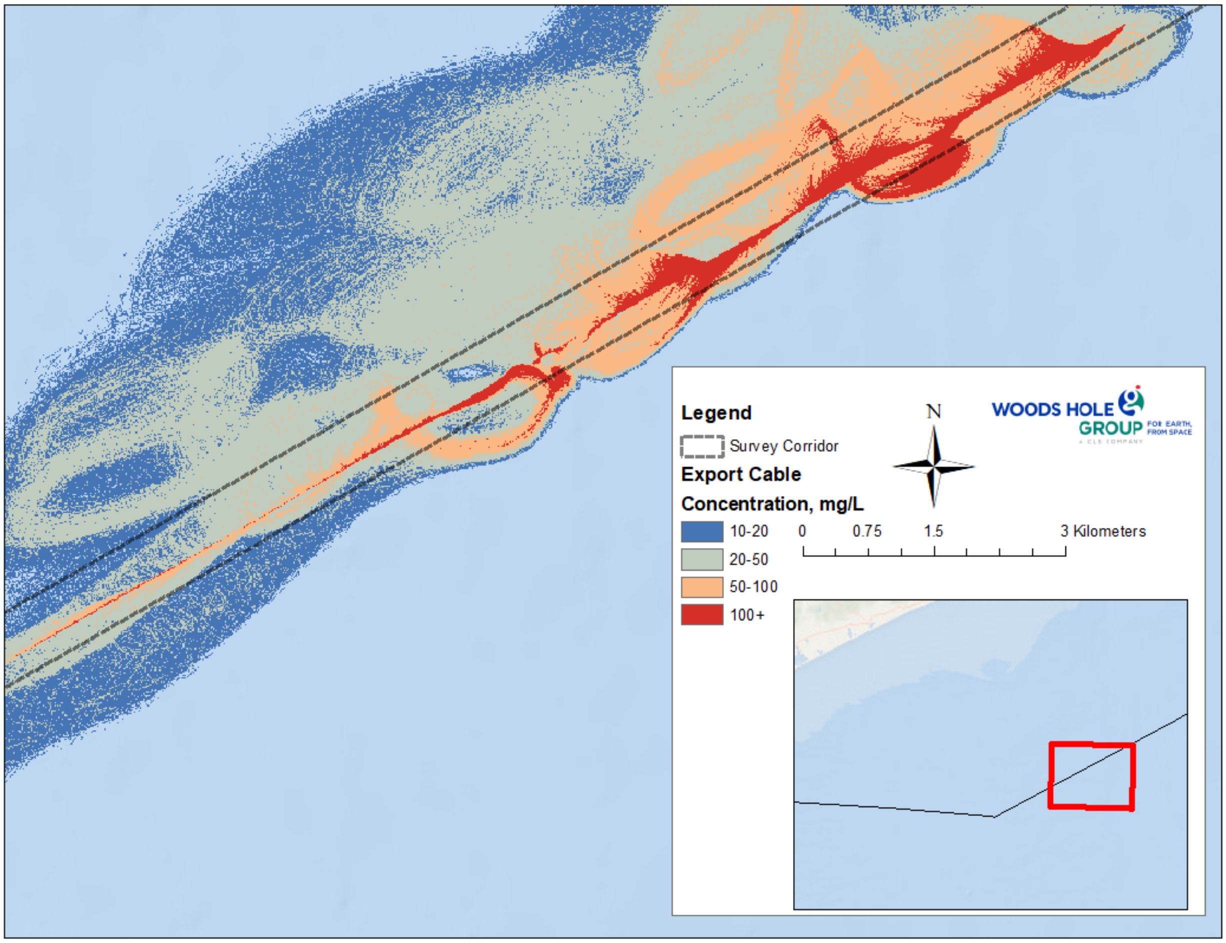

Figure 9.1-17 Maximum TSS concentrations occurring during SRWEC–OCS installation. Map 9 of 13 – refer to the inset for location relative to the full Project extent.

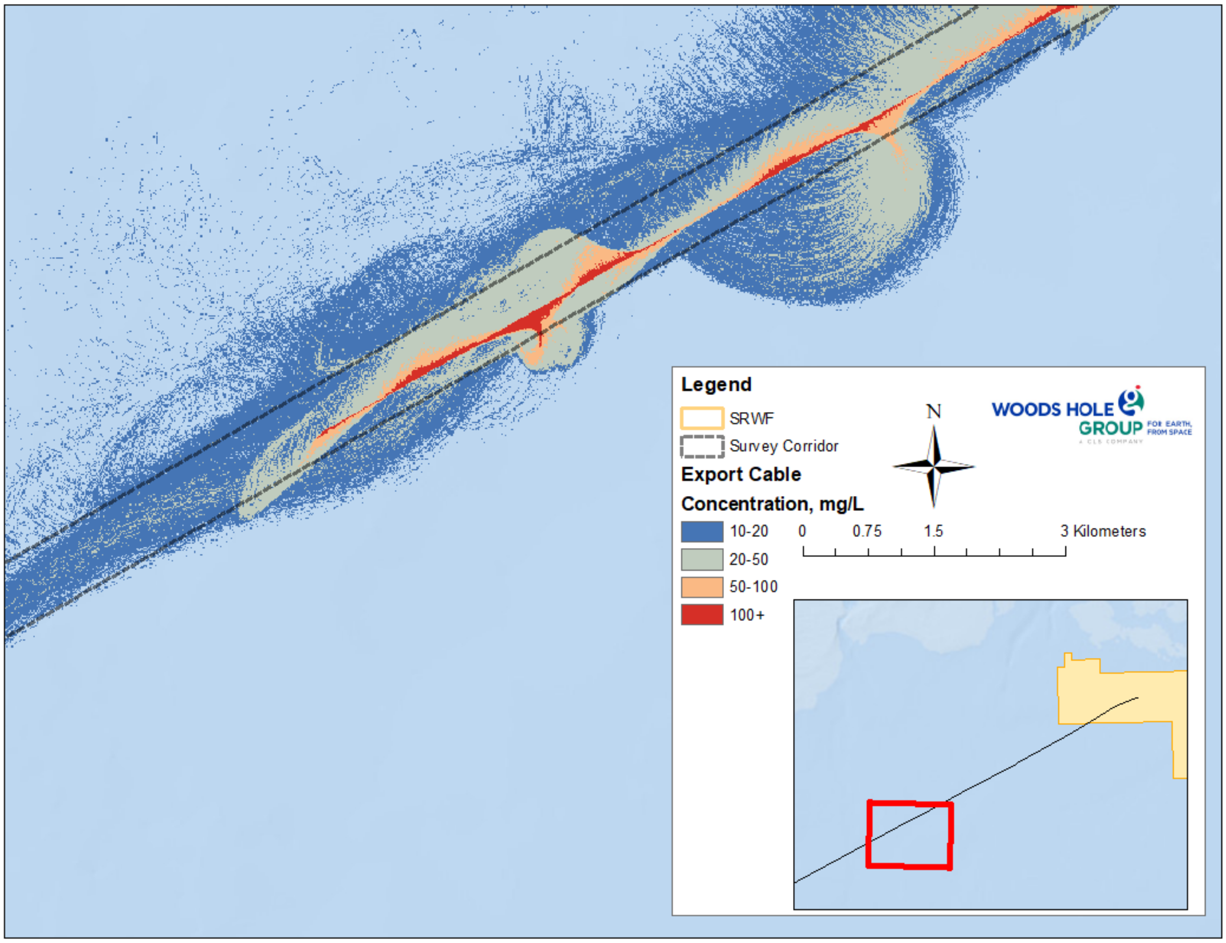

Figure 9.1-18 Maximum TSS concentrations occurring during SRWEC–OCS installation. Map 10 of 13 – refer to the inset for location relative to the full Project extent.

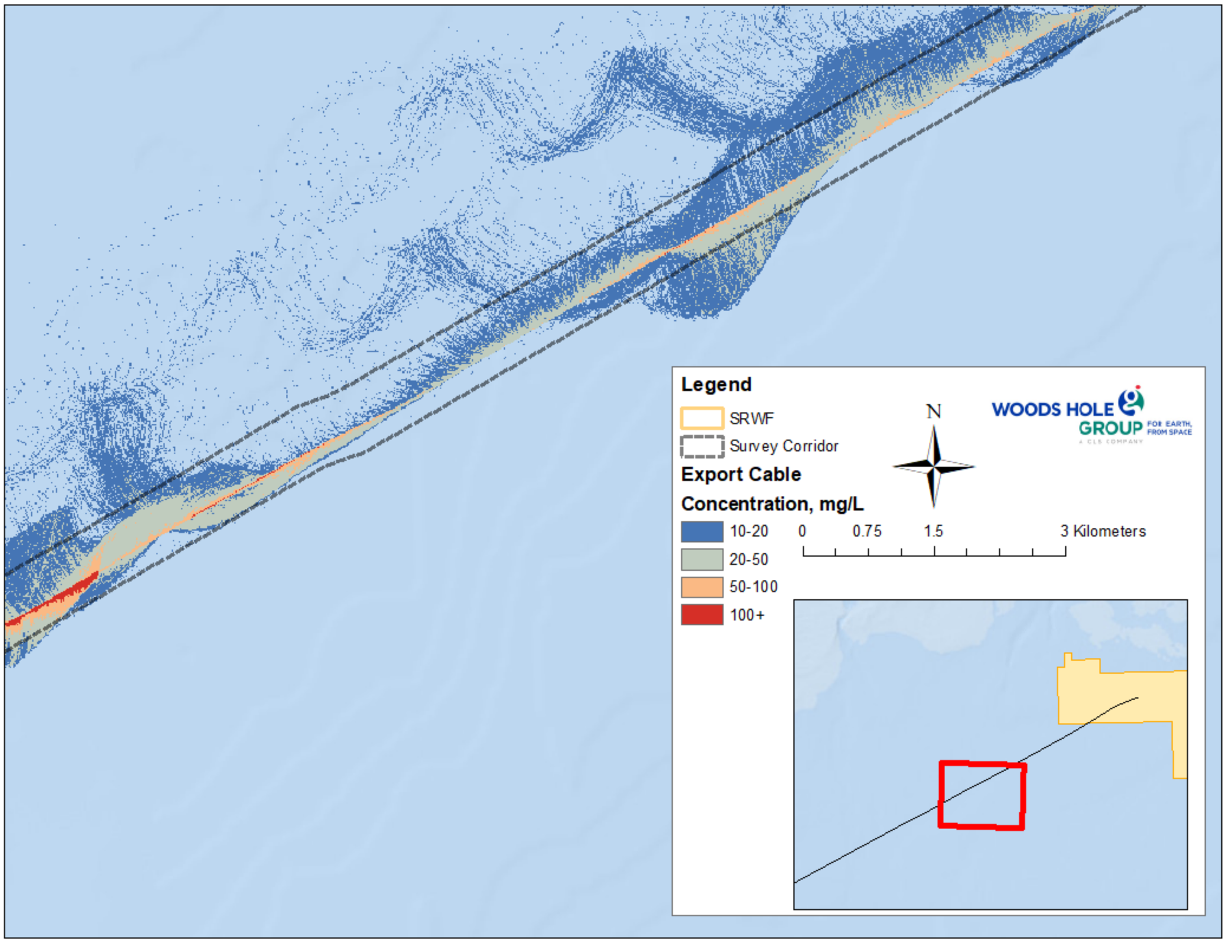

Figure 9.1-19 Maximum TSS concentrations occurring during SRWEC–OCS installation. Map 11 of 13 – refer to the inset for location relative to the full Project extent.

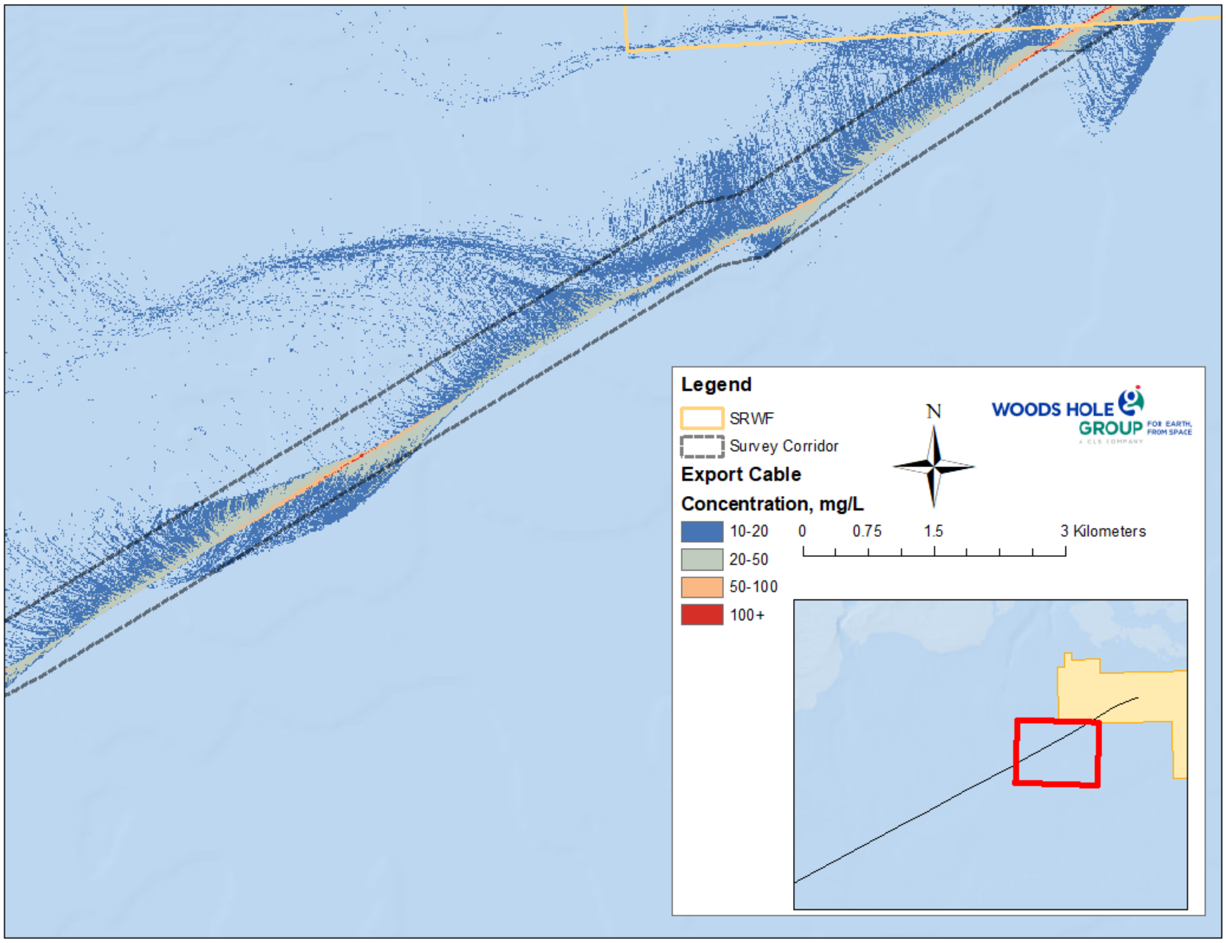

Figure 9.1-20 Maximum TSS concentrations occurring during SRWEC–OCS installation. Map 12 of 13 – refer to the inset for location relative to the full Project extent.

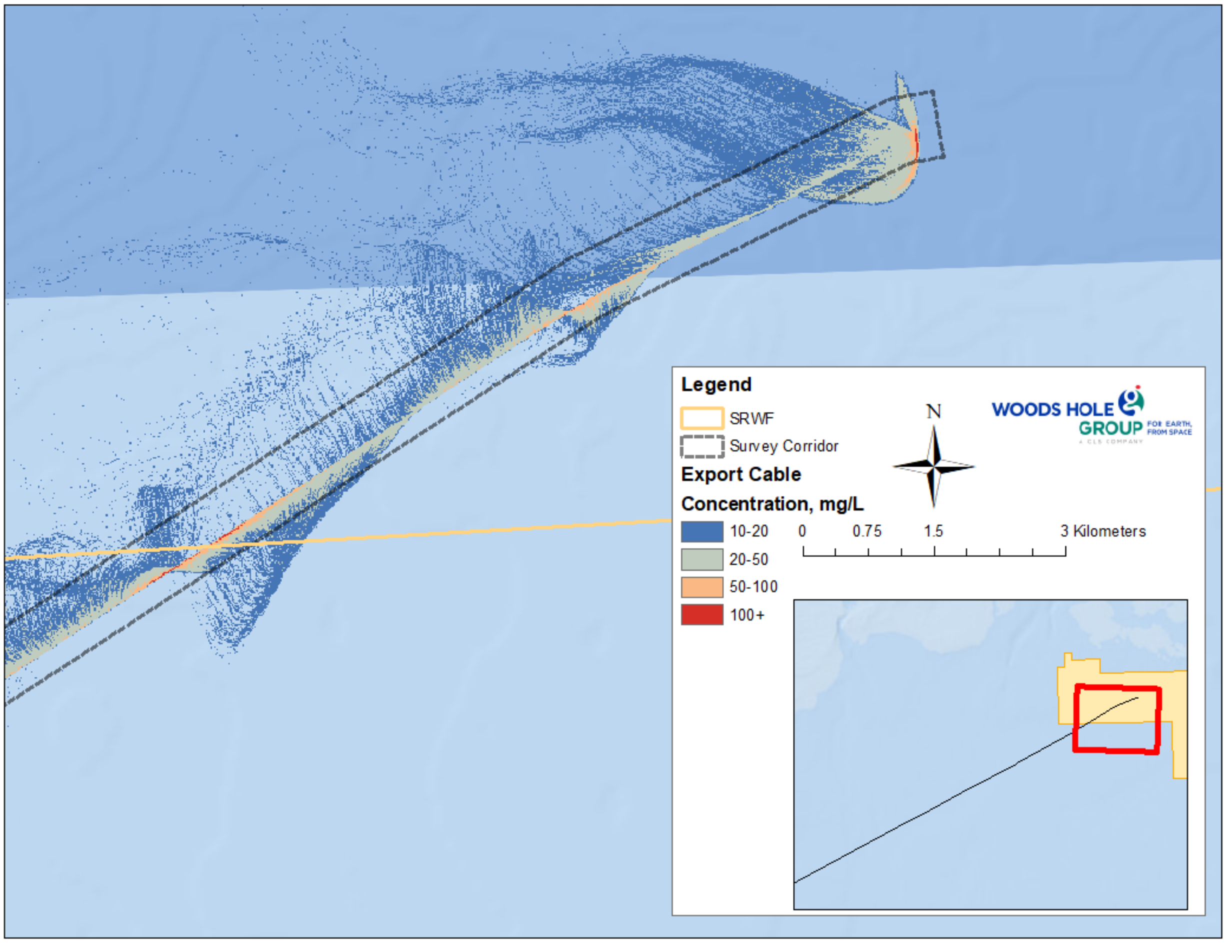

Figure 9.1-21 Maximum TSS concentrations occurring during SRWEC–OCS installation. Map 13 of 13 – refer to the inset for location relative to the full Project extent.

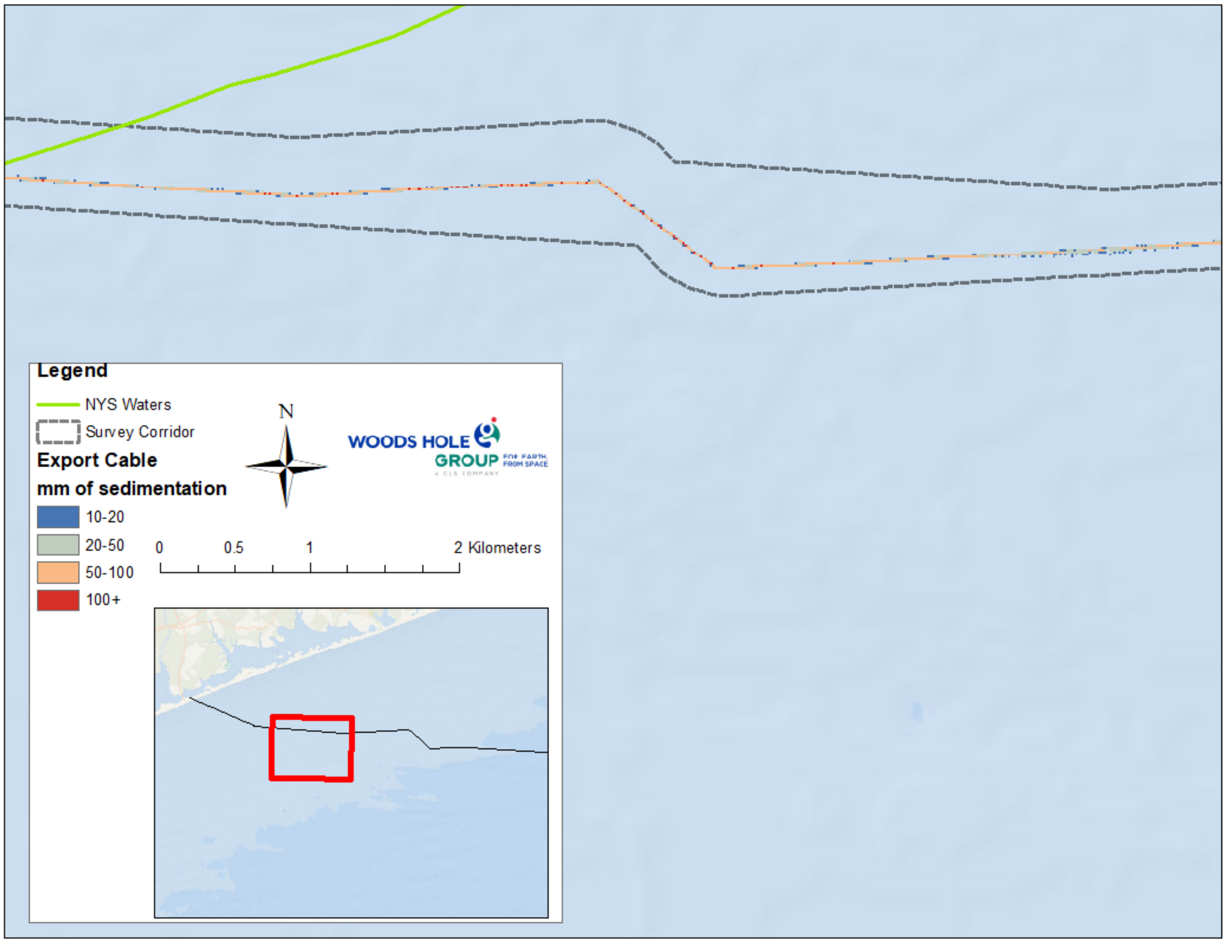

Figure 9.1-22 Sediment deposition on seafloor after SRWEC–OCS installation. Map 1 of 18 – refer to the inset for location relative to the full Project extent.

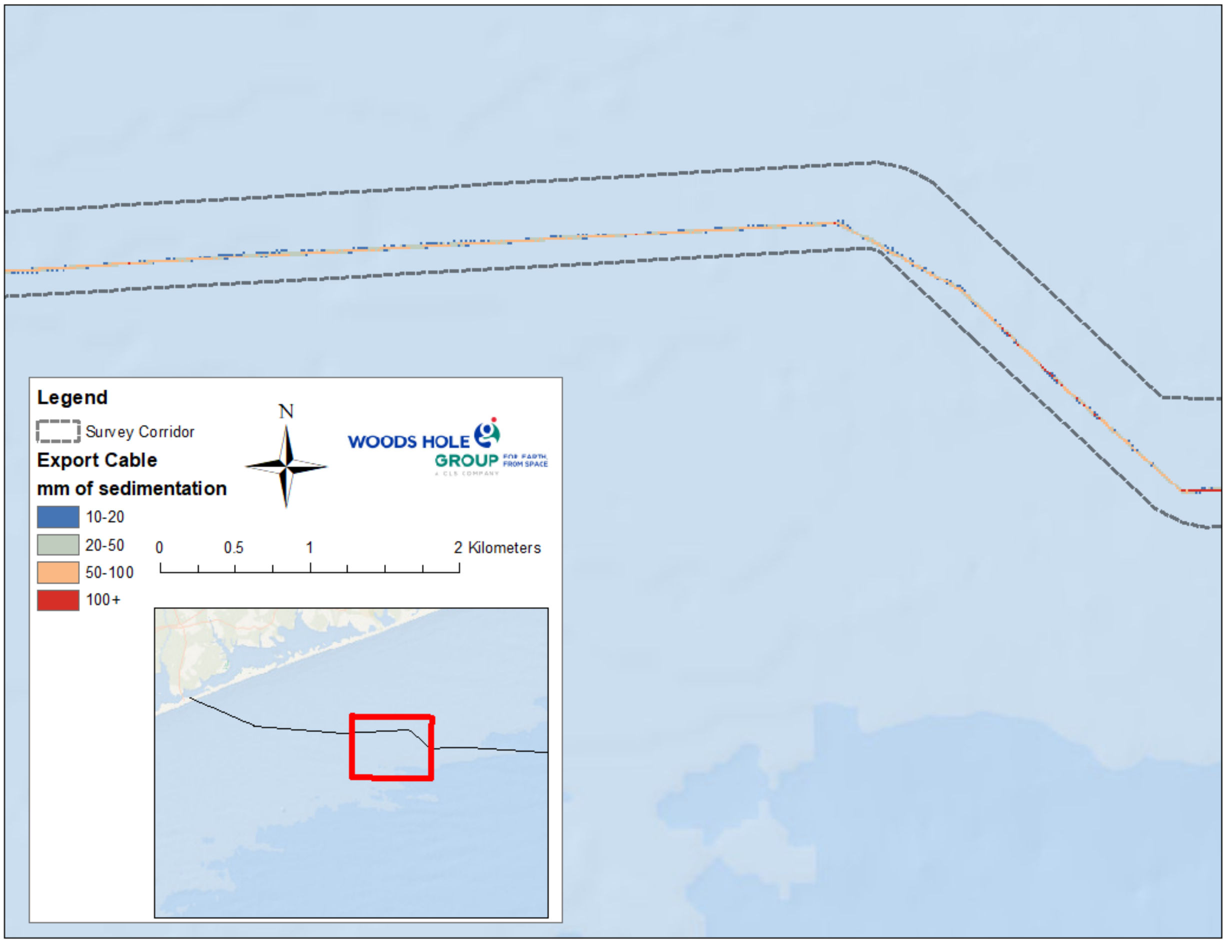

Figure 9.1-23 Sediment deposition on seafloor after SRWEC–OCS installation. Map 2 of 18 – refer to the inset for location relative to the full Project extent.

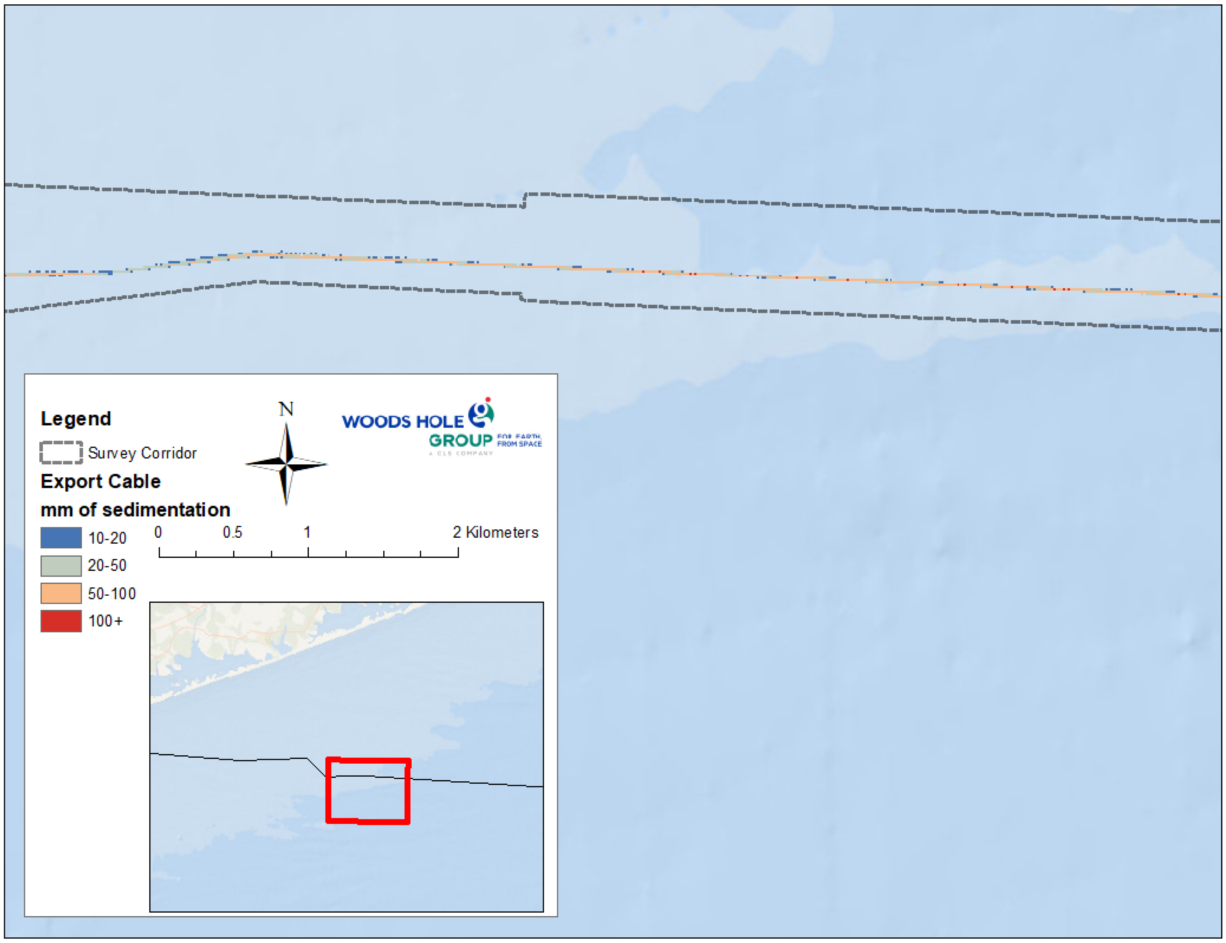

Figure 9.1-24 Sediment deposition on seafloor after SRWEC–OCS installation. Map 3 of 18 – refer to the inset for location relative to the full Project extent.

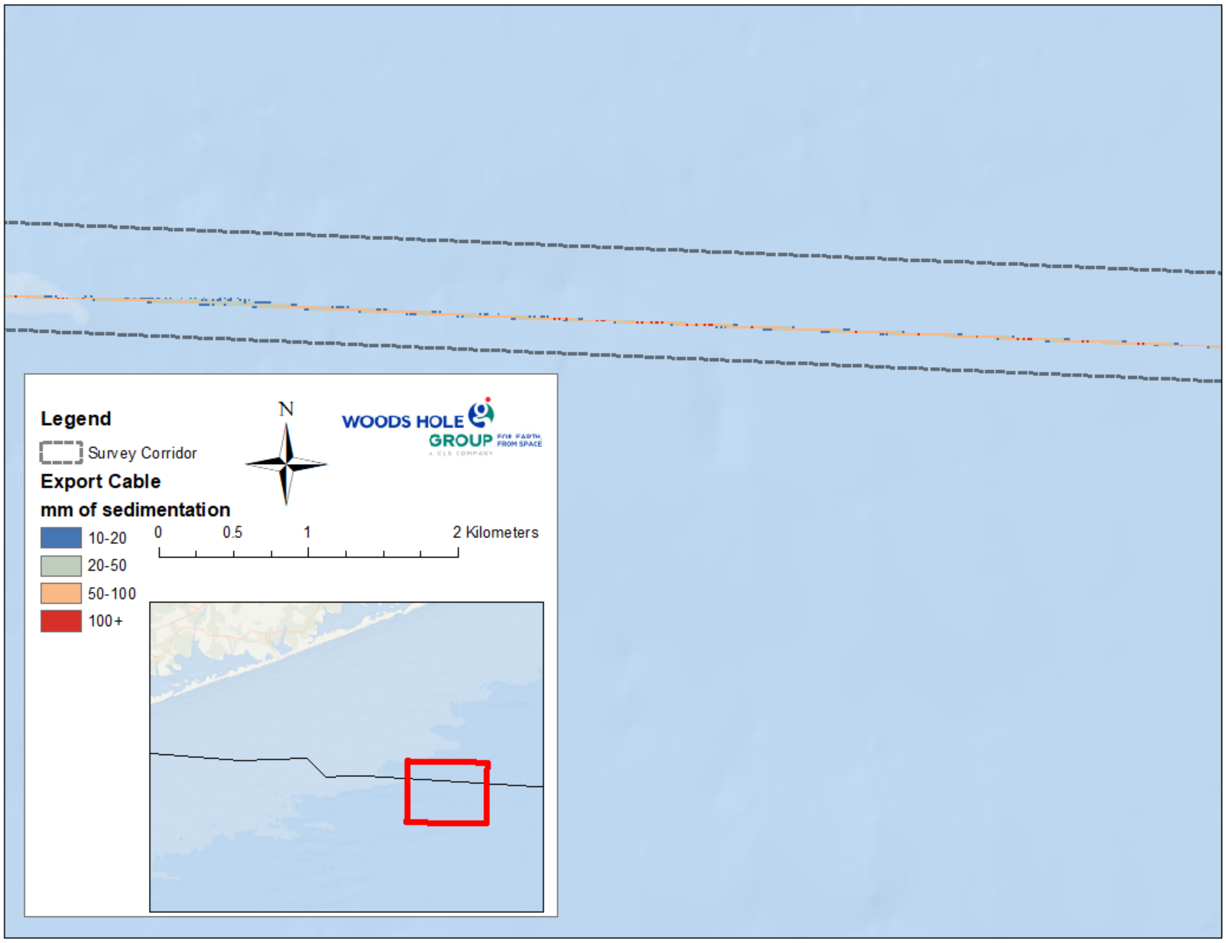

Figure 9.1-25 Sediment deposition on seafloor after SRWEC–OCS installation. Map 4 of 18 – refer to the inset for location relative to the full Project extent.

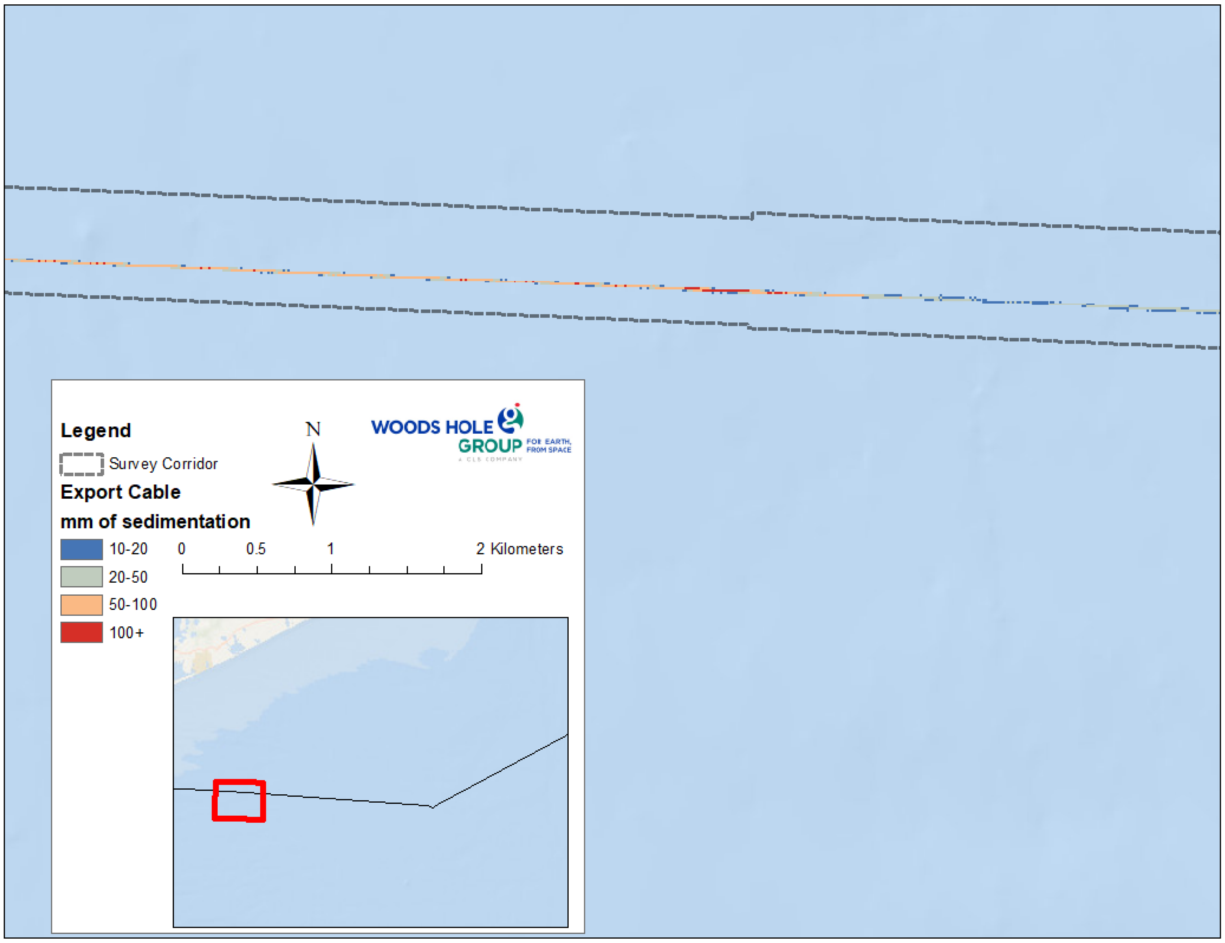

Figure 9.1-26 Sediment deposition on seafloor after SRWEC–OCS installation. Map 5 of 18 – refer to the inset for location relative to the full Project extent.

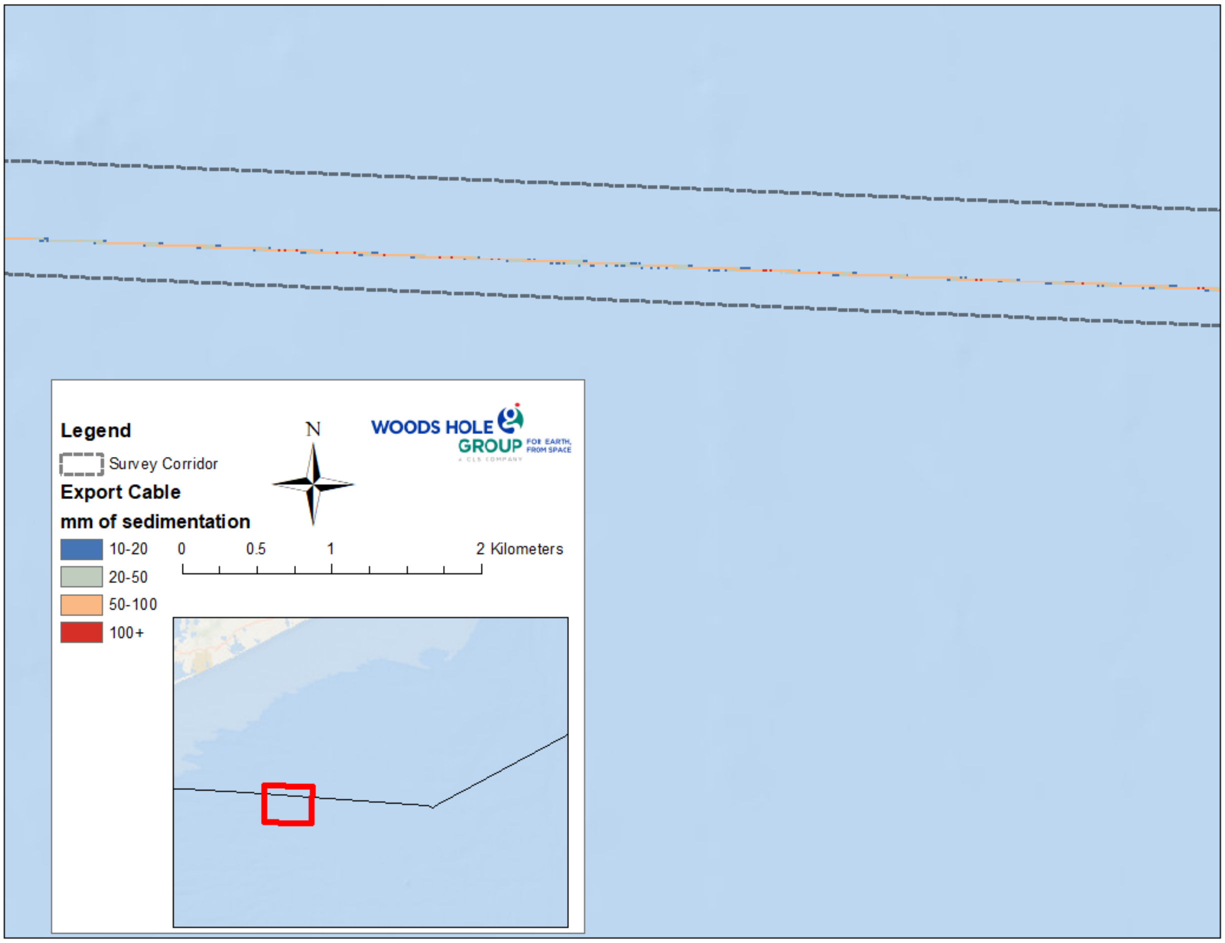

Figure 9.1-27 Sediment deposition on seafloor after SRWEC–OCS installation. Map 6 of 18 – refer to the inset for location relative to the full Project extent.

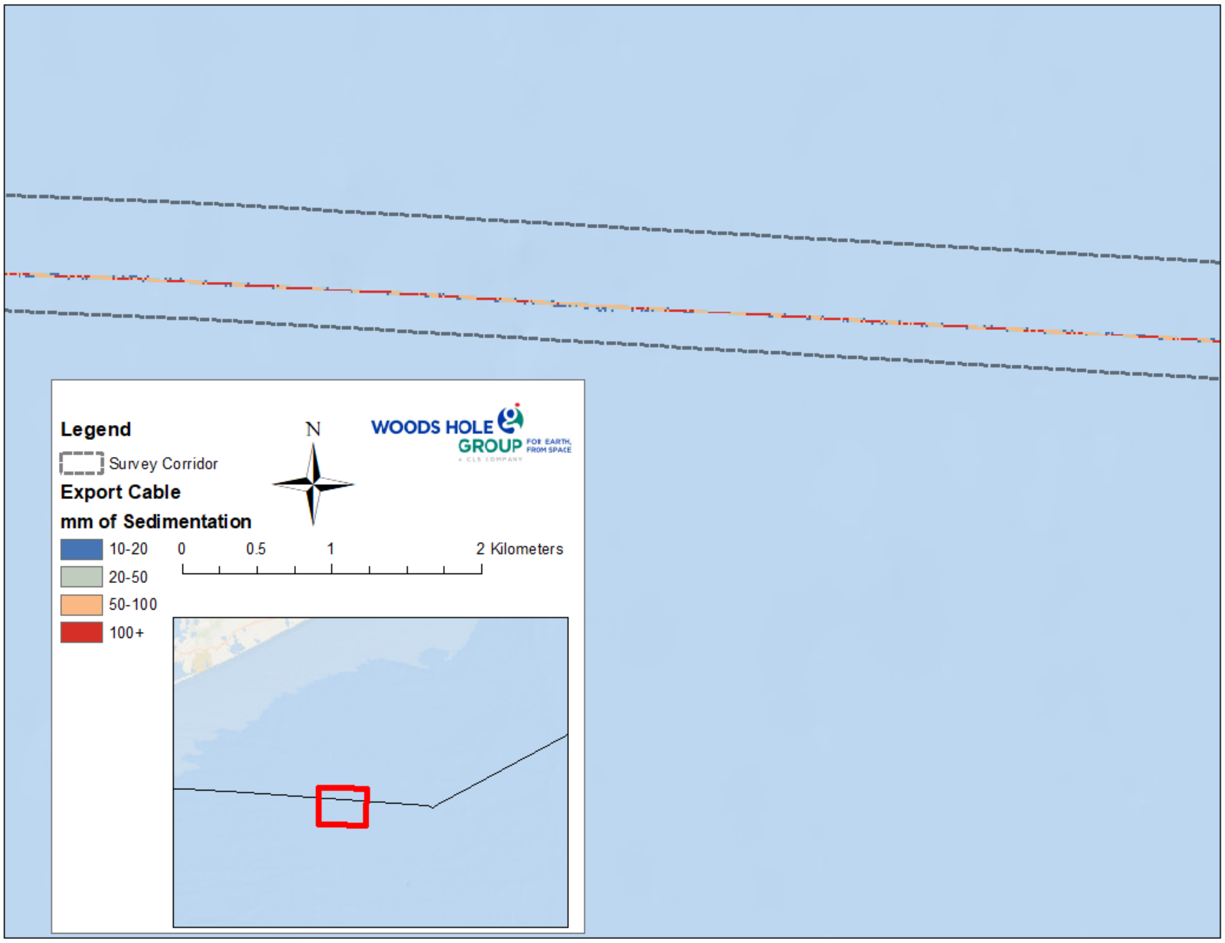

Figure 9.1-28 Sediment deposition on seafloor after SRWEC–OCS installation. Map 7 of 18 – refer to the inset for location relative to the full Project extent.

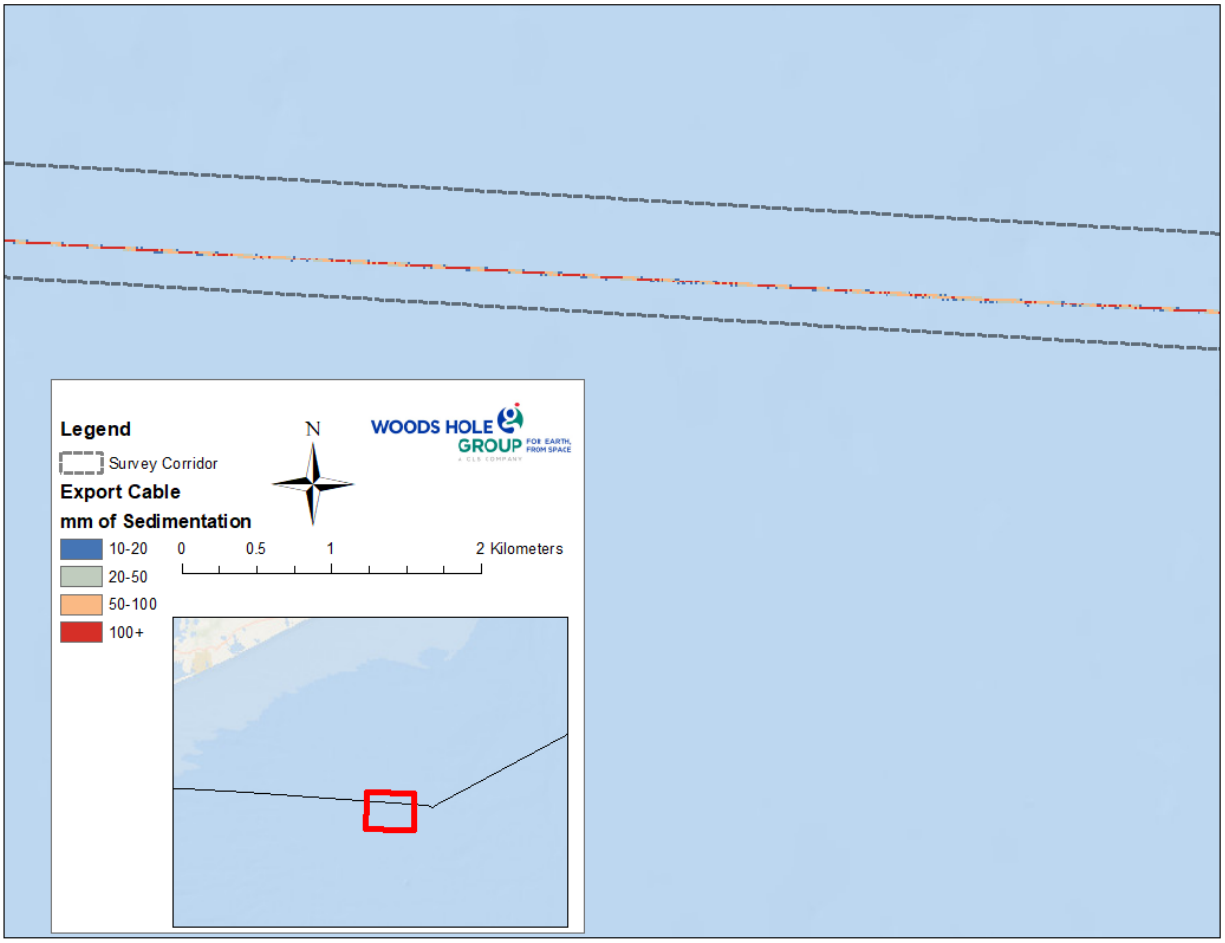

Figure 9.1-29 **Sediment deposition on seafloor after SRWEC–OCS installation. Map 8 of 18 – refer to the inset for location relative to the full Project extent.**

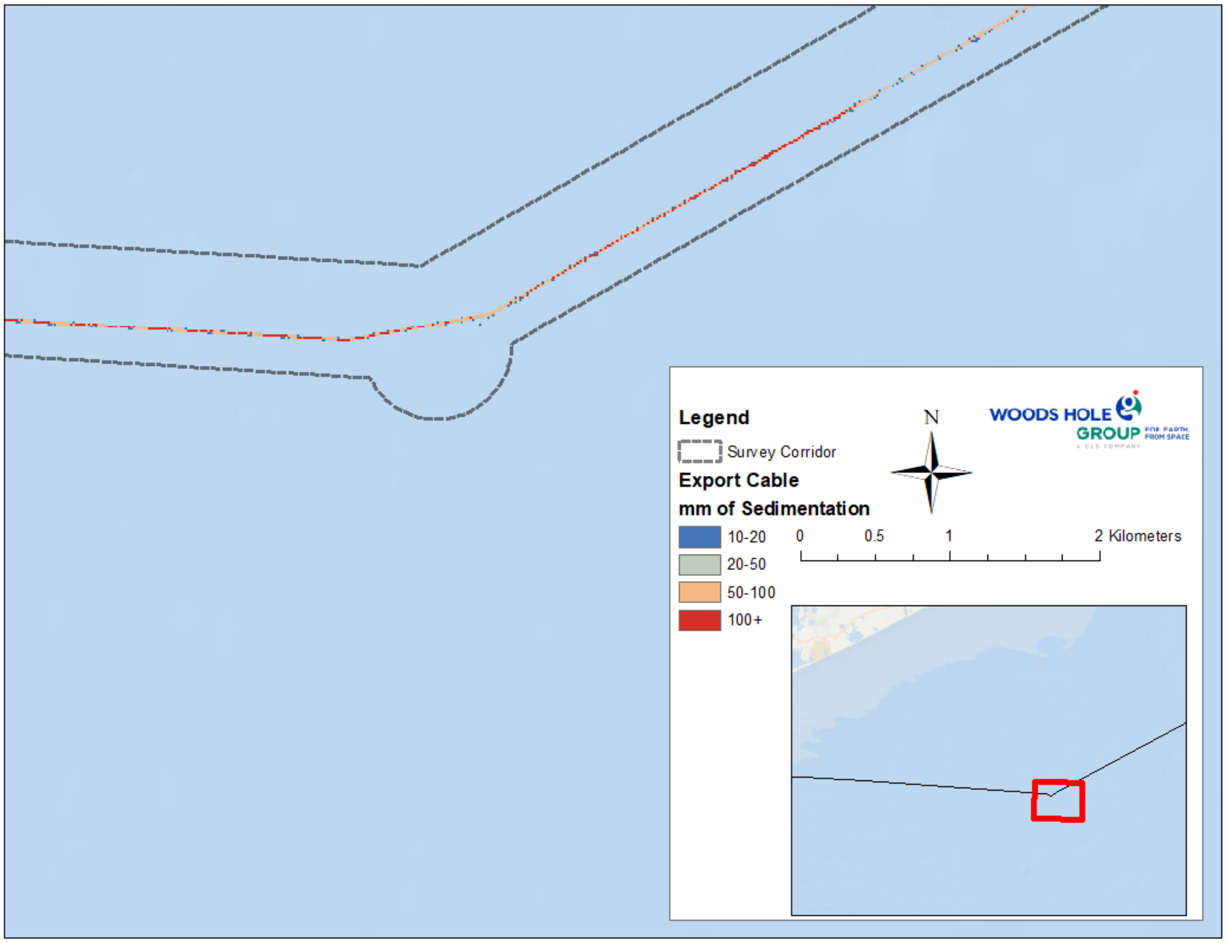

Figure 9.1-30 Sediment deposition on seafloor after SRWEC–OCS installation. Map 9 of 18 – refer to the inset for location relative to the full Project extent.

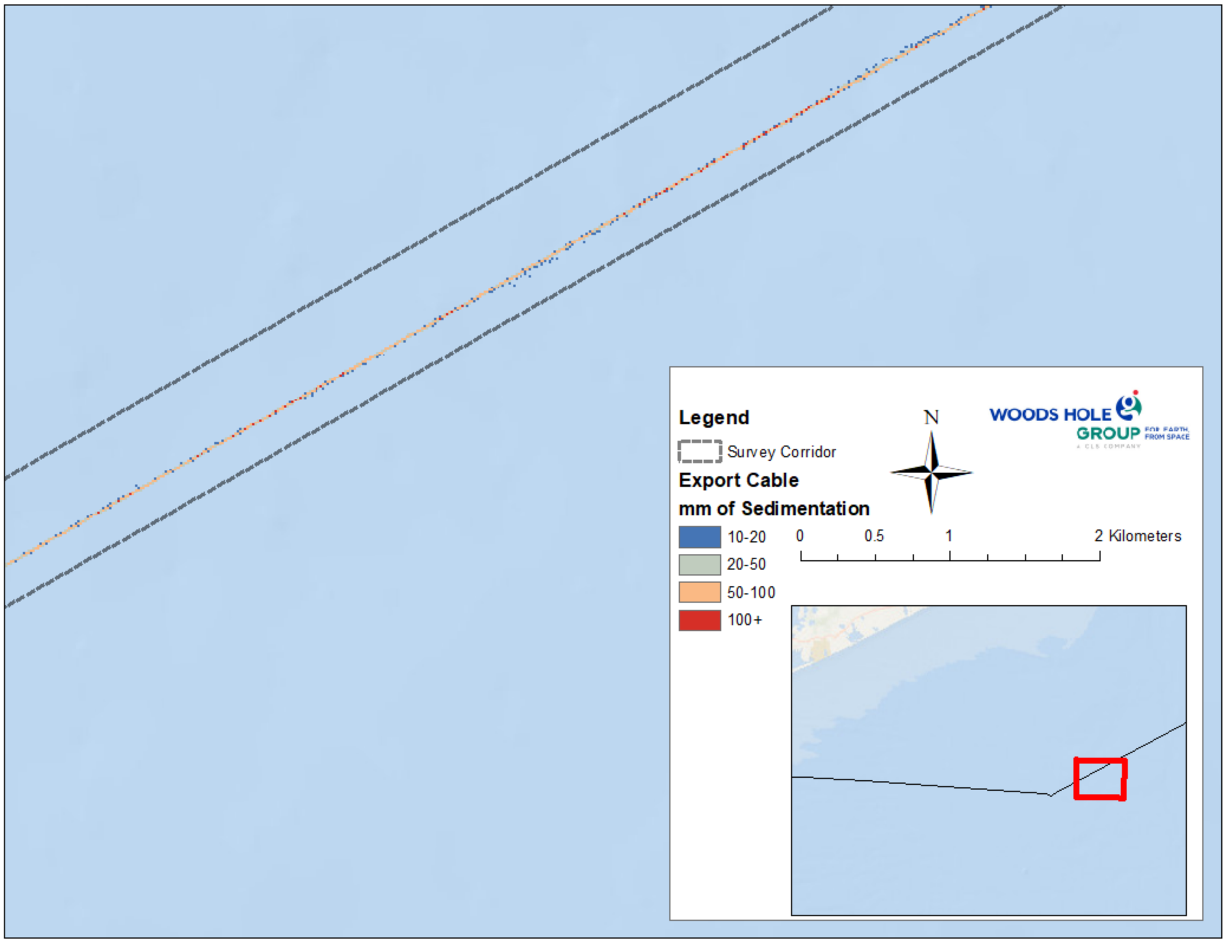

Figure 9.1-31 Sediment deposition on seafloor after SRWEC–OCS installation. Map 10 of 18 – refer to the inset for location relative to the full Project extent.

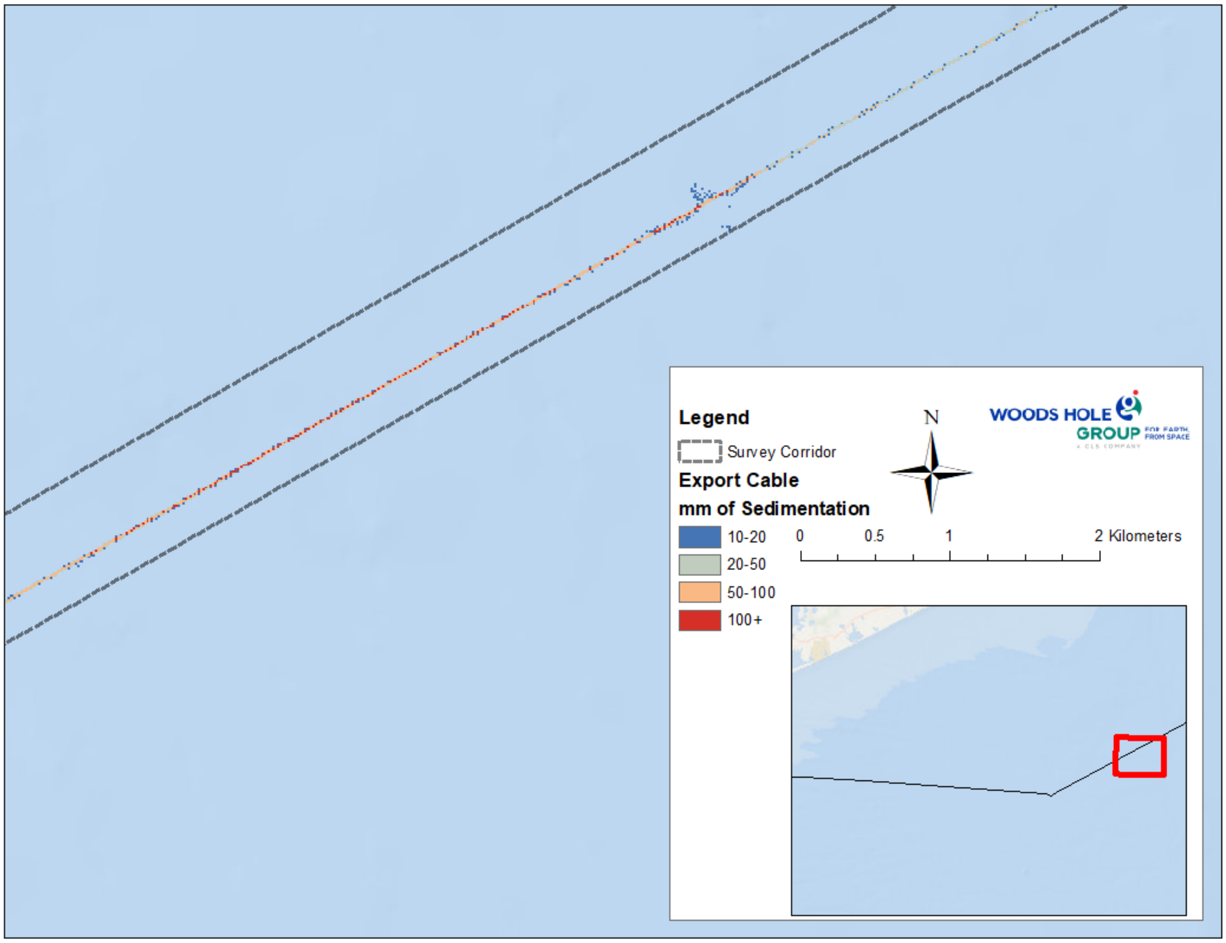

Figure 9.1-32 Sediment deposition on seafloor after SRWEC–OCS installation. Map 11 of 18 – refer to the inset for location relative to the full Project extent.

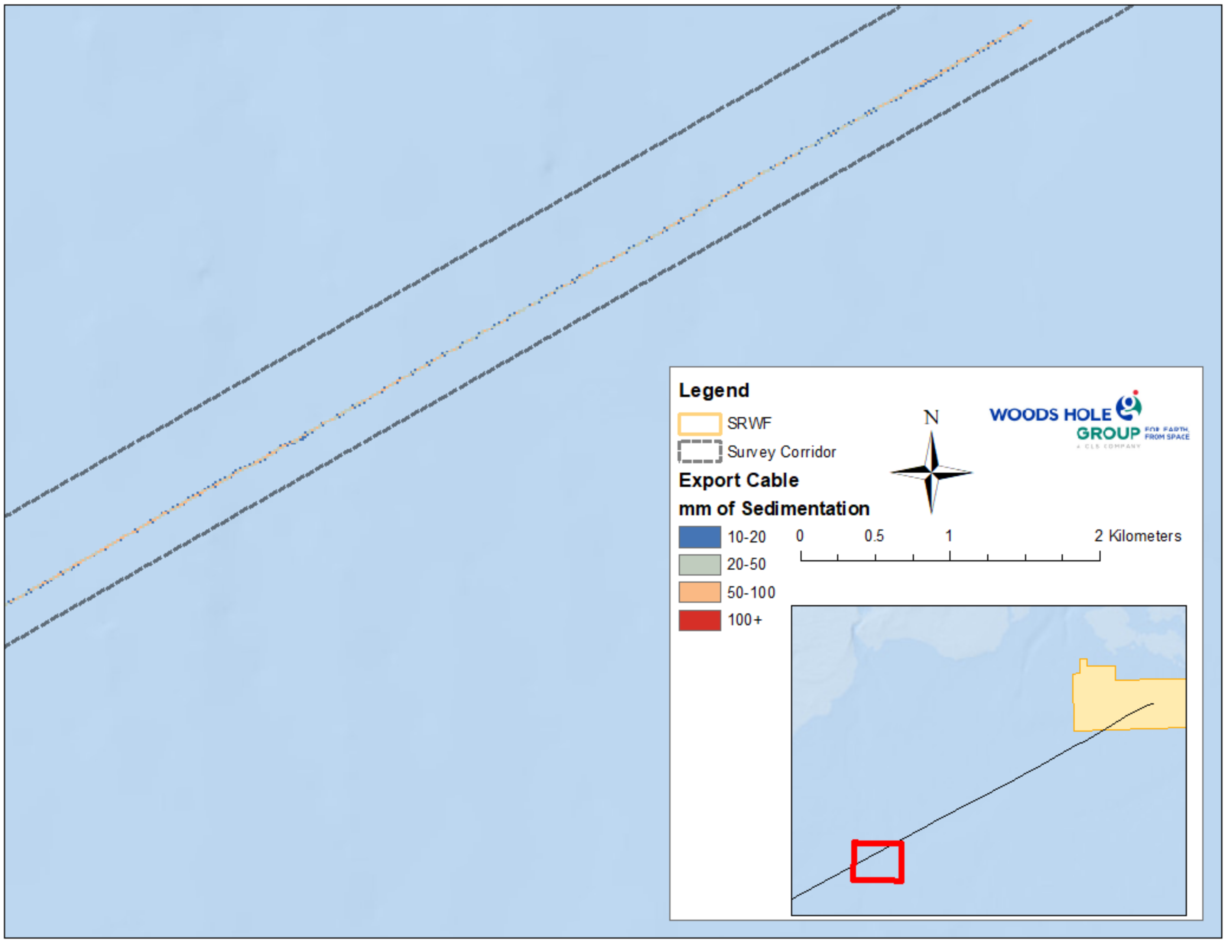

Figure 9.1-33 Sediment deposition on seafloor after SRWEC–OCS installation. Map 12 of 18 – refer to the inset for location relative to the full Project extent.

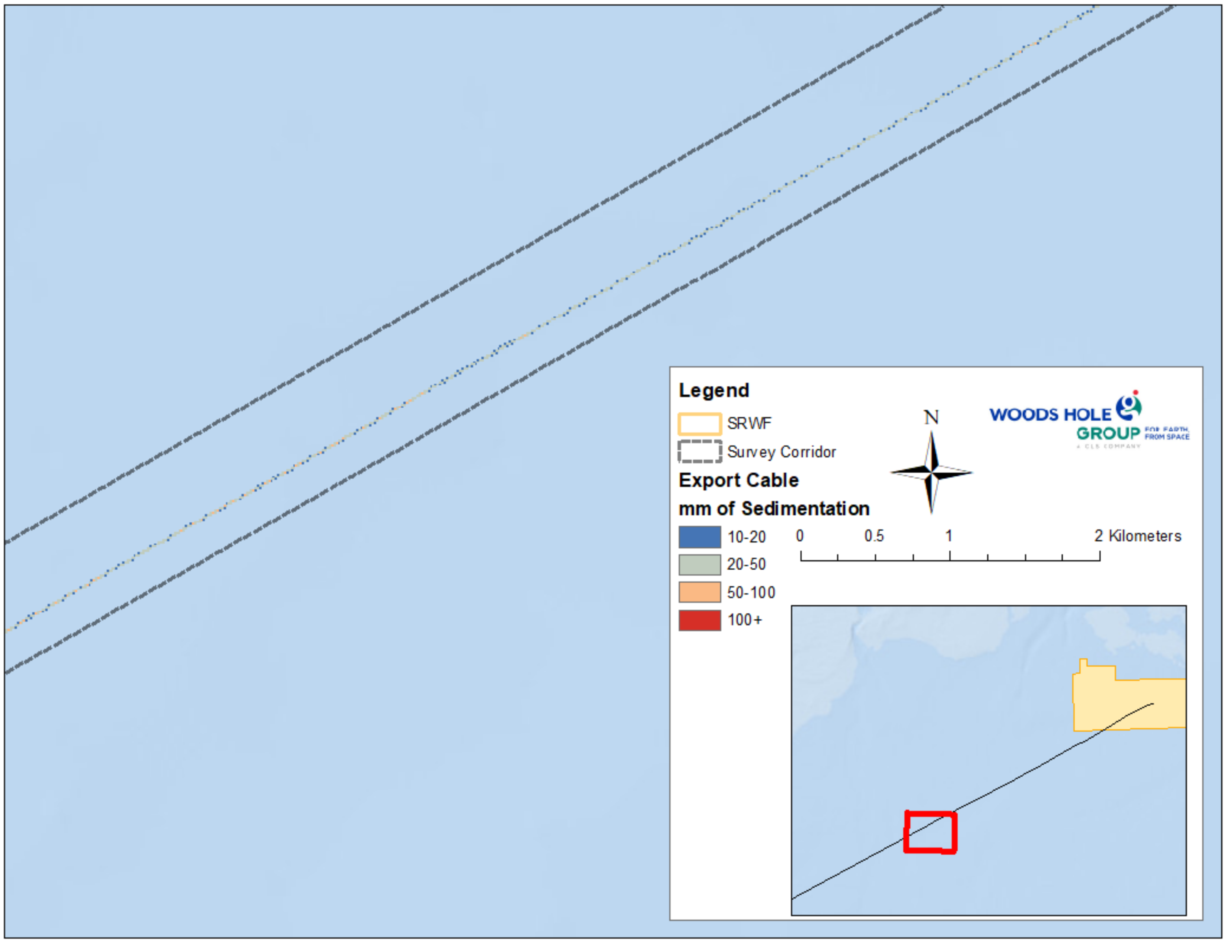

Figure 9.1-34 Sediment deposition on seafloor after SRWEC–OCS installation. Map 13 of 18 – refer to the inset for location relative to the full Project extent.

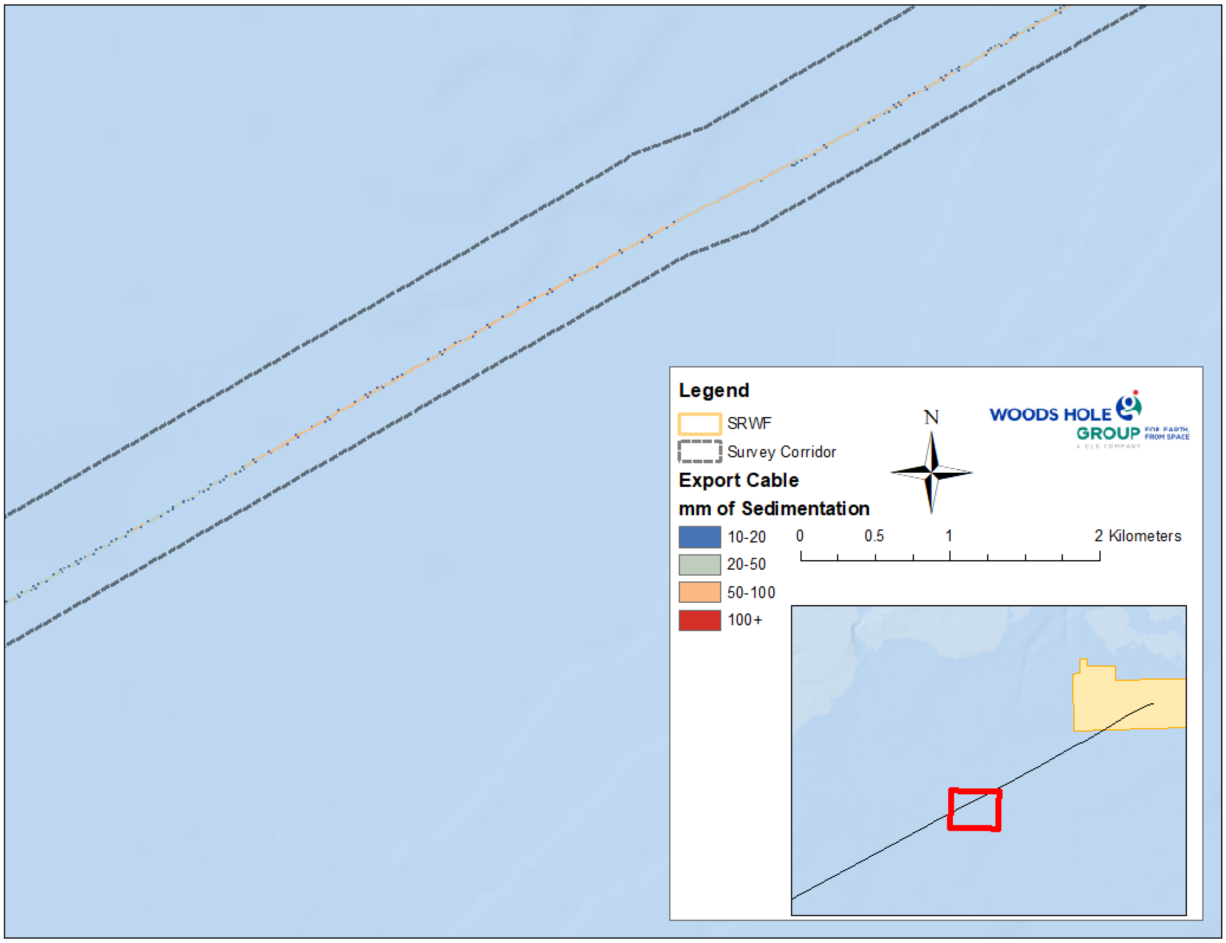

Figure 9.1-35 Sediment deposition on seafloor after SRWEC–OCS installation. Map 14 of 18 – refer to the inset for location relative to the full Project extent.

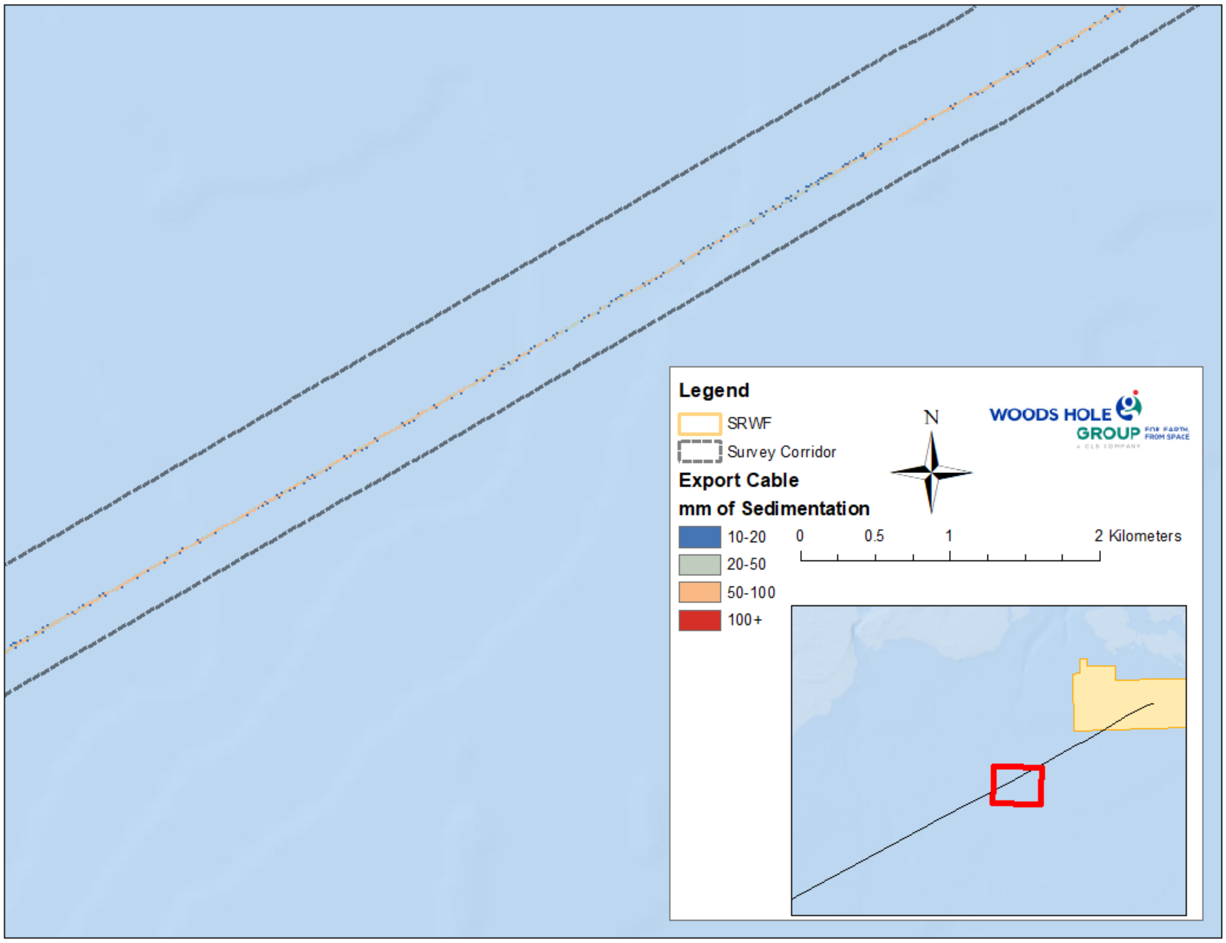

Figure 9.1-36 Sediment deposition on seafloor after SRWEC–OCS installation. Map 15 of 18 – refer to the inset for location relative to the full Project extent.

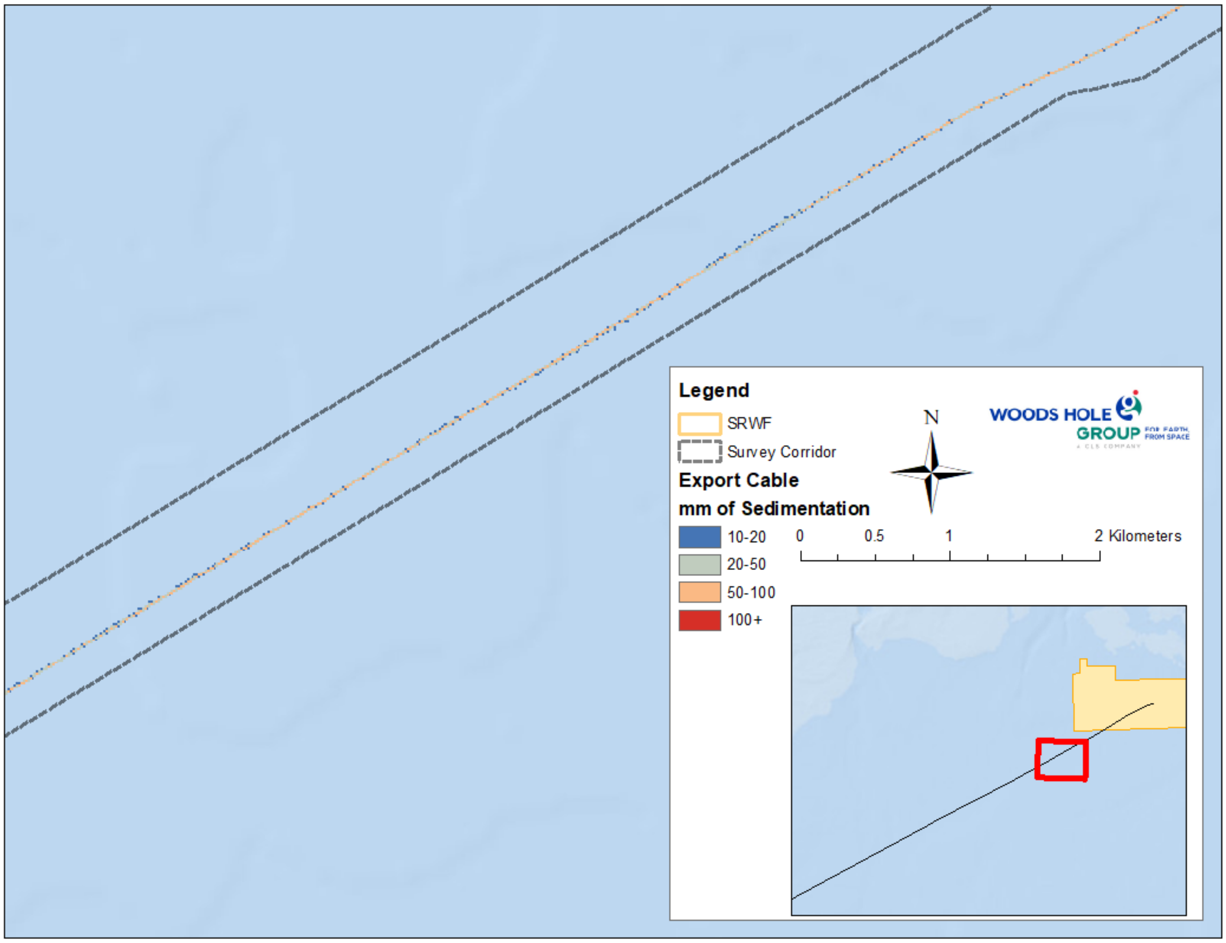

Figure 9.1-37 Sediment deposition on seafloor after SRWEC–OCS installation. Map 16 of 18 – refer to the inset for location relative to the full Project extent.

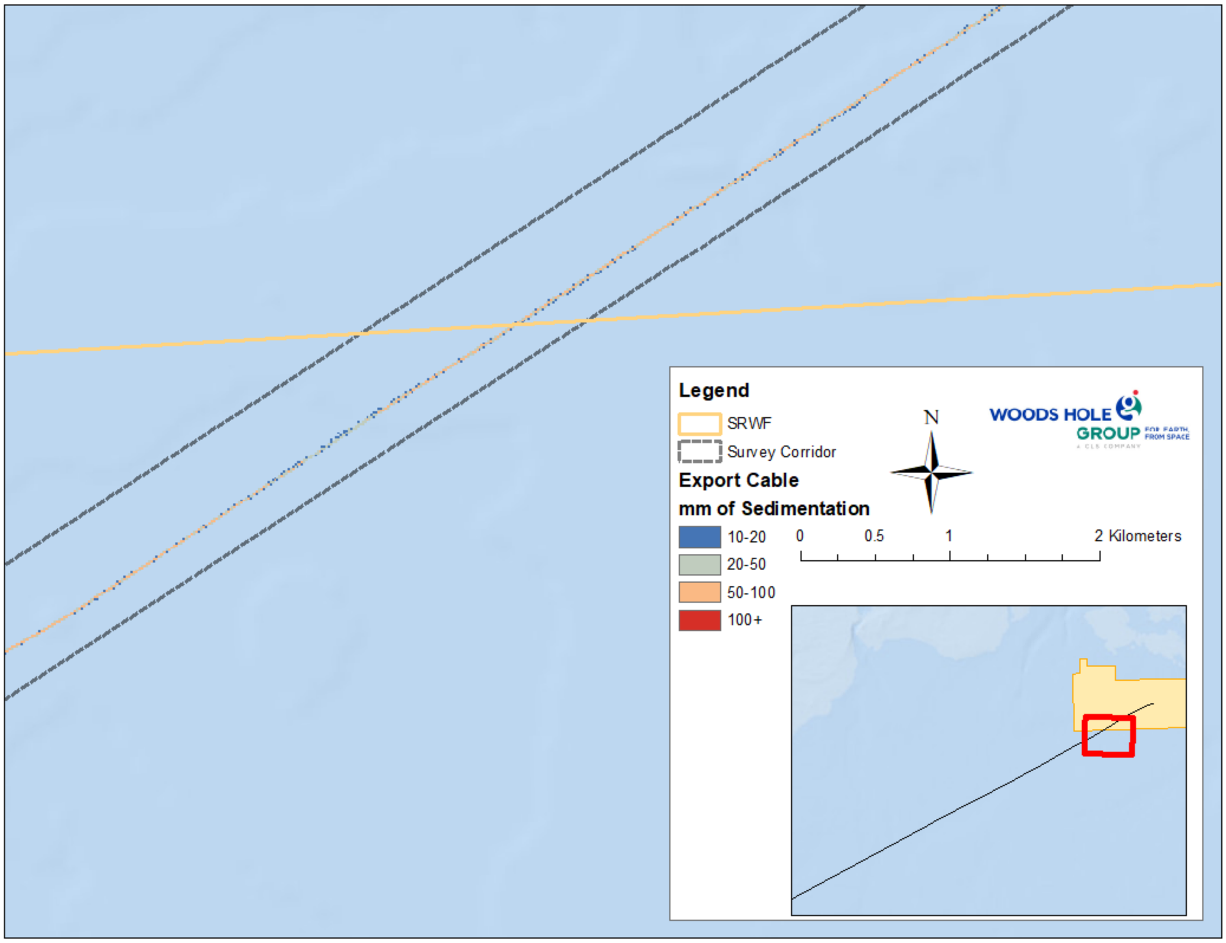

Figure 9.1-38 Sediment deposition on seafloor after SRWEC–OCS installation. Map 17 of 18 – refer to the inset for location relative to the full Project extent.

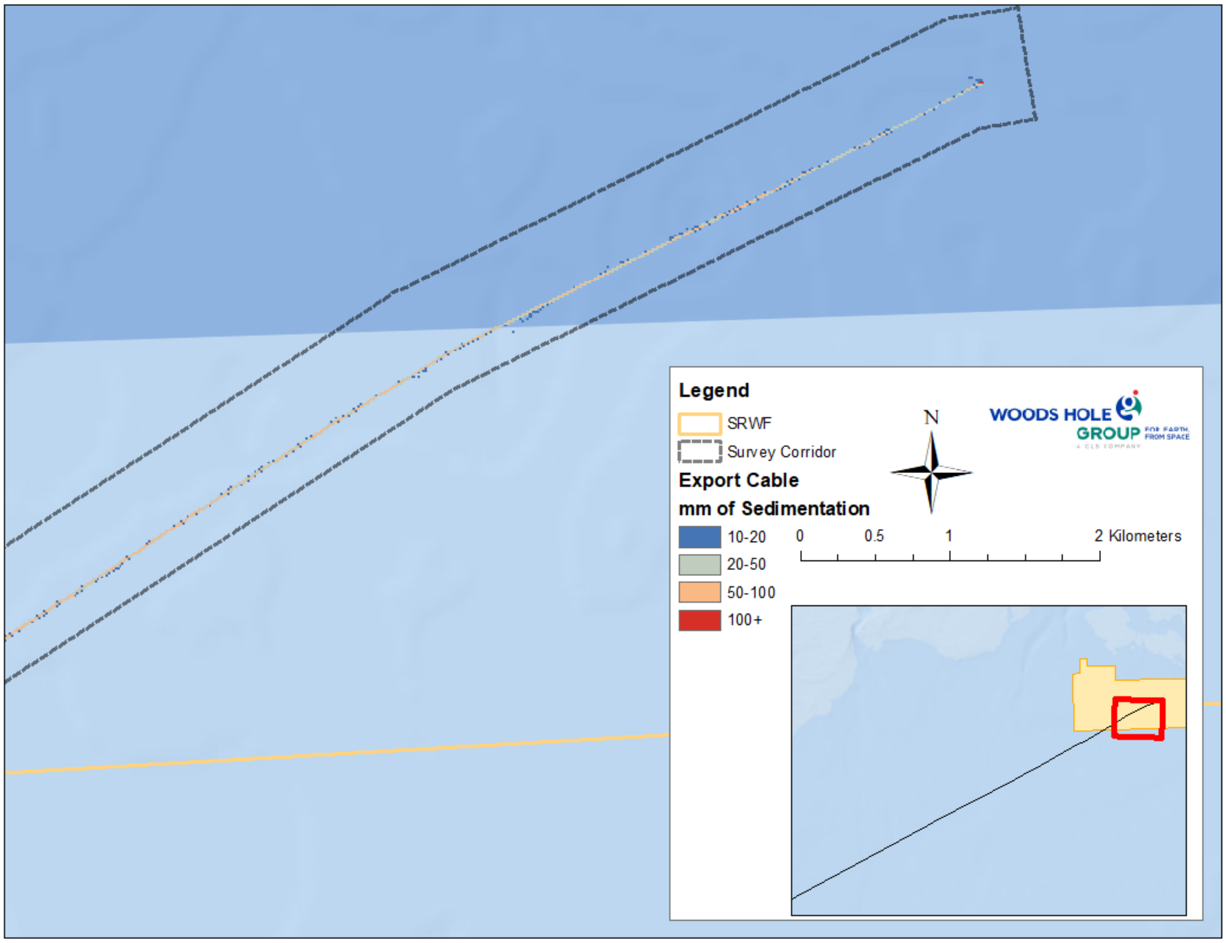

Figure 9.1-39 Sediment deposition on seafloor after SRWEC–OCS installation. Map 18 of 18 – refer to the inset for location relative to the full Project extent.

Scenario 6 – IAC Installation in Federal Waters – Typical Case

The scenario included the release of 1,800 m^3 (2354 cy) of sediment to the water column over the duration of the IAC installation (duration of 3.75 hours). This is considered to be a typical case segment utilized for the model. Maximum suspended sediment concentrations in excess of 10 mg/L occurring over the duration of the IAC installation are shown in Figure 9.1-40. The sediment deposition that results from this activity is shown in Figure 9.1-41.

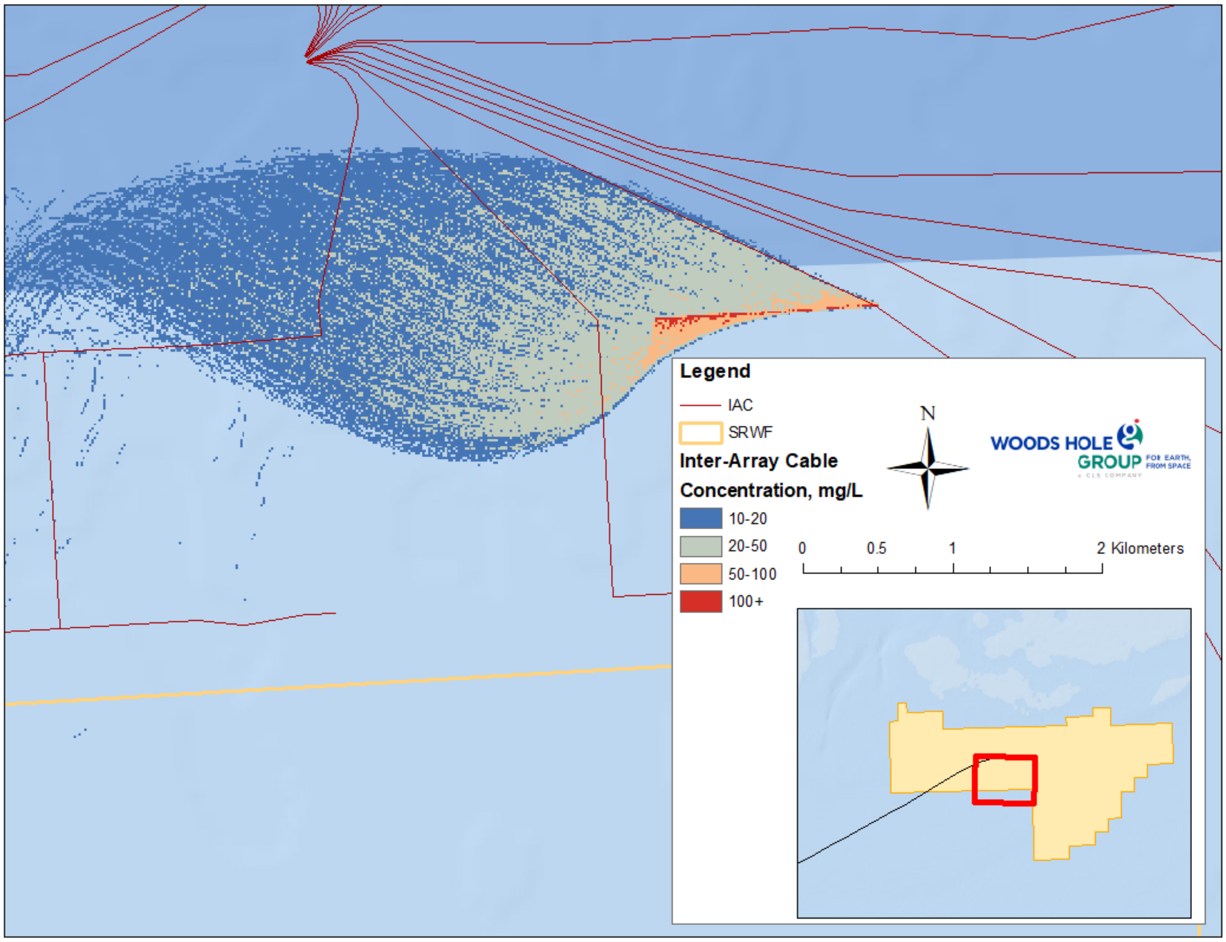

Figure 9.1-40. Maximum TSS concentrations occurring during representative IAC installation – typical case

The results shown in Figure 9.1-40 indicate maximum suspended sediment concentrations in excess of 100 mg/L occur within 619 m (2031 ft) of the cable centerline. The TSS plume is primarily contained within the lower portion of the water column, approximately 2.9 m (9.5 ft) above the seafloor. TSS concentrations are predicted to return to ambient levels (<10 mg/L) within 0.43 hours from completing the installation.

The maximum predicted deposition thickness is 73 mm (2.9 in). Sedimentation at or above 10 mm (0.4 in) extends a maximum of 47 m (154 ft) from the cable centerline and covers an area of 3.6 ha (8.9 acres) of the seafloor.

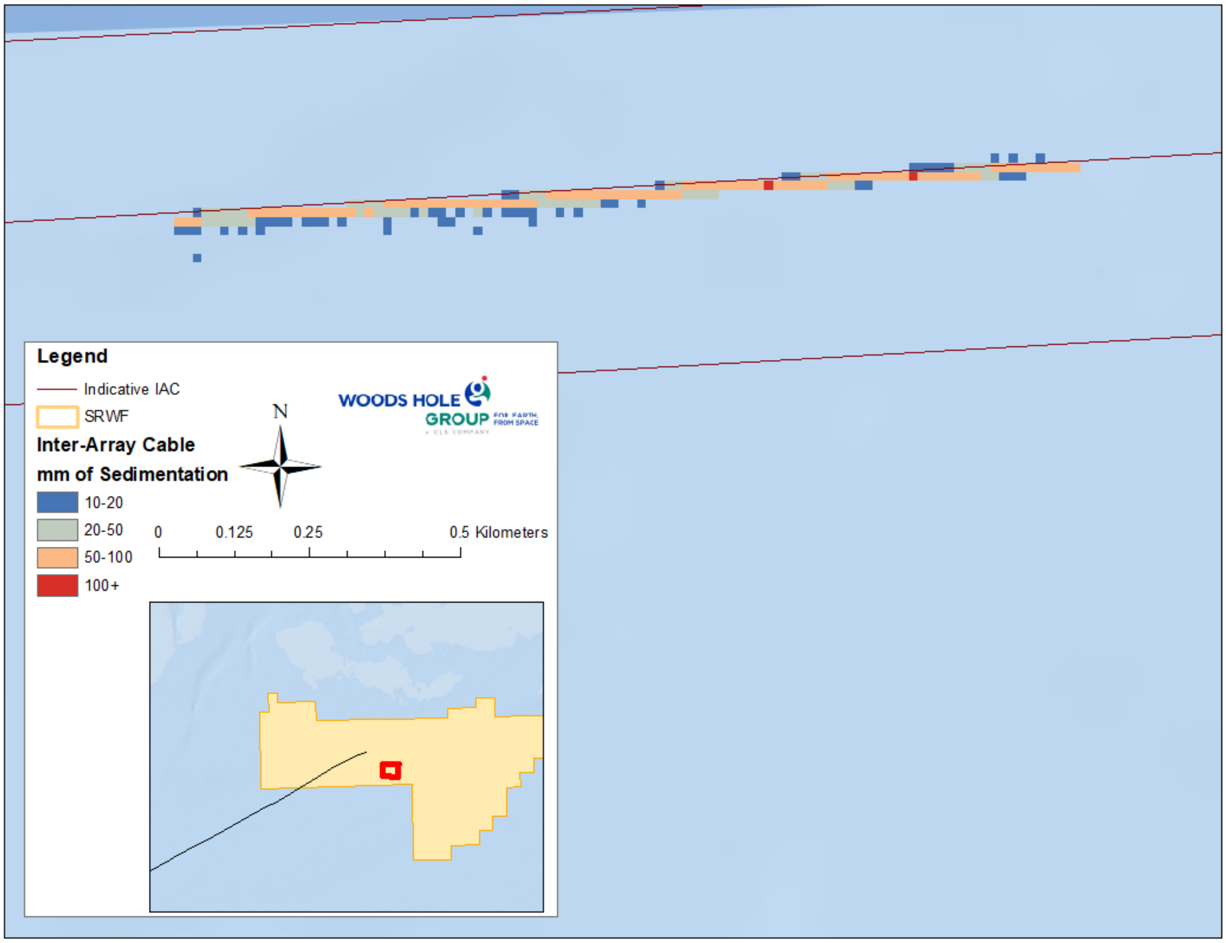

Figure 9.1-41 Sediment deposition on seafloor after representative IAC cable installation – typical case

Scenario 7 – IAC Installation in Federal Waters – Worst Case

The scenario included the release of 2,750 m^3 (3597 cy) of sediment to the water column over the duration of the IAC installation (duration of 3.75 hours). This is considered to be a worst-case segment utilized for the model. Maximum suspended sediment concentrations in excess of 10 mg/L occurring over the duration of the IAC installation are shown in Figure 9.1-42. The sediment deposition that results from this activity is shown in Figure 9.1-43.

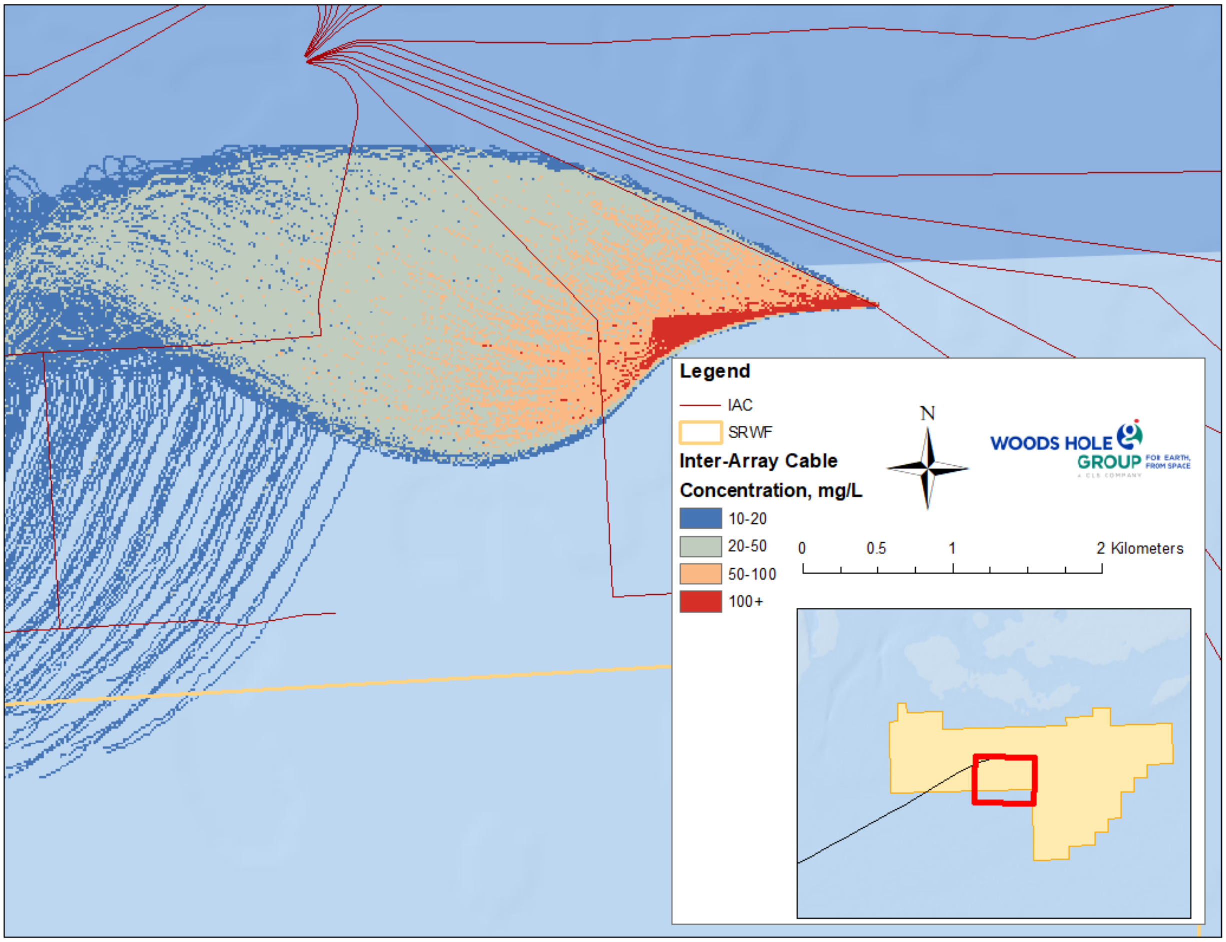

Figure 9.1-42. Maximum TSS concentrations occurring during representative IAC installation – worst case

The results shown in Figure 9.1-42 indicate maximum suspended sediment concentrations in excess of 100 mg/L occur within 1,020 m (3346 ft) of the cable centerline. The TSS plume is primarily contained within the lower portion of the water column, approximately 3.9 m (12.8 ft) above the seafloor. TSS concentrations are predicted to return to ambient levels (<10 mg/L) within 0.49 hours from completing the installation.

The maximum predicted deposition thickness is 61 mm (2.4 in). Sedimentation at or above 10 mm (0.4 in) extends a maximum of 67 m (220 ft) from the cable centerline and covers an area of 3.0 ha (7.4 acres) of the seafloor.

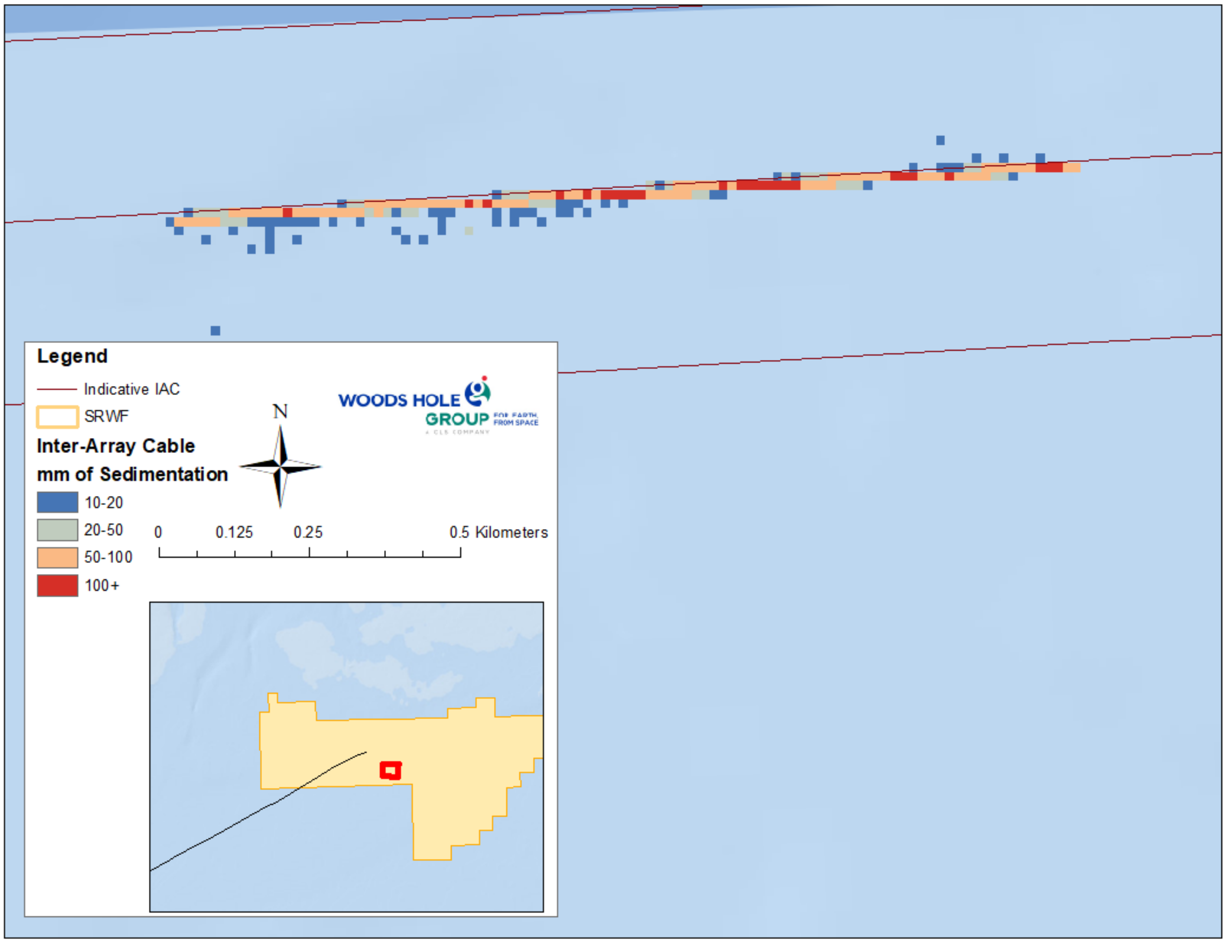

Figure 9.1-43 Sediment deposition on seafloor after representative IAC cable installation - worst case

Scenario 8 – CFE Sand Wave Leveling in Federal Waters

This scenario included the release of 11,344 m^3 (14,837 cy) of sediment to the water column in Federal waters over the duration of the sand wave leveling using CFE (duration of 49.5 hrs). This activity applies to specific portions of four (4) distinct segments that total a length of 19.8 km of the SRWEC–OCS. The modeling was conducted assuming a continuous operation along each segment. Maximum suspended sediment concentrations in excess of 10 mg/L occurring over the duration of the sand wave leveling are shown in Figures 9.1-44 through 9.1-47. The sediment deposition that results from this activity is shown in Figures 9.1-48 through 9.1-51.

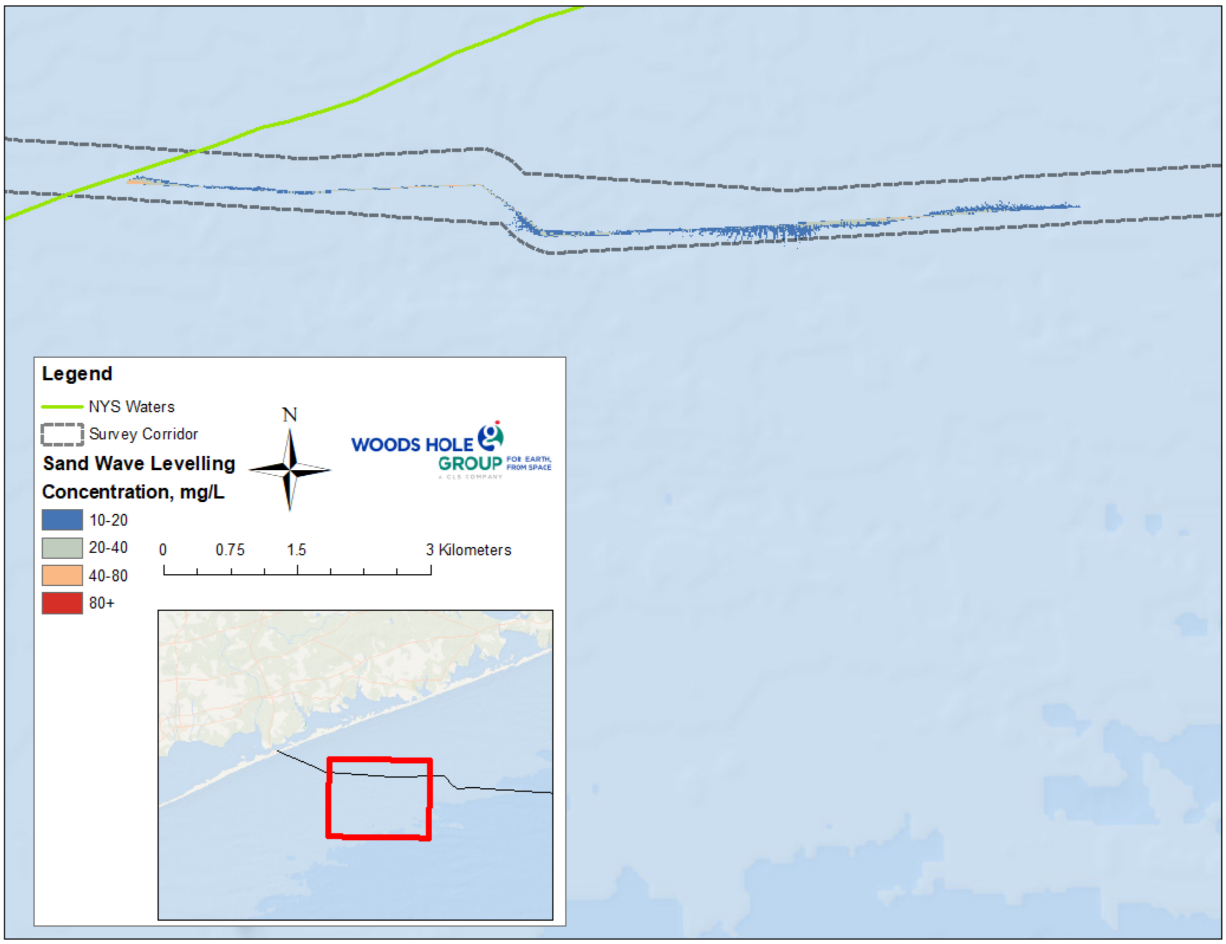

Figure 9.1-44. Maximum TSS concentrations occurring during sand wave leveling using CFE in Federal waters. Map 1 of 4 – refer to the inset for location relative to the full Project extent.

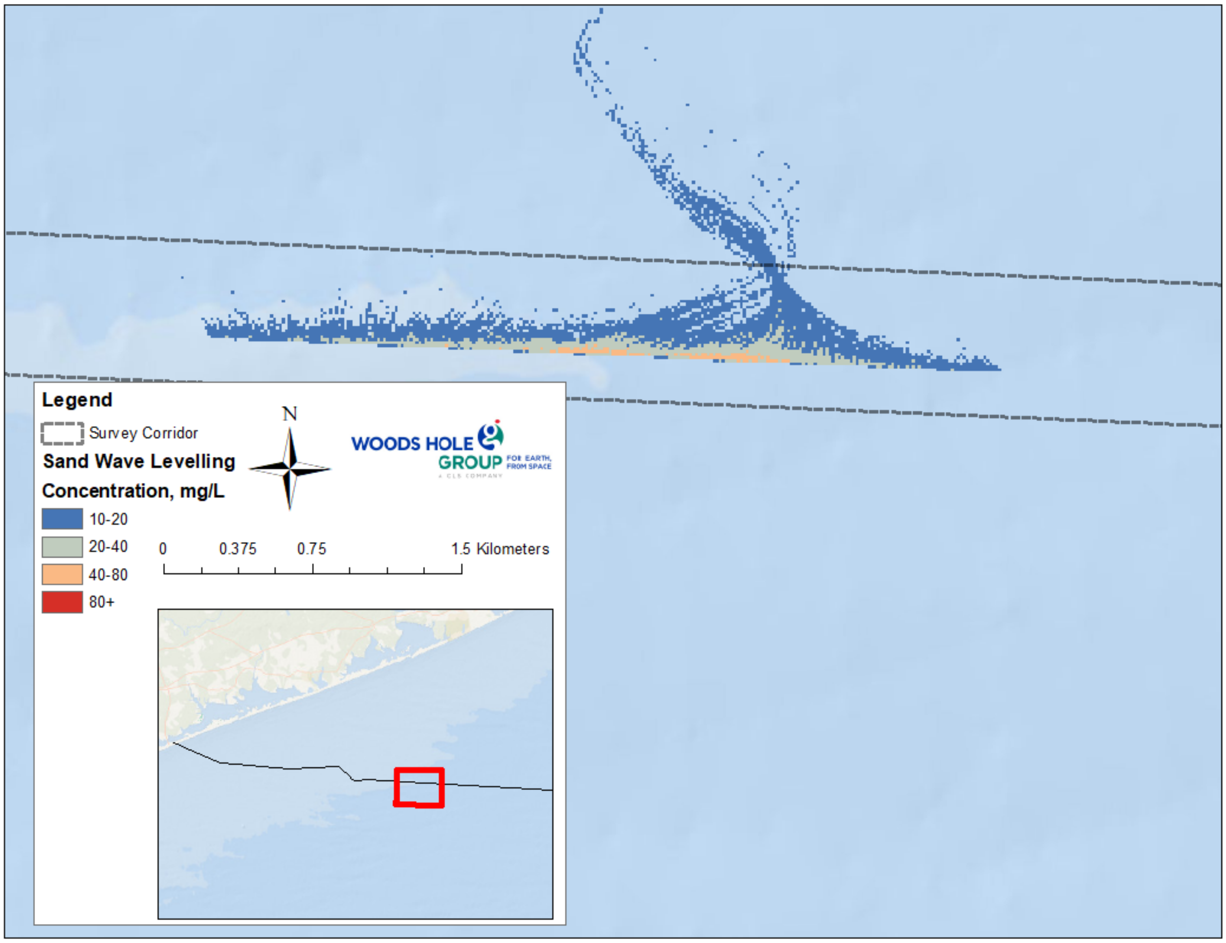

Figure 9.1-45 **Maximum TSS concentrations occurring during sand wave leveling using CFE in Federal waters. Map 2 of 4 – refer to the inset for location relative to the full Project extent.**

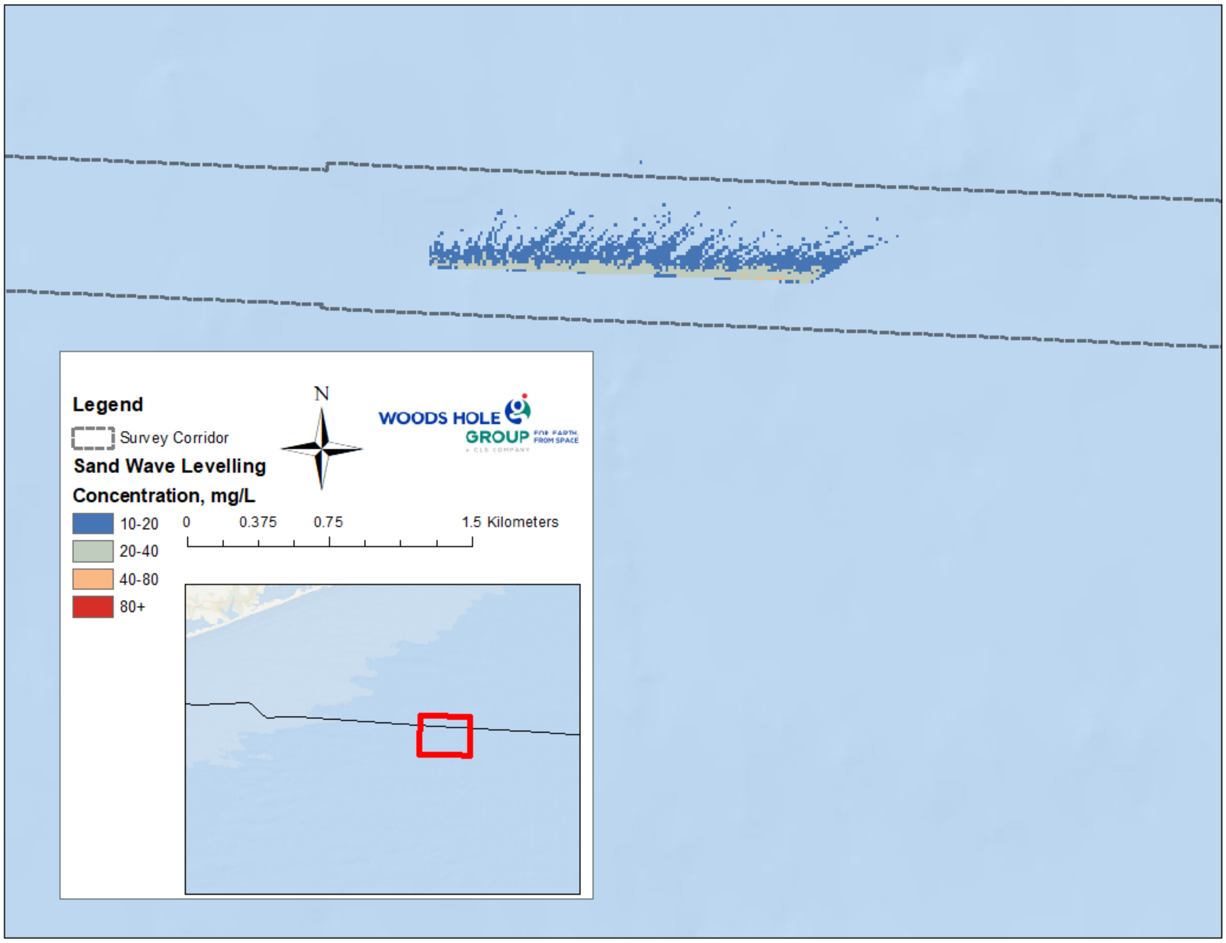

Figure 9.1-46 Maximum TSS concentrations occurring during sand wave leveling using CFE in Federal waters. Map 3 of 4 – refer to the inset for location relative to the full Project extent.

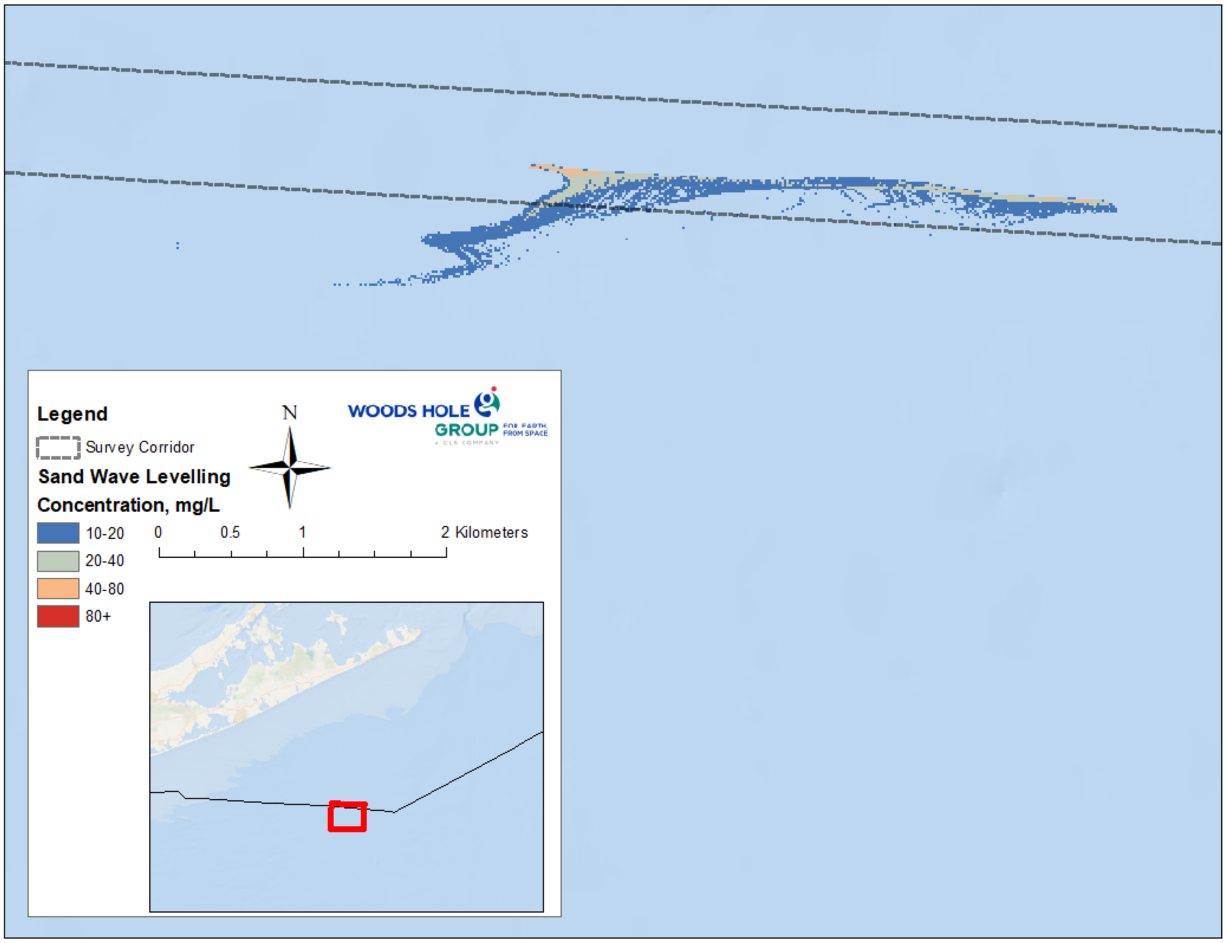

Figure 9.1-47 Maximum TSS concentrations occurring during sand wave leveling using CFE in Federal waters. Map 4 of 4 – refer to the inset for location relative to the full Project extent.

The results shown in Figures 9.1-44 through 9.1-47 indicate maximum suspended sediment concentrations in excess of 100 mg/L are not shown to occur. The TSS plume is primarily contained within the lower portion of the water column, approximately 1.1 m (3.6 ft) above the seafloor. TSS concentrations are predicted to return to ambient levels (<10 mg/L) within 0.35 hours from completing the clearance.

The maximum predicted deposition thickness is 388 mm (15.3 in). Sedimentation at or above 10 mm (0.4 in) extends a maximum of 435 m (1,427 ft) from the cable centerline and covers an area of 70.5 ha (174.2 acres) of the seafloor in Federal waters.

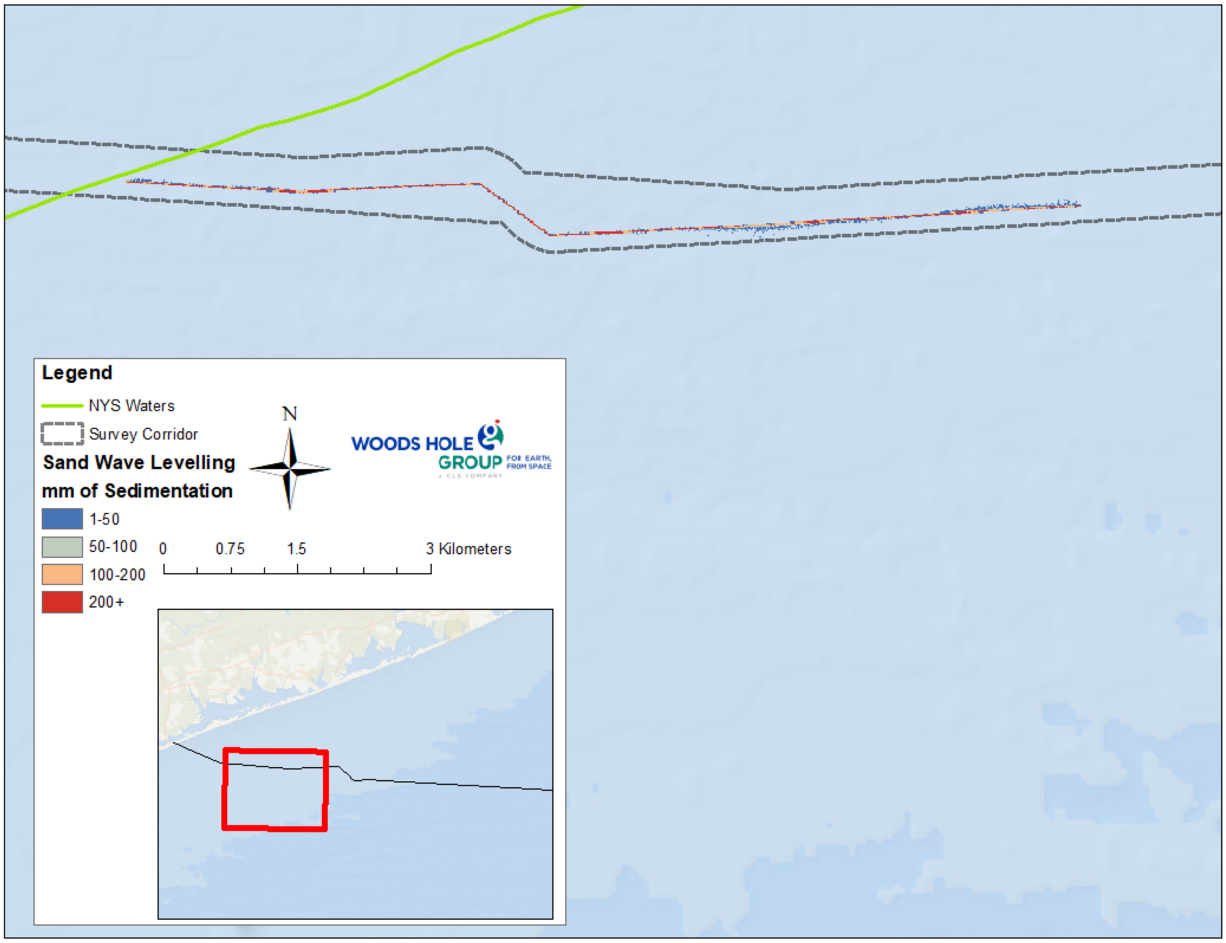

Figure 9.1-48 **Sediment deposition on seafloor after sand wave leveling using CFE in Federal waters. Map 1 of 4 – refer to the inset for location relative to the full Project extent.**

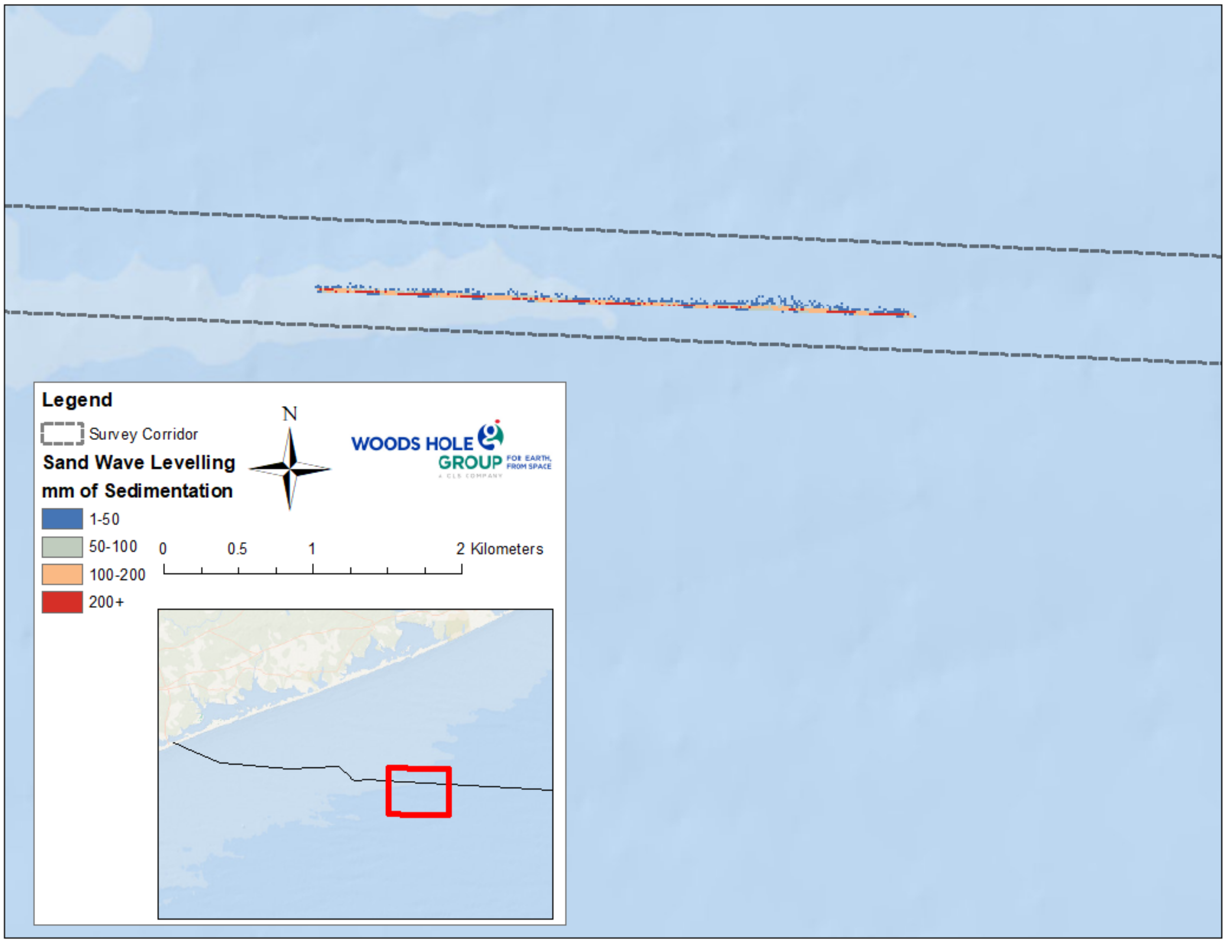

Figure 9.1-49 Sediment deposition on seafloor after sand wave leveling using CFE in Federal waters. Map 2 of 4 – refer to the inset for location relative to the full Project extent.

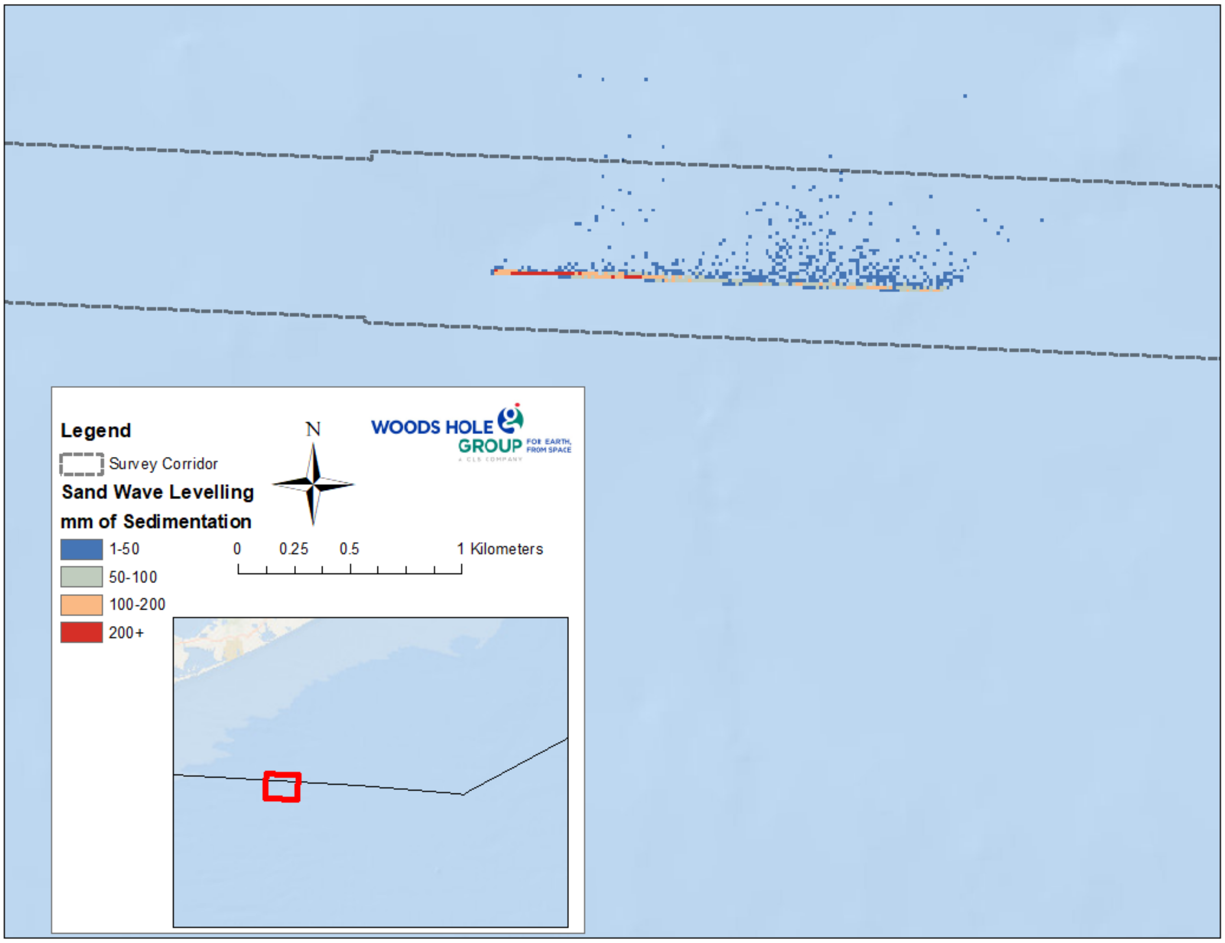

Figure 9.1-50 Sediment deposition on seafloor after sand wave leveling using CFE in Federal waters. Map 3 of 4 – refer to the inset for location relative to the full Project extent.

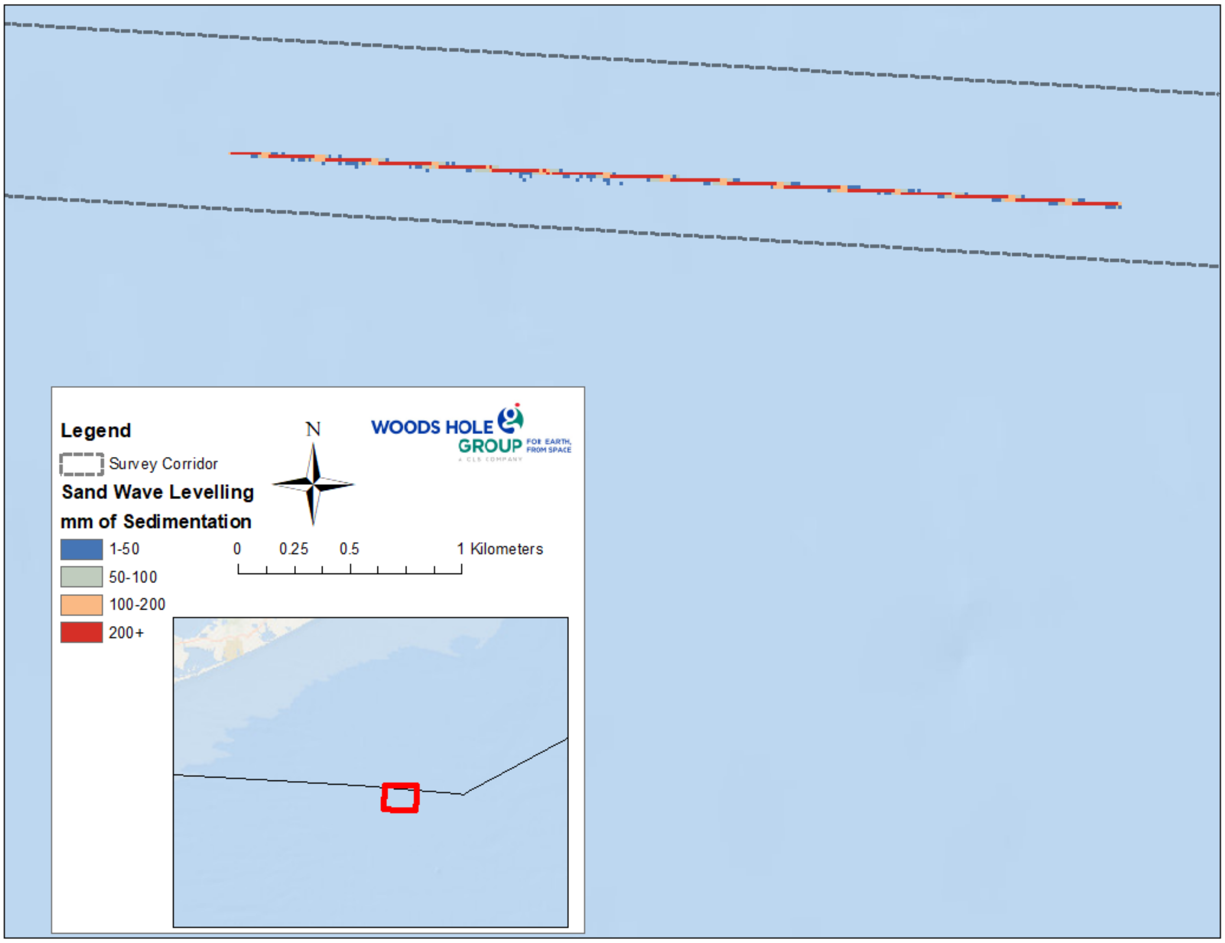

Figure 9.1-51 **Sediment deposition on seafloor after sand wave leveling using CFE in Federal waters. Map 4 of 4 – refer to the inset for location relative to the full Project extent.**

Scenario 9 – TSHD Sand Wave Leveling in Federal Waters –Continuous Overflow

This scenario included the release of 2,269 m^3 (2,968 cy) of sediment to the surface of the water column in Federal waters over the duration of the sand wave leveling using a TSHD (duration of 13.75 hrs). This activity applies to specific portions of four (4) distinct segments that total a length of 19.8 km of the SRWEC–OCS. The modeling was conducted assuming a continuous overflow occurring along each area where sand wave leveling would occur. Maximum suspended sediment concentrations in excess of 10 mg/L occurring over the duration of the sand wave leveling are shown in Figures 9.1-52 through 9.1-55. The sediment deposition that results from this activity is shown in Figures 9.1-56 through 9.1-59.

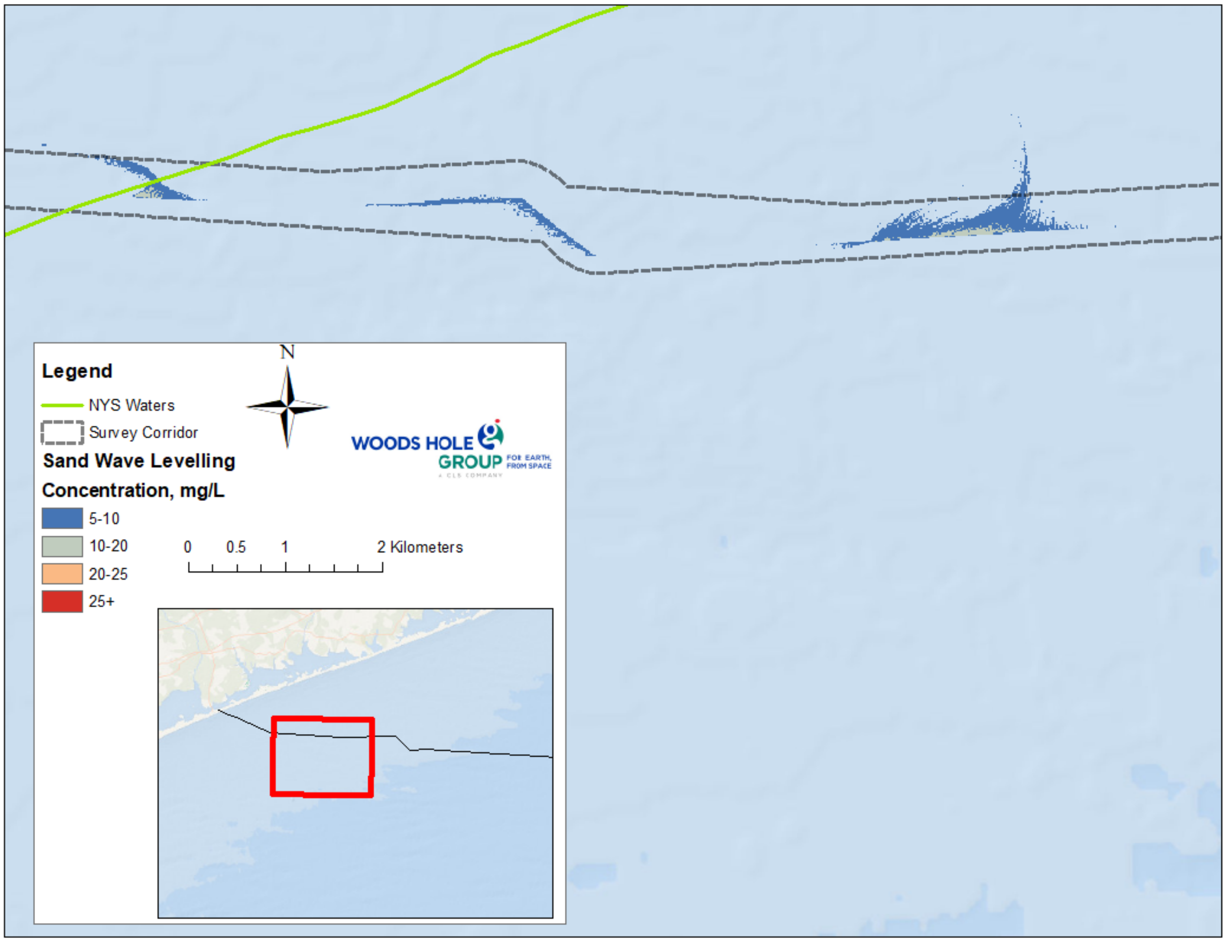

Figure 9.1-52 Maximum TSS concentrations occurring during sand wave leveling for TSHD with continuous overflow in Federal waters. Map 1 of 4 – refer to the inset for location relative to the full Project extent.

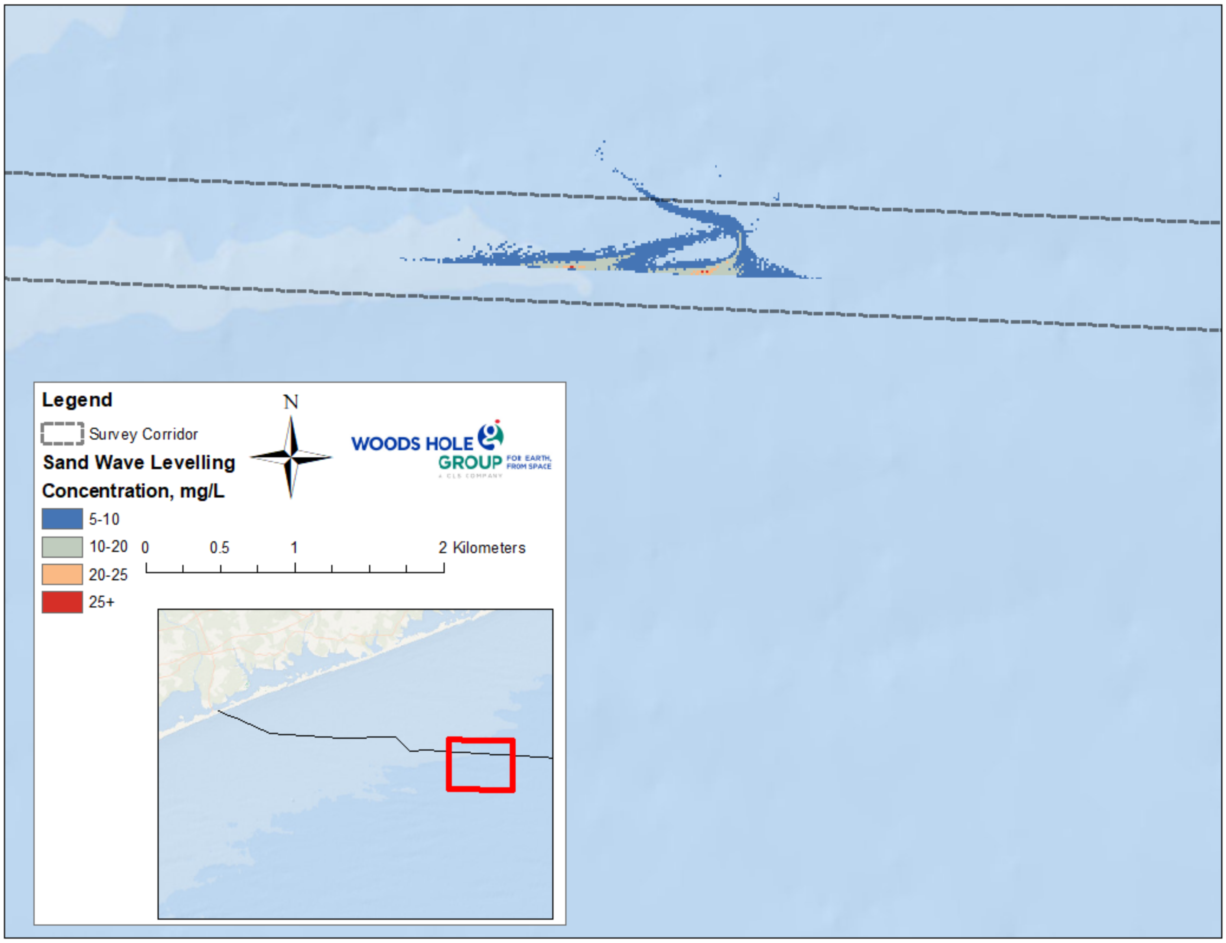

Figure 9.1-53 Maximum TSS concentrations occurring during sand wave leveling for TSHD with continuous overflow in Federal waters. Map 2 of 4 – refer to the inset for location relative to the full Project extent.

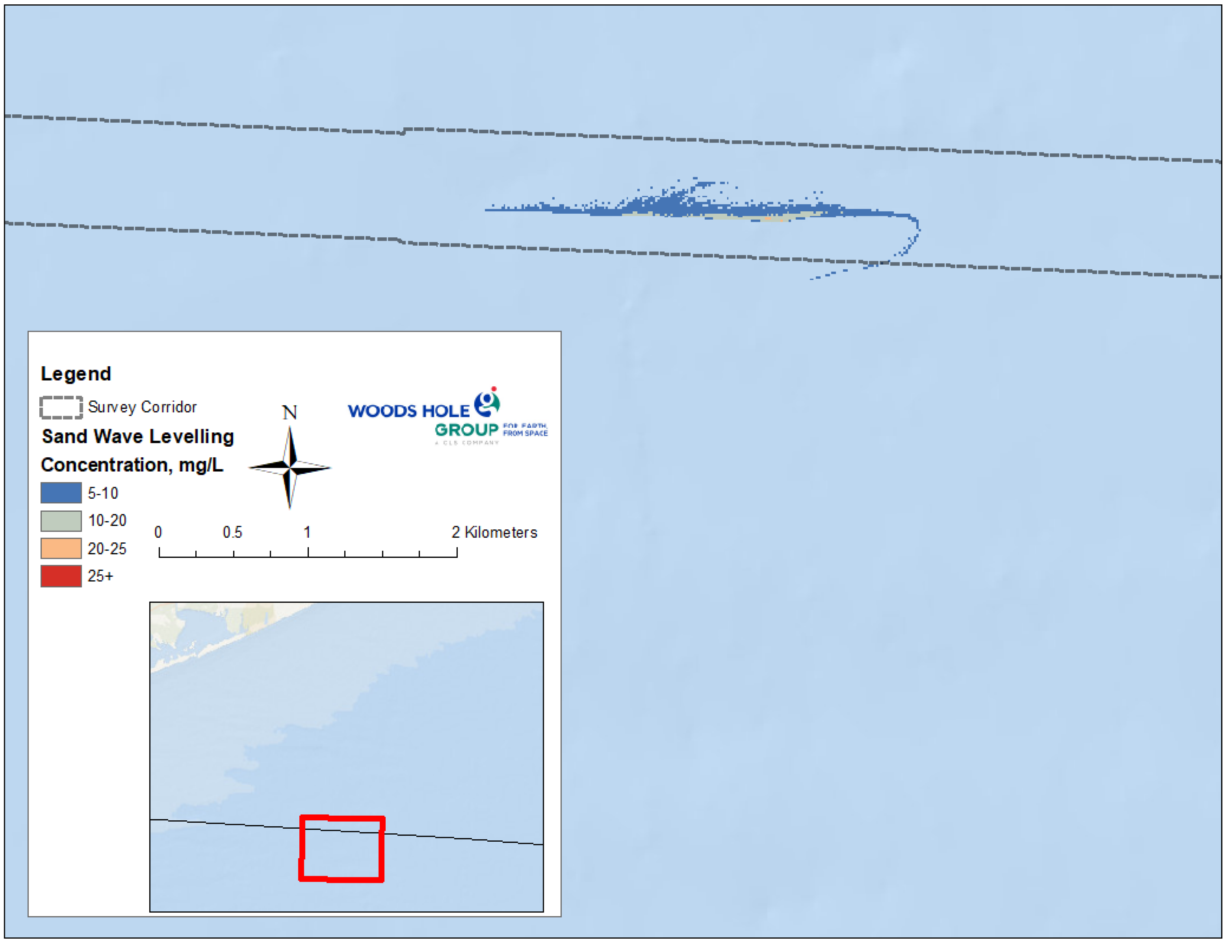

Figure 9.1-54 Maximum TSS concentrations occurring during sand wave leveling for TSHD with continuous overflow in Federal waters. Map 3 of 4 – refer to the inset for location relative to the full Project extent.

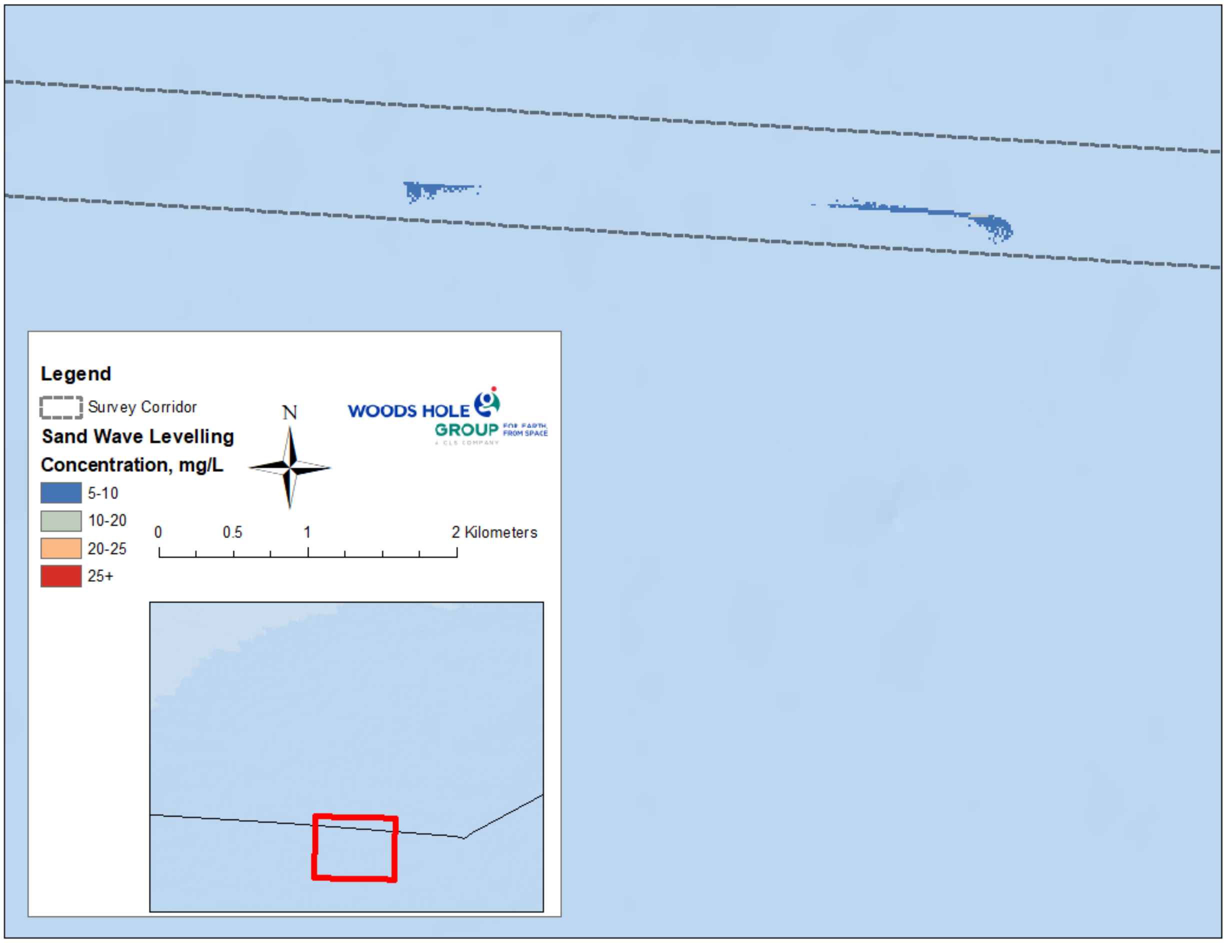

Figure 9.1-55 Maximum TSS concentrations occurring during sand wave leveling for TSHD with continuous overflow in Federal waters. Map 4 of 4 – refer to the inset for location relative to the full Project extent.

The results shown in Figures 9.1-52 through 9.1-55 indicate maximum suspended sediment concentrations in excess of 100 mg/L do not occur. TSS concentrations are predicted to return to ambient levels (<10 mg/L) within 0.4 hours from completing the clearance.

The maximum predicted deposition thickness is 13 mm (0.5 in). Sedimentation at or above 10 mm (0.4 in) extends a maximum of 27 m (89 ft) from the cable centerline and covers an area of 0.5 ha (1.2 acres) of the seafloor in Federal waters.

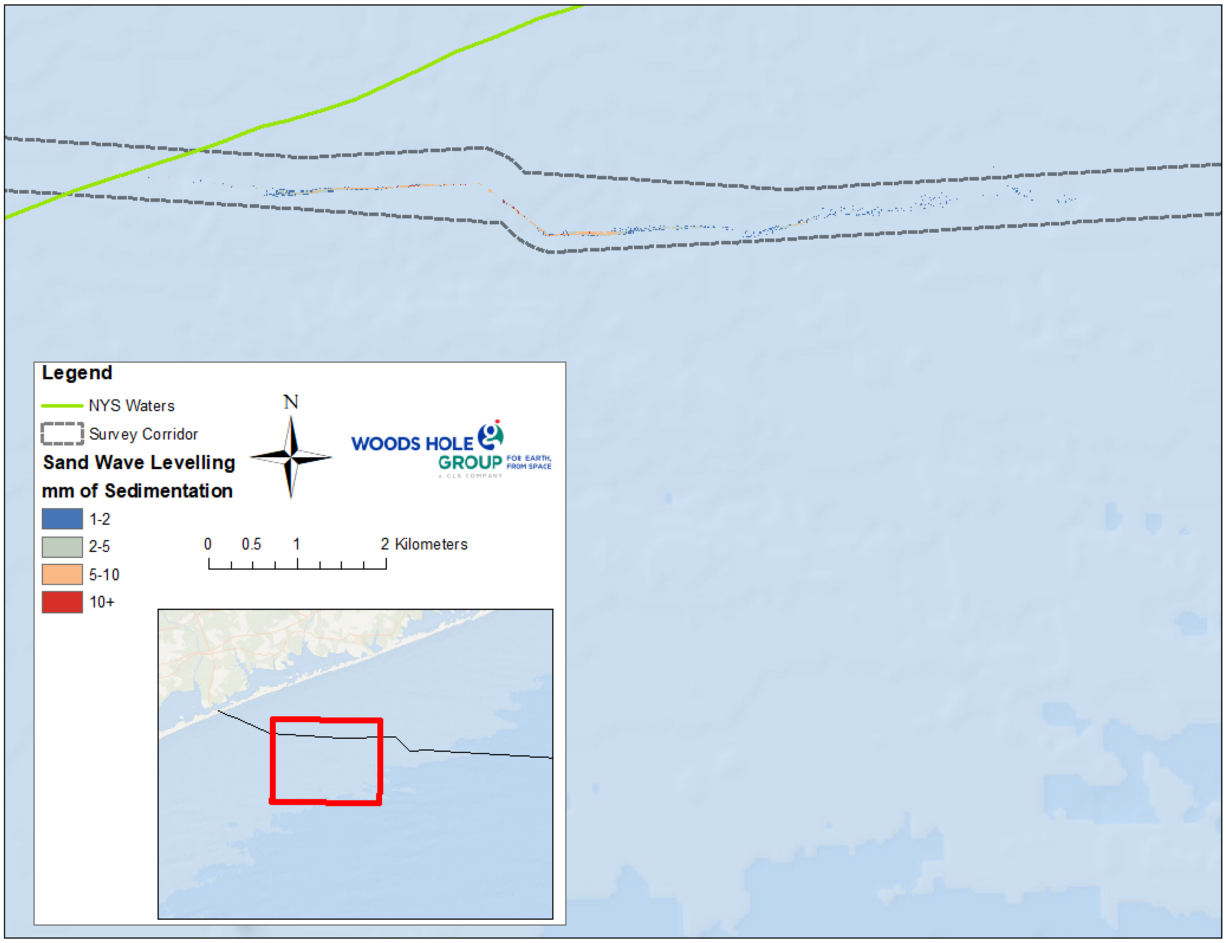

Figure 9.1-56 **Sediment deposition on seafloor after sand wave leveling for TSHD with continuous overflow in Federal waters. Map 1 of 4 – refer to the inset for location relative to the full Project extent.**

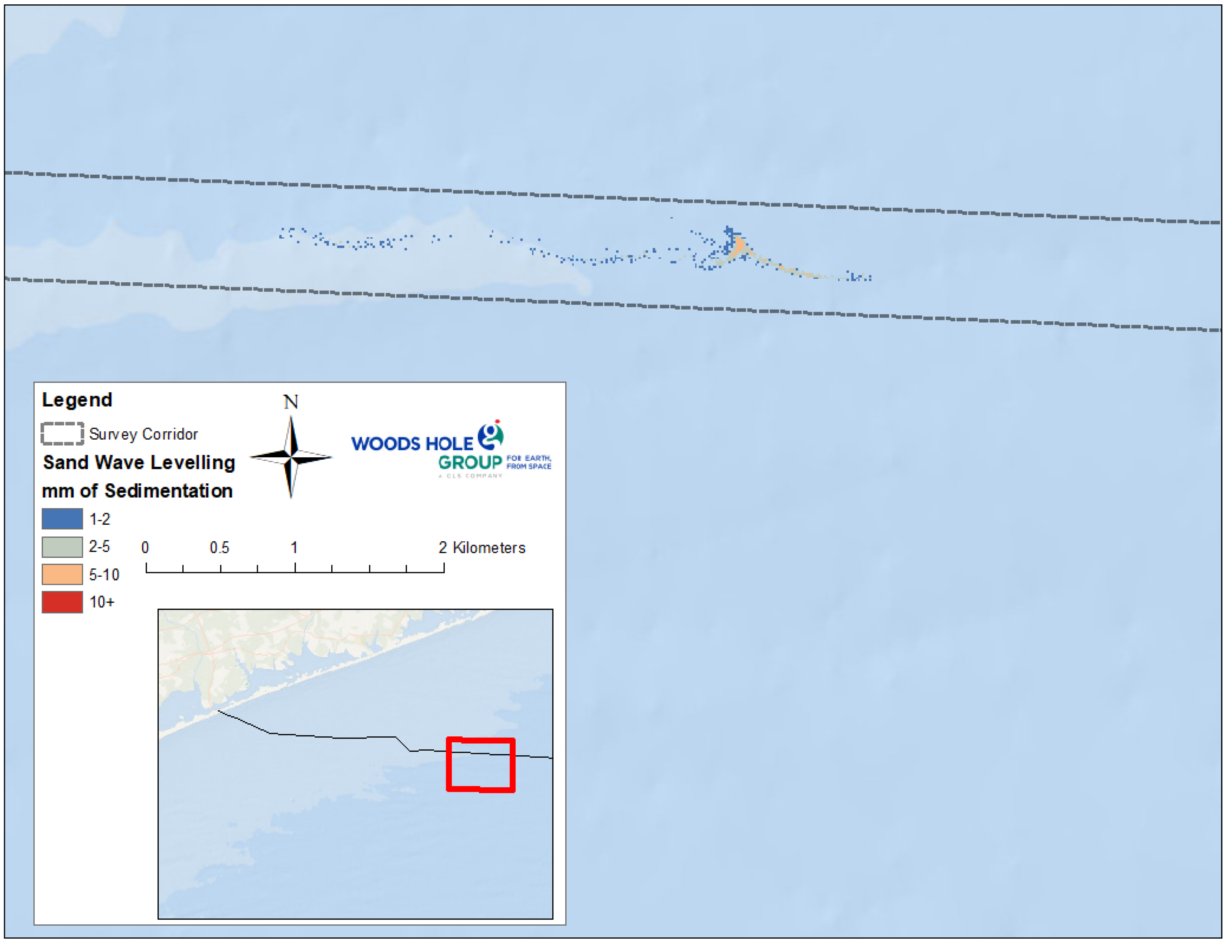

Figure 9.1-57 **Sediment deposition on seafloor after sand wave leveling for TSHD with continuous overflow in Federal waters. Map 2 of 4 – refer to the inset for location relative to the full Project extent.**

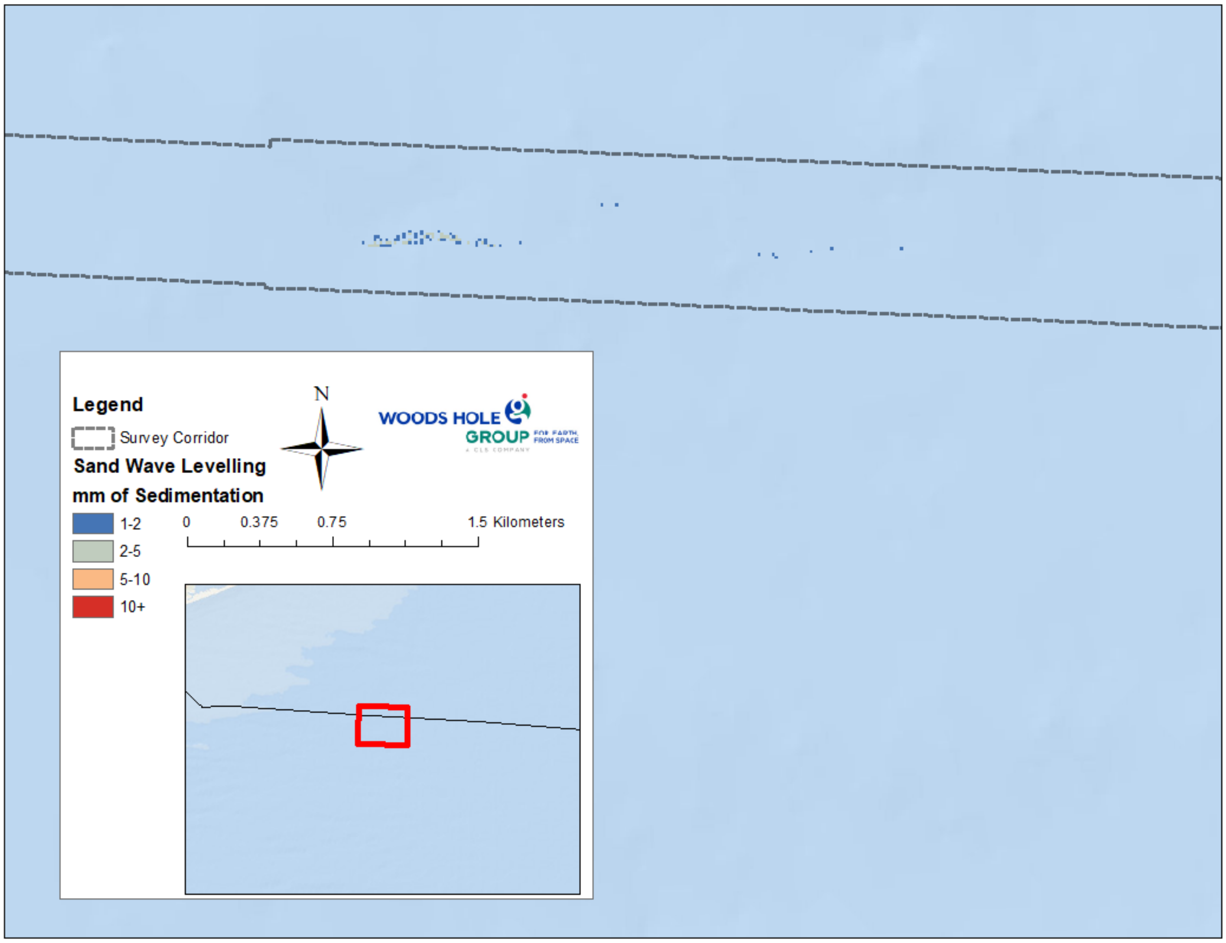

Figure 9.1-58 Sediment deposition on seafloor after sand wave leveling for TSHD with continuous overflow in Federal waters. Map 3 of 4 – refer to the inset for location relative to the full Project extent.

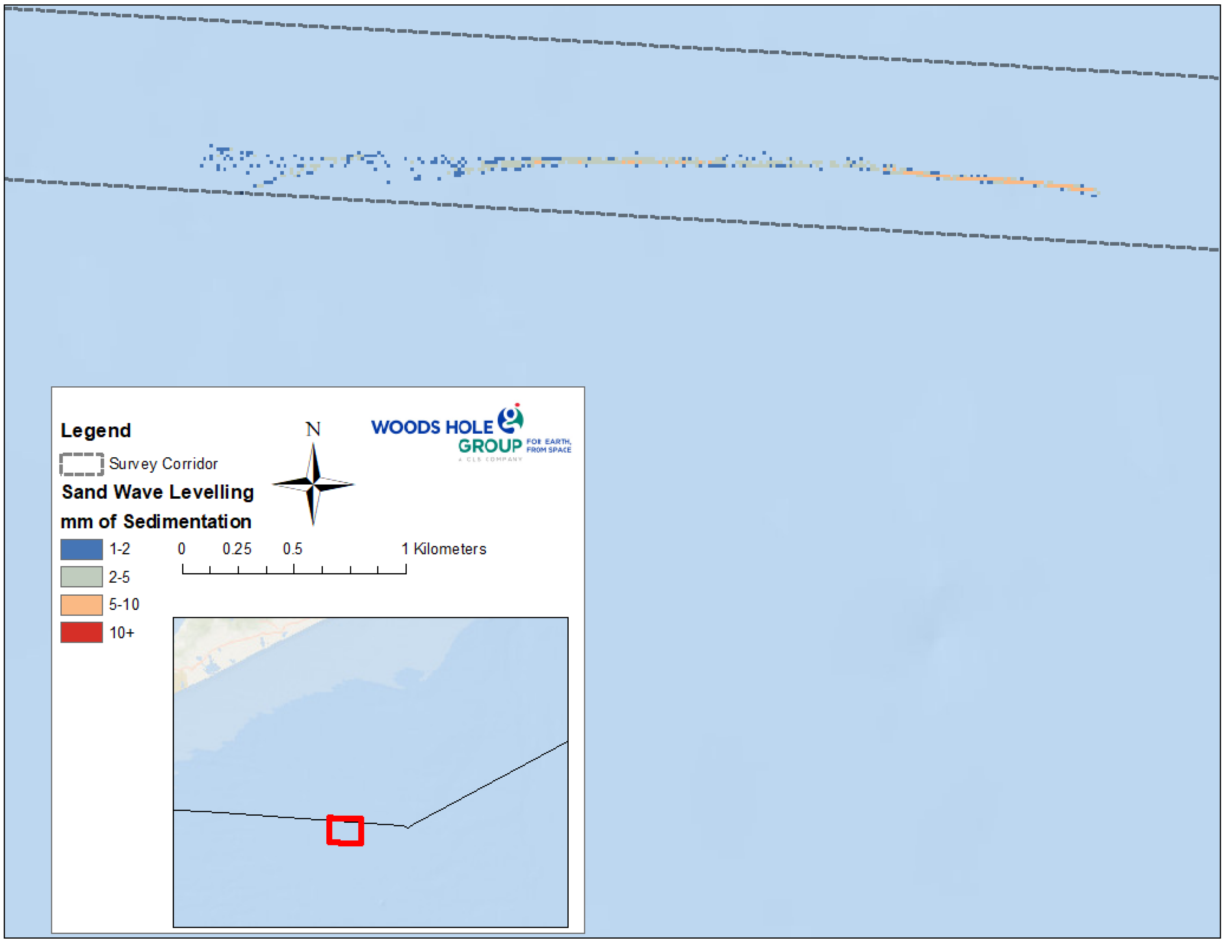

Figure 9.1-59 Sediment deposition on seafloor after sand wave leveling for TSHD with continuous overflow in Federal waters. Map 4 of 4 – refer to the inset for location relative to the full Project extent.

Scenario 10 – TSHD Sand Wave Bulk Disposal in Federal Waters

This scenario included the release of 9,075 m^3 (11,870 cy) of sediment at a depth 5 m below the surface of the water column in Federal waters over the duration of sand wave leveling using a TSHD (duration of 13.75 hrs). The modeling was conducted assuming five (5) disposals would occur intermittently over the areas of sand wave leveling activity. Maximum suspended sediment concentrations in excess of 10 mg/L occurring over the duration of the sand wave leveling are shown in Figures 9.1-60 through 9.1-62. The sediment deposition that results from this activity is shown in Figures 9.1-63 through 9.1-65.

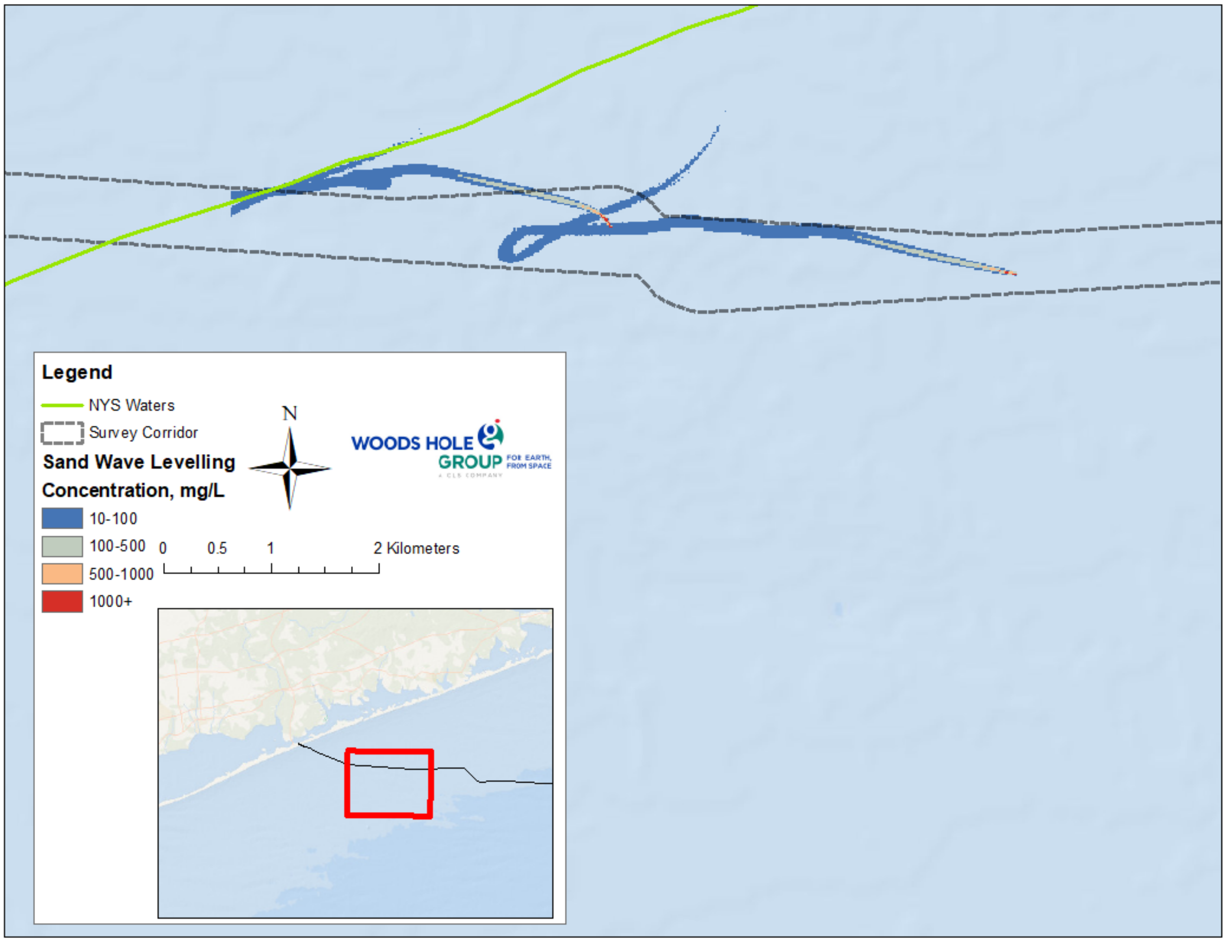

Figure 9.1-60 Maximum TSS concentrations occurring during sand wave leveling for TSHD bulk disposal in Federal waters. Map 1 of 3 – refer to the inset for location relative to the full Project extent.

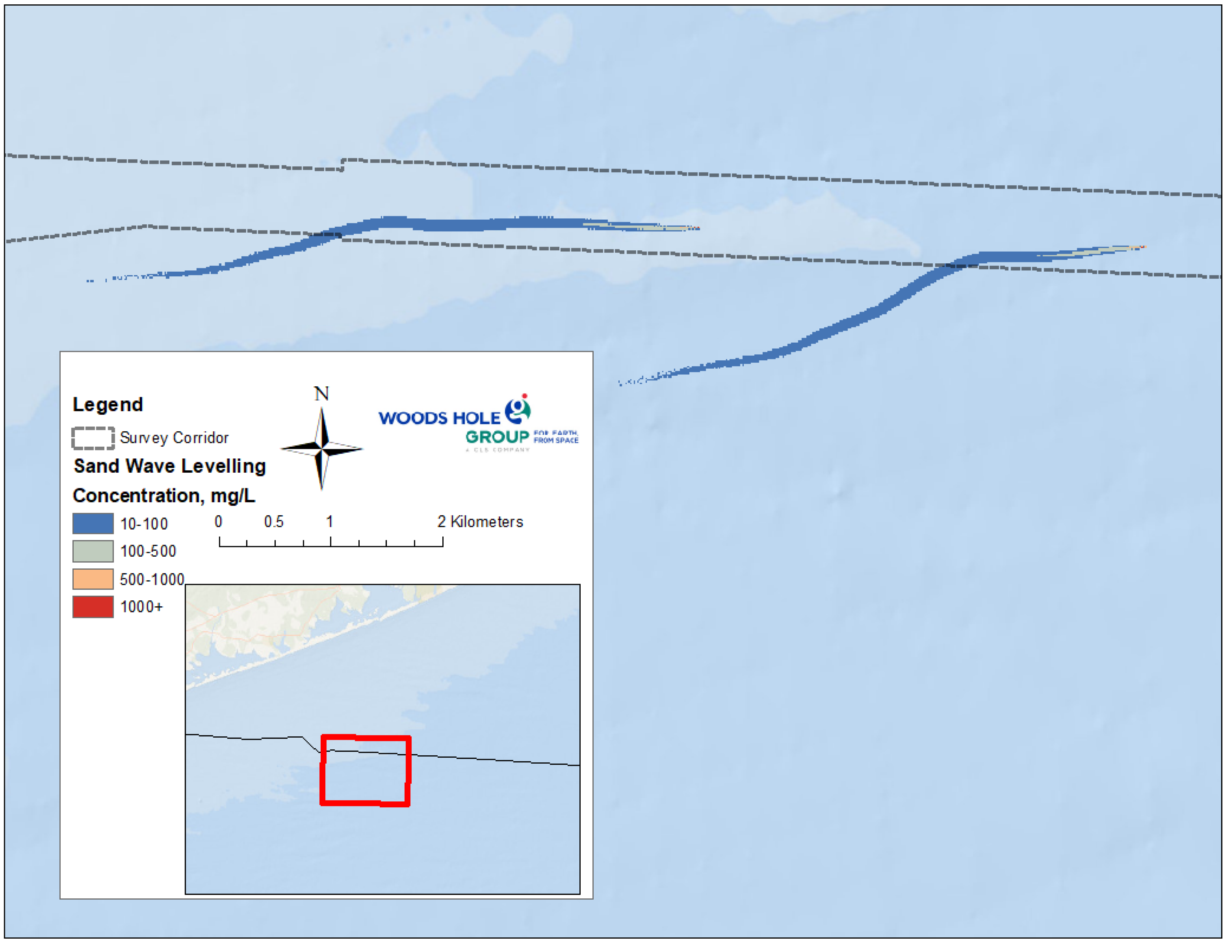

Figure 9.1-61 **Maximum TSS concentrations occurring during sand wave leveling for TSHD bulk disposal in Federal waters. Map 2 of 3 – refer to the inset for location relative to the full Project extent.**

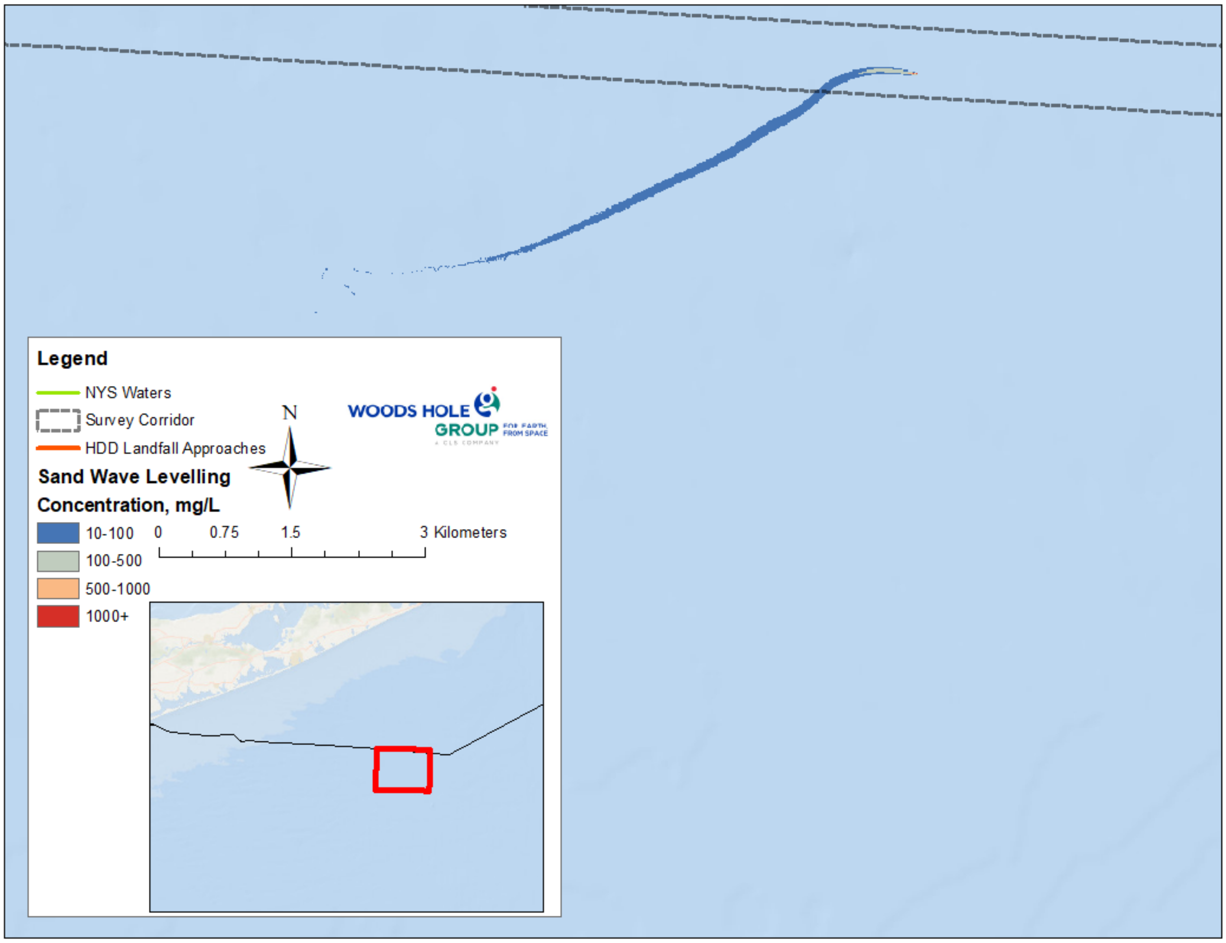

Figure 9.1-62 Maximum TSS concentrations occurring during sand wave leveling for TSHD bulk disposal in Federal waters. Map 3 of 3 – refer to the inset for location relative to the full Project extent.

The results shown in Figures 9.1-60 through 9.1-62 indicate maximum suspended sediment concentrations in excess of 100 mg/L occur within 1,540 m (5,052 ft) of the cable centerline. TSS concentrations are predicted to return to ambient levels (<10 mg/L) within 0.42 hours from completing the clearance.

The maximum predicted deposition thickness is 6.1 m (20 ft). Similar to NYS waters, this level of deposition is centrally located within a small area at the point of disposal and the total area of deposition greater than 1 m (3.3 ft) is 0.14 ha (0.3 ac). Sedimentation at or above 10 mm (0.4 in) extends a maximum of 72 m (236 ft) from the point of disposal and covers an area of 1.3 ha (3.2 acres) of the seafloor in Federal waters.

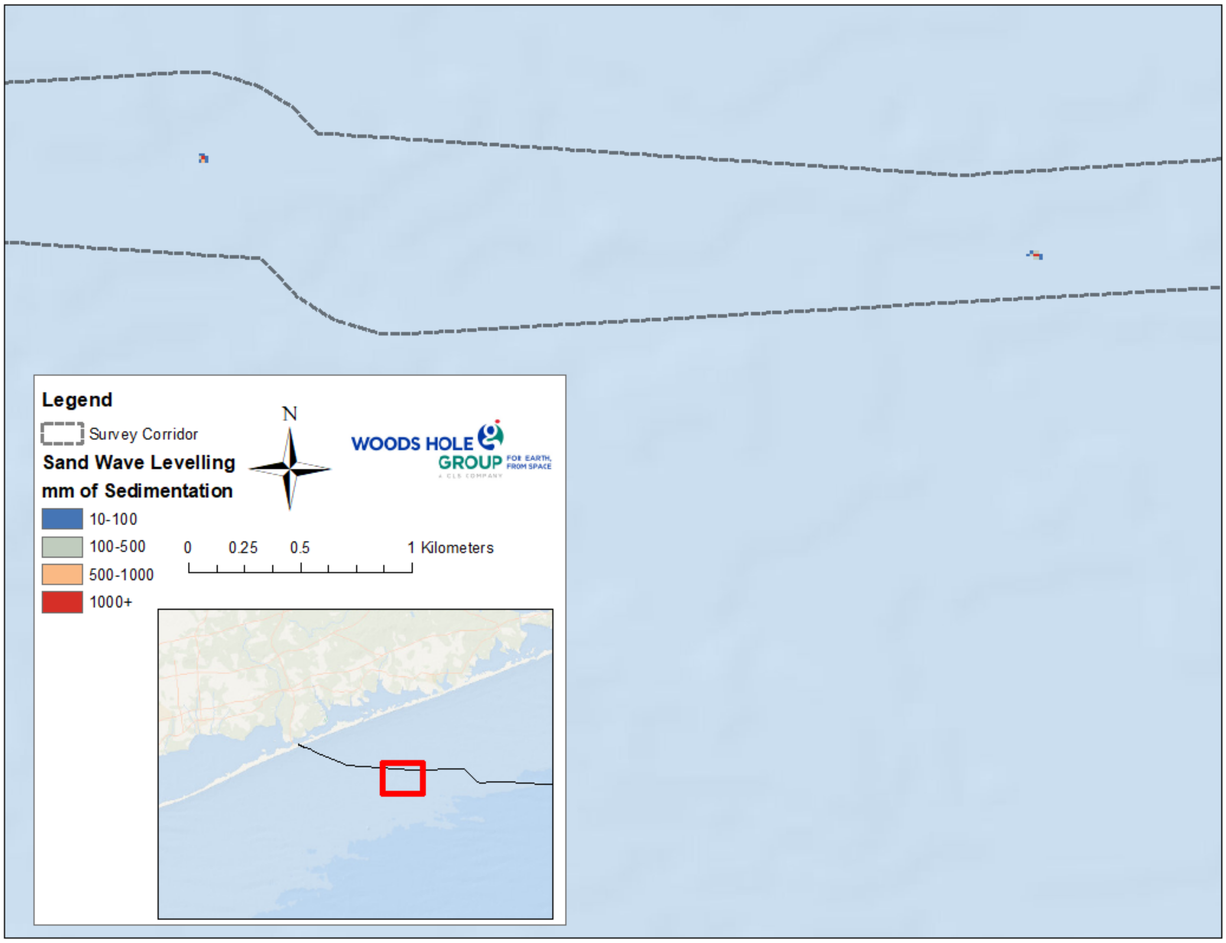

Figure 9.1-63 Sediment deposition on seafloor after sand wave leveling for TSHD bulk disposal in Federal waters. Map 1 of 3 – refer to the inset for location relative to the full Project extent.

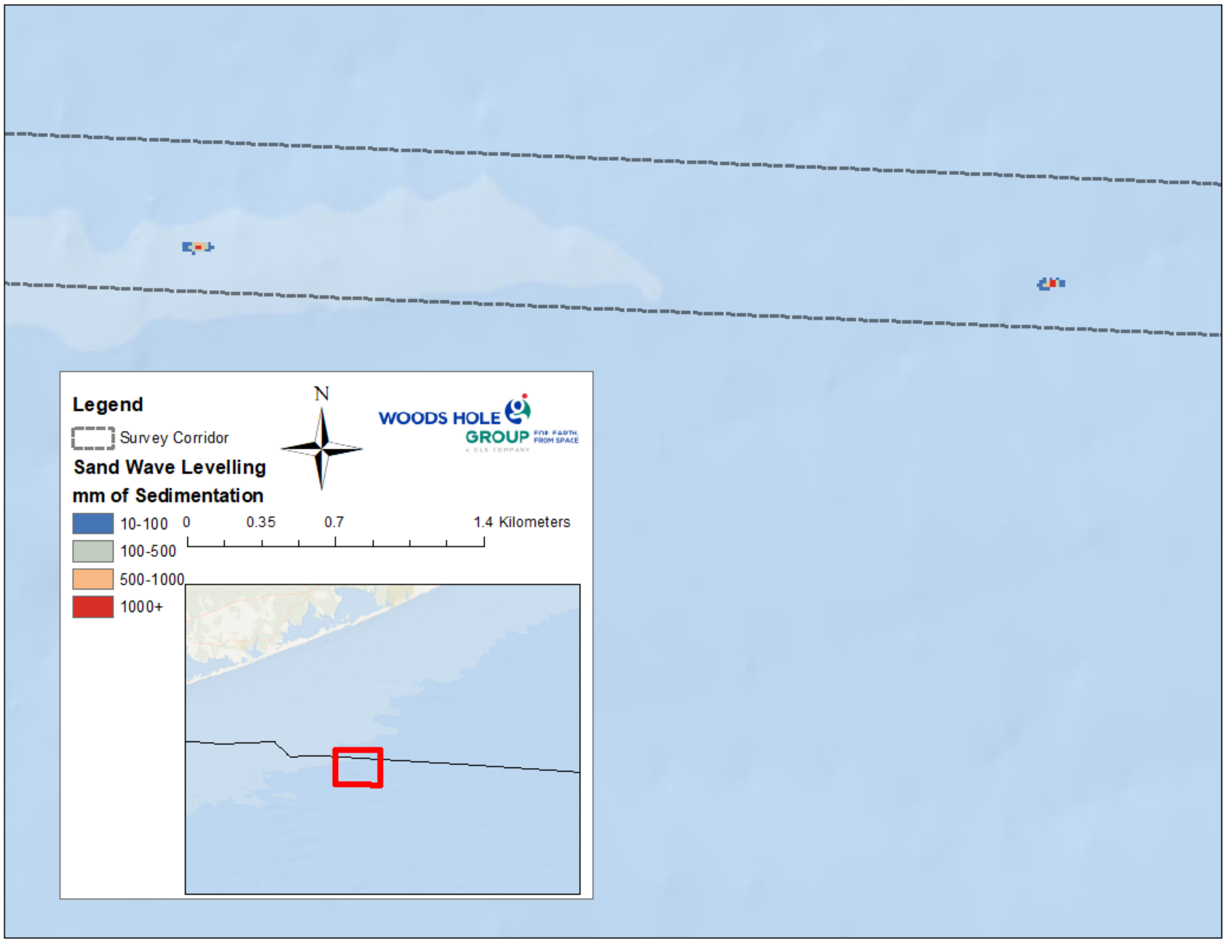

Figure 9.1-64 Sediment deposition on seafloor after sand wave leveling for TSHD bulk disposal in Federal waters. Map 2 of 3 – refer to the inset for location relative to the full Project extent.

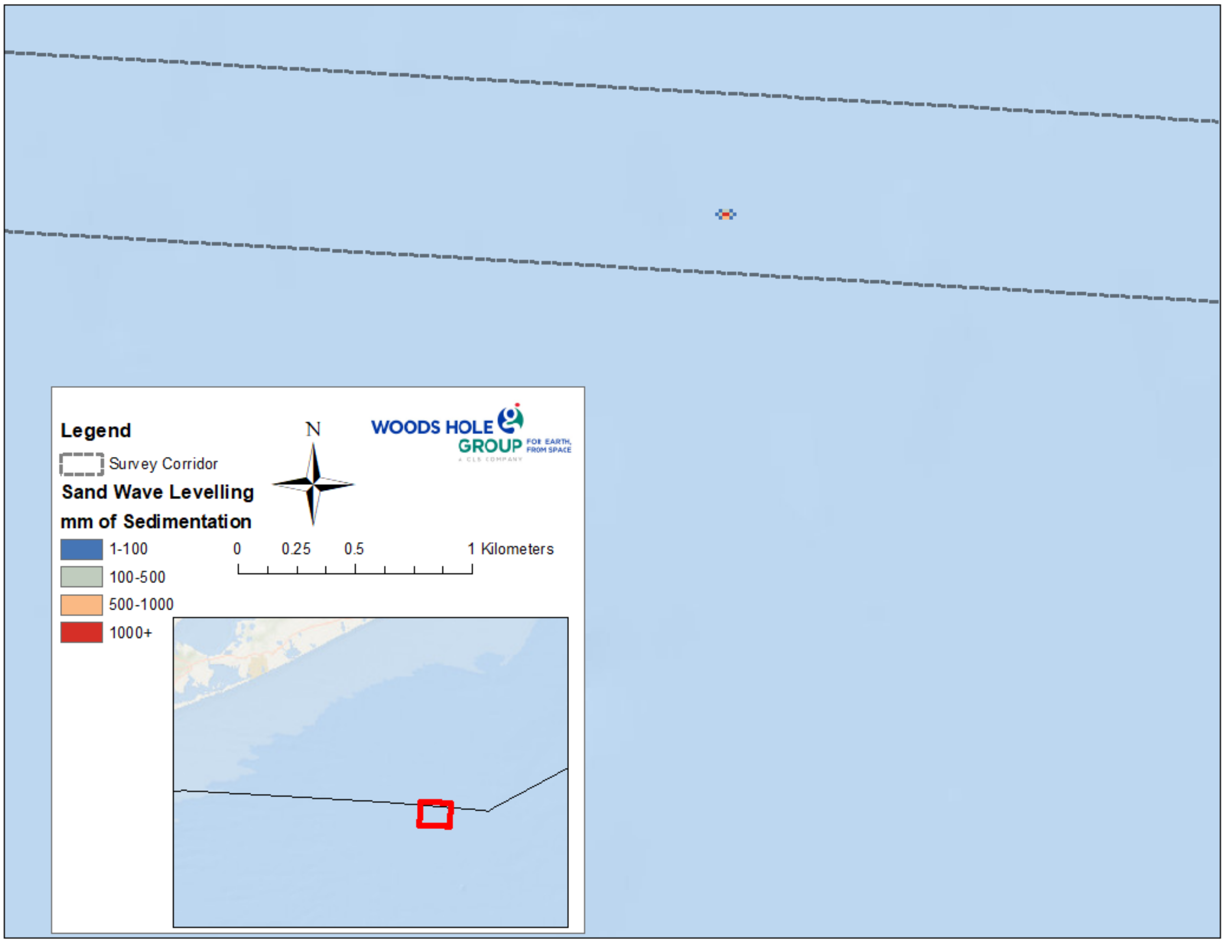

Figure 9.1-65 Sediment deposition on seafloor after sand wave leveling for TSHD bulk disposal in Federal waters. Map 3 of 3 – refer to the inset for location relative to the full Project extent.

Scenario 11 – TSHD Sand Wave Hydraulic Disposal in Federal Waters

This scenario included the release of 11,344 m^3 (14,837 cy) of sediment at the surface of the water column in Federal waters over the duration of sand wave leveling using a TSHD (duration of 13.75 hrs). This activity applies to specific portions of four (4) distinct segments that total a length of 19.8 km of the SRWEC–OCS. The modeling was conducted assuming hydraulic disposal would occur over four (4) areas identified for sand wave leveling located within the SRWEC–OCS survey corridor. Maximum suspended sediment concentrations in excess of 10 mg/L occurring over the duration of the sand wave leveling are shown in Figures 9.1-66 through 9.1-69. The sediment deposition that results from this activity is shown in Figures 9.1-70 through 9.1-73.

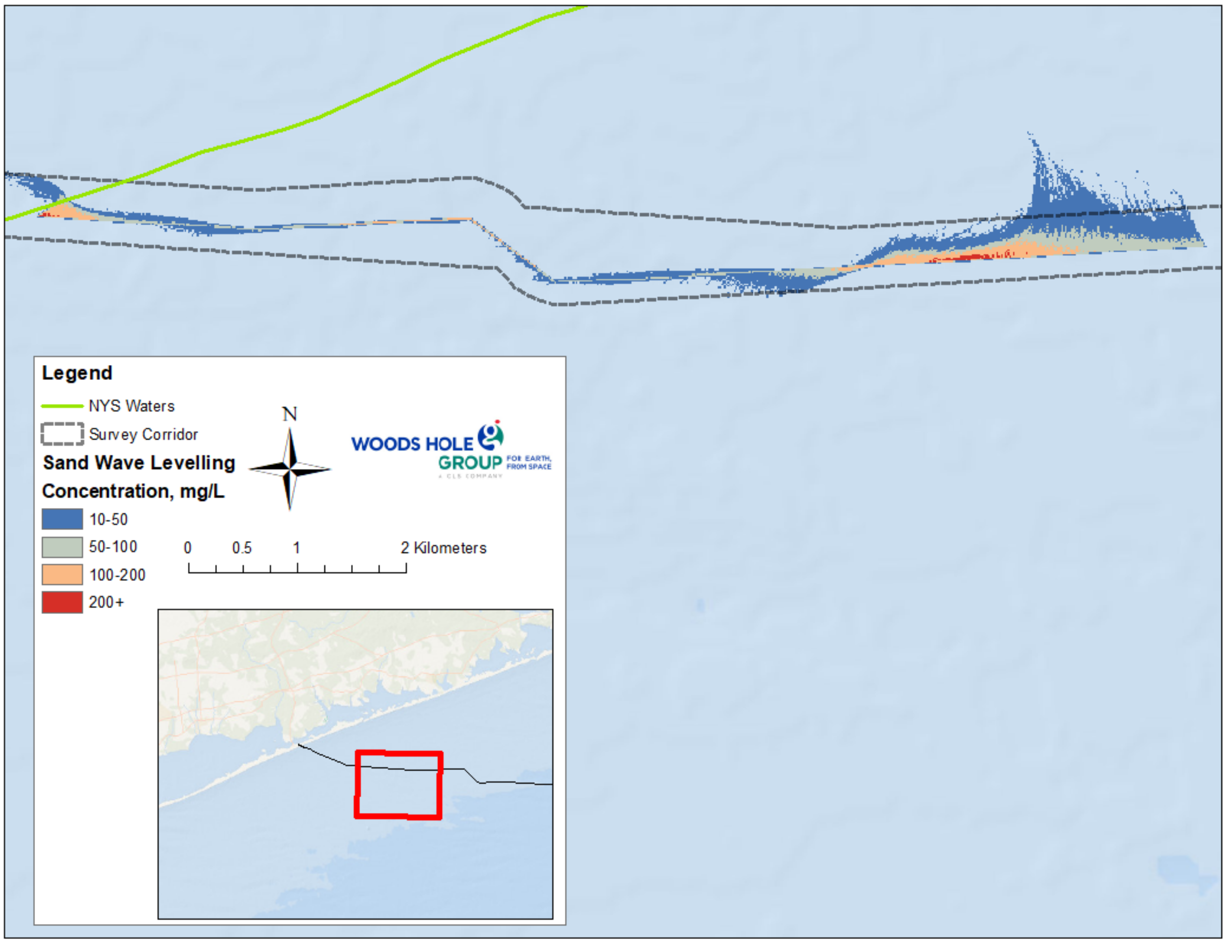

Figure 9.1-66 Maximum TSS concentrations occurring during sand wave leveling for TSHD hydraulic disposal in Federal waters. Map 1 of 4 – refer to the inset for location relative to the full Project extent.

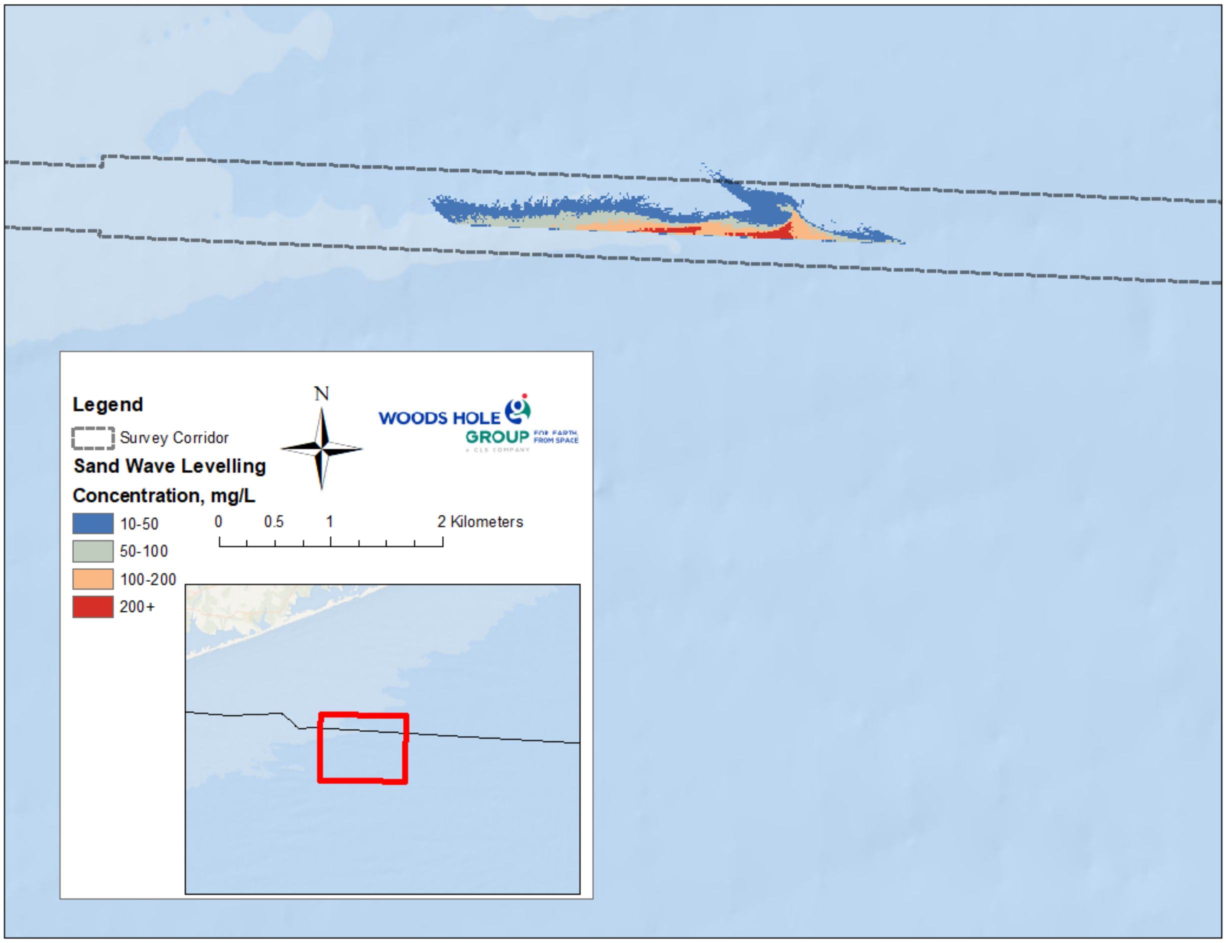

Figure 9.1-67 Maximum TSS concentrations occurring during sand wave leveling for TSHD hydraulic disposal in Federal waters. Map 2 of 4 – refer to the inset for location relative to the full Project extent.

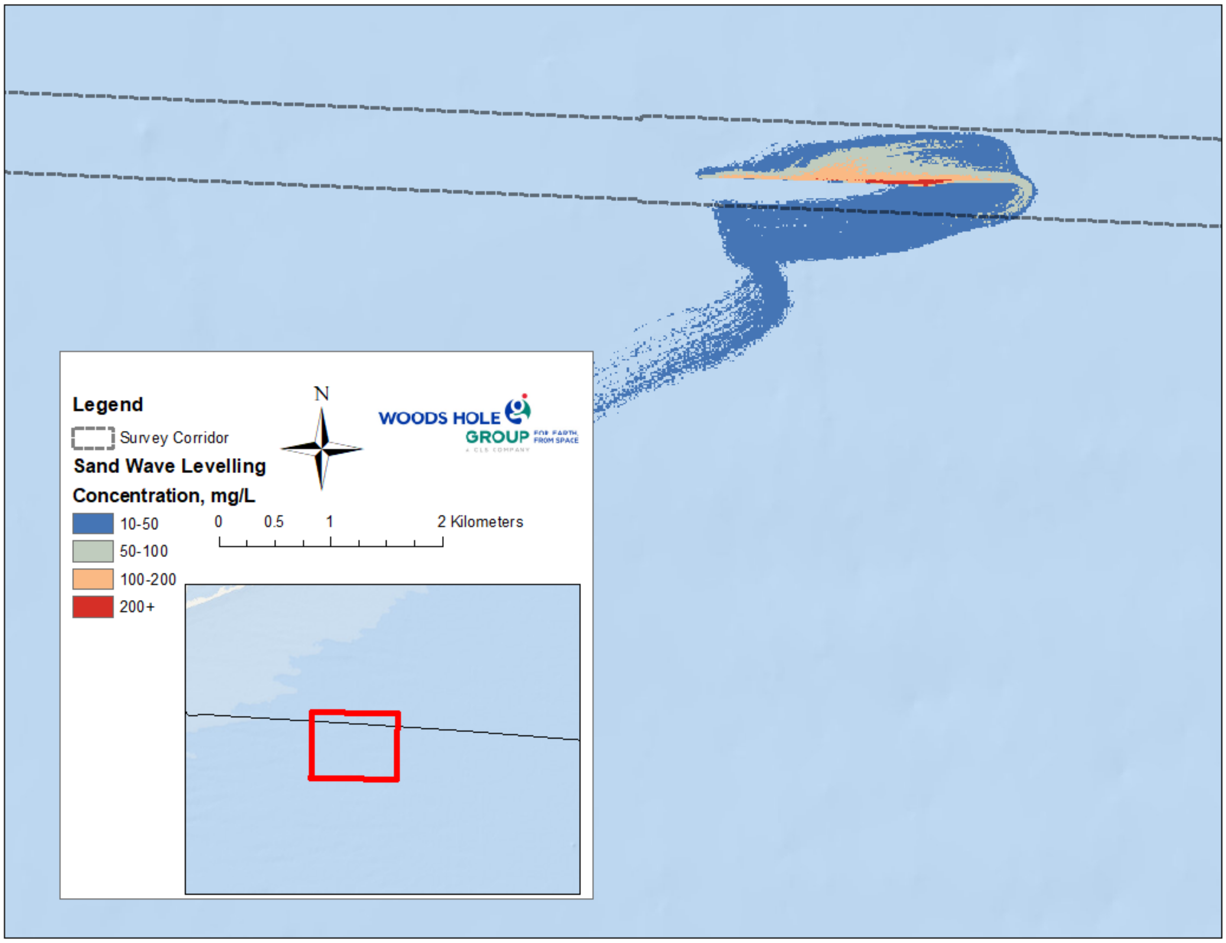

Figure 9.1-68 Maximum TSS concentrations occurring during sand wave leveling for TSHD hydraulic disposal in Federal waters. Map 3 of 4 – refer to the inset for location relative to the full Project extent.

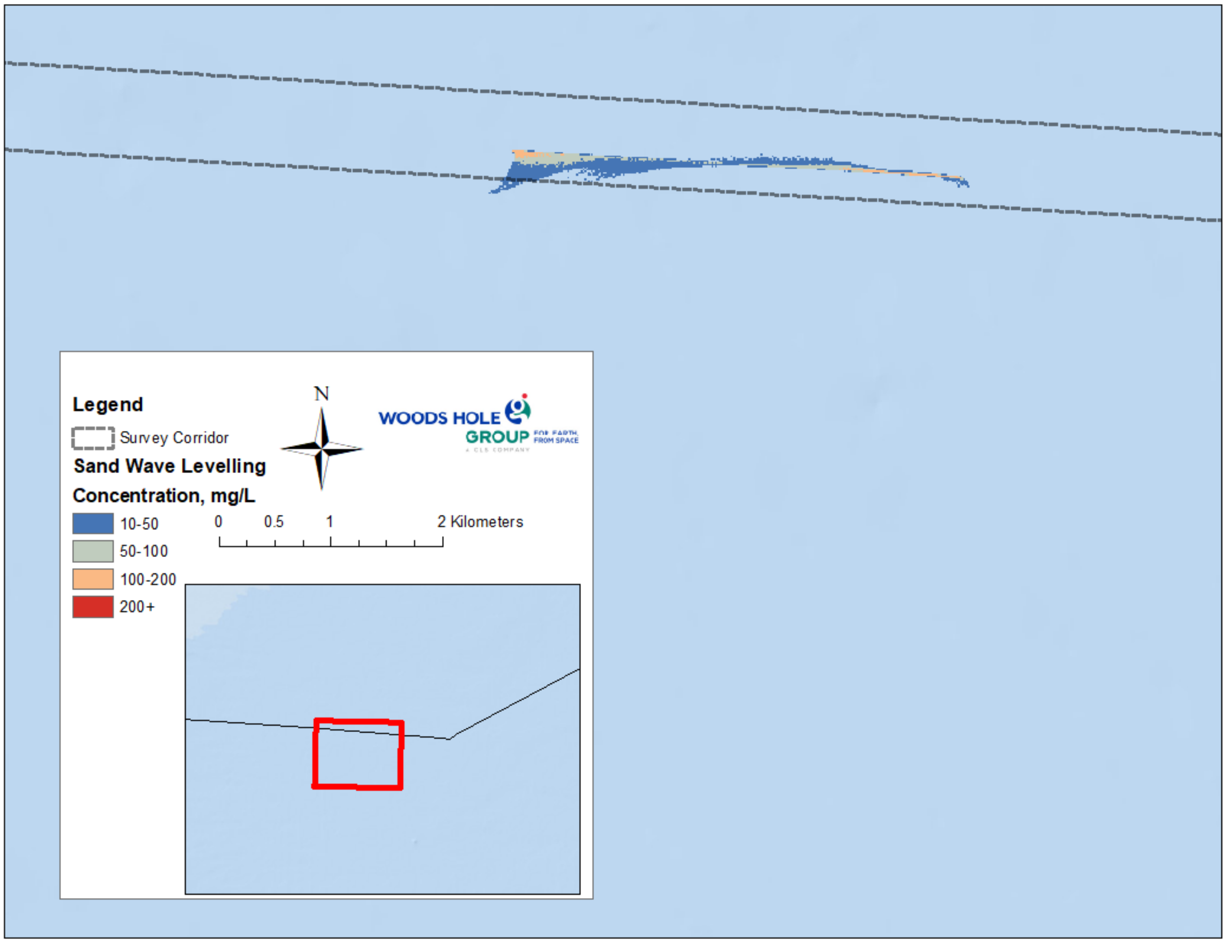

Figure 9.1-69 Maximum TSS concentrations occurring during sand wave leveling for TSHD hydraulic disposal in Federal waters. Map 4 of 4 – refer to the inset for location relative to the full Project extent.

The results shown in Figures 9.1-66 through 9.1-69 indicate maximum suspended sediment concentrations in excess of 100 mg/L occur within 250 m (820 ft) of the cable centerline. TSS concentrations are predicted to return to ambient levels (<10 mg/L) within 0.34 hours from completing the clearance activity.

The maximum predicted deposition thickness is 32 mm (1.3 in). Sedimentation at or above 10 mm (0.4 in) extends a maximum of 271 m (889 ft) from the cable route centerline and covers an area of 10.4 ha (25.7 acres) of the seafloor in Federal waters.

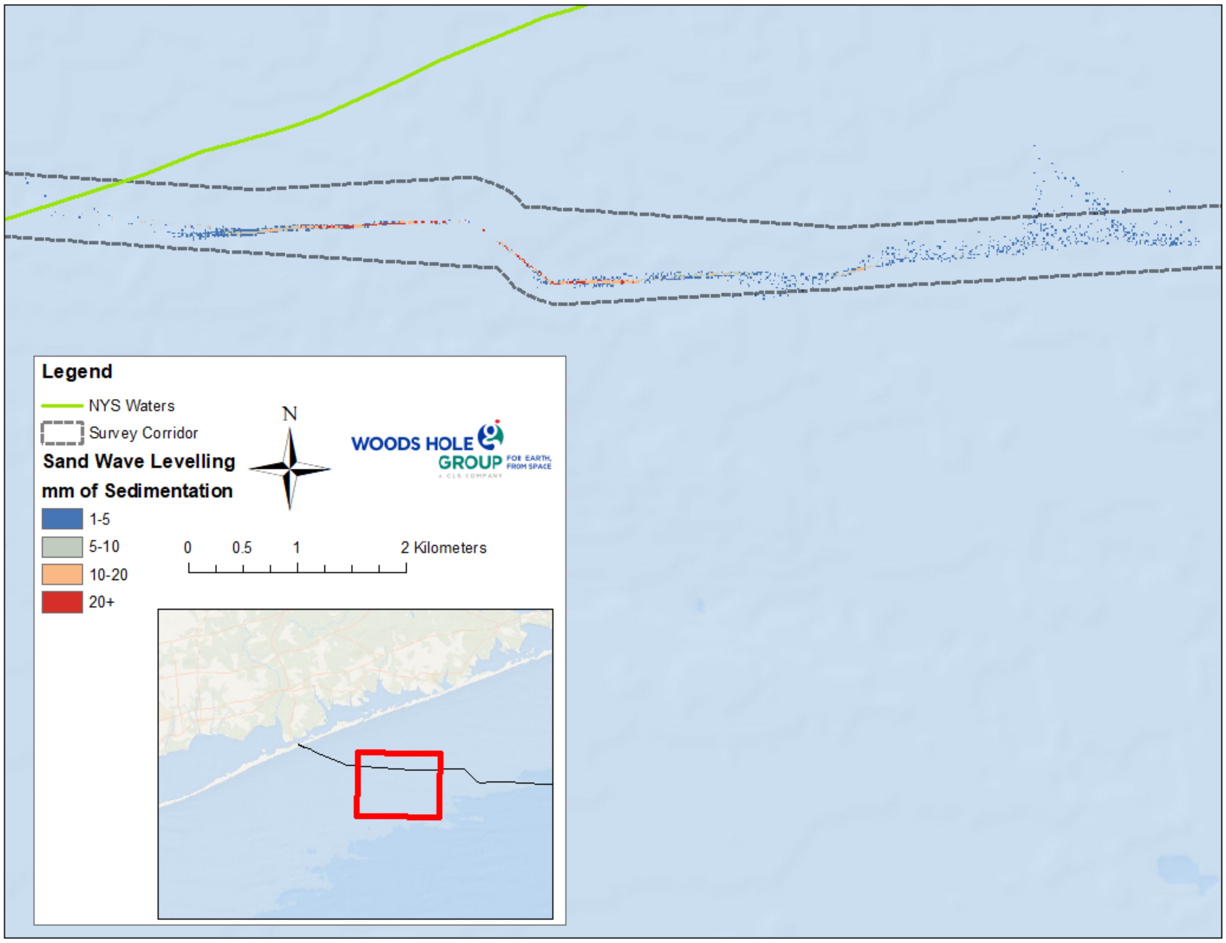

Figure 9.1-70 **Sediment deposition on seafloor after sand wave leveling for TSHD hydraulic disposal in Federal waters. Map 1 of 4 – refer to the inset for location relative to the full Project extent.**

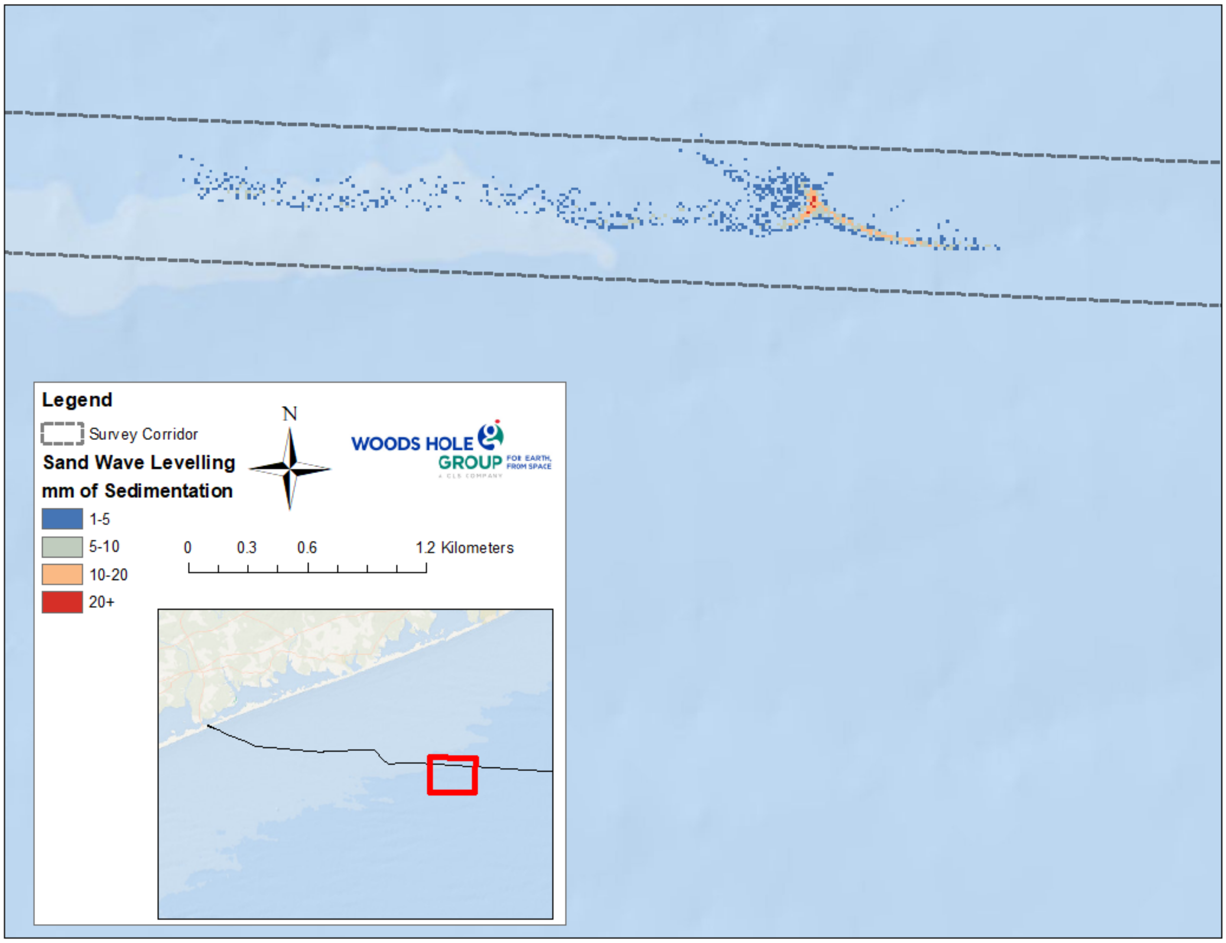

Figure 9.1-71 **Sediment deposition on seafloor after sand wave leveling for TSHD hydraulic disposal in Federal waters. Map 2 of 4 – refer to the inset for location relative to the full Project extent.**

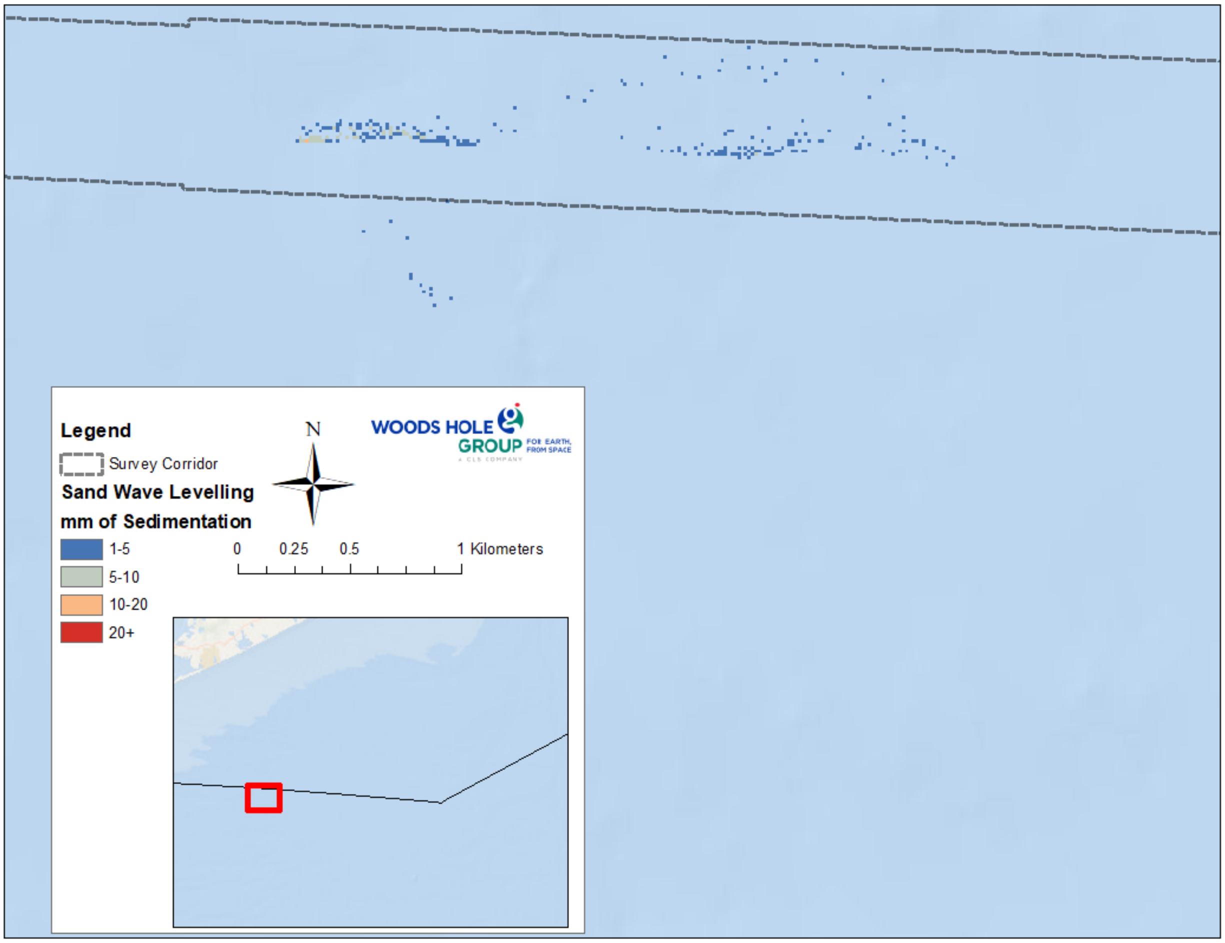

Figure 9.1-72 **Sediment deposition on seafloor after sand wave leveling for TSHD hydraulic disposal in Federal waters. Map 3 of 4 – refer to the inset for location relative to the full Project extent.**

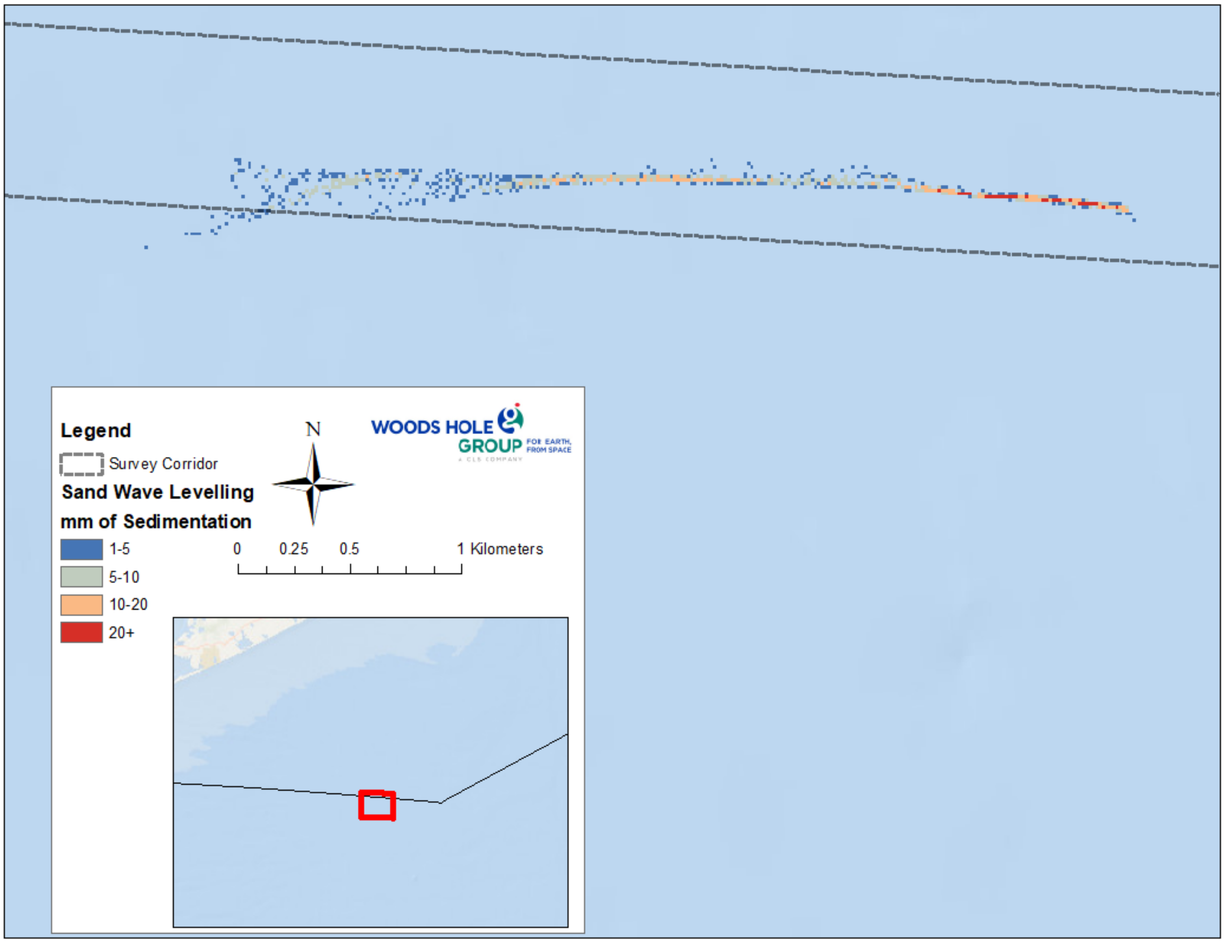

Figure 9.1-73 **Sediment deposition on seafloor after sand wave leveling for TSHD hydraulic disposal in Federal waters. Map 4 of 4 – refer to the inset for location relative to the full Project extent.**

9.2 Summary of Results

Hydrodynamic and sediment transport modeling were conducted to assess the sediment suspension and resulting deposition from proposed construction activities associated with the SRWF and SRWEC. The sediment disturbance was evaluated for excavation of an HDD exit pit in NYS waters, installation of the SRWEC (NYS and OCS), installation of the IAC in Federal waters, and sand wave leveling for seafloor preparation in Federal waters. The sediment transport model provided sediment turbidity levels (presented as TSS), and sediment deposition (thickness above seafloor).

Table 9.2-1 provides a summary of the sediment transport model results. The following are some general findings from the sediment transport analysis:

- The suspended sediment plume from the proposed construction activities is transient and its location in relation to the sediment disturbance varies with the tidal cycles. The sediment plume is shown to be larger in areas where there are higher percentages of fine-grained surficial seafloor sediments.
- The excavation of the HDD exit pit using a mechanical (clamshell) dredge resulted in peak TSS concentrations of 30 milligrams per Liter (mg/L). This activity resulted in a 0.1 hectares (ha) (0.25 acres (ac)) area on the seafloor where the deposition thickness was greater than 10 millimeters (mm) (0.4 inches (in)), extending a maximum of 24 m (78 feet (ft)) from the source. The predicted time to return to ambient turbidity levels is 0.3 hours after completion.
- Using an open bucket dredge and higher production rate, the HDD exit pit excavation resulted in peak TSS concentrations of 379 mg/L. This activity resulted in a 0.1 ha (0.25 ac) area on the seafloor where the deposition thickness was greater than 10 mm (0.4 in), extending a maximum of 39 m (128 ft) from the source. The predicted time to return to ambient turbidity levels is 0.3 hours after completion.
- The Project may include temporary placement of excavated HDD exit pit sediment on the seabed for a 45-day period. Model simulations show this placed sediment is subject to mobilization and resettlement during storm events (multi-day events with average winds in excess of 20 mph and gusts exceeding 35 mph). After a 45-day model simulation which included two mobilization events associated with storm activity, 89% of the excavated sediment is within 38 m (125 ft) of the initial placement.
- For the SRWEC–NYS installation, peak TSS concentrations reached 42 mg/L. The maximum deposition thickness was 191 mm (7.5 in) resulting in an area of deposition (21.5 ha) having a thickness greater than 10 mm with a maximum extent of 77 m (252 ft) from the route centerline. While the time to return to ambient turbidity levels will vary along the SRWEC–NYS route, the time to return to ambient levels was 0.3 hours after completion.
- The SRWEC–OCS installation showed results with peak TSS concentrations reaching 980 mg/L and concentrations exceeding 100 mg/L within 905 m (2,969 ft) of the SRWEC–OCS route centerline. The maximum deposition thickness was 289 mm (11.4 in) resulting in 336.8 ha (832 ac) having a thickness greater than 10 mm (0.4 in) with a maximum extent of 241 m (790 ft) from the route centerline. While the time to return to ambient turbidity levels will vary along the SRWEC–OCS route, the time to return to ambient levels was 0.4 hours after completion.
- Modeling of the IAC installation gave similar results to the SRWEC–OCS, however peak TSS concentrations were predicted to be lower (up to 376 mg/L) and concentrations exceeding 100 mg/L were shown to occur from 619 to 1,020 m (2,030 to 3,346 ft) of the route centerline depending on the sediment characteristics. Predicted sediment deposition had a maximum thickness of 61 to 73 mm (2.4 to 2.9 in) and the area with a thickness greater than 10 mm (0.4 in) ranged from 3.0 to 3.6 ha (7.4 to 8.9 ac).
- Using CFE for sand wave leveling results in a maximum suspended sediment concentration of 81 mg/L in Federal waters. This method is shown to produce deposition with a maximum thickness of 388

mm (15.3 in) in Federal waters. The area of deposition having a thickness greater than 10 mm is 70.5 ha (174.2 ac) within the SRWEC–OCS corridor.

- If a TSHD is used for sand wave leveling with bulk disposal, there will be a continuous release of sediment (primarily fines) at the surface due to overflow from the hopper. This overflow does not produce TSS concentrations greater than 100 mg/L and the resulting maximum deposition is relatively small (13 mm (0.5 in) in Federal waters). The area of deposition greater than 10 mm (0.4 in) is 0.5 ha (1.2 ac) in Federal waters.
- When conducting bulk disposal from the TSHD sand wave leveling, there are peak TSS concentrations in excess of 2,400 mg/L in Federal waters. This method of disposal also produces high levels of deposition (6.1 m (20 ft) in Federal waters), although this level of deposition is limited to small areas. The area of deposition greater than 1 m (3.3 ft) is 0.14 ha (0.3 ac) in Federal waters.
- Using a TSHD for sand wave leveling with hydraulic disposal at the surface produces peak TSS concentrations of 535 mg/L which exceed 100 mg/L within 250 m (820 ft) of the centerline). The maximum deposition from this activity in Federal waters is relatively small (32 mm (1.3 in)) and the area greater than 10 mm (0.4 in) in thickness is 10.4 ha (25.7 ac).

Table 9.2-1a Summary of sediment transport model results

Scenario	Total Sediment Volume Dispersed	Time for TSS to return to ambient	Max distance from source TSS plume exceeds ambient by		Height of TSS Plume above seafloor	Peak TSS concentration	Max deposition thickness	Max distance from source deposition > 10 mm	Area of deposition > 10 mm
			50 mg/L	100 mg/L					
	[m³]	[hrs]	[m]	[m]	[m]	[mg/L]	[mm]	[m]	[ha/ac]
1 – Excavation of the HDD exit pit (clamshell bucket, NYS waters)	750	0.3	NA	NA	2.2	30	476	24	0.1/0.25
2 – Excavation of the HDD exit pit (open bucket, NYS waters)	1,313	0.3	1,258	367	4.0	379	768	39	0.1/0.25
3 – Temporary Placement for HDD exit pit	300	NA	NA	NA	NA	NA	2,200	41	0.3/0.8
4 – Installation of SRWEC–NYS	14,481	0.34	NA	NA	2.5	42	191	77	21.5/53.1
5 – Installation of SRWEC–OCS	254,360	0.40	2,742	905	3	980	289	241	336.8/832.3
6 – Installation of IAC (typical case)	1,800	0.43	1,153	619	2.9	157	73	47	3.6/8.9
7 – Installation of IAC (worst case)	2,750	0.49	2,382	1,020	3.9	376	61	67	3.0/7.4
8 – CFE Sand wave leveling (federal waters)	11,344	0.35	32	NA	1.25	81	388	435	70.5/174.2

Table 9.2-1b Summary of sediment transport model results

Scenario	Total Sediment Volume Dispersed	Time for TSS to return to ambient	Max distance from source TSS plume exceeds ambient by		Peak TSS concentration	Max deposition thickness	Max distance from source deposition > 10 mm	Area of deposition > 10 mm
			50 mg/L	100 mg/L				
	[m^3]	[hrs]	[m]	[m]	[mg/L]	[mm]	[m]	[ha/ac]
9 – TSHD Sand wave leveling –continuous overflow (federal waters)	2,269	0.4	NA	NA	28	13	27	0.5/1.2
10 – TSHD Sand wave bulk disposal (federal waters)	9,075	0.42	2,542	1,540	2,413	6103	72	1.3/3.2
11 – TSHD Sand wave hydraulic disposal (federal waters)	11,344	0.34	415	250	535	32	271	10.4/25.7

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