Supplemental Norfolk Harbor Navigation Improvements Project – Thimble Shoal Channel, Chesapeake Bay Bridge Tunnel – Protective Rock Blanket Project

Virginia Beach, Virginia

Appendix G:
Biological Assessment

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Introduction

On 5 October 2018, the National Marine Fisheries Service (NMFS) issued USACE, Norfolk District, a batched Biological Opinion on the "*Construction and Maintenance of Chesapeake Bay Entrance Channels and Use of Sand Borrow Areas for Beach Nourishment*" following the submission of the June 2018 "*Norfolk Harbor Navigation Improvements Final General Reevaluation Report and Environmental Assessment*" which included the Biological Assessment in Appendix E2 (NHNIP GRR/EA/BA). The Chesapeake Bay Bridge Tunnel (CBBT) Protective Rock Blanket (PRB) project is one of the elements included in the NHNIP GRR and is the responsibility of the Virginia Port Authority (e.g. local sponsor) under the Lands, Easements, Right-of-Ways, Relocations (LERRs) provision in the project's local sponsor agreement. The scope, action area, and need to construct the CBBT PRB project remains unchanged. However, the means and methods to accomplish the project have further developed with a focus to minimize risk to the existing tunnel infrastructure by using a water injection dredge (WID). Although the NHNIP GRR/EA/BA, and associated Finding of No Significant Impact (FONSI) include the CBBT PRB, the means and methods of dredging by WID have emerged that were not specifically addressed in the noted reports.

Purpose

The purpose of this letter is to re-initiate Endangered Species Act (ESA) Section 7 Consultation for the modified means and methods for the construction of the CBBT PRB. The modified means and methods for the CBBT PRB project includes: an alternate dredging method (water injection dredging), new work conventional dredging to additional dredging depths (e.g. mechanical or hopper) in a limited area of Thimble Shoal Channel to construct a receiving trench, and additional dredging volumes and suitable dredged material placement at Dam Neck Ocean Disposal Site (DNODS) from construction of the receiving trench. All work will be conducted within the previously coordinated action area.

Project Description

The existing CBBT was constructed in the 1960's using an immersed-tube method which consists of a cut and cover technique where sections of the tunnel were floated to the site, placed, and joined within a dredged trench. The CBBT is protected with a rock armor layer over portions of the tunnel structure primarily on the side slopes of the channel up to the portal islands. The existing CBBT cover material in the Thimble Shoal Channel (toe to toe) consists of a medium to coarse-grained mix of sandy gravel hydraulic backfill placed following tunnel construction and natural sands and fine-grained sediments that have deposited since the completion of the initial tunnel construction(Figure 1). The NHNIP GRR authorizes installation of a protective rock cover over the CBBT, located in Thimble Shoal Channel, to mitigate future reduced cover depth over the structure as a result of the planned channel deepening. The project scope proposes to remove the existing CBBT cover material to -61 ft MLLW and replace it with a 3 feet (ft) deep rock blanket (e.g. -58 ft MLLW to -61 ft MLLW) below the deepened channel dredge prism (e.g. contract dredging depths of -56 ft MLLW required depth plus 1 ft of allowable pay depth, plus 1 ft of allowable non-pay depth). The purpose of the rock blanket is to provide an armored layer over the existing tunnel as protection from vessel strikes or vessel anchor drags that may occur in the channel. The scope and need to construct the CBBT PRB is unchanged. However, the means and methods to accomplish the project have further developed with a focus to minimize risk to the existing tunnel infrastructure. The project will remove the existing CBBT cover material using water injection dredging (WID). The WID will mobilize or displace the granular dredged material as a bed load to an adjacent receiving trench constructed by conventional dredging methods and located on the east side of the existing CBBT. The receiving trench dimensions have been specifically designed to establish the downward gradient between the CBBT cover area and the WID trench to allow for displacement and proper containment of the cover material. Due to the bulking of the material during this displacement, the capacity of the receiving trench needs to be one and a half to two times greater than the in-situ dredge material volume to contain it below maximum navigation dredging depths.

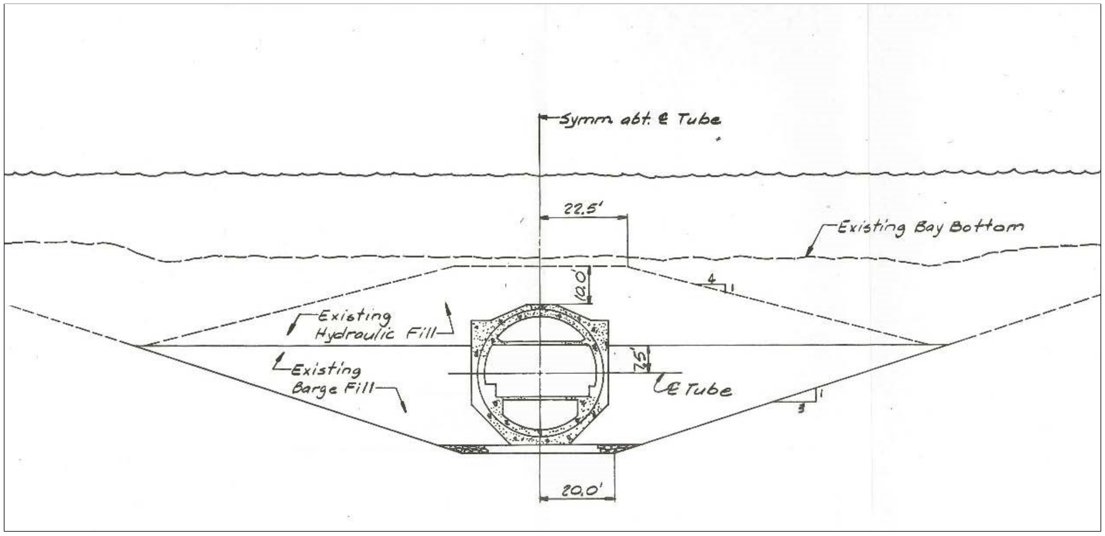


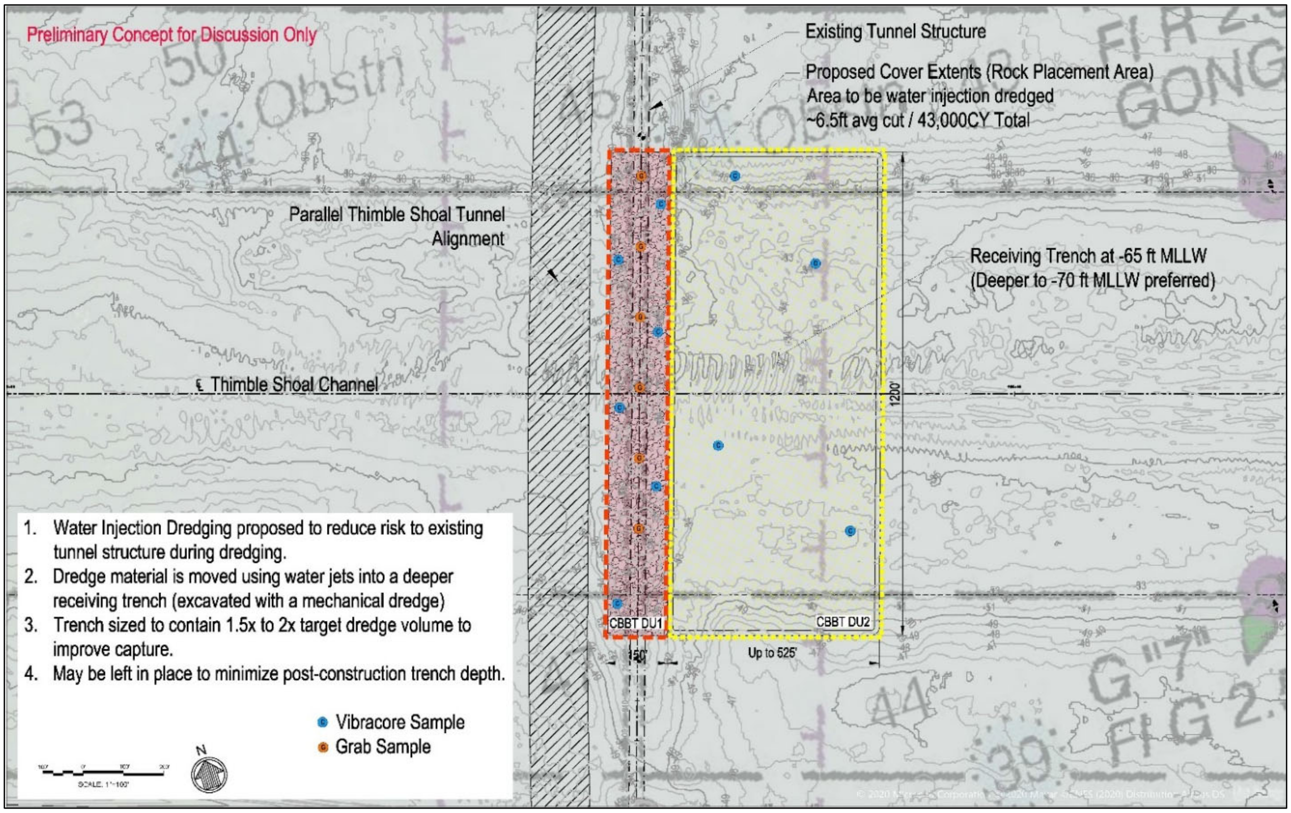
Figure 1. The existing CBBT cover material in Thimble Shoal Channel.

Description of the Action Area

The action area is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50CFR§402.02). For this project modification, the action area has not changed from the 2018 NHNIP GRR/EA/BA and subsequent 2018 NMFS Batched Biological Opinion.

Existing CBBT Cover

The CBBT cover area proposed for removal and reconstruction consists of a 150 ft wide by 1,200 ft long area (Figure 2) in the Thimble Shoal Channel over the existing CBBT. The CBBT has features that are as shallow as -63.8 ft MLLW in the cover area. Hydrographic surveys show the existing sediment surface over the existing CBBT cover area generally range between -53 ft to -56 ft MLLW. The CBBT cover area will be dredged to -61 ft MLLW removing approximately 43,000 cubic yards (cy) of cover material to accommodate the 3 ft deep rock layer from -58 ft to -61 ft MLLW. EA Engineering, Science, and Technology, Inc. collected and analyzed grab and core samples of the existing CBBT cover material in the Thimble Shoal Channel (toe to toe). These analyses determined the CBBT cover material consists of a medium to coarse-grained mix of sandy gravel hydraulic backfill placed following tunnel construction and natural sands and fine-grained sediments that have deposited since the completion of the initial tunnel construction.



1. Water Injection Dredging proposed to reduce risk to existing tunnel structure during dredging.
2. Dredge material is moved using water jets into a deeper receiving trench (excavated with a mechanical dredge)
3. Trench sized to contain 1.5x to 2x target dredge volume to improve capture.
4. May be left in place to minimize post-construction trench depth.

Figure 2. The CBBT cover area proposed for removal consists of a 150 ft wide by 1,200 ft long area in the Thimble Shoal Channel over the existing CBBT.

<u>Water Injection Dredging (WID) over the CBBT</u>: Coordination and input from the CBBT District and industry contractors raised concerns with employing conventional dredging methods (e.g. mechanical or hopper) over and around the existing tunnel structure. WID has been identified as an alternative dredging method to minimize risk to the structure. This dredging method jets water into the sediments at low pressure (10-12 pounds per square inch) and relatively high-volume flow rates to fluidize, displace, and mobilize sediments. The displaced sediments will be transported by gravity and natural water currents as a bed-load down a gradient along a constructed slope into an adjacent receiving trench. With WID, there is no need for direct contact with the bottom material as the jets bar is hovered over the material surface posing less risk to the tunnel structure. There is also no need to spud or anchor the vessel to move the material as the WID is mounted to a barge. In contrast to hopper dredging, WID does not involve suction, pipelines, or boosters (IADC, 2013).

Water Injection Dredge

A literature review of WID projects in the U.S. and Internationally indicated the following typical design for WID systems. The WID system is typically mounted on a marine barge. The barge size may vary, but previous employments of WID systems have utilized barges measuring 32 ft wide by 120 ft long with a draft of five to six feet. The WID typically consists of a centrifugal pump powered by diesel engine. It typically utilizes pipes that run along both sides of the barge to transport water from the pump, and a manifold with jets to inject the water into the sediment. The water is pumped directly below the barge, through a pipe that passes through the barge, to a header that supplies water to two pipes that run along the barge via two swing joints. The swing joints allow the two rigid steel pipes feeding the manifold to move up and down along the sides of the barge. The manifold (typically 38 ft long for WID projects in the U.S.) is raised and lowered by means of a winch and steel cable at the front of the barge. Controls for the winch are typically located in both the tug pilothouse and the office area of the barge. Based on the current typical configuration, the WID has a minimum dredging depth of 5 ft and a maximum dredging depth of 70 ft. Water is jetted through holes in the manifold at a pump discharge water pressure of approximately 10 to 12 pounds per square inch (Figure 3)(Welp et al., 2017). A tug is attached by steel cables to the back of the WID to be positioned and moved.

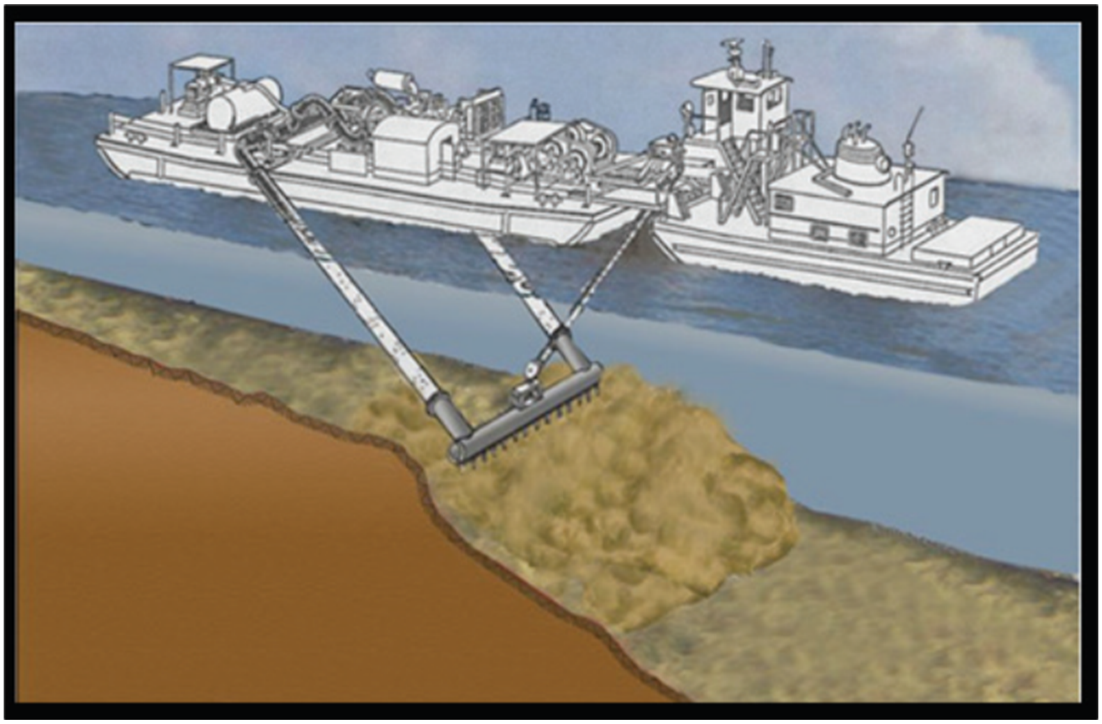


Figure 3a. The Weeks Marine, Inc. water injection dredge (Welp et. al, 2017).

Figure 3b. The Weeks Marine, Inc. water injection dredge, Weeks Marine BT 773 (Schroeder et. al, 2018).

"In operation, the barge is positioned over the shoaled area, the water pump engaged, and the manifold lowered to a depth within one to two feet above the surface of the sediment. The tug pushes the barge in both directions at speeds up to four to six knots in the area being worked, moving from one side of the area to the other with passes approximately 35 to 40 ft wide. The WID generally initiates work in areas of highest sediment elevation or in the area nearest the desired location for deposition of the sediment. For maximum effectiveness, the WID must maintain a gradient towards the deposition area to affect flow of the fluidized sediment. Personnel maintain that the direction of movement of the barge is not important since the jets in the manifold are directed downward perpendicular to the sediment surface and thus do not impart a directional thrust on the sediment. In long reaches, the WID is operated using 400 to 800 ft passes. This helps maintain a gradient to the deposition area. The WID works across and up and down the channel in increments until the full reach is covered. The length of time spent working in each increment is based on the characteristics of the sediment, the depth of sediment to be removed, and experience from previous projects" (Welp et al., 2017).

The WID does not remove material from the system, it simply mobilizes and displaces material from the current location to deeper water through the creation of a downward gradient. For the CBBT PRB, a deeper area adjacent and contiguous to the existing tunnel cover area would be required (e.g. WID receiving trench) for the downward gradient for the effective displacement of material. In addition, the process employed at the CBBT

PRB site may be less efficient due to currents counter to the direction to the flow of material.

Receiving Trench: A receiving trench is proposed for an area contiguous to the CBBT cover area located to the east of the CBBT within the Thimble Shoal Channel. The receiving trench is limited to east side of the CBBT PRB to avoid ongoing construction operations for the CBBT, Thimble Shoal Channel Parallel Tunnel Project. The proposed receiving trench will be a rectangular area up to 1,200 ft wide and 525 ft in length (approximately 15 acres). The proposed receiving trench depth is proposed up to -70 ft MLLW and may remove up to 250,000 cy of dredged material through conventional dredging methods (e.g. mechanical or hopper) (Figure 4a and 4b). This volume is in addition to the proposed deepening volume for Thimble Shoal Channel in the 2018 NHNIP GRR/EA/BA. The receiving trench would be constructed within the previously coordinated action area. The receiving trench area and depth dimensions are intended to accommodate the following:

- 1.5 to 2.0 times the estimated dredge volume of the existing CBBT cover;
- Collect the dredged sediments below -61 ft MLLW maximum navigation dredge depth established in the GRR/EA/BA decision documents and as part of establishing the downward gradient needed for WID to be effective;
- Contain the WID dredged sediments at depth to avoid impacts to navigation;
- Minimize subsequent migration of WID sediments due to water currents.

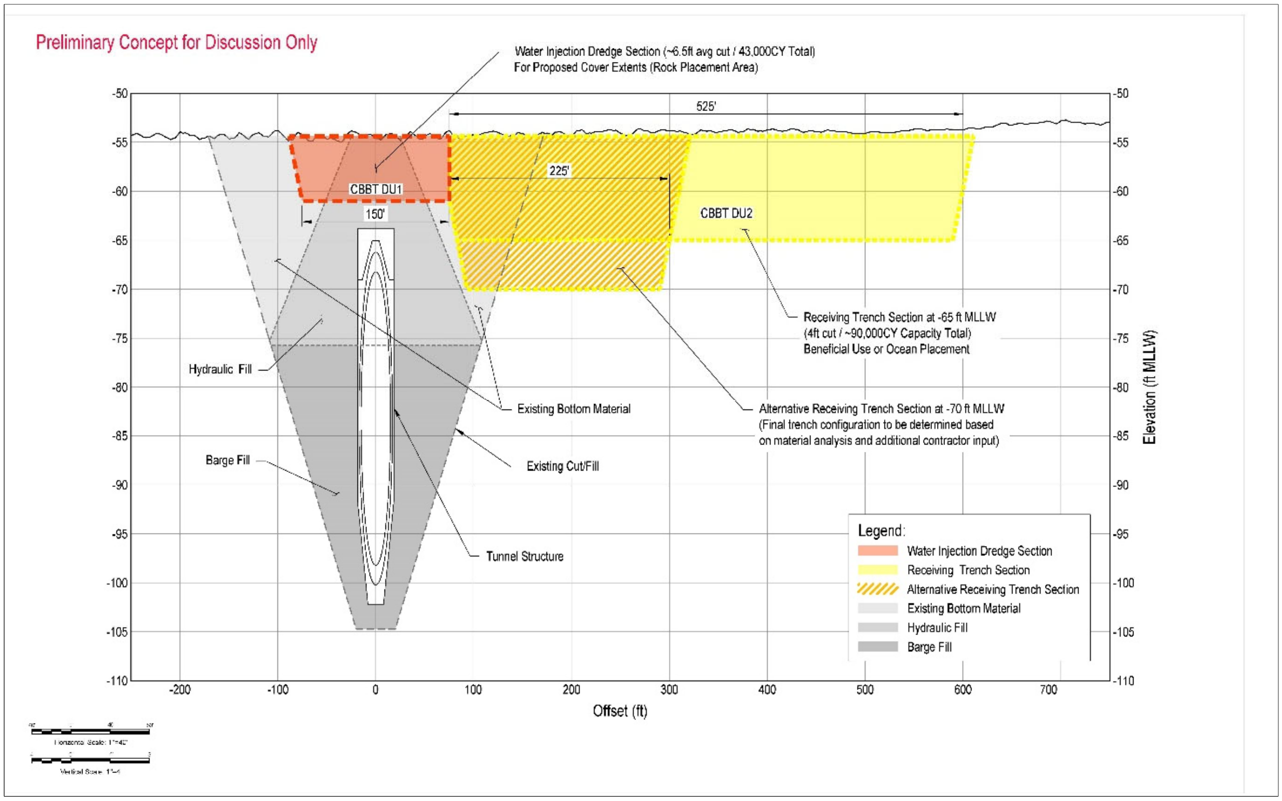


Figure 4 a. Receiving trench concept.

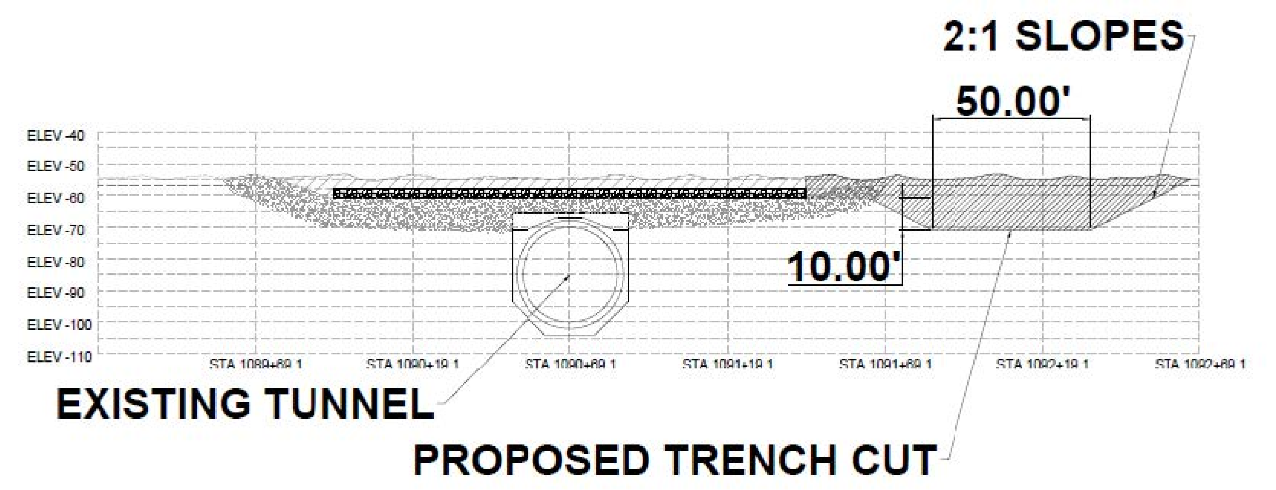


Figure 4b. Receiving trench concept.

Receiving Trench Dredging Methods
The most likely dredges to be employed for the receiving trench would be hopper and/or mechanical dredges with material transported for disposal using barges or scows. The effects of hopper and/or mechanical dredging and transport for disposal were analyzed in the 2018 NHNIP GRR/EA/BA, and the 2018 NMFS Batched Biological Opinion concluded the project "may adversely affect but is not likely to jeopardize the continued existence of any DPS of Atlantic sturgeon, Kemp's ridley or green sea turtles or the Northwest Atlantic DPS of loggerhead sea turtles and is not likely to adversely affect leatherback sea turtles, hawksbill sea turtles, shortnose sturgeon, fin whales, sei whales, blue whale, sperm whales, and North Atlantic right whales." The construction of the receiving trench and transportation of the additional dredged material for disposal by means of conventional dredging (e.g. mechanical and/or hopper) are anticipated to have the same affects on listed species as previously coordinated and would strictly follow the Terms and Conditions and Reasonable and Prudent Measures established in the 2018 NMFS Batched Biological Opinion.

Full details in the 2018 NHNIP GRR/EA/BA and subsequent 2018 NMFS Batched Biological Opinion and are hereby incorporated by reference.

Dredged Material Characterization

Dredged material from the existing CBBT cover area and the receiving trench area was evaluated in accordance with the testing procedures and protocols required under the Marine Protection, Research, and Sanctuaries Act (MPRSA), Section 103. The dredged material evaluation generates physical, chemical, and toxicological data to facilitate dredged material management decisions in regards to placement of the dredged material and compliance with water quality requirements under Clean Water Act (CWA) and/or the limiting permissible concentration under

MPRSA requirements. The full details of the dredged material evaluation performed by EA Engineering can be found in Appendix H, Interim Sampling Data Report, of the Supplemental Environmental Assessment for the CBBT Protective Rock Blanket. See below for a summary of the results.

The recent sediment evaluation performed by EA Engineering characterized the physical characteristics of the CBBT cover area and the WID trench CBBT. The cover area is composed of sandy/gravel material and naturally deposited alluvial sediments, while the WID trench is composed of maintenance and new work sediment that comprise the bay mouth shoal deposits formation and Channel Fill Deposits geologic formation. Physical testing of the material indicates the sediment grain size distribution are predominantly > 90% sand and gravel in the CBBT cover material and approximately 75% sand and 25% silt/clay in the WID trench.

The WID trench material and the CBBT cover material were evaluated for water column and benthic impacts to comply with the Limiting Permissible Concentration (LPC) (as defined in 40 CFR 227.27).

WID Trench Material Results

- The elutriate created using the WID trench sediment and dredging site water met the Limiting Permissible Concentration (LPC) for water quality criteria and water column toxicity for ocean placement at the DNODS.
- Results of 10-day whole sediment bioassays using two amphipod species, *Ampelisca abdita* and *Leptocheirus plumuolosus*, indicated that organism survival in the WID trench sediments was not significantly different than organism survival in reference sediment (EA 2021). Therefore, the WID trench sediments meet the LPC for benthic toxicity for ocean placement at the DNODS.
- Two marine species, *Macoma nasuta* (blunt-nosed clam) and *Nereis virens* (sand worm), were used to assess bioaccumulation of contaminants from the WID sediments during 28-day laboratory exposures. Following the 28-day exposure period, the tissues were analyzed for target constituents (metals and organics) based on the results of the bulk sediment testing. Results of the tissue analysis are pending. Based on the weight of evidence from other physical, chemical and biological testing, the WID sediments are expected to meet the LPC for benthic bioaccumulation for ocean placement at the DNODS.

CBBT Cover Material Results

- The elutriate created using the CBBT cover material and dredging site water comply with the water quality toxicity 404(b)(1) Guidelines and Section 401 State WQS for open water placement.
- Results of water column bioassays using three species of aquatic marine organisms, *Mytilus edulis* (blue mussel), *Americamysis bahia* (mysid shrimp), and *Menidia beryllina* (silverside minnows) indicated that the 100% elutriate was not

toxic to the three test species (EA 2021). The median lethal concentration (LC50) and/or median effective concentration (EC50) was greater than 100 percent elutriate for each of the three species. Therefore, the elutriates created with CBBT cover material and dredging site water comply with the water column toxicity as described in 40 CFR 230.61(b)(2) of the 404(b)(1) Guidelines for open water placement.

- Results of 10-day whole sediment bioassays using two amphipod species, *Ampelisca abdita* and *Leptocheirus plumuolosus*, indicated that organism survival in the CBBT cover sediments was not significantly different than organism survival in reference sediment (EA 2021). Therefore, the CBBT cover sediments comply with the benthic toxicity as described in 40 CFR 230.61(b)(3) of the 404(b)(1) Guidelines for open water placement.
- Two marine species, *Macoma nasuta* and *Nereis virens*, were used to assess bioaccumulation of contaminants from the CBBT cover sediments during 28-day laboratory exposures. Following the 28-day exposure period, the tissues were analyzed for target constituents (metals and organics) based on the results of the bulk sediment testing. Results of the tissue analysis are pending. Based on the weight of evidence from other physical, chemical and biological testing, the CBBT cover sediments are expected to comply with the benthic bioaccumulation toxicity as described in 40 CFR 230.61(b)(3) of the 404(b)(1) Guidelines for open water placement.

Dredged Material Placement

CBBT Cover Material: Approximately 43,000 cy of existing CBBT cover material will be placed in the proposed receiving trench through the WID method. The preferred alternative is to leave the CBBT cover material within the receiving trench contained below the channel navigation and maximum dredging prism. Other placement alternatives for the CBBT cover material includes beneficial uses at the CIEE, CIDMMA and/or beach nourishment projects dependent on sediment characterization data. Other alternatives included upland placement at a permitted solid waste facilities, such as Weanack LLC/Shirley Plantation. Note, the CBBT cover material will not be proposed for ocean placement at DNODS under MPRSA, Section 103.

Receiving Trench: The preferred placement alternative for the approximate 250,000 cy of dredged material from the receiving trench is ocean placement at the DNODS. The receiving trench dredged material was tested to determine its suitability for ocean placement through a USEPA approved sampling and analysis plan under MPRSA, Section 103. A summary of these results is located in the previous section titled “Dredged Material Characterization.” The full details of the dredged material evaluation performed by EA Engineering can be found in Appendix H, Interim Sampling Data Report, of the Supplemental Environmental Assessment for the CBBT Protective Rock Blanket. Other alternatives include beneficial use of the dredged material (e.g. beach nourishment, port development projects) for the navigation channel dredged material. Unsuitable materials that may be identified through testing and characterization would be managed for disposal at permitted upland facilities or Weanack/Shirley Plantation facilities depending disposal warranted by chemical and ecotoxicological testing results.

Status of Species within the Action Area

Listed species may be present in the action area include: Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*; 77 FR 5880 and 77 FR 5914), leatherback sea turtle (*Dermochelys coriacea*), Kemp's ridley sea turtle (*Lepidochelys kempii*), the North Atlantic Distinct Population Segment (DPS) of green sea turtle (*Chelonia mydas*), the Northwest Atlantic DPS of loggerhead sea turtle (*Caretta caretta*), fin whale (*Balaenoptera physalus*), North Atlantic right whale (*Eubalaena glacialis*), and the sei whale (*Balaenoptera borealis*). Species descriptions and details regarding presence and habitat within the action area can be found in the 2018 NHNIP GRR/EA/BA and subsequent 2018 NMFS Batched Biological Opinion and are hereby incorporated by reference.

As in the Appendix E2 Biological Assessment of the 2018 NHNIP GRR/EA, the following species were excluded from the effects analyses (full details regarding these species can be found in the 2018 NHNIP GRR/EA/BA and subsequent 2018 NMFS Batched Biological Opinion and are hereby incorporated by reference). Based on our review of the survey and Virginia stranding data, there is no documented occurrence of the blue whale (*Balaenoptera musculus*) in the action area or in coastal waters of Virginia. Also, blue whales have a predominantly offshore distribution. Therefore, we determined this species would not likely occur in the action area and therefore, there would be "no affect" to the blue whale and this species is dismissed from further analysis. There is only one limited occurrence of a stranded sperm whale (*Physeter macrocephalus*) in the action area and because of the preferred offshore distribution of this species we would not anticipate the sperm whale to typically occur in the action area; therefore, there would be "no affect" to the sperm whale and this species is dismissed from further analysis. There is no documented occurrence of the hawksbill sea turtle (*Eretmochelys imbricata*) in the action area and there is no preferred habitat for this species in the action area; therefore, there would be "no affect" to the hawksbill sea turtle and this species is dismissed from further analysis. There are no candidate species anticipated to occur in the action area.

Effects Determination

Impacts on listed species from conventional dredging (e.g. mechanical and/or hopper), transport, and placement of material at the disposal site, and cumulative impacts (e.g. future vessel traffic) as a result of the project as a whole would be the same as those discussed in the 2018 NHNIP GRR and subsequent 2018 NMFS Batched Biological Opinion. Therefore, this analysis focuses only on the potential impacts from the alternative means and methods of using the WID method.

Entrainment

Unlike conventional dredging methods (e.g. mechanical and/or hopper), the WID method does not require the use of pipelines, boosters, spuds, or suction to remove the material. With WID, there is no need for direct contact with the bottom material as the jets bar is hovered approximately two feet over the material surface, jets water at low pressures (10-12 psi), and moves at approximately four to six knots (with a maximum speed of approximately eight knots when the WID is not in use) posing less risk than conventional dredging to ESA listed species (Welp et al., 2017). Based on the information available, ESA listed species are not anticipated to be at risk for entrainment in the WID components or barge. For one project reviewed in the literature, the WID was implemented as one of several mitigation and protection measures to deter sea turtles away from dragheads during conventional dredging of Dhamra Port, India (Dickerson, 2009). However, more research is required to determine efficacy in deterring sea turtles through use of WID (Ramirez et al., 2017). The density current is maintained close to the bed, and it is anticipated that pelagic species, mobile demersal fish, sturgeon, sea turtles, and whales could easily move away from any potential danger without being subject to harmful effects (Sigwald et al., 2015); therefore, entrainment in the WID barge or tug would be highly unlikely and discountable . However, less mobile or non-mobile demersal species could potentially be impacted by the WID method, which could lead to temporary impacts to potential food sources and habitat for ESA listed species (see "Effects of Dredging on Habitat").

Vessel Interactions

Atlantic and Shortnose Sturgeon

Atlantic sturgeon interactions with vessels have been documented to occur nearby in the James River (Balazik et al., 2012). The Balazik et al. (2012) study was conducted in the freshwater portion of the James River from 2007-2010 from 31 carcasses of adult Atlantic sturgeon. Twenty-six of the carcasses had scars from propellers and five were too decomposed to determine the cause of death. Nearly all of the carcasses were recovered (84%) from a narrow reach that was modified to enhance shipping efficiency. Balazik et al. (2012) indicated that the vessel interactions were likely caused by deep draft vessels because of the benthic nature of Atlantic sturgeon based on the telemetry study.

Due to the open-water environment of the Port of Hampton Roads, the likelihood of sturgeon interactions with dredging vessel/equipment strikes is possible but is not anticipated to be a significant threat due to the limited amount of time the WID will be operating, the anticipated low speed of the WID barge and tug (6 knots or less), the ability of subadult and adult sturgeon to move away from dredging impacts, and the limited draft of the dredging vessels. The distance between the bottom hull of the dredging vessels and any potential support vessels and the river bottom would be greater than 10 feet; therefore, risks of bottom-dwelling sturgeon hull strikes with the WID barge or tug would be highly unlikely and therefore, discountable.

Sea Turtles

All species of sea turtles are also vulnerable to vessel strikes as they surface to breathe, bask near the surface, or forage in shallow areas or on prey near the sea surface. However, the risk of injury to sea turtles from collisions with dredge-related vessels is considered discountable considering the species mobility and slow speed of the WID barge and tug (approximately four to six knots when the WID is in use and approximately eight knots when the WID is not in use under ideal sea state conditions). No sea turtle vessel collisions with dredge-related vessels has ever been reported to occur in the action area from dredging operations. In addition, the WID method has been used on other projects (e.g. Dhamra Port, India) as a mitigation and protection measure to deter turtles from the area prior to hopper dredging (Dickerson, 2009). Since, the WID barge and tug would mobilize to construction locations at slow rates of speed or would remain between four and six knots during construction activities (with a maximum of approximately eight knots when the WID is not in use), any increased risk of a vessel strike caused by the project would be too small to be meaningfully measured or detected.

Whales

The speed of vessels is a factor thought to affect the potential risk for whales and vessel interactions. The NMFS (2017) reports that overall, most ship strikes of large whale species occurred when ships were traveling at speeds of 10 knots or greater and that collisions are more likely to occur with ships traveling at speeds of 14 knots or greater. Based on NMFS (2017), the average vessel speed that resulted in injury or mortality to large whales was 18.6 knots. There is a 10 knot speed restriction at the entrance to the harbor that is in effect during the northern right whale migration season (November 1-April 30). However, speed restrictions are not in place in the other portions of the action area. Whale strikes have been recorded to occur at speeds of only two knots (Jensen and Silber, 2003); therefore, even with the vessel speed restriction, the risk of a whale strike is likely reduced but not eliminated. However, Pace and Silber (2005) found that the probability of death or serious injury to large whales increased rapidly with increasing vessel speed. Specifically, the predicted probability of serious injury or death increased from 45 percent to 75 percent as vessel speed increased from 10 to 14 knots and exceeded 90 percent at 17 knots. In general, at higher speeds, vessel operators may have less opportunity to detect and avoid interactions with whales (Whale and Dolphin Conservation Society, 2006). Likewise, whales may also have less opportunity to detect and avoid interactions as well. Vessel interactions could result in injury or mortality to the whale. Also, the vessel interactions could result in a disturbance effect where there would be a disruption to whale behavior and could potentially cause a whale movement out of the area. Since, the WID barge and tug would steam to construction locations at slow rates of speed or would remain between four and six knots during construction activities (with a maximum of approximately eight knots when the WID is not in use in ideal conditions), any increased risk of a vessel strike caused by the project would be too small to be meaningfully measured or detected.

Vessel Interaction Determination

Adding project vessels to the existing baseline will not increase the risk that any vessel in the area will strike an individual (Atlantic sturgeon, sea turtle or whale) or will increase it to such a small extent that the effect of the action cannot be meaningfully measured or detected. The baseline risk of a vessel strike within the action area is unknown. The increase in traffic associated with the proposed action is extremely small. During the project activities, a minimal number of vessels (3–5 project vessels) will be added to the baseline during a dredging event. Project vessels are not permanent additions to the action area; their presence is temporary and only for the duration of the project. Additionally, the anticipated forward advance rate of the WID barge and tug (approximately four to six knots when the WID is in use and approximately eight knots when the WID is not in use), the ability of sturgeon, sea turtles, and whales to move away from dredging impacts, and the limited draft of the dredging vessels minimizes the risk to individuals in the action area. The addition of project vessels will also be intermittent, temporary, and restricted to a small portion of the overall action area on any given day. As such, any increased risk of a vessel strike caused by the project will be too small to be meaningfully measured or detected. As a result, the effect of the action on the risk of a vessel strike in the action area is insignificant, and incidental take is not anticipated to occur.

Water quality

According to Wilson (2007), WID induces very little total suspended solids (TSS) into the water column; because the majority of fluidized material remains close to the density current (Figure 5). Turbidity and suspended sediments during WID in the Upper Mississippi River (1992) and in New Orleans (2007) documented elevated turbidity above background levels within two to five feet above the bottom, with no evidence of dispersion into upper portions of the water column (Welp et al., 2017 and Clausner et al., 1993). Mid-depth and surface TSS concentrations remained low even when the bottom TSS reached as high as 384 mg/l in the Michoud Channel. Above approximately 33 ft in the Michoud Channel, there was essentially no measurable difference in TSS levels between the area in the vicinity of the dredge and the background (Wilson, 2007). By comparison, hopper dredging turbidity plumes may extend approximately 2,300 to 2,400 ft down-current from the dredge (USACE, 1983). TSS concentrations for hopper dredges may be as high as several hundred mg/L near the discharge port and as high as several tens of mg/L near the draghead (Wilber and Clarke, 2001). It is anticipated that turbidity will be dependent on project-specific grain size and flow characteristics at the project site. However, coarser-grained materials (sands) have a higher settling rate than finer-grained material (silts and clays) (IADC, 2013). "Monitoring of suspended sediment in the Michoud Canal and near Hellevoetsluis, Netherlands, demonstrated that, in the right conditions, the density current generated by WID can be confined to the near bottom. Confining the material to near the channel bottom can prevent sediment from being deposited in environmentally sensitive areas outside the channel" (Welp et al., 2017)(Figure 5). During water injection dredging sediment is not usually re-suspended, and so the technique tends to generate relatively little turbidity (PIANC, 2009). Based on the above references, it is also expected that the turbidity plumes from the WID method will be smaller and more localized than the turbidity plumes associated with hopper and cutterhead dredging. Physical results indicate the CBBT PRB material consist of predominantly gravels and sands with 5-8% fine content. Therefore, resuspension of fine-grained sediments will be minimal and coarse aggregates will not remain suspended. In addition, water quality compliance, water column toxicity, benthic toxicity and benthic bioaccumulation conducted on sensitive life stage organisms as part of the WID trench material and CBBT cover material evaluation comply with criteria for ocean placement at DNODS (WID trench material) and open water placement (CBBT cover material).

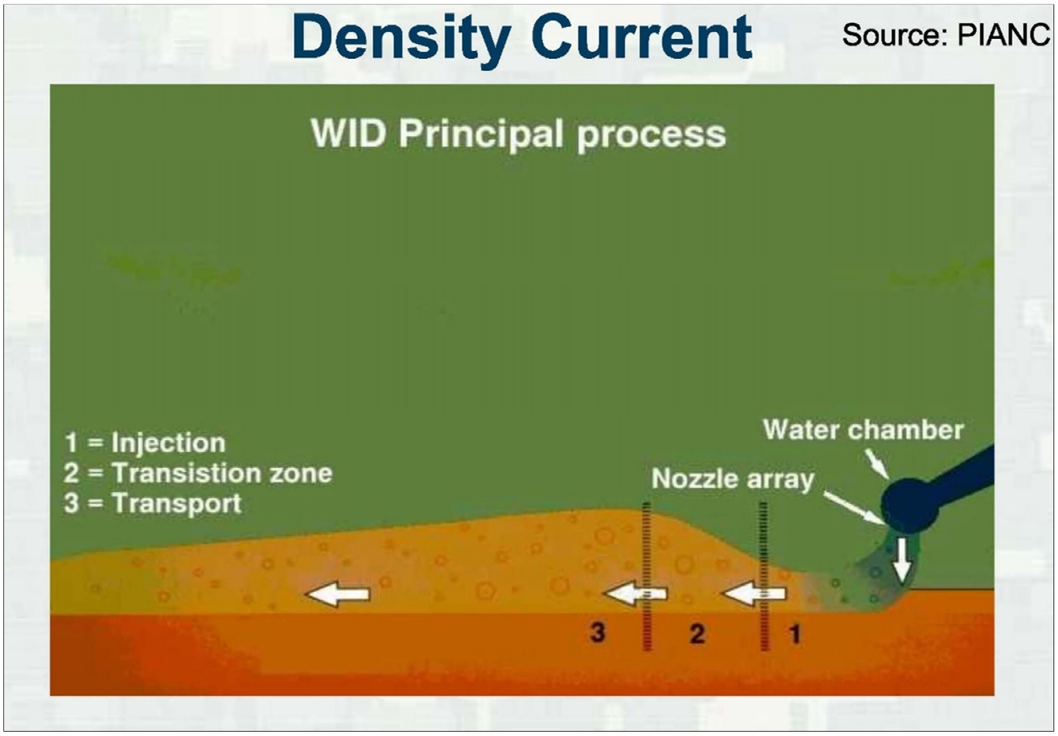


Figure 5. The WID Density Current Principal (PIANC, 2009).

Increased turbidity and suspended sediments caused by dredging and placement activities are anticipated to have temporary and localized impacts to water quality. WID is a relatively new hydrodynamic dredging technique, therefore more studies have been conducted on the impacts of turbidity and TSS on threatened and endangered species with conventional dredging methods. Since WID is anticipated to create a smaller, more localized turbidity plume with less widespread TSS concentrations than conventional dredging methods , this section will focus on the water quality impacts on threatened and endangered species from conventional dredging methods as a conservative measure in the absence of WID method impact studies.

Atlantic and Shortnose Sturgeon

Short term impacts to Atlantic and shortnose sturgeon from dredging are primarily related to localized and temporary decreases to water quality due to increased turbidity and suspended sediments from the WID method. Duration of WID operations are anticipated to be approximately two months or less. The duration of dredging activities is governed by several factors, such as the amount of shoaled material in the channel, the size and type of dredge, and distance to the placement area. Juvenile, sub-adult, and adult Atlantic sturgeon, as well as adult overwintering and migrating shortnose sturgeon, may be located within the WID area and, thus, the area of increased TSS. Although demersal species may be impacted initially, long-term impacts are not anticipated after dredging operations cease. A literature review by Burton (1993) demonstrated that lethal effects on fish due to turbid waters can occur at levels between 580 mg/l and 700,000 mg/l, depending on the species. Typical lethal effect levels for anadromous fish species exposed to TSS were in the range of approximately 1,000 mg/l to 2,000 mg/l (Burton 1993). Studies on striped bass, another anadromous species, showed that pre-spawners did not avoid TSS concentrations of 954 mg/l to 1,920 mg/l to reach spawning sites (Summerfelt and Moiser 1976, Combs 1979 as referenced in Burton 1993). Sturgeon are thought to be at least as tolerant of elevated turbidity as other anadromous fish. Dadswell et al. (1984) observed sturgeon foraging mostly when water turbidity was high. TSS concentrations at or above 390 mg/l may smother benthic communities (EPA, 1986) and reduce the quality of foraging habitat for sturgeon. TSS concentrations resulting from hydraulic dredging (i.e., up to 282 mg/l) and mechanical dredging (i.e., up to 445 mg/l) are less than those shown to have an adverse effect on fish (580.0 mg/l for the most sensitive species) or to negatively impact benthic communities (390 mg/l) for cutterhead dredges (EPA, 1986). Elevated TSS concentrations could also affect juvenile, sub-adult, and adult sturgeon if a plume causes a barrier to movement or migration; however, increased concentrations from WID are unlikely to affect sturgeon in these life stages, given that they forage in highly turbid waters. Although WID operations may produce temporary plumes above levels shown to adversely affect benthic communities, all effects will be temporary and isolated, leaving much of the benthic community in the action area available for foraging. As discussed above, elevated TSS concentrations would be limited to a localized area around the active dredging and placement activities. Given the relatively low TSS concentrations and the open area surrounding Thimble Shoal Channel, WID would not be expected to form a barrier to their movement. The high flushing rate, small area of impact, slow movement, and low PSI of the WID will minimize impacts to non-motile demersal organisms. Thus, any effects of suspended sediment resulting from proposed WID dredging and placement activities would be too small to be meaningfully measured, detected, or evaluated for juvenile, sub-adult, and adult Atlantic sturgeon and adult shortnose sturgeon and are, therefore, insignificant.

Dredging may also decrease dissolved oxygen (DO) in the water column through an increase in TSS. Low DO conditions, known as hypoxia, can be generated by the resuspension of sediments and the biochemical oxygen demand of the surrounding water (Johnston, 1981). This can be particularly important during the summer months when increased water temperatures decrease the dissolution rate of oxygen in water. Dredging during the warmer months can exacerbate low DO conditions (Hatin et al., 2007a). Reductions in DO will be most prevalent at the dredge site. Since there are minimal fines and predominantly gravels and sands, there should be minimal demand on dissolved oxygen since there are low amounts of organic sediments to consume that oxygen. Juvenile Atlantic sturgeon are particularly vulnerable to low DO conditions, especially during the summer months when the water temperature is already elevated (Secor and Gunderson, 1998). The action area is wide open surrounding Thimble Shoal Channel with no barrier and WID is anticipated to produce relatively low TSS concentrations and localized turbidity plume. The high flushing rate, small area of impact, slow movement, and low PSI of the WID would limit the impact of DO on threatened and endangered species. Therefore, any effects of DO concentration resulting from proposed dredging activities on the sturgeon would be too small to be meaningfully measured, detected, or evaluated and are, therefore, insignificant.

Sea Turtles

There is a lack of information available on the effects of turbidity and TSS on sea turtles. Sea turtles' surface to breathe air, are capable of swimming away from turbidity plumes, and would not be adversely affected by passing through a temporary increase in TSS (NMFS, 2020). While the increase in TSS may cause sea turtles to alter their normal movements, these minor movements will be too small to be meaningfully measured or detected. In the action area, turtles may be exposed to increased turbidity from the dredging plume; however, impacts to water quality will be minor and temporary, and sea turtles, which are highly mobile, are expected to avoid areas of high turbidity. Therefore, impacts from turbidity on sea turtles would be insignificant.

Whales

There is a lack of information available on the effects of turbidity and TSS on whales. Whales' surface to breathe air, are capable of swimming away from turbidity plumes, and would not be adversely affected by passing through a temporary increase in TSS (NMFS, 2020). While the increase in TSS may cause whales to alter their normal movements, these minor movements will be too small to be meaningfully measured or detected. In the action area, whales may be exposed to increased turbidity from the dredging plume; however, impacts to water quality will be minor and temporary, and whales, which are highly mobile, are expected to avoid areas of high turbidity. Therefore, impacts from turbidity on fin whales (*Balaenoptera physalus*), North Atlantic right whales (*Eubalaena glacialis*), and sei whales (*Balaenoptera borealis*) would be insignificant.

Water Quality Determination

Overall water quality impacts on threatened and endangered species are anticipated to be localized, minor, temporary, and too small to be meaningfully measured or detected. The elutriate and water column toxicity results from the testing demonstrate compliance with CWA (404) and MPRSA (103) numeric and toxicity water quality criteria and standards. Once dredging operations are complete, the action area will quickly return to ambient conditions due to both re-deposition of suspended sediments and strong littoral currents. As a result, impacts from water quality on threatened and endangered species would be insignificant.

Effects of Dredging on Habitat

Dredging activities would directly disturb and alter the bottom, potentially reducing the availability of prey species or altering prey composition. The effects of WID on habitat would be limited to the dredging area and the placement area. Temporary elevated TSS concentrations caused by a sediment plume from dredging may also affect habitat quality in the vicinity of the dredging area.

Atlantic and Shortnose Sturgeon

Atlantic and shortnose sturgeon feed on a variety of benthic invertebrates, and WID is likely to disturb or remove at least some of these potential forage items, such as shellfish, benthic worms, or other benthic invertebrates. Given the mobility of most benthic invertebrates that sturgeon feed on, most are unlikely to be able to actively avoid the dredge. Previous studies in the upper Chesapeake Bay have demonstrated rapid recovery and resettlement by benthic biota and similar biomass and species diversity to pre-dredging conditions (Johnston, 1981, Diaz, 1994). Similar studies in the lower portions of Chesapeake Bay produced rapid resettlement of dredging and placement areas by infauna (Sherk, 1972). McCauley et al. (1977) observed that, while infauna populations declined significantly after dredging, infauna at dredging and placement areas recovered to pre-dredging conditions within 28 and 14 days, respectively. Because the effects to benthic prey will be limited to the area immediately surrounding the dredge and placement areas, the potential for disruption of foraging is low. Thus, any effects to Atlantic or shortnose sturgeon as a result of reductions in foraging habitat from proposed dredging activities would be too small to be meaningfully measured, detected, or evaluated and are, therefore, insignificant.

Habitat for resting, migrating, and staging juvenile, sub-adult, and adult Atlantic sturgeon, as well as overwintering and migrating adult shortnose sturgeon, may also be impacted by dredging activities. As discussed previously, dredging and placement will not cause barriers to migration. Telemetry data from tagged adult Atlantic sturgeon suggest that sturgeon pass through areas with active hydraulic dredging operations without incident during spawning season (Balazik, pers. comm.). Additionally, the dredging footprint is small relative to the bottom of the action area as a whole, and the impacts of dredging to these habitats would be temporary; thus there will be no significant reduction in these habitat areas. Therefore, any effects to Atlantic or shortnose sturgeon as a result of reductions in resting, migrating, and staging habitat from proposed dredging activities would be too small to be meaningfully measured, detected, or evaluated, and are, therefore, insignificant.

Sea Turtles

There is no nesting habitat in the action area for any species of sea turtle; however, there is potentially foraging habitat for sea turtles. Sessile and slow-moving benthic fauna could be removed and potentially buried by WID operations in the dredging footprint and in surrounding areas affected by the turbidity plume. For the listed species anticipated to occur in the action area, loggerheads and Kemp's ridley sea turtles are most likely to be foraging in the action area on benthic species that could include crabs and mollusks. There is no submerged aquatic vegetation in the action area, therefore, adult green sea turtles are unlikely to be foraging in the action area; however, juveniles could potentially be foraging on benthic invertebrates in the action area. Therefore, the WID actions, may temporarily reduce prey populations used by juvenile green, loggerheads and Kemp's ridley sea turtles. Leatherbacks, which prefer to forage on soft-bodied invertebrates such as jellyfish, could also be potentially foraging in the action area and could be temporarily disrupted by dredging. The dredging area is relatively small, and there are other foraging areas within the immediate vicinity of the action area that could be used for foraging; thus, this is not anticipated to cause substantial foraging impacts. Therefore, effects of dredging on leatherback (*Dermochelys coriacea*), Kemp's ridley (*Lepidochelys kempii*), the North Atlantic Distinct Population Segment (DPS) of green (*Chelonia mydas*), or the Northwest Atlantic DPS of loggerhead (*Caretta caretta*) sea turtles are too small to be detected and, therefore, insignificant.

Whales

Dredging can temporarily create habitat degradation which affects benthic, epibenthic, and infaunal communities which may indirectly affect marine mammals through changes to prey. WID is likely to disturb or remove at least some benthic invertebrates, such as shellfish and benthic worms. The dredging area is relatively small, and there are other foraging areas within the immediate vicinity of the action area that could be used for foraging; thus, this is not anticipated to cause substantial foraging impacts. Therefore, effects of dredging on fin whales (*Balaenoptera physalus*), North Atlantic right whales (*Eubalaena glacialis*), and sei whales (*Balaenoptera borealis*) are too small to be detected and, therefore, insignificant.

Noise

The impact to Atlantic and shortnose sturgeon from dredging equipment and the associated noise has not been well documented. However, recent studies indicate that hydraulic-cutterhead dredging does not deter adult Atlantic sturgeon from migrating to spawning habitat and had no observable effect on swim behavior (Balazik, et al., 2020). Moser and Ross (1995) concluded that Atlantic sturgeon showed no difference in habitat preference or behavior between the dredged and undisturbed areas during dredging operations, and no impact to behavior, spawning, feeding, or movement of any Atlantic sturgeon within the vicinity of active dredging operations.

Sea turtles use a range of habitats depending on their stage of development, and each habitat can be characterized by varying acoustic conditions (onshore, offshore, nesting, etc.). Little is known about reptilian hearing and the role acoustics play in the ecology of sea turtles. Juvenile and adult sea turtles spend a significant amount of time in inshore habitats where the ambient noise is higher than the offshore habitat. These inshore habitats are often highly trafficked with a constant low frequency ambient sound from shipping, recreational boating, and various other marine activities (Hawkins and Myrberg, 1983). Sea turtles have a hearing threshold of 100 – 1000 Hz (Ketten and Bartol, 2005). There is almost no data available on auditory damage thresholds for sea turtles; and it is unknown whether sea turtles are capable of regenerating sensory hair cells that are vital to hearing and balance (Warchol, 2011). Two separate studies involving caged sea turtles demonstrated clear avoidance reactions to seismic signals at levels between 166 – 179 dB (Moein et al., 1994; McCauley et al., 2000). McCauley et al. (2000) observed an alarm response from captive sea turtles with two kilometers (km) and an avoidance behavior within one km of an operating seismic vessel. Furthermore, Moein et al. (1994) observed a habituation effect where sea turtles stopped responding to the noise produced from an airgun after three presentations. Based on the above referenced studies, it is anticipated that sea turtles will avoid areas with a temporary increase in noise due to WID.

Within a noisy harbor area such as the Norfolk Harbor, ongoing exposure to underwater noise by whales may cause a masking effect such that the noise of an oncoming vessel may not be detected (Whale and Dolphin Conservation Society, 2006). Whales may often habituate to the noisy harbor and simply not respond to an oncoming vessel as they are so adapted to the sound of vessels (Whale and Dolphin Conservation Society, 2006). In addition, the noise of the dredging vessel/equipment and also the vessels in the harbor itself has an adverse effect to listed whales in the action area and may interfere with their ability to communicate and forage for prey in addition to the vessel strike risks. According to Todd et al. (2014), there are few studies on the effects of dredging on marine mammals due to dredging activities in isolation. In terms of direct effects, vessel collisions are possible, but improbable because dredges operate either in a stationary position or at low speeds. Todd et al. (2014) note that while dredging noise levels vary greatly and depend partly on the method and the material being dredged, limited data seem to indicate that dredging is unlikely to cause physiological damage to marine mammal auditory systems. They note that it is more likely to lead to temporary masking and behavioral disturbances.

In summary, we would not anticipate any substantial increase to noise from WID. If sturgeon, sea turtles, or whales were in the action area during dredging/dredged material placement operations it is anticipated they would avoid or move away from noise. All impacts would be temporary. The implementation of the WID method would be considered to have a temporary, insignificant impact on any threatened and endangered species that could be transiting the action area.

Conclusions

In consideration of the proposed alternative dredging method (WID) within the previously coordinated action area, listed species known to inhabit the project area, and the potential effects on those species, USACE Norfolk District has determined the proposed method of WID may affect, but is not likely to adversely affect: Atlantic sturgeon, shortnose sturgeon, Kemp’s ridley, green, leatherback, or hawksbill sea turtles, the Northwest Atlantic DPS of loggerhead sea turtles, fin whales, sei whales, blue whale, sperm whales, or North Atlantic right whales. New work conventional dredging (including mechanical and hopper) methods were specifically addressed in the 2018 GRR, and the 2018 NMFS Batched Biological Opinion concluded the project “may adversely affect but is not likely to jeopardize the continued existence of any DPS of Atlantic sturgeon, Kemp’s ridley or green sea turtles or the Northwest Atlantic DPS of loggerhead sea turtles and is not likely to adversely affect leatherback sea turtles, hawksbill sea turtles, shortnose sturgeon, fin whales, sei whales, blue whale, sperm whales, and North Atlantic right whales.” Additional new work dredging by means of conventional dredges will be required as part of the WID method. However, since the additional conventional dredging will be conducted within the previously coordinated action area as part of the same project and in the same manner as coordinated in the 2018 NHNIP GRR, USACE Norfolk District has determined that the conventional new work dredging portion of the proposed alternative is covered in the 2018 NMFS Batched Biological Opinion (F/NER/2018/14816) finalized on 5 October 2018 and reinitiating formal ESA consultation is not necessary. USACE Norfolk District requests NMFS concurrence with these determinations.

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