APPENDIX – M
EFH ASSESSMENT, REV 1

I-64 Hampton Roads Bridge-Tunnel Expansion Project
Hampton Roads Connector Partners
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Norfolk, VA 23502

Hampton-Norfolk, Virginia
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DOCUMENT HISTORY

Issue Date	Description	By	Revision
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M.1 INTRODUCTION

M.1.1 PROJECT OVERVIEW

The Virginia Department of Transportation (VDOT) awarded the design and construction of the Hampton Roads Bridge-Tunnel (HRBT) Expansion Project (Project) in April 2019 to Hampton Roads Connector Partners (HRCP), a design-build joint venture and the permit applicant. The Department of Transportation (DOT) Federal Highway Administration (FHWA) is designated as the lead federal agency for consultation with the National Marine Fisheries Service (NMFS) for Essential Fish Habitat (EFH) as required under Section 305(b)(2) under the Magnuson Stevens Fishery Conservation and Management Act (see April 25, 2019 letter from the U.S. Army Corps of Engineers (USACE) to Mr. Edward Sundra (FHWA), included in Appendix Q of the Joint Permit Application (JPA).

The Project will widen Interstate (I)-64 for approximately 9.9 miles along I-64 from Settlers Landing Road in Hampton, Virginia to the I-64/I-564 interchange in Norfolk, Virginia. The Project will create an eight-lane facility with six consistent use lanes. The expanded facility will include four general purpose lanes, two new High Occupancy Toll (HOT) lanes, and two new drivable (hard-running) shoulders to be used as HOT lanes during peak usage.

The Project will include full replacement of the North and South Trestle Bridges, two new parallel tunnels constructed using a Tunnel Boring Machine (TBM), expansion of the existing portal islands, and widening of the Willoughby Bay Trestle Bridges, Bay Avenue Trestle Bridges, and Oastes Creek Trestle Bridges. Also, upland portions of I-64 will be widened to accommodate the additional lanes, the Mallory Street Bridge will be replaced, and the I-64 overpass bridges will be improved. Fish habitat in the Project area includes estuarine vegetated and unvegetated wetlands and subaqueous lands. The Project will require construction of permanent and temporary trestles and bridges, temporary docks and piers, and expansion of the North and South Islands. Construction activities will include pile installation, pile removal, and the moving and stockpiling of armor stone and dredging. These activities may result in temporary (less than six months), extended temporary (greater than six months), and permanent fish habitat impacts.

M.1.2 PURPOSE

The purpose of the Project is to relieve congestion at the I-64 HRBT in a manner that improves accessibility, transit, emergency evacuation, and military and goods movement along the primary transportation corridors in the Hampton Roads region, including the I-64, I-664, I-564, and Route 164 corridors.

M.1.3 PROPOSED ACTION

The existing bridge-tunnel facility is a four-lane facility including bridges, trestles, man-made islands, and tunnels under the main shipping channel for Hampton Roads Harbor. It connects the Phoebus area of Hampton with Willoughby Spit in Norfolk. The Project will include full replacement of the North and South Trestle Bridges, two new parallel tunnels constructed using a TBM, expansion of the existing portal islands, and widening of the Willoughby Bay Trestle Bridges, Bay Avenue Trestle Bridges, and Oastes Creek Trestle Bridges. Also, upland portions of I-64 will be widened to accommodate the additional lanes, the Mallory Street Bridge will be replaced, and the I-64 overpass bridges will be improved.

M.1.3.1 PERMANENT FEATURES

M.1.3.1.1 PORTAL ISLAND EXPANSION

The existing North and South Island structures will be expanded to accommodate the new tunnels and associated structures. The North Island will be expanded by 687,447 square feet (15.78 acres). The South Island needs to be expanded by 172,143 square feet (3.95 acres). The island expansion will result in permanent loss of 19.73 acres of intertidal and subtidal benthic habitat. The existing benthic habitat in these footprints will be replaced by a variety of fill materials that will compose the area of the islands.

The footprint of the North and South Island expansion areas will be dredged to a depth of 3 feet. The footprint of the South Island expansion area will be dredged to a depth of 3 feet to 18 feet. Final dredge depth will depend on the results of the ongoing geotechnical investigation. The presence of soft sediments under South Island may require deeper dredging. This dredging will remove soft sediment, existing shoreline armor stones (where needed), and other obstructions to prepare the area for island expansion. This will result in the direct removal of benthic substrates as well as organisms living within or on the substrates.

A gravel bund (berm) will then be placed around the outer edge of the island expansion footprint. The bund is then covered in underlayment stone and then capped with larger armoring stone to create a protected perimeter around the footprint of the island expansion. The area within the protected perimeter will be filled with a variety of materials. Sand will be placed at the North Island expansion and then compacted to form the new island footprint. At the South Island expansion area, steel pipe piles will be driven to prevent settling of the structures. Sheet piles will be driven within the footprint of the area to support the excavation and construction.

M.1.3.1.2 NORTH AND SOUTH TRESTLE BRIDGES

The existing two- lane North and South Trestle Bridges will be demolished and reconstructed. The North Trestle Bridge will be replaced by two four-lane structures with approximately 75 spans of 65 to 120 feet long. Span bents will be supported by approximately 478 precast 54-inch cylindrical piles or 30-inch precast square piles.

The two existing two-lane South Trestle Bridges will also be demolished. They will be replaced by an eight-lane structure with spans up to 130 feet long. Span bents will be supported by approximately 680 precast 54-inch cylindrical piles or 30-inch precast square piles. Piles will be driven to support approximately 91 spans including portions of the Y-shaped split at the north end of the trestle bridge.

M.1.3.1.3 WILLOUGHBY, BAY AVENUE, AND OASTES CREEK TRESTLE BRIDGES

The existing Willoughby Bay Trestle Bridge structure will be modified by widening the two existing structures to the outside in both directions to accommodate new travel lanes, shoulders, and new sound barriers. This will require installation of two to three additional piles at each pier location on the outside of both structures. Approximately 350 30-inch precast square piles will be driven to support the expansion. The trestle bridges crossing Bay Avenue and Oastes Creek will be similarly expanded. Approximately 210 piles will be driven at the Bay Avenue crossing and 92 piles will be driven to support the structure at Oastes Creek.

M.1.3.2 TEMPORARY STRUCTURES

There are several temporary pile supported structures that are needed to support different components of the Project. The duration that piles will be in place varies from a few months to several years. The installation of the piles will temporarily disturb the benthic sediments in the footprint of each pile. The piles will be driven with a combination of vibratory, impact, or down-the-hole hammers.

M.1.3.3 DREDGING

In addition to the dredging required for expansion of the portal islands, dredging is also required to support construction of the permanent South Trestle Bridge and demolition of the existing structures. A total of 343,942 square feet (7.90 acres) will be dredged. The areas to be dredged have depths of less than 4.5 feet and will be dredged to allow access for Project vessels and equipment. Maintenance dredging may be performed once to maintain access during construction.

M.1.4 ALTERNATIVES CONSIDERED

During FHWA’s April 2017 Hampton Roads Crossing Study (HRCS) Final Supplemental Environmental Impact Statement (SEIS) and early design, both the Immersed Tube Tunnel (ITT) and the bored tunnel solutions were considered.

An ITT would require mechanized or hydraulic dredging of approximately 60 acres for a trench the length of the tunnel (approximately 6,300 feet). Approximately 1,200,000 cubic yards of dredge material would be removed via barge and disposed of at an offsite location. Construction of an ITT also requires extensive marine works after dredging activities. The tunnel would be divided into at least sixteen concrete segments, which would be sunk one by one for placement in the trench. Once the segments are in place, the tunnel would be covered with fill and stones to provide protection from impacts and erosion.

In comparison, a tunnel bored using a TBM underneath the sediment-water interface avoids substantial in-water impacts and provides the following advantages:

- There is no dredging required for installation of the bored tunnel, avoiding direct navigation impacts to the federal channel.

- Less disturbance to the channel and open water reduces concerns to commercial ships and military vessels, which minimize impacts on the economy, tourism, and national security as the tunnel is being constructed.
- Construction of the bored tunnel will have less impacts to aquatic resources, as compared to an ITT that requires sinking concrete segments in a dredged trench, then backfilling and covering the tunnel with stone. With the bored tunnel approach, the impacts to aquatic resources are limited to temporary works which include installation of Jet Grouting Trestles, a TBM Platform, and Conveyor Trestle. These structures will be removed after construction.
- Construction underground results in a reduction of noise, dust, and visual impacts.
- A bored tunnel creates substantially less exposure to weather risks such as wind and wave action during construction.

Furthermore, the tunnel grades, and both vertical and horizontal alignments, were selected to minimize and mitigate construction impacts and schedule risks. Most importantly, the alignments reduce impacts to the existing HRBT infrastructure. The final tunnel grades were selected because they allow:

- A reduced island expansion footprint, as compared with a berm solution (i.e., rock blanket towards the marine channel), with less environmental impact.

- Minimization of marine works in the channel, facilitating Section 408 coordination and minimized impacts to the U.S. Navy and other marine stakeholders.

- Reduced depth and extent of the tunnel approach structures (TAS), minimizing potential for settlement impacts to adjacent existing island infrastructure, and VDOT operations.

- Minimized tunnel construction risks by maintaining sufficient tunnel cover, controlling tunnel buoyancy, scour protection, and avoiding areas of poor ground conditions. This benefits the overall durability of the tunnel during its service life.

The bored tunnel alignment also reduces the amount of marine work required, minimizing impacts to marine stakeholder, and to the overall environmental impacts. The horizontal alignments were selected because they allow for:

- Locating the tunnels and TAS (TBM launch and reception shafts) away from the existing infrastructure, including the existing trestles and tunnels, to minimize impacts to VDOT infrastructure and day-to-day VDOT operations.

- Avoidance of direct impacts to the rock protection above the existing tunnels; this allows ground improvement without needing to remove the rock protection and expose the existing tunnels.

- Adequate separation between the new bored tunnels, allowing quick separation of the tunnels and avoiding unnecessary risks associated with the proximity of the two tunnels.

- Minimization of the extent of island modification work.

- Optimization of the roadway alignment and improved overall traffic flow on and off the islands.

- Consideration of local ground conditions and optimization to the extent of the ground improvement work.

After construction, the bored tunnel is expected to have reduced operational costs, future maintenance, safety, and reduced community impacts as compared to the existing ITT tunnels.

M.1.5 EXISTING HABITAT DESCRIPTION

The Project lies within Hampton Roads subbasin (HUC 02080208) and Hampton Roads watershed (HUC 0208020803), which represents the confluence of the James River and Chesapeake Bay. More specifically, the Hampton side falls within Hampton Roads-Hampton River (HUC 020802080303), the center channel is in Hampton Roads Channel (HUC 020802080304), and the Norfolk side lies in Willoughby Bay (HUC 020802080302). Hampton Roads Channel is a tidal, navigable waterbody with a heavily trafficked channel that aligns with the existing tunnels. The USACE maintains the navigable channel. There are two constructed tunnel islands adjacent to the channel. The northern tunnel parallels the Fort Monroe National Monument and the south tunnel is contiguous to Fort Wool.

The Norfolk Harbor Entrance Reach is the portion of the navigable channel that crosses the HRBT. The Norfolk Harbor Entrance Reach is approximately 1,000 to 1,400 feet wide, with a depth of 50 feet mean lower low water (MLLW). Maintained navigation channels within Project area consist of:

- Norfolk Harbor Entrance Reach (1000 to 1400 feet wide and is maintained at a depth of 50 feet MLLW)
- Hampton Creek Entrance Channel (200 feet wide and is maintained at a depth of 12 feet MLLW)
- Phoebus Channel (150 feet wide and is maintained at a depth of 12 feet MLLW)
- Willoughby Channel (200 feet wide and is maintained at a depth of 10 feet MLLW).

The Norfolk Harbor Entrance Reach and the Norfolk Harbor Reach are authorized to be deepened to -55 feet MLLW.

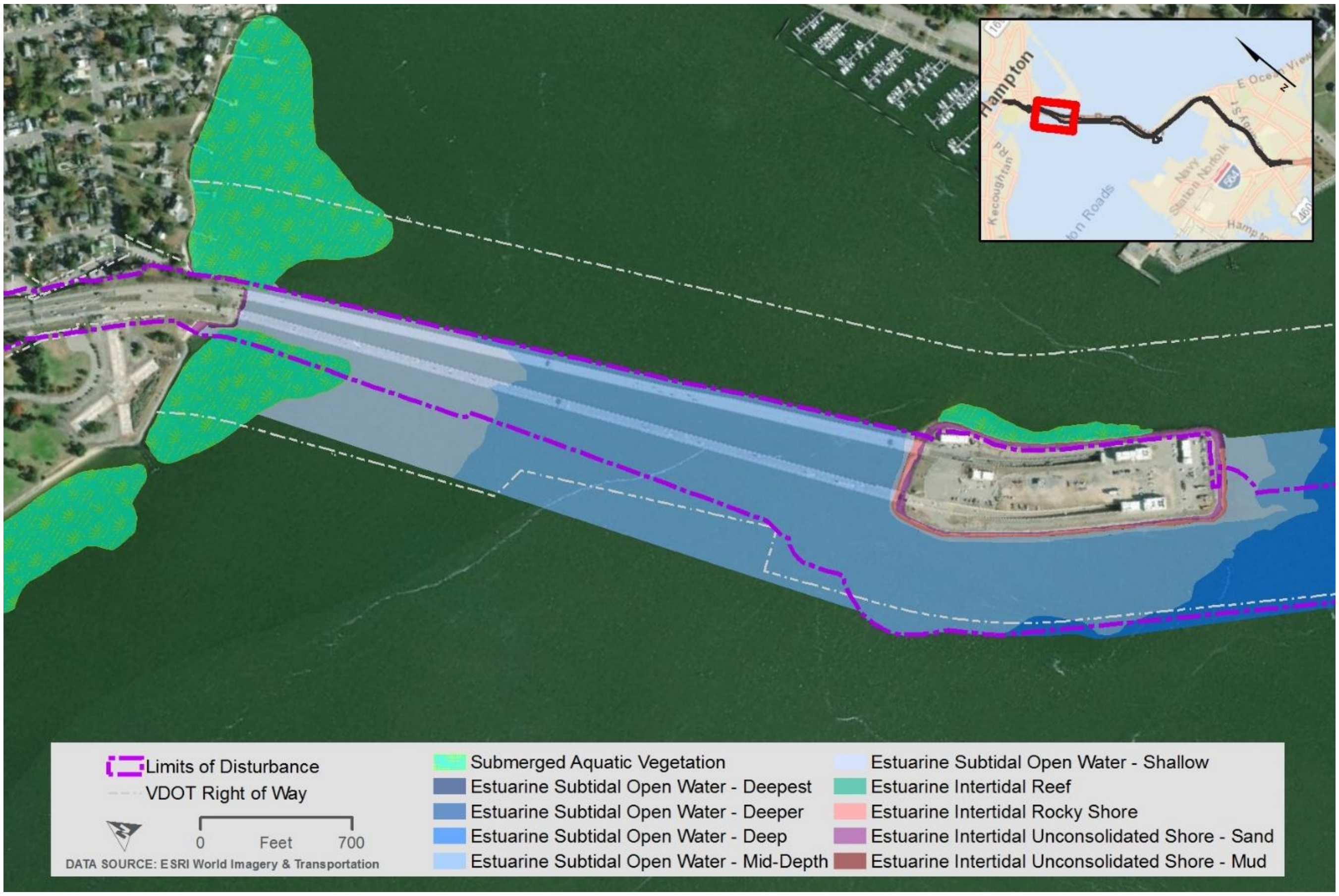
In 2018, a site-specific survey was conducted to characterize sediment composition and the benthic community within and adjacent to the proposed area of disturbance (Wong et al. 2018). Sediments are mostly fine and medium sands with various amounts of coarse sand and gravel, and low organic carbon content. The sediments generally are coarser in the northern portions of the Project area and finer in the southern. In the Fort Wool Cove, sediments are fine and very fine sands with various amounts of silt and clay. There is no naturally occurring rocky or cobble bottom present at or adjacent to the Project area. There are areas of intertidal rock located around the existing portal islands and where the bridge trestles make landfall. This intertidal rock is not naturally occurring and was placed as shoreline protection. The rocky intertidal zone is dominated by barnacles and amphipods, and the inner tip of the North Island exhibited high density and biomass of oysters and mussels. The rocky subtidal zone was covered by a dense canopy of algae that provided habitat for numerous species of amphipods. Sponges, anemones, amphipods, gastropods, and bryozoans are common in the rocky subtidal. Soft bottom substrate in the Project area is dominated by polychaetes and amphipods, with oligochaetes especially abundant in coarser sediments. High densities of polychaetes were recorded along the south bridge and inner (bridge side) tip of the south portal island.

Benthic community health was based on Chesapeake Bay Benthic Index of Biotic Integrity (B-IBI) values calculated as part of a site-specific benthic community survey (Weisberg et al. 1997; Wong et al. 2018). Among the 48 sites sampled during the 2018 survey, 32 sites (67%) met Chesapeake Bay Program Benthic Restoration Goals and 16 (33%) failed the goals. Of the 16 sites that failed, eight were classified as marginal, three were classified as degraded, and five were classified as severely degraded. Sites were classified as “degraded” or “severely degraded” because of low abundance and biomass overall, low abundance of deep-deposit feeding organisms, low abundance of pollution-sensitive organisms, and/or high biomass of pollution-indicative organisms.

Clam habitat occurs throughout the Project area. All the substrate in Hampton Roads is suitable clam habitat, which is composed of sand, mud, or a combination of both. A 2018 shellfish survey, identified low densities of hard clams (*Mercenaria mercenaria*) throughout the Project area. Throughout the sampled regions, clam densities were <0.3 clams/square meters (m^2), comparable to or less than 2001-2002 clam densities for the same region and below that generally targeted by for commercial fishing (typically ~1.00 – 8.00 clams/m^2). The observed 2018 clam densities and size distributions are not indicative of regular clam recruitment (Virginia Institute of Marine Sciences (VIMS) 2018). Additionally this study did not find evidence of wide spread presence of oysters within the sampled area or evidence of oyster reefs. Due to the presence of active wastewater outfalls, the Project area is also within a Virginia Department of Health Condemnation zone for shellfishing, which among other things, requires harvested shellfish to be transported to a depuration zone for 15 days prior to sale.

There is documented submerged aquatic vegetation (SAV) located near the shores on the Hampton side and along the east side of the North Island (Figure M-1). Species of SAV most commonly found in the Chesapeake Bay and its tributaries, within the vicinity of the Project area, include eelgrass (*Zostera marina*) and widgeon grass (*Ruppia maritima*). Other species, less likely to occur due to their association with freshwater and lower salinity levels, include wild celery (*Vallisneria americana*), hydrilla (*Hydrilla verticillata*), redhead grass (*Potamogeton perfoliatus*), sago pondweed (*Stuckenia pectinata*), and Eurasian watermilfoil (*Myriophyllum spicatum*). SAV provides food and shelter for shellfish and fish, particularly juveniles and small prey species. Additionally, SAV increase water quality by providing oxygen, filtering and trapping sediment, and absorbing nutrients like phosphorus and nitrogen (United States Fish and Wildlife Service (USFWS) 2011).

Figure M-1: Submerged Aquatic Vegetation Within the Project Area



There are both tidal and non-tidal wetlands within the Project area. Tidal vegetated wetlands are located primarily near tidal tributaries such as John's Creek, Oastes Creek, and Mason Creek. These tidal vegetated wetlands offer protection, shelter, and food for invertebrates and small fish. Additionally, these wetlands filter runoff and sedimentation from upland areas. Tidal non-vegetated wetlands consisting of intertidal sand or rocky shore are found around the tunnel islands and on both the Hampton and Norfolk shores of the James River. Mudflats within the Project area are confined to the I-64 cloverleaf at Mallory Street along John's Creek.

Temperature and salinity vary seasonally. Temperature in the water column is well-mixed in spring and winter due to larger turbulence mixing and weaker surface heating and stratified in the summer-fall, primarily due to solar heating. Overturning occurs during fall as the surface water becomes progressively cooler and eventually colder than the bottom water. The surface salinity over the navigational channels is slightly lower than that over the adjacent shoals, enhancing the 2-layer gravitational circulation there. The average bottom-surface salinity difference is 2-5 practical salinity units (PSU) over the Norfolk Harbor Entrance Reach Channel. Salinity stratification is the strongest in the channel, and the range of salinity in the Project area is 20-30 PSU. Salinity is lower during March to May and increases in the summer and early fall.

Section 305(b) of the Clean Water Act (CWA) requires each state to submit a biennial report to the United States Environmental Protection Agency (USEPA) describing the water quality of its surface waters (VDOT and FHWA 2016, 2017). The 305(b) report assesses six primary designated uses, as appropriate for a particular waterbody, based upon the state's Water Quality Standards. The primary uses include:

- Aquatic Life Use – supports the propagation, growth, and protection of a balanced indigenous population of aquatic life that may be expected to inhabit a waterbody.
- Recreation Use – supports swimming, boating, and other recreational activities.
- Fish Consumption Use – supports game and marketable fish species that are safe for human health.
- Shellfishing Use – supports the propagation and marketability of shellfish (clams, oysters, and mussels).
- Public Water Supply Use – supports safe drinking water.
- Wildlife Use – supports the propagation, growth, and protection of associated wildlife.

Virginia's Water Quality Standards (9 VAC 25.260) define the water quality needed to support each of these uses by establishing numeric physical and chemical criteria. If a waterbody fails to meet the Water Quality Standards, it would not support one or more of its designated uses as described above. These waters are considered to be impaired and placed on the 303(d) list as required by the CWA.

Once a waterbody has been identified as impaired due to human activities and placed on the 303(d) list, the Virginia Department of Environmental Quality (VDEQ) is required to develop a Total Maximum Daily Load (TMDL) for the parameters that do not meet state water quality standards. The TMDL is a reduction plan that defines the limit of a pollutant(s) that a waterbody can receive and still meet water quality standards. A TMDL implementation plan, including Waste Load Allocations (WLA), is developed by VDEQ once the TMDL is approved by USEPA. The ultimate goal of the TMDL Implementation Plan is to restore the impaired waterbody and maintain its water quality for its designated uses.

Table M-1: List of Impaired Waterbodies in the Project Area

Waterbody	Designated Use	Impairment
James River – Hampton Roads	Aquatic Life	**Chlorophyll-a, Nutrient/Eutrophication Biological Indicators**
	Fish Consumption	**Polychlorinated Biphenyl (PCB) in Fish Tissue**
Willoughby Bay (Less Beach Area)	Fish Consumption	**PCB in Fish Tissue**
Willoughby Bay (Beach Area)	**Recreation**	**PCB in Fish Tissue**

M.2 ESSENTIAL FISH HABITAT WITHIN THE PROJECT AREA

M.2.1 OVERVIEW

The Project area is at the mouth of the James River in the lower Chesapeake Bay. Species with EFH in the Project area were identified using the EFH mapper (NMFS 2019) and the Greater Atlantic National Oceanic and Atmospheric Administration (NOAA) Guide to EFH Designations in the Northeastern United States 10 minute squares (NOAA 2019a). The Project area lies within three 10 feet x10 feet squares as show in Table M-2 and Figure M-2 below.

Table M-2: 10 Minute EFH Squares

Square Number	Square Description	North	East	South	West
1	James River south of Fort Monroe, including Willoughby Bay	37° 00.0` N	76° 10.0` W	36° 50.0` N	**76° 20.0` W**
2	Northern bank of James River, including Fort Monroe	37° 10.0` N	76° 10.0` W	37° 00.0` N	**76° 20.0` W**
3	**James River including Craney Island and mouths of** Elizabeth and Nansemond River	**37° 00.0` N**	**76° 20.0` W**	**36° 50.0` N**	**76° 30.0` W**

Figure M-2: 10-minute EFH Squares

Based on the above information, the following federally-managed species have EFH for various life stages within the Project area and were noted to be in the general Project area with varying seasonality:

- Black Sea Bass (*Centropristis striata*)
- Bluefish (*Pomatomus saltatrix*)
- Atlantic Butterfish (*Peprilus triacanthus*)
- Summer Flounder (*Paralichthys dentatus*)
- Sandbar Shark (*Carcharhinus plumbeus*)
- Sand Tiger Shark (*Carcharias taurus*)
- Little Skate (*Leucoraja erinacea*)
- Atlantic Herring (*Clupea harengus*)
- Red Hake (*Urophycis chuss*)
- Winter Skate (*Leucoraja ocellata*)
- Clearnose Skate (*Raja eglanteria*)
- Windowpane Flounder (*Scophthalmus aquosus*)
- Red Drum (*Sciaenops occelatus*)
- Dusky Shark (*Carcharhinus obscurus*)
- Spanish Mackerel (*Scomberomorus maculatus*)
- King Mackerel (*Scomberomorus cavalla*)
- Cobia (*Rachycentron canadum*)
- Scup (*Stenotomus chrysops*)
- Atlantic Sharpnose Shark (*Rhizopriondon terraenovae*)

Table M-3 provides the characteristics of the EFH for these species as well as a characterization of the level of impact anticipated to be produced by Project activities. The potential impacts are described in detail in sections M.3 to M.5 below.

Table M-3: Designated EFH Descriptions, Associated Fish Species Occurrence within the Project Area, and Characterization of Effects Produced by Project Activities.

Species	Life Stage*	EFH Characteristics					Level of Impact
		Salinity (ppt)	Temp (°F)	Depth (feet)	Habitat Type	Presence in Project Area+	
Atlantic Butterfish[1] (*Peprilus triacanthus*)	Egg*	UN	43–71	650–5,000	Pelagic waters: estuaries and embayments	June-July	Minor short-term direct.
	Larvae*	UN	47–71	135–1,150	Pelagic waters: estuaries and embayments	July-August	Minor short-term direct.
	Juvenile*	> 5	43–81	32–920	Pelagic waters: estuaries and embayments	July-October	Minor short-term direct.
	Adult*	> 5	40–82	32–1820	Pelagic waters: estuaries and embayments. sand and mud	May-November	Short- and long-term direct.
	Spawning Adult	UN	> 59	UN	UN	June-July	UN
Atlantic Herring[2, 15] (*Clupea harengus*)	Juvenile*	UN	37-72	< 984	Pelagic waters: typically estuaries and bays	March-May	Minor short-term direct to none
	Adult*	> 25	< 50	< 328	Pelagic waters: typically estuaries and bays	December-May	Minor short-term direct.
Black Sea Bass[3, 14] (*Centropristus striata*)	Juvenile*	> 18	> 43	UN	Demersal waters: estuaries; found in association with rough bottom, shellfish and eelgrass beds	April-September	Short- and long-term direct.
	Adult*	30-35	48-53	UN	Demersal waters; estuaries; structured habitats (natural and man-made: wrecks, pilings, buoys, jetties), sand and shell	April-September	Minor short-term direct impact. Direct beneficial due to placement of artificial reef.
Bluefish[4, 13] (*Pomatomus saltatrix*)	Juvenile*	> 35	64-71	UN	Pelagic	June-October	Minor short-term direct impact to pelagic habitats.
	Adult*	> 25	57-60	UN	Pelagic	May-October	Minor short-term direct impact to pelagic habitats.

Species	Life Stage*	EFH Characteristics: Salinity (ppt)	Temp (°F)	Depth (feet)	Habitat Type	Presence in Project Area+	Level of Impact
Cobia[5, 20, 22] (*Rachycentron canadum*)	Egg*	UN	UN	UN	UN	June-August	UN
	Larvae*	UN	UN	UN	UN	June-August	UN
	Juvenile*	UN	UN	UN	UN	UN	UN
	Adult*	> 25	> 68	< 39	Pelagic: sandy shoals of capes and offshore bars, high profile rock bottoms, high salinity bays, estuaries, and seagrass habitat, shade of wrecks, buoys and pilings	May-October	Short- and long-term direct impacts.
	Spawning Adult	UN	UN	UN	UN	June-August	UN
King Mackerel[5, 18] (*Scomberomorus cavalla*)	Egg*	UN	UN	UN	UN	UN	UN
	Larvae*	UN	UN	UN	UN	UN	UN
	Juvenile*	UN	UN	UN	UN	UN	UN
	Adult*	> 25	> 68	UN	Pelagic: sandy shoals of capes and offshore bars, high profile rocky bottom, high salinity bays, estuaries and seagrass habitats	June-October	Short- and long-term direct ..
	Spawning Adult	UN	UN	UN	UN	July-September	UN
Red Drum[6] (*Sciaenops occelatus*)	Egg*	UN	UN	UN	UN	UN	UN
	Larvae*	UN	UN	UN	Pelagic: estuaries	June-September	Minor short-term direct.
	Juvenile*	UN	UN	UN	Pelagic: estuaries; seagrass beds, shallow areas of estuarine rivers and mainland shorelines	May-November	Minor short- and long-term direct.
	Adult*	UN	UN	Shoreline to 164	Pelagic: estuaries; flooded saltmarshes, brackish marsh, tidal creeks; estuarine scrub/shrub (mangrove fringe);	May-October	Minor short-term direct.

Species	Life Stage*	EFH Characteristics: Salinity (ppt)	Temp (°F)	Depth (feet)	Habitat Type	Presence in Project Area+	Level of Impact
					submerged rooted vascular plants (seagrasses); oyster reefs and shell banks; unconsolidated bottom (soft sediments); ocean high salinity surf zones; and artificial reefs		
	Spawning Adult	UN	UN	UN	UN		UN
Red Hake[2, 11] (*Urophycis chuss*)	Juvenile*	> 25	35-71	< 262	Benthic: estuaries and bays; mud and sand substrates	February-April	Short- and long-term direct.
	Adult*	> 25	UN	65-2,460	Shell beds, soft sediments (mud and sand), and artificial reefs	February-April	Short- and long-term direct. Long term direct benefit from placement of artificial reef material.
Scup[3, 12] (*Stenotomus chrysops*)	Egg	> 15	55-73	< 98	Pelagic: estuaries		Minor short-term direct.
	Larvae	> 15	55-73	< 66	Pelagic: estuaries		Minor short-term direct.
	Juvenile*	> 15	> 45	0-125	Benthic: estuaries and bays; sand, mud, mussel and eelgrass bed type substrates	May-October	Short- and long-term direct.
	Adult*	> 15	> 45	0-607	Benthic: estuaries	April-October	Short- and long-term direct.
	Spawning Adult	15	48-75	< 98	Weedy to sandy substrates		Short- and long-term direct.
Spanish Mackerel[5, 18] (*Scomberomorus maculatus*)	Egg*	UN	UN	UN	UN		UN
	Larvae*	UN	UN	UN	UN		UN
	Juvenile*	UN	UN	UN	UN		UN
	Adult*	> 30	> 68	UN	Pelagic: sandy shoals of capes and offshore bars, high profile rocky bottom		Short- and long-term direct.

Species	Life Stage*	EFH Characteristics: Salinity (ppt)	Temp (°F)	Depth (feet)	Habitat Type	Presence in Project Area+	Level of Impact
	Spawning Adult	UN	UN	UN	UN		UN
Summer Flounder[3] (*Paralicthys dentatus*)	Egg	UN	UN	30-360	Pelagic		UN
	Larvae*	0.5–25	UN	30-230	Pelagic: estuaries	January-April	Minor short-term direct.
	Juvenile*	10–30	> 37	UN	Demersal waters: salt marsh creeks, seagrass beds, mudflats, and open bay areas	July-November	Short- and long-term direct.
	Adult*	UN	UN	Shore to 500	Demersal waters; shallow coastal and estuaries	April-October	Short- and long-term direct.
	Spawning Adult	UN	UN	UN	UN		UN
Windowpane Flounder[3, 16] (*Scopthalmus aquosus*)	Egg	UN	42-68	< 229	Pelagic: bays and estuaries		Minor short-term direct.
	Larvae	UN	37-66	< 229	Pelagic: bays and estuaries		Minor short-term direct.
	Juvenile*	0.5–25	39-75	< 200	Benthic: estuaries and bays; mud and sand substrates	April-October	Short- and long-term direct.
	Adult*	0.5–25	< 80	< 230	Benthic: estuaries and bays; mud and sand substrates	April-October	Short- and long-term direct.
	Spawning Adult	UN	UN	UN	UN		UN
Clearnose Skate[2, 8] (*Raja eglanteria*)	Juvenile*	0.5–25	46-75	shoreline to 100	Benthic: mud and sand, but also on gravelly and rocky bottom	June-November	Short- and long-term direct.
	Adult*	0.5–25	46-75	shoreline to 131	Benthic: mud and sand, but also on gravelly and rocky bottom	June-November	Short- and long-term direct.
Little Skate[2, 7, 10] (*Leucoraja erinacea*)	Egg	UN	45	< 88	Benthic: egg deposited on the bottom.		Short- and long-term direct.
	Larvae	UN	UN	UN	UN		UN
	Juvenile	0.5-25	33-70	< 262	Benthic: sand and gravel substrates, but they are also found on mud		Short- and long-term direct.

Species	Life Stage*	EFH Characteristics Salinity (ppt)	Temp (°F)	Depth (feet)	Habitat Type	Presence in Project Area+	Level of Impact
	Adult*	0.5–25	33-70	< 328	Benthic: sand and gravel substrates, but they are also found on mud		Short- and long-term direct.
	Spawning Adult	UN	UN	UN	UN		UN
Winter Skate[2, 9, 19] (*Leucoraja ocellata*)	Juvenile	0.5–25	35-59	< 295	Benthic: sand and gravel substrates, but they are also found on mud		Short- and long-term direct.
	Adult*	0.5–25	35-59	< 262	Benthic: sand and gravel substrates, but they are also found on mud		Short- and long-term direct.
Atlantic Sharpnose Shark[7] (*Rhizopriondon terraenovae*)	Neonate/YOY	UN	UN	UN	UN		UN
	Juvenile	UN	UN	UN	Pelagic: bays and estuaries		Minor short-term direct.
	Adult*	UN	UN	UN	Pelagic: bays and estuaries		Minor short-term direct.
	Spawning Adult	UN	UN	UN	UN		UN
Dusky Shark[7] (*Carcharhinus obscurus*)	Neonate/YOY*	25–35	64-72	14-51	Pelagic		Minor short-term direct.
	Juvenile*	UN	UN	< 65	Pelagic		Minor short-term direct.
	Adult	UN	UN	65-6560	Pelagic		Minor short-term direct.
	Spawning Adult	UN	UN	UN	UN		UN
Sandbar Shark[7, 17] (*Carcharhinus plumbeus*)	Neonate/YOY*	15–35	59–86	2–75	Benthic: estuaries; sand, mud, shell, and rocky sediments		Short- and long-term direct.
	Juvenile*	15–35	59–86	2–75	Benthic: estuaries; sand, mud, shell, and rocky sediments		Short- and long-term direct.
	Adult*				Coastal waters: in harbors, bays and the mouths of rivers, smooth, sandy bottoms		Short- and long-term direct.

Species	Life Stage*	EFH Characteristics: Salinity (ppt)	Temp (°F)	Depth (feet)	Habitat Type	Presence in Project Area+	Level of Impact
	Spawning Adult	UN	UN	UN	UN		UN
Sand Tiger Shark[7, 21] (*Carcharias taurus*)	Neonate/YOY*	23–30	66-77	9–23	Benthic: sand and mud areas		Short- and long-term direct.
	Juvenile*	UN	UN	UN			UN
	Adult*	UN	62-75	> 625	Benthic: near the floor of bays		Short- and long-term direct.

Key: UN = Unknown; ppt = part per thousand; °F = degrees Fahrenheit; YOY = Young of Year

**EFH is designated Project area*

+Presence in the Project area was taken from Stone et al. 1994 (Chesapeake Bay mainstem or James River, Rare or Common Abundance) where available. See also other sources.

Sources: [1]Mid-Atlantic Fishery Management Council (MAFMC) 2011; [2]New England Fishery Management Council (NEFMC) 2017; [3]MAFMC 1998a; [4]MAFMC 1998b; [5]Struever Fidelco Cappelli, LLC 2007; [6]NOAA 2019b [7]National Marine Fisheries Service Office of Sustainable Fisheries 2017; [8]Packer et al. 2003a; [9]Packer et al. 2002b; [10]Packer et al. 2003c; [11]Steimle et al. 1999a; [12]Steimle et al. 1999c; [13]Fahay et al. 1999; [14]Steimle et al 1999b: [15]Reid et al. 1999: [16]Chang et al. 1999; [17]Chesapeake Bay Program 2019a; [18]Chesapeake Bay Program 2019b; [19]Virginia Institute of Marine Science 2019a; [20]Chesapeake Bay Program 2019c; [21]National Aquarium 2018; [22]Brown-Peterson et al. 2001.

M.2.1.1 ATLANTIC HERRING

Atlantic Herring, a pelagic schooling fish species, occurs in the lower Chesapeake Bay from December to May (Table M-2) (Stone et al. 1994; New England Fishery Management Council [NEFMC] 2017). Adults make extensive seasonal migrations between the summer and fall spawning grounds off New England (NEFMC 2017). Juvenile and adult Atlantic Herring are the only life stages with EFH designated in the Chesapeake Bay (Table M-2). Estuaries and embayments are their preferred habitat. Atlantic Herring prey on copepods (Reid et al. 1999).

M.2.1.2 ATLANTIC BUTTERFISH

Butterfish, a pelagic fish species, are found in the lower Chesapeake Bay between the months of May to November, before migrating to warmer waters with the onset of winter (Table M-2) (Stone et al. 1994). Atlantic Butterfish form large schools across the continental shelf and into large brackish estuaries; over sand/mud bottoms (Mid-Atlantic Fishery Management Council (MAFMC) 2011). Egg, larva, juvenile, and adult life stages have EFH designated in the Chesapeake Bay (Table M-2). Juvenile Butterfish prey upon plankton while adults prey on crustaceans, squid, and fish (Cross et al. 1999).

M.2.1.3 BLACK SEA BASS

Black Sea Bass visit the lower Chesapeake Bay from April to September (Table M-3) (Stone et al. 1994). Black Sea Bass are a demersal, coastal fish species that are most often found in sand and rocky areas around wrecks, pilings, buoys, jetties, and other structures of estuaries (Table M-3) (MAFMC 1998a). Black Sea Bass migrate seasonally to warm waters and leave the Chesapeake Bay in winter for southern offshore waters. Juveniles are found in association with rough bottom, shellfish and eelgrass beds, and vegetated areas and enter the Chesapeake Bay during spring, summer and fall (MAFMC 1998a). Juvenile and adult Black Sea Bass are the only life stages that have EFH designated in the Chesapeake Bay (Table M-2). Juvenile Black Sea Bass prey on small benthic crustaceans and adults feed on invertebrates (crustaceans, including juvenile American Lobster (*Homarus americanus*), small fish, pelagic squid, and baitfish) (Steimle et al. 1999b).

M.2.1.4 BLUEFISH

Bluefish, a large, pelagic schooling fish, occur in the open waters of the Chesapeake Bay from May to October (Table M-2) (MAFMC 1998b). They are abundant in the lower Bay, but also common most years in the upper Bay as far north as Baltimore. In early fall, Bluefish migrate out of the Chesapeake Bay to spend the winter in warmer waters off the Florida coast. Juvenile and adult Bluefish are the only life stages that have EFH designated in the Chesapeake Bay (Table M-3). Bluefish juveniles and adults eat locally abundant fish such as Atlantic Silverside (*Menidia menidia*), clupeids, Striped Bass (*Morone saxatilis*), and Bay Anchovy (*Anchoa mitchilli*) (Fahay et al. 1999).

M.2.1.5 COBIA

Cobia, a large, long pelagic fish, occur in the lower Chesapeake Bay's open waters from May to October (Table M-2). Cobia are often found in the shade of wrecks, buoys and pilings of sandy shoals of capes and offshore bars, high profile rock bottoms, high salinity bays, estuaries, and seagrass habitats (Struever Fidelco Cappelli, LLC 2007). Cobia move as far north as Tangier Sound and the mouth of the Potomac River and around October, migrate out of the Bay to warmer southern waters near the Florida Keys (Chesapeake Bay Program 2019c). Egg, larva, juvenile, and adult life stages have EFH designated in the Chesapeake Bay (Table M-2). This species feeds mostly on crabs, shrimp, squid, and smaller fish (Chesapeake Bay Program 2019c).

M.2.1.6 FLOUNDERS: SUMMER FLOUNDER AND WINDOWPANE FLOUNDER

Two species of flounder have EFH in the Chesapeake Bay: Summer Flounder and Windowpane Flounder (Table M-2).

Summer Flounder, a demersal species, visit the middle and lower Chesapeake Bay from spring through fall. Adult Summer Flounder prefer shallow coastal waters and estuaries; whereas, juveniles prefer salt marsh creeks, seagrass beds, mudflats, and open bay area habitats (Table M-2) (MAFMC 1998a). Larvae, juvenile, and adult Summer Flounder are the only life stages with EFH in the Chesapeake Bay (Table M-2). Summer Flounder feed on shrimp, squid, worms, crustaceans, and other fish (MAFMC 1998a).

Windowpane Flounder, also a demersal species, visit the Chesapeake Bay between April and October (Table M-2). Windowpane Flounder are found mainly in mud and sand substrates in estuaries and bays (Chang et al. 1999). As water temperatures decrease, both species usually migrate offshore for winter. Juvenile and adult Windowpane Flounder are the life stages that have EFH in the Chesapeake Bay (Table M-3). Windowpane Flounder feed on small crustaceans and various fish larvae (Chang et al. 1999).

M.2.1.7 MACKERELS: KING MACKEREL AND SPANISH MACKEREL

Two species of mackerel have EFH designated in the Chesapeake Bay: Spanish Mackerel and King Mackerel (Table M-2).

Mackerel, pelagic, fast-swimming fish with elongated bodies, occur in the Chesapeake Bay from spring through fall while migrating along the Atlantic coast (Chesapeake Bay Program 2019b). Spanish Mackerel migrate from Florida to the Chesapeake Bay in spring, entering the Bay by May and leaving in fall to return to Florida. Spanish Mackerel are found in the middle and lower Bay, in sandy shoals of capes and offshore bars, high profile rocky bottom habitat, and are most common along Virginia’s western shore and extending at least to the Patuxent River (Table M-2) (Struever Fidelco Cappelli, LLC. 2007).

King Mackerel occasionally visit the lower Chesapeake Bay between June and October (peaking in September) while migrating along the Atlantic coast. King Mackerel prefer sandy shoals of capes and offshore bars, high profile rocky bottoms, high salinity bays, estuaries, and seagrass habitats (Struever Fidelco Cappelli, LLC 2007).

Egg, larva, juvenile, and adult life stages for Spanish and King Mackerels have EFH designated in the Chesapeake Bay (Table M-2). Spanish and King Mackerels feed on Menhaden and anchovies (Chesapeake Bay Program 2019b).

M.2.1.8 RED DRUM

Red Drum occur in the lower Chesapeake Bay from May to November (Chesapeake Bay Program 2019d) (Table M-2). Adults are most common near the mouth of the Chesapeake Bay during spring and fall, when the coastal population migrates. Juveniles move up the Bay as far north as the Patuxent River. Adults are most often found near the shoreline; juveniles are common in the Bay's shallows. Red Drum can be found in estuaries, flooded saltmarshes, brackish marsh, tidal creeks, estuarine scrub/shrub (mangrove fringe), submerged rooted vascular plants (seagrasses), oyster reefs and shell banks, unconsolidated bottom (soft sediments), ocean high salinity surf zones, and artificial reef habitats (NOAA 2019b). Egg, larva, juvenile, and adult life stages have EFH designated in the Chesapeake Bay (Table M-2). The Red Drum feeds on smaller fish, crabs, and shrimp (Chesapeake Bay Program 2019d).

M.2.1.9 RED HAKE

Red Hake are demersal and generally observed in coastal waters ranging from approximately 16.5 feet to 985 plus feet depth and 35 to 72°F (Steimle et al. 1999a). Major habitat requirements for Red Hake include substrate and temperature. Juveniles are pelagic for several weeks before transitioning to demersal habitats, which are more typical of adults. Red Hake are often found over muddy bottoms that feature depressions, which are utilized as shelter. The species has been observed in the mainstem of the Chesapeake Bay during the winter and early spring; however, during the summer the species migrates offshore. Egg, larva, juvenile, and adult life stages of Red Hake have EFH in the Chesapeake Bay (Table M-2). Juvenile and adult Red Hake feed on crustaceans, fish, and squid (Steimle et al. 1999a).

M.2.1.10 SCUP

Scup are demersal fish that prefer hard-bottom areas and submerged structures and occur in the lower Chesapeake Bay in May through October (Table M-2). Juveniles and adults first appear in the Bay in late May to June and by July and August are distributed throughout the lower Bay and by October they have begun their offshore migration (Steimle et al. 1999c). Juvenile Scup eat amphipods, polychaetes, copepods, and other small crustaceans (Steimle et al. 1999c). Juvenile and adult life stages have EFH designated in the Chesapeake Bay (Table M-2). Adult Scup feed on a variety of prey, including small crustaceans, polychaetes, mollusks, small squid, vegetable detritus, insect larvae, hydroids, sand dollars, and small fish (Steimle et al. 1999c).

M.2.1.11 SHARKS: ATLANTIC SHARPNOSE SHARK, SANDBAR SHARK, DUSKY SHARK, AND SAND TIGER SHARK

Four species of sharks have EFH designated in the Chesapeake Bay: Atlantic Sharpnose Shark, Sandbar Shark, Dusky Shark, and Sand Tiger Shark (Table M-3).

The Atlantic Sharpnose Shark inhabits coastal areas, although it is sometimes found offshore, and occurs in the lower Chesapeake Bay during the summer (Table M-3). They are considered an infrequent and rare visitor to the lower Bay (Chesapeake Bay Program 2019e). During the summer, mature males are found in Virginia waters but are rarely seen inside Chesapeake Bay (VIMS 2019b).

Adults are the only life stage that has EFH designated in the Chesapeake Bay (Table M-2). Atlantic Sharpnose Sharks feed on invertebrates, squid and shrimp, and all fish (VIMS 2019b).

The Sandbar Shark is the most common shark found in the Chesapeake Bay. This species is a subtropical and warm temperate water species found in harbors, bays and the mouths of rivers, preferring protected waters and smooth, sandy bottoms (Table M-2) (NMFS Office of Sustainable Fisheries 2017; Chesapeake Bay Program 2019a). The Sandbar Shark occurs in the lower Chesapeake Bay from June through September. Important nursery and pupping grounds have been identified in shallow areas of the lower Chesapeake Bay and have been designated as a Habitat Area of Particular Concern (HAPC) (NMFS Office of Sustainable Fisheries 2017). Larva, juvenile, and adult life stages have EFH designated in the Chesapeake Bay (Table M-2). Adult Sandbar Sharks feed on fish and invertebrates, while juveniles feed on blue crabs (*Callinectes sapidus*) (Chesapeake Bay Program 2019a).

The Sand Tiger Shark is a large, coastal species found in tropical and warm temperate waters and is known to occur in the lower Chesapeake Bay from June to September, dwelling near the floor of the Bay (National Aquarium 2018). Important nursery and pupping grounds have identified for this species in shallow areas of the lower Chesapeake Bay and has been designated as HAPC (NMFS Office of Sustainable Fisheries 2017). Larva, juvenile, and adult life stages have EFH designated in the Chesapeake Bay (Table M-3). The Sand Tiger Shark feeds on bony fish (National Aquarium 2018).

The Dusky Shark is a large pelagic species which inhabits warm and temperate continental waters throughout the Atlantic and occurs infrequently in the lower Chesapeake Bay during the summer months (Chesapeake Bay Program 2019e). This migratory species moves north-south with the seasons and can be found from inshore waters to the outer reaches of continental shelves (NMFS Office of Sustainable Fisheries 2017). Larva and juvenile are the only life stages that have EFH designated in the Chesapeake Bay (Table M-2). Dusky Sharks feed on crustaceans, mollusks, fish, rays, and other sharks (National Marine Fisheries Service Office of Sustainable Fisheries 2017).

M.2.1.12 SKATES: CLEARNOSE SKATE, LITTLE SKATE, AND WINTER SKATE

Three species of skates can be found in the lower Chesapeake Bay: Clearnose Skate, Little Skate, and Winter Skate (Table M-2).

The Clearnose Skate occurs in the lower Chesapeake Bay from May to November (NEFMC 2017). The species inhabits the western Atlantic coast from Massachusetts to Florida and is found in mud and sand, but also on gravelly and rocky bottom substrates (Packer et al. 2003a). Juvenile and adult Clearnose Skate are the only life stages that have EFH in the Chesapeake Bay (Table M-2). Clearnose Skate feed on polychaetes, amphipods, mysid shrimps (Packer et al. 2003a).

The Little Skate occurs in the lower Chesapeake Bay from May through November (Stone et al. 1994). The species is observed over sand, gravel, and muddy bottoms of inshore waters of estuaries and embayments (NEFMC 2017) along the eastern sea board of North America from Nova Scotia to Cape Hatteras (Packer et al. 2003c). Juvenile and adult life stages of Little Skate have EFH in the Chesapeake Bay (Table M-2). Little Skates feed on crustaceans and amphipods (Packer et al. 2003c).

The range of the Winter Skate extends along the eastern sea board of North America from the Gulf of St. Lawrence to Cape Hatteras. The Winter Skate occurs in the lower Chesapeake Bay from November-April (Packer et al. 2003b). The species is often observed on sand and gravel substrates of inshore waters of estuaries and embayments (NEFMC 2017). The species appears to migrate inshore during the autumn and offshore to deeper waters in the summer. Juvenile and adult life stages of Winter Skate have EFH in the Chesapeake Bay (Table M-2). Winter Skate feed on polychaetes and amphipods (Packer et al. 2003b).

M.2.2 ANADROMOUS FISH

There are a number of anadromous fish known to inhabit the Chesapeake Bay (i.e., fish that spend the majority of their lives in marine environments and migrate to freshwater for spawning). Species of anadromous fish that migrate through the Project area include: Striped Bass, Shad, River Herrings, which are not federally-managed, and Atlantic Sturgeon (*Acipenser oxyrhynchus*). Atlantic Sturgeon are protected under the federal Endangered Species Act (ESA) and are discussed in Appendix I.

Hampton Roads, at the HRBT crossing, is a Confirmed Anadromous Fish Use Area. Six anadromous fish species: Alewife (*Alosa pseudoharengus*), American Shad (*Alosa sapidissima*), Blueback Herring (*Alosa aestivalis*), Hickory Shad (*Alosa mediocris*), Striped Bass, and White Perch (*Morone Americana*), use this area to migrate between the Chesapeake Bay and spawning grounds in the James River (Table M-4). The Project area lies within an important passage for anadromous fish; however, the majority of spawning occurs upstream of the Project. The anadromous fish time-of-year restriction (TOYR) for fishing exempts the James River below the Route 17 crossing, unless the Project spans the width of the River, significantly impeding fish passage (Virginia Department of Game and Inland Fisheries (VDGIF) 2018). As discussed in greater detail in Section M.4 below, Project activities will not create a barrier to migratory fish.

Table M-4. Anadromous Fish Species Potentially Present within Project Area

Species	Habitat Type	Spawning
Alewife (*Alosa pseudoharengus*)	Pelagic	February to April
Blueback Herring (*Alosa aestivalis*)	Pelagic	March to Mid-May
American Shad (*Alosa sapidissima*)	Pelagic	Mid-March to early May
Hickory Shad (*Alosa mediocris*)	Pelagic	Mid-March to May
Striped Bass (*Morone saxatilis*)	Pelagic	April to June
White Perch (*Morone americana*)	Pelagic	April to June

M.2.2.1 RIVER HERRING

Alewife and Blueback Herring are collectively known as river Herring. In Virginia, it is against the law to catch and possess river herring from tidal waters (4 Virginia Administrative Code (VAC) 20-1260; Virginia Marine Resources Commission 2012). These two species are listed by NMFS as federal species of concern. Additionally, Alewives are listed as a Tier IV species in the Virginia Wildlife Action Plan (VDGIF 2015; NMFS 2019). They are forage fish that feed on zooplankton, small crustaceans, small fish, and eggs (VDGIF 2019a, b). River herring migrate upstream in the spring to spawn. Alewives spawn earlier (February through April) than Blueback Herring (March through mid-May) (Table M-4) (Maryland Department of Natural Resources (MDDNR) 2019). Both species release eggs which stick to the bottom in the upper reaches of streams. The young travel back downstream towards salt water after a few months (VDGIF 2019a, b).

M.2.2.2 SHAD

American Shad and Hickory Shad begin swimming upstream when the water temperatures reach the mid-50°F (VDGIF 2019c, d). Hickory Shad begin their run in mid-March through May (Table M-4) and spawn at night when the water temperature is around 61°F (VDGIF 2019d). American Shad travel upstream between mid-March and May (Table M-4), but tend to spawn slightly later than Hickory Shad when the water temperature is around 65°F (VDGIF 2019c). Shad eggs are buoyant and float downstream with the current. During the fall, the young travel towards brackish waters (VDGIF 2019c, d). Both species feed on zooplankton, insect larvae, and as adults may eat worms and small fish, though they barely eat during spawning season (VDGIF 2019c,d).

M.2.2.3 STRIPED BASS

Striped Bass travel in schools and feed on small fish, insects, crabs, squid, and other aquatic organisms (VDGIF 2019e). In the spring, Striped Bass migrate to freshwater reaches of tidal rivers to spawn, which occurs when the water temperature is between 55°F and 60°F (VDGIF 2019e). The eggs float in the current (VDGIF 2019e). On April 1, 2019, the Virginia Marine Resources Commission amended the chapter pertaining to the taking of Striped Bass, which effectively closed the spring trophy season and limited possession to two fish (20-28 inches) per person (4 VAC 20-252). This change was implemented in an effort to maintain a sustainable fishery. Striped Bass populations in Chesapeake Bay have been declining since 2012 (Atlantic States Marine Fisheries Commission 2019e).

M.2.2.4 WHITE PERCH

White Perch is a semi anadromous species that inhabits brackish sections of estuaries and spawns in freshwater. White perch are close relative of the Striped Bass. White Perch spawn from April through June (MDDNR 2019).

M.3 ANALYSIS OF POTENTIAL EFFECTS ON EFH AND MANAGED SPECIES

Adverse impacts to EFH, as defined in 50 Code of Federal Regulations (CFR) 600.910(A), include any impact that reduces the quality and/or quantity of EFH. Adverse impacts may include direct impacts such as physical disturbance or the release of contaminants, indirect impacts such as the loss of prey, reduction in the number of offspring of a managed species, and any number of site-specific or habitat impacts.

Project construction activities are expected to occur year-round and the impacts summarized below will apply to all the EFH species and life stages identified in Table M-3. Since many of the species identified in Table M-5 are only present seasonally, as identified in Section M.2, these impacts are only applicable to the periods when that species or lifestage is potentially present in the Project area.

M.3.1 HABITAT MODIFICATION

M.3.1.1 LOSS OF EFH/OPEN WATER HABITAT

The Project will permanently impact 22.69 acres of EFH. Of the 22.69 acres, 8.40 acres will be converted to another type of EFH resulting in a net loss of 14.29 acres (Table M-5). The majority of EFH-related impacts are due to the expansions of the North Island (Figure M-3) and South Island (Figure M-4), primarily as a result of conversion of 13.74 acres of estuarine subtidal shallow, mid-depth, and deeper open water and estuarine intertidal rocky shore and sandy shore. This conversion provides virtually no habitat value to aquatic organisms with the exception of potential haul out habitat at the islands for seals that may occur seasonally in the vicinity of the Project area. The remaining conversion to upland consists of 0.38 acre of estuarine shallow open water, and estuarine intertidal rocky and sandy shore, plus 0.17 acre estuarine intertidal emergent wetlands adjacent to Johns Creek, Oastes Creek, and Mason Creek.

Overall, estuarine intertidal rocky shore habitat will increase from 0.70 acre to 0.99 acre. Estuarine subtidal shallow open water habitat, which supports SAV and shellfish resources in the vicinity of the Project area, will increase from 1.25 to 2.21 acres, offsetting a portion of the loss in function attributed to the conversion of estuarine intertidal mid-depth and deeper open water to uplands.

Table M-5: Permanent Impacts to Essential Fish Habitat (EFH)

Habitat Type	EFH Impacts (acres)	Post-Construction EFH (acres)
Estuarine Intertidal Emergent Wetland	2.17	0.45*
Estuarine Intertidal Rocky Shore	0.70	0.99
Estuarine Intertidal Sandy Shore	0.69	1.55**
Estuarine Subtidal Shallow Open Water	1.25	2.21
Estuarine Subtidal Mid-Depth Open Water	13.41	0.98
Estuarine Subtidal Deep Open Water	3.99	1.82
Estuarine Subtidal Deeper Open Water	0.08	0
Submerged Aquatic Vegetation	0.40*	0.40*
Total	**22.69**	**8.40**
Upland Conversion		14.29

**Extended temporary shading impacts from work trestles will likely revegetate post-construction; however, they are being compensated as a loss.*

***Permanent shading impact will likely convert E2EM to E2US; however, they are being compensated as a loss.*

The Project was reviewed for potential impacts to hydrodynamics in the James River. A Hydrodynamic Study was performed by the VIMS and provided as Appendix B of the HRBT Natural Resources Technical Report dated November 16, 2012. This report concluded that there is no difference between the No Build and Build Alternative impacts on tidal heights, tidal range, river inflow, currents or salinity.

In January 2017, VIMS conducted additional modeling, using a high resolution model SCHISM, on the preferred design alternative. On a local level, impacts were minor and concentrated in the vicinity of new bridge pilings. The change in salinity was very small, located in semi-enclosed areas of Mill Creek as the relatively stagnant water was sensitive to any blocking effects of the pilings. The present design being proposed in this permit application actually reduces the number of bridge pilings from the existing condition, and therefore, would be expected to improve circulation. The 2017 study also found on a global scale, that all examined variables (surface velocity, bottom velocity, surface salinity, bottom salinity, and bottom shear stress) have a central tendency toward zero deviation from the base case.

The updated footprint of the proposed island expansions was reviewed by VIMS in 2019. They concluded that the updated footprint was sufficiently similar to that used in the model; therefore, the conclusions presented in that report remain valid. VIMS did not recommend that the model be rerun. For these reasons, the HRCP design team has determined that no impacts to the hydrodynamics or adverse effects to open water habitat will result from the construction of the Project.

M.3.1.2 IMPACTS TO BENTHIC HABITAT

The island expansion accounts for the permanent loss of 13.74 acres of EFH (12.32 North Island, 1.42 South Island) due to the conversion of intertidal and subtidal aquatic habitat to non-aquatic upland areas (the additional 0.38 acre of upland conversion is a result of various other Project impacts). The existing benthic habitat in these footprints will be replaced by a variety of fill materials that will compose the area of the islands. Based on baseline sampling conducted in 2018, the substrate within the area of North Island expansion was dominated by sand and very fine sand while the South Island footprint was predominantly medium and fine sand as well as some silty clay (Wong et al. 2018). This loss of fine sediment habitat will result in a reduction of habitat for those species and life stages that utilize fine sediments as well as the loss of foraging areas.

The construction of permanent pile supported bridge/trestle structures will permanently occupy benthic sediments. The new permanent structures are wider than the existing structures and will result in a reduction of benthic habitat in some areas and a gain in others due to the reduction in number of foundations. In Willoughby Bay, the existing bridge will be widened which will result in a net loss of benthic habitat in this area due to the driving of additional piles to support the expanded bridge.

Figure M-3: North Tunnel Island Expansion Impacts

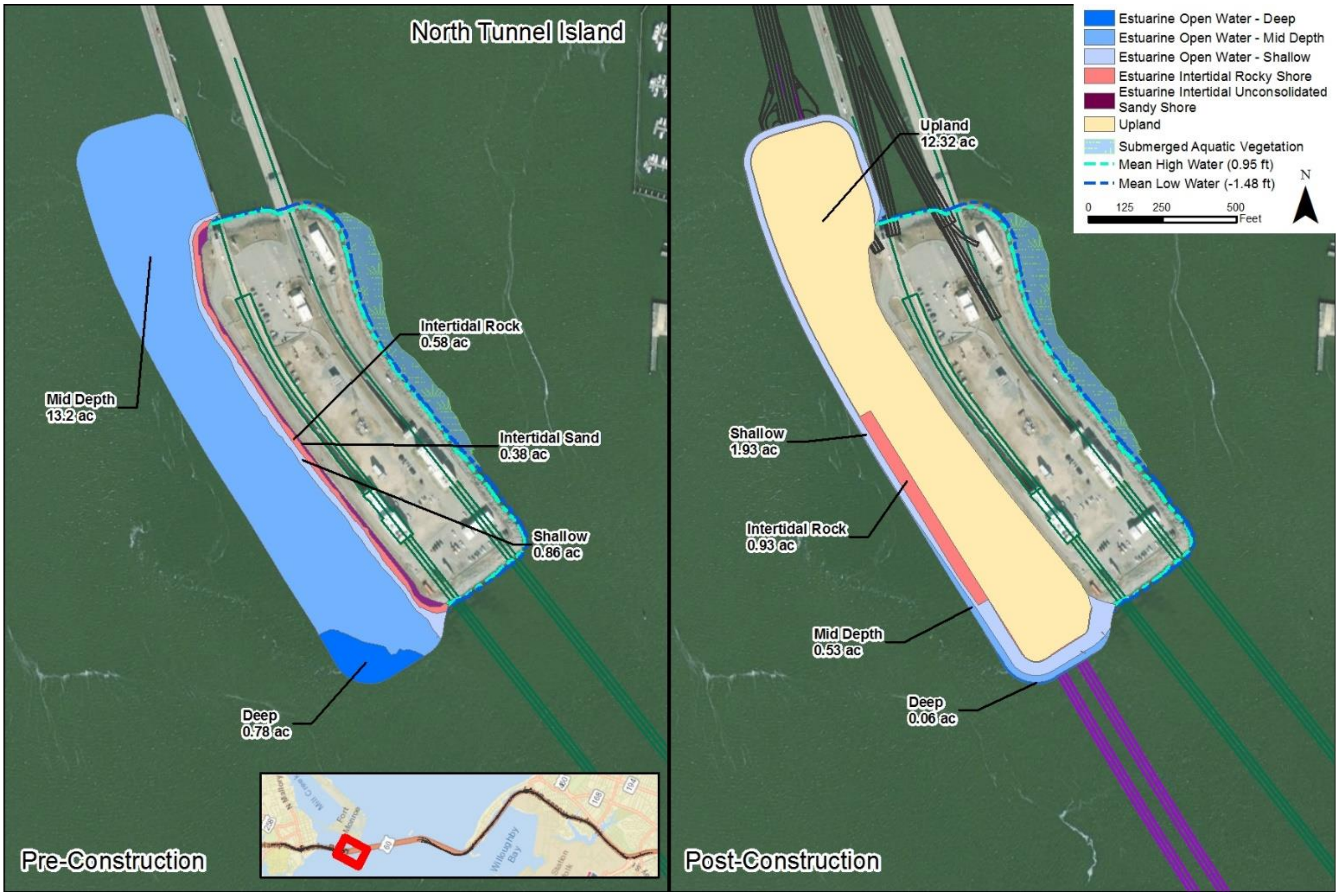
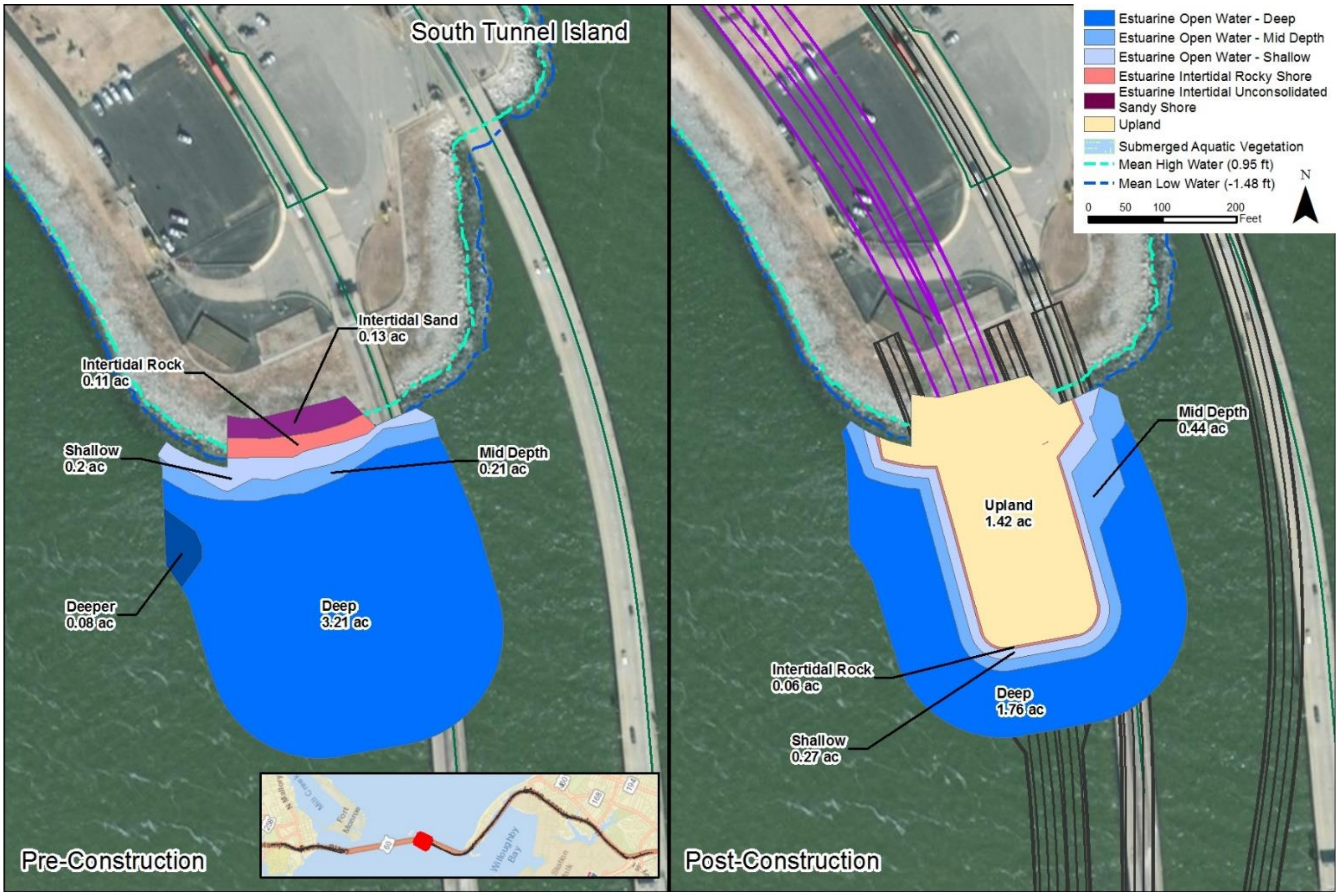


Figure M-4: South Island Expansion Impacts

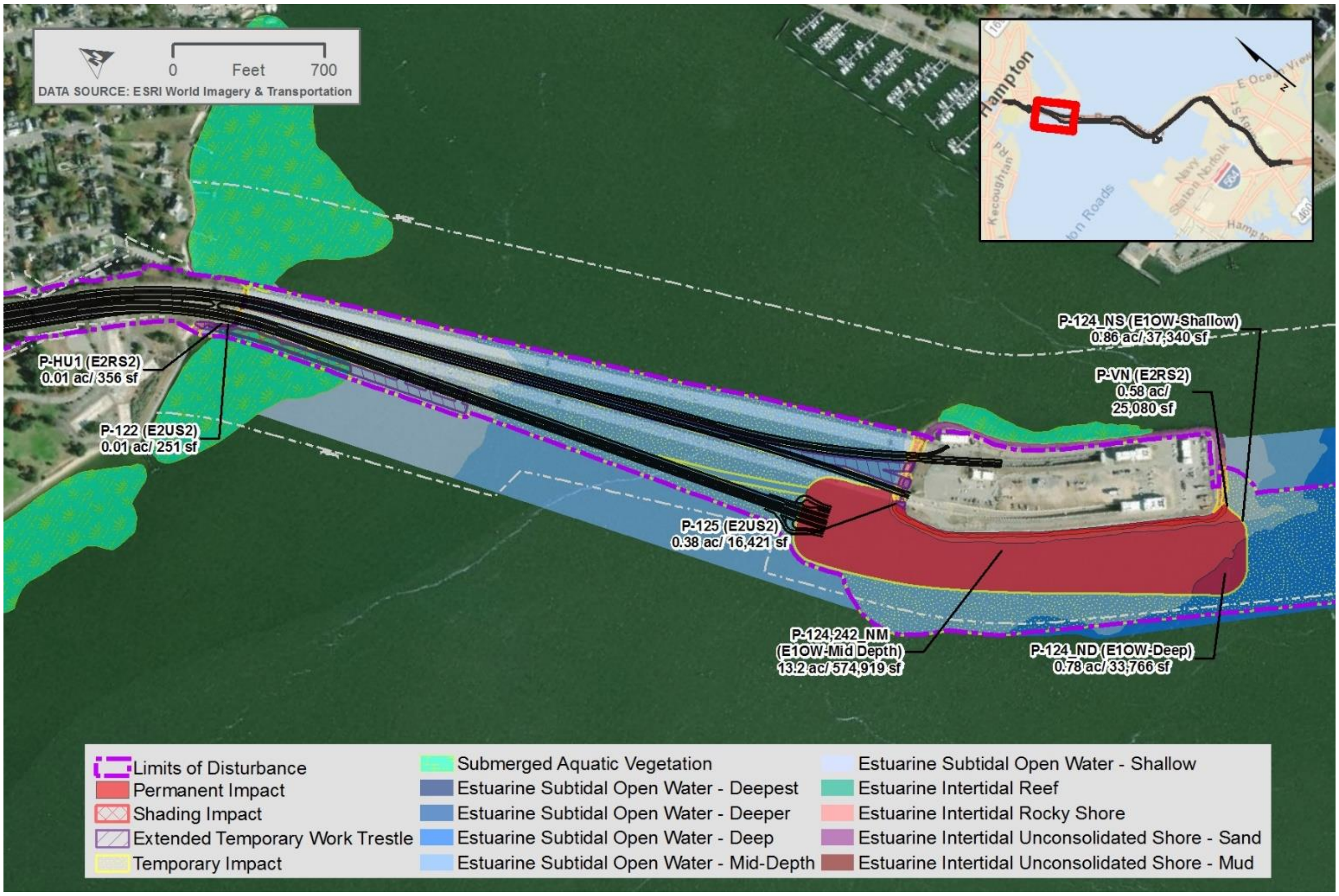


M.3.1.3 IMPACTS TO SAV

SAV is only present along the eastern side of the North Island of the HRBT and along the Hampton shore (Figure M-5). Design efforts to avoid impacts to SAV were made; however, minimal impacts to SAV in the area of the northern bridge and shoreline will be unavoidable. The construction of temporary and permanent trestles as well demolition of the existing North Trestle in this area will result in 0.52 acre of temporary disturbance and 0.40 acre of extended temporary impact to SAV. An extended temporary trestle west of the existing bridge is anticipated to be in place for several years, thus the shading impact will be considered permanent. SAV may also be able to recolonize post-construction. Additionally, one permanent pile will be directly driven into the SAV. No shading impacts are associated with the permanent trestle.

The construction of temporary work trestles will shade areas of SAV and shallow water habitat with the potential to support SAV. The use of “Jump Trestles” minimizes the potential for shading impacts. The Jump Trestles will be used to support the construction of the new North, South, and Willoughby Bay Bridge structures and consist of a small section of trestle that is limited to the area of active work. When the work in an area is completed, the piles at the rear of the trestle will be removed and additional piles will be driven off the front allowing the trestle to progress. Relative to a single continuous trestle or large areas of access dredging, the use of Jump Trestles allows the work to be completed with minimal impacts.

Figure M-5: SAV Locations



M.3.1.4 IMPACTS TO ESTUARINE EMERGENT WETLANDS

Permanent impacts to estuarine emergent wetlands total 2.17 acres and are primarily shading impacts located near Oastes Creek and Mason Creek. The direct impacts to vegetated wetlands are caused by piles; however, the trestles that will be in place longer than six months have the potential to cause permanent shading impacts based on the height and width of the platform. These areas provide suitable nursery habitat for fish. Fish will still have access to these locations, but the vegetation cover may be lacking.

M.3.1.5 IMPACTS TO SHELLFISH HABITAT

Project activities have the potential to impact shellfish habitat including habitat for commercially significant species such as hard clam, oyster, and blue crab. SAV represents an important habitat to blue crabs throughout their life cycle. There are documented areas of SAV blue crab habitat along the north shore of Hampton Roads. Unvegetated sand and mudflats also represent an important habitat for blue crabs; however, this habitat is scarce within the Project area.

The island expansion will lead to a permanent minor reduction in the amount of shellfish habitat in the Project area. The removal of the existing trestles may lead to a temporary loss of shellfish that had encrusted the pilings; however, this loss will be offset by the installation of new pilings that can be recolonized. Dredging will lead to a loss of habitat and the direct removal of those shellfish within the dredged sediments. Given the low density of shellfish and abundance of similar available habitat within the Project area, potential impacts related to temporary benthic disturbance and permanent habitat conversion due to the island expansion or trestle foundation installation would be minimal.

M.3.1.6 IMPACTS TO HARD BOTTOM

There is no naturally occurring hard bottom within the Project area, the majority of hard bottom present was placed as shoreline armoring. During the island expansion phase of the Project, existing armoring stones around the North and South Islands will be removed, and replaced with new armoring stones around the slope of the new expanded island. The removal of the existing trestles will also decrease the amount of hard complex structure in the Project area. The existing North and South Trestle have a greater number of foundations than the proposed replacement trestles. Given the lack of naturally occurring hard bottom within the Project area, the removal or modification of artificial hard bottom habitat is unlikely to have adverse impacts on EFH or EFH species.

M.3.1.7 ACCESS DREDGING CONVERSIONS

Limited dredging will occur along the southern extent of the existing bridge between the South Island and Willoughby Spit and in other select areas that are too shallow to allow access for construction vessels. Approximately 5 acres will be dredged from estuarine open water and 0.18 acre will be dredged from estuarine sandy shore. Dredging will be limited to the minimum depth necessary to allow access which in most cases is 3 feet deep. This dredging will lead to a temporary increase in depth in those areas. There will not be maintenance of the dredged areas, and natural sedimentation processes should return the area to the pre dredging depths. The dredging will also result in the direct removal of benthic macroinvertebrates and any other entrained motile organisms which will result in the temporary reduction in available prey resources. Benthic organisms have been observed to recolonize dredged areas relatively rapidly (months to year) following dredging events (Hirsch et al. 1978; LaSalle et al. 1978; Bain et al. 2006). The areas to be dredged represent a small portion of the total available benthic habitat in the Project area. As discussed further below, the use of temporary work trestles will minimize the extent of dredging required. A reduction in dredging minimizes the removal of benthic sediments and the prey species contained within.

The access related dredging will temporarily increase the depth in limited areas that are currently less than 4.5 feet. The removal of the existing trestles and construction of newer trestles may lead to some localized changes in scour and deposition, but this would not significantly alter depths throughout the Project area. The use of temporary trestles minimizes the amount of dredging and changes to water depth. The tunnel will be bored below the substrate; therefore, no changes to water depth are anticipated.

M.4 DEMOLITION OF EXISTING STRUCTURES

The demolition of the existing bridges that connect the North and South Portal Islands to the mainland will result in a temporary disturbance to the river bottom and a permanent reduction in the area of the bottom occupied by bridge foundations. The removal of concrete piles will result in a disturbance to sediments around the pile. The piles will be cut off at a depth of three feet below the mudline; therefore, sediments around the pile may need to be displaced to provide access for removal. These activities may temporarily impact benthic prey resources for EFH species.

The existing bridges have considerably more foundations than the replacement bridges. The existing North and South Bridges have 815 and 959 in-water foundation piles respectively, while the replacement bridges will be supported by 472 and 564 piles, respectively due to the longer span between foundations. The significant reduction in the number of foundations will result in a smaller benthic footprint for the new bridges and a net gain of 0.14 acre of predominantly sandy benthic habitat. This will benefit those EFH species, life stages, and prey resources that utilize fine grained substrates. The removal of the existing pilings will result in a reduction in hard structures with vertical relief within the Project area as well as the encrusting organism.

Suitable concrete materials from the demolition of existing structures may be placed at artificial reef sites permitted in the state of Virginia, pending proper coordination and regulatory approvals. The placement of these materials would support the development or maintenance of artificial reef sites and provide complex hard bottom habitat which will benefit demersal and structure oriented species and life stages. Reef habitat provides shelter to fish and crustaceans as well as foraging opportunities. The reef materials provide substrate for encrusting organisms that otherwise would be unable to colonize the fine sediments in the surrounding area, thus providing an additional food source for fish species.

M.5 TEMPORARY DISTURBANCES

M.5.1 PROJECT VESSEL OPERATIONS

Ship traffic will increase throughout Project construction. Project related vessels have the potential to disturb the river bottom while in operation in shallow areas and anchored. Anchors and spuds from barges and other vessels will temporarily disturb the river bottom. While the area occupied by an individual spud or anchor is very small, there will be several barges used on the Project and each barge may be shifted and temporarily anchor multiple times a day. A 500 feet wide buffer around barge base operations has been designated to contain the areas potentially disturbed by temporary mooring and spudding of barges. A larger 1,000 feet wide buffer around barge based operations has been designated to contain the areas potentially disturbed by barge anchorage. The disturbance to the river bottom from vessel anchoring will be temporary and spudding will be temporary, intermittent, and spatially limited. The disturbances from anchoring will be surficial and smoothed over by natural sediment transport processes in the Project area.

Benthic species that live at the bottom of the Chesapeake Bay form an important part of the food web, which reside in the vicinity of the Project area (VDOT and FHWA 2016). Shellfish, such as the hard clam, blue crab, and oysters, reside on the substrate. The physical disturbance of sediments and entrainment of associated benthic resources could reduce the availability of marine species prey, but the impacted benthic habitat represents an insignificant amount of the available habitat in the region, and recolonization of the opportunistic benthic species would occur quickly, making impacts to habitat and prey negligible (VDOT and FHWA 2016). Turbidity may reduce the photic zone in areas of SAV, and may release contaminants in the sediment, which would result in the temporary loss of benthic communities that provide food sources for fish.

M.5.2 UNDERWATER NOISE

Noise created by the installation of marine pilings has the potential to impact fish and effects from sound can include behavioral impacts and injuries. NMFS uses a peak sound pressure level (SPL) of 150 decibels (dB) as a conservative indicator of the noise level at which there is the potential for behavioral effects to Atlantic sturgeon. A peak SPL of 206 dB or a cumulative sound exposure level (cSEL) of 187 dB has been used as a conservative indicator of potential physiological effects. If vibratory pile driving is used, none of these values are likely to be exceeded, and if impact driving is used, the 150 dB peak SPL behavioral effects criteria and the 187 dB cSEL physiological effects criteria would likely be exceeded, and the 206 dB peak SPL physiological effects criteria may be exceeded (VDOT and FHWA 2016). Since Hampton Roads is approximately 3.5 miles wide, it is expected that the majority of the waterway would be unaffected by the sound and EFH species would be able to avoid the affected area (VDOT and FHWA 2016), see Figure M-6. No piles would be driven in the proximity of the deepest water within the habitat where anadromous or migratory species, like Atlantic sturgeon, would most likely occur.

Distances to the thresholds described above were estimated for Project piles using the Greater Atlantic Fisheries Organization (GARFO) Acoustics Tool, a spreadsheet developed by GARFO to analyze the potential effects of pile driving on ESA-listed species in the Greater Atlantic Region (GARFO 2018). Since the Project is located in a shallow water near shore environment, the Simplified Attenuation Formula (SAF) was used to estimate the distance to the various thresholds.

Figure M-6: Underwater Noise Impact Thresholds for Sturgeon - Impact Hammering

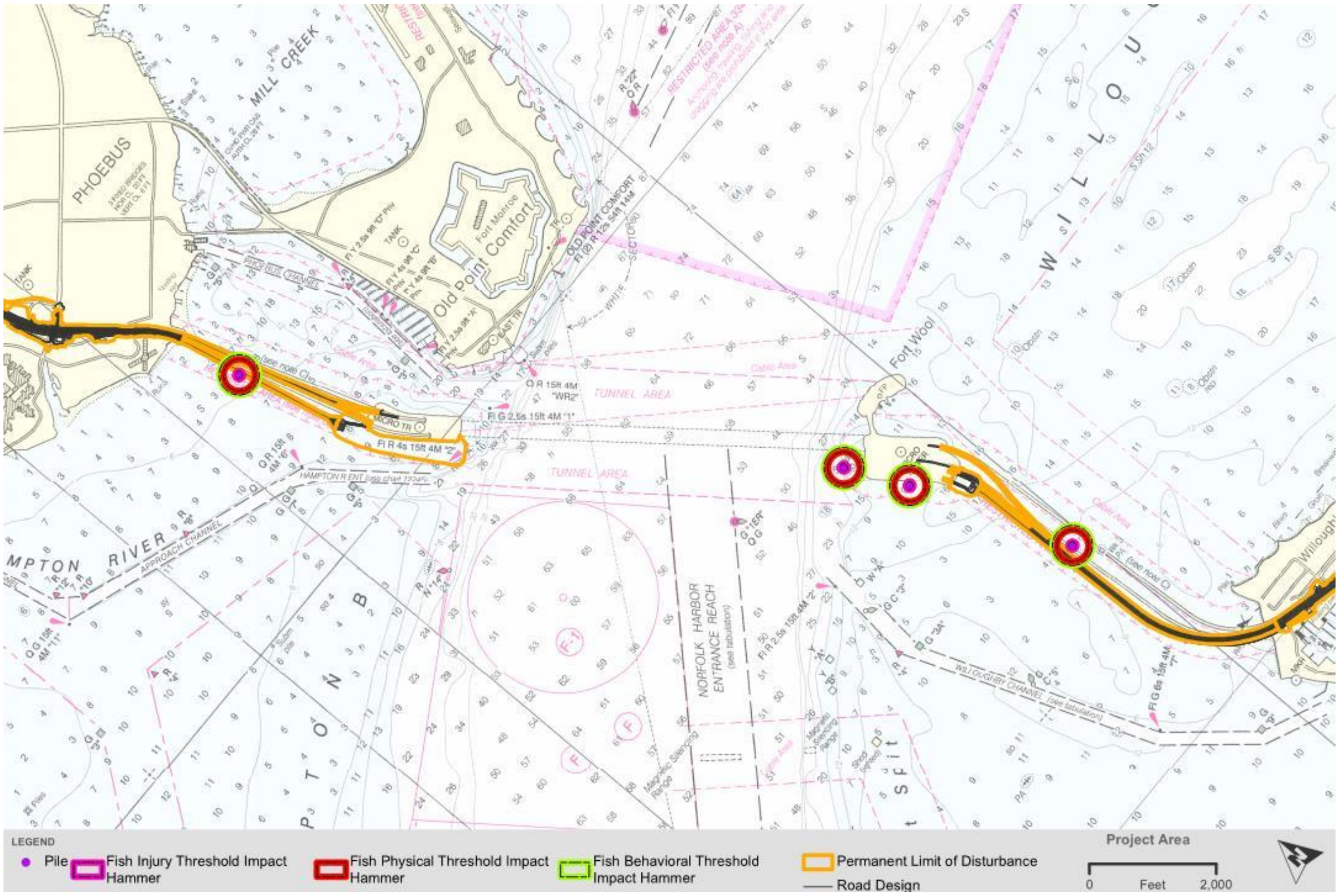


Figure M-6 depicts distances to underwater noise impact thresholds for sturgeon and zones of passage during the impact hammering of 36-inch steel piles at four different locations. The planned pile driving will not result in conditions where fish are unable to pass through the Project area without exposure to sound levels with the potential to cause behavioral effects for multiple reasons outlined below. The tunnel design does not necessitate the driving of piles across the main channel between the North and South Portal Islands which leaves a greater than one mile wide expanse of river below the acoustic thresholds regardless of pile driving activities in other portions of the Project area. The main channel is known to be the area where sturgeon spend the majority of their time including migratory movements through the Project area. Therefore, the area of primary importance to fish passage through the Project area will not be impacted by underwater noise from pile driving.

The distance between the North and South Islands is approximately 6,300 feet. The installation of temporary piles for support of the Jet Grouting Trestles off the South Island is the only pile driving activity that would encroach on this area. The diameter of the largest isopleth associated with the pile driving for the Jet Grouting Trestle is 630 feet. Therefore even when driving the piles that extend the furthest into the channel, there will still be a continuous approximately one mile wide area between the North and South Islands that will be free from underwater noise levels with the potential to cause behavior changes. At all times during pile driving at the Project area, a corridor of greater than 5,000 feet will be maintained regardless of the number of locations of concurrent pile driving.

Impact pile driving is projected to take place at three to four locations concurrently. If the largest estimated diameter behavioral effects isopleth (630 feet) is assumed, and the isopleths do not overlap, only 10% of the width between the northern shoreline and Willoughby Spit will be occupied. There is a potential for a maximum of seven concurrent pile driving locations; however, the potential concurrent pile driving scenarios are unlikely to occupy 10% due to the amount of pile driving in close proximity to the portal islands and shorelines that will occupy portions each isopleth, and the likelihood of overlapping isopleths due to the sequencing of Project operations. Based on the projected isopleth sizes and number of concurrent pile driving locations, any combination of locations will not produce a configuration of isopleths that would represent a barrier to fish passage through the Project area due to the small size of the isopleths relative the total width of habitat available for passage and lack of pile driving in the main channel. The driving of piles in a limited number of additional locations is unlikely to change this conclusion, for the reasons outlined above.

The potential for impacts is further mitigated by the use of a vibratory pile driver for significant portions of many pile driving components as well as the implementation of ramp up procedure while impact hammering which can cause fish to move away from the pile prior to onset of full energy pile driving. For the reasons detailed above, Project pile driving may affect and is not likely to adversely affect EFH and managed species.

No TOYR is recommended on the James River and its tributaries below the Route 17 Bridge or on the Elizabeth River unless the Project spans the width of the River to an extent that it significantly impedes fish passage (VDOT and FHWA 2016). A TOYR for Atlantic Sturgeon from 15 February to 30 June for instream construction within channel habitat would be considered if the HRBT impedes fish passage. However, the above analysis indicates that marine construction activities would not impede fish migration at the HRBT.

M.5.3 TURBIDITY AND WATER QUALITY IMPACTS

M.5.3.1 TURBIDITY

All in-water, bottom disturbing activities would result in temporary minor localized increases in turbidity. Dredging can cause water column turbidity. Mechanical dredging paired with a reduced bucket retrieval rate can minimize the amount of resuspended material in the water column. Excavated materials will be disposed of at an approved offsite location. Mechanical dredges include many different bucket designs (e.g., clamshell, closed versus open bucket, level-cut bucket) and backhoe dredges, representing a wide range of bucket sizes. Total suspended solids (TSS) concentrations associated with mechanical clamshell bucket dredging operations have been shown to range from 105 milligrams per liter (mg/L) in the middle of the water column to 445 mg/L near the bottom (210 mg/L, depth-averaged) (Army Corps of Engineers (ACOE) 2001). Furthermore, a study by Burton (1993) measured TSS concentrations at distances of 500, 1,000, 2,000 and 3,300 feet (152, 305, 610 and 1,006 meters) from dredge sites in the Delaware River and were able to detect concentrations between 15 mg/L and 191 mg/L up to 2,000 feet (610 meters) from the dredge site.

There are several temporary pile supported structures that are needed to support different components of the Project. The duration that piles will be in place varies from a few months to more than a year. The installation of the piles will temporarily disturb the benthic sediments in the footprint of each pile. The piles will be driven with a combination of vibratory and impact hammers. The piles will temporarily occupy benthic and water column habitats for the duration of their use. The removal of the temporary piles will also disturb benthic sediments. The temporary piles will be extracted with a vibratory hammer or cut off three feet below the mudline. Sediments surrounding the piles may need to be temporarily displaced to access the cut off elevation. The potential impacts related to resuspension of sediments and turbidity due to these activities are described in turbidity and water quality section below.

The installation of piles will disturb bottom sediments and may cause a temporary increase in suspended sediment in the action area. Using available information collected from a project in the Hudson River, pile driving activities are expected to produce TSS concentrations of approximately 5.0 to 10.0 mg/L above background levels within approximately 300 feet (91 meters) of the pile being driven (FHWA 2012). Using a clamshell to extract piles allows sediment attached to the pile to move vertically through the water column until gravitational forces cause it to slough off under its own weight. The small resulting sediment plume is expected to settle out of the water column within a few hours. Studies of the effects of turbid water on fish suggest that concentrations of suspended sediment can reach thousands of mg/L before an acute toxic reaction is expected (Burton 1993). The TSS levels expected for pile driving or removal (5.0 to 10.0 mg/L) are below those shown to have adverse effect on fish (580.0 mg/L for the most sensitive species, with 1,000.0 mg/L more typical; see summary of scientific literature in Burton 1993) and benthic communities (390.0 mg/L (EPA 1986)).

Conditions produced by dredging and other bottom disturbing activities are expected to remain below levels shown to have an adverse effect on fish and benthic community (590.0 mg/L, EPA 1986). The area of dredging is minimized by the use of temporary trestles, any impacts related to turbidity produced by dredging would be temporary and localized. Dredging will not occur near SAV or vegetated wetlands.

The potential short-term impacts of dredging to the environment include: the generation of suspended solids/turbidity and the resultant degradation of surface water quality and sediment quality; a decreased photic zone due to increased turbidity; elimination of benthic populations within the dredging zone; deposition of dredge-induced suspended sediment on benthic populations downstream of the dredging zone; fish mortality by dredge equipment; disruption of normal foraging or spawning behaviors; and gill injury from exposure to local increases in turbidity.

M.5.3.2 CONTAMINANTS

Several Project activities have the potential to disturb the river bottom and resuspend sediments potentially contaminated with PCBs, metals, semivolatile organic compounds (SVOC), and other contaminants. These activities include pile driving, dredging, trestle demolition, and vessel operations.

Based upon results from sediment sampling documented in the 2001 FEIS, by VDEQ between 1995 and 2012, and as reported in USEPA's STORET database, concentrations of PCBs in the sediment within the vicinity of the Project area appear to be below the effects range low (ER-L) threshold, all metals appear to be below effects range median (ER-M) thresholds, and no metal or SVOC water quality criteria are exceeded. Therefore, bottom disturbing activities would not be expected to result in impacts related to resuspended contaminants. However, additional sediment sampling is planned prior to the commencement of dredging and other bottom disturbing activities.

M.5.3.3 DISCHARGES

Multiple construction operations have the potential to produce a discharge to the Hampton Roads waterbody, these include: tunnel boring, jet grouting, slurry wall construction, and excavation dewatering. A Virginia Pollutant Discharges Elimination System (VPDES) permit will be obtained for these discharges; therefore, discharges will comply with the permit required thresholds. The spoils for each of these operations will be subject to an onsite treatment process treated prior to discharge to the environment in order to minimize potential impacts to water quality.

Jet grouting operations and slurry wall construction will produce spoils that consist of native materials and water that is exposed to bentonite and grout. The spoils will be conveyed to multiple decant tanks to remove solids. The exposure to grout and bentonite will raise the pH of the solution, the pH will be adjusted to an acceptable range prior to discharge. These operations will take place on both the North and South Islands; therefore, there will be discharges from two locations. The discharge at the South Island is projected to be in operation for 263 days and discharge an estimated peak flow of 384,000 gallons a day. The discharge at the North Island is projected to be in operation for 104 days and discharge an estimated peak flow of 384,000 gallons per day. Based on the Project schedule there is a limited period of time of approximately one month where both of these discharges would be in operation simultaneously. These discharges will not be in operation concurrent with the discharge from the TBM which is described below.

The spoils from the TBM will be sent to an onsite Slurry Treatment Plant/Separation Treatment Plant (STP) located on the South Island near the portal. The spoils will contain water, native sediments such as sand and clay, but will also be exposed to grout, bentonite, and EZ-Mud® used in the boring operation. The STP will remove solids from the incoming material, the remaining liquid will either be returned to the tunnel to support continued boring, used to prepare additional grout, or sent to a water treatment unit (WTU) for additional treatment prior to discharge. The exposure to grout and bentonite will raise the pH of the solution. The WTU will pass the incoming water through multiple levels of filtration before adjusting the pH to acceptable ranges before discharge into the sewer system or directly to the adjacent waters of Hampton Roads. The STP and WTU greatly minimize the potential for water quality impacts.

Additionally there are excavations at the North and South Island associated with the Tunnel Approach structures that will need to be dewatered due to the intrusion of ground water and potentially seawater. These excavations will need to be dewatered to allow construction to progress. This water may be exposed to sediments, residual grout or bentonite, and will be treated using the same process as described for the jet grouting and slurry operations. The spoil material from each of these operations is expected to be contained and conveyed through pipes on site. Therefore any releases of untreated material are expected to be incidental, limited in spatial/temporal extent, and unlikely to result in impacts to EFH.

The TBM will need to be cooled with water while in operation to prevent overheating. The source water will be taken from existing water supplies and will not be withdrawn from the surrounding waterbody. The cooling water will run through the TBM within an enclosed system that does not contact boring materials. The cooling water will not result in a discharge while in operation. There are no discharges planned from this water. If in the event that this water would require to be changed out, the water would be contained and subsequently treated by the water treatment plant. The water discharge temperature will comply with the limits of the permit. Prior to discharge, if the water temperature is elevated, the water will be allowed to cool until the temperature decreases below permitted thresholds.

The water will then be discharged into the surrounding James River. These thermal discharges will have a single point of discharge and may cause localized increases in temperature. The cooling water discharges will represent a small volume relative to the Hampton Roads Project area. The discharge will occur from a single point at the surface and will likely form a localized plume of warmer water in the upper portion of the water column. The plume will represent a limited area, and as fish are highly mobile, they will be able to avoid the plume if conditions are suboptimal and swim to similar adjacent habitats where conditions are more suitable. Since the plume would be primarily be at the surface, the impact to sessile benthic organisms would be limited, thus impacts prey resources are not anticipated. The thermal discharges will represent a temporary, intermittent impact to water quality that is spatially limited and is therefore unlikely to adversely EFH species and habitat.

The discharges described above are temporary, intermittent, spatially limited, and subject to treatment processes that minimize potential impacts to water quality. Therefore any potential water quality impacts associated with these discharges are unlikely to adversely affect EFH.

M.6 FEDERAL AGENCY'S CONCLUSIONS REGARDING THE EFFECTS OF THE ACTION ON EFH

The Project will not have a substantial adverse effect on EFH given the temporary nature of most impacts and the limited spatial extent of permanent impacts in an environment that is subject to regular disturbance and existing habitat modifications.

M.7 PROPOSED MITIGATION

M.7.1.1 HABITAT MODIFICATION

Compensation will be provided for impacts to wetlands resulting from permanent cut/fill, permanent shading, extended temporary shading lasting more than six months (from temporary work trestles), and permanent conversion. Compensation for permanent impacts to vegetated wetlands will be achieved through the purchase of wetland credits from approved mitigation banks using generally-accepted ratios.

M.7.1.1.1 EFH HABITAT LOSS

To quantify the net loss or gain of aquatic habitat functions and values that may result from the Project, a Habitat Condition Assessment (HCA) was performed (see Appendix P, Attachment 1). The HCA method is a semi-quantitative approach, similar to the NOAA Habitat Equivalency Analysis (NOAA 2000). HCAs have been performed for other projects within the Chesapeake Bay watershed to assess habitat value and to aid in determining compensatory mitigation (EA 2017). The HCA expresses habitat functions and values in terms of Habitat Units which are the product of habitat score multiplied by acreage.

The HCA found that impacts to tidal subaqueous and non-vegetated wetlands would result in a net loss of approximately 41 Habitat Units; however, the vast majority of this reduction (over 90%) was due to loss of habitat from conversion to uplands necessary for the expansion of the North and South Islands. When comparing average habitat scores pre- and post-construction, it was found that all other conversions not resulting in uplands did not result in a significant loss of functions and values. These results suggest that a loss of functions and values results if tidal subaqueous and non-vegetated wetlands are converted to uplands and that all other conversion impacts are self-mitigating. Consequently, HRCP is proposing to compensate for the conversion of tidal subaqueous and non-vegetated wetlands to uplands.

M.7.1.1.2 SUBMERGED AQUATIC VEGETATION

The Project will permanently impact a relatively small area (6.25 square feet) of SAV for one 30-inch permanent pile placement. Additionally, the Project will result in 0.4 acre of extended temporary shading impacts to SAV from pile-supported temporary work trestles that will remain in place for longer than six months. There will be no shading impacts to SAV from the permanent trestles; however, in coordination with permitting agencies, it was determined that compensating for both permanent and extended temporary impacts greater than six months to SAV beds at a 1:1 ratio would provide suitable replacement of lost functions and values. There are no “in-kind” commercially available mitigation credits available for SAV in the watershed; therefore, HRCP explored two options for SAV compensation: the purchase of advance release oyster credits from Living River Restoration Trust (LRRT) and providing funding for SAV restoration through the VIMS. LRRT currently has two advance release oyster credits for restoration of oyster reefs in the watershed.

VIMS is actively working to restore SAV through plantings of SAV seed and transplants. VIMS has restored over 6,000 acres of SAV on the seaside of Virginia (VIMS 2019) (outside of the Project watershed); however, restoration efforts in the Chesapeake Bay have been less successful. Efforts to restore eelgrass in the Chesapeake Bay by transplanting have failed to significantly increase its overall abundance in most locations. Early success in restoring eelgrass to the lower York and James Rivers via seed has also not persisted long-term. SAV restoration in the Chesapeake Bay is problematic due in large part to high levels of turbidity that result from suspended solids that are carried into the Bay from multiple riverine sources. High turbidity results in a bias for successful SAV establishment in shallower waters where SAV is susceptible to higher temperatures and an associated increase in mortality. Bayraktarov et al. (2016) found that seagrass restoration efforts worldwide had a survival rate of just 38% after two years.

One key criterion for improving the success of SAV restoration is improving water quality. The establishment of water-clarity goals to reduce sediment and nutrient inputs from upland sources, tidal shorelines, tidal resuspension, and estuarine processes facilitate seagrass restoration and recovery (VIMS 2019). Mann (2000) studied the interaction of oysters and SAV and found that, on a large scale, the presence of multiple reef systems with vertical relief in otherwise open bodies of water, like much of the Chesapeake Bay, reduces fetch and; therefore, wind-driven resuspension of particulate material in the water column. The presence of fringing reefs also reduces sediment input from shoreline erosion. At a smaller scale, filter feeding by oysters reduces water column loads of sediment and plankton, thereby increasing light penetration and increasing SAV growth. Mann (2000) concluded that a critical reduction in sediment load promoted SAV growth resulting in an oyster-SAV positive feedback interaction loop. Cerco and Noel (2005) also found that, in shallow regions, oyster removal of solids from the water column enhances adjacent SAV beds.

Because of the low success rate of SAV restoration in the Chesapeake Bay and the overall indirect benefit to SAV success from oyster reefs, it is HRCPs opinion that oyster reef restoration would provide the best replacement of lost functions and value from SAV impacts. Additionally, because SAV restoration through VIMS would be considered permittee responsible mitigation, the purchase of advance release credits from LRRT would be consistent with the mitigation hierarchy of the 2008 Final Mitigation Rule.

M.7.1.1.3 SHELLFISH HABITAT

Clam habitat will be mitigated at 1.3:1 with the purchase of chowder clams for placement on public clam grounds by the VMRC. HRCP would not conduct long-term monitoring of the clam sites and HRCP would assume that the clam compensation requirement would be satisfied upon purchase of the chowder clams. Baylor grounds will be avoided and mooring impacts to clamming grounds will be minimized to the maximum extent practicable.

M.7.1.1.4 HARD BOTTOM

There will be an increase of 0.19 acre of intertidal rock with the expansion of the tunnel islands. A rocky intertidal bench has been designed for the North Island to provide additional habitat for foraging and shelter. Additionally, suitable concrete materials from the demolition of existing structures may be placed at artificial reef sites permitted in the state of Virginia, pending proper coordination and regulatory approvals. The placement of these materials would support the development or maintenance of artificial reef sites and provide complex hard bottom habitat which will benefit demersal and structure oriented species and life stages. Reef habitat provides shelter to fish and crustaceans as well as foraging opportunities. The reef materials provide substrate for encrusting organisms that otherwise would be unable to colonize the fine sediments in the surrounding area, these encrusting organisms provide a food source for species and life stages utilizing the reef.

M.7.1.2 BENTHIC HABITAT FROM DREDGING

A comprehensive study by Wilber and Clarke (2007) observed dredgings across the U.S. and found that certain conditions dictate the rate of benthic community recovery time. They studied five sites in the U.S. (one of which being the Delaware Bay) pre- and post-channel dredge that recorded benthic recovery (equal to that of an un-impacted reference site) anywhere from one to six months. The Delaware Bay recorded a recovery time just greater than five months. No long-term impacts to infaunal community were reported (Wilber and Clark 2007).

Based on the limited extent of dredging and the relatively shallow nature of the dredging, it is expected that the benthic communities will recover quickly based on the existing scientific data. Since the benthic communities are expected to return to pre-dredged conditions in a fairly short time period, no compensatory mitigation is proposed for dredging impacts.

M.7.1.3 TEMPORARY IMPACTS

The Project area is an active harbor with a maintained navigation channel subject to frequent disturbance. The spatial extent of permanent construction impacts is limited and represents a very small amount of the available EFH in the Hampton Roads and lower Chesapeake Bay Area. The extent of temporary construction impacts will be limited spatially and temporally such that they will not represent a barrier to fish movements through the Project area or permanently reduce the quantity and quality of EFH at the Project area.

M.7.1.3.1 VESSEL OPERATIONS

Barges, tugs, and other related Project vessels will travel at reduced speeds to avoid strikes to fish.

M.7.1.3.2 NOISE

During Pile Driving Activities:

A soft start/ramp up procedure will be used during impact pile driving to allow fish to move away from the ensonified area prior to the onset of full energy pile driving. Vibratory hammers will be used for significant portions of most pile driving elements which minimizes the amount of impact hammering and reduces exposure to elevated levels of underwater noise.

M.7.1.3.3 TURBIDITY AND WATER QUALITY

Erosion and sedimentation Best Management Practices (BMPs) will be installed prior to construction in compliance with the Virginia Erosion and Sediment Control Handbook (VESCH) and according to the projects approved Erosion and Sediment Control Plan. Examples of such measures include: silt fence installation, culvert outlet protection, storm water conveyance channels, soil stabilization blankets and matting, dust control, and temporary and permanent seeding. Water will be diverted around the work area to prevent sedimentation of downstream aquatic resources. Impacts will be minimized by strict enforcement of BMPs for the protection of surface waters, restrictions against the staging of equipment in or adjacent to waters of the U.S., and coordination with the permitting agencies.

During dredging and placement activities, contractors will:

- Use mechanical dredging instead of hydraulic, which reduces localized turbidity and potential entrainment of aquatic organisms.
- Prevent overfilling of bucket to minimize additional loss of material during ascent through the water column.
- Verify that the bucket is completely closed prior to raising it to the surface.
- Will not drop the load at the water surface to dislodge debris, but will complete the dredge pass and place the debris on the barge or scow.
- Pause the bucket after ascent through the water column to allow free water to drain prior to swinging the bucket to the barge.
- Reduce the bucket ascent rate, which minimizes loss of residuals from the clamshell bucket.
- Implement an approved Water Quality Monitoring Plan during dredging activities.

M.8 REFERENCES

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