APPENDIX – O
WATER QUALITY MONITORING PLAN, REV 1

I-64 Hampton Roads Bridge-Tunnel Expansion Project

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Hampton-Norfolk, Virginia
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DOCUMENT HISTORY

Issue Date	Description	By	Revision
December 19, 2019	Revised to incorporate design refinement and USACE agency comment	T Sword	1

ATTACHMENTS

Attachment O-1: Water Quality Data Collection Sheet

Attachment O-2: Instrumentation QC Calibration Requirements*
*(*to be provided upon procurement of instruments)*

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ACRONYMS AND ABBREVIATIONS

BMP	Best Management Practice
CWA	Clean Water Act
cy	Cubic yard(s)
DGPS	Differential Global Positioning System
DO	Dissolved Oxygen
DQO	Data Quality Objective
ft	Foot or feet
HRBT	Hampton Roads Bridge Tunnel
mg/L	Milligram(s) per liter
NTU	Nephelometric Turbidity Unit
QA	Quality Assurance
QC	Quality Control
STP	Separation and Treatment Plant (for TBM)
ft^2	Square Feet
TBM	Tunnel Boring Machine
USACE	U.S. Army Corps of Engineers
VDEQ	Virginia Department of Environmental Quality
VMRC	Virginia Marine Resources Commission
VPDES	Virginia Pollutant Discharge Elimination System
WQMP	Water Quality Monitoring Plan

O. WATER QUALITY MONITORING PLAN

O.1 PROJECT DESCRIPTION

O.1.1 PROJECT OVERVIEW

The Hampton Roads Bridge-Tunnel Expansion Project ("Project") will widen 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 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.

The two tunnels will be west of and parallel to the existing tunnel system for I-64 at this location (Figure O-1 Project Location). The complete detailed Project description is contained in Appendix E of the Joint Permit Application (JPA).

Upon completion, the new tunnels will carry four lanes of eastbound traffic. The existing tunnels will remain in operation and carry four lanes of westbound traffic. The new parallel tunnels will be bored under the Hampton Roads Channel. The 7,900 feet (each way) tunnels will be constructed under the 1,000 ft wide navigation channel.

The Tunnel Boring Machine (TBM) will bore a tunnel approximately 44.5 ft in diameter in one pass that will accommodate two new lanes of traffic. Two tunnels parallel to each other will be constructed to allow for four new lanes of traffic. Construction of the bored tunnels will begin at the South Island and mined from the south to the North Island. Upon reaching the North Island, the TBM will be turned around and a parallel tunnel will be bored back to the South Island for the second set of lanes. The project has been planned to be of the least impacting on existing traffic operations along the HRBT corridor.

The TBM components will be barged and trucked to South Island for onsite assembly within the South Island entry/launch portal. As the TBM advances through the ground, the excavated material will be replaced with concrete tunnel segments as it progresses from the South Island to the North Island. The soil excavated from within the tunnel will be transported via a closed slurry plumbing system back to South Island where the excavated materials will be filtered out of the slurry at the Separation and Treatment Plant (STP). Approximately 968,000 cubic yards (cy) (bulked volume) of material is anticipated to be excavated by the TBM and transported via the slurry plumbing system to South Island. After separation at the STP, the solid materials will be characterized for beneficial use or will be disposed off-site at a permitted facility in accordance with the approved Material Management Plan.

After separation, the residual water will be processed through the water treatment plant and subsequently discharged under a Virginia Pollutant Discharge Elimination System (VPDES) discharge permit.

Precast concrete tunnel segments will be transported down to the TBM for installation. The TBM will assemble the tunnel segments in place as the tunnel is bored. Upon reaching the South Island and completing the second tunnel, the TBM will be disassembled and the components will be removed at the South portal structure. Once the tunnel structure is completed, final upland work for the Project will include installation of the final roadway, lighting, finishes, mechanical systems, and other required internal systems for tunnel use, traffic safety, and facility function.

O.1.2 BRIDGE TRESTLE CONSTRUCTION

Bridge trestle replacement construction will be performed from the North Island to landfall at the City of Hampton (North Trestle) adjacent landfall. From the South Island to Willoughby Spit (South Trestle) complete replacement will be accomplished and across Willoughby Bay (Willoughby Bay Trestle) is to be expanded, construction will be performed to allow for the additional lanes and improvements of I-64 along this span. The Willoughby Bay Trestle spans across Willoughby Bay and landfalls at the Ocean View section of Norfolk. Additional in-water construction activities and trestle construction details are provided in Section O.1.3. Figure O-1 presents the Project location and Figure O-2 provides locations for each of the planned over water construction areas.

O.1.3 IN-WATER CONSTRUCTION ACTIVITIES

The summary of in-water activities for the tunnel and trestle bridge construction will be limited to six primary actions:

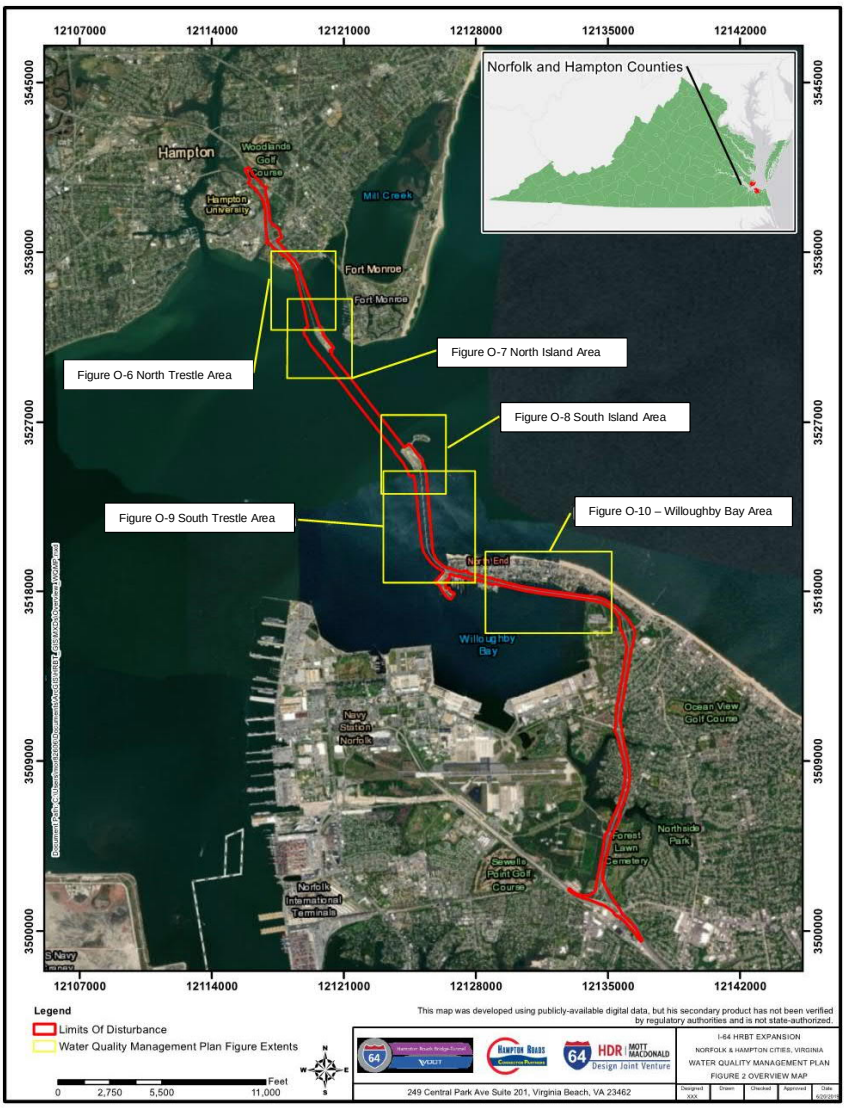
1. Construction and use of temporary docking and ship mooring areas within the Project's overall Limit of Disturbance;
2. Construction of engineered island expansions with bund material and other engineered fill (i.e. gradational stone, rip rap, armor stone) will include limited mechanical dredging, placement of sand after dredging, pile installation, sheet pile installation, followed by the addition of bedding stone, filter stone, and armor stone to complete the island expansion. Appendix E (of the JPA) further discusses the construction of the island expansions;
3. Construction of temporary dock quay structure on South Island to on-load/off-load the TBM and other construction equipment and materials;
4. Support structure construction for the off-loading via conveyor system of the TBM excavation materials;
5. Construction of the bridge trestle sections from South Island to Willoughby Spit, and across Willoughby Bay parallel to the existing trestle bridge; and
6. Construction of the bridge trestle sections from the North Island to the shore at Hampton.

Each of the primary actions is discussed in this section. All other construction activities will be conducted at the following: on the portal islands, underground (below the sediment-water interface) within the tunnel drive, within the installed tunnel structure, from/within the existing roadway and trestle

spans, or at approved upland disposal locations. Approximately 35 acres of upland area on the existing portal islands will be disturbed during construction and Project related island expansion. The portal islands are man-made and currently partially paved. Erosion and sediment controls as well as provisions of the construction general permit (VPDES for stormwater) will be in place during construction and an on-site wastewater treatment plant will be used for treatment of process water and discharged under a VPDES permit for treated water.

Figure O-1: Project Location

Figure O-2: Over Water Work Areas



At the South Island, an approximately 17,330 square foot (ft^2) temporary dock / unloading facility (TBM Quay, Quay) will be constructed on the west side of the island and will be used by barges and vessels delivering construction equipment and bulk materials. The quay structure will be supported by hollow steel pipe piles. In addition, up to four (4) mooring dolphins in front of the quay at South Island will be installed to accommodate barges involved in the construction. No dredging is required to support the temporary quay or the temporary mooring piles. Further, a Muck Quay for an unloading conveyor system is to be constructed adjacent to the TBM Quay. Five (5) mooring dolphins are to be constructed in front of the Muck Quay for the conveyor system at 50-ft spacing which will provide for docking (4) barges while loading.

It is estimated that vessels and barges ranging in size from 20 ft to 350 feet will deliver the necessary equipment and construction materials to the HRBT Project site over the 60-month construction period. Most of the barging/vessel traffic is expected to occur during the first 27 months of construction. Equipment and materials required for the HRBT Project will also be transported onto the portal islands via trucks throughout the construction period.

Hollow steel piles measuring 36 inches in diameter will be installed to support the TBM Quay at the South Island. In addition, hollow steel piles 36 inches in diameter will be installed to provide mooring facilities along the quay at the South Island (four dolphin moorings comprised of three piles each). The temporary Muck Quay off-island unloading conveyor (transfer of solids from the TBM excavation) will include a structure adjacent to the South Island with (5) mooring dolphins. Two temporary trestles 70 feet wide and extending 1000 feet are to be constructed at the northwest part of South Island to allow for ground improvement operations along the bored tunnel alignment. At the North Island piles will be installed for dolphins and temporary mooring locations around the island expansion area.

Construction of the North Trestle and South Trestle, as well as other temporary structures, will occur between May 2020 and July 2024. Installation for the temporary dock, mooring dolphins, temporary work platform trestles, and temporary roadway trestles will occur over approximately 4 years of construction commencing in May 2020 as shown in Table O-1 **Error! Reference source not found.**.

Table O- 1 In-Water Pile Installation Schedule

Pile Location	Pile Function	Anticipated Installation Date
South Island – Ground Improvement	Settlement Mitigation	July 2021 – October 2022
South Island TBM Dock	Temporary Dock	May 2020 – December 2020
Offshore Jet Grout Trestles	Temporary Platform	May 2020 – May 2021
Willoughby Bay Bridge & Temporary Trestles	Roadway Support & Temporary Work Platforms	September 2020 – October 2023
North Bridge Trestle & Temporary Trestles	Roadway Support & Temporary Work Platforms	May 2020 – September 2024
South Bridge Trestle & Temporary Trestles	Roadway Support & Temporary Work Platforms	May 2021 – July 2024
Willoughby Bay Bridge & Temporary Trestles	Roadway Support & Temporary Work Platforms	September 2020 – October 2023
Willoughby Spit Temporary Piers	Temporary Dock	September 2020 - February 2021
Mooring Piles for Safe Haven	Mooring Piles	May 2020 - February 2021

Between the existing South Approach Trestles an area has been identified for dredging which will be required to provide barge access during bridge demolition operations. Dredging is to be accomplished by mechanical dredging using a clam bucket. Figure O-3 indicates areas where the water depth is shallow and will require some dredging to allow barge traffic to access the South Trestle area for demolition. In addition, an area west of the existing South Trestles will require dredging for construction of the new South Trestles. Water quality monitoring up-current and down-current of these areas during construction will be necessary.

Figure O-3: Areas along South Trestle That Will Require Dredging for Barge Access

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In-water pile driving activities will also include installation of sheet piles for an in-water containment system required to facilitate construction of the engineered expansion of the South Island. Additional details regarding pile driving means and methods are described in Appendix E (Project Description) Section 10 Construction Means and Methods, including details on the types of piles being utilized and the different methods of installation. Appendix M (EFH Assessment) Appendix R (Marine Mammal Assessment) discusses noise impacts from the planned pile driving.

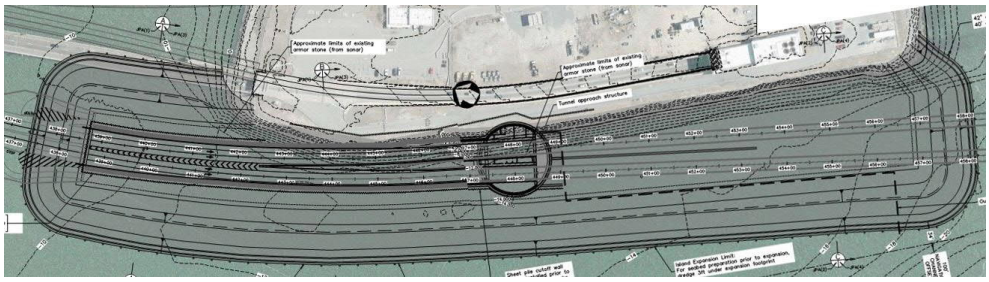
The North Island will have an engineered island expansion adding approximately 715,000 ft^2 to the footprint of the island (shown later in Figure O-4). Of this expansion, the island is being expanded approximately 325 feet to the north and parallel to the existing island on the western side for approximately 2,200 feet. The new area will be constructed by clearance dredging to the design depth, which then provides a suitable bottom for the engineered berm fill. The South Island will be expanded to encompass approximately an additional 150,000 ft^2. This South Island expansion will be mostly to the south end of the island, comprised of the same approximate 300 foot width of the existing island, but adding approximately 500 feet in length to the island (shown below in Figure O-5). This area will also be constructed on an engineered materials with specific fill and armor stone. The two engineered (island expansions) will provide structural support to the entry/exit sections of the tunnels and provide further areal extent for other tunnel support features. Initial boring from the South Island does not require that the island expansion be complete.

Construction of the engineered island expansions will require:

- Mechanical dredging of material at the North Island, and material at the South Island will be completed to remove existing rock and clear the footprint to enable installation of sheet pile sections, and engineered materials to complete island expansions.
- Final placement of external bedding, filter stone, and armor stone along the perimeter and side slopes to protect the expanded islands.

The constructed fill area landward out from the North Island will be approximately 325 feet from the current north end of the island will be constructed. During the construction activities of filling for island expansion and trestle placement for all bridge trestle improvements, up-current and down-current water quality monitoring data will be collected. **Error! Reference source not found.** depicts areas of the North Island expansion.

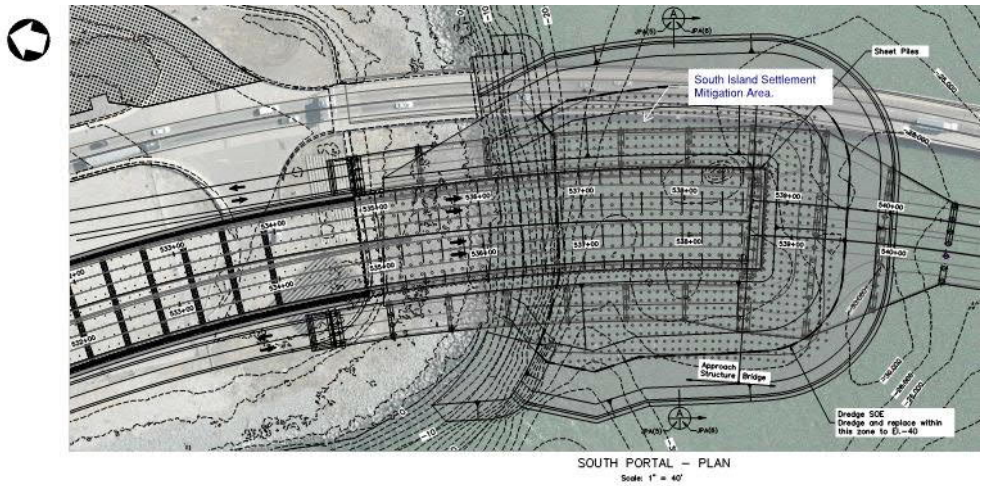
Figure O-4: North Island Expansion



The North Trestle structure to support the roadway and Movement of Traffic (MOT) temporary deck and roadway will be constructed by installing piles. During the construction efforts (pile driving), water quality monitoring will be conducted.

Settlement mitigation activities between the existing and the new tunnels are anticipated, and they will be conducted following construction of the engineered island expansion and prior to the initiation of the boring for the new tunnel. Settlement mitigation procedures will be accomplished through either jet grouting, sheet pile installation, or driving concrete piles. The mitigation procedures will be between the two tunnel alignments. For the South Island, approximately 250 linear feet of landward settlement mitigation actions will be installed. Figure O-5 depicts this location for the South Island.

Figure O-5: South Island Settlement Mitigation Area



O.1.4 WATER QUALITY MONITORING AND RESPONSE PLAN COMPONENTS

To comply with the Clean Water Act (CWA) Section 401 certification, Virginia Water Protection Permit, VPDES permits, Stormwater Construction General Permit (VPDES for Stormwater), and the conditions of the Virginia Marine Resources Commission (VMRC) permit for encroachment of subaqueous bottomlands, water quality monitoring will be performed prior to and during dredging and in-water construction activities to document that aquatic resources in the vicinity of the Project site will not be adversely impacted by HRBT Project construction activities.

This Water Quality Monitoring Plan:

- Describes the proposed locations and frequency of monitoring during dredging and in-water construction activities;
- Identifies the proposed water quality parameters to be monitored, the methodologies and/or instrumentation to be used, the quality assurance (QA) / quality control (QC) measures, and the proposed Data Quality Objectives (DQOs) needed for effective decision-making; and
- Describes the success criteria, regulatory reporting process, and the corrective action procedures for responding to water quality exceedances.

Additional specifics to monitoring during the demolition of the trestles as planned will be outlined in the demolition plan with details pertaining to the means and methods of demolition. Similar to the in-water construction activities, water quality will be monitored during the demolition phase up gradient and down gradient of the demolition activity that is over water.

Example water quality data collection sheets are provided as Attachment O-1 to this document.

This plan does not address the response plan for potential spills associated with oils or other hazardous substances during construction and in-water activity. Procedures for reporting and responding to spills will be documented in the Project Environmental Management Plan (EMP), the Spill Prevention, Control, and Countermeasures (SPCC) Plan and the Spill Prevention Response Plan (SPRP) Appendix S of the JPA. These plans will be maintained on-site and revised as required by ongoing project activities.

O.2 WATER QUALITY MONITORING METHODOLOGY

O.2.1 MONITORING DURING IN-WATER CONSTRUCTION ACTIVITIES

As presented in Section O.1.3, in-water activities for the HRBT Project will be limited to the following:

- Construction and use of temporary docking and ship mooring areas within the Project's overall Limit of Disturbance;
- Construction of engineered areas for the island expansions (one adjacent to each of the islands), will include limited mechanical dredging, placement of sand after dredging, pile installation, and sheet pile installation, followed by the addition of bedding stone, filter stone and armor stone to complete the island expansion area;

- Construction of TBM Quay structure on South Island for off loading the TBM, and related construction equipment and materials;
- Support structure construction for the temporary Muck Quay conveyor system and facilities to allow for removal of tunnel excavation spoils loaded into staged barges;
- Construction of the South Island temporary trestle structure to conduct ground improvement;
- Construction of the bridge trestle sections from South Island to Willoughby Spit, and across Willoughby Bay parallel to the existing trestle bridge;
- Construction of the bridge trestle sections from the North Island to the shore at Hampton; and
- Demolition activities associated with the dismantling of temporary trestles and old trestles replaced by new construction.

These in-water activities will be restricted to the Project's overall Limit of Disturbance footprint which is shown in Figure O-1 and Figure O-2.

Water quality monitoring will be limited to those in-water activities that are not 'confined,' and therefore have the potential to affect ambient quality of Willoughby and Chesapeake Bay waters. The sheet pile monitoring may be eliminated if early results confirm that water exchange is minimal and no longer determined to have the potential to create a plume. Confirmation may be made that the piling during installed shows no negative increases over background in monitoring criteria over a period of several days or the piling being installed is no longer in contact with a water body (i.e. the piling being installed now is "upland" away from water body contact). Monitoring during unconfined in-water construction activities will include measurements of:

- Turbidity (Nephelometric Turbidity Units [NTU]);
- Dissolved oxygen (DO) (milligrams per liter [mg/L]);
- pH (standard units); and
- Temperature (˚C).

Monitoring locations will be determined each morning based on communication with Project Construction Manager to determine what, when, and where in-water activities are expected to occur. Monitoring stations will be located approximately 500 feet up-current and down-current from the point of dredging or other in-water activity (e.g., island expansion construction, in-water sheet piling, armor stone placement, jet grouting). If multiple in-water activities are occurring simultaneously, additional monitoring locations will be sampled. Water quality monitoring locations will be located at the estimated 500 feet up-current and down-current locations adjacent to each of these various concurrent in-water activities.

Daily water quality monitoring per this Water Quality Monitoring Plan (WQMP) will begin 5 days before in-water construction activities are initiated to orient staff with the specified sampling program methods and reporting procedures, and to establish baseline conditions in the Project area.

Water quality monitoring will be conducted daily during daylight hours at approximate peak flood or peak ebb tidal flow conditions opposite where in-water work is occurring, both in the up-current

direction and the down-current direction. Current velocity varies daily throughout a tidal cycle, typically reaching a maximum during peak flood or peak ebb conditions before steadily decreasing in between these periods. Sampling at these higher velocity periods will allow the contractor to better characterize the extent of in-water construction related activity. Using current National Oceanic and Atmospheric Administration (NOAA) tide predictions for Naval Station Norfolk LB7 CB0402 and tidal current predictions for Thimble Shoal Channel Station CB 0301, the contractor will determine the best time for monitoring in-water activities based on the predicted peak flood or peak ebb events.

Using this tidally-dictated approach, monitoring data will be generated each day to address flood or ebb tide conditions. Spring and neap tide events will each occur approximately twice a month and will be reflected in the data. The contractor will make a note in the field log book when monitoring is being conducted during spring or neap tidal conditions. At each monitoring location, water column measurements will be taken at three depths: surface (1 ft below), mid-depth, and bottom (approximately 3 ft above sediment surface) adjacent to where in-water construction activity is occurring. Setback monitoring will normally be conducted 500 ft up-current and 500 ft down-current. If an obvious visible plume is identified, additional readings will be taken 500 ft further down current and will be immediately reported to the responsible Construction Manager and applicable agencies. The operations will be evaluated and changed to eliminate the plume. The readings will be monitored on a 15 minute basis for up to an hour or longer to record condition until the level of measured exceedances decreases to below the reporting threshold limit. If a water quality exceedance is measured, the water quality Monitoring Team Leader will immediately (within 15 minutes or sooner) contact the Construction Manager, the Environmental Compliance Manager. The Environmental Compliance Manager will contact the Virginia Department of Environmental Quality (VDEQ), USACE and VMRC.

Additionally, background locations (located up-current or down-current of the in-water activity areas) will be sampled daily during approximate peak flood or ebb tidal flows. The near-field and far-field background locations will be positioned at distances of approximately 1,000 and 2,500 ft up-current, and approximately 1,000 and 2,500 ft down-current from the specific in-water Project areas (Figure O-2). Up-current and down-current data collected at the 500-ft locations will be compared to the up-current and down-current background values (for interpreting turbidity data see Section O.2.5.1).

Monitoring locations will be determined each day based on the position of the in-water activity. The monitoring field crew will communicate with the Construction Manager each morning to determine what, when, and where in-water activities are expected to occur. In-water activities may be temporarily disrupted or intermittent within a workday. If daily in-water activities are intermittent or temporarily disrupted during peak tidal flows, daily monitoring will be conducted outside of the window of peak tidal flow when in-water activity resumes. The monitoring will be initiated or will resume within approximately 30 minutes following re-initiation of in-water activity. **Error! Reference source not found.** through Figure O-10 depict a typical monitoring scenario for the North Trestle, North Island, South Island, South Trestle, and Willoughby Bay Trestle locations respectively. The locations depicted in the figures are typical but not set, as the positions will move in accordance with construction activity locations to best monitor the water quality that may be affected by the construction.

To establish protocol for monitoring standards background water quality data measurements are to be taken. During the collection of background levels initial trigger levels of monitoring data will be at 50

percent greater than background turbidity units Nephelometric Turbidity Unit (NTU) whereby then monitoring will increase in frequency to every 15 minutes until levels drop below 50 percent. If levels remain sustained greater than 50 percent for longer than 1 hour reporting of the event will occur. Initial reporting will be to the Construction Manager and the agencies in that a sustained event of increased turbidity is being recorded. Upon reporting action is to be taken to reduce the event by altering construction activity for 15 minutes to see If the turbitity dissipates. If the elevated readings continue stop construction and determine if alternate means of construction activity can be implemented. Alternative methods can include administrative controls (such as performing the work at a lesser frequency i.e. hammer the pile in slower intervals) . Other engineering controls may also be needed mitigate the turbidity. The following table outlines the reporting approach and action limits.

Table O- 2 NTU Monitoring Criteria

Monitoring Readings (NTUs)	**Actions**
0-50% Above Background	Continue to monitor on normal frequency, approximately 1/ hour
50-75% Above Background	Increase monitoring frequency to 1/ 15 minutes Report event Begin Mitigation actions • Administrative Controls • Engineering Controls If with continued monitoring a decrease in turbidity levels is not recorded stop work and monitor for 15 minutes to see if dissipation of turbidity occurs. If not, more aggressive Engineering controls may be required.
>75% Above Background	Stop work for 15 minutes to see if levels decrease. Increase monitoring frequency to 1/ 15 minutes Report event Begin Mitigation actions • Administrative Controls • Engineering Controls If mitigation does not successfully decrease turbidity evaluate situation to see if there is a different means to facilitate the construction activity. Mitigation examples could be slowing the rate of pile driving hits per minute, or for dredging slowing the rate of bucket travel through the water column.

Studies of the effects of turbid water on fish suggest that concentrations of suspended sediment can reach thousands of milligrams per liter (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)).

Several project activities have the potential to disturb the river bottom and re-suspend sediments potentially contaminated with polychlorinated biphenyls (PCBs), metals, semi-volatile organic compounds (SVOC)s, and other contaminants. These activities include pile driving, dredging, trestle demolition, and vessel operation. 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 Study Area Corridors appear to be below the effects range low (ER-L) threshold, all metals appear to be below effects range medium (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 re-suspended contaminants.

Figure O-6: North Trestle Area

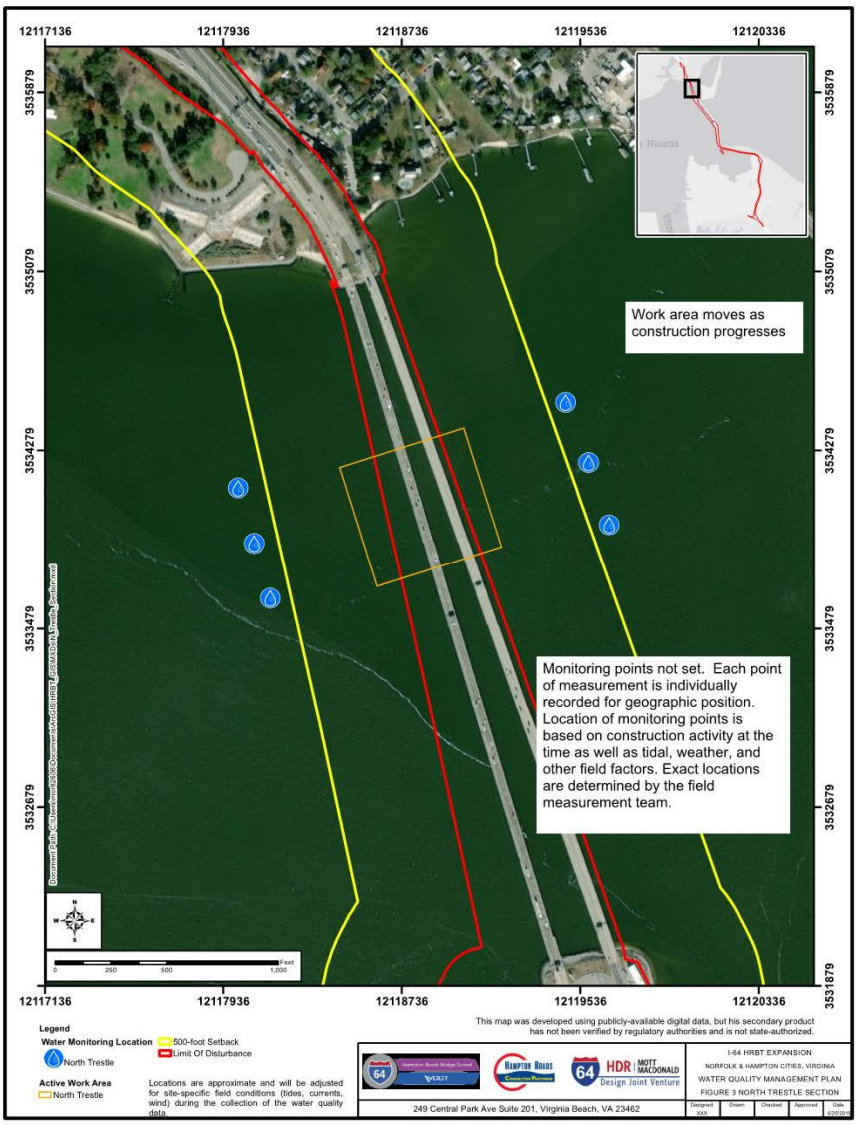


Figure O-7: North Island Area

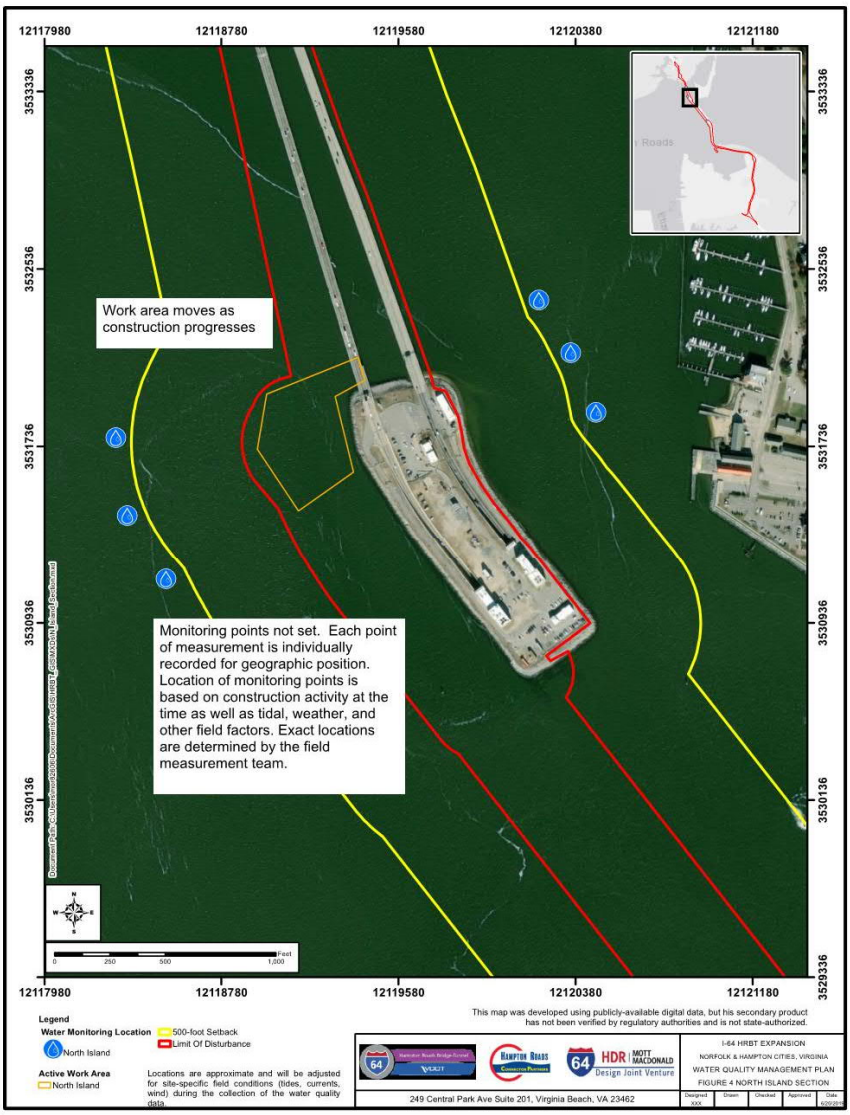


Figure O-8: South Island Area

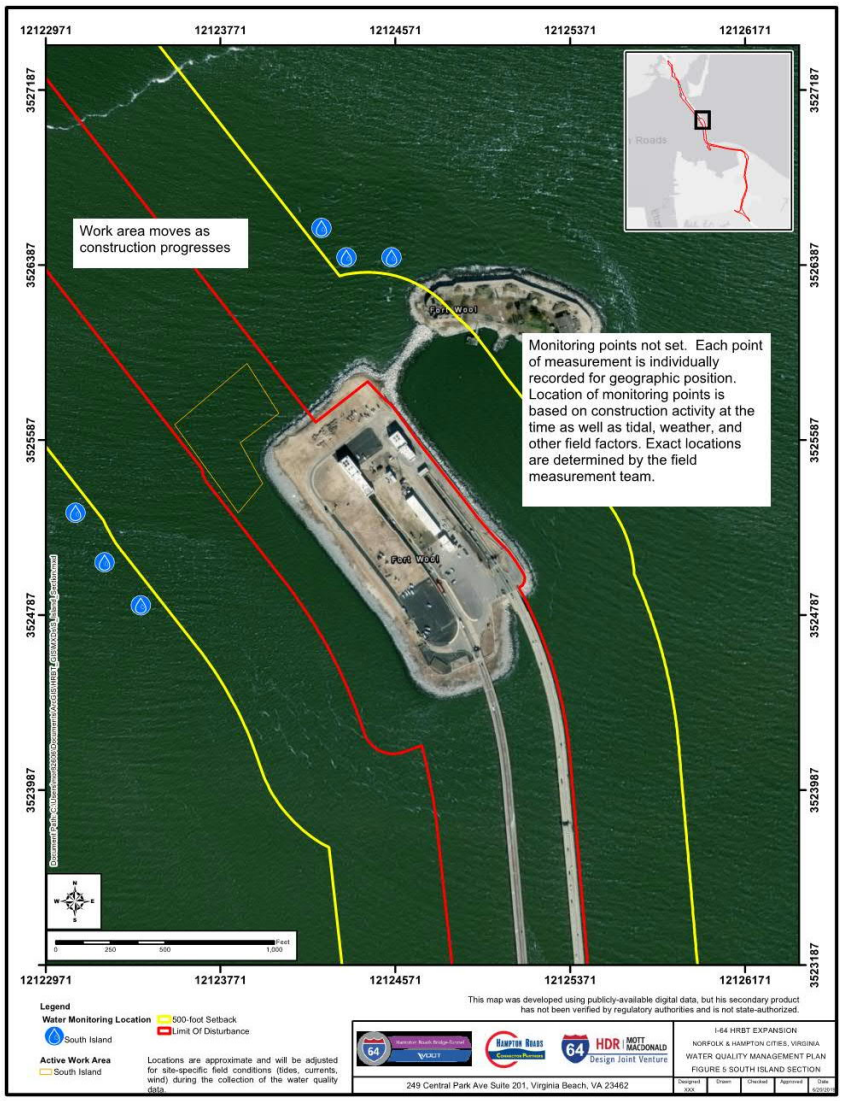


Figure O-9: South Trestle Area

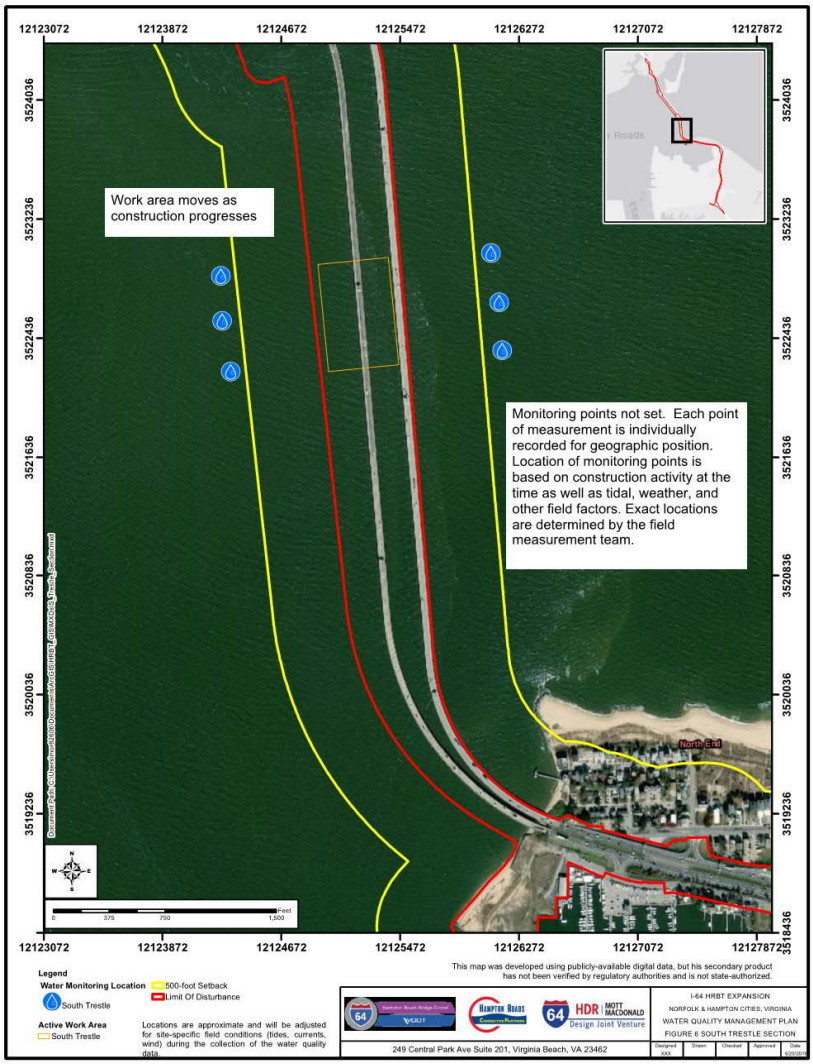
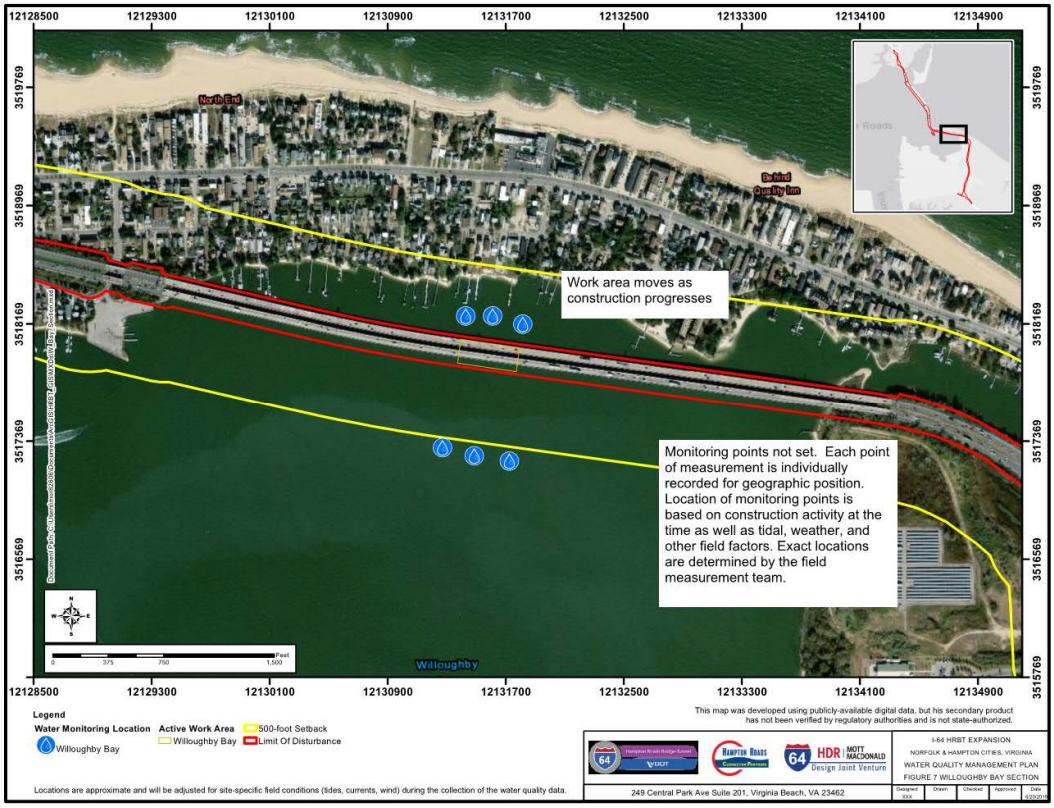


Figure O-10: Willoughby Bay Area



A daily log of the type, duration, and location of in-water activity will be maintained by the Project Environmental Compliance Manager. If in-water activities are suspended for a period of 24-hours or longer, monitoring will cease and resume within 24-hours of the re-initiation of in-water activity. If a sample cannot be collected for any reason (e.g., no in-water activity occurred during daylight hours or due to adverse/unsafe weather conditions), the rationale shall be provided in the daily monitoring report. Breaks of longer than 24 hours in the daily monitoring schedule will be communicated to the VDEQ via email.

At each location where water quality is measured, the position coordinates will be recorded in the field using a Differential Global Positioning System (DGPS). Visual observations (such as weather conditions and the presence/absence of a visible turbidity plume), as well as the water column depth (ft) for each measurement (surface, mid, and bottom) will also be recorded daily for each sampling location. A daily field logbook and/or data sheets will be completed each day. The logbook and/or data sheets will be completed in indelible ink and will include the sampling date, coordinates, sampler's name, weather conditions (e.g., approximate wind direction and velocity), tide stage, sea state, precipitation), data measurements, and other pertinent field conditions that could influence the monitoring data measurements/values.

O.2.2 MONITORING ADJACENT TO SILT/TURBIDITY CURTAINS

Turbidity curtains are commonly used for containing suspended sediments and turbidity within the water column such that plumes do not encroach upon specific sensitive environmental resources (e.g., oyster beds). However, as discussed in the U.S. Army Corps of Engineers (USACE) Dredging Project Management Practice Report (2005), they are most effective in relatively shallow quiescent water and do not work under many dynamic conditions that are encountered in navigation and environmental dredging projects in open water areas. The USACE Report concludes that "Currents greater than 1.0 to 1.5 knots are problematic…and silt curtains should not be used in current velocities greater than 3.0 to 5.0 knots unless there are unusual circumstances…"

The majority of in-water work for the Project will be conducted under conditions described above as being unsuitable for use of turbidity curtains; therefore, turbidity curtains will not be used for the Project with a few exceptions. Turbidity curtains may be used in shallow, quiescent water such as Oastes Creek and Mason Creek, on a case-by-case basis. If they are used, the turbidity curtains will be monitored for effectiveness during construction.

O.2.3 INSTRUMENTATION

A multi-parameter water quality sonde (e.g., Hydrolab Model DS5, YSI Model EXO2 or equal) with real-time output will be used to measure dissolved oxygen (DO) (mg/L), pH, temperature (°C), and turbidity (NTU). The DO instrument will have a limit of detection of approximately 0.1 mg/L. The pH meter will have a limit of detection of 0.1 Standard Units. Temperature accuracy is approximately 0.1 °C. Detection limits for turbidity will be approximately 0.1 NTU. Data will be recorded in a field logbook and/or on water quality data collection sheets (Attachment O-1).

O.2.4 QA AND QC

Electronic field equipment will be calibrated and undergo a QC check as specified for the specific instrumentation used. The accuracy of the DGPS will be checked by positioning the sampling vessel at a consistent, fixed location and comparing the DGPS coordinates against the actual coordinates. The multi-parameter water quality sonde will be calibrated according to the manufacturer's instruction manual. Calibration and QC checks for each water quality probe will be recorded on pre- and post-sampling field calibration sheets (Attachment O-2 *to be inserted upon procurement of instruments). Instrument models, serial numbers, lot numbers, and expiration dates of calibration standards will also be recorded.

O.2.5 SUCCESS CRITERIA, REPORTING, AND CORRECTING MEASURES

O.2.5.1 MONITORING DURING DREDGING AND IN-WATER CONSTRUCTION

Based on monitoring requirements for other regional dredging and in-water construction projects (EA 2012; ERP 2010), it is expected that the water quality turbidity goal will be set at 50 NTU above background. Operational controls/BMPs will be considered successful if turbidity at the 500-ft distance from the dredging or in-water activity is less than or equal to 50 NTU above background measurements.

The DO and pH goals are to be met at a distance of 500 ft from the in-water activity and will be set at VDEQ's water quality standards:

- VDEQ's water quality standard for pH in Estuarine or Ocean waters is a range of 6 to 9 pH Standard Units.
- VDEQ's water quality standards for DO in the Chesapeake Bay and tidal tributaries are complicated due to designated use categories, seasonality, temperature and averaging periods (9VAC25-260-185). VDEQ's applicable DO criteria are summarized in Table O-3 below:

Table O-3: Chesapeake Bay Criteria for Dissolved Oxygen (9VAC25-260-185)

Open Water	
30-day mean	≥5.0 mg/L
7-day mean	≥4.0 mg/L
Instantaneous minimum @ <29°C	≥3.2 mg/L
Instantaneous minimum @ ≥29°C	≥4.3 mg/L
Instantaneous minimum	≥5.0 mg/L (1 Feb-31 May)
Deep Water*	
30-day mean	≥3.0 mg/L (1 Jun-30 Sept)
1-day mean	≥2.3 mg/L(1 Jun-30 Sept)
Instantaneous minimum	≥1.7 mg/L (1 Jun-30 Sept)

The monitoring contractor will develop a spreadsheet where monitoring data from the various sampling locations will be added daily to address VDEQ's ambient water quality standards for DO, pH, temperature, and the Project-specific turbidity goal. This spreadsheet will be submitted to VDEQ, USACE, and VMRC monthly and will compare the monitoring data to applicable numeric water quality standards and turbidity goals. As noted, VDEQ's water quality standards for DO in Chesapeake Bay waters are complicated due to designated use categories, seasonality, temperature, and averaging periods. The proposed spreadsheet will present instantaneous DO concentrations, as well as applicable 1-day, 7-day, and/or 30-day average DO concentrations on a rolling average basis (see Table O-3). Deviation of specific numeric criteria will be noted.

Based on the results of the monitoring during the first 6 months of in-water activities, the frequency of monitoring may be reduced in consultation with the VDEQ and USACE. This reduction may be based on consistently negligible turbidity values above background for a recurring activity, and/or may be applicable to certain types of in-water activities that do not generate substantial turbidity. Repeated or substantial exceedances of the turbidity goal value or state water quality standards for DO and pH may require adjustments to equipment, adjustments to operational BMPs, or inclusion of additional BMPs to reduce suspended solids. If a water quality exceedance is measured, the water quality Monitoring Team Leader will immediately(within 15 minutes or sooner) contact the Construction Manager, the Project Environmental Compliance Manager. The Project Environmental Compliance Manager will contact the VDEQ, USACE and VMRC.

O.2.5.2 TURBIDITY

Monitoring points will be approximately 500 ft up current and down current from the construction activities. Exact locations will be determined in the field. Other factors determining exact position for the monitoring are safety of the crew, wave, wind, weather conditions, and other maritime traffic. Operational controls/BMPs will be considered successful if turbidity at the 500-ft distance from the dredging or in-water activity is less than or equal to 50 NTU above background measurements.

On the water quality data collection sheets (Attachment O-1) relevant date, time, location, and other information is recorded. Turbidity is recorded at 3 levels within the water column: just below the surface, mid-point, and approximately 3 ft above the sediment bottom. The NTU readings are recorded on the form for each measurement made.

O.2.5.3 TEMPERATURE

Temperature data is to be collected concurrent with collection of the turbidity information, pH, and DO levels. Similar to turbidity data collection described in Section O.2.5.2, temperature data is to be collected at each monitoring point approximately 500 ft up-current and down-current proximal to the active in-water construction activities. Temperature is to be recorded in ^{o}C on the water quality data collection sheets (Attachment O-1).

O.2.5.4 DISSOLVED OXYGEN

Dissolved Oxygen (DO) readings are to be collected at the same time/locations as turbidity and temperature. The DO reading is to be recorded on the data collection form for the Project records. As noted, the DO water quality standards for the Chesapeake Bay waters are complicated due to designated use categories, seasonality, temperature, and averaging periods. With the data collected and complied, it will be parsed to present instantaneous DO concentrations, as well as applicable 1-day, 7-day, and/or 30-day average DO concentrations on a rolling average basis. This database then will have record of the DO readings during the construction period and can be evaluated further in comparison to the Chesapeake Bay Criteria.

O.2.5.5 PH

Readings for pH are to be recorded on the data collection form at each of the monitoring locations concurrent with the collection of turbidity, temperature, and DO. The pH standard is between 6-9 Standard Units. As the pH data is recorded, any measurements outside of the standard are to be verified and reported. Tabulation of the data will be compiled for the Project records and periodic monthly reporting.

O.2.5.6 DATA QUALITY OBJECTIVES

DQOs are necessary to ensure that data collected is sufficient and suitable for decision-making. DQOs for this Project include the type, quantity, and quality of data needed to allow for identification of elevated turbidity values or low DO values that could adversely affect the aquatic environment. The turbidity values collected daily, approximately 500 ft from the location of in-water activity, will be compared to measured background values to determine if, and the magnitude by which, turbidity values are elevated above background. The collected data will allow for identification and implementation of corrective actions, BMPs, and operational changes (if needed and as appropriate), to minimize and reduce turbidity throughout the project construction period.

Dissolved oxygen data will be used to determine if concentrations drop below VDEQ's ambient water quality standards for DO (which are summarized in Table O-3 above).

Field instrumentation will be capable of and suitable for measuring: turbidity ranging from 0 to 1,000 NTU (with a detection limit of approximately 0.1 NTU); DO ranging from 0 to 20 mg/L (with a detection limit of approximately 0.1 mg/L); temperature accurate to 0.1°C; and pH ranging from 0 to 14 (with a detection limit of approximately 0.1 Standard Units). The accuracy of the multi-parameter water quality sonde will be sufficient to meet the DQOs of the water quality monitoring plan for this Project.

Exceedances of the turbidity goal, ambient water quality standards for DO and pH, and a description of corrective actions will be reported by the Project's Environmental Compliance Manager to VDEQ and VMRC via phone call and email within 4 hours following notification of the exceedance event. A written memorandum will be transmitted via email to VDEQ and VMRC within 24 hours of the exceedance event or on the next work day if it occurs outside of normal work hours. Turbidity data (with the exception of exceedance events), DO, pH, and water temperature data will be reported to VDEQ and VMRC in spreadsheet format at the end of each calendar month. An electronic copy of the daily log of the type, duration, and location of in-water activity (maintained by the Project's environmental compliance manager) will also be provided with the monitoring data.

O.3 REFERENCES

COWI Marine North America. 2015. Parallel Thimble Shoal Tunnel- Ocean Engineering Report. Prepared for the Chesapeake Bay Bridge and Tunnel District. Project No. A064489. August.

Burton, W.H. 1993. Effects of bucket dredging on water quality in the Delaware River and the potential for effects on fisheries resources. Versar, Inc., 9200 Rumsey Road, Columbia, Maryland 21045.

EA Engineering, Science, and Technology, Inc., PBC (EA). 2012. Water Quality Monitoring Response Plan. Midtown Tunnel/Downtown Tunnel/MLK Extension Project. Prepared for P.B. Americas, Inc.

Elizabeth River Project (ERP). 2010. Money Point – Phase 2: Water Quality Sampling and Restoration Monitoring Plan – Amended, Chesapeake, Virginia.

U. S. Army Corps of Engineers. 2005. Silt Curtains as a Dredging Project Management Practice. Report Number ERDC-TN-DOER-E21.

ATTACHMENT O-1: WATER QUALITY DATA COLLECTION FORM

(Example)

Report No. _____ Revision _____

WATER QUALITY DATA COLLECTION FORM

Sampler Name _____

DATE _____ Weather _____

TIME _____

LOCATION LAT _____ LONG _____

DEPTH[1] in ft	TOP	MID	BOTTOM
Turbidity in NTU[2]			
Dissolve Oxygen (DO) in mg/l			
pH Standard Units			
Temperature (°C)			

General Notes:

Notes: 1. Depth, Top is within 1.0 foot of surface, Bottom is 3 feet off bottom, and mid is half way between the two.
2. Turbidity NTU = Nephelometric Turbidity Units

ATTACHMENT 2 INSTRUMENTATION QC CALIBRATION REQUIREMENTS *

(to be provided upon procurement of instruments)