US Army Corps of Engineers
Baltimore District

MARYLAND DEPARTMENT OF TRANSPORTATION
MARYLAND PORT ADMINISTRATION

BALTIMORE HARBOR ANCHORAGES AND CHANNELS (BHAC) MODIFICATION OF SEAGIRT LOOP CHANNEL FEASIBILITY STUDY

DRAFT INTEGRATED FEASIBILITY REPORT & ENVIRONMENTAL ASSESSMENT

APPENDIX B:

ENGINEERING

FEBRUARY 2022

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1. Introduction

The U.S. Army Corps of Engineers (USACE) Baltimore District (CENAB), in partnership with the Maryland Department of Transportation Maryland Port Administration (MDOT MPA), is evaluating the advisability of modifications to the Baltimore Harbor Anchorages and Channels (BHAC), particularly pertaining to the Seagirt Loop, which includes the West Dundalk Branch Channel, the Dundalk-Seagirt Connecting Channel, and the West Seagirt Branch Channel. This Engineering Appendix details the methodology, assumptions, and analyses completed to determine sufficient details to prepare costs of alternatives for plan formulation leading to a national economic development (NED) plan.

The lead federal agency for this study is USACE. The non-federal sponsor for this study is the MDOT MPA.

2. Existing Federal Channels

2.1. General

The Port of Baltimore's (POB) harbor is located on a 32-square-mile area of the Patapsco River and its tributaries, approximately 12 miles northwest of the Chesapeake Bay. Container ship traffic enters the Port through federally authorized Baltimore Harbor Channels that run from the Atlantic Ocean by two distinct shipping routes: from the south through the Virginia Capes and the Chesapeake Bay, or from the east through the Delaware Bay, Chesapeake and Delaware (C&D) Canal, and the Chesapeake Bay. The Port includes three federal dredging projects; the BHAC Project (which is dredged to various depths), the 42-Foot Project, and a portion of the 50-Foot Project.

Baltimore Harbor encompasses many channels that provide access to the public and private terminals serving the POB and several anchorages serving those ports (Figure 1). The Baltimore Harbor Channels are defined as those channels west of the North Point-Rock Point line in the Patapsco River. The federally authorized channels located within the Baltimore Harbor are Curtis Bay Channel, Curtis Creek Channel, Middle Branch Channel, Ferry Bar East, Northwest Branch (East and West Channels), East and West Dundalk Branch Channels, Dundalk/Seagirt Connecting Channel, West Seagirt Branch Channel, South Locust Point Branch Channel, Brewerton Channel, Brewerton Angle, and Fort McHenry Channel.

The POB is the farthest inland port on the east coast. The Baltimore District presently maintains approximately 18 nautical miles of navigation channels within the harbor, which are used intensively for both commercial and recreational vessels. Other channels within the harbor are maintained by MDOT MPA, private terminal owners, and various commercial interests. Historically most channels have been maintained as two-way

channels; however, increasing vessel sizes often limit certain channels to one-way traffic due to limitations imposed by channel width or channel depth. The West Seagirt Branch Channel, for example, is maintained for vessels outbound to the Fort McHenry Channel but can only accommodate vessels up to El. – 45 feet mean lower low water (MLLW). Larger vessels requiring a deeper draft must back out from the Seagirt Marine Terminal, turn around in a turning basin, and transit outbound through the West Dundalk Branch Channel. Figure 1 shows the study area and the existing navigation channels within the POB. The channels of interest to this study are described in detail below.

The goal of this study is to reasonably maximize the contribution that the Seagirt Loop channels provide to NED, consistent with protecting the Nation's environment, by addressing the physical constraints and inefficiencies in the existing navigation system's ability to safely and efficiently serve the current and forecasted vessel fleet and process the forecasted cargo volumes.

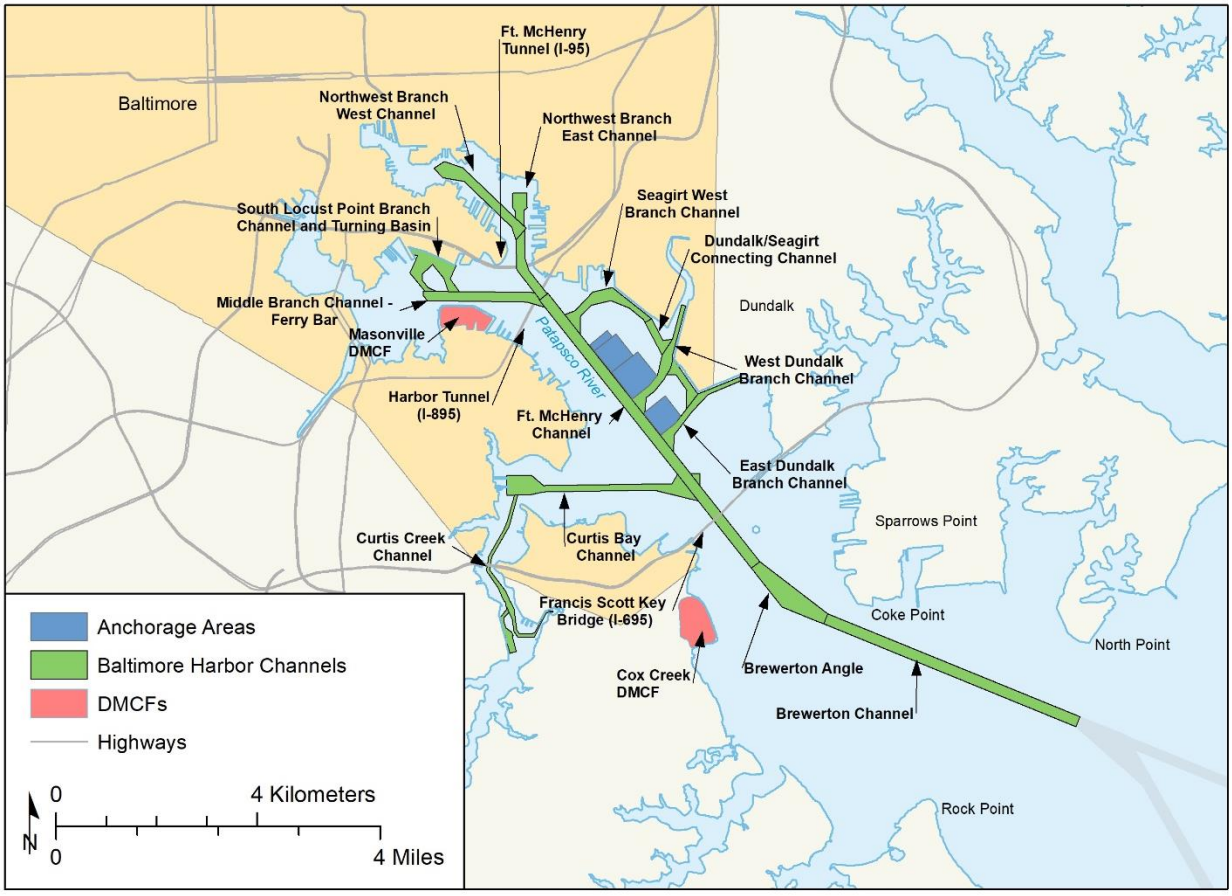

Figure 1. Baltimore Harbor Federal Channels, Anchorages, and dredged material containment facilities (DMCFs). (USACE 2017)

2.1.1. West Dundalk Branch Channel

The West Dundalk Branch Channel serves the Seagirt and Dundalk Marine Terminals. The Dundalk Marine Terminal, a 570-acre cargo terminal, is the largest general cargo facility at the POB. This terminal handles containers, automobiles, farm, construction and other Roll-on/Roll-off (Ro/Ro) equipment, wood pulp, steel, breakbulk, and project cargo. The West Dundalk Branch Channel is authorized to 500 feet wide by 0.67 nm long and is federally maintained to a depth of 42 feet and state maintained to a depth of 50 feet MLLW.

2.1.2. Seagirt/Dundalk Connecting Channel

The Seagirt/Dundalk Connecting Channel provides access to both the Dundalk and Seagirt Marine Terminals. The Seagirt Marine Terminal is a state-of-the-art, 284-acre container terminal, currently capable of handling 450,000 containers a year. The terminal has 4 ship berths, including two 50-foot berths, with a total of 15 cranes, 8 of which are super post-Panamax size with an outreach of 23 containers wide, thus providing the capability of unloading and loading new-Panamax ships. The Seagirt/Dundalk Connecting Channel is authorized at 500 feet wide by 0.42 nm long. The channel is federally maintained to a depth of 42 feet MLLW and state maintained to a depth of 50 feet MLLW.

2.1.3. West Seagirt Branch Channel

The West Seagirt Branch Channel allows for outbound transit of vessels from the Seagirt Marine Terminal. This channel is authorized to 500 feet wide with an actual average width of 655 feet wide by 0.86 nm long and is federally maintained to a depth of 42 feet MLLW and state maintained to a depth of 45 feet MLLW.

2.2. Physical Conditions of Baltimore Harbor

2.2.1. Climate

The project area has a continental type climate with four distinct seasons, although extreme winter and some temperatures are moderated somewhat by the Chesapeake Bay. The average annual temperature is 62 degrees F, with the highest temperatures occurring in late July (the average maximum is 89 degrees F) and the lowest temperatures occurring in January and February (the average minimum is 21 degrees F).

Annual precipitation ranges from 40 to 44 inches, distributed fairly evenly throughout the year. The lowest average monthly precipitation (2.57 inches) occurs in January and the highest (4.26 inches) in August. Winter low pressure systems moving up the Atlantic coast cause most of the precipitation during the cold months, while summer showers and

thunderstorms provide warm weather precipitation. Average snowfall in the project area is 20 to 25 inches, mainly occurring in December, January, and February.

The prevailing winds are southerly from May through September and west-northwesterly to northwesterly during the rest of the year. Hurricanes, blizzards, tornadoes, and other destructive storms are uncommon.

2.2.2. Tides, Currents, and Wind

The tide range is approximately 1 foot in the project area. In the larger Chesapeake Bay area, the mean range of tide is 2.8 feet at the Cape Henry Channel, 2.3 feet at the York Spit Channel, 1.4 feet at the Rappahannock Shoal Channel, 0.8 feet at the Craighill Entrance, 0.9 feet in the Craighill Upper Range, 1.1 feet at Fort McHenry, and 1.2 feet at Pooles Island in the upper Chesapeake Bay. Prolonged high winds from the north tend to blow water out of the bay, resulting in unusually low tides, and prolonged high winds from the south tend force water into the bay, resulting in unusually high tides.

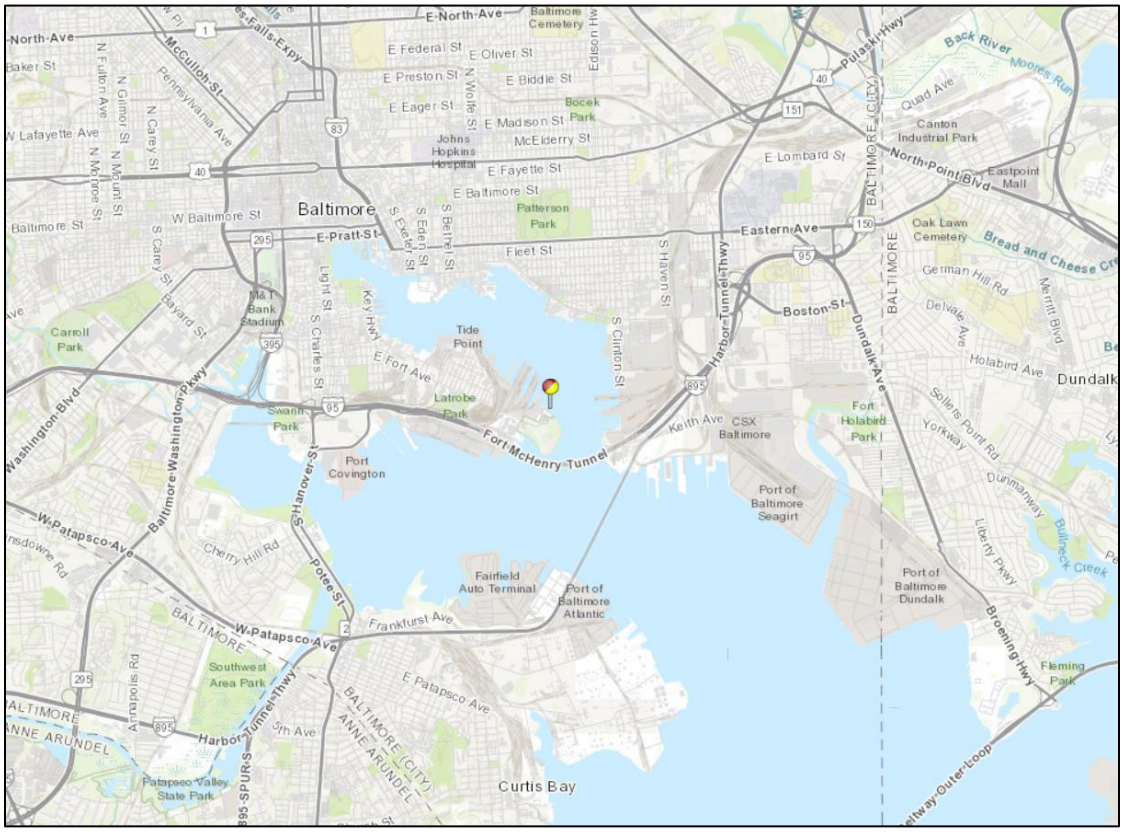

Figure 2. Location of NOAA Water Level/Meteorological Station at Fort McHenry (Station ID: 8574680).

Water levels in the Chesapeake Bay are dominated by a semidiurnal lunar tide, which is a tide multiple times a day driven by the gravitational pull of the moon. Tides enter the Bay via the Chesapeake Bay entrance and the C&D Canal. The combination of tides and freshwater inflow creates a spring tide (a high tide caused by a new or full moon) approximately 30 to 40 percent larger than mean tide and a neap tide (the lowest tides that occur during quarter and last quarter phases of the moon) approximately 30 to 40 percent smaller than the mean tide (Schubel and Pritchard 1987). While a single NOAA monitoring station is located in the vicinity of the project area (Figure 2), hydrodynamic studies of the Baltimore Harbor (Boicourt and Olson 1982) included field measurements of current velocity, temperature and salinity at several locations in the Patapsco River. Results from the study's tidal current measurements indicated the existence of a three-layer, density-driven circulation that can dominate flow such that typical semi-diurnal tidal current direction reversals (shifting between high and low tide) do not necessarily occur. The study also determined that wind events often dominate circulation patterns, especially within the Middle Branch and the tributaries; however, high flow events from the Patapsco River often produce a typical two-layer estuarine circulation. Two-layer circulation consists of fresh river water flowing out on the surface and higher salinity bay water flowing in at the bottom. The study determined that the short-term variability of circulation and density is as significant as seasonal variability.

2.2.3. Sediment Quality in Baltimore Harbor

Bottom sediments in the Chesapeake Bay and approach channels to Baltimore Harbor are predominantly clayey silt, with some locations containing a fraction of sandy material (CENAB 1997 and EA EST 2019). The upper Chesapeake Bay and Baltimore Harbor are zones of sediment deposition. The principal source of sediment is the Susquehanna River. The bottom sediments in the study area are generally characterized as soft, highly plastic, organic silty clay. The upper layer of sediment in the project area, varying from 0.5 to 3 feet thick, exists primarily in a semi-liquid state.

Sediment characteristics have been obtained from previous reports (CENAB 1997, MDOT MPA 2019, and EA EST 2019). In general, the site is characterized by very fine silt and clay sediments with a very low percentage of sand sediments. Surveys of bottom sediments by the Chesapeake Biological Laboratory in 1997 found that the sediments in the Patapsco River near the Masonville DMCF consisted of 90 to 95 percent silts and clays, while sediments closer to the mouth of the Patapsco were comprised mainly of sand sediments (CENAB 1997). Analyses conducted in 2019 confirm that sediments remain consistent with the 1997 survey findings (EA EST 2019).

Sediments in Baltimore Harbor/Patapsco River contain contaminants from industrial and municipal sources as well as from non-point sources as would be expected in an

urbanized/industrialized region. Studies indicate that sediments in some areas of Baltimore Harbor presently exhibit toxic characteristics, and sediment toxicity in tributary creeks and bays is patchy. Due to these characteristics, by law, all dredged material in the Harbor is considered contaminated and must be taken to a containment facility within the Harbor.

2.2.3.1 West Seagirt Branch Channel and Seagirt/Dundalk Connecting Channel

Under contract with the MDOT MPA and Gahagan & Bryant and Associates (GBA), Soil and Land Use Technology, Inc. (SaLUT) performed an extensive sampling program in 2019 in support of a study to deepen the Seagirt Loop Channel. Fifty-six borings were drilled to an elevation of approximately -60 feet MLLW. Borings were located afront Berth 1, Berth 2, Berth 3, in the Seagirt-Dundalk Connecting Channel, and in the West Seagirt Branch Channel (Appendix B1).

In nearly all boreholes, dark gray to grayish-brown and black silt and clay was encountered to the full depth of the borings. Blow counts ranged from Weight of Rod (WOR) to 15 blows per foot. Lab testing on representative samples indicates that the average moisture content of the material is 121.2 percent, fines content is 81 percent, plasticity index is 64 percent, and liquid limit is 108 percent. Given the in-situ moisture content of the sediments exceeds the liquid limit, the sediments exist in a liquid state. Blow counts indicate that the material is exceptionally weak and exhibits nearly no shear strength.

Analysis of a multi-beam survey performed by USACE Baltimore District in January 2021 shows the range of natural side-slopes that are achieved after dredging the channels. While some side slopes are as steep as 2H:1V (2:1) and 3:1, side slopes are generally between 4:1 and 5:1. If not for the low unit weight (approximately 86 lb/cubic foot given the average properties above), the side slopes would be much shallower because of the low shear strengths.

2.2.3.2 West Dundalk Branch Channel

Under contract with MDOT MPA and GBA, Findling Inc. performed a geotechnical investigation of the West Dundalk Branch channel in 2012 in support of the proposed widening and deepening of the channel. The widening and deepening have since been completed. A total of 15 borings were drilled in the area in which the channel was widened.

All borings contained surficial layers of dark gray to green silt with trace fine sand. Beneath the surficial layer of silt, brown silty fine to coarse sand with varying amounts of

gravel was found. The sand layer was encountered anywhere from approximately El. -43 feet MLLW to El. -53 feet MLLW. In some borings, only the silt layer was observed.

Blow counts within the silt layer were either WOR or Weight of Hammer (WOH). Blow counts within the sand layer ranged from one to 48. Only two Atterberg Limits tests were performed on the silt, resulting in plasticity indices of 39 and 44, with liquid limits of 84 and 90. Natural water contents within the silt layer generally exceeded 100 percent, indicating they exist in a liquid state. Based on grain size analysis, the sand classified as well-graded sand, poorly graded sand to silty sand, and silty sand with interspersed layers of gravel, classifying as well-graded gravel and well-graded to silty gravel.

2.2.3.3 South Locust Point Branch Channel and Turning Basin Sediments

A dredged material evaluation of Baltimore Harbor Channels was completed in 2019. This evaluation was the latest in a series of routine evaluations to assess the physical and chemical attributes of the sediments within the federal channels and anchorages. Three samples were collected in the South Locust Point Channel and analyzed. A composite sample that was composed of all three samples was tested.

Grain size analysis indicated that the material within the South Locust Point Channel was sandy elastic silt. The material was highly plastic. The in-situ water content was 76 percent. Unlike the material within the Seagirt Loop and Dundalk Loop Channels, the material within South Locust Point exists in a plastic state.

Strength data was not collected as a part of the material evaluation. However, given the lower in-situ water content, it is presumed that while still weak, the material likely had more strength than the materials found within the Seagirt Loop and Dundalk Loop Channels. A multi-beam survey performed by USACE in January 2021 indicates most existing channel side slopes are between 3H:1V and 4H:1V. This also suggests the material is slightly stronger than the material found within the Seagirt Loop Channel (EA EST 2019).

3. Tentatively Selected Plan

Through the study analysis the Tentatively Selected Plan (TSP) is the National Economic Development (NED) plan; specifically deepening and widening of the West Seagirt Branch Channel to a federally authorized depth of -47 feet MLLW with allowable underkeel to -49 feet MLLW. MDOT MPA has also expressed verbal interest in pursuing a Locally Preferred Plan (LPP) that includes deepening and widening of the channel to a federally authorized depth of -50 feet MLLW with allowable underkeel dredging to -52 feet MLLW. Engineering analyses reflect the assumption that that dredging will occur according to the LPP.

4. Design Vessel

The design vessel is based upon economic projections of the vessels most likely to call on the POB in the near future with consideration of limiting air draft conditions approaching the POB. The design vessel chosen for this study is *CMA CGM Marco Polo*, which is in the Ultra Large Container Vessel (ULCV) class of ship (Appendix B2). The dimensions of the design ship for this study are shown in Table 1.

Table 1. CMA CGM Marco Polo E Design Ship Dimensions (dimensions from Clarkson Register 2021.

Vessel	*CMA CGM Marco Polo*
Capacity (TEU)	16,000
Length Over All (LOA)	1,296 feet
Beam	175.9 feet
Design Draft	46 feet
Scantling Draft	52.5 feet
Keel to Masthead	230 feet

4.1. Air Draft

Vessel access to Baltimore Harbor will be constrained by the channel width and depth and the two bridges under which vessels must pass to reach Baltimore: the Chesapeake Bay Bridge (“Bay Bridge”) and the Francis Scott Key Bridge (“Key Bridge”). The air draft of the vessel is defined as the distance from the water surface to the highest point on a vessel (Figure 3).

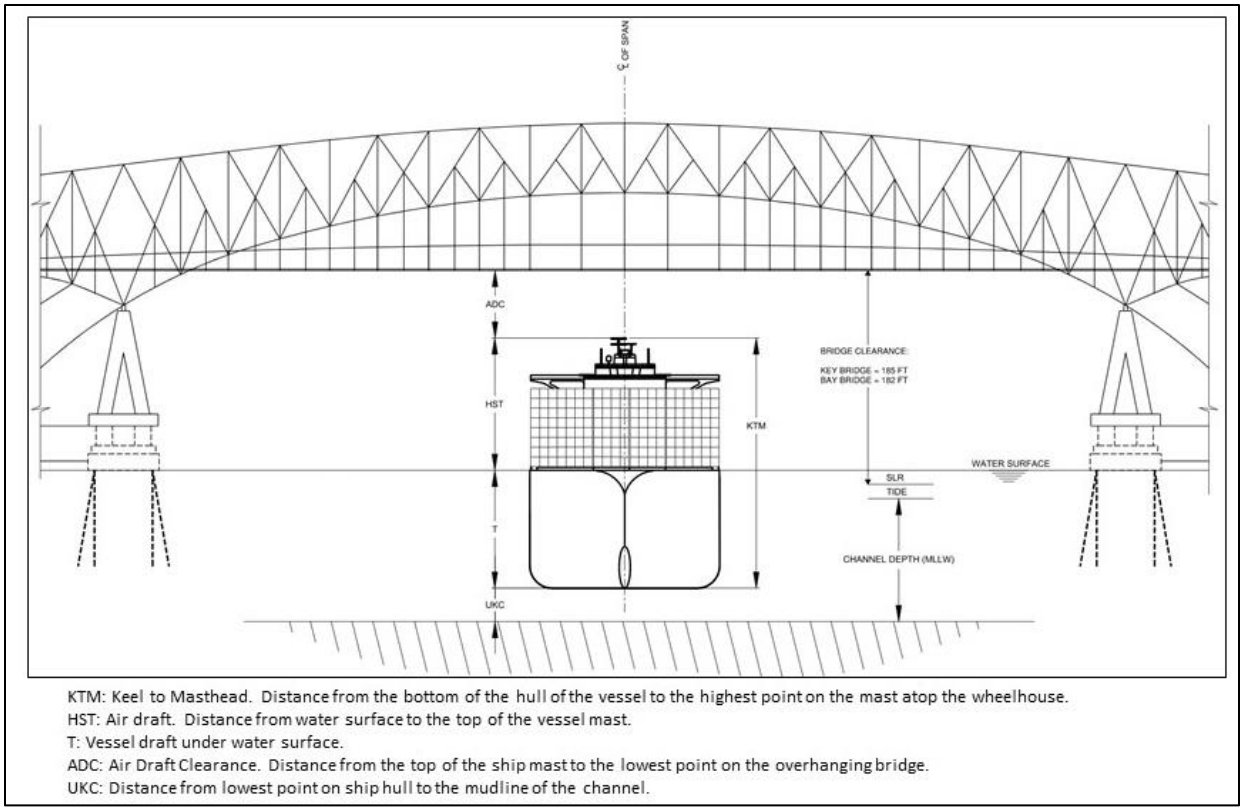

Figure 3. Air drafts of Bay Bridge and Key Bridge with parameter definitions.

To pass under the bridge safely, a minimum air draft clearance is required. The clearance is determined by the elevation of the water surface at a given time, the draft to which the vessel is loaded, and the speed of transit. The charted clearance of the two bridges is given by NOAA on the nautical chart relative to the mean high water (MHW) elevation:

- Chesapeake Bay Bridge 182 feet MHW
- Francis Scott Key Bridge 185 feet MHW

4.2. MITAGS Study (2018)

After the completion of the 50-foot deepening of Seagirt Marine Terminal (SMT) Berth 4, MDOT MPA commissioned a ship simulations study to design the deepening of SMT Berth 3 and help develop best practices for ULCVs to efficiently transit to SMT. This study was conducted on behalf of MDOT MPA at the MITAGS facility in Linthicum Heights, Maryland from April 30 to May 4, 2018. Participants in the study included pilots from the Association of Maryland Pilots (AMP) and docking and tug pilots from Moran Towing Corporation and McAllister Towing and Transportation Company.

Ships modeled for this study included the 14,000 TEU MSC *Kalina* and the 18,000 TEU *Ben Franklin*. The study included 34 different modeling runs with the goal of safely and consistently bring these ships into berths 3 and 4 at Seagirt Marine Terminal (SMT).

General results from the 2018 MITAGS ship simulation study are found in Table 6. The complete MITAGS study is provided as Attachment 5 to this appendix.

Throughout the study, 34 runs were completed with the *Kalina* and *Ben Franklin* container vessels transiting to SMT Berth 3 via the East and West Loop. The additional space from Wideners A and B were used in a majority of the runs. Figure 4 shows all the runs and the overall area the swept paths occupied. Halfway through the runs Widener 1 was modified on the East side and a new Widener was added on the West side. Both modifications are shown in Figure 5.

5. Channel Design

Numerous coordination meetings were held with the Pilots, the US Coast Guard, and local interest groups to ensure that the proposed channel improvements would provide adequate navigability for the design ship while meeting the needs of the port facilities and the maritime community. The recommended channel improvements are shown in Appendix B4.

5.1. Channel Width

The proposed channel improvements were designed in accordance with guidance contained in EM 1110-2-1613. This guidance is based upon factors such as traffic pattern (one way or two way), design vessel dimensions, channel cross section shape, current speed and direction, quality of aids to navigation and variability of channel and currents. For one-way channels, widths can vary from 2.5 times the vessel beam for a well-defined channel with minimal currents to 5.5 times the vessel beam for a variable channel with stronger currents. Two-way channels can vary from 4 to 8 times the vessel beam.

5.2. Channel Depth and Underkeel Clearance

The maximum channel depth is designed to permit the safe and efficient transit of a fully loaded design vessel at any phase of the tide. The determination of the navigation channel depth is based upon the loaded static summer saltwater draft of the design vessel, plus allowances for various underkeel clearances such as ship squat, water density, ship response to waves, and safety clearance. The selection of the actual project design depth is determined by economic analysis of the expected project benefits compared with the project cost at various alternative depths. Refer to Appendix C, Economic Analysis, for details of the optimization analyses.

5.2.1. Squat

Squat is the tendency of a vessel underway to sink and trim in the waterway, thereby reducing theunderkeel clearance. The sinkage is due to the reduction in pressure on the ship's hull resulting from the increased water velocity passing the ship. In a shallow or confined channel, squat tends to increase because the blockage caused by the ship creates a higher water velocity around the hull,lowering the actual water surface. Another component of squat is dynamic trim, or the change in pitch of a vessel due to the forward motion. Generally, it has been found that most full-bodied shipssuch as tankers and bulk carriers trim down at the bow, and sleeker containerships trim down at the stern. The magnitude of the squat depends on several factors including ship speed, dimensions, ship blockage coefficient, and channel depth.

5.2.2. Safety Clearance

A safety clearance is provided between the hull of the ship in transit and the design channel bottom to minimize the risk of damage to the vessel due to bottom irregularities and debris. The safety clearance also accounts for uncertainties such as tide stage, survey tolerances, etc. A safety clearance of 2 feet is provided for channels with a soft bottom. In time, as the channel begins to shoal, a safety clearance of 2 feet will be maintained since the recently deposited material tends to be soft.

5.2.3. Total Underkeel Clearance

The depth proposed for the Seagirt Loop channels is 50 feet MLLW plus two feet of underkeel clearance. The safety of these depths will be confirmed during the PED phase, using the Channel Analysis and Design Evaluation Tool (CADET) modeling system.

5.3. Ship Simulation Design Parameters

Discussed below are design parameters from the 2016 MITAGS ship simulation report. The actualparameters for this study will be developed during a later phase of the study in collaboration withthe harbor pilots, docking pilots and developers of the ship simulation model.

For safe transits to/from SMT Berth 3, AMP and tug masters made the following recommendations determined from this study:

- Transit speed:
    - 3 knots or less
- Environmental conditions:

        - For winds greater than 25 knots, consideration of the results of this study, wind direction and magnitude, available tug support, and AMP professional judgment should be used in determining safe transit conditions.

- *Kalina* tug requirements:
    - Wind less than 20 knots: 3 ASD tugs each with a minimum bollard pull of 60 tons
    - Wind 20 knots or greater: 4 ASD tugs with a minimum bollard pull of 60 tons

- *Ben Franklin* tug requirements:
    - 4 ASD tugs each with a minimum bollard pull of 60 tons

- Additional tug requirements:
    - Tugs must operate on shorter lines in the limited space and have no room for error in this position
    - Upgrade to more stable tugs: current tugs are not stable enough and get caught in wash

- Conduct additional Pilot and Tug Master training with the *Kalina* and *Ben Franklin*

5.4. Structural Considerations

5.4.1. Channel Stability Analysis

Seagirt Loop has been extensively sampled over the past three decades in support of numerous dredging contracts. The most recent investigation was performed by Soil and Land Use Technology Inc. (SaLUT) from December 2018 to January 2019. A total of 56 standard penetration (SPT) borings were performed within and adjacent to the Seagirt Loop Channel. Borings extended approximately to an elevation of -60 feet MLLW.

Blow counts are a poor indication of strength in weak/soft cohesive materials (undrained shear strength less than approximately 1,000 psf). A single blow count can cover a wide range of undrained shear strengths, and nearly every blow count within Seagirt Loop down to the proposed channel depth of -50 feet MLLW was WOR. A blow count of WOR indicates that the soil is unable to support the load of the drill rods even before adding the weight of the hammer to begin counting blows. Given that the plasticity index of the material is above 50 percent and the in-situ water content of the material is above the liquid limit, the material exhibits almost no strength. By definition, a soil with a water content exceeding the liquid limit behaves like a liquid instead of a solid. Liquids generally

have extremely small shear strengths. Water has no shear strength. The stability of side slopes can be calculated if reliable estimates of undrained shear strengths can be deduced. Within the Seagirt Loop, this would require either field vane shear testing, cone penetration testing, or dilatometer testing. Because past investigations were used primarily to characterize the dredged material for upland disposal, tests to specifically determine undrained shear strengths were not performed. The best indication of the strength of the material is observation of in-situ channel side slopes.

CENAB performed a multi-beam hydrographic survey of Seagirt Loop and Anchorage 3 in February 2021. Using the multi-beam survey, channel side slopes were computed on a 20-foot grid and plotted on top of the NOAA nautical chart (Figure 4). Side slopes were color-coded so that variations in side slopes could be easily identified. All prior dredging by both USACE and MDOT MPA within Seagirt Loop and Anchorage 3 was done according to a template with 3 Horizontal to 1 Vertical slopes (3H:1V). If 3H:1V side slopes were dredged in the past, and if they are stable, 3H:1V excavated slopes would be expected on the survey.

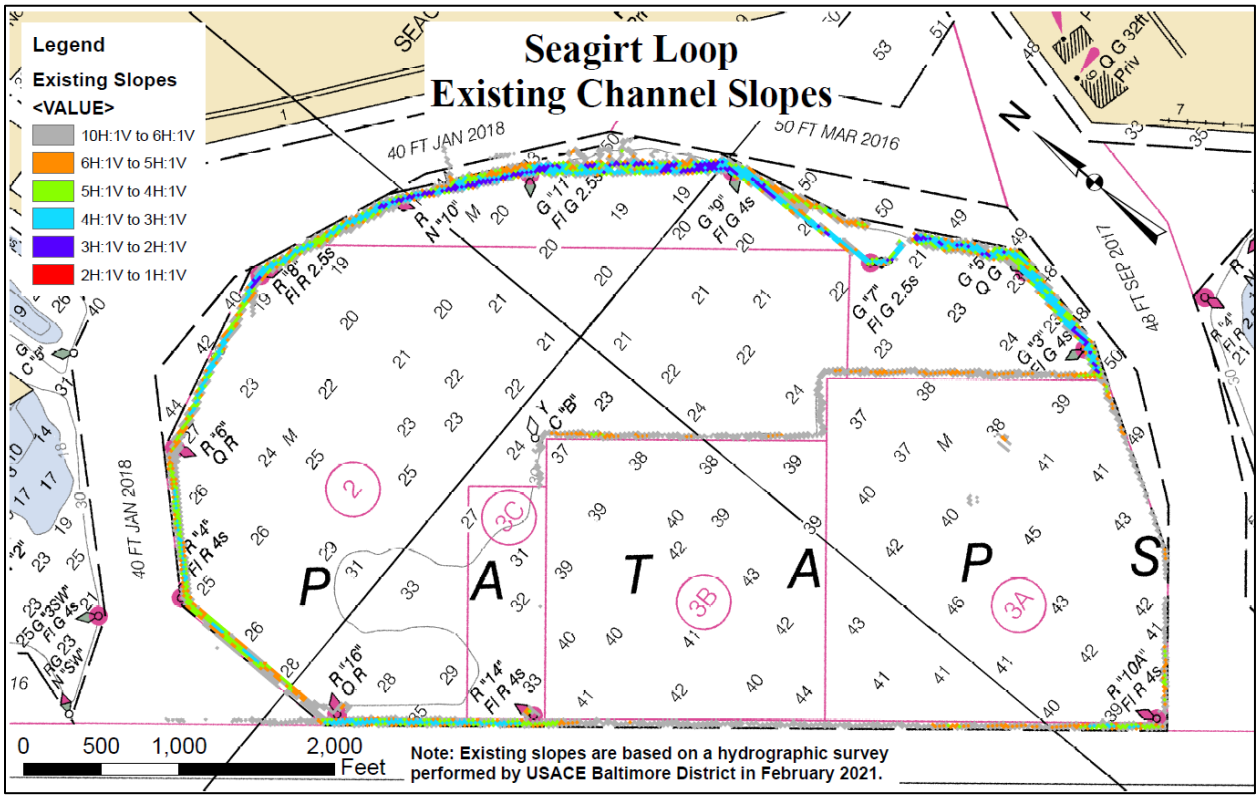

Figure 4. Hydrographic survey of Seagirt Loop and Anchorage 3 in February 2021 with side slopes.

The plot of the side slopes indicates that only limited reaches of the channel in front of Berth 2 and Berth 3 exhibit side slopes of 3H:1V or steeper. The majority of the side slopes for the Seagirt Loop channel are between 3H:1V and 5H:1V. Existing side slopes indicate the slope steepness that is marginally stable. The consequence of slope failure is sloughing of material into the channel, requiring more maintenance dredging. To prevent sloughing of the channel side slopes, a 5H:1V slope is recommended for the proposed project. The 5H:1V slope better matches the existing slopes than the traditionally recommended 3H:1V slopes and is a better risk-informed assumption in the study.

5.4.2. Berth Stability Analysis

The relationship of existing structures to the proposed improvements is shown in Figure 5.

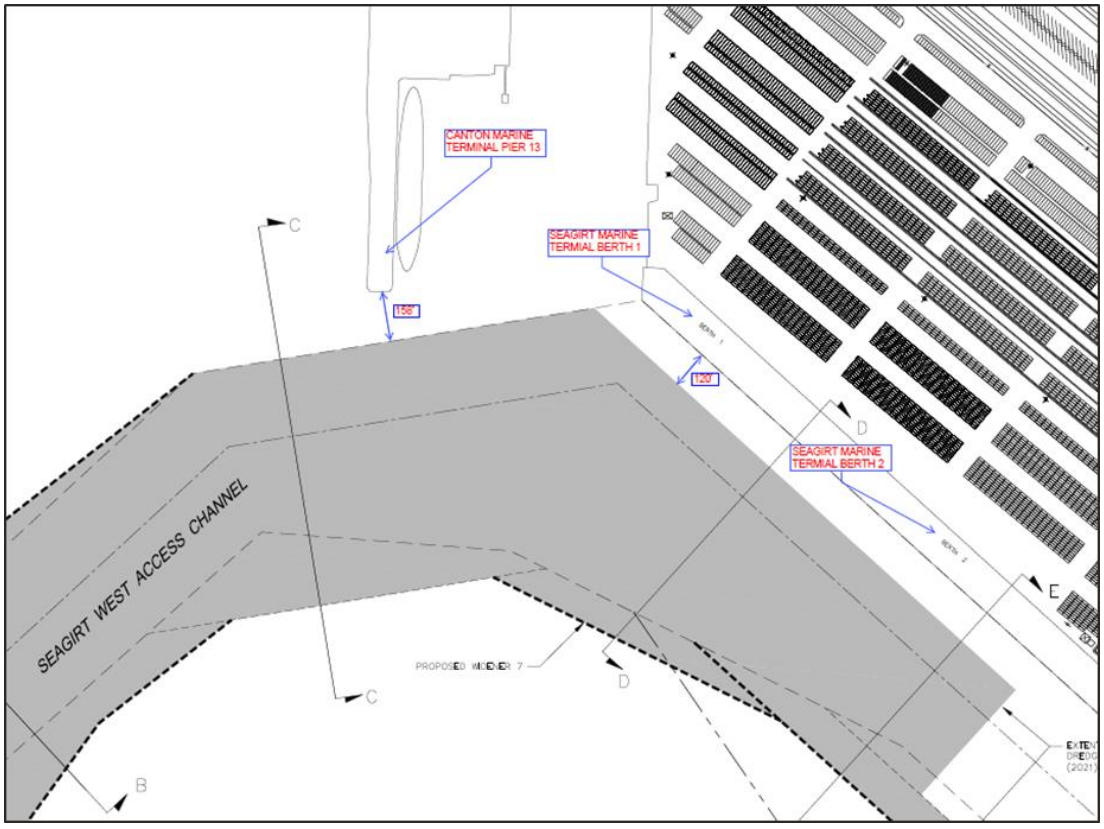

Figure 5. Existing berth features adjacent to the study area.

The proposed federal channel dredging for the West Seagirt Branch Channel (labeled as Seagirt West Access Channel in Figure 5) would not have any detrimental impact on the existing structures adjacent to the channel. The 50-foot dredge depth proposed as the Locally Preferred Plan (LPP) for the federal channel footprint is within 158 feet of the southeast corner of the Canton Marine Terminal Pier 13. If a 3:1 side slope is used, the slope intersects existing river bottom approximately 64 feet horizontally from the edge of

the 50-ft channel, or 94 feet from the pier. If a 5:1 side slope is used, it intersects existing river bottom approximately 113 feet from the edge of the 50-ft channel, or 45 feet from the pier. The proposed dredging within the federal channel limits is far enough away from the berth structures that the pile support would be unchanged from its present condition.

The proposed 50-ft dredge depth is within 120 feet of SMT Berths 1 and 2. If a 3:1 side slope is used, the slope intersects existing river bottom approximately 103 feet outboard of the berthing face of Berth 2 and 108 ft outboard of Berth 1. If a 5:1 side slope is used, the slope intersects existing river bottom approximately 92 feet outboard of the berthing face of Berth 1 and 103 ft outboard of Berth 2. The berth face is supported by concrete piles backed by a cellular cofferdam. The proposed dredging is far enough away from the berth and pier structures that the pile support would be unchanged from its present condition. Local and global stability analyses were performed to assess the impact of deepening the Federally Authorized portion of the channel on the structural stability of the piles and existing cofferdam. Calculated factors of safety for the cofferdam stability models exceeded requirements by more than two times when the proposed dredging is considered.

The analysis and associated memo dated 13 January, 202 conducted by Moffatt & Nichol can be found in Appendix B3.

6. Quantities Development

6.1. Existing Conditions Surface

In order to derive excavation quantities, a complete surface of the excavation areas must be developed. Areas to be excavated are included mostly within the existing channels and in adjacent areas of channel widening based on bathymetric data collected in February 2021. Preliminary quantities used in the screening of alternatives for the study are provided in Appendix B5.

Survey data were imported into AutoCAD to create a Triangulated Irregular Network (TIN) of the study area. Extraneous triangles were eliminated from the TIN in order to create a more representative surface.

6.2. Proposed Condition Surface

The proposed conditions surfaces correspond to the channel “templates” at the proposed depth(s) of excavation. The templates represent the cross-section of the proposed channels, including the proposed side slopes (Appendix B4). The proposed channels maintain the same footprints as the existing channels except where widenings are proposed. The side slope has been set at 5H:1V, which is meant to prevent excessive sedimentation back into the channel (Figure 6).

During plan optimization, the costs of proceeding with 5H:1V side slopes will be compared to costs for a 3H:1V side slope channel and the potential increased operations and maintenance dredging. 3H:1V will be considered during plan optimization for cost effectiveness and through the economic evaluation and a determination will be made by the PDT on the recommended channel side slopes based on the results of these analysis.

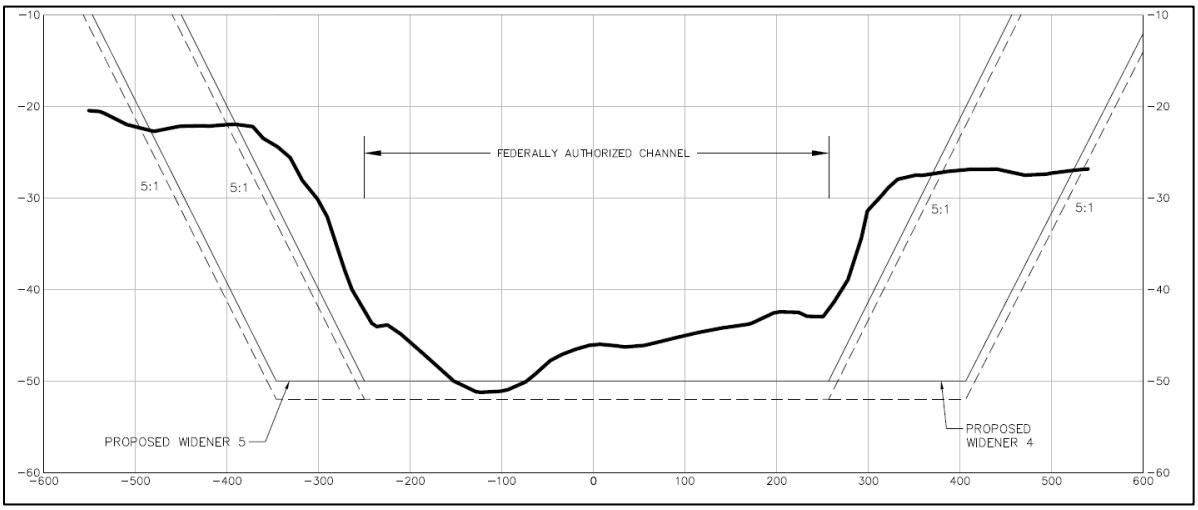

Figure 6. Sample Proposed Channel Template showing 5H:1V side slope.

6.3. Dredge Quantities

The gross excavation quantity for each channel segment was determined simply by subtracting the proposed conditions surface from the existing conditions surface at incremental one-foot depths (Table 2). Detailed calculations are found in Appendix B5.

Table 2. Cumulative volume dredged for West Seagirt Branch Channel and Wideners at increasing depths.

To Elevation (Feet/MLLW)	Segment	Cumulative Dredging Vol (cy)
-45	Channel	169,452
	Wideners	562,916
-46	Channel	244,532
	Wideners	603,975
-47	Channel	334,824
	Wideners	641,782
-48	Channel	451,400
	Wideners	680,457

-49	Channel	597,099
	Wideners	720,112
-50	Channel	753,740
	Wideners	760,709
-51	Channel	914,188
	Wideners	802,185
-52	Channel	1,077,594
	Wideners	844,469

6.4. Excavated Depth Summary

Figure 7 provides an illustration of the different dredge zones referenced in developing quantities. These horizons are defined as:

1) Existing Condition: Based on the most recent hydrographic data at the start of the study.

2) Maintained Depth: The maintenance quantity is the volume required to be dredged from the existing condition to the currently maintained channel dimensions

3) Authorized Depth: The authorized depth is the nominal depth used for the Plan Formulation increments and includes consideration for underkeel clearance (UKC)

4) Advanced Maintenance: Dredging contracts typically include a depth of advanced maintenance beyond the authorized depth. This depth is often greater in areas of rock than areas of sand.

5) Paid Overdepth: In consideration of the difficulty to dredge or blast to an exact depth, material within an agreed upon vertical distance below the authorized depth will be paid for.

6) Unpaid Overdepth: Material that is below the agreed upon paid overdepth quantity. Note that some material in this range may be paid for if it falls within the side slope area and is needed for slope stability.

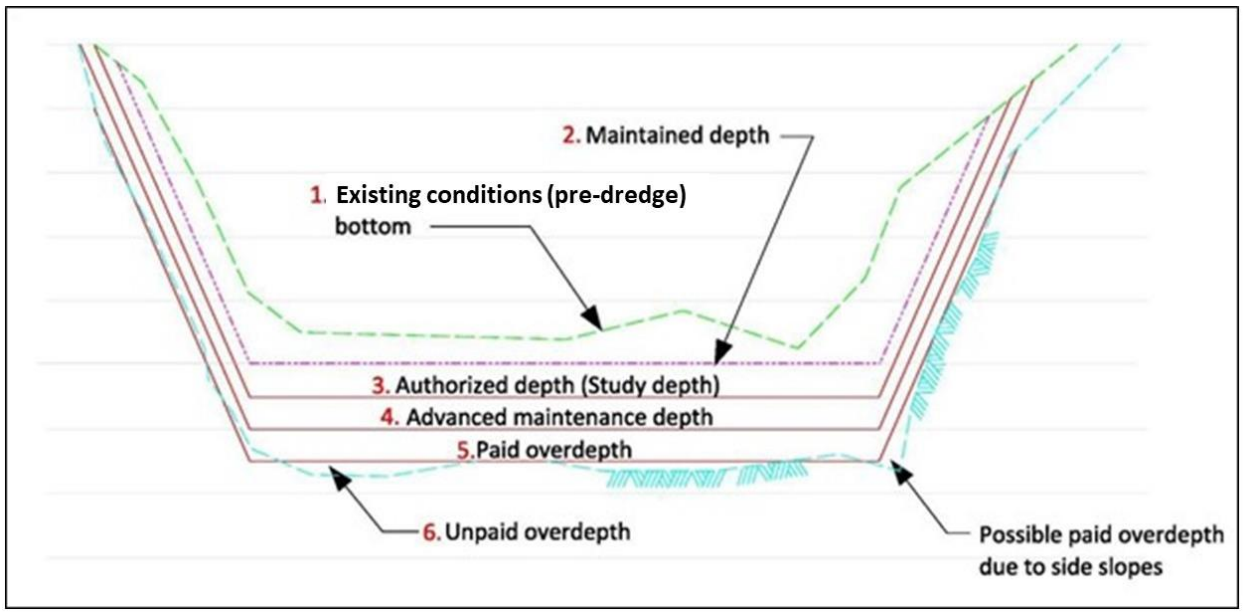

Figure 7. Typical dredge zones.

6.5. Placement Capacity

By law, all dredged material in the Harbor is considered contaminated and must be taken to a containment facility within the Harbor. The 2017 DMMP (USACE, 2017) details the current dredged material disposal sites for material dredged from the Harbor approach channels. The MDOT MPA maintains the Baltimore Harbor placement sites to accommodate at least the 20-year dredging placement need, calculated based on historical maintenance volumes and identified new work projects. The primary placement site being considered is Cox Creek DMCF. Appendix B5 analyzes the considerations utilized in determining available placement capacity.

7. Relative Sea Level Change and Air Draft Clearance

7.1. General Conditions

Changes in Sea level and its potential to impact the Seagirt Loop channel project are detailed in Appendix E. The USACE Sea Level Change Curve Calculator (described in Appendix E) was used to evaluate the effects of projected sea level rise (SLR) on the air draft clearance (ADC) at the Chesapeake Bay Bridge and Francis Scott Key Bridge and potential long-term impacts on navigation by post-Panamax Generation III max (up to 16,000 TEU) vessels. Since the Bay Bridge, built to 182 feet, and the Key Bridge, built to 185 feet, are fixed bridges (they do not fold up or retract), SLR will in effect decrease ADC.

The Sea Level Change Curve Calculator (Version 2021.12) was used to extrapolate projections from the latest year available, 2100, out to the year 2130 (Appendix B2). Tide gauges in proximity to the Bay Bridge (Annapolis) and the Key Bridge (Baltimore) were used to assess future vessel ADC. With its lower clearance of 182 feet, the Bay Bridge is the controlling ADC for vessels transiting to the POB.

The analysis showed impacts to be dependent on both the projection scenario of low, intermediate, or high and the tide stage when the vessel would pass beneath the Chesapeake Bay Bridge. The future ADC of the PPX IV vessel is shown graphically in Figure 8 as the future masthead elevation (relative to MLW) due to SLR for the three SLR projection scenarios. Regardless of SLR projection, it was found that the PPX IV vessels would have to transit at low tide (MLW or MLLW) to achieve sufficient ADC for present-day and future conditions. The intermediate and high SLR projection showed that ADC will be reduced by approximately 0.5 feet by 2050 and 2030, respectively, for a vessel transiting at MLW (Figure 8).

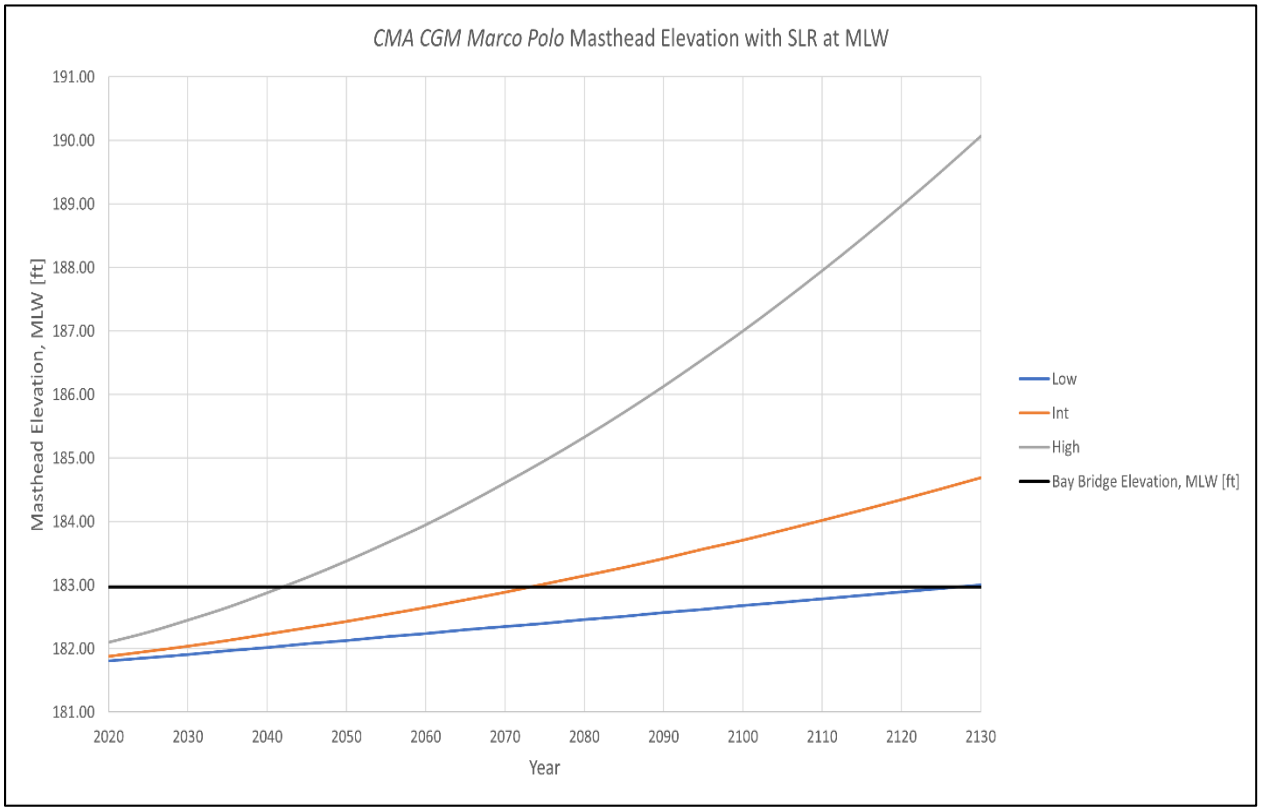

Figure 8. Masthead elevation of the CMA CGM Marco Polo transiting at MLW, draft 47.5 feet, with the three SLR scenarios applied.

The sea level change curve calculator data tables, with annual intervals, for each of these gauges are provided in Appendix B2. These tables were used in projecting changes in sea level rise whichare applied to the tidal datums of each of the relevant NOAA tide gauges.

The potential impacts of future local relative sea level change (SLC) on navigation structures and the possible adaptations that can be developed to counteract these impacts must be considered in all USACE studies and projects located in tidally influenced waters. Current USACE guidance (ER 1100-2-8162 and ETL 1100-2-1) requires planning studies to consider SLC in the development and assessment of planning alternatives. ETL 1100-2-1 recommends that analyses assess the effects of SLC on the project at three future time periods post-construction, including 20 years, 50 years, 80, and 100 years. Since the rate of future SLC (i.e. feet per century) is uncertain, the guidance specifies that the evaluation should consider the three different SLC curves(low, intermediate, and high) included in the USACE's online SLC calculator.

8. Further Analysis and Design Development Needs

No new data were collected for this feasibility study, commensurate with risk informed decision-making; however, data from the prior harbor deepening study were utilized. Suggested data collection and analysis to be conducted during the PED phase are discussed below. The design development concerns discussed are limited to those efforts related to channel design; therefore, this discussion of data and analysis needs should not be considered comprehensive.

8.1. Hydrodynamic Data Collection

The collection of water surface elevation, current velocity data, and wind velocity data may be warranted to both provide insight at critical project locations and to support the validation of an updated hydrodynamic and sediment model. The necessity and distribution of this data collection effort should be considered and developed in collaboration with harbor and docking pilots, and thedevelopers of both the recommended hydrodynamic and sediment model (discussed below) and ship navigation models (discussed below).

8.2. Hydrodynamic and Sediment Modeling and Analysis

A comprehensive hydrodynamic modeling study of the Harbor may be necessary to assist with ERDC ship simulation.

8.3. Ship Navigation Modeling

Ship navigation modeling is planned for the PED phase of this study. Navigation modeling is to be conducted at the ERDC Ship/Tow simulator in Vicksburg, MS with assistance from members of the various harbor and pilots associations within the Port. Pilots are planned to pilot a simulated Maersk Triple E class ship at the ERDC facility to determine whether the proposed channel widenings and deepening are sufficient for a range of weather, current, tide and traffic scenarios.

Although the widenings take into account suggestions made by the pilots to address the projected navigational difficulties they would experience within the existing channels,it is possible that additional modifications may result from ship simulations.

In addition to the ship navigation modeling, a vertical ship motion study using the Channel DesignAnalysis and Design Tool (CADET) is recommended. The CADET model will be used to predictvertical ship motions due to wave-induced heave, pitch and roll; squat and underkeel clearances will also be evaluated. The outputs of the model will be used to make informed judgments about the optimum channel depths for the ship loading conditions.

9. References

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BALTIMORE HARBOR ANCHORAGES AND CHANNELS (BHAC) MODIFICATION OF SEAGIRT LOOP CHANNEL FEASIBILITY STUDY

DRAFT INTEGRATED FEASIBILITY REPORT & ENVIRONMENTAL ASSESSMENT

APPENDIX B1:

GEOTECH DATA AND BORING LOGS

FEBRUARY 2022

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Geotechnical Investigation Report

Seagirt Berth 3 Dredging and Masonville Unloading Basin Dredging

Baltimore, Maryland
MES Contract No. 14-07-58 Task 17

Prepared for:

Maryland Port Administration
401 E. Pratt Street,
Suite 1900
Baltimore, MD 21202

And

Maryland Environmental Service
259 Najoles Road
Millersville, MD 21638

Prepared by:

Gahagan & Bryant Associates, Inc.
9008 Yellow Brick Road, Suite O
Baltimore, MD 21237

May 2019

GEOTECHNICAL INVESTIGATION DATA REPORT

SEAGIRT LOOP CHANNEL DEEPENING
BALTIMORE, MARYLAND

Prepared for:

Gahagan & Bryant Associates, Inc.
9008 Yellow Brick Road, Suite O
Baltimore, Maryland 21237

Prepared by:

SaLUT-TLB
530 McCormick Drive, Suite S
Glen Burnie, Maryland 21061

MAY 2, 2019

Soil and Land Use Technology, Inc. (SaLUT-TLB)
530 McCormick Drive, Suite S • Glen Burnie, MD 21061 (443) 577-1600
www.SaLUTinc.com

May 2, 2019

Gahagan & Bryant Associates, Inc.
9008 Yellow Brick Road, Suite O
Baltimore, Maryland 21237

Attn: Mr. William Murchison

Re: Geotechnical Investigation Data Report
Seagirt Loop Channel Deepening Project
Dundalk Marine Terminal
SaLUT-TLB Reference No. 18-0043

Dear Mr. Murchison,

Pursuant to your request, we have performed a geotechnical investigation in support of your planning efforts on the referenced project. The following revised report summarizes the results of our subsurface explorations and laboratory testing for the Seagirt Loop Channel Deepening project in Baltimore, Maryland.

We thank you for providing us this opportunity to perform these services for Gahagan & Bryant Associates, Inc., and look forward to working with you as the project progresses. Please do not hesitate to contact us if you have any comments or questions regarding this report, or when we can be of further assistance on this and other projects.

Sincerely,

SaLUT-TLB

Edward Dalton, P.E.
Executive Vice-President

Olivia Erony, P.E.
Project Engineer

TABLE OF CONTENTS

ATTACHMENTS

1.0 INTRODUCTION

Gahagan & Bryant Associates, Inc. (GBA) of Baltimore, MD has been engaged to perform engineering services for dredging at the Seagirt Marine Terminal in Baltimore, Maryland. To assist with obtaining subsurface information and laboratory testing GBA retained SaLUT-TLB. The subsurface investigation and testing were conducted in general accordance with the scope of services outlined in SaLUT-TLB's proposal dated November 15, 2018. The results of our investigation and testing are included in this data report.

2.0 PROJECT DESCRIPTION

The project consists of dredging in front of the Seagirt Marine Terminal Berth 3 and adjacent channels. More specifically the area included in this investigation included Berth 3, Seagirt – Dundalk Connecting Channel and the Seagirt West Access Channel. These areas will be deepened and widened. The project location is shown on the attached Drawing No. 1 – Project Location Plan. The areas will be dredged to about El -50 plus 2 foot over depth MLLW. To evaluate the subsurface conditions and obtain samples for testing in the area to be dredged 56 test borings were drilled at locations identified by GBA. Laboratory test were conducted on soil samples to identify the soil physical and environmental characteristics. This data report provides the geotechnical data and laboratory testing results for the project.

3.0 SCOPE OF SERVICES

The general scope of services consisted of:

- Mark boring locations from the barge using a handheld GPS unit.
- Obtain a Miss Utility ticket to identify underground utilities.
- Drill 56 soil borings to a depth of about El -60 ft MLLW
- Perform SPT sampling at 2.5-foot intervals
- Decontaminate down the hole drill tools between designated drill areas
- Perform laboratory testing on select samples to identify physical and environmental characteristics
- Perform strength test – Pocket Penetrometer and Torvane test to identify soil strength characteristics
- Prepare a Geotechnical Data Report

4.0 SUBSURFACE EXPLORATION

To evaluate the subsurface conditions, 56 test borings (PR-1 to PR-56) were drilled in 8 designated zones between Dec 06, 2018 to Jan 15, 2019. The borings were drilled with a Mobile 57 drill rig mounted on a barge equipped with two spuds to hold the barge in position during drilling. The test boring locations were selected by GBA and marked in the field by SaLUT-TLB using a Trimble Geo-7X handheld GPS and Terra-sync software. The planned test boring locations and the eight (8) designated environmental composite sample areas (Area 1 through Area 8) are shown on the attached Drawing No. 2– Test Boring Location Plan. The as-drilled coordinates for the test borings are included on the boring logs. The time each boring was drilled was recorded and based on the date and time of drilling the water surface elevation was estimated from National Oceanic and Atmospheric Administration tide recordings from Ft. McHenry Station. All tide data is referenced from MLLW.

The test borings extended to an approximate El -60 ft. The depth of the water was estimated using a lead line over the side on the barge prior to start of drilling, the lead line is approximately 4-inches in diameter and weighs about 5 lbs. The depth of water varied from about 20 feet to 52 feet and mudline elevation varied from about El -19.6 to El -50.3 ft. Depth and elevation data are included on the boring logs. Soil samples were obtained from the test borings at 2.5-foot intervals using a split-barrel sampler (spoon) in accordance with the Standard Penetration Test (SPT) procedure ASTM D1586. A representative portion of each split spoon sample was placed in a glass jar and transported to our laboratory for evaluation and testing. Two jar samples were retained from each split spoon sample, one for environmental testing and one for physical and strength testing. The environmental jar samples from each of the 8 designated areas were combined to make up one composite sample from each of the 8 areas for environmental testing. Environmental jar samples were stored in SaLUT lab refrigerator until the composite sample was delivered to the environmental lab for testing. To prevent cross contamination between the 8 designated environmental areas the down the hole drill tools were decontaminated when moving between areas. The initial drilling plan was to complete all borings in each one of the 8 environmental areas before moving to the next area but due to ship traffic restrictions and access restrictions in the Berth 3 area this was not possible, therefore multiple decontamination events were required during the day and at the end of each day.

5.0 SUBSURFACE CONDITIONS

Logs describing the subsurface soil conditions, are presented as "Records of Soil / Rock Exploration" in Appendix A. The descriptive terminology used to classify the soils encountered during this study is summarized on the first page of Appendix A. The subsurface conditions are summarized below.

5.1 Subsurface Stratigraphy

Dark Gray to Grayish-Brown, Brown and Black Silt and Clay was encountered from the mudline to the full depth of the borings except in PR-16, PR-36, PR-39, PR-46 and PR-51 to PR-56. The Standard Penetration Test (SPT) N-values for Clay and Silt ranged from Weight of Rods (WOR) over 18-inches to 15 blows per foot (bpf), indicating very soft to stiff relative consistencies. Gray, Brown to Dark Grayish-brown, and Dark Green interbedded Sand layers were encountered within Clay and Silt in borings PR-23, PR-35, PR-47 and PR-53 with Standard Penetration Test (SPT) N –values ranging from 1 to 7, indicating very loose to lose relative consistencies. Tan, Brown, and Gray to Grayish-Brown Sand was encountered in borings PR-16, PR-36, PR-39, PR-46 and PR-51 to PR-56 about EL. 29.7 to EL.54.3 and continued through boring termination depth. The Standard Penetration Test (SPT) N –values for Sand ranged from 2 to 27, indicating very loose to medium dense relative consistencies. Very loose Clay and Silt layers were encountered within Sand strata at Boring B-39 below elevation EL.-29.7 feet.

5.2 Laboratory Test Results

SaLUT-TLB selected soil samples from each boring for laboratory physical testing. The tests included natural moisture content (ASTM D2216), gradation analysis (with hydrometer) (ASTM D7928), Atterberg limits (ASTM D4318) and Specific Gravity (ASTM D854). The test results are presented in Appendix B and are summarized in the table on the next page. Each split spoon

sample was tested for shear strength evaluation using a Pocket Penetrometer and Torvane. The Pocket Penetrometer is a spring-operated device that provides direct measure of the unconfined compressive strength of the soil. A 0.25-inch diameter piston is pushed into the soil sample a depth of 0.25 inches and the unconfined compressive strength is indicated by the direct-reading scale on the piston barrel. The shear strength of the soil is one-half the unconfined compressive strength. The Torvane device uses a torsion spring to provide direct measurement of soil shear strength. Several samples were too soft to obtain any strength data as the range for the Pocket Penetrometer is about 500psf to about 4,500psf and the Torvane range is about 200psf to 5,000psf. The results are summarized in Appendix B. The environmental jar samples from each boring in each of the designated environmental areas were combined to make up one composite sample for environmental testing. The results of environmental test are included in Appendix B.

Test	Results	
	Range	Average
Moisture Content (%)	11.2 - 216.5	121.2
% Passing No. 200 Sieve	2.8 - 100	80.8
Liquid Limit (%)	27 - 178	107.7
Plastic Index (%)	3 - 126	64.1
Specific Gravity	2.52 - 2.67	2.59

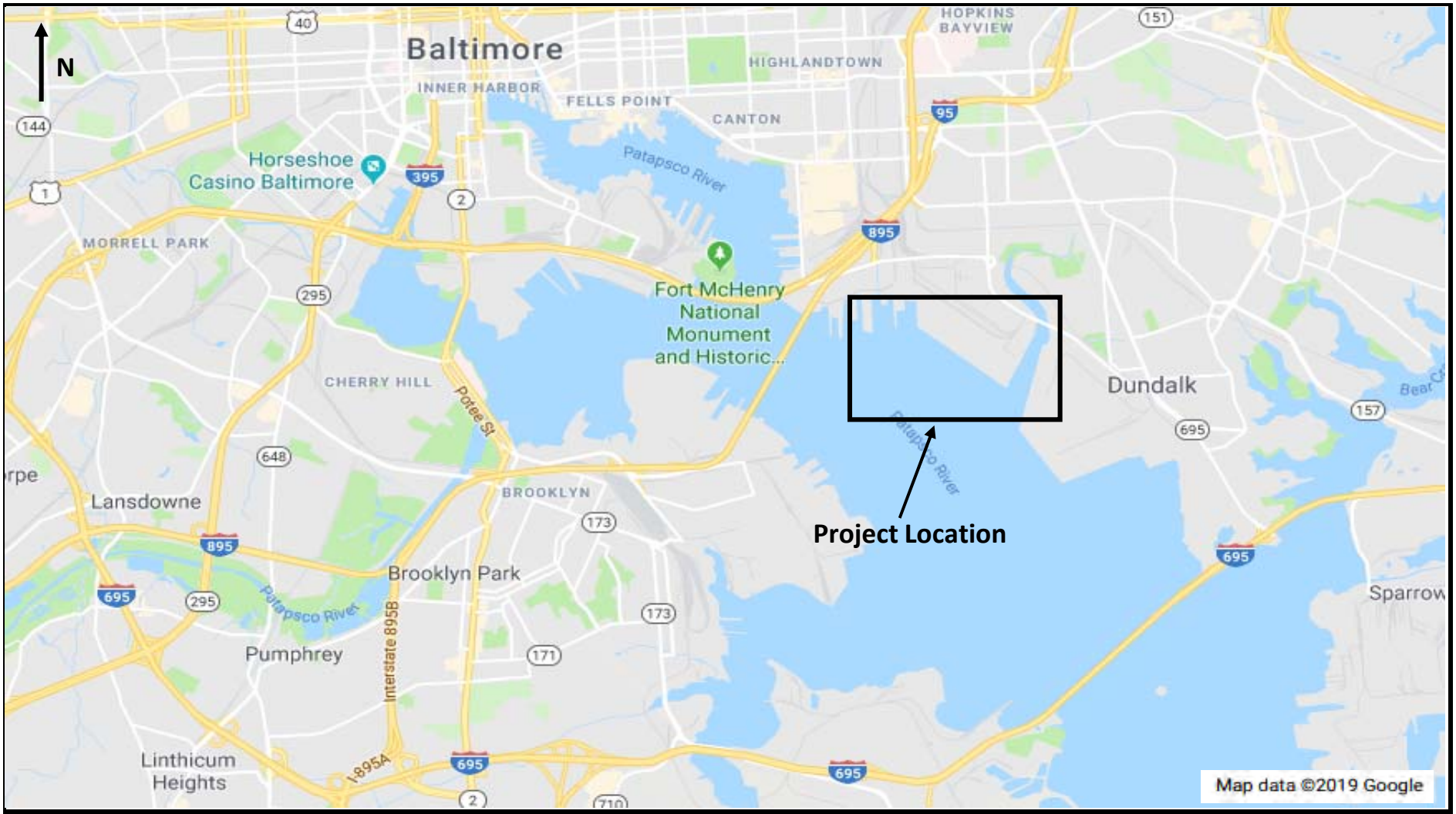
The remaining soil samples are being temporarily stored in our Glen Burnie, Maryland laboratory and are available for review. The samples will be discarded forty-five (45) days following the submittal of this report unless other arrangements are made.

6.0 LIMITATIONS

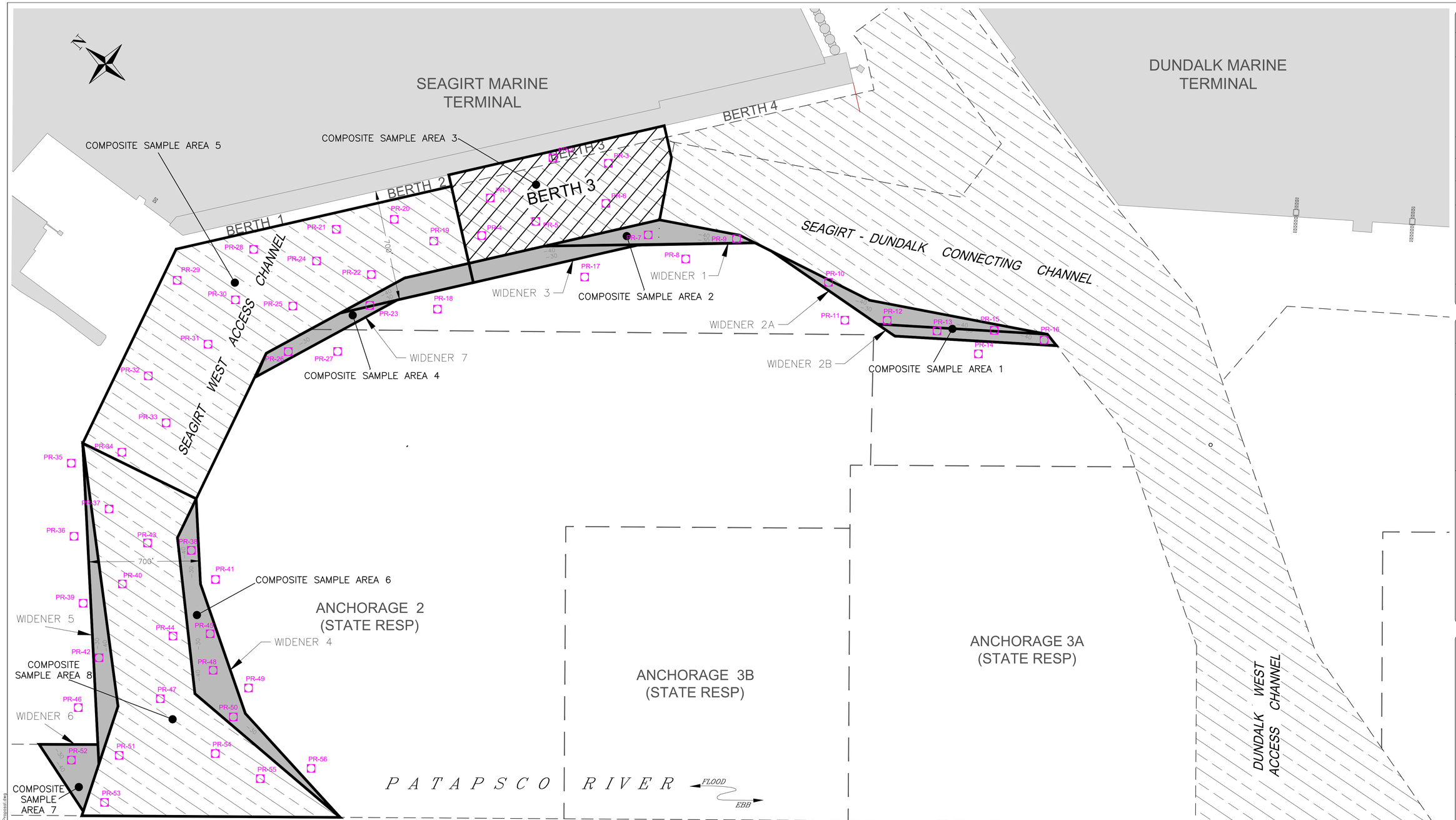
This report has been prepared to aid in the evaluation of this site and to assist GBA in the design aspects of aforementioned project. All subsurface explorations require the extrapolation of limited amounts of data based on general geologic knowledge. The water level observations, geologic descriptions, presented on the accompanying logs have been made with reasonable care and accuracy, but must be considered only an approximate representation of subsurface conditions to be encountered beyond a particular exploratory location.

Variations in the soil conditions noted in this report may be encountered during construction. SaLUT-TLB should be retained to observe subsurface conditions encountered during construction and to verify that conditions are compatible with the findings of this study. SaLUT-TLB should be contacted immediately if significant variations are encountered or if the proposed locations or designs are altered.

We have completed these services in accordance with general engineering practices used by members of the profession in the same region and under similar conditions of this project. We make no warranty or guarantee, either expressed or implied, for these services.



SaLUT-TLB Soil and Land Use Technology, Inc. Glen Burnie, Maryland	Seagirt Loop Channel Deepening Baltimore, Maryland	**PROJECT LOCATION PLAN**		
		DRAWN BY: OE	**CHECKED BY:** ED	**DRAWING NO.:** 1
		JOB NO.:18-0043	**DATE:** MAR 2019	**SCALE:** NTS



COMPOSITE SAMPLE AREA 1 (PHASE 1)		
PR. BORING	EASTING	NORTHING
PR-10	1441386.0803	576416.2574
PR-11	1441268.6613	576183.1192
PR-12	1441440.2735	575976.898
PR-13	1441591.8165	575691.9358
PR-14	1441649.1389	575398.3053
PR-15	1441827.5281	575417.5132
PR-16	1441983.1282	575135.5544

COMPOSITE SAMPLE AREA 2 (PHASE 1)		
PR. BORING	EASTING	NORTHING
PR-7	1440881.6958	577484.172
PR-8	1440917.6434	577204.1649
PR-9	1441222.5504	577040.2574
PR-17	1440418.7174	577621.1743

COMPOSITE SAMPLE AREA 3 (PHASE 1)		
PR. BORING	EASTING	NORTHING
PR-1	1440417.67	578401.036
PR-2	1440867.845	578260.2853
PR-3	1441066.7303	577968.2668
PR-4	1440200.7509	578289.8773
PR-5	1440489.9875	578083.8059
PR-6	1440861.9873	577817.2736

COMPOSITE SAMPLE AREA 4 (PHASE 2)		
PR. BORING	EASTING	NORTHING
PR-18	1439663.8782	578204.704
PR-23	1439406.6793	578548.228
PR-26	1438850.5128	578755.8638
PR-27	1439052.0762	578516.862

COMPOSITE SAMPLE AREA 5 (PHASE 2)		
PR. BORING	EASTING	NORTHING
PR-19	1439978.3964	578499.6903
PR-20	1439923.422	578779.8429
PR-21	1439638.8122	579020.4536
PR-22	1439562.2206	578666.313
PR-24	1439404.423	578987.5915
PR-25	1439089.3611	578918.9919
PR-28	1439205.382	579339.5189
PR-29	1438744.3601	579584.7894
PR-30	1438885.7923	579222.9721
PR-31	1438559.7439	579175.4598
PR-32	1438162.7446	579335.731
PR-33	1438007.9953	579058.5037
PR-34	1437685.3715	579153.0294

COMPOSITE SAMPLE AREA 6 (PHASE 2)		
PR. BORING	EASTING	NORTHING
PR-38	1437491.9489	578417.2049
PR-41	1437449.1108	578182.4102
PR-45	1437164.0436	577986.8197
PR-48	1436999.6013	577823.7906
PR-49	1437057.9605	577579.8153
PR-50	1436855.5389	577536.0004
PR-56	1436922.7654	576949.4077

COMPOSITE SAMPLE AREA 7 (PHASE 2)		
PR. BORING	EASTING	NORTHING
PR-35	1437426.1048	579355.1833
PR-36	1437082.3542	579044.0955
PR-39	1436795.3538	578727.3493
PR-42	1436595.5865	578428.1664
PR-46	1436269.5955	578326.0217
PR-52	1435986.7205	578146.3857

COMPOSITE SAMPLE AREA 8 (PHASE 2)		
PR. BORING	EASTING	NORTHING
PR-37	1437357.7321	578984.9141
PR-40	1437048.4475	578615.467
PR-43	1437349.6848	578660.5862
PR-44	1437001.9553	578157.6202
PR-47	1436646.1089	577964.469
PR-51	1436204.2654	577933.3239
PR-53	1435916.3407	577812.9134
PR-54	1436603.95	577474.4278
PR-55	1436665.4302	577154.2811

BATHYMETRY NOTE:

1. CONTOURS SHOWN ARE IN MEAN LOWER LOW WATER (MLLW), AND ARE FROM MARCH 2016 THROUGH JANUARY 2018 USACE BATHYMETRIC SURVEYS.

LEGEND

PR-□ BORINGS – PROPOSED JUNE 2018

EXISTING CHANNEL

PROPOSED WIDENING

0 300' 600'
GRAPHIC SCALE

Mark	Description	Date	Appr.

Designed by: DLB
Dwn by: DCM
Ckd by: BMN
Reviewed by: OAK
Submitted by: WAM
Date: OCT. 2018
Drawing Name : Seagirt_Geotech
Scale: AS SHOWN
Plot scale: 1 = 1
Rev.

MARYLAND PORT ADMINISTRATION
HARBOR DEVELOPMENT

GBA ENGINEERS ★ SURVEYORS
9008 Yellow Brick Rd.
Unit O
Baltimore, MD. 21237
Phone (410) 682-5995

SEAGIRT MARINE TERMINAL
50 FT STUDY
BALTIMORE, MARYLAND

SEAGIRT LOOP
CHANNEL DEEPENING AND WIDENING

SEAL

P:\Seagirt_Dundalk\2018_Seagirt_Design\CAD\Seagirt_Loop_Geotechnical_Proposed.dwg

Drawing No. 2: Boring Location Plan

APPENDIX A

RECORDS OF SOIL EXPLORATION

GENERAL CLASSIFICATION SUMMARY FOR SOIL AND ROCK EXPLORATION

SOIL

Particle Size Identification		
Boulders		- 12 inch diameter or more
Cobbles		- 3 to 12 inch diameter
Gravel	- Coarse	- 3/4 to 3 inches
	- Fine	- 4.75mm to 3/4 inch
Sand	- Coarse	- 2.00mm to 4.75 mm [Sieve #10 to #4]
	- Medium	- 0.4mm to 2.00mm [Sieve #40 to #10]
	- Fine	- 0.075mm to 0.4mm [Sieve #200 to #40]
Silt/Clay		- less than 0.075mm (Cannot see particles)
Silt		- Atterberg limits plot below "A" line
Clay		- Atterberg limits plot above "A" line

Relative Proportions

In accordance with ASTM D 2487 and ASTM D 2488

COHESIONLESS SOILS

Density	*N-Value*
Very loose	0-4 blows/ft.
Loose	5-10 blows/ft.
Medium Dense	11-30 blows/ft.
Dense	31-50 blows/ft.
Very Dense	> 50 blows/ft.

COHESIVE SOILS

Consistency	*N-Value*
Very Soft	0-1 blows/ft
Soft	2-4 blows/ft.
Medium Stiff	5- 8 blows/ft.
Stiff	9-15 blows/ft.
Very Stiff	16-30 blows/ft.
Hard	> 30 blows/ft.

Classifications on logs are made by visual inspection.

Standard Penetration Test - Driving a 2.0" O.D., 1 3/8" I.D., sampler a distance of 1.0 foot into undisturbed soil with a 140 pound hammer free failing a distance of 30.0 inches. It is customary for us to drive the spoon 6.0 inches of penetration to seat into undisturbed soil, and then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6.0 inches of penetration on the drill log (Example: 6-8-9). The standard penetration test resistance or "N"-value can be obtained by adding the last two figures (i.e., 8 + 9 = 17 blows/ft.).

Strata Changes - In the column "Soil Descriptions" on the drill log, the horizontal lines represent estimated strata changes.

Groundwater observations were made at the times indicated. Porosity of soil strata, weather conditions, site topography, etc., may cause changes in the water levels indicated on the logs.

ROCK

Rock Quality Designation (RQD) - The sum of the lengths of pieces of recovered core which are greater than four inches in length, expressed as a percentage of the total length of the core run. If the core has been broken by the drilling process, it is considered to be intact provided the broken fragments are cumulatively greater than 4 inches in length. For this investigation, vertical separations which split the core have not been considered discontinuities when determining RQD.

Recovery (REC) - The total length of core recovered expressed as a percentage of the total length of that coring run.

ROCK CLASSIFICATION

Residual Soil – reduced to soil. Rock fabric not discernible. Can be easily broken by hand.
Completely weathered (Saprolite) – Rock fabric discernible in a few scattered locations. Effectively reduced to soil and can be broken by hand.
Highly weathered – Almost all of the rock shows severe discoloration and weathering. Rock fabric evident in majority of the rock.
Moderately weathered – Significant portions show discoloration and weakening (softening, lighter color). Shows loss of weight. Rock fabric evident.
Slightly weathered – Slightly discolored. Lower in strength than fresh rock. Dull under hammer.
Fresh - No visible signs of discoloration or decomposition.

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR- 1
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	-0.4 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/7/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/7/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25, 30, 35, 40						1. Area 3 2. 578387.55 N 1440418.45 E

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR- 1
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	-0.4 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/7/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/7/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER *(continued)*			45						
-49.4		49.0								
	Gray, wet, very soft, elastic **SILT**, **(MH)**			50		WOR/18"	1	DS	12	
						WOR/18"	2	DS	18	
				55		WOR/18"	3	DS	15	
-58.4		58.0				WOR/18"	4	DS	18	
	Bottom of Boring at 58.0 ft			60						
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR- 2
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	0.7 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/12/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/12/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	SAMPLE Blows/6"	SAMPLE No.	SAMPLE Type	SAMPLE Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25, 30, 35, 40						1. Area 3 2. 578240.32 N 1440788.45 E

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR- 2
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum: MLLW | Hammer Wt.: 140 lb | Hole Diameter: 8 in | Foreman: M. Fletcher
Surf. Elev.: 0.7 ± ft | Hammer Drop: 30 in | Rock Core Dia.: N/A | Inspector: D. Patterson
Date Started: 12/12/18 | Spoon Size: 2 in | Boring Method: HSA | Date Completed: 12/12/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER *(continued)*			45						
-46.3		47.0								
	Brown, wet, very soft, elastic **SILT**, **(MH)**					WOR/18"	1	DS	8	
				50		WOR/18"	2	DS	18	
						WOR/18"	3	DS	18	
				55		WOR/18"	4	DS	18	
						WOR/18"	5	DS	15	
				60		WOR/18"	6	DS	18	
-60.3		61.0								
	Bottom of Boring at 61.0 ft			65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR- 3
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	0.4 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/6/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/6/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	SAMPLE Blows/6"	SAMPLE No.	SAMPLE Type	SAMPLE Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25, 30, 35, 40						1. Area 3 2. 577978.12 N 1441071.79 E

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR- 3
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	0.4 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/6/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/6/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER *(continued)*			45						
-49.6		50.0		50						
	Gray, wet, very soft, elastic **SILT**, **(MH)**					WOR/18"	1	DS	18	
						WOR/18"	2	DS	14	
				55		WOR/18"	3	DS	18	
-58.6		59.0				WOR/18"	4	DS	18	
	Bottom of Boring at 59.0 ft			60						
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR- 4
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.1 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/7/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/7/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	SAMPLE Blows/6"	SAMPLE No.	SAMPLE Type	SAMPLE Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25, 30, 35, 40						1. Area 3 2. 578283.25 N 1440214.8 E

SAMPLER TYPE
- DS - DRIVEN SPLIT SPOON
- PT - PRESSED SHELBY TUBE
- CA - CONTINUOUS FLIGHT AUGER
- RC - ROCK CORE

SAMPLE CONDITIONS
- D - DISINTEGRATED
- I - INTACT
- U - UNDISTURBED
- L - LOST

GROUNDWATER DEPTH
- AT COMPLETION _____ ft
- AFTER _____ HRS. _____ ft
- AFTER 24 HRS. _____ ft
- CAVED AT _____ ft

BORING METHOD
- HSA - HOLLOW STEM AUGERS
- CFA - CONTINUOUS FLIGHT AUGERS
- DC - DRIVING CASING
- MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR- 4
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum: MLLW | Hammer Wt.: 140 lb | Hole Diameter: 8 in | Foreman: M. Fletcher
Surf. Elev.: 1.1 ± ft | Hammer Drop: 30 in | Rock Core Dia.: N/A | Inspector: D. Patterson
Date Started: 12/7/18 | Spoon Size: 2 in | Boring Method: HSA | Date Completed: 12/7/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER *(continued)*			45						
-47.9		49.0								
	Gray, wet, very soft, elastic **SILT**, **(MH)**			50		WOR/18"	1	DS	18	
						WOR/18"	2	DS	8	
				55		WOR/18"	3	DS	18	
-56.9		58.0				WOR/18"	4	DS	18	
	Bottom of Boring at 58.0 ft			60						
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR- 5
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	0.2 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/7/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/7/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	SAMPLE Blows/6"	SAMPLE No.	SAMPLE Type	SAMPLE Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25, 30, 35, 40						1. Area 3 2. 578091.83 N 1440507.82 E

SAMPLER TYPE
- DS - DRIVEN SPLIT SPOON
- PT - PRESSED SHELBY TUBE
- CA - CONTINUOUS FLIGHT AUGER
- RC - ROCK CORE

SAMPLE CONDITIONS
- D - DISINTEGRATED
- I - INTACT
- U - UNDISTURBED
- L - LOST

GROUNDWATER DEPTH
- AT COMPLETION _____ ft
- AFTER _____ HRS. _____ ft
- AFTER 24 HRS. _____ ft
- CAVED AT _____ ft

BORING METHOD
- HSA - HOLLOW STEM AUGERS
- CFA - CONTINUOUS FLIGHT AUGERS
- DC - DRIVING CASING
- MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR- 5
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	0.2 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/7/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/7/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER *(continued)*			45						
-49.8		50.0		50						
	Gray, wet, very soft, elastic **SILT**					WOR/18"	1	DS	18	
						WOR/18"	2	DS	18	
				55		WOR/18"	3	DS	18	
-58.8		59.0				WOR/18"	4	DS	18	
	Bottom of Boring at 59.0 ft			60						
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR- 6
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	0.8 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/6/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/6/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	SAMPLE Blows/6"	SAMPLE No.	SAMPLE Type	SAMPLE Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25, 30, 35, 40						1. Area 3 2. 577852.7 N 1440848.53 E

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR- 6
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum: MLLW | Hammer Wt.: 140 lb | Hole Diameter: 8 in | Foreman: M. Fletcher
Surf. Elev.: 0.8 ± ft | Hammer Drop: 30 in | Rock Core Dia.: N/A | Inspector: D. Patterson
Date Started: 12/6/18 | Spoon Size: 2 in | Boring Method: HSA | Date Completed: 12/6/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER *(continued)*			45						
				50						
-50.2		51.0								
	Gray, wet, very soft, elastic **SILT**, **(MH)**					WOR/18"	1	DS	14	
				55		WOR/18"	2	DS	18	
						WOR/18"	3	DS	18	
-59.2		60.0		60		WOR/18"	4	DS	18	
	Bottom of Boring at 60.0 ft									
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR- 7
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.0 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/10/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/10/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER			5						1. Area 2 2. 577490.31 N 1440874.29 E
				10						
				15						
				20						
-24.0		25.0		25						
	Black, wet, very soft, elastic **SILT**, **(MH)**					WOR/18"	1	DS	10	
						WOR/18"	2	DS	12	
				30		WOR/18"	3	DS	14	
						WOR/18"	4	DS	15	
-33.0		34.0								
	Dark gray, wet, very soft, elastic **SILT**			35		WOR/18"	5	DS	15	
-35.5		36.5								
	Gray, wet, very soft, elastic **SILT**					WOR/18"	6	DS	15	
				40						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR- 7
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.0 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/10/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/10/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	Gray, wet, very soft, elastic **SILT** *(continued)*					WOR/18"	7	DS	18	
						WOR/18"	8	DS	14	
				45		WOR/18"	9	DS	18	
						WOR/18"	10	DS	18	
				50		WOR/18"	11	DS	18	
						WOR/18"	12	DS	18	
				55		WOR/18"	13	DS	18	
-58.0		59.0				WOR/18"	14	DS	15	
	Bottom of Boring at 59.0 ft			60						
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR- 8
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.0 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/10/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/10/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER									1. Area 2 2. 577206.57 N 1440904.41 E
-21.0		22.0								
	Gray, wet, very soft, elastic **SILT**					WOR/18"	1	DS	14	
-22.5		23.5								
	Gray, black, wet, very soft, elastic **SILT**, **(MH)**					WOR/18"	2	DS	18	
						WOR/18"	3	DS	18	
						WOR/18"	4	DS	18	
						WOR/18"	5	DS	18	
-32.5		33.5								
	Gray, wet, very soft, elastic **SILT**, **(MH)**					WOR/18"	6	DS	18	
						WOR/18"	7	DS	18	

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR- 8
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.0 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/10/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/10/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	Gray, wet, very soft, elastic **SILT**, **(MH)** *(continued)*					WOR/18"	8	DS	18	
						WOR/18"	9	DS	18	
				45		WOR/18"	10	DS	18	
						WOR/18"	11	DS	18	
				50		WOR/18"	12	DS	18	
						WOR/18"	13	DS	18	
				55		WOR/18"	14	DS	18	
						WOR/18"	15	DS	18	
				60		WOR/18"	16	DS	18	
-60.0		61.0								
	Bottom of Boring at 61.0 ft									
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR- 9
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.0 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/14/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/14/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	SAMPLE Blows/6"	SAMPLE No.	SAMPLE Type	SAMPLE Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25, 30, 35, 40						1. Area 2 2. 577067.3 N 1441281.03 E

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR- 9
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.0 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/14/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/14/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER *(continued)*			45						
				50						
-51.0		52.0								
	Black, wet, very soft, elastic **SILT**					WOR/18"	1	DS	6	
-52.5		53.5								
	Gray, wet, very soft, elastic **SILT**, **(MH)**			55		WOR/18"	2	DS	10	
						WOR/18"	3	DS	12	
				60		WOR/18"	4	DS	18	
-60.0		61.0								
	Bottom of Boring at 61.0 ft			65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-10
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.7 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/14/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/14/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	SAMPLE Blows/6"	SAMPLE No.	SAMPLE Type	SAMPLE Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25, 30, 35, 40						1. Area 1 2. 576427.13 N 1441383.55 E

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-10
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.7 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/14/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/14/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER *(continued)*			45						
-47.3		49.0								
	Black, wet, very soft, elastic **SILT**			50		WOR/18"	1	DS	6	
						WOR/18"	2	DS	8	
-51.3		53.0								
	Gray, wet, very soft, elastic **SILT**			55		WOR/18"	3	DS	14	
						WOR/18"	4	DS	14	
				60		WOR/18"	5	DS	14	
-58.8		60.5								
	Bottom of Boring at 60.5 ft			65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-11
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.4 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/11/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/11/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER									1. Area 1 2. 576187.01 E 1441274.66 N
-21.6		23.0								
	Black, wet, very soft, elastic **SILT**					WOR/18"	1	DS	6	
						WOR/18"	2	DS	8	
						WOR/18"	3	DS	15	
						WOR/18"	4	DS	18	
						WOR/18"	5	DS	3	
-35.6		37.0				WOR/18"	6	DS	15	
	Gray, wet, very soft, fat **CLAY**					WOR/18"	7	DS	18	

5 10 15 20 25 30 35 40

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-11
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.4 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/11/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/11/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	Gray, wet, very soft, fat **CLAY** *(continued)*					WOR/18"	8	DS	18	
				45		WOR/18"	9	DS	18	
						WOR/18"	10	DS	18	
						WOR/18"	11	DS	18	
				50		WOR/18"	12	DS	18	
						WOR/18"	13	DS	18	
				55		WOR/18"	14	DS	18	
						WOR/18"	15	DS	18	
-58.1		59.5		60						
	Bottom of Boring at 59.5 ft									
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-12
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.2 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/12/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/12/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER									1. Area 1 2. 575994.1 N 1441432.01 E
-21.8	Black, wet, very soft, elastic **SILT**	23.0		25		WOR/18"	1	DS	7	
						WOR/18"	2	DS	10	
				30		WOR/18"	3	DS	10	
-30.8	Brown, dark gray, wet, very soft, elastic **SILT**, **(MH)**	32.0				WOR/18"	4	DS	10	
				35		WOR/18"	5	DS	10	
						WOR/18"	6	DS	12	
				40		WOR/18"	7	DS	12	

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-12
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.2 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/12/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/12/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	Brown, dark gray, wet, very soft, elastic **SILT**, **(MH)** *(continued)*					WOR/18"	8	DS	18	
						WOR/18"	9	DS	18	
				45		WOR/18"	10	DS	18	
						WOR/18"	11	DS	18	
				50		WOR/18"	12	DS	18	
						WOR/18"	13	DS	18	
				55		WOR/18"	14	DS	18	
						WOR/18"	15	DS	18	
-58.3	Bottom of Boring at 59.5 ft	59.5		60						
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-13
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.2 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/12/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/12/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER									1. Area 1 2. 575717.76 N 1441578.68 E
-22.8	Black, wet, very soft, elastic **SILT**	24.0		25		WOR/18"	1	DS	8	
						WOR/18"	2	DS	10	
				30		WOR/18"	3	DS	12	
						WOR/18"	4	DS	10	
-34.3	Gray, wet, very soft, elastic **SILT**, **(MH)**	35.5		35		WOR/18"	5	DS	12	
						WOR/18"	6	DS	14	
				40		WOR/18"	7	DS	18	

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-13
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.2 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/12/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/12/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	Gray, wet, very soft, elastic **SILT**, **(MH)** *(continued)*					WOR/18"	8	DS	18	
				45		WOR/18"	9	DS	18	
						WOR/18"	10	DS	18	
				50		WOR/18"	11	DS	18	
						WOR/18"	12	DS	18	
				55		WOR/18"	13	DS	18	
						WOR/18"	14	DS	18	
-59.3		60.5		60		WOR/18"	15	DS	18	
	Bottom of Boring at 60.5 ft									
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-14
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.2 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/11/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/11/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER									1. Area 1 2. 575400.7 N 1441670.31 E
-21.8	Black, wet, very soft, elastic **SILT**	23.0		25		WOR/18"	1	DS	18	
						WOR/18"	2	DS	18	
				30		WOR/18"	3	DS	12	
-30.8	Gray, wet, very soft, elastic **SILT**	32.0				WOR/18"	4	DS	12	
				35		WOR/18"	5	DS	18	
						WOR/18"	6	DS	18	
				40		WOR/18"	7	DS	18	

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-14
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum: MLLW | Hammer Wt.: 140 lb | Hole Diameter: 8 in | Foreman: M. Fletcher
Surf. Elev.: 1.2 ± ft | Hammer Drop: 30 in | Rock Core Dia.: N/A | Inspector: D. Patterson
Date Started: 12/11/18 | Spoon Size: 2 in | Boring Method: HSA | Date Completed: 12/11/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	Gray, wet, very soft, elastic **SILT** *(continued)*					WOR/18"	8	DS	18	
						WOR/18"	9	DS	18	
				45		WOR/18"	10	DS	18	
						WOR/18"	11	DS	18	
				50		WOR/18"	12	DS	18	
						WOR/18"	13	DS	18	
				55		WOR/18"	14	DS	18	
						WOR/18"	15	DS	18	
-58.3		59.5		60						
	Bottom of Boring at 59.5 ft									
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-15
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.6 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/13/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/13/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER									1. Area 1 2. 575376.43 N 1441841.45 E
-33.4	Black, wet, very soft, elastic **SILT**, **(MH)**	35.0		35		WOR/18"	1	DS	3	
				40		WOR/18"	2	DS	3	

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-15
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.6 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/13/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/13/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	Black, wet, very soft, elastic **SILT**, **(MH)** *(continued)*					WOR/18"	3	DS	14	
						WOR/18"	4	DS	15	
				45		WOR/18"	5	DS	18	
						WOR/18"	6	DS	15	
-48.4		50.0		50						
	Gray, wet, very soft, fat **CLAY**					WOR/18"	7	DS	18	
						WOR/18"	8	DS	18	
				55		WOR/18"	9	DS	18	
-57.4		59.0				WOR/18"	10	DS	18	
	Bottom of Boring at 59.0 ft			60						
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-16
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	0.7 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/20/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/20/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	SAMPLE Blows/6"	SAMPLE No.	SAMPLE Type	SAMPLE Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25, 30, 35, 40						1. Area 1 2. 575143.1 N 1442012.05 E

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-16
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	0.7 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/20/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/20/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER *(continued)*			45						
-50.3		51.0		50						
	Black, wet, very soft to soft, **SILT**					WOR/18"	1	DS	4	
-54.3		55.0		55		WOH/12"-2	2	DS	6	
	Gray, wet, very soft, **CLAY**					WOH/18"	3	DS	12	
				60		WOH/12"-6	4	DS	10	
-60.8		61.5				7-7-6	5	DS	10	
	Brown, wet, medium dense, clayey **SAND**, and fine Gravel									
-63.3		64.0		65		7-6-4	6	DS	10	
	Gray, wet, loose to medium dense, fine to coarse, **SAND**, and fine Gravel									
-66.8		67.5				6-4-4	7	DS	10	
	Bottom of Boring at 67.5 ft			70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-17
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	0.7 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/10/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/10/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER			5						1. Area 2 2. 577624.52 N 1440418.84 E
				10						
				15						
				20						
-21.8		22.5								
	Black, wet, very soft, fat **CLAY**			25		WOR/18"	1	DS	8	
						WOR/18"	2	DS	10	
						WOR/18"	3	DS	14	
				30		WOR/18"	4	DS	15	
-33.3		34.0				WOR/18"	5	DS	18	
	Dark gray, black, wet, very soft, fat **CLAY**, **(CH)**			35		WOR/18"	6	DS	18	
						WOR/18"	7	DS	18	
				40						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-17
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum: MLLW | Hammer Wt.: 140 lb | Hole Diameter: 8 in | Foreman: M. Fletcher
Surf. Elev.: 0.7 ± ft | Hammer Drop: 30 in | Rock Core Dia.: N/A | Inspector: D. Patterson
Date Started: 12/10/18 | Spoon Size: 2 in | Boring Method: HSA | Date Completed: 12/10/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	Dark gray, black, wet, very soft, fat **CLAY**, **(CH)** *(continued)*					WOR/18"	8	DS	15	
						WOR/18"	9	DS	18	
-43.3		44.0		45		WOR/18"	10	DS	18	
	Dark gray, wet, very soft, elastic **SILT**, **(MH)**					WOR/18"	11	DS	18	
				50		WOR/18"	12	DS	18	
						WOR/18"	13	DS	18	
				55		WOR/18"	14	DS	18	
-58.3		59.0				WOR/18"	15	DS	18	
	Bottom of Boring at 59.0 ft			60						
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates — Boring #: PR-18
Project Name: Task 17 - Seagirt Loop Channel Deepening — Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	2.4 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/21/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/21/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER									1. Area 4 2. 578230.52 N 1439625.1 E
-19.6		22.0								
	Black, dark gray, wet, very soft, elastic **SILT**, with sand, **(MH)**					WOR/18"	1	DS	14	
						WOR/18"	2	DS	18	
						WOR/18"	3	DS	18	
						WOR/18"	4	DS	18	
						WOR/18"	5	DS	18	
						WOR/18"	6	DS	18	
-36.1		38.5				WOR/18"	7	DS	15	

5 10 15 20 25 30 35 40

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-18
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum: MLLW | Hammer Wt.: 140 lb | Hole Diameter: 8 in | Foreman: M. Fletcher
Surf. Elev.: 2.4 ± ft | Hammer Drop: 30 in | Rock Core Dia.: N/A | Inspector: D. Patterson
Date Started: 12/21/18 | Spoon Size: 2 in | Boring Method: HSA | Date Completed: 12/21/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	Gray, brown, wet, very soft, fat **CLAY**, **(CH)** *(continued)*					WOR/18"	8	DS	18	
						WOR/18"	9	DS	18	
				45		WOR/18"	10	DS	18	
						WOR/18"	11	DS	18	
				50		WOR/18"	12	DS	18	
						WOR/18"	13	DS	18	
				55		WOR/18"	14	DS	18	
						WOR/18"	15	DS	18	
				60		WOR/18"	16	DS	18	
-58.6		61.0								
	Bottom of Boring at 61.0 ft									
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-19
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	2.0 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/17/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/17/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	SAMPLE Blows/6"	SAMPLE No.	SAMPLE Type	SAMPLE Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25, 30, 35, 40						1. Area 5 2. 578539.11 N 1440002.23 E

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-19
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	2.0 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/17/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/17/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER *(continued)*			45						
-47.0		49.0								
	Dark gray, wet, very soft, fat **CLAY**, **(CH)**			50		WOR/18"	1	DS	15	
						WOR/18"	2	DS	18	
				55		WOR/18"	3	DS	18	
-56.0		58.0				WOR/18"	4	DS	18	
	Bottom of Boring at 58.0 ft			60						
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-20
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.4 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/17/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/17/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	SAMPLE Blows/6"	SAMPLE No.	SAMPLE Type	SAMPLE Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25, 30, 35, 40						1. Area 5 2. 578798.45 N 1439933.66 E

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-20
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum: MLLW | Hammer Wt.: 140 lb | Hole Diameter: 8 in | Foreman: M. Fletcher
Surf. Elev.: 1.4 ± ft | Hammer Drop: 30 in | Rock Core Dia.: N/A | Inspector: D. Patterson
Date Started: 12/17/18 | Spoon Size: 2 in | Boring Method: HSA | Date Completed: 12/17/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER *(continued)*			45						
-46.6		48.0								
	Dark gray, wet, very soft, elastic **SILT**, **(MH)**			50		WOR/18"	1	DS	18	
						WOR/18"	2	DS	18	
				55		WOR/18"	3	DS	18	
						WOR/18"	4	DS	18	
-58.1		59.5		60		WOR/18"	5	DS	18	
	Bottom of Boring at 59.5 ft			65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-21
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.3 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/17/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/17/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	SAMPLE Blows/6"	SAMPLE No.	SAMPLE Type	SAMPLE Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25, 30, 35, 40						1. Area 5 2. 579027.67 N 1439621.84 E

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-21
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum: MLLW | Hammer Wt.: 140 lb | Hole Diameter: 8 in | Foreman: M. Fletcher
Surf. Elev.: 1.3 ± ft | Hammer Drop: 30 in | Rock Core Dia.: N/A | Inspector: D. Patterson
Date Started: 12/17/18 | Spoon Size: 2 in | Boring Method: HSA | Date Completed: 12/17/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER *(continued)*			45						
-46.7		48.0								
	Gray, dark greenish brown, wet, very soft, fat **CLAY**, **(CH)**			50		WOR/18"	1	DS	9	
						WOR/18"	2	DS	18	
				55		WOR/18"	3	DS	18	
-55.7		57.0				WOR/18"	4	DS	18	
	Bottom of Boring at 57.0 ft			60						
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-22
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	2.3 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/17/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/17/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25, 30, 35, 40						1. Area 5 2. 578650.62 N 1439547.35 E

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-22
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	2.3 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/17/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/17/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER *(continued)*			45						
-43.7		46.0								
	Black, wet, very soft, elastic **SILT**					WOR/18"	1	DS	6	
-45.2		47.5								
	Dark gray, wet, very soft, elastic **SILT**, **(MH)**			50		WOR/18"	2	DS	15	
-49.7		52.0				WOR/18"	3	DS	18	
	Dark gray, wet, very soft, fat **CLAY**, **(CH)**			55		WOR/18"	4	DS	18	
						WOR/18"	5	DS	18	
-57.7		60.0		60		WOR/18"	6	DS	18	
	Bottom of Boring at 60.0 ft			65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-23
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.3 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/26/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/26/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER									1. Area 4 2. 578528.9 N 1439393.75 E
-26.7	Black, wet, very soft, **SILT**	28.0				WOR/18"	1	DS	6	
						WOR/18"	2	DS	8	
						WOR/18"	3	DS	10	
-34.7		36.0								
-35.2	Brown, wet, loose, Silty **SAND**	36.5				WOR/6"-2-3	4	DS	12	
	Brown, dark gray, wet, very soft, fat **CLAY**, **(CH)**					WOR/18"	5	DS	12	

5 10 15 20 25 30 35 40

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL EXPLORATION SEAGIRT LOGS.GPJ TLB2010.GDT 5/1/19

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-23
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.3 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/26/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/26/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	Brown, dark gray, wet, very soft, fat **CLAY**, **(CH)** *(continued)*					WOH/18"	6	DS	5	
				45		WOR/18"	7	DS	9	
						WOR/18"	8	DS	18	
-47.2		48.5				WOR/18"	9	DS	5	
	Dark gray, wet, very soft, elastic **SILT**, **(MH)**			50		WOR/18"	10	DS	18	
						WOR/18"	11	DS	18	
				55		WOR/18"	12	DS	18	
-58.2		59.5				WOR/18"	13	DS	18	
	Bottom of Boring at 59.5 ft			60						
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-24
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	0.2 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/18/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/18/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	SAMPLE Blows/6"	SAMPLE No.	SAMPLE Type	SAMPLE Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25, 30, 35, 40						1. Area 5 2. 578981.14 N 1439396.94 E

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-24
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	0.2 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/18/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/18/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER *(continued)*			45						
-46.8		47.0								
	Dark gray, wet, very soft, elastic **SILT**, **(MH)**					WOR/18"	1	DS	18	
				50		WOR/18"	2	DS	18	
-51.8		52.0								
	Dark gray, wet, very soft, fat **CLAY**					WOR/18"	3	DS	15	
				55		WOR/18"	4	DS	18	
-58.3		58.5				WOR/18"	5	DS	16	
	Bottom of Boring at 58.5 ft			60						
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-25
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	0.6 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/18/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/18/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	SAMPLE Blows/6"	SAMPLE No.	SAMPLE Type	SAMPLE Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25, 30, 35, 40						1. Area 5 2. 579033.53 N 1439109.98 E

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-25
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	0.6 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/18/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/18/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER *(continued)*			45						
-49.4		50.0		50						
	Dark gray, wet, very soft, fat **CLAY**, **(CH)**					WOR/18"	1	DS	15	
						WOR/18"	2	DS	15	
				55		WOR/18"	3	DS	18	
-58.4		59.0				WOR/18"	4	DS	18	
	Bottom of Boring at 59.0 ft			60						
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-26
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.2 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/27/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/27/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER									1. Area 4 2. 578724.72 N 1438875.95 E
-21.8	Black, wet, very soft, fat **CLAY**	23.0				WOR/18"	1	DS	9	
						WOR/18"	2	DS	15	
						WOR/18"	3	DS	12	
						WOR/18"	4	DS	15	
						WOR/18"	5	DS	12	
						WOR/18"	6	DS	18	
						WOR/18"	7	DS	15	

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-26
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.2 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/27/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/27/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	Black, wet, very soft, fat **CLAY** *(continued)*					WOR/18"	8	DS	18	
						WOR/18"	9	DS	18	
-43.8		45.0		45						
	Dark gray, wet, very soft, elastic **SILT**, **(MH)**					WOR/18"	10	DS	18	
						WOR/18"	11	DS	15	
-48.8		50.0		50						
	Black, wet, very soft, fat **CLAY**					WOR/18"	12	DS	18	
						WOR/18"	13	DS	14	
				55						
						WOR/18"	14	DS	18	
						WOR/18"	15	DS	18	
-58.3		59.5		60						
	Bottom of Boring at 59.5 ft									
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-27
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.1 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/27/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/27/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER									1. Area 4 2. 578555.9 N 1439086.09 E
-19.9	Black, wet, very soft, **CLAY**	21.0				WOR/18"	1	DS	9	
						WOR/18"	2	DS	12	
-23.9	Dark gray, black, wet, very soft, fat **CLAY**	25.0		25		WOR/18"	3	DS	14	
						WOR/18"	4	DS	15	
				30		WOR/18"	5	DS	14	
						WOR/18"	6	DS	15	
				35		WOR/18"	7	DS	15	
-36.4	Dark gray, wet, very soft, elastic **SILT**, **(MH)**	37.5				WOR/18"	8	DS	15	

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-27
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum: MLLW | Hammer Wt.: 140 lb | Hole Diameter: 8 in | Foreman: M. Fletcher
Surf. Elev.: 1.1 ± ft | Hammer Drop: 30 in | Rock Core Dia.: N/A | Inspector: D. Patterson
Date Started: 12/27/18 | Spoon Size: 2 in | Boring Method: HSA | Date Completed: 12/27/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	Dark gray, wet, very soft, elastic **SILT**, **(MH)** *(continued)*					WOR/18"	9	DS	18	
				45		WOR/18"	10	DS	15	
						WOR/18"	11	DS	18	
				50		WOR/18"	12	DS	18	
						WOR/18"	13	DS	18	
				55		WOR/18"	14	DS	18	
						WOR/18"	15	DS	18	
-58.9		60.0		60		WOR/18"	16	DS	18	
	Bottom of Boring at 60.0 ft									
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-28
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	0.6 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/18/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/18/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	SAMPLE Blows/6"	SAMPLE No.	SAMPLE Type	SAMPLE Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25, 30, 35, 40						1. Area 5 2. 579334.71 N 1439198.76 E

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-28
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	0.6 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/18/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/18/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER *(continued)*			45						
-47.4		48.0								
	Dark gray, wet, very soft, elastic **SILT**, **(MH)**			50		WOR/18"	1	DS	7	
						WOR/18"	2	DS	18	
-54.4		55.0		55		WOR/18"	3	DS	14	
	Dark gray, wet, very soft, fat **CLAY**					WOR/18"	4	DS	16	
-58.9		59.5		60		WOR/18"	5	DS	18	
	Bottom of Boring at 59.5 ft			65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-29
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	0.4 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/19/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/19/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	SAMPLE Blows/6"	SAMPLE No.	SAMPLE Type	SAMPLE Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25, 30, 35, 40						1. Area 5 2. 579628.66 N 1438708.3 E

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-29
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	0.4 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/19/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/19/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER *(continued)*			45						
-45.6		46.0								
	Black, wet, very soft, **SILT**					WOR/18"	1	DS	6	
				50		WOR/18"	2	DS	4	
-52.1		52.5				WOR/18"	3	DS	5	
	Dark gray, wet, very soft, fat **CLAY**, **(CH)**			55		WOR/18"	4	DS	18	
						WOR/18"	5	DS	15	
-59.6		60.0		60		WOR/18"	6	DS	18	
	Bottom of Boring at 60.0 ft			65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-30
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	0.3 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/19/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/19/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	SAMPLE Blows/6"	SAMPLE No.	SAMPLE Type	SAMPLE Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25, 30, 35, 40						1. Area 5 2. 579207.97 N 1438917.54 E

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-30
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	0.3 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/19/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/19/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER *(continued)*			45						
-48.7		49.0								
	Dark gray, wet, very soft, elastic **SILT**, **(MH)**			50		WOR/18"	1	DS	7	
						WOR/18"	2	DS	18	
-53.2		53.5								
	Dark gray, wet, very soft, fat **CLAY**, **(CH)**			55		WOR/18"	3	DS	18	
						WOR/18"	4	DS	18	
				60		WOR/18"	5	DS	18	
-60.2		60.5								
	Bottom of Boring at 60.5 ft			65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-31
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.0 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/19/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/19/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	SAMPLE Blows/6"	SAMPLE No.	SAMPLE Type	SAMPLE Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25, 30, 35, 40						1. Area 5 2. 579132.27 N 1438527.52 E

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-31
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.0 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/19/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/19/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER *(continued)*			45						
				50						
-50.0		51.0								
	Black, wet, very soft, fat **CLAY**					WOR/18"	1	DS	18	
-51.5		52.5								
	Dark gray, wet, very soft, fat **CLAY**, **(CH)**			55		WOR/18"	2	DS	18	
						WOR/18"	3	DS	18	
				60		WOR/18"	4	DS	18	
-59.0		60.0								
	Bottom of Boring at 60.0 ft			65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-32
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	0.6 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/20/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/20/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	SAMPLE Blows/6"	SAMPLE No.	SAMPLE Type	SAMPLE Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25, 30, 35, 40						1. Area 5 2. 579392.21 N 1438139.6 E

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-32
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum: MLLW | Hammer Wt.: 140 lb | Hole Diameter: 8 in | Foreman: M. Fletcher
Surf. Elev.: 0.6 ± ft | Hammer Drop: 30 in | Rock Core Dia.: N/A | Inspector: D. Patterson
Date Started: 12/20/18 | Spoon Size: 2 in | Boring Method: HSA | Date Completed: 12/20/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	SAMPLE Blows/6"	SAMPLE No.	SAMPLE Type	SAMPLE Rec (in)	BORING & SAMPLE NOTES
	WATER *(continued)*									
-44.4		45.0		45						
	Black, wet, very soft, elastic **SILT**					WOR/18"	1	DS	4	
-45.9		46.5								
	Dark gray, wet, very soft, fat **CLAY**, **(CH)**					WOR/18"	2	DS	9	
				50		WOR/18"	3	DS	15	
						WOR/18"	4	DS	18	
				55		WOR/18"	5	DS	18	
-58.4		59.0				WOR/18"	6	DS	18	
	Bottom of Boring at 59.0 ft			60						
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-33
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.5 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/28/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/28/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	SAMPLE Blows/6"	SAMPLE No.	SAMPLE Type	SAMPLE Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25, 30, 35, 40						1. Area 5 2. 579027.25 N 1437981.34 E

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-33
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.5 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/28/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/28/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER *(continued)*			45						
-47.5		49.0								
-49.0	Black, wet, very soft, elastic **SILT**	50.5		50		WOR/18"	1	DS	7	
	Dark gray, wet, very soft, fat **CLAY**, **(CH)**					WOR/18"	2	DS	16	
				55		WOR/18"	3	DS	18	
						WOR/18"	4	DS	18	
-59.0		60.5		60		WOR/18"	5	DS	15	
	Bottom of Boring at 60.5 ft									
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-34
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	2.4 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	12/28/18	Spoon Size	2 in	Boring Method	HSA	Date Completed	12/28/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	SAMPLE Blows/6"	SAMPLE No.	SAMPLE Type	SAMPLE Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25, 30, 35, 40						1. Area 5 2. 579157.52 N 1437661.81 E

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-34
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum: MLLW | Hammer Wt.: 140 lb | Hole Diameter: 8 in | Foreman: M. Fletcher
Surf. Elev.: 2.4 ± ft | Hammer Drop: 30 in | Rock Core Dia.: N/A | Inspector: D. Patterson
Date Started: 12/28/18 | Spoon Size: 2 in | Boring Method: HSA | Date Completed: 12/28/18

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER *(continued)*			45						
-43.6		46.0								
	Black, wet, very soft, elastic **SILT**					WOR/18"	1	DS	4	
-45.1		47.5								
	Dark gray, wet, very soft, fat **CLAY**, **(CH)**					WOR/18"	2	DS	16	
				50		WOR/18"	3	DS	18	
						WOR/18"	4	DS	18	
				55		WOR/18"	5	DS	18	
						WOR/18"	6	DS	18	
-57.6		60.0		60						
	Bottom of Boring at 60.0 ft									
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-35
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	0.3 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/2/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/2/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	SAMPLE Blows/6"	SAMPLE No.	SAMPLE Type	SAMPLE Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25, 30, 35, 40						1. Area 7 2. 579367.57 N 1437422.29 E

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-35
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	0.3 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/2/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/2/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER *(continued)*									
-41.7		42.0								
	Black, moist to wet, medium stiff to very stiff, elastic **SILT**					2-2-3	1	DS	18	
				45		5-5-11	2	DS	12	
-45.7		46.0								
	Dark green, moist to wet, very loose, fine to coarse, silty **SAND**, with gravel					2-1-1	3	DS	10	
-48.2		48.5								
	Gray, brown, moist to wet, very soft to soft, **SILT**, with sand, **(ML)**			50		WOH/6"-1-2	4	DS	18	
						WOH/18"	5	DS	18	
				55		WOR/18"	6	DS	18	
-55.7		56.0								
	Gray, moist to wet, soft to medium stiff, elastic **SILT**, trace sand, trace mica					WOH/6"-2-3	7	DS	18	
				60		WOH/12"-4	8	DS	16	
-60.7		61.0								
	Bottom of Boring at 61.0 ft									
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-36
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	0.2 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/2/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/2/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER									1. Area 7 2. 579039.74 N 1437071.29 E
-19.8		20.0		20						
	Black, brown, grey, wet, very soft, **CLAY**					WOR/18"	1	DS	7	
-23.8		24.0				WOR/18"	2	DS	10	
	Black, brown, dark gray, wet, very soft, fat **CLAY**, **(CH)**			25		WOR/18"	3	DS	15	
						WOR/18"	4	DS	12	
				30		WOR/18"	5	DS	18	
						WOR/18"	6	DS	16	
				35		WOR/18"	7	DS	14	
						WOR/18"	8	DS	18	
				40						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-36
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum: MLLW | Hammer Wt.: 140 lb | Hole Diameter: 8 in | Foreman: M. Fletcher
Surf. Elev.: 0.2 ± ft | Hammer Drop: 30 in | Rock Core Dia.: N/A | Inspector: D. Patterson
Date Started: 1/2/19 | Spoon Size: 2 in | Boring Method: HSA | Date Completed: 1/2/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	Black, brown, dark gray, wet, very soft, fat **CLAY**, **(CH)** *(continued)*					WOR/18"	9	DS	13	
						WOR/18"	10	DS	5	
				45		WOR/18"	11	DS	7	
-46.3		46.5								
	Dark greenish-brown, wet, loose to medium dense, fine to coarse, **SAND**, some silt and gravel					6-9-10	12	DS	2	
				50		5-10-12	13	DS	10	
						4-6-7	14	DS	6	
				55		3-3-7	15	DS	5	
-58.8		59.0				1-3-5	16	DS	12	
	Bottom of Boring at 59.0 ft			60						
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-37
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.7 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/9/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/9/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	SAMPLE Blows/6"	SAMPLE No.	SAMPLE Type	SAMPLE Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25, 30, 35, 40						1. Area 8 2. 579010.45 N 1437367.65 E

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-37
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.7 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/9/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/9/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER *(continued)*			45						
-45.3		47.0								
	Black, wet, very soft, elastic **SILT**					WOR/18"	1	DS	8	
-46.8		48.5								
	Dark gray, wet, very soft, fat **CLAY**, **(CH)**			50		WOR/18"	2	DS	18	
						WOR/18"	3	DS	15	
				55		WOR/18"	4	DS	18	
						WOR/18"	5	DS	18	
				60		WOR/18"	6	DS	18	
-59.3		61.0								
	Bottom of Boring at 61.0 ft			65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-38
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	0.8 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/14/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/14/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER									1. Area 6 2. 578408.06 N 1437491.71 E
-27.2		28.0								
	Black, wet, very soft, fat **CLAY**					WOR/18"	1	DS	5	
						WOR/18"	2	DS	7	
-33.7		34.5				WOR/18"	3	DS	10	
	Dark green, wet, very soft, fat **CLAY**, **(CH)**					WOR/18"	4	DS	18	
						WOR/18"	5	DS	18	

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL EXPLORATION SEAGIRT LOGS.GPJ TLB2010.GDT 5/1/19

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-38
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	0.8 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/14/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/14/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	Dark green, wet, very soft, fat **CLAY**, **(CH)** *(continued)*					WOR/18"	6	DS	18	
						WOR/18"	7	DS	18	
-44.2		45.0		45						
	Dark green, wet, very soft, elastic **SILT**, **(MH)**					WOR/18"	8	DS	18	
						WOR/18"	9	DS	16	
-49.2		50.0		50						
	Dark gray, wet, very soft, fat **CLAY**					WOR/18"	10	DS	18	
						WOR/18"	11	DS	18	
				55						
						WOR/18"	12	DS	18	
						WOR/18"	13	DS	18	
-58.7		59.5		60						
	Bottom of Boring at 59.5 ft									
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-39
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	0.9 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/3/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/3/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER									1. Area 7 2. 578726.69 N 1436798.21 E
-21.1		22.0								
	Black, gray, wet, very soft, elastic **SILT**, **(MH)**					WOR/18"	1	DS	12	
						WOR/18"	2	DS	18	
						WOR/18"	3	DS	18	
						WOR/18"	4	DS	18	
-30.1		31.0								
	Dark gray, wet, very loose to loose, fine to coarse, **SAND**, some gravel, trace silt, trace shells					2-2-3	5	DS	9	
						6-2-1	6	DS	7	
-35.1		36.0								
	Brown, wet, medium stiff, sandy **SILT**, trace mica					2-2-3	7	DS	11	
-38.1		39.0								

DEPTH SCALE: 5, 10, 15, 20, 25, 30, 35, 40

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL EXPLORATION SEAGIRT LOGS.GPJ TLB2010.GDT 5/1/19

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-39
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum: MLLW | Hammer Wt.: 140 lb | Hole Diameter: 8 in | Foreman: M. Fletcher
Surf. Elev.: 0.9 ± ft | Hammer Drop: 30 in | Rock Core Dia.: N/A | Inspector: D. Patterson
Date Started: 1/3/19 | Spoon Size: 2 in | Boring Method: HSA | Date Completed: 1/3/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	Greenish-brown, wet, very loose, fine, silty **SAND**, **(SM)** *(continued)*					WOH/6"-1-1	8	DS	18	
						WOH/12"-1	9	DS	18	
-42.6		43.5								
	Orange- brown, brown, wet, medium dense, fine, silty **SAND**, some gravel, **(SM)**			45		28-7-6	10	DS	18	
						8-12-17	11	DS	15	
-47.6		48.5								
	Brown, wet, soft, **CLAY**			50		5-2-2	12	DS	10	
-49.6		50.5								
	Dark gray, wet, soft, **SILT**, with sand, **(ML)**					6-2-2	13	DS	7	
-52.6		53.5								
	Orange-brown, wet, medium dense, fine, **SAND**, trace silt			55		2-7-8	14	DS	15	
						2-8-9	15	DS	9	
				60						
-60.1		61.0				4-8-12	16	DS	10	
	Bottom of Boring at 61.0 ft									
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-40
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.1 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/9/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/9/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	SAMPLE Blows/6"	SAMPLE No.	SAMPLE Type	SAMPLE Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25, 30, 35, 40						1. Area 8 2. 578642.07 N 1437025.38 E

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-40
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum: MLLW | Hammer Wt.: 140 lb | Hole Diameter: 8 in | Foreman: M. Fletcher
Surf. Elev.: 1.1 ± ft | Hammer Drop: 30 in | Rock Core Dia.: N/A | Inspector: D. Patterson
Date Started: 1/9/19 | Spoon Size: 2 in | Boring Method: HSA | Date Completed: 1/9/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER *(continued)*			45						
-45.9		47.0								
	Dark gray, wet, very soft, fat **CLAY**, trace sand, **(CH)**					WOR/18"	1	DS	18	
				50		WOR/18"	2	DS	18	
-51.9		53.0				WOR/18"	3	DS	18	
	Dark gray, wet, very soft, elastic **CLAY**, **(MH)**			55		WOR/18"	4	DS	18	
						WOR/18"	5	DS	18	
				60		WOR/18"	6	DS	18	
-59.9		61.0								
	Bottom of Boring at 61.0 ft			65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-41
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.5 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/8/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/8/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25						1. Area 6 2. 578181.16 N 1437432.76 E
-26.5	Black, wet, very soft, fat **CLAY**	28.0		30		WOR/18"	1	DS	4	
						WOR/18"	2	DS	10	
-33.0		34.5				WOR/18"	3	DS	12	
	Dark gray, wet, very soft, elastic **SILT**, **(MH)**			35		WOR/18"	4	DS	15	
				40		WOR/18"	5	DS	18	

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-41
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum: MLLW | Hammer Wt.: 140 lb | Hole Diameter: 8 in | Foreman: M. Fletcher
Surf. Elev.: 1.5 ± ft | Hammer Drop: 30 in | Rock Core Dia.: N/A | Inspector: D. Patterson
Date Started: 1/8/19 | Spoon Size: 2 in | Boring Method: HSA | Date Completed: 1/8/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	Dark gray, wet, very soft, elastic **SILT**, **(MH)** *(continued)*					WOR/18"	6	DS	18	
						WOR/18"	7	DS	18	
				45		WOR/18"	8	DS	18	
						WOR/18"	9	DS	16	
				50		WOR/18"	10	DS	18	
						WOR/18"	11	DS	18	
				55		WOR/18"	12	DS	18	
-58.0		59.5				WOR/18"	13	DS	16	
	Bottom of Boring at 59.5 ft			60						
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-42
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	0.7 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/9/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/9/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER									1. Area 7 2. 578425.93 N 1436587.91 E
-33.3	Black, wet, very soft, elastic **SILT**, trace fine sand	34.0		35		WOR/18"	1	DS	4	
						WOR/18"	2	DS	8	
				40		WOR/18"	3	DS	12	

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-42
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	0.7 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/9/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/9/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	Black, wet, very soft, elastic **SILT**, trace fine sand *(continued)*					WOR/18"	4	DS	15	
				45		WOR/18"	5	DS	15	
-45.3		46.0								
	Dark gray, wet, very soft, fat **CLAY**, trace fine sand					WOR/18"	6	DS	15	
				50		WOR/18"	7	DS	15	
						WOR/18"	8	DS	15	
				55		WOR/18"	9	DS	15	
						WOR/18"	10	DS	12	
-59.8		60.5		60		WOR/18"	11	DS	7	
	Bottom of Boring at 60.5 ft									
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-43
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.6 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/9/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/9/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	SAMPLE Blows/6"	SAMPLE No.	SAMPLE Type	SAMPLE Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25, 30, 35, 40						1. Area 8 2. 578666.37 N 1437370.13 E

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-43
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.6 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/9/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/9/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER *(continued)*			45						
-47.4		49.0								
	Dark gray, wet, very soft, fat **CLAY**			50		WOR/18"	1	DS	18	
-49.4		51.0								
	Dark gray, wet, very soft, elastic **SILT**, **(MH)**					WOR/18"	2	DS	18	
				55		WOR/18"	3	DS	15	
-56.4		58.0				WOR/18"	4	DS	15	
	Bottom of Boring at 58.0 ft			60						
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-44
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	-1.1 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/10/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/10/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	SAMPLE Blows/6"	SAMPLE No.	SAMPLE Type	SAMPLE Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25, 30, 35, 40						1. Area 8 2. 578134.06 N 1437023.39 E

SAMPLER TYPE
- DS - DRIVEN SPLIT SPOON
- PT - PRESSED SHELBY TUBE
- CA - CONTINUOUS FLIGHT AUGER
- RC - ROCK CORE

SAMPLE CONDITIONS
- D - DISINTEGRATED
- I - INTACT
- U - UNDISTURBED
- L - LOST

GROUNDWATER DEPTH
- AT COMPLETION _____ ft
- AFTER _____ HRS. _____ ft
- AFTER 24 HRS. _____ ft
- CAVED AT _____ ft

BORING METHOD
- HSA - HOLLOW STEM AUGERS
- CFA - CONTINUOUS FLIGHT AUGERS
- DC - DRIVING CASING
- MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-44
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	-1.1 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/10/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/10/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER *(continued)*									
-46.1		45.0		45						
-47.6	Black, wet, very soft, **CLAY**	46.5				WOR/18"	1	DS	8	
	Dark gray, wet, very soft, fat **CLAY**, trace sand, **(CH)**					WOR/18"	2	DS	12	
				50		WOR/18"	3	DS	18	
						WOR/18"	4	DS	18	
				55		WOR/18"	5	DS	18	
-60.1		59.0				WOR/18"	6	DS	18	
	Bottom of Boring at 59.0 ft			60						
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-45
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	-1.6 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/10/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/10/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER									1. Area 6 2. 577991.32 N 1437151.02 E
-29.6		28.0								
	Black, wet, very soft, fat **CLAY**					WOR/18"	1	DS	7	
						WOR/18"	2	DS	5	
						WOR/18"	3	DS	12	
-36.6		35.0								
	Dark gray, wet, very soft, fat **CLAY**, **(CH)**					WOR/18"	4	DS	10	
						WOR/18"	5	DS	10	

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-45
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	-1.6 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/10/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/10/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	Dark gray, wet, very soft, fat **CLAY**, **(CH)** *(continued)*					WOR/18"	6	DS	18	
				45		WOR/18"	7	DS	15	
						WOR/18"	8	DS	18	
				50		WOR/18"	9	DS	18	
						WOR/18"	10	DS	18	
				55		WOR/18"	11	DS	18	
						WOR/18"	12	DS	18	
-61.1		59.5		60		WOR/18"	13	DS	18	
	Bottom of Boring at 59.5 ft									
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-46
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.1 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/4/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/4/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER									1. Area 7 2. 578332.37 N 1436280.4 E
-22.9	Black, gray, wet, very soft to stiff, fat **CLAY**	24.0		25		WOR/18"	1	DS	9	
						WOR/18"	2	DS	10	
				30		WOR/18"	3	DS	8	
-31.9	Trace gravel at 32'	33.0				3-7-8	4	DS	7	
	Brown, wet, very loose to medium dense, fine to coarse, **SAND**, and gravel, trace silt			35		6-11-14	5	DS	10	
						4-6-5	6	DS	9	
				40		2-4-6	7	DS	8	

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-46
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.1 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/4/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/4/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	Brown, wet, very loose to medium dense, fine to coarse, **SAND**, and gravel, trace silt *(continued)*					3-2-2	8	DS	9	
-41.9		43.0								
	Gray, tan, brown, wet, very loose to loose, fine, **SAND**, trace silt			45		6-3-3	9	DS	7	
						2-3-3	10	DS	14	
				50		2-1-1	11	DS	7	
						1-1-2	12	DS	10	
-52.9		54.0								
	Tan, brown, wet, very loose, fine to medium, **SAND**, **(SP)**			55		2-2-2	13	DS	12	
						2-1-2	14	DS	8	
-59.4		60.5		60		4-4-4	15	DS	6	
	Bottom of Boring at 60.5 ft									
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-47
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	-0.9 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/10/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/10/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	SAMPLE Blows/6"	SAMPLE No.	SAMPLE Type	SAMPLE Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25, 30, 35, 40						1. Area 8 2. 577963.18 N 1436641.95 E

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-47
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	-0.9 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/10/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/10/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER *(continued)*			45						
-48.9		48.0								
	Light gray, wet, soft, **CLAY**, trace					6-1-3	1	DS	12	
-50.4	sand, trace mica	49.5		50						
	Reddish brown, wet, very loose, fine, silty **SAND**					WOH/12"-2	2	DS	7	
-52.9		52.0								
	Light gray, wet, very soft, **CLAY**					WOR/18"	3	DS	5	
-55.4		54.5		55						
	Tan, brown, wet, very loose to medium dense, fine, silty **SAND**					WOH/12"-2	4	DS	15	
						6-9-5	5	DS	10	
-60.4		59.5		60						
	Bottom of Boring at 59.5 ft									
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-48
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	0.5 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/14/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/14/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER									1. Area 6 2. 577809.49 N 1436996.37 E
-26.5		27.0								
	Brown, black, wet, very soft, elastic **SILT**, **(MH)**					WOR/18"	1	DS	10	
						WOR/18"	2	DS	18	
-31.5		32.0								
	Dark gray, wet, very soft, fat **CLAY**, **(CH)**					WOR/18"	3	DS	17	
						WOR/18"	4	DS	18	
						WOR/18"	5	DS	14	

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-48
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	0.5 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/14/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/14/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
-40.5		41.0				WOR/18"	6	DS	18	
	Dark gray, wet, very soft, elastic **SILT**, **(MH)**					WOR/18"	7	DS	14	
				45		WOR/18"	8	DS	18	
						WOR/18"	9	DS	16	
				50		WOR/18"	10	DS	18	
						WOR/18"	11	DS	17	
				55		WOR/18"	12	DS	18	
-58.0		58.5				WOR/18"	13	DS	12	
	Bottom of Boring at 58.5 ft			60						
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-49
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	2.1 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/8/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/8/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER									1. Area 6 2. 577567.31 N 1437052.45 E
-26.9		29.0		5 10 15 20 25						
	Black, gray, wet, very soft, fat **CLAY**			30		WOR/18"	1	DS	6	
						WOR/18"	2	DS	11	
				35		WOR/18"	3	DS	9	
						WOR/18"	4	DS	2	
				40		WOR/18"	5	DS	15	

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-49
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	2.1 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/8/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/8/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
-38.9	Black, gray, wet, very soft, fat **CLAY** *(continued)*	41.0								
	Dark gray, wet, very soft, elastic **SILT**, **(MH)**					WOR/18"	6	DS	18	
				45		WOR/18"	7	DS	16	
						WOR/18"	8	DS	18	
				50		WOR/18"	9	DS	17	
						WOR/18"	10	DS	18	
				55		WOR/18"	11	DS	18	
						WOR/18"	12	DS	18	
-58.4		60.5		60		WOR/18"	13	DS	18	
	Bottom of Boring at 60.5 ft									
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-50
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	1.4 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/15/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/15/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER									1. Area 6 2. 577536 N 1436855.53 E
-29.6		31.0								
	Gray, black, wet, very soft, elastic **SILT**, **(MH)**					WOR/18"	1	DS	10	
						WOR/18"	2	DS	18	
						WOR/18"	3	DS	17	
-38.6		40.0				WOR/18"	4	DS	18	

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-50
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum: MLLW | Hammer Wt.: 140 lb | Hole Diameter: 8 in | Foreman: M. Fletcher
Surf. Elev.: 1.4 ± ft | Hammer Drop: 30 in | Rock Core Dia.: N/A | Inspector: D. Patterson
Date Started: 1/15/19 | Spoon Size: 2 in | Boring Method: HSA | Date Completed: 1/15/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	Gray, wet, very soft, fat **CLAY**					WOR/18"	5	DS	18	
				45		WOR/18"	6	DS	18	
						WOR/18"	7	DS	17	
				50		WOR/18"	8	DS	18	
						WOR/18"	9	DS	18	
				55		WOR/18"	10	DS	18	
						WOR/18"	11	DS	14	
-58.6		60.0		60		WOR/18"	12	DS	18	
	Bottom of Boring at 60.0 ft									
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-51
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	-0.6 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/11/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/11/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25, 30, 35, 40						1. Area 8 2. 577973.42 N 1436379.64 E

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-51
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	-0.6 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/11/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/11/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER *(continued)*			45						
-48.6		48.0								
	Black, wet, very soft, **CLAY**					WOR/18"	1	DS	8	
-50.1		49.5		50						
	Gray, wet, very loose, fine to medium, clayey **SAND**					3-3-4	2	DS	15	
						1-2-3	3	DS	16	
-55.6		55.0		55						
	Gray-brown, wet, very loose to loose, fine to coarse, **SAND**, little gravel, **(SP)**					2-3-6	4	DS	18	
						3-3-4	5	DS	13	
				60						
-62.6		62.0				2-2-1	6	DS	12	
	Bottom of Boring at 62.0 ft									
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-52
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	0.3 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/7/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/7/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	SAMPLE Blows/6"	SAMPLE No.	SAMPLE Type	SAMPLE Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25, 30, 35, 40						1. Area 7 2. 577936.74 N 1436029.5 E

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-52
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum: MLLW | Hammer Wt.: 140 lb | Hole Diameter: 8 in | Foreman: M. Fletcher
Surf. Elev.: 0.3 ± ft | Hammer Drop: 30 in | Rock Core Dia.: N/A | Inspector: D. Patterson
Date Started: 1/7/19 | Spoon Size: 2 in | Boring Method: HSA | Date Completed: 1/7/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER *(continued)*			45						
-45.7		46.0								
	Black, wet, very soft, **CLAY**					WOR/18"	1	DS	6	
						WOR/18"	2	DS	6	
-49.7		50.0		50						
	Gray, brown, wet, very loose, fine, **SAND**, trace silt, **(SP-SM)**					1-1-2	3	DS	18	
-52.7		53.0								
	Gray, brown, wet, very loose, fine, **SAND**, **(SP)**			55		1-1-1	4	DS	16	
						1-2-1	5	DS	14	
-59.7		60.0		60		1-1-3	6	DS	17	
	Bottom of Boring at 60.0 ft			65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-53
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	0.9 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/7/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/7/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	SAMPLE Blows/6"	SAMPLE No.	SAMPLE Type	SAMPLE Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25, 30, 35, 40						1. Area 8 2. 577796.88 N 1435910.87 E

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-53
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum: MLLW | Hammer Wt.: 140 lb | Hole Diameter: 8 in | Foreman: M. Fletcher
Surf. Elev.: 0.9 ± ft | Hammer Drop: 30 in | Rock Core Dia.: N/A | Inspector: D. Patterson
Date Started: 1/7/19 | Spoon Size: 2 in | Boring Method: HSA | Date Completed: 1/7/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
-40.1	**WATER** *(continued)*	41.0								
	Black, wet, very soft, **CLAY** to **SILT**					WOR/18"	1	DS	4	
				45		WOR/18"	2	DS	4	
-46.6		47.5				WOR/18"	3	DS	6	
	Gray-brown, wet, very loose, fine to medium, **SAND**, trace clay, **(SP)**									
-49.1		50.0		50		3-3-4	4	DS	14	
	Black, wet, medium stiff, **CLAY**									
-51.1		52.0				6-2-3	5	DS	9	
	Gray-brown, wet, very loose to loose, fine to medium, **SAND**, trace silt, trace gravel			55		6-1-2	6	DS	15	
						2-4-5	7	DS	18	
-59.1		60.0		60		3-3-4	8	DS	18	
	Bottom of Boring at 60.0 ft									
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-54
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	-0.6 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/11/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/11/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	SAMPLE Blows/6"	SAMPLE No.	SAMPLE Type	SAMPLE Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25, 30, 35, 40						1. Area 8 2. 577479.82 N 1436578.7 E

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-54
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum: MLLW | Hammer Wt.: 140 lb | Hole Diameter: 8 in | Foreman: M. Fletcher
Surf. Elev.: -0.6 ± ft | Hammer Drop: 30 in | Rock Core Dia.: N/A | Inspector: D. Patterson
Date Started: 1/11/19 | Spoon Size: 2 in | Boring Method: HSA | Date Completed: 1/11/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	SAMPLE Blows/6"	SAMPLE No.	SAMPLE Type	SAMPLE Rec (in)	BORING & SAMPLE NOTES
	WATER *(continued)*			45						
-48.6		48.0								
-50.1	Dark gray, wet, very soft, sandy fat **CLAY**, **(CH)**	49.5		50		WOR/18"	1	DS	12	
	Tan, wet, very loose to loose, medium to coarse, **SAND**, trace gravel					3-1-2	2	DS	5	
				55		7-4-5	3	DS	3	
						20-6-3	4	DS	4	
-60.1		59.5		60		3-3-3	5	DS	3	
	Bottom of Boring at 59.5 ft			65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-55
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	-0.7 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/11/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/11/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	SAMPLE Blows/6"	SAMPLE No.	SAMPLE Type	SAMPLE Rec (in)	BORING & SAMPLE NOTES
	WATER			5, 10, 15, 20, 25, 30, 35, 40						1. Area 8 2. 577137.49 N 1436714.92 E

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL EXPLORATION SEAGIRT LOGS.GPJ TLB2010.GDT 5/1/19

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-55
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	-0.7 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/11/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/11/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER *(continued)*									
-42.7		42.0								
	Dark gray, wet, medium stiff, elastic **SILT**, trace fine sand, **(MH)**					WOR/18"	1	DS	9	
				45		WOR/18"	2	DS	8	
						WOR/18"	3	DS	18	
-50.2		49.5								
	Gray-brown, wet, medium dense, clayey **SAND**, and gravel, **(SC)**			50		4-9-17	4	DS	11	
-52.7		52.0								
	Grayish-brown, wet, very loose to medium dense, clayey **SAND**, little gravel					9-13-14	5	DS	7	
				55		2-2-4	6	DS	10	
-59.2		58.5				WOH/12"-1	7	DS	6	
	Bottom of Boring at 58.5 ft			60						
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-56
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	2.1 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/15/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/15/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	WATER									1. Area 6 2. 576972.07 N 1436910.2 E
-31.9	Black, gray, wet, very soft to medium stiff, fat **CLAY**, **(CH)**	34.0		35		WOR/18"	1	DS	6	
						WOR/18"	2	DS	16	
				40		WOR/18"	3	DS	18	

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

RECORD OF SOIL / ROCK EXPLORATION

Contracted With: Gahagan & Bryant Associates | Boring #: PR-56
Project Name: Task 17 - Seagirt Loop Channel Deepening | Job #: 18-0043
Location: Baltimore, MD

SAMPLER

Datum	MLLW	Hammer Wt.	140 lb	Hole Diameter	8 in	Foreman	M. Fletcher
Surf. Elev.	2.1 ± ft	Hammer Drop	30 in	Rock Core Dia.	N/A	Inspector	D. Patterson
Date Started	1/15/19	Spoon Size	2 in	Boring Method	HSA	Date Completed	1/15/19

ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec (in)	BORING & SAMPLE NOTES
	Black, gray, wet, very soft to medium stiff, fat **CLAY**, **(CH)** *(continued)*					WOR/18"	4	DS	18	
				45		WOR/18"	5	DS	18	
						WOR/18"	6	DS	18	
				50		WOR/18"	7	DS	17	
-50.9		53.0				WOH/6"-2-3	8	DS	18	
	Gray, wet, loose, **ROCK FRAGMENTS**			55		3-4-4	9	DS	4	
-53.4		55.5								
	Grayish-brown, wet, medium dense, medium to coarse, **SAND**, little gravel, trace silt					4-5-8	10	DS	10	
-58.4		60.5		60		6-6-7	11	DS	7	
	Bottom of Boring at 60.5 ft									
				65						
				70						
				75						
				80						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION _____ ft
AFTER _____ HRS. _____ ft
AFTER 24 HRS. _____ ft
CAVED AT _____ ft

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

BALTIMORE HARBOR ANCHORAGES AND CHANNELS (BHAC) MODIFICATION OF SEAGIRT LOOP CHANNEL FEASIBILITY STUDY

DRAFT INTEGRATED FEASIBILITY REPORT & ENVIRONMENTAL ASSESSMENT

APPENDIX B2:

DESIGN VESSEL AND AIR DRAFT ANALYSIS

FEBRUARY 2022

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moffatt & nichol

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MEMORANDUM

To:	MPA and MES PDT
From:	Moffatt & Nichol
Date:	December 10, 2021
Subject:	*Design Vessel and Air Draft Clearance [FINAL]*
M&N Job No.:	10848-07 BHAC Seagirt Loop Deepening Feasibility

The purpose of this memorandum is to evaluate the selection of design vessels for the BHAC Seagirt Loop Channel Deepening Feasibility in regard to compatibility with Seagirt Marine Terminal, the existing vessel services on the East Coast, and air draft clearance under the bridges, accounting for future sea level rise.

Design Vessel

Two vessel classes have been identified for use in the Seagirt Loop Deepening Feasibility Study: Post Panamax (PPX) Generation III and Generation IV containerships with capacity of 13,800 – 16,000 TEU Capacity. PPX III vessels represent the existing vessels calling at Seagirt Marine Terminal (SMT) Berth 4 and will be accommodated at Berth 3 following ongoing upgrades to the berth.

SMT cargo cranes will be able to handle vessels loaded with container stacks up to 22 containers wide with a working boom height of 164 feet. PPX III vessels (up to 14,000 TEU) are typically loaded 20 containers wide. PPX IV vessels (up to 16,000 TEU) up to 22 containers wide can take full advantage of the capacity of the upgrade to SMT.

Two representative vessels were selected as prototypes for evaluating the relative dimensions of the design vessels as shown in Table 1. Two draft design values are provided in Table 1:

Design Draft	The draft of the vessel upon which the naval architecture stability and performance of the vessel hull are based.
Scantling Draft	The maximum structural draft for which the ship hull and supporting structures are designed. Typically, greater than the design draft and represents the maximum limit to which a ship can be loaded.

PPX III Vessels currently call at SMT Berth 4 on a regular basis. According to AIS records from Jan 2019 to Jun 2020, 46 vessels greater than 1,180 feet called at SMT 4, or an average of 30 per year. In 2018, only 8 vessels in this class called at SMT, therefore the trend shows increasing calls of vessels of this size and it is anticipated to continue with SMT Berth 3 upgrades.

PPX IV vessels are beginning to work routes on the US East Coast beginning in 2021. The *CMA CGM Marco Polo* made its first calls to US East Coast in May 2021 stopping at Halifax, New York, Norfolk, Charleston and Savannah. The *CMA CGM Marco Polo* and her sister ships will establish a rotating service between South Asian Ports and US West and East Coasts as shown in Figure 1. Three additional calls of these vessels to the US East Coast are planned in 2021. While these vessels were the largest containerships in the world when constructed in 2012, newer vessels greater than 20,000 TEU have supplanted them on the high volume Asia-Europe/Asia-West Coast services and the PPX IV vessels are therefore providing more service on East Coast routes. Berth 4 at SMT currently has sufficient water depth and crane capacity to service PPX IV vessels. By the end of 2021 Berth 3 will have the same capability, providing 2 berths in Baltimore equipped for PPX IV vessels.

Table 1. Design Vessel Characteristics

Parameter	PPX III	PPX IV
Prototype	*MSC Beatrice*	*CMA CGM Marco Polo*
Number of Vessels in Peer Group*	54	18
Nominal TEU Capacity	13,800	16,000
Length Overall (LOA)	1200 ft	1296 ft
Beam (B)	168.0 ft	175.9 ft
Design Draft (T)	47.6 ft	46 ft
Scantling Draft	51.2 ft	52.5 ft
Keel to Masthead	220 ft	230 ft
Air Draft**	168.8 - 172.4 ft	177.5 - 184 ft

* Represents number of vessels in world fleet with similar dimensions and cargo capacity, as reported by Clarkson Register 2021

** Range of values reflect possible air draft between scantling and design draft

Figure 1. Planned Service Routes for CMA CGM PPX IV Containerships

Air Draft

Efficient access to Baltimore Harbor for the design vessels will be constrained both by the channel dimensions (width and depth) and the two bridges which vessels must pass under to reach Baltimore: The Chesapeake Bay Bridge ("Bay Bridge") and the Francis Scott Key Bridge ("Key Bridge"). The Air Draft of the vessel is defined as the distance from the water surface to the highest point on a vessel. Figure 2 presents definitions important to defining clearance distance under the controlling bridges. It should be noted that Figure 2 is not to scale and should only be used for relevant term definitions or as a general schematic.

KTM Keel to Masthead. Distance from the bottom of the hull of the vessel to the highest point on the mast atop the wheelhouse.

HST	Air draft. Distance from water surface to the top of the vessel mast.
T	Vessel draft under water surface.
ADC	Air Draft Clearance. Distance from the top of the ship mast to the lowest point on the overhanging bridge.
UKC	Distance from lowest point on ship hull to the mudline of the channel.

To pass under the bridge safely, a minimum air draft clearance is required. The clearance is determined by the elevation of the water surface at a given time, the draft to which the vessel is loaded, and the speed of transit. The charted clearance of the two bridges is given by NOAA on the nautical chart relative to the mean high water (MHW) elevation:

Chesapeake Bay Bridge	182 feet MHW
Francis Scott Key Bridge	185 feet MHW

The charted channel depths are given relative to mean lower low water (MLLW). Therefore, to calculate the vertical clearance available at a given time, the water surface elevation must be computed accounting for stage of the tide and any additional allowance, such as sea level rise (SLR). Figure 2 illustrates the variability in the water surface elevation with tide and future SLR. The tidal datum elevations for the current epoch are shown in **Error! Reference source not found.**.

The general trend of air draft of a vessel (based on the vessel design draft) with increasing TEU capacity is presented in Figure 3. The data is based on general arrangement drawings of vessels from the annual publication *Significant Ships* (RINA, 2004-2019). For reference the bridge clearances of the Bay Bridge and Key Bridge are included as horizontal lines. Above 16,000 TEU, the best fit trend line and data exceed the height of the bridges (at MHW). Therefore, the selection of design vessels appears to represent the feasible maximum under present day bridge constraints. The accessibility of the design vessels is examined in more detail below.

Sea Level Rise Effect on Air Draft

The Bay Bridge and Key Bridge are fixed bridges (i.e., do not fold up or retract) and therefore SLR will act to decrease the ADC. The impact of SLR to navigation of the design vessels (e.g., *MSC Beatrice and CMA CGM Marco Polo*) in the future to Baltimore Harbor is assessed below.

SLR projections were obtained from the USACE Sea-Level Change Curve Calculator (Version 2021.12) to the latest year available, 2100, using measured data from the NOAA tide gauge in Baltimore (8574680) and Annapolis (8575512). The SLR projections were extrapolated to the year 2130 by calculating the coefficients of a 2nd order polynomial fit to the available SLR projections to 2100.

The SLR projections from the Baltimore tide gauge were used to assess future vessel ADC at the Key Bridge while the SLR projections from the Annapolis tide gauge were used at the Bay Bridge due to the location of the gauges relative to the bridges of interest. For reference, the Key Bridge is about 4.25 miles southwest of the Baltimore tide gauge and the Bay Bridge is about 5.50 miles east-northeast of the Annapolis tide gauge.

The projected water levels relative to NAVD88 (ft) for three possible scenarios (low, intermediate, and high) from the Sea-Level Change Curve Calculator at Baltimore and Annapolis are shown in Figure 4 and tabulated in

Table 2. SLR projections are provided relative to the present tidal epoch, 1983 - 2001, and therefore the table and figure includes SLR adjustment starting at year 2000 to 2130.

Based on the gauge records at Baltimore and Annapolis, the SLR to date is tracking on the USACE "Intermediate" trend with about 0.3 – 0.4 ft of SLR observed by 2020. To assess the effects of SLR on future ADC, both the "intermediate" and "high" SLR projection scenarios were evaluated with the high scenario resulting in one foot less ADC in 2050 and five feet less ADC in 2130.

The future ADC of the PPX III and PPX IV Vessels are reported below in Table 3 and Table 4, respectively, for both SLR scenarios. The ADC for the PPX III vessels is sufficient to pass beneath the bridges at any stage of the tide, however the PPX IV prototype vessel (*CMA CGM Marco Polo*) must pass under the bridges during low tide to clear the lower chord of the bridge. Therefore, Table 3 presents ADC using the MHW while Table 4 for uses MLW. The future ADC of the PPX IV vessel is shown graphically in Figure 5 as the future masthead elevation (relative to MLW) due to SLR for the three SLR projection scenarios. The controlling elevation of the Bay Bridge (relative to MLW) is also shown in Figure 5 where the intersection between the Bay Bridge elevation (black) and the future vessel masthead elevation (blue, orange, and gray) suggests no ADC for that year due to the specific SLR projection.

It is important to emphasize that the ADC with future SLR incorporated assumes that both vessels are transiting at the channel design draft of 47.5 ft draft. For lighter loaded vessels, the vessel water draft will decrease with a concomitant decrease in ADC.

The Bay Bridge with lower clearance controls the allowable air draft into Baltimore. For the PPX IV vessel transiting at low tide, there is approximately one foot of ADC under present day conditions. For the intermediate SLR scenario, the ADC decreases to 0.54 feet in 2050 and 0.08 feet in 2070 after which the PPX IV vessel would not be able to transit beneath the Bay Bridge. For the high SLR scenario, the ADC reduces to less than 0.10 feet in 2040.

Additional Considerations

The ADC will vary by individual vessel, loading conditions, speed of transit, and environmental conditions at the time of transiting under the bridge. The ADC presented in Table 3 and Table 4 does not account for squat of the vessel underway, which will increase ADC. Vessel squat is a sinkage of the hull lower in the water due to the effects of water running past the hull. EM 1110-2-1613 provides a simplified expression to estimate squat (see below) which is proportional to the square of velocity. Assuming a typical transit speed in the upper Chesapeake of 10 knots, the resultant squat for the *CMA CGM Marco Polo* is approximately 0.5 feet, which would provide additional ADC to a vessel passing under the bridge.

$$Z_{max} = \frac{C_b B T V^2}{4.573 L h}$$

Z_{max} = Squat in feet

C_b = Vessel block coefficient (~0.68 for large containerships)

L = Vessel length (feet)

h = water depth (feet)

V = vessel speed through water (knots)

The existing channels are maintained to -50 feet MLLW based on the current tidal epoch (1983 - 2001). As sea level rises, channels maintained to the same mudline will become concomitantly deeper. For example, a 0.5 ft increase in sea level, would increase channel depth to -50.5 feet relative to MLLW measured against the 1983 - 2001 tidal epoch. Therefore, vessels could take advantage of the deeper water to transit at a deeper draft and offset the reduction in ADC due to sea level rise. This offset is dependent on how the maintained depth of the channel is defined as water levels change.

Pilots consider the above factors, in combination with tide stage, to determine the available ADC for a given ship. The bridge crossings on the approach to Port of Baltimore do not have a defined minimum ADC, the permissible ADC is at the discretion of the pilots. To aid in the assessment, both the Key Bridge and Bay Bridge are equipped with air gap sensors, which report the real-time air gap clearance available through the online NOAA Ports System.

Conclusion

Recent trends in container service to the US East Coast indicates the PPX IV Class will become more common at East Coast ports. Based on both the air draft trend in the world fleet and the 100-year projected SLR, the PPX IV class (16,000 TEU) represents the practical maximum feasible design vessel for the Seagirt Loop Channel that can call at the Seagirt Marine Terminal with the present-day air gap clearance of the Chesapeake Bay Bridge.

The effects of SLR on the ADC of the PPX IV class vessels showed to be dependent on both the assumed projection scenario (low, intermediate, high) and the tide stage when the vessel would pass beneath the Chesapeake Bay Bridge. Regardless of SLR projection, it was found that the PPX IV vessels would have to transit at low tide (MLW or MLLW) to achieve sufficient ADC for present-day and future conditions. The intermediate and high SLR projection showed that ADC will be approximately 0.5 feet by 2050 and 2030, respectively, for a vessel transiting at MLW.

Potential actions can be taken to maintain sufficient ADC for the PPX IV vessels and reduce the impact of SLR. Allowing the transiting vessels to draft deeper than the current limit of 47.5 ft would increase or maintain the present-day ADC. However, allowing vessels to draft deeper than 47.5 ft presently would pose a navigation risk within the -50 ft MLLW channel and the additional amount of draft would have to be equal to or greater than the amount of SLR observed from the middle of the last tidal epoch (currently 1992). Allowing vessels to draft deeper would also require either deepening the channel or maintaining the channel elevation relative to a fixed geodetic datum (e.g., NAVD88) as opposed to the tidal datum MLLW that will change overtime as SLR occurs and the tidal epoch is updated. Other potential actions to maintain sufficient ADC for future conditions include a collapsible mast requirement for transiting PPX IV vessels or to require PPX IV vessels to transit during the lowest of the two daily low tides (i.e., MLLW) experienced in the Chesapeake Bay.

The main restriction for vessel access is the height of the Chesapeake Bay Bridge. Maryland Transportation Authority has commissioned studies for replacement of the span and the Tier 1 Draft Environmental Impact Study (DEIS) was released for public comment in February 2021. Replacement of the span could alleviate the ADC restrictions and allow unimpeded access by PPX IV class vessels (and larger). The DEIS focused on alternatives for accommodating traffic volumes in 2040, which corresponds well with the exceedance of the ADC with rising SLR. Therefore, selection of the PPX Class IV vessels as the maximum design vessel for the Seagirt Loop Deepening is feasible given present day conditions and anticipated future improvements to the bridge spans.

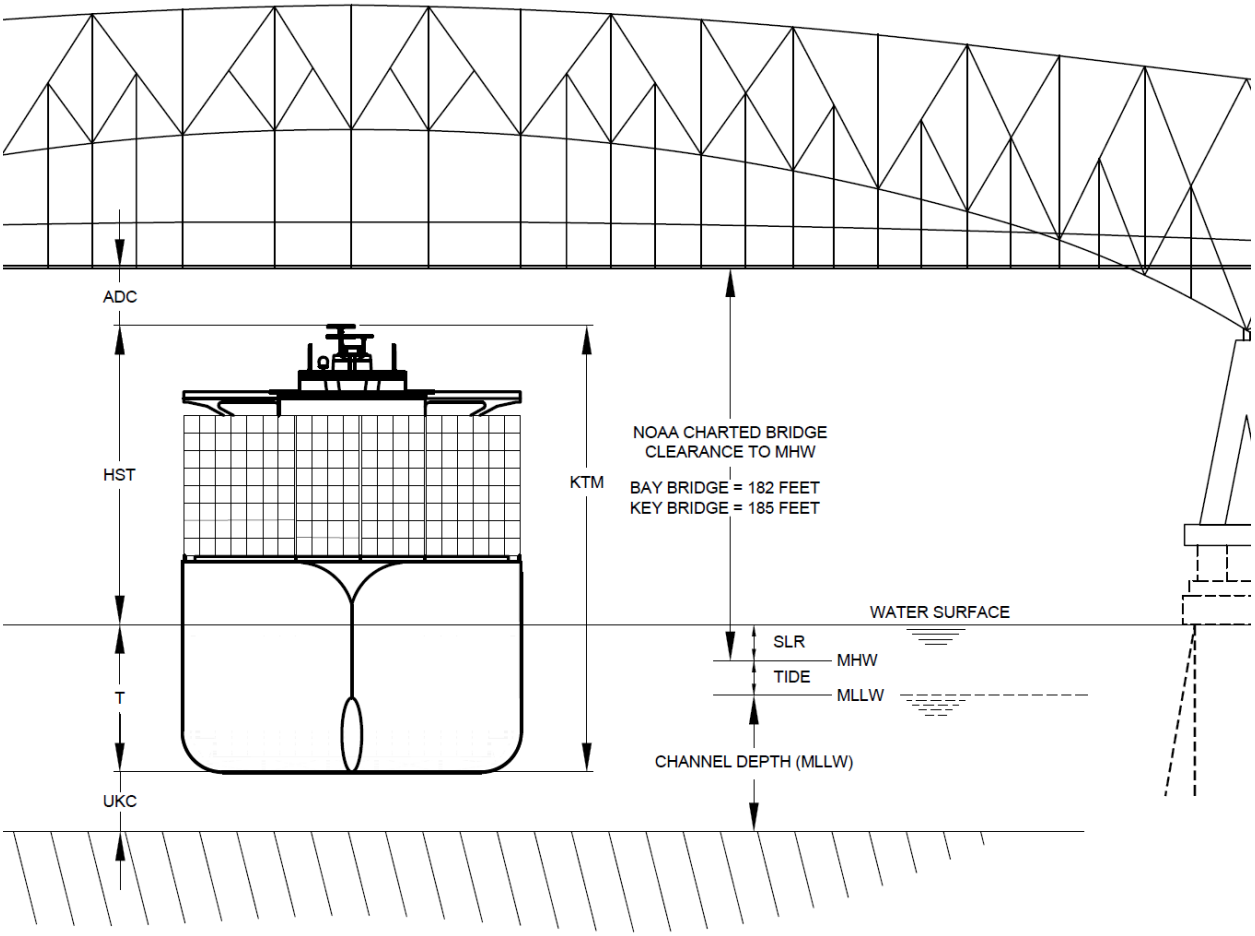

Figure 2. Air Draft Parameter Definitions (Not to scale)

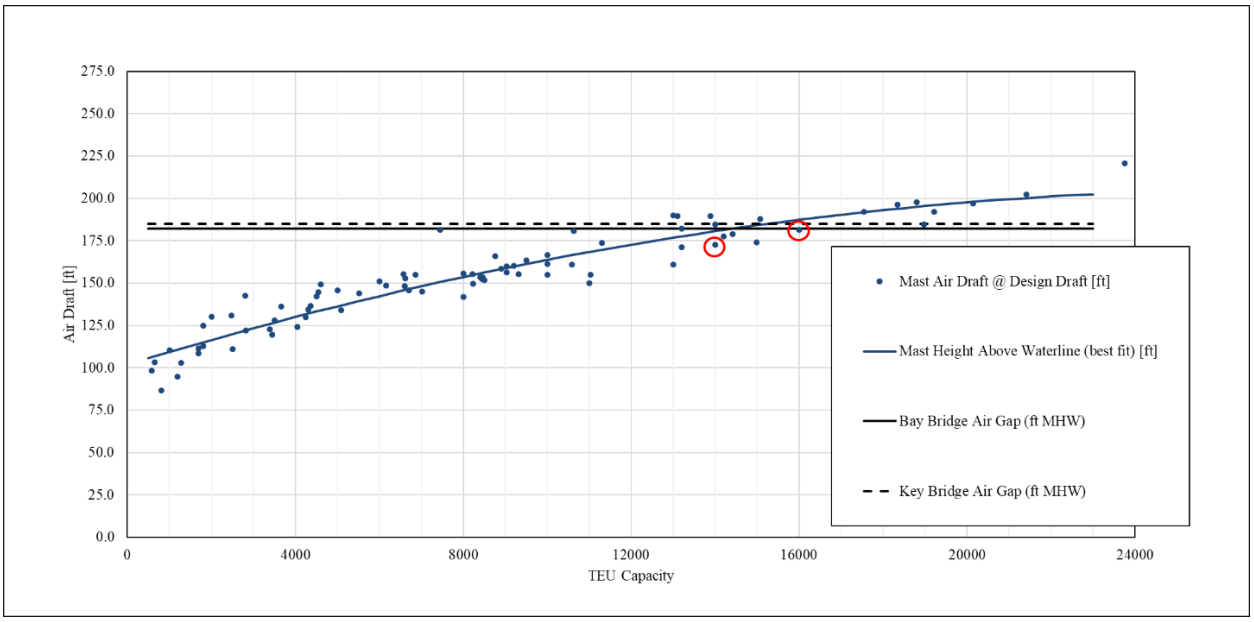

Figure 3. Air Draft Trend for Containerships (RINA), design prototype vessels circled in red

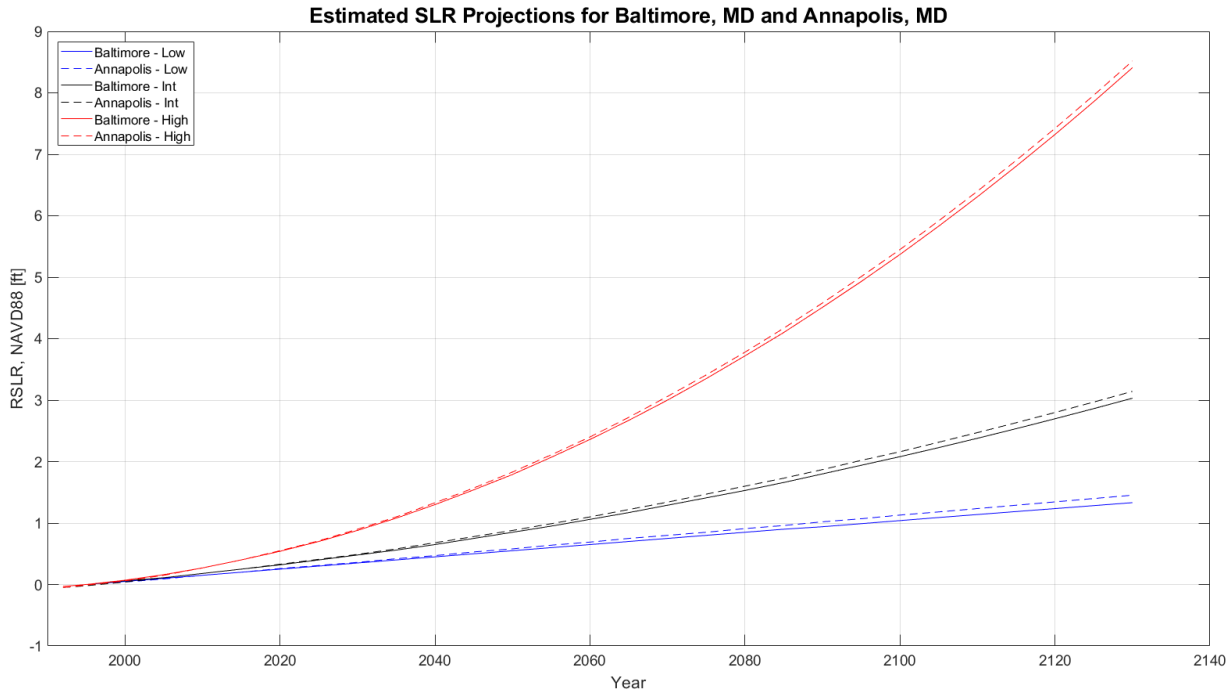

Figure 4: Water level projections (low, intermediate, and high) due to sea level rise (SLR) from USACE Sea-Level Change Calculator (Version 2021.12) at Baltimore (8574680) and Annapolis (8575512)

Table 2: Tabulated water level projections (low, intermediate, and high) due to sea level rise (SLR) from USACE Sea-Level Change Calculator (Version 2021.12) at Baltimore (8574680) and Annapolis (8575512)

Year	Water elevation, NAVD88 (MLLW) [ft]					
	Baltimore (8574680)			Annapolis (8575512)		
	Low	Intermediate	High	Low	Intermediate	High
2000	0.05 (0.89)	0.06 (0.90)	0.07 (0.91)	0.04 (0.81)	0.04 (0.81)	0.06 (0.83)
2005	0.10 (0.94)	0.11 (0.95)	0.16 (1.0)	0.09 (0.86)	0.11 (0.88)	0.15 (0.92)
2010	0.15 (0.99)	0.18 (1.02)	0.27 (1.11)	0.15 (0.92)	0.18 (0.95)	0.27 (1.04)
2015	0.20 (1.04)	0.25 (1.09)	0.40 (1.24)	0.20 (0.97)	0.25 (1.02)	0.40 (1.17)
2020	0.25 (1.09)	0.32 (1.16)	0.54 (1.38)	0.26 (1.03)	0.33 (1.10)	0.55 (1.32)
2025	0.30 (1.14)	0.40 (1.24)	0.70 (1.54)	0.31 (1.08)	0.41 (1.18)	0.71 (1.48)
2030	0.35 (1.19)	0.48 (1.32)	0.88 (1.72)	0.36 (1.13)	0.49 (1.26)	0.90 (1.67)
2035	0.40 (1.24)	0.56 (1.40)	1.08 (1.92)	0.42 (1.19)	0.58 (1.35)	1.10 (1.87)
2040	0.45 (1.29)	0.65 (1.49)	1.30 (2.14)	0.47 (1.24)	0.68 (1.45)	1.33 (2.10)
2045	0.50 (1.34)	0.75 (1.59)	1.54 (2.38)	0.53 (1.30)	0.78 (1.55)	1.57 (2.34)
2050	0.55 (1.39)	0.85 (1.69)	1.79 (2.63)	0.58 (1.35)	0.88 (1.65)	1.83 (2.60)
2055	0.60 (1.44)	0.95 (1.79)	2.07 (2.91)	0.64 (1.41)	0.99 (1.76)	2.11 (2.88)
2060	0.65 (1.49)	1.06 (1.90)	2.36 (3.20)	0.69 (1.46)	1.10 (1.87)	2.40 (3.17)
2065	0.70 (1.54)	1.17 (2.01)	2.67 (3.51)	0.75 (1.52)	1.22 (1.99)	2.72 (3.49)
2070	0.75 (1.59)	1.29 (2.13)	3.00 (3.84)	0.80 (1.57)	1.34 (2.11)	3.06 (3.83)
2075	0.80 (1.64)	1.41 (2.25)	3.35 (4.19)	0.85 (1.62)	1.47 (2.24)	3.41 (4.18)
2080	0.85 (1.69)	1.53 (2.37)	3.72 (4.56)	0.91 (1.68)	1.60 (2.37)	3.78 (4.55)
2085	0.90 (1.74)	1.66 (2.50)	4.10 (4.94)	0.96 (1.73)	1.73 (2.50)	4.17 (4.94)
2090	0.94 (1.78)	1.80 (2.64)	4.51 (5.35)	1.02 (1.79)	1.87 (2.64)	4.58 (5.35)
2095	0.99 (1.83)	1.94 (2.78)	4.93 (5.77)	1.07 (1.84)	2.02 (2.79)	5.01 (5.78)
2100	1.04 (1.88)	2.08 (2.92)	5.37 (6.21)	1.13 (1.90)	2.16 (2.93)	5.45 (6.22)
2105	1.09 (1.93)	2.23 (3.07)	5.83 (6.67)	1.18 (1.95)	2.32 (3.09)	5.92 (6.69)
2110	1.14 (1.98)	2.38 (3.22)	6.31 (7.15)	1.24 (2.01)	2.47 (3.24)	6.40 (7.17)
2115	1.19 (2.03)	2.54 (3.38)	6.81 (7.65)	1.29 (2.06)	2.63 (3.40)	6.90 (7.67)
2120	1.24 (2.08)	2.70 (3.54)	7.32 (8.16)	1.34 (2.11)	2.80 (3.57)	7.42 (8.19)
2125	1.28 (2.12)	2.86 (3.70)	7.86 (8.70)	1.40 (2.17)	2.97 (3.74)	7.96 (8.73)
2130	1.33 (2.17)	3.03 (3.87)	8.41 (9.25)	1.45 (2.22)	3.14 (3.91)	8.52 (9.29)

Table 3: Air Draft Clearance (ADC) of MSC Beatrice with Sea Level Rise Projection*

Year	Air Draft Clearance (ADC) [ft] at MHW			
	Bay Bridge		Key Bridge	
	Intermediate SLR	High SLR	Intermediate SLR	High SLR
2020	9.12		12.15	
2025	9.04	8.74	12.07	11.77
2030	8.96	8.55	11.99	11.59
2035	8.87	8.35	11.91	11.39
2040	8.77	8.12	11.82	11.17
2045	8.67	7.88	11.72	10.93
2050	8.57	7.62	11.62	10.68
2055	8.46	7.34	11.52	10.40
2060	8.35	7.05	11.41	10.11
2065	8.23	6.73	11.30	9.80
2070	8.11	6.39	11.18	9.47
2075	7.98	6.04	11.06	9.12
2080	7.85	5.67	10.94	8.75
2085	7.72	5.28	10.81	8.37
2090	7.58	4.87	10.67	7.96
2095	7.43	4.44	10.53	7.54
2100	7.29	4.00	10.39	7.10
2105	7.13	3.53	10.24	6.64
2110	6.98	3.05	10.09	6.16
2115	6.82	2.55	9.93	5.66
2120	6.65	2.03	9.77	5.15
2125	6.48	1.49	9.61	4.61
2130	6.31	0.93	9.44	4.06

* Vessel analyzed at channel design draft of 47.5 ft.

Table 4: Air Draft Clearance (ADC) of CMA CGM Marco Polo with Sea Level Rise Projection*

Year	Air Draft Clearance [ft] @ MLW			
	Bay Bridge		Key Bridge	
	Intermediate SLR	High SLR	Intermediate SLR	High SLR
2020	1.09	-	4.30	-
2025	1.01	0.71	4.22	3.92
2030	0.93	0.52	4.14	3.74
2035	0.84	0.32	4.06	3.54
2040	0.74	0.09	3.97	3.32
2045	0.64	-0.15	3.87	3.08
2050	0.54	-0.41	3.77	2.83
2055	0.43	-0.69	3.67	2.55
2060	0.32	-0.98	3.56	2.26
2065	0.20	-1.30	3.45	1.95
2070	0.08	-1.64	3.33	1.62
2075	-0.05	-1.99	3.21	1.27
2080	-0.18	-2.36	3.09	0.90
2085	-0.31	-2.75	2.96	0.52
2090	-0.45	-3.16	2.82	0.11
2095	-0.60	-3.59	2.68	-0.31
2100	-0.74	-4.03	2.54	-0.75
2105	-0.90	-4.50	2.39	-1.21
2110	-1.05	-4.98	2.24	-1.69
2115	-1.21	-5.48	2.08	-2.19
2120	-1.38	-6.00	1.92	-2.70
2125	-1.55	-6.54	1.76	-3.24
2130	-1.72	-7.10	1.59	-3.79

* Vessel analyzed at channel design draft of 47.5 ft.

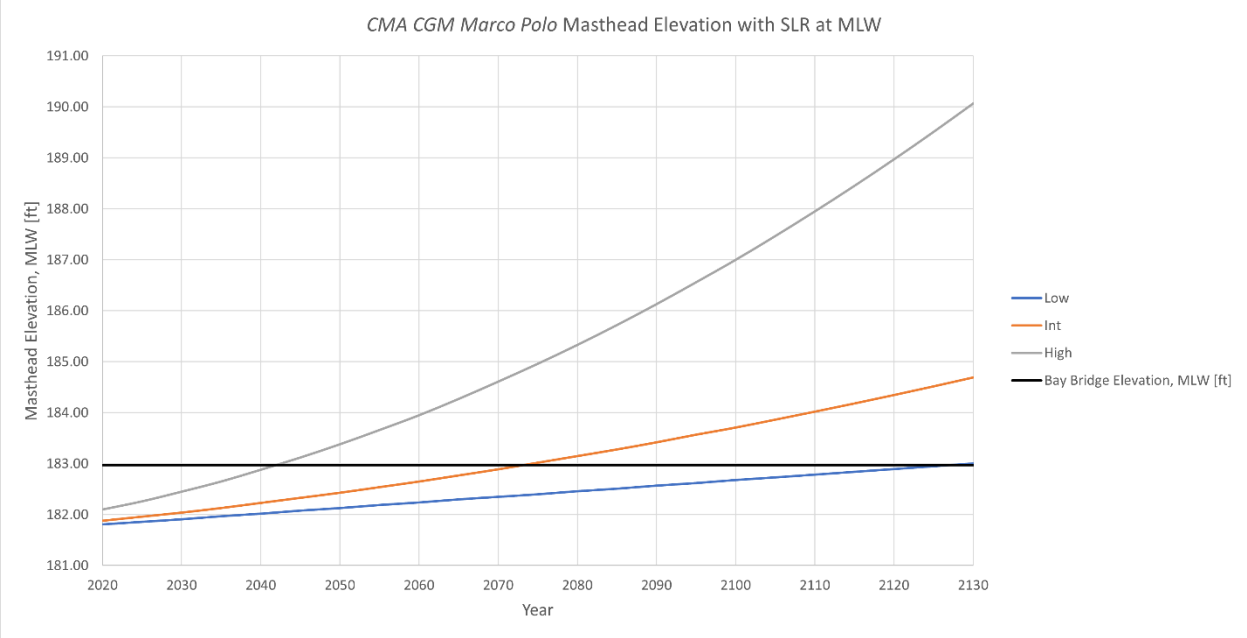

Figure 5: Masthead elevation of the CMA CGM Marco Polo transiting at MLW, draft 47.5 feet, with the three SLR scenarios (blue, orange, and grey) applied. The controlling Bay Bridge elevation is shown (black) to reflect the change in ADC due to SLR.

References

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http://www.cma-cgm.com/products-services/line-services/flyer/CJX

BALTIMORE HARBOR ANCHORAGES AND CHANNELS (BHAC) MODIFICATION OF SEAGIRT LOOP CHANNEL
FEASIBILITY STUDY

DRAFT INTEGRATED FEASIBILITY REPORT & ENVIRONMENTAL ASSESSMENT

APPENDIX B3:

BERTH STABILITY ASSESSMENT

FEBRUARY 2022

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MEMORANDUM

To:	MES/MPA PDT
From:	Moffatt & Nichol
Date:	1/13/2022
Subject:	Berth Stability Assessment with Cofferdam Global Stability
M&N Job No.:	10848-05 BHAC Seagirt Loop Deepening Feasibility

Introduction

The purpose of this memorandum is to summarize the findings regarding potential impact of the proposed Seagirt West Loop deepening on existing berth structures in the vicinity. Moffatt & Nichol has reviewed the Seagirt West Loop dredge plan and cross sections dated June 2021 prepared by Gahagan & Bryant Associates, Inc (GBA), attached. We have also reviewed available structural drawings for Seagirt Marine Terminal Berths 1 and 2 and Canton Marine Terminal Pier 13. Relationship of these structures to the proposed dredge limits is shown in Figure 1, below. The analysis herein evaluates the potential impact, if any, the channel deepening may have on the stability of the existing structures.

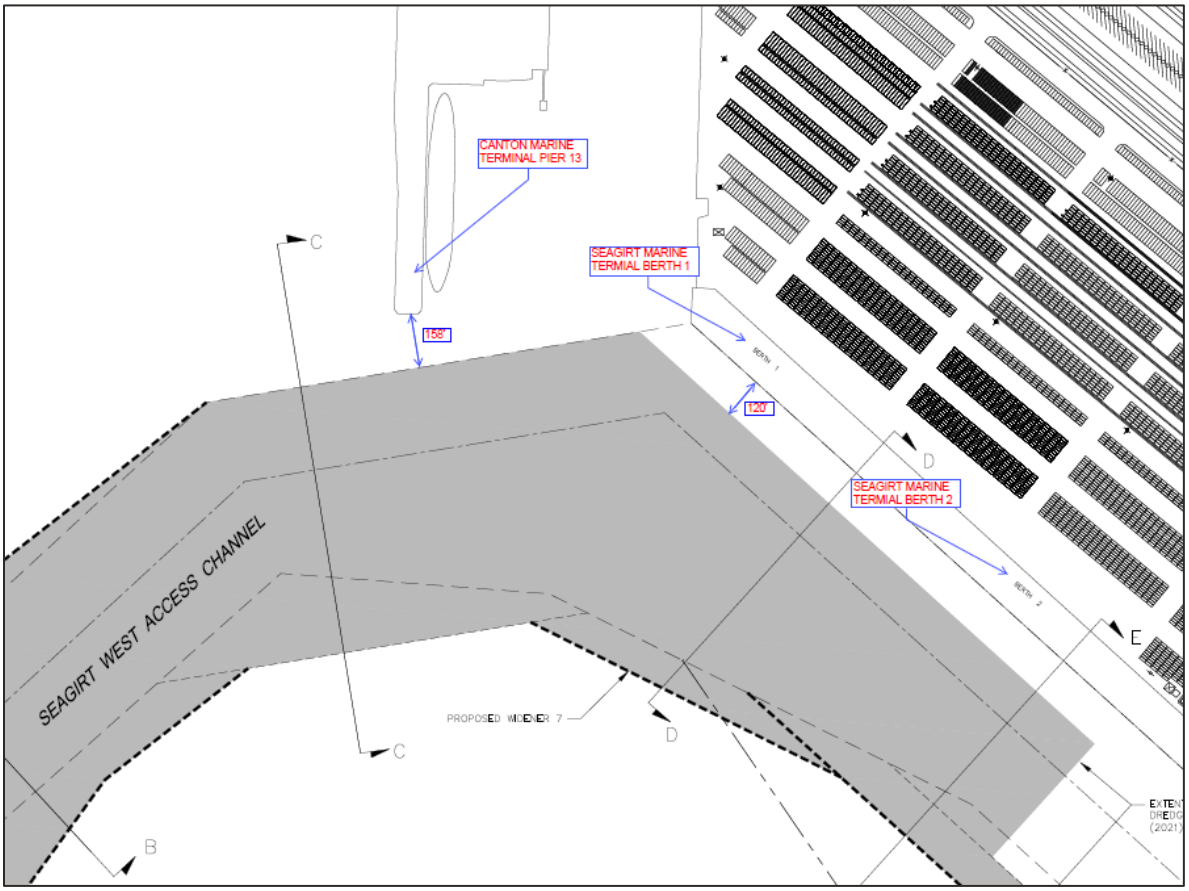


Figure 1 – Structure Location Relative to Proposed Channel Deepening

Analysis Procedure

The primary concern with dredging near existing structures is the effective lengthening of the structure's piles. If the mudline is deepened near a pile, its effective length increases, and it becomes more flexible, with a lower capacity. This deepening can result in lowering the overall capacity of the structure. In the worst case, this deepening can make a structure unstable.

In order to determine whether or not the proposed dredging will compromise the lateral stability or unbraced length of the piles, an estimated depth to fixity was first calculated. The depth to fixity is the depth of pile embedment into the river bottom where the pile is fully laterally braced. This lateral bracing is provided by the surrounding soils and is affected primarily by stiffness of the pile element and stiffness of the soil. A stiff pile in "soft" soil will have a much deeper point of fixity than a relatively flexible pile in very stiff soil.

After depth to fixity was calculated, the width of the passive soil wedge in front of the pile was estimated. The method used to determine the width of the passive wedge for a sheetpile deadman anchor was used as shown in US Army Corps of Engineers EM 1110-2-204 *Design of Sheet Pile Walls.* An excerpt of this manual is included in Attachment B to this memo In sheet pile wall design, the deadman anchor is placed a distance behind the wall sufficient to preclude overlap of the wall's active soil wedge and the anchors passive soil wedge. For evaluation of possible impact of the proposed dredging, if it can be shown the proposed dredging does not overlap the pile's passive soil wedge, then the lateral stability of the pile is not affected by the dredging.

Figure 2, below, illustrates the concepts of depth to fixity and passive soil wedge.

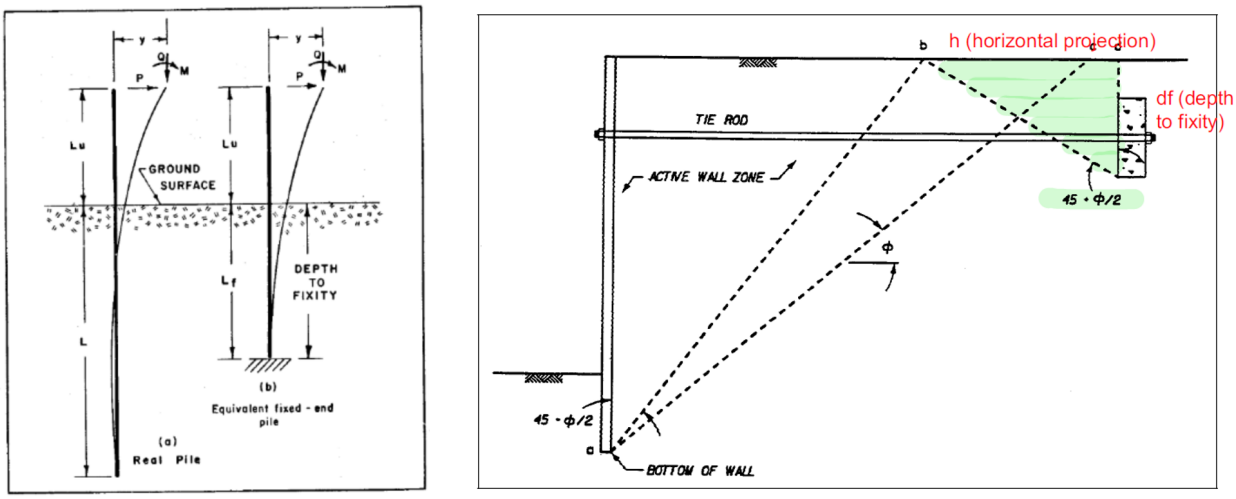


Figure 2 – Depth to Fixity and Passive Soil Wedge

Soil properties were estimated based upon soil boring information included in the Seagirt Berth 1-3 construction drawings. A formula to calculate depth to fixity was used as published in the USDOT FHWA manual *Design and Construction of Driven Pile Foundations – Volume I.* Both the soil boring data and excerpts from the referenced manual are included in Attachment B to this memo.

The pile stiffness is determined primarily by the pile material (concrete, timber, steel) and pile shape (hollow pipe, solid square, H-shape). The pile properties for both Canton Marine Terminal Pier 13 and Seagirt Marine Terminal Berths 1-2 were considered. The resultant depth to fixity and passive soil wedge width for each were compared to the proximity of the proposed dredging. Results of this analysis are summarized below, and calculations are included in Attachment C to this memo.

Canton Marine Terminal Pier 13

Pier 13 at Canton Marine Terminal is a timber pile-supported pier with a low-level concrete deck, several feet of ballast, and an asphalt surface. A typical section of the pier is shown in Figure 3 below. The age of the structure and its original dredge depth are not known. A 2008 inspection report references original drawings dated 1918. Notes from that inspection include some mudline elevations from which we calculate an average depth of 28.6 feet, at the A and V-piles, over the outboard 150 feet of the pier.

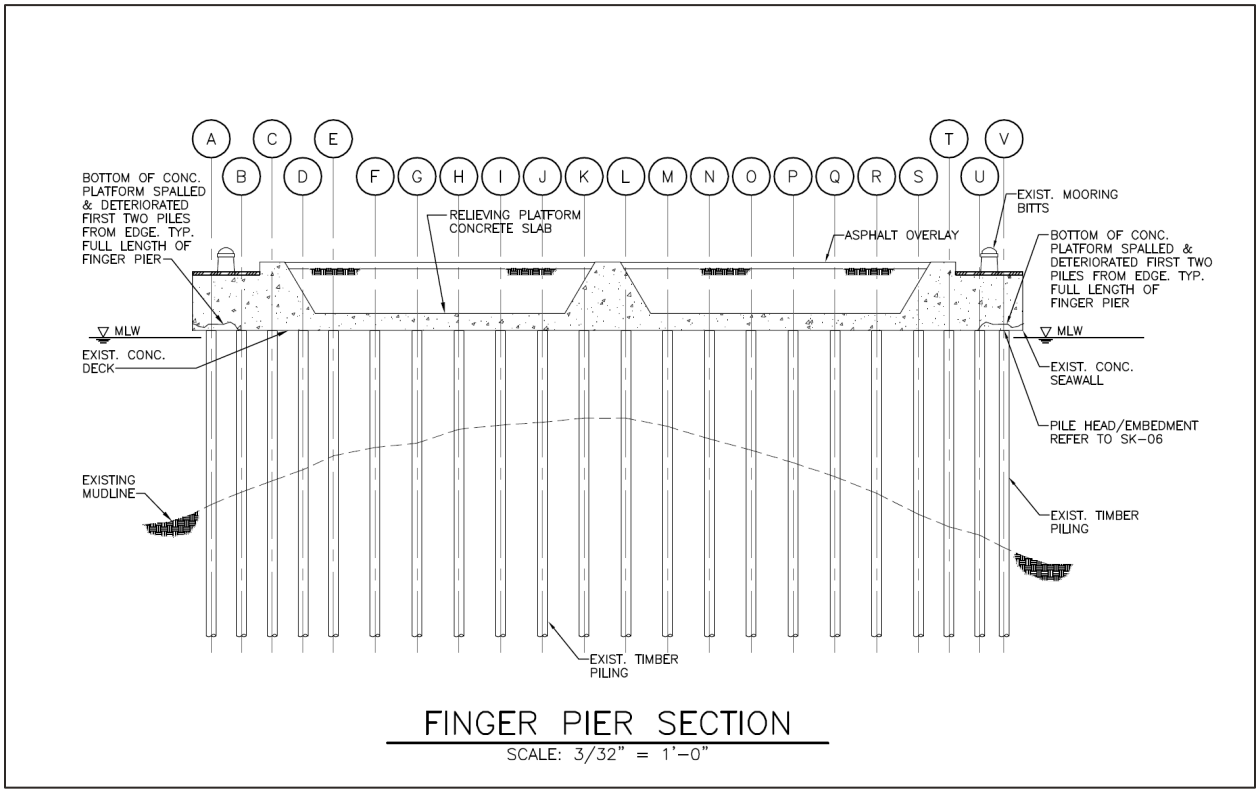


Figure 3 – Typical Section - Canton Marine Terminal Pier 13

The proposed 50-ft dredge depth for the federal channel footprint is within 158 feet of the southeast corner of the pier. If a 3:1 side slope is used, the slope intersects existing river bottom approximately 64 feet horizontally from the edge of the 50-ft channel, or 94 feet from the pier, see Figure 4 below. If a 5:1 side slope is used, it intersects existing river bottom approximately 113 feet from the edge of the 50-ft channel, or 45 feet from the pier, see Figure 5, below.

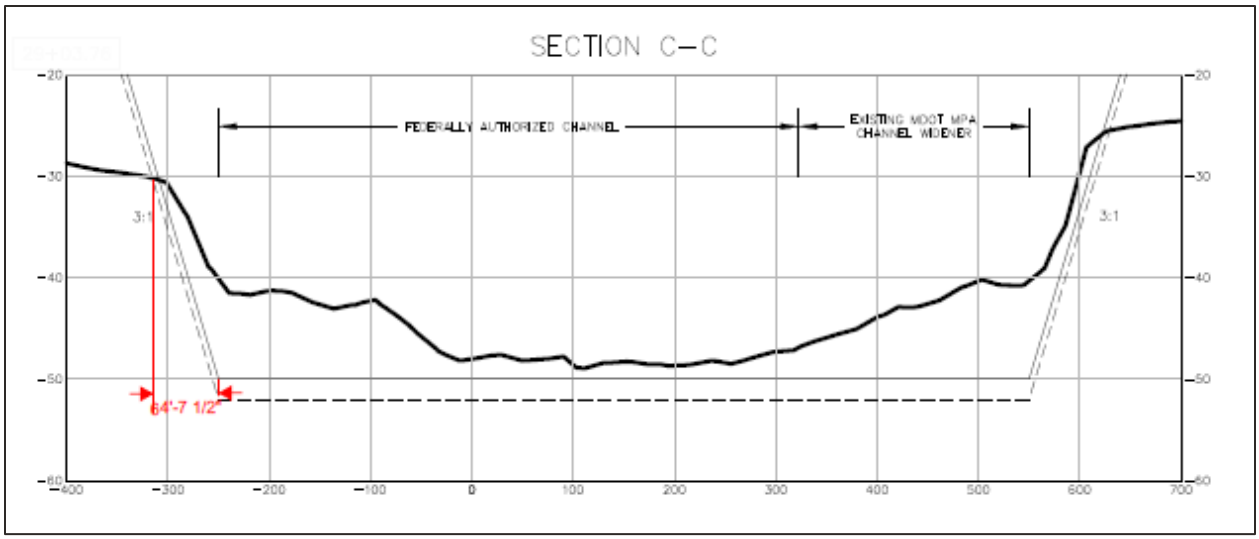


Figure 4 – Dredge Section C-C – 3:1 side slope

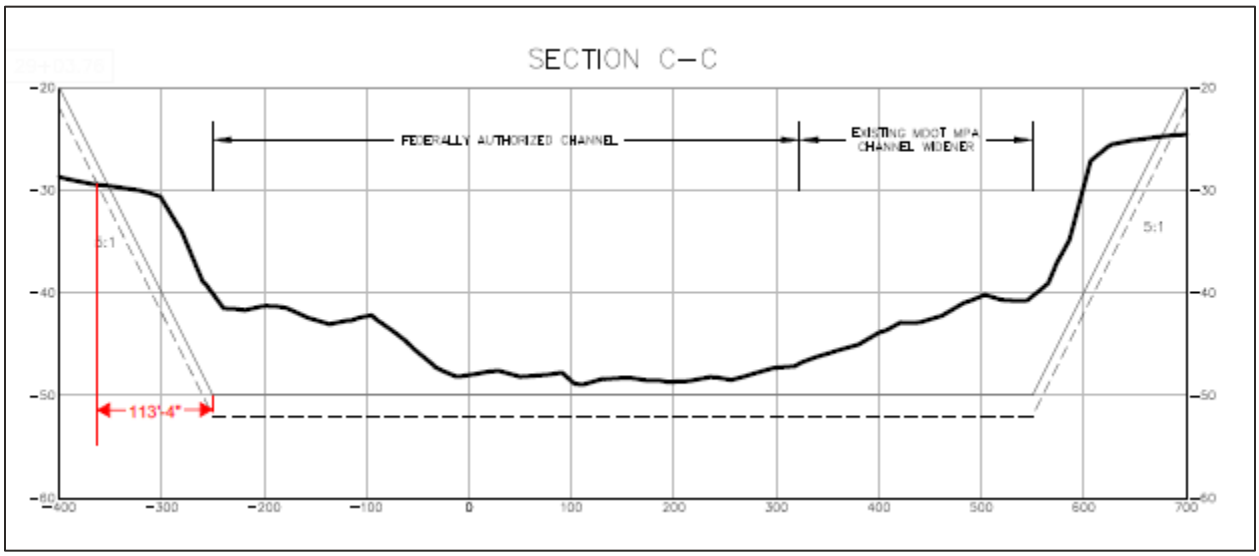


Figure 5 – Dredge Section C-C – 5:1 side slope

Proposed Dredge Impact on Canton Marine Terminal Pier 13

As noted above, the depth to fixity and resulting passive soil wedge for Pier 13's timber piles was compared to the proximity of the proposed dredge profile. As timber piles are relatively flexible compared to concrete or steel piles, the depth to fixity was relatively shallow at seven feet below mudline.

A pile diameter of 12 inches was used along with the modulus of elasticity for a new timber pile. The modulus of elasticity is a measure of a material's resistance to being deformed; stiffer materials have a higher modulus of elasticity. It should be noted that due to the age of the timber piles at Pier 13, the current modulus of elasticity is likely significantly reduced from this value, making it more flexible. Sampling of timber piles from nearby Dundalk Marine Terminal originally installed in 1929 were found to have a residual modulus of elasticity 65% that of a new pile. An excerpt of the testing report is included in Attachment C to this memo.

Using the seven-foot depth to fixity, a passive wedge with a horizontal projection of approximately 10 feet was calculated. Two conditions for the passive wedge were considered, a short term and long term (drained) condition. In the short-term, undrained condition, the soil has an effective angle of internal friction (phi) of zero. In the drained condition, the soil would have an angle of internal friction estimated at 20-degrees; this value was taken from a geotechnical report prepared for Seagirt Marine Terminal Berth 4, excerpt included in Attachment C to this memo. A third estimate of passive wedge width was made assuming a soil with a high angle of internal friction. If the soil were sand with a phi of 34-degrees, the passive soil width would be approximately 13 feet.

As the nearest potential dredging is 45 feet from Pier 13, no effect on the pile's lateral support, and resulting capacity, would be expected.

Seagirt Marine Terminal Berths 1 and 2

Seagirt Marine Terminal Berths 1 and 2 consist of prestressed concrete piles supporting a concrete low-deck, approximately two feet of ballast, and a paved surface. The landside edge of the structure is supported by steel cofferdam cells. The structures were built under the same contract in 1986. The construction drawings note the design dredge depth as 42 feet. A typical section of the structure is shown in Figure 6, below.

The current dredge profile includes a depth of 45 feet (plus two feet overdredge) approximately 64 feet from the face of the structure. The depth at the face of structure is approximately 37 feet, based on the sections in the Seagirt West Loop dredge plans, resulting in an approximate 6:1 average slope to the existing channel.

The proposed 50-ft dredge depth within the federal channel footprint is within 120 feet of SMT Berths 1 and 2. If a 3:1 side slope is used, the slope intersects existing river bottom approximately 103 feet outboard of the berthing face of Berth 1 (108 ft outboard of Berth 2), see Figures 7 and 8, below. If a 5:1 side slope is used, the slope intersects existing river bottom approximately 92 feet outboard of the berthing face of Berth 1 (103 ft outboard of Berth 2), see Figures 9 and 10, below.

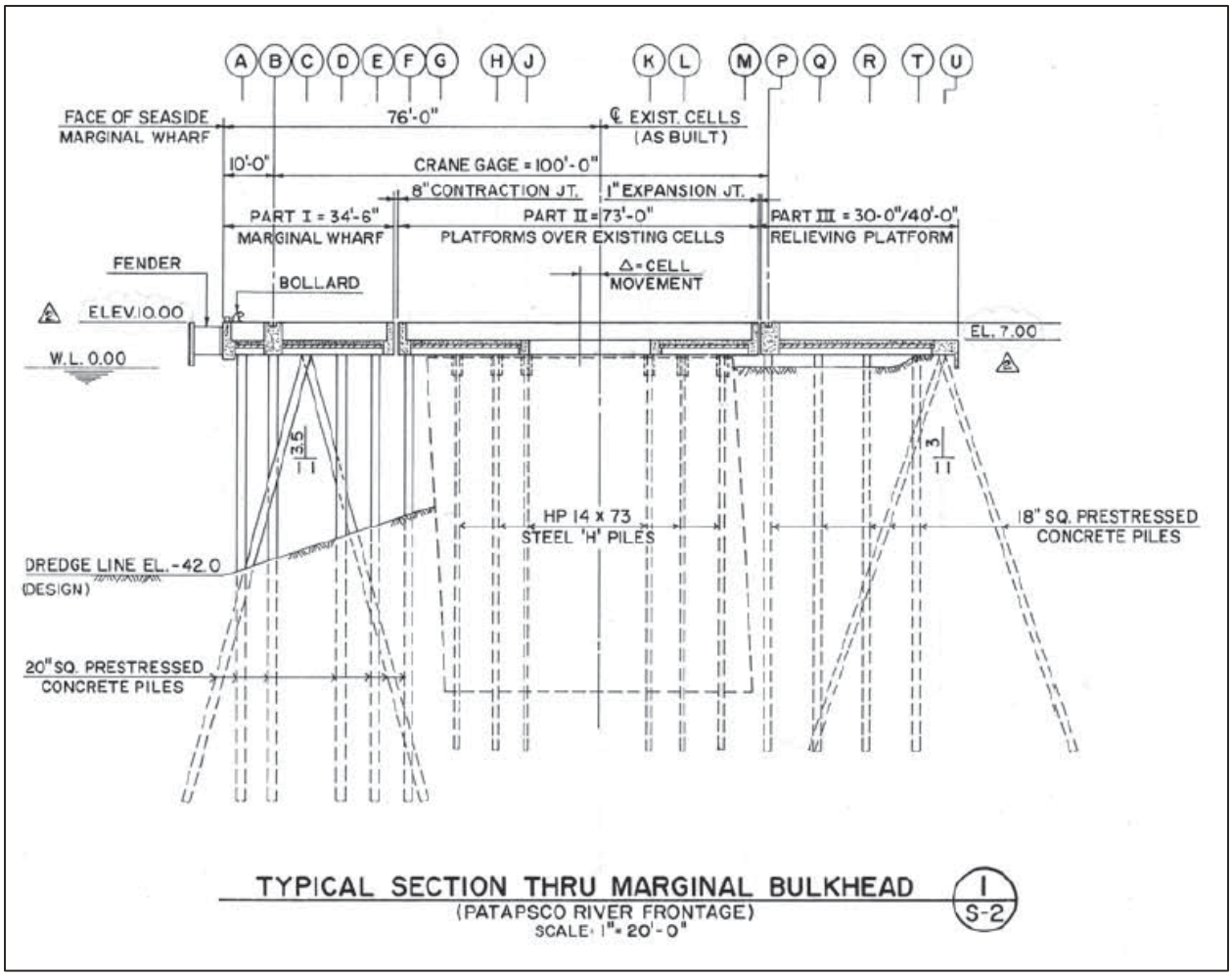


Figure 6 – Typical Section – SMT Berths 1 and 2

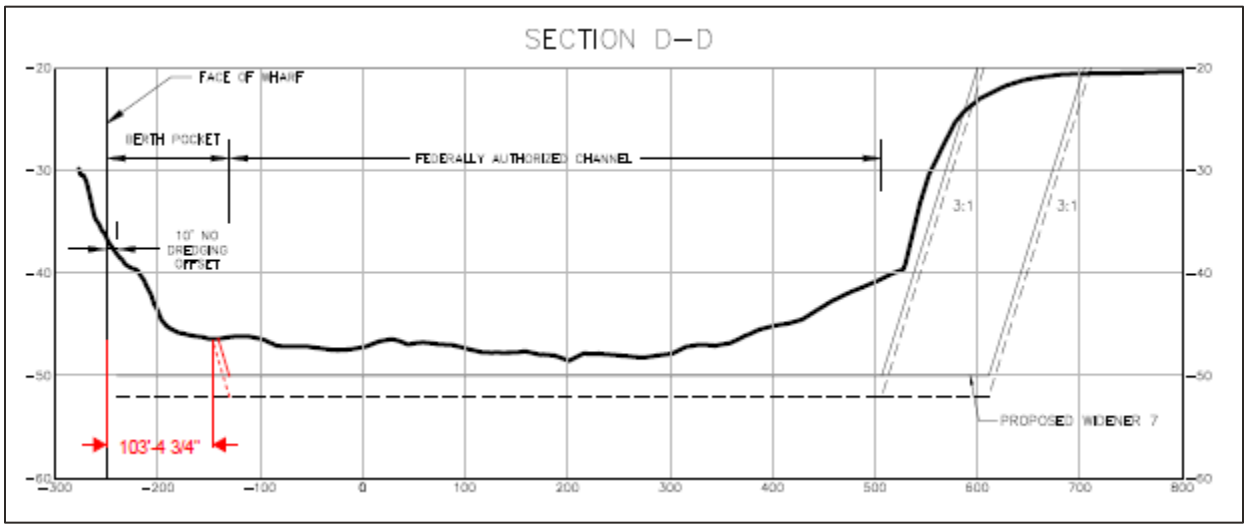


Figure 7 – Proximity of 3:1 Side Slope to SMT Berth 1

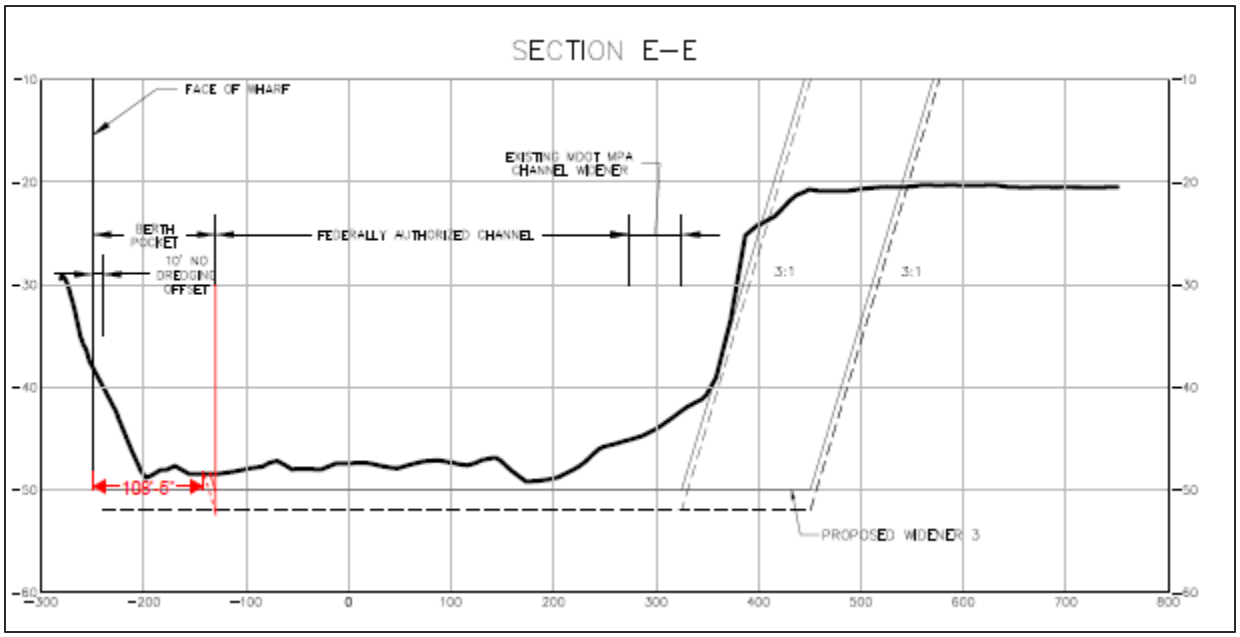


Figure 8 – Proximity of 3:1 Side Slope to SMT Berth 2

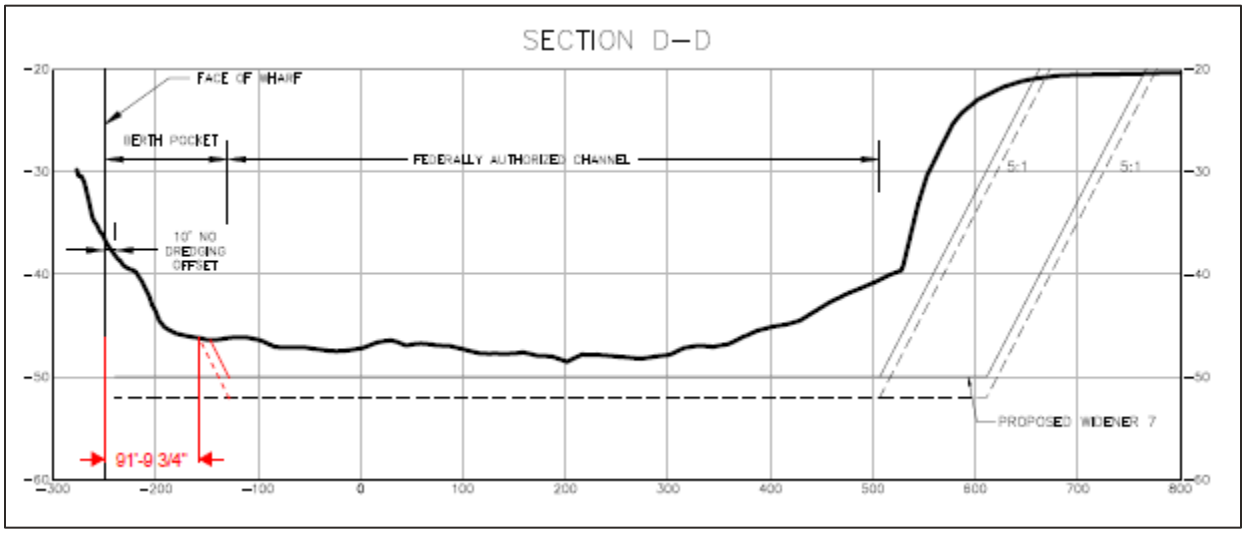


Figure 9 – Proximity of 5:1 Side Slope to SMT Berth 1

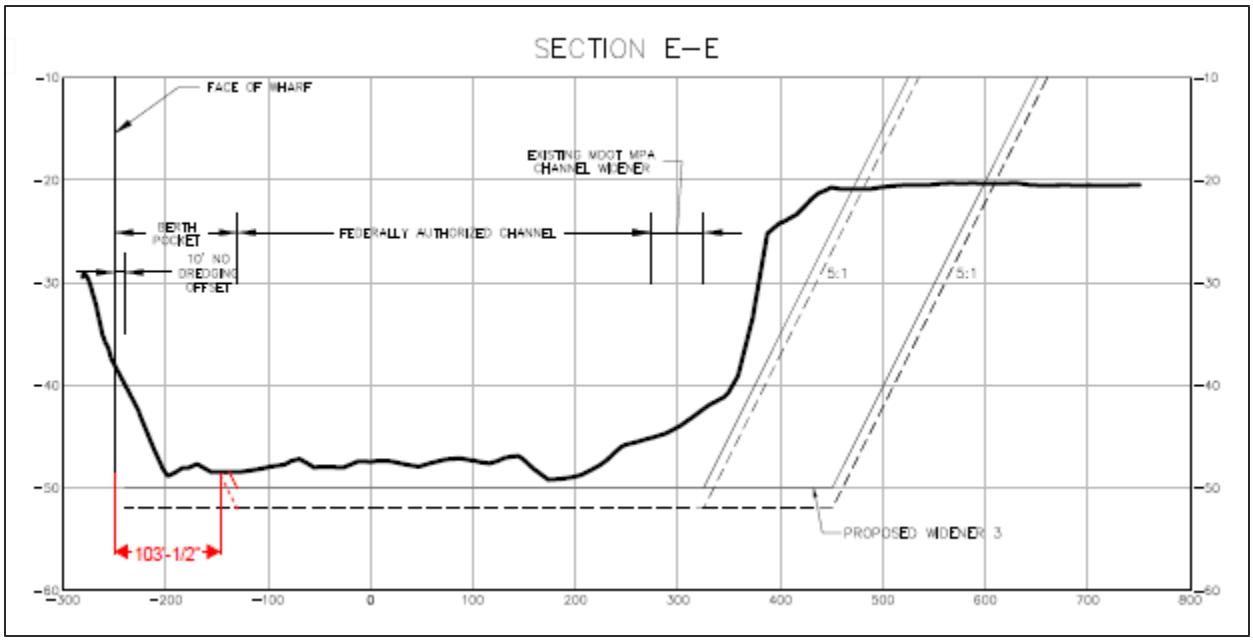


Figure 10 – Proximity of 5:1 Side Slope to SMT Berth 2

Proposed Dredge Impact on Seagirt Marine Terminal Berths 1-2

As noted above, the depth to fixity and resulting passive soil wedge for SMT Berths 1-2 concrete piles was compared to the proximity of the proposed dredge profile. As concrete piles are relatively stiff compared to timber piles, the depth to fixity was deeper than that calculated for Pier 13, at 17 feet below mudline.

The piles are 20-inch square with a compressive strength of 5,000 psi, as shown in the contract drawings, excerpt included in Attachment C to this memo. Modulus of elasticity was calculated per ACI 318-14 for normal weight concrete using the compressive strength specified in the contract drawings.

Using the 17-foot depth to fixity, a passive wedge with a horizontal projection of approximately 24 feet was calculated. Two conditions for the passive wedge were considered, a short term and long term (drained) condition. In the short-term, undrained condition, the soil has an effective angle of internal friction (phi) of zero. In the drained condition, the soil would have an angle of internal friction estimated at 20-degrees; this value was taken from a geotechnical report prepared for Seagirt Marine Terminal Berth 4, excerpt included in Attachment C to this memo. A third estimate of passive wedge width was made assuming a soil with a high angle of internal friction. If the soil were sand with a phi of 34-degrees, the passive soil width would be approximately 32 feet.

As the nearest potential dredging is 92 feet from Berths 1-2, no effect on the pile's lateral support, and resulting capacity, would be expected.

SMT Cofferdam Stability

The west end of the proposed dredging fronts SMT Berths I and II. The inshore toe of the Federally Authorized Channel is approximately 115' offset from face of berth. An allowance for 2.0' for overdredge takes the permitted depth to -52.0 MLLW. Existing mudline elevations within the existing channel vary, but typically average -47' MLLW. See dredging cross sections in Attachment A.

Local and global stability analyses were performed to assess the 3:1 proposed dredging pocket slope and the impact of deepening the Federally Authorized portion of the channel on the structural stability of the existing cofferdam.

Design Assumptions

The local and global stability analyses were performed at cell #50 (bent #95) located in Berth II, which roughly aligns with Section E-E shown in Figure 1. Data sources include:

1. The configuration of the berth is taken from the construction drawings for Berths I, II, III Marginal Wharf, dated 1986.
2. Existing bathymetry is taken from cross-sections prepared by Gahagan & Bryant Associates, dated 2021, supplemented by cross-sections under the berth taken by WSP, dated 2019.
3. Subsurface stratigraphy was based on soil profiles contained in the construction drawings for Berths I, II, and III, dated 1986. Soil properties for the various strata are tabulated in the output file included in Attachment B.
4. The 'pinning' action of the piles inboard and outboard of the wharf was not accounted for.
5. A uniform live load of 600 psf was applied behind the inboard relieving platform.

Local and Global Stability Analysis

The 3:1 slope of the federal channel deepening was evaluated in terms of local stability from the outboard side of the cellular cofferdam to the Federal Channel using Slope/W (GeoStudio 2020) software program. The minimum factor of safety against slope failure for the proposed 3:1 slope was calculated to be 8.25.

The impact of deepening the federal channel was also evaluated in terms of global stability from the inboard edge of the inboard relieving platform to the Federal Channel using Slope/W (GeoStudio 2020) software program. The minimum factor of safety against slope failure was computed to be 3.10.

Graphical representation of the critical slip surfaces, the critical factors of safety, and the model's output files are included in Attachment D.

According to USACE publication number EM 1110-2-1902 titled "Slope Stability", a minimum safety factor of 1.5 is considered acceptable for long-term slope stability of excavated slopes. Local and global factors of safety computed exceed the 1.5 minimum, therefore, it can be concluded that the proposed dredging slope is acceptable and the proposed dredged pocket does not adversely impact berth stability.

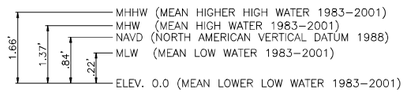
Conclusion

The proposed dredging within the federal channel limits (including side slopes) is far enough away from the berth and pier structures that the pile support would be unchanged from its present condition. Calculated factors of safety for the cofferdam stability models exceeded requirements by more than two times when the proposed dredging is considered.

The proposed federal channel dredging for the Seagirt West Loop would not have any detrimental impact on the existing structures adjacent to the channel.

ATTACHMENT A
SEAGIRT WEST LOOP DREDGE SECTIONS

VERTICAL DATUM IS IN REFERENCE TO MEAN LOWER LOW WATER (MLLW), WHICH IS 0.84 FT. BELOW NAVD 1988.



SEAGIRT WEST ACCESS CHANNEL

FORT MCHENRY CHANNEL

PROPOSED WIDENER 5

PROPOSED WIDENER 6

PROPOSED WIDENER 7

PROPOSED WIDENER 4

PROPOSED WIDENER 3

EXISTING WIDENER 1 (2021)

EXTENTS OF BERTH 3 DREDGING (2021)

BERTH 1

BERTH 2

BERTH 3

BERTH 4

A

B

C

D

E

PATAPSCO RIVER

ANCHORAGE 2

LEGEND

- AUTHORIZED FEDERAL CHANNEL
- EXISTING MDOT MPA CHANNEL WIDENER
- CHANNEL CENTERLINE
- PROPOSED WIDENER
- EXISTING ANCHORAGE
- SEAGIRT WEST LOOP STUDY AREA

0 200' 400'
GRAPHIC SCALE

1

SEAGIRT WEST LOOP CROSS SECTIONS

BALTIMORE, MD

DRAWING DATE:	JUNE 2021
DRAWN BY:	C. MANUEL
CHECKED BY:	L. FOLKERT
DRAWING NAME:	Seagirt_Cross_Sections(5-to-1).dwg
DRAWING SCALE:	1" = 200'
SHEET NUMBER:	1 OF 3

CONDITION SURVEYS	
SURVEY DATE:	OCTOBER 2020 (GBA) & JANUARY 2021 (CENAB)
HORIZONTAL PROJECTION:	MARYLAND STATE PLANE
ZONE:	1900
VERTICAL REFERENCE:	MEAN LOWER LOW WATER (MLLW)
SURVEY UNITS:	U.S. SURVEY FEET

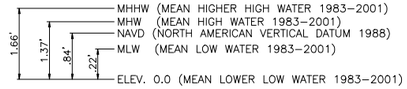
NOTES:
1. THE INFORMATION DEPICTED ON THIS MAP REPRESENTS THE RESULT OF SURVEYS MADE ON THE DATES SHOWN AND CAN ONLY BE CONSIDERED AS INDICATING THE GENERAL CONDITION EXISTING AT THAT TIME.
2. PLANIMETRICS INDICATE THE APPROXIMATE LOCATION OF FEATURES AS PROVIDED BY THE USACE BALTIMORE DISTRICT.
3. SURVEYED OCTOBER 2020 BY GAHAGAN & BRYANT ASSOCIATES, INC. & JANUARY 2021 BY CENAB.
4. TIDES WERE OBTAINED FROM NOAA TIDE STATION 8574680 BALTIMORE, FORT MCHENRY.
5. THE PLANE OF MLLW IS 0.84 FEET BELOW NAVD88.

GAHAGAN & BRYANT ASSOCIATES, INC.
BALTIMORE, MARYLAND
(410) 682-5595

GBA ENGINEERS ★ SURVEYORS

C:\Users\gba289\Desktop\FROM SERVER\SEAGIRT\2021_Seagirt_5-to-1\2) Seagirt West Loop\Seagirt_Cross_Sections(5-to-1).dwg

VERTICAL DATUM IS IN REFERENCE TO MEAN LOWER LOW WATER (MLLW), WHICH IS 0.84 FT. BELOW NAVD 1988.



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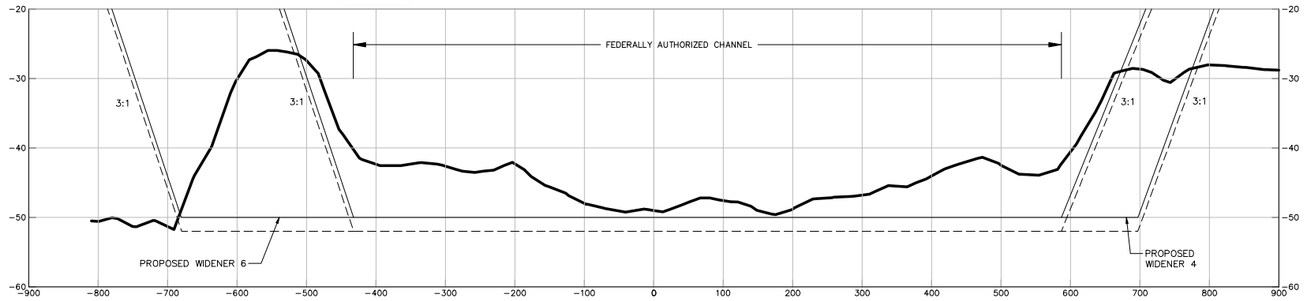

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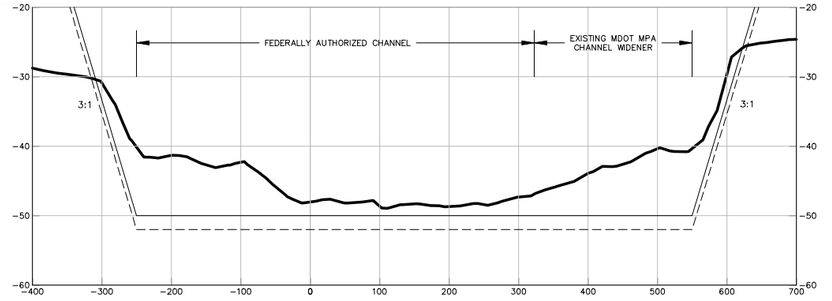

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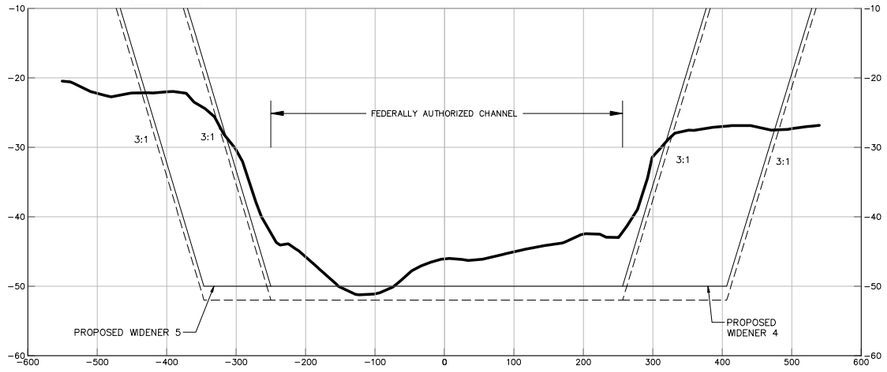

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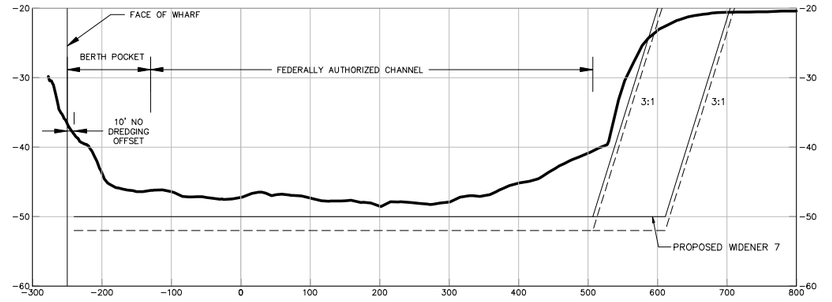

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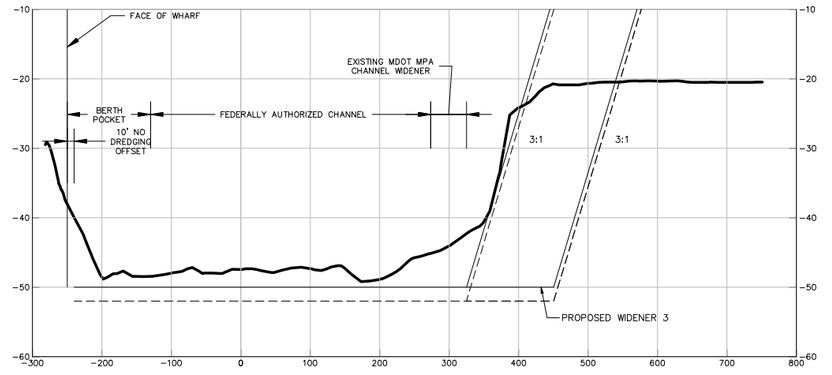


LEGEND

- CENAB/GBA COMBO SURVEY
- PROPOSED REQUIRED GRADE (–50')
- PROPOSED OVERDEPTH (–52')

0 100' 200'
HORIZONTAL SCALE

0 10' 20'
VERTICAL SCALE

C:\Users\gba285\Desktop\Seagirt Feasability\Engineering\Cross Sections\210520_Harbor_Overlays_Seagirt_West.dwg

SEAGIRT WEST LOOP
CROSS SECTIONS 3H:1V SLOPES

BALTIMORE, MD

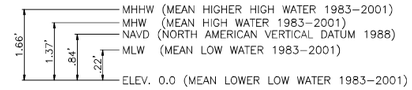
DRAWING DATE:	JUNE 2021
DRAWN BY:	C. MANUEL
CHECKED BY:	L. FOLKERT
DRAWING NAME:	SEAGIRT WEST LOOP CROSS SECTIONS
DRAWING SCALE:	AS SHOWN
SHEET NUMBER:	2 OF 3

CONDITION SURVEYS	
SURVEY DATE:	OCTOBER 2020 (GBA) & JANUARY 2021 (CENAB)
HORIZONTAL PROJECTION:	MARYLAND STATE PLANE
ZONE:	1900
VERTICAL REFERENCE:	MEAN LOWER LOW WATER (MLLW)
SURVEY UNITS:	U.S. SURVEY FEET

NOTES:
1. THE INFORMATION DEPICTED ON THIS MAP REPRESENTS THE RESULT OF SURVEYS MADE ON THE DATES SHOWN AND CAN ONLY BE CONSIDERED AS INDICATING THE GENERAL CONDITION EXISTING AT THAT TIME.
2. PLANIMETRICS INDICATE THE APPROXIMATE LOCATION OF FEATURES AS PROVIDED BY THE USACE BALTIMORE DISTRICT.
3. SURVEYED OCTOBER 2020 BY GAHAGAN & BRYANT ASSOCIATES, INC. & JANUARY 2021 BY CENAB.
4. TIDES WERE OBTAINED FROM NOAA TIDE STATION 8574680 BALTIMORE, FORT MCHENRY.
5. THE PLANE OF MLLW IS 0.84 FEET BELOW NAVD88.

GAHAGAN & BRYANT ASSOCIATES, INC.
BALTIMORE, MARYLAND
(410) 682-5595
GBA ENGINEERS ★ SURVEYORS

VERTICAL DATUM IS IN REFERENCE TO MEAN LOWER LOW WATER (MLLW), WHICH IS 0.84 FT. BELOW NAVD 1988.



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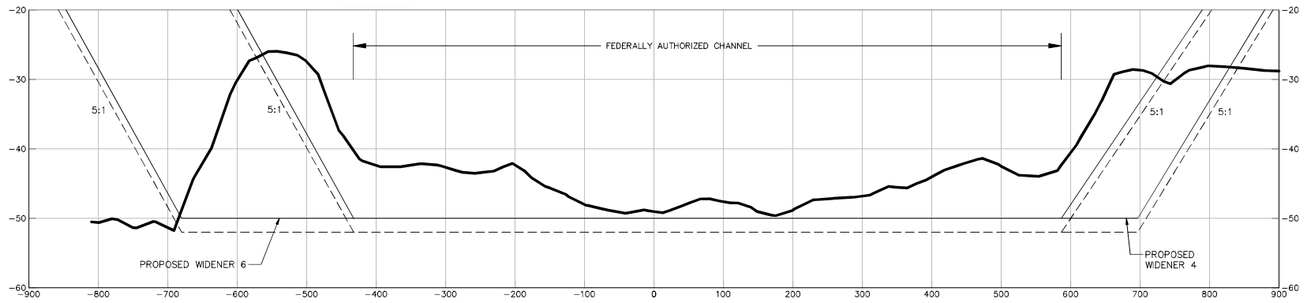

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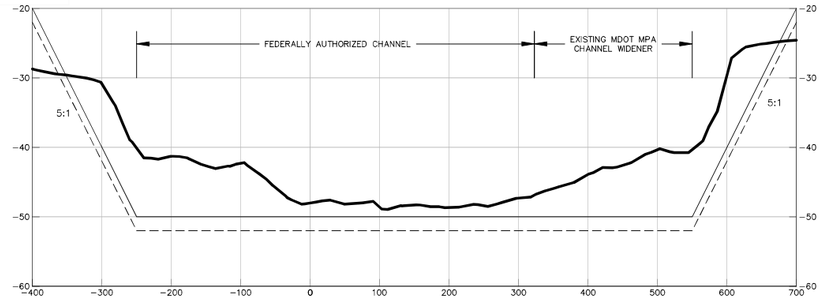

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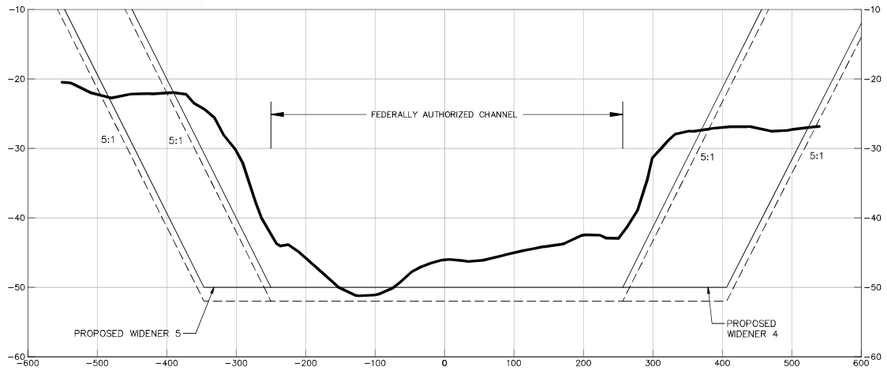

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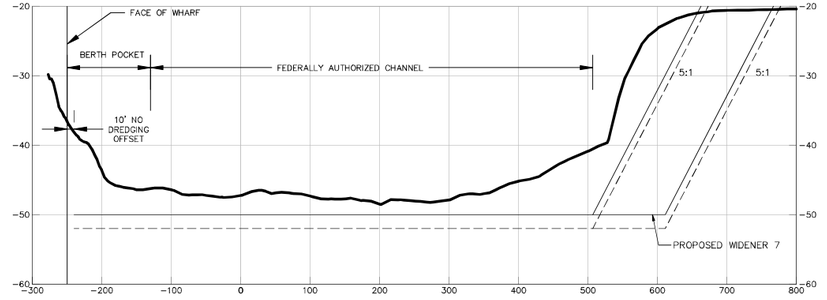

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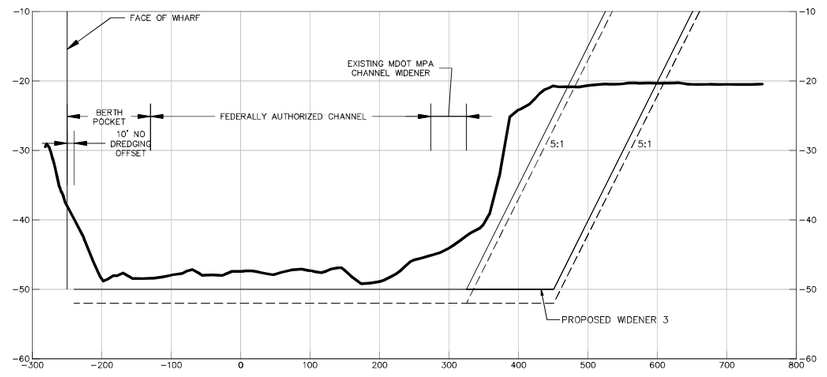

LEGEND

- CENAB/GBA COMBO SURVEY
- PROPOSED REQUIRED GRADE (–50')
- PROPOSED OVERDEPTH (–52')

0 100' 200'
HORIZONTAL SCALE

0 10' 20'
VERTICAL SCALE

SEAGIRT WEST LOOP
CROSS SECTIONS – 5H:1V SLOPES

BALTIMORE, MD

DRAWING DATE:	JUNE 2021
DRAWN BY:	C. MANUEL
CHECKED BY:	L. FOLKERT
DRAWING NAME:	Seagirt_Cross_Sections(5-to-1).dwg
DRAWING SCALE:	AS SHOWN
SHEET NUMBER:	3 OF 3

CONDITION SURVEYS	
SURVEY DATE:	OCTOBER 2020 (GBA) & JANUARY 2021 (CENAB)
HORIZONTAL PROJECTION:	MARYLAND STATE PLANE
ZONE:	1900
VERTICAL REFERENCE:	MEAN LOWER LOW WATER (MLLW)
SURVEY UNITS:	U.S. SURVEY FEET

NOTES:
1. THE INFORMATION DEPICTED ON THIS MAP REPRESENTS THE RESULT OF SURVEYS MADE ON THE DATES SHOWN AND CAN ONLY BE CONSIDERED AS INDICATING THE GENERAL CONDITION EXISTING AT THAT TIME.
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4. TIDES WERE OBTAINED FROM NOAA TIDE STATION 8574680 BALTIMORE, FORT MCHENRY.
5. THE PLANE OF MLLW IS 0.84 FEET BELOW NAVD88.

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C:\Users\gba289\Desktop\FROM SERVER\SEAGIRT\2021_Seagirt_5-to-1\2) Seagirt West Loop\Seagirt_Cross_Sections(5-to-1).dwg

ATTACHMENT B
EXCERPTS FROM REFERENCE MATERIAL

CECW-ED Engineer Manual 1110-2-2504	Department of the Army U.S. Army Corps of Engineers Washington, DC 20314-1000	EM 1110-2-2504 31 March 1994
	Engineering and Design DESIGN OF SHEET PILE WALLS	
	Distribution Restriction Statement Approved for public release; distribution is unlimited.	

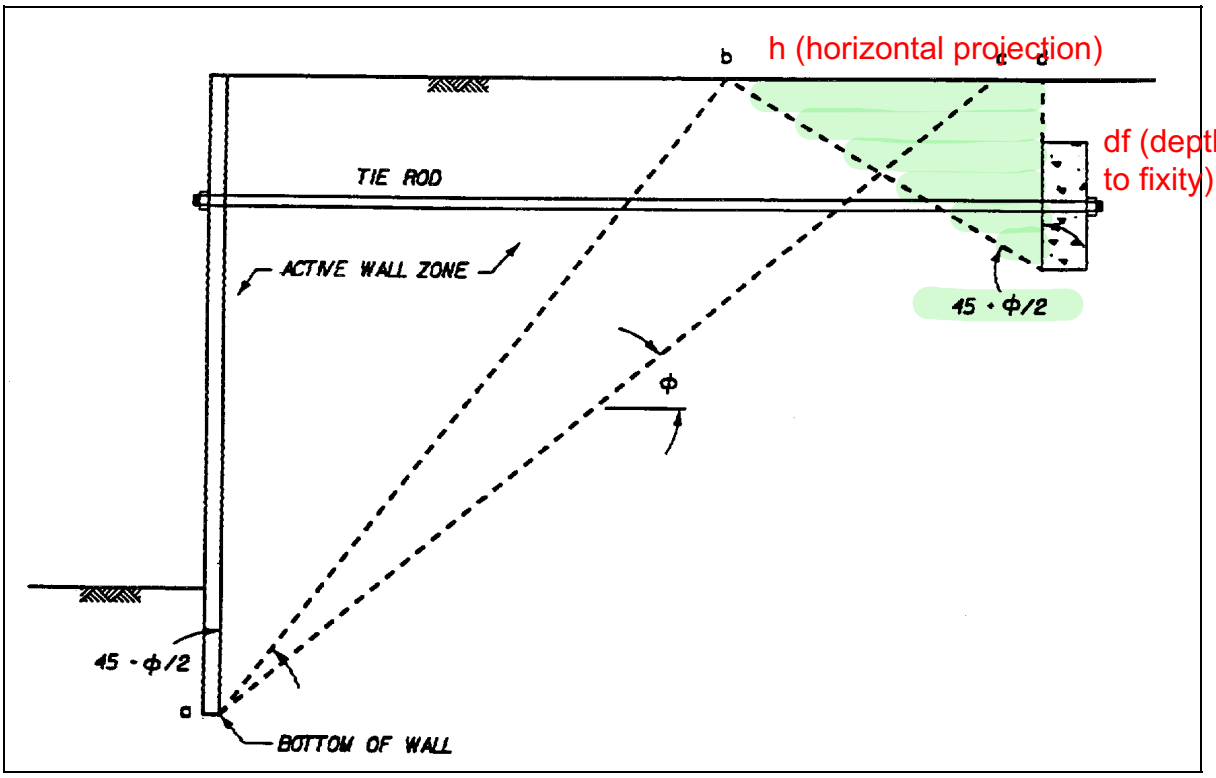


Figure 5-8. Minimum anchor - wall spacing for full passive anchor resistance in homogeneous soil

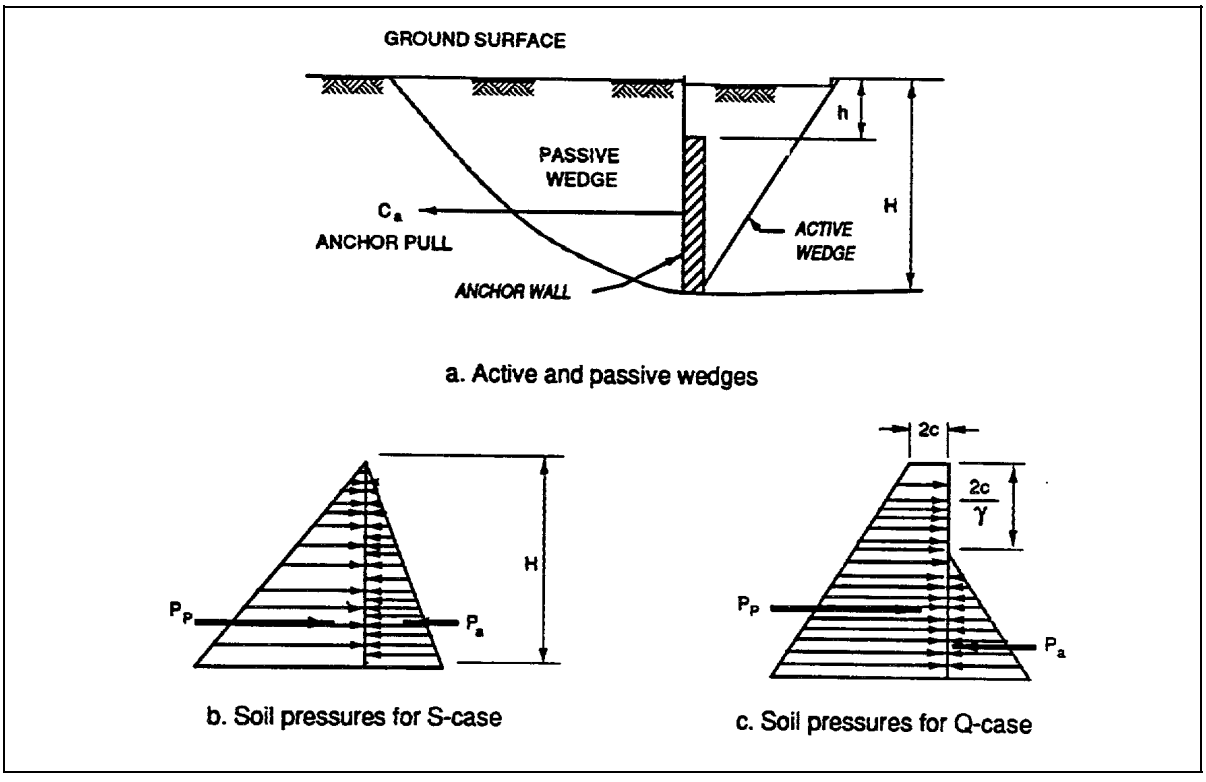
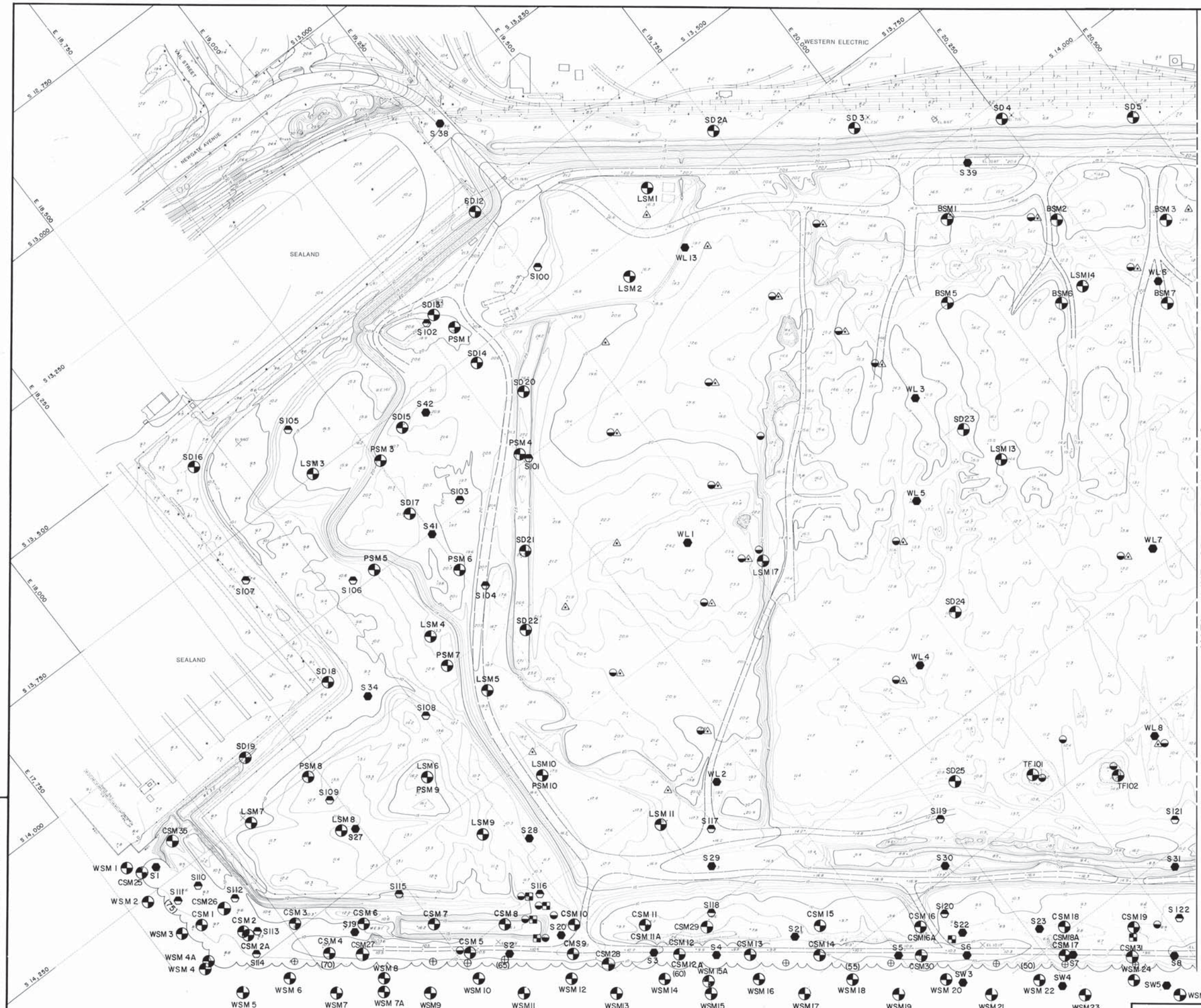


Figure 5-9. Resistance of continuous anchor wall



MATCH LINE SEE DRAWING NO. 2

SUBSURFACE STRATA DESCRIPTION

GF	GRANULAR FILL CONSISTING OF GRAVEL AND SAND WITH SOME INCLUSIONS OF CLAY.
SL	DREDGED SPOIL (SLURRY) CONSISTING PREDOMINANTLY OF VERY SOFT SILTS MIXED WITH VARIABLE AMOUNT OF CLAY AND FINE SAND.
SF	SAND FILL CONSISTING OF GREY, BROWN, MEDIUM FINE SAND.
O-F	BLACK TO DARK GREY, VERY SOFT TO MEDIUM STIFF, ORGANIC CLAYEY SILT TO SILT.
O-2	GREY, SOFT TO MEDIUM STIFF, SILTY CLAY TO CLAYEY SILT.
C-1	GREY, BROWN, MEDIUM STIFF SILTY CLAY.
C-2	BROWN, STIFF SILTY CLAY.
C-3	RED, HARD CLAY.
S-1	GREY LOOSE TO MEDIUM DENSE, FINE SAND TO SILTY SAND.
S-2	GREY, BROWN, DENSE COARSE TO FINE SAND.
S-3	LIGHT BROWN, GREY, VERY DENSE, COARSE TO FINE SAND TO SILTY SAND.

LEGEND

● WL S SW	BORINGS PERFORMED BY PITTSBURGH TESTING LABORATORY FROM NOV. 1982 TO JAN., 1983 UNDER THE INSPECTION OF STV/LYON ASSOCIATES.
◓ S	BORINGS PERFORMED BY PITTSBURGH TESTING LABORATORY IN SEPT. & OCT., 1983 UNDER THE INSPECTION OF STV/LYON ASSOCIATES.
◐ CSM LSM PSM WSM SD	BORINGS PERFORMED BY FROEHLING & ROBERTSON, INC. FROM JULY, 1985 TO DEC, 1985 AND FROM APRIL, 1986 TO MAY, 1986 UNDER THE INSPECTION OF EBA ENG., INC.
◒	PIEZOMETER
△	SETTLEMENT PLATE OR SETTLEMENT MONITORING DEVICE
▪	PRESSURE LOAD CELL
⊕	INCLINOMETER

SURVEYED BY:
DESIGNED BY:
DRAWN BY:
TRACED BY:
CHECKED BY:

NO.	DATE	REVISION	BY

MARYLAND TRANSPORTATION AUTHORITY
AND
MARYLAND PORT ADMINISTRATION

SEAGIRT MARINE TERMINAL

MARGINAL BULKHEAD

BORING AND INSTRUMENT LOCATION PLAN

SHEET NO. G-1

STV/LYON ASSOCIATES.
ENGINEERS, ARCHITECTS & PLANNERS.

DATE: OCT. 1986 | CONTRACT NO. 28791I | DRAWING NO. 96
SCALE: 1"=100'

MARYLAND PORT ADMINISTRATION
REVIEWED BY:
DIRECTOR OF ENGINEERING
DATE: 10-9-86

STATE OF MARYLAND — THOMAS SHIELDS KATZ — NO. 12121 — REGISTERED PROFESSIONAL ENGINEER

PF-5-12/4-45

MATCH LINE SEE DRAWING NO. I

E 20,750 S 14,250 E 21,000 S 14,500 E 21,250 S 14,750 E 21,500 E 21,750 S 15,000 E 22,000 S 15,250

WESTERN ELECTRIC

SEDIMENTATION BASIN

MUCK AREA

BSM 4 LSM 15 BSM 8 LSM 16 WL 9 WL 10 WL 11 WL 12

S40 SD 8 S37 SD26 SD 9 SD10 SD11 WSM 43 SD 27 S36 WSM 42 SD28 S124 S35 WSM41 S126 WSM40C S32 WSM 40A S123 S33 WSM40B S125 S127 WSM40 S24 S25 S26 CSM 22 CSM 23 CSM23A CSM 20 S9 S10 CSM 21 S11 CSM 24 CSM34 CSM 32 CSM33 S12 SW6 SW7 WSM 26 WSM 27 WSM 28 WSM29 WSM 30 WSM 31A WSM 31 WSM 32 WSM 33 WSM 34 WSM 35 WSM 36

(45) (40) (35) (30) (25) (20) (15)

LEGEND

- WL S SW — BORINGS PERFORMED BY PITTSBURGH TESTING LABORATORY FROM NOV. 1982 TO JAN.,1983 UNDER THE INSPECTION OF STV/LYON ASSOCIATES.
- S — BORINGS PERFORMED BY PITTSBURGH TESTING LABORATORY IN SEPT. & OCT., 1983 UNDER THE INSPECTION OF STV/ LYON ASSOCIATES.
- CSM LSM WSM SD — BORINGS PERFORMED BY FROEHLING & ROBERTSON, INC. FROM JULY, 1985 TO DEC., 1985 AND FROM APRIL, 1986 TO MAY, 1986 UNDER THE INSPECTION OF E B A ENG., INC.
- PIEZOMETER
- △ SETTLEMENT PLATE OR SETTLEMENT MONITORING DEVICE
- ⊕ INCLINOMETER

SURVEYED BY: ____ DESIGNED BY: ____ DRAWN BY: ____ TRACED BY: ____ CHECKED BY: ____

NO.	DATE	REVISION	BY

MARYLAND TRANSPORTATION AUTHORITY
AND
MARYLAND PORT ADMINISTRATION

SEAGIRT MARINE TERMINAL

MARGINAL BULKHEAD

BORING AND INSTRUMENT LOCATION PLAN

SHEET NO. G-2

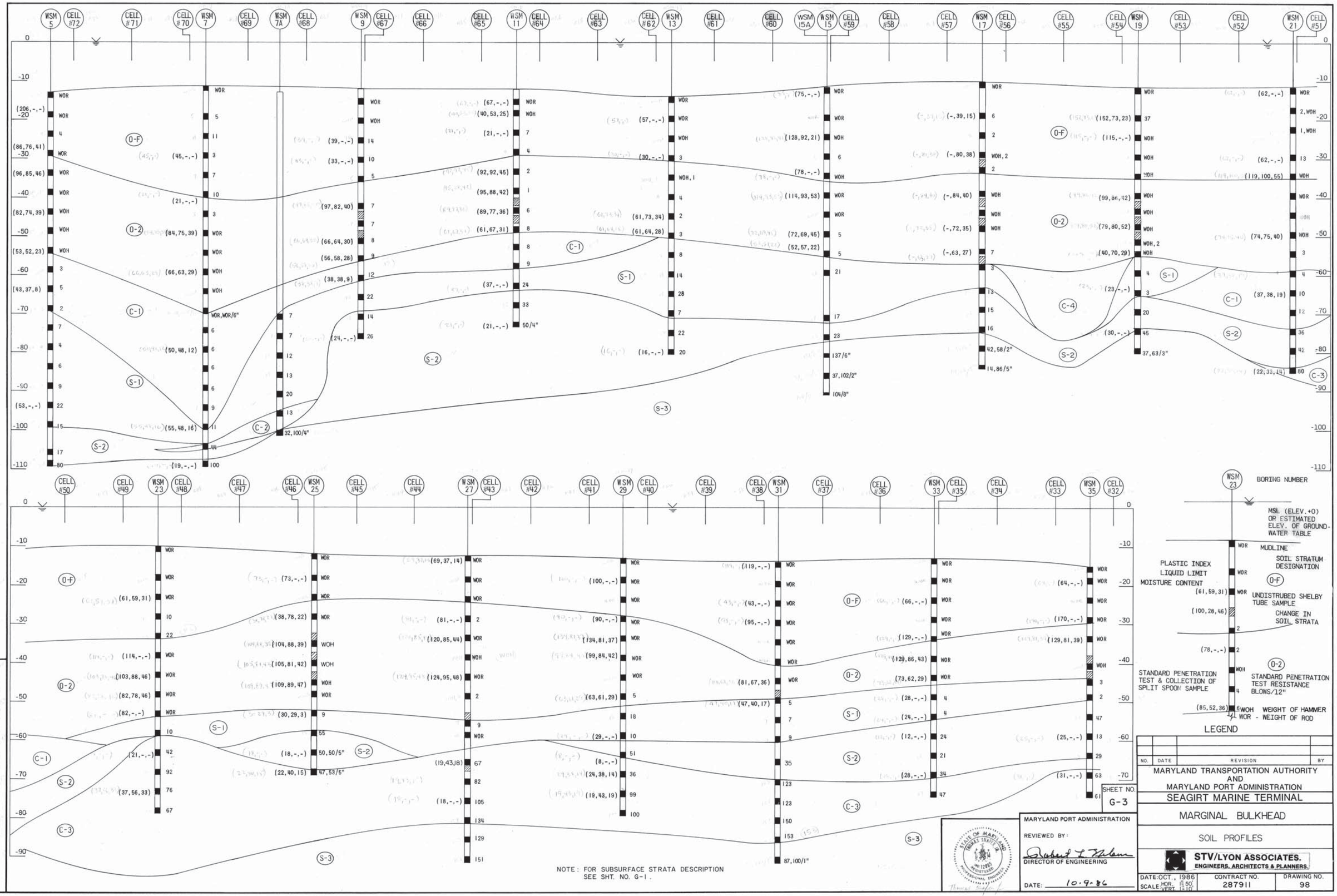
MARYLAND PORT ADMINISTRATION
REVIEWED BY:
Robert L. Nelson
DIRECTOR OF ENGINEERING
DATE: 10-9-86

STATE OF MARYLAND THOMAS SHAFFER JR. NO. 17953 REGISTERED PROFESSIONAL ENGINEER
Thomas Shaffer Jr.

STV/LYON ASSOCIATES.
ENGINEERS, ARCHITECTS & PLANNERS.

DATE: OCT. 1986	CONTRACT NO.	DRAWING NO.
SCALE: 1"=100'	287911	97

PE-5-12/4-46



NOTE: FOR SUBSURFACE STRATA DESCRIPTION SEE SHT. NO. G-1.

SURVEYED BY:
DESIGNED BY:
DRAWN BY:
TRACED BY:
CHECKED BY:

NO.	DATE	REVISION	BY

MARYLAND TRANSPORTATION AUTHORITY
AND
MARYLAND PORT ADMINISTRATION

SEAGIRT MARINE TERMINAL

MARGINAL BULKHEAD

SOIL PROFILES

STV/LYON ASSOCIATES.
ENGINEERS, ARCHITECTS & PLANNERS.

SHEET NO. G-3

MARYLAND PORT ADMINISTRATION
REVIEWED BY:
DIRECTOR OF ENGINEERING
DATE: 10-9-86

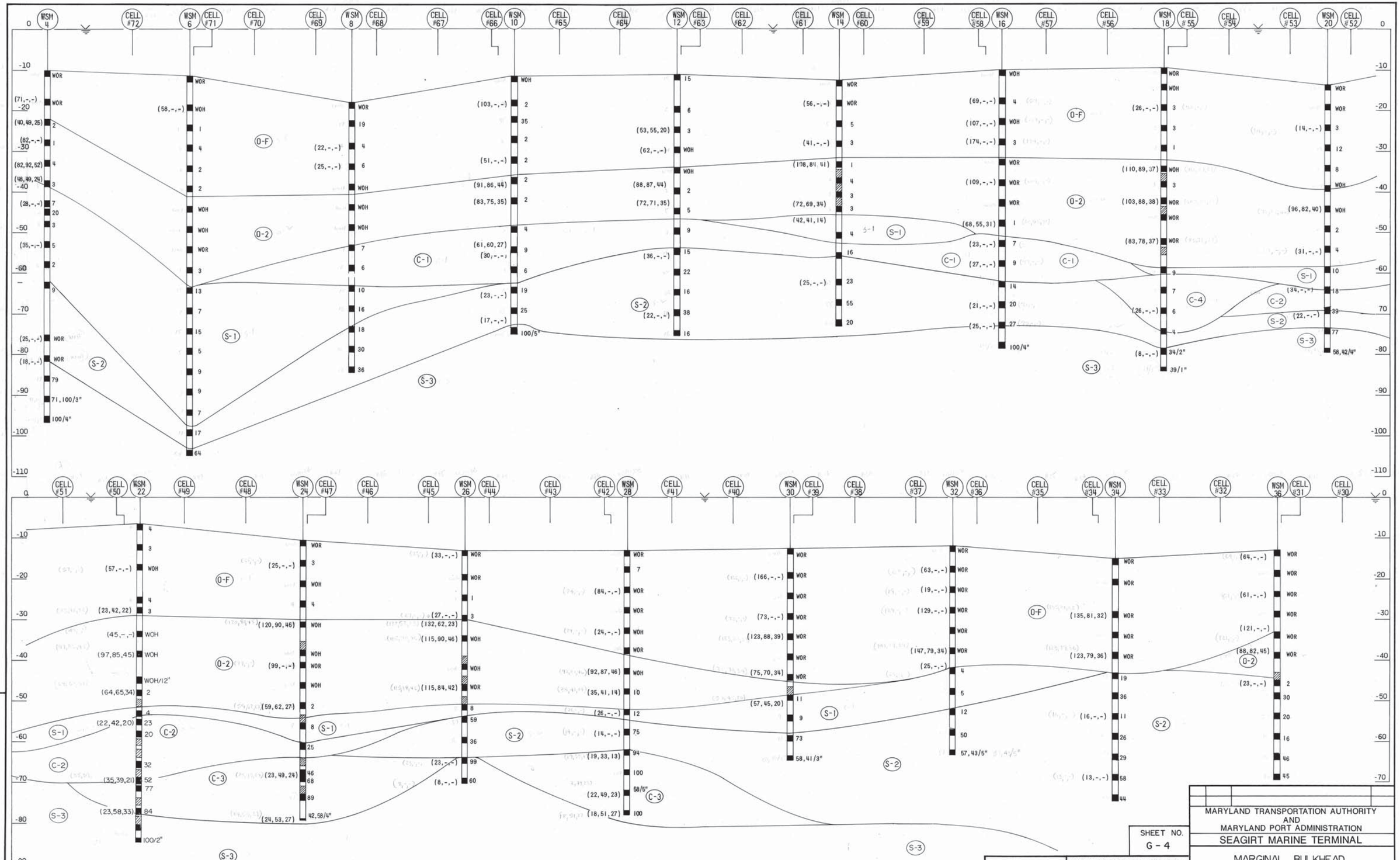
STATE OF MARYLAND THOMAS SNAITH JR. NO. 12981 REGISTERED PROFESSIONAL ENGINEER

DATE: OCT., 1986
SCALE: HOR. 1" = 50'
VERT. 1" = 10'

CONTRACT NO. 287911

DRAWING NO. 98

PF-5-12/4-47



NOTE: FOR SUBSURFACE STRATA DESCRIPTION SEE SHT. NO. G-1

TRACED BY:
CHECKED BY:
SURVEYED BY:
DESIGNED BY:
DRAWN BY:

SHEET NO. G - 4

MARYLAND PORT ADMINISTRATION
REVIEWED BY:
Robert L. Nelson
DIRECTOR OF ENGINEERING
DATE: 10-9-86

MARYLAND TRANSPORTATION AUTHORITY
AND
MARYLAND PORT ADMINISTRATION

SEAGIRT MARINE TERMINAL

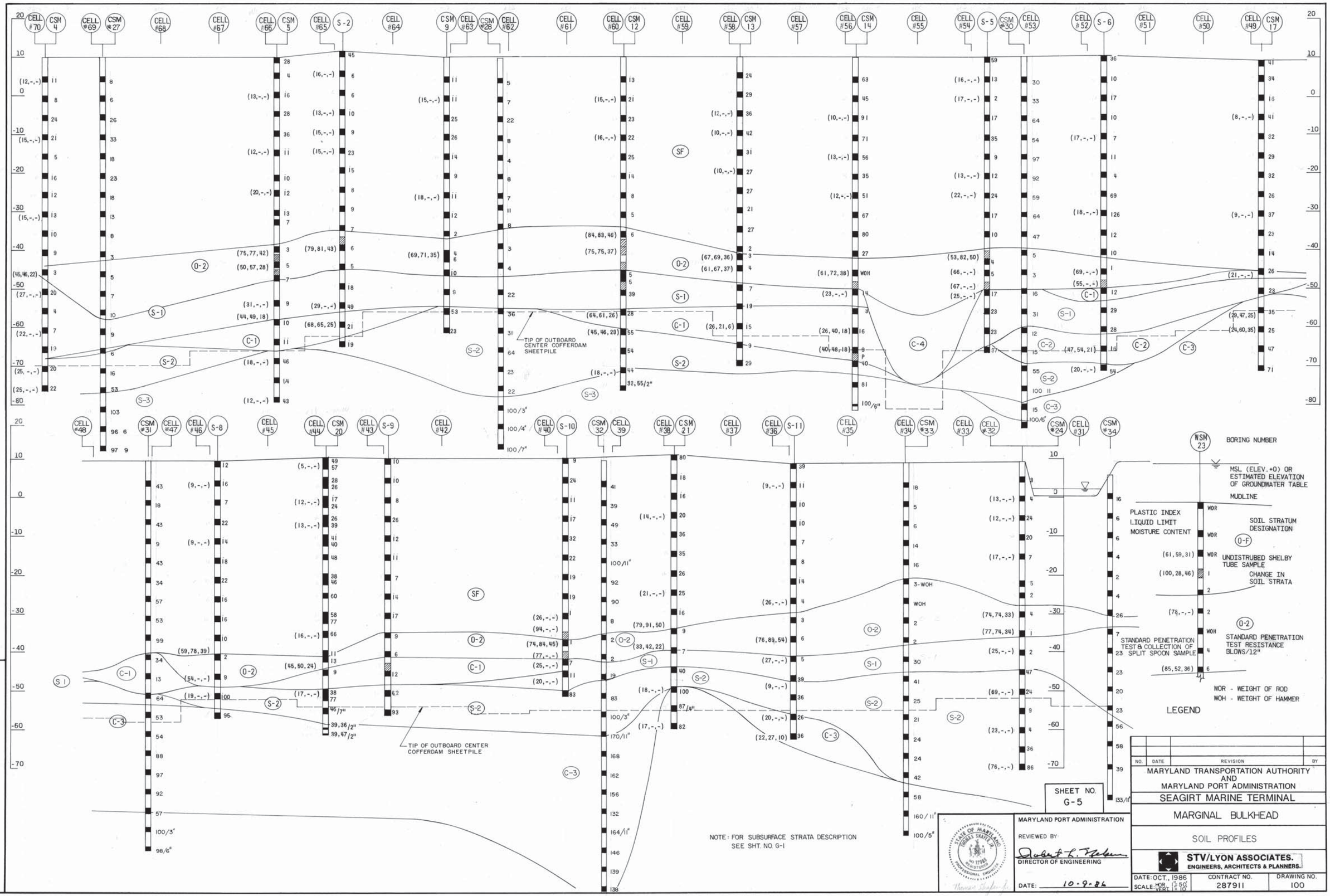
MARGINAL BULKHEAD

SOIL PROFILES

STV/LYON ASSOCIATES.
ENGINEERS, ARCHITECTS & PLANNERS.

DATE: OCT., 1986	CONTRACT NO.	DRAWING NO.
SCALE: HOR. 1"=50' VERT. 1"=10'	28791I	99

PF-5-12/4-48



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SEAGIRT MARINE TERMINAL

MARGINAL BULKHEAD

SOIL PROFILES

SHEET NO. G-5

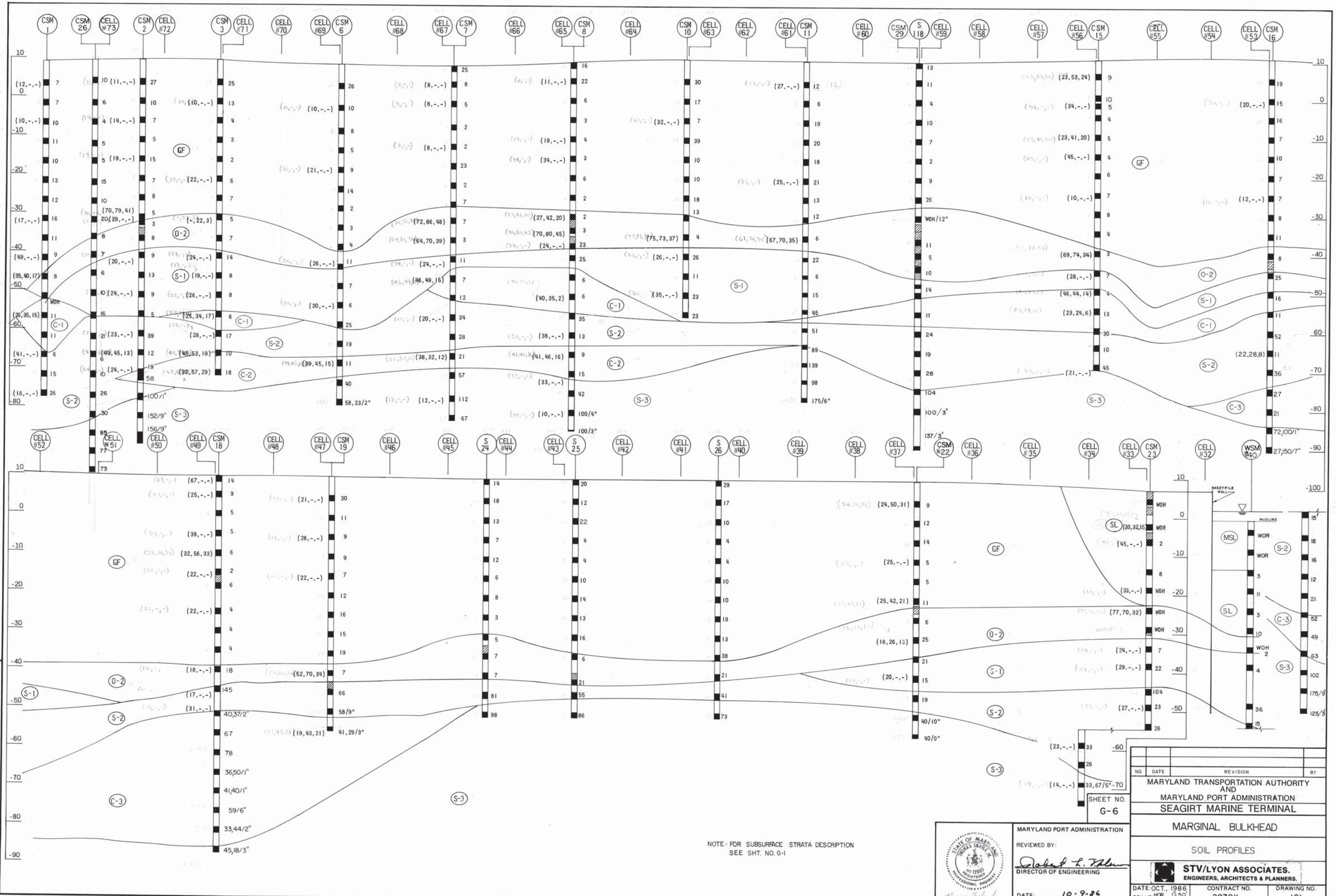
MARYLAND PORT ADMINISTRATION
REVIEWED BY:
DIRECTOR OF ENGINEERING
DATE: 10-9-86

STATE OF MARYLAND THOMAS STAFFORD JR. NO. 17981 REGISTERED PROFESSIONAL ENGINEER

STV/LYON ASSOCIATES.
ENGINEERS, ARCHITECTS & PLANNERS.

DATE: OCT., 1986	CONTRACT NO.	DRAWING NO.
SCALE: HOR. 1"=50' VERT. 1"=10'	287911	100

PF-5-12/4-49



NOTE: FOR SUBSURFACE STRATA DESCRIPTION SEE SHT. NO. G-1

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MARYLAND TRANSPORTATION AUTHORITY
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SEAGIRT MARINE TERMINAL

MARGINAL BULKHEAD

SOIL PROFILES

SHEET NO. G-6

STATE OF MARYLAND — THOMAS SHAFFER JR. — NO. 12983 — REGISTERED PROFESSIONAL ENGINEER

MARYLAND PORT ADMINISTRATION
REVIEWED BY:
DIRECTOR OF ENGINEERING
DATE: 10-9-86

STV/LYON ASSOCIATES.
ENGINEERS, ARCHITECTS & PLANNERS.

DATE: OCT., 1986	CONTRACT NO.	DRAWING NO.
SCALE: HOR. 1"=50' VERT. 1"=10'	28791I	101

U.S. Department of Transportation
Federal Highway Administration

Publication No. FHWA-NHI-16-009
FHWA GEC 012 – Volume I
July 2016

NHI Courses No. 132021 and 132022

Design and Construction of Driven Pile Foundations – Volume I

Developed following:
AASHTO LRFD Bridge Design Specifications, 7th Edition, 2014,with 2015 Interim.

AASHTO LRFD Bridge Construction Specifications, 3rd Edition, 2010, with '11, '12, '13, '14, and '15 Interims.

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The factored resistance must be greater than factored loads applied to the pile. The recommended AASHTO limits for factored pile design stresses will generally keep the driving stresses within recommended limits. Factored loads are covered in Article 3 of the AASHTO Specification (2014) while driving stress limits are presented in the respective pile material sections for concrete (Article 5), steel (Article 6), and timber (Article 8).

8.3.1 Depth to Fixity

The unbraced length, l, or laterally unsupported length is defined by AASHTO (2014) as the distance between two braced points that resist buckling or distortion modes. For embedded piles, the unbraced length is considered for scour and pile stickup through air and/or water. For preliminary analysis, when lateral loads are applied, the effective length, *K*, for flexural or torsional resistance calculations is taken as the total unsupported length, plus an embedded depth to "fixity." If a lateral pile analysis with p-y curves for soil-structure interaction has been performed as discussed in Chapter 7, the depth to fixity concept is unnecessary. Most software with lateral analysis also includes additional features to determine a pile's buckling capacity given the soil model and a pile model with the expected stick-up above the ground level.

For preliminary calculations, however, the depth to fixity below the ground may be evaluated based on soil type and soil strength parameters as shown in Equation 8-6 for clays and Equation 8-8 for sands. Table 8-4 contains the rate of increase in soil modulus for sands, n_h, and should be used as applicable in the following depth to fixity estimates.

For clays:

$$d_f = 1.4\left(\frac{EI_w}{E_s}\right)^{0.25} \qquad \text{Eq. 8-6}$$

$$E_s = 0.465 s_u \qquad \text{Eq. 8-7}$$

For sands:

$$d_f = 1.8\left(\frac{EI_w}{n_h}\right)^{0.2} \qquad \text{Eq. 8-8}$$

Where:

d_f = depth to fixity below the ground (ft).
E = elastic modulus of pile material (ksi).

E_s = elastic modulus of clay soil (ksi).
s_u = undrained shear strength of clay (ksf).
I_w = weak axis moment of inertia of pile (ft^4).
n_h = rate of increase of soil modulus with depth (Table 8-4) (ksi/ft).

Table 8-4 Rate of Increase of Soil Modulus with Depth for Sands (ksi/ft) (after AASHTO 2014)

Consistency	Dry or Moist	Submerged
Loose	0.417	0.208
Medium	1.110	0.556
Dense	2.780	1.390

8.3.2 Limiting Slenderness Ratio

Piles extending through air or water are unbraced over some length and therefore, for axial compression, the slenderness ratio should be checked during design. For non-composite steel piles, which are not fully embedded, slenderness ratio limits should be satisfied as follows:

$$\frac{Kl}{r_s} \leq 120 \qquad \text{Eq. 8-9}$$

Where:
K = effective length factor (Figure 8-4) (dimensionless).
l = unbraced length, or laterally unsupported length plus d_f (inches).
r_s = minimum radius of gyration, $\sqrt{I/A}$ (inches).

8.3.3 Resistance Factors

A discussion and step by step determination of the nominal structural resistance for timber, steel, and concrete piles is provided in the following sections. The AASHTO (2014) specifications form the basis of these respective sections. Following the Load and Resistance Factor Design (LRFD) approach, a resistance factor is applied to the calculated nominal structural resistance.

In practical terms, the imposed factored load must be less than or equal to the factored resistance. Chapter 2 provides a discussion on load combinations in which load factors are applied to respective load effects. The critical load combination is

ATTACHMENT C
CALCULATIONS

Moffat & Nichol
2780 Lighthouse Point East, Suite D
Baltimore, MD 21224

Evaluation of Timber Piles Removed from Dundalk Marine Terminal Berths 1 and 2

Wood Science Consulting
March 12, 2021- Report WSC-21.15.01

4.3 Comparison of 2011 and 2021 Test Results

The pile test data collected from DMT in 2021 was compared to the test data collected in 2011. In 2011, four pilings were also tested, and those results were reported in WAS Report 11.133.01. In 2011 two pilings from the 1929 vintage were tested as well as on from 1961 and another from 1966.

The results from both data sets were grouped into two vintages: 1966 and 1929. The results do no illustrate that the overall strength of the pilings has reduced from 2011 to 2021, however, there is a clear difference in the overall strength of the 1996 vintage pilings as compared to the 1929 pilings. Overall, all three mechanical property value means were higher in the pilings tested in 2021 than those tested in 2011. At this point and based on the limited number of pilings that have been tested there is no evidence that the pilings at Berths 1-4 have lost any strength since 2011. However, there is a clear difference between the mean property values from 1966 versus those from 1929. There was a 17% difference in mean MOR and a 20% difference in the mean MOE and C//.

Table 3. Results of the Wood Pile Testing for DMT Berths 1-4 in 1966 and 1929.

Year Tested	Modulus of Rupture (psi)		Modulus of Elasticity ($x10^6$ psi)		Compression Parallel (psi)	
	1966	**1929**	**1966**	**1929**	**1966**	**1929**
2021	5,912	5,016	1.523	1.095	2,541	2,434
2011	5,148	4,470	1.085	1.030	2,039	1,902
Average	5,661	4,743	1.139	1.062	2,486	1,970
Difference	**17%**		**20%**		**20%**	

4.4 Recommended Reference Design Values

Based on the results of the testing from 2011 and 2021 the recommended allowable design values provided in 2011 remain the same. The values provided in 2011 were based on the lowest mean residual design factors that were then applied to the allowable design values published in the NDS. The lowest residual design values were based on the lowest residual values to be conservative. Since there was no reduction in property values found since 2011 based on the recent testing there is no justification to reduce the allowable design values.

Table 4a. Recommended Reference Design Values for the Pilings at DMT Berths 1 and 2, 1966 vintage.

Design Value	Reference Design Value per the NDS	Residual Value per Testing	Recommended Reference Design Value
F_b	2,400 psi	X 0.63	1,500 psi
F_c	1,200 psi	X 0.63	750 psi
E	1,500,000 psi	X 0.65	0.98 x 10^6 psi
E_{min}	790,000 psi	X 0.65	0.51 x 10^6 psi

Table 4b. Recommended Reference Design Values for the Pilings at DMT Berths 1 and 2, 1929 vintage.

Design Value	Reference Design Value per the NDS	Residual Value per Testing	Recommended Reference Design Value
F_b	2,400 psi	X 0.47	1,150 psi
F_c	1,200 psi	X 0.45	550 psi
E	1,500,000 psi	X 0.65	0.98 x 10^6 psi
E_{min}	790,000 psi	X 0.65	0.51 x 10^6 psi

4.4 Degradation Rate Curves

In order to estimate life expectancy over time and reduction in allowable stresses into the future, three degradation rate curves were developed. Rate of degradation over time is very difficult to predict, however, a simplified rate of degradation can be obtained following the concept published in "*A Study of Fracture of Wood Based on the Theory of Stochastic Process*" (Sumiya, 1963 – Wood Research 29:1-24.). An exponential rate of degradation over time is assumed for DMT since the environment has remained constant over time (i.e. the timbers have remained in a wet and submerged condition since the time of construction).

The rate of degradation is expressed as follows:

$$Y_T = Y_o e^{-BT}$$

where:

T = time in service (years),
Y_T = property at time T,
Y_o = property at T=0, and
B = degradation rate constant (calculated using historical ASTM D2555 data and current ASTM D143 test results).

Three curves are provided in Appendix II illustrating the approximate degradation over time for F_b, F_c and E based on the results of the testing at DMT. It should be noted that these are generalized curves and should be used as estimates based on the number of pilings that have been mechanically tested at DMT. The mean property values from 2011 compared to 2021 did not show any evidence of property reductions, however, this may be simply attributed to the samples that were extracted in 2011 and 2021. A general reduction in allowable stresses over time should be assumed.

Geotechnical Engineering Study, Seagirt Terminal, Berth-IV, 2700 Broening Highway, Baltimore, Maryland (DWK Contract Number 09202.P)

4.0 Bulkhead Analysis

4.1 Discussion

A pile supported wharf deck and an inboard sheet pile cut-off wall braced by the wharf deck is planned for the Berth IV construction. We understand that the existing cellular cofferdams will be left in place. A stability analysis of the cellular cofferdam has been performed by others. We understand that improvement of the materials within the cofferdam cell using stone columns is planed to improve stability of the cells. The wharf deck foundation support piles will be installed both within and outside the cellular cofferdams.

4.2 Soil Parameters for Inboard Sheet Pile Cut-off Wall

Based on the soil borings performed and the soil laboratory tests performed for this project and the available empirical relations of soil parameters to the SPT values, we have developed soil strength parameters for the design of the inboard sheet pile cut-off wall.

Estimated Design Parameters of On-Site Soils for Sheet Pile Analysis

Soil Type	Bulk Density (γ)/pcf	Effective Friction Angle (Φ')/degrees	Effective Cohesion (c')/psf
Unsurcharged Muck Slurry (MSL)	100	20	50
Stone Column Improved Muck Slurry (MSL)	115	27	50
Miscellaneous Fill (MF)	110	30	0
Recent Alluvial (O-2)	100	20	20
Stone Column Improved Recent Alluvial (O-2)	115	27	50
Basal Alluvial Sand (S-1)	115	30	0
Recent Alluvial Organic Clay/Elastic Silt (C-1)	110	24	50
Stone Column Improved Recent Alluvial Organic Clay / Elastic Silt (C-1)	115	27	50
Potomac Sand (S-3)	120	34	0
Potomac Clays (C-3)	125	24	100

These values can be used to develop the required soil pressures for analysis of the sheet pile wall. For both the cantilevered construction loading condition and the long term braced condition the stability of the wall needs to be analyzed. It is recommended that the effective soil strength parameters be used in the design of the sheet pile wall analysis as the drained condition is expected to be the critical case. A minimum construction surcharge of 200 psf is recommended to account for the general construction vehicle traffic. Additional surcharge may be required for heavier construction equipment. Two generalized design soil cross sections, one through Cell-19 and another through Cell-29 are presented as Figure Number -2 to this report. These values can be checked against the soil

STRUCTURAL NOTES

I. DESIGN CODES

A. BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE (ACI-318-83) WITH COMMENTARY.

B. STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, THE AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS, AASHTO, 13TH EDITION, 1983.

C. SPECIFICATION FOR THE DESIGN, FABRICATION, AND ERECTION OF STRUCTURAL STEEL FOR BRIDGES, AISC, 1978.

D. DESIGN MANUALS PUBLISHED BY THE DEPARTMENT OF THE NAVY, NAVAL FACILITIES ENGINEERING COMMAND.

II. DESIGN LOADS

A. PATAPSCO FRONTAGE

1. VERTICAL LIVE LOADS
   A) UNIFORM LOAD
      (1) 1000 PSF FOR SUPERSTRUCTURE
      (2) 800 PSF FOR PILING
   B) CONTAINER CRANE
      (1) RAIL MOUNTED 100' GAGE.
      (2) CAPACITY UNDER SPREADER 55 SHORT TONS.
      (3) 130 KIP VERTICAL WHEEL LOAD @ 4.5' C-C SPACING.
      (4) 30% IMPACT.
      (5) 150 KIP UPLIFT FORCE FOR LANDSIDE CRANE TIE DOWNS. 250 KIP UPLIFT FORCE FOR SEASIDE CRANE TIE DOWNS.
   C) TRUCK LOAD: HS 20-44
   D) SPECIAL EQUIPMENT LOADS (AS AN OVERLOAD PROVISION): THE SUPERSTRUCTURE WILL BE ANALYZED FOR THE FOLLOWING LOADS IN ACCORDANCE WITH LOADING COMBINATION GROUP IB IN ARTICLE 3.22 OF AASHTO 13TH EDITION.
      (1) MARATHON LETRO-PORTER MODEL 2782 W/ 251.
         - 90,000 LBS. CAPACITY AT 48 INCHES LOAD CENTER
         - AXLE LOAD 226,000 LBS. WITH 30% IMPACT.
         - TIRE 98 INCHES OUTSIDE DIAMETER - 48 PLY-RATING (2 TIRES PER AXLE) AT 86 PSI.
         - 175 INCHES FROM OUTSIDE TO OUTSIDE OF TIRES.
         - CONTACT AREA OF TIRE 1320 SQ. INCHES.
      (2) CLARK EQUIPMENT, CLARKLIFT CY 700.
         - 70,000 LBS CAPACITY AT 48 INCHES LOAD CENTER.
         - AXLE LOAD 166,500 LBS PLUS 30% IMPACT.
         - TIRE 18 X 25 - 32 PLY TANDEM (4 TIRES) AT 138 PSI.
         - 81 INCHES FROM CENTERLINE TO CENTERLINE OF INTERIOR TIES.
         - 127.25 INCHES FROM OUTSIDE TO OUTSIDE OF OUTER TIRES.
         - CONTACT AREA OF TIRE 300 SQ. INCHES.

2. LATERAL LOADS
   A) SHIP BERTHING - 60,000 DWT VESSEL WITH 0.4 FT/SEC. VELOCITY, AND 50,000 DWT VESSEL WITH 0.5 FT/SEC. VELOCITY AT 10° APPROACH ANGLE. 585 T.E.U. CONTAINER BARGE WITH 1.0 FT/SEC VELOCITY AT 45° APPROACH ANGLE.
   B) MOORING FORCE - 200 KIPS PER BOLLARD. at 38° (from the horizontal)
   C) WIND LOAD ON CONTAINER CRANE - 350 KIPS ON LANDSIDE RAIL AND 100 KIPS ON SEASIDE RAIL, (BASED ON 50 PSF WIND PRESSURE WITH 1.5 GUST FACTOR).
   D) CRANE STOPS - BASED ON 1000 TON CONTAINER CRANE TRAVELING AT SPEED OF 150 FT/MIN. MAXIMUM IMPACT FORCE = 150 KIPS.
   E) STOWAGE PINS - 270 KIPS SEASIDE RAIL. 230 KIPS LANDSIDE RAIL.

B. SEA-LAND EXTENSION (TO MATCH EXISTING WHARF)

1. VERTICAL LIVE LOADS
   A) UNIFORM LOAD
      (1) 600 PSF FOR SUPERSTRUCTURE.
      (2) 480 PSF FOR PILES.
   B) CONTAINER CRANE
      (1) RAIL MOUNTED 50' GAGE.
      (2) 73.5 KIP VERTICAL WHEEL LOAD AT 5.0' C-C SPACING.
      (3) 30% IMPACT.
      (4) 150 KIP UPLIFT FORCE FOR CRANE TIE DOWNS
   C) TRUCK LOAD: HS 20-44

2. LATERAL LOADS
   A) SHIP BERTHING - 3.0 KLF LATERAL FORCE.
   B) MOORING FORCE - 150 KIP PER BOLLARD
   C) WIND LOAD ON CONTAINER CRANE - 3.5 KIP HORIZONTAL LOAD AT EACH WHEEL.
   D) CRANE STOPS AND STOWAGE PINS - TO MATCH EXISTING WHARF.

C. LOAD COMBINATIONS

1. SUPERSTRUCTURE (DECK SLABS, CAP BEAMS, CRANE GIRDERS, ETC.)

LOAD COMBINATION	% ALLOWABLE STRESS
DEAD LOAD + LIVE LOAD (W/IMPACT)	100
DEAD LOAD + LIVE LOAD (W/IMPACT) + BERTHING FORCE + SOIL PRESSURE	100
DEAD LOAD + LIVE LOAD (W/IMPACT) + SOIL PRESSURE + MOORING FORCE + WIND LOAD	133

2. SUBSTRUCTURE (PRESTRESSED CONCRETE PILES AND H-PILES) SAME AS ABOVE EXCEPT IMPACT IS EXCLUDED.

III. MATERIAL PROPERTIES

A. REINFORCED CONCRETE, MINIMUM COMPRESSIVE STRENGTH AT 28 DAYS.

1. f'c = 4000 PSI FOR CAST-IN-PLACE CONCRETE DECK SLABS, BEAMS, CRANE GIRDERS, PILE BENTS AND OTHER STRUCTURAL MEMBERS.

2. f'c = 5000 PSI FOR PRESTRESSED CONCRETE PLANKS AND 18" SQ. PRESTRESSED CONCRETE PILES.

3. f'c = 6000 PSI FOR 20" SQ. PRESTRESSED CONCRETE PILES AND STRUTS.

B. REINFORCING STEEL

1. DEFORMED REINFORCING BARS SHALL CONFORM TO ASTM A615, GRADE 60 (Fy =60KSI), EXCEPT TIES AND STIRRUPS, WHICH SHALL CONFORM TO ASTM A615, GRADE 40 (Fy =40KSI).

2. PRESTRESSED STRANDS SHALL BE SEVEN WIRE, STRESS RELIEVED STRANDS CONFORMING TO ASTM A416 GRADE 270K.

3. WIRE SPIRAL TIES SHALL CONFORM TO ASTM A82.

C. STRUCTURAL STEEL

1. ROLLED SHAPES AND PLATES SHALL CONFORM TO ASTM A36.

2. BOLTS AND ANCHOR BOLTS SHALL CONFORM TO ASTM A307.

3. WELDING SHALL CONFORM TO AWS, ELECTRODES SHALL BE E70XX SERIES FOR A36 STEEL, OR APPROVED EQUAL.

D. PILE CAPACITY, ALL PILES SHALL BE DRIVEN TO A MINIMUM BEARING CAPACITY AS FOLLOWS:

1. 18" SQ. PRECAST CONCRETE PILES - 140 TONS.

2. 20" SQ. PRECAST CONCRETE PILES - 145 TONS.

3. 14HP73 PILES - 130 TONS.

IV. MINIMUM CONCRETE COVER OVER REINFORCING BARS SHALL BE AS FOLLOWS UNLESS OTHERWISE SHOWN ON THE DRAWINGS:

A. CONCRETE CAST AGAINST AND PERMANENTLY EXPOSED TO EARTH	3 IN.
B. CONCRETE EXPOSED TO EARTH OR WEATHER	
1. BOTTOM OF BEAMS AND SLABS	3 IN. (4 IN. BEAMS OVER PILES)
2. TOP OF BEAMS AND SLABS	2 IN.
3. SIDES OF BEAMS AND WALLS	2 IN. (3 IN. OUTSIDE FACE OF FASCIA BEAM)

V. ALL EXPOSED CONCRETE EDGES SHALL BE CHAMFERED 3/4" UNLESS OTHERWISE SHOWN.

VI. SEE DRAWING NO. TS-9 FOR FENDER DESIGN REQUIREMENTS.

ABBREVIATIONS

STANDARD

@	AT
ABT.	ABOUT
ADD.	ADDITION
ADDL.	ADDITIONAL
ALT.	ALTERNATE
APPROX.	APPROXIMATE
B	BOTTOM OF
BM.	BEAM
BRG.	BEARING
BETW.	BETWEEN
BOT.	BOTTOM
C.I.P.	CAST-IN-PLACE
CTR.	CENTER CENTERLINE
C/C	CENTER TO CENTER
CL.	CLEAR
CONC.	CONCRETE
CONT.	CONTINUOUS
CONTR. JT.	CONTRACTION JOINT
C.J.	CONSTRUCTION JOINT
DET.	DETAIL
DIAG.	DIAGONAL
DIA.Ø	DIAMETER
DIM.	DIMENSION
DO.	DITTO
DWG.	DRAWING
EA.	EACH
EL.	ELEVATION
EQ.	EQUAL
EXIST.	EXISTING
EXP.	EXPANSION
E.S.	EACH SIDE
E.J.	EXPANSION JOINT
FIN.	FINISH
F.S.	FAR SIDE
GALV.	GALVANIZE
GR.	GRADE
GRD.	GROUND
HEX.	HEXAGON
HORZ.	HORIZONTAL
JT.	JOINT
KIP.	1000 POUNDS
KSI.	KIP PER SQUARE INCH
LONGIT.	LONGITUDINAL
MAX.	MAXIMUM
MET.	METAL
MIN.	MINIMUM
N.	NORTH
N.S.	NEAR SIDE
NTS.	NOT TO SCALE
NO.	NUMBER
O.C.	ON CENTER
OPNG.	OPENING
OPP.	OPPOSITE
O/O	OUT TO OUT
PL.	PLATE
PSI.	POUND PER SQUARE INCH
LB.	POUND
P.S.	PRESTRESSED
P.C.	PRECAST CONCRETE
PROJ.	PROJECTION
R.	RADIUS
R/C	REINFORCED CONCRETE
REQD.	REQUIRED
SCH.	SCHEDULE
SECT.	SECTION
S/SHT.	SHEET
SIM.	SIMILAR
SPEC.	SPECIFICATION
SQ.	SQUARE
STD.	STANDARD
ST.	STEEL
STR.	STRUCTURAL
SYM.	SYMMETRICAL
SP.	SPACE, SPACING
STAGG.	STAGGERED
T	TOP OF THICKNESS
THK.	THICKNESS
THRU	THROUGH
TOT.	TOTAL
TS	TYPICAL STRUCTURE DETAILS
TYP.	TYPICAL
TRANS.	TRANSVERSE
VERT.	VERTICAL
W/	WITH
W/O	WITHOUT
W.L.	WATER LEVEL

STRUCTURAL

PART I	- SEASIDE MARGINAL WHARF (34'-6")
PART II	- PLATFORMS OVER EXISTING CELLS (73'-0")
PART III	- LANDSIDE RELIEVING PLATFORMS (30'-0" OR 40'-0")
CB	- CAP BEAM
EB	- EDGE BEAM
FB	- FASCIA BEAM (SEASIDE)
LCG	- LANDSIDE CRANE GIRDER
LB	- LONGITUDINAL BEAM
PS	- PRESTRESSED CONCRETE SLAB
SCG	- SEASIDE CRANE GIRDER
SLB	- SEALAND BEAM
SLCG	- SEALAND CRANE GIRDER
SLLB	- SEALAND LONGITUDINAL BEAM
SLTB	- SEALAND TIE-BEAM

SYMBOLS

EARTH

CONCRETE

PRECAST PRESTRESSED CONCRETE SLAB

STEEL SECTION

STRUCTURAL STEEL SHAPES

FENDER

200K BOLLARD

PLAN SECTION, DETAIL NOS. ETC.

SHEET NO.

LEGEND

- 20" SQ. PRESTRESSED CONCRETE PLUMB PILES
- 20" SQ. PRESTRESSED CONCRETE PLUMB INDICATOR PILES
- 18" SQ. PRESTRESSED CONCRETE PLUMB PILES
- 18" SQ. PRESTRESSED CONCRETE PLUMB INDICATOR PILES
- HP 14X73 STEEL 'H' PLUMB PILES
- HP 14X73 STEEL 'H' PLUMB INDICATOR PILES
- 3 VERTICAL TO 1 HORIZONTAL BATTER PILE (3:1)
- WATER LEVEL (W.L.)

SURVEYED BY: ____ TRACED BY: ____
DESIGNED BY: ____ CHECKED BY: ____
DRAWN BY: ____

NO.	DATE	REVISION	BY
3	3-87	NOTES CHANGE	N.B.

MARYLAND TRANSPORTATION AUTHORITY AND MARYLAND PORT ADMINISTRATION

SEAGIRT MARINE TERMINAL

MARGINAL BULKHEAD

STRUCTURAL NOTES, ABBREVIATIONS, SYMBOLS AND LEGEND

SHEET NO. S-1

MARYLAND PORT ADMINISTRATION

REVIEWED BY: Robert L. Falcon
DIRECTOR OF ENGINEERING

DATE: 10-9-86

STV/LYON ASSOCIATES. ENGINEERS, ARCHITECTS & PLANNERS.

DATE: OCT., 1986 | CONTRACT NO. 287911 | DRAWING NO. 21

SCALE: NONE

PF-5-12/3-21

SEAGIRT LOOP DEEPENING FEASIBILITY - PILE FIXITY AND PASSIVE WEDGE

DEPTH TO FIXITY FOR CONCRETE PILES AT SMT 1-2

df	**17.10697**	**ft**	per FHWA-NHI-16-009 = depth to fixity
E	4030.509	ksi	per ACI 318-14
Iw	0.643004	ft^4	
Es	0.11625	ksi	per FHWA-NHI-16-009
su	0.25	ksf	interpreted from soil profile
fc	5000	psi	per drawings

df =	1.4((E*Iw)/Es)^0.25			
E =	57000*fc^0.5 =	4030509	psi =	4030.509 ksi
I =	bh^3/12 =	0.643004	ft^4	for 20-inch square pile
Es =	0.465*su =	0.11625	ksi	

Horizontal Projection of Passive Wedge

phi	0	degrees	for clay soil
phi	20	degrees	drained condition (from SMT 4)
h	17.10697		for phi = 0
h	24.43129		for phi = 20 (drained condition)
h	32.17354		for phi = 34 (high phi for comparison)

h = df*tan(45-phi/2)

DEPTH TO FIXITY FOR TIMBER PILES AT CANTON MARINE TERMINAL PIER 13

df	**7.022472**	**ft**	per FHWA-NHI-16-009 = depth to fixity
E	1500	ksi	per NDS
Iw	0.049063	ft^4	
Es	0.11625	ksi	per FHWA-NHI-16-009
su	0.25	ksf	interpreted from soil profile
fc	5000	psi	per drawings

df =	1.4((E*Iw)/Es)^0.25			
E =	1500000	psi =	1500	ksi
I =	PI*d^4/64	0.049063	ft^4	for 12-inch round pile
Es =	0.465*su =	0.11625	ksi	

Horizontal Projection of Passive Wedge

phi	0	degrees	for clay soil
phi	20	degrees	drained condition (from SMT 4)
h	7.022472		for phi = 0
h	10.02913		for phi = 20 (drained condition)
h	13.20735		for phi = 34 (high phi for comparison)

h = df*tan(45-phi/2)

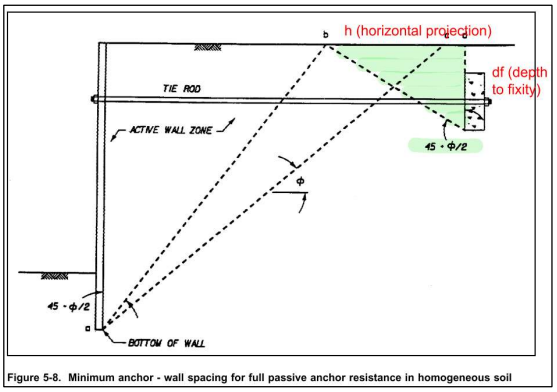

Figure 5-8. Minimum anchor - wall spacing for full passive anchor resistance in homogeneous soil

Estimated Design Parameters of On-Site Soils for Sheet Pile Analysis

Soil Type	Bulk Density (γ)/pcf	Effective Friction Angle (Φ')/degrees	Effective Cohesion (c')/psf
Unsurcharged Muck Slurry (MSL)	100	20	50
Stone Column Improved Muck Slurry (MSL)	115	27	50
Miscellaneous Fill (MF)	110	30	0
Recent Alluvial (O-2)	100	20	20
Stone Column Improved Recent Alluvial (O-2)	115	27	50
Basal Alluvial Sand (S-1)	115	30	0
Recent Alluvial Organic Clay/Elastic Silt (C-1)	110	24	50
Stone Column Improved Recent Alluvial Organic Clay / Elastic Silt (C-1)	115	27	50
Potomac Sand (S-3)	120	34	0
Potomac Clays (C-3)	125	24	100

These values can be used to develop the required soil pressures for analysis of the sheet pile wall. For both the cantilevered construction loading condition and the long term braced condition the stability of the wall needs to be analyzed. It is recommended that the effective soil strength parameters be used in the design of the sheet pile wall analysis as the drained condition is expected to be the critical case. A minimum construction surcharge of 200 psf is recommended

Table 4b. Recommended Reference Design Values for the Pilings at DMT Berths 1 and 2, 1929 vintage.

Design Value	Reference Design Value per the NDS	Residual Value per Testing	Recommended Reference Design Value
F_b	2,400 psi	X 0.47	1,150 psi
F_c	1,200 psi	X 0.45	550 psi
E	1,500,000 psi	X 0.65	0.98 x 10^6 psi
E_{min}	790,000 psi	X 0.65	0.51 x 10^6 psi

BALTIMORE HARBOR ANCHORAGES AND CHANNELS (BHAC) MODIFICATION OF SEAGIRT LOOP CHANNEL
FEASIBILITY STUDY

DRAFT INTEGRATED FEASIBILITY REPORT & ENVIRONMENTAL ASSESSMENT

APPENDIX B4:

WEST SEAGIRT BRANCH CHANNEL SECTIONS

FEBRUARY 2022

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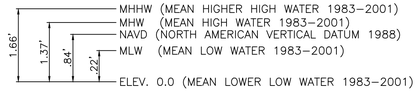
VERTICAL DATUM IS IN REFERENCE TO MEAN LOWER LOW WATER (MLLW), WHICH IS 0.84 FT. BELOW NAVD 1988.



SEAGIRT WEST ACCESS CHANNEL

FORT MCHENRY CHANNEL

PROPOSED WIDENER 5

PROPOSED WIDENER 6

PROPOSED WIDENER 7

PROPOSED WIDENER 4

PROPOSED WIDENER 3

EXTENTS OF BERTH 3 DREDGING (2021)

EXISTING WIDENER 1 (2021)

BERTH 1

BERTH 2

BERTH 3

BERTH 4

A

B

C

D

E

PATAPSCO RIVER

ANCHORAGE 2

LEGEND

- AUTHORIZED FEDERAL CHANNEL
- EXISTING MDOT MPA CHANNEL WIDENER
- CHANNEL CENTERLINE
- PROPOSED WIDENER
- EXISTING ANCHORAGE
- SEAGIRT WEST LOOP STUDY AREA

0 200' 400'
GRAPHIC SCALE

1

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SEAGIRT WEST LOOP CROSS SECTIONS

BALTIMORE, MD

DRAWING DATE:	JUNE 2021
DRAWN BY:	C. MANUEL
CHECKED BY:	L. FOLKERT
DRAWING NAME:	Seagirt_Cross_Sections(5-to-1).dwg
DRAWING SCALE:	1" = 200'
SHEET NUMBER:	1 OF 3

CONDITION SURVEYS	
SURVEY DATE:	OCTOBER 2020 (GBA) & JANUARY 2021 (CENAB)
HORIZONTAL PROJECTION:	MARYLAND STATE PLANE
ZONE:	1900
VERTICAL REFERENCE:	MEAN LOWER LOW WATER (MLLW)
SURVEY UNITS:	U.S. SURVEY FEET

NOTES:
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2. PLANIMETRICS INDICATE THE APPROXIMATE LOCATION OF FEATURES AS PROVIDED BY THE USACE BALTIMORE DISTRICT.
3. SURVEYED OCTOBER 2020 BY GAHAGAN & BRYANT ASSOCIATES, INC. & JANUARY 2021 BY CENAB.
4. TIDES WERE OBTAINED FROM NOAA TIDE STATION 8574680 BALTIMORE, FORT MCHENRY.
5. THE PLANE OF MLLW IS 0.84 FEET BELOW NAVD88.

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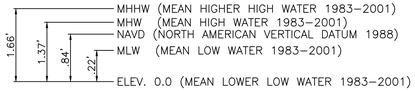
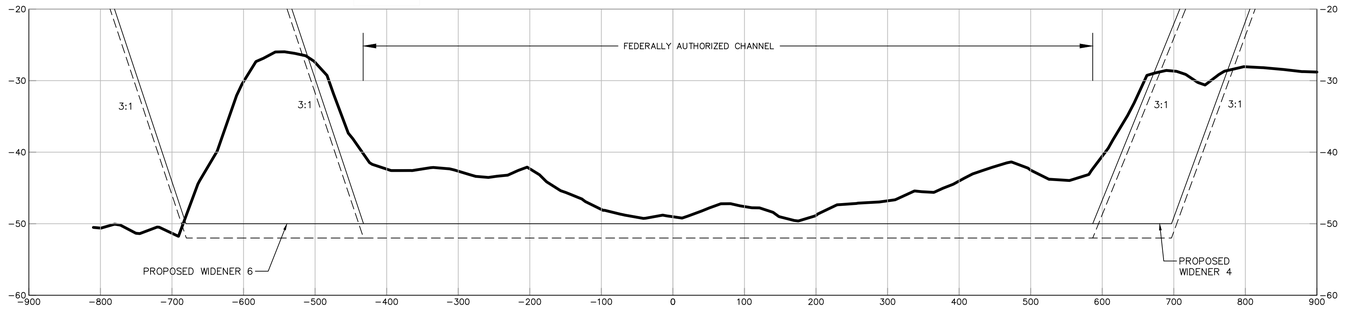
VERTICAL DATUM IS IN REFERENCE TO MEAN LOWER LOW WATER (MLLW), WHICH IS 0.84 FT. BELOW NAVD 1988.



SECTION A–A



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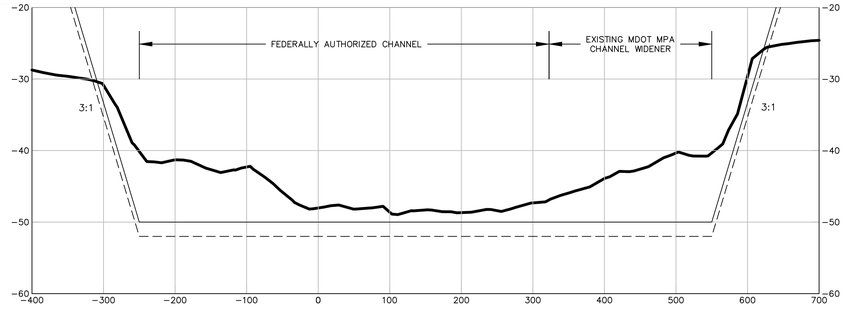

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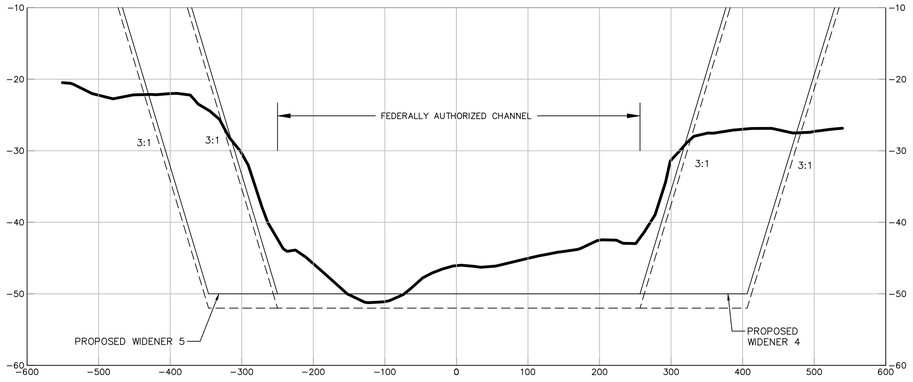

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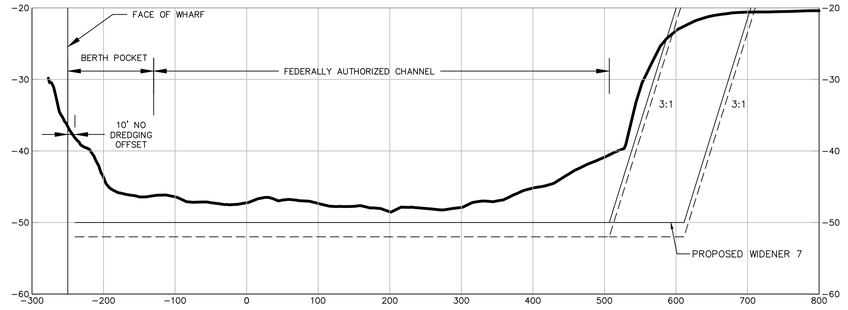

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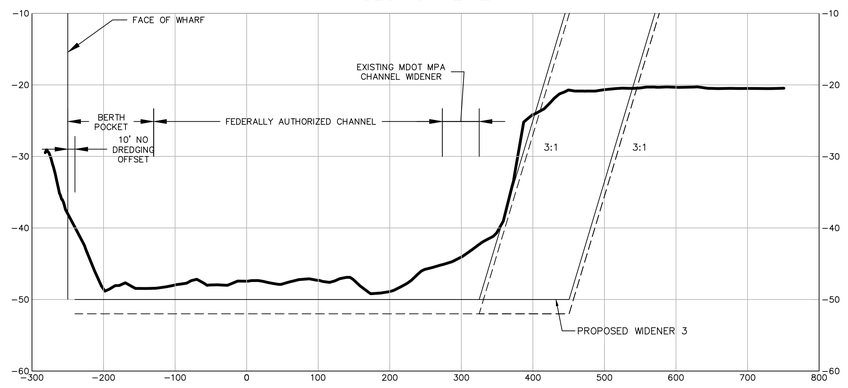

LEGEND

- CENAB/GBA COMBO SURVEY
- PROPOSED REQUIRED GRADE (−50')
- PROPOSED OVERDEPTH (−52')

0 100' 200'
HORIZONTAL SCALE

0 10' 20'
VERTICAL SCALE

SEAGIRT WEST LOOP
CROSS SECTIONS 3H:1V SLOPES

BALTIMORE, MD

DRAWING DATE:	JUNE 2021
DRAWN BY:	C. MANUEL
CHECKED BY:	L. FOLKERT
DRAWING NAME:	SEAGIRT WEST LOOP CROSS SECTIONS
DRAWING SCALE:	AS SHOWN
SHEET NUMBER:	2 OF 3

CONDITION SURVEYS	
SURVEY DATE:	OCTOBER 2020 (GBA) & JANUARY 2021 (CENAB)
HORIZONTAL PROJECTION:	MARYLAND STATE PLANE
ZONE:	1900
VERTICAL REFERENCE:	MEAN LOWER LOW WATER (MLLW)
SURVEY UNITS:	U.S. SURVEY FEET

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4. TIDES WERE OBTAINED FROM NOAA TIDE STATION 8574680 BALTIMORE, FORT MCHENRY.
5. THE PLANE OF MLLW IS 0.84 FEET BELOW NAVD88.

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GBA ENGINEERS ★ SURVEYORS

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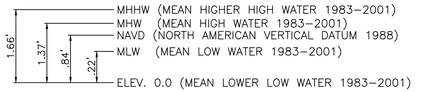
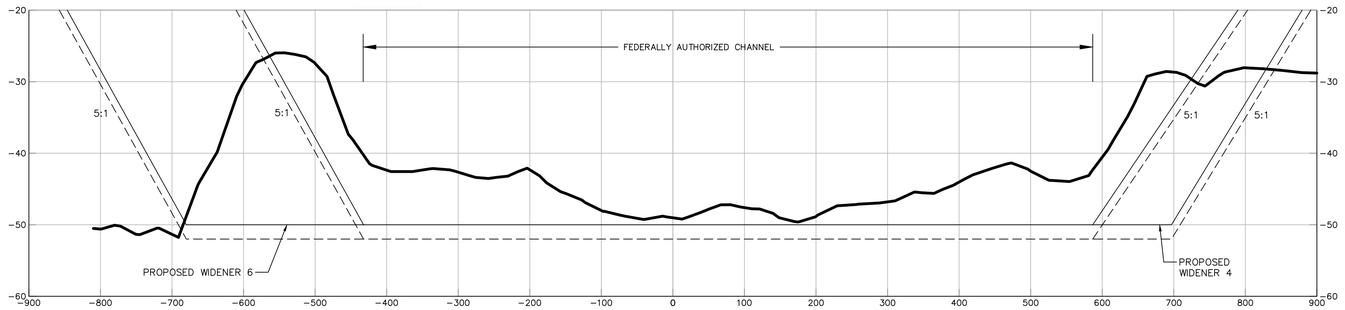
VERTICAL DATUM IS IN REFERENCE TO MEAN LOWER LOW WATER (MLLW), WHICH IS 0.84 FT. BELOW NAVD 1988.



SECTION A–A



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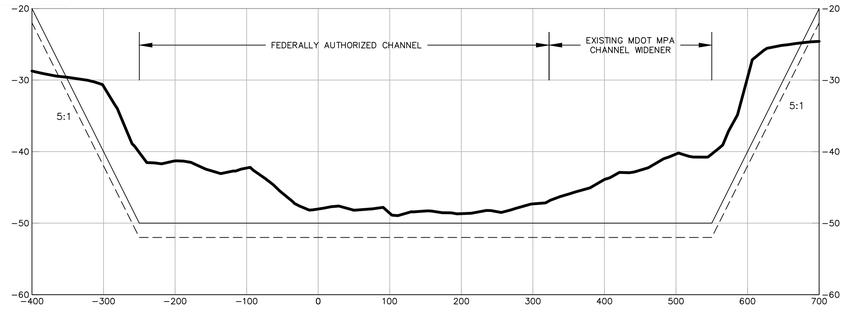

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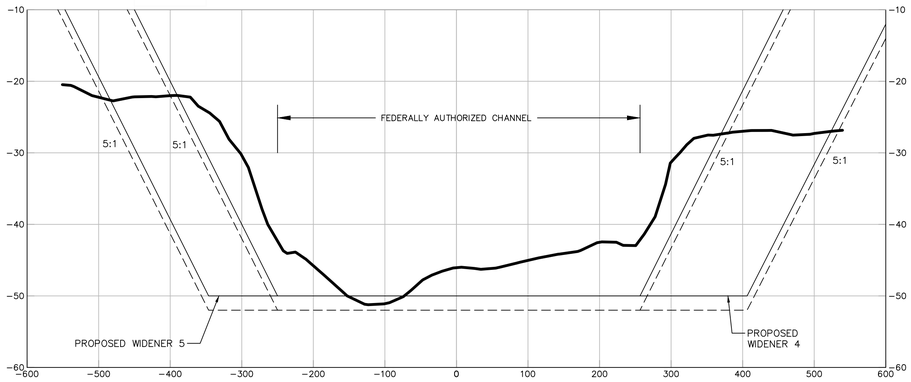

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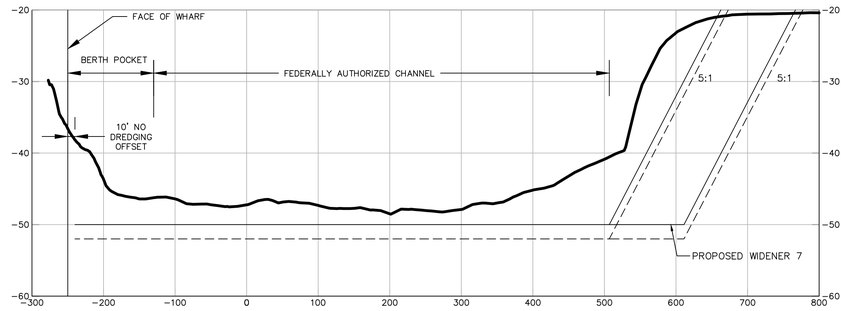

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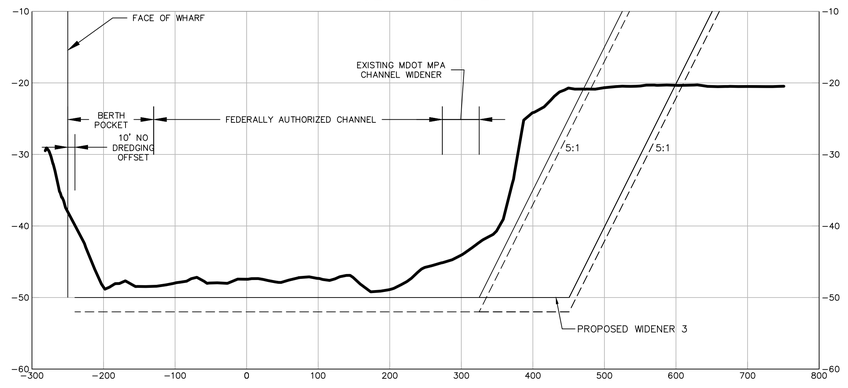

LEGEND

- CENAB/GBA COMBO SURVEY
- PROPOSED REQUIRED GRADE (−50')
- PROPOSED OVERDEPTH (−52')

0 100' 200'
HORIZONTAL SCALE

0 10' 20'
VERTICAL SCALE

SEAGIRT WEST LOOP
CROSS SECTIONS – 5H:1V SLOPES

BALTIMORE, MD

DRAWING DATE:	JUNE 2021
DRAWN BY:	C. MANUEL
CHECKED BY:	L. FOLKERT
DRAWING NAME:	Seagirt_Cross_Sections(5–to–1).dwg
DRAWING SCALE:	AS SHOWN
SHEET NUMBER:	3 OF 3

CONDITION SURVEYS	
SURVEY DATE:	OCTOBER 2020 (GBA) & JANUARY 2021 (CENAB)
HORIZONTAL PROJECTION:	MARYLAND STATE PLANE
ZONE:	1900
VERTICAL REFERENCE:	MEAN LOWER LOW WATER (MLLW)
SURVEY UNITS:	U.S. SURVEY FEET

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BALTIMORE HARBOR ANCHORAGES AND CHANNELS (BHAC) MODIFICATION OF SEAGIRT LOOP CHANNEL
FEASIBILITY STUDY

DRAFT INTEGRATED FEASIBILITY REPORT & ENVIRONMENTAL ASSESSMENT

APPENDIX B5:

CAPACITY EVALUATION

FEBRUARY 2022

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ENGINEERS ★ SURVEYORS

MEMORANDUM

Date: September 22, 2021

To: Mindy Strevig, P.E., Holly Miller

From: Brian Newbury, P.E., Lauren Folkert, E.I.T.

Cc: David Bibo, David Peters

Re: Seagirt Feasibility Study – Capacity and Phasing Planning

INTRODUCTION

Gahagan & Bryant Associates, Inc. (GBA) was tasked to evaluate the scheduling, sequencing, and available capacity for the modifications being considered in the Baltimore Harbor Anchorages and Channels (BHAC) Modifications of Seagirt Loop Channel, Maryland Feasibility Study. This feasibility study focuses on the deepening and widening of the Seagirt Loop Channels and the deepening and expansion of a federally authorized anchorage. See Attachment A – Harbor Map and Attachment B – Proposed Anchorages for details of each study area. Note that the information presented in this memorandum is based on conditions known as of July 2021. Information presented can be adjusted as assumptions change.

BALTIMORE HARBOR CHANNEL IMPROVEMENTS

Seagirt Loop Channels Deepening and Widening

Seagirt Marine Terminal (SMT) is one of the Port's primary terminals. The channels that serve Seagirt Marine Terminal include the Seagirt West Access Channel, Dundalk West Access Channel, and the Seagirt–Dundalk Connecting Channel. All three (3) channels are currently federally authorized to a depth of -42′ MLLW.

In 2013, SMT Berth 4 was deepened to El. -50′ MLLW and neo-Panamax cranes were installed to allow larger vessels to call on the Port of Baltimore. MDOT MPA is currently performing channel improvements (deepening and widening) to allow a second 50-foot berth to come online early in State Fiscal Year (SFY) 2022. MDOT MPA maintains the Dundalk West Access Channel and Seagirt-Dundalk Connecting Channel to elevation -50 feet mean lower low water (MLLW) plus 2 feet of allowable pay overdepth (El. -50′ + 2′ OD MLLW) to allow deep draft vessels to call on Berths 3 and 4. MDOT MPA maintains the Seagirt West Access Channel to a depth of -45′+2′ OD MLLW. To allow for 3′ of under keel clearance any vessel with drafts greater than of 42′ must back out of the berthing areas and exit via the 50′ channels.

The proposed modifications to the Seagirt Loop channels will improve existing navigation to accommodate the increased expected traffic and larger vessel sizes calling on SMT. The modifications being studied include deepening the existing channel to EL. -50'+2' OD MLLW and adding channel wideners (EL.-50'+2' OD MLLW). The proposed wideners 3-7 shown on Attachment A are based on results of a 2018 ship simulation performed at the Maritime Institute of Technology and Graduate Studies (MITAGS). Concept volumes for the Seagirt West Loop modifications are based on both 3H:1V side slopes and 5H:1V side slopes and are shown in Table 1. MDOT MPA in partnership with Ports America Chesapeake (PAC) will plan to develop a third 50-foot berth with improvements to SMT Berths 1 and 2. This effort will be done independently of the Seagirt Loop Feasibility Study, but the volumes for SMT Berths 1 and 2 were considered for capacity modeling.

Table 1: Seagirt West Loop Concept Volumes

Area	Channel and Widener Volume[1,2] (CY)	
	3H:1V Slopes	5H:1V Slopes
Seagirt West Access Channel	873,700	1,077,600
Proposed Wideners 3-7	755,200	844,500
Berths 1 and 2	52,400	55,300
Total	**1,681,300**	**1,977,400**

[1]Volumes presented include 2 feet of overdepth (EL. -50' + 2' OD MLLW).
[2]Planning volumes based on surveys conducted by CENAB in January 2021 & GBA in October 2020.

ANCHORAGES

The addition of a second 50 ft berth at Seagirt Marine Terminal is expected to increase the frequency of large vessels calling on the Port of Baltimore. Currently, the only available 50 ft anchorage is near Annapolis. MDOT MPA and the Association of Maryland Pilots (Maryland Pilots) have identified a need for a 50 ft anchorage in the Baltimore Harbor to decrease vessel stand by time, and to promote safe at more efficient channel traffic.

Based on preliminary discussions, a free-swinging anchorage was determined to provide the safest solution for an anchorage area. It was determined that a circular area with a minimum diameter of 3,300 ft. was required for a vessel with a length of 1,200 ft. Given the existing depths in the harbor, in was recommended to expand upon an existing anchorage to minimize the required dredging quantity. Existing Anchorage 3A/B, Anchorage 5, and Anchorage 6 were the best options for future expansion. The three (3) proposed anchorage locations considered are shown in Attachment B. The required dredging volumes for the proposed anchorage to El. -50' + 1' OD MLLW ranges from about 6.47 mcy (proposed Anchorage 3A/B) to 11.18 mcy (proposed Anchorage 6). Only one (1) foot of overdepth was assumed for the anchorage because the volume increases by about 400,00 CY every foot below El. -50' MLLW. Concept volumes for each proposed anchorage location are shown in Table 2. Volumes associated with 3H:1V side slopes and 5H:1V side slopes are shown for proposed Anchorage 3A/B, however the 5H:1V side slopes were not calculated for proposed Anchorage 5 and

Anchorage 6 since those volumes exceeded the 3H:1V volumes that are discussed later in this memorandum.

Table 2: Proposed Anchorage Concept Volumes

Area	Volume[1] (MCY)	
	3H:1V Slopes	5H:1V Slopes
Anchorage 3A/B	6.47[2]	6.58[2]
Anchorage 5	11.04[3]	N/A
Anchorage 6	11.18[3]	N/A

[1]*Volumes presented include 1 foot of overdepth (EL. -51' + 1' OD MLLW)*
[2]*Volumes based on February 2021 USACE survey data and April 2021 GBA survey data.*
[3]*Volumes based on 2018 USACE survey data and NOAA digitized soundings.*

BALTIMORE HARBOR PLACEMENT SITES

The Maryland Department of Transportation Maryland Port Administration (MDOT MPA) maintains the Baltimore Harbor placement sites to accommodate at least the 20-year dredging placement need, calculated based on historical maintenance volumes and identified new work projects. The active placement sites for the Baltimore Harbor are the Cox Creek Dredged Material Containment Facility (DMCF) and the Masonville DMCF.

Cox Creek DMCF and Cox Creek Expanded

The existing Cox Creek site includes a DMCF as well as wetland and upland areas. The current dikes are constructed to El. +36' MLLW. MDOT MPA is actively expanding the Cox Creek DMCF. The Cox Creek Expanded (CCE) project consists of raising the existing dikes to El. +60' MLLW and expanding the facility onto the upland portion of the property by summer of 2024. The dikes will then be raised as needed to accommodate demand to El. +80' MLLW utilizing reclaimed dredged material. This memorandum assumes that the dike raising milestones shown in Table 3 are met. The milestone dates and elevations up to El. +60' MLLW are assumptions that have been provided by the Cox Creek design team during harbor capacity planning meetings and are subject to change throughout construction. Construction timing for the El. +80' MLLW dikes is unknown at this point, but a completion date in State Fiscal Year (SFY) 2033 is assumed for this analysis.

Table 3: Cox Creek Dike Raising Schedule

State Fiscal Year[1]	Dike Crest Elevation (FT, MLLW)	Maximum Filling Elevation[2] (FT, MLLW)
Existing	36	29
2023 (January)	44	38
2024 (April)	60	57
2033	80	77

[1]Milestone dates are based on information provided at Harbor Planning Meetings.
[2]Maximum filling elevation based on freeboard requirements.

MDOT MPA is considering the acquisition of additional real estate adjacent to the Cox Creek site for innovative reuse (IR) of recovered dredged material which will provide increased capacity for dredged material placement within Cox Creek DMCF.

Masonville DMCF

The existing Masonville DMCF dikes are currently constructed to El. +18′ MLLW. MDOT MPA will begin construction later in 2021 for the raising of the dikes beyond El. +18′ MLLW incrementally to El. +30′ MLLW. Ultimately, the facility will be raised to El. +42′ MLLW. This memo assumes that the dike raising milestones shown in Table 4 are met.

Table 4: Masonville Dike Raising Schedule

State Fiscal Year	Dike Crest Elevation (FT, MLLW)	Maximum Filling Elevation[1] (FT, MLLW)
Existing	18	15
2022	18 (with BDW[2])	15
2025	24	21
2026	30	27
2034	42	39

[1]Maximum filling elevation based on 3′ on required freeboard.
[2]Base Dike Widening (BDW)

Future Capacity

The available capacity estimates associated with the future dike raisings of Masonville to El. +42′ MLLW and Cox Creek to El +80′ MLLW (based on preliminary designs) are shown in Table 5. Note that the available capacities shown in Table 5 are subject to change as preliminary designs and model assumptions are refined.

Table 5: Capacity Estimates for the Masonville and Cox Creek DMCFs.

Disposal Site	Dike Crest Elevation (ft, MLLW)	Maximum Filling Elevation[1] (ft, MLLW)	Capacity (mcy)[2,3]
Masonville	42	39	10.3
Cox Creek	80	77	24.3
		Total	**34.6**

[1] Maximum filling elevations accounts for a 3' required freeboard.
[2]Capacity values shown are subject to change as preliminary designs and model assumptions are refined.
[3] Cox Creek Capacity assumes that innovative reuse (IR) material removed is equal to the required El. +80' MLLW dike construction volume.

Discussion

Attachment C shows a Baltimore Harbor Dredged Material Containment Facilities Placement Plan for SFY 2021 through SFY 2041. The SFY 2021 cumulative placement values shown for Masonville and Cox Creek are based on actual placement quantities. The projected quantities shown from SFY 2022 through SFY 2041 are based on the 20-year Baltimore Harbor and Channels operations and maintenance (O&M) and Federal and State new work dredging demand summarized below in Table 6.

Table 6: Baltimore Harbor 20-Year Dredging Demand Projections (SFY2022-SFY2041)

Annual (O & M) Average[1] (mcy)	New Work[5] (mcy)			Total (O &M + New Work) (mcy)	Average Annual Dredging Demand (mcy)
	Seagirt West Loop[2]	Proposed Anchorage 3A/B[3]	Other Planned Projects[4]		
0.693	1.98	6.58	4.7	27.12	1.36

[1]The federal, state, local, and private O&M dredging is a 20-year average of approximately 0.693 mcy per year which includes a 15% allowance.
[2] The New Work dredging quantity for the Seagirt West Loop is based on the Total Volume associated with 5H:1V side slopes from Table 1.
[3]The New Work dredging quantity for Proposed Anchorage 3A/B is based on the Total Volume associated with 5H:1V side slopes from Table 2.
[4]The New Work dredging quantity for other planned projects is based on the high estimate for all other new work projects MDOT MPA predicts will occur in the next 20-years.
[5]No private new work projects are to be placed in the MDOT MPA-owned Baltimore Harbor DMCF's.

The remaining Cox Creek capacity and remaining Masonville capacity shown in Attachment C assume the dike raising milestones are achieved in the State Fiscal Years presented in Table 3 and Table 4. The cumulative cell volumes and capacity displayed for each dike raising milestone are based on primary designs. Numbers are subject to change as preliminary designs and model assumptions are refined.

The placement plan includes the quantity associated with the Seagirt West Loop deepening and widening to be placed in Cox Creek as two (2) 988,700 CY inflows: the first in SFY 2025 and the second in SFY 2026.

The quantity required to deepen proposed anchorages to El. -50′ + 1′ OD MLLW is not shown as specific inflows on this placement plan. New work material was incorporated into state fiscal years as capacity was available after the annual O&M material was accounted for.

- This placement plan includes about 4,800,000 cy of new work material that can be accommodated between SFY 2027 and SFY 2033 when the Masonville dikes have been constructed to EL. +30′ MLLW and the Cox Creek dikes have been constructed to El. +60′ MLLW.
- This placement plan includes an additional 6,243,000 cy of new work material that can be accommodated between SFY 2034 and SFY 2041 when the Masonville dikes have been constructed to El. +42 MLLW and the Cox Creek dikes have been constructed to El. +80′ MLLW.
- Inflows will need to be sequenced with the expansion of the Baltimore Harbor DMCFs. Timing of the Baltimore Harbor DMCF raising is not defined in enough detail at this time to differentiate between State Fiscal Year and Federal Fiscal Year.

Conclusions

Seagirt West Loop Deepening and Widening

- Both 988,700 CY Seagirt West Loop inflows can be placed in Cox Creek.
    - The Seagirt West Loop Deepening and Widening inflow requires all El. +60′ MLLW dike raising to be complete and the borrow area ready to accept dredged material. If the dike raising to El. +60′ MLLW schedule slips, the Seagirt West Loop inflow will need to be deferred until the dike raising is completed.
    - If Cox Creek dike raising to El. +60′ MLLW construction is completed when currently planned, Seagirt West Loop deepening and widening could be completed by SFY 2026.

Proposed Anchorage 3A/B

- Dredging quantities associated proposed Anchorage 3A/B are significantly lower than the quantities associated with proposed Anchorage 5 and Anchorage 6.
- The material required to deepen proposed anchorage 3A/B to El. -50′ + 1′ OD MLLW can be placed in the future Baltimore Harbor DMCFs.
- Depending on the timing of other planned Baltimore Harbor new work projects, the total quantity associated with the 50′ anchorage, could be accommodated by SFY 2035. This would require the Masonville dikes constructed to El. +30 MLLW, and the Cox Creek Dikes constructed to El. +80′ MLLW.

- If other planned Baltimore Harbor new work projects take priority over the anchorage deepening, the completion of the anchorage may slip to SFY 2038 when the Masonville dikes are constructed to El. +42 MLLW, and the Cox Creek Dikes are constructed to El. +80' MLLW.
- A one-foot incremental volume summary for proposed Anchorage 3A/B is shown in Table 7. Incremental depths can be studied to determine an anchorage depth that results in a benefit cost ratio (BCR) of at least 1 and help determine constructions phasing.

Table 7: Proposed Anchorage 3A/B – 1' Volume Summary

Cumulative Volume (MCY)		
To Elevation (FT MLLW)	**3H:1V Side Slopes**	**5H:1V Side Slopes**
-39	2.07	2.10
-40	2.29	2.32
-41	2.53	2.57
-42	2.81	2.85
-43	3.13	3.18
-44	3.50	3.55
-45	3.90	3.96
-46	4.32	4.39
-47	4.75	4.82
-48	5.18	5.26
-49	5.61	5.70
-50	6.04	6.14
-51	6.47	6.58

[1]*Volumes based on February 2021 USACE survey data and April, 2021 GBA survey data.*

Proposed Anchorages 5 & 6

- If the quantities required to deepen proposed Anchorages 5 / 6 are considered for long term capacity planning, by SFY 2041 the predicted Baltimore Harbor dredging demand will exceed the planned Baltimore Harbor DMCF available capacity by 4.27 mcy / 4.41 mcy respectively.
- An alternative placement area would need to be considered or a significant portion would need to be accommodated through IR in order to minimize impacts to harbor maintenance dredging.

APPENDICES

- Appendix A – Harbor Map
- Appendix B – Proposed Anchorages
- Appendix C – Baltimore Harbor Dredged Material Containment Facilities Placement Plan

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APPENDIX A

Location Map

CHANNEL	USACE AUTHORIZED MAINTENANCE DEPTH[1] DEPTH1 (FT MLLW)	MDOT MPA OPERATING DEPTH (FT MLLW)
SEAGIRT WEST ACCESS CHANNEL (SEAGIRT BERTHS 1 - 2)	42	45 (+2' OD)
DUNDALK WEST ACCESS & SEAGIRT CONNECTING CHANNEL (SEAGIRT BERTHS 3 - 4 & DUNDALK BERTHS 4 – 6)	42	50 (+2' OD)
COLGATE CREEK (DUNDALK BERTHS 1 – 3)	42	43 (+2' OD)
COLGATE CREEK TUG SHELF	-	22 (+2' OD)
DUNDALK CONNECTING CHANNEL (DUNDALK BERTHS 7 – 10)	38	42 (+2' OD)
DUNDALK EAST ACCESS CHANNEL (DUNDALK BERTHS 11-13)	38	42 (+2' OD)
ANCHORAGE 3 (3A, 3B, 3C)	(42, 42, 35)	-

NOTES□

1□ THE □EDERAL MAINTAINING AUTHORITY □OR THE CHANNELS LISTED ABOVE IS USACE PER CONGRESSIONAL AUTHORI□ATION □□ RDA 1999□AUTHORI□ED MAINTENANCE DEPTHS TO BE CON□IRMED THROUGHOUT STUDY□RE□UEST USACE PROVIDE MOST RECENT DOCUMENTATION O□ AUTHORI□ED SOUTH LOCUST POINT SHO□ N ON SHEET 2□

2□ THE □EDERAL MAINTAINING AUTHORITY □OR ANCHORAGE 3 IS USACE □BALTIMORE HARBOR AND CHANNELS DMMP UPDATE 2017□□

LEGEND

- E□ISTING CONDITIONS
- PROPOSED □OR DEEPENING TO 50 □EET
- E□ISTING ACTIVE ANCHORAGE
- PROPOSED □ IDENER
- □EDERALLY AUTHORI□ED CHANNEL
- MDOT MPA MAINTAINED

SEAGIRT MARINE TERMINAL

DUNDALK MARINE TERMINAL

COLGATE CREEK

TUG SHELF

DUNDALK EAST ACCESS CHANNEL

SEAGIRT - DUNDALK CONNECTING CHANNEL

DUNDALK CONNECTING CHANNEL

BERTH 1

BERTH 2

BERTH 3

BERTH 4

BERTH 5

BERTH 6

BERTH 7

BERTH 8

BERTH 9

BERTH 10

BERTH 11

BERTH 12

BERTH 13

WIDENER 1

WIDENER 2A

WIDENER 2B

WIDENER 3

WIDENER 4

WIDENER 5

WIDENER 6

WIDENER 7

ANCHORAGE 2 (NOT IN USE)

SEAGIRT WEST ACCESS CHANNEL

DUNDALK WEST ACCESS CHANNEL

1,801'

1,800'

500'

1,544'

1,850'

2,250'

ANCHORAGE 3C (AUTHORIZED TO 35 FT MLLW)

ANCHORAGE 3B (AUTHORIZED TO 42 FT MLLW)

ANCHORAGE 3A (AUTHORIZED TO 42 FT MLLW)

1,655'

1,368'

ANCHORAGE 4 (AUTHORIZED TO 35 FT MLLW)

ANCHORAGE 6 (NOT IN USE)

TURNING BASIN

FORT McHENRY CHANNEL

0 800' 1,600'

GRAPHIC SCALE

C:\Users\gba285\Desktop\Seagirt Fesssibility\Anchorages\Harbor_Maintenance_2020_recover.dwg

Mark	Description	Date	Appr.

Designed by: BMN
Dwn by: DCM
Ckd by: LEF
Reviewed by: DCU
Submitted by: BMN

Date: JULY 2021
Drawing Name: HARBOR MAP 2021
Scale: AS SHOWN
Plot scale: 1 = 1

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Attachment A

OVERVIEW OF MANAGEMENT MEASURES
SEAGIRT & DUNDALK MARINE TERMINALS

SEAL

1

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APPENDIX B

Proposed Anchorages

LEGEND

PROPOSED ANCHORAGE

SEAGIRT MARINE TERMINAL

BERTH 1 BERTH 2 BERTH 3 BERTH 4

COLGATE CREEK

BERTH 1 BERTH 2 BERTH 3 BERTH 4 BERTH 5 BERTH 6

DUNDALK MARINE TERMINAL

BERTH 7 BERTH 8 BERTH 9 BERTH 10 BERTH 11 BERTH 12 BERTH 13

DUNDALK EAST ACCESS CHANNEL

SEAGIRT - DUNDALK CONNECTING CHANNEL

DUNDALK CONNECTING CHANNEL

SEAGIRT WEST ACCESS CHANNEL

DUNDALK WEST ACCESS CHANNEL

ANCHORAGE 2

ANCHORAGE 3C

ANCHORAGE 3B

ANCHORAGE 3A

Ø3,300'

PROPOSED ANCHORAGE 6

Ø3,300'

ANCHORAGE 4

ANCHORAGE 6

TURNING BASIN

FORT McHENRY CHANNEL

PROPOSED ANCHORAGE 3A/B

ANCHORAGE 1

P A T A P S C O R I V E R

ANCHORAGE 5

Ø3,300'

CURTIS BAY CHANNEL

PROPOSED ANCHORAGE 5

0 1,200' 2,400'

GRAPHIC SCALE

Mark	Description	Date	Appr.	Mark	Description	Date	Appr.

Designed by: BMN | Date: APR 2021 | Rev.

Dwn by: DCM | Ckd by: LEF | Drawing Name: ANCHORAGE

Reviewed by: DCU | Scale: AS SHOWN

Submitted by: BMN | Plot scale: 1 = 1

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ATTACHMENT B

CONCEPTUAL ANCHORAGE LOCATIONS

SEAL

1

C:\Users\gba285\Desktop\Seagirt Feasability\Anchorages\Harbor_Maintenance_2020_recover.dwg

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APPENDIX C

Baltimore Harbor Dredged Material Containment Facilities Placement Plan

Baltimore Harbor Dredged Material Containment Facilities Placement Plan

(Actual Placement Quantities Through SFY 2021 and Projected Quantities Thereafter)

9/17/2021

	Milestone	Cell Volume (MCY)	Cumulative Cell Capacity[2,3,4] (MCY)	SFY2020	SFY2021	SFY2022	SFY2023	SFY2024	SFY2025	SFY2026	SFY2027	SFY2028	SFY2029	SFY2030	SFY2031	SFY2032	SFY2033	SFY2034	SFY2035	SFY2036	SFY2037	SFY2038	SFY2039	SFY2040	SFY2041
Masonville DMCF	El. +18' MLLW	4.8	6.2		614,300																				
	El. +18' MLLW w/ BDW	4.7	6.1			148,800	440,000	285,000																	
	El. +24' MLLW	5.4	6.9						85,000																
	El. +30' MLLW	6.4	8.2							0	0	759,200	693,000	400,000		125,000	400,000								
	El. +42' MLLW	8.0	10.3															993,000	793,000	400,000	200,000	320,000	125,000	118,000	60,000
Cox Creek DMCF	El. +36' MLLW	4.8	6.2																						
	El. +36' MLLW W/ BDW	3.9	5.0		198,900	575,000	575,000																		
	El. +44' MLLW (January 2023)	5.0	6.4					575,000																	
	El. +60' MLLW (April 2024)	11.5	14.8						1,763,700	1,648,700	897,000	1,000,000	1,000,000	1,193,000	1,193,000	1,068,000	1,193,000								
	El. +80' MLLW (with IR Material) (June 3032)	14.9	24.3															1,280,000	1,100,000	1,493,000	1,093,000	793,000	893,000	893,000	631,000
Cumulative Placement Total				6.6	7.2	7.9	8.9	9.8	11.6	13.3	14.2	16.0	17.6	19.2	20.4	21.6	23.2	25.5	27.4	29.3	30.6	31.7	32.7	33.7	34.4
Cumulative Placement MV				3.4	3.9	4.0	4.5	4.8	4.9	4.9	4.9	5.6	6.3	6.7	6.7	6.8	7.2	8.2	9.0	9.4	9.6	9.9	10.1	10.2	10.2
Cumulative Placement CC				3.2	3.3	3.9	4.5	5.0	6.8	8.4	9.3	10.3	11.3	12.5	13.7	14.8	16.0	17.3	18.4	19.9	20.9	21.7	22.6	23.5	24.2
Remaining MV Capacity				2.8	2.3	2.1	1.6	1.3	2.0	2.0	3.3	2.6	1.9	1.5	1.5	1.4	1.0	2.1	1.3	0.9	0.7	0.4	0.2	0.1	0.1
Remaining Capacity in %				45.2%	37.7%	33.6%	26.4%	21.7%	33.5%	29.6%	40.7%	31.5%	23.0%	18.2%	18.2%	16.6%	9.4%	20.1%	12.4%	8.5%	6.6%	3.5%	2.3%	1.1%	0.5%
Remaining CC Capacity				1.8	1.7	1.1	0.6	1.4	8.0	6.4	5.5	4.5	3.5	2.3	1.1	0.0	8.3	7.0	5.9	4.4	3.4	2.6	1.7	0.8	0.1
Remaining Capacity in %				36.0%	34.0%	22.5%	11.0%	21.5%	54.1%	43.0%	36.9%	30.2%	23.4%	15.4%	7.3%	0.1%	56.2%	29.0%	24.4%	18.3%	13.8%	10.5%	6.9%	3.2%	0.6%

Capacity Adjustment due to dike raising milestone

Inflow includes quantity associated with Seagirt West Loop deepening and widening.

Inflow includes quantity associated with Anchorage Deepening

Notes:

1) State Fiscal Year (SFY)
2) Cumulative cell capacities for Masonville to El. +18' MLLW based on AD survey. Cell capacities for future dike milestones are based on preliminary designs.
3) Cumulative cell capacities for Cox Creek are based on preliminary designs. Cell capacity for Cox Creek to El. +80' MLLW assume the dikes will be constructed using IR material which will provide more capacity for dredged material placement within the DMCF.
4) Cumulative cell capacities for Cox Creek assume that innovative reuse (IR) material removed is equal to the required El. +80' MLLW dike construction volume.
5) The quantity for the Seagirt West Loop Modifications is based on 5H:1V slopes. Seagirt West Loop material is assumed to be placed in two (2) inflows; 988,700 CY in SFY2025 and 988,700 CY in SFY2026.
6) The quantity for the Proposed Anchorage Modifications is based on 5H:1V slopes . Anchorage Material is assumed to be placed in ten (10) inflows between SFY 2028 and SFY 2037. Inflows vary between 500,000 CY and 1,000,00 CY.
7) Cumulative material placed at Masonville and Cox through SFY2021 is based on actual placement quantities.
8) Inflow quantities past SFY2027 are based on the Baltimore Harbor and Channels O&M Dredging and New Work Dredging requirements.
   - The federal, state, local, and private O&M dredging is a 20-year average of approximately 0.693 mcy per year which includes a 15% allowance.
   - The high end of the estimate for the identified state and federal new work projects over the next twenty years includes 6.58 mcy required for proposed Anchorage 3A/B, 1.98 mcy required for the Seagirt West Loop deepening and widening, and 4.7 mcy of other anticipated new work projects (13.26 mcy of new work dredging). No private new work projects are to be placed in the MDOT MPA-owned Baltimore Harbor DMCF's.