

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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Contents

1. Introduction	. 5
2. Existing Federal Channels	. 5
2.1.General	. 5
2.1.1.West Dundalk Branch Channel	. 7
2.1.2.Seagirt/Dundalk Connecting Channel	. 7
2.1.3.West Seagirt Branch Channel	. 7
2.2. Physical Conditions of Baltimore Harbor	. 7
2.2.1.Climate	. 7
2.2.2.Tides, Currents, and Wind	. 8
2.2.3.Sediment Quality in Baltimore Harbor	. 9
2.2.3.1 West Seagirt Branch Channel and Seagirt/Dundalk Connecting Channel	10
2.2.3.2 West Dundalk Branch Channel	10
2.2.3.3 South Locust Point Branch Channel and Turning Basin Sediments	11
3. Tentatively Selected Plan	11
4. Design Vessel	12
4.1. Air Draft	12
4.2. MITAGS Study (2018)	13
5. Channel Design	14
5.1. Channel Width	14
5.2. Channel Depth and Underkeel Clearance	14
5.2.1.Squat	15
5.2.2.Safety Clearance	15
5.2.3.Total Underkeel Clearance	15
5.3. Ship Simulation Design Parameters	15
5.4. Structural Considerations	16
5.4.1.Channel Stability Analysis	16
5.4.2.Berth Stability Analysis	18
6. Quantities Development	19
6.1. Existing Conditions Surface	19

6.2. Proposed Condition Surface	19
6.3. Dredge Quantities	20
6.4. Excavated Depth Summary	21
6.5. Placement Capacity	22
7. Relative Sea Level Change and Air Draft Clearance	22
7.1. General Conditions	22
8. Further Analysis and Design Development Needs	24
8.1. Hydrodynamic Data Collection	24
8.2. Hydrodynamic and Sediment Modeling and Analysis	24
8.3. Ship Navigation Modeling	25
9. References	25

List of Figures

Figure 1. Baltimore Harbor Federal Channels, Anchorages, and dredged material containment facilities (DMCFs). (USACE 2017)	6
Figure 2. Location of NOAA Water Level/Meteorological Station at Fort McHenry (Station ID: 8574680).	8
Figure 3. Air drafts of Bay Bridge and Key Bridge with parameter definitions	. 13
Figure 4. Hydrographic survey of Seagirt Loop and Anchorage 3 in February 2021 with side slopes.	. 17
Figure 5. Existing berth features adjacent to the study area.	. 18
Figure 6. Sample Proposed Channel Template showing 5H:1V side slope	. 20
Figure 8. Masthead elevation of the CMA CGM Marco Polo transiting at MLW, draft 47.5 feet, w the three SLR scenarios applied.	

List of Tables

Table 1. CMA CGM Marco Polo E Design Ship Dimensions (dimensions from	Clarkson Register
2021	
Table 2. Cumulative volume dredged for West Seagirt Branch Channel and W depths.	0

List of Appendices

- Appendix B1. Geotech Data and Boring Logs
- Appendix B2. Design Vessel and Air Draft Analysis
- Appendix B3. Berth Stability Assessment
- Appendix B4. West Seagirt Branch Channel Sections
- Appendix B5. Capacity Evaluation

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.

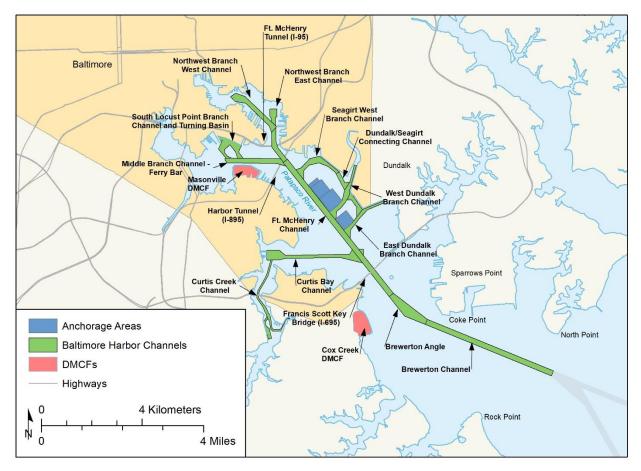


Figure 1. Baltimore Harbor Federal Channels, Anchorages, and dredged material containment facilities (DMCFs). (USACE 2017)

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.

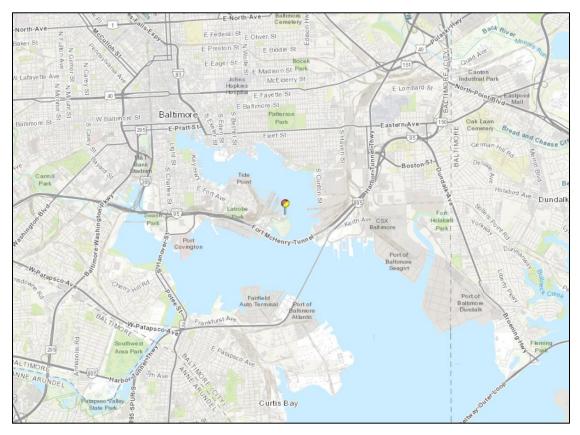


Figure 2. Location of NOAA Water Level/Meteorological Station at Fort McHenry (Station ID: 8574680).

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 threelayer, 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.

CMA CGM Marco Polo
16,000
1,296 feet
175.9 feet
46 feet
52.5 feet
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).

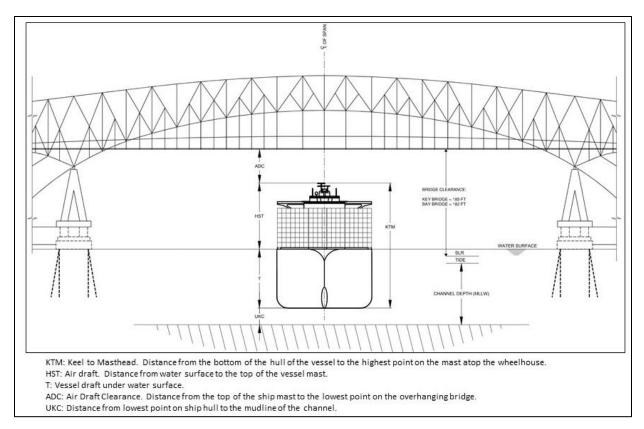


Figure 3. Air drafts of Bay Bridge and Key Bridge with parameter definitions.

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 with the 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.

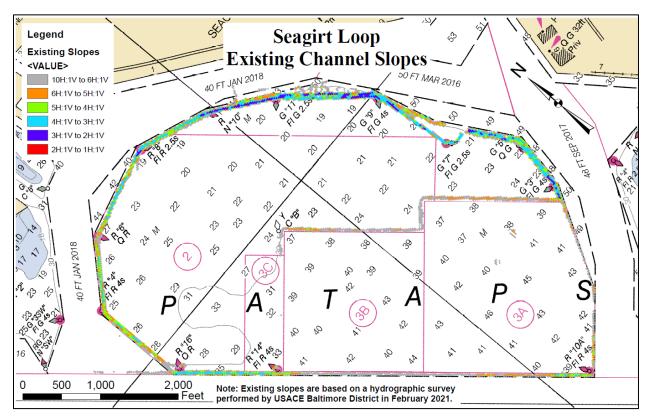


Figure 4. Hydrographic survey of Seagirt Loop and Anchorage 3 in February 2021 with side slopes.

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.

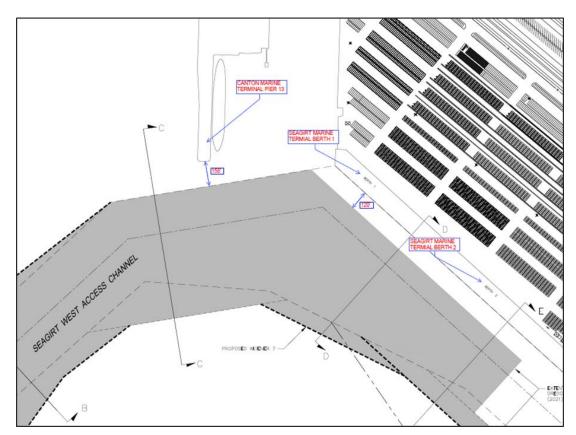


Figure 5. Existing berth features adjacent to the study area.

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.

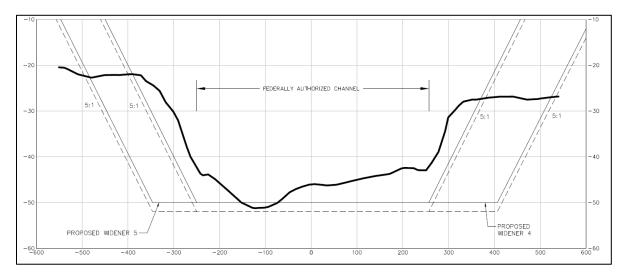


Figure 6. Sample Proposed Channel Template showing 5H:1V side slope.

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
-45	Wideners	562,916
-46	Channel	244,532
-40	Wideners	603,975
-47	Channel	334,824
-47	Wideners	641,782
-48	Channel	451,400
-40	Wideners	680,457

-49	Channel	597,099
-49	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.

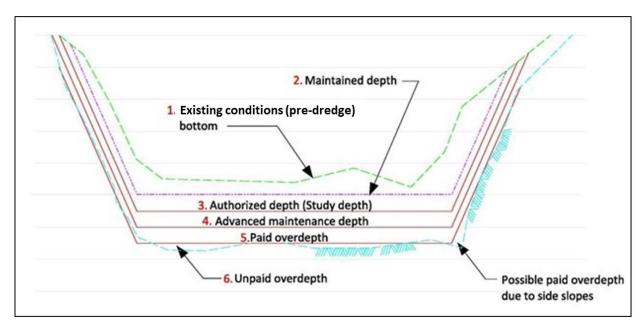


Figure 7. Typical dredge zones.

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).

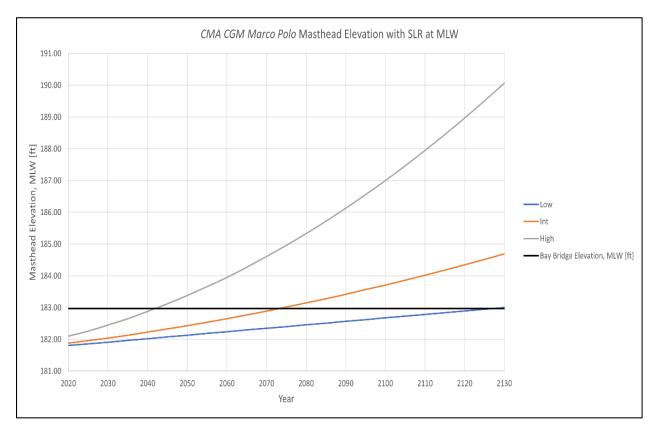


Figure 8. Masthead elevation of the CMA CGM Marco Polo transiting at MLW, draft 47.5 feet, with the three SLR scenarios applied.

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 which are 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 the developers 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 Design Analysis 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



MARYLAND PORT ADMINISTRATION

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



 \pm 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

Shul Aplat

Edward Dalton, P.E. Executive Vice-President

Olivia P Erony

Olivia Erony, P.E. Project Engineer

Drilling•Geotechnical•Pavements•Corrosion

MDOT DBE Certification No.:93-031 • City of Baltimore MBE Certification No.:13-358349 • District of Columbia CBE Certification No.:LSDZ8385112013 MWAA and Commonwealth of Virginia DBE Certification No. DB-1992-0048-2015 • MWAA LDBE Certification No. LD1990-0179-2015



TABLE OF CONTENTS

LETTE	ER OF TRANSMITTAL	I
1.0	INTRODUCTION	1
2.0	PROJECT DESCRIPTION	1
3.0	SCOPE OF SERVICES	1
4.0	SUBSURFACE EXPLORATION	1
5.0	SUBSURFACE CONDITIONS.5.1Subsurface Stratigraphy.5.2Laboratory Test Results.	2
6.0	LIMITATIONS	

ATTACHMENTS

Drawing No. 1 - Project Location Plan
Drawing No. 2 - Test Boring Location Plan

APPENDIX A Records of Soil Exploration

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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 EI -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 EI -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 EI -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									
Test	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								

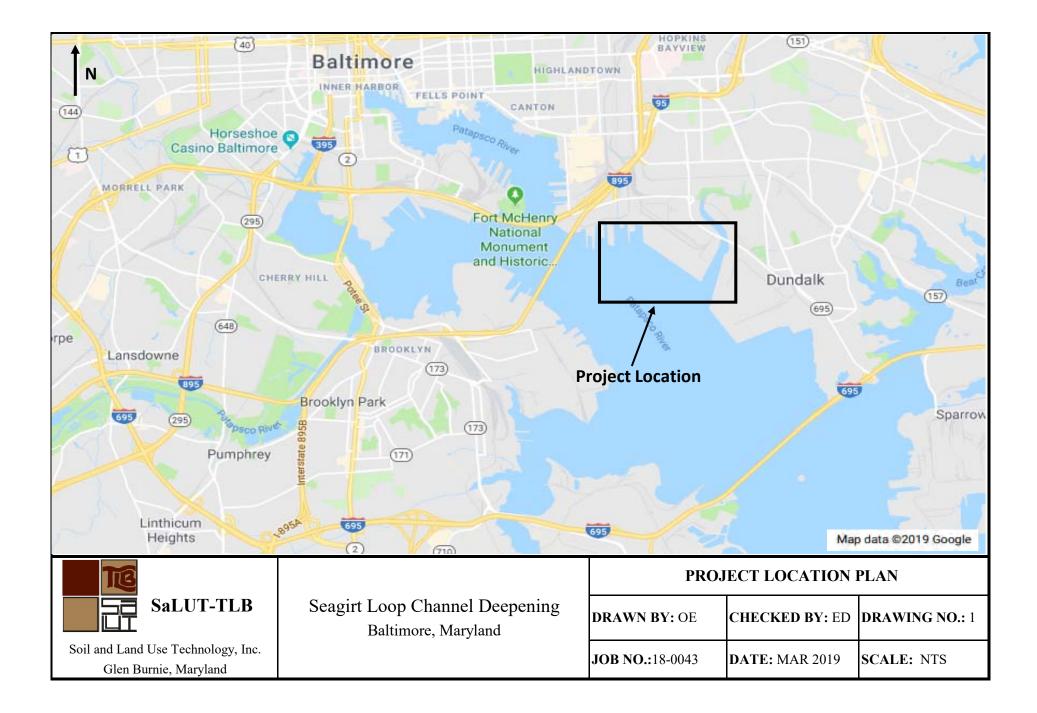
The remaining soil samples are being temporarily stored in our Glen Burnie, Maryland laboratory and are available for review. The samples will be discarded forty-five (45) days following the submittal of this report unless other arrangements are made.

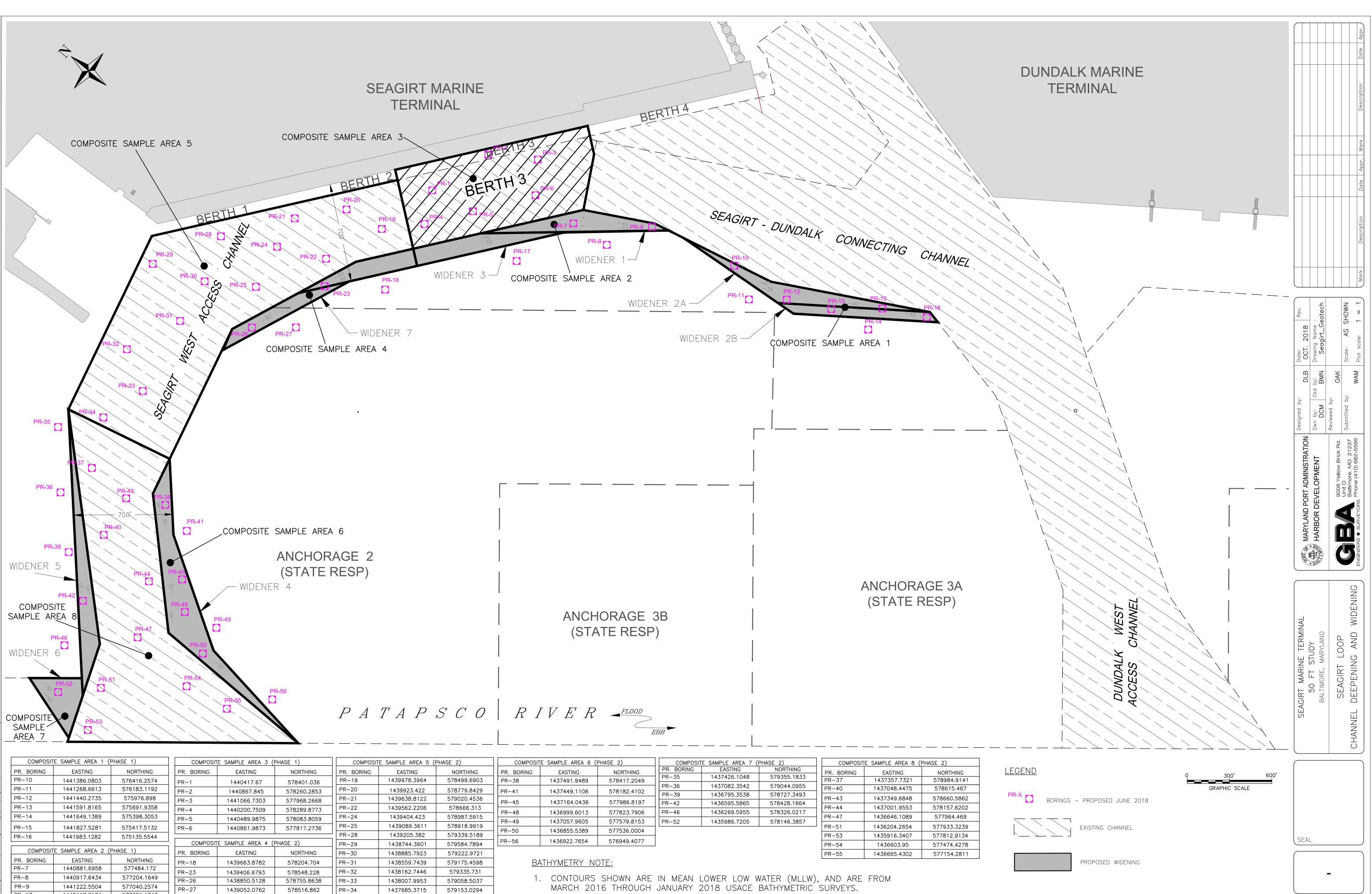
6.0 LIMITATIONS

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.





PR-17 577621.1743 1440418.7174

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

Drawing No. 2: Boring Location Plan

APPENDIX A

RECORDS OF SOIL EXPLORATION

GENERAL CLASSIFICATION SUMMARY FOR SOIL AND ROCK EXPLORATION

SOIL

	Particle Siz	ze Identification	Relative Proportions
Boulders		- 12 inch diameter or more	
Cobbles		- 3 to 12 inch diameter	In accordance with ASTM D 2487 and
Gravel	- Coarse	- 3/4 to 3 inches	ASTM D 2488
	- 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	

COHESIONLESS SOILS

COHESIVE SOILS

Density	N-Value	Consistency	1	V-Value
Very loose	0-4 blows/ft.	Very Soft	0-1	blows/ft
Loose	5-10 blows/ft.	Soft	2-4	blows/ft.
Medium Dense	11-30 blows/ft.	Medium Stiff	5-8	blows/ft.
Dense	31-50 blows/ft.	Stiff	9-15	blows/ft.
Very Dense	> 50 blows/ft.	Very Stiff	16-30	blows/ft.
•		Hard	> 30	blows/ft.

<u>Classifications</u> on logs are made by visual inspection.

<u>Standard Penetration Test</u> - 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.

<u>Groundwater</u> 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.

<u>ROCK</u>

<u>Rock Quality Designation</u> (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.

<u>Recovery</u> (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.



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Datur	n <u> </u>	LW	Hammer Wt.			Ho	le Diam	neter <u>8 in</u>		For	eman _	M. Fletcher	
	Elev	-0.4 ± ft	Hammer Drop		in		ock Core				pector _	D. Patterson	
Date	Started _	12/7/18	Spoon Size _	2 in		Bo	ring Me	thod HSA		Dat	e Compl	eted12/7/18	
Γ		SOIL DESCRI		STDV	Ь.	ΞШ		SAN	/IPLE				
	ELEV. (ft)	Color, Moisture, Density Proportior	, Plasticity, Size	STRA DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
		WATER (continued)											-
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_					h	45							
					fun								
					h								
_] _							L
_	-49.4	Gray, wet, very soft, e		49.0		_							-
		(MH)	iastic SILI ,			<u>50</u>		WOR/18"	1	DS	12		<u> </u>
_													-
_						-		WOR/18"	2	DS	18		-
_													-
_						55		WOR/18"	3	DS	15		-
								montrio	5	00	15		
	-58.4			58.0				WOR/18"	4	DS	18		
_		Bottom of Boring at 58	3.0 ft										
						<u>60</u>							
_													-
_						_							+
_						_							-
_						65							-
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						70							
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						<u>75</u>							<u> </u>
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						80							
	S	AMPLER TYPE	SAMPLE CO	NDITIC	ONS	GRO	UND	VATER DEP	тн		BOF	RING METHOD	
	DS - DRIVEN SPLIT SPOON D - DISINTEGRATED AT COMPLETION ft HSA - HOLLOW STEM AUGERS												
CA	- CONT	SED SHELBY TUBE	I - INTACT U - UNDISTI	JRBED		AFTE	r 24 Hf	RS ft	_ IL	DC	- DRI\	ITINUOUS FLIGHT AUGERS /ING CASING	
RC	- ROCK	CORE	L - LOST			CAV	ED AT	ft		MD	- MUE) DRILLING	
ST	ANDARD	PENETRATION TEST DRIVI	NG 2" OD SAMPLER	1' WITH	140# HA	MMER	FALLIN	NG 30": COUNT	MADE	AT 6" IN	TERVAL	S	



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		With Gahagan & Br									Boring # PR- 2		
-	ect Nar		• ·	innel De	eepeni	ng					Job #	18-0043	
Loca	ation _	Ballinore, MD				C 4 1 /		, ,					
							IPLEF						
Datun	n <u>ML</u> Elev. <u> </u>	LW 0.7 ± ft	140 n 30			le Diam				eman	M. Fletcher D. Patterson		
	⊑iev Started _	12/12/18	 Hammer Dro Spoon Size 	2 in							InspectorD. Patterson Date Completed12/12/18		
Г								544	/IPLE				
	ELEV. (ft)	SOIL DESCRIPTIO Color, Moisture, Density, Pla Proportions	ON asticity, Size	STRA DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
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					fun	45							
					frm								
-	-46.3			47.0									
_		Brown, wet, very soft, ela (MH)	SUC SILI,			-		WOR/18"	1	DS	8		-
_						50							-
						50_		WOR/18"	2	DS	18		-
_						_		WOR/18"	3	DS	18		
_													–
						<u>55</u> _		WOR/18"	4	DS	18		<u> </u>
-													\vdash
								WOR/18"	5	DS	15		E
_													
						<u>60</u>		WOR/18"	6	DS	18		<u> </u>
+	-60.3	Bottom of Boring at 61.0	ft	61.0		┥_┻			Ű	20	10		\vdash
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						65							
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DS		AMPLER TYPE	D - DISINT					VATER DEP	171	HSA		RING METHOD LOW STEM AUGERS	
PT	PT - PRESSED SHELBY TUBE I - INTACT AFTER HRS ft CFA - CONTINUOUS FLIGHT AUGERS CA - CONTINUOUS FLIGHT AUGER U - UNDISTURBED AFTER 24 HRS ft DC - DRIVING CASING												
	- ROCK		L - LOST			CAVE		.s n ft				DRILLING	
ST	ANDARD	PENETRATION TEST DRIVING	2" OD SAMPLER	1' WITH	140# HA	MMER	FALLIN	IG 30": COUNT	MADE	AT 6" IN	[ERVAL	S	



			Bryant Associa									Boring #		
-	ect Nai		eagirt Loop Cha	innel De	eepeni	ng					Job #18-0043			
Loca	tion _	Baltimore, N	(ID											
						SAN	IPLEF	२						
Datum	חML	_LW	Hammer Wt	140	lb	_ Но	le Diarr	neter <u>8 in</u>		For	eman _	M. Fletcher		
Surf. E	Elev	0.4 ± ft	Hammer Dro		in	_ Ro	ck Core			Insp	pector _	D. Patterson		
Date S	Started _	12/6/18	Spoon Size	2 in		Boring MethodHSA					Date Completed <u>12/6/18</u>			
Г				07704	2			SA	MPLE					
	ELEV. (ft)	SOIL DESCRIP Color, Moisture, Density, Proportion	Plasticity, Size	STRA DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES		
		WATER										1. Area 3	<u> </u>	
					m							2. 577978.12 N		
					h							1441071.79 E		
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					fun									
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		AMPLER TYPE	SAMPLE CO)NS		יחאט	NATER DEF	тн	I	BO			
DS		EN SPLIT SPOON	D - DISINTI					FION ft		HS		LOW STEM AUGERS		
PT CA	- PRES	SED SHELBY TUBE INUOUS FLIGHT AUGER	I - INTACT U - UNDIST L - LOST	•		AFTEF AFTEF	R R 24 HF	HRS RSft ft		CF/ DC	4 - CON - DRIV	ITINUOUS FLIGHT AUGERS /ING CASING D DRILLING		
		PENETRATION TEST DRIVIN		1' WITH	140# <u>H</u> A									



	tracted			int Associat								_ Boring # PR- 3			
-	ect Nar			t Loop Cha	nnel De	eepeni	ng					Job #	18-0043		
Location Baltimore, MD															
	SAMPLER														
Datum	·	LW 0.4 ± ft		Hammer Wt.	~~~			le Diam				eman	M. Fletcher D. Patterson		
Surf. E	=lev Started _	12/6/18		Hammer Drop Spoon Size _		30 in Rock Core Dia. N/A 2 in Boring Method HSA						InspectorD. Patterson Date Completed12/6/18			
												e compi			
	ELEV.	SOIL I Color, Moisture		aity Size	STRA DEPTH	SYMBOL	DEPTH		SAI	MPLE			BORING & SAMPLE		
	(ft)	P	roportions	city, Size	(ft)	SYM	SC/	Cond	Blows/6"	No.	Туре	Rec (in)	NOTES		
		WATER (contin	und)												
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-	-49.6				50.0	frm	50							\vdash	
	-40.0	Gray, wet, very	soft, elastic	SILT,	00.0	ÎÎÎÎÎ	00		WOR/18"	1	DS	18		<u> </u>	
		(MH)													
_							-		WOR/18"	2	DS	14			
_									WORTO	2		14		-	
							55							<u> </u>	
-							-		WOR/18"	3	DS	18		\vdash	
	-58.6				59.0				WOR/18"	4	DS	18			
		Bottom of Borir	ng at 59.0 ft				<u>60</u>							<u> </u>	
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20	SAMPLER TYPE SAMPLE CONDITIONS GROUNDWATER DEPTH BORING METHOD Ds - DRIVEN SPLIT SPOON D - DISINTEGRATED AT COMPLETIONft HSA - HOLLOW STEM AUGERS														
PT CA	T - PRESSED SHELBY TUBE I - INTACT AFTERHRSft CFA - CONTINUOUS FLIGHT AUGERS A - CONTINUOUS FLIGHT AUGER U - UNDISTURBED AFTER 24 HRSft DC - DRIVING CASING C - ROCK CORE L - LOST CAVED ATft MD - MUD DRILLING														
		PENETRATION TES	ST DRIVING 2"	OD SAMPLER	1' WITH [,]	140# HA				MADE	AT 6" IN1		S		



Cont	Contracted WithGahagan & Bryant Associates											_ Boring #PR- 4		
		me Task 17 - S	eagirt Loop Cha				Job #							
Loca	tion _	Baltimore, I	MD											
						SAM	PLEF	र						
Datum	ML	LW	Hammer Wt.			_ Ho	le Diam			For	eman _	M. Fletcher		
Surf. E		1.1 ± ft	Hammer Dro		in		ck Core				pector _	D. Patterson		
Date S	started _	12/7/18	Spoon Size _	2 in		_ Bo	Boring Method HSA D				e Compl	eted 12/7/18		
Γ		SOIL DESCRI		STRA	Ч	тш		SA	MPLE					
	ELEV. (ft)	Color, Moisture, Density Proportion	, Plasticity, Size	DEPTH (ft)	SOIL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES		
		WATER			·····							1. Area 3		
					·····	_						2. 578283.25 N		
_					·····	_						1440214.8 E		
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	e	AMPLER TYPE	SAMPLE CC		NS		יחאט	VATER DEP	тн	1	BOI			
DS ·		IN SPLIT SPOON	D - DISINTE					TION ft		HS/		LOW STEM AUGERS		
PT · CA ·	- PRES	SED SHELBY TUBE INUOUS FLIGHT AUGER	I - INTACT U - UNDIST L - LOST			AFTEF AFTEF	R R 24 HF	HRS RSft	ft	CF/ DC	4 - CON - DRIV	ITINUOUS FLIGHT AUGERS /ING CASING) DRILLING		
		PENETRATION TEST DRIVI		1' WITH 1	140# HAI				T MADE					



	tracted		ahagan & Brya										_ Boring #		
-	ect Nar		ask 17 - Seagii	t Loop Cha	nnel De	eepeni	ng					Job #	18-0043		
Loca	Location Baltimore, MD														
							SAM	IPLEF	<i>κ</i>						
Datun		LW 1.1 ± ft		Hammer Wt.	00			le Diam				eman	M. Fletcher		
	Elev Started _	12/7/18		Hammer Dro Spoon Size _									DectorD. Patterson e Completed12/7/18		
Date												e Compi			
	ELEV.	S	DIL DESCRIPTION		STRA DEPTH	BOL	王비		SAI	MPLE			BORING & SAMPLE		
	(ft)	Color, Mois	ture, Density, Plast Proportions	icity, Size	(ft)	SYMBOL	DEPTH	Cond	Blows/6"	No.	Туре	Rec (in)	NOTES		
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						fun									
	-47.9				49.0										
		Gray, wet, \ (MH)	very soft, elastic	SILT,			<u>50</u>		WOR/18"	1	DS	18			
_		(1111)					_								
_							-		WOR/18"	2	DS	8		-	
-							-4			-		Ũ		-	
-							55				50	10		-	
							55_		WOR/18"	3	DS	18			
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	-56.9				58.0		-		WOR/18"	4	DS	18			
		Bottom of B	oring at 58.0 ft												
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20	SAMPLER TYPE SAMPLE CONDITIONS GROUNDWATER DEPTH BORING METHOD Ds - DISINTEGRATED AT COMPLETIONft HSA - HOLLOW STEM AUGERS														
PT CA	- PRESS	SED SHELBY TU INUOUS FLIGHT	IBE	U - DISINTE I - INTACT U - UNDIST L - LOST			AFTEF AFTEF	R R 24 HR	ION ft HRS LS ft ft	ft	CFA DC	A - CON - DRIV	LOW STEM AUGERS ITINUOUS FLIGHT AUGERS /ING CASING) DRILLING		
			TEST DRIVING 2"		1' WITH	140# HA				MADE					



		With Gahagan & Br									Borin		
	ect Nar			innel De	eepeni	ng					Job #	t18-0043	
Loca	tion _	Baltimore, MD											
						SAN	1PLEF	२					
Datum	ML	LW	Hammer Wt	140	lb	Ho	ole Dian	neter 8 in		For	eman _	M. Fletcher	
Surf. E		0.2 ± ft	Hammer Dro		in		ock Core				pector _	D. Patterson	
Date S	Started _	12/7/18	Spoon Size	2 in		_ Bo	oring Me	ethod HSA		Dat	e Compl	leted12/7/18	
Г				1									_
	ELEV. (ft)	SOIL DESCRIPTIO Color, Moisture, Density, Pla Proportions		STRA DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	MPLE No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
					0						()		
		WATER			fuu							1. Area 3	L
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			SAMPLE CO										
		EN SPLIT SPOON SED SHELBY TUBE	D - DISINTI I - INTACT			AFTE	R	TION ft HRS	ft			LOW STEM AUGERS	
CA		INUOUS FLIGHT AUGER	U - UNDIST L - LOST			AFTE	r 24 Hf	RS ft		DC	- DRI\	/ING CASING D DRILLING	
		PENETRATION TEST DRIVING		1' WITH [·]	140# HAI				T MADE				



		With <u>Gahagan & Bry</u>									Borin	•		
-		me <u>Task 17 - Seagi</u> Baltimore, MD	rt Loop Cha	nnel De	eepeni	ng					Job #	18-0043		
Loca	tion _	Daiumore, MD				~ • • •								
						SAM	IPLEF	र						
Datum	·	_LW	Hammer Wt.				le Diam				eman	M. Fletcher D. Patterson		
Surf. E	Elev Started _	0.2 ± ft 12/7/18	 Hammer Drop Spoon Size _ 	o <u>30</u> 2 in	10		ck Core ring Me				bector e Comple			
Date C											e compi			
	ELEV.	SOIL DESCRIPTION		STRA DEPTH	gr Br	王빌		SAN	/IPLE			BORING & SAMPLE		
	(ft)	Color, Moisture, Density, Plas Proportions	ticity, Size	(ft)	SYMBOL	DEPTH	Cond	Blows/6"	No.	Туре	Rec (in)	NOTES		
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_		WATER (continued)			fuu									
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Grav wat yory soft alastic SUT														
_		Gray, wet, very sent, elastic	0.21			-		WOR/18"	1	DS	18		-	
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						-		WOR/18"	2	DS	18			
						55								
						_		WOR/18"	3	DS	18			
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_						-		WOR/18"	4	DS	18		–	
-	-58.8	Bottom of Boring at 59.0 ft		59.0		60							-	
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			SAMPLE CO						ТΗ					
PT CA	- PRES	EN SPLIT SPOON SED SHELBY TUBE 'INUOUS FLIGHT AUGER (CORE	D - DISINTE I - INTACT U - UNDIST L - LOST			AFTER	R R 24 HF	∩ON ft HRS RS ft ft	ft	CFA DC	4 - CON - DRIV	LOW STEM AUGERS ITINUOUS FLIGHT AUGERS /ING CASING) DRILLING		
		PENETRATION TEST DRIVING 2		1' WITH	140# HA				MADE					



	d WithGahagan & Brya									Borin		
Project Na		t Loop Chai	nnei De	epeni	ng					Job #	#18-0043	
Location							_					
					SAM	IPLEF	र					
DatumN	MLLW	Hammer Wt.			_ Ho	le Diam			For	eman _	M. Fletcher	
Surf. Elev	0.8 ± ft	Hammer Drop		in		ck Core				pector _	D. Patterson	
Date Started	12/6/18	Spoon Size _	2 in		_ Bo	ring Me	thod HSA		Dat	e Compl	leted12/6/18	
	SOIL DESCRIPTION		STRA	Ь.	Ξщ		SAI	MPLE				7
ELEV. (ft)	Color, Moisture, Density, Plasti Proportions	city, Size	STRA DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
	WATER										1. Area 3	<u> </u>
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		AMPLE CO					VATER DEP	РТН			RING METHOD	
PT - PRE CA - CON	/EN SPLIT SPOON SSED SHELBY TUBE ITINUOUS FLIGHT AUGER	D - DISINTE I - INTACT U - UNDISTI			AFTEF AFTEF	R R 24 HF	「ION ft HRS RS ft	ft	CF/ DC	4 - CON - DRI\	LOW STEM AUGERS ITINUOUS FLIGHT AUGERS /ING CASING	
RC - ROC STANDAR	CK CORE	L - LOST	1' WITH 1		CAVE	ED AT	ft	T MADE /) DRILLING S	



Contracted		Gahagan & Brya Fask 17 - Seagi			eneni	na					Borin Job #	-	
Project Nar Location _		Baltimore, MD			sepen	iig					# doL		
		· · · · · ·				SAM	IPLEF	ξ					
DatumML	LW		Hammer Wt.	140	lb		le Diam	<u>.</u>		For	eman	M. Fletcher	
Surf. Elev.	0.8 ± ft		Hammer Drop	30			ck Core	Dia. <u>N/A</u>			pector _	D. Patterson	
Date Started _	12/6/18		Spoon Size _	2 in		_ Во	ring Me	thod HSA		Date	e Compl	eted12/6/18	
		SOIL DESCRIPTION		STRA	Б.	ΞШ		SAI	NPLE				
ELEV. (ft)		bisture, Density, Plast Proportions		STRA DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
	WATER (continued)											
_		continueu)			h								+
_													-
					hin								
					fuu	45							
					h								
_] _							
_					hin								-
_					fuu	50							-
-50.2				51.0	h	50							-
		, very soft, elastic	SILT,	01.0				WOR/18"	1	DS	14		-
	(MH)												
_						_		WOR/18"	2	DS	18		
						55			2	03	10		
_													-
_						-		WOR/18"	3	DS	18		+
													-
-59.2				60.0		60		WOR/18"	4	DS	18		
_	Bottom of	Boring at 60.0 ft											
_													-
_													-
_						65							+
						00							
													E
_													-
						<u>70</u>							<u> </u>
-													F
\dashv													\vdash
						75							
													\vdash
4													\vdash
-													\vdash
\dashv						80							\vdash
S	AMPLER T	YPE S	SAMPLE CO	NDITIC	NS			VATER DEP	тн		BOF	RING METHOD	
	EN SPLIT SPO		D - DISINTE	GRATED				TION ft	÷			LOW STEM AUGERS	
	SED SHELBY ⁻ INUOUS FLIGH CORE		I - INTACT U - UNDISTI L - LOST	URBED		AFTER	R 24 HR	HRS S ft ft	_ II	DC	- DRIV	TINUOUS FLIGHT AUGERS /ING CASING) DRILLING	
		N TEST DRIVING 2"		1' WITH	140# HA				MADE				



roject Nan		jirt Loop Ch	iannei De	eepen	ing					Job #	±18-0043	
	,				SAN	1PLEF	R					
atum <u>ML</u>	LW	Hammer W	/t 140	lb		ole Diam	0.1		For	eman _	M. Fletcher	
	1.0 ± ft	Hammer Di	/t			ock Core				entan _	D. Patterson	
ate Started _	12/10/18	_ Spoon Size	•			oring Me				e Comp	leted12/10/18	
			-								1	
ELEV.	SOIL DESCRIPTIO Color, Moisture, Density, Pla	N sticity Size	STRA DEPTH	BOL	DEPTH SCALE		SAM	MPLE		-	BORING & SAMPLE	
(ft)	Proportions	Sticity, Olze	(ft)	SOIL	SC	Cond	Blows/6"	No.	Туре	Rec (in)	NOTES	
_	WATER										1. Area 2	_
_	WATER			fm	4 —							
_				m	_						2. 577490.31 N	
-				h] —						1440874.29 E	
-				Ĩ	5							
-				hi	<u> </u>							
				μm	-							
				h								
]							
_				hi	<u>10</u>							
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_				fm	4 —							
_				h	_							
_					15							
				hi	15							
				μm	-							
				μm								
_					<u>20</u>							
_				hi	_							
_				fun	4 _							
_				μπ	4 —							
-24.0			25.0		25							
-24.0	Black, wet, very soft, elast	tic SILT,	25.0				WOR/18"	1	DS	10		
\neg	(MH)				-		WOIVIO	'	03	10		
							WOR/18"	2	DS	12		
_					<u>30</u>							
_					_		WOR/18"	3	DS	14		
_					_							
			24.0		-		WOR/18"	4	DS	15		
- <u>-33.0</u>	Dark gray, wet, very soft, o	elastic	<u>34.0</u> .	╎╂╂╂╂	35							
-	SILT				55		WOR/18"	5	DS	15		
- <u>35.5</u>	Gray, wet, very soft, elasti		<u>36.5</u>	╎┨┨┨┨						15		
	Gray, wei, very soit, eldsti							_				
							WOR/18"	6	DS	15		
					40							
		SAMPLE C					VATER DEP	тн			RING METHOD	
PT - PRESS	n split spoon Sed Shelby Tube Nuous flight Auger	D - DISIN I - INTAC U - UNDIS	т)	AFTE AFTE	R R 24 HF	TION ft HRS ts ft	ft	CFA	- CON - DRIV	LOW STEM AUGERS ITINUOUS FLIGHT AUGERS VING CASING D DRILLING	



Page 2 of 2

		With <u> </u>									Borin	-	
-		neTask 17 - Seagi Baltimore, MD			epen	ng					Job #	£ <u>10-0043</u>	
LUUG		Balancio, MB				SAN	IPLEF	>					
	m ML	1.34/		140	lh							M Eletebor	
Datur	m Elev	1.0 ± ft	 Hammer Wt. Hammer Dro 	00			le Diam ck Core				eman ector _	M. Fletcher D. Patterson	
	⊑iev Started _	12/10/18	Spoon Size	2 in			ring Me				ector _ e Compl		
г							5					1	_
	ELEV.	SOIL DESCRIPTION Color, Moisture, Density, Plasi	l licity Sizo	STRA DEPTH	SYMBOL	DEPTH SCALE		SAN	/IPLE			BORING & SAMPLE	
	(ft)	Proportions	licity, Size	(ft)	SYMS	SC/	Cond	Blows/6"	No.	Туре	Rec (in)	NOTES	
		Onever weet warms a off a la atia	011 T										
_		Gray, wet, very soft, elastic (continued)	SILI			_		WOR/18"	7	DS	18		
_													_
_						-		WOR/18"	8	DS	14		-
-						45							-
						45		WOR/18"	9	DS	18		
								WORVIO	9	03	10		-
								WOR/18"	10	DS	18		
					50								
_					_		WOR/18"	11	DS	18		_	
_					-							_	
_						-		WOR/18"	12	DS	18		-
-						 55							-
						55_		WOR/18"	13	DS	18		
								WORVIO	15	03	10		-
	-58.0			59.0				WOR/18"	14	DS	15		
		Bottom of Boring at 59.0 ft				<u>60</u>							
_													_
_													-
_													-
_						65							-
						00							
						<u>70</u>							
_													-
_													-
-													-
_						75							-
$\neg \uparrow$						<u>· · ·</u>							
						80							
00	-	AMPLER TYPE	D - DISINTE					VATER DEP	ιH	LC	-	RING METHOD LOW STEM AUGERS	
PT CA	- PRESS	SED SHELBY TUBE INUOUS FLIGHT AUGER	I - INTACT U - UNDIST			AFTER	R R 24 HF	HRS RS ft	_ ft	CFA DC	- CON - DRIV	ITINUOUS FLIGHT AUGERS /ING CASING	
	- ROCK		L - LOST					ft) DRILLING	
ST.	ANDARD	PENETRATION TEST DRIVING 2"	OD SAMPLER	1' WITH '	140# HA	MMER	FALLIN	NG 30": COUNT	MADE	at 6" int	ERVAL	S	



	Gahagan & Bryant Assoc								Borin		
Project Name	<u>Task 17 - Seagirt Loop C</u> Baltimore, MD	hannel D	eepen	ing					Job #	#18-0043	
ocation											
atumMLLW	Hammer				IPLEF	eter <u>8 in</u>		Fore	eman _	M. Fletcher	
urf. Elev. <u>1.0 ± ft</u>	Hammer		in		ock Core				pector _	D. Patterson	
ate Started 12/10/18	Spoon Si	ze 2 in		Bo	oring Me	thod HSA		Date	e Comp	leted12/10/18	
	SOIL DESCRIPTION	STRA	Ъ	Ξщ		SAN	//PLE				
ELEV. (ft) Color, M	Proportions	STRA DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
WATER			h							1. Area 2	
			μm	_						2. 577206.57 N	
			μιι							1440904.41 E	
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7			h	10							
			Lui								
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			h	<u>15</u>							
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-			hi	-							
-			μu								
			μιι	20							
_											
-21.0		22.0	μũ								
Gray, we	i, very soft, elastic SILT	23.5		_		WOR/18"	1	DS	14		
Gray, bla	ck, wet, very soft, elastic		╵╏╏╏╏	- I							
				<u>25</u>		WOR/18"	2	DS	18		
_ ()							_				
-							_	D 0	40		
-				-		WOR/18"	3	DS	18		
7				30							
						WOR/18"	4	DS	18		
-32.5		33.5				WOR/18"	5	DS	18		
Gray, we	, very soft, elastic SILT ,		╎╏╏╏╏	1							
(MH)				35		WOR/18"	6	DS	18		
-							-				
\neg						WOR/18"	7	00	10		
7							1	DS	18		
				40							
SAMPLER	YPE SAMPLE	CONDITIC	ONS	GRO	UNDV	VATER DEP	тн		BO	RING METHOD	
	ON D - DISI	NTEGRATED)	AT CO	OMPLET	ION ft		HSA	A - HOL	LOW STEM AUGERS	
DS - DRIVEN SPLIT SPC		VCT					ft				
DS - DRIVEN SPLIT SPC PT - PRESSED SHELBY CA - CONTINUOUS FLIC RC - ROCK CORE		ISTURBED		AFTE	R R 24 HR	HRSft	_ ft	CFA DC	- DRI	NTINUOUS FLIGHT AUGERS VING CASING D DRILLING	



Page 2 of 2

		With <u>Gahagan & Bry</u> me Task 17 - Seagi									Borin	-	
-	ect Nar ation _				epen	ing					Job #	£ <u>10-0043</u>	
LUUG		Balantere, mb				SAM	IPLEF	२					
Datur	n ML	LW	_ Hammer Wt.	140	lb		le Diarr			For	eman	M. Fletcher	
	Elev	1.0 ± ft	_ Hammer Dro				ck Core				pector _	D. Patterson	
Date	Started _	12/10/18	Spoon Size	2 in		Во	ring Me	thod <u>HSA</u>		Dat	e Compl	eted12/10/18	
Г					4			SAN	MPLE				
	ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plas Proportions	I ticity, Size	STRA DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
		Gray, wet, very soft, elastic						WOR/18"	8	DS	18		
_		(MH) (continued)	SILI,					Werthe	0	03	10		_
_													-
_						-		WOR/18"	9	DS	18		-
_						45							-
								WOR/18"	10	DS	18		
_						_		WOR/18"	11	DS	18		
_													
						<u>50</u>		WOR/18"	12	DS	18		
_									12		10		_
_									10	50	40		-
_						-		WOR/18"	13	DS	18		-
_						55							-
								WOR/18"	14	DS	18		
_						_		WOR/18"	15	DS	18		
_													<u> </u>
	60.0			61.0		<u>60</u>		WOR/18"	16	DS	18		
-	-60.0	Bottom of Boring at 61.0 ft		01.0									-
_		-											
						65							
_													
_													_
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_						70							-
						<u>70</u>							
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						<u>75</u>							
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-						80							-
	S	AMPLER TYPE	SAMPLE CC	NDITIC	NS			VATER DEP	тн	1	BOF		
	- DRIVE	EN SPLIT SPOON	D - DISINTE	GRATED	-	AT CC	MPLE	ΓΙΟΝ ft			A - HOL	LOW STEM AUGERS	
		SED SHELBY TUBE INUOUS FLIGHT AUGER	I - INTACT U - UNDIST					HRS RS ft	_ #			ITINUOUS FLIGHT AUGERS /ING CASING	
	- ROCK		L - LOST					ft				D DRILLING	
ST	ANDARD	PENETRATION TEST DRIVING 2	OD SAMPLER	1' WITH 1	140# HA	MMER	FALLIN	NG 30": COUNT	MADE	AT 6" IN	FERVAL	S	



	ted With <u>Gahagan & Brya</u>			ononi						Borin		
	Name <u>Task 17 - Seagi</u> n Baltimore, MD		nnei De	epeni	ng					Job #	£18-0043	
Location	n Baltimore, MD				~ • • •							
					SAN	IPLEF	۲ ۲					
Datum	MLLW	Hammer Wt.				le Diam				eman _	M. Fletcher	
Surf. Elev.		Hammer Drop		in		ck Core				pector _	D. Patterson leted 12/14/18	
Date Starte	ed	Spoon Size _	2 in		_ Bo	ring Me	thod		Dat	e Compl	leted12/14/16	
	SOIL DESCRIPTION		STRA	Ŀ	Ξщ		SAI	MPLE				7
ELE (ft)	V. Color Moisturo Donsity Plast	city, Size	STRA DEPTH (ft)	SVMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
	WATER										1. Area 2	}
_					_						2. 577067.3 N	-
_				m							1441281.03 E	
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				·····	<u>10</u>							<u> </u>
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	SAMPLER TYPE	SAMPLE CO	עדוחא		40 GPO	יסאוו	VATER DEP	 Этц			RING METHOD	
DS - DF	SAWIPLER ITPE 3	D - DISINTE					TION ft	п	HSA		LOW STEM AUGERS	
PT - PF CA - CO	RESSED SHELBY TUBE ONTINUOUS FLIGHT AUGER OCK CORE	I - INTACT U - UNDIST L - LOST			AFTEF AFTEF	R R 24 HF	HRSft	ft	CF/ DC	4 - CON - DRI\	ITINUOUS FLIGHT AUGERS /ING CASING D DRILLING	
	ARD PENETRATION TEST DRIVING 2"		1' WITH 1	140# HAI				T MADE /				



Contracted										Borin	-	
Project Nat Location		n Loop Cha	nnei De	eepeni	ng					Job #	18-0043	
Location _	Datimore, MD				SVM	PLEF)					
5.41	LLW		140	lla							M. Elatabar	
DatumN Surf. Elev	1.0 ± ft	. Hammer Wt. . Hammer Dro				e Diam ck Core				eman pector	M. Fletcher D. Patterson	
Date Started	12/14/18	Spoon Size	2 in			ring Me				e Compl	eted12/14/18	
			OTDA	2	_		SAM	/IPLE				
ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plast Proportions	icity, Size	STRA DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
	MATED (continued)			0,						()		
_	WATER (continued)			h								_
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				f	<u>45</u>							
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		h	<u>50</u>									
		fuu								_		
	Black, wet, very soft, elastic	SILT	52.0				WOR/18"	1	DS	6		-
<u>-52.5</u>	Gray, wet, very soft, elastic		<u>53.5</u>	┨┨┨┨				'		0		
	(MH)	 ,			55_		WOR/18"	2	DS	10		
_								2		10		-
-					_		WOR/18"	3	DS	12		-
								0		12		
					<u>60</u>		WOR/18"	4	DS	18		
-60.0	Bottom of Boring at 61.0 ft		61.0					4	00	10		-
_	Bottom of Botting at office it											\vdash
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S	AMPLER TYPE	SAMPLE CC	NDITIC		GRO	-	VATER DEP	тн		BOF	RING METHOD	
PT - PRES CA - CONT	EN SPLIT SPOON ISED SHELBY TUBE INUOUS FLIGHT AUGER	D - DISINTE I - INTACT U - UNDIST			AFTEF AFTEF	₹ ₹24 HR	TION ft HRS ts ft	_ ft	CFA DC	4 - CON - DRIV	LOW STEM AUGERS ITINUOUS FLIGHT AUGERS /ING CASING	
RC - ROCK STANDARD	CORE) PENETRATION TEST DRIVING 2"	L - LOST OD SAMPLER	<u>1' W</u> ITH	140 <u>#</u> HA			ft IG 30": COUNT	MADE) DRILLING S	



Contracte	d With <u>Gahagan</u> a	& Bryant Associate	es							Borin	g #PR-10	
Project Na		Seagirt Loop Char	nnel De	epenin	g					Job #		
Location	Baltimore,	MD										
				5	SAMPL	ER						
DatumN	1LLW	Hammer Wt.	140 I		Hole D	iameter _	8 in		For	eman _	M. Fletcher	
Surf. Elev	1.7 ± ft	Hammer Drop		n		Core Dia.	N/A			ector _	D. Patterson	
Date Started	12/14/18	Spoon Size	2 in		Boring	Method .	HSA		Dat	e Compl	eted 12/14/18	
	SOIL DESCR		STRA	Ъ	тш		SAI	MPLE				
ELEV. (ft)	Color, Moisture, Densi Proportio	ty, Plasticity, Size	DEPTH (ft)	SOIL SYMBOL	DEPIH SCALE	nd Blo	ows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
	WATER										1. Area 1	
_				m	_						2. 576427.13 N	
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	SAMPLER TYPE	SAMPLE CO					ER DEP	тн		BO		
DS - DRIV	EN SPLIT SPOON	D - DISINTE		А	T COMP	LETION .	ft			A - HOL	LOW STEM AUGERS	
	SSED SHELBY TUBE ITINUOUS FLIGHT AUGER K CORE	I - INTACT U - UNDISTU L - LOST	JRBED	A A	FTER FTER 24	HF HRS	RS ft	ft	DC	- DRI\	ITINUOUS FLIGHT AUGERS /ING CASING) DRILLING	
STANDAR	D PENETRATION TEST DRIV	VING 2" OD SAMPLER 1	I' WITH 1						AT 6" IN	FERVAL	s	



Con	tracted	WithGahagan & Bry									Boring		
Proj	ect Nar	meTask 17 - Seagi	rt Loop Cha	innel De	eepeni	ng					Job #	-	
Loca	ation _	Baltimore, MD											
						SAM	PLEF	र					
Datur	nML	LW	. Hammer Wt.	140	lb	_ Hol	e Diam	eter <u>8 in</u>		For	eman	M. Fletcher	
Surf.	Elev	1.7 ± ft	Hammer Dro		in	_ Roo	ck Core			Insp	ector _	D. Patterson	
Date	Started _	12/14/18	Spoon Size	2 in		_ Bor	ing Me	thod HSA		Dat	e Comple	eted12/14/18	
Г		SOIL DESCRIPTION	1	OTDA	Ы	тш		SAN	/IPLE				
	ELEV. (ft)	Color, Moisture, Density, Plas		STRA DEPTH	SYMBOL	DEPTH SCALE	Cond	Blows/6"		Turne	Rec	BORING & SAMPLE NOTES	
	(14)	Proportions		(ft)	°∕S	ВХ	Cond	DIOWS/0	No.	Туре	(in)		
		WATER (continued)											<u> </u>
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Block wet your off electic CUT													–
		Diack, wel, very soit, elasti				<u>50</u>		WOR/18"	1	DS	6		<u> </u>
_													-
_	-51.3			53.0		-		WOR/18"	2	DS	8		\vdash
-	- <u></u>	Gray, wet, very soft, elastic	SILT										\vdash
_						55		WOR/18"	3	DS	14		
											17		
								WOR/18"	4	DS	14		L
_													
	-58.8			60.5		<u>60</u>		WOR/18"	5	DS	14		
_	00.0	Bottom of Boring at 60.5 ft		00.0									-
_													-
_													\vdash
_						65							\vdash
						05							<u> </u>
_													\vdash
						70							
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						<u>75</u>							<u> </u>
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						80							
	S	AMPLER TYPE	SAMPLE CO	ONDITIC	ONS	GRO	UNDV	VATER DEP	тн		BOF	RING METHOD	
		EN SPLIT SPOON SED SHELBY TUBE	D - DISINTE I - INTACT					「ION ft HRS	ft			LOW STEM AUGERS TINUOUS FLIGHT AUGERS	
CA	- CONT	INUOUS FLIGHT AUGER	U - UNDIST			AFTER	24 HF	RS ft	_ 11	DC	- DRIV	/ING CASING	
RC	- ROCK	CORE	L - LOST			CAVE	DAT	ft		MD	- MUD	DRILLING	
ST	ANDARD	PENETRATION TEST DRIVING 2"	OD SAMPLER	1' WITH	140# HA	MMER	FALLIN	NG 30": COUNT	MADE	AT 6" IN	FERVAL	S	



Task 17 - Sea Baltimore, MI 4 ± ft 12/11/18									Job #	t18-0043	
/ 4 ± ft											
4 ± ft	Hammer W			SAM	1PLEF	2					
4 ± ft	Hammer W	/t 140	lh			0.1		-		M. Fletcher	
	Hammer D	vi			ole Diam ock Core				eman ector _	D. Patterson	
	Spoon Size	10p			oring Me				e Compl		
	0p00110120	-							o o op.		_
SOIL DESCRIPT	ION	STRA	BGF	LE		SAM	MPLE			BORING & SAMPLE	
Color, Moisture, Density, P Proportions	lasticity, Size	DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	NOTES	
WATER			Lun							1. Area 1	t
			hin							2 576187 01 F	
			fun							1441274.66 N	
			fuu								
			fun	5							
			μm								
			h	1 _							
]							
			hin	10							
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			hi								
			h								
			μιι								
			μιι	<u>15</u>							
				1 _							
] _							
			Lin] _							
			hi								
			hin	<u>20</u>							
			fuu	-							
			fuu	- 1							
Black wet verv soft ela	stic SILT	23.0	μ								
Black, Wet, Fory Colt, Old				~		WOR/18"	1	DS	6		
				25							
				-		WOR/18"	2	DS	8		
						WOR/18"	2	DC	15		
				30			3	05	15		
				-		WOR/18"	4	DS	18		
						WOR/18"	5	กร	3		
				35					5		
		37.0				WOR/18"	6	DS	15		
Gray, wet, very soft, fat	CLAY										
						WOR/18"	7	DS	18		
				40		-					
IPLER TYPE	SAMPLE C	ONDITIC	ONS	GRO	UNDV	VATER DEP	TH		BO	RING METHOD	
SPLIT SPOON							£				
D SHELBY TUBE JOUS FLIGHT AUGER							_ ft				
DRE	L - LOST			CAV	ED AT	ft					
	Black, wet, very soft, ela Gray, wet, very soft, fat IPLER TYPE SPLIT SPOON D SHELBY TUBE IOUS FLIGHT AUGER DRE	Black, wet, very soft, elastic SILT	Black, wet, very soft, elastic SILT 37.0 Gray, wet, very soft, fat CLAY 37.0 IPLER TYPE SAMPLE CONDITION SPLIT SPOON D - DISINTEGRATED OS HELBY TUBE J. INTACT IOUS FLIGHT AUGER U - UNDISTURBED INTACT U - UNDISTURBED INTACT U - UNDISTURBED	Black, wet, very soft, elastic SILT	Black, wet, very soft, elastic SILT	Black, wet, very soft, elastic SILT Gray, wet, very soft, fat CLAY Black, wet, very soft, fat CLAY APPLER TYPE SAMPLE CONDITIONS SAMPLE CONDITIONS CAVED AT CAVED	Black, wet, very soft, elastic SILT Black, wet, very soft, elastic SILT Gray, wet, very soft, fat CLAY Set Transmission Set Elay Tube Set Tube	Black, wet, very soft, elastic SILT 23.0 WOR/18" 1 22.0	Black, wet, very soft, elastic SILT VOR/18" 1 DS 23.0 10 10 10 10 10 30 15 1 WOR/18" 1 DS 30 1 WOR/18" 2 DS 30 1 WOR/18" 3 DS 30 1 WOR/18" 4 DS 30 1 WOR/18" 5 DS 31 WOR/18" 6 DS 1 32.1 WOR/18" 7 DS DS 31 WOR/18" 6 DS 1 32.1 WOR/18" 7 DS DS 32.5 WOR/18" 7 DS DS 32.5 WOR/18" 7 DS DS 35.1 WOR/18" 7 DS DS 35.1 WOR/18" 7 DS DS 35.1 WOR/18" 7 DS DS <	Black, wet, very soft, elastic SILT 23.0 WOR/18" 1 DS 6 20	Black, wet, very soft, elastic SILT 23.0 WOR/18" 1 DS 6 23.0 0 1 WOR/18" 1 DS 6 30 WOR/18" 2 DS 8 30 WOR/18" 3 DS 15 30 WOR/18" 3 DS 15 30 WOR/18" 4 DS 18 30 WOR/18" 5 DS 3 31 WOR/18" 5 DS 3 32 WOR/18" 6 DS 15 33 WOR/18" 7 DS 18 33 WOR/18" 7 DS 18 34 WOR/18" 7 DS 18 35 D D D D D 35 MOR/18" 7 DS 18 35 WOR/18" 7 DS 18 36 WOR/18" 7 DS 18 36 WOR/18" 7 DS 18 37.0 U WOR/18" 18 HELE 36 WOR/18" 10 MOR 18 37.0 U MOR 18



Page 2 of 2

Con	tracted		n & Bryant Associa		Borin								
	ect Nar	meTask 17 -	- Seagirt Loop Cha	annel D	eepen	ing					Job #	18-0043	
Loca	ation _	Baltimore	e, MD										
						SAM	IPLEF	R					
Datur		LW	Hammer Wi			Ho	le Diam			For	eman _	M. Fletcher	
Surf.		1.4 ± ft	Hammer Dr	ορ <u> </u>	in		ck Core				ector _	D. Patterson	
Date	Started _	12/11/18	Spoon Size	2 in		Boi	ring Me	thod HSA		Date	e Compl	eted12/11/18	
ſ	ELEV.	SOIL DESC		STRA DEPTH	ы С	王믜		SAM	MPLE			BORING & SAMPLE	
	(ft)	Color, Moisture, Den Propor	sity, Plasticity, Size rtions	DEPTH (ft)	SVMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	NOTES	
		Gray, wet, very soft											-
_		(continued)				-		WOR/18"	8	DS	18		+
_						_							-
_								WOR/18"	9	DS	18		-
						45					10		
_						_		WOR/18"	10	DS	18		
_								WOIVIO		03	10		_
_													-
_								WOR/18"	11	DS	18		-
						<u> </u>							-
								WOR/18"	12	DS	18		
_													
_								WOR/18"	13	DS	18		<u> </u>
						<u>55</u>							
_						-		WOR/18"	14	DS	18		-
_													-
	-58.1			59.5				WOR/18"	15	DS	18		E
	-30.1	Bottom of Boring at	t 59.5 ft	59.5		<u>60</u>							
_													-
_						_							-
_													
						65							
_													
_													-
_													-
_						70							-
						<u> </u>							
													L
_													\vdash
						75							<u> </u>
-						-							\vdash
\neg						$ \neg$							\vdash
						80							
	SAMPLER TYPE SAMPLE CONDITIONS GROUNDWATER DEPTH BORING METHOD												
PT	- PRES	EN SPLIT SPOON SED SHELBY TUBE	D - DISINT I - INTAC	Г		AFTEF	א	TION ft HRS	ft	CFA	A - CON	LOW STEM AUGERS	
	- CONT	INUOUS FLIGHT AUGER	U - UNDIS L - LOST	IURBED		AFTEF CAVE	R 24 HF Ed at	2S ft				/ING CASING) DRILLING	
ST	ANDARD	PENETRATION TEST DR	RIVING 2" OD SAMPLEF	R 1' WITH	140# HA	MMER	FALLIN	IG 30": COUNT	MADE	AT 6" IN1	FERVAL	S	



roject Nan			nannel De	eepen	ng					Job #	±18-0043	
ocation _	Baltimore, MD				C ^ •	יחי רי						
					SAIV	1PLEF						
tum <u>MLI</u>	<u>_W</u> 1.2 ± ft	Hammer W				le Diam				eman _	M. Fletcher D. Patterson	
	12/12/18	Hammer D	10p	111		ck Core				ector _		
ite Started	12/12/10	Spoon Size	9		_ во	ring Me			Date	e Compl		
	SOIL DESCRIPTION	NC	STRA DEPTH	٦ ۲	Ξщ		SAM	MPLE				
ELEV. (ft)	Color, Moisture, Density, Pla Proportions	asticity, Size	DEPTH (ft)	SOIL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
	WATER			hi							1. Area 1	
				hi							2. 575994.1 N	
				μı							1441432.01 E	
				μπ								
				μιι	5							
				μιι								
				h								
				h								
				Lin								
				hi	10							
_				hi								
				μı								
				μιι								
				μιι								
				μιι	<u>15</u>							
				h	1 _							
_] _							
_				Liii] _							
_				m								
-				hi	20							
-				μı								
-				μιι								
-21.8	Black, wet, very soft, elas		23.0	$ \dots $								
-	Diack, wei, very soit, eias				_		WOR/18"	1	DS	7		
_					25							
_					-		WOR/18"	2	DS	10		
-					_							
-					-							
-							WOR/18"	3	DS	10		
-					<u>30</u>							
20.0			32.0		-		WOR/18"	4	DS	10		
-30.8	Brown, dark gray, wet, ve	ery soft,	<u>32.0</u> _	╶╏╏╏╏								
-	elastic SILT,							_		10		
-	(MH)				35		WOR/18"	5	DS	10		
-					35							
-					-		WOR/18"	6	DS	12		
-												
-							M/OD/10"	7	DS	12		
-					40		WOR/18"	'	03	12		
S	AMPLER TYPE	SAMPLE C		ONS	GRO		VATER DEP	TH	ı	BO		
	N SPLIT SPOON		TEGRATED		AT CO	MPLET	ION ft		HSA		LOW STEM AUGERS	
PT - PRESS	ED SHELBY TUBE	I - INTAC	СТ		AFTE	٦	HRS	ft	CFA	A - CON	ITINUOUS FLIGHT AUGERS	
RC - ROCK	NUOUS FLIGHT AUGER CORE	U - UNDIS L - LOST					S ft				/ING CASING D DRILLING	
						-						



Page 2 of 2

Contracte												
Project Na Location				epen	ing					Job #	10-0043	
Location					SAM		8					
DatumN	ILLW	Hammer Wt.	140	lb		e Diam			For	eman	M. Fletcher	
Surf. Elev	1.2 ± ft	Hammer Vvi Hammer Drop				e Diam ck Core				ector _	D. Patterson	
Date Started	12/12/18	Spoon Size _	2 in			ing Me				e Compl	eted12/12/18	
			0754	۲			SAN	/IPLE				7
ELEV. (ft)	SOIL DESCRIPTIO Color, Moisture, Density, Pla Proportions	N sticity, Size	STRA DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
	Brown, dark gray, wet, ver elastic SILT, (MH) (continued)		59.5 _				WOR/18" WOR/18" WOR/18" WOR/18" WOR/18" WOR/18" WOR/18"	8 9 10 11 12 13 14 15	DS DS DS DS DS DS DS	(III) 18 18 18 18 18 18 18 18		
					80							\vdash
	SAMPLER TYPE	SAMPLE CO	NDITIC	NS		UNDV	VATER DEP	тн		BOF	RING METHOD	
PT - PRES CA - CON RC - ROC	/EN SPLIT SPOON SSED SHELBY TUBE ITINUOUS FLIGHT AUGER	D - DISINTE I - INTACT U - UNDIST L - LOST	GRATED URBED		AFTER AFTER CAVE	R R 24 HF D AT _	TION ft HRS ft ft		CF# DC MD	A - HOL A - CON - DRIN - MUD	LOW STEM AUGERS ITINUOUS FLIGHT AUGERS /ING CASING) DRILLING	



oject Na		Seagirt Loop Cl	nannel De	eepen	ing					Job #	t18-0043	
cation _	Baltimore,	MD										
					SAN	1PLEF	R					
tum <u>ML</u>	LW	Hammer V	Vt140	lb	_ но	ole Diam	eter <u>8 in</u>		For	eman _	M. Fletcher	
rf. Elev	1.2 ± ft	Hammer D		in	_ Ro	ock Core			Insp	ector _	D. Patterson	
te Started _	12/12/18	Spoon Size	e <u>2 in</u>		Bc	oring Me	thod <u>HSA</u>		Dat	e Compl	leted 12/12/18	
							C 41	MPLE				
ELEV.	SOIL DESCR Color, Moisture, Densit		STRA DEPTH	SOIL	DEPTH SCALE		541			Dee	BORING & SAMPLE	
(ft)	Proportic		(ft)	SYN S	E S C	Cond	Blows/6"	No.	Туре	Rec (in)	NOTES	
_											4	
_	WATER			μı	- 1						1. Area 1	
_				μιι							2. 575717.76 N	
-				μιι	۱ –						1441578.68 E	
-]_ —							
-				Ĩ	5							
-				hi	-							
-				fun	-							
				fm	4 —							
				μı	10							
				h	<u> </u>							
				Lin] —							
				hi								
				fun								
				μιι	<u>15</u>							
_				μιι	- I							
_				h] _							
_] _							
_				hi	_							
-				fun	<u>20</u>							
-				μιι	4 —							
-				μιι	4 —							
-22.8			24.0] —							
-22.0	Black, wet, very soft,	elastic SILT	24.0		25		WOR/18"	1	DS	8		
-	-				20_		WUR/10	'	03	0		
							WOR/18"	2	DS	10		
					<u>30</u>		WOR/18"	3	DS	12		
_												
								4		10		
							WOR/18"	4	DS	10		
-												
-34.3			35.5		<u>35</u>		WOR/18"	5	DS	12		
1	Gray, wet, very soft, o	elastic SILT ,										
-	(MH)				-		WOR/18"	6	DS	14		
-												
-					40			7	DS	10		
	AMPLER TYPE	SAMPLE C		LIII DNS	GRO	עחאט	WOR/18" VATER DEP		05			
	EN SPLIT SPOON		ITEGRATED)	AT CO	OMPLET	ION ft		HSA		LOW STEM AUGERS	
PT - PRES	SED SHELBY TUBE	I - INTACU U - UNDI	СТ		AFTE	R	HRSft	ft	CFA	A - CON	ITINUOUS FLIGHT AUGERS /ING CASING	
RC - ROCK		L - LOST					.s n				DRILLING	



Page 2 of 2

		With <u>Gahagan & Bi</u> me Task 17 - Sea		Borin	•								
-	ect Nar ation _				epen	ing					Job #	16-0043	
LUUG		2				SAM	IPLEF	2					
D (М	LW		140	lh					-		M. Fletcher	
Datur Surf.		1.2 ± ft	Hammer Wt Hammer Dro				le Diam ck Core				eman ector _	D. Patterson	
	Started _	12/12/18	Spoon Size				ring Me				e Compl	eted12/12/18	
Г								SAN	/PLE				
	ELEV. (ft)	SOIL DESCRIPTI Color, Moisture, Density, Pl Proportions	ON asticity, Size	STRA DEPTH (ft)	SVMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec	BORING & SAMPLE NOTES	
				(11)	ک						(in)		
_		Gray, wet, very soft, elas (MH) (continued)	tic SILT ,										
_						_		WOR/18"	8	DS	18		_
_											10		_
_						45		WOR/18"	0	D 0	40		-
						45_		WUR/10	9	DS	18		
								WOR/18"	10	DS	18		
_													L
						<u>50</u>		WOR/18"	11	DS	18		
-													-
_						-		WOR/18"	12	DS	18		-
													E
						<u>55</u>		WOR/18"	13	DS	18		
_													_
_						-		WOR/18"	14	DS	18		-
-						-							-
						60		WOR/18"	15	DS	18		-
	-59.3	Bottom of Boring at 60.5	ft	60.5									
_		-				_							_
_						-							-
-						65							-
						00							
_													
_													-
						70							
-													-
													-
						<u>75</u>							
\neg													\vdash
_													\vdash
-													\vdash
						80							
	-	AMPLER TYPE	SAMPLE CO					VATER DEP	тн			RING METHOD	
PT	- PRES	EN SPLIT SPOON SED SHELBY TUBE	D - DISINT I - INTACT	-)	AFTER	۲	FION ft HRS	_ ft	CFA	A - CON	LOW STEM AUGERS ITINUOUS FLIGHT AUGERS	
	- CONT	INUOUS FLIGHT AUGER	U - UNDIST L - LOST	FURBED				RS ft				/ING CASING) DRILLING	
ST	ANDARD	PENETRATION TEST DRIVING	2" OD SAMPLER	<u>1' WIT</u> H ⁻	140# HA	MMER	FALLIN	NG 30": COUNT	MADE	AT 6" <u>I</u> NT	ERVAL	S	



ontracted oject Nar	meTask 17 - S	eagirt Loop Cl	hannel D	eepen	ing					Borin Job #		
cation _	Baltimore, I	ND										
					SAM	1PLEF						
	LW	Hammer V				le Diam				eman _	M. Fletcher	
rf. Elev	1.2 ± ft 12/11/18	Hammer D		IN		ck Core				ector _	D. Patterson leted 12/11/18	
te Started _	12/11/10	Spoon Siz	e		_ Во	ring Me	thod		Dat	e Compl	leted12/11/16	
	SOIL DESCRI	PTION	STRA DEPTH	٦ ت	Ξщ		SAM	MPLE			BORING & SAMPLE	
ELEV. (ft)	Color, Moisture, Density Proportior	, Plasticity, Size ns	DEPTH (ft)	SOIL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	NOTES	
	WATER			h							1. Area 1	
				fun							2. 575400.7 N	
				μu							1441670.31 E	
				μιι								
				μιι	5							
				μιι								
_] _							
_] _							
				Lin								
_				hi	10							
_				hi	_							
_				μιι	_							
_				μιι	4 _							
_				μιι								
-				h	<u>15</u>							
-] —							
-				Lin] _							
-				hi	_							
-				hi								
_				μu	<u>20</u>							
_				μιι	- 1							
			22.0	μιι	- 1							
-21.8	Black, wet, very soft, e	elastic SILT	23.0						50	4.0		
-	,,,,				25		WOR/18"	1	DS	18		
-					25							
-					-		WOR/18"	2	DS	18		
-					_							
							WOR/18"	3	DS	10		
-					30			3		12		
1												
-30.8			32.0				WOR/18"	4	DS	12		
	Gray, wet, very soft, e	lastic SILT										
7							WOR/18"	5	DS	18		
					35							
							MOD!:					
							WOR/18"	6	DS	18		
_							WOR/18"	7	DS	18		
					40							
S	AMPLER TYPE	SAMPLE (CONDITIC	ONS	GRO	UNDV	VATER DEP	тн		BO	RING METHOD	
	N SPLIT SPOON)			TION ft	#			LOW STEM AUGERS	
	SED SHELBY TUBE INUOUS FLIGHT AUGER	I - INTA U - UNDI	CI ISTURBED				HRS S ft	_π			ITINUOUS FLIGHT AUGERS /ING CASING	
	CORE	L - LOST					ft				D DRILLING	



Page 2 of 2

		With <u>Gahagan & Bry</u> ne Task 17 - Seag											
Projec Locatio			In Loop Cha	nnei De	epen	ing					Job #	10-0043	
LUCali	UN _	Balantere, mb				SVW	IPLEF	>					
	N 41	1.14/		140	lh							M Eleteber	
Datum _ Surf. Ele	ML	1.2 ± ft	 Hammer Wt. Hammer Dro 	00			le Diam ck Core				eman ector	M. Fletcher D. Patterson	
Date Sta		12/11/18	_ Hammer Dro _ Spoon Size .	Ρ			ring Me	- Dia			ector _		
—						1 1							-
EL	LEV. (ft)	SOIL DESCRIPTIO Color, Moisture, Density, Plas Proportions	N sticity, Size	STRA DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec	BORING & SAMPLE NOTES	
		· ·		(,	S						(in)		
		Gray, wet, very soft, elasti (continued)	c SILT			_		WOR/18"	0		10		
_		(continued)						WUR/10	8	DS	18		_
_						-							-
-						45		WOR/18"	9	DS	18		-
						45							
						_		WOR/18"	10	DS	18		
_						_		WOR/18"	11	DS	18		
						<u>50</u>							
-						-		WOR/18"	12	DS	18		-
-						_							-
								WOR/18"	13	DS	18		Ľ
						55							
_						_		WOR/18"	14	DS	18		_
_									14		10		-
-						_		WOR/18"	15	DS	18		-
-5	58.3	Bottom of Boring at 59.5 fl		59.5		60		WOIN 10	15	03	10		-
		Dottom of Doning at 59.5 h											
_													
_													_
						65							-
						05							<u> </u>
_													L_
						<u>70</u>							
\neg						-							\vdash
\neg													\vdash
						75							
4													\vdash
\neg						-							\vdash
\neg													\vdash
						80							
SAMPLER TYPE SAMPLE CONDITIONS GROUNDWATER DEPTH BORING METHOD													
		N SPLIT SPOON SED SHELBY TUBE	D - DISINTE I - INTACT		1			ΓΙΟΝ ft HRS	ft			LOW STEM AUGERS ITINUOUS FLIGHT AUGERS	
CA -	CONTI	INUOUS FLIGHT AUGER	U - UNDIST L - LOST			AFTEF	R 24 HF	RS ft		DC	- DRI\	/ING CASING) DRILLING	
		PENETRATION TEST DRIVING 2		1' WITH 1	40# HA				MADE				



Contracted Project Nar				eepeni	ng					Borin Job #		
ocation _					-					000 11		
					SAM	1PLEF	R					
atumML	LW	Hammer V	vt 140	lb	Ца	le Diam	_{eter} 8 in		For	eman	M. Fletcher	
urf. Elev	1.6 ± ft	Hammer D	vi			ck Core				pector _	D. Patterson	
ate Started	12/13/18	Spoon Size	•			ring Me				e Compl	eted 12/13/18	
[]						-						
ELEV.	SOIL DESCRIPT Color, Moisture, Density, F	ION	STRA DEPTH	BOL	PTH ■LE		SAI	MPLE		_	BORING & SAMPLE	
(ft)	Proportions	lasticity, Size	(ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	NOTES	
-	WATER			L							1. Area 1	
				hin							2. 575376.43 N	
				hi							1441841.45 E	
				h								
				h	5							
				μπ								
				h	1 _							
] _							
_				Lin								
_				hin	10							
_				h	_							
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_				h								
_				m	Ì							
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-				h	20							
-				h								
-												
				L] —							
				hin	25							
-				hin								
7				fuu								
				fun								
				h								
					30							
				in								
				hi								
_				h								
-33.4	Diants web	atia Oll T	35.0	<u> </u>	35							
	Black, wet, very soft, ela (MH)	ISUC SILI,			_		WOR/18"	1	DS	3		
	· ···/				_							
					_		WOR/18"	2	DS	3		
								ΊΗ	110			
PT - PRES	IN SPLIT SPOON SED SHELBY TUBE INUOUS FLIGHT AUGER	I - INTAC U - UNDIS	STURBED		AFTEI AFTEI	R R 24 HR	TION ft HRS IS ft ft	ft	CFA DC	4 - CON - DRIV	LOW STEM AUGERS ITINUOUS FLIGHT AUGERS /ING CASING) DRILLING	
	CODE	L - LOST										



Page 2 of 2

		With Gahagan & Bry											
-	ect Nar		irt Loop Cha	nnel De	epeni	ing					Job #	18-0043	
Loca	ation _	Bailinore, MD				0.4.4							
						SAN	1PLEF						
Datum	•	LW 1.6 ± ft	_ Hammer Wt.				le Diam				eman _	M. Fletcher D. Patterson	
Surf. E	=lev Started _	12/13/18	 Hammer Drop Spoon Size _ 	p <u> </u>	111		ick Core ring Me	- Dia			ector _ e Compl		
Date t							ing we				s comp		
	ELEV.	SOIL DESCRIPTION	N	STRA	SYMBOL	ΞIJ		SAM	MPLE			BORING & SAMPLE	
	(ft)	Color, Moisture, Density, Plas Proportions	ticity, Size	DEPTH (ft)	SM	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	NOTES	
					0,						()		
_		Black, wet, very soft, elasti (MH) (continued)	c SILT,			_		WOR/18"	3	DS	14		
_		(_							-
_						-		WOR/18"	4	DS	15		+
-						45							-
						45		WOR/18"	5	DS	18		
								Workito			10		
										50	45		
_								WOR/18"	6	DS	15		
	<u>-48.4</u>	Gray, wet, very soft, fat CL	~~	<u>50.0</u>		<u>50</u>							
4			AI			-		WOR/18"	7	DS	18		-
-						—							-
-						-		WOR/18"	8	DS	18		-
						55							
								WOR/18"	9	DS	18		
_						_		WOR/18"	10	DS	18		
+	-57.4	Bottom of Boring at 59.0 ft		59.0							10		-
		Dettern of Dennig at 60.0 h				<u>60</u>							
-						-							-
-													
						<u>65</u>							
_						_							_
4						_							-
-						_							-
-						70							-
_													
_						_							_
						<u>75</u>							<u> </u>
\dashv													\vdash
\dashv													F
4													
						80							
	-		SAMPLE CO		-			NATER DEP	тн			RING METHOD	
		IN SPLIT SPOON SED SHELBY TUBE	D - DISINTE I - INTACT)	AT CC	OMPLET	ΓΙΟΝ ft HRS	ft			LOW STEM AUGERS ITINUOUS FLIGHT AUGERS	
CA	- CONT	INUOUS FLIGHT AUGER	U - UNDIST L - LOST			AFTER	r 24 Hf	RS ft		DC	- DRI\	/ING CASING) DRILLING	
				1' \\/ITL! /	140# 니^								
31/		PENETRATION TEST DRIVING 2'	OD SAIVIPLER		1 4 0# ⊓A	uviivi⊏R		10 JU . COUNT				0	



Contracted										Borin	-	
Project Na		irt Loop Cha	nnel De	epeni	ng					Job #	t18-0043	
Location _	Baltimore, MD											
					SAM	1PLEF	२					
DatumML	LLW	_ Hammer Wt.	140	lb	_ Но	le Diam	eter <u>8 in</u>		For	eman _	M. Fletcher	
Surf. Elev	0.7 ± ft	_ Hammer Dro	р30	in	_ Ro	ck Core			Insp	pector _	D. Patterson	
Date Started _	12/20/18	_ Spoon Size _	2 in		_ Bo	ring Me	thod HSA		Dat	e Compl	leted12/20/18	
				4	-		SA	MPLE				7
ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plas Proportions		STRA DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
	WATER			·····							1. Area 1	
				h							2. 575143.1 N	
_				h							1442012.05 E	
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					5							
_												-
_				h								-
_				h	_							\vdash
				h	10							-
					10							
				l								
				h								
_				h								
				h	<u>15</u>							
_					_							_
_					_							-
_				m	_							-
-				h	20							-
				·····	<u>20</u>							
				m								
				h	25							
_				h								
_					_							_
_					_							-
_				h								-
				h	<u>30</u>							
				h	-							-
					_							
				h								
				h	35							
				h								L
				·····								L
												\vdash
_												\vdash
					40							
	SAMPLER TYPE	D - DISINTE					VATER DEF FION ft		цел		RING METHOD LOW STEM AUGERS	
PT - PRES CA - CONT	ISED SHELBY TUBE TINUOUS FLIGHT AUGER	I - INTACT U - UNDIST L - LOST			AFTEF AFTEF	R R 24 HF	HRS RS ft	ft	CFA DC	4 - CON - DRIV	IOW STEM AUGERS ITINUOUS FLIGHT AUGERS /ING CASING DRILLING	
RC - ROCK STANDARD	PENETRATION TEST DRIVING 2		1' WITH 1	140# HAI			ft NG 30": COUN [*]	T MADE				



Contracted Project Nam				eepeni	ng					Boring Job #		
Location _												
					SAN	1PLEF	२					
DatumMLL		. Hammer Wt.				ole Diam				eman	M. Fletcher	
Surf. Elev Date Started	0.7 ± ft 12/20/18	 Hammer Drop Spoon Size _ 	2 <u>30</u> 2 in	In		ock Core oring Me				ector e Comple	D. Patterson ated 12/20/18	
Dale Starled _	12/20/10		2		_ DC	ning ivie			Dat	e Comple		
ELEV.	SOIL DESCRIPTION		STRA DEPTH	gr	프믜		SAN	/IPLE	-		BORING & SAMPLE	
(ft)	Color, Moisture, Density, Plast Proportions	ticity, Size	DEPTH (ft)	SVMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	NOTES	
	WATER (continued)											
-				h	1 —							-
-] —							-
				hin								
				fun	45							
				fun								
					1 _							
_				in] _							–
_				h								-
-50.3			51.0	μm	50							<u> </u>
-50.5	Black, wet, very soft to soft	, SILT	51.0	\mathbb{H}			WOR/18"	1	DS	4		\vdash
					-		Workito		00	-		
								_				
-54.3			<u> 55.0 </u>		55		WOH/12"-2	2	DS	6		
_	Gray, wet, very soft, CLAY											\vdash
_					- 1		WOH/18"	3	DS	12		-
-												-
-					60		WOH/12"-6	4	DS	10		-
					<u> </u>							<u> </u>
60.8	Brown, wet, medium dense	. clavev	<u>61.5</u>				7-7-6	5	DS	10		
	SAND, and fine Gravel	, , , ,										
<u>-63.3</u>	Gray, wet, loose to medium		<u>_64.0</u>		-		7-6-4	6	DS	10		<u> </u>
	fine to coarse, SAND , and	fine			<u>65</u>							<u> </u>
-	Gravel				• -		6-4-4	7	DS	10		\vdash
-66.8	Bottom of Boring at 67.5 ft		67.5	• • • • • • • • •	• -		0-4-4	1	03	10		
	bollom of boning at 07.5 h											
					<u>70</u>							
_					_							
_					_							\vdash
-					-							-
-					75							-
					<u>15</u>							
												L
					80							
		SAMPLE CO						тн				
PT - PRESS	N SPLIT SPOON SED SHELBY TUBE	D - DISINTE			AFTE	R	TION ft HRS	ft	CFA	A - CON	LOW STEM AUGERS	
CA - CONTII RC - ROCK	NUOUS FLIGHT AUGER CORE	U - UNDISTI L - LOST	URBED				RS ft ft				'ING CASING DRILLING	
STANDARD F	PENETRATION TEST DRIVING 2"	OD SAMPLER	1' WITH	140# HA	MMER	R FALLI	NG 30": COUNT	MADE	AT 6" IN	ERVAL	8	



ontracted roject Na		Bryant Associ eagirt Loop Ch		eepeni	ng					Borin Job #		_
cation _		ID										
					SAM	1PLEF	R					
atumM	LW	Hammer W	/t 140	lb	Ho	le Diam	_{eter} 8 in		For	eman _	M. Fletcher	
ırf. Elev	0.7 ± ft	Hammer D	~~	in		ck Core				ector _	D. Patterson	
ate Started _	12/10/18	Spoon Size	e2 in		Bo	ring Me	hod HSA		Date	e Comp	leted 12/10/18	
							CA1	MPLE				
ELEV.	SOIL DESCRIP Color, Moisture, Density,	TION Plasticity Size	STRA DEPTH	SOIL	DEPTH SCALE					Rec	BORING & SAMPLE	
(ft)	Proportions		(ft)	SYN	SC	Cond	Blows/6"	No.	Туре	(in)	NOTES	
	WATER										1. Area 2	
_	WAIER			μιι	-						1. Alea 2	
_				μιι							2. 577624.52 N	
_					1 —						1440418.84 E	
_				hi	5							
-				h	5							
1				fm								
1				μιι								
				h								
					10							
				hi								
_				h								
_				μιι								
_				μιι								
-				h	<u>15</u>							
-				h] —							
-				hi								
-				h	—							
-				μιι	20							
				μιι	20							
-21.8	Black, wet, very soft, fa		22.5									
							WOR/18"	1	DS	8		
					<u>25</u>							
_					_		WOR/18"	2	DS	10		
_												
_					-		WOR/18"	3	DS	14		
_												
-					30		WOR/18"		50	4.5		
-					-		WUR/10	4	DS	15		
1												
-33.3			34.0				WOR/18"	5	DS	18		
	Dark gray, black, wet, v	very soft, fat			35							
	CLAY, (CH)						WOR/18"	6	DS	18		
_	. ,											
4							WOR/18"	7	DS	18		
4							1101010	'	03	10		
		0.000			40							
	AMPLER TYPE		CONDITIC TEGRATEI					ΊΗ	1164		RING METHOD	
PT - PRES	SED SHELBY TUBE	I - INTAC	СТ		AFTE	۲	ION ft HRS	ft	CFA	A - CON	ITINUOUS FLIGHT AUGERS	
CA - CONT RC - ROCK	INUOUS FLIGHT AUGER	U - UNDIS L - LOST			AFTEI	R 24 HR =D AT	S ft				VING CASING D DRILLING	
		L - 1001			0,101		IL			WOL		



Page 2 of 2

					SAMF	LER						
um <u>ML</u>	LW	_ Hammer Wt	140	lb	_ Hole	Diame	eter <u>8 in</u>		For	eman	M. Fletcher	
f. Elev	0.7 ± ft	_ Hammer Dro		in		Core			Insp	ector _	D. Patterson	
e Started _	12/10/18	_ Spoon Size	2 in		_ Borir	ng Metl	hod <u>HSA</u>		Dat	e Comple	eted12/10/18	
			OTDA	5	T III		SAM	MPLE				
ELEV. (ft)	SOIL DESCRIPTIO Color, Moisture, Density, Plas Proportions	sticity, Size	STRA DEPTH (ft)	SVMBOL	DEPTH SCALE	ond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
-	Dark gray, black, wet, very CLAY, (CH) (continued)	v soft, fat					WOR/18"	8	DS	15		
			44.0				WOR/18"	9	DS	18		
-	Dark gray, wet, very soft, e SILT, (MH)	elastic			<u>45</u> _		WOR/18"	10	DS	18		
-							WOR/18"	11	DS	18		
-					<u>50</u> –		WOR/18"	12	DS	18		
							WOR/18"	13	DS	18		
-					<u>55</u> _		WOR/18"	14	DS	18		
-58.3	Bottom of Boring at 59.0 ft		59.0				WOR/18"	15	DS	18		
-	Bottom of Bonng at 00.0 h				<u>60</u>							
-												
-					<u>65</u>							
-												
					70							
					 75							
-												
					80							
S - DRIVE	AMPLER TYPE IN SPLIT SPOON SED SHELBY TUBE	D - DISINT	EGRATED		GROU AT CON	1PLETI	ION ft HRS			A - HOLI	RING METHOD LOW STEM AUGERS TINUOUS FLIGHT AUGERS	



contracted		Bryant Associ				Borin	-					
Project Na		agirt Loop Cl חו	nannel De	eepen	ng					Job #	£18-0043	
ocation .	Daitimore, iv	U			~ ~ ~							
					SAN	1PLEF						
	_LW 2.4 ± ft	Hammer V				ole Diam				eman _	M. Fletcher D. Patterson	
urf. Elev	12/21/18	Hammer D	•	In		ock Core				ector _		
ate Started	12/21/10	Spoon Siz	e <u>2111</u>		_ BC	oring Me	Inod <u>Hora</u>		Dat	e Compl	eted	
	SOIL DESCRIP	TION	STRA	٦Ļ	Ξщ		SA	MPLE				
ELEV. (ft)	Color, Moisture, Density, Proportion:	Plasticity, Size	DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
	WATER			L							1. Area 4	
7				m] —						2. 578230.52 N	
				fun							1439625.1 E	
				μm								
_				μιι	5							
_				μι	1_							
_] _							
4				h								
_				hi								
_				fun	<u>10</u>							
-				μιι								
-				ļ	1 —							
-				h] —							
-				Ĩ	15							
-				hi	<u> </u>							
-				fun								
7				μιι								
				h								
					20							
				[iii] _							
	6	<u> </u>	22.0	h	_							
_	Black, dark gray, wet, v elastic SILT , with sand	/ery soπ,			_		WOR/18"	1	DS	14		
_	(MH)											
_					25_		WOR/18"	2	DS	18		
-												
-							WOR/18"		D 0	40		
-					-		WUR/10	3	DS	18		
-					30							
-					<u> </u>		WOR/18"	4	DS	18		
1												
							WOR/18"	5	DS	18		
_					35		WOR/18"			10		
_								6	DS	18		
_					_							
- <u></u>			<u>38.5</u>		-		WOR/18"	7	DS	15		
		SAMPLE (ערואו		тц		PO		
	EN SPLIER TYPE		ITEGRATED				VATER DEP	111	HSA		RING METHOD LOW STEM AUGERS	
PT - PRES	SED SHELBY TUBE	I - INTA	СТ		AFTE	R	HRS	ft	CFA	A - CON	ITINUOUS FLIGHT AUGERS	
CA - CONT RC - ROCH	INUOUS FLIGHT AUGER	U - UNDI L - LOST	STURBED -		AF LE CAV	k 24 HR ED AT	S ft				/ING CASING) DRILLING	
					-	-			=			



Page 2 of 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. 2.4 ± ft Hammer Vt. 140 lb Hole Diameter N/A Inspector D. Patterson Date Started 12/21/18 Spoon Size 2 in Boring Method HSA Date Completed 12/21/18 SOIL DESCRIPTION Soil DESCRIPTION Size STRA Tog 8 60 S Cond Blows/6" No. Type Rec NOTES Gray, brown, wet, very soft, fat CLAY, Gray, brown, wet, very soft, fat Image: Start 10 DS 18 Image: Start 11 DS 18 Image: Start 11 Image: Start 11 Image: Start 12 Image: Start 12 <td< th=""></td<>
SAMPLER DatumMLLW Hammer Wt,140 lb Hole Diameter 8 in Foreman Fletcher
Datum MLLW Hammer Wt. 140 lb Hole Diameter 8 in Foreman M. Fletcher Surf. Elev. 24±ft Hammer Drop 30 in Boring Method HSA Date Started D. Patterson Date Started 12/21/18 Spoon Size 2 in Boring Method HSA Date Completed 12/21/18 ELEV. Color, Moisture, Density, Pasticity, Size STRA Does Boring Method HSA Does BORING & SAMPLE Vortifit Gray, brown, wet, very soft, fat DEPTH 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Surf. Elev. 24 ± 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. Color, Molsture, Density, Plasticity, Size STRA TO BY 600 (the bit of the
Date Started 12/21/18 Spoon Size 2 in Boring Method HSA Date Completed 12/21/18 ELEV. SOIL DESCRIPTION Color, Molsture, Density, Plasticity, Size Proportions STRA DEPTH (ft) 00 9 % 40 9 % 40 9 % 60 SAMPLE Cond Boring Method HSA BORING & SAMPLE NOTES Gray, brown, wet, very soft, fat CLAY, (CH) (continued) Gray, brown, wet, very soft, fat Soft WOR/18" 8 DS 18 WOR/18" 9 DS 18 - - - WOR/18" 10 DS 18 - - - WOR/18" 11 DS 18 - - WOR/18" 12 DS 18 - - WOR/18" 13 DS 18 - - WOR/18" 13 DS 18 - - WOR/18" 14 DS 18 - -
Soli DESCRIPTION (ft) STRA DepTH Proportions To BEPTH (ft) STRA DEPTH (ft) Type (ft) Rec Cond BORING & SAMPLE (ft) BORING & SAMPLE NOTES Gray, brown, wet, very soft, fat CLAY, (CH) (continued) Gray, brown, wet, very soft, fat CLAY, (CH) (continued) WOR/18" 8 DS 18 45 WOR/18" 10 DS 18 45 WOR/18" 10 DS 18 45 WOR/18" 10 DS 18 45 WOR/18" 11 DS 18 50 WOR/18" 11 DS 18 45 WOR/18" 12 DS 18 50 WOR/18" 13 DS 18
Gray, brown, wet, very soft, fat WOR/18" 8 DS 18 (CH) (continued) WOR/18" 9 DS 18 45 WOR/18" 10 DS 18 WOR/18" 10 DS 18 WOR/18" 11 DS 18 WOR/18" 11 DS 18 WOR/18" 11 DS 18 WOR/18" 12 DS 18 WOR/18" 13 DS 18 WOR/18" 14 DS 18
Gray, brown, wet, very soft, fat WOR/18" 8 DS 18 (CH) (continued) WOR/18" 9 DS 18 45 WOR/18" 10 DS 18 WOR/18" 10 DS 18 WOR/18" 11 DS 18 WOR/18" 11 DS 18 WOR/18" 11 DS 18 WOR/18" 12 DS 18 WOR/18" 13 DS 18 WOR/18" 14 DS 18
CLAY, (CH) (continued) WOR/18" 9 DS 18 45 WOR/18" 10 DS 18 WOR/18" 11 DS 18 WOR/18" 11 DS 18 WOR/18" 12 DS 18 WOR/18" 13 DS 18 WOR/18" 14 DS 18
CLAY, (CH) (continued) WOR/18" 9 DS 18 45 WOR/18" 10 DS 18 WOR/18" 11 DS 18 WOR/18" 11 DS 18 WOR/18" 12 DS 18 WOR/18" 13 DS 18 WOR/18" 14 DS 18
- WOR/18" 9 DS 18 45 WOR/18" 10 DS 18 - WOR/18" 11 DS 18 - WOR/18" 12 DS 18 - WOR/18" 13 DS 18 - WOR/18" 14 DS 18
45 WOR/18" 10 DS 18 WOR/18" 11 DS 18 10 WOR/18" 11 DS 18 10 WOR/18" 12 DS 18 10 WOR/18" 12 DS 18 10 WOR/18" 12 DS 18 10 WOR/18" 13 DS 18 10 WOR/18" 13 DS 18 10 WOR/18" 14 DS 18
WOR/18" 11 DS 18 WOR/18" 12 DS 18 WOR/18" 13 DS 18 WOR/18" 13 DS 18 S5 WOR/18" 14 DS 18
WOR/18" 11 DS 18 WOR/18" 12 DS 18 WOR/18" 13 DS 18 WOR/18" 13 DS 18 S5 WOR/18" 14 DS 18
50 WOR/18" 12 DS 18 WOR/18" 13 DS 18 WOR/18" 13 DS 18 WOR/18" 14 DS 18
50 WOR/18" 12 DS 18 WOR/18" 13 DS 18 WOR/18" 13 DS 18 WOR/18" 14 DS 18
WOR/18" 12 DS 18 WOR/18" 13 DS 18
WOR/18" 12 DS 18 WOR/18" 13 DS 18
WOR/18" 14 DS 18
WOR/18" 14 DS 18
WOR/18" 15 DS 18
58.6 WOR/18" 16 DS 18
-58.6 61.0 61.0 61.0 61.0 61.0 61.0 61.0 61
65
80
SAMPLER TYPE SAMPLE CONDITIONS GROUNDWATER DEPTH BORING METHOD
DS - DRIVEN SPLIT SPOON D - DISINTEGRATED AT COMPLETIONft HSA - HOLLOW STEM AUGERS PT - PRESSED SHELBY TUBE I - INTACT AFTERHRSft CFA - CONTINUOUS FLIGHT AUGERS CA - CONTINUOUS FLIGHT AUGER U - UNDISTURBED AFTER 24 HRSft DC - DRIVING CASING DO - DRIVING CASING DO - DRIVING CASING DC - DRIVING CASING
RC - ROCK CORE L - LOST CAVED ATft MD - MUD DRILLING STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS



Contracted			Borin									
Project Na		LOOP Char	inei De	epenii	ng					Job #	±18-0043	
Location _	Daliinore, MD											
					SAM	PLEF	र					
DatumM	LLW	Hammer Wt.	140		_ Hol	e Diam			For	eman _	M. Fletcher	
Surf. Elev.	2.0 ± ft	Hammer Drop		n		ck Core				pector _	D. Patterson	
Date Started	12/17/18	Spoon Size _	2 in		_ Bor	ring Me	thod HSA		Dat	e Compl	leted12/17/18	
	SOIL DESCRIPTION		STDA	Ъ	тш		SA	MPLE				7
ELEV. (ft)	Color, Moisture, Density, Plasti Proportions	city, Size	STRA DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
	WATER			·····							1. Area 5	
_				·····	_						2. 578539.11 N	
_				·····	_						1440002.23 E	
_				····	_							\vdash
					5							<u> </u>
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e	AMPLER TYPE S	AMPLE CO	סידוסא		40 GROI	ייסאוו	VATER DEP	л		BOI	RING METHOD	
	EN SPLIT SPOON	D - DISINTE					TION ft		HSA		LOW STEM AUGERS	
PT - PRES	SED SHELBY TUBE TINUOUS FLIGHT AUGER	I - INTACT U - UNDISTU L - LOST			AFTEF AFTEF	R R 24 HF	HRS RSft	ft	CFA DC	4 - CON - DRI\	ITINUOUS FLIGHT AUGERS /ING CASING D DRILLING	
	PENETRATION TEST DRIVING 2" (1' WITH 1	40# HAN				T MADE				



Contracted		<u>Gahagan & Bry</u> Task 17 - Seag		Boring	•								
Project Nar		Baltimore, MD	IT LOOP Cha	nnei D	eepeni	ng					Job #	10-0043	
						SAM	IPLEF	,					
– . MI	.LW			140	lb					_		M. Fletcher	
DatumNL Surf. Elev	2.0 ± ft		 Hammer Wt. Hammer Dro 				le Diam ck Core				eman pector	D. Patterson	
Date Started	12/17/18		_ Spoon Size _	2 in			ring Me				e Comple	eted12/17/18	
						[<u>_</u>]		S 4 1	MPLE				_
ELEV.	Color, M	SOIL DESCRIPTION loisture, Density, Plas		STRA DEPTH	SYMBOL	DEPTH SCALE					Rec	BORING & SAMPLE	
(ft)		Proportions		(ft)	SYIS	ЩХ	Cond	Blows/6"	No.	Туре	(in)	NOTES	
	WATER	(continued)											-
		. ,											–
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_					fun								
					h	<u>45</u>							<u> </u>
_													-
_					h								\vdash
-47.0			h								F		
		y, wet, very soft, fa		50		WOR/18"	1	DS	15				
	(CH)												
_				_		WOR/18"	2	DS	18				
_								Workito	2		10		-
_						55					40		-
						<u> </u>		WOR/18"	3	DS	18		
-56.0				58.0				WOR/18"	4	DS	18		
	Bottom o	f Boring at 58.0 ft											
						<u>60</u>							<u> </u>
_													\vdash
_													-
						65							
_													
_													–
_						_							-
_						70							\vdash
						10							
													E
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						<u>75</u>							<u> </u>
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						80							
									тн	,			
PT - PRES	EN SPLIT SPC SED SHELBY	TUBE	d - Disinte I - Intact			AFTE	२	ion ft HRS	ft	CFA	A - CON	LOW STEM AUGERS TINUOUS FLIGHT AUGERS	
CA - CONT RC - ROCK	INUOUS FLIG	GHT AUGER	U - UNDIST L - LOST	URBED		AFTER CAVE	R 24 HR ED AT	S ft				ING CASING	
		ON TEST DRIVING 2		1' WITH	140# HA				MADE				



Contracted					Borin							
Project Na		LOOP Cha	nnei De	epeni	ng					Job #	t10-0043	
Location _	Daliinole, MD											
					SAM	IPLEF	र					
DatumM	LLW	Hammer Wt.			_ Ho	le Diam			For	eman _	M. Fletcher	
Surf. Elev.	1.4 ± ft	Hammer Drop		in		ck Core				pector _	D. Patterson	
Date Started	12/17/18	Spoon Size _	2 in		_ Bo	ring Me	thod HSA		Dat	e Compl	leted12/17/18	
	SOIL DESCRIPTION		STDA	Ч	тш		SA	MPLE				7
ELEV. (ft)	Color, Moisture, Density, Plasti Proportions	city, Size	STRA DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
	WATER			·····							1. Area 5	
_				·····							2. 578798.45 N	
_				·····	_						1439933.66 E	_
_				····								–
					5							<u> </u>
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				·····	35							
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c	SAMPLER TYPE S	AMPLE CO		NS	40 GRO	יחאט	VATER DEF	тн		ROI		
	EN SPLIT SPOON	D - DISINTE			AT CC	MPLE	FION ft		HSA		LOW STEM AUGERS	
PT - PRES	SED SHELBY TUBE TINUOUS FLIGHT AUGER	I - INTACT U - UNDIST L - LOST			AFTEF AFTEF	R R 24 HF	HRS RSft ft	ft	CFA DC	4 - CON - DRI\	ITINUOUS FLIGHT AUGERS /ING CASING) DRILLING	
	PENETRATION TEST DRIVING 2"		1' WITH 1	140# HAI				T MADE				



			& Bryant Associa								Borin	-	
-	ect Nar		Seagirt Loop Cha	innel De	eepeni	ing					Job #	18-0043	
Loca	ation _	Baltimore,	MD										
						SAM	PLEF						
Datum	·	LW 1.4 ± ft					e Diam				eman	M. Fletcher D. Patterson	
Surf. E	≟lev Started _	12/17/18	Hammer Dro	p 2 in			ck Core ring Me				ector e Comple		
Duio (1			ing mo			Dut	o oompi		
	ELEV.	SOIL DESCF Color, Moisture, Densi	RIPTION	STRA DEPTH	BOL	DEPTH SCALE		SAN	/IPLE		-	BORING & SAMPLE	
	(ft)	Proportio	ons	(ft)	SYMBOL	SCE	Cond	Blows/6"	No.	Туре	Rec (in)	NOTES	
		WATER (continued)											
-						1 -							\vdash
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					fuu	\square							
					h	<u>45</u>							
_] –							-
-	-46.6			48.0	h								\vdash
+	-40.0	Dark gray, wet, very	soft, elastic	40.0				WOR/18"	1	DS	18		F
		SILT, (MH)				50							
_						_		WOR/18"	2	DS	18		
_									-		10		-
-								WOR/18"	3	DS	18		-
						55		WORVIO	5	03	10		
										D 0	40		
_						_		WOR/18"	4	DS	18		
_						-			_				-
_	-58.1			59.5		60		WOR/18"	5	DS	18		\vdash
		Bottom of Boring at 5	59.5 ft			00							<u> </u>
_						_							
_													-
						<u>65</u>							-
-						_							F
_													
						<u>70</u>							<u> </u>
4						-							+
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						<u>75</u>							
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						80							
		AMPLER TYPE	D - Disinti					VATER DEP	тн			RING METHOD	
		IN SPLIT SPOON SED SHELBY TUBE)			'ION ft HRS	ft			LOW STEM AUGERS ITINUOUS FLIGHT AUGERS			
CA	PT - PRESSED SHELBY TUBE I - INTACT CA - CONTINUOUS FLIGHT AUGER U - UNDISTURBED RC - ROCK CORE L - LOST						24 HR	S ft		DC	- DRIV	ING CASING DRILLING	
		PENETRATION TEST DRIV		1' WITH	140# HA				MADE				
	_												



Contract		ahagan & Brya		Borin	-								
Project N		ask 17 - Seagir altimore, MD	t Loop Cha	nnel De	epenii	ng					Job #	t18-0043	
Location	Be	alumore, ND											
						SAM	IPLEF	R					
Datum	MLLW		Hammer Wt.	140	lb	_ Ho	le Diam	eter <u>8 in</u>		For	eman _	M. Fletcher	
Surf. Elev.	1.3 ± ft		Hammer Dro	•	in	_ Ro	ck Core			Insp	pector _	D. Patterson	
Date Started	d <u>12/17/18</u>		Spoon Size	2 in		_ Bo	ring Me	thod HSA		Dat	e Compl	leted12/17/18	
				OTDA	Ъ	T III		SA	MPLE				
ELEV (ft)		OIL DESCRIPTION ture, Density, Plasti Proportions	city, Size	STRA DEPTH (ft)	SOIL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
	WATER											1. Area 5	
					·····							2. 579027.67 N	
_					·····	_						1439621.84 E	
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						5							
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						40							
DC 7-	SAMPLER TY												
PT - PR	IVEN SPLIT SPOON ESSED SHELBY TU	IBE	D - DISINTE I - INTACT			AFTEF	۲ ۲	TION ft HRS	ft	CFA	A - CON	LOW STEM AUGERS	
	NTINUOUS FLIGHT CK CORE	AUGER	U - UNDIST L - LOST	URBED		AFTEF	R 24 HR	S ft				/ING CASING D DRILLING	
	RD PENETRATION	TEST DRIVING 2"		1' WITH [·]	140# HAI				T MADE				



			<mark>k Bryant Associa</mark> Seagirt Loop Ch		aanani						Borin	-	
-	ect Nar ation _			annei D	eepeni	ng					Job #	10-0043	
LUUG		200000,				SAM	IPLEF	2					
D (М	LW		H 140	lb					-		M. Fletcher	
Datur Surf.	n Elev	1.3 ± ft	Hammer W Hammer Dr		in		le Diam ck Core				eman pector	D. Patterson	
	Started _	12/17/18	Spoon Size				ring Me				e Comple	eted12/17/18	
Г		SOIL DESCRI		STDA	Ь.	тш		SAM	MPLE				
	ELEV. (ft)	Color, Moisture, Density Proportio	y, Plasticity, Size	STRA DEPTH	SOIL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec	BORING & SAMPLE NOTES	
ŀ		Рюронио	115	(ft)	l ís	00					(in)		_
		WATER (continued)			h								
_					h								-
_													-
-					h	45							F
					h								
_	40.7			40.0									-
-	-46.7	Gray, dark greenish b	rown, wet,	48.0				WOR/18"	1	DS	9		-
		very soft, fat CLAY, (CH)		50					5				
_		()		_		WOR/18"	2	DS	18		<u> </u>		
_							_		10		\vdash		
_								WOR/18"	3	DS	18		-
						55					10		
_						-		WOR/18"	4	DS	18		–
-	-55.7	Bottom of Boring at 5	7.0 ft	57.0									-
													E
						<u>60</u>							
_													-
_													\vdash
													E
						<u>65</u>							
_													-
_													\vdash
						<u>70</u>							<u> </u>
_													\vdash
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													Ľ
						<u>75</u>							<u> </u>
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	e		SAMPLE C			80 GPO			 тц		POT		
DS	-	AMPLER TYPE	D - DISINT	-			-	TION ft		HSA	-	LOW STEM AUGERS	
CA	- CONT	SED SHELBY TUBE INUOUS FLIGHT AUGER		AFTER	R R 24 HF	HRS RS ft	_ ft	DC	- DRIV	ITINUOUS FLIGHT AUGERS /ING CASING			
	- ROCK		L - LOST			CAVE	ED AT	ft				DRILLING	
ST.	ANDARD	PENETRATION TEST DRIV	ING 2" OD SAMPLE	≺ 1' WITH	140# HA	MMER	FALLIN	NG 30": COUNT	MADE	at 6" in	ERVAL	5	



Contracted			Borin	-								
Project Na		Loop Char	nnei De	epeni	ng					Job #	#18-0043	
Location _	Daiumore, MD											
					SAM	PLEF	र					
DatumN	LLW	Hammer Wt.	140		_ Ho	le Diam			For	eman _	M. Fletcher	
Surf. Elev	2.3 ± ft	Hammer Drop		in		ck Core				pector _	D. Patterson	
Date Started	12/17/18	Spoon Size _	2 in		_ Bo	ring Me	thod HSA		Dat	e Compl	leted12/17/18	
	SOIL DESCRIPTION		OTDA	Ъ	τш		SA	MPLE				7
ELEV. (ft)	Color, Moisture, Density, Plasti Proportions	city, Size	STRA DEPTH (ft)	SYMBOL SOIL	DEPTH	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
	WATER			·····							1. Area 5	
_				·····	_						2. 578650.62 N	
_				·····	_						1439547.35 E	
_				····	_							-
					5							<u> </u>
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				·····	35							
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	AMPLER TYPE S	AMPLE CO		NC	40 GPO	ייסאוו	VATER DEP	л		POI	RING METHOD	
	EN SPLIT SPOON	D - DISINTE					TION ft	111	HSA		LOW STEM AUGERS	
PT - PRES	SED SHELBY TUBE TINUOUS FLIGHT AUGER	I - INTACT U - UNDISTU L - LOST			AFTEF AFTEF	R R 24 HF	HRSft	ft	CFA DC	4 - CON - DRI\	ITINUOUS FLIGHT AUGERS /ING CASING D DRILLING	
	PENETRATION TEST DRIVING 2" (1' WITH 1	40# HAI				T MADE /				



Contracted								Boring	-	
Project Na		irt Loop Channel I	Deepen	ing				Job #	18-0043	
Location	Daitinore, MD			SAMPLE	D					
Datam	2.3 ± ft		0 lb 0 in	Hole Diar				eman	M. Fletcher D. Patterson	
Surf. Elev Date Started	12/17/18	_ Hammer Drop <u>3</u> _ Spoon Size <u>2 in</u>		Rock Cor Boring M				ector e Comple		
										_
ELEV.	SOIL DESCRIPTIO Color, Moisture, Density, Plas	N STRA sticity, Size DEPT	SYMBOL	DEPTH SCALE H DEPTH	SAN	MPLE		Dee	BORING & SAMPLE	
(ft)	Proportions	(ft)	SXN	Cond	Blows/6"	No.	Туре	Rec (in)	NOTES	
	WATER (continued)									-
_			h							-
-										-
			h	~						
			h	45						
-43.7	Disale wat voru soft slast	46.0								
<u> </u>	Black, wet, very soft, elast	47.5		_	WOR/18"	1	DS	6		-
_	Dark gray, wet, very soft, e SILT,	lastic								-
-	(MH)			50	WOR/18"	2	DS	15		-
				<u> </u>						
<u>-49.7</u>		52.0			WOR/18"	3	DS	18		
_	Dark gray, wet, very soft, f	at CLAY,								
_					WOR/18"	4	DS	18		-
				<u>55</u>				-		
-					WOR/18"	5	DS	18		-
								10		
_					WOR/18"	6	DS	18		
57.7	Bottom of Boring at 60.0 ft	60.0		<u>60</u>		6	05	18		<u> </u>
_	Bolloni of Bonng at 60.0 h									-
_										-
-										-
				65						
_										
_										
_										-
_				70						-
										<u> </u>
										F
_										\vdash
				75						<u> </u>
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\neg										F
				80						
-		SAMPLE CONDIT				тн		-		
PT - PRES	EN SPLIT SPOON SED SHELBY TUBE	D - DISINTEGRATE		AFTER	TION ft HRS	ft	CFA	A - CON	LOW STEM AUGERS TINUOUS FLIGHT AUGERS	
CA - CONT RC - ROCK	FINUOUS FLIGHT AUGER K CORE	U - UNDISTURBED L - LOST		AFTER 24 H CAVED AT	RS ft				/ING CASING DRILLING	
STANDARD	PENETRATION TEST DRIVING 2	OD SAMPLER 1' WITH	1 140# HA			MADE	AT 6" IN	[ERVAL	S	



ca	ition _	Baltimore,	שואו									
						SAN	1PLEF	र				
tum	n ML	LW	Hammer W	/t. 140	lb	Но	le Diam	eter 8 in		For	eman _	M. Fletcher
	Elev	1.3 ± ft	Hammer D		in		ock Core				ector _	D. Patterson
te S	Started _	12/26/18	Spoon Size	<u>2 in</u>		_ Bo	ring Me	thod <u>HSA</u>		Dat	e Comp	leted12/26/18
Г												
	ELEV.	SOIL DESCR Color, Moisture, Densit		STRA DEPTH	BO	DEPTH SCALE		SAM	1PLE			BORING & SAMPLE
	(ft)	Proportic		(ft)	SOIL	E S S	Cond	Blows/6"	No.	Туре	Rec (in)	NOTES
												4
		WATER			μm	_						1. Area 4
					μιι	- 1						2. 578528.9 N
_					μιι	1 —						1439393.75 E
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-					μιι	- 1						
						1 —						
					h	25						
					hi	20						
					hi							
	-26.7			28.0	μm							
		Black, wet, very soft,	SILT					WOR/18"	1	DS	6	
						30						
						-		WOR/18"	2	DC	0	
						_		WOIN 18	2	DS	8	
_												
_						_		WOR/18"	3	DS	10	
-	047					35						
L	<u>-34.7</u> -35.2 -	Brown, wet, loose, Si		<u>36.0</u> <u>36.5</u> -		-		WOR/6"-2-3	4	DS	12	
		Brown, dark gray, we	t, very soft, fat									
		CLAY, (CH)						WOR/18"	5	D 0	10	
						40			5	DS	12	
	S	AMPLER TYPE	SAMPLE C	ONDITIC	ONS	GRO			тн		BO	
	- DRIVE	N SPLIT SPOON	D - DISIN	TEGRATED)	AT CO	OMPLET	TION ft			A - HOL	LOW STEM AUGERS
эт	- PRESS	SED SHELBY TUBE	I - INTAC	т		AFTE	R	HRS	ft	CEA	A - CON	ITINUOUS FLIGHT AUGERS



Page 2 of 2

		With <u>Gahagan & Br</u> ne Task 17 - Sea			aanani						Borin	•	
Projec Locati					eepeni	ing					Job #	£10-0045	
Locati		Balanoro, MD				SAM	IPLEF	٦					
Datum	ML	LW	Hammer Wt.	140	lb	Но	le Diarr	neter 8 in		For	eman	M. Fletcher	
Surf. Ele	ev	1.3 ± ft	Hammer Dro	~ ~ ~	in		ck Core	e Dia. <u>N/A</u>			pector _	D. Patterson	
Date Sta	arted _	12/26/18	Spoon Size	2 in		_ Bo	ring Me	thod HSA		Dat	e Compl	leted12/26/18	
				отра	Б	T III		SAI	MPLE				
E	LEV. (ft)	SOIL DESCRIPTIO Color, Moisture, Density, Pla Proportions	asticity, Size	STRA DEPTH (ft)	SVMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
		Brown, dark gray, wet, ve CLAY, (CH) <i>(continued)</i>	ry soft, fat					WOH/18" WOR/18" WOR/18"	6 7 8	DS DS DS	5 9 18		
	<u>47.2</u>	 Dark gray, wet, very soft,	elastic	48.5				WOR/18"	9	DS	5		
		SILT, (MH)				<u>50</u> –		WOR/18"	10	DS	18		_
_								WOR/18"	11	DS	18		-
						<u>55</u>							
								WOR/18"	12	DS	18		
	58.2	Bottom of Boring at 59.5	ft	59.5		<u>60</u>		WOR/18"	13	DS	18		_
_													_
_													_
_						_							
_													<u> </u>
						<u>70</u>							<u> </u>
-													\vdash
\neg						$ \neg$							
						75							
_													\vdash
_						_							-
_						_							-
_						80							-
	S	AMPLER TYPE	SAMPLE CO		ONS			NATER DEP	тн		BO	RING METHOD	
PT - CA - RC -	DRIVE PRESS CONT ROCK	IN SPLIT SPOON SED SHELBY TUBE INUOUS FLIGHT AUGER CORE PENETRATION TEST DRIVING	D - DISINTE I - INTACT U - UNDIST L - LOST	EGRATEI URBED	D	AFTEF AFTEF CAVE	R R 24 HF ED AT	FION ft HRS RS ft ft		CFA DC MD	a - Hol a - Con - Driv - Mue	LOW STEM AUGERS ITINUOUS FLIGHT AUGERS /ING CASING D DRILLING	



Contracted	With Gahagan & Brya	nt Associat	es							Borin	g #PR-24	
Project Nar		t Loop Cha	nnel De	epeni	ng					Job #		
Location _	Baltimore, MD											
					SAM	IPLEF	र					
DatumML	LW	Hammer Wt.			_ Ho	le Diam			For	eman _	M. Fletcher	
Surf. Elev.	0.2 ± ft	Hammer Drop		in		ck Core				ector _	D. Patterson	
Date Started _	12/18/18	Spoon Size _	2 in		_ Bo	ring Me	thod HSA		Date	e Compl	eted12/18/18	
	SOIL DESCRIPTION		STRA	Б.	тш		SA	MPLE				
ELEV. (ft)	Color, Moisture, Density, Plasti Proportions	city, Size	DEPTH (ft)	SOIL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
	WATER			·····							1. Area 5	
				·····	_						2. 578981.14 N	
_				·····	_						1439396.94 E	_
_												-
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				·····	20							-
				in								
				·····								
				·····	<u>25</u>							
_				····	_							_
_												_
				in	-							-
				·····	30							_
				·····	<u> </u>							
												-
				un								
				·····	35							
				·····								_
				····	_							_
-					_							\vdash
-				um	40							-
e	AMPLER TYPE S	AMPLE CO		NS		יחאט	VATER DEF	тн		RO		
DS - DRIVE PT - PRESS	AWIFLER ITFE S EN SPLIT SPOON SED SHELBY TUBE INUOUS FLIGHT AUGER	D - DISINTE I - INTACT U - UNDIST	GRATED)	AT CC AFTEF	MPLET	TION ft HRS RS ft		CFA	A - HOL A - CON	LOW STEM AUGERS ITINUOUS FLIGHT AUGERS /ING CASING	
RC - ROCK		L - LOST			CAVE	ED AT	ft	T MADE .	MD	- MUE) DRILLING	



Contracted		Bryant Associa								Boring		
Project Nan _ocation _		agirt Loop Ch D	annei D	eepen	ing					Job #	18-0043	
	,				SAM	IPLEF	2					
DatumML	LW	Hammer W	/t. 140	lb		le Diam	0.1		For	eman	M. Fletcher	
	0.2 ± ft	Hammer D	iop	in	_ Ro	ck Core	Dia. <u>N/A</u>			pector	D. Patterson	
Date Started _	12/18/18	Spoon Size	9 2 in		_ Bo	ring Me	thod <u>HSA</u>		Dat	e Comple	eted12/18/18	
ELEV.	SOIL DESCRIP	ΓΙΟΝ	STRA	ЗОГ	ΗЩ		SAM	MPLE			BORING & SAMPLE	
(ft)	Color, Moisture, Density, Proportions	Plasticity, Size	DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	NOTES	
_	WATER (continued)											-
-				h								┢
				hi								
				h								
					45							ŀ
-46.8			47.0	h								F
	Dark gray, wet, very so SILT ,	ft, elastic]]		WOR/18"	1	DS	18		Ĺ
_	(MH)											╞
					<u>50</u>		WOR/18"	2	DS	18		ŀ
			52.0									F
	Dark gray, wet, very so	ft, fat CLAY					WOR/18"	3	DS	15		
_												+
					<u>55</u> _		WOR/18"	4	DS	18		┢
												Ľ
-58.3			58.5		_		WOR/18"	5	DS	16		
	Bottom of Boring at 58.	5 ft	00.0		60							+
_					00							F
_					_							+
-					65							+
					0.5							F
_					_							
-					70							ŀ
					<u> </u>							
					_							
-					_							
-												F
												Ľ
4												
-					-							┝
-					80							F
DS - DRIVE PT - PRESS	AMPLER TYPE N SPLIT SPOON SED SHELBY TUBE NUOUS FLIGHT AUGER	D - DISIN D - DISIN I - INTAC U - UNDIS	TEGRATEI T		GRO AT CC	MPLET	VATER DEP TON ft HRS IS ft		CFA	a - Holi a - Con'	RING METHOD LOW STEM AUGERS TINUOUS FLIGHT AUGERS VING CASING	L
RC - ROCK		L - LOST		140# HA	CAVI	ED AT	ft	MADE	MD	- MUD	DRILLING	



	tracted		Bryant Associa agirt Loop Cha		oponi	na					Borin		
	ect Nar ation _				epeni	ny					Job #	<u> </u>	
LUCA		Balantoro, Ma				CAN							
						SAIV	1PLEF						
Datum	•	LW	Hammer Wt.				le Diam				eman _	M. Fletcher	
Surf. E	Elev Started _	0.6 ± ft 12/18/18	Hammer Dro	p <u>30</u> 2 in	IN		ck Core				ector _	D. Patterson leted 12/18/18	
Dates	Starteu _		Spoon Size	2		_ 60	ring Me			Dai	e Compl		
Γ	ELEV.	SOIL DESCRIPT	ION	STRA DEPTH	öĽ	ШΗ		SA	MPLE	1		BORING & SAMPLE	
	(ft)	Color, Moisture, Density, F Proportions	Plasticity, Size	DEPTH (ft)	SVMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	NOTES	
F		· · ·		(14)	ο Ο						(11)		-
		WATER			h							1. Area 5	
					h							2. 579033.53 N	
					fuu							1439109.98 E	
_					m	- I							–
						5							<u> </u>
_					m] —							-
_			h								\vdash		
_				h								\vdash	
					fun	10							-
					m								
					h								L
					frin								
					h	<u>15</u>							
_						_							-
_					m] —							-
_					h								\vdash
_					frm	20							\vdash
					fun	20							<u> </u>
					h								
					h								
					frm	25							
_					fuu								
_													-
_					h] _							-
-					h	20							-
					fuu	<u>30</u>							-
\neg					h								\vdash
					m								
					hin	35							
					hin								
_					h								\vdash
\dashv						_							\vdash
\neg					h								\vdash
	e	AMPLER TYPE	SAMPLE CO	ן אידורואנ		40 GRO	ירואוו	VATER DEF	л	I	BOI		
DS		EN SPLIT SPOON	D - DISINTI					FION ft		HS		LOW STEM AUGERS	
PT CA	- PRES	SED SHELBY TUBE INUOUS FLIGHT AUGER	I - INTACT U - UNDIST L - LOST			AFTEI AFTEI	r R 24 HF	HRS RSft ft	ft	CF/ DC	4 - CON - DRIV	VING CASING D DRILLING	
		PENETRATION TEST DRIVING		1' WITH [·]	140# HA				T MADE				



				ant Associat rt Loop Cha		oononi	ng					Boring	•	
Projec Locati			nore, MD			eepeni	ny					Job #	10-0043	
Loodd	<u> </u>						SAM	1PLEF	2					
Detro	м	LW		1.1	140	lb			<u>.</u>		5		M. Fletcher	
Datum _ Surf. Ele		0.6 ± ft		 Hammer Wt. Hammer Dro 		in		le Diam ick Core				eman pector	D. Patterson	
Date Sta		12/18/18		Spoon Size	2 in			ring Me				e Comple	eted12/18/18	
				1	OTDA	5	–		SAN	MPLE				
	LEV. (ft)	Color, Moisture,	DESCRIPTION Density, Plast roportions		STRA DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec	BORING & SAMPLE NOTES	
			•		(,	ο Ο						(in)		
		WATER (contin	ued)			fun								
_						free								
-] —							\vdash
-						hin	45							\vdash
						fun	<u> </u>							
						h								
_						h								–
-	40.4				50.0	h								-
	49.4	Dark gray, wet,	very soft, fa	at CLAY,	50.0		<u>50</u>		WOR/18"	1	DS	15		
		(CH)	-				-		001010		03	15		-
									WOR/18"		D 0	45		
_									WUR/10	2	DS	15		
							55							
-							-		WOR/18"	3	DS	18		-
-														-
{	58.4				59.0				WOR/18"	4	DS	18		
		Bottom of Borir	ng at 59.0 ft				<u>60</u>							
_							_							-
-														-
							<u>65</u>							
_														—
-														-
-														-
							70							
_														\vdash
4														\vdash
-							75							\vdash
							<u>''</u>							
\dashv														F
_														\vdash
	c .	AMPLER TYPE		SAMPLE CO	ידוחא(80 GRO	ערואון	VATER DEP	тн		ROF	RING METHOD	
	DRIVE	N SPLIT SPOON	•	D - DISINTE	GRATE	C	AT CC	MPLET	ION ft			a - Holi	LOW STEM AUGERS	
		Sed Shelby Tube Nuous Flight Au	GER	I - INTACT U - UNDIST			AFTER	R 24 HR	HRS S ft	ft			TINUOUS FLIGHT AUGERS	
	ROCK			L - LOST			CAVE	ED AT	ft				DRILLING	
STAN	IDARD	PENETRATION TES	T DRIVING 2"	OD SAMPLER	1' WITH	140# HA	MMER	FALLIN	IG 30": COUNT	MADE	at 6" in	TERVAL	S	



Contracted				oononi	na					Borin	-	
Project Nan				eepeni	ng					Job #	[#] 10-0043	
	Balantere, mb	·			SVI	1PLEF)					
			140				<u>.</u>					
atum <u>ML</u>	_ <u></u> 1.2 ± ft	Hammer W				le Diam				eman _	M. Fletcher D. Patterson	
urf. Elev ate Started	12/27/18	Hammer D Spoon Size	10p			ock Core oring Me				bector _ e Comp		
		3poort Size			_ DU	ing we				e comp		
	SOIL DESCRIPTI	ON	STRA	٦ او	폰백		SAM	MPLE				
ELEV. (ft)	Color, Moisture, Density, Pl Proportions	asticity, Size	DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
_	WATER			h							1. Area 4	
_				fun							2. 578724.72 N	
_				μι	-						1438875.95 E	
-												
-				Lun	5							
-				fin								
-				fun								
-				μιι	-							
7					10							
				hi								
				fun								
_				fun								
_					<u>15</u>							
-				hin] —							
-				fun								
\neg				fun								
				h	20							
				hin								
-21.8	Diack wat warms acht fat		23.0	h	_							
_	Black, wet, very soft, fat	GLAY					WOR/18"	1	DS	9		
_					<u>25</u>							
-					-		WOR/18"	2	DS	15		
-					_							
							WOR/18"	3	DS	12		
					30							
					_		WOR/18"		D0	15		
_								4	DS	15		
_					_							
_							WOR/18"	5	DS	12		
-					<u>35</u>							
\neg					-		WOR/18"	6	DS	18		
					_							
							WOR/18"	7	DS	15		
					40		-					
S	AMPLER TYPE	SAMPLE C	ONDITIO	ONS	GRO	UNDV	VATER DEP	тн		BO	RING METHOD	
	N SPLIT SPOON ED SHELBY TUBE	D - DISIN I - INTAC					TION ft HRS	ft			LOW STEM AUGERS	
		U - UNDIS						_ ··			VING CASING	
CA - CONTI RC - ROCK		L - LOST			AFIE		S ft				D DRILLING	



Page 2 of 2

		With Gahagan & Br									Boring	-	
-	ect Nar			nnel De	eepeni	ng					Job #	18-0043	
Loca	ation _	Ballinore, MD				<u> </u>							
						SAMF	LF	< compared with the second sec					
Datur		LW	Hammer Wt.				Diam				eman	M. Fletcher	
	Elev	1.2 ± ft 12/27/18	Hammer Drop	2 <u>30</u> 2 in	IN		< Core				ector	D. Patterson ated 12/27/18	
Date	Started _	12/21/10	Spoon Size _	2 111		_ Borir	ng Met			Dat	e Comple	eted2/2//10	
[ELEV.	SOIL DESCRIPTIO	N	STRA	٦c			SAN	IPLE			BORING & SAMPLE	
	(ft)	Color, Moisture, Density, Pla Proportions	asticity, Size	DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	NOTES	
-				(14)	<u>ن</u>						(11)		_
		Black, wet, very soft, fat ((continued)	CLAY						_	50	10		
_		(continueu)						WOR/18"	8	DS	18		
_						_							
_						_		WOR/18"	9	DS	18		\vdash
	<u>-43.8</u>	Dark gray, wet, very soft,		<u>45.0</u>	////	<u>45</u>							
_		SILT,				-		WOR/18"	10	DS	18		-
-		(MH)											-
-								WOR/18"	11	DS	15		-
_	-48.8			50.0		50		WORVIO		00	15		
		Black, wet, very soft, fat (
								WOR/18"	12	DS	18		
_						_							
_						_		WOR/18"	13	DS	14		_
						55							
_						_		WOR/18"	14	DS	18		_
_													-
-								WOR/18"	15	DS	18		-
_	-58.3	Bottom of Boring at 59.5	f 1	59.5		60		WORVIO	15	00	10		-
		Boltom of Boring at 59.5	it.										
													L
_													
_													–
						<u>65</u>							
_						_							-
-						_							\vdash
_						_							-
-						70							
													L
_													\vdash
						<u>75</u>							
_													\vdash
-													\vdash
-													F
-						80							
	S	AMPLER TYPE	SAMPLE CO	NDITIC	ONS		INDV	VATER DEP	тн		BOF	RING METHOD	
		N SPLIT SPOON	D - DISINTE					TION ft	æ				
CA	- CONT	SED SHELBY TUBE INUOUS FLIGHT AUGER	I - INTACT U - UNDIST			AFTER	24 HR	HRS S ft	_π	DC	- DRIV	TINUOUS FLIGHT AUGERS ING CASING	
RC	- ROCK	CORE	L - LOST					ft		MD	- MUD	DRILLING	
ST	ANDARD	PENETRATION TEST DRIVING	2" OD SAMPLER	1' WITH	140# HA	MMER F	ALLIN	IG 30": COUNT	MADE	at 6" int	FERVAL	6	



roject Nar	With <u>Gahagan &</u> ne Task 17 - S	eagirt Loop Cl	hannel D	eepeni	ng					Borin Job #		
ocation _	Baltimore, N				0					000 #		
					SAN	1PLEF	2					
atumML	LW	Hammer V	_{A/t} 140	lb		le Diam	0.1		For	eman _	M. Fletcher	
IIII	1.1 ± ft	Hammer D	VI			ck Core				ector _	D. Patterson	
ate Started _	12/27/18	Spoon Siz				ring Met				e Comp	leted 12/27/18	
				· ·								_
ELEV.	SOIL DESCRIF Color, Moisture, Density	PTION Plasticity Size	STRA DEPTH	BOL	DEPTH SCALE		SAN	MPLE			BORING & SAMPLE	
(ft)	Proportion		(ft)	SYMBOL	SCE	Cond	Blows/6"	No.	Туре	Rec (in)	NOTES	_
	WATER			h							1. Area 4	Ī
				μu							2. 578555.9 N	
				μm							1439086.09 E	
_				μιι								
-				h	5							
_				h	_							
-				hi	_							
_				h	. —							
				μιι	10							
				μιι	10							
					·							
-] —							
-				m								
				h	15							
				μu								
				μιι								
_				h	·							
_												
_				hi	<u>20</u>							
-19.9	Black, wet, very soft,		21.0	1111	_							
-	DIACK, wel, very soil,	CLAT			_		WOR/18"	1	DS	9		
_					_							
			25.0				WOR/18"	2	DS	12		
-23.9	Dark gray, black, wet,	very soft, fat	25.0		<u>25</u>							
_	CLAY						WOR/18"	3	DS	11		
_					-		WOIV10	3	03	14		
					_							
					30		WOR/18"	4	DS	15		
					_		WOR/18"	5	DS	14		
					_		WOR/18"	6	DS	15		
4					<u>35</u>				03	15		
					_		· · · · · - ·					
- <u>36.4</u>			37.5		-		WOR/18"	7	DS	15		
-	Dark gray, wet, very so SILT,	oft, elastic			_							
	(MH)				40		WOR/18"	8	DS	15		
 ?	AMPLER TYPE	SAMPLE			GRO		VATER DEP	тн	1]	BO		
	N SPLIT SPOON		ITEGRATE		AT CO	MPLET	ION ft		HSA		LOW STEM AUGERS	
	SED SHELBY TUBE INUOUS FLIGHT AUGER	I - INTA U - UNDI					HRS S ft	ft			ITINUOUS FLIGHT AUGERS /ING CASING	



		agan & Bryant Associa 17 - Seagirt Loop Cha		oponi						Borin	-	
-		nore, MD		epen	ing					Job #	16-0043	
Location	·				SAM	PLEF	र					
Datum Surf. Elev. Date Starte	1.1 ± ft	Hammer Wt Hammer Dru Spoon Size	op <u>30 i</u>		_ Ro	le Diam ck Core ring Me	Dia. <u>N/A</u>		Insp	eman pector e Comple	M. Fletcher D. Patterson eted 12/27/18	
						-	SAN	/IPLE				7
ELE (ft	V. Color, Moisture	DESCRIPTION , Density, Plasticity, Size Proportions	STRA DEPTH (ft)	SOIL SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
	Dark gray, wet SILT, (MH) (continue)	, very soft, elastic	60.0				WOR/18" WOR/18" WOR/18" WOR/18" WOR/18" WOR/18" WOR/18"	9 10 11 12 13 14 15 16	DS DS DS DS DS DS DS	(III) 18 15 18 18 18 18 18 18		
4					80							-
PT - PF CA - CO RC - RO	SAMPLER TYPE RIVEN SPLIT SPOON RESSED SHELBY TUBE ONTINUOUS FLIGHT AL OCK CORE ARD PENETRATION TES	D - DISINT I - INTAC	EGRATED T TURBED	_	GRO AT CO AFTER AFTER CAVE	MPLET R R 24 HF D AT	VATER DEP -ION ft HRS HRS ft ft NG 30": COUNT	_ ft	CF# DC MD	A - HOL A - CON - DRIV - MUD	RING METHOD LOW STEM AUGERS ITINUOUS FLIGHT AUGERS /ING CASING D DRILLING S	



		With <u>Gahagan & Brya</u>									Borin		
		ne <u>Task 17 - Seagir</u> Baltimore, MD	t Loop Cha	nnel De	eepeni	ng					Job #	t18-0043	
Locati	on _	Dailinore, MD						_					
						SAM	1PLEF	र					
Datum _			Hammer Wt.				ole Diam				eman _	M. Fletcher	
Surf. Ele		0.6 ± ft 12/18/18	Hammer Dro	•	in		ock Core				pector _	D. Patterson leted 12/18/18	
Date Sta	arted _	12/10/10	Spoon Size	2 in		_ Bo	oring Me	thod		Dat	e Compl	leted12/10/10	
		SOIL DESCRIPTION		STRA	Ъ	Ξщ		SA	MPLE				
	LEV. (ft)	Color, Moisture, Density, Plasti Proportions	city, Size	STRA DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec	BORING & SAMPLE NOTES	
				(19	٥ ا						(in)		-
		WATER			h							1. Area 5	
					h	_						2. 579334.71 N	
					fuu							1439198.76 E	
_					h								\vdash
						5							<u> </u>
_					h								-
-					hin								\vdash
-					h								-
-					h	10							-
					h	10							
					hin								
					h								
					fuu	15							
_					h								
_													
_					m	_							-
_					h								\vdash
					fuu	<u>20</u>							<u> </u>
-					h								\vdash
-													\vdash
-													
					him	25							
					h								
					h								
					m								
_													
					m	<u>30</u>							
_					h								–
_					fuu								-
-					h								\vdash
-						35							\vdash
						<u>35</u>							<u> </u>
\neg					m								\vdash
1					h								
					frm								
					h	40							
			AMPLE CO					VATER DEF	PTH			RING METHOD	
		N SPLIT SPOON SED SHELBY TUBE	D - DISINTE					rion ft HRS	ft			LOW STEM AUGERS	
CA -		NUOUS FLIGHT AUGER	U - UNDIST L - LOST			AFTE	r 24 Hf	RS ft	-	DC	- DRI\	/ING CASING D DRILLING	
				1 \\\/	14041141								
STAN	IDARD	PENETRATION TEST DRIVING 2"	JU SAIVIPLER	I VVIIH	140# HA			NO DU : COON		או ס וא		.0	



Con	tracted	WithGahagan & Bry									Borin		
Proj	ect Nar	me Task 17 - Seag	girt Loop Cha	annel De	eepeni	ing					Job #	-	
Loca	ation _	Baltimore, MD											
						SAM	PLEF	र					
Datun	nML	LW	_ Hammer Wt	. 140	lb	_ Hol	le Diam	eter <u>8 in</u>		For	eman	M. Fletcher	
Surf. I	Elev	0.6 ± ft	Hammer Dro		in	_ Ro	ck Core			Insp	ector _	D. Patterson	
Date	Started _	12/18/18	_ Spoon Size	2 in		Bor	ring Me	thod HSA		Dat	e Compl	eted <u>12/18/18</u>	
Г		SOIL DESCRIPTIO	NI.	STDA	Ь.	тш		SAN	/IPLE				
	ELEV. (ft)	Color, Moisture, Density, Pla Proportions		STRA DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
		· · ·			رە س						(11)		
		WATER (continued)			h								
_					fuu								_
_					h								_
-													-
					hin	45							-
-					h								-
-47.4													
		Dark gray, wet, very soft,	elastic		IIII			WOR/18"	1	DS	7		E
		SILT, (MH)		50									
_		· · ·			_		WOR/18"	2	DS	18			
_					_		WORVIO	2	03	10		-	
_						_							-
_	-54.4			55.0				WOR/18"	3	DS	14		-
	<u>-54.4</u>	Dark gray, wet, very soft, t	fat CLAY	<u></u>		<u>55</u>							
-						-		WOR/18"	4	DS	16		-
	59.0			59.5				WOR/18"	5	DS	18		
	-58.9	Bottom of Boring at 59.5 f	t	59.5		<u>60</u>							
_													
_													-
_													+
-						65							-
						00							<u> </u>
_													
_						<u>70</u>							<u> </u>
-													-
-						-							\vdash
-						$ \neg$							F
-						75							
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													F
_													\vdash
				ידיסאר		80 CRO			 т		D 07		
20		EN SPLIER TYPE	D - DISINT					VATER DEP	п	Нел		RING METHOD LOW STEM AUGERS	
PT CA	- PRES	SED SHELBY TUBE INUOUS FLIGHT AUGER	U - UNDIS U - UNDIS L - LOST	Г		AFTER AFTER	R R 24 HF	HRS ft	_ ft	CFA DC	- CON - DRIV	ITINUOUS FLIGHT AUGERS /ING CASING DRILLING	
ST	ANDARD	PENETRATION TEST DRIVING 2	2" OD SAMPLEF	R 1' WITH	140# HA	MMER	FALLIN	NG 30": COUNT	MADE	AT 6" IN	[ERVAL	S	



Contracted										Borin		
Project Nar		t Loop Cha	nnel De	epeni	ng					Job #	18-0043	
Location _	Daiumore, MD											
					SAM	PLEF	ξ.					
Datum <u>ML</u>		Hammer Wt.	140			e Diam				eman _	M. Fletcher	
Surf. Elev.	0.4 ± ft 12/19/18	Hammer Drop		in		ck Core				pector _	D. Patterson eted 12/19/18	
Date Started _	12/19/10	Spoon Size _	2 in		_ Boi	ring Me	thod		Dat	e Compl	eted	
	SOIL DESCRIPTION		STRA	Ъ	Ξщ		SAI	MPLE				
ELEV. (ft)	Color, Moisture, Density, Plasti Proportions	city, Size	STRA DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
				0)						()		_
_	WATER			·····	_						1. Area 5	L
_				·····							2. 579628.66 N	L
_											1438708.3 E	-
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				m	<u>20</u>							
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PT - PRESS	N SPLIT SPOON SED SHELBY TUBE	D - DISINTE I - INTACT			AFTEF	<u> </u>	TION ft HRS	ft	CFA	A - CON	LOW STEM AUGERS	
CA - CONT RC - ROCK	INUOUS FLIGHT AUGER CORE	U - UNDIST	URBED				S ft				/ING CASING) DRILLING	
STANDARD	PENETRATION TEST DRIVING 2"	OD SAMPLER	1' WITH 1	40# HAI	MMER	FALLIN	IG 30": COUNT	T MADE	AT 6" IN1	TERVAL	S	



oject Nan										Job #		
					SAM	IPLEF	R					
tumMLI	_W	_ Hammer Wt	140	lb	_ Ho	le Diam	eter <u>8 in</u>		For	eman	M. Fletcher	
II. LICV	0.4 ± ft	_ Hammer Dro	·P	in		ck Core				pector	D. Patterson	
te Started _	12/19/18	_ Spoon Size	2 in		_ Bo	ring Me	thod HSA		Dat	e Comple	eted 12/19/18	—
	SOIL DESCRIPTIO	N	STRA	Ы.	тш		SAM	MPLE				
ELEV. (ft)	Color, Moisture, Density, Plas Proportions	ticity, Size	DEPTH (ft)	SOIL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec	BORING & SAMPLE NOTES	
			(14)	<u>ن</u>						(in)		_
	WATER (continued)			h								Ī
				h								
_				h								
_				h								
45.6			46.0	h	45							
-45.6	Black, wet, very soft, SIL1	-	46.0	1111			WOR/18"	1	DS	6		
-	·				-		WOIVIO	I	03	0		
					50		WOR/18"	2	DS	4		
-52.1			52.5		_		WOR/18"	3	DS	5		
+	Dark gray, wet, very soft, f	at CLAY,			-							
-	(CH)						WOR/18"	4	DS	18		
-					<u> </u>							
							WOR/18"	5	DS	15		
								Ŭ				
					_		WOR/18"	6	DS	18		
-59.6	Bottom of Boring at 60.0 ft		60.0		<u>60</u>		WORVIO	0	03	10		
_	Bollom of Boring at 00.0 h				_							
-					-							
					65							
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e	AMPLER TYPE	SAMPLE CO	ידוחאכ		80 GRO	יחאו	VATER DEP	тн	I	ROP		
DS - DRIVE PT - PRESS	N SPLIT SPOON ED SHELBY TUBE NUOUS FLIGHT AUGER	D - DISINT I - INTACT U - UNDIST	EGRATEI ſ	D	AT CO	MPLET	"IONft HRS !Sft		CFA	a - Holl a - Con ⁻	OW STEM AUGERS INUOUS FLIGHT AUGERS ING CASING	



Contracted				ononi						Borin		
Project Nar		LUOP Chai		epenn	ng					Job #	t10-0043	
Location _	Datamore, MD				~							
					SAM	PLEF	۲ ۲					
DatumML	LW	Hammer Wt.	140		_ Ho	le Diam			For	eman _	M. Fletcher	
Surf. Elev.	0.3 ± ft	Hammer Drop		in		ck Core				pector _	D. Patterson	
Date Started _	12/19/19	Spoon Size _	2 in		_ Bo	ring Me	thod HSA		Dat	e Compl	leted12/19/19	
	SOIL DESCRIPTION		OTDA	Ъ	тш		SA	MPLE				٦
ELEV. (ft)	Color, Moisture, Density, Plasti Proportions	city, Size	STRA DEPTH (ft)	SYMBOL SOIL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
	WATER			····	_						1. Area 5	
_				\dots							2. 579207.97 N	
_				uu	_						1438917.54 E	–
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PT - PRES CA - CONT	EN SPLIT SPOON SED SHELBY TUBE INUOUS FLIGHT AUGER	D - DISINTE I - INTACT U - UNDISTU			AFTEF AFTEF	R R 24 HF	rion ft HRS RS ft	ft	CFA DC	4 - CON - DRI\	LOW STEM AUGERS ITINUOUS FLIGHT AUGERS /ING CASING	
RC - ROCK STANDARD	CORE PENETRATION TEST DRIVING 2" (L - LOST	1' WITH 1	40# HAI			ft NG 30": COUNT	T MADE /) DRILLING S	



	ted With										Boring	-	
Project I Locatior	Name	Task 17 - Seag Baltimore, MD	In Loop Cha	innei D	eepen	ing					Job #	18-0043	
LUCATION	I					SAN	IPLER)					
	MLLW			140	lb			<u>.</u>		_		M. Fletcher	
Datum Surf. Elev.			 Hammer Wt. Hammer Dro 				le Diam ck Core				eman pector	D. Patterson	
Date Starte		19	_ Spoon Size _	2 in			ring Met				e Comple	eted 12/19/19	
								S 4 1	MPLE				_
ELE		SOIL DESCRIPTIO		STRA DEPTH	SOIL	DEPTH SCALE					Rec	BORING & SAMPLE	
(ft))	Proportions	,	(ft)	syn	SCE	Cond	Blows/6"	No.	Туре	(in)	NOTES	
	WATE	ER (continued)											
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_					hi] –							
					fun								
					μιι	<u>45</u>							
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_			hi								-		
-48	7		fun	-							-		
	Dark	gray, wet, very soft, e	† T T T T	50		WOR/18"	1	DS	7		_		
	SILT, (MH)							Hertie			'		
	(MH) [*]					_				D 0	10		
	-53.2 53.							WOR/18"	2	DS	18		
	Dark	gray, wet, very soft, f	at CLAY,										-
	(CH)					<u>55</u>		WOR/18"	3	DS	18		
_						_							-
						-		WOR/18"	4	DS	18		–
-60	2			60.5		<u>60</u>		WOR/18"	5	DS	18		
	Botto	m of Boring at 60.5 ft		00.0									_
_						-							-
_													-
_						65							-
_													_
_													-
						<u>70</u>							<u> </u>
\neg													\vdash
						<u>75</u>							
\neg											\vdash		
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						80							
	SAMPLE	R TYPE	SAMPLE CO	NDITIO	ONS	GRO	UNDV	VATER DEP	тн		BOF	RING METHOD	
	RIVEN SPLIT : RESSED SHEI		D - DISINTE I - INTACT					ion ft HRS	ft			LOW STEM AUGERS TINUOUS FLIGHT AUGERS	
CA - C0	ONTINUOUS P	FLIGHT AUGER	U - UNDIST			AFTER	R 24 HR	S ft		DC	- DRIV	ING CASING	
	OCK CORE		L - LOST	41.14.0				ft				DRILLING	
STANDA	ARD PENEIR	ATION TEST DRIVING 2	OD SAMPLER	TWITH	140# HA	INIMER	FALLIN	IG 30": COUNT	MADE	41 6" IN	IERVALS	>	



Contracted	With Gahagan & Brya									Borin	g #PR-31	
Project Nar		t Loop Chai	nnel De	epeni	ng					Job #	18-0043	
Location _	Baltimore, MD											
					SAM	IPLEF	र					
DatumML	LW	Hammer Wt.	140		_ Но	le Diam			For	eman	M. Fletcher	
Surf. Elev.	1.0 ± ft	Hammer Drop		n	_ Ro	ck Core			Insp	pector _	D. Patterson	
Date Started _	12/19/18	Spoon Size _	2 in		_ Bo	ring Me	thod <u>HSA</u>		Dat	e Compl	eted12/19/18	
				4			SAI	MPLE				٦
ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasti Proportions	city, Size	STRA DEPTH (ft)	SOIL	DEPTH	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
	WATER			um							1. Area 5	
				uu							2. 579132.27 N	
				·····							1438527.52 E	
				·····								L
				um	5							
				um								L
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				m	_							
				un	<u>10</u>							<u> </u>
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					<u>15</u>							<u> </u>
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				um								
					30							
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				m	_							
				uu								
				um	_							
				·····	<u>35</u>							
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4												\vdash
				Me	40 CPO			тц		BOT		
-	AMPLER TYPE S	D - DISINTE					VATER DEP TION ft		цел		RING METHOD LOW STEM AUGERS	
PT - PRESS	SED SHELBY TUBE INUOUS FLIGHT AUGER	I - INTACT U - UNDISTI L - LOST			AFTEF AFTEF	R R 24 HF	10Ν ft	ft	CFA DC	4 - CON - DRIV	IOW STEM AUGERS ITINUOUS FLIGHT AUGERS /ING CASING) DRILLING	
STANDARD	PENETRATION TEST DRIVING 2"	OD SAMPLER	1' WITH 1	40# HAI	MMER	FALLIN	IG 30": COUNT	T MADE	AT 6" IN		S	



Contracted										Boring		
Project Nar		rt Loop Char	nnel De	eepeni	ng					Job #	18-0043	
Location _	Baltimore, MD											
					SAM	IPLEF	R					
Datum <u>ML</u>	LW	Hammer Wt.			_ Ho	le Diam			For	eman	M. Fletcher	
Surf. Elev.	1.0 ± ft	Hammer Drop		in		ck Core				pector	D. Patterson	
Date Started _	12/19/18	_ Spoon Size _	2 in		_ Во	ring Me	thod <u>HSA</u>		Dat	e Comple	eted12/19/18	
ELEV.	SOIL DESCRIPTION	1	STRA	ы Г	王믜		SAN	/IPLE			BORING & SAMPLE	
(ft)	Color, Moisture, Density, Plas Proportions	ticity, Size	DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	NOTES	
	·		()	ى م						(11)		
_	WATER (continued)			h								
				frm								
_				h								-
_					45							-
				h	45							
				frm								
		54.0	frm	50								
-50.0	Black, wet, very soft, fat CL	AY	51.0				WOR/18"		50	10		-
<u>-51.5</u>	 Dark gray, wet, very soft, fa	<u>52.5</u>		-			1	DS	18		-	
	(CH)				_							_
					55		WOR/18"	2	DS	18		
					_							
_					_		WOR/18"	3	DS	18		_
_												_
-59.0			60.0		60		WOR/18"	4	DS	18		-
	Bottom of Boring at 60.0 ft		00.0		00_							
_												_
					<u>65</u>							
_					_							-
					-							-
					70							
_					_							-
-												-
\neg					75							\vdash
					<u>···</u>							
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	AMPLER TYPE	SAMPLE CO	עדוחא		80 GPO	ייסארו	VATER DEP	ти		BOL	RING METHOD	
	N SPLIT SPOON	D - DISINTE					ION ft	п	HSA		LOW STEM AUGERS	
PT - PRESS	SED SHELBY TUBE INUOUS FLIGHT AUGER	I - INTACT U - UNDISTU L - LOST			AFTER AFTER	R R 24 HR	HRSft	_ ft	CFA DC	A - CON - DRIV	TINUOUS FLIGHT AUGERS (ING CASING DRILLING	
STANDARD	PENETRATION TEST DRIVING 2"	OD SAMPLER	1' WITH	140# HA	MMER	FALLIN	IG 30": COUNT	MADE	AT 6" IN	TERVAL	8	



Contracte										Borin		
Project Na		jirt Loop Cha	innel De	eepeni	ng					Job #	£18-0043	
Location	Baltimore, MD											
					SAM	IPLEF	२					
DatumN	/LLW	_ Hammer Wt.	140	lb	_ Ho	le Diam	neter 8 in		For	eman _	M. Fletcher	
Surf. Elev.	0.6 ± ft	Hammer Dro	~~~	in		ck Core	e Dia. <u>N/A</u>			pector _	D. Patterson	
Date Started	12/20/18	_ Spoon Size	2 in		_ Bo	ring Me	thod HSA		Dat	e Compl	leted 12/20/18	
							SA	MPLE				7
ELEV. (ft)	SOIL DESCRIPTIO Color, Moisture, Density, Pla: Proportions		STRA DEPTH (ft)	SVMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
	WATER			·····							1. Area 5	
				m							2. 579392.21 N	
				frm							1438139.6 E	_
				frm	_							
					5							
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				frm	<u>15</u>							
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_				frm	20							\vdash
				frm	20							<u> </u>
				m								
				fuu								
				fuu	<u>25</u>							
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_				m								-
_				fuu	30							-
				fuu	30							
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				in								
				h	35							
				h								
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4				hin								\vdash
	SAMPLER TYPE	SAMPLE CO	ן אידירואנ		40 GPO	יסאו	VATER DEF	л		POI		
	JAIVIPLER ITPE /EN SPLIT SPOON	D - DISINTE					FION ft		HSA		LOW STEM AUGERS	
PT - PRE	SSED SHELBY TUBE ITINUOUS FLIGHT AUGER	I - INTACT U - UNDIST L - LOST			AFTEF AFTEF	R R 24 HF	HRS RSft ft	ft	CFA DC	4 - CON - DRIV	ITINUOUS FLIGHT AUGERS /ING CASING D DRILLING	
	D PENETRATION TEST DRIVING 2		<u>1' WIT</u> H ⁻	140# HAI				T MADE				



ontracted roject Nam		ant Associates rt Loop Channel [Boring Job #	-					
ocation _									JOD #		
				SAMF	PLER	ł					
atum <u>MLI</u>			0 lb		Diam				eman	M. Fletcher	
urf. Elev ate Started	0.6 ± ft 12/20/18	_ Hammer Drop <u>3</u> _ Spoon Size <u>2 in</u>	0 in		k Core ng Met				pector e Comple	D. Patterson ated 12/20/18	
ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plas Proportions	ticity, Size STRA (ft)	SYMBOL	DEPTH	Cond	SAM Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
-	WATER (continued)										
-	()		h								
			hi								
			fun								
-44.4		45.0	h	45							
	Black, wet, very soft, elasti	c SILI 46.5		_		WOR/18"	1	DS	4		
	Dark gray, wet, very soft, fa	at CLAY ,		_							
-	(CH)			-		WOR/18"	2	DS	9		
-				50							
				<u> </u>		WOR/18"	3	DS	15		
							Ŭ				
						WOR/18"	4	DS	18		
						WUR/10	4	05	18		
_				<u>55</u>							
-				-		WOR/18"	5	DS	18		
-				—							
-58.4		59.0		-		WOR/18"	6	DS	18		
	Bottom of Boring at 59.0 ft			60							
-											
-				<u>65</u>							
-				_							
				_							
				<u>70</u>							
				_							
4											
-											
-				75							
-											
-											
				80					_		
DS - DRIVEI PT - PRESS	N SPLIT SPOON ED SHELBY TUBE	D - DISINTEGRATE	Ð	AT COM	/IPLET	VATER DEP ION ft HRS		CFA	a - Holi a - Con'	RING METHOD LOW STEM AUGERS TINUOUS FLIGHT AUGERS	
RC - ROCK	NUOUS FLIGHT AUGER CORE PENETRATION TEST DRIVING 2'	U - UNDISTURBED L - LOST		CAVED	DAT _	S ft ft		MD	- MUD	/ING CASING DRILLING	



Contracte	d With <u> </u>	Bryant Associate	es							Borin	g #PR-33	
Project Na		agirt Loop Chan	inel De	epenir	ng					Job #		
Location	Baltimore, M	D										
				:	SAMI	PLEF	R					
DatumN	MLLW	Hammer Wt	140 I		. Hole	e Diam			For	eman _	M. Fletcher	
Surf. Elev	1.5 ± ft	Hammer Drop		n		k Core				pector _	D. Patterson	
Date Started	12/28/18	Spoon Size	2 in		_ Bori	ng Me	thod HSA		Dat	e Compl	eted12/28/18	
	SOIL DESCRIP	TION	STRA	Б.	тш		SA	MPLE				
ELEV. (ft)	Color, Moisture, Density, Proportions	Plasticity, Size	DEPTH (ft)	SVMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
	WATER			····							1. Area 5	
_				·····	_						2. 579027.25 N	
_				·····	_						1437981.34 E	
_												<u> </u>
					5							
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				m								
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					25							
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_					_							-
_				m	_							-
-				m	30							-
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				m								
				m	35							
_				·····								
4					_							-
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	SAMPLER TYPE	SAMPLE CO	סידוסע			וחטו	VATER DEF	л	L	ROI		
	VEN SPLIT SPOON	D - DISINTEC		A		MPLET	ION ft		HSA		LOW STEM AUGERS	
PT - PRE	SSED SHELBY TUBE	I - INTACT U - UNDISTU L - LOST		A A	AFTER AFTER	24 HR	HRSft Sft	ft	CFA DC	4 - CON - DRIV	ITINUOUS FLIGHT AUGERS /ING CASING) DRILLING	
STANDAR	D PENETRATION TEST DRIVIN	G 2" OD SAMPLER 1	' WITH 1						AT 6" IN	TERVAL	s	



		With <u>Gahagan & Bry</u>									Boring	-	
-	ct Nar		girt Loop Cha	nnel De	eepeni	ng					Job #	18-0043	
Locat	ion _	Balumore, MD				0.0.0		<u> </u>					
						SAIV	PLEF						
Datum		LW 1.5 ± ft	_ Hammer Wt.				le Diam				eman	M. Fletcher D. Patterson	
Surf. El Date St		12/28/18	 Hammer Dro Spoon Size _ 	p0 2 in			ck Core ring Me				ector		
				i		· · · ·							
E	ELEV.	SOIL DESCRIPTIO Color, Moisture, Density, Pla		STRA DEPTH	SYMBOL	DEPTH SCALE		SAN	MPLE	1	_	BORING & SAMPLE	
	(ft)	Proportions	Slicity, Size	(ft)	SYMS	SC/	Cond	Blows/6"	No.	Туре	Rec (in)	NOTES	
_		WATER (continued)			fm								-
-					h								-
-													\vdash
-					hi	45							-
					fuu								
_													
	47.5	Black, wet, very soft, elast		49.0	॑ ᢧᢧᢧᢧ								-
	49.0	-	50.5		<u>50</u>		WOR/18"	1	DS	7			
-		Dark gray, wet, very soft, t (CH)			-							\vdash	
					-		WOR/18"	2	DS	16		–	
					_								
						55		WOR/18"	3	DS	18		
_													
_						-		WOR/18"	4	DS	18		–
_													-
-						60		WOR/18"	_	D 0	45		-
	·59.0	Bottom of Boring at 60.5 f	4	60.5		00		WOIN 10	5	DS	15		-
		Bollom of Boring at 60.5 h	L										
_						_							
_						<u>65</u>							<u> </u>
_						-							-
-						-							\vdash
													–
						70							
_													\vdash
4						-							\vdash
-						75							\vdash
				<u>75</u>							<u> </u>		
-						$ \neg$							F
						80							
D 0			SAMPLE CO						тн				
PT - CA -	PRESS	en Split Spoon Sed Shelby Tube Inuous Flight Auger Core	D - DISINTE I - INTACT U - UNDIST L - LOST			AFTEF AFTEF	R R 24 HF	∩ON ft HRS RS ft ft	_ ft	CF/ DC	A - CON - DRIV	LOW STEM AUGERS TINUOUS FLIGHT AUGERS /ING CASING DRILLING	
STA	NDARD	PENETRATION TEST DRIVING 2	2" OD SAMPLER	1' WITH	140# HA				MADE	AT 6" IN	TERVAL	S	



		With Gahagan & Brya									Borin		
		me <u>Task 17 - Seagir</u> Baltimore, MD	t Loop Cha	nnel De	epeni	ng					Job #	£ <u>18-0043</u>	
Loca	tion _	Daiumore, MD											
						SAN	1PLEF	R					
Datum	ML		Hammer Wt.			_ Ho	le Diam			For	eman _	M. Fletcher	
Surf. E		2.4 ± ft 12/28/18	Hammer Dro		in		ck Core				pector _	D. Patterson eted 12/28/18	
Date S	tarted _	12/20/10	Spoon Size	2 in		_ Bo	ring Me	thodA		Dat	e Compl	eted2/20/10	
Γ.		SOIL DESCRIPTION		STRA	Ъ	Ξщ		SA	MPLE				7
	ELEV. (ft)	Color, Moisture, Density, Plasti Proportions	city, Size	STRA DEPTH (ft)	SVMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec	BORING & SAMPLE NOTES	
				(14)	<u>ن</u>						(in)		-
		WATER			h							1. Area 5	
					fuu	_						2. 579157.52 N	
_					fuu	_						1437661.81 E	
_					h	_							_
						5							<u> </u>
-					in	_							-
-					h	—							-
-					frm	_							\vdash
					h	10							
					hin								
				frm	_								
_				frm	_							L	
					15							<u> </u>	
-				h	_							-	
-					h	_							-
-					frm	_							-
				frm	20							-	
					h								
					h	_							
_					fuu	_							
					frm	<u>25</u>							
_						_							-
-					m	_							-
-					fuu	—							-
					frm	30							-
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					hin	_							L
					h	_							
					frm	<u>35</u>							<u> </u>
4						_							\vdash
-						_							\vdash
\neg					hin								\vdash
-					hn	40							\vdash
	S	AMPLER TYPE S	AMPLE CC	NDITIC	NS		UNDV	VATER DEP	PTH		BO	RING METHOD	·
		N SPLIT SPOON	D - DISINTE					TION ft	<u>a</u>			LOW STEM AUGERS	
CA ·	- CONT	SED SHELBY TUBE INUOUS FLIGHT AUGER	I - INTACT U - UNDIST			AFTE	R 24 HF	HRS RS ft	_ π	DC	- DRI\	ITINUOUS FLIGHT AUGERS /ING CASING	
RC ·	- ROCK	CORE	L - LOST					ft		MD	- MUE) DRILLING	
STA	NDARD	PENETRATION TEST DRIVING 2"	OD SAMPLER	1' WITH '	140# HA	MMER	FALLIN	IG 30": COUNT	T MADE	AT 6" IN1	TERVAL	S	



Con	tracted	WithGahagan & Brya									Boring		
Proj	ect Nar	meTask 17 - Seagi	rt Loop Cha	innel D	eepeni	ing					Job #	-	
Loca	ation _	Baltimore, MD											
						SAM	PLEF	र					
Datur	mML	LW	. Hammer Wt.	140	lb	_ Hol	le Diam	eter <u>8 in</u>		For	eman	M. Fletcher	
Surf.		2.4 ± ft	Hammer Dro		in		ck Core				pector _	D. Patterson	
Date	Started _	12/28/18	Spoon Size	2 in		_ Boi	ring Me	thod HSA		Dat	e Comple	eted 12/28/18	
Γ		SOIL DESCRIPTION		STRA	Б.	тш		SAN	/IPLE				
	ELEV. (ft)	Color, Moisture, Density, Plast		STRA DEPTH	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec	BORING & SAMPLE NOTES	
-	. ,	Proportions		(ft)	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	οv	Conta	Biotici o	110.	1,900	(in)		_
		WATER (continued)			L								
					hi								
					h								
_					h								
						45							
-+	-43.6	Black, wet, very soft, elastic	SILT	46.0									\vdash
-	<u>-45.1</u>	-		47.5	JIII			WOR/18"	1	DS	4		-
-		Dark gray, wet, very soft, fa (CH)	it CLAY,			_							-
						50		WOR/18"	2	DS	16		
_						_		WOR/18"	3	DS	18		
_						_							–
_								WOR/18"	4	DS	18		-
						<u>55</u>							<u> </u>
-								WOR/18"	5	DS	18		-
						-		Werthe	5	00	10		
								WOR/18"	•		40		
	-57.6			60.0		<u>60</u>		WUR/10	6	DS	18		
_		Bottom of Boring at 60.0 ft				_							–
-						_							\vdash
-						-							\vdash
-						65							-
_						_							
_													–
						70							<u> </u>
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1						$ \neg$							
						75							
_													\vdash
4						-							\vdash
-						80							-
		AMPLER TYPE	SAMPLE CO		ONS			VATER DEP	тн		BOF	RING METHOD	
	- DRIVE	EN SPLIT SPOON	D - DISINTE	EGRATED)	AT CO	MPLET	TION ft			a - Holi	LOW STEM AUGERS	
		SED SHELBY TUBE INUOUS FLIGHT AUGER	I - INTACT U - UNDIST			AFTEF	२	HRS RS ft	_ ft			TINUOUS FLIGHT AUGERS ING CASING	
	- ROCK		L - LOST									DRILLING	
ST	ANDARD	PENETRATION TEST DRIVING 2"	OD SAMPLER	1' WITH	140# HA	MMER	FALLIN	IG 30": COUNT	MADE	AT 6" IN	TERVAL	3	



Contracted										Borin		
Project Na		Loop Chan	nei De	epenii	ng					Job #	± <u>18-0043</u>	
Location _	Daitinore, MD				~ • • •							
					SAM	PLEF	۲ ۲					
DatumN	LW	Hammer Wt	140			le Diam				eman _	M. Fletcher	
Surf. Elev.	0.3 ± ft 1/2/19	Hammer Drop	30 i	n		ck Core				pector _	D. Patterson eted 1/2/19	
Date Started _	1/2/19	Spoon Size	2 in		_ Boi	ring Me	thod		Dat	e Compl	eted	
	SOIL DESCRIPTION		STRA	Ъ'	Ξщ		SAI	MPLE				7
ELEV. (ft)	Color, Moisture, Density, Plastic Proportions	city, Size	STRA DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
	WATER										1. Area 7	
_												–
_			ĺ								2. 579367.57 N 1437422.29 E	-
				in								F
				·····	5							
				·····								
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				·····								
			ľ		30							
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			ľ	\dots	<u>35</u>							<u> </u>
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				····	_							
				····	40							
S	AMPLER TYPE S	AMPLE CON	NDITIO				VATER DEP	тн		BO	RING METHOD	
PT - PRES	EN SPLIT SPOON SED SHELBY TUBE	D - DISINTEG			AFTEF	۲	TION ft HRS	ft	CFA	A - CON	LOW STEM AUGERS ITINUOUS FLIGHT AUGERS	
CA - CONT RC - ROCK	INUOUS FLIGHT AUGER	U - UNDISTU L - LOST	RBED				RS ft				/ING CASING) DRILLING	
STANDARD	PENETRATION TEST DRIVING 2" (DD SAMPLER 1	' WITH 1	40# HAN	MMER	FALLIN	IG 30": COUNT	MADE	AT 6" IN	TERVAL	S	



Page 2 of 2

cation _	Baltimore, MD				SVV	1PLEI	>					
			440				0.1					
um <u>ML</u>	0.3 ± ft	. Hammer Wt	~~			le Dian				eman	M. Fletcher D. Patterson	
Elev Started	1/2/19	. Hammer Dro Spoon Size	op			ock Core oring Me	5 Dia			ector e Comple		
					_ DC	ing we				e compie		
ELEV.	SOIL DESCRIPTION		STRA	30L	ΞIJ		SAN	/IPLE	1		BORING & SAMPLE	
(ft)	Color, Moisture, Density, Plast Proportions	icity, Size	DEPTH (ft)	SVMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec	NOTES	
			(11)	ک						(in)		
	WATER (continued)											
-41.7			42.0	in] _							
	Black, moist to wet, mediur	n stiff to					2-2-3	1	DS	18		
	very stiff, elastic SILT							•				
					45							
45.7			46.0				5-5-11	2	DS	12		
	Dark green, moist to wet, v	ery			:							
	loose, fine to coarse, silty S with gravel	SAND,	40.5				2-1-1	3	DS	10		
<u>-48.2</u>	Gray, brown, moist to wet,	verv soft	48.5									
	to soft, SILT , with sand,	vory con			50							
	(ML)						WOH/6"-1-2	4	DS	18		
					_		WOH/18"	5	DS	18		
					55_		WOR/18"	0	D 0	10		
<u>-55.7</u>			56.0	╎┙┙╸			WOIV 18	6	DS	18		
	Gray, moist to wet, soft to r stiff, elastic SILT , trace san				_							
	mica	u,			_		WOH/6"-2-3	7	DS	18		
-					_							
					<u>60</u>		WOH/12"-4	8	DS	16		
-60.7	Bottom of Boring at 61.0 ft		61.0				WOI#12 4	U				
-	Dottom of Doning at 01.0 ft				-							
-					-							
-												
-					<u>65</u>							
-					-							
-					-							
-					-							
-					70							
-					<u>10</u>							
-					-							
1					-							
1												
1					75							
1					<u> </u>							
1												
1												
1												
					80							
S	AMPLER TYPE	SAMPLE CO	ONDITIC	ONS			NATER DEP	тн		BOR	RING METHOD	
	N SPLIT SPOON	D - DISINT					TION ft	-	HS/		LOW STEM AUGERS	
	SED SHELBY TUBE	I - INTAC	г		AFTE	P	HRS	ft	CE		TINUOUS FLIGHT AUGERS	



roject Nar										Job #	
ocation _	Baltimore, MD										
					SAM	1PLEF	र				
atumML	LW	_ Hammer Wt.	140	lb	_ Ho	le Diam	eter 8 in		For	eman _	M. Fletcher
urf. Elev	0.2 ± ft	_ Hammer Dro		in		ck Core			Insp	ector _	D. Patterson
ate Started _	1/2/19	_ Spoon Size _	2 in		_ Bo	ring Me	thod <u>HSA</u>		Dat	e Comp	leted1/2/19
	SOIL DESCRIPTION	J	STRA	Б.	ΞШ		SAM	MPLE			
ELEV. (ft)	Color, Moisture, Density, Plas Proportions	ticity, Size	STRA DEPTH (ft)	SOIL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES
	WATER			h							1. Area 7
				hin							2. 579039.74 N
				fun							1437071.29 E
_				h							
-					5						
				hin	_						
\dashv				fun							
				h							
				h	10						
_				h							
_				h							
-					-						
-				h	15						
				h							
				h							
_											
				hin							
-19.8	Black, brown, grey, wet, ve	ery soft,	20.0		<u>20</u>		WOR/18"		D 0	-	
-	CLAY				-		WUR/10	1	DS	7	
-23.8			<u>_24.0</u>				WOR/18"	2	DS	10	
_	Black, brown, dark gray, w soft, fat CLAY ,	et, very			<u>25</u>						
_	(CH)				_		WOR/18"	3	DS	15	
-					_						
					-		WOR/18"	4	DS	12	
					30						
							WOR/18"	5	DS	18	
-					-		WOR/18"	6	DS	16	
-					25						
-					<u></u>		WOR/18"	7	DS	14	
								'		14	
										40	
_							WOR/18"	8	DS	18	
					40						
	AMPLER TYPE	D - DISINTE					TION ft	ΊΗ	HSA		RING METHOD
PT - PRES	SED SHELBY TUBE	I - INTACT			AFTE	R	HRS	ft	CFA	A - CON	ITINUOUS FLIGHT AUGERS
UA - CONT	INUOUS FLIGHT AUGER	U - UNDIST	UKBED		AFIE	r 24 HH	RS ft		DC	- DRI	VING CASING



Page 2 of 2

ation _	Baltimore, MD				<u> </u>						
					SAM	1PLEF	र				
	LW	Hammer Wt.				le Diam				eman	M. Fletcher
	0.2 ± ft 1/2/19	Hammer Dro		IN		ck Core				pector	D. Patterson ated 1/2/19
Started _	1/2/19	Spoon Size	2 10		_ Bo	ring Me	thod <u>noa</u>		Dat	e Comple	eted
	SOIL DESCRIPTION		STRA	Ъ	Ξщ		SAM	MPLE			
ELEV. (ft)	Color, Moisture, Density, Plastic	city, Size	DEPTH	SOIL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec	BORING & SAMPLE NOTES
	Proportions		(ft)	° S	SD	Conta	Biomoro		1,900	(in)	
	Black, brown, dark gray, wet	t, very					WOR/18"	9	DS	13	
	soft, fat CLAY, (CH) (continued)				-		montrio	5	00	15	
					_		WOR/18"	10	DS	5	
					45						
			10.5				WOR/18"	11	DS	7	
<u>-46.3</u>	Dark greenish-brown, wet, lo		46.5								
	medium dense, fine to coars	se,					0.0.40	10	50	_	
	SAND, some silt and gravel						6-9-10	12	DS	2	
					50						
					- 1		5-10-12	13	DS	10	
							4-6-7	14	DS	6	
							101		20	Ũ	
					55						
					-		3-3-7	15	DS	5	
-58.8			59.0		-		1-3-5	16	DS	12	
-30.0	Bottom of Boring at 59.0 ft		39.0		60						
	0				00						
					65						
					_						
					_						
					70						
					_						
					_						
					<u>75</u>						
					80						
<u>.</u>	AMPLER TYPE S	AMPLE CC		ONS			VATER DEP	тн	1	BOF	
	N SPLIT SPOON	D - DISINTE					TION ft		HSA		LOW STEM AUGERS
	SED SHELBY TUBE	I - INTACT					HRS	ft			TINUOUS FLIGHT AUGERS



Contracted										Borin		
Project Na		Loop Chan	inei De	epenii	ng					Job #	£ <u>18-0043</u>	
Location _	Datamore, MD				~ • • •							
					SAM	PLEF	۲ ۲					
Batan	LLW	Hammer Wt.	140			e Diam				eman _	M. Fletcher	
Surf. Elev.	1.7 ± ft 1/9/19	Hammer Drop	30 i 2 in	n		ck Core				pector _	D. Patterson	
Date Started	1/5/15	Spoon Size	2 111		_ Boi	ring Me	thod <u>13A</u>		Dat	e Compl	eted	
	SOIL DESCRIPTION		STRA DEPTH	٦ م	Ξщ		SAI	MPLE				7
ELEV. (ft)	Color, Moisture, Density, Plastic Proportions	city, Size	DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
			()	ک						(11)		-
	WATER			·····							1. Area 8	
_				·····	_						2. 579010.45 N	
_				·····	_						1437367.65 E	\vdash
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_					45							-
				in	<u>15</u>							<u> </u>
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				·····	40							
S	AMPLER TYPE S	AMPLE CO	NDITIO	NS	GRO	UND	VATER DEP	тн		BO	RING METHOD	
	EN SPLIT SPOON SED SHELBY TUBE	D - DISINTEO	GRATED				-ION ft HRS	ft.			LOW STEM AUGERS ITINUOUS FLIGHT AUGERS	
	INUOUS FLIGHT AUGER	U - UNDISTU L - LOST	JRBED		AFTEF	R 24 HF	HRS RSft ft	1L	DC	- DRI\	/ING CASING) DRILLING	
	PENETRATION TEST DRIVING 2" (I' WITH 1	40# HAN				MADE /				



Contracted										Boring		
Project Na		rt Loop Chan	nel De	epeni	ng					Job #	18-0043	
Location	Baltimore, MD											
					SAM	PLER						
Datam	LLW	_ Hammer Wt	140			e Diame				eman	M. Fletcher	
Surf. Elev Date Started	1.7 ± ft 1/9/19	 Hammer Drop Spoon Size 	30 i 2 in	In		k Core ing Met				ector e Comple	D. Patterson ated 1/9/19	
						ing wet				Comple		
ELEV.	SOIL DESCRIPTION		STRA DEPTH	SVMBOL	ΞIJ		SAN	/IPLE			BORING & SAMPLE	
(ft)	Color, Moisture, Density, Plas Proportions	licity, Size	(ft)	SVMI	DEPTH	Cond	Blows/6"	No.	Туре	Rec (in)	NOTES	
										. ,		
_	WATER (continued)			·····	_							_
_				·····	_							_
-					_							-
-				m	45							-
				·····	<u>+5</u>							
-45.3			47.0	·····	_							
	Black, wet, very soft, elasti	c SILT	48.5				WOR/18"	1	DS	8		
<u>-46.8</u> _	Dark gray, wet, very soft, fa	at CLAY,	40.5									
	(CH)				<u>50</u>		WOR/18"	2	DS	18		
-					_			-				-
-					-		WOR/18"	2		45		-
-					-		WUR/10	3	DS	15		-
-					55							-
							WOR/18"	4	DS	18		
_												
_					_		WOR/18"	5	DS	18		
_					_							_
F0 2			61.0		<u>60</u>		WOR/18"	6	DS	18		
-59.3	Bottom of Boring at 61.0 ft		01.0									-
-					_							_
					65							
_					_							
_					_							_
_					_							-
-					70							_
					<u>70</u>							
-												
					<u>75</u>							
_												\vdash
_					_							_
-												F
-					80							\vdash
S	SAMPLER TYPE			NS			ATER DEP	тн	<u> </u>	BOF	RING METHOD	
DS - DRIVE	EN SPLIT SPOON	D - DISINTEG	-	_	AT CO	MPLET	ION ft			A - HOLL	OW STEM AUGERS	
CA - CONT	SED SHELBY TUBE TINUOUS FLIGHT AUGER	I - INTACT U - UNDISTU	RBED		AFTER	24 HR	HRS S ft	_ ft	DC	- DRIV	TINUOUS FLIGHT AUGERS ING CASING	
RC - ROCK		L - LOST			CAVE	DAT _	ft				DRILLING	
STANDARD	PENETRATION TEST DRIVING 2"	OD SAMPLER 1	WITH 1	40# HA	MMER	FALLIN	G 30": COUNT	MADE	at 6" int	ERVALS	6	



				SAN	1PLEF	R				
tum <u>MI</u> rf. Elev. <u></u> te Started _	LW 0.8 ± ft 1/14/19		40 lb 30 in 1	_ Ro	le Diam ck Core ring Me	Dia. <u>N/A</u>		Insp	eman _ pector _ e Compl	M. Fletcher D. Patterson eted 1/14/19
ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plast Proportions	icity, Size STR/ DEPT (ft)	SYMBOL	DEPTH SCALE	Cond	SAN Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES
	WATER									1. Area 6
-										2. 578408.06 N 1437491.71 E
-										
_				<u>10</u>						
_				 						
_										
_				20 						
-				 25						
-27.2	Black, wet, very soft, fat CL	28.0 AY				WOR/18"	1	DS	5	
_						WOR/18"	2	DS	7	
<u>-33.7</u>	Dark green, wet, very soft, 1 CLAY,	34.5				WOR/18" WOR/18"	3	DS DS	10 18	
-	(CH)					WOR/18"	4 5	DS	18	
e	AMPLER TYPE			40 GPO		VATER DEP	тн		BOI	RING METHOD
DS - DRIVE PT - PRES	EN SPLIT SPOON SED SHELBY TUBE 'INUOUS FLIGHT AUGER	D - Disintegrati I - Intact U - Undisturbee	ED	AT CO AFTE)MPLET R R 24 HR	TION ft HRS S. ft		CFA	A - HOL A - CON	LOW STEM AUGERS ITINUOUS FLIGHT AUGERS /ING CASING



Page 2 of 2

cation _	Baltimore	,			SAM		R				
tum <u>ML</u>	W	Llowmore	w/t 140	lb			0.1		For	eman	M. Fletcher
f. Elev	0.8 ± ft	Hammer				e Diam k Core				eman pector	D. Patterson
te Started _	1/14/19	Spoon Siz				ng Met				e Comple	eted1/14/19
		-				-					
ELEV.	SOIL DES	CRIPTION	STRA DEPTH	SOIL	DEPTH		SAI	MPLE			BORING & SAMPLE
(ft)	Color, Moisture, Den Propo	tions	(ft)	SM	NC/BE	Cond	Blows/6"	No.	Туре	Rec (in)	NOTES
				0)						()	
_	Dark green, wet, ve CLAY,	ery soft, fat			_				D 0	10	
_	(CH) (continued)						WOR/18"	6	DS	18	
4											
-					_		WOR/18"	7	DS	18	
-44.2	Dark green, wet, ve		45.0		45						
-	SILT,	ery soit, elastic			_		WOR/18"	8	DS	18	
-	(MH)				_						
-					-						
40.0			50.0				WOR/18"	9	DS	16	
- <u>49.2</u>	Dark gray, wet, ver	v soft. fat CLAY	<u>50.0</u>		<u>50</u>						
-	5,,,,,	, ,			-		WOR/18"	10	DS	18	
1											
-							WOR/18"	11	DS	18	
1					55		WORVIO		03	10	
1											
1							WOR/18"	12	DS	18	
507			59.5				WOR/18"	13	DS	18	
-58.7	Bottom of Boring a	t 59.5 ft	59.5		60						
-	Ũ										
-											
-					_						
-											
-					<u>65</u>						
-					_						
-					-						
-					-						
-					70						
1					<u> </u>						
1					_						
1											
1					75						
4											
		_			80					_	
	AMPLER TYPE	SAMPLE					VATER DEP	TH			RING METHOD
	N SPLIT SPOON	D - DISII	NTEGRATED)	AT COM	MPLET	ION ft		HS/	a - Holi	LOW STEM AUGERS



Contracted Project Na				eepeni	na					Borin Job #	-	
Location										300 #		
					SAM	1PLEF	R					
DatumM	LW	_ Hammer Wt.	140	lb	_ Ho	le Diam	eter <u>8 in</u>		For	eman _	M. Fletcher	
Surf. Elev	0.9 ± ft	_ Hammer Dro		in		ck Core			Insp	ector _	D. Patterson	
Date Started	1/3/19	_ Spoon Size	2 in		_ Bo	ring Me	thod <u>HSA</u>		Dat	e Compl	eted1/3/19	
	SOIL DESCRIPTIO	N	STRA	Б.	тш		SAN	/IPLE				7
ELEV. (ft)	Color, Moisture, Density, Pla Proportions		DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
	WATER			h							1. Area 7	
_				fuu							2. 578726.69 N	–
_											1436798.21 E	-
_				L	5							-
				fun	<u> </u>							
-				fuu								F
				μm								
												Ľ
				in	10							
_				h								<u> </u>
_				fuu								-
_												-
_				him	15							\vdash
				h								
				h								
				h								
_] _							
				hin	<u>20</u>							
-				fuu								-
	Black, gray, wet, very soft	elastic	22.0									-
-	SILT,	,			-		WOR/18"	1	DS	12		\vdash
-	(MH)				25							-
							WOR/18"	2	DS	18		
_					_		WOR/18"	3	DS	18		
_					- I							-
					30_		WOR/18"	4	DS	18		
<u>-30.1</u>	Dark gray, wet, very loose	to loose,	<u>_31.0</u> -									-
-	fine to coarse, SAND, so trace silt. trace shells	ne gravel,					2-2-3	5	DS	9		-
	trace siit, trace shells						2-2-3	5	03	9		
					35			-		_		
<u>-35.1</u>			<u>36.0</u>				6-2-1	6	DS	7		
_	Brown, wet, medium stiff, SILT, trace mica	sandy										
4					_		2-2-3	7	DS	11		<u> </u>
<u>-38.1</u>			<u>39.0</u>									\vdash
	AMPLER TYPE	SAMPLE CO	ידוחאנ	NIC SNC	40 GRO	ערואוו		тн		RO1	RING METHOD	
	EN SPLIT SPOON	D - DISINTE					ION ft		HSA		LOW STEM AUGERS	
PT - PRES	SED SHELBY TUBE INUOUS FLIGHT AUGER	I - INTACT U - UNDIST			AFTE	R	HRSft	_ ft	CFA	A - CON	ITINUOUS FLIGHT AUGERS /ING CASING	
RC - ROCK		L - LOST	UNDED		CAVI	ED AT	.5 ft) DRILLING	
STANDARD	PENETRATION TEST DRIVING	2" OD SAMPLER	1' WITH	140# HA	MMER	FALLIN	IG 30": COUNT	MADE	AT 6" IN	ERVAL	S	



Page 2 of 2

		With Gahagan & Bryant Associ								Borin	•	
-		me <u>Task 17 - Seagirt Loop Ch</u> Baltimore, MD	nannel Do	eepen	ing					Job #	18-0043	
Loca	ation _	Balumore, MD					_					
					SAN	1PLE	R					
Datun	nML	LW Hammer V			_ но	ole Dian			For	eman _	M. Fletcher	
Surf. I		0.9 ± ft Hammer D 1/3/19 Spoon Size		in		ock Cor				ector _	D. Patterson	
Date \$	Started _	1/3/19 Spoon Size	e 2 in		Bo	oring Me	ethod		Dat	e Compl	eted1/3/19	
Γ		SOIL DESCRIPTION	STRA	٦ ٦	Ξщ		SAN	IPLE				
	ELEV. (ft)	Color, Moisture, Density, Plasticity, Size Proportions	DEPTH (ft)	SVMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
_		Greenish-brown, wet, very loose, fine, silty SAND ,					WOH/6"-1-1	8	DS	18		
_	-42.6	(SM) (continued)	43.5				WOH/12"-1	9	DS	18		
		Orange- brown, brown, wet, medium dense, fine, silty SAND , some gravel,			45		28-7-6	10	DS	18		
		(SM)					20-7-0	10	00	10		
	-47.6	Brown, wet, soft, CLAY	<u>48.5</u>				8-12-17	11	DS	15		
	-49.6	Dark gray, wet, soft, SILT, with	<u> </u>		<u>50</u>		5-2-2	12	DS	10		
_	50.0	sand, (ML)	50.5				6-2-2	13	DS	7		
_	<u>-52.6</u>	Orange-brown, wet, medium dense, fine, SAND , trace silt	<u> </u>		55							
_							2-7-8	14	DS	15		
							2-8-9	15	DS	9		
_	-60.1		61.0		60		4-8-12	16	DS	10		
-		Bottom of Boring at 61.0 ft			_							
					<u>65</u>							
_					-							-
-												-
-					-							-
-					70							-
					_							
_					_							
					<u>75</u>							
_					-							-
_					-							-
-					-							-
-					80							-
	S	AMPLER TYPE SAMPLE C	ONDITIC	ONS		UND	WATER DEP	тн		BOF	RING METHOD	
PT CA	- PRES	SED SHELBY TUBE I - INTAG INUOUS FLIGHT AUGER U - UNDI:	STURBED		AFTE AFTE	R R 24 HI	TION ft HRS RS ft	_ ft	CFA DC	- CON - DRI	LOW STEM AUGERS TINUOUS FLIGHT AUGERS /ING CASING	
	- ROCK	CORE L - LOST PENETRATION TEST DRIVING 2" OD SAMPLE		<u>140# H</u> A			ft NG 30": COUNT	MADE) DRILLING S	



	cted With <u>Gahagan & Brya</u>									Borin		
	Name <u>Task 17 - Seagi</u> n Baltimore, MD	n Loop Cha	nnei De	epeni	ng					Job #	£ <u>18-0043</u>	
Locatio	n Baltimore, MD				~ • • •							
					SAN	IPLEF	۲ ۲					
Datum	MLLW	. Hammer Wt.				le Diam				eman _	M. Fletcher	
Surf. Elev.		. Hammer Dro		in		ck Core				pector _	D. Patterson	
Date Start	ied1/9/19	Spoon Size _	2 in		_ Bo	ring Me	thod		Dat	e Compl	eted	
	SOIL DESCRIPTION		STRA	Ŀ	Ξщ		SAI	MPLE				7
ELE (ft	EV. Color Moisture Donsity Plast	icity, Size	STRA DEPTH (ft)	SVMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
	WATER										1. Area 8	
-					-							\vdash
-					_						2. 578642.07 N 1437025.38 E	\vdash
-				un								F
				·····	5							
				·····								
_												
_				m	_							–
_				·····								-
				·····	<u>10</u>							-
-				····								\vdash
-												-
				un								
				·····	15							
_				·····								L
_												L
_				m	_							-
_				·····								-
				·····	<u>20</u>							<u> </u>
-				····								-
-					_							F
				in								
				····	25							
_				·····								
_												-
_				in								-
-				·····	30							-
				·····	30							-
-				····								F
				un								
				·····	<u>35</u>							
4				·····								\vdash
4				·····								\vdash
												\vdash
				·····	40							\vdash
	SAMPLER TYPE	SAMPLE CO	NDITIC	ONS			VATER DEP	тн	1	BOI		
	RIVEN SPLIT SPOON	D - DISINTE	GRATED)	AT CC	MPLE	TION ft			A - HOL	LOW STEM AUGERS	
CA - C	RESSED SHELBY TUBE ONTINUOUS FLIGHT AUGER OCK CORE	I - INTACT U - UNDIST L - LOST			AFTEF	r 24 Hf	HRS RS ft ft	ft	DC	- DRI\	ITINUOUS FLIGHT AUGERS /ING CASING) DRILLING	
	ARD PENETRATION TEST DRIVING 2"		1' WITH 1	140# HAI				T MADE /				



		ahagan & Bry ask 17 - Seagi			eepeni	ina					Boring Job #	-	
Location		altimore, MD			oopon	ing					JOD #		
						SAM	IPLEF	2					
Datum	MLLW		_ Hammer Wt.			_ Ho	le Diam			For	eman	M. Fletcher	
Surf. Elev.			Hammer Dro		in		ck Core				ector	D. Patterson	
Date Starte	d <u>1/9/19</u>		Spoon Size	2 in		Bo	ring Me	hod <u>HSA</u>		Dat	e Comple	eted1/9/19	
	, s	OIL DESCRIPTION	1	STRA DEPTH	٦ ت	Ξщ		SAM	/IPLE				
ELE\ (ft)		sture, Density, Plas Proportions	ticity, Size	DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
	WATER (c	ontinued)											
_						1 -							-
_					h]							-
_					fun								
					fun	45							
_					h								
-45.	9 Derk grov	wat your oaft fe		47.0									
_	trace sand	wet, very soft, fa				-		WOR/18"	1	DS	18		+
_	(CH)					50							-
						<u> </u>		WOR/18"	2	DS	18		-
_													
51.	9⊥			53.0				WOR/18"	3	DS	18		
_	Dark gray, CLAY,	wet, very soft, e	lastic										
	(MH)					55_		WOR/18"	4	DS	18		<u> </u>
_						_			-				-
_						_		WOR/18"	_	D 0	10		-
_						-		WUR/10	5	DS	18		-
						60							
-59.	9			61.0				WOR/18"	6	DS	18		
_	Bottom of	Boring at 61.0 ft											
_						_							-
_						65							-
						05							-
_													–
_													
						<u>70</u>							<u> </u>
-						-							\vdash
-													\vdash
_													
						75							
4													F
_													\vdash
-						-							\vdash
-						80							\vdash
	SAMPLER TY	PE S	SAMPLE CO		ONS			VATER DEP	тн		BOF		
	IVEN SPLIT SPOO	N	D - DISINTI	EGRATED)	AT CC	MPLET	ION ft			A - HOLL	LOW STEM AUGERS	
CA - CC	ESSED SHELBY T NTINUOUS FLIGH		I - INTACT U - UNDIST			AFTER	R 24 HR	HRS S ft	_ #			TINUOUS FLIGHT AUGERS ING CASING	
RC - RC	CK CORE		L - LOST			CAVE	ED AT	ft		MD	- MUD	DRILLING	
STANDA	RD PENETRATION	TEST DRIVING 2	OD SAMPLER	1' WITH	140# HA	MMER	FALLIN	IG 30": COUNT	MADE	AT 6" IN	FERVALS	6	



cati	ion _	Baltimore, MD										
						SAM	1PLEF	R				
tum .	ML	_W	Hammer Wt	140 I	b	_ Ho	le Diam	eter <u>8 in</u>		For	eman _	M. Fletcher
rf. Ele	ev	1.5 ± ft	Hammer Drop _	30 i	n	_ Ro	ck Core			Insp	ector _	D. Patterson
te Sta	arted _	1/8/19	Spoon Size	2 in		_ Bo	ring Me	thod HSA		Date	e Compl	eted1/8/19
								CAN	/IPLE			
E	ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plastic Proportions	city, Size DE	TRA EPTH (ft)	SVMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES
		WATER										1. Area 6
-						_						
												2. 578181.16 N 1437432.76 E
					in	_						
					um	5						
					un	-						
					·····							
1					·····	_						
					·····	_						
						10						
				[
					m							
					un							
					uu							
					·····	15						
					·····	_						
					····	_						
						_						
					m							
4					un	<u>20</u>						
_					um	_						
_					·····	_						
-					·····	_						
-					um							
-					····	<u>25</u>						
-				[_						
+ ,	06 E		2		m	_						
	26.5	Black, wet, very soft, fat CLA		8.0				WOR/18"		D 0		
-						30		WOR/10	1	DS	4	
-						<u></u>						
1								WOR/18"	2	DS	10	
1								WOR/18"	3	DS	12	
<u></u> :	<u>33.0</u>	Dark gray, wet, very soft, ela	$\underline{-}$	4.5		35			U		12	
]		SILT,										
		(MH)						WOR/18"	4	DS	15	
								WOR/18"	5	DS	18	
						40			-		-	
	S	AMPLER TYPE S	AMPLE CONE	DITIO	NS	GRO	UNDV	VATER DEP	тн		BO	RING METHOD
		N SPLIT SPOON ED SHELBY TUBE	D - DISINTEGR	ATED				ION ft	#			LOW STEM AUGERS
- I -	LUC	U ORELDI IUDE	I - INTACT			ᆔᆝᄇ	<u>۱</u>	HRS	_ 11		1 - UUN	ITINUOUS FLIGHT AUGERS



Page 2 of 2

Contracted										Borin	-	
Project Nar		t Loop Char	nnel De	epeni	ing					Job #	£18-0043	
Location _	Baltimore, MD											
					SAM	PLEF						
	<u>LW</u> 1.5 ± ft	Hammer Wt.				le Diam				eman _	M. Fletcher D. Patterson	
Surf. Elev Date Started _	1/8/19	Hammer Drop Spoon Size	2 in			ck Core ring Me	- Dia			ector _ e Compl		
										e eenip	I	
ELEV.	SOIL DESCRIPTION Color, Moisture, Density, Plasti	city Size	STRA DEPTH	SVMBOL	DEPTH SCALE		SAN	/IPLE		Dee	BORING & SAMPLE	
(ft)	Proportions	onty, Oize	(ft)	SYN	SCE	Cond	Blows/6"	No.	Туре	Rec (in)	NOTES	
	Dark gray, wet, very soft, ela	astic										—
	SILT,			ш	-		WOR/18"	6	DS	18		-
	(MH) (continued)			ш								
				ш			WOR/18"	7	DS	18		
				ш	45							
_				ш	-		WOR/18"	8	DS	18		-
_				ш	_			-				-
				ш			WOR/18"	9	DS	16		-
				ш	50				00	10		
				ш	_		WOR/18"	10	DS	18		
_				ш			Werthe	10	00	10		-
_				ш	_		WOR/18"	44		10		-
				ш			WUR/10	11	DS	18		-
				ш								
_				ш			WOR/18"	12	DS	18		
_				ш	_							<u> </u>
-58.0			59.5		60		WOR/18"	13	DS	16		-
	Bottom of Boring at 59.5 ft				<u>60</u>							
_												–
					<u>65</u>							
												-
												-
					<u>70</u>							
4												\vdash
-												-
\neg												F
					75							
4												_
-												\vdash
					80							-
S	AMPLER TYPE S		NDITIO	NS			WATER DEP	тн		BO		
PT - PRESS CA - CONT	IN SPLIT SPOON SED SHELBY TUBE INUOUS FLIGHT AUGER	D - DISINTEO I - INTACT U - UNDISTU			AT CO AFTEF AFTEF	MPLE1 R R 24 HF	ΓΙΟΝ ft HRS RS ft		CFA DC	- CON - DRI	LOW STEM AUGERS ITINUOUS FLIGHT AUGERS /ING CASING	
RC - ROCK STANDARD	PENETRATION TEST DRIVING 2"	L - LOST OD SAMPLER 1	' WITH 1	40# HA			ft NG 30": COUNT	MADE) DRILLING S	



	cted With	Gahagan & Bry Task 17 - Seag			oononi	<u>na</u>					Borin	-	
-	Name on	Baltimore, MD	In Loop Cha	nnei De	eepeni	ng					Job #	£ <u>10-0043</u>	
Localio	лт <u> </u>	20000,002				SAM	IPLER	2					
Datum	MLLW		_ Hammer Wt.	140	lb		le Diam			For	eman	M. Fletcher	
Surf. Elev			_ Hammer Dro				ick Core	Dia. <u>N/A</u>			pector _	D. Patterson	
Date Star	rted1/9/1	9	_ Spoon Size _	2 in		_ Во	ring Met	hod <u>HSA</u>		Dat	e Compl	eted1/9/19	
		SOIL DESCRIPTION	N	STRA	Ъ'	Ξщ		SAN	IPLE				7
ELI (f	EV. ft) Co	lor, Moisture, Density, Plas Proportions	ticity, Size	STRA DEPTH (ft)	SOIL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
	WA	TER			h							1. Area 7	-
					hin							2. 578425.93 N	
_					h							1436587.91 E	-
_						5							\vdash
					fuu								<u> </u>
_					m								+
_					fuu	10							\vdash
_					h	_							
_						-							\vdash
_					h	15							F
					fun								
_													_
_					h								-
_					fun	20							F
_					h								-
_						_							-
_						25							-
					fuu								
_													-
_					hin	. –							\vdash
					h	30							
_													
_					fuu								-
	3.3			34.0									-
	Blac	k, wet, very soft, elasti	c SILT ,		ĬĬĬĬ	35		WOR/18"	1	DS	4		
_	uac	e fine sand											<u> </u>
\neg								WOR/18"	2	DS	8		\vdash
													L
						40		WOR/18"	3	DS	12		
	-						-		тн				
PT - P CA - C	DRIVEN SPLIT PRESSED SH CONTINUOUS ROCK CORE		D - DISINTE I - INTACT U - UNDIST L - LOST			AFTER	₹ 7 24 HR	ION ft HRS S ft ft	_ ft	CFA DC	- CON - DRIV	LOW STEM AUGERS ITINUOUS FLIGHT AUGERS /ING CASING) DRILLING	
		RATION TEST DRIVING 2		1' WITH	140# HA				MADE				



Page 2 of 2

oject Nan				sopen					Job #	18-0043	
	Balancio, MB				SAMPLE	R					
um ML	1 \\\/		_t 140	lb		0.1		_		M. Fletcher	
um	0.7 ± ft	 Hammer W Hammer Dr 			_ Hole Diar _ Rock Cor				eman pector	D. Patterson	
e Started	1/9/19	_ Spoon Size	ор <u>— — — — — — — — — — — — — — — — — — —</u>		_ Boring M				e Comple	eted 1/9/19	
		•	-		1 1						
ELEV.	SOIL DESCRIPTIO		STRA DEPTH	SYMBOL	DEPTH SCALE Coud	SAI	MPLE			BORING & SAMPLE	
(ft)	Color, Moisture, Density, Plas Proportions	sticity, Size	(ft)	SM	E Cond	Blows/6"	No.	Туре	Rec (in)	NOTES	
				0)					()		
	Black, wet, very soft, elast trace fine sand (continued)	c SILT ,									
					_	WOR/18"		D 0	45		
						WUR/10	4	DS	15		
					_						
_					<u>45</u>	WOR/18"	5	DS	15		
-45.3			46.0								
_	Dark gray, wet, very soft, f	at CLAY,				WOR/18"	6	DC	15		
_							0	DS	15		
_											
-					<u>50</u>	WOR/18"	7	DS	15		
-											
-						WOR/18"	8	DS	15		
-							0		15		
-					_						
-					<u>55</u>	WOR/18"	9	DS	15		
-					_						
-					_	WOR/18"	10	DS	12		
-											
-											
-59.8			60.5		<u>60</u>	WOR/18"	11	DS	7		
-	Bottom of Boring at 60.5 ft										
-											
-											
-					65						
-					00						
					70						
1											
]											
					75						
					80						
S	AMPLER TYPE	SAMPLE C	ONDITIC	ONS	GROUND	WATER DEP	тн		BOF	RING METHOD	
	N SPLIT SPOON SED SHELBY TUBE	D - DISIN I - INTAC	т		AFTER	TION ft HRS	ft			LOW STEM AUGERS TINUOUS FLIGHT AUGERS	
	NUOUS FLIGHT AUGER	U - UNDIS				RS ft				ING CASING	



Project Name Task 17 - Seagift Loop Channel Despening Job # 18-0043 Location Baltimore, MD SAMPLER Data MLIM Herrore VM 190 No. Herrore VM H	Contracted										Borin		
SAMPLER Date::::::::::::::::::::::::::::::::::::			t Loop Cha	nnel De	eepeni	ng					Job #	±18-0043	
Data Maller Harmon VII. Mol Denotor Bit Forman M. Peaton Build Bergelow 10419 Spon Size 2/n Boord Method BSA Persence Mol Denotor	Location												
Shift Bare, 16 ± ft. Hermore Dog 20 in Rock Core Dia. NA Importor Deleteron Date Stated 19910 Spon Size 2 in Borng Method Date Correlated Date Correl						SAM	IPLEF	R					
Date Started			Hammer Wt.	-		_ Ho	le Diam			For	eman _		
SAMPLE Coord Source SAMPLE Coord BORING & SAMPLE Image: Sample in the second secon					in			Dia					
SAMPLER TYPE Sample Continues	Date Started	1/9/19	Spoon Size _	2 11		_ Bo	ring Me	thod		Dat	e Compl	leted1/9/19	
WATER Image: Construct of the second se		SOIL DESCRIPTION		STRA	Ъ	Ξщ		SA	MPLE				
WATER Image: Construct of the second se		Color, Moisture, Density, Plasti Proportions	city, Size	DEPTH (ft)	SOI	DEP	Cond	Blows/6"	No.	Туре		NOTES	
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SAMPLER TYPE SAMPLE CONDITIONS GRUNDWATER DETH HGA - NOLLOW STEM ALGERS CA - CONTINUOUS FILLER TALGERS D D. DISINTEGRATED ATER Z + RE ATER Z + RE T HGA - NOLLOW STEM ALGERS CA - CONTINUOUS FILLER TALGERS	_	WATER			h	_						1. Area 8	
SAMPLER TYPE SAMPLE CONDITION GCUNDWATER DEPTH BORING METHOD D J J J J J J J J J J J J J J J J J J J J J J J J J J J J J J J	_				fuu	_							_
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SAMPLER TYPE SAMPLE CONDITIONS GROUNDWATER DEPTH BORING METHOD DS - DRIVEN SPLIT SPOON D. DISINTEGRATED ATER 4HRSf HS.A - HOLLOW STEM AUGERS PT - PRESSED SHELBY TUBE D DISINTEGRATED ATER 24 HRSf HS.A - HOLLOW STEM AUGERS RC - ROCK CORE D. UNDISTURBED ATER 24 HRSf MD - MUD DRILLING						25							
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SAMPLER TYPE SAMPLE CONDITIONS GROUNDWATER DEPTH BORING METHOD DS - DRIVEN SPLIT SPOON D - DISINTEGRATED AT COMPLETIONf HRSf HSA - HOLLOW STEM AUGERS PT - PRESSED SHELBY TUBE D - DISINTEGRATED AT COMPLETIONf HSA - HOLLOW STEM AUGERS CA - CONTINUOUS FLIGHT AUGER D - DISINTEGRATED AT ECOMPLETIONf HSA - HOLLOW STEM AUGERS CA - CONTINUOUS FLIGHT AUGER D - DISINTEGRATED AT ECOMPLETIONf MD - MUD DRILLING	-				h								
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SAMPLER TYPE SAMPLE CONDITIONS GROUNDWATER DEPTH BORING METHOD DS - DRIVEN SPLIT SPOON D - DISINTEGRATED AT COMPLETIONft HSA - HOLLOW STEM AUGERS PT - PRESSED SHELBY TUBE D - DISINTEGRATED AT COMPLETIONft HSA - HOLLOW STEM AUGERS CA - CONTINUOUS FLIGHT AUGER U - UNDISTURBED AFTER 24 HRSft DC - DRIVING CASING RC - ROCK CORE L - LOST CAVED ATft MD - MUD DRILLING	-					-							\vdash
SAMPLER TYPE SAMPLE CONDITIONS GROUNDWATER DEPTH BORING METHOD DS - DRIVEN SPLIT SPOON PT - PRESSED SHELBY TUBE CA - CONTINUOUS FLIGHT AUGER RC - ROCK CORE D - DISINTEGRATED I - INTACT U - UNDISTURBED L - LOST AT COMPLETIONft AFTERHRSft CAVED ATft HSA - HOLLOW STEM AUGERS CFA - CONTINUOUS FLIGHT AUGERS DC - DRIVING CASING MD - MUD DRILLING	\neg				fnn	-							
SAMPLER TYPE SAMPLE CONDITIONS GROUNDWATER DEPTH BORING METHOD DS - DRIVEN SPLIT SPOON PT - PRESSED SHELBY TUBE CA - CONTINUOUS FLIGHT AUGER RC - ROCK CORE D - DISINTEGRATED I - INTACT AT COMPLETIONft AFTERHRSft CAVED ATft HSA - HOLLOW STEM AUGERS CFA - CONTINUOUS FLIGHT AUGERS DC - DRIVING CASING MD - MUD DRILLING													
DS - DRIVEN SPLIT SPOON D - DISINTEGRATED AT COMPLETIONft HSA - HOLLOW STEM AUGERS PT - PRESSED SHELBY TUBE I - INTACT AFTERHRSft CFA - CONTINUOUS FLIGHT AUGERS CA - CONTINUOUS FLIGHT AUGER U - UNDISTURBED AFTER 24 HRSft DC - DRIVING CASING RC - ROCK CORE L - LOST CAVED ATft MD - MUD DRILLING													
PT - PRESSED SHELBY TUBE I - INTACT AFTERHRSft CFA - CONTINUOUS FLIGHT AUGERS CA - CONTINUOUS FLIGHT AUGER U - UNDISTURBED AFTER 24 HRSft DC - DRIVING CASING RC - ROCK CORE L - LOST CAVED ATft MD - MUD DRILLING									PTH				
CA - CONTINUOUS FLIGHT AUGERU - UNDISTURBEDAFTER 24 HRSftDC - DRIVING CASINGRC - ROCK COREL - LOSTCAVED ATftMD - MUD DRILLING									ft				
	CA - CON	TINUOUS FLIGHT AUGER	U - UNDIST			AFTEF	R 24 HF	S ft		DC	- DRI\	/ING CASING	
				1' WITH ·	140# HAI								



Contra	acted	WithGahagan & Bry									Borin		
Projec	ct Nar		rt Loop Cha	nnel De	eepeni	ng					Job #	18-0043	
Locati	ion _	Baltimore, MD											
						SAM	1PLEF	र					
Datum .	ML	LW	_ Hammer Wt.	140	lb	_ Ho	le Diam	eter <u>8 in</u>		For	eman	M. Fletcher	
Surf. Ele	ev	1.6 ± ft	_ Hammer Drop		in	_ Rc	ck Core			Insp	pector _	D. Patterson	
Date Sta	arted _	1/9/19	_ Spoon Size _	2 in		Bo	ring Me	thod <u>HSA</u>		Dat	e Compl	eted1/9/19	
					2			SAM	MPLE				7
	LEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plas		STRA DEPTH	SYMBOL	DEPTH SCALE				-	Rec	BORING & SAMPLE NOTES	
	(11)	Proportions		(ft)	s YI	BS	Cond	Blows/6"	No.	Туре	(in)	NOTES	
		WATER (continued)											
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	47.4			49.0									
		Dark gray, wet, very soft, fa	at CLAY			<u>50</u>		WOR/18"	1	DS	18		
4	<u>49.4</u>	 Dark gray, wet, very soft, e		<u>_51.0</u>	////								
_		SILT,	lastic			-		WOR/18"	2	DS	18		
_		(MH)						Workito	2	00	10		-
_													-
						<u>55</u>		WOR/18"	3	DS	15		<u> </u>
_						_							-
	56.4			58.0		-		WOR/18"	4	DS	15		-
`		Bottom of Boring at 58.0 ft		00.0		-							-
						60							-
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			SAMPLE CO					VATER DEP	тн			RING METHOD	
		IN SPLIT SPOON SED SHELBY TUBE	D - DISINTE I - INTACT	GRATED				rion ft HRS	ft			LOW STEM AUGERS ITINUOUS FLIGHT AUGERS	
CA -	CONT	INUOUS FLIGHT AUGER	U - UNDIST	URBED		AFTE	R 24 HF	RS ft		DC	- DRIV	/ING CASING	
		CORE	L - LOST					ft) DRILLING	
STAN	IDARD	PENETRATION TEST DRIVING 2"	OD SAMPLER	1' WITH	140# HA	MMER	FALLIN	NG 30": COUNT	MADE	AT 6" IN	TERVAL	S	



Contracted										Borin	-	
Project Na		irt Loop Cha	nnel De	epeni	ng					Job #	£18-0043	
Location _	Baltimore, MD											
					SAM	1PLEF	२					
DatumML	_LW	_ Hammer Wt.	140	lb	_ Но	le Diam	eter <u>8 in</u>		For	eman _	M. Fletcher	
Surf. Elev.	-1.1 ± ft	_ Hammer Dro	р 30	in	_ Ro	ck Core			Insp	pector _	D. Patterson	
Date Started _	1/10/19	_ Spoon Size _	2 in		_ Bo	ring Me	thod HSA		Dat	e Compl	leted1/10/19	
				2	-		SA	MPLE				
ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plas Proportions		STRA DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
	WATER			·····							1. Area 8	
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				fuu	<u>25</u>							
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_				m								-
_				h	20							-
				fuu	<u>30</u>							
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				h	35							
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4				fin								-
			ידיסא		40 GPO	יסאוו						
	EN SPLIER TYPE	D - DISINTE					VATER DEF FION ft		HS		RING METHOD LOW STEM AUGERS	
PT - PRES	SED SHELBY TUBE INUOUS FLIGHT AUGER	I - INTACT U - UNDIST L - LOST			AFTEF AFTEF	R R 24 HF	HRS RSft	ft	CFA DC	4 - CON - DRIV	ITINUOUS FLIGHT AUGERS /ING CASING D DRILLING	
	PENETRATION TEST DRIVING 2		1' WITH 1	140# HAI				T MADE				



Contracted W			-						Boring	-	
Project Name Location		t Loop Channel I	Jeepen	ng					Job #	18-0043	
				SAM	IPLEF	2					
Datum <u>MLLW</u> Surf. Elev. <u>-1.</u>	1 ± ft		10 lb 10 in	_ Ho	le Diam ck Core	eter <u>8 in</u>			eman pector	M. Fletcher D. Patterson	
	1/10/19	Spoon Size2 in	l		ring Me				e Comple	eted1/10/19	
ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plasti Proportions	city, Size STR/ DEPT (ft)	SOIL SVMBOL	DEPTH SCALE	Cond	SAN Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
	NATER (continued)										+
											-
-47.6	Black, wet, very soft, CLAY Dark gray, wet, very soft, fal	46.5		45		WOR/18"	1	DS	8		
t	race sand, CH)			 		WOR/18"	2	DS	12		
						WOR/18" WOR/18"	3	DS DS	18 18		-
-				<u>55</u> _		WOR/18"	5	DS	18		
	Bottom of Boring at 59.0 ft	59.0		 		WOR/18"	6	DS	18		
				<u>65</u>							
-				70							
				75							
DS - DRIVEN S PT - PRESSED	PLIT SPOON 9 SHELBY TUBE OUS FLIGHT AUGER	AMPLE CONDIT D - DISINTEGRATI I - INTACT U - UNDISTURBEL L - LOST	ΞD	AT CC AFTER AFTER)MPLET R R 24 HR	VATER DEP 'ION ft HRS ft ft		CFA DC	a - Holi a - Con - Driv	RING METHOD LOW STEM AUGERS TINUOUS FLIGHT AUGERS /ING CASING DRILLING	



Contracted W										Borin	-	
Project Name		irt Loop Ch	annel De	eepeni	ng					Job #	±18-0043	
_ocation	Baltimore, MD											
					SAN	IPLEF	२					
DatumMLLV	V	_ Hammer W	t140	lb	_ но	ole Diam	eter <u>8 in</u>		For	eman _	M. Fletcher	
	1.6 ± ft	_ Hammer Dr	•	in		ock Core				pector _	D. Patterson	
Date Started	1/10/19	_ Spoon Size	2 in		_ Bo	oring Me	thod HSA		Dat	e Comp	leted1/10/19	
	SOIL DESCRIPTIO	.1	STRA	Ъ	тш		SAM	MPLE				٦
ELEV. (ft)	Color, Moisture, Density, Plas Proportions	ticity, Size	DEPTH (ft)	SOIL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
	WATER										1. Area 6	7
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_					<u>25</u>							
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-29.6			28.0	h	-							
	Black, wet, very soft, fat C	_AY					WOR/18"	1	DS	7		
					<u>30</u>							
					_		WOR/18"	2	DC	F		
							WUR/10	2	DS	5		
					-							
							WOR/18"	3	DS	12		
<u></u>	Dark gray, wet, very soft, f	at CLAY	35.0		<u>35</u>							
	(CH)	,			-		WOR/18"	4	DS	10		
							WOR/18"	5	DS	10		
					40				55	10		
SAN	MPLER TYPE	SAMPLE C	ONDITIC	ONS	GRC	UND	VATER DEP	тн		BO	RING METHOD	
DS - DRIVEN	SPLIT SPOON	D - DISINT	FEGRATED)	AT CO	OMPLET	TION ft			A - HOL	LOW STEM AUGERS	
	D SHELBY TUBE JOUS FLIGHT AUGER	I - INTAC U - UNDIS			AFTE	R 24 HF	HRS RS ft	_π			ITINUOUS FLIGHT AUGERS /ING CASING	
RC - ROCK CO		L - LOST			CAV	ED AT	ft				D DRILLING	
STANDARD PE	ENETRATION TEST DRIVING 2	OD SAMPLE	R 1' WITH	140# HA	MMEF	RFALLIN	NG 30": COUNT	MADE	AT 6" IN	TERVAL	S	



Page 2 of 2

Contracted										Borin		
Project Nar		• ·	annel D	eepeni	ing					Job #	t18-0043	
Location _	Baltimore, MD)										
					SAM	IPLEF	र					
DatumML	LW	Hammer W	140	lb	Ho	le Diam	eter <u>8 in</u>		For	eman _	M. Fletcher	
Surf. Elev.	-1.6 ± ft	Hammer Dr	op	in	Ro	ck Core			Insp	ector _	D. Patterson	
Date Started _	1/10/19	Spoon Size	2 in		_ Bo	ring Me	thod <u>HSA</u>		Dat	e Compl	leted1/10/19	
		011	OTDA	۲ ا	_		SAN	MPLE				
ELEV. (ft)	SOIL DESCRIPTI Color, Moisture, Density, P Proportions	ON asticity, Size	STRA DEPTH (ft)	SOIL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
	Proportions Dark gray, wet, very soft (CH) (continued) Bottom of Boring at 59.5		(ft) 59.5			Cond	Biows/6" WOR/18" WOR/18" WOR/18" WOR/18" WOR/18" WOR/18" WOR/18" WOR/18" WOR/18" WOR/18"	No. 6 7 8 9 10 11 12 13	Iype DS DS DS DS DS DS DS			
_												F
-					-							\vdash
\neg					$ \neg$							\vdash
					80							-
S	AMPLER TYPE	SAMPLE C	ONDITIO	ONS			VATER DEP	тн		BO	RING METHOD	
DS - DRIVE PT - PRESS CA - CONT RC - ROCK	en split spoon Sed Shelby Tube 'Inuous flight Auger	D - DISINT I - INTAC U - UNDIS L - LOST	EGRATEI T TURBED	0	AT CC AFTEF AFTEF CAVE	MPLET R R 24 HF ED AT	FION ft HRS RS ft ft	ft	CFA DC MD	A - HOL A - CON - DRIN - MUE	LOW STEM AUGERS ITINUOUS FLIGHT AUGERS /ING CASING) DRILLING	



Contracted V										Borin		
Project Nam		t Loop Cha	nnei D	eepeni	ng					Job #	±18-0043	
ocation _	Baltimore, MD											
					SAM	1PLEF	र					
DatumMLL		Hammer Wt.			_ Ho	ole Diam	eter <u>8 in</u>		For	eman _	M. Fletcher	
	1.1 ± ft	Hammer Drop		in		ock Core				pector _	D. Patterson	
Date Started	1/4/19	Spoon Size _	2 in		_ Bo	oring Met	thod HSA		Dat	e Comp	leted1/4/19	
	SOIL DESCRIPTION		STRA	5	тш		SAM	MPLE				٦
ELEV. (ft)	Color, Moisture, Density, Plastic Proportions	city, Size	DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
	WATER			h							1. Area 7	
				h							2. 578332.37 N	
				him							1436280.4 E	
				h								
				μπ	5							
				pm								
				hin								
_				fun	10							
_				μm								
-				μιι								
-				h								
-					15							
_				Lin	15							
-				him								
-				fun								
				μιι								
				h	20							
				h								
				Lun								
				him								
-22.9			24.0	h	_							
_	Black, gray, wet, very soft to CLAY	o stiff, fat			<u>25</u>		WOR/18"	1	DS	9		
_					_							
_					_		WOR/18"	2	DS	10		
-					_			-		10		
-					20							
-					30		WOR/18"	3	DS	8		
-					—							
	Trace gravel at 32'		33.0		_		3-7-8	4	DS	7		
++	Brown, wet, very loose to me	edium										
	dense, fine to coarse, SANI gravel, trace silt	D, and			35		6-11-14	5	DS	10		
	gravoi, ildoo 311						• • • • • •					
										_		
							4-6-5	6	DS	9		
					40		2-4-6	7	DS	8		
	MPLER TYPE S	AMPLE CO	NDITIC	ONS	GRO	UNDV	VATER DEP	тн		BO	RING METHOD	
DS - DRIVEN	N SPLIT SPOON	D - DISINTE	GRATE)	AT CO		TION ft HRS.	ft			LOW STEM AUGERS	
DS - DRIVEN PT - PRESS	I SPLIT SPOON ED SHELBY TUBE NUOUS FLIGHT AUGER		GRATE	0	AT CO AFTEI AFTEI	R R 24 HR	TION ft HRS RS ft ft	ft	CFA DC	4 - CON - DRIV	LOW STEM AUGERS ITINUOUS FLIGHT AUGERS /ING CASING) DRILLING	



Page 2 of 2

		With <u>Gahagan & Bry</u> ne <u>Task 17 - Seag</u>			enen						Borin Job #	-	
-	ect Nar				sepen	ing					# doL		
2000		· · ·				SAN	IPLEF	ર					
Datum Surf. E	·	LW 1.1 ± ft	_ Hammer Wt. _ Hammer Dro	р 30		_ Но	ole Diam ock Core	neter <u>8 in</u> e Dia. <u>N/A</u>			eman pector	M. Fletcher D. Patterson	
Date S	Started _	1/4/19	_ Spoon Size	2 in		Bo	oring Me	thod HSA		Dat	e Compl	eted1/4/19	
Γ		SOIL DESCRIPTION	N	STRA	Ъ'	Ξщ		SAM	MPLE				
	ELEV. (ft)	Color, Moisture, Density, Plas Proportions	ticity, Size	DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	_
	<u>-41.9</u>	Brown, wet, very loose to r dense, fine to coarse, SAN gravel, trace silt <i>(continued</i> Gray, tan, brown, wet, very loose, fine, SAND , trace si	ND , and) 7 loose to	43.0				3-2-2	8	DS	9		
_			iit.			45		6-3-3	9	DS	7		_
_								2-3-3	10	DS	14		_
_						50		2-1-1	11	DS	7		
_	50.0			54.0				1-1-2	12	DS	10		_
_	<u>-52.9</u>	Tan, brown, wet, very looso medium, SAND,	e, fine to	<u>54.0</u>		55		2-2-2	13	DS	12		
_		(SP)						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							-
						<u>10</u>							
_													—
-						75							-
						<u>15</u>							
_													
\neg													\vdash
	S	AMPLER TYPE	SAMPLE CO		ONS	80 GRC		VATER DEP	тн		BOF		
PT CA	- DRIVE - PRES	n split spoon Sed Shelby Tube Inuous flight Auger	D - DISINTI I - INTACT U - UNDIST L - LOST	EGRATED		AT CO AFTE AFTE	omplet R R 24 HF	FION ft HRS RS ft ft		CFA DC	A - HOL A - CON - DRIV	LOW STEM AUGERS ITINUOUS FLIGHT AUGERS /ING CASING D DRILLING	
STA	NDARD	PENETRATION TEST DRIVING 2	OD SAMPLER	1' WITH	140# HA	MMEF	R FALLIN	NG 30": COUNT	MADE	at 6" int	FERVAL	S	



Contrac	ted With	Gahagan & Brya	ant Associa	tes							Borin	g #PR-47	
	Name	Task 17 - Seagi	rt Loop Cha	nnel De	eepeni	ng					Job #		
Location	ו	Baltimore, MD											
						SAM	1PLEF	र					
Datum	MLLW		_ Hammer Wt.			_ Ho	le Diam			For	eman _	M. Fletcher	
Surf. Elev.			Hammer Dro	•	in		ock Core				pector _	D. Patterson	
Date Starte	ed <u>1/10/19</u>		Spoon Size	2 in		_ Bo	ring Me	thod HSA		Dat	e Compl	leted1/10/19	
		SOIL DESCRIPTION		STRA	Ы.	тш		SA	MPLE				
ELE (ft)	V. Color,	Moisture, Density, Plas Proportions	ticity, Size	DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
_	WATER	R			h							1. Area 8	
_					fuu	_						2. 577963.18 N	_
_					h	—						1436641.95 E	-
_													-
					m	5							
_					h	_							-
_					h	—							-
_					fun	_							—
						10							
					h								
_					h	_							
_					h	_							
_					frm								_
						<u>15</u>							
_					h	_							-
_					h	_							-
_					fuu	—							-
_					h	20							
					h								
					him								
_					h	_							
					fuu	25							
_						_							_
_						_							-
_					him	_							-
_					h	30							-
					fuu	<u> </u>							
_					h	_							
						_							
					him								
					hin	35							
					frm								
					h								
_													\vdash
4					h								\vdash
	SAMPLER		SAMPLE CO	ן אידירואנ		40 GPO	ירואוו		ти		POI		
DS - DF	SAIVIPLER RIVEN SPLIT SF		D - DISINTE					TION ft		HSA		LOW STEM AUGERS	
PT - PF CA - CO	RESSED SHELB DNTINUOUS FL DCK CORE	YTUBE	I - INTACT U - UNDIST L - LOST			AFTEI AFTEI	r R 24 HF	HRSft ft	ft	CFA DC	4 - CON - DRI\	ITINUOUS FLIGHT AUGERS /ING CASING D DRILLING	
STANDA	ARD PENETRAT	ION TEST DRIVING 2"	OD SAMPLER	1' WITH [·]	140# HAI	MMER		NG 30": COUN	T MADE	AT 6" IN	TERVAL	S	



			hagan & Brya sk 17 - Seagi			oononi	na					Borin	-	
Projec Locat			timore, MD	n Loop Cha		eepeni	ny					Job #	10-0045	
Loodt							SAM	IPLEF	२					
Datum	ML	LW		Hammer Wt.	140	lb		le Diam			For	eman	M. Fletcher	
Surf. El		-0.9 ± ft		. Hammer Dro			_	ick Core				ector _	D. Patterson	
Date St	arted _	1/10/19		Spoon Size	2 in		_ Во	ring Me	thod <u>HSA</u>			e Compl	eted1/10/19	
					OTDA	2	–		SAN	/IPLE				7
E	ELEV. (ft)		L DESCRIPTION ire, Density, Plast		STRA DEPTH	SYMBOL	DEPTH	Cond	Blows/6"	No.	Туре	Rec	BORING & SAMPLE NOTES	
	(11)		Proportions		(ft)	<u>∽</u>	ЗŇ	Conu	DIOWS/0	NO.	туре	(in)		_
		WATER (con	tinued)			h								
						h								
						h								
_						h								-
							<u>45</u>							<u> </u>
-						fuu								-
	48.9				48.0	fuu								
		Light gray, was sand, trace n	et, soft, CLAY	, trace					6-1-3	1	DS	12		
	<u>50.4</u>	Reddish brov	vn, wet, very lo		<u>49.5</u>		50							
_		fine, silty SAI	ND				-		WOH/12"-2	2	DS	7		
+-	<u>52.9</u>	Light grav, w	et, very soft, C		<u>52.0</u>					_	20			+
_		ggj,	, ·, ·						WOR/18"	3	DS	5		-
	<u>55.4</u>	Tan brown	wet, very loose		<u>54.5</u>		55		WORTO	5	03	5		
			se, fine, silty S								50	45		
							_		WOH/12"-2	4	DS	15		
_														-
	60.4				59.5		60		6-9-5	5	DS	10		-
		Bottom of Bo	oring at 59.5 ft				00							-
_														-
							<u>65</u>							<u> </u>
-														-
														–
							<u>70</u>							
\neg														+
\neg														\vdash
\neg							-							F
							75							E
\neg														
\neg														\vdash
\neg							80							\vdash
	S	AMPLER TYP	E s	SAMPLE CC		ONS			WATER DEP	тн	1	BOF		
	DRIVE	N SPLIT SPOON		D - DISINTE	GRATED)	AT CC	MPLE ⁻	TION ft			A - HOL	LOW STEM AUGERS	
CA -	CONT	SED SHELBY TUB		I - INTACT U - UNDIST			AFTER	R 24 HF	HRS RS ft	_ π	DC	- DRIV	ITINUOUS FLIGHT AUGERS /ING CASING	
	ROCK			L - LOST			CAVE	ED AT	ft) DRILLING	
STAN	NDARD	PENETRATION T	EST DRIVING 2"	OD SAMPLER	1' WITH	140# HA	MMER	FALLI	NG 30": COUNT	MADE	AT 6" IN	FERVAL	S	



	n					SAM	1PLEF	ξ					
um	MLLW		. Hammer Wt	140	lb		le Diam	<u>.</u>		For	eman _	M. Fletcher	
f. Elev.		± ft	. Hammer Dro				ick Core				entan _	D. Patterson	
e Start		/14/19	Spoon Size				ring Me				e Comp	leted 1/14/19	
							-					I	
ELE	EV.	SOIL DESCRIPTION	i - ita - Oi	STRA DEPTH	BOL	VLE		SAN	MPLE			BORING & SAMPLE	
(ft	t)	Color, Moisture, Density, Plast Proportions	icity, Size	(ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	NOTES	
					0,						()		
_	V	VATER			fun	-						1. Area 6	
_					μιι							2. 577809.49 N	
-					h							1436996.37 E	
-]_ —							
-					Lin	5							
-					hi								
-					h								
-					fun								
1					h	10							
1					Lun								
					hi								
					h								
					fun	<u>15</u>							
_					μιι								
_						1 _							
_] _							
-					hi								
-					h	<u>20</u>							
-					μιι	- 1							
-					h								
-													
1					hin	25							
					hin								
-26	6.5			27.0	fun								
		Brown, black, wet, very soft SILT,	t, elastic					WOR/18"	1	DS	10		
	(MH)											
_	-					30		WOR/18"	2	DS	18		
_								WORVIO	2	03	10		
	1.5	Dark gray, wet, very soft, fa		32.0))))	-							
-		CH)				-		WOR/18"	3	DS	17		
-													
-						<u>35</u>		WOR/18"	4	DS	18		
-													
1								WOR/18"	5	DS	14		
1									5	03	14		
1						40							
_	SAM	PLER TYPE S	SAMPLE CO		ONS	GRO	UNDV	VATER DEP	тн		BO	RING METHOD	
	RIVEN S	PLIT SPOON	D - DISINT	EGRATED)	AT CO	MPLET	ION ft			A - HOL	LOW STEM AUGERS	
7 - PI	RESSED	SHELBY TUBE	I - INTAC			AFTE	، ۲	HRS	tt	CEA	4 - CON	ITINUOUS FLIGHT AUGERS	



Page 2 of 2

cation _	Baltimor	e, MD										
					SAM	IPLEF	र					
umML	LW	Hammer	Wt. 140	lb	Ho	le Diam	neter 8 in		For	eman	M. Fletcher	
	0.5 ± ft	Hammer		in		ck Core				pector _	D. Patterson	
e Started _	1/14/19	Spoon S	ize 2 in		_ Во	ring Me	thod HSA		Dat	e Comple	eted1/14/19	
ELEV.	SOIL DES Color, Moisture, Der	CRIPTION	STRA DEPTH	SYMBOL	DEPTH SCALE		SAI	MPLE		_	BORING & SAMPLE	
(ft)	Propo	rtions	(ft)	SXN NVS	SC	Cond	Blows/6"	No.	Туре	Rec (in)	NOTES	
				0)						. ,		
-40.5			41.0	<i>\///</i>			WOR/18"	6	DS	18		
	Dark gray, wet, ver	y 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		
_					_		WOIVIO	10	03	10		
-					_							
-					_		WOR/18"	11	DS	17		
-					_							
-					<u>55</u>		WOR/18"	12	DS	18		
-					_							
-					_							
-58.0			58.5		_		WOR/18"	13	DS	12		
-	Bottom of Boring a	t 58.5 ft			60							
-					<u>60</u>							
-					_							
1					_							
1					_							
1					65							
					70							
4					75							
4												
4												
4												
4												
					80							
	AMPLER TYPE		CONDITIC				NATER DEP	тн			RING METHOD	
	N SPLIT SPOON ED SHELBY TUBE	D - DIS I - INT	INTEGRATED ACT)			ГION ft HRS	ft			LOW STEM AUGERS TINUOUS FLIGHT AUGERS	



roject Nar		eagirt Loop Cł	nannel D	eepeni	ng					Job #	t18-0043	
ocation _	Baltimore, N	//D										
					SAN	1PLEF	R					
atumML	LW	Hammer V	Vt 140	lb	Нс	ole Diam	_{eter} 8 in		For	eman	M. Fletcher	
ırf. Elev	2.1 ± ft	Hammer D	~~	in		ock Core				pector _	D. Patterson	
ate Started _	1/8/19	Spoon Size	e 2 in		_ Bo	oring Me	thod HSA		Dat	e Comp	leted1/8/19	
							SAN	MPLE				
ELEV. (ft)	SOIL DESCRI Color, Moisture, Density Proportior	, Plasticity, Size	STRA DEPTH (ft)	SOIL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
	WATER			L							1. Area 6	
-				h] —						2. 577567.31 N	
				hi							1437052.45 E	
				fun								
				μιι	5							
_				h	1 _							
_] _							
-				hin								
-				fun								
-				fun	<u>10</u>							
-				h								
-] —							
				hin								
				h	15							
				fun								
				h	1 _							
_					1 _							
_				hin								
-				fun	<u>20</u>							
-				free								
-				h	-							
-				h	1 —							
				hin	25							
				fun								
				μm								
				h	_							
-26.9	Dia da ante contra contra com		29.0									
_	Black, gray, wet, very	SOIT, TAT CLAY			<u>30</u>		WOR/18"	1	DS	6		
_					_							
-					-		WOR/18"	2	DS	11		
-					_							
-					35		WOR/18"	3	DS	9		
					<u></u>		1101110	5		3		
							WOR/18"	4	DS	2		
					_							
					40		WOR/18"	5	DS	15		
	AMPLER TYPE	SAMPLE C					VATER DEP	тн			RING METHOD	
PT - PRESS	N SPLIT SPOON SED SHELBY TUBE INUOUS FLIGHT AUGER	D - DISIN I - INTAC U - UNDI L - LOST	STURBED		AFTE	R	"ION ft HRS !S ft	ft	CFA	A - CON	LOW STEM AUGERS ITINUOUS FLIGHT AUGERS /ING CASING	



Page 2 of 2

cati	ion _	Baltimore,				0 4 4 4 10							
						SAMP	LER						
um.		W 2.1 ± ft	Hammer \				Diame				eman	M. Fletcher D. Patterson	
	ev	1/8/19	Hammer I Spoon Siz	Jiop			Core [ng Meth	Jiu			pector e Comple		
- 01			0p0011012				ig meu	iou			e compie		
	ELEV.	SOIL DESCRI		STRA DEPTH	ğĽ	프비_		SAM	MPLE			BORING & SAMPLE	
	(ft)	Color, Moisture, Densit Proportio		DEPTH (ft)	SOIL	DEPTH SCALE	ond	Blows/6"	No.	Туре	Rec (in)	NOTES	
-:	38.9	Black, gray, wet, very	soft, fat CLAY	41.0									
† ·		_ <i>(continued)</i> _Dark gray, wet, very s		/									
		SILT,	on, elastic					WOR/18"	6	DS	18		
		(MH)											
						45		WOR/18"	7	DS	16		
_													
_						_		WOR/18"	8	DS	18		
4								101010	0	03	10		
-													
-						<u>50</u>		WOR/18"	9	DS	17		
-													
-						-		WOR/18"	10	DS	18		
1						55		WOR/18"	11	DS	18		
1						<u> </u>		WORVIO		03	10		
1													
1						_		WOR/18"	12	DS	18		
	58.4			60.5		<u>60</u>		WOR/18"	13	DS	18		
<u> </u>	50.4	Bottom of Boring at 6	0.5 ft	00.5									
4													
-						_							
-													
-						<u>65</u>							
-													
1													
1						$ \neg$							
						70							
						75							
-													
-													
						80							
10			SAMPLE						ΠH				
		I SPLIT SPOON ED SHELBY TUBE	I - INTA	NTEGRATED	,			ON ft _ HRS				OW STEM AUGERS	



Contracted										Borin		
Project Nar		-	annel De	eepeni	ng					Job #	£18-0043	
ocation _	Baltimore, MD											
					SAN	1PLEF	R					
atumML	LW	Hammer Wi	t140	lb	_ Но	ole Diam	eter <u>8 in</u>		For	eman _	M. Fletcher	
urf. Elev	1.4 ± ft	Hammer Dr		in	_ Ro	ock Core			Insp	pector _	D. Patterson	
ate Started _	1/15/19	Spoon Size	2 in		_ Bo	oring Me	thod <u>HSA</u>		Dat	e Comp	eted1/15/19	
			OTDA	5	–		SAN	MPLE				
ELEV. (ft)	SOIL DESCRIPTIO Color, Moisture, Density, Pla Proportions	on asticity, Size	STRA DEPTH (ft)	SVMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
	WATER										1. Area 6	
				Lin] —						2. 577536 N	
				hin							1436855.53 E	
				hin								
				fuu	5							
				μιι								
_				h	1_							
					1 _							
_				Lin] _							
_				hi	<u>10</u>							
_				fun								
_				fuu	- 1							
_				μm	1 —							
_												
_					<u>15</u>							
-				hin								
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_				hin	<u>30</u>							
-29.6	Gray, black, wet, very sof	t elastic	31.0	-								
_	SILT,				-		WOR/18"	1	DS	10		
-	(MH)				-							
-					35		WOR/18"	2	DS	18		
\dashv					33							
\neg							WOR/18"	3	DS	17		
-38.6			40.0		40		WOR/18"	4	DS	18		
S	AMPLER TYPE	SAMPLE C	ONDITIC	ONS	GRO	UNDV	VATER DEP	TH		BO	RING METHOD	
PT - PRES	in Split Spoon Sed Shelby Tube Inuous Flight Auger	D - DISINT I - INTAC U - UNDIS	Т		AFTE	R	TION ft HRS IS ft	ft	CFA	A - CON	LOW STEM AUGERS ITINUOUS FLIGHT AUGERS /ING CASING	



Page 2 of 2

Con	tracted		n & Bryant Associa								Borin		
-	ect Nar		- Seagirt Loop Ch	annel D	eepen	ing					Job #	£ <u>18-0043</u>	
Loca	ation _	Baltimore	e, MD										
						SAM	IPLEF	र					
Datun	nML	LW	Hammer W	t140	lb	_ Но	le Diam	neter <u>8 in</u>		For	eman	M. Fletcher	
Surf. I	Elev	1.4 ± ft	Hammer Di	op <u>30</u>	in	Ro	ck Core			Insp	ector _	D. Patterson	
Date	Started _	1/15/19	Spoon Size	2 in		Bo	ring Me	thod <u>HSA</u>		Dat	e Compl	eted1/15/19	
Г				OTDA	F	–		SAN	MPLE				
	ELEV. (ft)	SOIL DESC Color, Moisture, Den	sity, Plasticity, Size	STRA DEPTH	SYMBOL	DEPTH	a 1			-	Rec	BORING & SAMPLE NOTES	
L	(14)	Propor	rtions	(ft)	_o,⊱	ВX	Cond	Blows/6"	No.	Туре	(in)		
		Gray, wet, very soft	t, fat CLAY										<u> </u>
-								WOR/18"	5	DS	18		-
-						-		WORTO	5	03	10		\vdash
						45		WOR/18"	6	DS	18		
_						_		WOR/18"	7	DS	17		
_						_							<u> </u>
_								WOR/18"	8	DS	18		-
						<u>50</u>							<u> </u>
-								WOR/18"	9	DS	18		\vdash
_						-		WORTO	9	03	10		
						55		WOR/18"	10	DS	18		
_						_							
_						_		WOR/18"	11	DS	14		
_						_							–
_	50.0			00.0				WOR/18"	12	DS	18		-
	-58.6	Bottom of Boring at	t 60.0 ft	60.0		<u>60</u>							<u> </u>
-		5				-							\vdash
_													
						65							
_													
_													–
_													-
-						70							-
						10							-
-						$ \neg$							\vdash
]							L
						<u>75</u>							
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4													\vdash
-						-							\vdash
-						80							\vdash
	S	AMPLER TYPE	SAMPLE C		ONS			WATER DEP	TH		BOF		
	- DRIVE	N SPLIT SPOON	D - DISIN	EGRATE		AT CC	MPLET	ΓΙΟΝ ft			A - HOL	LOW STEM AUGERS	
		SED SHELBY TUBE INUOUS FLIGHT AUGER	I - INTAC U - UNDIS			AFTEF	R 24 HF	HRS RS ft	ft			ITINUOUS FLIGHT AUGERS /ING CASING	
	- ROCK		L - LOST			CAVE	ED AT	ft				DRILLING	
ST	ANDARD	PENETRATION TEST DR	RIVING 2" OD SAMPLE	R 1' WITH	140# HA	MMER	FALLIN	NG 30": COUNT	MADE	AT 6" IN	ERVAL	S	



	d With <u>Gahagan & Brya</u>									Borin		
Project Na		t Loop Chai	nnei De	epeni	ng					Job #	<u> </u>	
Location							_					
					SAM	IPLEF	र					
	1LLW	Hammer Wt.			_ Ho	le Diam			For	eman _	M. Fletcher	
Surf. Elev.	-0.6 ± ft	Hammer Drop		in		ck Core				pector _	D. Patterson	
Date Started	1/11/19	Spoon Size _	2 in		_ Bo	ring Me	thod HSA		Dat	e Compl	eted1/11/19	
	SOIL DESCRIPTION		STRA	Ъ'	Ξщ		SAI	MPLE				7
ELEV. (ft)	Color, Moisture, Density, Plasti Proportions	city, Size	STRA DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
				•,							4 4 7 7 7 9	-
_	WATER			·····							1. Area 8	-
_				·····	_						2. 577973.42 N	-
_					_						1436379.64 E	-
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				m	_							
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	SAMPLER TYPE S	AMPLE CO		NS		יחאט	VATER DEP	 РТН		BO		
	YEN SPLIT SPOON	D - DISINTE			AT CC	MPLE	TION ft		HS		LOW STEM AUGERS	
PT - PRE	SSED SHELBY TUBE TINUOUS FLIGHT AUGER	I - INTACT U - UNDISTI L - LOST			AFTEF AFTEF	R R 24 HF	HRS RSft	ft	CF/ DC	4 - CON - DRI\	ITÍNUOUS FLIGHT AUGERS /ING CASING) DRILLING	
	N CORE D PENETRATION TEST DRIVING 2" (1' WITH 1	40# HAI				T MADE /				



Con	tracted	WithGahagan & Bry									Borin		
-	ect Nai		jirt Loop Cha	annel D	eepeni	ng					Job #	18-0043	
Loca	ation _	Baltimore, MD											
						SAN	1PLEF	२					
Datur		LW		~~			le Diam				eman	M. Fletcher	
Surf.	Elev Started _	-0.6 ± ft 1/11/19	 Hammer Dro Spoon Size 	op <u>30</u> 2 in	In		ock Core ring Me			-	bector e Comple	D. Patterson eted 1/11/19	
Date						_ DC	ing we			Dat	e compi		
	ELEV.	SOIL DESCRIPTIO		STRA	BOL	LΠ		SAN	/IPLE	<u> </u>		BORING & SAMPLE	
	(ft)	Color, Moisture, Density, Pla Proportions	sticity, Size	DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	NOTES	
		WATED (continued)											-
_		WATER (continued)			h	- 1							-
_] —							\vdash
_					hin								
					fun	45							
_					h	_							
_] _							_
-	-48.6	Black, wet, very soft, CLA	Y	48.0									-
_	<u>-50.1</u>				 50		WOR/18"	1	DS	8		-	
		Gray, wet, very loose, fine medium, clayey SAND	to										
								3-3-4	2	DS	15		
_													
_	0							1-2-3	3	DS	16		-
	<u>-55.6</u>	Gray-brown, wet, very loos	 se to	<u>_55.0</u>		55							
_		loose, fine to coarse, SAN gravel,	ND, little			-		2-3-6	4	DS	18		-
		(SP)											
_						·		3-3-4	5	DS	13		
						<u>60</u>							
_	-62.6			62.0		-		2-2-1	6	DS	12		-
_	02.0	Bottom of Boring at 62.0 f	t	02.0									
						<u>65</u>							
_						-							-
_						-							-
						70							
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_						80							\vdash
	S	AMPLER TYPE	SAMPLE CO		ONS			VATER DEP	тн	I	BOF		
	- DRIVE	EN SPLIT SPOON	D - DISINTI	EGRATED)	AT CO	OMPLET	ΓΙΟΝ ft			A - HOL	LOW STEM AUGERS	
CA	- CONT	SED SHELBY TUBE INUOUS FLIGHT AUGER	I - INTACT U - UNDIST			AFTE	R 24 HF	HRS RS ft	_ #	DC	- DRIV	ITINUOUS FLIGHT AUGERS	
	- ROCK		L - LOST	41.14.0-1	4.40			ft					
SL	ANDARD	PENETRATION TEST DRIVING 2	OD SAMPLER	T WITH	140# HA	NIMER		NG 30": COUNT	MADE	AI 6" IN	IERVAL	5	



Contracted										Borin		
Project Na		Loop Char	nei De	epenii	ng					Job #	£18-0043	
Location							_					
					SAM	PLEF	R					
DatumM	ILLW	Hammer Wt	140 I		_ Hol	le Diam			For	eman _	M. Fletcher	
Surf. Elev.	0.3 ± ft	Hammer Drop		n		ck Core				pector _	D. Patterson	
Date Started	1/7/19	Spoon Size _	2 in		_ Boi	ring Me	thod HSA		Dat	e Compl	eted1/7/19	
	SOIL DESCRIPTION		STRA	Ъ'	Ξщ		SAI	MPLE				7
ELEV. (ft)	Color, Moisture, Density, Plastic Proportions	city, Size	STRA DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
											4 Area 7	-
_	WATER			·····	_						1. Area 7	–
_				·····	_						2. 577936.74 N	-
_					_						1436029.5 E	-
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				·····								
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				·····	10							<u> </u>
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	SAMPLER TYPE S	AMPLE COI	סידיסא			ייסאוו	VATER DEP					
	EN SPLIT SPOON	D - DISINTE					TION ft	111	HS		LOW STEM AUGERS	
PT - PRES	SSED SHELBY TUBE TINUOUS FLIGHT AUGER	I - INTACT U - UNDISTL L - LOST			AFTEF AFTEF	R R 24 HF	HRSft	ft	CF/ DC	4 - CON - DRI\	ITINUOUS FLIGHT AUGERS /ING CASING) DRILLING	
	D PENETRATION TEST DRIVING 2" (I' WITH 1	40# HAN				MADE /				



	ted With										Borin	•	
-	Name	Task 17 - Seagi Baltimore, MD	eepeni	ng					Job #	18-0043			
Locatio	n	Baltimore, MD											
						SAN	1PLEF	۲					
Datum	MLLW		. Hammer Wt.			_ Ho	le Diam			For	eman	M. Fletcher	
Surf. Elev			Hammer Dro	•	in		ck Core				pector	D. Patterson	
Date Start	ted//18	9	Spoon Size	2 in		_ Bo	ring Me	thod HSA		Dat	e Comple	eted1/7/19	
		SOIL DESCRIPTION	1	STRA	Ъ'	Ξщ		SAN	MPLE				7
ELE (fi	EV. t) Cole	or, Moisture, Density, Plas	icity, Size	DEPTH	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec	BORING & SAMPLE NOTES	
	-	Proportions		(ft)	്ഗ്	00		Biolitoro		.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	(in)		_
	WAT	ER (continued)											-
					h								
					h								
					fun								
					fun	45							
-45	5.7	<i></i>		46.0									
_	Black	k, wet, very soft, CLA	r			_		WOR/18"	1	DS	6		-
_						1 –							-
-								WOR/18"	2	DS	6		+
49	9 <u>.7</u> Grav	, brown, wet, very loos	e. fine.	<u>50.0</u>		<u>50</u>					_		-
_	SAN	D, trace silt,	-,,					4 4 0	2	D 0	10		-
	(SP-9	SM)		53.0		-		1-1-2	3	DS	18		-
	Gray	, brown, wet, very loos	e, fine,										
	SANI (SP)					55		1-1-1	4	DS	16		_
	(01)												
								1-2-1	5	DS	14		
_													
_								1-1-3	6	DS	17		L
-59).7 Rotta	om of Boring at 60.0 ft		60.0		<u>60</u>		1-1-5	0	03	17		
_	DOLLC	on bonng at 60.0 n				_							+
_						_							-
_						-							_
_						65							-
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						$\mid \square$							Ĺ
						<u>70</u>							
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\neg						-							F
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						80							
	SAMPLE	ER TYPE	SAMPLE CC	NDITIO	ONS	GRO	UND	NATER DEP	тн		BOF	RING METHOD	
	RIVEN SPLIT		D - DISINTE I - INTACT)			TION ft HRS	ft			LOW STEM AUGERS	
CA - C		FLIGHT AUGER	U - UNDIST			AFTE	r 24 Hf	RS ft	_ n	DC	- DRIV	TINUOUS FLIGHT AUGERS /ING CASING	
	OCK CORE		L - LOST					ft				DRILLING	
STAND	ARD PENETR	RATION TEST DRIVING 2"	OD SAMPLER	1' WITH	140# HA	MMER	FALLIN	NG 30": COUNT	MADE	AT 6" IN	TERVAL	S	



Contracted										Borin		
	ject NameTask 17 - Seagirt Loop Channel DeepeningationBaltimore, MD									Job #	<u> </u>	
Location	Daiumore, MD						_					
					SAM	PLEF	R					
DatumM	LLW	Hammer Wt.	140		_ Ho	le Diam			For	eman _	M. Fletcher	
Surf. Elev.	0.9 ± ft 1/7/19	Hammer Drop		in		ck Core				pector _	D. Patterson	
Date Started	1/1/19	Spoon Size _	2 in		_ Boi	ring Me	thod		Dat	e Compl	eted	
	SOIL DESCRIPTION		STRA	Ъ	Ξщ		SAI	MPLE				7
ELEV. (ft)	Color, Moisture, Density, Plastic Proportions	city, Size	STRA DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
			(11)	Ś						(11)		-
	WATER			·····							1. Area 8	
				·····	_						2. 577796.88 N	
_				·····							1435910.87 E	\vdash
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				\cdots	40							
S	SAMPLER TYPE S	AMPLE CO	NDITIC	NS	GRO	UND	VATER DEP	тн		BO	RING METHOD	
	EN SPLIT SPOON SED SHELBY TUBE	D - DISINTE	GRATED				-ION ft HRS	ft.			LOW STEM AUGERS ITINUOUS FLIGHT AUGERS	
	FINUOUS FLIGHT AUGER	U - UNDISTU L - LOST	JRBED		AFTEF	R 24 HF	RSft ft	n	DC	- DRI\	/ING CASING DRILLING	
	PENETRATION TEST DRIVING 2" (1' WITH 1	40# HAI				MADE /				



Page 2 of 2

Conti	racted	With <u>Gahagan & Bry</u>									Borin	-	
-	Dject Name Task 17 - Seagirt Loop Channel Deepening cation Baltimore, MD										Job #	18-0043	
Loca	tion _	Baltimore, MD											
						SAM	1PLEF	२					
Datum	ML	LW	_ Hammer Wt.			_ Ho	le Diam			For	eman _	M. Fletcher	
Surf. E		0.9 ± ft	_ Hammer Dro		in		ock Core				ector _	D. Patterson	
Date S	started _	1/7/19	_ Spoon Size _	2 in		_ Bo	ring Me	thod HSA		Dat	e Compl	eted1/7/19	
Γ		SOIL DESCRIPTIO	N	STRA	Б.	ΞШ		SAM	MPLE				
	ELEV. (ft)	Color, Moisture, Density, Plas Proportions	sticity, Size	DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec	BORING & SAMPLE NOTES	
-				(14)	ک						(in)		_
	-40.1	WATER (continued)		41.0	h								
		Black, wet, very soft, CLA SILT	Y to					WOR/18"	1	DS	4		
		SILI											
_								WOR/18"	2	DS	4		
						<u>45</u>		WORTO	2	03	4		
_													_
	-46.6			47.5				WOR/18"	3	DS	6		-
-		Gray-brown, wet, very loos medium, SAND , trace clay				-							-
	-49.1	(SP)	,	50.0		50		3-3-4	4	DS	14		
		Black, wet, medium stiff,											
	-51.1			<u>52.0</u>				6-2-3	5	DS	9		
		Gray-brown, wet, very loos loose, fine to medium, SA											
		silt, trace gravel	IND, liace					6-1-2	6	DS	15		
						<u>55</u>		0-1-2	0		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											
_													<u> </u>
						<u>65</u>							
-													-
-						-							-
						-							-
						70							
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						<u>75</u>							
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						80							
	S	AMPLER TYPE	SAMPLE CO	ONDITIC	ONS	GRO	UND	WATER DEP	тн		BOF	RING METHOD	
		EN SPLIT SPOON SED SHELBY TUBE	D - DISINTE I - INTACT					ГІОN ft HRS	ft			LOW STEM AUGERS ITINUOUS FLIGHT AUGERS	
CA ·	- CONT	INUOUS FLIGHT AUGER	U - UNDIST			AFTE	R 24 HF	RSft		DC	- DRI\	/ING CASING	
	- ROCK		L - LOST	41 \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	4 4 0 4 1 1 1			ft) DRILLING	
SIA	NDARD	PENETRATION TEST DRIVING 2	OD SAMPLER	TWITH	140# HA	NIMER		NG 30": COUNT	MADE	AI 6" IN	ERVAL	5	



Contracted										Borin	-	
Project Nar										Job #	£18-0043	
Location _	Baltimore, MD											
					SAN	1PLEF	र					
DatumML	LW	Hammer Wt.	140	lb	_ Ho	le Diam	eter 8 in		For	eman _	M. Fletcher	
Surf. Elev.	-0.6 ± ft	Hammer Dro	00	in		ck Core	Dia. <u>N/A</u>			pector _	D. Patterson	
Date Started _	1/11/19	Spoon Size	2 in		_ Bo	ring Me	thod HSA		Dat	e Compl	eted1/11/19	
							SA	MPLE				7
ELEV. (ft)	SOIL DESCRIPTION Color, Moisture, Density, Plast Proportions		STRA DEPTH (ft)	SYMBOL	DEPTH SCALE	Cond	Blows/6"	No.	Туре	Rec (in)	BORING & SAMPLE NOTES	
	WATER			·····							1. Area 8	
_				h	_						2. 577479.82 N	
_				h							1436578.7 E	_
_												-
					5							
_				m								-
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	AMPLER TYPE S	D - DISINTE					VATER DEF FION ft		HS		RING METHOD LOW STEM AUGERS	
PT - PRES	SED SHELBY TUBE INUOUS FLIGHT AUGER	I - INTACT U - UNDIST L - LOST			AFTEF AFTEF	R R 24 HF	HRS RSft	ft	CFA DC	4 - CON - DRIV	ITINUOUS FLIGHT AUGERS /ING CASING) DRILLING	
	PENETRATION TEST DRIVING 2"		1' WITH 1	140# HAI				T MADE				



Con	tracted	WithGahagan & Bry									Boring		
Proj	ect Nai	ameTask 17 - Seagirt Loop Channel Deepening									Job #	18-0043	
Loca	ation _	Baltimore, MD											
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Datur	mML	LW	_ Hammer Wt.			_ Но	le Diam			For	eman	M. Fletcher	
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Page 2 of 2

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Page 2 of 2

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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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2780 Lighthouse Point East, Suite D Baltimore, MD 21224

(410)563-7300 www.moffattnichol.com

MEMORANDUM

То:	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.

$$Z_{max} = \frac{C_b BT V^2}{4.573Lh}$$

 $Z_{max} = Squat in feet$

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.

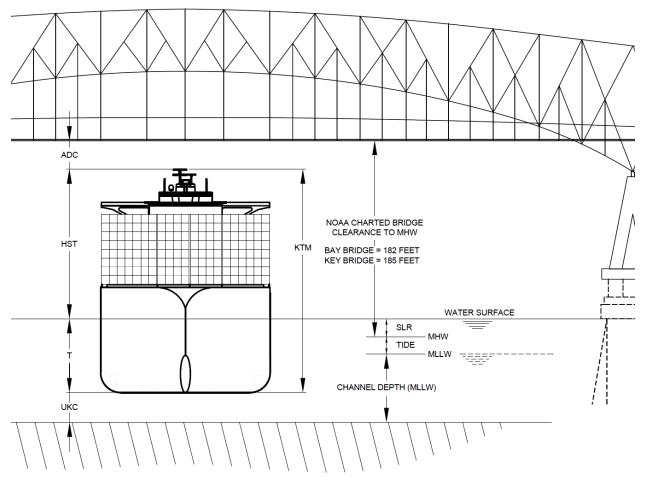


Figure 2. Air Draft Parameter Definitions (Not to scale)

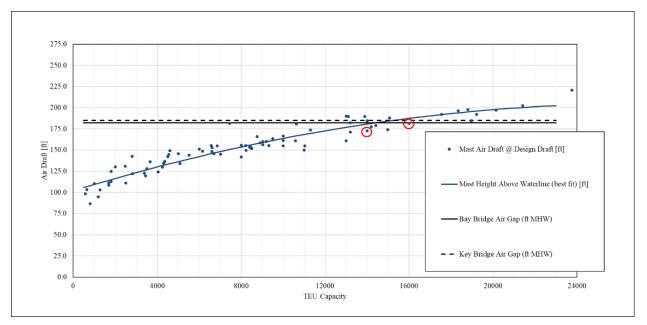
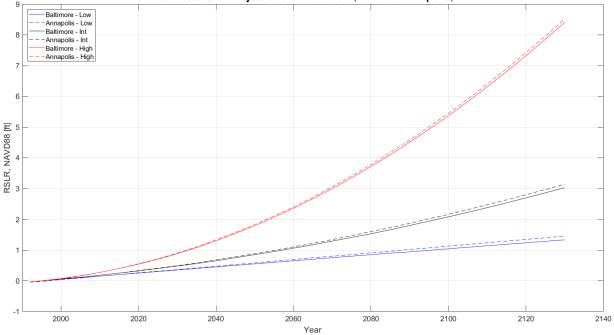


Figure 3. Air Draft Trend for Containerships (RINA), design prototype vessels circled in red



Estimated SLR Projections for Baltimore, MD and Annapolis, MD

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)

	Water elevation, NAVD88 (MLLW) [ft]					
Year	ar Baltimore (8574680) Annapolis (857		napolis (85755	12)		
	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 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)

	Air Draft Clearance (ADC) [ft] at MHW				
Year	Bay Br	idge	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	

Table 3: Air Draft Clearance (ADC) of MSC Beatrice^{*} with Sea Level Rise Projection

* Vessel analyzed at channel design draft of 47.5 ft.

	Air Draft Clearance [ft] @ MLW					
Year	Bay Bridge		Key B	Key Bridge		
- Cui	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		

Table 4: Air Draft Clearance (ADC) of CMA CGM Marco Polo^{*} with Sea Level Rise Projection

* Vessel analyzed at channel design draft of 47.5 ft.

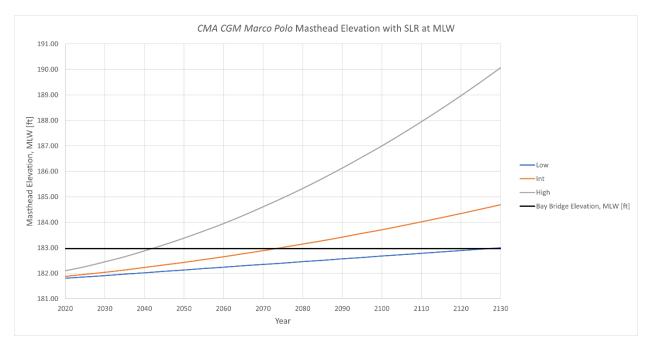


Figure 5: Masthead elevation of the CMA CGM Marco Polo transiting at MLW, draft 47.5 feet, with the three SLR scenarios (blue, orange, and grey) applied. The controlling Bay Bridge elevation is shown (black) to reflect the change in ADC due to SLR.

References

Clarkson Research. (2021). The Containership Register. Clarkson Research.

Royal Institute of Naval Architects. (2009-2012). Significant Ships.

- US Army Corps of Engineers. (2006). *EM 1110-2-1613 Hydraulic Design of Deep Draft Navigation Projects.*
- US Department of Transportation, Federal Highway Adminstratoin, and Maryland Transportation Authority. (2021). *Cheapeake Bay Crossing Stdy: Tier 1 NEPA Draft Environmental Impact Statement.* MDTA.

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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(410) 563-7300 www.moffattnichol.com

MEMORANDUM

То:	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.

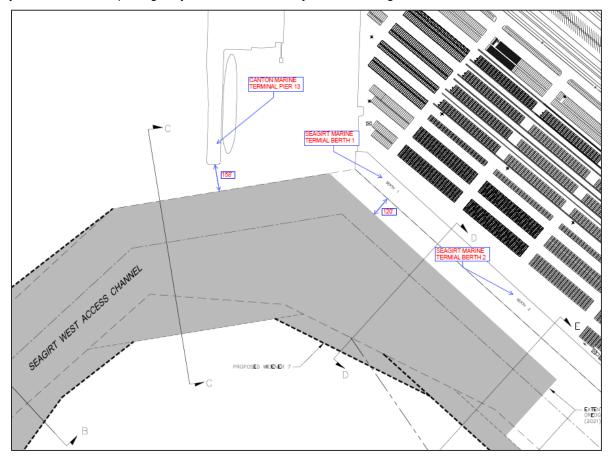


Figure 1 – Structure Location Relative to Proposed Channel Deepening

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.

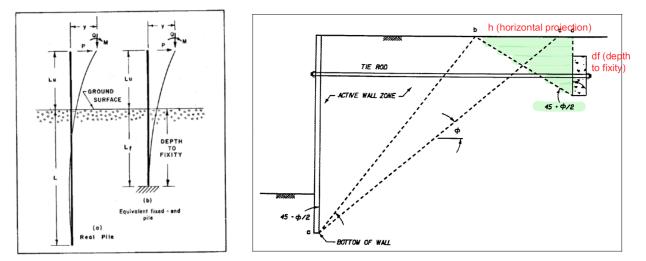


Figure 2 – Depth to Fixity and Passive Soil Wedge

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.

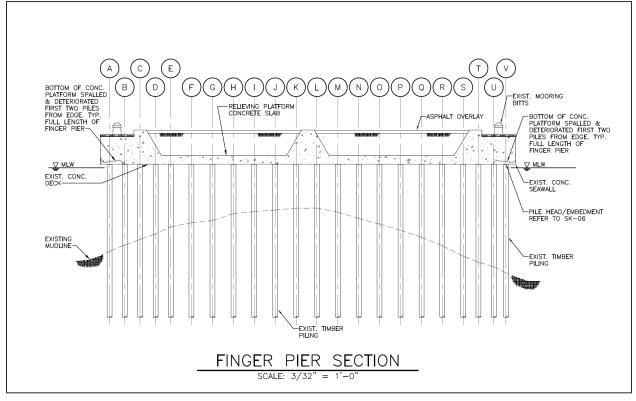


Figure 3 – Typical Section - Canton Marine Terminal Pier 13

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.

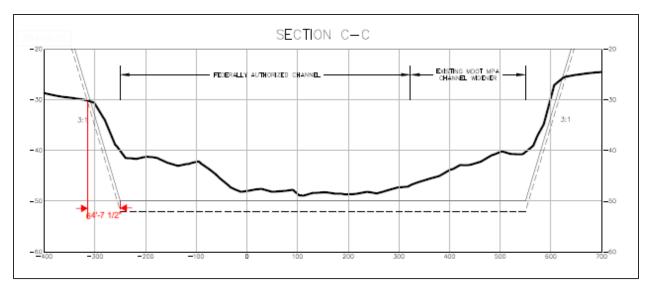


Figure 4 – Dredge Section C-C – 3:1 side slope

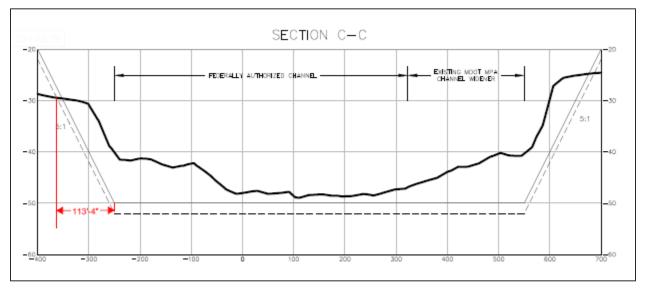


Figure 5 – Dredge Section C-C – 5:1 side slope

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 lowdeck, 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 1), see Figures 9 and 10, below.

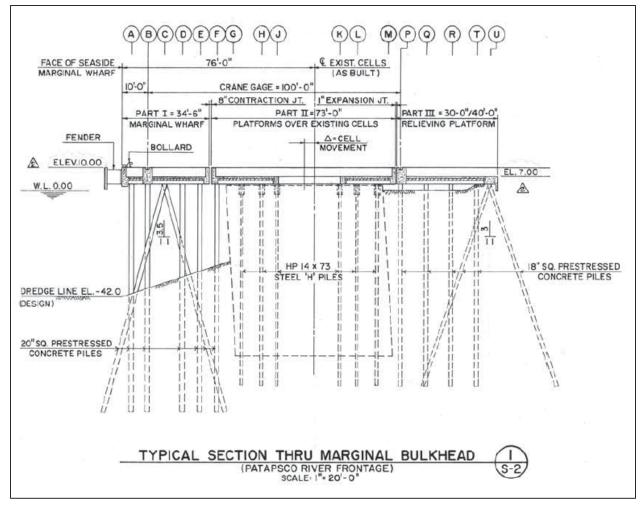


Figure 6 – Typical Section – SMT Berths 1 and 2

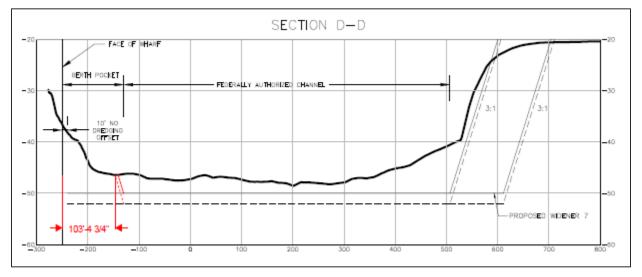


Figure 7 – Proximity of 3:1 Side Slope to SMT Berth 1

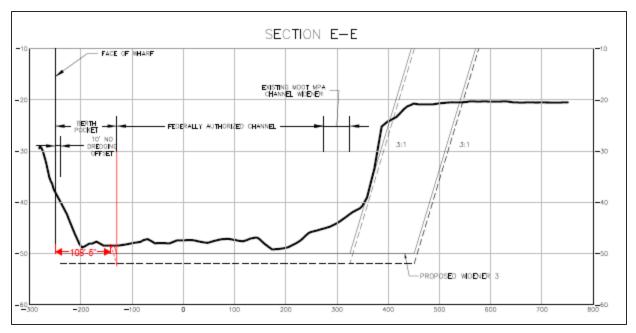


Figure 8 – Proximity of 3:1 Side Slope to SMT Berth 2

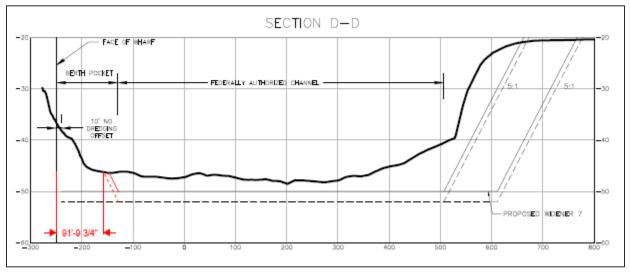


Figure 9 – Proximity of 5:1 Side Slope to SMT Berth 1

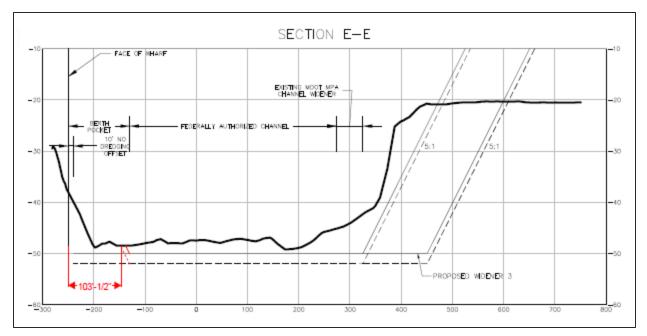


Figure 10 – Proximity of 5:1 Side Slope to SMT Berth 2

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.
- 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.

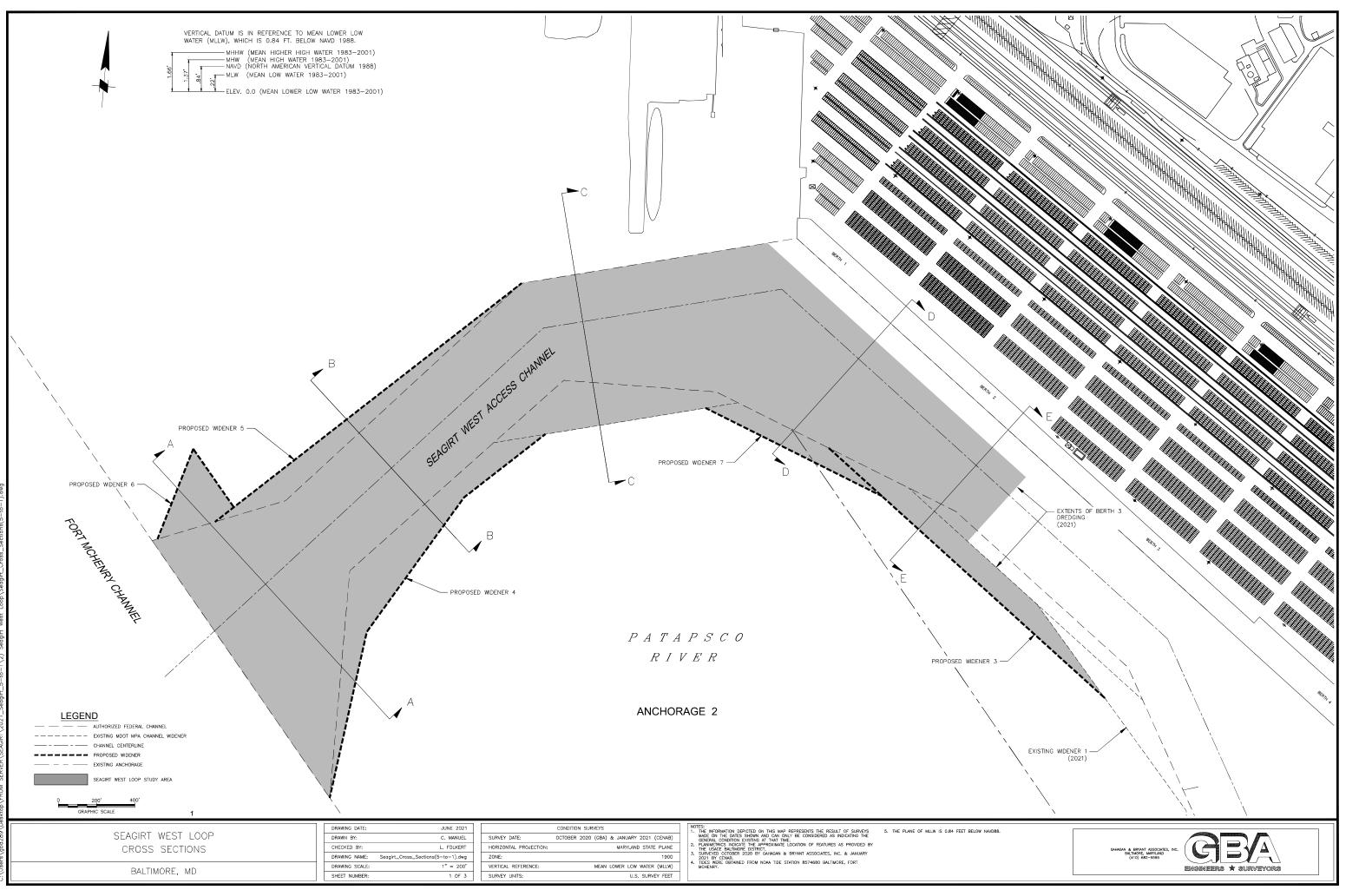
According to USACE publication number EM 1110-2-1902 titled "Slope Stability", a minimum safety factor of 1.5 is considered acceptable for long-term slope stability of excavated slopes. Local and global factors of safety computed exceed the 1.5 minimum, therefore, it can be concluded that the proposed dredging slope is acceptable and the proposed dredged pocket does not adversely impact berth stability.

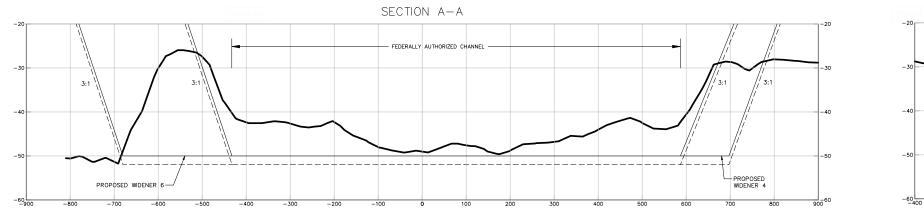
Conclusion

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.

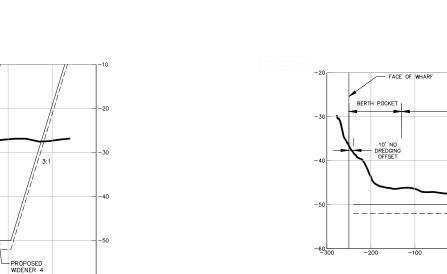
ATTACHMENT A SEAGIRT WEST LOOP DREDGE SECTIONS





SECTION B-B

FEDERALLY AUTHORIZED CHANNEL

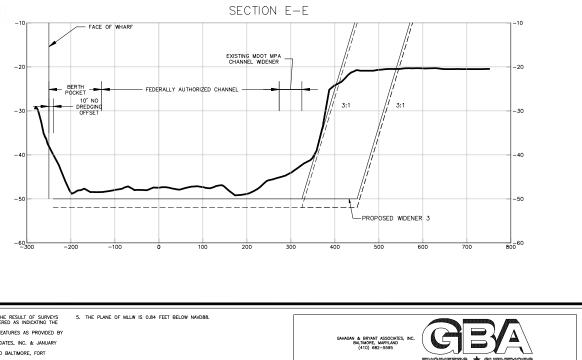


3:

-300

-200

-100



CENAB/GBA COMBO SURVEY ----- PROPOSED OVERDEPTH (-52')

LEGEND





SEAGIRT WEST LOOP CROSS SECTIONS 3H:1V SLOPES

BALTIMORE, MD

3:1

PROPOSED WIDENER 5-

-400

-300

-200

DRAWING DATE:

DRAWN BY:

CHECKED BY:

DRAWING SCALE:

SHEET NUMBER

DRAWING NAME: SEAGIRT WEST LOOP CROSS SECTIONS

-500

-60 -600

JUNE 2021 CONDITION SURVEYS OCTOBER 2020 (GBA) & JANUARY 2021 (CENAB) SURVEY DATE: HORIZONTAL PROJECTION: MARYLAND STATE PLANE ZONE: AS SHOWN VERTICAL REFERENCE: MEAN LOWER LOW WATER (MLLW) 2 OF 3 SURVEY UNITS: U.S. SURVEY FEET

C. MANUEL

L. FOLKERT

3:1

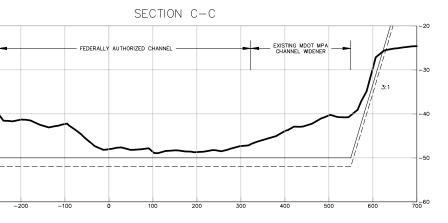
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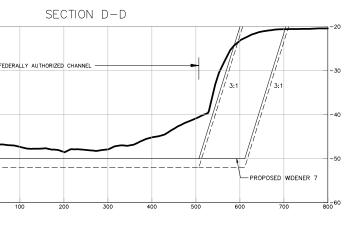
500

NOTES: 1. THE INFORMATION DEPICTED ON THIS MAP REPRESENTS THE RESULT OF SURVEYS 2. THE INFORMATION DEPICTED ON TAND CAN UNLY BE CONSIDERED AS INDICATING THE GENERAL CONTIONE DESTINGAT THAT THE 2. PLANMETRICS INDICATE THE APPROXIMATE LOCATION OF FEATURES AS PROVIDED BY THE USACE BAILTINGRE DISTRICT. 3. SURVEYED OCTOBER 2020 BY GAHAGAN & BRYANT ASSOCIATES, INC. & JANUARY 2021 BY CENAB. 4. TIDES WERE DETAINED FROM NOAA TIDE STATION 8574680 BALTIMORE, FORT MCHENYY.

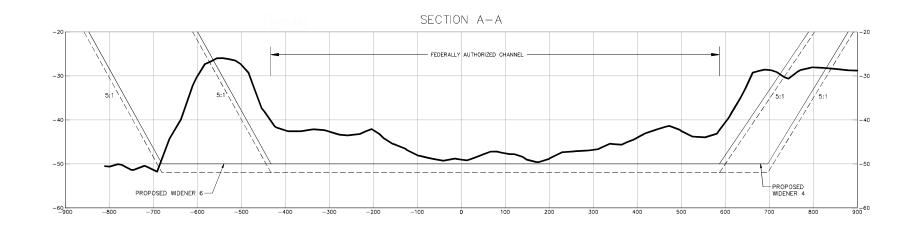
1900

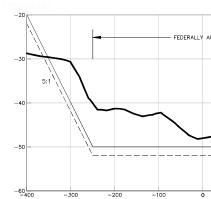
VERTICAL DATUM IS IN REFERENCE TO MEAN LOWER LOW WATER (MLLW), WHICH IS 0.84 FT. BELOW NAVD 1988. MHW (MEAN HIGHER HIGH WATER 1983-2001) MHW (MEAN HIGH WATER 1983-2001) NAVD (NORTH AMERICAN VERTICAL DATUM 1988) MLW (MEAN LOW WATER 1983-2001) 1.37' 84 ELEV. 0.0 (MEAN LOWER LOW WATER 1983-2001)

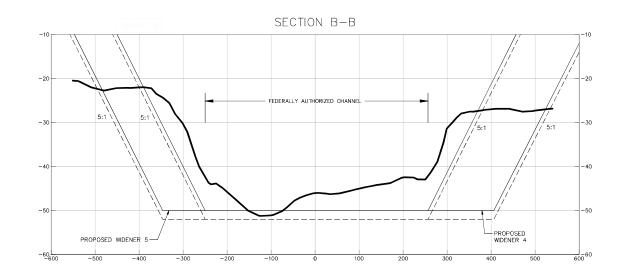


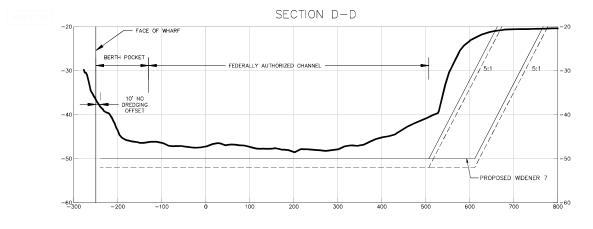


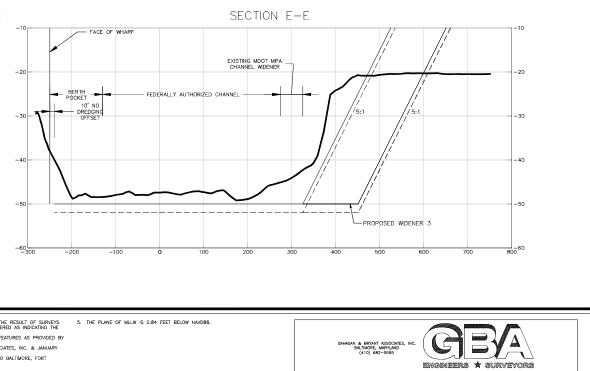
Engineers 🖈 Surveyors











LEGEND

CENAB/GBA COMBO SURVEY ----- PROPOSED OVERDEPTH (-52')

VERTICAL SCALE

	DRAWING DATE:	JUNE 2021		CONDITION SURVEYS	NOTES: 1. THE INFORMATION DEPICTED ON THIS MAP REPRESENTS THE RESULT OF SURVEYS	5. THE PLANE OF MILW IS 0.84 FEET BELOW NAVD88.
SEAGIRT WEST LOOP	DRAWN BY:	C. MANUEL	SURVEY DATE:	OCTOBER 2020 (GBA) & JANUARY 2021 (CENAB)	MADE ON THE DATES SHOWN AND CAN ONLY BE CONSIDERED AS INDICATING THE GENERAL CONDITION EXISTING AT THAT TIME.	
CROSS SECTIONS - 5H:1V SLOPES	CHECKED BY:	L. FOLKERT	HORIZONTAL PROJECTION:	MARYLAND STATE PLANE	 PLANIMETRICS INDICATE THE APPROXIMATE LOCATION OF FEATURES AS PROVIDED BY THE USACE BALTIMORE DISTRICT. 	
	DRAWING NAME:	Seagirt_Cross_Sections(5-to-1).dwg	ZONE:	1900	 SURVEYED OCTOBER 2020 BY GAHAGAN & BRYANT ASSOCIATES, INC. & JANUARY 2021 BY CENAB. 	
BALTIMORE, MD	DRAWING SCALE:	AS SHOWN	VERTICAL REFERENCE:	MEAN LOWER LOW WATER (MLLW)	 TIDES WERE OBTAINED FROM NOAA TIDE STATION 8574680 BALTIMORE, FORT MCHENRY. 	
DALIMORE, MD	SHEET NUMBER:	3 OF 3	SURVEY UNITS:	U.S. SURVEY FEET		

VERTICAL DATUM IS IN REFERENCE TO MEAN LOWER LOW WATER (MLLW), WHICH IS 0.84 FT. BELOW NAVD 1988. MHHW (MEAN HIGHER HIGH WATER 1983-2001) MHW (MEAN HIGH WATER 1983-2001) NAVD (NORTH AMERICAN VERTICAL DATUM 1988) MLW (MEAN LOW WATER 1983-2001) 84,

ELEV. 0.0 (MEAN LOWER LOW WATER 1983-2001)

SECTION C-C EXISTING MDOT MPA CHANNEL WIDENER FEDERALLY AUTHORIZED CHANNEL ____ 500 600 100 200 300 400

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.	

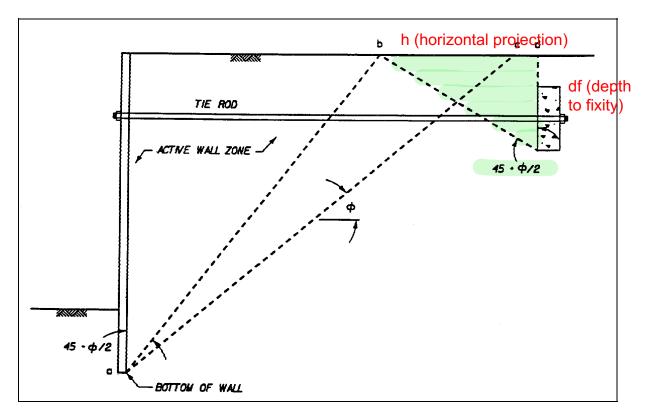


Figure 5-8. Minimum anchor - wall spacing for full passive anchor resistance in homogeneous soil

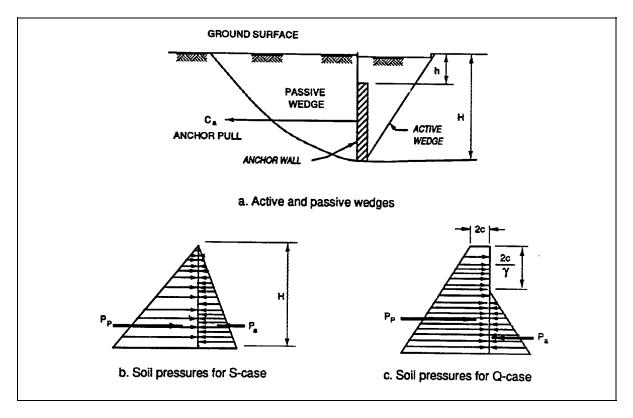
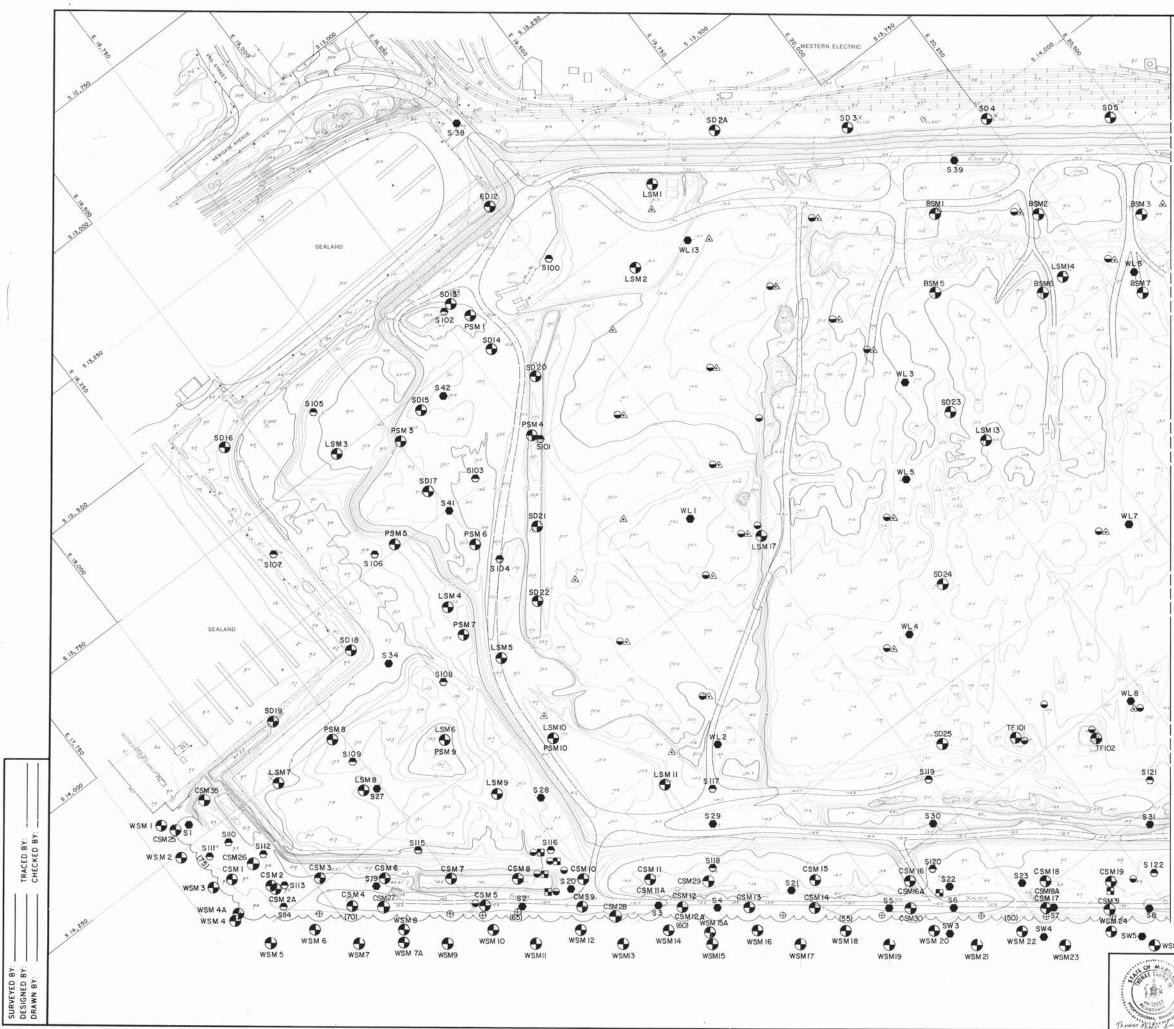


Figure 5-9. Resistance of continuous anchor wall



SUBSURFACE STRATA DESCRIPTION

GF	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.
0-F	BLACK TO DARK GREY, VERY SOFT TO MEDIUM STIFF. ORGANIC CLAYEY SILT TO SILT.
0-2	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

- •s BORINGS PERFORMED BY PITTSBURGH TESTING LABORATORY FROM NOV. SW 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.

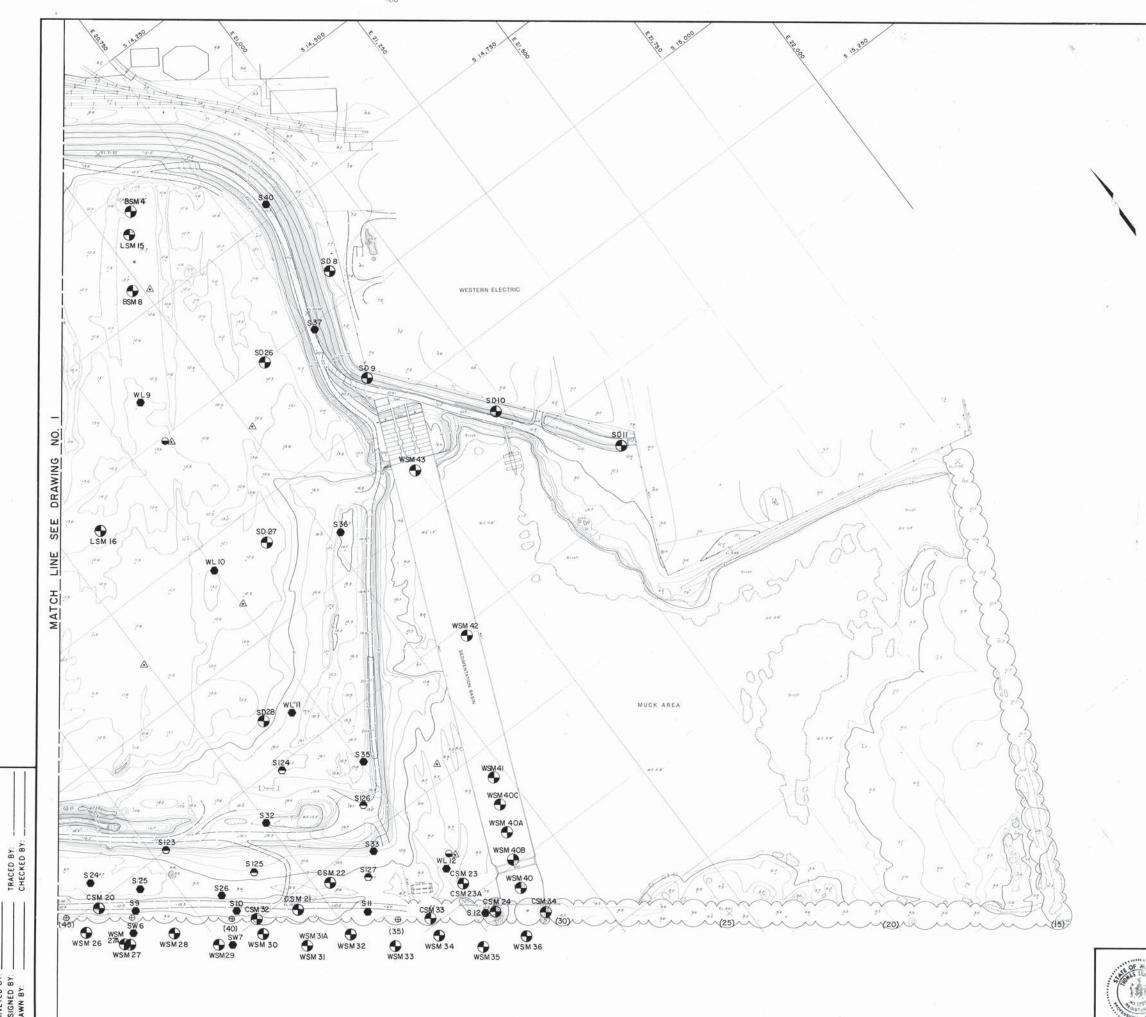
CSM LSM PSM WSM SD

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
5	PRESSURE LOAD CELL
\oplus	INCLINOMETER

		NO.	DATE	_	REVISION	
	SHEET NO.	Γ			RANSPORTATION AND D PORT ADMINIS	AUTHORITY
	G-I		SE	AGIR	MARINE TER	MINAL
MARYLAND PORT ADMINISTRATION		MARGINAL BULKHEAD				
REVIEWED BY:			BC		AND INSTR CATION PLA	
DIRECTOR OF E	L. Meken		(ث)		V/LYON ASSOC	
DATE: 10-	9-86		E: OCT.		CONTRACT NO. 287911	DRAWING NO



SURVEYED BY: DESIGNED BY: DRAWN BY:

LEGEND



BORINGS PERFORMED BY PITTSBURGH TESTING LABORATORY FROM NOV. 1982 TO JAN, 1983 UNDER THE INSPECTION OF STV/LYON ASSOCIATES.



BORINGS PERFORMED BY PITTSBURGH TESTING LABORATORY IN SEPT. & OCT., 1983 UNDER THE INSPECTION OF STV/ LYON ASSOCIATES.



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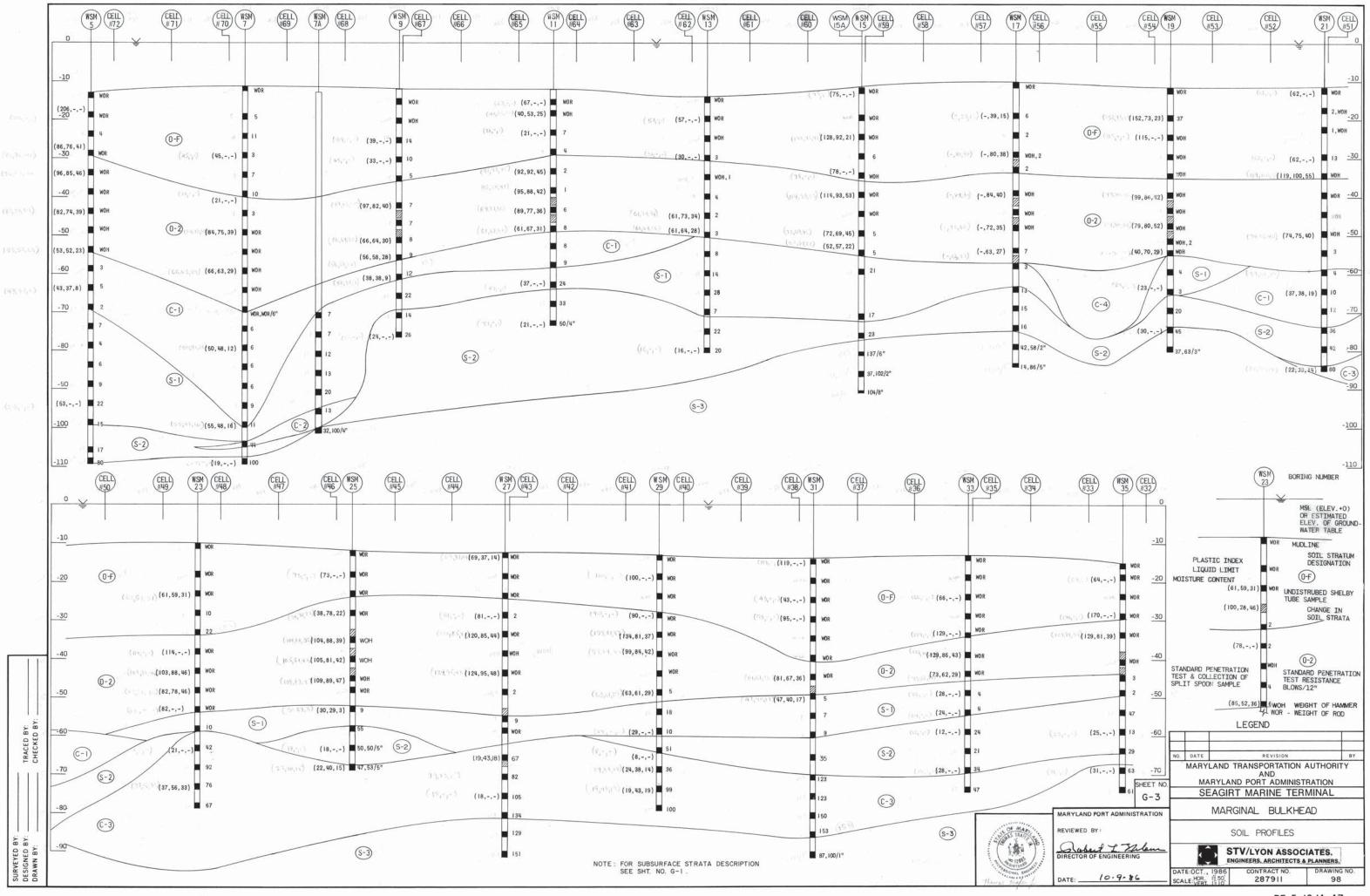
BORINGS PERFORMED BY FROEHLING & ROBERTSON, INC. FROM JULY, 1985 TO DEC., 1985 AND FROM APRIL, 1986 TO MAY, 1986 UNDER THE INSPECTION OF EBA ENG., INC.

PIEZOMETER

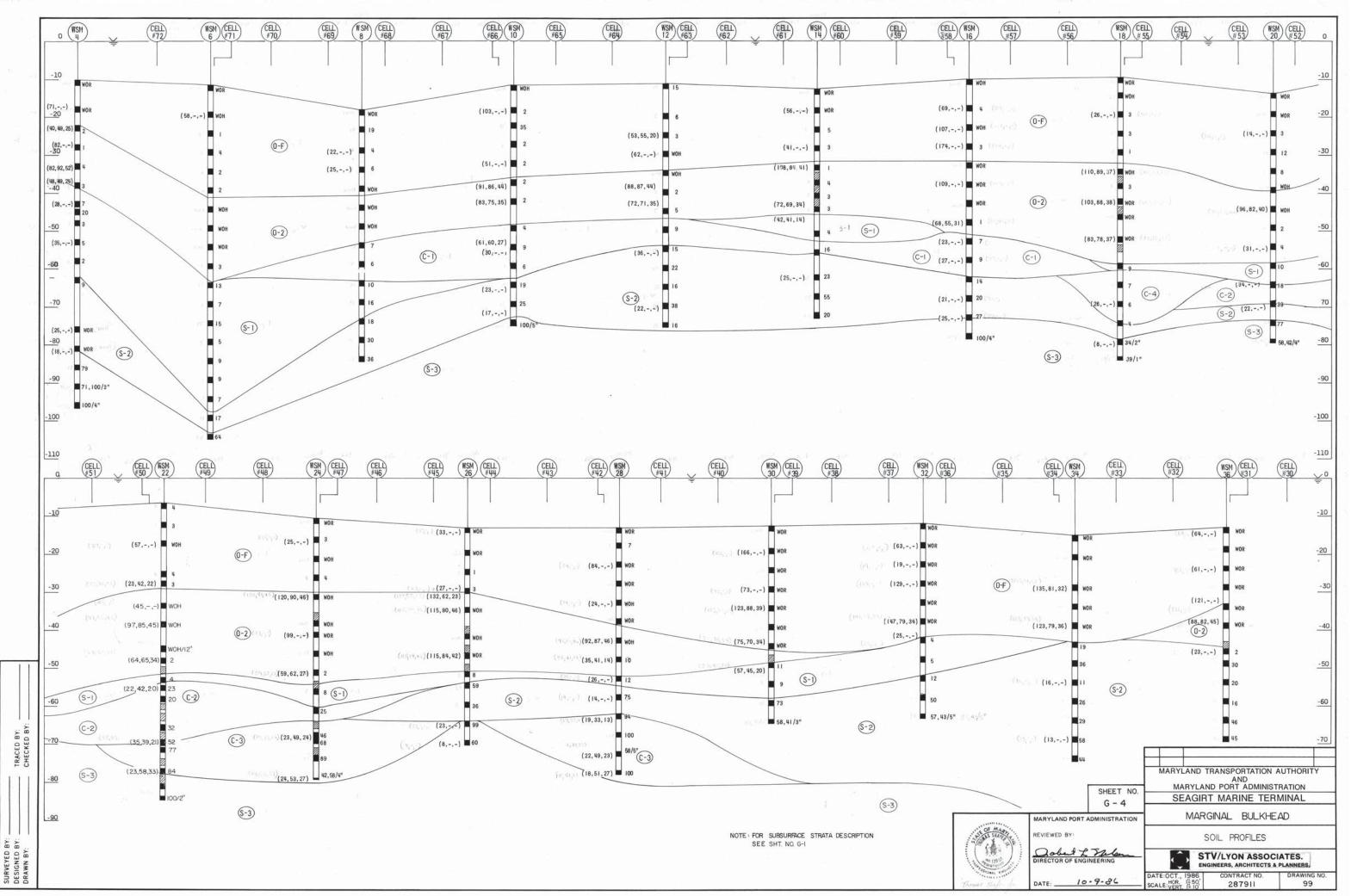
SETTLEMENT PLATE OR SETTLEMENT MONITORING DEVICE

INCLINOMETER

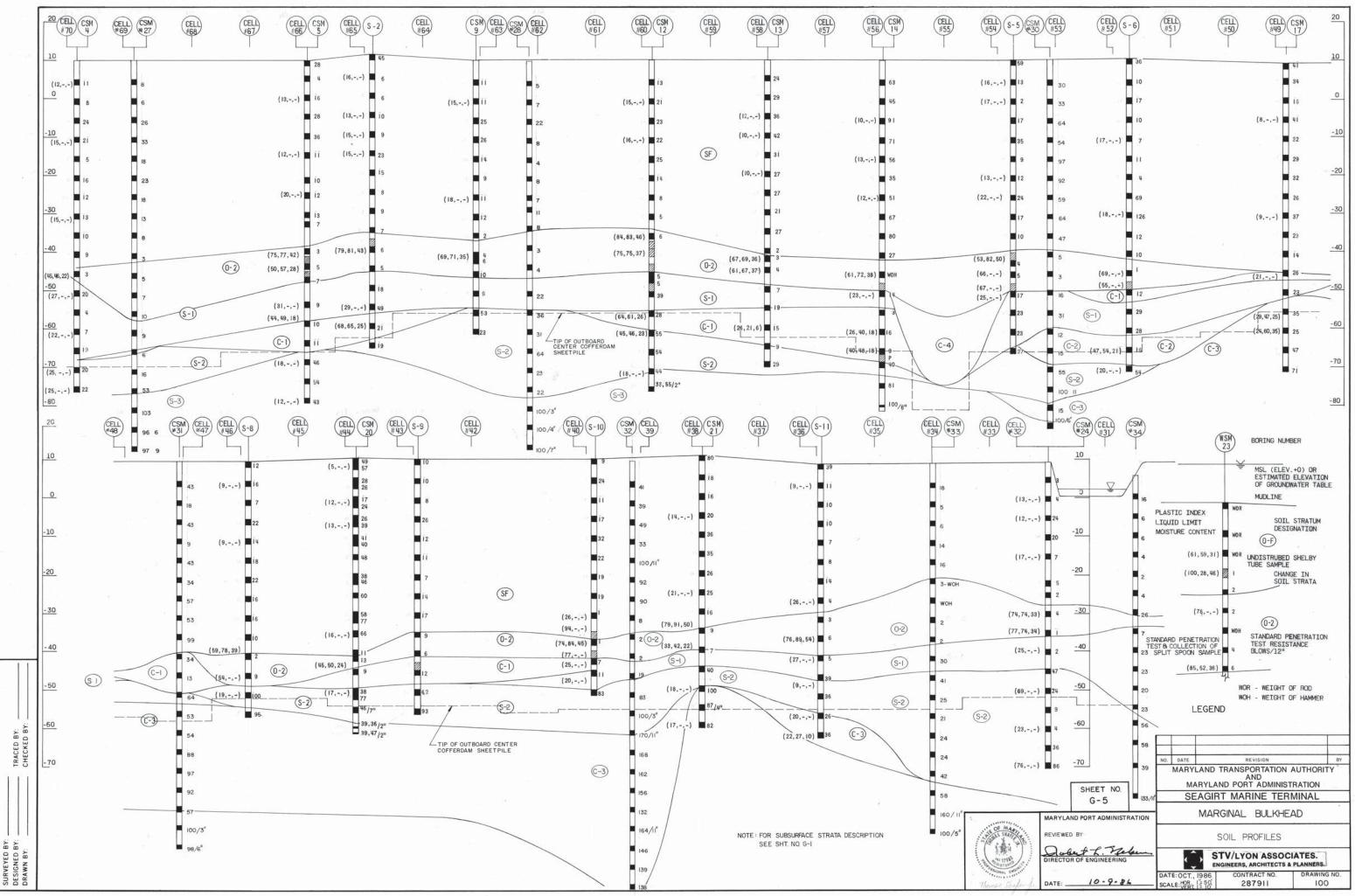
		NO	DATE	-	REVISION	8
	SHEET NO.		MARYL		ANSPORTATION AND PORT ADMINIS	AUTHORITY
	G - 2		SE	AGIRT	MARINE TER	RMINAL
MARYLAND PORT ADMINISTRATION			N	ARG	INAL BULK	HEAD
REVIEWED BY:			BC		AND INSTR ATION PLA	
DIRECTOR OF EN	GINEERING		¢,		LYON ASSOC	
DATE:	0.9.86		E: OCT.		CONTRACT NO. 287911	DRAWING NO. 97

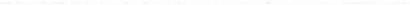


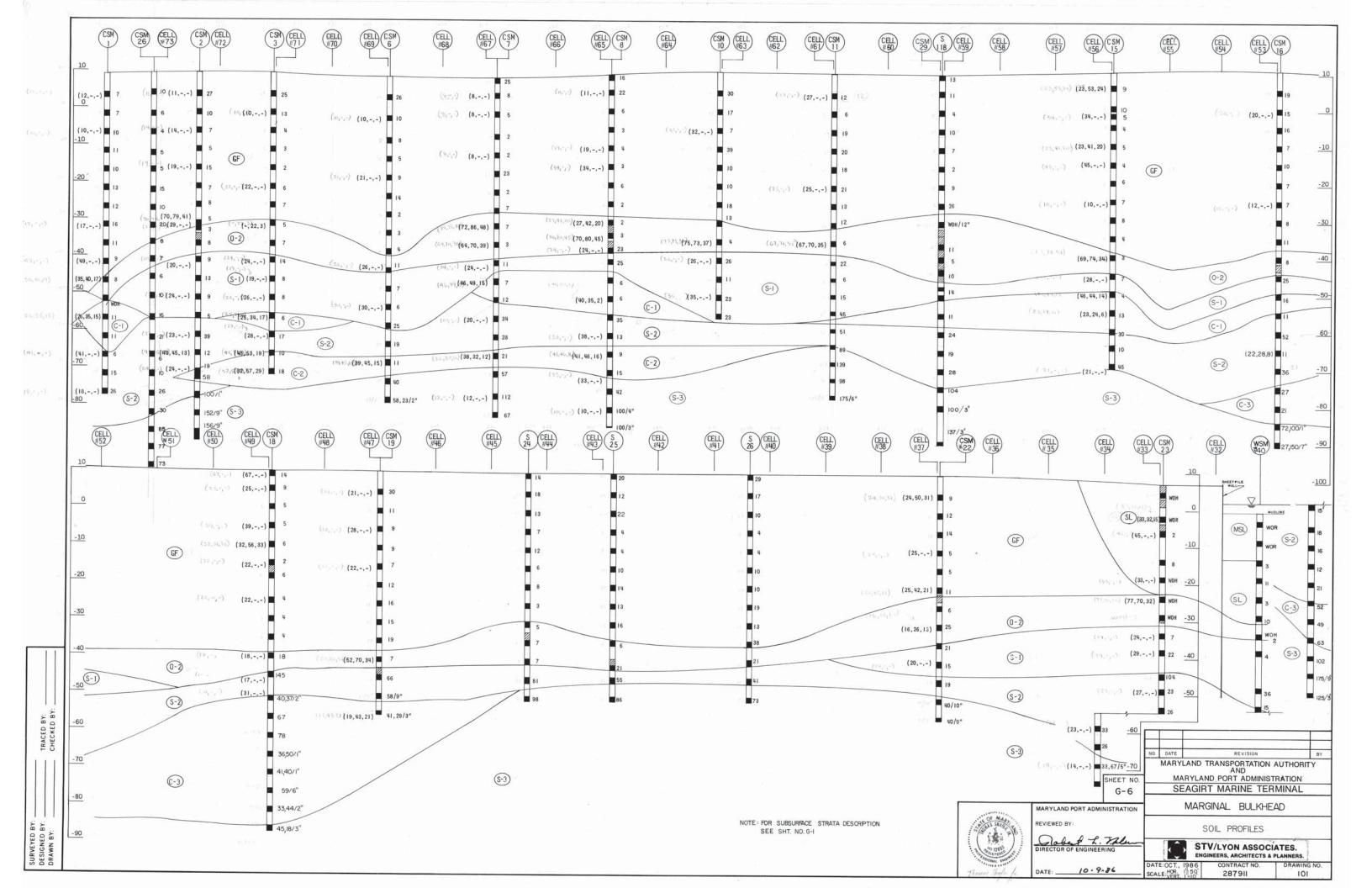
PF-5-12/4-47



PF-5-12/4-48









Publication No. FHWA-NHI-16-009 FHWA GEC 012 – Volume I July 2016

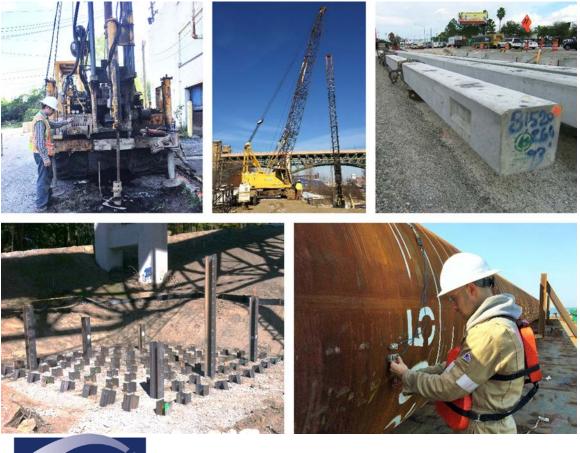
NHI Courses No. 132021 and 132022

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.





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:

$$d_f = 1.4 \left(\frac{EI_w}{E_s}\right)^{0.25}$$
 Eq. 8-6
 $E_s = 0.465s_u$ Eq. 8-7

For sands:

$$d_f = 1.8 \left(\frac{EI_w}{n_h}\right)^{0.2}$$
 Eq. 8-8

Where:

 d_f = depth to fixity below the ground (ft).

E = elastic modulus of pile material (ksi).

- $E_{\rm s}$ = elastic modulus of clay soil (ksi).
- s_u = undrained shear strength of clay (ksf).
- I_w = weak axis moment of inertia of pile (ft⁴).
- n_h = rate of increase of soil modulus with depth (Table 8-4) (ksi/ft).

Table 8-4Rate 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:

$$\frac{Kl}{r_s} \le 120$$
 Eq. 8-9

Where:

K = effective length factor (Figure 8-4) (dimensionless).

I = unbraced length, or laterally unsupported length plus d_f (inches).

 $r_{\rm s}$ = 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//.

Year Tested	Modulus of Rupture (psi)			f Elasticity ⁶ psi)	Compression Parallel (psi)	
Testeu	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%	

 Table 3. Results of the Wood Pile Testing for DMT Berths 1-4 in 1966 and 1929.

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

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
Е	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.

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:

where:

 $Y_T = Y_o e^{-BT}$

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 <u>Discussion</u>

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.

	Bulk Density	Effective Friction Angle	Effective Cohesion
Soil Type	(γ)/pcf	(Φ')/degrees	(c')/psf
Unsurcharged Muck Slurry (MSL)	100	20	50
Stone Column Improved Muck Slurry	115	27	50
(MSL)			
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	110	24	50
(C-1)			
Stone Column Improved Recent Alluvial	115	27	50
Organic Clay / Elastic Silt (C-1)			
Potomac Sand (S-3)	120	34	0
Potomac Clays (C-3)	125	24	100

Estimated Design Parameters of On-Site Soils for Sheet Pile Analysis

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

TRACED BY: CHECKED BY:

SURVEYED BY: DESIGNED BY: DRAWN BY:

ABBREVIATIONS

PRESTRESSED

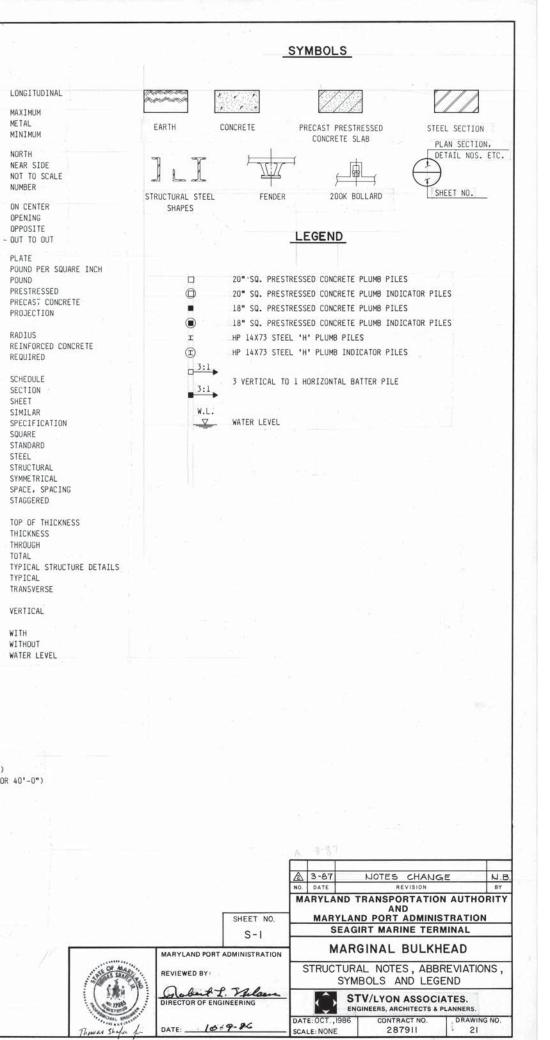
PROJECTION

SYMMETRICAL

WATER LEVEL

STANDARD

		STANDARD	
I. DESIGN CODES		Ø AT	LONGIT. LONGITUDI
A. BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE	2. LATERAL LOADS	ABT. ABOUT	MAX. MAXIMUM
(ACI-318-83) WITH COMMENTARY.	A) SHIP BERTHING - 3.0 KLF LATERAL FORCE.	ADD. ADDITION ADDL. ADDITIONAL	MET. METAL
	B) MOORING FORCE - 150 KIP PER BOLLARD	ALT. ALTERNATE	MIN. MINIMUM
B. STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, THE AMERICAN	C) WIND LOAD ON CONTAINER CRANE - 3.5 KIP HORIZONTAL	APPROX. APPROXIMATE	
ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS,	LOAD AT EACH WHEEL.	ALL ROAL	N. NORTH
AASHTO, 13TH EDITION, 1983.	D) CRANE STOPS AND STOWAGE PINS - TO MATCH EXISTING	B BOTTOM OF	N.S. NEAR SIDE
	WHARF.	BM. BEAM	NTS. NOT TO SCA
C. SPECIFICATION FOR THE DESIGN, FABRICATION, AND ERECTION OF		BRG. BEARING	NO. NUMBER
STRUCTURAL STEEL FOR BRIDGES, AISC, 1978.	C. LOAD COMBINATIONS	BETW. BETWEEN	0.C. ON CENTER
		BOT. BOTTOM	OPNG. OPENING
D. DESIGN MANUALS PUBLISHED BY THE DEPARTMENT OF THE NAVY,	1. SUPERSTRUCTURE (DECK SLABS, CAP BEAMS, CRANE GIRDERS,		OPP. OPPOSITE
NAVAL FACILITIES ENGINEERING COMMAND.	ETC.)	C.I.P. CAST-IN-PLACE	0/0 ~ OUT TO OUT
II. DESIGN LOADS	LOAD COMBINATION & ALLOWABLE STRESS	CTR. CENTER	
	DEAD LOAD + LIVE LOAD (W/IMPACT) 100	CENTERLINE	PL. PLATE
A. PATAPSCO FRONTAGE	DEAD LOAD + LIVE LOAD (W/IMPACT) +	C/C CENTER TO CENT	
	BERTHING FORCE + SOIL PRESSURE 100	CL. CLEAR CONC. CONCRETE	LB. POUND
1. VERTICAL LIVE LOADS	DEAD LOAD + LIVE LOAD (W/IMPACT) + SOIL	CONT. CONTINUOUS	P.S. PRESTRESS P.C. PRECAST CO
A) UNIFORM LOAD	PRESSURE + MOORING FORCE + WIND LOAD 133	CONTR. JT. CONTRACTION JO	
(1) 1000 PSF FOR SUPERSTRUCTURE		C.J. CONSTRUCTION J	
(2) 800 PSF FOR PILING	SUBSTRUCTURE (PRESTRESSED CONCRETE PILES AND H-PILES)		R. RADIUS
B) CONTAINER CRANE	SAME AS ABOVE EXCEPT IMPACT IS EXCLUDED.	DET. DETAIL	R/C REINFORCED
(1) RAIL MOUNTED 100' GAGE.		DIAG. DIAGONAL	REQD. REQUIRED
	I. MATERIAL PROPERTIES	DIA.Ø DIAMETER	
(3) 130 KIP VERTICAL WHEEL LOAD @ 4.5' C−C		DIM. DIMENSION	SCH. SCHEDULE
SPACING. (4) 30% IMPACT.	A. REINFORCED CONCRETE, MINIMUM COMPRESSIVE STRENGTH AT 28	DO, DITTO	SECT. SECTION
(4) 30% IMPACT.	DAYS.	DWG. DRAWING	S/SHT. SHEET
250 KIP UPLIFT FORCE FOR SEASIDE CRANE THE DOWNS.	1. f'c = 4000 PSI FOR CAST-IN-PLACE CONCRETE DECK SLABS,	100	SIM. SIMILAR
C) TRUCK LOAD: HS 20-44	BEAMS, CRANE GIRDERS, PILE BENTS AND OTHER STRUCTURAL	EA. EACH	SPEC. SPECIFICAT
D) SPECIAL EQUIPMENT LOADS (AS AN OVERLOAD PROVISION):	MEMBERS.	EL. ELEVATION	SQ. SQUARE
THE SUPERSTRUCTURE WILL BE ANALYZED FOR THE	HENDERG.	EQ. EQUAL EXIST. EXISTING	STD. STANDARD
FOLLOWING LOADS IN ACCORDANCE WITH LOADING	2. f'c = 5000 PSI FOR PRESTRESSED CONCRETE PLANKS AND 18"	EXP. EXPANSION	ST. STEEL STR. STRUCTURAL
COMBINATION GROUP IB IN ARTICLE 3.22 OF AASHTO 13TH	SQ. PRESTRESSED CONCRETE PILES.	E.S. EACH SIDE	SYM. SYMETRICA
EDITION.		E.J. EXPANSION JOIN	
 MARATHON LETRO-PORTER MODEL 2782 W/ 251. 	3. f'c = 6000 PSI FOR 20" SQ. PRESTRESSED CONCRETE PILES		STAGG. STAGGERED
o 90,000 LBS. CAPACITY AT 48 INCHES LOAD	AND STRUTS.	FIN. FINISH	STREET.
CENTER		F.S. FAR SIDE	T TOP OF THI
o AXLE LOAD 226,000 LBS. WITH 30% IMPACT.	B. REINFORCING STEEL		THK. THICKNESS
o TIRE 98 INCHES DUTSIDE DIAMETER - 48 PLY-		GALV. GALVANIZE	THRU THROUGH
RATING (2 TIRES PER AXLE) AT 86 PSI.	1. DEFORMED REINFORCING BARS SHALL CONFORM TO ASTM A615,	GR. GRADE	TOT. TOTAL
 0 175 INCHES FROM OUTSIDE TO OUTSIDE OF TIRES. 	GRADE 60 (Fy =60KSI), EXCEPT TIES AND STIRRUPS, WHICH	GRD. GROUND	TS TYPICAL ST
CONTACT AREA OF TIRE 1320 SQ. INCHES.	SHALL CONFORM TO ASTM A615, GRADE 40 (Fy=40KSI).		TYP. TYPICAL
(2) CLARK EQUIPMENT, CLARKLIFT CY 700.	2. PRESTRESSED STRANDS SHALL BE SEVEN WIRE, STRESS RE-	HEX. HEXAGON	TRANS. TRANSVERSE
o 70,000 LBS CAPACITY AT 48 INCHES LOAD	LIEVED STRANDS CONFORMING TO ASTM A416 GRADE 270K.	HORZ. HORIZONTAL	inter interaction
CENTER.	ELEVED STRANDS COM DRAINS TO ASTA A410 BRADE 270K.	17 101117	VERT. VERTICAL
 AXLE LOAD 166,500 LBS PLUS 30% IMPACT. 		JT. JOINT	W/ WITH
o TIRE 18 X 25 - 32 PLY TANDEM (4 TIRES) AT	3. WIRE SPIRAL TIES SHALL CONFORM TO ASTM A82.	KIP. 1000 POUNDS	W/O WITHOUT
138 PSI.		KSI. KIP PER SQUARE	
o 81 INCHES FROM CENTERLINE TO CENTERLINE OF	C. STRUCTURAL STEEL	Nort Hit Fell Subme	
INTERIOR TIES.			
o 127.25 INCHES FROM OUTSIDE TO OUTSIDE OF	 ROLLED SHAPES AND PLATES SHALL CONFORM TO ASTM A36. 		
OUTER TIRES.			
o CONTACT AREA OF TIRE 300 SQ. INCHES.	2. BOLTS AND ANCHOR BOLTS SHALL CONFORM TO ASTM A307.		
2. LATERAL LOADS			
 A) SHIP BERTHING - 60,000 DWT VESSEL WITH 0.4 FT/SEC. 	 WELDING SHALL CONFORM TO AWS, ELECTRODES SHALL BE E70XX SERIES FOR A36 STEEL, OR APPROVED EQUAL. 	STRUCTURAL	
VELOCITY, AND 50,000 DWT VESSEL WITH 0.4 FT/SEC.	SERIES FOR ADO SIEEL, OR AFFROVED EQUAL.	STRUCTURAL	
VELOCITY AT 10° APPROACH ANGLE. 585 T.E.U. CON-	D. PILE CAPACITY, ALL PILES SHALL BE DRIVEN TO A MINIMUM	PART I - SEASIDE MARGI	NAL WHARF (34'-6")
TAINER BARGE WITH 1.0 FT/SEC VELOCITY AT 45°	BEARING CAPACITY AS FOLLOWS:	PART II - PLATFORMS OVER	R EXISTING CELLS (73"-0")
APPROACH ANGLE.		PART III - LANDSIDE RELI	EVING PLATFORMS (30'-0" OR 40'-0")
APPROACH ANGLE. B) MOORING FORCE - 200 KIPS PER BOLLARD. at 3° (From the Horizontal) C) MIDD LOD ON CONTAINED COMP. 350 KIPS ON LANDLES	1. 18" SQ. PRECAST CONCRETE PILES - 140 TONS.	CB – CAP BEAM	
C) WIND LOAD ON CONTAINER CRANE - 350 KIPS ON LANDSIDE		EB – EDGE BEAM	
RAIL AND 100 KIPS ON SEASIDE RAIL, (BASED ON 50 PSF	20" SQ. PRECAST CONCRETE PILES - 145 TONS.	FB - FASCIA BEAM (
WIND PRESSURE WITH 1.5 GUST FACTOR).	7 NUR73 AN 50 170 YOUR	LCG - LANDSIDE CRAN	
D) CRANE STOPS - BASED ON 1000 TON CONTAINER CRANE	3. 14HP73 PILES - 130 TONS.	LB - LONGITUDINAL	
TRAVELING AT SPEED OF 150 FT/MIN. MAXIMUM IMPACT		PS – PRESTRESSED C SCG – SEASIDE CRANE	
E) STOWAGE PINS - 270 KIPS SEASIDE RAIL. 230 KIPS LANDSIDE RAIL. 11 230 KIPS LANDSIDE RAIL.	. MINIMUM CONCRETE COVER OVER REINFORCING BARS SHALL BE AS	SLB - SEALAND BEAM	GINDER
230 KIPS LANDSIDE RAIL	FOLLOWS UNLESS OTHERWISE SHOWN ON THE DRAWINGS:	SLCG - SEALAND CRANE	GIRDER
B. SEA-LAND EXTENSION (TO MATCH EXISTING WHARF)		SLLB - SEALAND LONGI	
1. VERTICAL LIVE LOADS	A. CONCRETE CAST AGAINST AND PERMANENTLY	SLTB - SEALAND TIE-B	
A) UNIFORM LOAD	EXPOSED TO EARTH 3 IN.		
(1) 600 PSF FOR SUPERSTRUCTURE.			
(2) 480 PSF FOR PILES.	B. CONCRETE EXPOSED TO EARTH OR WEATHER	55)	
B) CONTAINER CRANE	1. BOTTOM OF BEAMS AND SLABS 3 IN. (4 IN. BEAMS OVER PIL	E 57	
(1) RAIL MOUNTED 50' GAGE.	2. TOP OF BEAMS AND SLABS 2 IN. 3. SIDES OF BEAMS AND WALLS 2 IN. (3 IN. OUTSIDE FACE 0	F	
(2) 73.5 KIP VERTICAL WHEEL LOAD AT 5.0' C-C SPAC-	 SIDES OF BEAMS AND WALLS IN. (3 IN. OUTSIDE FACE O FASCIA BEAM) 		
ING.	FROUN DENIT	0	
(3) 30% IMPACT. V	ALL EXPOSED CONCRETE EDGES SHALL BE CHAMFERED 3/4" UNLESS OTHER-		
(4) 150 KIP UPLIFT FORCE FOR CRANE TIE DOWNS	WISE SHOWN.		
C) TRUCK LOAD: HS 20-44	. SEE DRAWING NO. TS-9 FOR FENDER DESIGN REQUIREMENTS.		
	. SEE GARTING NO. 13-2 FOR FERDER DESIGN REQUIREMENTS.		



PF-5-12/3-21

SEAGIRT LOOP DEEPENING FEASIBILITY - PILE FIXITY AND PASSIVE WEDGE

DEPTH TO FIXITY FOR CONCRETE PILES AT SMT 1-2

h =

df*tan(45-phi/2)

DEPTH TO FIXITY FOR CONCRETE PILES AT SMT 1-2					
df	17.10697	ft	per FHWA-NHI-16-009	e depth to fixity	
E	4030.509	ksi	per ACI 318-14		
lw	0.643004	ft^4			
Es	0.11625	ksi	per FHWA-NHI-16-009)	
su	0.25	ksf	interpreted from soil	orofile	
fc	5000	psi	per drawings		
df =	1.4((E*Iw)/	′Es)^0.25			
E =	57000*fc^	0.5 =	4030509 psi =	4030.509 ksi	
=	bh^3/12 =		0.643004 ft^4	for 20-inch square pile	
Es =	0.465*su =		0.11625 ksi		
Horizont	al Projectior	of Passive	Wodgo		
phi	•	degrees	for clay soil		
phi		degrees	,	m SMT 4)	
h	17.10697	ucgrees	for phi = 0		
h	24.43129		for phi = 20 (drained o	ondition)	
h	32.17354		for phi = 34 (high phi f		
				,	
h =	df*tan(45-	phi/2)			
df	7.022472	ft	per FHWA-NHI-16-009		
df E	7.022472 1500	ft ksi			
df E Iw	7.022472 1500 0.049063	ft ksi ft^4	per FHWA-NHI-16-009 per NDS	9 = depth to fixity	
df E Iw Es	7.022472 1500 0.049063 0.11625	ft ksi ft^4 ksi	per FHWA-NHI-16-009 per NDS per FHWA-NHI-16-009	9 = depth to fixity	
df E Iw Es su	7.022472 1500 0.049063 0.11625 0.25	ft ksi ft^4 ksi ksf	per FHWA-NHI-16-009 per NDS per FHWA-NHI-16-009 interpreted from soil	9 = depth to fixity	
df E Iw Es	7.022472 1500 0.049063 0.11625	ft ksi ft^4 ksi ksf	per FHWA-NHI-16-009 per NDS per FHWA-NHI-16-009	9 = depth to fixity	
df E Iw Es su	7.022472 1500 0.049063 0.11625 0.25 5000	ft ksi ft^4 ksi ksf psi	per FHWA-NHI-16-009 per NDS per FHWA-NHI-16-009 interpreted from soil	9 = depth to fixity	
df E Iw Es su fc	7.022472 1500 0.049063 0.11625 0.25	ft ksi ft^4 ksi ksf psi (Es)^0.25	per FHWA-NHI-16-009 per NDS per FHWA-NHI-16-009 interpreted from soil	9 = depth to fixity	
df E Iw Es su fc df =	7.022472 1500 0.049063 0.11625 0.25 5000 1.4((E*Iw)/	ft ksi ft^4 ksi ksf psi (Es)^0.25	per FHWA-NHI-16-009 per NDS per FHWA-NHI-16-009 interpreted from soil p per drawings	9 = depth to fixity	
df E Iw Es su fc df = E =	7.022472 1500 0.049063 0.11625 0.25 5000 1.4((E*Iw)/ 1500000	ft ksi ft^4 ksi ksf psi (Es)^0.25 psi =	per FHWA-NHI-16-005 per NDS per FHWA-NHI-16-005 interpreted from soil p per drawings 1500 ksi	9 = depth to fixity 9 profile	
df E Iw Es su fc df = E = I =	7.022472 1500 0.049063 0.11625 0.25 5000 1.4((E*Iw))/ 1500000 PI*d^4/64	ft ksi ft^4 ksi ksf psi (Es)^0.25 psi =	per FHWA-NHI-16-005 per NDS per FHWA-NHI-16-005 interpreted from soil p per drawings 1500 ksi 0.049063 ft^4	9 = depth to fixity 9 profile	
df E Iw Es su fc df = E = I = Es = Horizonta	7.022472 1500 0.049063 0.11625 0.25 5000 1.4((E*Iw)/ 1500000 PI*d^4/64 0.465*su =	ft ksi ft^4 ksi ksf psi (Es)^0.25 psi =	per FHWA-NHI-16-005 per NDS per FHWA-NHI-16-005 interpreted from soil p per drawings 1500 ksi 0.049063 ft^4 0.11625 ksi 2 Wedge	9 = depth to fixity 9 profile	
df E Iw Es su fc df = E = I = Es = Horizonta	7.022472 1500 0.049063 0.11625 0.25 5000 1.4((E*Iw)/ 1500000 PI*d^4/64 0.465*su = bl Projectior 0	ft ksi ft^4 ksi ksf psi (Es)^0.25 psi = of Passive degrees	per FHWA-NHI-16-005 per NDS per FHWA-NHI-16-005 interpreted from soil p per drawings 1500 ksi 0.049063 ft^4 0.11625 ksi 2 Wedge for clay soil	e) = depth to fixity porofile for 12-inch round pile	
df E Iw Es su fc df = E = I = Es = Horizonta phi phi	7.022472 1500 0.049063 0.11625 0.25 5000 1.4((E*Iw)/ 150000 PI*d^4/64 0.465*su = al Projection 0 20	ft ksi ft^4 ksi ksf psi (Es)^0.25 psi = of Passive degrees degrees	per FHWA-NHI-16-005 per NDS per FHWA-NHI-16-005 interpreted from soil p per drawings 1500 ksi 0.049063 ft*4 0.11625 ksi 2 Wedge for clay soil drained condition (fro	e) = depth to fixity porofile for 12-inch round pile	
df E Iw Es su fc df = E = I = Es = Horizonta phi phi h	7.022472 1500 0.049063 0.11625 0.25 5000 1.4((E*Iw)) 150000 PI*d^4/64 0.465*su = Al Projection 0 20 7.022472	ft ksi ft^4 ksi ksf psi (Es)^0.25 psi = of Passive degrees degrees	per FHWA-NHI-16-005 per NDS per FHWA-NHI-16-005 interpreted from soil p per drawings 1500 ksi 0.049063 ft^4 0.11625 ksi 2 Wedge for clay soil drained condition (fro for phi = 0	e) = depth to fixity porofile for 12-inch round pile m SMT 4)	
df E Iw Es su fc df = E = I = Es = Horizonta phi phi	7.022472 1500 0.049063 0.11625 0.25 5000 1.4((E*Iw)/ 150000 PI*d^4/64 0.465*su = al Projection 0 20	ft ksi ft^4 ksi ksf psi (Es)^0.25 psi = of Passive degrees degrees	per FHWA-NHI-16-005 per NDS per FHWA-NHI-16-005 interpreted from soil p per drawings 1500 ksi 0.049063 ft*4 0.11625 ksi 2 Wedge for clay soil drained condition (fro	e = depth to fixity porofile for 12-inch round pile m SMT 4) condition)	

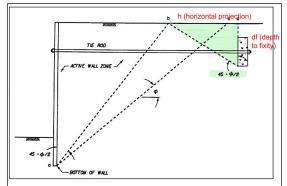


Figure 5-8. Minimum anchor - wall spacing for full passive anchor resistance in homogeneous soil

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 pcf is recommended

Design Value	Reference Design Value	Residual Value per Testing	Recommended Reference Design
	per the NDS		Value
Fb	2,400 psi	X 0.47	1,150 psi
Fc	1,200 psi	X 0.45	550 psi
Е	1,500,000 psi	X 0.65	0.98 x 10 ⁶ psi
Emin	790,000 psi	X 0.65	0.51 x 106 psi

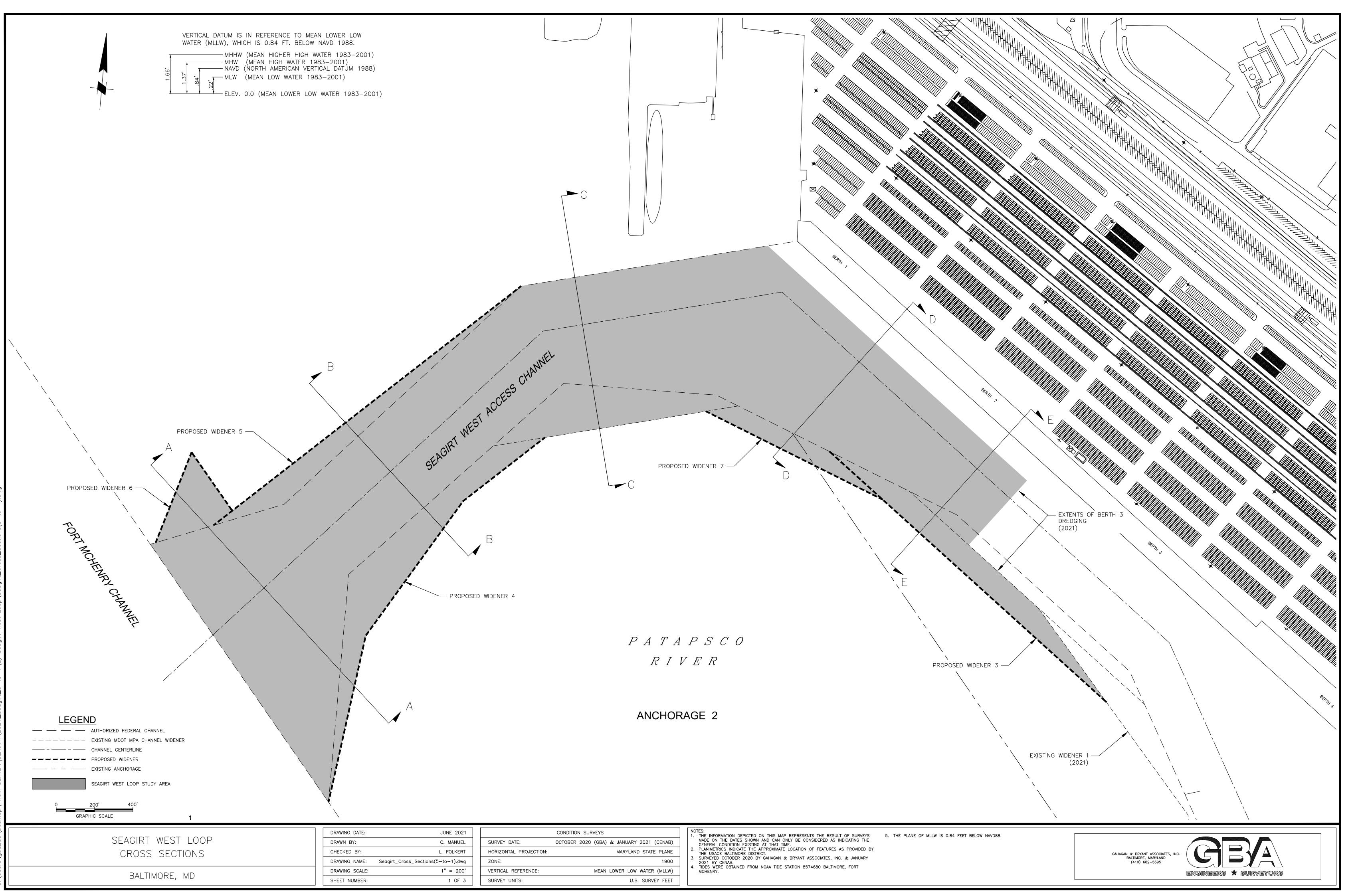
BALTIMORE HARBOR ANCHORAGES AND CHANNELS (BHAC) MODIFICATION OF SEAGIRT LOOP CHANNEL FEASIBILITY STUDY

DRAFT INTEGRATED FEASIBILITY REPORT & ENVIRONMENTAL ASSESSMENT

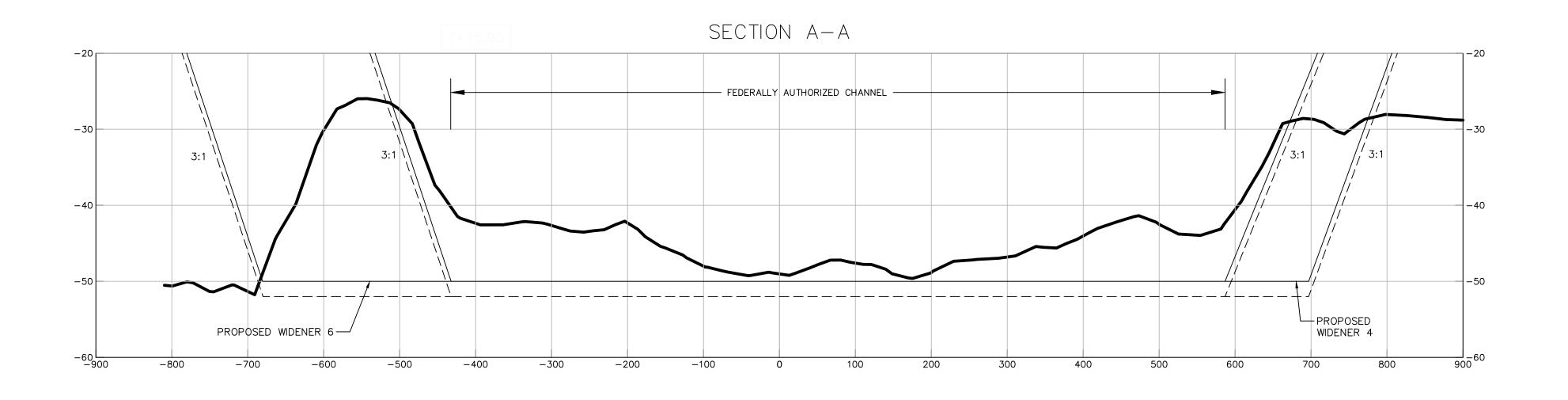
APPENDIX B4: WEST SEAGIRT BRANCH CHANNEL SECTIONS

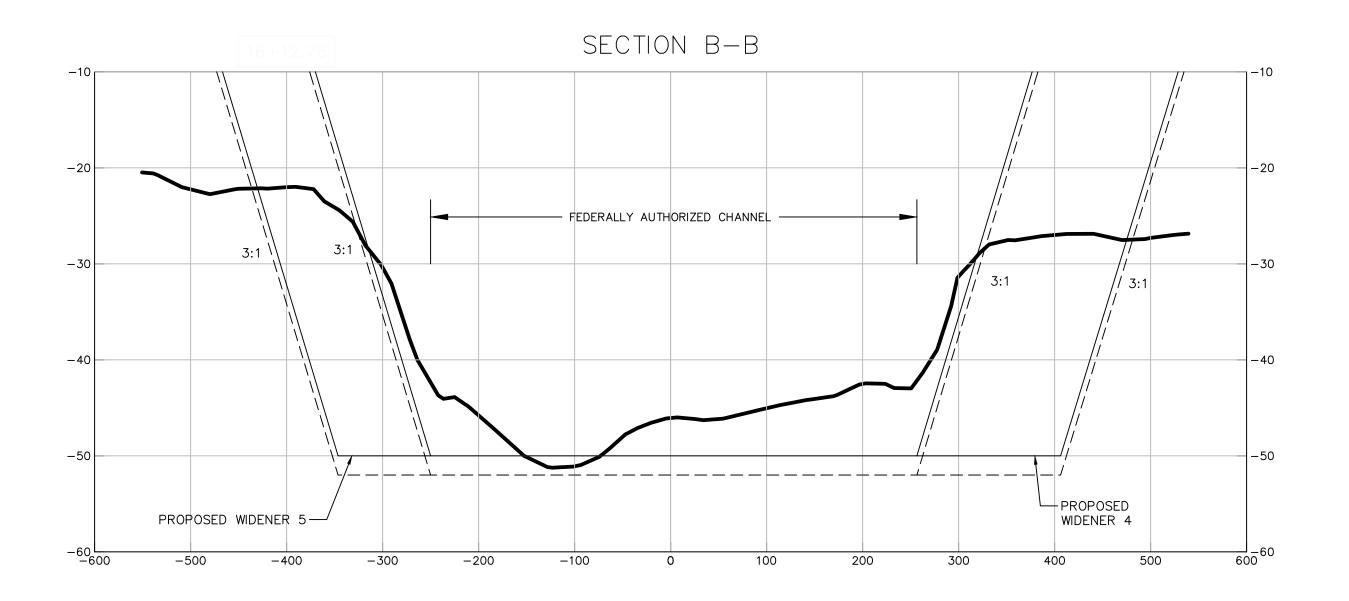
FEBRUARY 2022

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2021	CONDITION SURVEYS			
ANUEL	SURVEY DATE:	OCTOBER 2020 (GBA) & JANUARY 2021 (CENAB)		
_KERT	HORIZONTAL PROJECTION:	MARYLAND STATE PLANE		
).dwg	ZONE:	1900		
200'	VERTICAL REFERENCE:	MEAN LOWER LOW WATER (MLLW)		
OF 3	SURVEY UNITS:	U.S. SURVEY FEET		





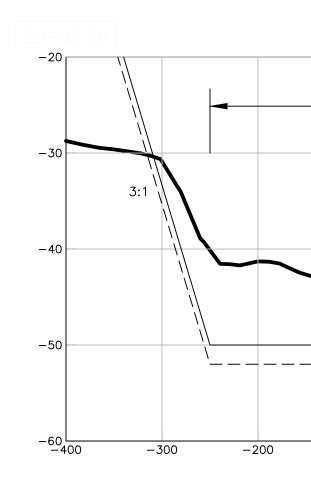
LEGEND CENAB/GBA COMBO SURVEY ------ PROPOSED REQUIRED GRADE (-50')

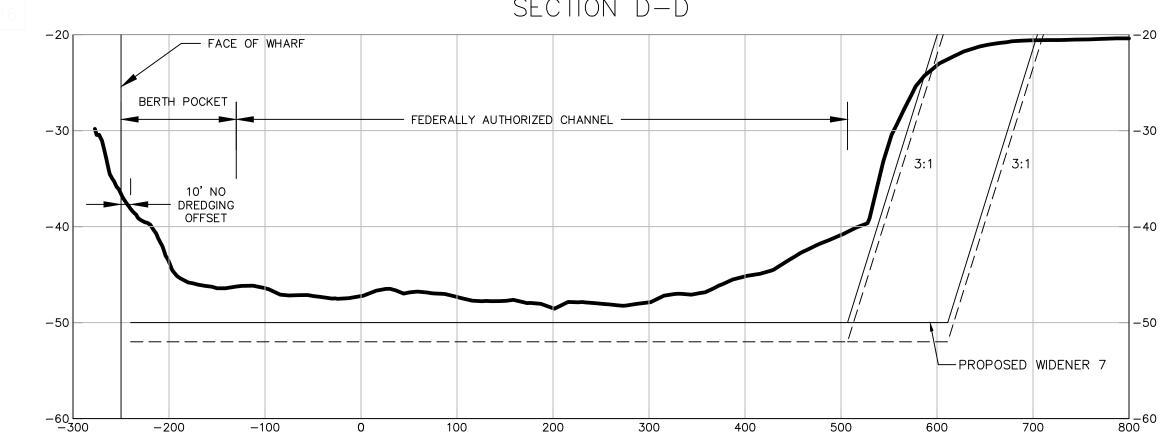
HORIZONTAL SCALE VERTICAL SCALE

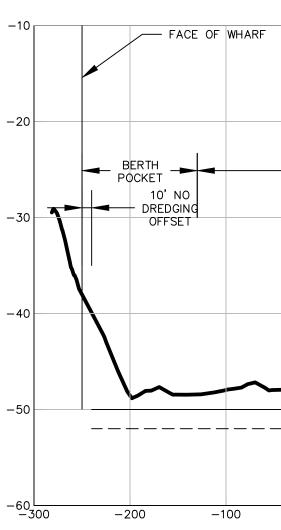
SEAGIRT WEST LOOP CROSS SECTIONS 3H:1V SLOPES

DRAWING DATE:	JUNE 20
DRAWN BY:	C. MANU
CHECKED BY:	L. FOLKE
DRAWING NAME:	SEAGIRT WEST LOOP CROSS SECTIO
DRAWING SCALE:	AS SHO
SHEET NUMBER:	2 OF

BALTIMORE, MD

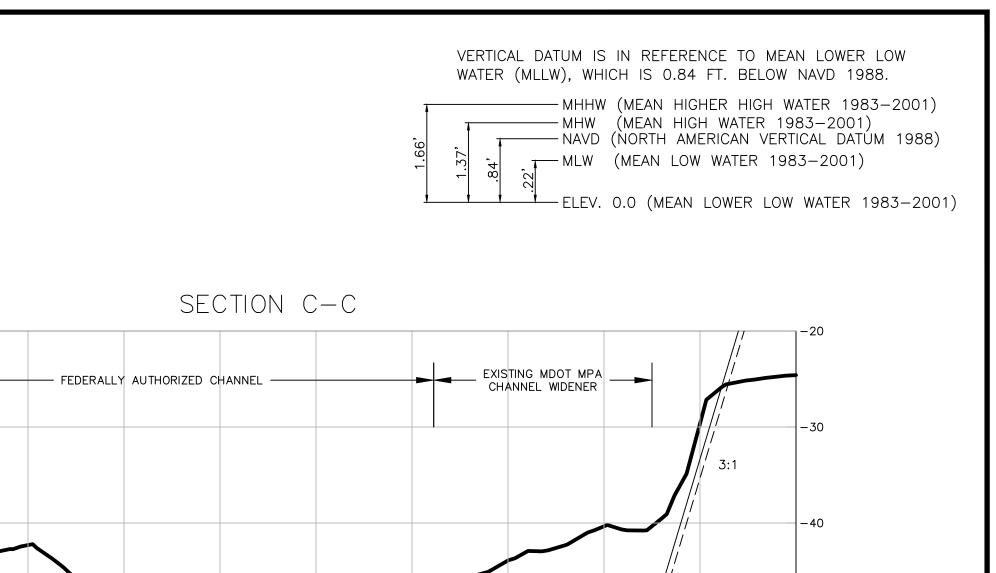




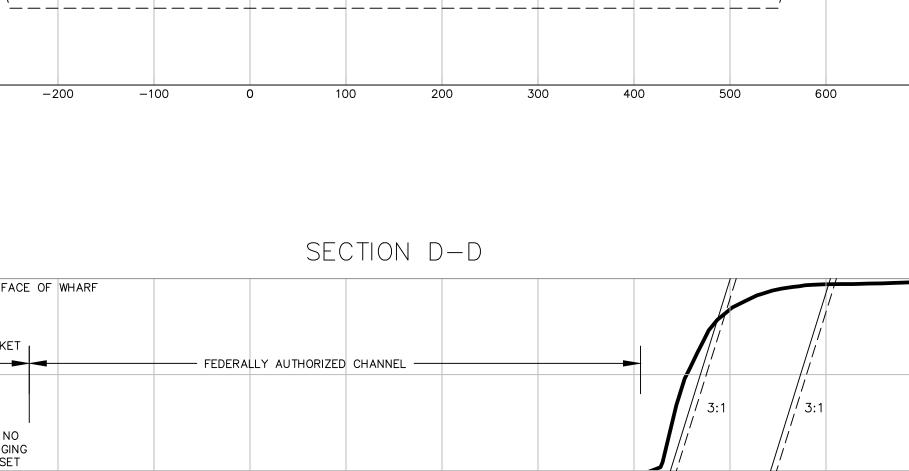


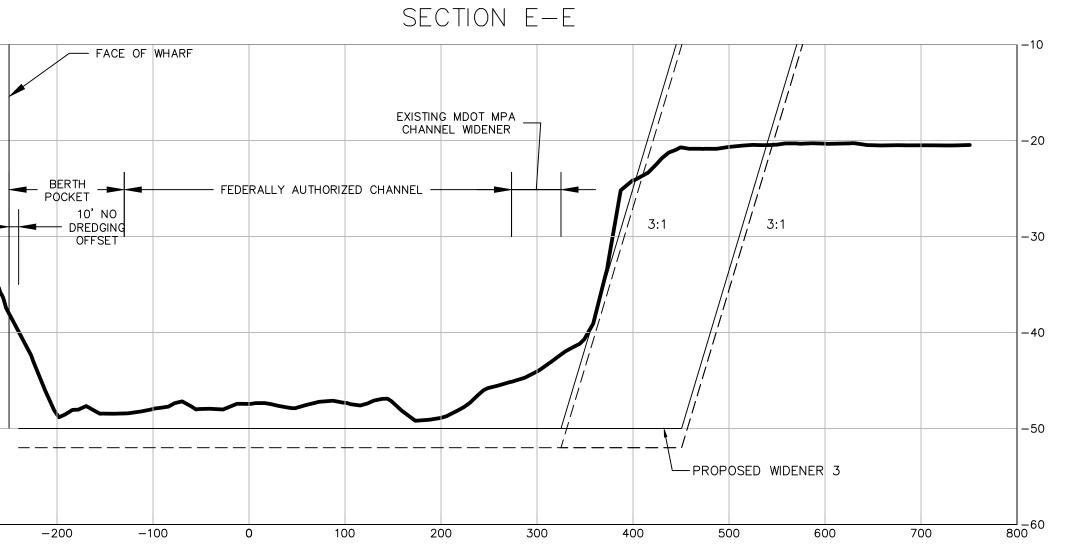
2021	CONDITION SURVEYS				
UEL	SURVEY DATE:	OCTOBER 2020 (GBA) & JANUARY 2021 (CENAB)			
ERT	HORIZONTAL PROJECTION:	MARYLAND STATE PLANE			
ONS	ZONE:	1900			
OWN	VERTICAL REFERENCE:	MEAN LOWER LOW WATER (MLLW)			
F 3	SURVEY UNITS:	U.S. SURVEY FEET			

NOTES:
 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.
 PLANIMETRICS INDICATE THE APPROXIMATE LOCATION OF FEATURES AS PROVIDED BY THE USACE BALTIMORE DISTRICT.
 SURVEYED OCTOBER 2020 BY GAHAGAN & BRYANT ASSOCIATES, INC. & JANUARY 2021 BY CENAB.
 TIDES WERE OBTAINED FROM NOAA TIDE STATION 8574680 BALTIMORE, FORT MCHENRY.



-50

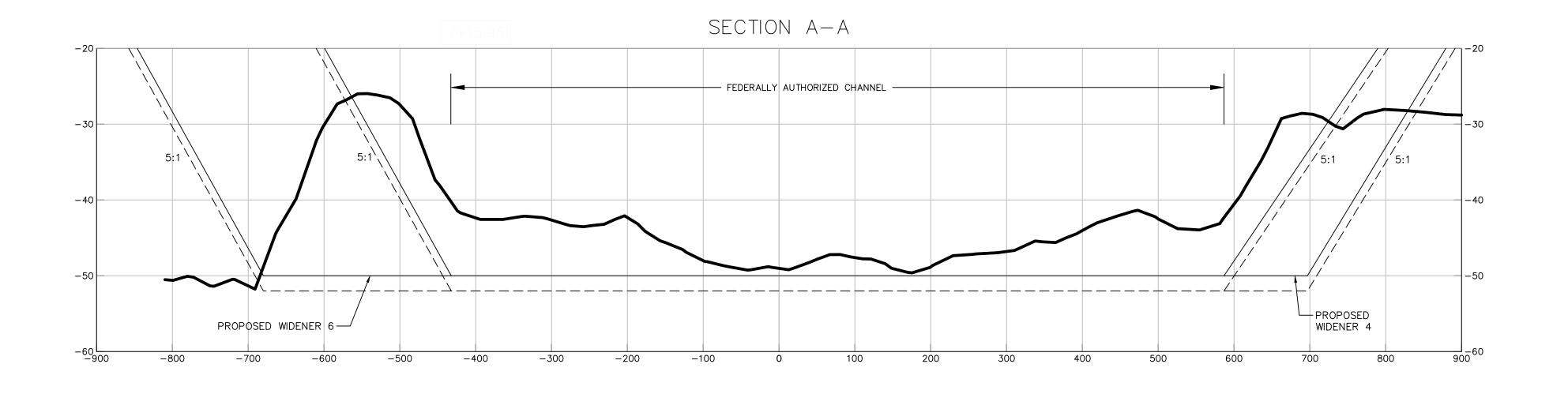


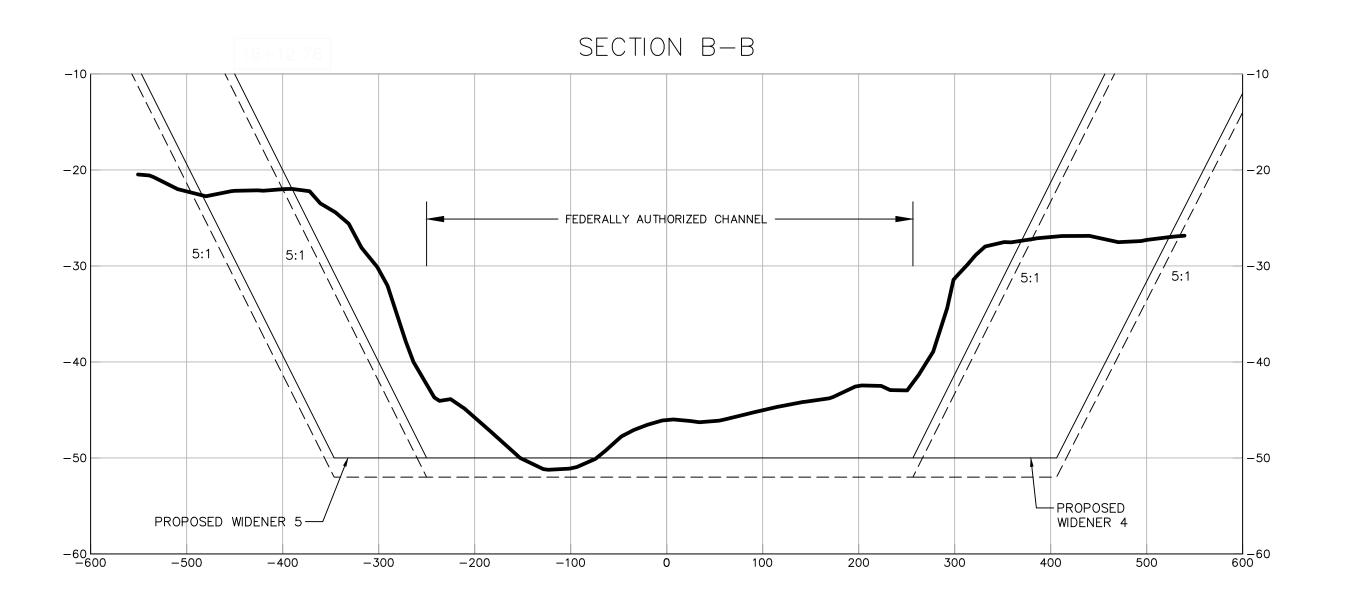


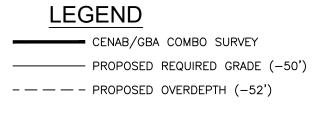


5. THE PLANE OF MLLW IS 0.84 FEET BELOW NAVD88.

GAHAGAN & BRYANT ASSOCIATES, INC. BALTIMORE, MARYLAND (410) 682–5595





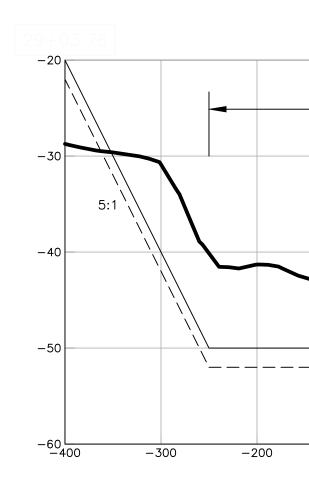


HORIZONTAL SCALE VERTICAL SCALE

> SEAGIRT WEST LOOP CROSS SECTIONS - 5H:1V SLOPES

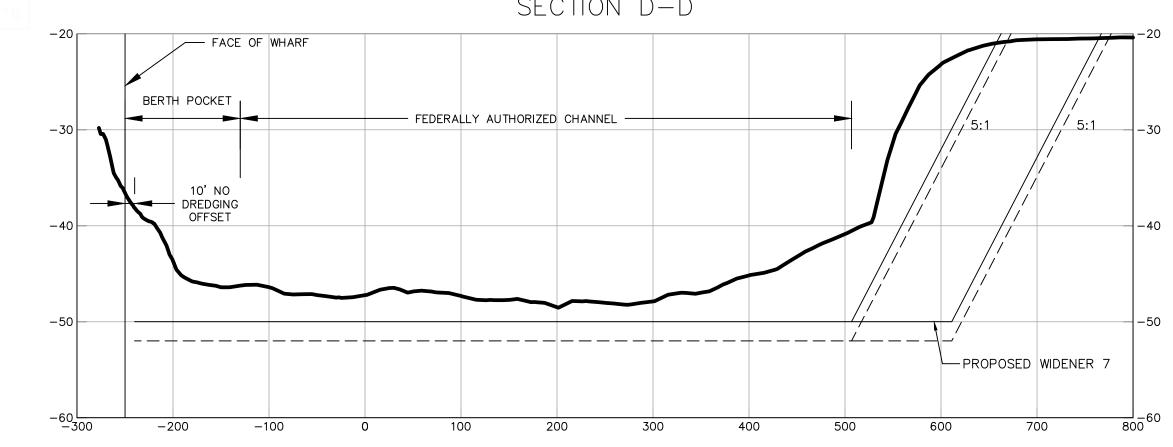
DRAWING DATE:	JUNE 2021		CONDITION SURVEYS
DRAWN BY:	C. MANUEL	SURVEY DATE:	OCTOBER 2020 (GBA) & JANUARY 2021 (CENAB)
CHECKED BY:	L. FOLKERT	HORIZONTAL PROJECTION:	MARYLAND STATE PLANE
DRAWING NAME:	Seagirt_Cross_Sections(5-to-1).dwg	ZONE:	1900
DRAWING SCALE:	AS SHOWN	VERTICAL REFERENCE:	MEAN LOWER LOW WATER (MLLW)
SHEET NUMBER:	3 OF 3	SURVEY UNITS:	U.S. SURVEY FEET

BALTIMORE, MD



-100

0

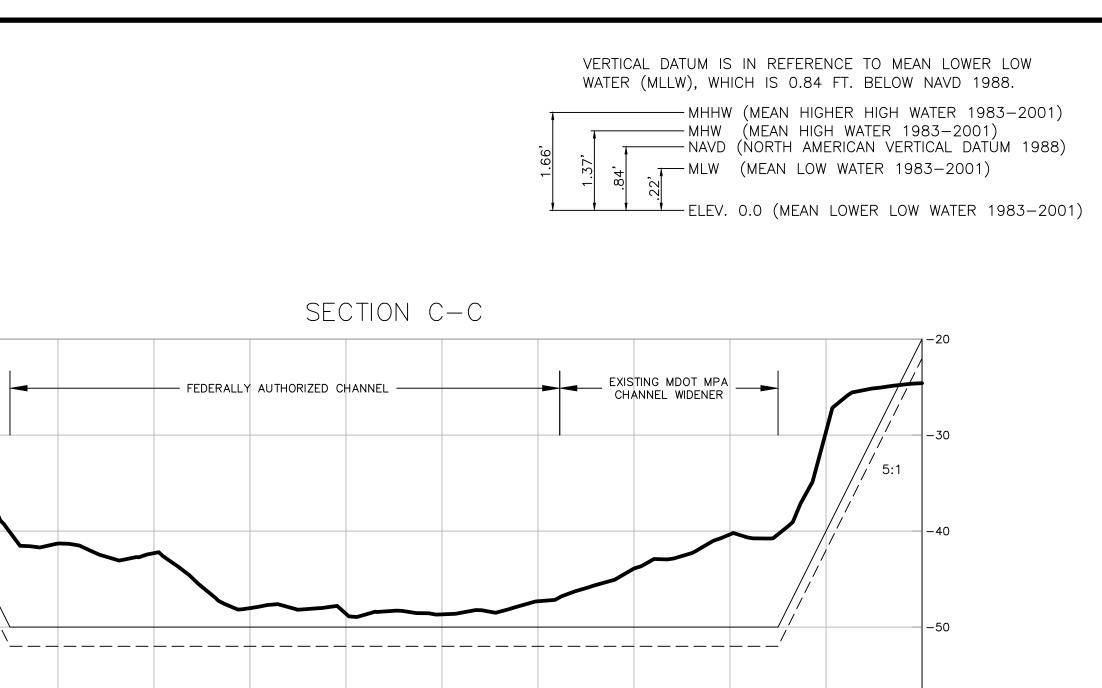


 -10_{10} - FACE OF WHARF -20 10' NO -30 -40 -50

-60 -300

- NOTES:
 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.
 PLANIMETRICS INDICATE THE APPROXIMATE LOCATION OF FEATURES AS PROVIDED BY THE USACE BALTIMORE DISTRICT.
 SURVEYED OCTOBER 2020 BY GAHAGAN & BRYANT ASSOCIATES, INC. & JANUARY 2021 BY CENAB.
 TIDES WERE OBTAINED FROM NOAA TIDE STATION 8574680 BALTIMORE, FORT MCHENRY.

-200





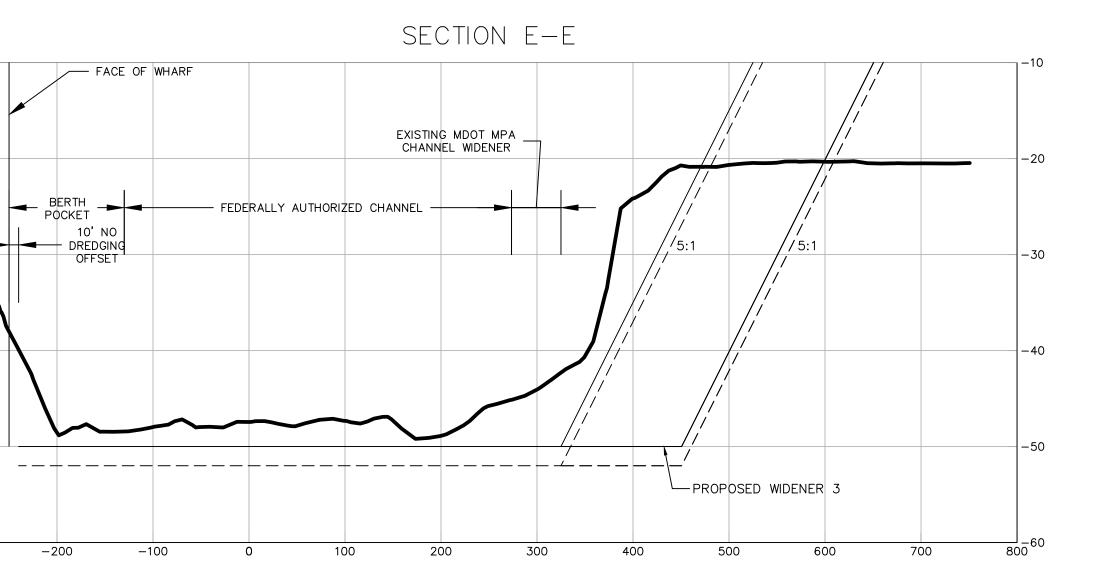
200

300

400

500

100





600

5. THE PLANE OF MLLW IS 0.84 FEET BELOW NAVD88.

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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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.

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	

Table 1: Seagirt West Loop Concept Volumes

¹Volumes presented include 2 feet of overdepth (EL. -50' + 2' OD MLLW).

²Planning 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 5 and

Anchorage 6 since those volumes exceeded the 3H:1V volumes that are discussed later in this memorandum.

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		

Table 2: Proposed Anchorage Concept Volumes

¹Volumes presented include 1 foot of overdepth (EL. -51' + 1' OD MLLW) ²Volumes based on February 2021 USACE survey data and April 2021 GBA survey data. ³Volumes 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.

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

¹Milestone dates are based on information provided at Harbor Planning Meetings. ²Maximum 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.

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

Table 4: Masonville Dike Raising Schedule

¹Maximum filling elevation based on 3' on required freeboard. ²Base 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.

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				

Table 5: Capacity Estimates for the Masonville and Cox Creek DMCFs.

¹ Maximum filling elevations accounts for a 3' required freeboard.

²Capacity 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.

Annual		New Work⁵ (mcy)		Avorago Appual		
(O & M) Average ¹ (mcy)	Seagirt West Loop ²	Proposed Anchorage 3A/B ³	Other Planned Projects ⁴	Total (O &M + New Work) (mcy)	Average Annual Dredging Demand (mcy)		
0.693	1.98	6.58	4.7	27.12	1.36		

 Table 6: Baltimore Harbor 20-Year Dredging Demand Projections (SFY2022-SFY2041)

¹The 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.

³The New Work dredging quantity for Proposed Anchorage 3A/B is based on the Total Volume associated with 5H:1V side slopes from Table 2.

⁴The 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.

⁵No 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.

	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											

Table 7: Proposed Anchorage 3A/B – 1' Volume Summary

¹Volumes 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

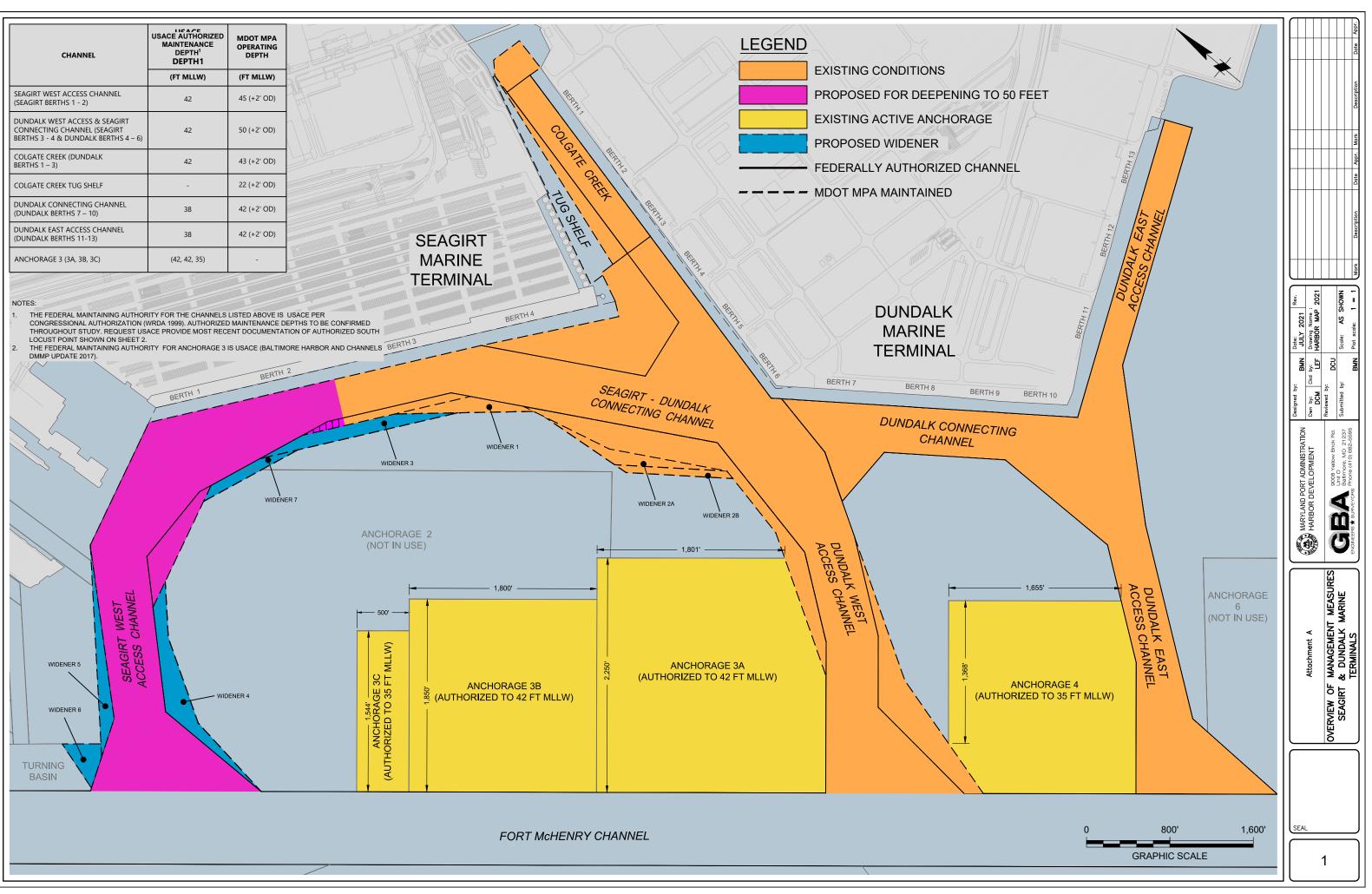


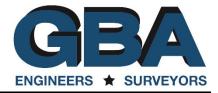
APPENDIX A

Location Map

 HOUSTON
 LOS ANGELES
 PHILADELPHIA
 ROHNERT PARK, CA
 NORTH CAROLINA
 TAMPA
 VANCOUVER

 32-377-4800
 310-521-8127
 215-425-6283
 707-595-3492
 910-313-3338
 813-831-4408
 360-210-4292



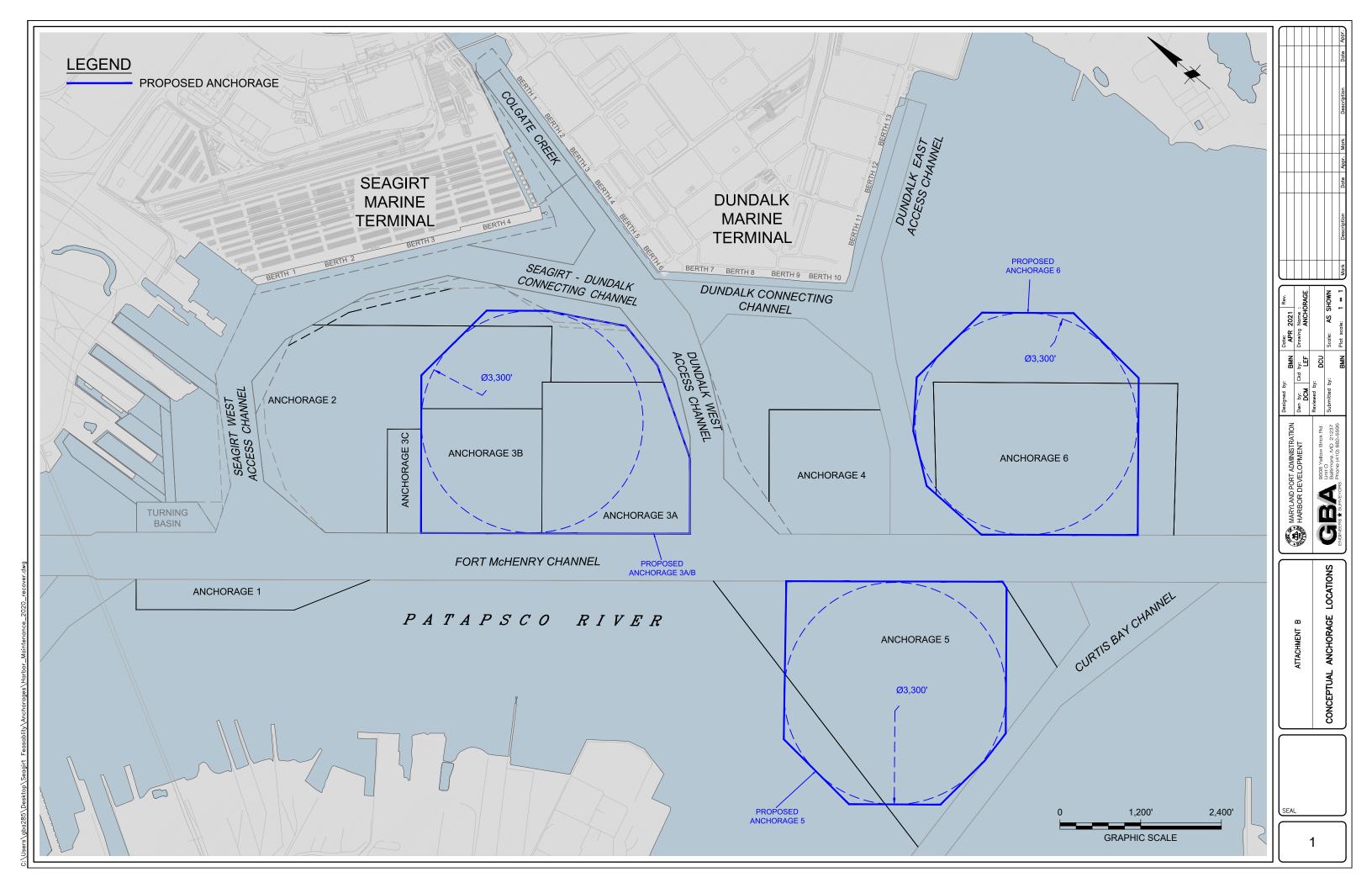


APPENDIX B

Proposed Anchorages

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APPENDIX C

Baltimore Harbor Dredged Material Containment Facilities Placement Plan

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Baltimore Harbor Dredged Material Containment Facilities Placement Plan

(Actual Placement Quantities Through SFY 2021 and Projected Quantities Thereafter)

	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
	El. +18' MLLW	4.8	6.2		614,300																				
DMCF	El. +18' MLLW w/ BDW	4.7	6.1			148,800	440,000	285,000																	
I ville I	El. +24' MLLW	5.4	6.9						85,000																
Masonville	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
				L											•	•		•							ı
	El. +36' MLLW	4.8	6.2																						
ц	El. +36' MLLW W/ BDW	3.9	5.0		198,900	575,000	575,000																		
ek DMCF	El. +44' MLLW (January 2023)	5.0	6.4					575,000																	
Cox Creek I	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								
0	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 P	lacement 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	e 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
			g MV Capacity g Capacity in %	2.8 45.2%	2.3 37.7%	2.1 33.6%	1.6 26.4%	1.3 21.7%	2.0 33.5%	2.0 29.6%	3.3 40.7%	2.6 31.5%	1.9 23.0%	1.5 18.2%	1.5 18.2%	1.4 16.6%	1.0 9.4%	2.1 20.1%	1.3 12.4%	0.9 8.5%	0.7 6.6%	0.4 3.5%	0.2 2.3%	0.1 1.1%	0.1 0.5%
			ng CC Capacity g Capacity in %	1.8 36.0%	1.7 34.0%	1.1 22.5%	0.6 11.0%	1.4 21.5%	8.0 54.1%	6.4 43.0%	5.5 36.9%	4.5 30.2%	3.5 23.4%	2.3 15.4%	1.1 7.3%	0.0 0.1%	8.3 56.2%	7.0 29.0%	5.9 24.4%	4.4 18.3%	3.4 13.8%	2.6 10.5%	1.7 6.9%	0.8 3.2%	0.1 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.