

LAKE DEVELOPMENT AUTHORITY

REQUEST FOR PROPOSALS FOR PROFESSIONAL DESIGN SERVICES

for the

**Coastal Design Services for the
Mentor Harbor Entrance Channel Improvements**

for the

**Lake Development Authority
105 Main Street, Suite B501
Painesville, Ohio 44077**

ISSUED: January 30th, 2023

**PROPOSALS SUBMITTAL DUE:
March 3rd, 2023, 2:00 P.M. (EST)**

LAKE DEVELOPMENT AUTHORITY

LEGAL NOTICE

REQUEST FOR PROPOSALS

Request for Proposals for Professional Design Services in Accordance with ORC 153.67.

Request for Proposals may be obtained by visiting Lake Development Authority website at LDAuthority.org. Statement of Proposal must be received on or before 2:00 p.m. (EST), Friday, March 3rd, 2023, at which time Proposals will be publicly recorded.

Coastal Design Services for the Mentor Harbor Entrance Channel Improvements

Firms must comply with all applicable federal and state laws and regulations pertaining to Equal Employment Opportunities.

The Lake Development Authority is a governmental agency exempt from all local, state and federal taxes. Firms shall be responsible for the collection of and payment of all sales and other taxes that may be applicable.

Any person who submits, or attempts to submit Proposals is solely responsible for the method of submission and assumes the risk that the qualifications may be delayed or not received by the Lake Development Authority, whether by reason of equipment malfunction, human error or any other cause whatsoever. LATE PROPOSALS WILL NOT BE CONSIDERED.

The Lake Development Authority reserves the right, in its sole discretion, to negotiate or to reject any and all Proposals, parts of any and all Proposals and waive all technicalities.

BY THE ORDER OF THE LAKE DEVELOPMENT AUTHORITY.

Mr. David E. Anderson,
Executive Director
Lake Development Authority
January 30th, 2023

Lake Development Authority

Coastal Design Services for the Mentor Harbor Entrance Channel Improvements

Responses Due: March 3rd, 2023, 2:00 pm

The Lake Development Authority invites qualified professional consulting design firms to submit Proposals to undertake the design and engineering for the construction of improvements to the Mentor Harbor Entrance Channel in Mentor, Ohio. Proposal packages are due no later than 2:00 pm on Friday, March 3rd, 2023.

Communication Restrictions

Please note the following policy concerning communication between Consultants and the Lake Development Authority during the announcement and selection process. During the time between advertisement and the announcement of the final consultant selection, communication with consultants (or their agents) shall be limited as follows:

Communications which are strictly prohibited:

Any discussions or marketing activities related to this specific project.

Allowable communications include:

Technical or scope of services questions specific to the project or RFP requirements, but not in person. Written questions must be submitted via email to Myranda Keister, Director of Planning and Development at MKeister@LDAuthority.org by Wednesday, February 22nd, 2023. The Lake Development Authority will not be responsible for any oral instructions or information. Answers to all questions will be emailed to all parties that have expressed an interest in submitting a Proposal for this project.

This Request for Proposals consists of:

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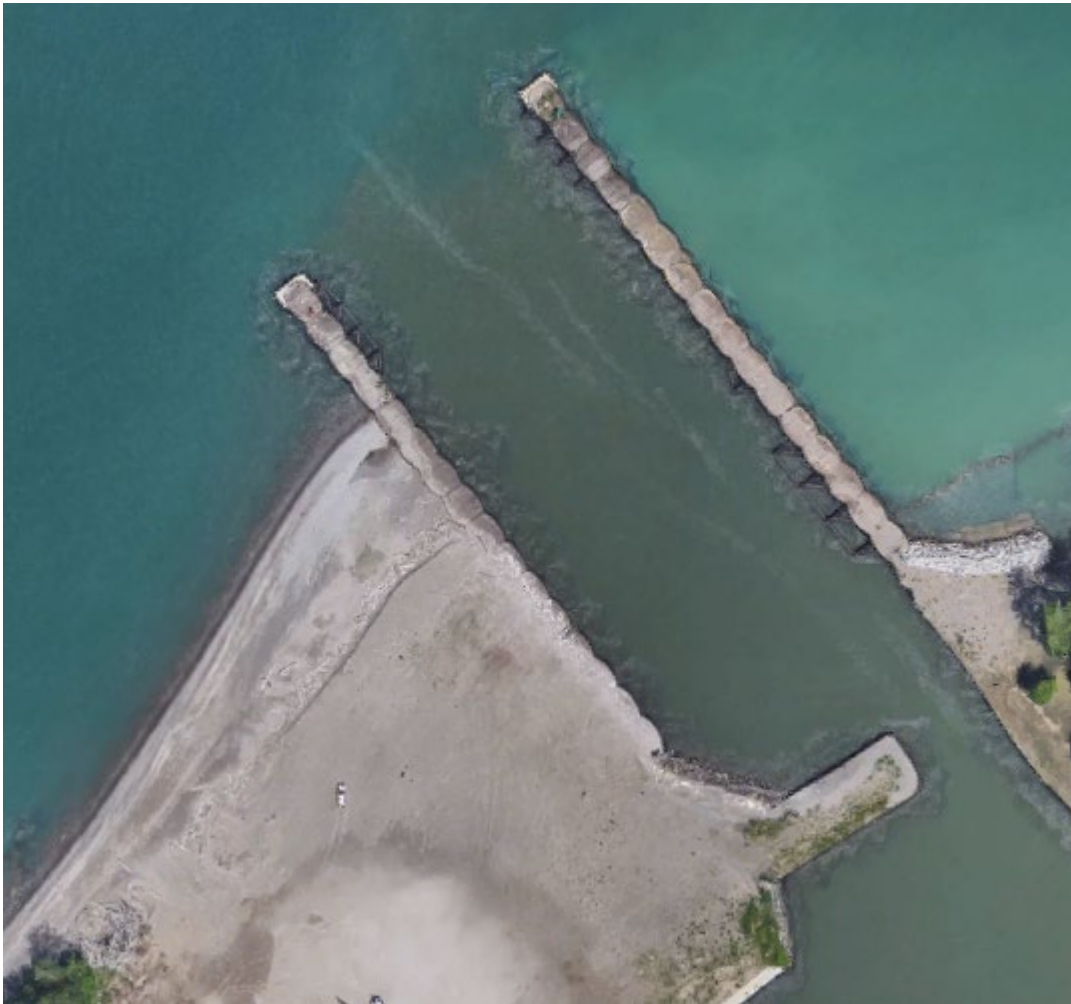
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EXHIBIT A – USACE Geotechnical Information and Lake Bottom Survey

EXHIBIT B - USACE Mentor Harbor Study

A. Project Description

The Lake Development Authority intends to construct improvements to the existing structures supporting the entrance channel to Mentor Harbor. The photograph below is an aerial photo of the existing Mentor Harbor Channel.



The Mentor Harbor Channel was constructed approximately 90 years ago (circa 1920s). The Mentor Harbor Channel is approximately 600 feet in length and is created by two parallel, East and West, Steel Sheet Piling Channel Wall Structures. When one designs and builds marine structures like the Mentor Harbor Channel walls, engineers expect the structures to have a useful life of 40 to 50 years. In 1986 there was a major sudden failure at the North end of the West Channel Wall which was promptly repaired and a preemptive repair was also performed on the North end of the East wall. During the 1980's steel sheet piling baffle walls were constructed along the East and West channel walls at strategic locations so as to reduce the wave reflection within the channel and surge within the channel and harbor. Over the ensuing years, Lake Erie storms and winter ice have destroyed these baffle walls. Over the past 90 years, the top circumferential structural tension rings that hold the tops of the individual Steel Sheet piling cells together have rusted away and are no longer

functional, thus, reducing the structural stability of the Channel Wall structure. Also, over the past 90 years, the steel sheet piling interlocks have rusted to a point where a sudden and catastrophic failure could occur at any time and at any location within the Channel Wall System thus resulting in a potential “unzipping” of a large section of the Channel Walls. On September 22, 2022, a failure occurred that demonstrates the fragile condition of the Mentor Harbor Channel Walls. The failure started as a 5 foot long wall section failure which “unzipped” itself to an immediate 10 foot long wall replacement.

The Mentor Harbor Channel Walls are 90 years old and have served their function well beyond their life expectancy. The Mentor Harbor Channel Walls need to be restructured immediately because they are extremely fragile due to the steel’s advanced age and their vulnerability to a complete and catastrophic failure at any time. It is expected that the selected designer will examine and consider potential alternatives and present options to the Lake Development Authority stating the Pros and Cons of each potential design solution. The relative cost of each potential option will be a key factor in the decision making process.

B. Scope of Services

The scope of services includes engineering assessment, preliminary design, permitting, design development, final design, and construction administration. The Tasks below are divided into two Phases. It is anticipated that Phase I will be undertaken immediately. Phase II will be undertaken as funding is made available for the Project.

PHASE I

Task 1. Site Conditions Analysis

Includes survey, geotechnical investigations, site inspections, historical data review, metocean analysis, preliminary modeling. The USACE has performed a Geotechnical Investigation of the Mentor Harbor Channel area and has performed an in-water bottom survey of the area. These two elements will be provided as Exhibit B.

Task 2. Preliminary Design

Includes alternatives, antidegradation analysis, initial regulatory coordination, preliminary design, modeling to verify preferred alternative, preliminary construction cost estimates for the alternative designs considered.

PHASE II

Task 3. Regulatory Permitting

Authorizations are anticipated to be required from the U.S. Army Corps of Engineers, Ohio Department of Natural Resources, and Ohio Environmental Protection Agency. The consultant will prepare permit applications for submittal to each agency and coordinate with the agencies throughout the review process. The consultant will respond to comments from the regulatory agencies and revise the design as needed to address agency comments.

Task 4. Design Development

The consultant will refine the design and develop engineered plans, specifications, opinions of probable construction costs, and other documents required for bidding and construction of the improvements to the waterfront infrastructure. Deliverables will be required at 60%, 90% and final design.

Task 5. Bidding Phase Services

The consultant will assist in the public advertising of the construction bid process in accordance with

the Ohio State requirements. The consultant will hold a pre-bid meeting for the interested construction contractors where the contractors may ask questions. The consultant will be responsible for receiving construction contractor questions during the bid period and issuing answers to those questions and clarifications via addendums to the potential construction bidders. Following the receipt of the bids, the consultant will make a recommendation to the Lake Development Authority as to which bid is the best bid.

Task 6. Construction Phase Services

The consultant will be responsible to draft the construction contract using an industry standard form, in accordance with the applicable governmental requirements. The consultant will attend monthly construction project progress meeting and maintain minutes and an agenda for each meeting. The consultant will promptly answer any and all contractor questions and address any unanticipated condition that may arise during construction. The consultant will receive, review, and once approved, the construction contractor's monthly invoices and forward said invoices to the Lake Development Authority for payment. The consultant will provide regular inspection of the work and weekly progress reports.

Upon completion of the work the consultant will issue a Certificate of Final Completion.

Final deliverables and detailed consultant schedules will be discussed during the Scope of Services negotiations with the selected firm. The selected firm will be required to develop and adhere to a design schedule. Within your submission, you are to include your likely design schedule for Phase I. The Design Contract will be structured so as to release the Designer to perform each Task upon written authorization. The Tasks within Phase II will occur as funding is made available for the design and construction of the Project.

C. Tentative Selection Schedule

March 3 rd , 2023	Proposals packets due to the Lake Development Authority
March 24 th , 2023	Notification of Shortlist Firms
April 14 th , 2023	Interview up to four (4) firms
May 5 th , 2023	Notify all firms of selection
May 26 th , 2023	Deadline to finalize Scope of Services and contracts
June 16 th , 2023	Contract approval/Notice to Proceed

D. Submittal Requirements

Please provide the information requested below, in the same order listed below, in a letter signed by an officer of the firm. Do not send additional forms, brochures, or other material. Statements of Proposal are limited to twenty-five (25) single sided 8.5-inch by 11-inch pages. Please use a minimum font size of 12-point and maintain margins of 1-inch on all four sides. Bind submittals by stapling at the upper left hand corner only. Do not use any other binding system. Do not provide tabbed inserts or other features that may interfere with machine copying.

Please include with the Proposal packet:

- A. Cover letter (1 page maximum).
- B. Identify prime consultant and any subconsultants included on the project team (2 pages maximum).
- C. Provide brief bios of key project team members. The bios should clearly state each team member's proposed roll on the project, experience, and location relative to the project site (5 pages maximum).
- D. Experience of firm and personnel assigned to this project that will uniquely qualify your firm to

- complete this work, including descriptions of up to 10 projects demonstrating the staff's experience delivering similar projects (10 pages maximum).
- E. Description of the firm's overall understanding of the project and recommended scope of services to accomplish the stated goals (2 pages maximum).
 - F. A project management schedule showing all milestones and expected completion dates (1 page maximum)
 - G. Project staffing plan and organizational chart (1 page maximum)
 - H. References (1 page maximum)
 - I. Resumes for the project manager and key technical staff (remaining pages).

The Lake Development Authority will form a Selection Committee comprised of staff and other stakeholders. The Selection Committee will evaluate and select the most qualified consultant(s). Competitive price selection will not be utilized under the selection process.

The following criteria will be used in the consultant selection process:

- Strength of project manager and strength/experience of key team members and proposed subcontracted firms' key personnel;
- Past performance and experience with projects of similar scope and size;
- Project understanding and approach, which includes all listed items in the Scope of Work;

Suggested areas of expertise for this project include but are not limited to:

- Experience performing hydrographic surveys and topographic surveys for waterfront projects.
- Experience designing projects in accordance with the Ohio Coastal Design Manual prepared by Ohio Department of Natural Resources Office of Coastal Management.
- Demonstrated experience successfully permitting waterfront and in-water projects in Ohio, including Section 401/Section 10 Permits from the U.S. Army Corps of Engineers, Section 401 Water Quality Certifications from the Ohio Environmental Protection Agency, and Coastal Zone Management Federal Consistency Certifications from the Ohio Department of Natural Resources.
- Cost estimating for in-water construction projects, knowledge of Lake Erie/Great Lakes marine construction markets preferred.
- Experience preparing construction drawings and specifications for shoreline protection and channel improvement projects.
- Successful oversight of in-water construction projects.

Based on the Proposals submitted, the Selection Committee may conduct interviews of firms that best demonstrate an understanding of the Lake Development Authority's objectives and adequately address all elements of the RFP. Whether interviews are performed or not, the Lake Development Authority shall enter into contract negotiations with the preferred firm to determine the final scope of services and project budget. If negotiations fail, the Lake Development Authority shall enter into negotiations with the second highest ranked firm. This process shall continue until a contract is successfully negotiated or the Lake Development Authority determines to issue a second RFP or delays the project or abandons the project. The contract must be approved by the Lake Development Authority Board of Directors.

All Proposals shall be considered without regard to race, color, religion, sex, national origin, citizenship, age, mental or physical disabilities, veteran/reserve/national guard or any other similarly protected status.

One original Proposals packet and one electronic copy via email in PDF or MSWord format shall be submitted by Friday, March 3rd, 2023 at 2:00 pm to:

Mr. David E. Anderson,
Executive Director
Lake Development Authority
105 Main Street, Suite B501
Painesville, Ohio 44077

In care of Myranda Keister at, MKeister@LDAuthority.org.

Responses received after 2:00 pm local time on the response due date will not be considered unless an acceptable occurrence has occurred and the selection committee grants a specific waiver. The Lake Development Authority is not responsible for any costs incurred by Consultants in the preparation of a Statement of Proposals or prior to contract execution.

E. Example Scoresheet

Selection Criteria		Available Points		Points Awarded
Strength of project manager and strength/experience of key team members (40 points)				
Project Management Lead	Experience/ability of project manager to manage scope/budget/schedule/quality		10	
Project Design Lead	Experience of project designer to achieve owner’s vision and project requirements		10	
Key Discipline Leads	Experience/ability of key consultants to perform effectively and collaboratively		10	
Technical Staff	Experience/ability of technical staff to create fully coordinated construction documents		10	
Construction Administration Staff	Experience/ability of field representative to identify and solve issues during construction			
Past performance and experience with projects of similar scope and size (30 points)				
Previous Team Collaboration			10	
	Experience and sample projects			
Waterfront Project Experience			10	
	Experience and sample projects			
Permitting Experience Section 404/10, Section 401			5	
	Experience and sample projects			
Team Organization	Clarity of responsibility / communication demonstrated by table of organization	5		
Project understanding and approach (30 points)				
Project understanding	Consultant’s understanding of the project, site conditions, and design requirements	15		
Project approach	Consultant’s understanding of the scope and ability to perform in a timely manner	15		
Total Score				
100				

F. Contract Type and Method of Payment

It is expected that an industry standard contract form will be used and then modified in accordance with the terms, conditions and payments for each Task agreed upon during the negotiation period for the services to be provided by the selected Design Firm.

G. Compliance with Title VI of the Civil Rights Act of 1964

In accordance with the Title VI of the Civil Rights Act of 1964 (78 Stat. 252, 42 U.S.C. SS 2000d to 2000d-4) and the regulations, hereby notifies all Proposers that it will affirmatively ensure that any contract entered into pursuant to this advertisement, all Proposers including disadvantaged business enterprises will be afforded full and fair opportunity to submit proposals in response to this invitation and will not be discriminated against on the grounds of race, color, national origin, sex, age, disability, low income status, or limited English proficiency in consideration for an award.

H. Suspended or Debarred Firms

Firms included on the current Federal list of firms suspended or debarred are not eligible for selection.

I. Exhibits

EXHIBIT A

USACE Geotechnical Information and Bottom Survey Information

EXHIBIT B

USACE Mentor Harbor Study

<https://www.dropbox.com/sh/xr393lylytfnsyf/>

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Exhibit A

Appendix B

GEOTECHNICAL EVALUATION

MAY 27, 2021

DRAFT

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1. Site Geology

A surficial geology map of the area is included as Figure 1. Relative to other areas along the south shore of Lake Erie, the past environments and processes contributing to overburden deposition seem to be quite variable. In addition to the typical bedrock/glacial till/glaciolacustrine stratigraphy, alluvium and organic soils are present.

Approximately 25,000 years ago, an ice sheet associated with the Wisconsin glaciation covered the Erie basin. The ice sheet advanced in a northeast to southwest direction across the area, depositing till at the bedrock/ice interface. Near the end of the Wisconsin glaciation, the ice sheet made a series of retreats and advances as a lobe across the Erie basin. During retreats, drainage at the northeast end of the basin remained blocked by ice, and glacial lakes formed behind the retreating ice (Dreimanis, 1958). During these periods, fine-grained silts and clays were deposited at the bottom of the glacial lakes. Approximately 12,500 years ago, the ice sheet retreated far enough to the north to open a drainage path to the east for water trapped behind the ice in the Erie and Ontario basins (Coakley and Lewis 1985). This resulted in drainage of the Erie basin via the Niagara River. Post-glacial Lake Erie water levels in the Central Basin, as estimated by Holcombe et. al. (2003) and presented in Figure 2, were initially significantly lower than current levels. Therefore, the previously deposited glaciolacustrine sediments tend to be overconsolidated due to erosion, loss of buoyancy, and desiccation. Based on the presence of alluvium and organic deposits in the area, it is likely that the mouth of a post-glacial river became submerged as the water level in Lake Erie rose.

2. Subsurface Investigations

Approximate locations for the borings discussed below are illustrated on Figure 3. Boring logs and the results of grain-size analyses for the lakebed sand at B20-01 and B20-04 are included in Attachment 1. The Mentor Harbor Yachting Club provided logs for borings B00-01 through B00-05, which were placed in 2000 to facilitate design of site improvements. In the mid-1980's, USACE evaluated proposed breakwater construction offshore of Mentor Beach Park as part of a Section 103 project (USACE, 1986). Borings D85-01, DUV85-02, and DUV85-03 were placed to investigate subsurface conditions along the proposed breakwater alignment. Six standard test borings, B20-01 through B20-06, were placed in September 2020 to facilitate the geotechnical evaluation for this project.

3. Subsurface Conditions

Fine sand was encountered on the lakebed at all 2020 boring locations. At borings B20-01 through B20-05, the thickness of this stratum ranges from approximately 2 to 8 feet. At B-06, the thickness of the sand stratum encountered was approximately 20 feet. A very soft silty clay stratum was encountered beneath the sand. This stratum includes varying amounts of silt and fine sand. This very soft stratum is underlain by relatively strong/incompressible sand and/or glacial till. Elevations of the major stratigraphic changes are presented in Table 1.

BORING	LAKEBED (FEET LWD)	TOP OF VERY SOFT SILTY CLAY/CLAYEY SILT STRATUM (FEET LWD)	BOTTOM OF VERY SOFT SILTY CLAY/CLAYEY SILT STRATUM (FEET LWD)
B20-01	-11.8	-16.3	-33.8
B20-02	-11.3	-13.3	-36.1
B20-03	-10.8	-24.3	-38.8
B20-04	-6.8	-14.8	-35.8
B20-05	-6.8	-11.8	-37.3
B20-06	-8.3	-29.3	-31.3

Table 1 – Elevations of major stratigraphic changes at 2020 exploration locations relative to Low Water Datum

4. Geotechnical Analyses and Design

The alternatives being considered are illustrated in Attachment 2. The primary objectives of geotechnical analyses and design are to assess the potential for foundation failure through the very soft silty clay stratum under the weight of new breakwater materials and estimate the magnitude of long-term foundation settlement.

4.1 Undrained Shear Strengths for Very Soft Silty Clay Stratum

As new breakwater materials are placed, excess pore water pressures will develop in the silty clay under the weight of the new materials. Therefore, for end-of-construction conditions, undrained shear strengths are applicable for foundation stability analyses. Undrained shear strengths of the stratum were measured via laboratory unconsolidated undrained triaxial (UU) tests of undisturbed samples. A summary of laboratory UU test results are presented in Table 2, and a plot of the undrained shear strengths vs. elevation is illustrated in Figure 4. The ratio of undrained shear strength to vertical effective stress is also presented in Table 2. The relatively high ratios suggest that the stratum is overconsolidated.

Boring	Approximate Sample Elevation (FEET LWD)	Approximate Existing Vertical Total Stress (PSF)	Laboratory Confining Stress (PSF)	Undrained Shear Strength (PSF)	Approximate Existing Vertical Effective Stress (PSF)	Ratio of Undrained Shear Strength to Vertical Effective Stress
B20-01	-20.3	2100	1872	503	532	0.95
B20-01	-25.3	2800	2592	286	845	0.34
B20-02	-19.8	2100	2016	389	532	0.73
B20-02	-22.3	2400	2448	452	689	0.66
B20-02	-22.3	2400	4896	313	689	0.45
B20-04	-17.3	2080	2016	888	657	1.35
B20-04	-17.3	2080	4032	704	657	1.07
B20-04	-24.8	3018	2880	748	1127	0.66
B20-05	-14.8	1768	3600	875	501	1.75
B20-05	-27.3	3330	3168	587	1283	0.46
B20-05	-27.3	3330	6336	531	1283	0.41

Table 2 – Undrained shear strengths and ratio of undrained shear strength to vertical effective stress

Due to the relatively high silt/sand content and low plasticity of the stratum, undisturbed samples were highly susceptible to disturbance during collection, handling, and extrusion. Sample disturbance can result in decreased undrained shear strengths as measured during UU testing. For these soils, despite having the results of the UU testing, it is difficult to accurately estimate undrained shear strength of the stratum in situ.

For stability analyses for proposed breakwaters in the vicinity of borings B20-01 and B20-02, the very soft silty clay stratum was divided into two substrata at -27 feet LWD. Based on the UU test results and engineering judgement, the upper substratum was estimated to have undrained shear strength of 400 PSF, and the lower substratum was estimated to have undrained shear strength of 500 PSF. Near boring B20-03, all clay strata were estimated to have undrained shear strength of 500 PSF.

4.2 Stability Analyses

The Morgenstern-Price analysis method was utilized in Slope/W for stability analyses. The following material properties were presumed/calculated.

Armor Stone above water

- Presumed specific gravity ≈ 2.7
- Presumed porosity $\approx 37\%$ (Table VI-5-51 of EM 1110-2-1100)
- Calculated dry unit-weight = 106 PCF
- Presumed water content above water level $\approx 2\%$
- Calculated unit-weight above water = 108 PCF
- Presumed angle of internal friction ≈ 36 degrees

Breakwater stone below water

- Presumed specific gravity ≈ 2.7
- Presumed porosity $\approx 32\%$
- Calculated dry unit-weight = 115 PCF
- Calculated saturated unit-weight = 135 PCF
- Presumed angle of internal friction ≈ 36 degrees

Lakebed sand

- Presumed specific gravity ≈ 2.65
- Presumed void ratio ≈ 0.75
- Calculated dry unit-weight = 95 PCF
- Calculated saturated unit-weight = 121 PCF
- Presumed angle of internal friction ≈ 30 degrees

Silty clay above -27 feet LWD in vicinity of borings B20-01 and B20-02

- Measured saturated unit-weight ≈ 125 PCF
- Estimated undrained shear strength ≈ 400 PSF

Silty clay below -27 feet LWD in vicinity of borings B20-01 and B20-02

- Measured saturated unit-weight ≈ 125 PCF
- Estimated undrained shear strength ≈ 500 PSF

Silty clay strata in vicinity of boring B20-03

- Measured saturated unit-weight ≈ 125 PCF
- Estimated undrained shear strength ≈ 500 PSF

A survey of existing lakebed bathymetry was conducted by USACE in November 2019 and the results are presented in Figure 5. This information was used to select lakebed elevations for stability analyses. The proposed alignments for the offshore breakwaters are also illustrated on Figure 5. The proposed crest elevation for the west offshore breakwaters is +12 feet LWD, and the proposed crest elevation for the east offshore breakwater is +10 feet LWD.

Stability analyses for the west offshore breakwaters in the vicinity of boring B20-01 are illustrated on Figures 6 and 7. These results indicate stability berms, with crest elevations at -7 feet LWD, are required to achieve an end-of-construction target factor of safety of 1.3. The crests of the stability berms extend horizontally 70 feet from the breakwater centerline. Stability analyses for the west offshore breakwaters in the vicinity of boring B20-03 are illustrated on Figures 8 and 9. These results indicate

stability berms, with crest elevations at -10 feet LWD, are required to achieve an end-of-construction target factor of safety of 1.3. The crests of the stability berms extend horizontally 60 feet from the breakwater centerline. The stability analysis for the east offshore breakwater in the vicinity of boring B20-02 is illustrated in Figure 10. These results indicate stability berms, with crest elevations at -7 feet LWD, are required to achieve an end-of-construction target factor of safety of 1.3. The crests of the stability berms extend horizontally 50 feet from the breakwater centerline.

4.3 Settlement Analysis

Four undisturbed samples collected from the very soft silty clay stratum were subjected to laboratory consolidation testing. Plots of effective pressure vs. strain are presented as Figure 11 and the average values are plotted on Figure 12.

Due to the combination of loading and subsurface conditions, the maximum foundation settlement will likely occur at the north ends of the west breakwaters, in the vicinity of boring B20-01. At this location, existing vertical effective stresses near the middle of the very soft silty clay stratum are approximately 750 PSF. The proposed breakwater construction with stability berms will increase vertical effective stresses to approximately 2700 PSF. As illustrated on Figure 12, for this range of effective pressures, the stress-strain response of the silty clay is approximately linear. The slope of this line represents the constrained modulus, which is approximately 65 KSF.

An effective angle of internal friction of 33 degrees was presumed (Table 5.16 Duncan et. al., 2014) and Poisson's ratio was estimated as follows.

Poisson's ratio = $(1 - \sin \phi) / (2 - \sin \phi) = 0.31$ (Duncan and Bursey 2013)

Elastic modulus can be estimated from constrained modulus using the following relationship.

$$E = M * (1 + \nu) * (1 - 2\nu) / (1 - \nu)$$

E = Elastic Modulus

M = Constrained Modulus

ν = Poisson's Ratio

For a constrained modulus of 65 KSF and Poisson's ratio of 0.31, the corresponding elastic modulus is approximately 47 KSF. A SIGMA/W load/deformation model, as shown on Figure 13, was used to estimate the settlement response of the very soft silty clay stratum under the weight of the proposed breakwater. Calculated settlement magnitudes are relatively insensitive to the elastic modulus and Poisson's ratio assumed for the breakwater materials. Therefore, a relatively low elastic modulus of 200 KSF was assumed to minimize bridging effects.

The estimated long-term settlement profile perpendicular to the breakwater is included as Figure 14. The estimated magnitude of settlement under the breakwater crest is approximately 0.6 feet. A significant portion of this settlement will likely occur during construction without significant

consequence. Therefore, post-construction settlements related to consolidation of the very soft silty clay stratum are likely to be less than 6 inches, and overbuilding is unnecessary. However, when estimating quantities for breakwater materials, an average of 6 inches of settlement during construction should be assumed for all breakwaters, including those placed inside the existing channel.

4.4 Filter Requirements

The lakebed beneath the footprint of proposed breakwaters consists of fine sand. Therefore, as discussed on page VI-5-95 of EM 1110-2-1100, a filter layer should be placed between the breakwater stone and the lakebed to prevent significant movement of lakebed sand beneath the breakwater. The filter layer may be omitted if stability of the lakebed soils beneath the proposed breakwaters, under the expected hydrodynamic conditions, can be demonstrated.

The filter layer placed directly on the lakebed should be a minimum of 2 feet thick and constructed with ODOT Coarse Aggregate Size 57. The bedding layer should also be a minimum of 2 feet thick and constructed with ODOT Dumped Rock Fill Type D. Above the bedding layer, a toe berm should be incorporated to support the main armor layer. Guidance for toe berm design is included in EM 1110-2-1100 beginning on page VI-5-111.

Potential use of a geotextile filter rather than a coarse aggregate filter can be evaluated during final design.

4.5 Stability Berms

As previously discussed, stability analyses indicated that three types of stability berms are needed for the proposed breakwaters north of the existing piers. Locations for Type 1, Type 2, and Type 3 stability berms are shown on Figure 15. Foundation platforms of ODOT Dumped Rock Fill Type D can be used to construct these. Required volumes of dumped rock fill can be reduced by incorporating sand-filled geosynthetic containers (USACE 2021) into the foundation platforms.

The Type 1 foundation platform should be constructed to a minimum crest elevation of -7 feet LWD with a minimum crest width of 140 feet. The Type 2 foundation platform should be constructed to a minimum crest elevation of -10 feet LWD with a minimum crest width of 120 feet. The Type 3 foundation platform should be constructed to a minimum crest elevation of -7 feet LWD with a minimum crest width of 100 feet.

The centerline of the foundation platforms should match the breakwater centerlines and platform side slopes should be constructed to 1V:1.5H. A filter layer, as discussed above, should be used under the central portion of the foundation platforms beneath where underlayer and armor stone will be placed.

4.6 Sheet Pile Walls

Alternatives 2B and 3B include installation of new sheet pile walls. For feasibility-level design, lateral earth pressures acting on the sheet pile walls can be estimated via Coulomb active earth pressure theory and effective stress analyses utilizing the following soil parameters.

Existing soils above elevation -36 feet LWD

- $\phi' = 30$ degrees
- $Y_{sat} = 125$ PCF
- $Y_{moist} = 125$ PCF
- $\delta' = 9$ degrees

Existing soils below elevation -36 feet LWD

- $\phi' = 36$ degrees
- $Y_{sat} = 135$ PCF
- $\delta' = 11$ degrees

Gravel backfill

- $\phi' = 34$ degrees
- $Y_{sat} = 135$ PCF
- $Y_{moist} = 125$ PCF
- $\delta' = 17$ degrees

Groundwater levels can be assumed to be roughly the same as lake water levels. If the use of sheet pile walls is deemed to be feasible, these recommendations can be further refined.

5. References

Coakley, J.P. and Lewis, C.F.M.; 1985; *Postglacial Lake Levels in the Erie Basin*; Geological Association of Canada Special Paper 30: pp. 195-212.

Dreimanis, A.; 1958; *Wisconsin Stratigraphy at Port Talbot on the North Shore of Lake Erie, Ontario*; Ohio Journal of Science 58(2): pp. 65-84.

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Duncan, J.M., Wright, S.G., and Brandon, T.L.; 2014; *Soil Strength and Slope Stability, 2nd Ed.*

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USACE, 1986; *Detailed Project Report on Shoreline Erosion/Beach Restoration on Lake Erie – Mentor Beach Park*

USACE, 2021; *DRAFT DETAILED PROJECT REPORT AND ENVIRONMENTAL ASSESSMENT - SECTION 204 BENEFICIAL USE OF DREDGED MATERIAL FOR ECOSYSTEM RESTORATION FAIRPORT HARBOR, OHIO*

FIGURES



Figure 1 – Surficial geology map for vicinity of Mentor Harbor (ODNR, 2006)

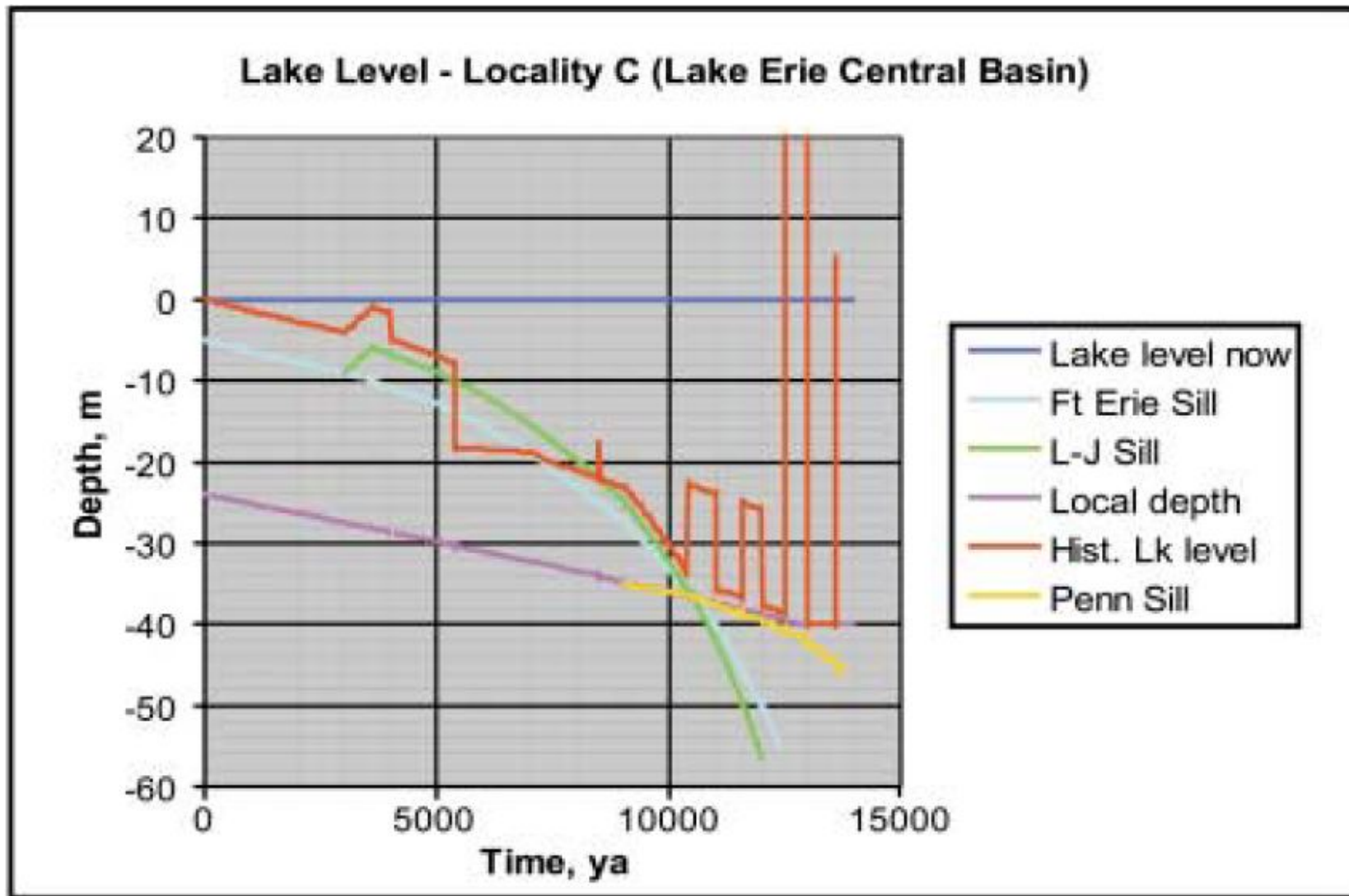


Figure 2 – Estimated Lake Erie post-glacial water levels in Central Basin (from Holcombe et. al., 2003)



Figure 3 – Boring location plan

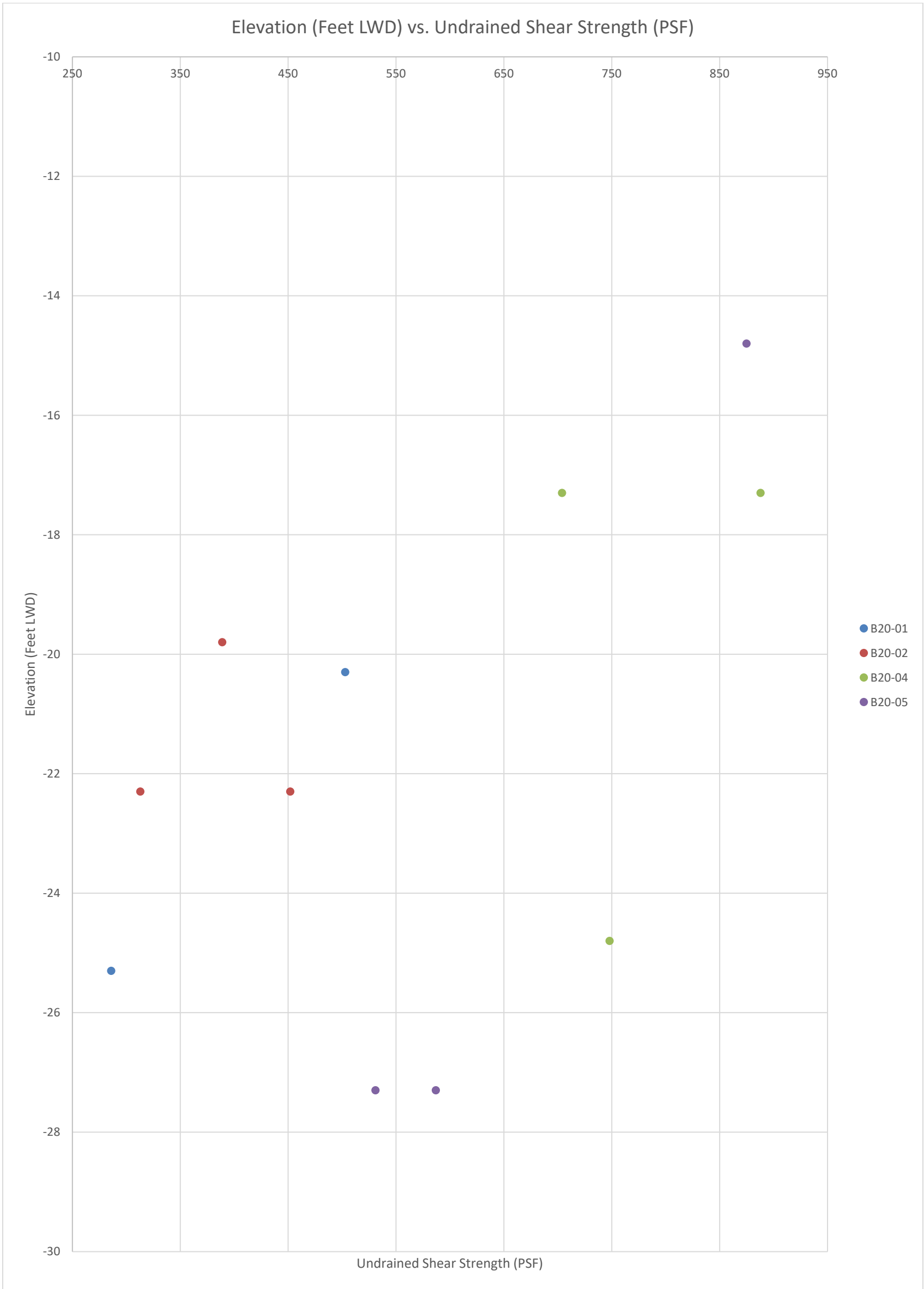


Figure 4 – Undrained shear strengths from laboratory UU testing vs. elevation

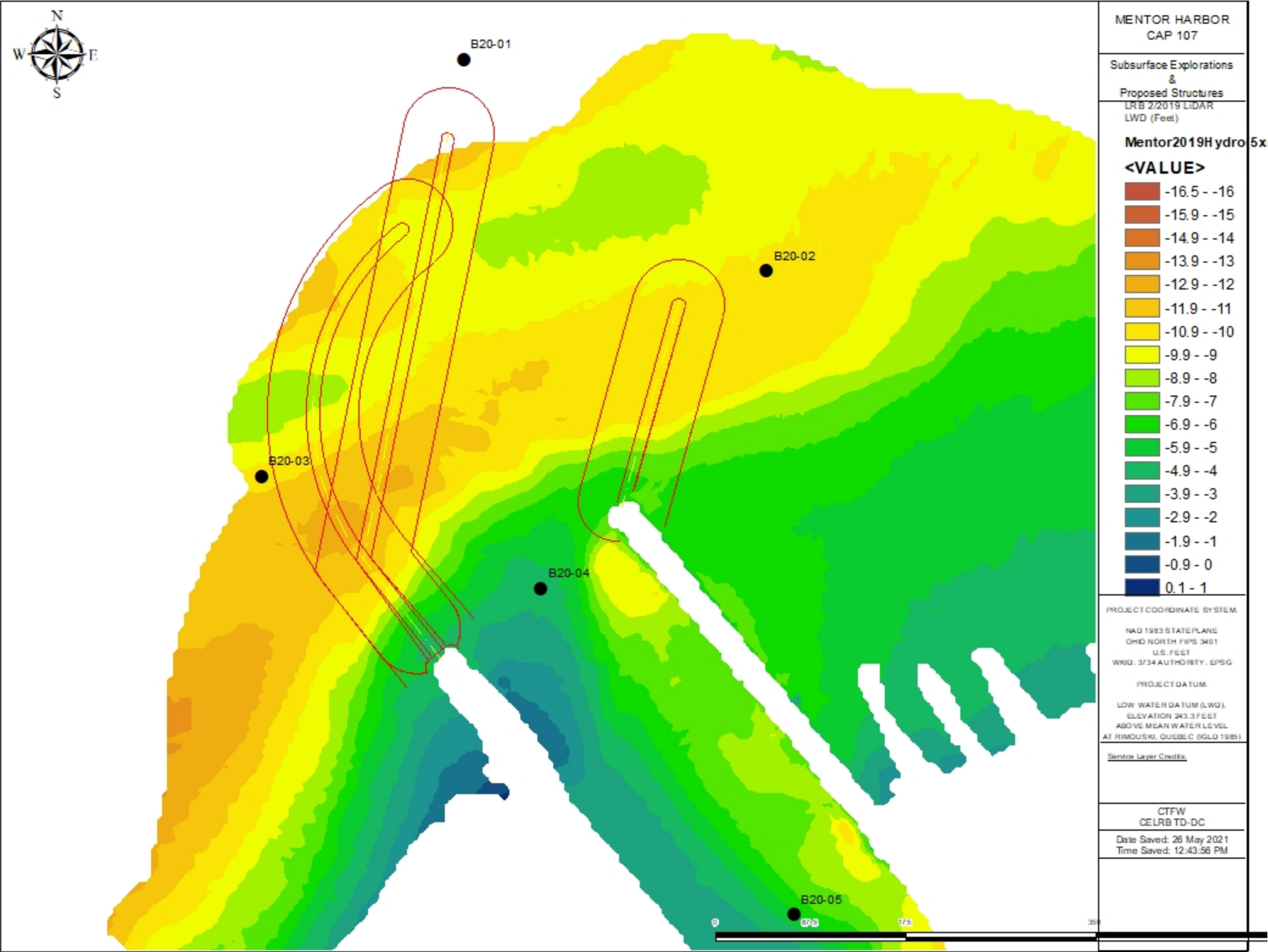


Figure 5 – Lakebed bathymetry in November 2019 (Feet LWD)

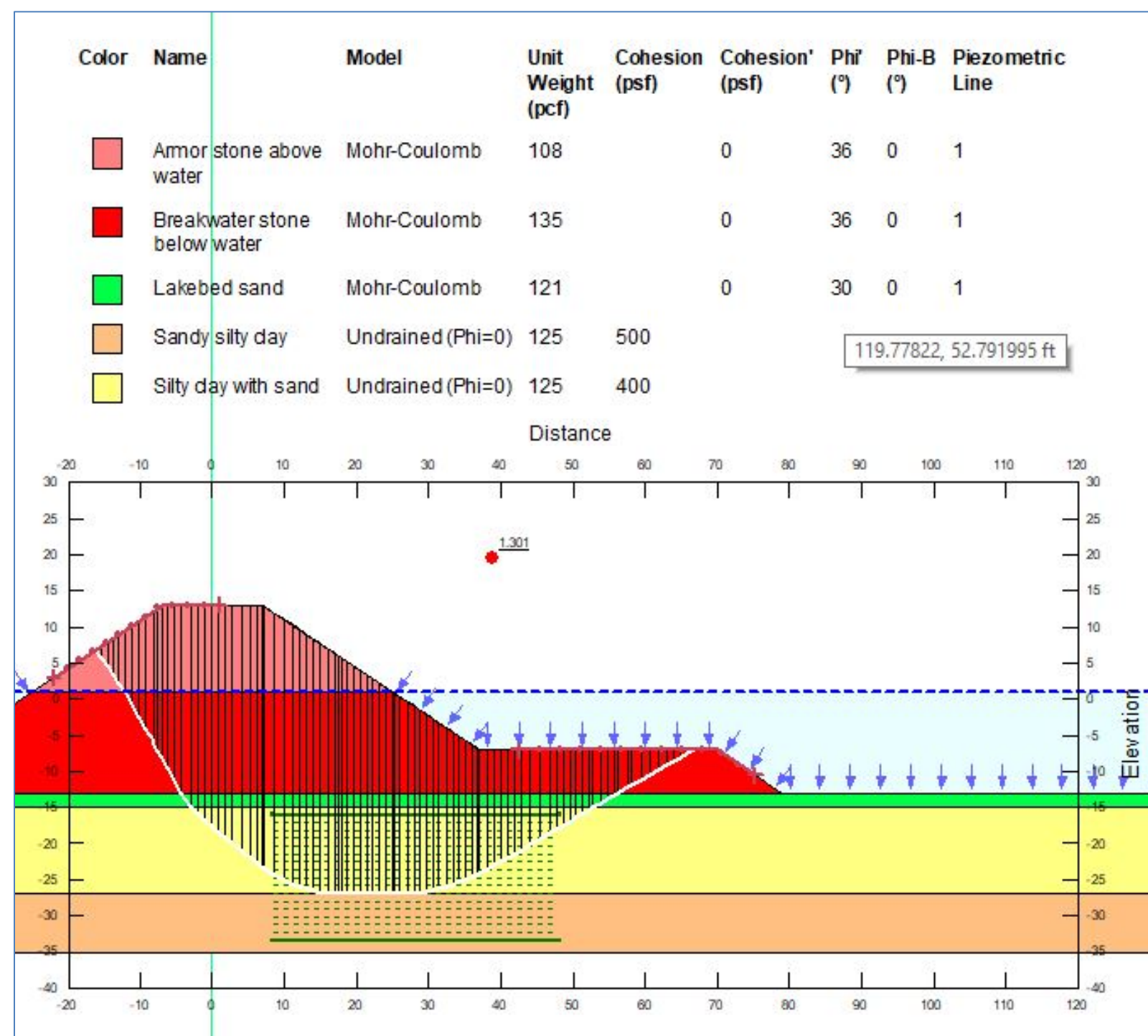


Figure 6 – Stability analysis for west offshore breakwater in vicinity of boring B20-01 – slip surface through stability berm

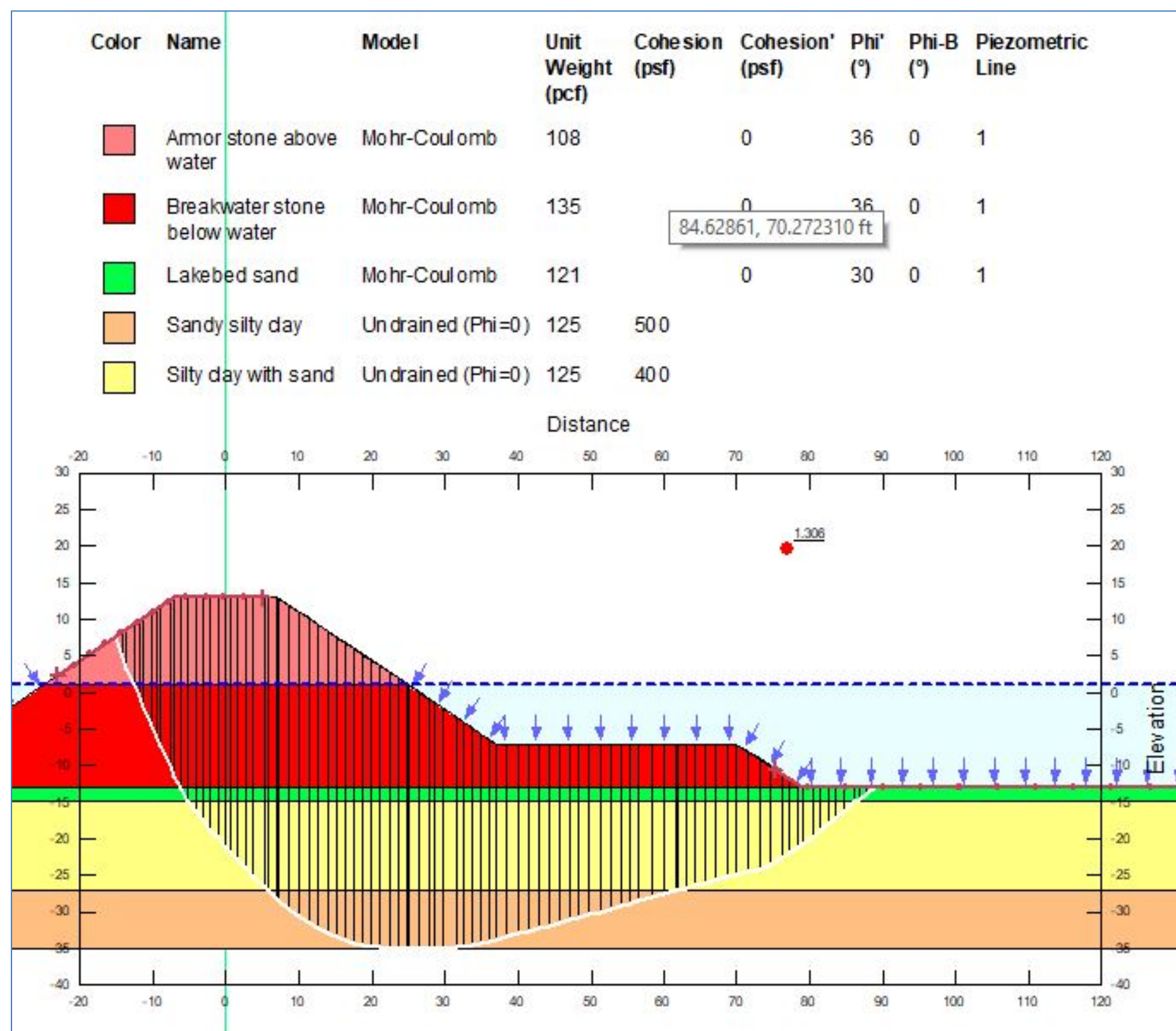


Figure 7 – Stability analysis for west offshore breakwater in vicinity of boring B20-01 – slip surface beyond stability berm

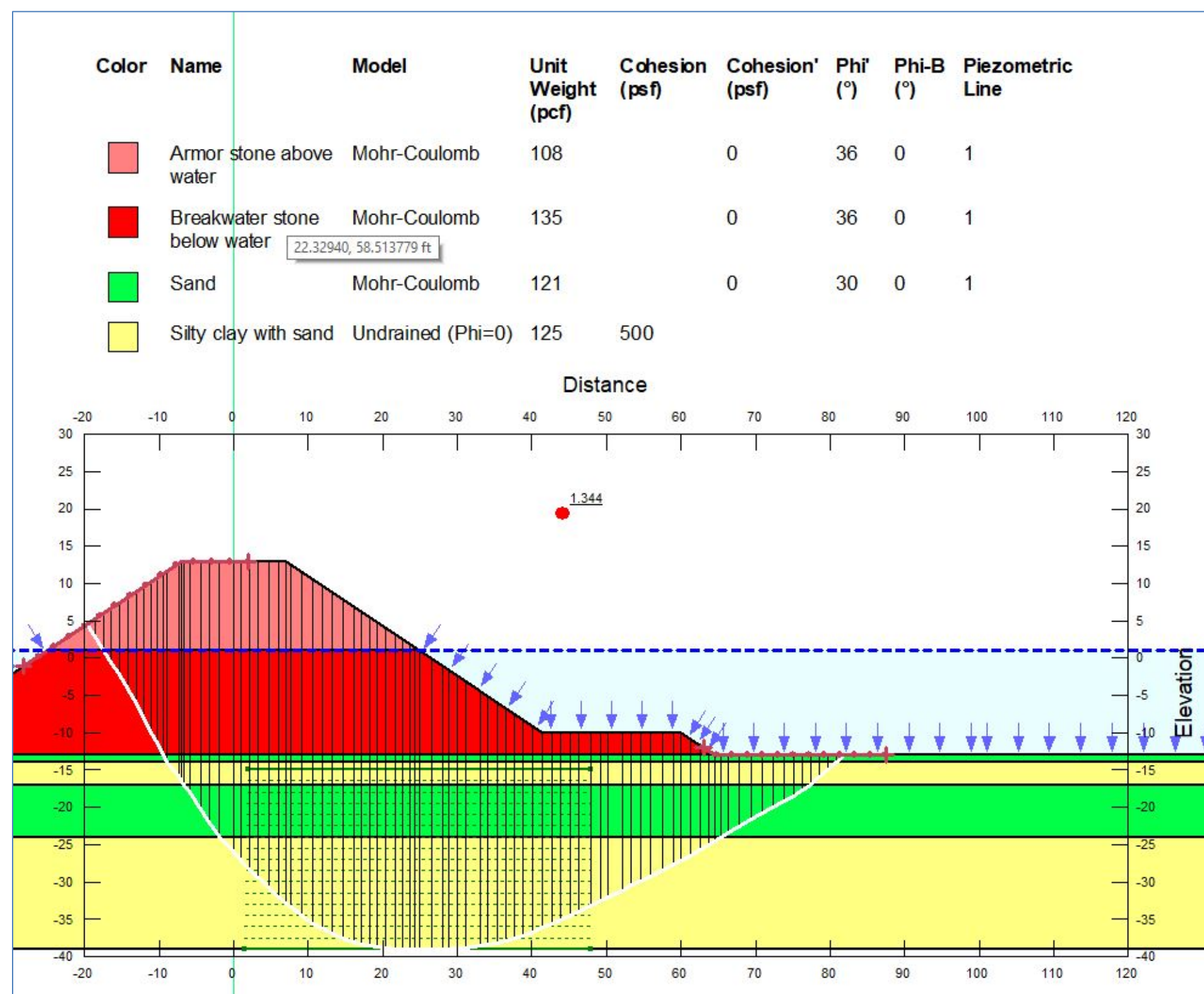


Figure 8 – Stability analysis for east offshore breakwater in vicinity of boring B20-03 – slip surface beyond stability berm

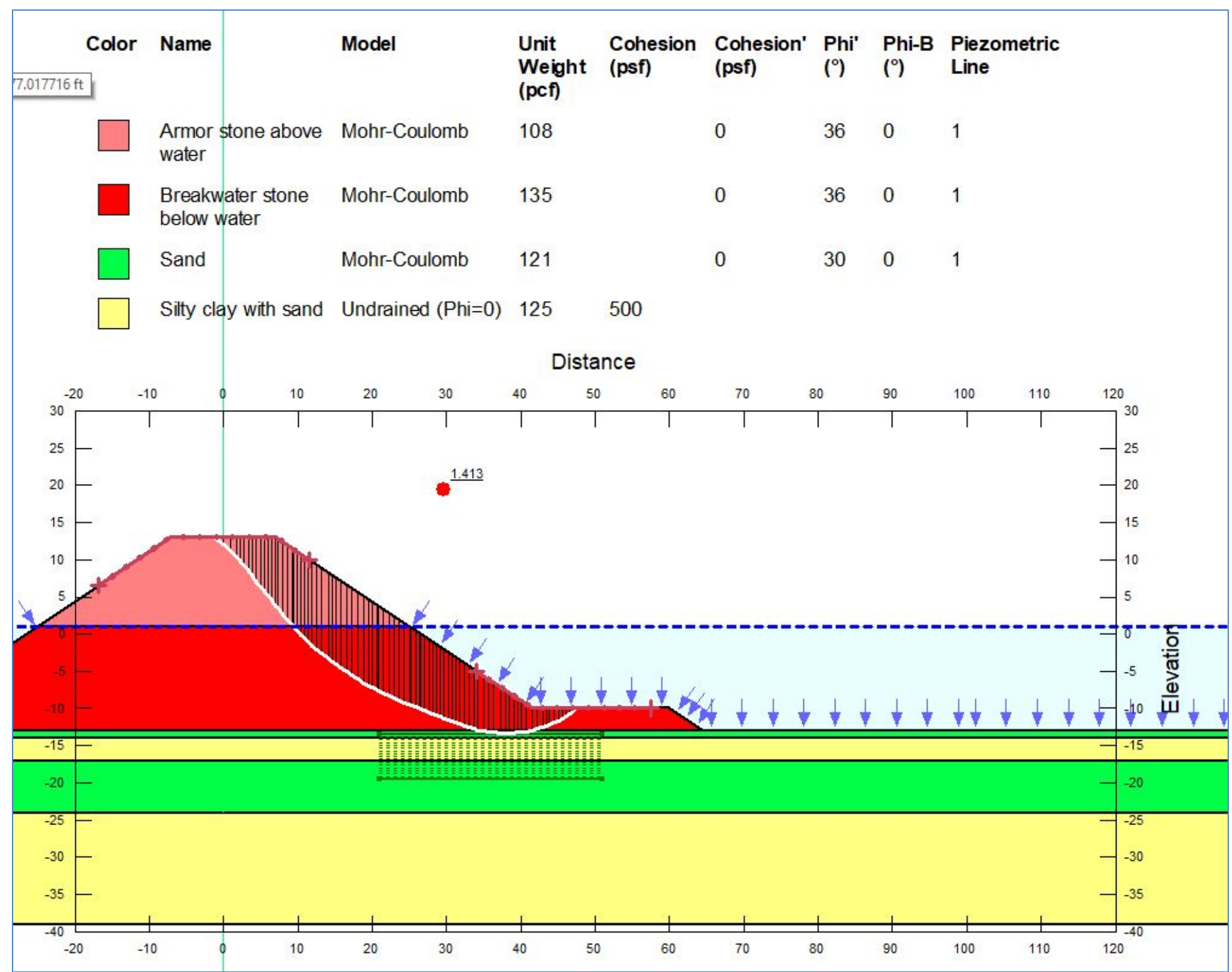


Figure 9 – Stability analysis for east offshore breakwater in vicinity of boring B20-03 – slip surface through stability berm

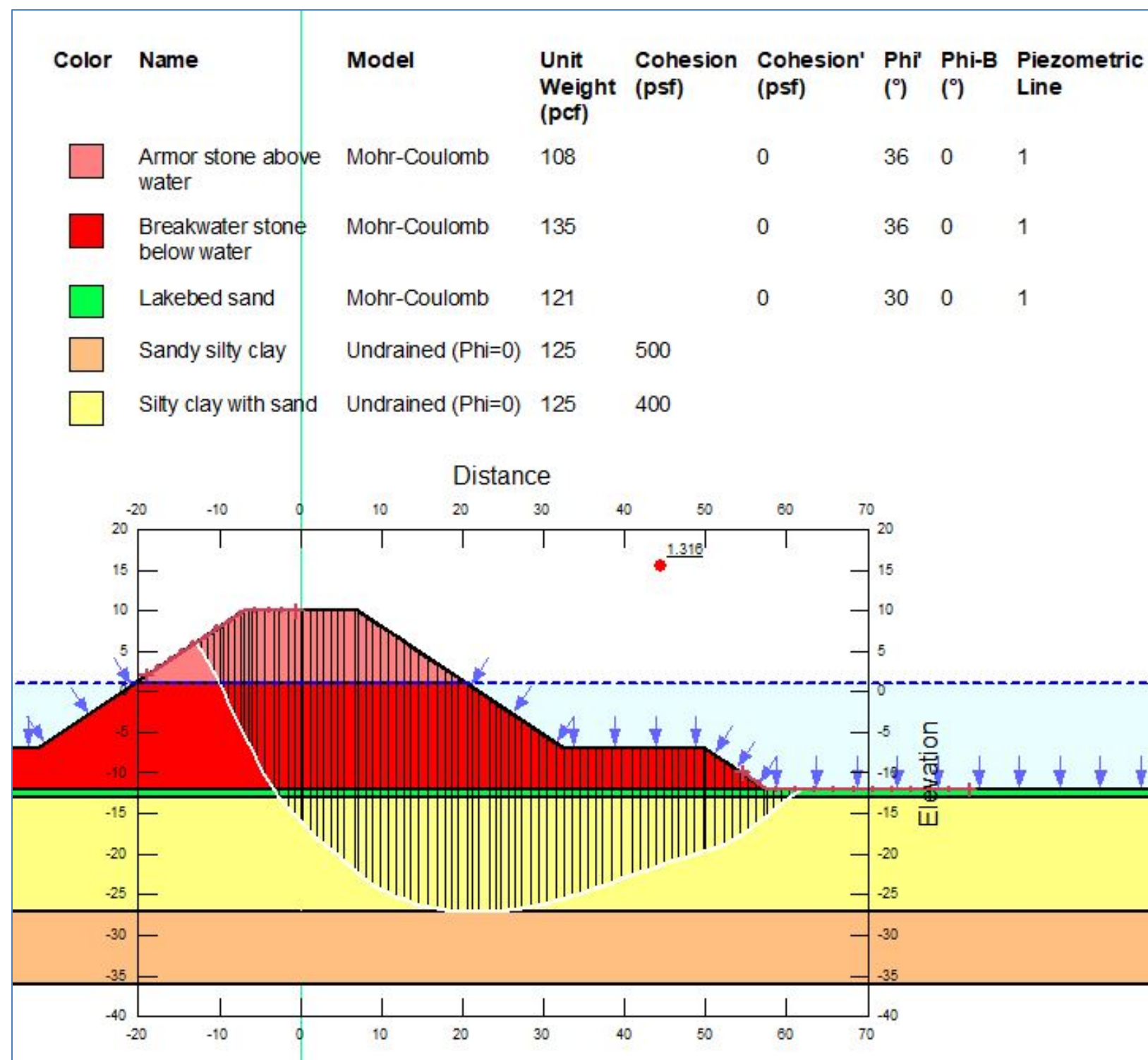


Figure 10 – Stability analysis for east offshore breakwater in vicinity of boring B20-02

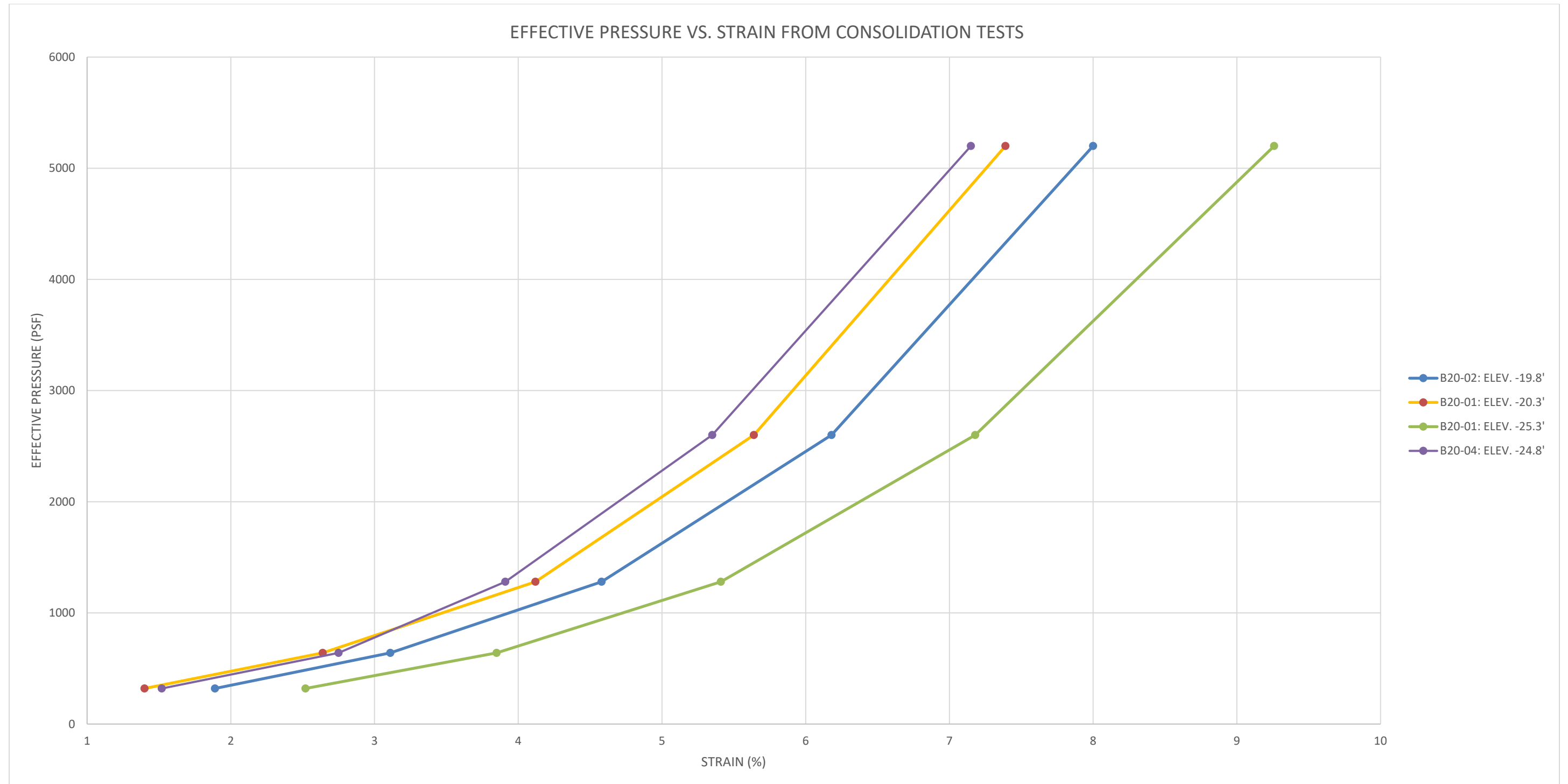


Figure 11 – Effective pressure vs. strain from laboratory consolidation tests

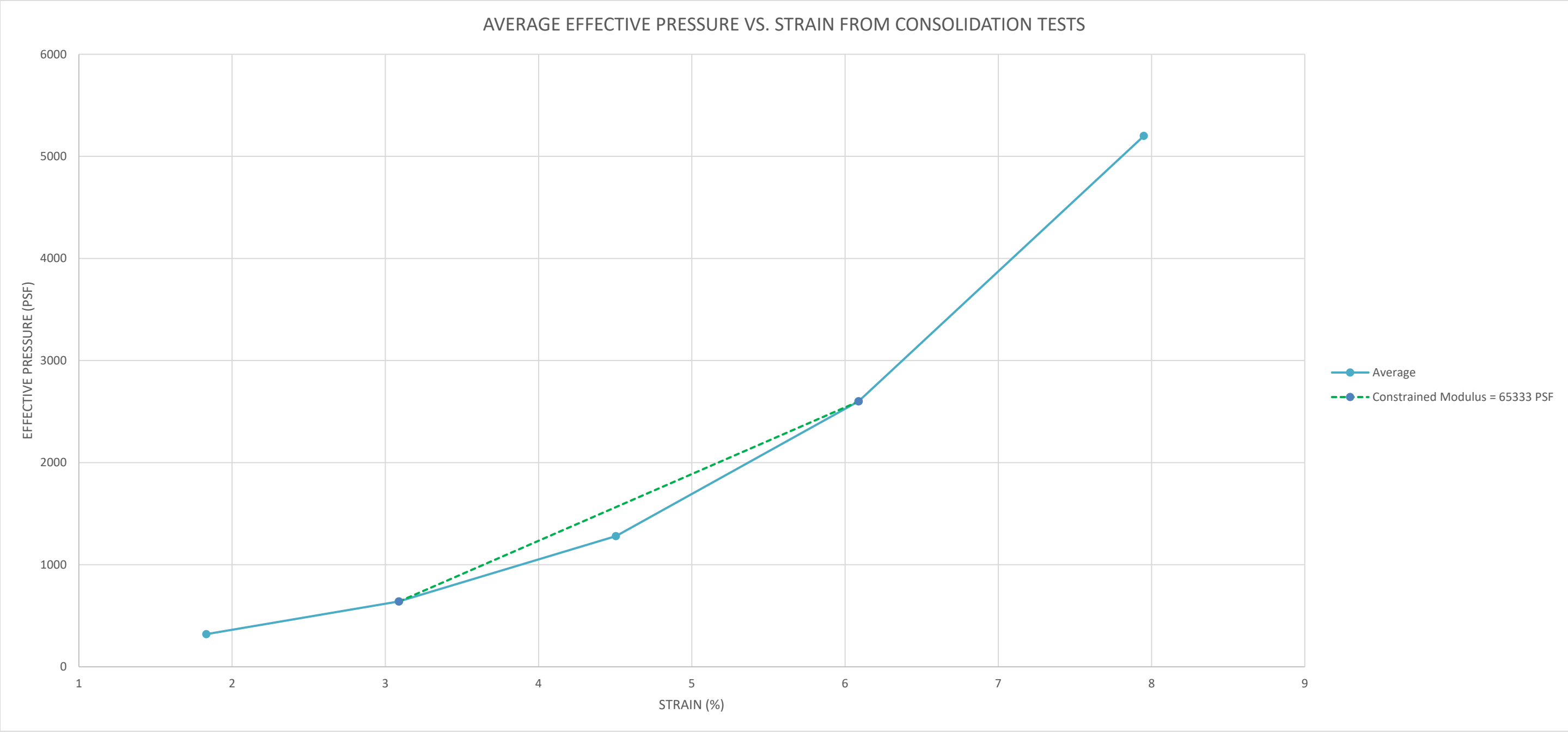


Figure 12 – Average effective pressure vs. strain from laboratory consolidation tests

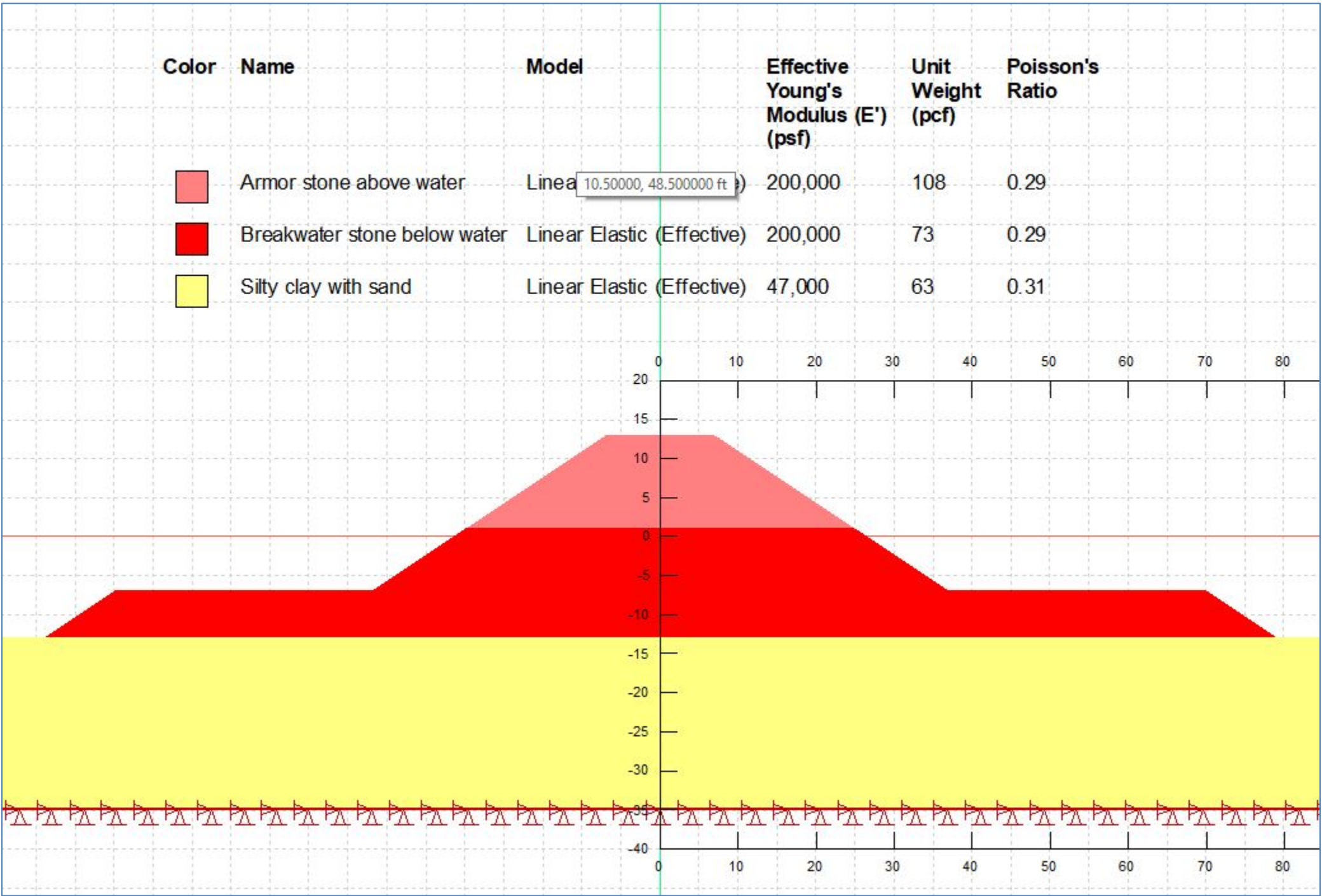


Figure 13 – Sigma/W load-deformation model

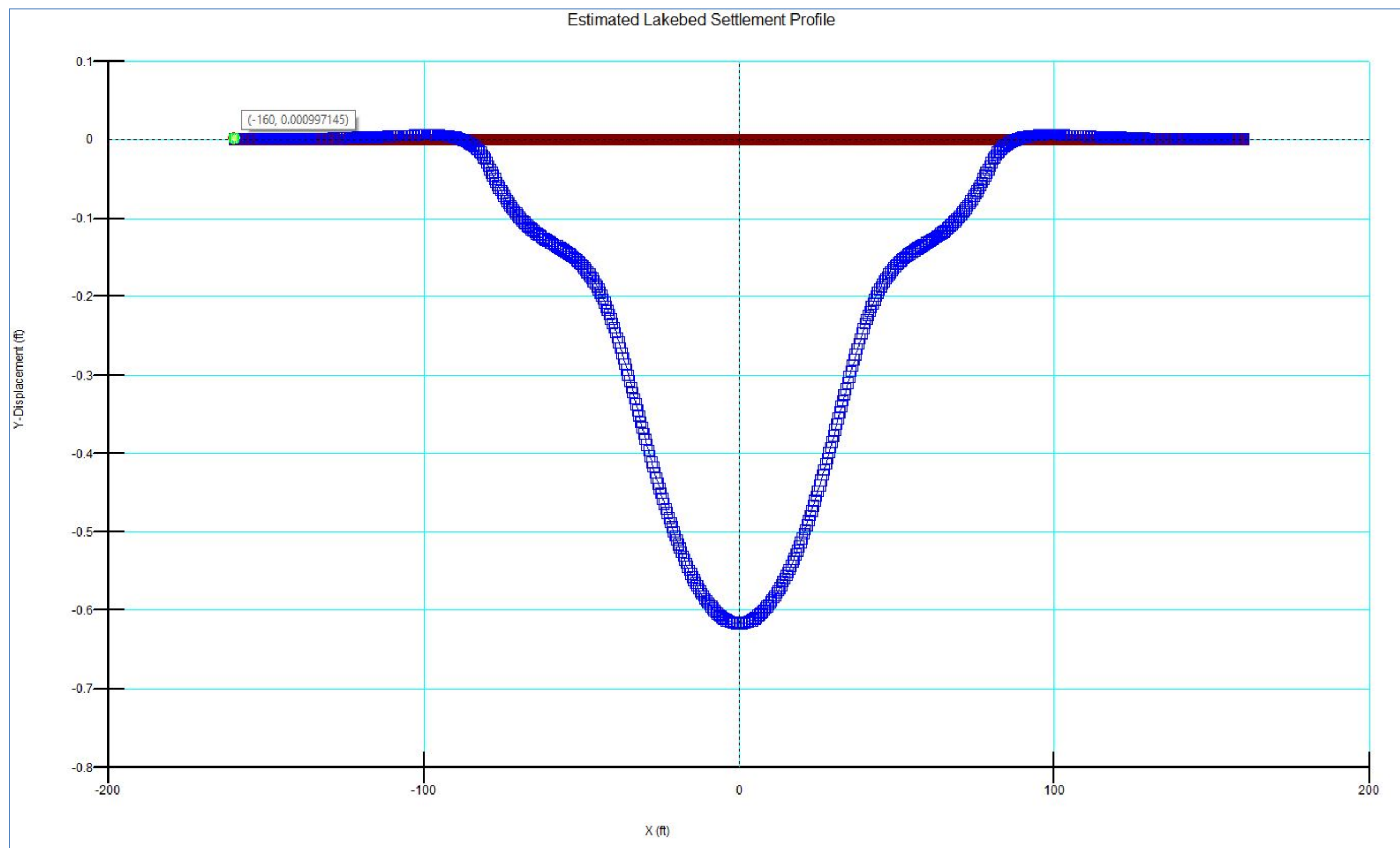


Figure 14 – Estimated lakebed settlement profile perpendicular to breakwater centerline

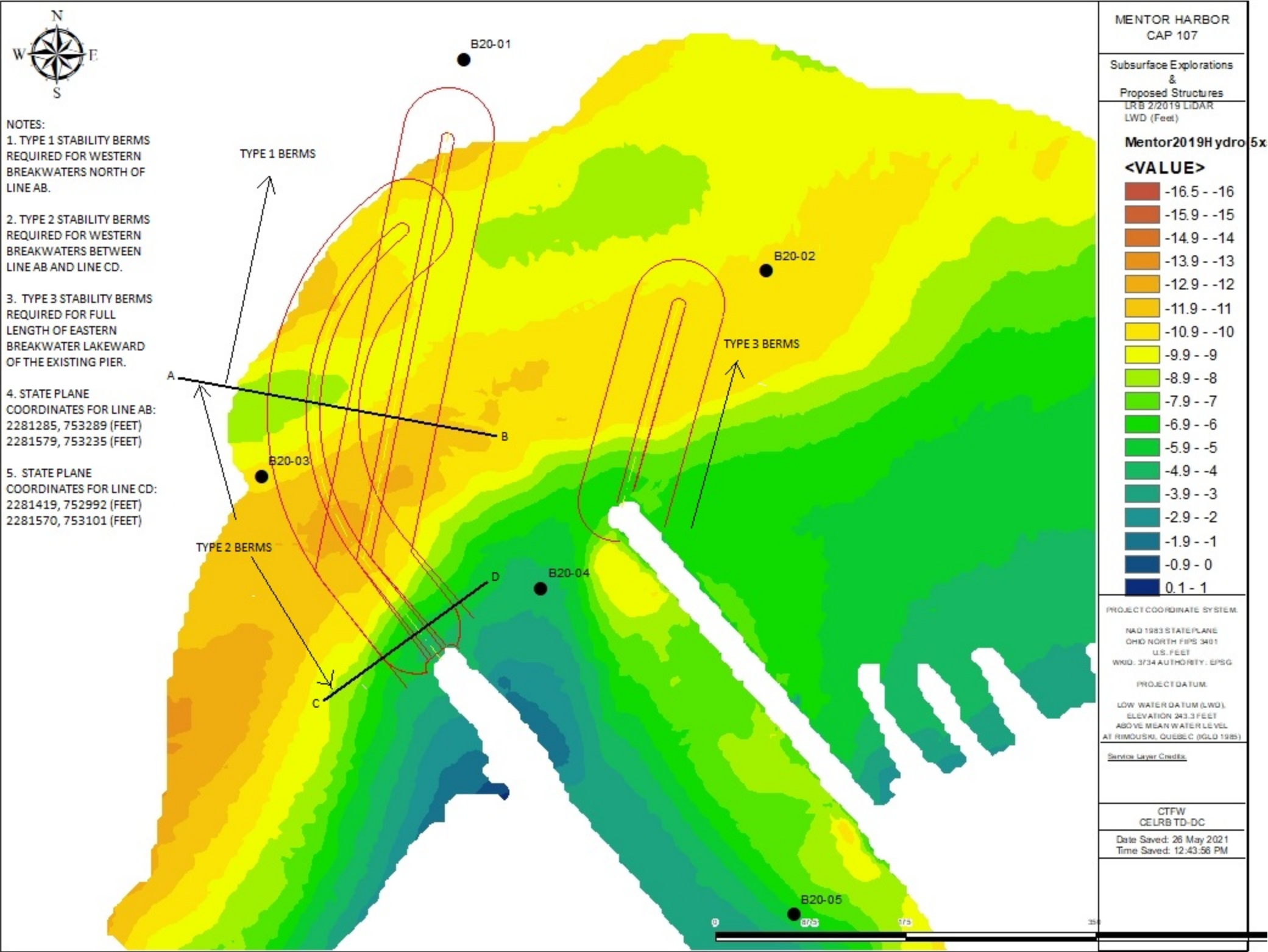


Figure 15 – Locations for Type 1, Type 2, and Type 3 stability berms

ATTACHMENT 1

DRILLING LOG		DIVISION	INSTALLATION	SHEET 1 OF 2 SHEETS	
1. PROJECT Mentor Harbor		9. COORDINATE SYSTEM State Plane		HORIZONTAL NAD83	VERTICAL LWD
2. HOLE NUMBER B00-01		LOCATION COORDINATES N 752,165.0 E 2,281,726.0		10. SIZE AND TYPE OF BIT	
3. DRILLING AGENCY Ohio Testbor		11. MANUFACTURER'S DESIGNATION OF DRILL		12. TOTAL SAMPLES DISTURBED 0 UNDISTURBED 0	
4. NAME OF DRILLER		13. TOTAL NUMBER CORE BOXES 0		14. DEPTH GROUND WATER	
5. DIRECTION OF BORING ☒ VERTICAL ☐ INCLINED		DEG FROM VERTICAL ---		BEARING	
6. THICKNESS OF OVERBURDEN		15. DATE BORING STARTED 7/21/00 COMPLETED 7/21/00		16. ELEVATION TOP OF BORING	
7. DEPTH DRILLED INTO ROCK		17. TOTAL CORE RECOVERY FOR BORING N/A		18. SIGNATURE AND TITLE OF INSPECTOR	
8. TOTAL DEPTH OF BORING 44.1					

ELEV	DEPTH	Blows/ 0.5 ft	N _i	N ₆₀	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory							REMARKS
									Gravel	Sand	Fines	LL	PI	MC	ASTM Class	
	0.2					0' to 0.2': ASPHALT MOIST										WATER ENCOUNTERED 24.6' WATER @ COMPLETION 14.0'
		3				0.2' to 5.5': BLACK PEAT W/ORGANICS MOIST										
		2														
		1														
			3													
		1														
		0														
		0														
	5.5			0												
		1				5.5' to 6.9': VERY SOFT GRAY SILTY CLAY TRACE PEAT MOIST										
	6.9	1														
		1				6.9' to 15.5': VERY SOFT BROWN/GRAY SILTY CLAY W/TRACE SILT LAYERS MOIST										
		1		2												
		2														
		1														
			3													
		1														
		2														
	15.5	3		5												
						15.5' to 24.6': VERY SOFT GRAY SILTY CLAY MOIST										
		1														
		2														
		2														
	24.6															

DRILLING LOG (Cont Sheet)					INSTALLATION					SHEET 2 OF 2 SHEETS						
PROJECT Mentor Harbor					COORDINATE SYSTEM State Plane			HORIZONTAL NAD83			VERTICAL LWD					
LOCATION COORDINATES N 752,165.0 E 2,281,726.0					ELEVATION TOP OF BORING											
ELEV	DEPTH	Blows/ 0.5 ft	N _f	N ₆₀	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory							REMARKS
									Gravel	Sand	Fines	LL	PI	MC	ASTM Class	
	26.0		4			24.6' to 26': BROKEN SHALE W/ VERY SOFT SILTY CLAY & SILTS WET (continued)										
						26' to 31': MEDIUM STIFF, GRAY SILTY CLAY / SOME ROCK FRAGMENTS WET										
		2 3 5														
	31.0		8													
						31' to 44': VERY DENSE GRAY SILT W/ SOME GRAVELS & ROCK FRAGS MOIST										
		15 26 37														
			63													
		31 51 55														
			106													
	44.0	37														
	44.1	50 /1"	50 /1"			44' to 44.1': POSSIBLE BEDROCK (SANDSTONE)(SILTSTONE)? MOIST										
						44.1': BORING TERMINATED										

ACE 1836-A (DRILLING LOG) MENTOR FINAL COMBINED.GPJ ACE MVD WITH RAPID CPT 2008_11_17.GDT 12/28/20

Boring Designation B00-02

DRILLING LOG		DIVISION	INSTALLATION	SHEET 1 OF 2 SHEETS
1. PROJECT Mentor Harbor		9. COORDINATE SYSTEM State Plane		HORIZONTAL NAD83
2. HOLE NUMBER B00-02		LOCATION COORDINATES N 752,151.0 E 2,281,587.0		VERTICAL LWD
3. DRILLING AGENCY Ohio Testbor		10. SIZE AND TYPE OF BIT		
4. NAME OF DRILLER		11. MANUFACTURER'S DESIGNATION OF DRILL		
5. DIRECTION OF BORING ☒ VERTICAL ☐ INCLINED		DEG FROM VERTICAL ---		BEARING
6. THICKNESS OF OVERBURDEN		12. TOTAL SAMPLES DISTURBED 0 UNDISTURBED 0		
7. DEPTH DRILLED INTO ROCK		13. TOTAL NUMBER CORE BOXES 0		
8. TOTAL DEPTH OF BORING 44.8		14. DEPTH GROUND WATER		
		15. DATE BORING STARTED 7/21/00 COMPLETED 7/21/00		
		16. ELEVATION TOP OF BORING		
		17. TOTAL CORE RECOVERY FOR BORING N/A		
		18. SIGNATURE AND TITLE OF INSPECTOR		

ELEV	DEPTH	Blows/ 0.5 ft	N _t	N ₆₀	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory							REMARKS
	0.2					0' to 0.2': ASPHALT			Gravel	Sand	Fines	LL	PI	MC	ASTM Class	
	2.8	3 3 3				0.2' to 2.8': SOFT BROWN/GRAY SILTY CLAY MOIST										WATER ENCOUNTERED 24.6'
	6.3		6			2.8' to 6.3': BLACK PEAT/VEGETATION MOIST										WATER @ COMPLETION COULD NOT BE MEASURED DUE TO BOREHOLE CAVING
			1 1 0													
				1												
			1 0 1			6.3' to 16': VERY SOFT TO SOFT GRAY/BROWN SILTY CLAY MOIST										
				1												
			1 1 1													
				2												
			2 2 3													
	16.0			5												
						16' to 31': VERY SOFT GRAY SILTY CLAY W/TRACE ORGANICS MOIST										
			1 1 2													
				3												
			1 1 2													
			1 1 2													

ACE 1836-A (DRILLING LOG) MENTOR FINAL COMBINED.GPJ ACE MVD WITH RAPID CPT 2008_11_17.GDT 12/28/20

ACE 1836-A (DRILLING LOG) MENTOR FINAL COMBINED.GPJ ACE MVD WITH RAPID CPT 2008_11_17.GDT 12/28/20

Boring Designation B00-03

DRILLING LOG		DIVISION		INSTALLATION		SHEET 1 OF 2 SHEETS	
1. PROJECT Mentor Harbor				9. COORDINATE SYSTEM State Plane		HORIZONTAL NAD83	
2. HOLE NUMBER B00-03				LOCATION COORDINATES N 752,325.0 E 2,281,517.0		11. MANUFACTURER'S DESIGNATION OF DRILL	
3. DRILLING AGENCY Ohio Testbor				12. TOTAL SAMPLES		DISTURBED 0	
4. NAME OF DRILLER				13. TOTAL NUMBER CORE BOXES		0	
5. DIRECTION OF BORING ☒ VERTICAL ☐ INCLINED				DEG FROM VERTICAL ---		BEARING	
6. THICKNESS OF OVERBURDEN				14. ELEVATION GROUND WATER			
7. DEPTH DRILLED INTO ROCK				15. DATE BORING		STARTED 7/24/00	
8. TOTAL DEPTH OF BORING 44.1				16. ELEVATION TOP OF BORING		5.0	
				17. TOTAL CORE RECOVERY FOR BORING		N/A	
				18. SIGNATURE AND TITLE OF INSPECTOR			

ELEV	DEPTH	Blows/ 0.5 ft	N _t	N ₆₀	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory							REMARKS	
									Gravel	Sand	Fines	LL	PI	MC	ASTM Class		
2.5	2.5	15 27 31	58			0' to 2.5': BROWN SANDS W/GRAVELS MOIST										WATER ENCOUNTERED 2.5' WATER @ COMPLETION 30.0' ???	0.0
						2.5' to 5.5': VERY LOOSE BROWN/GRAY SANDS WET											2.5
-0.5	5.5	2 1 1	2			5.5' to 6.9': ORGANICS (PEAT) MOIST											5.0
-1.9	6.9	1 0 1	1			6.9' to 12': VERY SOFT GRAY SILTY CLAY W/SOME ORGANICS MOIST											7.5
-7.0	12.0	0 2 1	3			12' to 17': MEDIUM STIFF BROWN/GRAY SILTY CLAY MOIST											10.0
-12.0	17.0	2 3 3	6			17' to 37': VERY SOFT TO SOFT GRAY SILTY CLAY W/SOME ORGANICS MOIST											12.5
																	15.0
																	17.5
																	20.0
																	22.5
																	25.0

ACE 1836-A (DRILLING LOG) MENTOR FINAL COMBINED.GPJ ACE MVD WITH RAPID CPT 2008_11_17.GDT 12/28/20

DRILLING LOG (Cont Sheet)					INSTALLATION					SHEET 2 OF 2 SHEETS									
PROJECT Mentor Harbor					COORDINATE SYSTEM State Plane			HORIZONTAL NAD83			VERTICAL LWD								
LOCATION COORDINATES N 752,325.0 E 2,281,517.0					ELEVATION TOP OF BORING 5.0														
ELEV	DEPTH	Blows/ 0.5 ft	N _f	N ₆₀	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory							REMARKS			
									Gravel	Sand	Fines	LL	PI	MC	ASTM Class				
			2			17' to 37': VERY SOFT TO SOFT GRAY SILTY CLAY W/SOME ORGANICS MOIST (continued)													
		2 2 2																	
			4																
		1 2 2																	
			4																
-32.0	37.0																		
						37' to 44.1': MEDIUM DENSE TO DENSE GRAY CLAYEY SILT W/SOME GRAVELS & ROCK FRAGMENTS WET													
		9 13 20																	
			33																
		19 50 /1"																	
-39.1	44.1																		
						44.1': BORING TERMINATION DEPTH													

ACE 1836-A (DRILLING LOG) MENTOR FINAL COMBINED.GPJ ACE MVD WITH RAPID CPT 2008_11_17.GDT 12/28/20

Boring Designation B00-04

DRILLING LOG		DIVISION	INSTALLATION	SHEET 1 OF 2 SHEETS
1. PROJECT Mentor Harbor		9. COORDINATE SYSTEM State Plane		HORIZONTAL NAD83
2. HOLE NUMBER B00-04		LOCATION COORDINATES N 752,454.0 E 2,281,661.0		VERTICAL LWD
3. DRILLING AGENCY Ohio Testbor		10. SIZE AND TYPE OF BIT		
4. NAME OF DRILLER		11. MANUFACTURER'S DESIGNATION OF DRILL		
5. DIRECTION OF BORING ☒ VERTICAL ☐ INCLINED		DEG FROM VERTICAL ---		BEARING
6. THICKNESS OF OVERBURDEN		12. TOTAL SAMPLES DISTURBED 0 UNDISTURBED 0		
7. DEPTH DRILLED INTO ROCK		13. TOTAL NUMBER CORE BOXES 0		
8. TOTAL DEPTH OF BORING 45.0		14. ELEVATION GROUND WATER		
		15. DATE BORING STARTED 7/24/00 COMPLETED 7/24/00		
		16. ELEVATION TOP OF BORING 6.0		
		17. TOTAL CORE RECOVERY FOR BORING N/A		
		18. SIGNATURE AND TITLE OF INSPECTOR		

ELEV	DEPTH	Blows/ 0.5 ft	N _t	N ₆₀	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory							REMARKS	
									Gravel	Sand	Fines	LL	PI	MC	ASTM Class		
3.0	3.0	8 2 5	7			0' to 3': BROWN SAND W/GRAVELS & COBBLES MOIST										WATER ENCOUNTERED 3.0' WATER @ COMPLETION COULD NOT BE MEASURED DUE TO BOREHOLE CAVING	0.0
1.6	4.4	3 3 3				3' to 4.4': LOOSE GRAY SAND WET											2.5
-0.9	6.9	1 1 1	6			4.4' to 6.9': ORGANICS, PEAT WET											5.0
-6.5	12.5	1 1 0	2			6.9' to 12.5': VERY SOFT GRAY SILTY CLAY W/TRACE ORGANICS MOIST											7.5
-11.0	17.0	1 2 4	6			12.5' to 17': SOFT BROWN/GRAY SILTY CLAY W/TRACE ORGANICS MOIST											10.0
		0 1 2	3			17' to 37': VERY SOFT TO SOFT GRAY SILTY CLAY W/ SOME ORGANICS MOIST											12.5
		0 0 2															15.0
																	17.5
																	20.0
																	22.5
																	25.0

ACE 1836-A (DRILLING LOG) MENTOR FINAL COMBINED.GPJ ACE MVD WITH RAPID CPT 2008_11_17.GDT 12/28/20

DRILLING LOG (Cont Sheet)					INSTALLATION					SHEET 2 OF 2 SHEETS								
PROJECT Mentor Harbor					COORDINATE SYSTEM State Plane			HORIZONTAL NAD83			VERTICAL LWD							
LOCATION COORDINATES N 752,454.0 E 2,281,661.0					ELEVATION TOP OF BORING 6.0													
ELEV	DEPTH	Blows/ 0.5 ft	N _f	N ₆₀	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory							REMARKS		
									Gravel	Sand	Fines	LL	PI	MC	ASTM Class			
			2			17' to 37': VERY SOFT TO SOFT GRAY SILTY CLAY W/ SOME ORGANICS MOIST (continued)											25.0	
		0 2 2																27.5
			4															30.0
		1 1 2																32.5
			3														35.0	
-31.0	37.0																	
		5 5 5				37' to 42': MEDIUM STIFF GRAY SILTY CLAY W/TRACE & SOME GRAVELS MOIST											37.5	
			10															40.0
-36.0	42.0																	
		15 20 26				42' to 45': DENSE GRAY SANDY SILT WITH ROCK FRAGMENTS, LAYERED MOIST											42.5	
-39.0	45.0																	45.0
			46		45': BORING TERMINATION DEPTH													

ACE 1836-A (DRILLING LOG) MENTOR FINAL COMBINED.GPJ ACE MVD WITH RAPID CPT 2008_11_17.GDT 12/28/20

B00-05

DRILLING LOG		DIVISION	INSTALLATION		SHEET 1 OF 2 SHEETS
1. PROJECT Mentor Harbor		9. COORDINATE SYSTEM State Plane		HORIZONTAL NAD83	VERTICAL LWD
		10. SIZE AND TYPE OF BIT			
2. HOLE NUMBER B00-05	LOCATION COORDINATES N 752,600.0 E 2,281,854.0		11. MANUFACTURER'S DESIGNATION OF DRILL		
3. DRILLING AGENCY Ohio Testbor		12. TOTAL SAMPLES		DISTURBED 0	UNDISTURBED 0
4. NAME OF DRILLER		13. TOTAL NUMBER CORE BOXES		0	
5. DIRECTION OF BORING ☒ VERTICAL ☐ INCLINED		DEG FROM VERTICAL ---	BEARING	14. ELEVATION GROUND WATER	
				15. DATE BORING	
6. THICKNESS OF OVERBURDEN		16. ELEVATION TOP OF BORING		7.0	
7. DEPTH DRILLED INTO ROCK		17. TOTAL CORE RECOVERY FOR BORING		N/A	
8. TOTAL DEPTH OF BORING		45.0		18. SIGNATURE AND TITLE OF INSPECTOR	

[illegible]

ACE 1836-A (DRILLING LOG) MENTOR FINAL COMBINED.GPJ ACE MVD WITH RAPID CPT 2008_11_17.GDT 12/28/20

DRILLING LOG (Cont Sheet)					INSTALLATION					SHEET 2 OF 2 SHEETS						
PROJECT Mentor Harbor					COORDINATE SYSTEM State Plane			HORIZONTAL NAD83			VERTICAL LWD					
LOCATION COORDINATES N 752,600.0 E 2,281,854.0					ELEVATION TOP OF BORING 7.0											
ELEV	DEPTH	Blows/ 0.5 ft	N _f	N ₆₀	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory							REMARKS
									Gravel	Sand	Fines	LL	PI	MC	ASTM Class	
			3			23.7' to 30': VERY SOFT GRAY SILTY CLAY, TRACE ORGANICS MOIST (continued)										
		1														
		2														
-23.0	30.0	2														
			4			30' to 44': SOFT TO MEDIUM STIFF GRAY SILTY CLAY W/TRACE ORGANICS MOIST										
		1														
		2														
		3														
			5													
		2														
		3														
		4														
			7													
-37.0	44.0	3														
		7														
-38.0	45.0	18				44' to 45': MEDIUM DENSE GRAY SANDY SILT WITH TRACE ROCK FRAGMENTS WET										
				25		45': BORING TERMINATION DEPTH										

DRILLING LOG		DIVISION		INSTALLATION		SHEET 1 OF 4 SHEETS			
1. PROJECT Mentor Harbor				9. COORDINATE SYSTEM State Plane		HORIZONTAL NAD83		VERTICAL LWD	
2. HOLE NUMBER B20-01				LOCATION COORDINATES N 753,582.0 E 2,281,548.0		11. MANUFACTURER'S DESIGNATION OF DRILL CME-550			
3. DRILLING AGENCY SME				12. TOTAL SAMPLES		DISTURBED 9		UNDISTURBED 2	
4. NAME OF DRILLER JH/RM				13. TOTAL NUMBER CORE BOXES		0			
5. DIRECTION OF BORING ☒ VERTICAL ☐ INCLINED				DEG FROM VERTICAL		BEARING		14. ELEVATION GROUND WATER	
6. THICKNESS OF OVERBURDEN				15. DATE BORING		STARTED 9/21/20		COMPLETED 9/21/20	
7. DEPTH DRILLED INTO ROCK				16. ELEVATION TOP OF BORING		9.7			
8. TOTAL DEPTH OF BORING 52.5				17. TOTAL CORE RECOVERY FOR BORING		N/A			
				18. SIGNATURE AND TITLE OF INSPECTOR JF Geotechnical Engineer					

ELEV	DEPTH	Blows/ 0.5 ft	N _i	N ₆₀	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory							REMARKS
									Gravel	Sand	Fines	LL	PI	MC	ASTM Class	
						0' to 5.5': Working Platform										
4.2	5.5					5.5' to 21.5': Lake Water Level										

Document may not reflect the most up-to-date assumptions and has not been reviewed.

DRILLING LOG (Cont Sheet)						INSTALLATION		SHEET 3 OF 4 SHEETS									
PROJECT Mentor Harbor						COORDINATE SYSTEM State Plane		HORIZONTAL NAD83		VERTICAL LWD							
LOCATION COORDINATES N 753,582.0 E 2,281,548.0						ELEVATION TOP OF BORING 9.7											
ELEV	DEPTH	Blows/ 0.5 ft	N _f	N ₆₀	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory							REMARKS	
									Gravel	Sand	Fines	LL	PI	MC	ASTM Class		
-26.8	36.5		WOH			26' to 36.5': SILTY CLAY with Sand-Gray- Wet- Very Soft (CL-ML) (continued)	100	5	0	14		20	4	27	CL-ML	UU Su = 286 PSF 20% FINER THAN 0.005 mm Sg = 2.71	35.0
-28.8	38.5	0				36.5' to 38.5': Sandy SILT- Gray- Wet- Very Soft (ML)	100	6	0	36		21	3	26	ML	17% FINER THAN 0.005 mm	37.5
		0															
			WOH			38.5' to 43.5': Sandy SILTY CLAY- Gray- Wet- Soft to Medium Stiff (CL-ML)	100	7	0	34		21	4	25	CL-ML	16% FINER THAN 0.005 mm	40.0
		0															
		3		4													
		WOH/12"-3															
		1					100	8									42.5
		3															
		3		7													
-33.8	43.5			6													
		1				43.5' to 46': Silty Medium to Coarse SAND with Gravel- Gray- Wet- Medium Dense (SM)	33	9									45.0
		5															
		14		22													
-36.3	46.0			19													
		6				46' to 49.5': Sandy LEAN CLAY with Gravel- Reddish Brown and Gray- Damp- Hard (CL)	55	10						15			47.5
		10															
		18		33													
				28													
-39.8	49.5					49.5' to 52.5': Sandy LEAN CLAY with Gravel- Gray- Damp- Hard (CL)											50.0

ACE 1836-A (DRILLING LOG), MENTOR FINAL COMBINED.GPJ ACE MVD WITH RAPID CPT 2008_11_17.GDT 12/28/20

DRILLING LOG (Cont Sheet)						INSTALLATION				SHEET 4 OF 4 SHEETS							
PROJECT Mentor Harbor						COORDINATE SYSTEM State Plane				HORIZONTAL NAD83				VERTICAL LWD			
LOCATION COORDINATES N 753,582.0 E 2,281,548.0						ELEVATION TOP OF BORING 9.7											
ELEV	DEPTH	Blows/ 0.5 ft	N _f	N ₆₀	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory								REMARKS
									Gravel	Sand	Fines	LL	PI	MC	ASTM Class		
-42.8	52.5	30 50				49.5' to 52.5': Sandy LEAN CLAY with Gravel- Gray- Damp- Hard (CL) (continued)	84	11							14		
1/6" -																	

52.5

ACE 1836-A (DRILLING LOG) MENTOR FINAL COMBINED.GPJ ACE MVD WITH RAPID CPT 2008_11_17.GDT 12/28/20

B20-02

DRILLING LOG			DIVISION	INSTALLATION			SHEET 1 OF 4 SHEETS	
1. PROJECT Mentor Harbor			9. COORDINATE SYSTEM State Plane			HORIZONTAL NAD83	VERTICAL LWD	
			10. SIZE AND TYPE OF BIT					
2. HOLE NUMBER B20-02		LOCATION COORDINATES N 753,387.0 E 2,281,827.0		11. MANUFACTURER'S DESIGNATION OF DRILL CME-550				
3. DRILLING AGENCY SME			12. TOTAL SAMPLES			DISTURBED 10	UNDISTURBED 3	
4. NAME OF DRILLER JH/RM			13. TOTAL NUMBER CORE BOXES 0					
			14. ELEVATION GROUND WATER					
5. DIRECTION OF BORING ☒ VERTICAL ☐ INCLINED		DEG FROM VERTICAL		BEARING		15. DATE BORING		
		---				STARTED 9/22/20	COMPLETED 9/22/20	
6. THICKNESS OF OVERBURDEN			16. ELEVATION TOP OF BORING 9.7					
7. DEPTH DRILLED INTO ROCK			17. TOTAL CORE RECOVERY FOR BORING N/A					
8. TOTAL DEPTH OF BORING 53.0			18. SIGNATURE AND TITLE OF INSPECTOR TPO Geotechnical Engineer					

[illegible]

ACE 1836-A (DRILLING LOG) MENTOR FINAL COMBINED.GPJ ACE MVD WITH RAPID CPT 2008_11_17.GDT 12/28/20

Document may not reflect the most up-to-date assumptions and has not been reviewed.

DRILLING LOG (Cont Sheet)					INSTALLATION		SHEET 3 OF 4 SHEETS									
PROJECT Mentor Harbor					COORDINATE SYSTEM State Plane		HORIZONTAL NAD83	VERTICAL LWD								
LOCATION COORDINATES N 753,387.0 E 2,281,827.0					ELEVATION TOP OF BORING 9.7											
ELEV	DEPTH	Blows/ 0.5 ft	N _f	N ₆₀	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory							REMARKS
									Gravel	Sand	Fines	LL	PI	MC	ASTM Class	
-23.6	33.3	0				33.3' to 38': SILTY CLAY with Sand-Gray- Wet- Very Soft (CL-ML)	100	6	0	29		23	5	29	CL-ML	19% FINER THAN 0.005 mm
		0		0												
		0			WOH											
		0				38' to 40.5': Sandy SILTY CLAY- Gray- Wet- Very Soft (CL-ML)	100	7				26	6	29		19% FINER THAN 0.005 mm
		0														
		0		0												
-28.3	38.0				WOH	38' to 40.5': Sandy SILTY CLAY- Gray- Wet- Very Soft (CL-ML)	100	8	0	38		21	4	25	CL-ML	19% FINER THAN 0.005 mm
		0														
		0		0												
-30.8	40.5				WOH	40.5' to 45.8': SILTY CLAY with Sand-Gray- Wet- Very Soft (CL-ML)	100	9	0	15		23	4	27	CL-ML	23% FINER THAN 0.005 mm
		0														
		0		0												
		0			WOH	40.5' to 45.8': SILTY CLAY with Sand-Gray- Wet- Very Soft (CL-ML)	100	10	0	46		21	4	29	CL-ML	15% FINER THAN 0.005 mm
		0														
		0		0												
-36.1	45.8					45.8' to 48': Fine to Coarse SAND-Gray- Wet- Very Loose (SP)	100	11								
		1														
		1		2												
-38.3	48.0		2			48' to 53': Sandy LEAN CLAY with Gravel- Gray- Damp- Hard (CL)										
		7					55	12								
		19														
		14		39												50.0
			33													

ACE 1836-A (DRILLING LOG) MENTOR FINAL COMBINED.GPJ ACE MVD WITH RAPID CPT 2008_11_17.GDT 12/28/20

DRILLING LOG (Cont Sheet)					INSTALLATION					SHEET 4 OF 4 SHEETS									
PROJECT Mentor Harbor					COORDINATE SYSTEM State Plane					HORIZONTAL NAD83					VERTICAL LWD				
LOCATION COORDINATES N 753,387.0 E 2,281,827.0					ELEVATION TOP OF BORING 9.7														
ELEV	DEPTH	Blows/ 0.5 ft	N _f	N ₆₀	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory								REMARKS		
									Gravel	Sand	Fines	LL	PI	MC	ASTM Class				
		35				48' to 53': Sandy LEAN CLAY with Gravel- Gray- Damp- Hard (CL) (continued)											PIECE OF SHALE IN WATER CONTENT SAMPLE		
		45					100	13								8			
-43.3	53.0	50		115															

95

52.5

ACE 1836-A (DRILLING LOG) MENTOR FINAL COMBINED.GPJ ACE MVD WITH RAPID CPT 2008_11_17.GDT 12/28/20

DRILLING LOG		DIVISION		INSTALLATION			SHEET 1 OF 4 SHEETS		
1. PROJECT Mentor Harbor				9. COORDINATE SYSTEM State Plane		HORIZONTAL NAD83		VERTICAL LWD	
2. HOLE NUMBER B20-03				LOCATION COORDINATES N 753,198.0 E 2,281,362.0		11. MANUFACTURER'S DESIGNATION OF DRILL CME-550			
3. DRILLING AGENCY SME				12. TOTAL SAMPLES		DISTURBED 13		UNDISTURBED 1	
4. NAME OF DRILLER JH/RM				13. TOTAL NUMBER CORE BOXES		0			
5. DIRECTION OF BORING ☒ VERTICAL ☐ INCLINED				DEG FROM VERTICAL		BEARING		14. ELEVATION GROUND WATER	
6. THICKNESS OF OVERBURDEN				15. DATE BORING		STARTED 9/22/20		COMPLETED 9/22/20	
7. DEPTH DRILLED INTO ROCK				16. ELEVATION TOP OF BORING		9.7			
8. TOTAL DEPTH OF BORING 54.5				17. TOTAL CORE RECOVERY FOR BORING		N/A			
				18. SIGNATURE AND TITLE OF INSPECTOR TPO Geotechnical Engineer					

ELEV	DEPTH	Blows/ 0.5 ft	N _i	N ₆₀	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory							REMARKS
									Gravel	Sand	Fines	LL	PI	MC	ASTM Class	
						0' to 5.5': Working Platform										
4.2	5.5					5.5' to 20.5': Lake Water Level										

DRILLING LOG (Cont Sheet)						INSTALLATION		SHEET 2 OF 4 SHEETS													
PROJECT						COORDINATE SYSTEM		HORIZONTAL		VERTICAL											
Mentor Harbor						State Plane		NAD83		LWD											
LOCATION COORDINATES						ELEVATION TOP OF BORING															
N 753,198.0 E 2,281,362.0						9.7															
ELEV	DEPTH	Blows/ 0.5 ft	N _f	N ₆₀	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory								REMARKS				
									Gravel	Sand	Fines	LL	PI	MC	ASTM Class						
						5.5' to 20.5': Lake Water Level (continued)															
-10.8	20.5																				
		1				20.5' to 24': Fine to Coarse SAND- Gray- Wet- Loose (SP)	0	1													
		2																			
		2																			
		1		5																	
			4																		
-14.3	24.0	0				24' to 26': LEAN CLAY- Gray- Wet- Very Soft (CL)	72	2													
		0																			
		0		0																	
		WOH																			
-16.3	26.0																				
		0				26' to 29.5': Fine to Medium SAND- Gray- Wet- Very Loose (SP)	0	3													
		0																			
		0		0																	
		WOH																			
		0																			
-19.8	29.5	1					50	4													
		1		2		29.5' to 30.5': SILTY CLAY- Gray- Wet- Very Soft (CL-ML)															
			2																		
-20.8	30.5					30.5' to 34': Fine to Medium Sand with Silt- Gray- Wet- Very Loose (SP-SM)															
		0																			
		0																			
		0		0																	
		WOH																			

ACE 1836-A (DRILLING LOG) MENTOR FINAL COMBINED.GPJ ACE MVD WITH RAPID CPT 2008_11_17.GDT 12/28/20

DRILLING LOG (Cont Sheet)						INSTALLATION			SHEET 3 OF 4 SHEETS								
PROJECT Mentor Harbor						COORDINATE SYSTEM State Plane		HORIZONTAL NAD83		VERTICAL LWD							
LOCATION COORDINATES N 753,198.0 E 2,281,362.0						ELEVATION TOP OF BORING 9.7											
ELEV	DEPTH	Blows/ 0.5 ft	N _f	N ₆₀	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory							REMARKS	
									Gravel	Sand	Fines	LL	PI	MC	ASTM Class		
-24.3	34.0	2				30.5' to 34': Fine to Medium Sand with Silt- Gray- Wet- Very Loose (SP-SM) (continued)										21% FINER THAN 0.005 mm	
		1				34' to 40': SILTY CLAY- Gray- Wet- Very Soft (CL-ML)	67	6									
		1		2							25	5	28				
			2														
		0															
		0									25	6	27				
		0		0													35.0
		0															
		0		0													
		0															
		0															
-30.3	40.0	0		0			100	8									
		0															
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ACE 1836-A (DRILLING LOG) MENTOR FINAL COMBINED.GPJ ACE MVD WITH RAPID CPT 2008_11_17.GDT 12/28/20

DRILLING LOG (Cont Sheet)					INSTALLATION					SHEET 4 OF 4 SHEETS									
PROJECT Mentor Harbor					COORDINATE SYSTEM State Plane					HORIZONTAL NAD83					VERTICAL LWD				
LOCATION COORDINATES N 753,198.0 E 2,281,362.0					ELEVATION TOP OF BORING 9.7														
ELEV	DEPTH	Blows/ 0.5 ft	N _i	N ₆₀	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory								REMARKS		
									Gravel	Sand	Fines	LL	PI	MC	ASTM Class				
-41.8	51.5	50				51.5' to 54.5': Sandy LEAN CLAY with Gravel- Gray- Hard (CL)	100	13							12				
		50																	
		32																	
		21																	
-44.8	54.5	33		63			89	14							13				

54

52.5

ACE 1836-A (DRILLING LOG) MENTOR FINAL COMBINED.GPJ ACE MVD WITH RAPID CPT 2008_11_17.GDT 12/28/20

DRILLING LOG		DIVISION		INSTALLATION			SHEET 1 OF 4 SHEETS		
1. PROJECT Mentor Harbor				9. COORDINATE SYSTEM State Plane		HORIZONTAL NAD83		VERTICAL LWD	
2. HOLE NUMBER B20-04				LOCATION COORDINATES N 753,095.0 E 2,281,619.0		11. MANUFACTURER'S DESIGNATION OF DRILL CME-550			
3. DRILLING AGENCY SME				12. TOTAL SAMPLES		DISTURBED 13		UNDISTURBED 2	
4. NAME OF DRILLER JH/RM				13. TOTAL NUMBER CORE BOXES		0			
5. DIRECTION OF BORING ☒ VERTICAL ☐ INCLINED				DEG FROM VERTICAL		BEARING		14. ELEVATION GROUND WATER	
6. THICKNESS OF OVERBURDEN				15. DATE BORING		STARTED 9/24/20		COMPLETED 9/24/20	
7. DEPTH DRILLED INTO ROCK				16. ELEVATION TOP OF BORING		9.7			
8. TOTAL DEPTH OF BORING 55.0				17. TOTAL CORE RECOVERY FOR BORING		N/A			
				18. SIGNATURE AND TITLE OF INSPECTOR JF Geotechnical Engineer					

ELEV	DEPTH	Blows/ 0.5 ft	N _i	N ₆₀	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory							REMARKS
									Gravel	Sand	Fines	LL	PI	MC	ASTM Class	
						0' to 5.5': Working Platform										
4.2	5.5					5.5' to 16.5': Lake Water Level										

[illegible]

DRILLING LOG (Cont Sheet)					INSTALLATION		SHEET 3 OF 4 SHEETS									
PROJECT Mentor Harbor					COORDINATE SYSTEM State Plane		HORIZONTAL NAD83	VERTICAL LWD								
LOCATION COORDINATES N 753,095.0 E 2,281,619.0					ELEVATION TOP OF BORING 9.7											
ELEV	DEPTH	Blows/ 0.5 ft	N _f	N ₆₀	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory							REMARKS
									Gravel	Sand	Fines	LL	PI	MC	ASTM Class	
						28.5' to 43': SILTY CLAY- Trace Sand- Gray- Wet- Very Soft (CL-ML) (continued)										UU Su = 748 PSF 26% FINER THAN 0.005 mm Sg = 2.73
							100	8	0	3		25	5	26	CL-ML	
		0					100	9				25	6	27		
		0		0												37.5
		0			WOH											
		0		0			100	10				24	5	26		
		0		0												40.0
		0			WOH											
		0		0			95	11								
-33.3	43.0	0		0					0	20		24	5	25	CL-ML	25% FINER THAN 0.005 mm
		0			WOH											
		0		0		43' to 45.5': SILTY CLAYEY SAND- Gray- Wet- Very Soft (SC-SM)										
		0					100	12								14% FINER THAN 0.005 mm
		0		0					1	52		22	5	22	SC-SM	
-35.8	45.5	0			WOH											
		5				45.5' to 52': Fine to Coarse SILTY SAND with Gravel- Gray- Wet- Medium Dense (SM)										47.5
		9					55	13								
		10		22												
			19													50.0
		13					72	14								
		10														
		13		27												
			23													

DRILLING LOG (Cont Sheet)					INSTALLATION					SHEET 4 OF 4 SHEETS									
PROJECT Mentor Harbor					COORDINATE SYSTEM State Plane					HORIZONTAL NAD83					VERTICAL LWD				
LOCATION COORDINATES N 753,095.0 E 2,281,619.0					ELEVATION TOP OF BORING 9.7														
ELEV	DEPTH	Blows/ 0.5 ft	N _f	N ₆₀	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory								REMARKS		
								Gravel	Sand	Fines	LL	PI	MC	ASTM Class					
-42.3	52.0					52' to 55': Sandy SILTY CLAY with Gravel- Brown and Gray- Moist- Hard (CL/ML)													
		7																	
-45.3	55.0	16		34			67	15											

29

52.5

55.0

ACE 1836-A (DRILLING LOG) MENTOR FINAL COMBINED.GPJ ACE MVD WITH RAPID CPT 2008_11_17.GDT 12/28/20

DRILLING LOG		DIVISION		INSTALLATION		SHEET 1 OF 4 SHEETS			
1. PROJECT Mentor Harbor				9. COORDINATE SYSTEM State Plane		HORIZONTAL NAD83		VERTICAL LWD	
2. HOLE NUMBER B20-05				LOCATION COORDINATES N 752,795.0 E 2,281,852.0		11. MANUFACTURER'S DESIGNATION OF DRILL CME-550			
3. DRILLING AGENCY SME				12. TOTAL SAMPLES		DISTURBED 14		UNDISTURBED 2	
4. NAME OF DRILLER JH/RM				13. TOTAL NUMBER CORE BOXES		0			
5. DIRECTION OF BORING ☒ VERTICAL ☐ INCLINED				DEG FROM VERTICAL		BEARING		14. ELEVATION GROUND WATER	
6. THICKNESS OF OVERBURDEN				15. DATE BORING		STARTED 9/25/20		COMPLETED 9/25/20	
7. DEPTH DRILLED INTO ROCK				16. ELEVATION TOP OF BORING		9.7			
8. TOTAL DEPTH OF BORING 54.0				17. TOTAL CORE RECOVERY FOR BORING		N/A			
				18. SIGNATURE AND TITLE OF INSPECTOR TPO Geotechnical Engineer					

ELEV	DEPTH	Blows/ 0.5 ft	N _i	N ₆₀	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory							REMARKS
									Gravel	Sand	Fines	LL	PI	MC	ASTM Class	
						0' to 5.5': Working Platform										
4.2	5.5					5.5' to 16.5': Lake Water Level										

Document may not reflect the most up-to-date assumptions and has not been reviewed.

SPK FORM 1836-A
SEP 05

DRILLING LOG (Cont Sheet)					INSTALLATION					SHEET 4 OF 4 SHEETS									
PROJECT Mentor Harbor					COORDINATE SYSTEM State Plane					HORIZONTAL NAD83					VERTICAL LWD				
LOCATION COORDINATES N 752,795.0 E 2,281,852.0					ELEVATION TOP OF BORING 9.7														
ELEV	DEPTH	Blows/ 0.5 ft	N _f	N ₆₀	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory							REMARKS			
									Gravel	Sand	Fines	LL	PI	MC	ASTM Class				
-43.3	53.0	19				50.5' to 53': Sandy LEAN CLAY with Rock Fragments- Gray- Hard (CL) (continued)	95	15											
		25		51															
			44			53' to 54': SHALE- Gray- Soft													
-44.3	54.0	50					100	16											

1/6" -

52.5

ACE 1836-A (DRILLING LOG) MENTOR FINAL COMBINED.GPJ ACE MVD WITH RAPID CPT 2008_11_17.GDT 12/28/20

DRILLING LOG		DIVISION		INSTALLATION		SHEET 1 OF 3 SHEETS			
1. PROJECT Mentor Harbor				9. COORDINATE SYSTEM State Plane		HORIZONTAL NAD83		VERTICAL LWD	
2. HOLE NUMBER B20-06				LOCATION COORDINATES N 752,616.0 E 2,282,105.0		11. MANUFACTURER'S DESIGNATION OF DRILL CME-550			
3. DRILLING AGENCY SME				12. TOTAL SAMPLES		DISTURBED 11		UNDISTURBED 1	
4. NAME OF DRILLER JH/RM				13. TOTAL NUMBER CORE BOXES		0			
5. DIRECTION OF BORING ☒ VERTICAL ☐ INCLINED				DEG FROM VERTICAL		BEARING		14. ELEVATION GROUND WATER	
6. THICKNESS OF OVERBURDEN				16. ELEVATION TOP OF BORING		9.7			
7. DEPTH DRILLED INTO ROCK				17. TOTAL CORE RECOVERY FOR BORING		N/A			
8. TOTAL DEPTH OF BORING 47.5				18. SIGNATURE AND TITLE OF INSPECTOR TPO Geotechnical Engineer					

ELEV	DEPTH	Blows/ 0.5 ft	N _f	N ₆₀	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory							REMARKS	
									Gravel	Sand	Fines	LL	PI	MC	ASTM Class		
4.2	5.5					0' to 5.5': Working Platform											
					5.5' to 18': Lake Water Level												

SPK FORM 1836-A
SEP 05

Document may not reflect the most up-to-date assumptions and has not been reviewed.

Billing Designation

B20-06

SHEET 2 of 3

DRILLING LOG (Cont Sheet)					INSTALLATION		SHEET 3 OF 3 SHEETS									
PROJECT					COORDINATE SYSTEM		HORIZONTAL									
Mentor Harbor					State Plane		NAD83									
LOCATION COORDINATES					ELEVATION TOP OF BORING											
N 752,616.0 E 2,282,105.0					9.7											
ELEV	DEPTH	Blows/ 0.5 ft	N _f	N ₆₀	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory						REMARKS	
									Gravel	Sand	Fines	LL	PI	MC		ASTM Class
-29.3	39.0	0				25.5' to 39': Fine to Medium SAND with Silt- Gray- Wet- Very Loose (SP) (continued)	100	7								
		0														
		0		0												
		WOH														
-31.3	41.0	0					100	8								
		0														
		0		0												
		WOH														
-37.8	47.5	4				39' to 41': SILTY CLAY- Gray- Moist- Soft (CL-ML)	84	9	0	11		24	5	22	CL-ML	27% FINER THAN 0.005 mm
		6														
		10		19												
		16														
		14														
		22														
		41		74												
		63														
-37.8	47.5	28				41' to 47.5': Sandy LEAN CLAY with Gravel- Gray- Very Stiff to Hard (CL)	100	10								
		31														
		50		95												

81

D85-01

DRILLING LOG		DIVISION	INSTALLATION		SHEET 1 OF 2 SHEETS
1. PROJECT Mentor Harbor		9. COORDINATE SYSTEM State Plane		HORIZONTAL NAD83	VERTICAL LWD
2. HOLE NUMBER D85-01		LOCATION COORDINATES N 750,766.0 E 2,279,172.0		10. SIZE AND TYPE OF BIT	
3. DRILLING AGENCY		11. MANUFACTURER'S DESIGNATION OF DRILL		12. TOTAL SAMPLES DISTURBED 0 UNDISTURBED 0	
4. NAME OF DRILLER		13. TOTAL NUMBER CORE BOXES 0		14. ELEVATION GROUND WATER	
5. DIRECTION OF BORING ☒ VERTICAL ☐ INCLINED		DEG FROM VERTICAL ---		BEARING	
6. THICKNESS OF OVERBURDEN		15. DATE BORING 10/22/85		STARTED COMPLETED	
7. DEPTH DRILLED INTO ROCK		16. ELEVATION TOP OF BORING -5.0		17. TOTAL CORE RECOVERY FOR BORING N/A	
8. TOTAL DEPTH OF BORING 24.5		18. SIGNATURE AND TITLE OF INSPECTOR			

[illegible]

DRILLING LOG (Cont Sheet)					INSTALLATION					SHEET 2 OF 2 SHEETS							
PROJECT Mentor Harbor					COORDINATE SYSTEM State Plane			HORIZONTAL NAD83		VERTICAL LWD							
LOCATION COORDINATES N 750,766.0 E 2,279,172.0					ELEVATION TOP OF BORING -5.0												
ELEV	DEPTH	Blows/ 0.5 ft	N _f	N ₆₀	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory						REMARKS		
									Gravel	Sand	Fines	LL	PI	MC		ASTM Class	
-21.0	16.0					2' to 16': PEAT, SOFT N-VALUES 1 TO 4 (continued)											
						16' to 24.5': SAND, TRACE GRAVEL, SOME ORGANICS IN THIN LENSES, SOME LAYERS OF SILTY CLAY											
-29.5	24.5					24.5': BORING TERMINATED											

15.0
17.5
20.0
22.5

ACE 1836-A (DRILLING LOG), MENTOR FINAL COMBINED.GPJ, ACE MVD WITH RAPID CPT 2008_11_17.GDT 12/28/20

DRILLING LOG		DIVISION	INSTALLATION	SHEET 1 OF 2 SHEETS
1. PROJECT Mentor Harbor		9. COORDINATE SYSTEM State Plane		HORIZONTAL NAD83
		10. SIZE AND TYPE OF BIT		VERTICAL LWD
2. HOLE NUMBER DUV85-02	LOCATION COORDINATES N 750,603.0 E 2,278,883.0		11. MANUFACTURER'S DESIGNATION OF DRILL	
3. DRILLING AGENCY		12. TOTAL SAMPLES	DISTURBED 0	UNDISTURBED 0
4. NAME OF DRILLER		13. TOTAL NUMBER CORE BOXES 0		
5. DIRECTION OF BORING ☒ VERTICAL ☐ INCLINED		14. ELEVATION GROUND WATER		
DEG FROM VERTICAL ---		15. DATE BORING 10/22/85		
BEARING		STARTED COMPLETED		
6. THICKNESS OF OVERBURDEN		16. ELEVATION TOP OF BORING -5.0		
7. DEPTH DRILLED INTO ROCK		17. TOTAL CORE RECOVERY FOR BORING N/A		
8. TOTAL DEPTH OF BORING 24.5		18. SIGNATURE AND TITLE OF INSPECTOR		

ELEV	DEPTH	Blows/ 0.5 ft	N _r	N ₆₀	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory							REMARKS	
									Gravel	Sand	Fines	LL	PI	MC	ASTM Class		
-6.0	1.0					0' to 1': SAND											
						1' to 13.5': PEAT, SOFT TO VERY SOFT N-VALUES WOH TO 2											
																	
																	
																	
																	
																	
																	
-18.5	13.5					13.5' to 17': SILTY CLAY, VERY SOFT N-VALUE 2											
																	
																	

DRILLING LOG (Cont Sheet)					INSTALLATION					SHEET 2 OF 2 SHEETS							
PROJECT Mentor Harbor					COORDINATE SYSTEM State Plane			HORIZONTAL NAD83		VERTICAL LWD							
LOCATION COORDINATES N 750,603.0 E 2,278,883.0					ELEVATION TOP OF BORING -5.0												
ELEV	DEPTH	Blows/ 0.5 ft	N _f	N ₆₀	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory						REMARKS		
									Gravel	Sand	Fines	LL	PI	MC		ASTM Class	
-22.0	17.0					13.5' to 17': SILTY CLAY, VERY SOFT N-VALUE 2 (continued)											
						17' to 23.5': MEDIUM TO FINE SAND, TRACE GRAVEL, SOME ORGANICS											
-28.5	23.5																
-29.5	24.5					23.5' to 24.5': SILTY CLAY, SOME GRAVEL, MEDIUM STIFF TO STIFF CL-ML											
						24.5': BORING TERMINATED											

15.0
17.5
20.0
22.5

ACE 1836-A (DRILLING LOG) MENTOR FINAL COMBINED.GPJ ACE MVD WITH RAPID CPT 2008_11_17.GDT 12/28/20

Boring Designation DUV85-03

DRILLING LOG		DIVISION	INSTALLATION		SHEET 1 OF 2 SHEETS
1. PROJECT Mentor Harbor		9. COORDINATE SYSTEM State Plane		HORIZONTAL NAD83	VERTICAL LWD
2. HOLE NUMBER DUV85-03		LOCATION COORDINATES N 750,435.0 E 2,278,629.0		10. SIZE AND TYPE OF BIT	
3. DRILLING AGENCY		11. MANUFACTURER'S DESIGNATION OF DRILL		12. TOTAL SAMPLES DISTURBED 0 UNDISTURBED 0	
4. NAME OF DRILLER		13. TOTAL NUMBER CORE BOXES 0		14. ELEVATION GROUND WATER	
5. DIRECTION OF BORING ☒ VERTICAL ☐ INCLINED		DEG FROM VERTICAL ---		BEARING	
6. THICKNESS OF OVERBURDEN		15. DATE BORING STARTED 10/23/85		COMPLETED	
7. DEPTH DRILLED INTO ROCK		16. ELEVATION TOP OF BORING -4.5		17. TOTAL CORE RECOVERY FOR BORING N/A	
8. TOTAL DEPTH OF BORING 24.0		18. SIGNATURE AND TITLE OF INSPECTOR			

[illegible]

DRILLING LOG (Cont Sheet)					INSTALLATION					SHEET 2 OF 2 SHEETS								
PROJECT Mentor Harbor					COORDINATE SYSTEM State Plane			HORIZONTAL NAD83		VERTICAL LWD								
LOCATION COORDINATES N 750,435.0 E 2,278,629.0					ELEVATION TOP OF BORING -4.5													
ELEV	DEPTH	Blows/ 0.5 ft	N _f	N ₆₀	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory							REMARKS		
									Gravel	Sand	Fines	LL	PI	MC	ASTM Class			
-24.5	20.0					2' to 20': PEAT N-VALUES AS LOW AS 1 (continued)												
-25.5	21.0					20' to 21': CLAY, SOME SILT, SOFT, MOIST, DAMP, GRAY												
-27.5	23.0					21' to 23': SAND												
-28.5	24.0					23' to 24': SILTY CLAY WITH GRAVEL, STIFF TO HARD												
24': BORING TERMINATED																		

ACE 1836-A (DRILLING LOG), MENTOR FINAL COMBINED.GPJ, ACE MVD WITH RAPID CPT 2008_11_17.GDT 12/28/20

GRAIN SIZE DISTRIBUTION

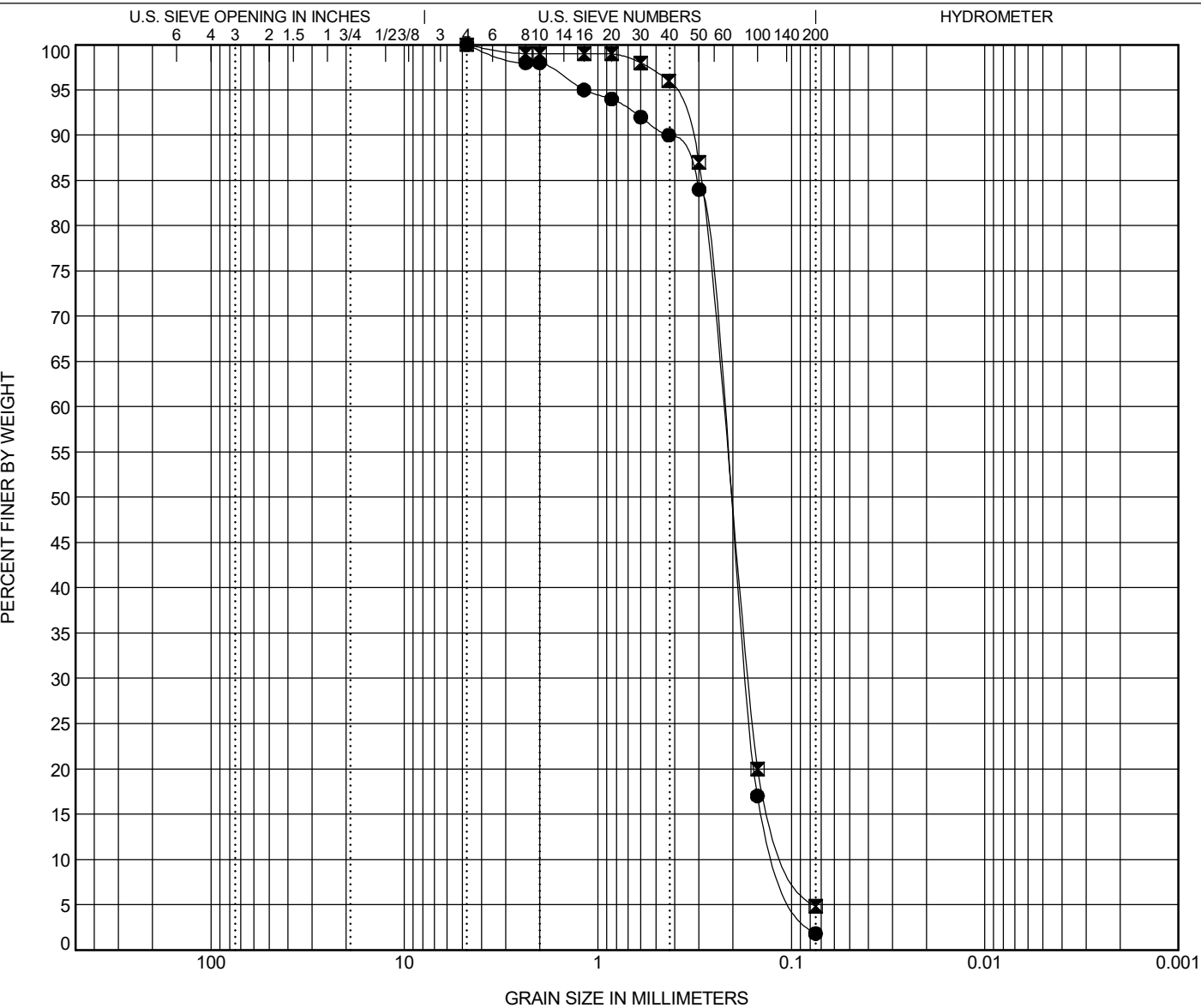
USACE BUFFALO

CLIENT _____

PROJECT NAME Mentor Harbor

PROJECT NUMBER _____

PROJECT LOCATION _____



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification					LL	PL	PI	Cc	Cu
●	B20-01	21.5	POORLY GRADED SAND(SP)								1.15	2.15
☒	B20-04	16.5	POORLY GRADED SAND(SP)								1.28	2.39
Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt		%Clay	
●	B20-01	21.5	4.75	0.234	0.172	0.109	0.0	98.2	1.8			
☒	B20-04	16.5	4.75	0.227	0.166	0.095	0.0	95.2	4.8			
Document may not reflect the most up-to-date assumptions and has not been reviewed												

GRAIN SIZE MENTOR FINAL COMBINED.GPJ ACE MVD WITH RAPID CPT 2008_12_23.GDT 12/29/20

ATTACHMENT 2

AERIAL PHOTO
DATED 2011

RUBBLEMOUND
BREAKWATER

400 FEET

D

D

E

E

B

B

200 FEET

80 FT WIDE CHANNEL

C

C

E

E

A

A

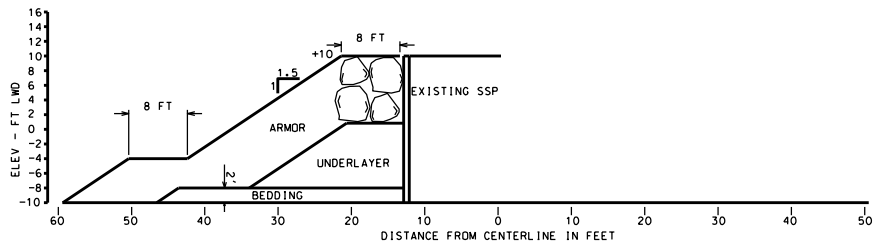
REMOVE NAVIGATION
OBSTRUCTION

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SCALE IN FEET

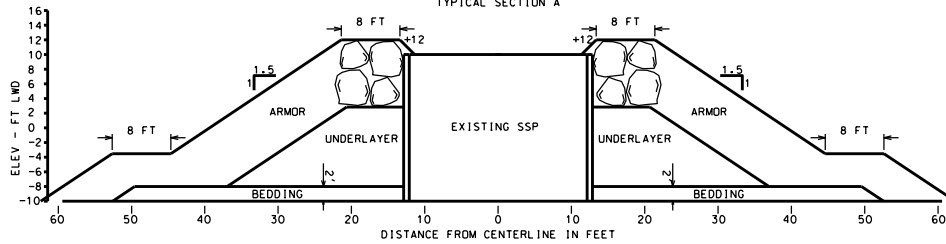
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ALTERNATIVE 2A: RUBBLEMOUND BREAKWATER
AND SSP PIER STABILIZATION

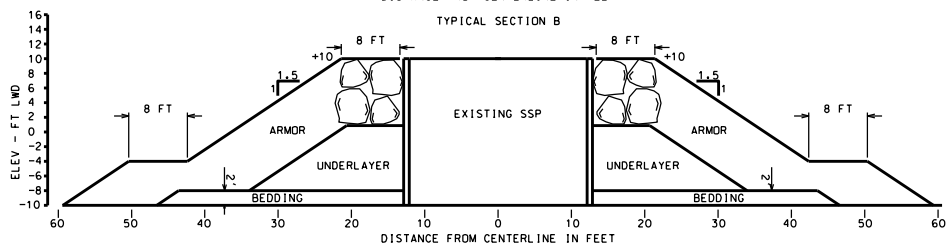
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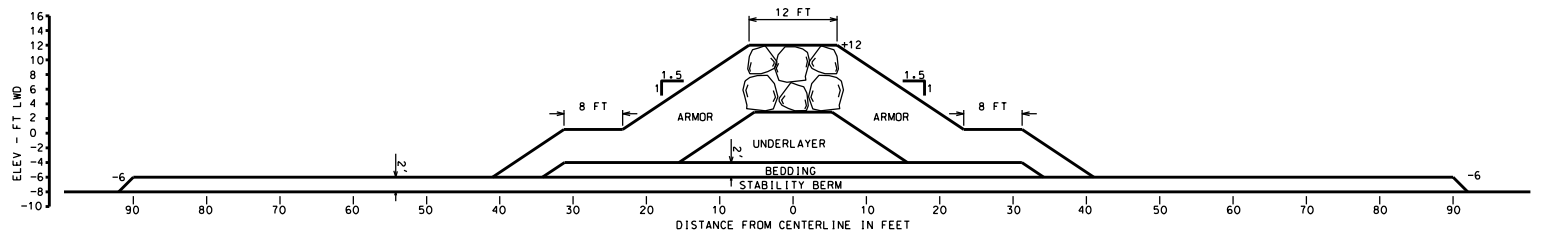
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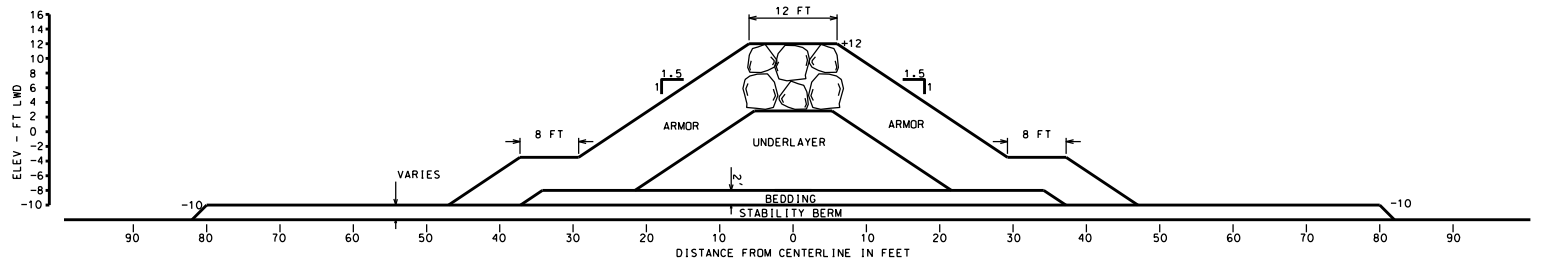
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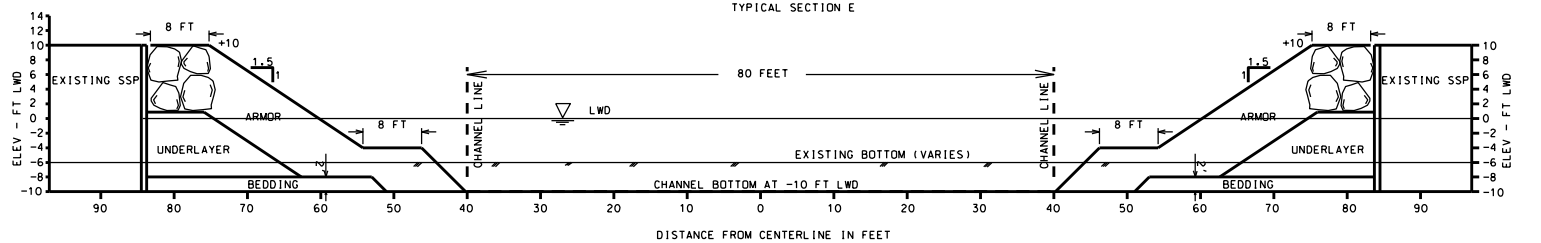
TYPICAL SECTION C



TYPICAL SECTION D



TYPICAL SECTION E



TYPICAL CHANNEL SECTION (F)

AERIAL PHOTO
DATED 2011

RUBBLEMOUND
BREAKWATER

400 FEET

D

D

E

E

200 FEET

B

B

80 FT WIDE CHANNEL

C

C

E

F

A

A

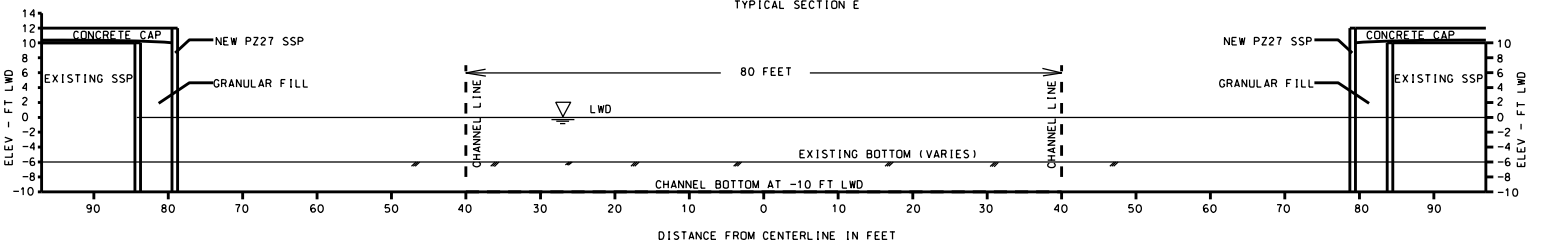
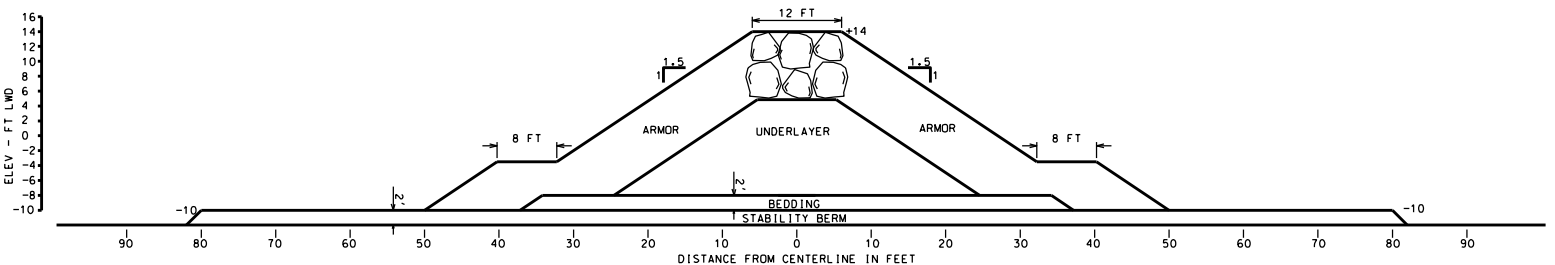
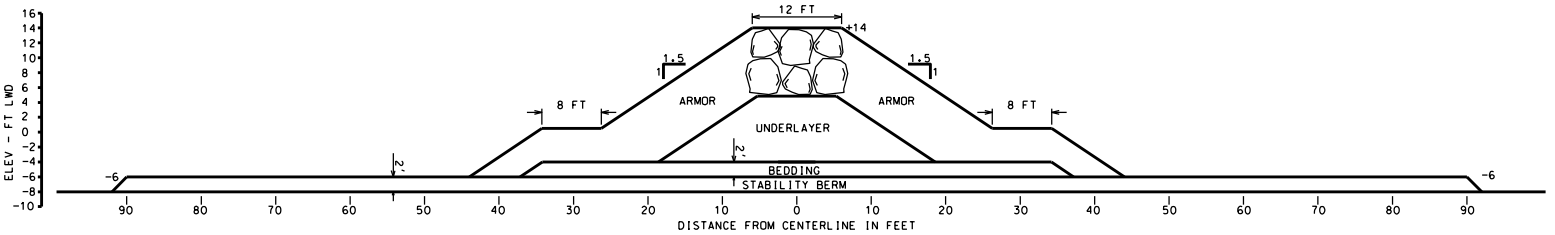
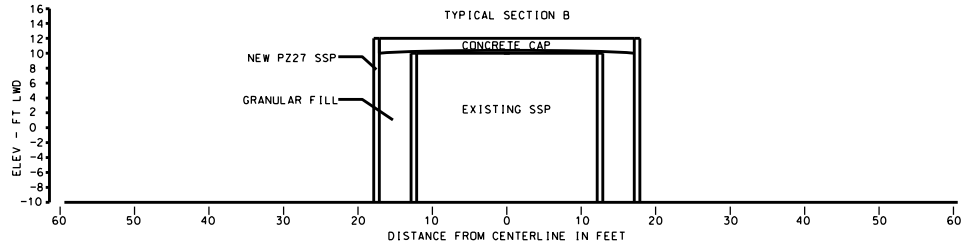
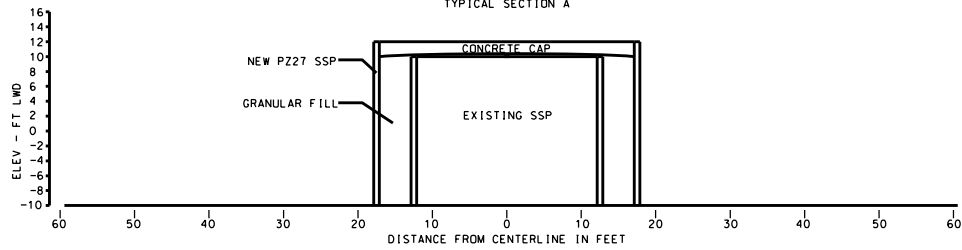
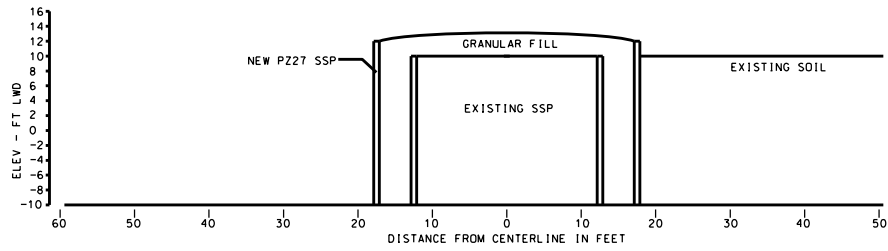
REMOVE NAVIGATION
OBSTRUCTION

0 200
SCALE IN FEET

N

ALTERNATIVE 2B: RUBBLEMOUND BREAKWATER
WITH SSP ENCASEMENT OF EXISTING PIERS

Document may not reflect the most up-to-date assumptions and has not been revised.



AERIAL PHOTO
DATED 2011

RUBBLEMOUND
BREAKWATER

80 FT WIDE CHANNEL

0 200
SCALE IN FEET

N

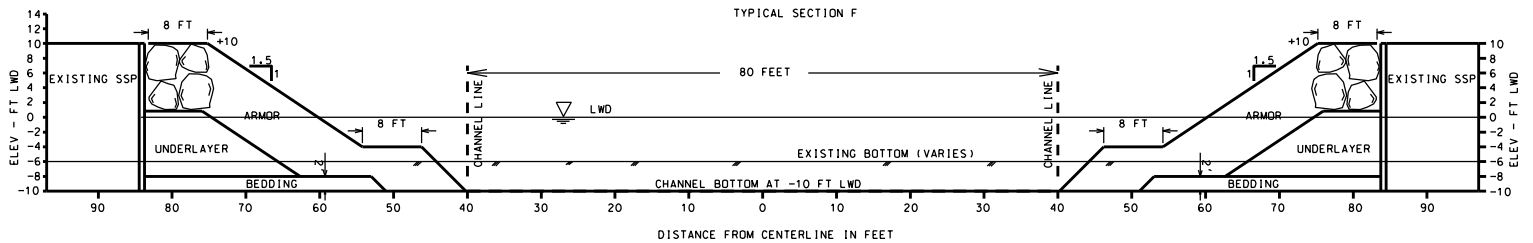
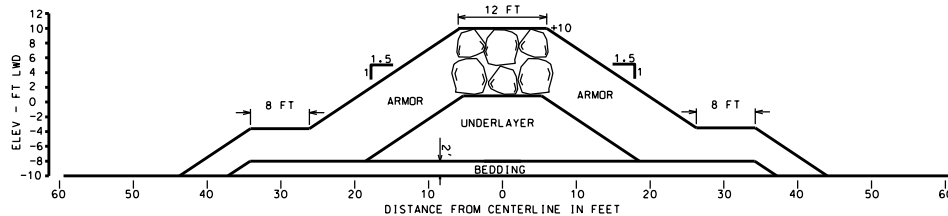
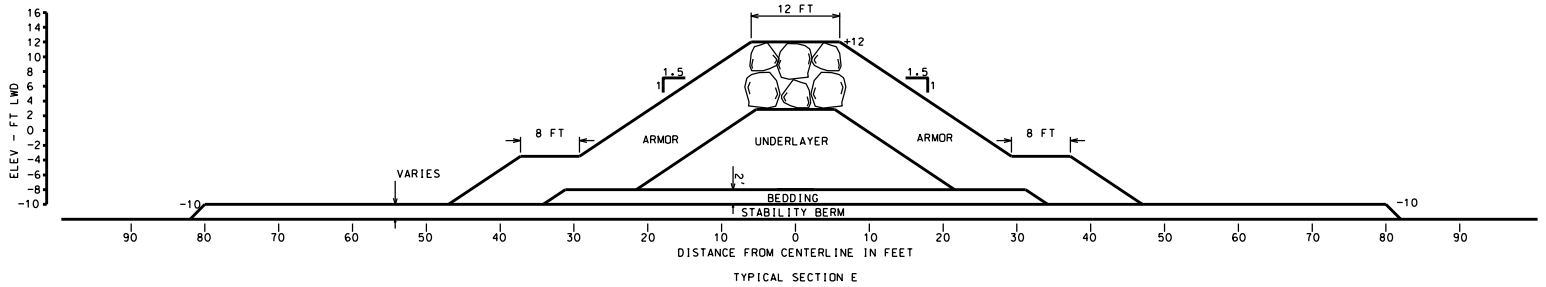
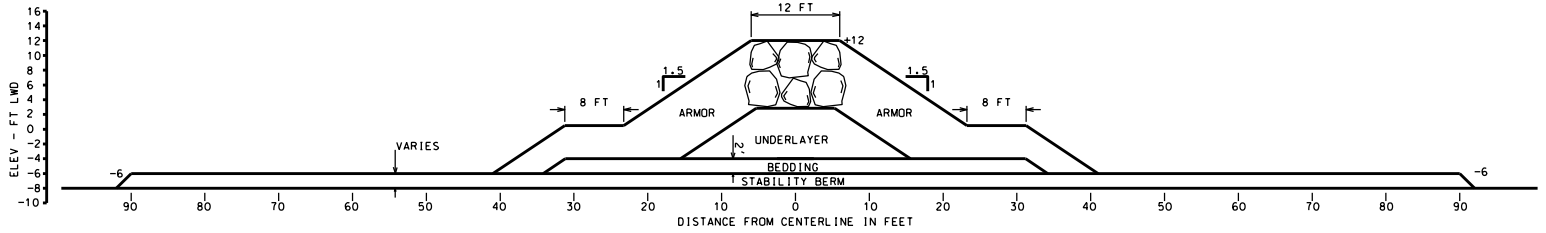
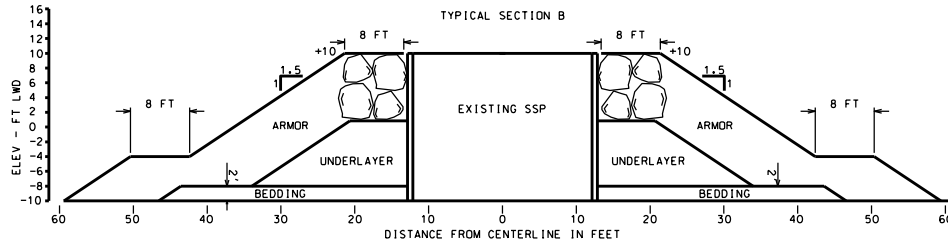
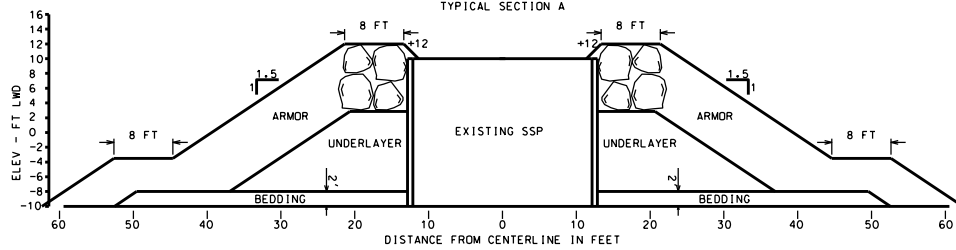
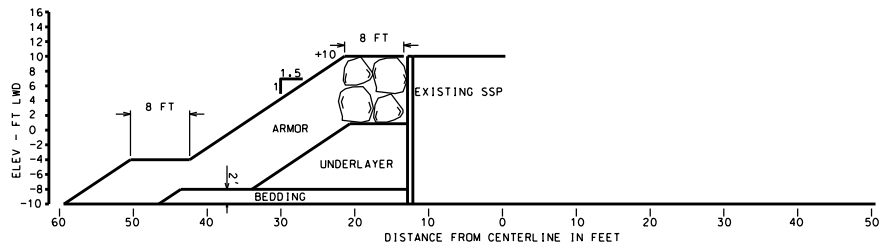
400 FEET

200 FEET

REMOVE NAVIGATION
OBSTRUCTION

ALTERNATIVE 3A: RUBBLEMOUND BREAKWATER (E&W)
AND SSP PIER STABILIZATION

Document may not reflect the most up-to-date assumptions and has not been reviewed



AERIAL PHOTO
DATED 2011

RUBBLEMOUND
BREAKWATER

400 FEET

200 FEET

80 FT WIDE CHANNEL

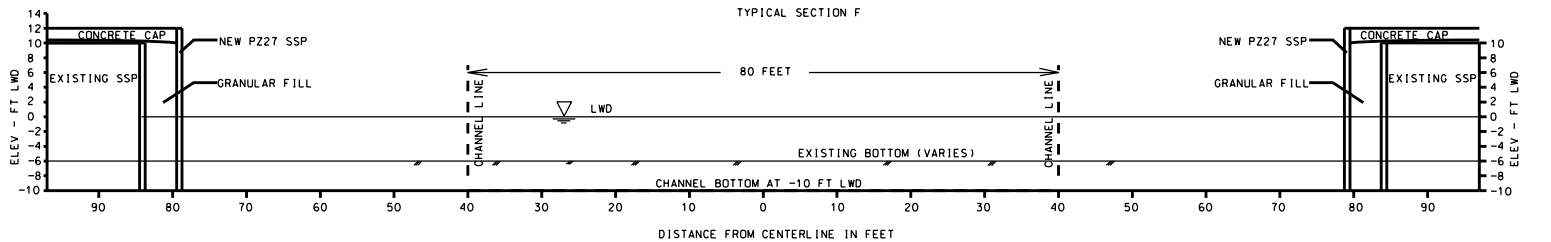
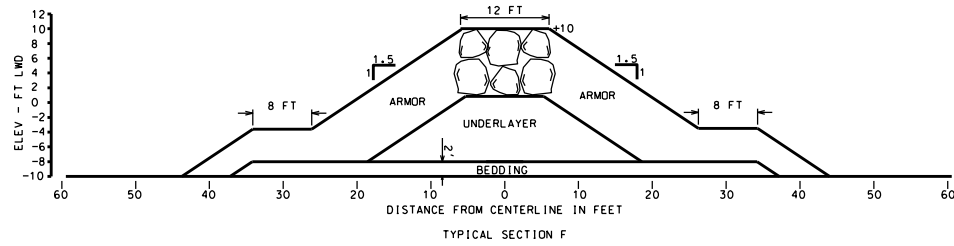
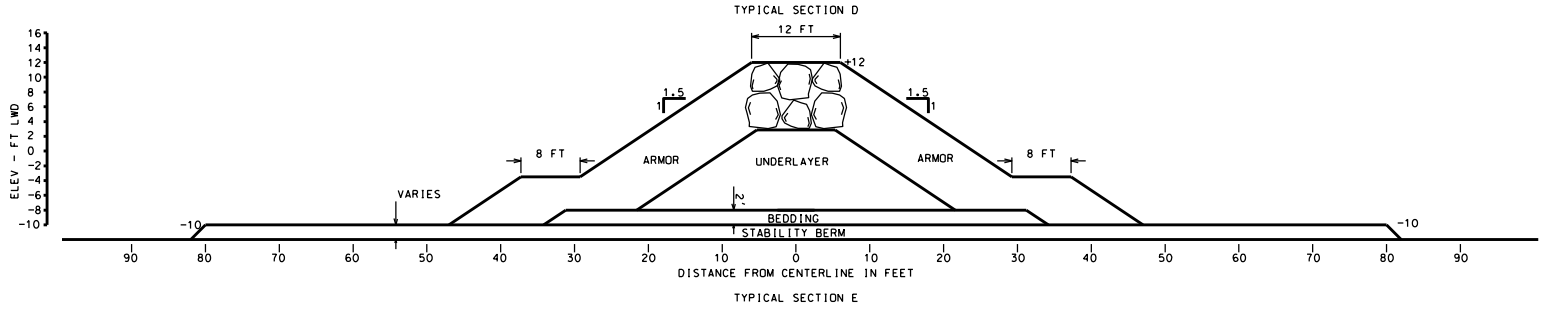
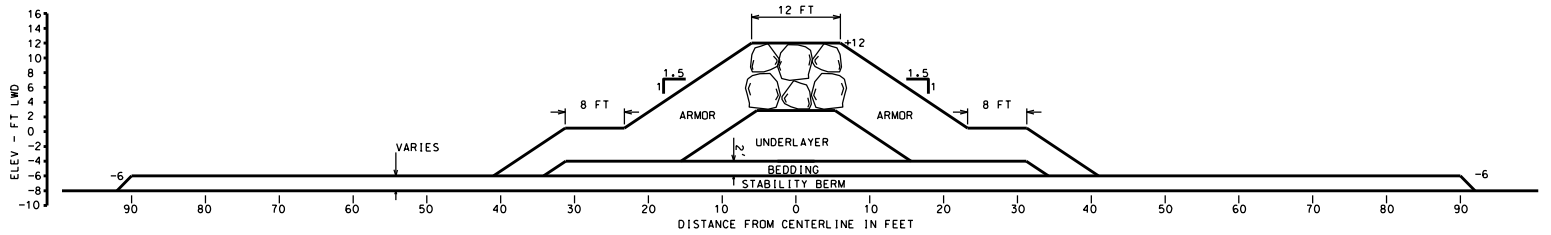
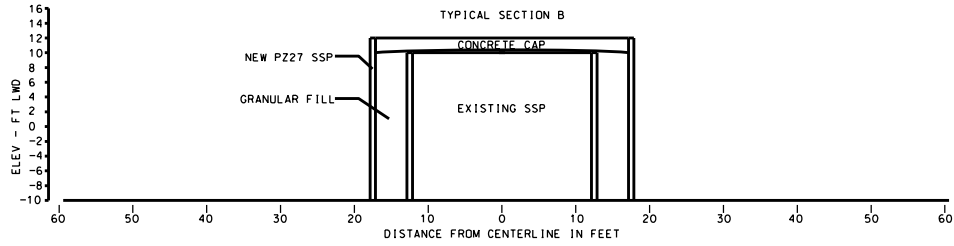
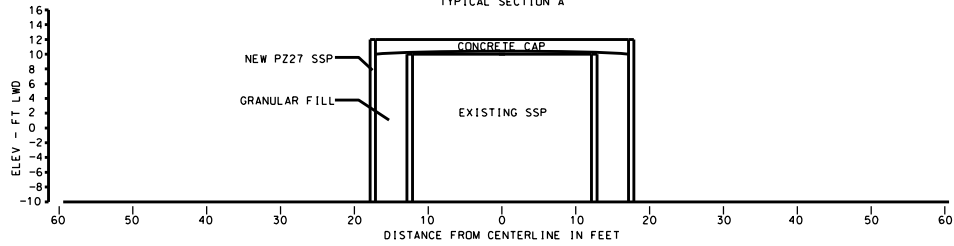
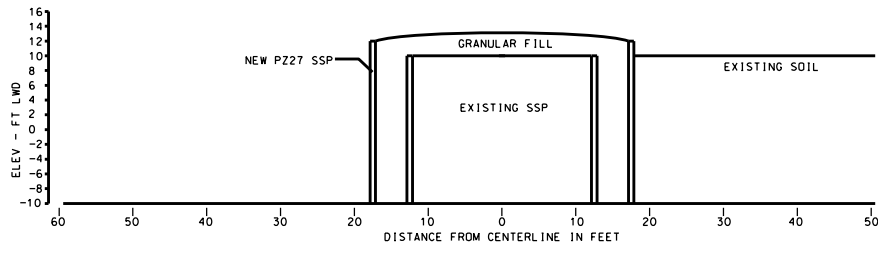
0 200
SCALE IN FEET

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REMOVE NAVIGATION
OBSTRUCTION

ALTERNATIVE 3B: RUBBLEMOUND BREAKWATER (E&W)
WITH SSP ENCASEMENT OF EXISTING PIERS

Document may not reflect the most up-to-date assumptions and has not been reviewed.



AERIAL PHOTO
DATED 2011

RUBBLEMOUND
BREAKWATER

0 200
SCALE IN FEET

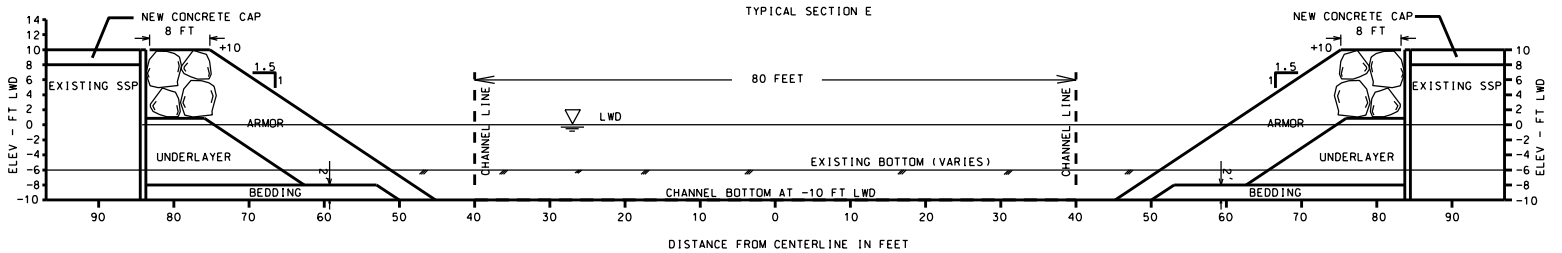
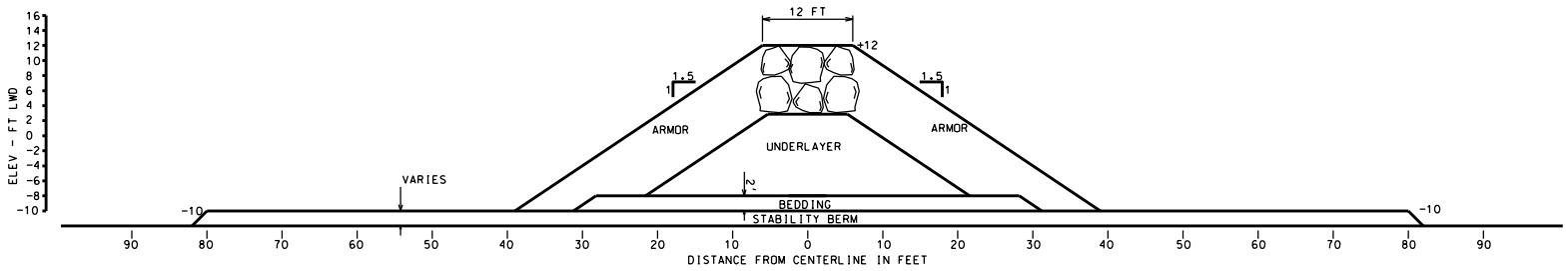
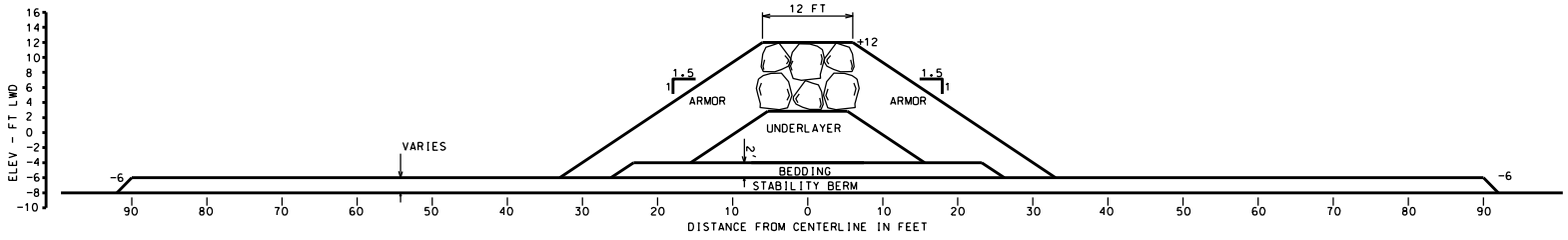
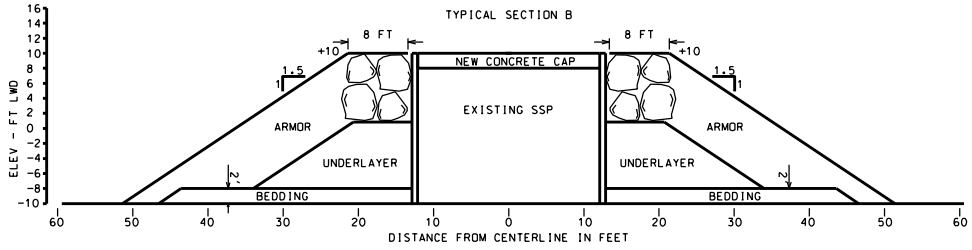
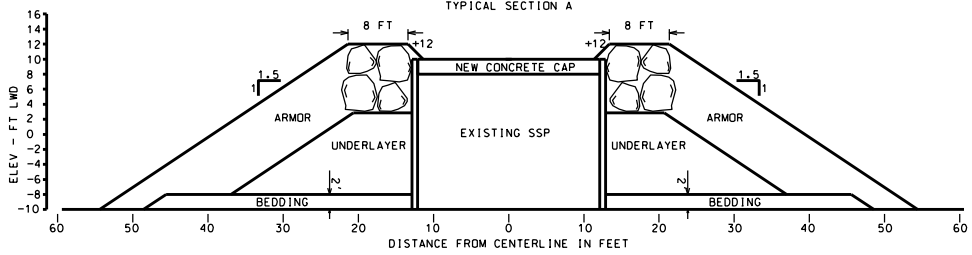
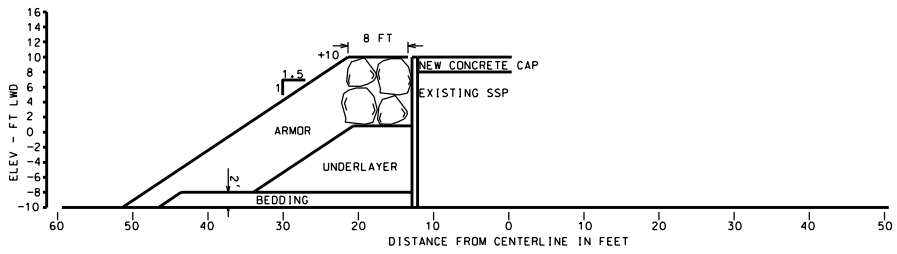
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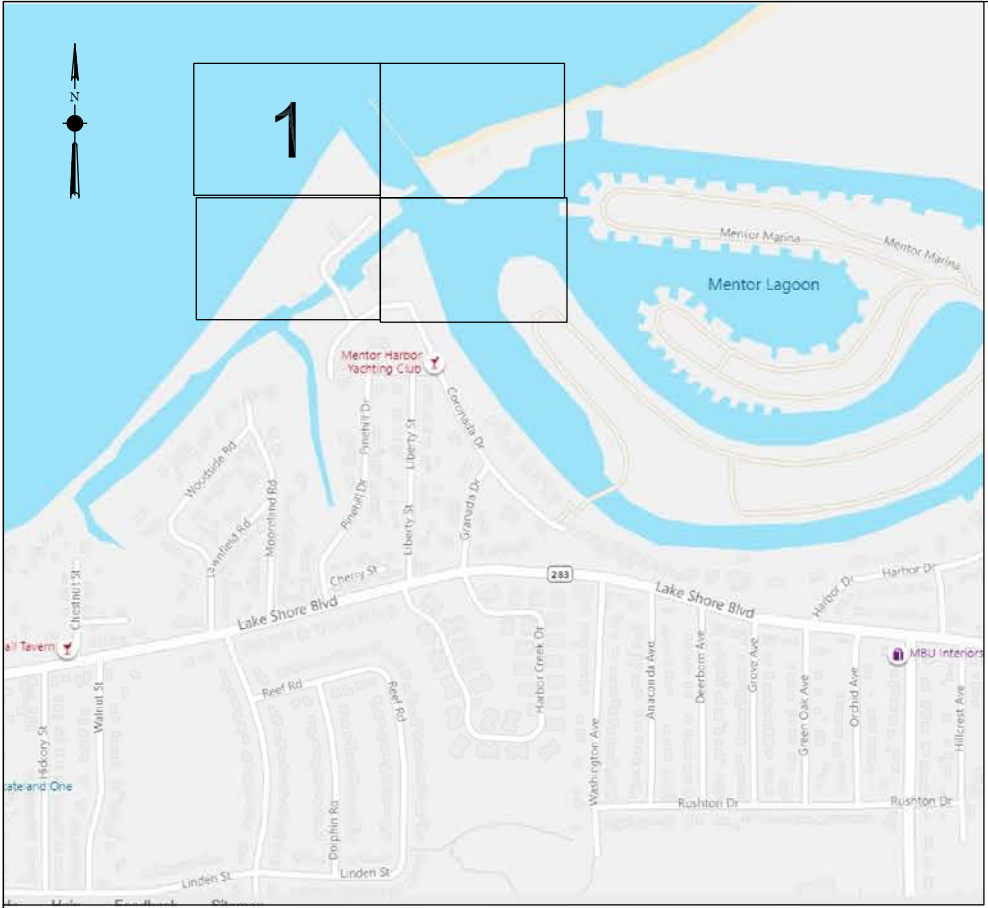
80 FT WIDE CHANNEL

REMOVE NAVIGATION
OBSTRUCTION

ALTERNATIVE 6 CURVED RUBBLEMOUND BREAKWATER
AND SSP PIER STABILIZATION

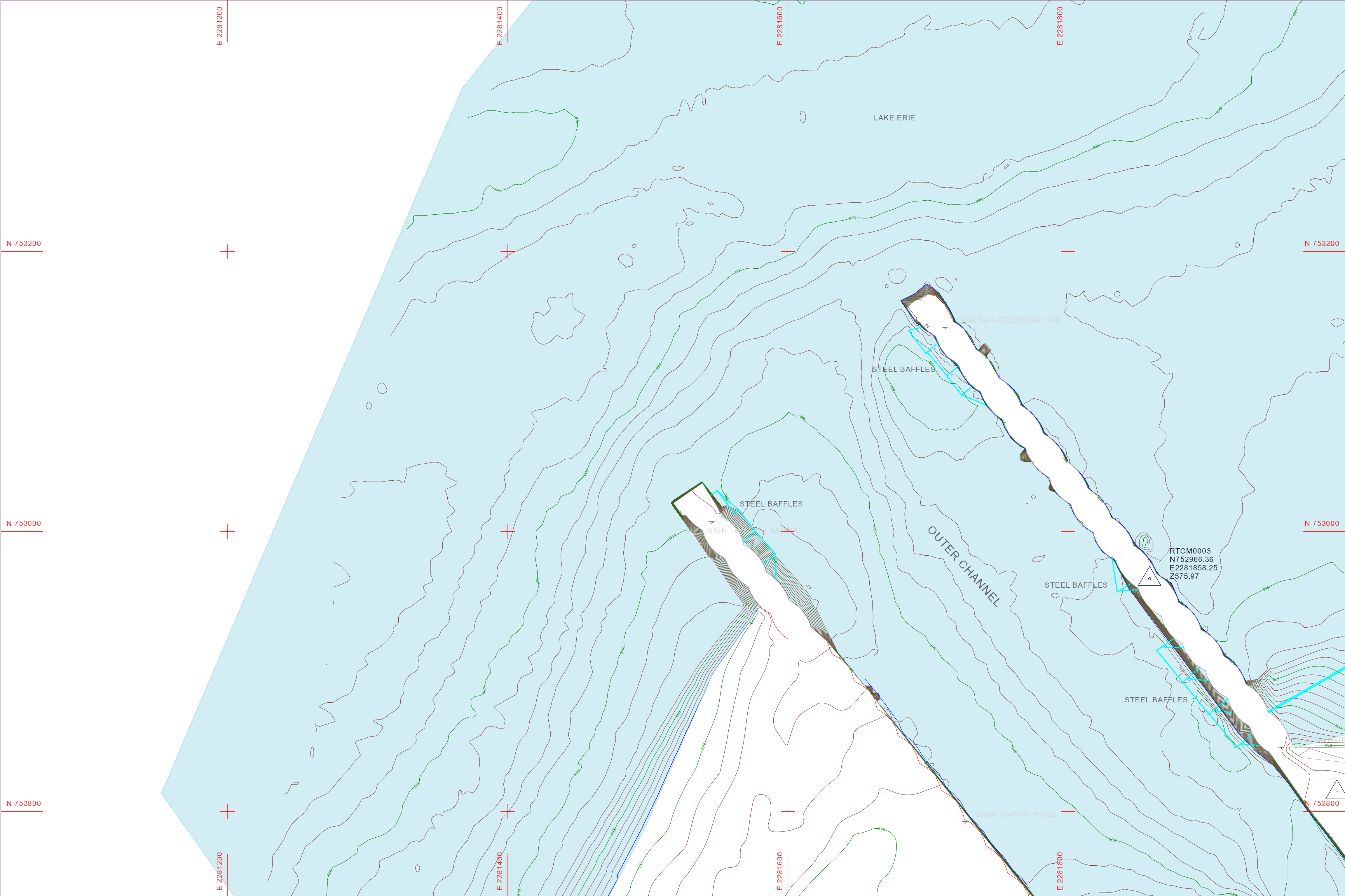
Document may not reflect the most up-to-date assumptions and has not been reviewed





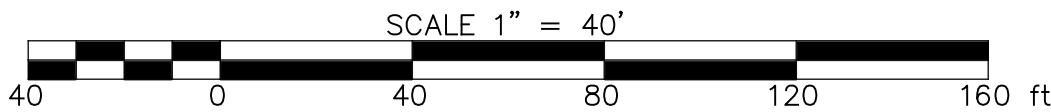
VICINITY MAP
(NOT TO SCALE)

LEGEND OF SYMBOLS	
	BORE HOLE
	BOLLARD
	BOULDER
	BUSH
	CATCH BASIN
	CLEAT
	CONIFEROUS TREE
	DECIDUOUS TREE
	ELECTRIC BOX
	GUY ANCHOR
	HYDRANT
	LIFT GATE
	LIGHT POLE
	MONITORING WELL
	PIPE INVERT
	POST
	SANITARY MANHOLE
	SIGN
	SOUNDING
	SPOT ELEVATION
	STORM MANHOLE
	SURVEY CONTROL POINT
	TELEPHONE MANHOLE
	UTILITY POLE
	WATER VALVE
	PROPERTY LINE
	BOTTOM OF BANK/ DITCH
	FENCE LINE
	GRADE BREAK LINE
	GUARD RAIL
	MAJOR CONTOUR
	MINOR CONTOUR
	OVERHEAD WIRE
	RAILROAD TRACK
	TOP OF BANK/DITCH



SITE SPECIFIC NOTES

1. CONTOURS AND SOUNDINGS ARE U.S. SURVEY FEET REFERRED TO VERTICAL DATUM OF IGLD 1985.
2. HORIZONTAL COORDINATES ARE U.S. SURVEY FEET REFERRED TO NAD 1983 (Conus) United States/State Plane 1983-Ohio North 3401.
3. THE TOPOGRAPHIC INFORMATION DEPICTED ON THE MAP REPRESENTS THE RESULTS OF SURVEYS MADE ON THE DATE INDICATED AND CAN ONLY BE CONSIDERED AS INDICATING THE GENERAL CONDITION AT THAT TIME.
4. THIS SURVEY WAS PREPARED IN ACCORDANCE WITH THE STANDARDS OUTLINED IN CORPS OF ENGINEERS HYDROGRAPHIC SURVEY MANUAL EM 1110-2-1003 AND CORPS OF ENGINEERS CONTROL AND TOPOGRAPHIC SURVEY MANUAL EM 1110-1-1005.
5. UNDERGROUND UTILITIES SHOWN HEREON ARE APPROXIMATE AND SHOULD NOT BE RELIED ON FOR EXCAVATION WORK. CONTACT "811 - CALL BEFORE YOU DIG" PRIOR TO ANY EXCAVATION WORK.
6. SUBMERGED SHEETPILE WALL SHOWN ALONG LAKESIDE BEACH ON EASTERLY SIDE OF OUTER CHANNEL WAS LOCATED USING STATE OF OHIO GEOGRAPHICALLY REFERENCED ORTHOPHOTOS ONLY - NO SURVEY DATA COULD BE OBTAINED.



US Army Corps
of Engineers
Buffalo District

REVISIONS

Drawn by: DOB
Checked by: ACK
Reviewed by: Roman H. Fidler III PLS
Chief, Survey Section
Approved by: Adam W. Hamm
Chief, NY/PA Navigation and Maintenance Section

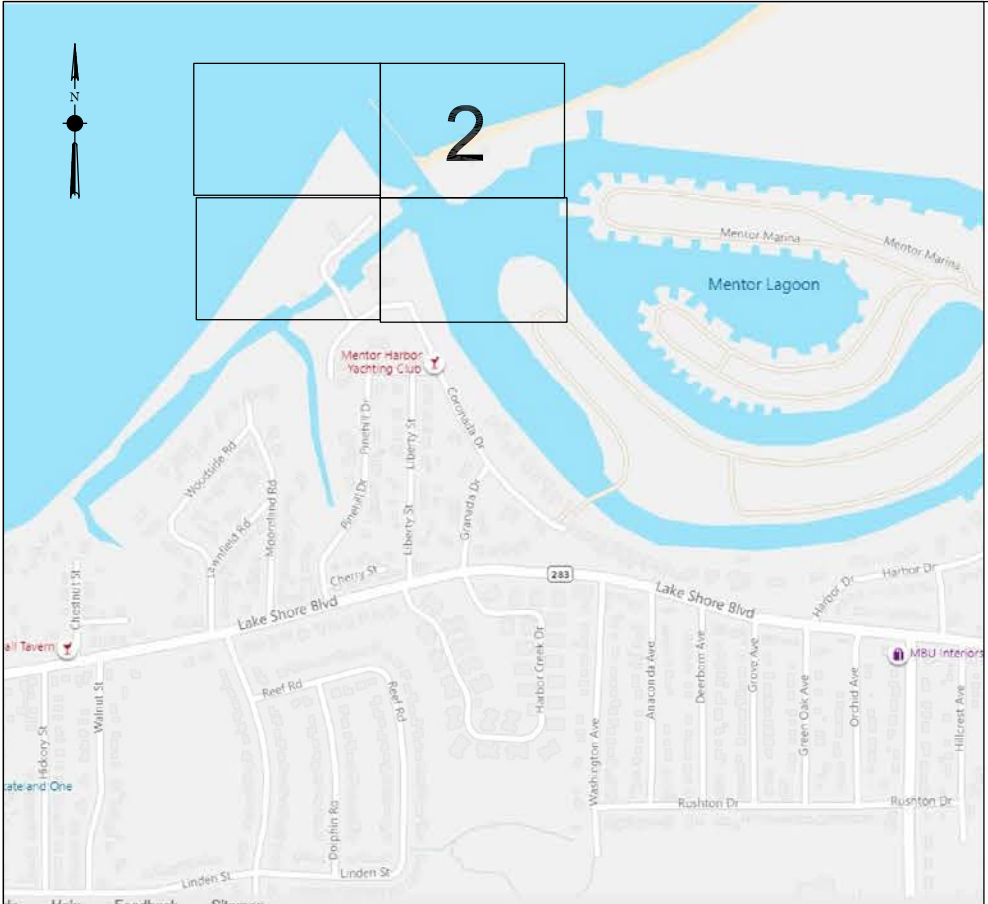
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207-3199

MENTOR HARBOR
MENTOR, OHIO
TOPOGRAPHIC SURVEY

SCALE: AS SHOWN DATE OF SURVEY: 11/20/19

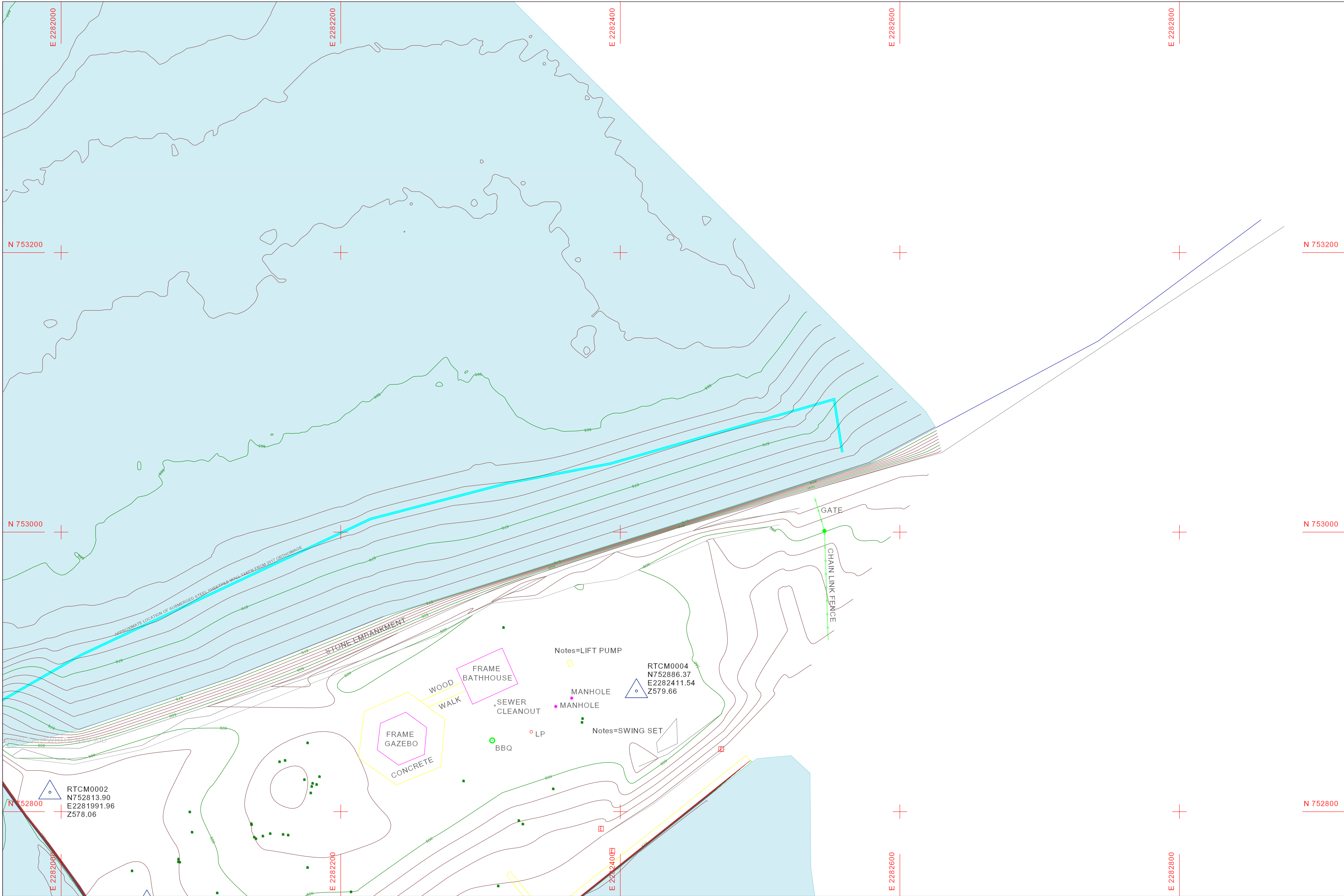
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Sheet 1



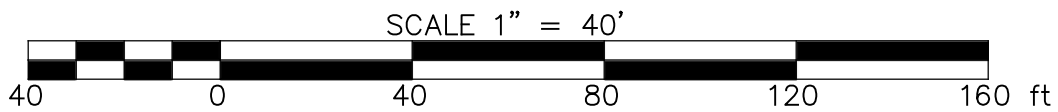
VICINITY MAP
(NOT TO SCALE)

LEGEND OF SYMBOLS	
	BORE HOLE
	BOLLARD
	BOULDER
	BUSH
	CATCH BASIN
	CLEAT
	CONIFEROUS TREE
	DECIDUOUS TREE
	ELECTRIC BOX
	GUY ANCHOR
	HYDRANT
	LIFT GATE
	LIGHT POLE
	MONITORING WELL
	PIPE INVERT
	POST
	SANITARY MANHOLE
	SIGN
	SOUNDING
	SPOT ELEVATION
	STORM MANHOLE
	SURVEY CONTROL POINT
	TELEPHONE MANHOLE
	UTILITY POLE
	WATER VALVE
	PROPERTY LINE
	BOTTOM OF BANK/ DITCH
	FENCE LINE
	GRADE BREAK LINE
	GUARD RAIL
	MAJOR CONTOUR
	MINOR CONTOUR
	OVERHEAD WIRE
	RAILROAD TRACK
	TOP OF BANK/DITCH



SITE SPECIFIC NOTES

1. CONTOURS AND SOUNDINGS ARE U.S. SURVEY FEET REFERRED TO VERTICAL DATUM OF IGLD 1985.
2. HORIZONTAL COORDINATES ARE U.S. SURVEY FEET REFERRED TO NAD 1983 (Conus) United States/State Plane 1983-Ohio North 3401.
3. THE TOPOGRAPHIC INFORMATION DEPICTED ON THE MAP REPRESENTS THE RESULTS OF SURVEYS MADE ON THE DATE INDICATED AND CAN ONLY BE CONSIDERED AS INDICATING THE GENERAL CONDITION AT THAT TIME.
4. THIS SURVEY WAS PREPARED IN ACCORDANCE WITH THE STANDARDS OUTLINED IN CORPS OF ENGINEERS HYDROGRAPHIC SURVEY MANUAL EM 1110-2-1003 AND CORPS OF ENGINEERS CONTROL AND TOPOGRAPHIC SURVEY MANUAL EM 1110-1-1005.
5. UNDERGROUND UTILITIES SHOWN HEREON ARE APPROXIMATE AND SHOULD NOT BE RELIED ON FOR EXCAVATION WORK. CONTACT "811 - CALL BEFORE YOU DIG" PRIOR TO ANY EXCAVATION WORK.
6. SUBMERGED SHEETPILE WALL SHOWN ALONG LAKESIDE BEACH ON EASTERLY SIDE OF OUTER CHANNEL WAS LOCATED USING STATE OF OHIO GEOGRAPHICALLY REFERENCED ORTHOPHOTOS ONLY - NO SURVEY DATA COULD BE OBTAINED.



US Army Corps
of Engineers
Buffalo District

REVISIONS	Drawn by: DOB	Checked by: ACK	Reviewed by: Roman H. Figler III PLS	Approved by: Adam W. Hamm	Chief, NY/PA Navigation and Maintenance Section	2/4/2020 1:04:26 PM (UTC-5)	Original sheet size = ANSI D
			Chief, Survey Section				

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207-3199

MENTOR HARBOR
MENTOR, OHIO

TOPOGRAPHIC SURVEY

SCALE: AS SHOWN DATE OF SURVEY: 11/20/19

Sheet
reference
number

Sheet 2

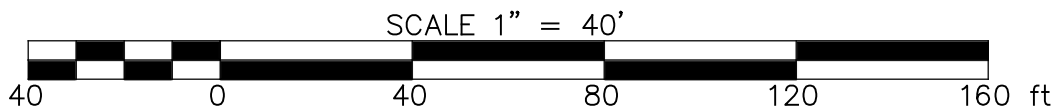
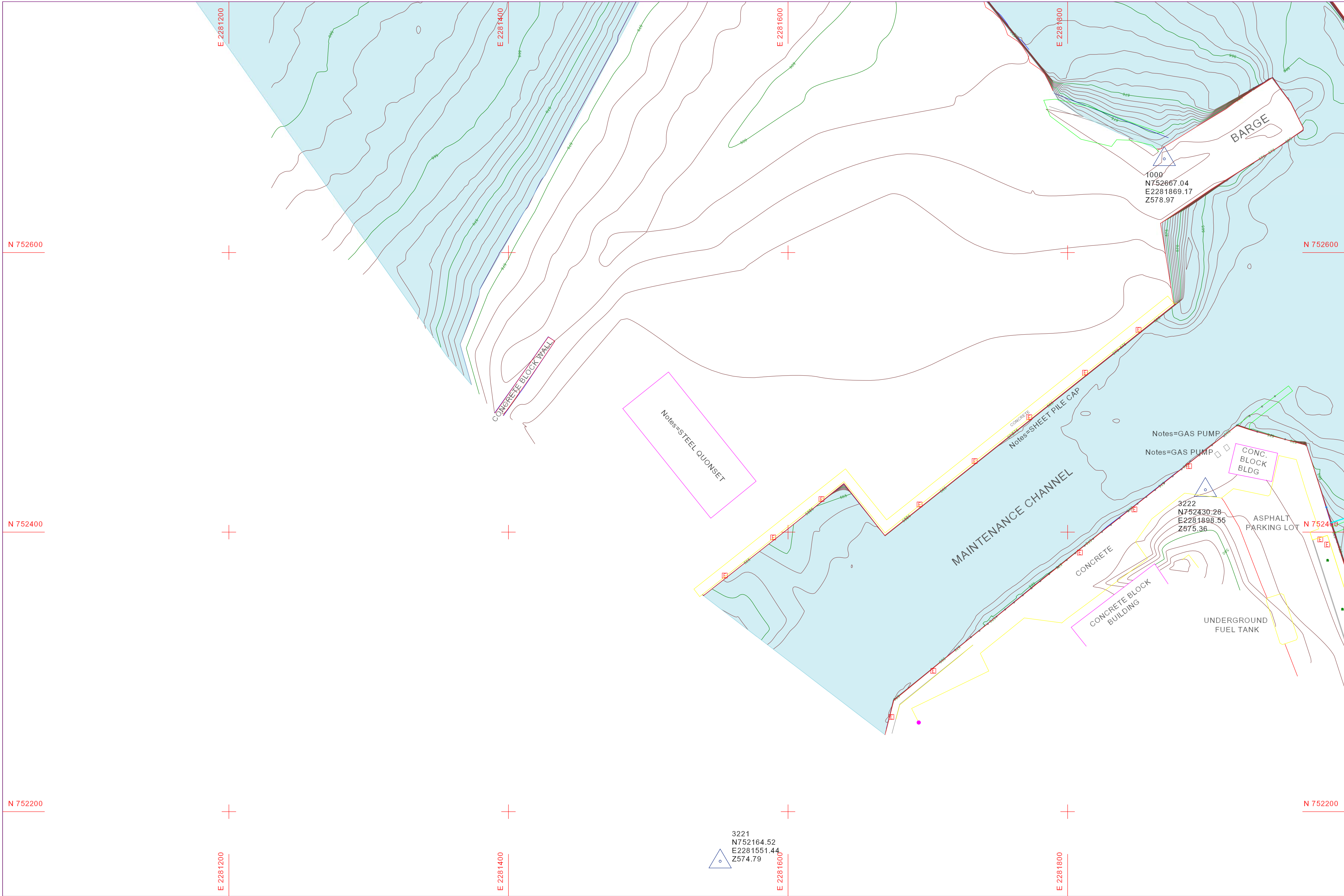


VICINITY MAP
(NOT TO SCALE)

LEGEND OF SYMBOLS	
	BORE HOLE
	BOLLARD
	BOULDER
	BUSH
	CATCH BASIN
	CLEAT
	CONIFEROUS TREE
	DECIDUOUS TREE
	ELECTRIC BOX
	GUY ANCHOR
	HYDRANT
	LIFT GATE
	LIGHT POLE
	MONITORING WELL
	PIPE INVERT
	POST
	SANITARY MANHOLE
	SIGN
	SOUNDING
	SPOT ELEVATION
	STORM MANHOLE
	SURVEY CONTROL POINT
	TELEPHONE MANHOLE
	UTILITY POLE
	WATER VALVE
	PROPERTY LINE
	BOTTOM OF BANK/ DITCH
	FENCE LINE
	GRADE BREAK LINE
	GUARD RAIL
	MAJOR CONTOUR
	MINOR CONTOUR
	OVERHEAD WIRE
	RAILROAD TRACK
	TOP OF BANK/DITCH

SITE SPECIFIC NOTES

1. CONTOURS AND SOUNDINGS ARE U.S. SURVEY FEET REFERRED TO VERTICAL DATUM OF IGLD 1985.
2. HORIZONTAL COORDINATES ARE U.S. SURVEY FEET REFERRED TO NAD 1983 (Conus) United States/State Plane 1983-Ohio North 3401.
3. THE TOPOGRAPHIC INFORMATION DEPICTED ON THE MAP REPRESENTS THE RESULTS OF SURVEYS MADE ON THE DATE INDICATED AND CAN ONLY BE CONSIDERED AS INDICATING THE GENERAL CONDITION AT THAT TIME.
4. THIS SURVEY WAS PREPARED IN ACCORDANCE WITH THE STANDARDS OUTLINED IN CORPS OF ENGINEERS HYDROGRAPHIC SURVEY MANUAL EM 1110-2-1003 AND CORPS OF ENGINEERS CONTROL AND TOPOGRAPHIC SURVEY MANUAL EM 1110-1-1005.
5. UNDERGROUND UTILITIES SHOWN HEREON ARE APPROXIMATE AND SHOULD NOT BE RELIED ON FOR EXCAVATION WORK. CONTACT "811 - CALL BEFORE YOU DIG" PRIOR TO ANY EXCAVATION WORK.
6. SUBMERGED SHEETPILE WALL SHOWN ALONG LAKESIDE BEACH ON EASTERLY SIDE OF OUTER CHANNEL WAS LOCATED USING STATE OF OHIO GEOGRAPHICALLY REFERENCED ORTHOPHOTOS ONLY - NO SURVEY DATA COULD BE OBTAINED.



US Army Corps
of Engineers
Buffalo District

REVISIONS

** COPY OF SIGNED ORIGINAL **

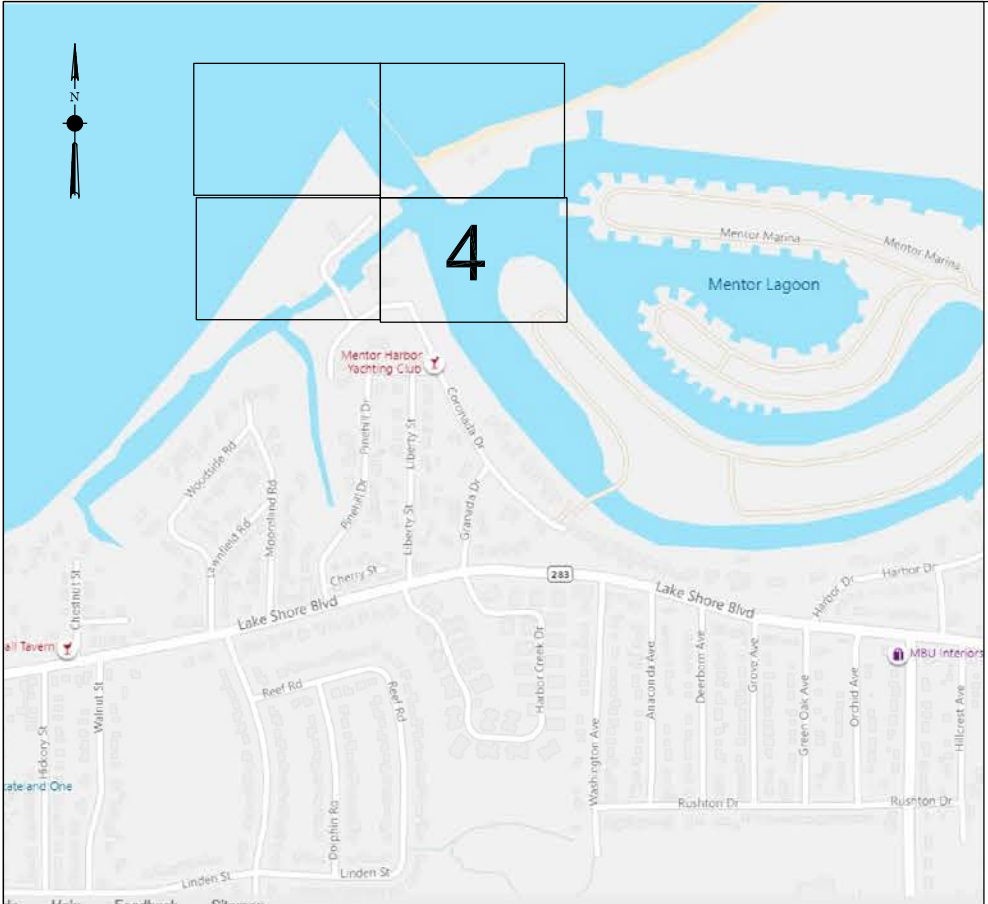
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207-3199

MENTOR HARBOR
MENTOR, OHIO
TOPOGRAPHIC SURVEY

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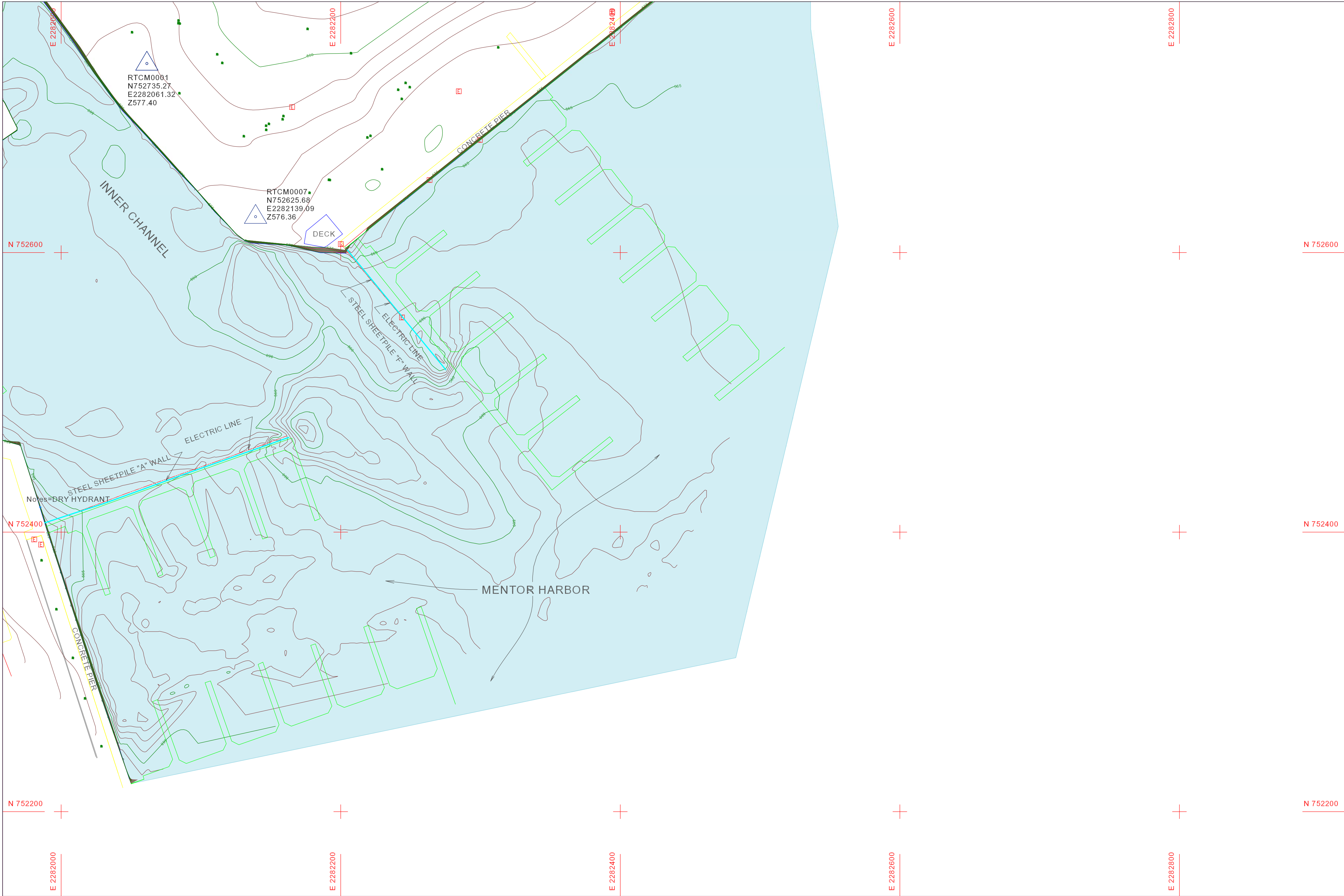
Sheet 3



VICINITY MAP
(NOT TO SCALE)

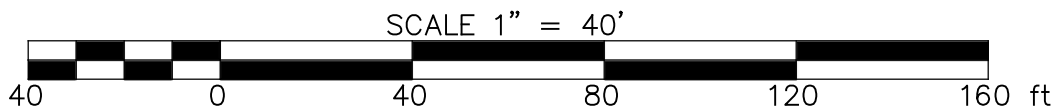
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US Army Corps
of Engineers
Buffalo District

REVISIONS

Drawn by: DOB
Checked by: ACK
Reviewed by: Roman H. Figler III PLS
Chief, Survey Section
Approved by: Adam W. Hamm
Chief, NY/PA Navigation and Maintenance Section

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MENTOR HARBOR
MENTOR, OHIO

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