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Geotechnical Subsurface Investigation

PREPARED FOR

City of Painesville

9565 Headlands Rd, Mentor, OH 44060

ISSUED: September 26, 2024

CT consultants
engineers • architects • planners
A Verdantas Company

September 26, 2024 CT Project No. 232515

Mr. Orin McMonigle
City of Painesville
7 Richmond Street
Painesville, Ohio 44077

Re: Geotechnical Subsurface Investigation
Painesville/Chlorine Feed Building
9565 Headlands Road
Painesville, Ohio 44060

Dear Mr. Orin McMonigle:

Following is the report of the geotechnical subsurface investigation performed by CT Consultants, Inc. (CT) at the site of the referenced project. This investigation was performed in general accordance with a work authorization approved by the City of Painesville on December 28, 2023.

This report contains the results of our study, our engineering interpretation of the results with respect to the project characteristics, and our recommendations for installation and support of the proposed Chlorine Feed Room as well as design and construction of foundations.

Soil samples collected during this investigation will be stored at our laboratory for 90 days from the date of this report. The samples will be discarded after this time unless you request that they be saved or delivered to you.

Should you have any questions regarding this report or require additional information, please contact our office.

Respectfully,

CT Consultants, Inc.

Imad El Hajjar, EI
Geotechnical Project Manager

Curtis E. Roupe, P.E.
Vice President

\\mtr-fs01.ctc.local\mtr-projects$\2023\232515\PHASE\02 Geotechnical\Reports and Other Deliverables\232515 - Geotech Report - Mentor WTP Chlorine Housing Addition.docx

GEOTECHNICAL SUBSURFACE INVESTIGATION
PAINESVILLE WATER TREATMENT PLANT PROPOSED CHLORINE FEED CONVERSION

9565 HEADLANDS ROAD
PAINESVILLE, OHIO 44060

FOR

CITY OF PAINESVILLE
7 RICHMOND STREET
PAINESVILLE, OHIO 44077

SUBMITTED

SEPTEMBER 26, 2024
CT PROJECT NO. 232515

8150 STERLING COURT
MENTOR OH 44060
(440) 951-9000
(440) 951-7487 FAX

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1.0 INTRODUCTION

This geotechnical subsurface investigation report has been prepared for the proposed new chlorine feed and storage room at the existing Painesville Water Treatment Plant located at 9565 Headlands Road in Painesville, Ohio. The general area of the site is shown on the attached Site Location Map (Plate 1.0).

This report summarizes our understanding of the proposed construction, describes the investigative and testing procedures, presents the findings, discusses our evaluations and conclusions, and provides our design and construction recommendations for installation and support of the proposed structure.

The purpose of this investigation was to evaluate the subsurface conditions and laboratory data relative to the design and construction of foundations, floor slabs and pavements at the referenced site. To accomplish this, CT performed two (2) test borings, field and laboratory soil testing, and a geotechnical engineering evaluation of the test results.

This report includes:

- A description of the subsurface soil and groundwater conditions encountered in the borings.
- Design recommendations for foundations and floor slabs related to the proposed chlorine feed and storage room.
- Recommendations concerning soil- and groundwater-related construction procedures such as site preparation, earthwork, foundation construction, and related field testing.

2.0 INVESTIGATIVE PROCEDURES

This subsurface investigation included two (2) test borings, designated as Borings B-1 and B-2, drilled on July 10, 2024. The borings were located in the field by CT in accordance with a proposed boring location plan. The borings were performed in the proposed addition area under the existing overhand canopy. Ground surface elevations at the boring locations were estimated to the nearest foot from Google Earth. The approximate locations of the borings are shown on the Test Boring Location Plan (Plate 2.0).

The test borings were performed in general accordance with geotechnical investigative procedures outlined in ASTM Standard D 6151. The test borings performed during this investigation were drilled with a track-mounted drill rig with utilizing 3¼-inch inside diameter hollow-stem augers. Borings B-1 and B-2 were drilled to a depth of 30 feet.

During auger advancement, soil samples were generally collected at 2½-foot intervals to 30 feet below existing grade using 18-inch sample drives. Split-spoon (SS) samples were obtained by the Standard Penetration Test (SPT) Method (ASTM D 1586), which consists of driving a 2-inch outside diameter split-barrel sampler into the soil with a 140-pound weight falling freely through a distance of 30 inches. The sampler was driven in three successive 6-inch increments with the number of blows per increment being recorded. The sum of the number of blows required to advance the sampler the second and third 6-inch increments is termed the Standard Penetration Resistance (N-value) and is presented on the Logs of Test Borings attached to this report. The samples were sealed in jars and transported to our laboratory for further classification and testing.

All of the recovered samples of the subsoils were visually or manually classified in accordance with the Unified Soil Classification System (USCS) (ASTM D 2487 and D 2488) and were tested in our laboratory for moisture content (ASTM D 2216). Dry density determinations and unconfined compressive strength tests by the constant rate of strain method (ASTM D 2166) were performed on select samples. Unconfined compressive strength estimates were obtained for the remaining intact cohesive samples using a calibrated hand penetrometer. A particle size analysis (ASTM D 6913 and D 7928) and an Atterberg limits test (ASTM D 4318) were performed on select samples to determine soil classification and soil index properties. Organic Content

(ASTM 2974) was performed on select samples. The test results are presented on the Logs of Test Borings, Tabulation of Test Data sheets, and Grain Size Distribution sheet attached to this report.

Soil conditions encountered in the test borings are presented in the Logs of Test Borings along with information related to sample data, SPT results, water conditions observed in the borings, and laboratory test data. It should be noted that these logs have been prepared on the basis of laboratory classification and testing as well as field logs of the encountered soils and rock.

Experience indicates that the actual subsoil and bedrock conditions at a site could vary from those generalized on the basis of test borings made at specific locations. Therefore, it is essential that a geotechnical engineer be retained to provide soil engineering services during the site preparation, excavation, and foundation phases of the proposed project. This is to observe compliance with the design concepts, specifications, and recommendations, and to allow design changes in the event subsurface conditions differ from those anticipated prior to the start of construction.

3.0 PROPOSED CONSTRUCTION

The project involves constructing a new chlorine feed and storage room at the water treatment plant located at 9565 Headlands Road, Mentor, Ohio.

The proposed structure will consist of a prefabricated metal building housing three (3) chlorine tanks with a capacity of roughly 2,300 gallons weighing approximately 19,000 lbs. each.

The maximum building foundation loads were not available at the time of preparing this report but are assumed to be light in magnitude. Maximum wall loads are assumed to be 2,000 pounds per lineal foot (plf), excluding contributions from the chlorine tanks.

It is our understanding the proposed structure along with the chlorine tanks will be supported on a deep foundation system consisting of either helical piles or micropiles.

4.0 FINDINGS

4.1 General Site Conditions

At the time of our investigation, the project area consisted of asphalt pavement with an overhang roof. The borings were performed under the existing overhang and encountered asphalt generally ranging in thickness from 3 to 4 inches. A distinct subbase material was not identified underlying the asphalt.

Undocumented Granular Fill Materials were encountered in Borings B-1 and B-2 underlying the surface material and extending to depth of 21 feet below existing grades (Elev. 559 +/- feet). The granular fill generally consisted of poorly graded sand mixed with silt and varying amounts of gravel (USCS: SP-SM). SPT N-values generally ranged from 2 to 33 blows per foot (bpf), indicating variable compactness across the site, from very loose (<4 bpf) to dense (31-50 bpf). Moisture contents ranged from 7 to 17 percent. This variability in SPT N values and in moisture content suggests that the fill material was likely placed without controlled compaction.

4.2 General Site Geology

The project site is located within the Glacial Till Plains of Ohio. This physiographic province is characterized by a landscape of rolling moraine hills, small sandy ridges and highly fertile soil.

The Quaternary deposits at this site predominantly consist of glacial till, outwash, and lacustrine sediments. Glacial till, an unsorted mixture of clay, silt, sand, gravel, and boulders, is prevalent and typically exhibits low permeability and variable consolidation. Outwash deposits, composed of stratified sands and gravels, are more permeable and are often found in areas influenced by glacial meltwater, forming primary aquifers. Lacustrine sediments, which include fine-grained silts and clays, were deposited in glacial lakes and are typically found in low-lying areas.

Aquifers in the Painesville area are located within both the unconsolidated Quaternary deposits and the underlying bedrock formations. Unconfined aquifers in the outwash sands and gravels provide significant groundwater storage and transmission capacity, typically recharged by precipitation and surface water infiltration. Confined aquifers within the glacial till and lacustrine sediments may also be present, with groundwater flow controlled by the permeability and continuity of these deposits.

The bedrock underlying the site is primarily composed of Devonian and Mississippian-age sedimentary formations, including sandstones, shales, and siltstones. These formations were deposited in ancient marine and fluvial environments, resulting in varied lithologies with different degrees of consolidation and fracturing.

4.3 General Soil Conditions

Based on the results of the borings performed by CT for this study, The subsoils encountered underlying the undocumented fill materials can generally be described as predominantly medium stiff to stiff cohesive soils. It should be noted that the borings were terminated within this stratum at a planned depth of 30 feet. The cohesive soils were generally classified as lean clay (USCS: CL) mixed with varying amounts of sand and gravel. SPT N-values generally ranged from 5 to 12 bpf. Unconfined compressive strengths ranged from 1,580 to 8,380 psf pounds per square foot (psf). A pocket exhibiting very stiff consistency (SPT N values = 16 bpf) was observed in Boring B-1. Unconfined compressive strengths within the borderline soft soils ranged from 1,580 to 8,380 psf. Moisture contents varied from 5 to 12 percent.

Additional descriptions of the stratigraphy encountered in the borings are presented on the Logs of Test Borings.

4.4 Groundwater Conditions

Groundwater was encountered during drilling and observed upon completion of drilling operations in both borings. The summary of groundwater conditions is summarized in Table 4.5. It should be noted that the boreholes were drilled and backfilled within the same day, and stabilized water levels may not have occurred over this limited time period.

Table 4.5 Summary of Groundwater Conditions					
Boring Number	Ground Surface Elevations (feet)	Depth At Time of Drilling (feet)	Elevation At Time of Drilling Operations (feet)	Depth At End of Drilling (feet)	Elevation At End of Drilling Elevation (Feet)
B-1	581	8	573	8	573
B-2	581	7.5	573.5	98.5	572.5

Based on the soil characteristics and groundwater conditions encountered in the borings, it is our opinion that the "normal" groundwater table will generally be encountered at or slight above the water elevation in the adjacent potion of Lake Erie. Based on available topographic information from google earth the water level was indicated at approximately Elev. 569 feet. However, groundwater elevations tend to fluctuate with seasonal and climatic influences. In particular, "perched" water may be encountered in the existing fill materials that are underlain by the relatively impermeable native clay soils. Additionally, water levels may vary based on seasonal fluctuations of Lake Erie. Therefore, the groundwater conditions may vary at different times of the year from those encountered during this investigation.

5.0 ANALYSES AND RECOMMENDATIONS

The following analyses and recommendations are based on our understanding of the proposed construction and upon the data obtained during our field exploration.

The subsurface investigation revealed pockets of undocumented fill material extending to depths of up to 21 feet, posing significant challenges to shallow foundation design. The fill's variable composition could lead to potential settlement issues compromising the stability and bearing capacity required for a shallow foundation system.

Removal and replacement of the existing fill is not economically feasible due to its depth, volume, proximity to existing structures, potential disruption to adjacent facilities, and potential excavation below the groundwater table.

Considering these constraints, a deep foundation system is recommended to transfer structural loads to competent native soils. This approach ensures reliable load-carrying capacity, minimizes settlement risks, and reduces impact on adjacent structures. However, it is essential to acknowledge that our subsurface investigation was limited to 30 feet, without encountering bedrock. Therefore, this recommendation is contingent upon the conditions observed within this depth range and may be subject to revision based on future investigations. As noted in the historical boring logs, bedrock was encountered at approximately 55 feet below existing grades. Historic boring logs are presented in Appendix E.

The site's overhead obstructions, restricted access, and limited overhead space necessitate a special deep foundation solution that can navigate these limitations. Helical piles and/or micropiles emerge as the most suitable option for the proposed structure and associated chlorine tanks. These systems offer high load-carrying capacity, minimal site disruption, and adaptability to varying soil conditions.

Careful consideration of the location of the new foundation with respect to the existing foundation elements must be given in order to minimize the potential for conflict between the existing and proposed foundation elements.

If the project information or location as outlined is incorrect or should change significantly, a review of these recommendations should be made by CT.

5.1 Helical Piles

Based on our analysis, helical piles installed in the native cohesive soils appear to be a suitable foundation solution for supporting the proposed structures, including associated chlorine tanks and slabs.

A helical pile is an extendable deep foundation system with helical bearing plates welded to a central steel shaft. Load is transferred from the shaft to the soil through these bearing plates (helices). Helical piles are installed quickly, do not generate spoils, and achieve bearing resistance immediately. Helical piles are suitable for light structures with service loads up to 200 kips in compression and can be installed in sections using relatively smaller equipment in limited access areas.

Helical piles should be installed through Stratum I into medium stiff to very stiff Stratum II lean clay encountered about Elev. 559. Helical Piles should be installed in accordance with OBC Section 1810, under adequate specifications and monitored by a qualified geotechnical engineer. It should be noted that Helical Piles are proprietary systems, and structural design will be completed by the specialty contractor. The following table includes corresponding soil design parameters.

- Unit Weight : 115 pcf
- Average SPT -N_{60} value: 11 bpf
- Average Undrained Shear Strength (Cohesion): 1,200psf

Helical pile components should be hot dip galvanized for corrosion resistance in accordance with ASTM A123. The shaft material should conform to ASTM A500 with minimum yield strength of 50 ksi. All helical pile components should satisfy manufacturer's requirements. Pile torque strength rating shall have a minimum of 7,000 foot-pounds (ft-lb). The target final installation torque shall not be less than 3,500 ft-lb. The minimum pile length shall be 25 feet to ensure complete embedment in native soils.

Contributions from the existing fill material to the pile's load-carrying capacity shall be completely disregarded

The minimum center-to-center spacing of micro piles is 3 times the micro pile diameter (3D) for vertical installations. However, when battered piles are proposed, the center-to-center spacing shall be increased to a minimum of 5 times the micro pile diameter (5D) to account for additional loading and stability considerations. The pile cap bearing depth shall be approximately 3½ feet below existing grades to protect against frost penetration. Additionally, 2 feet of pile stickup shall be embedded in the pile cap.

Structural loads have not been provided to us at this time; however, if the recommended allowable compressive loads are used for design, we estimate that total foundation settlement will be on the order of 1.0 inch or less. Differential settlements of adjacent loaded elements are expected to be 0.75 inches or less. These recommendations should be confirmed by CT Geotechnical Engineers when the structural loads become available.

5.2 Micropiles

Based on our analysis, micropiles installed in the native cohesive soils appear to be a suitable foundation option for supporting the proposed structures, including associated chlorine tanks and slabs. The micropiles will be driven into Stratum II i.e. expected to be encountered starting at 21 ft. below ground surface (bgs).

Similarly to helical piles, the design of micropiles is dependent on the installation techniques and can differ for different type of casing and the method utilized to grout them. As such, the structural design will be completed uing the same soil design parameters presented in section 5.1.

A factor of safety of 3 should be applied to the ultimate design value. If a load testing program as described in the following section will be implements, a factor of safety of 2 could be applied instead.

It is important to note the minimum embedment depth if designed for Stratum II only. If a significant change of lithology and/or bedrock is encountered beyond 30 feet bgs during construction, the micropile embedment depth should be revised by the CT or a qualified geotechnical engineer.

Micropiles should be spaced center-to-center a minimum of 3 pile diameters or 4 feet whichever is greater. If piles are closer, the allowable side shear should be reduced due to group effects.

For properly installed micropiles designed with suitable factor of safety (and associated load testing), settlement for new structures supported on micropiles are anticipated to be less than 1 inch.

5.2.1 Pile Load Testing

A pre-construction test pile and pile load test program should be performed to verify the micropile element's geotechnical and structural capacities, based on the contractor's construction means and methods.

A full-scale static axial load test program should be developed and performed, in accordance with the 2012 International Building Code (2010 CBC), under full-time observation of a geotechnical engineer to verify the compression capacity of micropiles. If the micropiles are utilized for uplift (tension) or lateral load transfer, load tests should also be performed to verify capacity for these loading conditions. Load tests shall be performed in accordance with ASTM D1143 (compression), ASTM D3689 (tension), ASTM D3966 (lateral), and the 2012 IBC.

At this time, a minimum of one (1) load test programs (vertical capacity, along with lateral and/or uplift capacity as appropriate) should be performed. The test pile program should be performed prior to the installation of production piles to confirm that the installation and grouting techniques are suitable to achieve the required side shear resistance. The test piles should be loaded to three (3) times the Design Load to confirm the factor of safety of 3 utilized for the evaluations in this report. The test pile should be instrumented with strain gauges at multiple depths to determine load transfer versus depth within the pile, for evaluating pile settlements.

The micropile depth may be modified based on the load test results. Additional load tests may be required based on the test results, prior to the installation of production piles.

In addition to pre-installation load tests, proof tests should be performed on 5 percent of production micropiles spread across the project areas at the time of installation. The proof tests are intended to verify that the contractor's construction procedure has remained constant and that the micropiles have not been drilled and grouted in a soil zone not tested by the load test verification testing. Proof tests should be performed up to a load equal to 160 percent of the design load. Proof testing can be applied in compression, tension, or laterally. This testing should be performed in general accordance with FHWA Publication No. NHI-05-039 (December 2005) Section 7.4.2. respectively.

5.3 Structural Floor Slabs

Due to the uncertainty posed by undocumented fill material and significant floor loads generated by the chlorine tanks, a structural slab connected to the deep foundation system is necessary. This design transfers loads to a more competent underlying bearing stratum, ensuring structural integrity and stability.

A pile-supported structural slab shall be used in building areas where pile foundations are utilized. The slab shall be supported on grade beams and/or pile caps and designed to include provisions for supporting below-slab utilities, which shall be hung from the structural slab.

A vapor barrier with a minimum thickness of 10 mils shall be installed beneath floor slabs. Additionally, a 6-inch layer of 3/4-inch clean crushed stone shall be provided beneath the slabs and vapor barrier to ensure proper drainage and protection.

Site-specific environmental conditions may necessitate more substantial vapor mitigation measures. Therefore, the vapor barrier specification shall be coordinated with the site's environmental requirements to ensure adequate protection.

5.4 Excavations and Slopes

The sides of temporary excavations for utility installations, and other construction should be adequately sloped to provide stable sides and safe working conditions. Otherwise, the excavation must be properly braced against lateral movements.

If the excavation is to be performed with sloped banks, adequate stable slopes must be provided in accordance with the criteria presented below. The soils encountered in the test boring within the anticipated depth of excavation may be classified as the following OSHA designations:

- OSHA Type A soils (cohesive soils with unconfined compressive strengths of 3,000 pounds per square foot (psf) or greater),
- OSHA Type B soils (cohesive soils with unconfined compressive strengths greater than 1,000 psf but less than 3,000 psf), and
- Type C soils (cohesive soils with unconfined compressive strengths of 1,000 psf or less, granular soils and existing fill materials).

For temporary excavations in Type A, B, C soils, side slopes should be constructed no steeper than ¾ horizontal to 1 vertical (¾H:1V), 1H:1V, and 1½H:1V, respectively. For situations where an excavation encounters a lower strength soil underlying a higher strength soil, the slope of the entire excavation is governed by the lower strength soil. In all cases, flatter slopes may be required if lower strength soils or adverse seepage conditions are encountered during construction.

For permanent excavation slopes, we recommend that grades be no steeper than 3H:1V without a more extensive geotechnical evaluation of the proposed construction plans and site conditions.

6.0 CONSTRUCTION CONSIDERATIONS

6.1 Sedimentation and Erosion Control

In planning the implementation of earthwork operations, special consideration should be given to provide measures to prevent or reduce soil erosion and the subsequent sedimentation into nearby waterways. These measures may include some or all of the following:

1. Scheduling of earthwork operations such that erodible areas are kept as small as possible and are exposed for the shortest possible time.
2. Using special grading practices, along with diversion or interceptor structures, to reduce the amount of run-off water from an erodible area.
3. Providing vegetative buffer zones, filter berms, or sedimentation basins to trap sediment from surface run-off water.

A specific and detailed soil erosion and sedimentation control program and permits may be required by local, state, or federal regulatory agencies.

6.2 Site Preparation

Prior to proceeding with construction operations, site preparation activities should include the removal of any structures or substructures which are not appropriated for spillway protection, as well as topsoil, root systems, and vegetation from all proposed structure areas.

6.3 Fill

Material for engineered fill or backfill required to achieve design grades may consist of any non-organic soils having a maximum dry density as determined by the Standard Proctor (ASTM D 698) of 90 pounds per cubic foot (pcf) or greater. On-site soils may be used as engineered fill materials provided that they are free of organic matter, debris, excessive moisture, and rock or stone fragments larger than 3 inches in diameter. Depending on seasonal conditions, the on-site soils may be wet of optimum and could require scarification and aeration to achieve satisfactory compaction. Additional discussion is provided in Section 5.9 regarding moisture conditioning anticipated to be required for borrow materials from the pond area. If the construction schedule does not allow for scarification and aeration activities, it may be more practical or economical to utilize imported granular fill.

Fill should be placed in uniform layers no more than 8 inches thick (loose measure) and adequately keyed into stripped and scarified soils. All fill within the building areas and pavement subgrades should be compacted to not less than 100 percent of the maximum dry density as determined by ASTM D 698 (Standard Proctor).

The upper soil profile at the site consists of both granular soils and cohesive soils. The contractor should be prepared to use a sheepsfoot roller to provide effective compaction of the cohesive soils. For the on-site granular soils, and if imported granular soils are utilized as engineered fill, a vibratory smooth-drum roller should be utilized for compaction. In narrow utility or footing excavations, the on-site cohesive soils may be difficult to compact; therefore, a clean granular material may be required in these areas.

7.0 QUALIFICATION OF RECOMMENDATIONS

Our evaluation of foundation and floor slabs design and construction conditions has been based on our understanding of the site and project information and the data obtained during our field investigation. The general subsurface conditions were based on interpretation of the subsurface data at specific boring locations. Regardless of the thoroughness of a subsurface investigation, there is the possibility that conditions between borings will differ from those at the boring locations, that conditions are not as anticipated by the designers, or that the construction process has altered the soil conditions. This potential is increased at previously developed sites. Therefore, experienced geotechnical engineers should observe earthwork construction to confirm that the conditions anticipated in design are noted. Otherwise, CT assumes no responsibility for construction compliance with the design concepts, specifications, or recommendations.

The design recommendations in this report have been developed on the basis of the previously described project characteristics and subsurface conditions. If project criteria or locations change, a qualified geotechnical engineer should be permitted to determine whether the recommendations must be modified. The findings of such a review will be presented in a supplemental report.

The nature and extent of variations between the borings may not become evident until the course of construction. If such variations are encountered, it will be necessary to reevaluate the recommendations of this report after on-site observations of the conditions.

Our professional services have been performed, our findings derived, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. This warranty is in lieu of all other warranties either expressed or implied. CT is not responsible for the conclusions, opinions, or recommendations of others based on this data.

PLATES

PLATE 1.0 SITE LOCATION MAP
PLATE 2.0 TEST BORING LOCAITON PLAN

BASE PLAN "SITE AERIAL PLAN" DATED 09/17/2024 OBTAINED FROM GOOGLE EARTH.

SITE LOCATION MAP

PROPOSED CHLORINE FEED BUILDING
MENTOR WATER TREATMENT PLANT

PREPARED FOR

CITY OF PAINESVILLE
PAINESVILLE, OH

DRAWN:	MSI / 09/17/24
REVISED:	---
PROJECT No:	232515

PLATE 1.0

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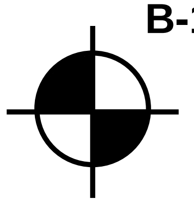
LEGEND:



APPROXIMATE TEST BORING LOCATION

SCALE IN FEET
0' 20' 40'

BASE PLAN "SITE AERIAL PLAN" DATED 09/17/2024 OBTAINED FROM GOOGLE EARTH.

TEST BORING LOCATION PLAN

PROPOSED CHLORINE FEED BUILDING
MENTOR WATER TREATMENT PLANT

PREPARED FOR

CITY OF PAINESVILLE
PAINESVILLE, OH

DRAWN:	MSI / 09/17/24
REVISED:	---
PROJECT No:	232515

PLATE 2.0

CT consultants
engineers • architects • planners
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APPENDIX A

LOGS OF TEST BORINGS

CT consultants

CT Consultants, Inc.
1915 N 12th Street
Toledo Ohio 43604
Telephone: (419)324-2222

BORING NUMBER B-1

CLIENT City of Painesville
PROJECT NAME WTP Chlorine Feed Building
PROJECT NUMBER 232515
PROJECT LOCATION Mentor, OH
DRILLING CONTRACTOR Ohio TestBor, Inc. Corey Jim
RIG NO. D-25
GROUND ELEVATION 580.5 ft
DRILLING METHOD HSA
GROUND WATER LEVELS:
DATE STARTED 7/10/24 **COMPLETED** 7/10/24
▽ **AT TIME OF DRILLING** 8.0 ft / Elev 572.5 ft
LOGGED BY KKC **CHECKED BY** IEH
▼ **AT END OF DRILLING** 8.0 ft / Elev 572.5 ft
NOTES Lat: 41°45'11.03"N Long: 81°17'43.61"W (Approx.)
0hrs AFTER DRILLING Backfilled w/Cuttings

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF. COMP. STR. (tsf)	DRY UNIT WT. (pcf)	PL / MC / LL (20 40 60 80); ▲ SPT N VALUE ▲ (20 40 60 80)
580	0	ASPHALT - 3 Inches (0.3')						
		FILL - Moist Medium Dense Gray POOLRY GRADED SAND w/Crushed Stone and Trace Silt	SS 1	100	11-12-8 (20)	NP NP		4, 8
575	5	@3.5': Loose	SS 2	100	2-4-5 (9)	NP		5
		@6': Medium Dense, Trace Gravel	SS 3	100	5-7-5 (12)	NP		13
		▼ (8.0 ft)						
570	10		SS 4	100	4-8-8 (16)	NP		15
565	15	@13.5': Wet, (Free Water Noted in Jar)	SS 5	100	4-7-5 (12)	NP		16
560	20	@18.5': Moist (21.0')	SS 6	100	6-7-6 (13)	NP		24
		Moist Stiff Gray LEAN CLAY w/Sand and Trace Gravel (CL) (25.0')	SS 7	100	3-5-5 (10)	0.86	114	16
555	25	Moist Stiff Gray LEAN CLAY w/Sand and Trace Gravel (CL) (30.0')	SS 8	100	3-6-6 (12)	1.25	115	15
	30	Bottom of hole at 30.0 feet.						

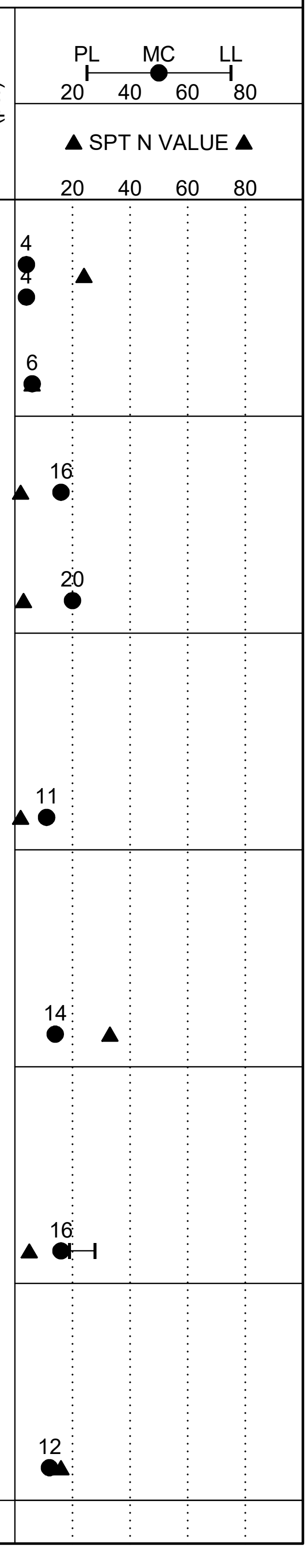
CT Consultants, Inc.
1915 N 12th Street
Toledo Ohio 43604
Telephone: (419)324-2222

BORING NUMBER B-2

CLIENT City of Painesville
PROJECT NAME WTP Chlorine Feed Building
PROJECT NUMBER 232515
PROJECT LOCATION Mentor, OH
DRILLING CONTRACTOR Ohio TestBor, Inc. Corey Jim
RIG NO. D-25
GROUND ELEVATION 580.5 ft
DRILLING METHOD HSA
GROUND WATER LEVELS:
DATE STARTED 7/10/24 **COMPLETED** 7/10/24
▽ **AT TIME OF DRILLING** 7.5 ft / Elev 573.0 ft
LOGGED BY KKC **CHECKED BY** IEH
▼ **AT END OF DRILLING** 8.5 ft / Elev 572.0 ft
NOTES Lat: 41°45'11.40"N Long: 81°17'43.87"W (Approx.)
0hrs AFTER DRILLING Backfilled w/Cuttings

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION
580	0	ASPHALT - 4 Inches (0.3')
		FILL - Moist Medium Dense Gray CRUSHED STONE w/Sand and Trace Silt (2.0')
		FILL - Moist Medium Dense Brown/Gray POORLY GRADED SAND w/Silt and Trace Gravel (SP-SM) (3.5')
575	5	FILL - Moist Loose Brown/Gray POORLY GRADED SAND w/Silt and Trace Gravel (SP-SM)
		@6': Very Loose
		▽ ▼ @7.5': Gray
570	10	
565	15	@13.5': Wet, (Free Water Noted in Jar)
560	20	@18.5': Dense (21.0')
		Moist Medium Stiff Gray SANDY LEAN CLAY w/Trace Gravel (CL) (28.5')
555	25	
	30	Moist Very Stiff Gray LEAN CLAY w/Sand and Trace Gravel (CL) (30.0')
		Bottom of hole at 30.0 feet.

SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF. COMP. STR. (tsf)	DRY UNIT WT. (pcf)
SS 1	100	17-15-9 (24)	NP NP	
SS 2	100	3-3-3 (6)	NP	
SS 3	67	0-1-1 (2)	NP	
SS 4	100	1-2-1 (3)	NP	
SS 5	33	1-1-1 (2)	NP	
SS 6	56	12-21-12 (33)	NP	
SS 7	100	1-2-3 (5)	0.79	114
SS 8	100	6-8-8 (16)	4.19	121



TTL_GEOTECH_STANDARD 232515.GPJ GINT US LAB.GDT 9/23/24

APPENDIX B

LEGEND KEY

LEGEND KEY

Unified Soil Classification System Soil Symbols

- GW - WELL GRADED GRAVEL Includes Gravel-Sand mixtures, little or no fines.
- GP - POORLY GRADED GRAVEL Includes Gravel-Sand mixtures, little or no fines.
- GM - SILTY GRAVEL Includes Gravel-Sand-Silt mixtures.
- GC - CLAYEY GRAVEL Includes Gravel-Sand-Clay mixtures.
- SW - WELL GRADED SAND Includes Gravelly Sands, little or no fines.
- SP - POORLY GRADED SAND Includes Gravelly Sands, little or no fines.
- SM - SILTY SAND Includes Sand-Silt mixtures.
- SC - CLAYEY SAND Includes Sand-Clay mixtures.
- ML - SILT Includes Silt with Sand and Sandy Silt.
- CL - LEAN CLAY Includes Sandy Lean Clay and Lean Clay with Sand and Gravel.
- MH - ELASTIC SILT Includes Sandy Elastic Silt and Elastic Silt with Sand.
- CH - FAT CLAY Includes Sandy Fat Clay and Fat Clay with Sand.
- CL-ML - SILTY CLAY Includes Clayey Silt of low plasticity.
- OL - ORGANIC SILT and ORGANIC CLAY of low plasticity.
- OH - ORGANIC SILT and ORGANIC CLAY of medium to high plasticity.
- Pt - PEAT Includes humus, swamp and other soils with high organic content.
- FILL MATERIAL - Includes controlled and non-controlled soil and non-soil materials.
- TOPSOIL
- ASPHALT - Bituminous Asphalt
- CONCRETE - Includes broken concrete rubble.

Sample Symbols

- SS - Split Spoon
- ST - Shelby Tube
- RC - Rock Core
- GS - Geoprobe Sleeve
- AU - Auger Cuttings
- GB - Grab

Notes:

1. Exploratory borings were drilled on July 10, 2024, using hollow stem augers.
2. These logs are subject to the limitations, conclusions, and recommendations in the report and should not be interpreted separate from the report.
3. The borings were located in the field by CT in accordance with a boring plan provided by the City of Painesville (Client).
4. Latitude, Longitude, and ground surface elevation for all borings were surveyed by CT via a hand-held GPS device. The accuracy from the handheld GPS device was generally found to be approximately 2 to 6 inches horizontal, and approximately 4 to 12 inches vertical.
5. Unconfined Compressive Strength:
   NP = Non-Plastic

APPENDIX C

TABULATION OF LABORATORY TEST DATA

CT Consultants, Inc.
1915 N 12th Street
Toledo Ohio 43604
Telephone: (419)324-2222

SUMMARY OF LABORATORY RESULTS

CLIENT City of Painesville **PROJECT NAME** WTP Chlorine Feed Building

PROJECT NUMBER 232515 **PROJECT LOCATION** Mentor, OH

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
B-1	1.5							4.2			
B-1	2.3							7.8			
B-1	3.5	NP	NP	NP	37.5	7	SP-SM	4.9			
B-1	6.0							12.8			
B-1	8.5							14.7			
B-1	13.5							15.6			
B-1	18.5							24.4			
B-1	23.5							16.1	113.8		
B-1	28.5							14.7	115.2		
B-2	1.5							4.1			
B-2	2.3							4.4			
B-2	3.5							5.5			
B-2	6.0							15.9			
B-2	8.5							20.0			
B-2	13.5							11.0			
B-2	18.5							14.3			
B-2	23.5	28	19	9	12.5	65	CL	16.1	114.0		
B-2	28.5							12.3	121.0		

APPENDIX D

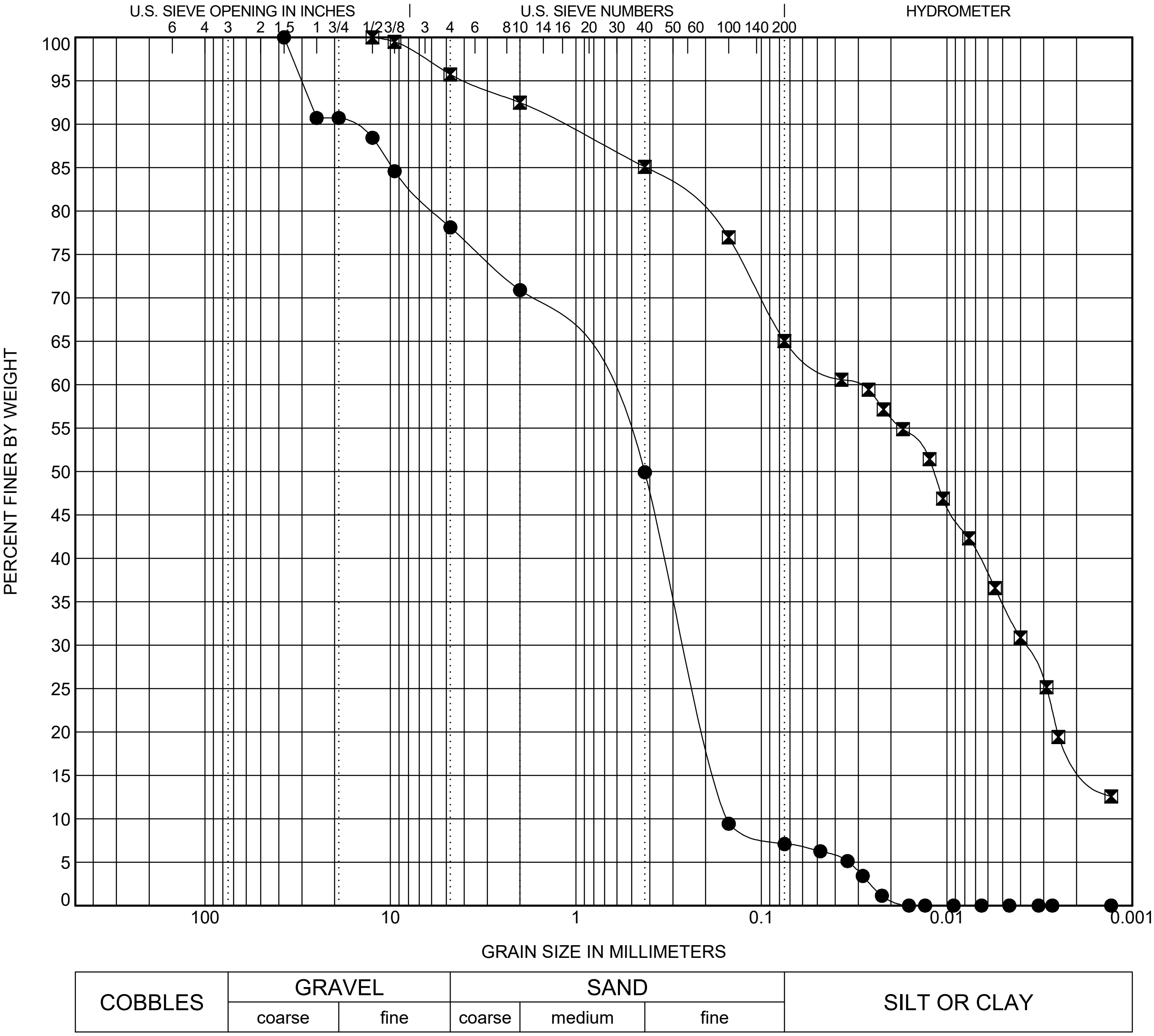
LABORATORY TEST RESULTS

CT Consultants, Inc.
1915 N 12th Street
Toledo Ohio 43604
Telephone: (419)324-2222

GRAIN SIZE DISTRIBUTION

CLIENT City of Painesville **PROJECT NAME** WTP Chlorine Feed Building

PROJECT NUMBER 232515 **PROJECT LOCATION** Mentor, OH



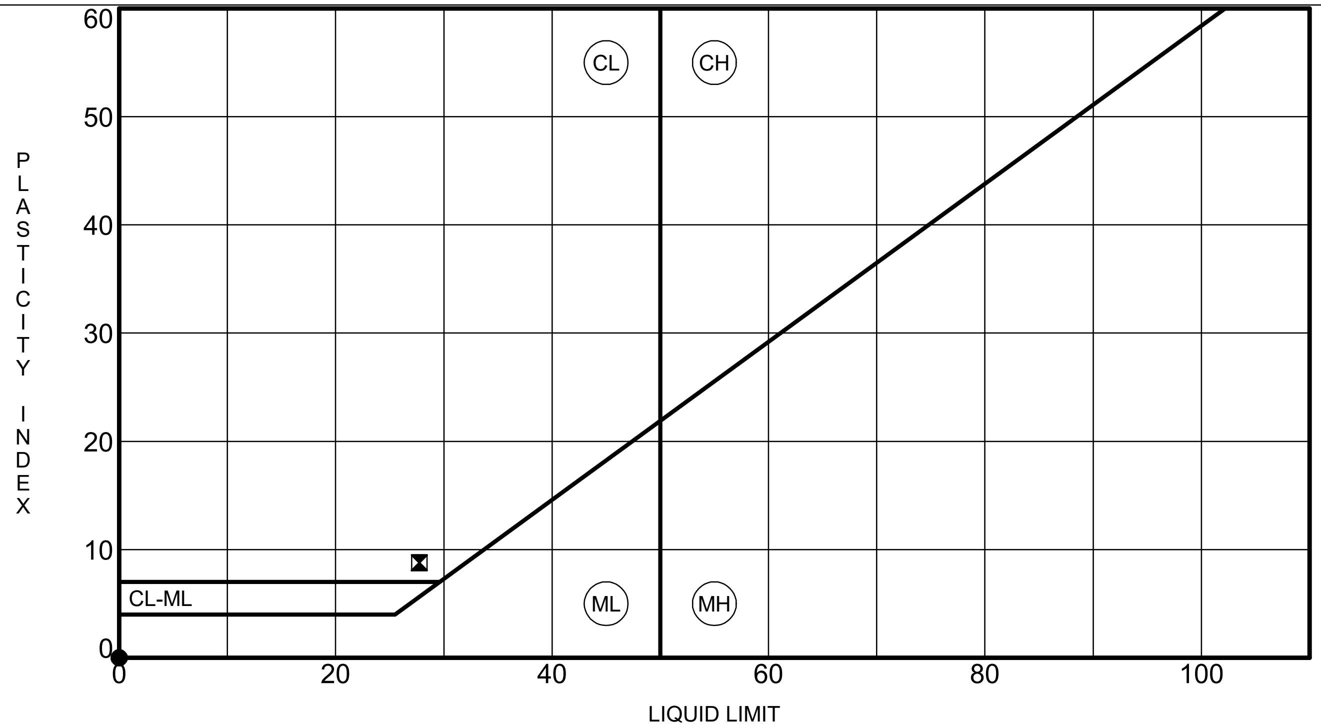
Specimen Identification		USCS Classification	LL	PL	PI	Cc	Cu
● B-1	3.5	**POORLY GRADED SAND with SILT and GRAVEL (SP-SM)**	**NP**	**NP**	**NP**	**0.5**	**5.9**
⊠ B-2	23.5	**SANDY LEAN CLAY (CL)**	**28**	**19**	**9**		

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-1	3.5	**37.5**	**0.895**	**0.255**	**0.152**	**21.9**	**71.0**	**7.1**	**0.0**
⊠ B-2	23.5	**12.5**	**0.031**	**0.004**		**4.3**	**30.7**	**30.2**	**34.9**

CT Consultants, Inc.
1915 N 12th Street
Toledo Ohio 43604
Telephone: (419)324-2222

ATTERBERG LIMITS' RESULTS

CLIENT City of Painesville
PROJECT NAME WTP Chlorine Feed Building
PROJECT NUMBER 232515
PROJECT LOCATION Mentor, OH



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**B-1**	**3.5**	**NP**	**NP**	**NP**	**7**	**POORLY GRADED SAND with SILT and GRAVEL (SP-SM)**
⧗	**B-2**	**23.5**	**28**	**19**	**9**	**65**	**SANDY LEAN CLAY (CL)**

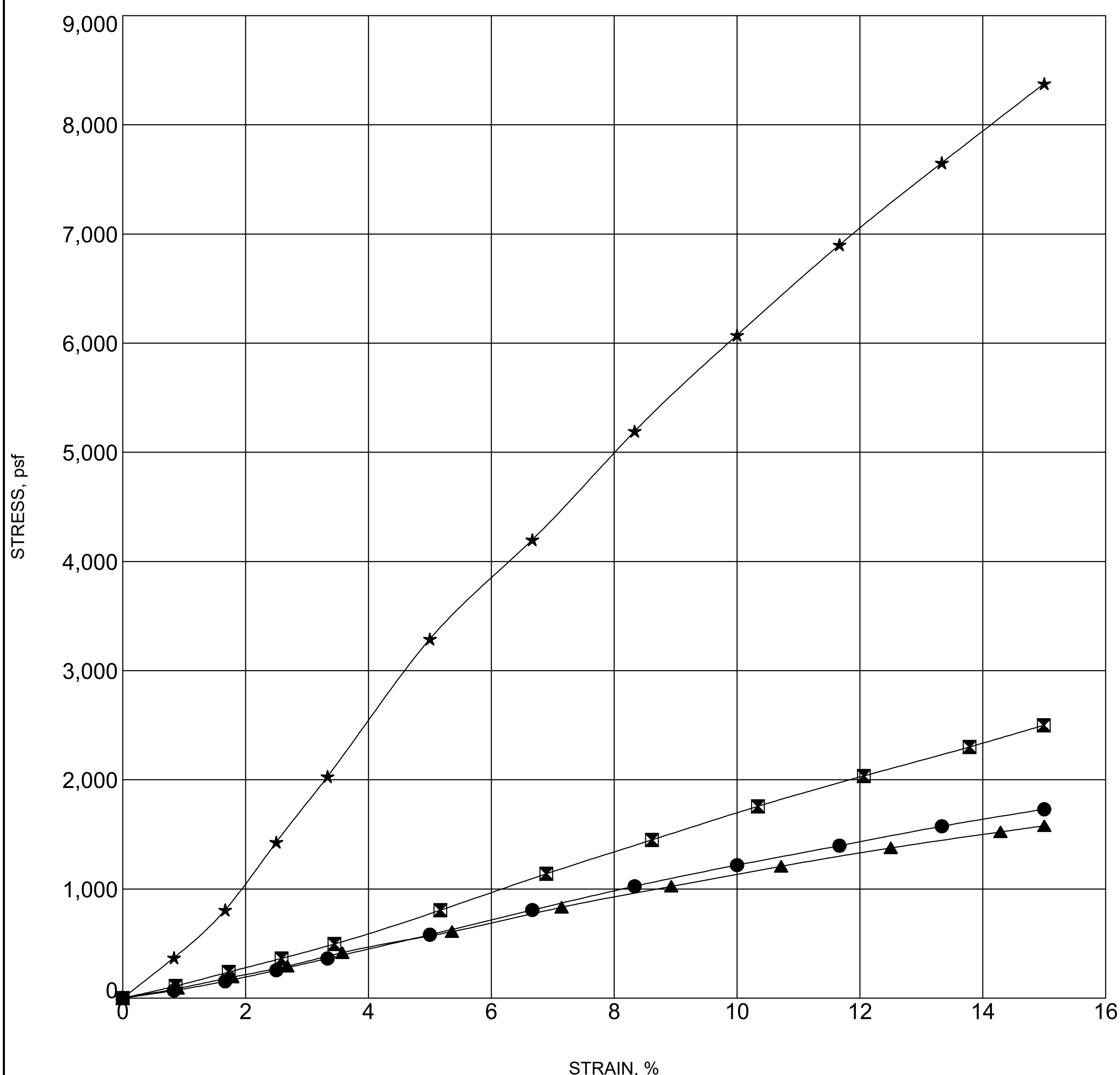
CT consultants

CT Consultants, Inc.
1915 N 12th Street
Toledo Ohio 43604
Telephone: (419)324-2222

UNCONFINED COMPRESSION TEST

CLIENT City of Painesville **PROJECT NAME** WTP Chlorine Feed Building

PROJECT NUMBER 232515 **PROJECT LOCATION** Mentor, OH

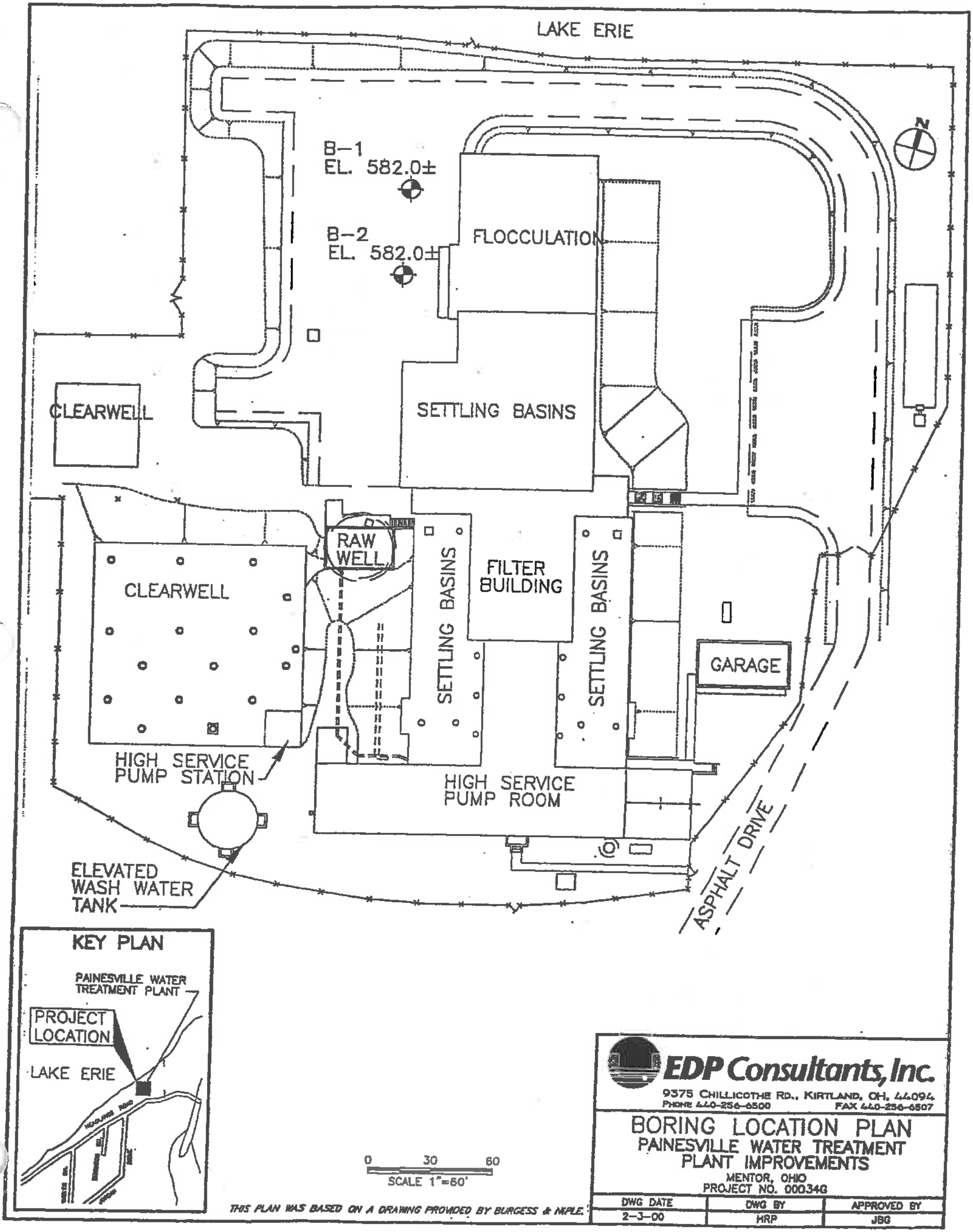


	Specimen Identification		Classification	γ_d	MC%
●	**B-1**	**23.5**		**114**	**16**
⊠	**B-1**	**28.5**		**115**	**15**
▲	**B-2**	**23.5**	**SANDY LEAN CLAY (CL)**	**114**	**16**
★	**B-2**	**28.5**		**121**	**12**

APPENDIX E

Historic Boring Logs

consultants
engineers • architects • planners
A Verdantas Company


LAKE ERIE
B-1
EL. 582.0±
B-2
EL. 582.0±
FLOCCULATION
CLEARWELL
SETTLING BASINS
RAW WELL
CLEARWELL
SETTLING BASINS
FILTER BUILDING
SETTLING BASINS
GARAGE
HIGH SERVICE PUMP STATION
HIGH SERVICE PUMP ROOM
ELEVATED WASH WATER TANK
ASPHALT DRIVE
N
KEY PLAN
PAINESVILLE WATER TREATMENT PLANT
PROJECT LOCATION
LAKE ERIE
0
30
60
SCALE 1"=60'
THIS PLAN WAS BASED ON A DRAWING PROVIDED BY BURGESS & NIPLE.
EDP Consultants, Inc.
9375 CHILLICOTHE RD., KIRTLAND, OH, 44094
PHONE 440-256-6500
FAX 440-256-6507
BORING LOCATION PLAN
PAINESVILLE WATER TREATMENT PLANT IMPROVEMENTS
MENTOR, OHIO
PROJECT NO. 00034G
DWG DATE
2-3-00
DWG BY
HRP
APPROVED BY
JBG

LABORATORY LOG OF BORING

EDP Consultants, Inc.

ROJECT NAME Painesville Water Treatment Plant	LOCATION Mentor, Ohio					
IENT City of Painesville	PROJECT NUMBER 00034G	BORING NUMBER B-1	BORING DEPTH 58.5 ft		SHEET 1 of 1	
RILLING METHOD Hollow Stem Auger	DRILLER/HELPER/LOGGED BY: RM/JH/JBG	WATER LEVEL	10 ft	53 ft	50 ft	10.5 ft
		DATE	2/1/00	2/1/00	2/1/00	2/3/00
ORING START & COMPLETION Date/Time 2/1/00-9:39 am, 2/1/00-1:36 pm	SURFACE ELEVATION 582.0 ft	TIME	Encount.	Complet.	3:44 pm	1:00 pm
		BOREHOLE OPEN				

SAMPLE	TYPE	SAMPLE RECOVERY, in / CORE RECOVERY %	SOIL DESCRIPTION	STANDARD PEN. Blows/6in. / RQD %	Qu (tsf)	DRY UNIT WEIGHT (pcf)	PL (%)	WC (%)	LL (%)
			ASPHALT (4")						
			BASE (6")						
1	SB	14		7-7-8					
2	SB	14		5-7-9					
3	SB	15		11-12-13					
4	SB	12	Medium dense brown fine to medium SAND with gravel (SP to SP/SM)	8-11-13					
5	SB	18		28-38-48					
6	SB	18	Medium stiff gray silty CLAY with sand layers (CL-ML)	2-2-4			19	28	25
7	SB	14	Very stiff gray lean CLAY with sand layers (CL)	7-10-13			17	15	25
8	ST	12			6.8	130		13	
9	SB	10		9-16-23			16	15	22
10	SB	6		50/6"				12	
11	SB	5	Hard gray silty CLAY with gravel and shale fragments (CL-ML)	50/5"			15	11	21
12	SB	3		50/3"				10	
13	SB	2		50/2"				7	
			Moderately hard black SHALE						
14	SB	1/2		50/.5"					

S = SPLIT-BARREL/SPLIT-SPOON
T = SHELBY TUBE
S = AUGER SAMPLE
X = DIAMOND BIT CORE

REMARKS: A 60 ft deep, 3/4 inch diameter PVC well, with a 20 ft long slotted screen at the bottom was placed in the hole. Water level was 10 ft at 6 pm on 2/4/00. Water level was 8.75 ft at 11 am on 2/10/00.

LABORATORY LOG OF BORING

EDP Consultants, Inc.

OJECT NAME	LOCATION
'ainesville Water Treatment Plant	Mentor, Ohio
IENT	PROJECT NUMBER
City of Painesville	00034G
ILLING METHOD	DRILLER/HELPER/LOGGED BY:
Hollow Stem Auger	RM/JH/JBG
'RING START & COMPLETION Date/Time	SURFACE ELEVATION
/1/00-1:43 pm, 2/1/00-3:09 pm	582.0 ft

BORING NUMBER	BORING DEPTH	SHEET
B-2	30.0 ft	1 of 1

WATER LEVEL	10 ft ∇	23 ft ∇	9.5 ft ∇	9.5 ft ∇
DATE	2/1/00	2/1/00	2/3/00	2/4/00
TIME	Encount.	Complet.	1:00 pm	6:00 pm
BOREHOLE OPEN				

DEPTH (FT)	SAMPLE	TYPE	SAMPLE RECOVERY, in / CORE RECOVERY %	SYMBOL	SOIL DESCRIPTION	STANDARD PEN. Blows/6in. / RQD %	Qu (tsf)	DRY UNIT WEIGHT (pcf)	PL (%)	WC (%)	LL (%)
					ASPHALT (4")						
					BASE (6")						
	1	SB	14			9-8-7					
5	2	SB	6		Medium dense brown fine to medium SAND with gravel (SP)	7-12-12					
10	3	SB	12			5-8-9					
15	4	SB	14		Medium dense brown medium to coarse SAND with gravel (SP)	9-11-11					
20	5	SB	12			8-10-13					
25	6	SB	18		Stiff gray sandy lean CLAY with gravel (CL)	3-5-9				16	
					Gray coarse SAND and GRAVEL (SP/GP)						
30	7	SB	16		Very stiff gray lean CLAY with gravel (CL)	7-12-15				14	

= SPLIT-BARREL/SPLIT-SPOON
= SHELBY TUBE
= AUGER SAMPLE
= DIAMOND BIT CORE

REMARKS: A 30 ft deep, 3/4 inch diameter PVC well, with a 10 ft long slotted screen at the bottom was placed in the hole. Water level was 9.4 ft at 11 am on 2/10/00.