Village of Marblehead
Marblehead, Ohio

Geotechnical Subsurface Investigation
Proposed Waterline Installation
Johnson's Island, Marblehead, Ohio

January 2015

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February 4, 2015

TTL Project No. 11903.01

Village of Marblehead
c/o Robert Boytim
Board of Public Affairs
513 West Main Street
Marblehead, Ohio 43440

Geotechnical Subsurface Investigation
Proposed Waterline Installation
Johnson's Island, Marblehead, Ohio

Dear Mr. Boytim:

Following is the report of our geotechnical subsurface investigation for the referenced project. This investigation was performed in general accordance with Proposal No. 11903.01R, dated December 8, 2014, and was authorized by the Village of Marblehead Board of Public Affairs during the December 9, 2014, board meeting.

This report describes the investigative procedures, presents a summary of the findings, and includes geotechnical-related evaluations and construction considerations. This investigation did not include an environmental assessment of the subsurface materials.

PROJECT DESCRIPTION

We understand that the project consists of nearly 4 miles of new waterline installation from the Village of Marblehead mainland to Johnson's Island, in Ottawa County, Ohio. Approximately 4,000 lineal feet (LF) of waterline will cross Sandusky Bay. Approximately 19,000 LF of new waterline is planned on Johnson's Island. This report only addresses the portion of the project on Johnson's Island and does not address any crossing over the bay. The general project area is shown on the attached Site Location Map (Plate 1.0).

In general, the proposed 10-inch diameter waterline is planned to be aligned in close proximity to the existing roadways on Johnson's Island. The proposed waterline is expected to have approximately 5 feet of ground cover, with nominal pipe invert elevations generally no greater than 6 feet below existing grades. We understand the proposed waterline is generally planned for cut-and-cover construction. The purpose of this investigation was to evaluate the constructability of the proposed waterline based on the soil conditions and bedrock depths along the proposed alignment.

INVESTIGATIVE PROCEDURES

Field Procedures

This investigation included 42 auger probes and test borings performed by TTL during the period from January 13 through January 16, 2015. Ten (10) of these locations were drilled and samples as test borings (Borings B-1, B-5, B-8, B-11, B-14, B-18, B-21, B-24, B-32 and B-38). The remaining 32 locations, identified by a "P-" designation, were drilled as auger probes, without sampling, primarily for the purpose of determining the depth to bedrock.

The probes/borings were located in the field by CT Consultants, Inc. (CT) in general accordance with locations planned for fire hydrants, based on a drawing provided by CT on December 29, 2014. However, the following relocations were made due to utility clearance concerns:

- Boring B-1 was moved approximately 13 feet west and 19 feet south due to the presence of electrical junction boxes at the planned boring location.
- Probe P-3 was moved approximately 68 feet to the north due to overhead utilities at the planned probe location.
- Probes P-19 and P-20 were moved to the opposite side of South Memorial Shoreway Drive due to overhead utilities at the planned probe locations.
- Probe P-28 was moved approximately 18 feet east and 18 feet south due to the presence of overhead utilities at the planned probe location.

The majority of the probes/borings were drilled through the paved roadway surface, as access to areas off of the roadway was limited due to the presence of snow and snow piles at the time of this investigation. The approximate as-drilled locations of the probes are shown on the Test Probe Location Plan (Plate 2.0).

Surveyed ground surface elevations at the probe/boring locations were not available at the time of this report.

The auger probes and test borings were performed in general accordance with geotechnical investigative procedures outlined in ASTM Standards D 1452 and D 5434. The probes/borings performed during this investigation were completed with a truck-mounted drilling rig, utilizing 3-inch solid-stem augers. During auger advancement in the test borings split-spoon soil samples were generally collected continuously to the target completion depth of 8 feet or auger refusal.

Split-spoon (SS) samples were obtained at each interval 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 four 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 Borings attached to this report. The samples were sealed in jars and transported to our laboratory for further classification and testing.

Soil conditions encountered in the auger probes and test borings are presented in the Logs of Borings, along with information related to sample data, SPT results, 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. In the auger probes without sampling, soil descriptions are based solely on visual classifications of the auger cuttings.

This investigation did not include an environmental assessment of the surface or subsurface soils at the site.

Laboratory Testing

Samples of the subsoils recovered from the test borings were visually or manually classified in our laboratory using designations in accordance with the Unified Soil Classification System (USCS), in general accordance with ASTM Standards D 2487 and D 2488. Selected samples were also tested for moisture content (ASTM D 2216). Unconfined compressive strength estimates were obtained for the intact cohesive samples using a calibrated hand penetrometer. Atterberg limits tests (ASTM D 4318) and particle size analyses (ASTM D 422) were performed on representative soil samples from Borings B-11 (SS-2) and B-24 (SS-3) to determine soil classification and index properties. The results of these tests are presented on the Logs of Borings, Tabulation of Test Data sheets, and Grain Size Distribution sheet attached to this report.

ENCOUNTERED CONDITIONS

Existing grades along the proposed waterline alignment were generally level, with a few gradual slopes. Roadway grades were estimated to be generally less than ½ to 1 foot above the surrounding elevation.

Surface Materials

We understand that the proposed waterline installation generally will occur outside of the paved roadway surface. However, as indicated previously, access to areas off of the roadway was limited at the time of this investigation due to snow. With the exception of Boring B-8, and Probes P-9 and P-10, all of the probes/borings were performed through the roadway pavement, and encountered approximately 3 inches of asphalt pavement underlain by road base stone generally ranging in thickness from approximately 9 to 15 inches. . However, at six probe/boring locations, the stone base was noted to be on the order of 18 to 21 inches.

Among those locations not drilled through the roadway, Boring B-8 was drilled on the pavement shoulder and encountered road base stone from the surface to a depth of approximately 1 foot below ground surface. Surface materials in Probes P-9 and P-10 consisted of approximately

1 inch of topsoil, underlain by approximately11 inches of road base stone. The road base stone was observed to be frozen at the time of this exploration.

Fill Materials

Granular **fill** materials were encountered underlying the road base stone in Boring B-32 to a depth of approximately 7 feet. These granular fill materials consisted of crushed stone that appeared to be similar to ODOT 304 dense-graded aggregate, typically of roadway base. SPT N-values generally ranged from 34 to 39 blows per foot (bpf), indicating dense compactness, although one sample interval encountered split-spoon refusal (50 blows or more for 6 inches or less of penetration.

Native Soil Strata

Based on the observations of auger probe cuttings, and the limited sampling and laboratory testing completed as part of this investigation, the native subsoils encountered underlying the surface materials consisted of predominantly cohesive soils, which were underlain by bedrock.

The native soil strata were predominantly very stiff to hard cohesive lean clay (CL) soils with varying amounts of sand and gravel. SPT N-values generally ranged from 20 to 68 bpf, although sample intervals just above bedrock may have encountered split-spoon refusal. Unconfined compressive strengths were generally on the order of 6,000 to greater than 9,000 psf (the maximum reading obtainable using a hand penetrometer). Moisture contents of the native soil strata ranged from 6 to 21 percent. Tested samples from Borings B-11 and B-24 indicted liquid limits of 42 and 36 percent, and plasticity indices of 21 and 16 percent, respectively. These values, along with the associated particle size gradations, are indicative of lean clay (CL) as classified in accordance with the Unified Soil Classification System (USCS).

It should be noted that possible cobbles/boulders or weathered/fractured bedrock "floaters" or "erratics" were encountered within the clay strata in five boring locations (P-2, P-12, P-26, P-37, and B-38). Only Boring B-38 was a sampled location, so the encountered conditions in the probes reflect only driller's interpretation of drill rig chatter, auger penetration, and limited cutting materials from the borehole. In Probes P-2 and P-12, the thickness of this zone was only on the order of 6 inches, and thus, appear to be cobbles/boulders or floaters within the native soil.

In Probes P-26 and P-37 as well as Boring B-38, this zone was on the order of 15 to 27 inches thick, and was encountered just below the road stone and above the underlying native clays, suggesting that the encountered materials could possibly be boulders or rock materials that are man-made fill associated with past grading at these locations. The sample recovered from Boring B-38 (SS-1) appeared to be crushed rock fill material. It should be noted that Probes P-39 through P-42 are located along the same roadway (Baycliffs Drive) as Boring B-38. In these probes, the drillers noted weathered rock during drilling at a depth of 1 foot below existing ground surface based on auger resistance. A portion of the noted weather rock may in fact be man-made, crushed rock fills similar to what was encountered in Boring B-38. However, because

these locations were probes only without sampling, it was not possible to make further evaluations or determinations to distinguish between weathered rock and man-made fill.

Bedrock

One of the primary purposes of this investigation was to evaluate the depth of bedrock throughout the island with respect to the proposed waterline alignment. Of the 42 probes/borings drilled for this investigation, bedrock (interpreted from auger penetration resistance and/or auger refusal) was encountered at 30 locations. A summary of the encountered rock conditions is provided in Tables 1 through 6 that follow, with borings generally grouped together by six main street designations within the proposed project area. In these tables, the depth to top of rock references the depth at which the drillers first noted drill rig chatter and auger penetration rates indicative of the transition from soils to rock, but not necessarily the point of auger refusal, which is generally indicative of "sound" bedrock. The difference between these two depths is interpreted as the thickness of the weathered/fractured bedrock zone noted on the tables, typically shown simply as "weathered" on the Logs of Borings and the text discussion herein.

It should be noted that rock coring was not included in the scope of this investigation, so borings were only advanced to auger refusal or to the target completion depth of 8 feet below existing grades. Without coring, the quality, strength, or fracture frequency of the bedrock was not determined.

As indicated above, weathered or fractured zones were noted by the drillers based on drill rig chatter and auger penetration rates. At approximately 10 percent of the locations where rock was encountered, the weathered zone was either absent or indistinguishably transitional and too thin to be noted by the drillers. In the majority of probes/borings where encountered (19 of 27), the thickness of the weathered zone typically ranged from approximately 3 inches to 18 inches, generally less than 12 inches. In the remaining 30 percent of the probes/borings where an appreciable weathered zone was encountered, the thickness of this zone generally varied from approximately 24 to 36 inches. However, at two locations, the weathered/fractured zone interpreted from auger penetration was on the order of 4 feet (Probe P-29) to 5 feet (Probe P-10).

The shallowest bedrock, including interpreted top of weathered/fractured rock zones, was encountered at a depth of approximately 1 foot below existing grades, most consistently along the Baycliffs Drive alignment (approximately 10 percent of the probes/borings completed for this investigation). However, shallow bedrock at depths of 1 to 2 feet was also recorded at 8 other locations (approximately 20 percent of the probes/borings) throughout the overall project area. The shallowest auger refusal was recorded at a depth of 1.5 feet in Probe P-22 along South Memorial Shoreway. Where "sound" bedrock was interpreted based on auger refusal, the average depth where auger refusal was encountered was approximately 4.7 feet below ground surface. At 19 probe/boring locations, auger refusal was encountered at a depth of 6 feet or less below existing grade, the anticipated depth of installed waterline invert.

Locations along South Confederate Drive					
Probe/ Boring Number	Split-Spoon Sampled	Auger Refusal	Weathered / Fractured Rock Zone		Probe/Boring Auger Refusal Depth or Termination Depth (feet)
			Approximate Depth to Top of Rock (feet)	Approximate Thickness of Weathered Zone (inches)	
B-1	✓	✓	3.1	3	3.3
P-2		✓	7.0	6	7.5
P-3		✓	Weathered Zone Not Encountered		4.0
P-4		✓	4.0	3	4.2
B-5	✓	✓	5.0	4	5.3
P-6		✓	6.0	6	6.5
P-7		✓	Weathered Zone Not Encountered		2.5
B-8	✓	✓	1.0	3	1.2
P-9			Rock Not Encountered		8.0
P-10		✓	1.5	60	6.5
B-11	✓	✓	5.2	6	5.7
P-12			6.5	18	8.0
P-13		✓	2.0	24	4.0
B-14	✓	✓	2.0	18	3.5
P-15			Rock Not Encountered		8.0
P-16			Rock Not Encountered		8.0
P-17			Rock Not Encountered		8.0
P-29		✓	3.0	46	6.8

Locations along Forrest Glenn Lane					
Probe/ Boring Number	Split-Spoon Sampled	Auger Refusal	Weathered / Fractured Rock Zone		Probe/Boring Auger Refusal Depth or Termination Depth (feet)
			Approximate Depth to Top of Rock (feet)	Approximate Thickness of Weathered Zone (inches)	
P-30			Rock Not Encountered		8.0
P-31			Rock Not Encountered		8.0

Locations along South Quarry Stone Court					
Probe/ Boring Number	Split-Spoon Sampled	Auger Refusal	Weathered / Fractured Rock Zone		Probe/Boring Auger Refusal Depth or Termination Depth (feet)
			Approximate Depth to Top of Rock (feet)	Approximate Thickness of Weathered Zone (inches)	
B-32	✓	✓	6.8	4	7.0
P-33		✓	1.2	16	2.5

Locations along South Woodcliff Drive					
Probe/ Boring Number	Split-Spoon Sampled	Auger Refusal	Weathered / Fractured Rock Zone		Probe/Boring Auger Refusal Depth or Termination Depth (feet)
			Approximate Depth to Top of Rock (feet)	Approximate Thickness of Weathered Zone (inches)	
P-34		✓	4.5	24	6.5
P-35		✓	1.0	15	2.2
P-36		✓	Weathered Zone Not Encountered		4.0
P-37		✓	5.8	3	6.1

Locations along Baycliffs Drive					
Probe/ Boring Number	Split-Spoon Sampled	Auger Refusal	Weathered / Fractured Rock Zone		Probe/Boring Auger Refusal Depth or Termination Depth (feet)
			Approximate Depth to Top of Rock (feet)	Approximate Thickness of Weathered Zone (inches)	
B-38	✓		Rock Not Encountered		9.0
P-39		✓	1.0	36	4.0
P-40		✓	1.0	25	3.1
P-41		✓	1.0	31	3.6
P-42		✓	1.0	21	2.8

Locations along South Memorial Shoreway					
Probe/ Boring Number	Split-Spoon Sampled	Auger Refusal	Weathered / Fractured Rock Zone		Probe/Boring Auger Refusal Depth or Termination Depth (feet)
			Approximate Depth to Top of Rock (feet)	Approximate Thickness of Weathered Zone (inches	
B-18	✓	✓	Weathered Zone Not Encountered		7.6
P-19		✓	1.2	10	2.0
P-20			Rock Not Encountered		8.0
P-21	✓	✓	4.0	6	4.5
P-22		✓	1.1	5	1.5
P-23		✓	6.8	9	7.5
B-24	✓	✓	7.5	3	7.9
P-25			Rock Not Encountered		8.0
P-26			Rock Not Encountered		8.0
P-27			Rock Not Encountered		8.0
P-28		✓	6.0	6	6.5

Groundwater Conditions

Groundwater was not encountered during or at the completion of drilling operations in any of the probes or borings. Inasmuch as the probes/borings were drilled within or immediately adjacent to roadways, they were all backfilled upon completion of drilling operations at each location. Because the native soil profile consists of predominantly clays with low permeability, stabilized water levels are not expected to have occurred over the limited time period required for completion of the probes/borings.

Based on the soil characteristics and limited moisture content data obtained during this investigation, it is our opinion that the "normal" groundwater level on the island will generally be encountered at depths at or slightly above the water level in surrounding Sandusky Bay, generally below a depth of 8 feet below existing grade. However, it should be noted that groundwater elevations can fluctuate with seasonal and climatic influences. In particular, "perched" water may be encountered at shallower depths in zones that are underlain by relatively impermeable clays, as well as in zones of fractured rock at the top of the bedrock profile.

Based upon a review of the USDA Natural Resources Conservation Service (NRCS) "Web Soil Survey for Ottawa County, Ohio" mapping, the soils at the site are comprised predominantly of Nappanee silty clay loam and Castalia very stony fine sandy loam. In the Nappanee soils, the

seasonal high groundwater table is indicated to occur as shallow as 1 to 2 feet below grade, while the seasonal high water table typically greater than 6½ feet below grade in the Castalia soils. Therefore, the groundwater conditions may vary at different times of the year from those encountered during this investigation.

EVALUATIONS AND CONCLUSIONS

Waterline Installation

We understand that the waterline is generally planned to be aligned in close proximity to the existing roadways on Johnson's Island and is expected to have approximately 5 feet of ground cover, with nominal pipe invert elevations generally no greater than 6 feet below existing ground. We understand the waterline is generally planned for cut-and-cover construction, although directional drilling or bore-and-jack methods may be considered to avoid disruption to roadways and residential driveways.

The soils and rock encountered at a depth of 5 to 6 feet are considered generally suitable for pipe support provided sufficient bedding and haunching is maintained below and above the proposed waterline. Although not anticipated, if unsuitable soils are encountered at pipe invert elevations, undercutting and replacement with additional bedding stone may be required. As a minimum, unsuitable soils should be undercut to a depth of one pipe diameter below invert, or 12 inches, whichever is greater. The undercut zones should be replaced with engineered fill, properly placed and compacted prior to placement of the bedding and haunching material.

Based on the conditions encountered in the auger probes and test borings drilled for this investigation, it is our opinion that cut-and-cover construction methods are feasible for waterline installation. However, based on the encountered variable depths between soil strata and top of rock throughout the project area, as well as variable thickness between weathered/fractured zones and sound bedrock, broad usage of directional drilling does not appear to be a likely construction option for general waterline installation. Localized directional drilling or bore-and-jack methods could possibly be used to extend short sections of pipe beneath roadways or residential driveways, if rock penetration is not required.

Based on the probes/boring, some amount of rock excavation should be anticipated throughout at least half of the project area. It is our experience that weathered/fractured rock that is penetrable with drill rig augers can sometimes be effectively removed with conventional trackhoe equipment, with some assistance with rock removal equipment such as hoe-rams, hydraulic wedges, or jackhammers. However, it should be noted that in locations where sound bedrock is encountered, based on drill rig auger refusal, full-scale hard rock removal construction practices may be required. These practices may include the use of rock trenchers, extensive utilization of hoe-rams, pre-cutting or pre-drilling of the rock, light blasting, expansive chemicals, or a combination of these or other methods. Vibrations from any of these methods will need to be minimized to avoid damage to homes and existing roadways in close proximity to the construction area.

Additional assessment of rock removal methods would include evaluation of data such as rock unconfined compressive strength, index point strength, fracture frequency, and/or Rock Quality Designation (RQD), requiring rock coring and associated laboratory testing.

General Excavation Considerations

The sides of temporary excavations for waterline installation should be adequately sloped to provide stable sides and safe working conditions. Otherwise, the excavation must be properly braced against lateral movements. In any case, applicable Occupational Safety and Health Administration (OSHA) standards must be followed.

Encountered trench excavation soils may include existing road base and granular fill materials as well as cohesive strata, and depending on the depth of excavations, much of the project area may also include a zone of weathered/fractured rock and/or "sound" bedrock. For these various conditions, the sides of excavations may not stand vertically unsupported for any significant period. In addition, OSHA standards would apply to trench excavations for all soil/rock types. Thus, provisions should be made for the waterline installation to proceed as a sloped bank excavation, or alternately, as a steeper cut with properly designed and installed lateral bracing. The latter system may include the use of a portable trench box or a sliding trench shield.

If the excavation is to be performed with sloped banks, adequate stable slopes must be provided. Based on the probes drilled for this investigation, soils/rock encountered in trench excavations may include one or more of the following:

- Type A soils (cohesive soils with unconfined compressive strengths of 3,000 pounds per square foot or greater),
- Type B soils (includes dry rock that is not stable), and
- Type C soils (fill materials and granular soils).

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

Construction traffic and excavated material stockpiles should be kept away from the edge of excavations at a minimum distance equal to the full depth of the excavation. In all cases, pertinent OSHA requirements (Part 1926, Subpart M, Amended 1989) must be followed and adequate protection for workers must be provided.

Backfill

The construction excavations should not be left open any longer than necessary. As soon as a section is completed, the trench should be backfilled to final grade. For the waterline in **non-pavement** areas, backfill soils may include suitable on-site excavated materials that 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. The on-site soils that are free of organic matter, excessive moisture, debris, and rock or stone fragments larger than 3 inches in diameter may be used as engineered fill materials. However, for areas where the backfill will be placed in existing **pavement** locations, the backfill should consist of dense-graded aggregate such as ODOT Item 304 material.

In general, backfill material should be placed in controlled lifts and compacted sufficiently to achieve stability and to avoid undesirable settlements. However, specifically below streets, driveways, and other pavement areas, the backfill material must be placed in uniform layers of not more than 8 inches (loose measure) and compacted to a density of not less than 100 percent of the maximum dry density as determined by ASTM D 698 (Standard Proctor). All fill materials should be placed within 3 percent of the optimum moisture content to facilitate satisfactory compaction.

It is recommended that all earthwork and site preparation activities be conducted under adequate specifications and properly monitored in the field by a TTL geotechnical engineer or a qualified representative.

Construction Dewatering

Groundwater was not encountered during or at the completion of drilling operations in any of the probes or borings performed during this investigation. As indicated previously, it is our opinion that the "normal" groundwater level on the island will generally be encountered at depths at or slightly above the water level in surrounding Sandusky Bay, generally below a depth of 8 feet below existing grades. However, it should be noted that groundwater elevations can fluctuate with seasonal and climatic influences. In particular, "perched" water may be encountered at shallower depths in fill materials that are underlain by relatively impermeable cohesive soils, as well as in zones of fractured rock at the top of the bedrock profile.

For shallow excavations in cohesive soil profiles extending not more than a few feet below the ambient groundwater level, it is our experience that adequate control of groundwater seepage should be achievable by minor dewatering systems, such as pumping from prepared sumps. If saturated or unstable subgrade conditions are encountered, the bottom of the excavation may require a nominal undercut and replacement with crushed stone to maintain a workable subgrade and to facilitate sump-and-pump dewatering. In the event excessive seepage is encountered during construction, TTL should be notified to evaluate whether other dewatering methods are required.

QUALIFICATION OF RECOMMENDATIONS

Our evaluation of waterline installation as related to soil and rock 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 obtained at specific auger probe and test boring locations. Regardless of the thoroughness of

a subsurface investigation, there is the possibility that conditions between the probes/borings will differ from those at the drilled locations, that conditions are not as anticipated by the designers, or that the construction process has altered the soil conditions. Therefore, experienced geotechnical engineers should observe earthwork and waterline line installation to confirm that the conditions anticipated in design are noted. Otherwise, we assume no responsibility for construction compliance with the design concepts, specifications, or recommendations.

The recommendations in this report have been developed based on the previously described project characteristics and subsurface conditions. If project criteria or locations change, TTL should be permitted to determine if 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 probes 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. TTL is not responsible for the conclusions, opinions, or recommendations of others based on this data.

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.

Sincerely,

TTL Associates, Inc.

Chett A. Siefring, P.E.
Senior Geotechnical Engineer

J. Scott Heisey, P.E.
Vice President & Chief Geotechnical Engineer

Attachments:
- Plate 1.0 Site Location Map
- Plate 2.0 Test Boring Location Plan
- Logs of Borings
- Legend Key
- Tabulation of Test Data
- Grain Size Distribution

cc: Mr. Kent Bryan, P.E. – CT Consultants, Inc.

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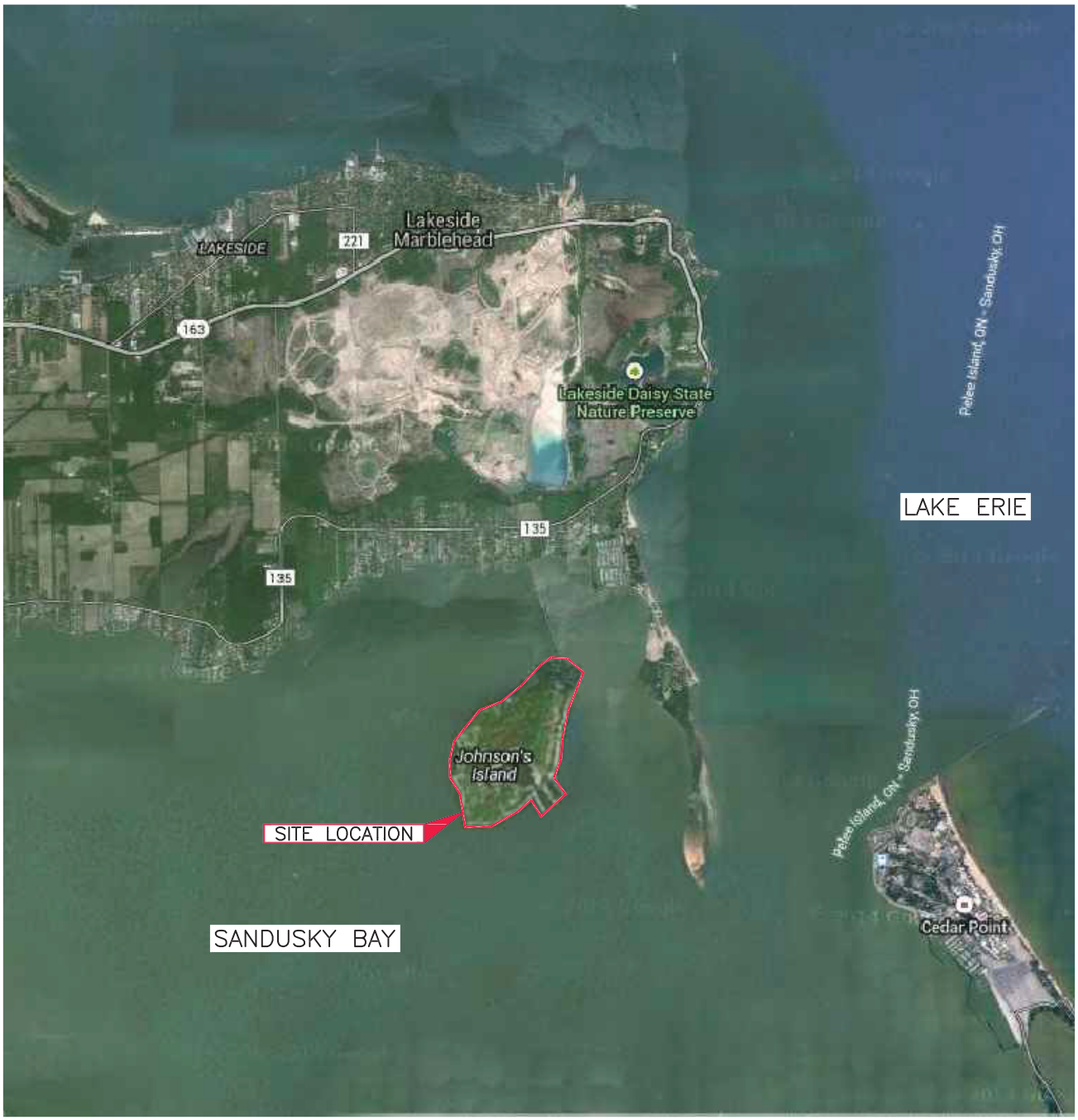


LEGEND

APPROXIMATE SITE LOCATION

N

APPROXIMATE SCALE – FEET

0 5,000 10,000

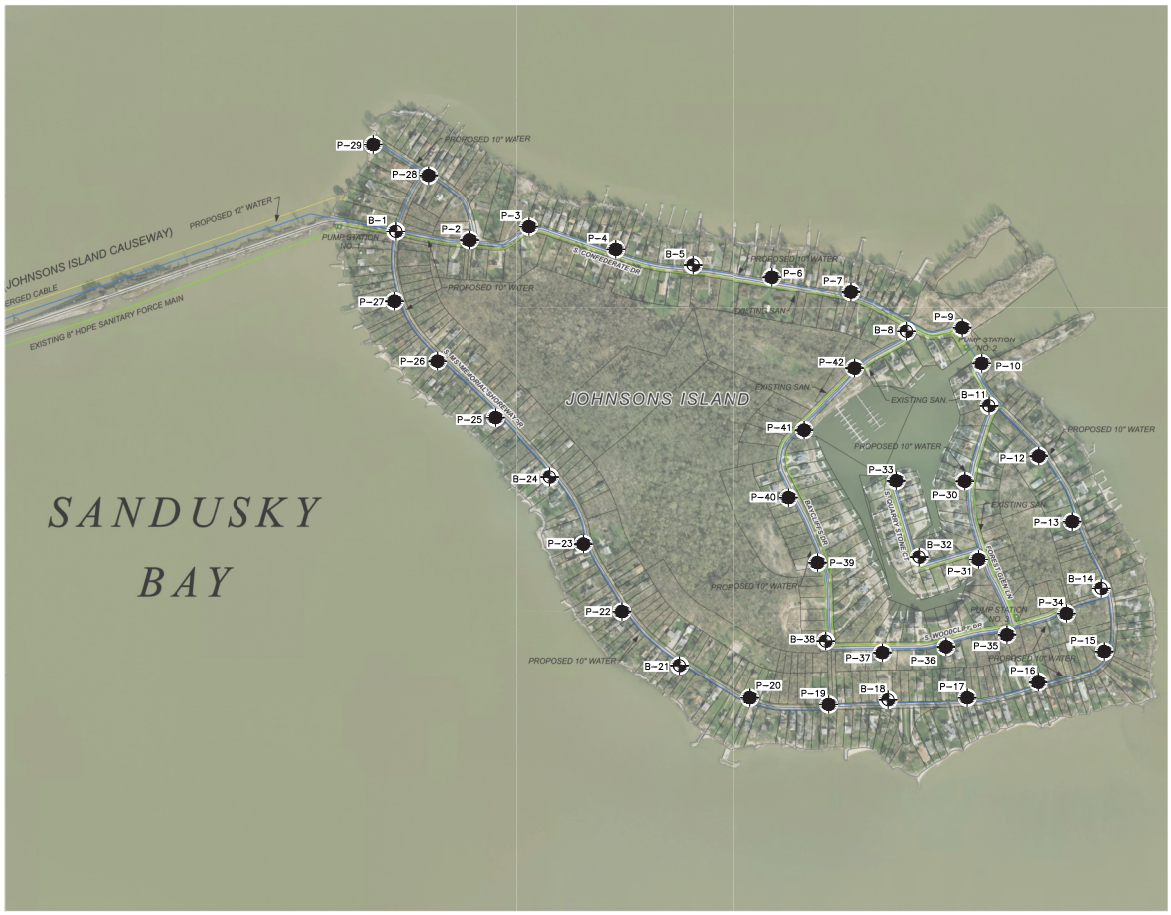
PLATE 1.0
SITE LOCATION MAP

PROPOSED WATERLINE INSTALLATION
JOHNSON'S ISLAND, MARBLEHEAD, OHIO

PREPARED FOR
VILLAGE OF MARBLEHEAD
MARBLEHEAD, OHIO

DRAWN	CLW/01–19–15	CHECKED	CS/01–19–15
REVISED		APPROVED	
JOB NO.	11903.01		
DRAWING NUMBER	**1190301–01G**		

ATL associates inc
Environmental, Geotechnical Engineering & Testing



BASE DRAWING "JOHNSONISLAND_REPORT11X17" PROVIDED BY CT CONSULTANTS ON DECEMBER 29, 2014.

N

LEGEND

B-1 APPROXIMATE LOCATION OF TEST BORING WITH SOIL SAMPLING

P-2 APPROXIMATE LOCATION OF AUGER PROBE WITHOUT SOIL SAMPLING

APPROXIMATE SCALE – FEET

0 600 1,200

PLATE 2.0
TEST BORING LOCATION PLAN
PROPOSED WATERLINE INSTALLATION
JOHNSON'S ISLAND, MARBLEHEAD, OHIO

PREPARED FOR
VILLAGE OF MARBLEHEAD
MARBLEHEAD, OHIO

DRAWN	CLW/01-19-15	CHECKED	CS/01-19-15
REVISED		APPROVED	
JOB NO.	11903.01		
DRAWING NUMBER	1190301-02G		

ITL associates inc

TTL Associates, Inc.
1915 N 12th Street
Toledo, Ohio 43624
Telephone: 419-324-2222
Fax: 419-241-1808

BORING NUMBER B-01

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/16/15
COMPLETED 1/16/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES Auger refusal encountered at a depth of 3.3 feet.
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF. COMP. STR. (tsf)	DRY UNIT WT. (pcf)	PL MC LL / SPT N VALUE
	0.0		ASPHALT - 3 Inches						
			0.3' CRUSHED STONE - 13 Inches						
			1.3' Moist Very Stiff to Hard Gray LEAN CLAY w/Sand, Trace Gravel, and Calcite Stain Seam (CL)	SS 1	79	20-20-12-12 (32)	3.75		16
	2.5		3.1' Moist Very Dense Brown/Gray WEATHERED LIMESTONE w/Clay	SS 2	100	50/2"	NP		>>
			3.3' Bottom of hole at 3.3 feet.						

PL MC LL
20 40 60 80
▲ SPT N VALUE ▲
20 40 60 80

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Fax: 419-241-1808

BORING NUMBER P-02

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/16/15
COMPLETED 1/16/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES Auger refusal encountered at a depth of 7.5 feet.
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF. COMP. STR. (tsf)	DRY UNIT WT. (pcf)	PL MC LL / SPT N VALUE
	0.0		ASPHALT - 2 Inches						
			0.2'						
			CRUSHED STONE - 10 Inches						
			1.0'						
			Moist Brown LEAN CLAY w/Sand and Trace Gravel (CL)						
	2.5								
			4.5'						
			POSSIBLE COBBLES and/or BOULDERS						
	5.0		5.0'						
			Moist Brown LEAN CLAY w/Sand and Trace Gravel (CL)						
			7.0'						
			Moist Brown WEATHERED LIMESTONE						
	7.5		7.5'						
			Bottom of hole at 7.5 feet.						

PL MC LL
20 40 60 80
▲ SPT N VALUE ▲
20 40 60 80

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BORING NUMBER P-03

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/16/15
COMPLETED 1/16/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES Auger refusal encountered at a depth of 4.0 feet.
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	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
	0.0		ASPHALT - 3 Inches 0.3'						
			CRUSHED STONE - 21 Inches 2.0'						
	2.5		Moist Brown LEAN CLAY w/Sand and Trace Gravel (CL) 4.0'						
			Bottom of hole at 4.0 feet.						

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BORING NUMBER P-04

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/16/15
COMPLETED 1/16/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES Auger refusal encountered at a depth of 4.2 feet.
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	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
	0.0		ASPHALT - 3 Inches						
			0.3'						
			CRUSHED STONE - 21 Inches						
			2.0'						
	2.5		Moist Brown LEAN CLAY w/Sand and Trace Gravel (CL)						
			4.0'						
			Moist Brown WEATHERED LIMESTONE						
			4.2'						
			Bottom of hole at 4.2 feet.						

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BORING NUMBER B-05

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/16/15
COMPLETED 1/16/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES Auger refusal encountered at a depth of 5.3 feet.
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF. COMP. STR. (tsf)	DRY UNIT WT. (pcf)	PL MC LL / SPT N VALUE
	0.0		ASPHALT - 3 Inches						
			0.3' Moist Very Dense Gray CRUSHED STONE w/Clay	SS 1	75	30-50/2"	NP		10 ● >>▲
			2.0' Moist Hard Gray/Brown LEAN CLAY w/Sand, Trace Gravel, Iron Oxide, and Calcite Stain Seam (CL)						
	2.5			SS 2	83	12-28-40-33 (68)	>4.5		12 ● ▲
	5.0		5.0' Moist Very Dense Brown WEATHERED LIMESTONE w/Clay	SS 3	100	50/1"	NP		>>▲
			5.3' Bottom of hole at 5.3 feet.						

PL MC LL
20 40 60 80
▲ SPT N VALUE ▲
20 40 60 80

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BORING NUMBER P-06

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/16/15
COMPLETED 1/16/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES Auger refusal encountered at a depth of 6.5 feet.
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	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
	0.0		ASPHALT - 3 Inches 0.3'						
			CRUSHED STONE - 21 Inches 2.0'						
	2.5		Moist Brown LEAN CLAY w/Sand and Trace Gravel (CL)						
	5.0		6.0'						
			Moist Brown WEATHERED LIMESTONE 6.5'						
			Bottom of hole at 6.5 feet.						

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BORING NUMBER P-07

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/15/15
COMPLETED 1/15/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES Auger refusal encountered at a depth of 2.5 feet.
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	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
	0.0		ASPHALT - 3 Inches 0.3'						
			CRUSHED STONE - 15 Inches 1.5'						
	2.5		Moist Brown LEAN CLAY w/Sand and Trace Limestone Fragments (CL) 2.5'						
			Bottom of hole at 2.5 feet.						

TTL_GEOTECH_STANDARD 11903.01.GPJ GINT US LAB.GDT 2/3/15

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BORING NUMBER B-08

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/13/15
COMPLETED 1/13/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES Auger refusal encountered at a depth of 1.2 feet.
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF. COMP. STR. (tsf)	DRY UNIT WT. (pcf)	PL MC LL / SPT N VALUE
	0.0		CRUSHED STONE - 12 Inches						
			1.0'						
			Moist Very Dense Gray WEATHERED LIMESTONE	SS 1		50/0"	NR		>>
			1.2'						
			Bottom of hole at 1.2 feet.						

PL MC LL
20 40 60 80
▲ SPT N VALUE ▲
20 40 60 80

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BORING NUMBER P-09

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/13/15 **COMPLETED** 1/13/15
AT TIME OF DRILLING None
LOGGED BY KKC **CHECKED BY** CAS
AT END OF DRILLING None
NOTES
0hrs AFTER DRILLING Backfilled w/Cuttings

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	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
	0.0		TOPSOIL - 1 Inch 0.1'						
			CRUSHED STONE - 11 Inches 1.0'						
			Moist Brown LEAN CLAY w/Sand, Trace Gravel, and Iron Oxide Stain Seam (CL)						
	2.5								
	5.0								
			@5.4': w/Trace Limestone Fragments and Calcite Stain Seam						
	7.5		8.0'						
			Bottom of hole at 8.0 feet.						

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BORING NUMBER P-10

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/13/15 **COMPLETED** 1/13/15
AT TIME OF DRILLING None
LOGGED BY KKC **CHECKED BY** CAS
AT END OF DRILLING None
NOTES Auger refusal encountered at a depth of 6.5 feet.
0hrs AFTER DRILLING Backfilled w/Cuttings

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	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
	0.0		TOPSOIL - 1 Inch 0.1'						
			CRUSHED STONE - 17 Inches 1.5'						
			Moist Brown WEATHERED LIMESTONE						
	2.5								
	5.0								
			6.5'						
			Bottom of hole at 6.5 feet.						

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BORING NUMBER B-11

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/14/15
COMPLETED 1/14/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES Auger refusal encountered at a depth of 5.7 feet.
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF. COMP. STR. (tsf)	DRY UNIT WT. (pcf)	PL MC LL / ▲ SPT N VALUE ▲
	0.0		ASPHALT - 3 Inches						20 40 60 80
			0.3' CRUSHED STONE - 14 Inches						
			1.4' Moist Very Stiff Brown GRAVELLY LEAN CLAY w/Trace Sand and Limestone Fragments (CL)	SS 1	100	50/3"	NI		14 >>
	2.5			SS 2	79	5-11-11-11 (22)	3.50		19
	5.0		5.2' Mosit Very Dense Gray WEATHERED LIMESTONE	SS 3	50	50/4"	NP		>>
			5.7' Bottom of hole at 5.7 feet.						

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BORING NUMBER P-12

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/14/15
COMPLETED 1/14/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	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
	0.0		ASPHALT - 3 Inches 0.3'						
			CRUSHED STONE - 9 Inches 1.0'						
			Moist Brown LEAN CLAY w/Sand and Trace Gravel (CL)						
	2.5		3.5'						
			POSSIBLE COBBLES and/or BOULDERS 4.0'						
			Moist Brown LEAN CLAY w/Sand and Trace Gravel (CL)						
	5.0		6.5'						
			Moist Brown WEATHERED LIMESTONE						
	7.5		8.0'						
			Bottom of hole at 8.0 feet.						

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BORING NUMBER P-13

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/14/15
COMPLETED 1/14/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES Auger refusal encountered at a depth of 4.0 feet.
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	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
	0.0		ASPHALT - 3 Inches 0.3'						
			CRUSHED STONE - 9 Inches 1.0'						
			Moist Brown LEAN CLAY w/Sand (CL) 2.0'						
	2.5		Moist Brown WEATHERED LIMESTONE 4.0'						
			Bottom of hole at 4.0 feet.						

TTL_GEOTECH_STANDARD 11903.01.GPJ GINT US LAB.GDT 2/3/15

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BORING NUMBER B-14

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/14/15
COMPLETED 1/14/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES Auger refusal encountered at a depth of 3.5 feet.
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF. COMP. STR. (tsf)	DRY UNIT WT. (pcf)	PL MC LL / SPT N VALUE
	0.0		ASPHALT - 3 Inches						
			0.3' CRUSHED STONE - 9 Inches						
			1.0' Moist Very Stiff to Hard Brown LEAN CLAY w/Sand and Trace Limestone Fragments (CL)	SS 1	86	11-15-42-50/3" (57)	3.50		15 ● ▲
			2.0' Moist Very Dense Brown WEATHERED LIMESTONE						
	2.5			SS 2		50/0"	NR		>>▲
			3.5' Bottom of hole at 3.5 feet.						

PL MC LL
20 40 60 80
▲ SPT N VALUE ▲
20 40 60 80

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BORING NUMBER P-15

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/14/15
COMPLETED 1/14/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	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
	0.0		ASPHALT - 3 Inches 0.3'						
			CRUSHED STONE - 9 Inches 1.0'						
			Moist Brown LEAN CLAY w/Sand and Trace Gravel (CL)						
	2.5								
	5.0								
	7.5		8.0'						
			Bottom of hole at 8.0 feet.						

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BORING NUMBER P-16

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/14/15
COMPLETED 1/14/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	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
	0.0		ASPHALT - 3 Inches 0.3'						
			CRUSHED STONE - 9 Inches 1.0'						
			Moist Brown LEAN CLAY w/Sand and Trace Gravel (CL)						
	2.5								
	5.0								
	7.5		8.0'						
			Bottom of hole at 8.0 feet.						

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BORING NUMBER P-17

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/14/15
COMPLETED 1/14/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	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
	0.0		ASPHALT - 3 Inches						
			0.3' CRUSHED STONE - 11 Inches						
			1.2' Moist Brown LEAN CLAY w/Sand and Trace Gravel (CL)						
	2.5								
	5.0								
	7.5								
			8.0' Bottom of hole at 8.0 feet.						

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BORING NUMBER B-18

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/15/15
COMPLETED 1/15/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES Auger refusal encountered at a depth of 7.6 feet.
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF. COMP. STR. (tsf)	DRY UNIT WT. (pcf)	PL MC LL / SPT N VALUE
	0.0		ASPHALT - 3 Inches						
			0.3' CRUSHED STONE - 11 Inches						
			1.2' Moist Very Stiff to Hard Brown LEAN CLAY w/Sand (CL)	SS 1	75	25-25-15-15 (40)	3.00		19
	2.5		@2': w/Trace Limestone Fragments and Calcite Stain Seam						
			@3': Hard	SS 2	75	8-16-25-25 (41)	>4.5		12
	5.0			SS 3	75	11-21-30-33 (51)	>4.5		15
			@7': w/Limestone Fragments	SS 4	60	50/5"	>4.5		>>▲
	7.5		7.6' Bottom of hole at 7.6 feet.						

PL MC LL
20 40 60 80
▲ SPT N VALUE ▲
20 40 60 80

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Fax: 419-241-1808

BORING NUMBER P-19

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/15/15
COMPLETED 1/15/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES Auger refusal encountered at a depth of 2.0 feet.
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	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
	0.0		ASPHALT - 3 Inches 0.3'						
			CRUSHED STONE - 11 Inches 1.2'						
			Moist Brown WEATHERED LIMESTONE 2.0'						
			Bottom of hole at 2.0 feet.						

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BORING NUMBER P-20

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/15/15
COMPLETED 1/15/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	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
	0.0		ASPHALT - 3 Inches						
			0.3' CRUSHED STONE - 12 Inches						
			1.3' Moist Brown LEAN CLAY w/Sand and Trace Gravel (CL)						
	2.5								
	5.0								
	7.5								
			8.0' Bottom of hole at 8.0 feet.						

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BORING NUMBER B-21

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/15/15
COMPLETED 1/15/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES Auger refusal encountered at a depth of 4.5 feet.
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF. COMP. STR. (tsf)	DRY UNIT WT. (pcf)	PL MC LL / SPT N VALUE
	0.0		ASPHALT - 3 Inches						
			0.3' CRUSHED STONE - 12 Inches						
			1.3' Moist Very Stiff to Hard Gray/Brown LEAN CLAY w/Sand, Trace Limestone Fragments, and Calcite Stain Seam (CL)	SS 1	75	32-11-9-9 (20)	>4.5		19
	2.5		@3': Hard	SS 2	71	7-14-50/2"	>4.5		16 >>▲
			4.0' Mosit Very Dense Brown WEATHERED LIMESTONE						
			4.5' Bottom of hole at 4.5 feet.						

PL 20 MC 40 LL 60 80
▲ SPT N VALUE ▲
20 40 60 80

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BORING NUMBER P-22

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/15/15
COMPLETED 1/15/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES Auger refusal encountered at a depth of 1.5 feet.
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	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
	0.0		ASPHALT - 3 Inches 0.3'						
			CRUSHED STONE - 11 Inches 1.2'						
			Moist Brown WEATHERED LIMESTONE 1.5'						
			Bottom of hole at 1.5 feet.						

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BORING NUMBER P-23

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/15/15
COMPLETED 1/15/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES Auger refusal encountered at a depth of 7.5 feet.
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	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
	0.0		ASPHALT - 3 Inches						
			0.3' CRUSHED STONE - 11 Inches						
			1.2' Moist Brown LEAN CLAY w/Sand and Trace Gravel (CL)						
	2.5								
	5.0								
			6.8' Moist Brown WEATHERED LIMESTONE						
	7.5		7.5' Bottom of hole at 7.5 feet.						

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BORING NUMBER B-24

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/15/15
COMPLETED 1/15/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES Auger refusal encountered at a depth of 7.9 feet.
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF. COMP. STR. (tsf)	DRY UNIT WT. (pcf)	PL MC LL / SPT N VALUE
	0.0		ASPHALT - 3 Inches						
			0.3' CRUSHED STONE - 15 Inches						
			1.5' Moist Very Stiff Brown LEAN CLAY w/Sand and Trace Calcite Stain Seam (CL)	SS 1	100	6-8-12-15 (20)	3.75		21
	2.5		3.0' Moist Hard Brown LEAN CLAY w/Sand, Trace Gravel, and Iron Oxide Stain Seam (CL)	SS 2	100	31-21-10-10 (31)	>4.5		18
	5.0		@5': Calcite Stain Seam	SS 3	100	8-16-18-20 (34)	>4.5		17
	7.5		7.5' Moist Very Dense Brown WEATHERED LIMESTONE 7.9'	SS 4	100	7-50/5"	>4.5		>>
			Bottom of hole at 7.9 feet.						

PL MC LL
20 40 60 80
▲ SPT N VALUE ▲
20 40 60 80

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BORING NUMBER P-25

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/15/15
COMPLETED 1/15/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	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
	0.0		ASPHALT - 3 Inches						
			0.3'						
			CRUSHED STONE - 11 Inches						
			1.2'						
			Moist Brown LEAN CLAY w/Sand (CL)						
	2.5								
	5.0								
	7.5								
			8.0'						
			Bottom of hole at 8.0 feet.						

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BORING NUMBER P-26

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/15/15
COMPLETED 1/15/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	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
	0.0		ASPHALT - 3 Inches						
			0.3'						
			CRUSHED STONE - 11 Inches						
			1.2'						
			BOULDERS and/or CRUSHED ROCK - POSSIBLE FILL						
	2.5								
			3.8'						
			Moist Brown LEAN CLAY w/Sand and Trace Gravel (CL)						
	5.0								
			@7': w/Trace Limestone Fragments						
	7.5								
			8.0'						
			Bottom of hole at 8.0 feet.						

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BORING NUMBER P-27

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/15/15
COMPLETED 1/15/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	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
	0.0		ASPHALT - 3 Inches						
			0.3'						
			CRUSHED STONE - 12 Inches						
			1.3'						
			Moist Brown LEAN CLAY w/Sand and Trace Gravel (CL)						
	2.5								
	5.0								
	7.5								
			8.0'						
			Bottom of hole at 8.0 feet.						

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BORING NUMBER P-28

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/15/15
COMPLETED 1/15/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES Auger refusal encountered at a depth of 6.5 feet.
0hrs AFTER DRILLING Backfilled w/Cuttings

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	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
	0.0		CRUSHED STONE - 12 Inches						
			1.0'						
			Moist Brown LEAN CLAY w/Sand and Trace Gravel (CL)						
	2.5								
	5.0								
			6.0'						
			Moist Brown WEATHERED LIMESTONE						
			6.5'						
			Bottom of hole at 6.5 feet.						

TTL_GEOTECH_STANDARD 11903.01.GPJ GINT US LAB.GDT 2/3/15

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BORING NUMBER P-29

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/15/15
COMPLETED 1/15/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES Auger refusal encountered at a depth of 6.8 feet.
0hrs AFTER DRILLING Backfilled w/Cuttings

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	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
	0.0		TOPSOIL - 2 Inches 0.2'						
			CRUSHED STONE - 8 Inches 0.8'						
			Moist Brown LEAN CLAY w/Sand and Trace Gravel (CL)						
	2.5		3.0'						
			Moist Brown WEATHERED LIMESTONE						
	5.0		6.8'						
			Bottom of hole at 6.8 feet.						

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BORING NUMBER P-30

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/14/15
COMPLETED 1/14/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	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
	0.0		ASPHALT - 3 Inches						
			0.3' CRUSHED STONE - 12 Inches						
			1.3' Moist Brown LEAN CLAY w/Sand, Trace Gravel, and Limestone Fragments (CL)						
	2.5								
	5.0								
	7.5								
			8.0' Bottom of hole at 8.0 feet.						

TTL_GEOTECH_STANDARD 11903.01.GPJ GINT US LAB.GDT 2/3/15

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BORING NUMBER P-31

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/14/15
COMPLETED 1/14/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	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
	0.0		ASPHALT - 3 Inches						
			0.3' CRUSHED STONE - 18 Inches						
			1.8' Moist Brown LEAN CLAY w/Sand and Trace Gravel (CL)						
	2.5								
	5.0								
	7.5								
			8.0' Bottom of hole at 8.0 feet.						

TTL_GEOTECH_STANDARD 11903.01.GPJ GINT US LAB.GDT 2/3/15

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BORING NUMBER B-32

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/14/15
COMPLETED 1/14/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES Auger refusal encountered at a depth of 7.0 feet.
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF. COMP. STR. (tsf)	DRY UNIT WT. (pcf)	PL MC LL / SPT N VALUE
	0.0		ASPHALT - 3 Inches						
			0.3' FILL - Moist Very Dense Gray CRUSHED STONE	SS 1	100	50/3"	NP		>>
	2.5		@3': Dense	SS 2	50	29-16-18-15 (34)	NP		6
	5.0			SS 3	57	15-10-29-50/3" (39)	NP		
			6.8' Moist Very Dense Brown WEATHERED LIMESTONE 7.0' Bottom of hole at 7.0 feet.						

PL MC LL
20 40 60 80
▲ SPT N VALUE ▲
20 40 60 80

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BORING NUMBER P-33

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/14/15
COMPLETED 1/14/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES Auger refusal encountered at a depth of 2.5 feet.
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	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
	0.0		ASPHALT - 3 Inches 0.3'						
			CRUSHED STONE - 11 Inches 1.2'						
			Moist Brown WEATHERED LIMESTONE						
	2.5		2.5'						
			Bottom of hole at 2.5 feet.						

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BORING NUMBER P-34

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/16/15
COMPLETED 1/16/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES Auger refusal encountered at a depth of 6.5 feet.
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	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
	0.0		ASPHALT - 3 Inches						
			0.3' CRUSHED STONE - 21 Inches						
			2.0' Moist Brown LEAN CLAY w/Sand and Trace Gravel (CL)						
	2.5		4.5' Moist Brown WEATHERED LIMESTONE						
	5.0		6.5'						
			Bottom of hole at 6.5 feet.						

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BORING NUMBER P-35

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/13/15
COMPLETED 1/13/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES Auger refusal encountered at a depth of 2.2 feet.
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	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
	0.0		ASPHALT - 3 Inches 0.3'						
			CRUSHED STONE - 9 Inches 1.0'						
			Moist Brown WEATHERED LIMESTONE 2.2'						
			Bottom of hole at 2.2 feet.						

TTL_GEOTECH_STANDARD 11903.01.GPJ GINT US LAB.GDT 2/3/15

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BORING NUMBER P-36

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/16/15
COMPLETED 1/16/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES Auger refusal encountered at a depth of 4.0 feet.
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	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
	0.0		ASPHALT - 3 Inches 0.3'						
			FILL - Moist Brown CRUSHED STONE						
			@1': Brown/Gray						
	2.5		4.0'						
			Bottom of hole at 4.0 feet.						

TTL Associates, Inc.
1915 N 12th Street
Toledo, Ohio 43624
Telephone: 419-324-2222
Fax: 419-241-1808

BORING NUMBER P-37

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/13/15
COMPLETED 1/13/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES Auger refusal encountered at a depth of 6.1 feet.
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	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
	0.0		ASPHALT - 3 Inches						
			0.3'						
			CRUSHED STONE - 11 Inches						
			1.1'						
			BOULDERS and/or CRUSHED ROCK - POSSIBLE FILL						
	2.5								
			3.4'						
			Moist Brown LEAN CLAY w/Sand and Trace Gravel (CL)						
	5.0								
			5.8'						
			Moist Brown WEATHERED LIMESTONE						
			6.1'						
			Bottom of hole at 6.1 feet.						

TTL Associates, Inc.
1915 N 12th Street
Toledo, Ohio 43624
Telephone: 419-324-2222
Fax: 419-241-1808

BORING NUMBER B-38

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/13/15 **COMPLETED** 1/13/15
AT TIME OF DRILLING None
LOGGED BY KKC **CHECKED BY** CAS
AT END OF DRILLING None
NOTES
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF. COMP. STR. (tsf)	DRY UNIT WT. (pcf)	PL MC LL / SPT N VALUE
	0.0		ASPHALT - 3 Inches						
			0.3'						
			CRUSHED STONE - 9 Inches						
			1.0'						
			FILL - CRUSHED ROCK	SS 1	100	50/4"	NP		4 >>
			2.3'						
	2.5		Moist Very Stiff to Hard Brown LEAN CLAY w/Sand, Trace Gravel, Iron Oxide, and Calcite Stain Seam (CL)						
				SS 2	67	12-12-12-17 (24)	>4.5		19
	5.0		@5': Hard						
				SS 3	67	16-18-20-27 (38)	>4.5		12
	7.5								
				SS 4	75	27-27-36-41 (63)	>4.5		15
			9.0'						
			Bottom of hole at 9.0 feet.						

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Toledo, Ohio 43624
Telephone: 419-324-2222
Fax: 419-241-1808

BORING NUMBER P-39

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/13/15
COMPLETED 1/13/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES Auger refusal encountered at a depth of 4.0 feet.
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	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
	0.0		ASPHALT - 3 Inches 0.3'						
			CRUSHED STONE - 9 Inches 1.0'						
			Moist Brown WEATHERED LIMESTONE						
	2.5		4.0'						
			Bottom of hole at 4.0 feet.						

TTL Associates, Inc.
1915 N 12th Street
Toledo, Ohio 43624
Telephone: 419-324-2222
Fax: 419-241-1808

BORING NUMBER P-40

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/13/15
COMPLETED 1/13/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES Auger refusal encountered at a depth of 3.1 feet.
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	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
	0.0		ASPHALT - 3 Inches 0.3'						
			CRUSHED STONE - 9 Inches 1.0'						
			Moist Brown WEATHERED LIMESTONE						
	2.5		3.1'						
			Bottom of hole at 3.1 feet.						

TTL_GEOTECH_STANDARD 11903.01.GPJ GINT US LAB.GDT 2/3/15

TTL Associates, Inc.
1915 N 12th Street
Toledo, Ohio 43624
Telephone: 419-324-2222
Fax: 419-241-1808

BORING NUMBER P-41

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/13/15
COMPLETED 1/13/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES Auger refusal encountered at a depth of 3.6 feet.
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	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
	0.0		ASPHALT - 3 Inches 0.3'						
			CRUSHED STONE - 9 Inches 1.0'						
			Moist Brown WEATHERED LIMESTONE						
	2.5		3.6'						
			Bottom of hole at 3.6 feet.						

TTL Associates, Inc.
1915 N 12th Street
Toledo, Ohio 43624
Telephone: 419-324-2222
Fax: 419-241-1808

BORING NUMBER P-42

CLIENT Village of Marblehead
PROJECT NAME Proposed Waterline Installation
PROJECT NUMBER 11903.01
PROJECT LOCATION Johnson's Island, Marblehead, OH
DRILLING CONTRACTOR TTL Associates CW Brad
RIG NO. 844
GROUND ELEVATION
DRILLING METHOD 3 in. SSA
GROUND WATER LEVELS:
DATE STARTED 1/13/15
COMPLETED 1/13/15
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CAS
AT END OF DRILLING None
NOTES Auger refusal encountered at a depth of 2.8 feet.
0hrs AFTER DRILLING Backfilled w/Cuttings and Asphalt Patch

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	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
	0.0		ASPHALT - 3 Inches 0.3'						
			CRUSHED STONE - 9 Inches 1.0'						
			Moist Brown WEATHERED LIMESTONE						
	2.5		2.8'						
			Bottom of hole at 2.8 feet.						

TTL_GEOTECH_STANDARD 11903.01.GPJ GINT US LAB.GDT 2/3/15

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 between January 13 and 16, 2015 using 3-inch diameter solid-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 test borings were staked in the field by CT Consultants, Inc.

4. Unconfined Compressive Strength (tsf):
   NR = No Recovery
   NP = Non-Plastic

PROJECT: Proposed Waterline Installation, Johnson's Island, Marblehead, Ohio	**TTL Associates, Inc.**	PROJECT NO: 11903.01

TABULATION OF TEST DATA

Boring Number	Sample Number	Sample Interval Depth (Feet)		Standard Penetration (Blows per Foot)	Natural Moisture Content (% of Dry Weight)	In-Place Dry Density (Pounds per Cubic Foot)	Unconfined Compressive Strength (Pounds per Square Foot)		Particle Size Distribution (%)						Atterberg Limits (%)			Unified Soil Classification
									Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay	Liquid Limit	Plastic Limit	Plasticity Index	
B-1	SS-1	1.0-3.0		32	16.4		*7,500											
	SS-2	3.0-3.2		SSR														
B-5	SS-1	1.0-1.7		SSR	9.6													
	SS-2	3.0-5.0		68	11.7		*9,000+											
	SS-3	5.0-5.1		SSR														
B-8	SS-1	1.0-1.0																
B-11	SS-1	1.0-1.3		SSR	14.2													
	SS-2	3.0-5.0		22	19.1		*7,000		22	1	3	5	16	53	42	21	21	CL
	SS-3	5.0-5.3		SSR														
B-14	SS-1	1.0-2.8		SSR	15.4		*7,000											
	SS-2	3.0-3.0																

SSR = Split-Spoon Refusal

*Unconfined compressive strength derived from a calibrated hand penetrometer

PROJECT: Proposed Waterline Installation, Johnson's Island, Marblehead, Ohio	**TTL Associates, Inc.**	PROJECT NO: 11903.01

TABULATION OF TEST DATA

Boring Number	Sample Number	Sample Interval Depth (Feet)		Standard Penetration (Blows per Foot)	Natural Moisture Content (% of Dry Weight)	In-Place Dry Density (Pounds per Cubic Foot)	Unconfined Compressive Strength (Pounds per Square Foot)		Particle Size Distribution (%)						Atterberg Limits (%)			Unified Soil Classification
									Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay	Liquid Limit	Plastic Limit	Plasticity Index	
B-18	SS-1	1.0-3.0		40	18.8		*6,000											
	SS-2	3.0-5.0		41	12.3		*9,000+											
	SS-3	5.0-7.0		51	14.7		*9,000+											
	SS-4	7.0-7.4		SSR			*9,000+											
B-21	SS-1	1.0-3.0		20	19.0		*9,000+											
	SS-2	3.0-4.2		SSR	16.2		*9,000+											
B-24	SS-1	1.0-3.0		20	21.1		*7,500											
	SS-2	3.0-5.0		31	18.0		*9,000+											
	SS-3	5.0-7.0		34	16.7		*9,000+		9	3	2	6	20	60	36	20	16	CL
	SS-4	7.0-7.9		SSR			*9,000+											
B-32	SS-1	1.0-1.3		SSR														
	SS-2	3.0-5.0		34	5.6													
	SS-3	5.0-6.8		SSR														

SSR = Split-Spoon Refusal

*Unconfined compressive strength derived from a calibrated hand penetrometer

PROJECT: Proposed Waterline Installation, Johnson's Island, Marblehead, Ohio	**TTL Associates, Inc.**	PROJECT NO: 11903.01

TABULATION OF TEST DATA

Boring Number	Sample Number	Sample Interval Depth (Feet)		Standard Penetration (Blows per Foot)	Natural Moisture Content (% of Dry Weight)	In-Place Dry Density (Pounds per Cubic Foot)	Unconfined Compressive Strength (Pounds per Square Foot)		Particle Size Distribution (%)						Atterberg Limits (%)			Unified Soil Classification
									Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay	Liquid Limit	Plastic Limit	Plasticity Index	
B-38	SS-1	1.0-1.3		SSR	3.9													
	SS-2	3.0-5.0		24	18.9		*9,000+											
	SS-3	5.0-7.0		38	12.1		*9,000+											
	SS-4	7.0-9.0		63	14.8		*9,000+											

SSR = Split-Spoon Refusal

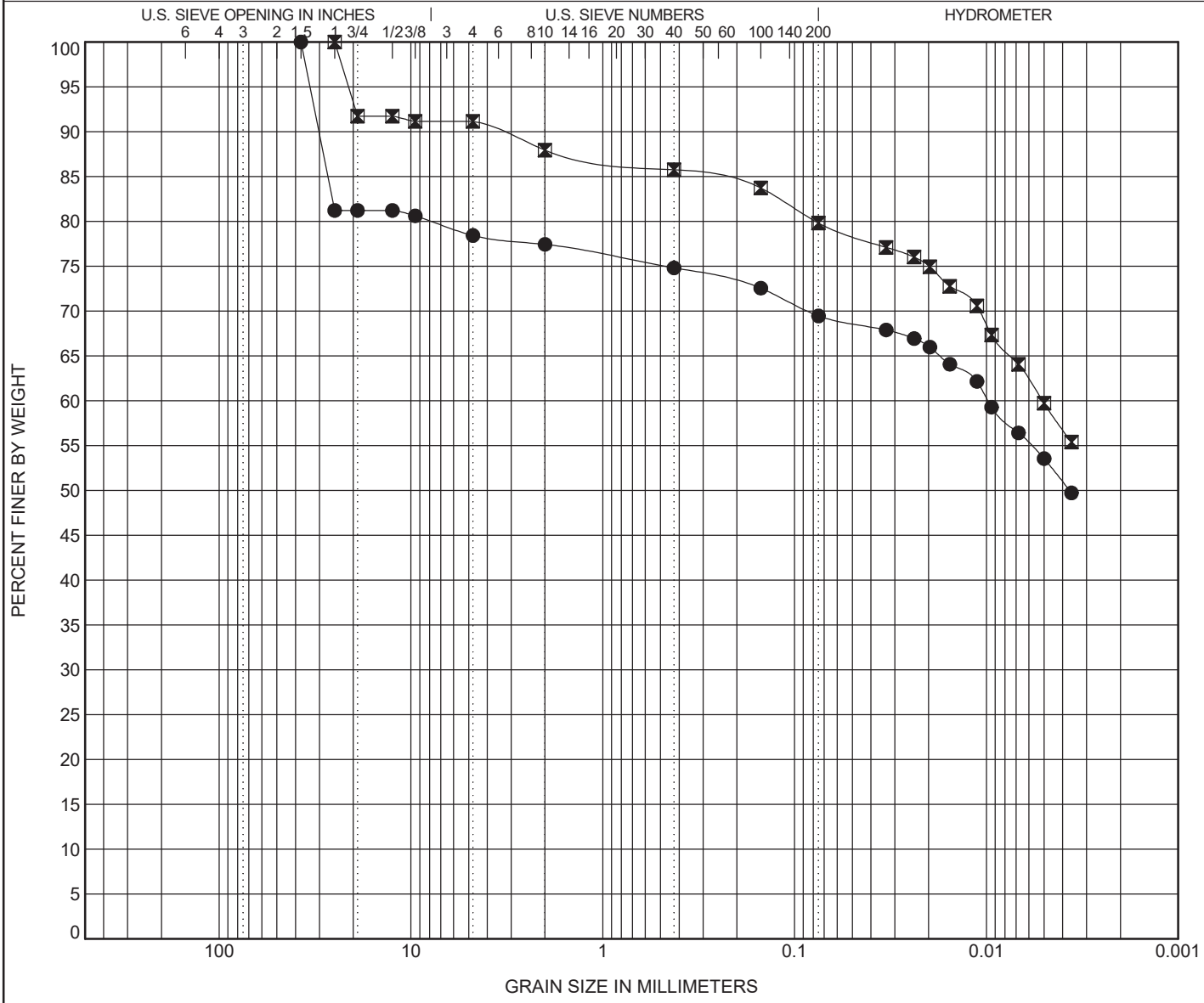
*Unconfined compressive strength derived from a calibrated hand penetrometer

TTL Associates, Inc.
1915 N 12th Street
Toledo, Ohio 43624
Telephone: 419-324-2222
Fax: 419-241-1808

GRAIN SIZE DISTRIBUTION

CLIENT Village of Marblehead **PROJECT NAME** Proposed Waterline Installation

PROJECT NUMBER 11903.01 **PROJECT LOCATION** Johnson's Island, Marblehead, OH



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		USCS Classification	LL	PL	PI	Cc	Cu
●	B-11	3.0	GRAVELLY LEAN CLAY (CL)	42	21	21		
⊠	B-24	5.0	LEAN CLAY with SAND (CL)	36	20	16		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-11	3.0	37.5	0.01			21.6	9.0	15.9	53.5
⊠	B-24	5.0	25	0.005			8.9	11.3	20.1	59.7

GRAIN SIZE 11903.01.GPJ GINT US LAB.GDT 2/3/15

Memorandum

To:	Quinn Baker, Dan Barr CT
From:	Imad El Hajjar – CT
Subject:	Johnson Island Waterline Project – Supplemental Subsurface Investigations
Date:	September 18, 2023

Following are our recommendations related to the excavation of the underlying bedrock at the site. A full subsurface investigation was completed by TTL associates in January 2015 for the proposed waterline installation project. Subsequently, CT performed a supplemental subsurface exploration in June 2023 to evaluate the depth of bedrock throughout the island with respect to the proposed waterline alignment.

General Site Conditions

At the time of our investigation, the project area consisted of primarily residential properties. Ground surface elevations at the boring locations ranged from Elevs. 577 to 583 feet.

The thickness of the pavement materials and encountered underlying subgrade soils in the borings are summarized in the following table.

Boring Number	Pavement Thickness (in)	
	Asphalt	Aggregate Base
B-1	6	9
B-2	5	12
B-3	5	9
B-6	5	10

General Soil and Rock Conditions

Based on the results of our supplemental field and laboratory tests, the subsoils encountered underlying the pavement in Borings B-3 and B-4 l materials consisted of predominantly stiff to hard stiff cohesive soils.

The Cohesive soils consisted of predominantly lean clay with sand or lean Clay (CL), mixed with sand and trace amounts of gravel. SPT N-values generally ranged from 9 to 82 blows per foot (bpf). Unconfined compressive strengths were consistently greater than 9,000 pound per square foot (psf) (The highest attainable value using a hand penetrometer). Moisture contents ranged from 12 to 19 percent.

Severely Weathered Bedrock was encountered underlying the surface material in Borings B-1 and B-2 and underlying the above noted subsoils in Borings B-3 and B-4. This layer consisted of fragments of decomposed dolomite and was encountered at approximately 1½ to 11 feet below existing grades (Elev. 582± to 571±). This weathered portion of the bedrock was severely weathered and decomposed such that it was augerable and was found to range in thickness from 2½ to 21½ inches. Within the severely weathered rock, the SPT generally resulted in split-spoon refusal (SSR, 50 or more blows over 6 inches or less penetration). Moisture contents ranged from 2 to 8 percent.

Bedrock consisting of dolomite was encountered in all the borings at approximately 3 to 11 feet (Elev. 579± to 571±). The depths of encountered rock are summarized in the following table. Rock core runs were obtained upon auger refusal in all the supplemental Borings. Rock core data and unconfined compressive strength test results for selected intact specimens from each supplemental boring are summarized in the following table.

Boring No.	Ground Surface Elev. (feet)	Depth to Corable Bedrock (feet)	Top of Bedrock Elev. (feet)	Rock Core Run No.	Recovery (%)	RQD (%)	Unconfined Compressive Strength (psi)
B-1	577	3.1	573.9	RC-1	33	10	10,780

Boring No.	Ground Surface Elev. (feet)	Depth to Corable Bedrock (feet)	Top of Bedrock Elev. (feet)	Rock Core Run No.	Recovery (%)	RQD (%)	Unconfined Compressive Strength (psi)
B-2	583	3.7	579.3	RC-1	100	73	7,010
B-3	582	11.2	570.8	RC-1	100	52	20,140
B-4	583	11.2	571.8	RC-1	100	90	19,340

Evaluations of rock mass quality and rock strength were made based on the cored bedrock. The rock core recovery ranged from 33 to 100 percent for the cores obtained. RQD values for the core runs ranged from 10 to 90 percent, indicating the rock mass quality of the bedrock can be generally described as poor to fair. The retrieved rock specimens exhibited nearly horizontal bedding; fractures in the core were generally nearly horizontal. Four (4) intact specimens were tested for compressive strength, and those test results (summarized in the table above) are indicative of slightly strong to very strong characterization. Rock core photographic logs are attached to this report in Appendix C.

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

Excavation Recommendations

The sides of the temporary excavations for underground utilities installation should be adequately sloped to provide stable sides and safe working conditions. If the proposed underground utilities alignment requires working in close proximity to existing underground utilities or other structures, this may not be possible. Where sloped excavations will not be used, the excavation must be properly braced against lateral

movements. In any case, applicable OSHA safety standards must be followed. It is the responsibility of the installation contractor to develop appropriate installation methods and equipment prior to commencement of work, and to obtain the services of a geotechnical engineer to design or approve sloped or benched excavations and/or lateral bracing systems as required by OSHA criteria. While not anticipated, any excavations greater than 20 feet deep should be evaluated by a registered professional engineer.

If the excavation is to be performed with sloped banks, adequate stable slopes must be provided. Based on the borings drilled for this investigation, soils encountered in trench excavations may include one or more of the following:

- Stable Rock (rock that can be excavated with vertical sides and remain intact while exposed),
- 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 dry rock), and
- OSHA Type C soils (granular soils and fill materials).

Vertical side slopes are acceptable for temporary excavations in stable rock. Based on the variability of the RQD values of the cored rock which ranged from 10 to 90 percent, we recommend that temporary excavations in bedrock be considered borderline material and treated as Type B materials unless test excavations are performed to substantiate use of the Stable Rock designation.

For temporary excavations in Type A, B and C soils, side slopes must be no steeper than ¾ horizontal to 1 vertical (¾H:1V), 1H:1V, and 1½H:1V, respectively. For situations where a higher strength soil is underlain by a lower strength soil and the excavation extends into the lower strength soil (including excavation through cohesive soils that are underlain by granular soils or bedrock), the slope of the entire excavation is governed by that required for 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 excavations and 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.

Based on the conditions encountered in the test borings, the probable method of excavation within the “severely weathered shale” zone which was penetrable with augers is expected to consist of conventional excavation equipment such as a backhoe or track excavator, with some assistance from pneumatic chippers, jackhammers, or hydraulic wedging equipment. However, excavation into the more intact bedrock beyond the depth of auger refusal is expected to be unproductive and uneconomical with conventional excavation equipment. Excavations that must extend into this zone will likely require use of hard rock removal methods or blasting. Based on the rock coring and unconfined compressive strength testing performed, it is anticipated that equipment including pneumatic chippers, jackhammers, or hydraulic wedging equipment may not be sufficient to rip and dig the rock. It is likely that there may be some areas beyond the depth of auger refusal that will require drilling and use of blasting or expansive chemicals to fracture and loosen the rock.

Plates

Notes: Aerial Basemap obtained From Google Earth and dated 03/20/2021.

Site Location Map

Johnsons Island Waterline Project
Marblehead, Ohio

Village of Marblehead

DRAWN:	RK 09/13/23
REVISED:	---
Project No.:	210900
Drawing No.:	Plate 1.0

LEADING THROUGH the next 100 years
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Legend:

B-1

Approximate Supplemental Test Boring Location

0' 625' 1250'

N

Notes: Aerial Basemap obtained From Google Earth and dated 07/01/2022

Test Boring Location Plan

Johnsons Island Waterline Project
Marblehead, Ohio

Village of Marblehead

DRAWN:	RK 09/13/23
REVISED:	---
Project No.:	210900
Drawing No.:	Plate 2.0

100 YEARS
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APPENDIX A

Logs of Test Borings

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

BORING NUMBER B-1

CLIENT Village of Marblehead
PROJECT NAME Johnson Island Waterline Project
PROJECT NUMBER 210900
PROJECT LOCATION Marblehead, OH
DRILLING CONTRACTOR CT Consultants Inc. JP DC
RIG NO. 844
GROUND ELEVATION 577 ft
DRILLING METHOD 3-1/4 in. HSA
GROUND WATER LEVELS:
DATE STARTED 6/30/23
COMPLETED 6/30/23
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY
AT END OF DRILLING None
NOTES Auger refusal emcountered at 3.1 feet and 5.0 feet of rock cored.
0hrs AFTER DRILLING Backfilled w/Cuttings and Bentonite Chips

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF. COMP. STR. (tsf)	DRY UNIT WT. (pcf)	PL MC LL / SPT N VALUE
	0		ASPHALT - 6 Inches						
			0.5' CRUSHED STONE - 9 Inches						
			1.3' Gray SEVERELY WEATHERED DOLOMITE w/Sand	SS 1	100	50/3"	NP		8 >>
575			3.1' Gray Moderetly to Highly Weathered, Moderetly to Highly Fractured, Strong DOLOMITE						
			@4.3': Qu - 10780 PSI				770	150	
	5			RC 1	33 (10)				
570			8.1'						
			Bottom of hole at 8.1 feet.						

PL MC LL
20 40 60 80
▲ SPT N VALUE ▲
20 40 60 80

TTL_GEOTECH_STANDARD 210900.GPJ GINT US LAB.GDT 9/18/23

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

BORING NUMBER B-2

CLIENT Village of Marblehead
PROJECT NAME Johnson Island Waterline Project
PROJECT NUMBER 210900
PROJECT LOCATION Marblehead, OH
DRILLING CONTRACTOR CT Consultants Inc. JP DC
RIG NO. 844
GROUND ELEVATION 583 ft
DRILLING METHOD 3-1/4 in. HSA
GROUND WATER LEVELS:
DATE STARTED 6/30/23 **COMPLETED** 6/30/23
AT TIME OF DRILLING None
LOGGED BY KKC **CHECKED BY**
AT END OF DRILLING None
NOTES Auger refusal emcountered at 3.7 feet and 5.0 feet of rock cored.
0hrs AFTER DRILLING Backfilled w/Cuttings and Bentonite Chips

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF. COMP. STR. (tsf)	DRY UNIT WT. (pcf)	PL MC LL / SPT N VALUE
	0		ASPHALT - 5 Inches						
			0.4' CRUSHED STONE - 12 Inches						
			1.4' Brown SEVERELY WEATHERED DOLOMITE w/Sand	SS 1	100	50/3"	NP		7 >>
580			3.7'						
	5		Brown Moderetly to Highly Weathered, Moderetly, Slight to Moderetly Fractured, Strong DOLOMITE @3.8': Qu - 7010 PSI	RC 1	100 (73)		504	148	
575			8.7' Bottom of hole at 8.7 feet.						

PL MC LL
20 40 60 80
▲ SPT N VALUE ▲
20 40 60 80

TTL_GEOTECH_STANDARD 210900.GPJ GINT US LAB.GDT 9/18/23

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

BORING NUMBER B-3

CLIENT Village of Marblehead
PROJECT NAME Johnson Island Waterline Project
PROJECT NUMBER 210900
PROJECT LOCATION Marblehead, OH
DRILLING CONTRACTOR CT Consultants Inc. JP DC
RIG NO. 844
GROUND ELEVATION 582 ft
DRILLING METHOD 3-1/4 in. HSA
GROUND WATER LEVELS:
DATE STARTED 6/30/23
COMPLETED 6/30/23
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY
AT END OF DRILLING None
NOTES Auger refusal emcountered at 11.2 feet and 5.0 feet of rock cored.
0hrs AFTER DRILLING Backfilled w/Cuttings and Bentonite Chips

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 / SPT N VALUE
	0	ASPHALT - 5 Inches						
		0.4' CRUSHED STONE - 9 Inches						
		1.2' Moist Stiff Brown LEAN CLAY w/Sand, Trace Gravel, and Iron Oxide Stain Seam (CL)	SS 1	100	4-4-5 (9)	>4.5		19
580		@3.5': Gray/Brown	SS 2	100	3-6-8 (14)	>4.5		19
	5	6.0' Moist Hard Gray/Brown LEAN CLAY w/Sand, Trace Gravel, and Iron Oxide Stain Seam (CL)	SS 3	100	13-20-22 (42)	>4.5		16
575		@8.5': Very Hard	SS 4	100	25-30-32 (62)	>4.5		17
	10	11.0' Brown/Gray SEVERELY WEATHERED DOLOMITE	SS 5	100	50/2"	NI		5 >>
		11.2' Brown/Gray Slighty to Moderetly Weathered, Slight to Moderetly Fractured, Very Strong DOLOMITE	RC 1	100	52			
570	15	@15': Qu - 20140 PSI				1447	167	
		16.2' Bottom of hole at 16.2 feet.						

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

BORING NUMBER B-4

CLIENT Village of Marblehead
PROJECT NAME Johnson Island Waterline Project
PROJECT NUMBER 210900
PROJECT LOCATION Marblehead, OH
DRILLING CONTRACTOR CT Consultants Inc. JP DC
RIG NO. 844
GROUND ELEVATION 583 ft
DRILLING METHOD 3-1/4 in. HSA
GROUND WATER LEVELS:
DATE STARTED 6/30/23
COMPLETED 6/30/23
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY
AT END OF DRILLING None
NOTES Auger refusal emcountered at 11.2 feet and 5.0 feet of rock cored.
0hrs AFTER DRILLING Backfilled w/Cuttings and Bentonite Chips

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 / SPT N VALUE
	0	ASPHALT - 5 Inches 0.4' CRUSHED STONE - 10 Inches 1.3' Moist Very Stiff Gray/Brown LEAN CLAY w/Sand, Trace Gravel, and Iron Oxide Stain Seam (CL)	SS 1	100	8-10-12 (22)	>4.5		19
580		3.5' Moist Hard Brown LEAN CLAY w/Sand, Trace Gravel, and Iron Oxide Stain Seam (CL)	SS 2	100	18-22-26 (48)	>4.5		12
	5	@6': Very Hard, Gray/Brown, w/Trace Calcite Stain	SS 3	100	20-22-32 (54)	>4.5		16
575		@8.5': Brown/Gray	SS 4	100	30-34-48 (82)	>4.5		12
	10	11.0' Brown/Gray SEVERELY WEATHERED DOLOMITE w/Clay and Sand	SS 5	100	50/1"	NP		2 >>
570		11.2' Brown/Gray Slighty to Moderetly Weathered, Slight to Moderetly Fractured, Very Strong DOLOMITE @12': Qu - 19340 PSI	RC 1	100 (90)		1390	166	
	15	16.2' Bottom of hole at 16.2 feet.						

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 June 20, 2023. The borings were advanced utilizing 2¼ -inch inside diameter hollow-stem augers. Rock Coring was also performed for 5 feet after auger refusal.

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 proposed Boring location plan provided by CT Consultants.

4. Ground Surface Elevations were depicted from Google Earth and reported to the nearest foot.

5. Unconfined Compressive Strength (tsf):
   NI = Not Intact
   NP = Non-Plastic

100 YEARS
LEADING THROUGH
the next 100 years
www.ctconsultants.com

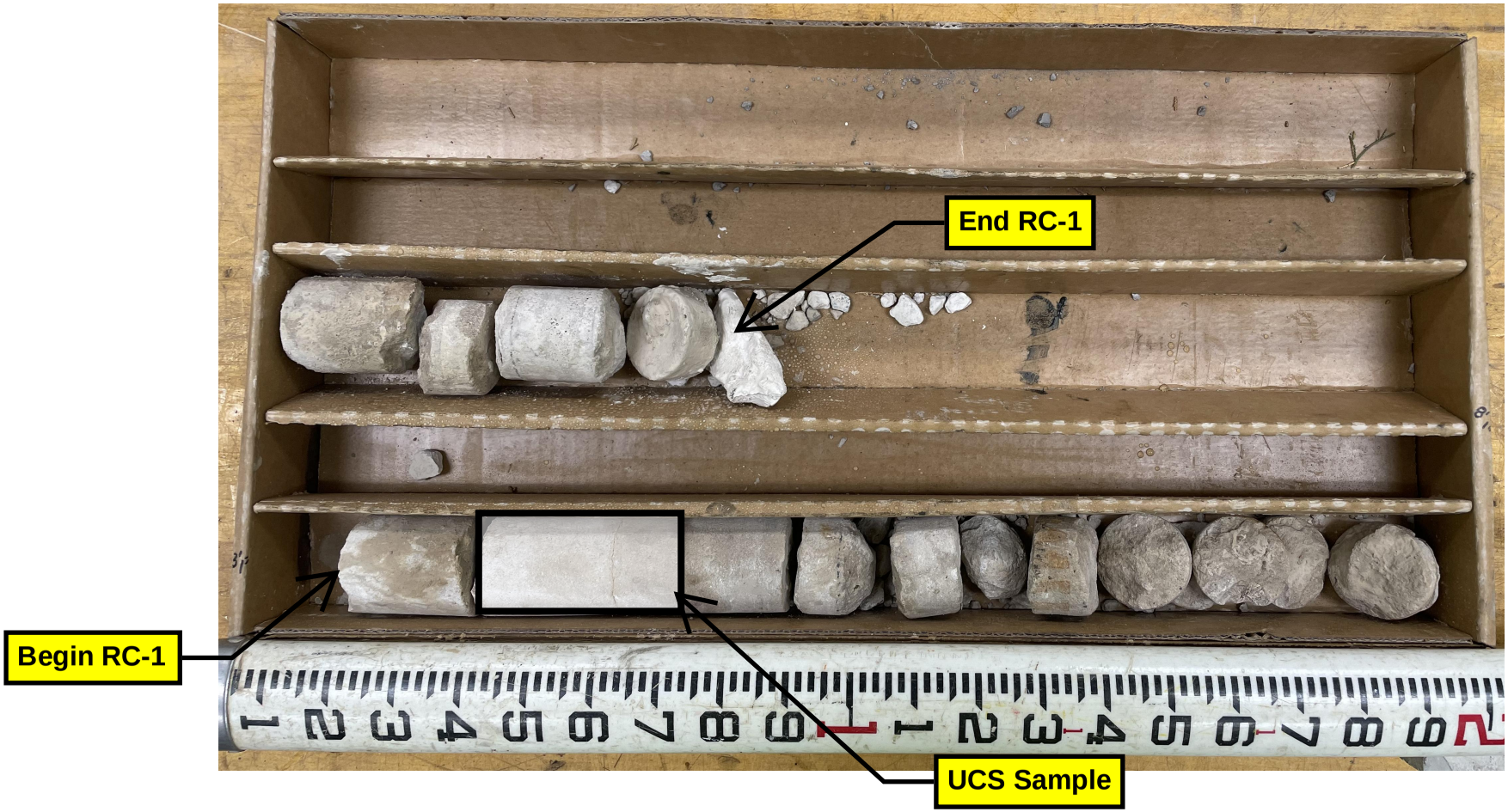
APPENDIX C

Rock Core Photographic Logs

CORE PHOTO LOG - BORING B-1

Project: Johnsons Island Waterline Project
Project Location: Marblehead, Ohio
TTL Project No.: 210900
Core Date: June 30, 2023

Core Run	Depth (feet)	Elevation (feet)
RC-1	3.1 to 8.1	573.9 to 568.9



CORE PHOTO LOG - BORING B-2

Project: Johnsons Island Waterline Projects
Project Location: Marblehead, Ohio
CT Project No.: 210900
Core Date: June 30, 2023

Core Run	Depth (feet)	Elevation (feet)
RC-1	3.7 to 8.7	579.3 to 574.3

CORE PHOTO LOG - BORING B-3

LEADING THROUGH the next 100 years
www.ctconsultants.com

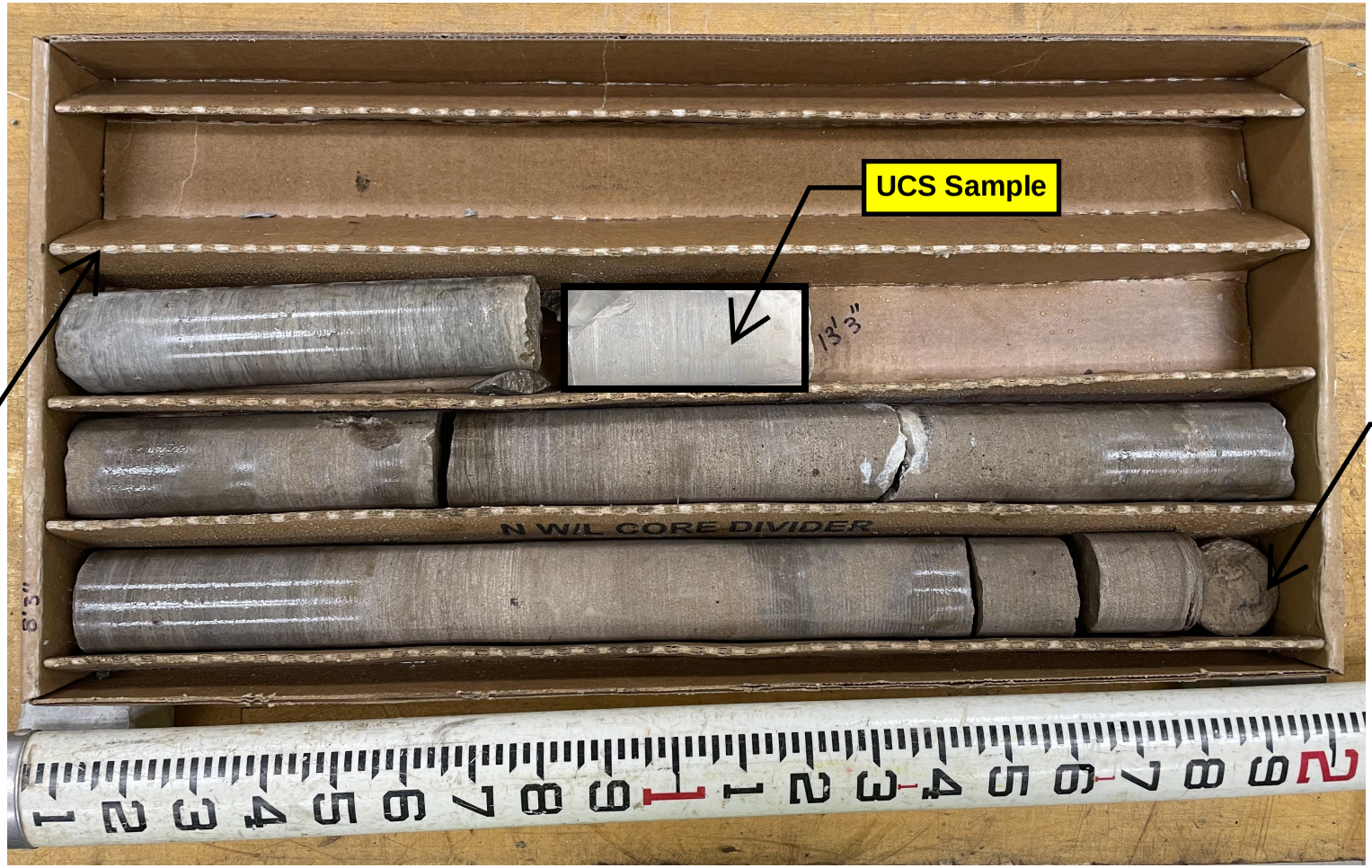
Project: Johnsons Island Waterline Projects
Project Location: Marblehead, Ohio
CT Project No.: 210900
Core Date: June 30, 2023

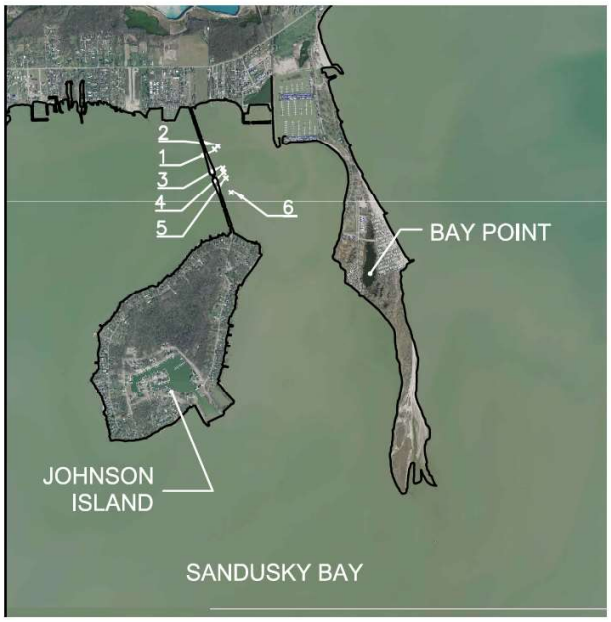
Core Run	Depth (feet)	Elevation (feet)
RC-1	11.2 to 16.2	570.8 to 565.8

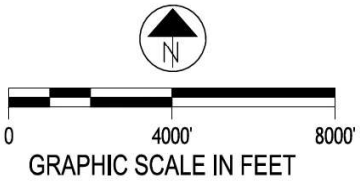
CORE PHOTO LOG - BORING B-4

Project: Johnsons Island Waterline Projects
Project Location: Marblehead, Ohio
CT Project No.: 210900
Core Date: June 30, 2023

Core Run	Depth (feet)	Elevation (feet)
RC-1	11.2 to 16.2	571.8 to 566.8







PROBED BOTTOM OF BAY				
POINT #	LATITUDE	LONGITUDE	WATER DEPTH (FT)	BOTTOM THICKNESS AT REFUSAL (FT)
1	41.50896	−82.73137	2	5
2	41.50919	−82.73108	2	5
3	41.50771	−82.7364	9.5	2
4	41.50742	−82.73055	9	2
5	41.50704	−82.73035	3.5	4
6	41.50607	−82.72988	3	3.5

BAY BOTTOM INVESTIGATION
SEPTEMBER 23, 2014

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