GEOTECHNICAL EXPLORATION REPORT

FOR THE

PROPOSED ASHTABULA COUNTY DOES HARPERSFIELD WATER TOWER – 1878 SOUTH BROADWAY SITE - HARPERSFIELD TOWNSHIP, OHIO

WGE #20221035

PREPARED FOR

CT CONSULTANTS, INC.
8150 STERLING COURT
MENTOR, OHIO 44060

BY

WERTZ GEOTECHNICAL ENGINEERING, INC.
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DRILLING | MATERIAL TESTING | ENGINEERING

May 6, 2022

CT Consultants, Inc.
8150 Sterling Court
Mentor, Ohio 44060

ATTN: **Mr. Tim McLaughlin, P.E., Engineer**

RE: **Geotechnical Exploration Report for the proposed Ashtabula County DOES Harpersfield Water Tower – 1878 South Broadway Site in Harpersfield Township, Ohio; WGE Project #20221035**

Dear Mr. McLaughlin:

Wertz Geotechnical Engineering (WGE) has completed the requested subsurface investigation for the proposed Ashtabula County DOES Harpersfield Water Tower – 1878 South Broadway Site to be located just north of the proposed Dollar General Store to be constructed at 1878 South Broadway (State Route 534) in Harpersfield Township, Ashtabula County, Ohio. The purposes of this investigation are to define the general subsurface conditions at the project site and to make recommendations relative to site preparation and earthwork, foundation design, construction, support of utilities, and other pertinent geotechnical aspects of the project. This report was prepared in accordance with our proposal to you dated January 3, 2022 and authorized by you via email on February 11, 2022. These professional services have been performed, the findings obtained, and the recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices.

If you have any questions or concerns regarding the information presented in this submittal, or have need of additional services, please contact our office at (330) 991-0041
Sincerely,

Eric A. Angyal, P.E
Senior Project Engineer

Leroy Wertz, P.E.
Senior Project Engineer

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PROJECT DESCRIPTION

The project site is located at 1878 South Broadway (State Route 534), on the east side of the roadway, in Harpersfield Township, Ashtabula County, Ohio. The planned location of the center of the proposed water tower is approximately 115 feet north of the projected centerline of Alex Court and 245 feet east of the centerline of State Route 534. The project will include construction of a new, pedisphere or composite type, 300,000-gallon water tower with a high-water line of about 220 feet. In addition to the water tower, approximately 240 feet of new water line will connect the water tower to the existing water system along State Route 534. This alternate site is located approximately 115 feet southeast of the most recent, previously proposed site for the proposed water tower which has been abandoned.

SITE DESCRIPTION

The coordinates of the approximate center of the current location of the proposed water tower are 41.775638° North (Latitude), 80.945747° West (Longitude). At the time of our field work, the areas of the proposed water tower and water line alignment consisted of a relatively flat, vacant, wooded lot that was in the process of being cleared of trees.

Project information for the previous water tower location was provided to WGE by CT Consultants, Inc. (CT) via emails and telephone conversations between September 17 and October 19, 2020 and from December 21, 2021 and April 5, 2022. Some of the information related to the previous tower location also pertains to the current tower location, including the preliminary tower type, height, and anticipated tower loads if a pedisphere type tower will be selected.

A telephone conversation with CT on May 18, 2020, informed us that the tower would be 220 feet tall and hold 300,000 gallons of water. Preliminary structural loads were provided to WGE via email by Caldwell Tanks, Inc. for a 220-foot pedisphere type tower containing 300,000 gallons of water. Table One A includes a summary of the preliminary structural loading and design details. The sum of the dead load of the tank structure, the weight of the water, and the snow load will generate an average vertical pressure of about 2,360 psf on the ring foundation. The additional 2,640 psf of pressure will be generated from moments caused by wind and/or earthquake loading.

On December 21, 2021 WGE was contacted by CT as the proposed tower location was shifted approximately 115 feet southeast of its previously planned location. A preliminary Site Plan included with that email indicated that tower will be located to the north of a proposed Dollar General Store. After a review of the existing site grades in the proposed tower area, the tower footprint was moved approximately 60 feet to the west in order to avoid 15 feet of grade change across the tower footprint. A (temporary) Concept Site Plan was provided to us by CT via email on February 14, 2022, showing the revised location of the tower as well as an associated drive. On April 5, 2022, WGE received an email from CT stating that the tower will be approximately the same height and volume as before. However, both a pedisphere style and a composite style tower with a concrete pedestal and a steel bowl are being considered. Table

One B includes a summary of preliminary information provided to WGE by Landmark Structures via email on April 26, 2022, for a composite style tower.

Table One A **Preliminary Structural Loading and Design Details – Pedisphere Tower Configuration**	
Preliminary Net Allowable Soil Bearing Pressure	5,000 psf
Tower Base Diameter	35 feet
Ring Footing – Outside Diameter	46.3 feet
Ring Footing – Inside Diameter	24 feet
Ring Footing - Thickness	17 inches
Approximate Footing Depth of Embedment	8 feet
Dead Load (Tower Weight)	298.5 kips
Water	2,538.7 kips
Snow Load	21.2 kips
Vertical Seismic	91.1 kips
Wind Moment at Top of Foundation	13,186.2 kips-ft
Wind Shear at Top of Foundation	71.2 kips
Seismic Moment at Top of Foundation	9,465.8 kips-ft
Seismic Shear at Top of Foundation	26.6 kips

Table One B **Preliminary Structural Loading and Design Details – Composite Tower Configuration**	
ASD Dead Load (Tower Weight)	1,777.09 kips
ASD Foundation Weight (concrete + soil)	1,026.55 kips
Dead Load (Structure, Raft Foundation, Soil)	2,803.64 kips
ASD Water	2,567.58 kips
ASD Snow Load	33.02 kips
LRFD Seismic Vertical = 0.2 Sds (D+F)	174.03 kips
LRFD Wind Base Moment	24,510 kips-ft kips
LRFD Seismic Base Moment	11,280 kips-ft
ASD Out-of-Plumb Base Moment	1,709.3 kips-ft

Topographic data for project area was obtained from the Ashtabula County GIS website. Existing site grades were also shown on the Concept Site Plan provided to WGE by CT. The available topographic data indicates that existing site grades in the area of the tower and water line generally range from about Elevation 788 feet MSL to 790 feet MSL. Site grades then drop in elevation to the north of the planned tower location.

Planned site regrading information was not available at the time of this submittal. Based upon our understanding of the existing site grades in conjunction with the composition of the existing site soils, it is anticipated that only minor (less than about two feet) regrading will be required to achieve final site grades in the project area. The anticipated cut/fill depths do not take into consideration the removal of sod, topsoil, and any existing, unsuitable, subgrade materials encountered in the area of the planned tower.

The diameter, location, and planned invert depths/elevations of the water line were also unavailable at the time of this submittal. For the purpose of our recommendations, it has been assumed that the water line will have a diameter of approximately 30 inches and its invert will be located near Elevation 783 feet MSL, approximately 7 feet below the existing site grades in the western portion of the project site.

The locations of the four (4) borings advanced to depths ranging from 55 to 65 feet for the tower and the one (1) boring drilled to a depth of 10 feet for the water line were mutually agreed upon between CT and WGE.

If any of our project assumptions or understanding summarized above are incorrect, we should be contacted in order to determine if our recommendations remain valid.

DESCRIPTION OF REGIONAL GEOLOGICAL SETTING

The project site in Harpersfield, Ashtabula County is situated in the Grand River Low Plateau Physiographic Region of Ohio, which is defined by gently rolling ground and an end moraine having thin to thick drift, with poorly drained areas, and relatively common wetlands (Ohio Department of Natural Resources Division of Geological Survey, 1998).

According to the USDA Web Soil Survey, the project area is mapped by the local soil and water conservation district as predominantly Darien and Platea Silt Loams, materials derived from fine-silty / loamy glacial till and deposited as ground moraines within end moraines (USDA, 2020). A USDA Web Soil Survey site map is included as Figure 2.

According to publicly available mine data from ODNR, no active or inactive surface or underground sand and gravel, limestone, or coal mining activities are present within the site footprint or nearby surrounding areas.

According to 24k Ohio Division of Geological Survey (ODNR-DGS) Bedrock Geology Maps, bedrock in the area consists of the Ohio Shale, of which the major lithologies consist of shale and black shale (Ohio Department of Natural Resources Division of Geological Survey, 1991). Bedrock is reported by ODNR-DGS around 700 to 725 feet above mean sea level, which is approximately 75 to 100 feet below the existing grades. A geologic map of the site is included as Figure 3.

FIELD INVESTIGATION & LABORATORY TESTING

Five (5) soil borings were advanced to termination depths ranging from 10 to 65 feet below the existing ground surface from March 21 through 23, 2022, to characterize the subsurface conditions in the areas of the proposed water tower and water line. The borings were advanced utilizing a CME-550 all-terrain, track-mounted, rotary drilling rig, with 3.25-inch hollow stem augers, operated by WGE drilling staff. The boring locations, denoted as B-1 through B-5, were field marked by WGE personnel at the approximate locations as shown on the attached Geotechnical Boring Location Map (Figure 1) utilizing a handheld GPS unit and by measuring from existing site features. Borings B-1 through B-4, which were advanced to depths ranging from 55 to 65 feet, were located in the area of the planned water tower. Boring B-5 was advanced to a depth of 10 feet approximately halfway between the water tower footprint and South Broadway, along the potential alignment for the planned water line.

Standard penetration testing and sampling was performed at the depth intervals shown on the attached Boring Logs utilizing a 140-lb automatic hammer falling 30 inches to drive a 2 inch outer-diameter split spoon sampler over three (3), six-inch intervals. Relatively undisturbed (Shelby) tube samples were obtained from a depth of 13.5 to 15.5 feet in Boring B-1 and from a depth of 23.5 to 25.5 feet in Boring B-3 for strength and consolidation testing. Collected SPT samples were examined and visually identified by our personnel in the field based on the visual-manual procedure (ASTM D-2488). Representative samples were retained and transported to our office, for further classification and the assignment of laboratory testing.

Static groundwater level observations and hole depth soundings were made upon completion of each boring. This was followed by backfilling the holes. Groundwater level observations, made during the drilling of each boring, are indicated on the attached Boring Logs. It should be noted that groundwater levels and zones of saturation should be expected to fluctuate seasonally based on variation in amounts of precipitation, evapotranspiration, runoff from impervious areas, and other factors.

Moisture content testing was performed on selected representative samples per ASTM D-2216. Fifty-eight (58) moisture content tests and six (6) Atterberg limits tests were performed on selected representative samples. In addition, the unconfined compressive strength and wet and dry unit weights were determined for portions of the Shelby tube samples obtained from Borings B-1 and B-3. A consolidation test was performed on a portion of the Shelby tube sample obtained from a depth of 23.5 to 25.5 feet in Boring B-3 as well. A summary of the test results is shown on the Boring Logs included as Attachment A. The unconfined compressive strength test results are included as Attachment B and the consolidation test results are included as Attachment C.

SUBSURFACE CONDITIONS

Data collected at the boring locations indicated the presence of sod and topsoil overlying natural, medium stiff to very stiff, lean clay to the 10-foot to 65-foot boring termination depths. Sand

layers were generally encountered between a depth of 52 and 56.5 feet in the four (4) tower borings. The encountered subsurface conditions can be described for engineering purposes as the following.

- Approximately 7 to 14 inches of topsoil was encountered beginning at the ground surface in Borings B-1 through B-5. Topsoil depths may vary between and away from the boring locations.

- Underlying the topsoil at the boring locations were natural, lean clay soils with varying lesser amounts of sand and gravel. These glacially deposited (till) soils continued to the 10-foot to 65-foot boring termination depths and were generally in a dry to moist, stiff to very stiff condition. Exceptions were noted where SPT blow-counts suggest medium stiff zones are present at varying depths between 17 and 37 feet in Borings B-2 and B-3. However, laboratory strength testing indicates these soils are in a very stiff condition, regardless of the SPT blow count data. In Borings B-1 through B-4, a layer of wet to saturated, silty fine sand was encountered between a depth of approximately 52 and 56.5 feet below the ground surface. Borings B-3 and B-4 were terminated in the silty fine sand layer. The sand layer in Boring B-1 was described as being in a very loose condition. Based on the other nearby borings, the sand layer in Boring B-1 was likely loose to medium dense; and the blow counts were likely reduced due to disturbance from drilling and sampling operations.
- Groundwater and/or wet granular soils were first encountered during drilling at depths ranging from about 53.5 to 55 feet below the ground surface in Borings B-1 through B-3 with the other two bore holes being dry. Groundwater was observed at depths ranging from about 19 to 26.5 feet in Borings B-1 through B-4 upon completion of drilling and sampling. The five (5) bore holes remained open to depths ranging from about 7 to 50 feet below the ground surface after removal of the augers from the ground. Based on the groundwater observations made by WGE from March 21 through 23, 2022, it is likely that the groundwater table was at or below Elevation 771 feet MSL in the water tower borings at the time of drilling.

GEOTECHNICAL RECOMMENDATIONS

We offer the following for your consideration based on our analysis of the subsurface conditions encountered at the boring locations indicated; and the assumption that conditions between and away from the borings are similar to those that are known:

GENERAL CONSIDERATIONS

Analyses performed by WGE indicates that the tower can be supported on a ring footing proportioned for a gross allowable bearing pressure of 5,000 psf and a corresponding maximum net allowable soil bearing pressure of 3,200 psf for footings bearing at a depth of 13 feet (at Elevation 777 feet MSL) or a maximum net allowable bearing pressure of 4,000 psf for footings bearing at a depth of 8 feet (at Elevation 782 feet MSL). Tower footings should bear on the natural, stiff to very stiff, lean clay site soils encountered at the four (4) tower boring locations.

Estimates of settlement have been provided for footings bearing at a depth of about 8 feet below existing site grades (Elevation 782 feet MSL) and about 13 feet below existing site grades (Elevation 777 feet MSL).

Table Two
Summary of Bearing Elevations, Bearing Pressures, and Estimated Foundation Settlements

Bearing Elevation (ft MSL)	Gross Bearing Pressure (psf)	Maximum Net Allowable Bearing Pressure (psf)	Estimated Ring Foundation Maximum/Differential Settlement (inches)
782	5,000	4,000	1.5 / 0.5
777	5,000	3,200	1.0 / 0.25

The estimated maximum settlement of the ring foundation occurs at the midpoint of the ring (at a diameter of about 35 feet). The estimated differential settlement occurs at the inside and the outside edges of the ring foundation.

Settlement calculations suggest that ring footings bearing at Elevation 777 feet MSL and proportioned for a gross bearing pressure of 5,000 psf and a corresponding net allowable bearing pressure of 3,200 psf will have maximum and differential settlements of the ring foundation that are not expected to exceed approximately 1.0 and 0.25 inches, respectively. Footings bearing at Elevation 782 feet MSL and proportioned for a gross bearing pressure of 5,000 psf and a corresponding net allowable bearing pressure of 4,000 psf will have maximum and differential settlements of the ring foundation that are not expected to exceed approximately 1.5 and 0.5 inches, respectively. Table Two includes a summary of the estimated maximum and differential settlements for ring foundations bearing in natural, stiff or better lean clay soils at depths of about 8 feet and 13 feet below the existing ground surface.

Based upon the stratigraphy encountered in the borings and the SPT blow counts, it is the opinion of WGE that the site is best characterized as Seismic Site Class “D”.

The soils on site should be classified as Type "B" per OSHA. Therefore, temporary excavations should be cut back to a temporary slope no steeper than a 1.1:1 (horizontal:vertical) which is equivalent to a slope angle of 45°

EXCAVATIONS

In Federal Register, Volume 54, No. 209 (October 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its "Construction Standards for Excavations, 29 CFR, part 1926, Subpart P". This document was issued to better ensure the safety of workers entering trenches or excavations. It is mandated by this federal regulation that excavations, whether they be utility trenches, basement excavations, excavations required for undercutting, or footing excavations, be constructed in accordance with the OSHA guidelines. It

is our understanding that these regulations are being strictly enforced and if they are not closely followed, the owner and the contractor could be liable for substantial penalties.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, sheet, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's "responsible person", as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations. If an excavation (including a trench) is extended to a depth of more than twenty (20) feet, it will be necessary to have the side slopes designed by a professional engineer registered in the state where the construction is occurring.

We are providing this information solely as a service to our client. WGE does not assume responsibility for construction site safety or the contractor's or other parties' compliance with local, state, and federal safety or other regulations.

With respect to temporary unsupported excavation side slopes, the layered subsurface profile containing dry to moist, medium stiff to very stiff lean clay should be classified as Type "B" per OSHA. Therefore, temporary excavations should be cut back to a temporary slope no steeper than a 1:1 (horizontal:vertical) which is equivalent to a slope angle of 45°. Steeper temporary cut slopes may be acceptable if the exposed soils are evaluated by an on-site qualified person and the encountered soils are judged to be suitable for safely maintaining the required excavation sidewall slopes.

The existing, natural, medium stiff to very stiff lean clay soils encountered at the boring locations can be excavated by a medium-sized hydraulic excavator equipped with an earth bucket.

EARTHWORK GUIDELINES

- Prior to construction, all sod, topsoil, trees, and vegetation should be completely removed from within the footprint of the proposed water tower and water line.

- Any engineered fill and undercut backfill in the area of the water tower and water line should consist of ODOT Item #304 crushed limestone which should be approved by the Geotechnical Engineer. The ODOT Item #304 crushed limestone should have a compacted dry unit weight greater than 130 pcf.

- All engineered fill and backfill material should be placed on a stable, approved subgrade in controlled lifts. Each lift of engineered fill and backfill should be compacted to a stable condition and to at least 100% of its maximum dry density per ASTM D-698 with a moisture content between 2% below and 2% over optimum moisture. All filling and backfilling operations should be observed by a qualified soils technician under the supervision of the Geotechnical Engineer. Field density tests should be made to assure compaction to specification.

- All surfaces should be sealed and sloped after each day or prior to inclement weather to promote positive drainage of water offsite.

- Construction traffic should be kept off any wet subgrades.

- If site work is performed during times of drier weather, the need for undercutting may be substantially reduced. Therefore, it is recommended that site work be performed during these times.

RING FOOTING FOUNDATION

Based upon preliminary design information provided by Caldwell Tanks, Inc. and Landmark Structures, WGE understands that pedisphere type water tower foundations typically consist of a concrete ring footing bearing approximately 8 feet (or greater) below proposed surrounding finished site grades. The inner and outer diameter of the ring foundation are dependent upon the anticipated structural loads generated by the tower, live (wind and earthquake) loads, and the maximum net allowable soil bearing pressure provided by the Geotechnical Engineer.

Discussions with Landmark personnel indicate that foundations for a composite style tank will be very similar in geometry, bearing depth, and foundation bearing pressure to those for a pedisphere style tower.

Analyses performed by WGE indicates that the natural, stiff to very stiff lean clay site soils are suitable for support of the water tower using a ring footing proportioned for a maximum gross bearing pressure of 5,000 psf and a corresponding maximum net allowable bearing pressure ranging from 3,200 psf (foundation bearing at Elevation 777 feet MSL) to 4,000 psf (foundation bearing at Elevation 782 feet MSL). The bearing elevation and maximum net allowable bearing pressure should be selected based upon on the magnitude of allowable maximum and differential settlements as summarized in Table Two within this report under “General Considerations”.

Based upon a water tower high water line of 220 feet, a tower water volume of 300,000 gallons, and a maximum gross soil bearing pressure of 5,000 psf, WGE understands that the inside diameter of the ring footing will be about 24 feet, the outside diameter will be slightly larger than 46 feet, and the concrete footing thickness will be about 1.5 feet for the pedisphere style tower. Although the maximum soil pressure generated by the structure will be approximately 5,000 psf, we understand that sum of the dead load of the tank structure, the weight of the water, and the snow load will generate an average vertical pressure of about 2,360 psf on the ring foundation. The additional 2,640 psf of pressure will be generated from moments caused by wind and/or earthquake loading.

Refer to Table Two under “General Considerations” for a summary of the anticipated ring foundation maximum and differential settlement for footings bearing at Elevation 777 feet MSL and Elevation 782 feet MSL. The following provisions for foundation design and construction also apply:

- Foundation subgrades, for a maximum net allowable design bearing pressure of 5,000 psf, should consist of natural soils composed of stiff to very stiff (or better) lean clay. The foundation subgrades should be evaluated and approved by a Geotechnical Engineer, or their designated representative, prior to concrete placement. Any soft to medium stiff clay or otherwise deleterious foundation subgrade soils should be undercut and backfilled with additional foundation concrete.

- If the ring foundation will be designed as a structural slab or mat foundation, a Modulus of Subgrade Reaction (k) of 135 pci should be used for design of the foundation bearing on natural stiff to very stiff lean clay site soils.

- Based on our understanding of the tower geometry and volume of the water tower, the ring footing will likely have an inside diameter of approximately 24 feet and an outside diameter of approximately 46 feet.

- It is recommended that the ring foundation bear at or below a depth of 8 feet (at or below Elevation 982 feet MSL). The bearing depth/elevation selected should be based on the allowable maximum and differential settlement for the ring foundation as determined by the water tower designer.

- Footing excavations will require sheeting/shoring and/or sloping back during foundation construction.

- Foundation subgrades should be concreted in a dry and frost-free condition as soon after exposure as possible.

- The ground surface surrounding the water tower should be graded to direct surface drainage of water away from the foundation excavation.

SEISMIC SITE CLASSIFICATION

The seismic design requirements for buildings and other structures are based on Seismic Design Category. Seismic Site Classification is required to determine the Seismic Design Category for a structure. The Seismic Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, Standard Penetration Test (SPT) resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7. Borings at this site were extended to a maximum depth of 65 feet. The site properties below the boring depths to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area as well as from other geotechnical data available online for other nearby projects.

Based upon the stratigraphy encountered in the borings, the SPT blow counts, and the cohesion of the soil, it is the opinion of WGE that the site is best characterized as Seismic Site Class “D”.

LATERAL EARTH PRESSURES FOR BELOW GRADE STRUCTURES

The proposed ring foundation and below grade portions of the structure must be designed to withstand lateral earth pressures, hydrostatic pressures, and pressures due to traffic and construction equipment loading that may develop adjacent to the structure. The magnitude of the lateral earth pressures varies on the basis of soil type, permissible movement, and the configuration of the backfill.

If it is desired to help minimize lateral earth pressures on the below grade walls, the zone behind the walls should be backfilled with granular soil, and the backfill should be effectively drained. For effective drainage, a zone of free-draining gravel (ODOT Item 518.03 or equivalent) should be used directly behind the foundation wall for a minimum thickness of 24 inches in accordance with ODOT Item 518.05. This granular zone should drain to either weepholes or a pipe, so that hydrostatic pressures do not develop against the walls.

The type of soil beyond the free-draining granular zone will govern the magnitude of the pressure to be used for structural design. Lateral pressures of a relatively low magnitude will be developed by the use of granular backfill, whereas a cohesive (clay) backfill will result in the development of much higher pressures. Therefore, it is recommended that granular backfill be used next to the walls. The backfill should be placed in a wedge formed by the wall of the structure and a line rising from the base of the structure foundations at an angle no greater than 60 degrees from the horizontal. Granular backfill behind the structures should be compacted in accordance with recommendations provided under "*Earthwork Guidelines"* in this report. Overcompaction in areas directly behind the below grade walls should be avoided as this might cause damage to the structure.

If proper drainage is provided and the granular backfill is compacted and placed in the geometry as specified, an equivalent fluid unit weight of 35 pounds per cubic foot (pcf) may be used for the granular backfill if a wall movement equivalent to 0.25 percent of the height of the wall (H) is allowed to occur. Such movement is sufficient to mobilize an "active" earth pressure condition. If "at-rest" conditions are expected at the wall, that is to say no wall movement can occur as would typically be the case for below grade ring foundation walls, an equivalent fluid unit weight of 55 pcf should be used for the granular backfill in wall design. These parameters were estimated based on a drained friction angle of 34 degrees and a moist unit weight of 125 pcf for the backfill material.

The structure must also be designed to withstand the vertical load resulting from construction equipment, traffic, and pavement to be placed adjacent to the structures. To estimate vertical loading from soil, total unit weights of 125 pcf and 135 pcf may be used for compacted granular and cohesive soil, respectively. Additionally, the surcharge effect of traffic should be included when designing the below grade walls.

The unit weights and at-rest, active, and passive earth pressure coefficients provided in Table Three should be used for design of sheeting/shoring of excavations for the tower construction. Equivalent fluid pressures can be derived for a given range of elevations by multiplying the appropriate lateral earth pressure coefficient (at-rest, active, or passive) in Table Three by the corresponding recommended unit weight for the elevation range.

Table Three Lateral Earth Pressure Design Parameters					
Relative Elevation (ft)	**Angle of Internal Friction (degrees)**	**At-Rest Coefficient (Ko)**	**Active Coefficient (Ka)**	**Passive Coefficient (Kp)**	**Recommended Unit Weight (pcf)**
790 – 771	22	0.63	0.45	2.19	135
771 - 765	22	0.63	0.45	2.19	73 (submerged)

Note that no factor of safety is included for the lateral earth pressure design parameters in Table Three or for those included previously in this section of the report.

An ultimate coefficient of sliding friction of 0.35 should be used for foundation concrete bearing on existing natural lean clay site soils. This coefficient should be used to proportion the footings for the structures to resist lateral loading. If additional lateral resistance is required, then a shear key can be constructed beneath the footing and passive resistance can be generated by the shear key. It is recommended that the passive resistance generated by the toe of the ring foundation be neglected during design of the structure resistance to lateral loading. An appropriate factor of safety should be applied to the sliding resistance.

All below grade walls and temporary shoring must be designed to resist lateral earth pressures generated by the retained soil, hydrostatic forces from groundwater, and live load surcharges (including construction traffic), as appropriate. Note that the groundwater table may be present as near Elevation 771 feet MSL in the project area.

WATER LINE SUPPORT

The water line can be supported on the encountered natural, medium stiff or better lean clay site soils encountered at the boring locations. Bedding should be provided in accordance with the pipe manufacturers specifications. Some stabilization of the pipe excavation bottom and/or undercutting and replacement of unsuitable subgrades may be required along portions of the pipe alignment if zones of soft to medium stiff clay are encountered at the planned pipe invert elevation. Note that at the time of this report neither the pipe diameter nor the relative Elevation of the pipe invert were available. Refer to *Construction Groundwater Considerations* for a discussion of potential construction groundwater related problems that may be encountered during installation of the water line.

CONSTRUCTION GROUNDWATER CONSIDERATIONS

Based on the groundwater observations made by WGE from March 21 through 23, 2022, at the boring locations, groundwater and/or wet granular soils were first encountered at depths ranging

from about 53.5 to 55 feet below the ground surface in Borings B-1 through B-3. Groundwater was not encountered during drilling in Borings B-4 and B-5. Upon completion of drilling and sampling and removal of the augers from the ground, groundwater had risen to depths ranging from about 19 to 26.5 feet in Borings B-1 through B-4. Based upon the available information, it is likely that the groundwater table was at or below Elevation 771 feet MSL in the water tower borings at the time of drilling. As such, significant groundwater accumulations are not anticipated during water tower foundation construction or earthwork activities in the area of the tower. Water accumulations caused by seepage from wet seams or more permeable layers can likely be controlled by pumping from sumps in shallow sump pits. Groundwater levels can fluctuate with seasonal variations in precipitation.

Surface water and groundwater should be removed from the foundation and utility excavations during construction, as the lean clay soils that will likely be present at the proposed foundation bearing level and water line invert could soften and lose strength in the presence of water. WGE recommends that the sides and bottoms of the foundation excavation be closely monitored during the construction. If the soils at the bottom of an excavation become disturbed by construction activity or softened by standing water, it is recommended that the disturbed/softened material be undercut and replaced with additional foundation concrete. Consideration should be made to placing a mud mat (1.5-inch thick layer of concrete) at the base of the foundation excavation to protect the subgrade during construction of the foundations.

STANDARD OF CARE AND LIMITATIONS

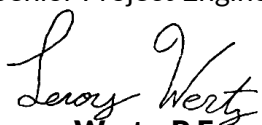
Our recommendations for this project were developed utilizing the project information provided to WGE and the subsurface information obtained from the test borings that were made at the project site. The test borings only depict the subsurface conditions at the specified locations and time at which they were made. The subsurface conditions at other locations on the site may differ from those occurring at the boring locations. Additionally, the conclusions and recommendations have been based upon the available subsurface information and the design details furnished to us. We should be immediately notified, if during design and/or construction, any conditions different from those found in this investigation are evident, or if our project assumptions or understanding are incorrect. We will advise you of any modifications to our conclusions and recommendations deemed necessary, after observing the exposed conditions and/or changes to the project scope. The scope of our services does not include any environmental assessment or investigation for the presence or absence of hazardous or toxic materials in the soil, groundwater, or surface water within or beyond the site studied.

Our professional services have been performed, our findings obtained, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. Wertz Geotechnical Engineering, Inc. is not responsible for the conclusions, opinions, or recommendation made by others based upon the data included herein.

We hope you will find this report satisfactory. Please contact our office if we can be of further service or you have questions regarding this submittal.

Respectfully submitted,

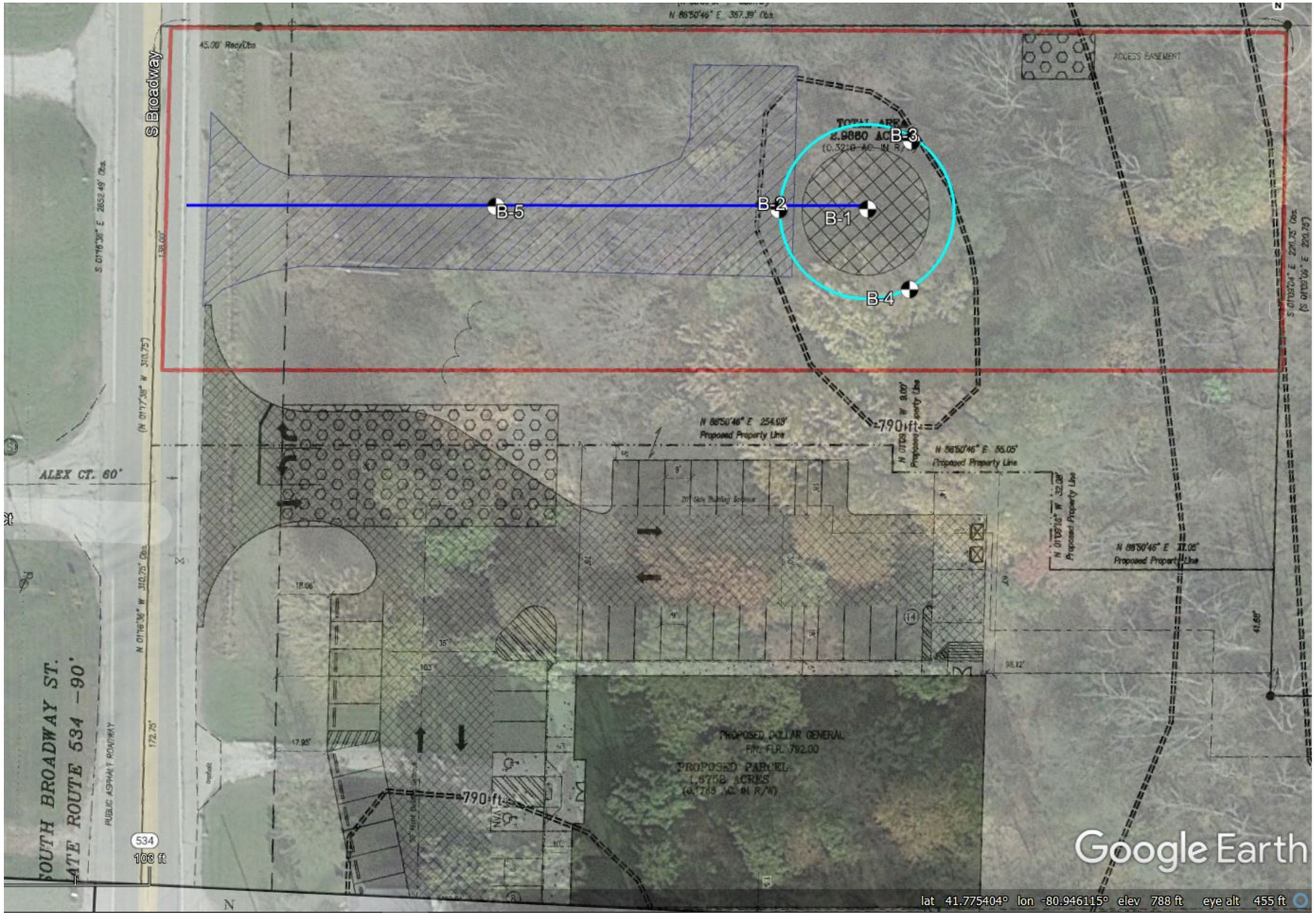
Eric A. Angyal, P.E.
Senior Project Engineer



Leroy Wertz, P.E.
Senior Project Engineer

FIGURE 1

Geotechnical Boring Location Map



LEGEND

- **Boring Locations**
- **Proposed Water Tower Location**

WERTZ
GEOTECHNICAL ENGINEERING

400 Collier Drive, Doylestown, Ohio 44230

330-991-0041

OFFICE@WERTZGEO.COM

GEOTECHNICAL BORING LOCATION MAP

CLIENT

CT CONSULTANTS, INC.
8150 STERLING COURT
MENTOR, OHIO 44060

SITE

1878 S. BROADWAY, GENEVA, OHIO 44041

PROJECT NAME

HARPERSFIELD WATER TOWER - 1878 SOUTH BROADWAY SITE

LAYOUT BY **EA**	DATE: **4/27/2022**
DRAWN BY **EA**	FIGURE NO. **1**
CHECKED BY **LW**	

FIGURE 2

USDA Web Soil Survey Map

Map Scale: 1:437 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 5 10 20 30

Feet: 0 20 40 80 120

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Ashtabula County, Ohio
Survey Area Data: Version 20, Sep 1, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Dec 31, 2009—Oct 4, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
PrB	Platea-Darien silt loams, 2 to 6 percent slopes	0.5	100.0%
Totals for Area of Interest		**0.5**	**100.0%**

FIGURE 3

Geologic Map

1878 SOUTH BROADWAY WATER TOWER PROJECT GEOLOGIC MAP

Bedrock Topography of Ohio 24K (ODNR-DGS) -Bedrock Topography 24K - Contours

Bedrock Topography Contour (50-ft Interval), data from ODNR-DGS)

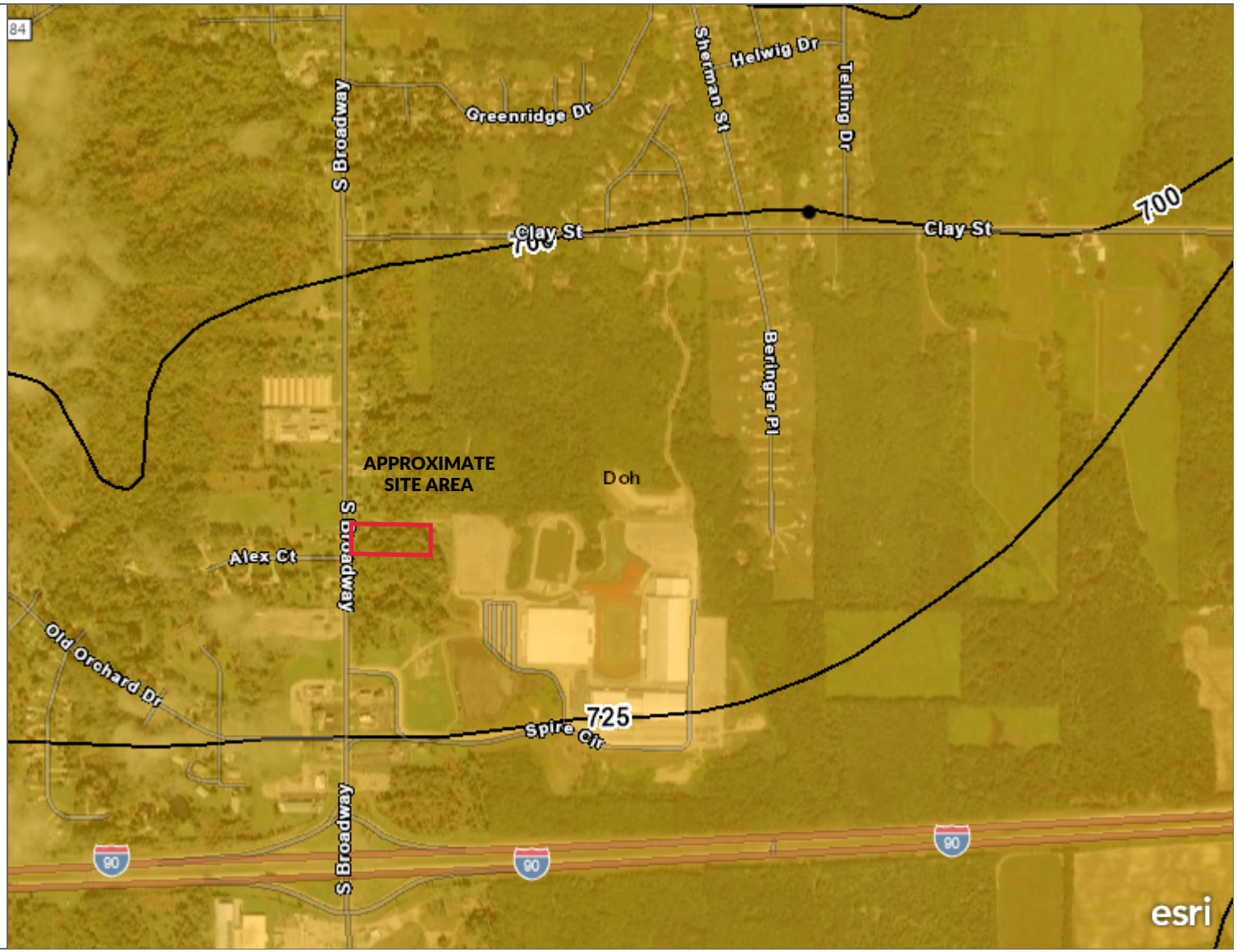
Oil-and-gas well

Water well, data from Ohio Division of Water

-Bedrock Geology 24K
-Data Bedrock Geology of Ohio 24K (ODNR-DGS)

Doh - *Ohio Shale* Major: Shale, Black Shale.

Bedrock Contours are interpolated by ODNR-DGS based on data from local water wells and oil and gas wells.



Bedrock may be encountered approximately 70 to 90 feet below existing site grades.

0.2mi

Maxar, Microsoft | Esri Community Maps Contributors, Cuyahoga County, BuildingFootprintUSA, Esri, HERE, Garmin, SafeGraph, INCREMENT P, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA | Ohio Department of Natural Resources-Division of Geological Survey

ATTACHMENT A

Geotechnical Boring Logs

WERTZ GEOTECHNICAL ENGINEERING

WERTZ GEOTECHNICAL ENGINEERING, INC.
DRILLING | MATERIAL TESTING | ENGINEERING

400 COLLIER DRIVE
DOYLESTOWN, OHIO, 44230
(330) 991-0041
office@wertzgeo.com

PROJECT:	Harpersfield Water Tower - 1878 South Broadway Site	**PROJECT NO.:** 20221035	**DRILL RIG:**	CME 550	**BORING ID:**	B-1	
LOCATION:	1878 S. Broadway, Geneva, Ohio		**METHOD:**	Hollow Stem	**DATE STARTED:**	3/21/2022	
LOGGED BY:	D.K.		**AUGER SIZE:**	3.25 inches	**DATE COMPLETED:**	3/21/2022	
DRILL CREW:	J.R. & J.K.		**HAMMER:**	Automatic SPT	**ELEVATION:**	790 feet MSL	
GROUNDWATER ENCOUNTER DEPTH	53.5'	**GROUNDWATER AT COMPLETION:** 19'	**TOTAL DEPTH:**	65'	**CAVE DEPTH:**	50'	

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE DEPTH	BLOW COUNTS (BLOWS/FOOT)	RECOVERY (INCHES)	POCKET PEN (TSF)	GRAPHIC LOG	LITHOLOGY
1		AS	--	--	--		7" TOPSOIL.
2	1	1.0-2.5	5-6-6	18	3		Moist, stiff, brown and gray, lean CLAY, minor silt, trace fine to coarse sand. Wn%: 23.2
4	2	3.5-5.0	8-8-9	18	5		Damp, very stiff, brown, lean CLAY, some silt, trace fine to coarse sand. Wn%: 14.9
7	3	6.0-7.5	7-8-9	18	5		Moist, very stiff, brown and gray, lean CLAY, minor silt, trace fine sand. Wn%: 16.4
9	4	8.5-10.0	6-6-7	18	3		Moist, stiff, gray, lean CLAY, minor silt, trace fine to coarse sand, trace gravel. Wn%: 15.3
14	5	13.5-15.5	ST	24	4		Moist, very stiff, gray, lean CLAY, trace of sand, trace of gravel. LL: 28, PL: 15, Wn%: 16.1, Dry Unit Weight: 119.7 pcf, Unconfined Compressive Strength (Qu): 6,140 psf
19	6	18.5-20.0	3-5-7	18	2		Moist, stiff, gray, lean CLAY trace silt, trace fine sand. Wn%: 17.5
24	7	23.5-25.0	4-4-5	18	2		Moist, stiff, gray, lean CLAY, trace silt, trace fine sand. Wn%: 18.1
29	8	28.5-30.0	3-4-6	18	3		Moist, stiff, gray, lean CLAY, minor silt, trace fine to coarse sand, trace gravel. Wn%: 18.0
34	9	33.5-35.0	4-3-6	18	2.5		Moist, stiff, gray, lean CLAY, trace silt, trace fine sand. Wn%: 17.5

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PROJECT:	Harpersfield Water Tower - 1878 South Broadway Site	**PROJECT NO.:** 20221035	**DRILL RIG:**	CME 550	**BORING ID:**	B-1	
LOCATION:	1878 S. Broadway, Geneva, Ohio		**METHOD:**	Hollow Stem	**DATE STARTED:**	3/21/2022	
LOGGED BY:	D.K.		**AUGER SIZE:**	3.25 inches	**DATE COMPLETED:**	3/21/2022	
DRILL CREW:	J.R. & J.K.		**HAMMER:**	Automatic SPT	**ELEVATION:**	790 feet MSL	
GROUNDWATER ENCOUNTER DEPTH	53.5'	**GROUNDWATER AT COMPLETION:** 19'	**TOTAL DEPTH:**	65'	**CAVE DEPTH:**	50'	

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE DEPTH	BLOW COUNTS (BLOWS/FOOT)	RECOVERY (INCHES)	POCKET PEN (TSF)	GRAPHIC LOG	LITHOLOGY
39	10	38.5-40.0	3-4-7	18	2		Moist, stiff, gray, lean CLAY, trace silt, trace fine to coarse sand, trace gravel. Wn%: 17.7
44	11	43.5-45.0	4-4-8	18	1.5		Moist, stiff, gray, lean CLAY, trace silt, trace fine to coarse sand. Wn%: 18.5
49	12	48.5-50.0	4-5-9	18	4		Moist, stiff, gray, lean CLAY, minor silt, trace fine to coarse sand. Wn%: 20.8
54	13	53.5-55.0	0-0-1	18			Saturated, very loose, gray, silty, fine SAND. Wn%: 16.5
59	14	58.5-60.0	12-14-18	18	5+		Wet, very stiff, gray, lean CLAY, some fine sand, minor silt. Wn%: 16.8
64	15	63.5-65.0	11-14-16	N/A	5+		Moist, very stiff, gray, lean CLAY, some silt, minor fine to coarse sand. LL: 23, PL: 13, Wn%: 15.0

Note: Ground surface elevation at boring location estimated from topographic data from Ashtabula County GIS website.

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PROJECT:	Harpersfield Water Tower - 1878 South Broadway Site	**PROJECT NO.:** 20221035	**DRILL RIG:**	CME 550	**BORING ID:**	B-2	
LOCATION:	1878 S. Broadway, Geneva, Ohio		**METHOD:**	Hollow Stem	**DATE STARTED:**	3/21/2022	
LOGGED BY:	D.K.		**AUGER SIZE:**	3.25 inches	**DATE COMPLETED:**	3/21/2022	
DRILL CREW:	J.R. & J.K.		**HAMMER:**	Automatic SPT	**ELEVATION:**	790 feet MSL	
GROUNDWATER ENCOUNTER DEPTH	55'	**GROUNDWATER AT COMPLETION:** 20'	**TOTAL DEPTH:**	55'	**CAVE DEPTH:**	50'	

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE DEPTH	BLOW COUNTS (BLOWS/FOOT)	RECOVERY (INCHES)	POCKET PEN (TSF)	GRAPHIC LOG	LITHOLOGY
1		AS	--	--	--		12" TOPSOIL.
2	1	1.0-2.5	2-3-5	13	2.5		Moist, medium stiff, brown, lean CLAY, trace fine to coarse sand (contains root fibers). LL: 40, PL: 16, Wn%: 19.3
4	2	3.5-5.0	6-6-7	18	5+		Damp, stiff, brown, lean CLAY, minor silt, trace fine to coarse sand, trace gravel. Wn%: 16.1
7	3	6.0-7.5	6-7-4	14	5		Damp, stiff, brown, lean CLAY, some silt, minor fine to coarse sand, trace gravel. Wn%: 16.2
9	4	8.5-10.0	6-7-9	18	5		Moist, stiff, gray, lean CLAY, trace silt, trace fine to coarse sand. Wn%: 14.4
14	5	13.5-15.0	4-4-5	18	3.5		Moist, stiff, brown and gray, lean CLAY, minor silt, trace fine to coarse sand. Wn%: 17.9
19	6	18.5-20.0	3-4-5	18	2.75		Moist, stiff, gray, lean CLAY, minor silt, trace fine sand. Wn%: 18.1
24	7	23.5-25.0	2-3-4	18	1.5		Moist, medium stiff, gray, lean CLAY, trace silt, trace fine to coarse sand, trace gravel. Wn%: 19.6
29	8	28.5-30.0	2-3-4	18	3.5		Moist, medium stiff, gray, lean CLAY, minor silt, trace fine to coarse sand, trace gravel. Wn%: 15.8
34	9	33.5-35.0	2-2-5	18	1.5		Moist, medium stiff, gray, lean CLAY, trace sillt, trace fine to coarse sand, trace gravel. Wn%: 17.5

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PROJECT: Harpersfield Water Tower - 1878 South Broadway Site
PROJECT NO.: 20221035
DRILL RIG: CME 550
BORING ID: B-2
LOCATION: 1878 S. Broadway, Geneva, Ohio
METHOD: Hollow Stem
DATE STARTED: 3/21/2022
LOGGED BY: D.K.
AUGER SIZE: 3.25 inches
DATE COMPLETED: 3/21/2022
DRILL CREW: J.R. & J.K.
HAMMER: Automatic SPT
ELEVATION: 790 feet MSL
GROUNDWATER ENCOUNTER DEPTH 55'
GROUNDWATER AT COMPLETION: 20'
TOTAL DEPTH: 55'
CAVE DEPTH: 50'

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE DEPTH	BLOW COUNTS (BLOWS/FOOT)	RECOVERY (INCHES)	POCKET PEN (TSF)	GRAPHIC LOG	LITHOLOGY
36							
37							
38							
39	10	38.5-40.0	2-3-6	18	2.25		Moist, stiff, gray, lean CLAY, trace silt, trace fine sand. Wn%: 19.0
40							
41							
42							
43							
44	11	43.5-45.0	3-4-7	18	3.5		Moist, stiff, gray, lean CLAY, minor silt, minor fine to coarse sand, trace gravel. LL: 36, PL: 22, Wn%: 19.4
45							
46							
47							
48							
49	12	48.5-50.0	5-5-9	18	3.5		Moist, stiff, gray, lean CLAY, minor silt, trace fine to coarse sand, trace gravel. Wn%: 18.1
50							
51							
52							
53							
54	13	53.5-55.0	9-13-14	18	3.5		Wet, very stiff, gray, lean CLAY, minor silt, minor fine to medium sand, trace gravel (wet silty fine sand seam present from about 52 to 54 feet depth). Wn%: 14.8
55							**Note:** Ground surface elevation at boring location estimated from topographic data from Ashtabula County GIS website.
56							
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PROJECT:	Harpersfield Water Tower - 1878 South Broadway Site	**PROJECT NO.:** 20221035	**DRILL RIG:**	CME 550	**BORING ID:**	B-3	
LOCATION:	1878 S. Broadway, Geneva, Ohio		**METHOD:**	Hollow Stem	**DATE STARTED:**	3/23/2022	
LOGGED BY:	D.K.		**AUGER SIZE:**	3.25 inches	**DATE COMPLETED:**	3/23/2022	
DRILL CREW:	J.R. & J.K.		**HAMMER:**	Automatic SPT	**ELEVATION:**	790 feet MSL	
GROUNDWATER ENCOUNTER DEPTH	54'	**GROUNDWATER AT COMPLETION:** 22'	**TOTAL DEPTH:**	55'	**CAVE DEPTH:**	46'	

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE DEPTH	BLOW COUNTS (BLOWS/FOOT)	RECOVERY (INCHES)	POCKET PEN (TSF)	GRAPHIC LOG	LITHOLOGY
1		AS	--	--	--		10" TOPSOIL.
2	1	1.0-2.5	3-5-6	16	3.5		Damp, stiff, brown, lean CLAY, some silt, minor fine to coarse sand. Wn%: 17.0
3							
4	2	3.5-5.0	6-7-13	18	5+		Damp, very stiff, brown, lean CLAY, minor silt, minor fine to coarse sand. Wn%: 15.7
5							
6							
7	3	6.0-7.5	6-7-10	18	5+		Damp, very stiff, brown, lean CLAY, some silt, minor fine to coarse sand. Wn%: 16.5
8							
9	4	8.5-10.0	6-10-11	18	5+		Damp, very stiff, brown, lean CLAY, minor silt, minor fine to coarse sand. Wn%: 13.1
10							
11							
12							
13							
14	5	13.5-15.0	7-5-8	18	4.5		Moist, stiff, gray, lean CLAY, minor silt, minor fine to coarse sand. Wn%: 14.9
15							
16							
17							
18							
19	6	18.5-20.0	4-4-3	18	3.5		Moist, medium stiff, gray, lean CLAY, minor silt, minor fine to coarse sand. Wn%: 16.4
20							
21							
22							
23							
24	7	23.5-25.5	ST	24	3.5		Moist, very stiff, gray, lean CLAY, trace sand, trace gravel. LL: 28, PL: 15, Wn%: 17.1, Dry Unit Weight: 117.7 pcf, Unconfined Compressive Strength (Qu): 6,090 psf Initial Void Ratio: 0.479, Specific Gravity: 2.79
25							
26							
27							
28							
29	8	28.5-30.0	3-4-3	18	2.5		Moist, medium stiff, gray, lean CLAY, trace silt, trace fine to coarse sand, trace gravel. Wn%: 17.2
30							
31							
32							
33							
34	9	33.5-35.0	2-4-7	18	3		Moist, stiff, gray, lean CLAY, minor silt, trace fine to coarse sand, trace gravel. Wn%: 18.1
35							

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office@wertzgeo.com

PROJECT:	Harpersfield Water Tower - 1878 South Broadway Site	**PROJECT NO.:** 20221035	**DRILL RIG:**	CME 550	**BORING ID:**	B-3	
LOCATION:	1878 S. Broadway, Geneva, Ohio		**METHOD:**	Hollow Stem	**DATE STARTED:**	3/23/2022	
LOGGED BY:	D.K.		**AUGER SIZE:**	3.25 inches	**DATE COMPLETED:**	3/23/2022	
DRILL CREW:	J.R. & J.K.		**HAMMER:**	Automatic SPT	**ELEVATION:**	790 feet MSL	
GROUNDWATER ENCOUNTER DEPTH	54'	**GROUNDWATER AT COMPLETION:** 22'	**TOTAL DEPTH:**	55'	**CAVE DEPTH:**	46'	

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE DEPTH	BLOW COUNTS (BLOWS/FOOT)	RECOVERY (INCHES)	POCKET PEN (TSF)	GRAPHIC LOG	LITHOLOGY
36							
37							
38							
39	10	38.5-40.0	4-8-9	18	2.5		Moist, very stiff, gray, lean CLAY, minor silt, trace fine to coarse sand. Wn%: 18.2
40							
41							
42							
43							
44	11	43.5-45.0	2-4-7	18	3		Moist, stiff, gray, lean CLAY, minor silt, trace fine sand. Wn%: 19.5
45							
46							
47							
48							
49	12	48.5-50.0	3-4-8	18	3		Moist, stiff, gray, lean CLAY, trace silt, trace fine sand. Wn%: 19.3
50							
51							
52							
53							
54	13	53.5-55.0	4-5-6	18	2		Moist, stiff, gray, lean CLAY, minor silt, minor and fine sand (wet silty fine sand seam present at about 54.5 feet depth). Wn%: 25.3
55							**Note:** Ground surface elevation at boring location estimated from topographic data from Ashtabula County GIS website.
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PROJECT:	Harpersfield Water Tower - 1878 South Broadway Site	**PROJECT NO.:** 20221035	**DRILL RIG:**	CME 550	**BORING ID:**	B-4	
LOCATION:	1878 S. Broadway, Geneva, Ohio		**METHOD:**	Hollow Stem	**DATE STARTED:**	3/22/2022	
LOGGED BY:	J.R.		**AUGER SIZE:**	3.25 inches	**DATE COMPLETED:**	3/22/2022	
DRILL CREW:	J.G. & J.K.		**HAMMER:**	Automatic SPT	**ELEVATION:**	790 feet MSL	
GROUNDWATER ENCOUNTER DEPTH	None	**GROUNDWATER AT COMPLETION:** 26.5'	**TOTAL DEPTH:**	55'	**CAVE DEPTH:**	46'	

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE DEPTH	BLOW COUNTS (BLOWS/FOOT)	RECOVERY (INCHES)	POCKET PEN (TSF)	GRAPHIC LOG	LITHOLOGY
1		AS	--	--	--		12" TOPSOIL.
2	1	1.0-2.5	2-4-5	12	5+		Damp to moist, stiff, brown, lean CLAY, trace fine to coarse sand, trace gravel (contains root fibers). Wn%: 19.8
4	2	3.5-5.0	6-8-10	18	5+		Dry to damp, very stiff, brown, lean CLAY, minor fine to coarse sand, minor gravel. Wn%: 16.2
7	3	6.0-7.5	5-8-11	18	5		Dry to damp, very stiff, brown, lean CLAY, minor fine to coarse sand, minor gravel. Wn%: 17.1
9	4	8.5-10.0	6-9-12	18	5+		Moist, very stiff, brown, lean CLAY, some silt, minor fine to coarse sand, trace gravel. LL: 37 , PL: 19, Wn%: 15.7
14	5	13.5-15.0	4-6-10	18	4.25		Moist, stiff, gray, lean CLAY, some silt, minor fine to coarse sand, trace gravel. Wn%: 19.1
19	6	18.5-20.0	3-4-6	18	3		Moist, stiff, gray, lean CLAY, minor silt, minor fine to coarse sand, trace gravel. Wn%: 16.6
24	7	23.5-25.0	2-4-5	18	2.25		Moist, stiff, gray, lean CLAY, some silt, minor fine to coarse sand, trace gravel. Wn%: 18.5
29	8	28.5-30.0	3-4-5	18	2.25		Moist, stiff, gray, lean CLAY, some silt, trace fine to coarse sand, trace gravel. Wn%: 17.1
34	9	33.5-35.0	2-4-5	18	2		Moist, stiff, gray, lean CLAY, some silt, trace fine sand. Wn%: 17.5

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PROJECT: Harpersfield Water Tower - 1878 South Broadway Site
PROJECT NO.: 20221035
DRILL RIG: CME 550
BORING ID: B-4
LOCATION: 1878 S. Broadway, Geneva, Ohio
METHOD: Hollow Stem
DATE STARTED: 3/22/2022
LOGGED BY: J.R.
AUGER SIZE: 3.25 inches
DATE COMPLETED: 3/22/2022
DRILL CREW: J.G. & J.K.
HAMMER: Automatic SPT
ELEVATION: 790 feet MSL
GROUNDWATER ENCOUNTER DEPTH None
GROUNDWATER AT COMPLETION: 26.5'
TOTAL DEPTH: 55'
CAVE DEPTH: 46'

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE DEPTH	BLOW COUNTS (BLOWS/FOOT)	RECOVERY (INCHES)	POCKET PEN (TSF)	GRAPHIC LOG	LITHOLOGY
39	10	38.5-40.0	2-4-7	18	3.5		Moist, stiff, gray, lean CLAY, some silt, trace fine sand. Wn%: 16.6
44	11	43.5-45.0	3-6-9	17	3		Moist, very stiff, gray, lean CLAY, some silt, trace fine to coarse sand, trace gravel. Wn%: 18.2
49	12	48.5-50.0	3-5-9	18	3		Moist, stiff, gray, lean CLAY, some silt, trace sand. Wn%: 20.1
54	13	53.5-55.0	4-5-8	18	2.5		Moist, stiff, gray, lean CLAY, some fine sand, minor silt (wet silty fine sand seam encountered at about 54.5 feet depth). Wn%: 25.9
55							**Note:** Ground surface elevation at boring location estimated from topographic data from Ashtabula County GIS website.

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PROJECT:	Harpersfield Water Tower - 1878 South Broadway Site	**PROJECT NO.:** 20221035	**DRILL RIG:**	CME 550	**BORING ID:**	B-5	
LOCATION:	1878 S. Broadway, Geneva, Ohio		**METHOD:**	Hollow Stem	**DATE STARTED:**	3/23/2022	
LOGGED BY:	D.K.		**AUGER SIZE:**	3.25 inches	**DATE COMPLETED:**	3/23/2022	
DRILL CREW:	JR & JK		**HAMMER:**	Automatic SPT	**ELEVATION:**	789 feet MSL	
GROUNDWATER ENCOUNTER DEPTH	None	**GROUNDWATER AT COMPLETION:** None	**TOTAL DEPTH:**	10'	**CAVE DEPTH:**	7'	

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE DEPTH	BLOW COUNTS (BLOWS/FOOT)	RECOVERY (INCHES)	POCKET PEN (TSF)	GRAPHIC LOG	LITHOLOGY
1		AS	--	--	--		14" TOPSOIL.
2	1	1.0-2.5	2-4-3	18	1.75		Moist, medium stiff, brown and gray, lean CLAY, minor silt, minor fine to coarse sand, trace gravel (contains root fibers). Wn%: 21.9
3							
4	2	3.5-5.0	6-5-7	18	5		Moist, stiff, brown, lean CLAY, some silt, minor fine to coarse sand. Wn%: 16.2
5							
6							
7	3	6.0-7.5	6-6-7	18	5		Damp to moist, stiff, brown, lean CLAY, some silt, minor fine to coarse sand. LL: 33, PL: 17, Wn%: 16.2
8							
9	4	8.5-10.0	5-8-10	16	5+		Moist, very stiff, gray, lean CLAY, some silt, trace fine sand. Wn%: 14.0
10							**Note:** Ground surface elevation at boring location estimated from topographic data from Ashtabula County GIS website.
11							
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ATTACHMENT B

Unconfined Compression Test Results

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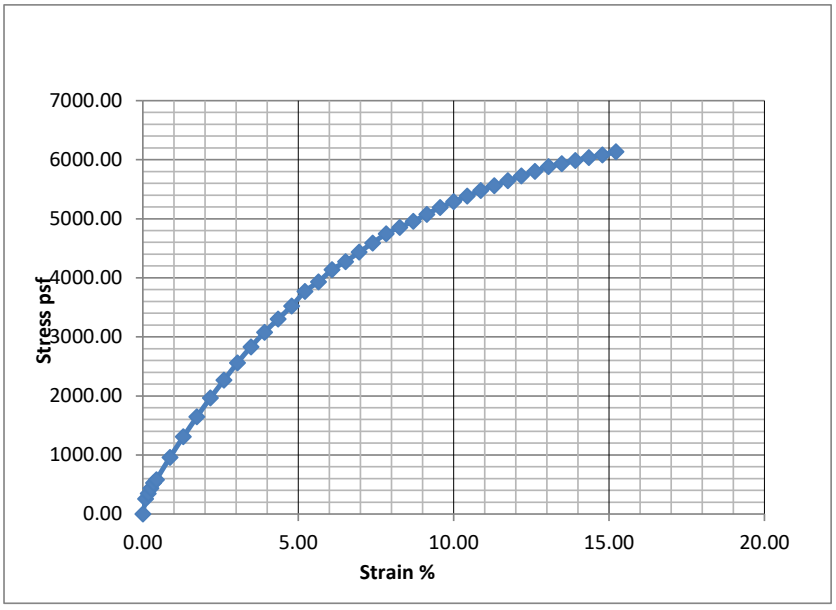
ENGINEERING

Unconfined Compression Test (ASTM D-2166)

Job Name:	1878 South Broadway Water Tower Site	Lab Number:	20221-1-035
Date:	3/29/22	Moisture Content (%)	16.1
Sample:	B-1	Dry Unit Weight (pcf):	119.7
Depth	13.5'-15.5'		
Strain Rate:	1% per minute	Compressive Strength (psf):	6140
Soil:	Moist, gray, lean CLAY, trace of sand & gravel	Strain at Failure (%):	15.2
		Shear Strength (psf):	3070
Pocket Pen (tsf):	4.0	Average Length (in):	5.748
Torvane (kg/cm^2):	1.7	Average Diameter (in):	2.856
		Length to Dia. Ratio:	2.01
		Technician:	N.C.

Strain (%)	Stress (psf)
0.00	0.00
0.09	258.27
0.17	347.80
0.26	437.17
0.35	526.39
0.43	581.88
0.87	958.14
1.30	1308.89
1.74	1645.47
2.17	1968.02
2.61	2265.75
3.04	2560.74
3.48	2831.30
3.91	3077.71
4.35	3300.29
4.78	3520.71
5.22	3770.93
5.65	3933.89
6.09	4137.40
6.52	4275.82
6.96	4433.69
7.39	4589.90
7.83	4744.45
8.26	4856.09
8.70	4956.21
9.13	5075.57
9.57	5193.57
10.00	5289.96
10.44	5385.19
10.87	5479.24
11.31	5562.15
11.74	5643.98
12.18	5724.74
12.61	5804.42
13.05	5883.03
13.48	5931.39
13.92	5988.65
14.35	6035.40
14.79	6081.36



Specimen Post-Test:

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DRILLING | MATERIAL TESTING | ENGINEERING

400 COLLIER DRIVE
DOYLESTOWN, OHIO, 44230
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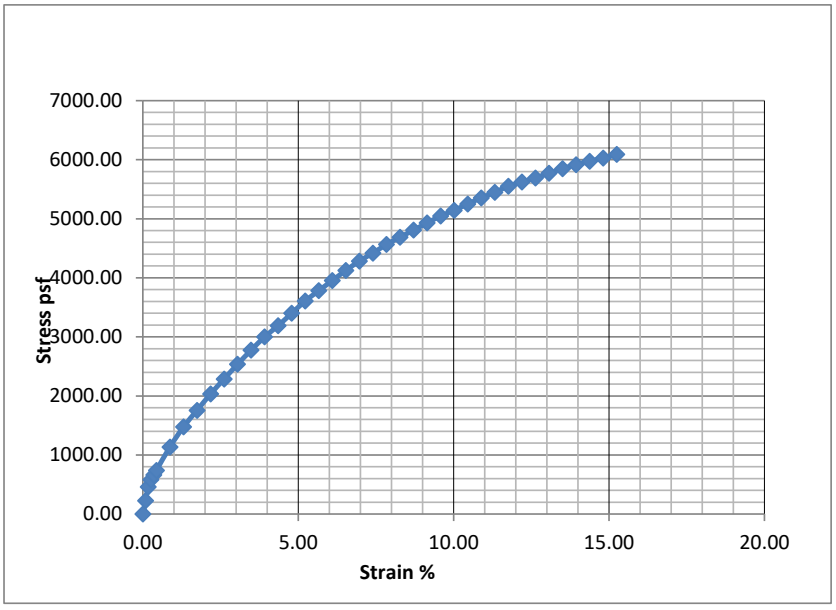
Unconfined Compression Test (ASTM D-2166)

Job Name:	1878 South Broadway Water Tower Site	Lab Number: Moisture	2022-1-035
Date:	3/29/22	Content (%)	17.1
Sample:	B-3	Dry Unit Weight (pcf):	117.7
Depth	23.5'-25.5'		
Strain Rate:	1% per minute	Compressive Strength (psf):	6090
Soil:	Moist, gray, lean CLAY, trace of sand & gravel;	Strain at Failure (%):	15.2
		Shear Strength (psf):	3045
Pocket Pen (tsf):	3.5	Average Length (in):	5.74
Torvane (kg/cm^2):	1.2	Average Diameter (in):	2.857
		Length to Dia. Ratio:	2.01
		Technician:	N.C.

Strain (%)	Stress (psf)
0.00	0.00
0.09	224.43
0.17	459.67
0.26	582.49
0.35	660.32
0.44	738.02
0.87	1135.59
1.31	1474.21
1.74	1754.63
2.18	2032.50
2.61	2285.95
3.05	2537.06
3.48	2774.97
3.92	2999.85
4.36	3190.35
4.79	3400.37
5.23	3608.34
5.66	3782.47
6.10	3954.84
6.53	4125.45
6.97	4283.85
7.40	4419.79
7.84	4564.61
8.28	4687.26
8.71	4808.54
9.15	4928.45
9.58	5047.00
10.02	5143.96
10.45	5249.80
10.89	5354.37
11.32	5447.71
11.76	5549.79
12.20	5621.01
12.63	5691.26
13.07	5770.28
13.50	5848.24
13.94	5915.45
14.37	5972.06
14.81	6027.80



Specimen Post-Test:

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ATTACHMENT C

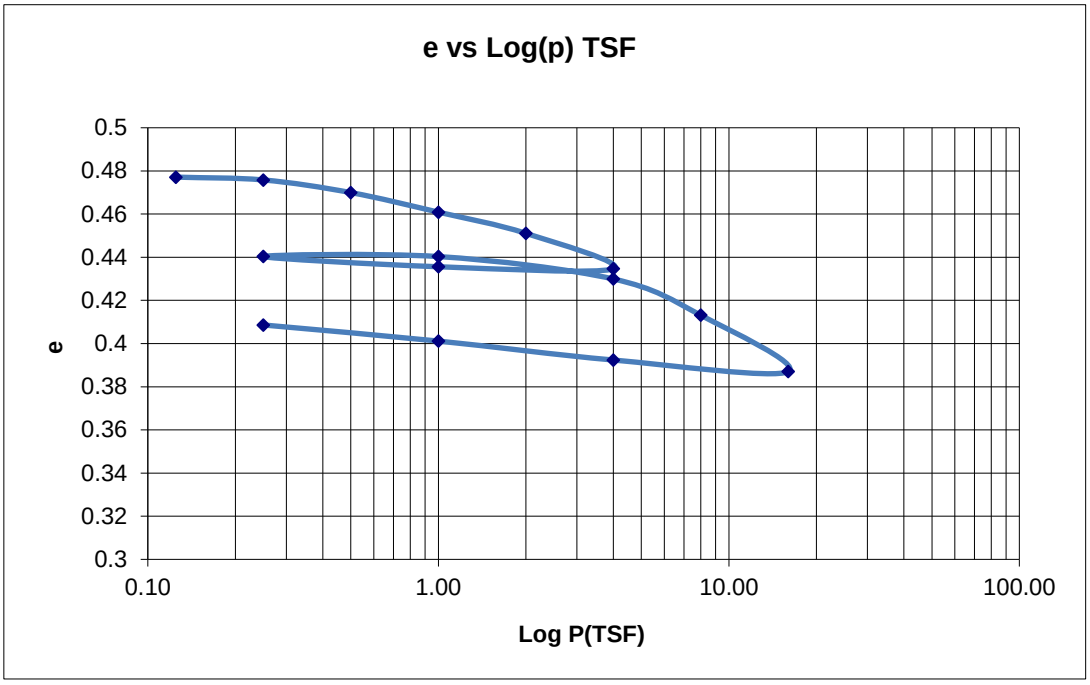
Consolidation Test Results

Consolidation Test (ASTM D-2435) Method A

Job Name: 1878 South Broadway
Water Tower Site
Project Number: 2022-1-035
Boring Number: B-3
Depth: 23.5'-25.5'

Date: 04/12/22
Technician: N.C.
Sample Description: Moist, gray, lean CLAY, trace of sand & gravel.
Initial/Final Moisture Content: 16.4%/16.1%
Dry Unit Weight: 116.2 pcf
Initial/Final Void Ratio: 0.476/0.409

Initial/Final Degree S: N/A
Final Differential Height: 0.0357"
Preconsolidation Stress: N/A
Coeff of Consolidation: N/A



	P (TSF)	e
Increment 1:	0.125	0.477132
Increment 2:	0.250	0.475811
Increment 3:	0.500	0.46996
Increment 4:	1.000	0.4609
Increment 5:	2.000	0.451085
Increment 6:	4.000	0.434664
Increment 7:	1.000	0.435608
Increment 8:	0.250	0.440327

	P(TSF)	e
Increment 9:	1.00	0.440326573
Increment 10:	4.00	0.429945417
Increment 11:	8.00	0.413146819
Increment 12:	16.00	0.38700518
Increment 13:	4.00	0.392384507
Increment 14:	1.00	0.401161302
Increment 15:	0.25	0.40861686

Test Procedure: Trimmed with cutting shoe. Sample inundated at 0.125 TSF.
Coeff. Of Consolidation to be determined by engineer.
Deviations from procedure: None

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