Resource International, Inc.

ODNR HISTORIC OLDTOWN
NEW INTERPRETIVE CENTER
DNR-210003
GREENE COUNTY, OHIO

GEOTECHNICAL INVESTIGATION REPORT

Prepared For:
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Rii Project No. W-22-005

March 2022

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March 10, 2022

Mr. Kyle Carpenter, RA
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Abbot Studios
130 E. Chestnut St. Suite 302
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Re: Geotechnical Investigation
Ohio Department of Natural Resources
Historic Oldtown New Interpretive Center
DNR-210003
Greene County, Ohio
Rii Project No. W-22-005

Mr. Carpenter:

Resource International, Inc. (Rii) is pleased to submit this geotechnical investigation report for the above-referenced project. Engineering logs have been prepared and are attached to this report along with the results of the laboratory testing. This report includes recommendations for design and construction of the proposed new interpretive center for Historic Oldtown in Greene County, Ohio.

We appreciate having been given the opportunity to be of service to you on this project. If you have any questions concerning the geotechnical investigation or this report, do not hesitate to contact us.

Sincerely,

RESOURCE INTERNATIONAL, INC.

Johnnatan Garcia-Ruiz
Staff Engineer

Jonathan P. Sterenberg, P.E.
Vice President – Geotechnical Services

Enclosure: Geotechnical Investigation Report

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APPENDICES

1.0 INTRODUCTION

This report is a presentation of the geotechnical investigation performed for the proposed interpretive center for Historic Oldtown in Greene County, Ohio. Based on preliminary information provided by Mr. Mike Lutsch and Mr. Kyle Carpenter with Abbot Studios, it is understood that the proposed facility will be a two-story structure that will have a finished floor of approximately 838 feet mean sea level (msl). The building will include a basement extended approximately 12 feet below the existing ground surface, as well as an elevator shaft on the west side of the facility, extended to a depth of approximately16 feet below existing grade. Additionally, it is understood that the proposed work includes associated parking lot and driveways, as well as stormwater detention basin.

Structural loading information was provided by Kabil Associates consisting of interior column loads ranging from 80 to 145 kips and wall loads along the basement of 15 kips per linear foot.

1.1 Existing Site Conditions

The project site is located on the west side US Route 68, approximately 3.0 miles north of Xenia, in Greene County, Ohio. It is understood that the site was formerly the location of a motel building facility and have an existing parking lot in very deteriorated condition. In general, the surrounding area consists of an existing autoshop to the north, a driveway to the south, an agricultural field to the west, and US 68 to the east. Land use surrounding the project site is predominantly commercial and agricultural. The topography within the project area is generally flat with surface elevations within 835 and 839 feet msl. Regionally, the area drains to the east toward Oldtown Creek.

1.2 Site Geology

The Historic Oldtown site lies on late Wisconsinan, glacially deposited, ground moraine, and outwash. The glacial and non-glacial regions are comprised of five (5) physiographic sections grouped by age, depositional process and geomorphic occurrence. All of the geotechnical borings drilled for Historic Oldtown, fall within the Till Plain section of the Southern Ohio Loamy Till Plain region, of the Central Lowland Province. The Southern Ohio Loamy Till Plain is a surface of loamy till, end moraines, and recessional moraines, between relatively flat lying ground moraine. Cut by steep-valleyed large streams, the valleys were often filled with outwash, and alternate between broad and narrow floodplains. The soils present at the site are comprised of Eldean Silt Loam (EmA), loamy outwash, with well drained, 0 to 2 percent slopes, as well as the Wea Silt Loam (WeB), loamy outwash over gravelly outwash, with well drained, 0 to 2 percent slopes.

Based on bedrock geology and topography maps of the area from the Ohio Department of Natural Resources (ODNR), the underlying bedrock directly beneath ODNR Historic

Oldtown is comprised of the Ordovician-aged Cincinnati Group. The Cincinnati Group consists of various shades of gray, interbedded shale, dolomite and limestone that are thin to medium bedded. The group ranges from 700 feet thick, to 950 feet thick and is present at depths between 180 and 230 feet below the existing ground surface. A total of ten (10) formations make up the Cincinnati Group, including Clays Ferry, Kope, Fairview, Miamitown Shale, Grant Lake Limestone, Arnheim, Waynesville, Liberty, Whitewater, and Drakes Formation. According to the geotechnical data obtained for ODNR Historic Oldtown, bedrock was not encountered in any of the borings performed for this investigation.

2.0 SUBSURFACE INVESTIGATION

Between February 2 and 8, 2022, a total of four (4) structure borings, designated as B-1 through B-4; two (2) pavement borings, designated as P-1 and P-2; and one (1) detention basin boring, designated as D-1, were drilled at the locations illustrated on the boring plan provided in Appendix I of this report. Borings B-1 through B-4 were extended to termination depths ranging from 35.0 to 40.0 feet below the ground surface. Borings P-1, P-2, and D-1 were all extended to a termination depth of 15 feet below existing grade/ground surface. A summary of the boring program is presented in Table 1 as follows:

Table 1. Test Boring Summary

Boring Number	Northing	Easting	Ground Elevation (feet msl)	Boring Depth (feet)
B-1	632984.790	1564374.430	837.4	35.0
B-2	632973.700	1564419.780	835.6	35.0
B-3	632914.850	1564375.060	837.2	40.0
B-4	632886.450	1564415.110	836.0	35.0
D-1	632839.940	1564392.820	835.4	15.0
P-1	633054.030	1564372.330	838.7	15.0
P-2	632935.240	1564450.520	835.3	15.0

The boring locations were provided by Abbot Studios and field located by Rii prior to commencing the drilling program. Rii utilized a handheld GPS unit to obtain northing and easting coordinates of the boring locations. Ground surface elevations were interpolated using topographic mapping provided by Abbot Studios.

The borings were sampled using both a CME-55 and a Diedrich D-50 rotary drilling machines, utilizing 3.25-inch inside diameter hollow stem auger to advance the holes. Standard penetration test (SPT) and split spoon sampling were performed at maximum

2.5-foot intervals to depth of 30.0 feet below grade followed by 5.0-foot sampling to boring termination depth. The SPT, per the American Society for Testing and Materials (ASTM) designation D1586, is conducted using a 140-pound hammer free falling 30.0 inches to drive a 2.0-inch outside diameter split spoon sampler 18.0 inches. Rii utilized a calibrated automatic drop hammer to generate consistent energy transfer to the sampler. Driving resistance is recorded on the boring logs in terms of blows per 6.0-inch interval of the driving distance. The second and third intervals are added to obtain the number of blows per foot (N). SPT blow counts aid in determining soil properties applicable in pavement subgrade design. Measured blow count (N_m) values are corrected to an equivalent (60%) energy ratio, N_{60}, by the following equation. Both values are represented on boring logs in Appendix III.

$$N_{60} = N_m*(ER/60)$$

Where:
N_m = measured N value
ER = drill rod energy ratio, expressed as a percent, for the system used

The hammer for the CME-55 and Diedrich D-50 drill rig used for this project were calibrated on September 4, 2020 and January 20, 2022, and have a drill rod energy ratio of 84.2 percent and 82.6 percent, respectively.

Hand penetrometer readings, which provide a rough estimate of the unconfined compressive strength of the soil, were reported on the boring logs in units of tons per square foot (tsf) and were utilized to classify the consistency of the cohesive soil in each layer. An indirect estimate of the unconfined compressive strength of the cohesive split spoon samples can also be made from a correlation with the blow counts (N_{60}). Please note that split spoon samples are considered to be disturbed and the laboratory determination of their shear strengths may vary from undisturbed conditions.

In general, for instances in which there was no recovery within a standard split spoon sampler, a 2.5-inch outside diameter split spoon sampler was driven the full length of the standard split spoon interval plus an additional 6.0 inches to obtain a representative sample. These samples are designated with a “2S” preceding the sample number on the boring logs. Only the final 6.0 inches of sample were retained for classification. Blow counts from the 2S sampling are not correlated with N_{60} values.

Upon completion of drilling, the borings were backfilled with a mixture of soil cuttings generated during the drilling process and bentonite chips to seal the bore holes.

2.1 Laboratory Testing

During drilling, field personnel prepared field logs showing the encountered subsurface conditions. Soil samples obtained from the drilling operation were preserved in sealed glass jars and delivered to the soil laboratory. In the laboratory, the soil samples were visually classified and select samples were tested, as noted in Table 2.

Table 2. Laboratory Test Schedule

Laboratory Test	Test Designation	Number of Tests Performed
Natural Moisture Content	ASTM D2216	19
Plastic and Liquid Limits	ASTM D4318	14
Gradation – Sieve/Hydrometer	ASTM D422	14
Gradation - Sieve Only	ASTM D422	2
Hydraulic Conductivity	ASTM D-5084	1

These tests are necessary to classify the soil according to the Unified Soil Classification System (USCS). The results are also used to estimate engineering properties of importance in pavement design and soil related construction considerations. Results of the laboratory testing are presented in Appendix IV and, in part, on the boring logs in Appendix III. A description of the soil terms used throughout this report is presented in Appendix II.

3.0 SUBSURFACE PROFILE

Interpreted engineering logs have been prepared based on the field logs, visual examination of samples and laboratory test results. Classification follows the current USCS specifications. The following is a summary of what was found in the test borings and what is represented on the boring logs.

3.1 Surface Materials

Between 4.0 and 7.5 inches of topsoil was encountered in borings B-1, D-1 and P-1, while the rest of the borings encountered 4.0 inches of asphalt overlying 9.0 to 12.0 inches of aggregate. A summary of the surface materials encountered at each boring location is provided in Table 3.

Table 3. Summary of Surface Material

Boring Number	Topsoil (in)	Asphalt (in)	Aggregate Base (in)
B-1	7.0	--	--
B-2	--	4.0	--
B-3	--	4.0	12.0
B-4	--	4.0	11.8
D-1	4.0	--	--
P-1	7.5	--	--
P-2	--	4.0	9.0

3.2 Subsurface Soils

Underlying the surficial materials, natural cohesive and granular soils were encountered. The natural cohesive soils were described as dark brown to brown, brown to gray, and grayish brown, soft to very stiff, lean clay with sand, sandy lean clay and sandy silt (USCS CL and ML). The natural granular soils were described as brown to brownish gray and gray, medium dense to very dense, poorly graded gravel, silty gravel with sand, poorly graded sand, silty sand with gravel, well graded sand with silt and gravel, and silty, clayey sand with gravel (USCS GP, GM, SP, SM, SW-SM, and SC-SM).

The shear strength and consistency of the cohesive soils are primarily derived from the hand penetrometer values (HP). The cohesive soil encountered ranged from medium stiff ($0.5 < HP \leq 1.0$ tsf) to very stiff ($2.0 < HP \leq 4.0$ tsf). The unconfined compressive strength of the cohesive soil samples tested, obtained from the hand penetrometer, ranged from 0.5 to 3.5 tsf. The relative density of the granular soils are derived from SPT blow counts. Based on the SPT blow count obtained within the granular soils, the relative density ranged from medium dense ($10 < N_{60} < 31$ blows per foot [bpf]) to very dense ($N_{60} > 50$ bpf). The blow counts recorded from the SPT sampling ranged from 15 bpf to split spoon sampler refusal. Split spoon sampler refusal is defined as exceeding 50 blows with less than 6.0 inches of penetration by the split spoon sampler.

Natural moisture contents of the soil samples tested ranged from 6 to 21 percent. The natural moisture content of the cohesive soil samples tested for plasticity index ranged from 4 percent below plastic limit to 7 percent over the plastic limit. In general, the soils exhibited natural moisture contents estimated to be slightly below to moderately above optimum moisture levels.

3.3 Bedrock

Bedrock was not encountered in any of the borings performed as part of this investigation.

3.4 Groundwater

Groundwater seepage was encountered in boring P-1 at a depth of 6.5 feet beneath the existing ground surface. Groundwater was encountered initially during drilling in borings B-1 through B-4 at depths ranging from 21.0 to 25.0 feet beneath the existing grade or ground surface. Upon completion, groundwater was not encountered in any of the borings conducted during this investigation. Please note that short-term water level readings, especially in cohesive soils, are not necessarily an accurate indication of the actual groundwater conditions. In addition, groundwater levels or the presence of groundwater are considered to be dependent on seasonal fluctuations in precipitation at the time of the drilling.

4.0 CONCLUSION AND RECOMMENDATION

Data obtained from the drilling and testing program have been used to determine soil parameters and their performance for the proposed structure. These parameters have been used to provide guidelines for the design of foundation, basement walls, pavements as well as general earthwork recommendations, which are discussed in the following paragraphs.

Structural loading information was provided by Kabil Associates consisting of interior column loads ranging from 80 to 145 kips and wall loads along the basement of 15 kips per linear foot. Based on site plan information provided by Abbot Studios, the proposed finished floor elevation will be approximately 838 feet msl. It is understood that the basement floor will be located approximately 12 feet below the existing ground surface, and that an elevator shaft will be located on the west side of the facility, extended to a depth of approximately 16 feet below existing grade.

4.1 Structure Foundation Recommendation

Based upon an evaluation of the subsurface conditions encountered on the site, it is anticipated that the bearing soils for the proposed structure will consist of medium dense to very dense silty gravel with sand (USCS GM). Conventional shallow foundations bearing on these natural soils may be proportioned for a **maximum allowable bearing capacity of 4.0 ksf**. Maximum total settlement is estimated to be 1.0 inch or less with differential settlements of 0.5 inches or less.

Following excavation, the bearing strata should be carefully inspected as soon as possible to assure adequacy. Inadequate bearing soil (soft/loose/organic), if encountered, should be over excavated to expose the underlying competent natural soils. The over excavations may then be backfilled with either compacted engineered fill in accordance with Section 4.5 or Item 613 Low Strength Mortar Backfill (LSM) from the Ohio Department of Transportation (ODOT) Construction and Materials Specification (CMS). If engineered fill is used, the over excavations should extend down and out from the bottom of the proposed foundation edge at 45 degree plane to remove this material from the zone of influence of the structure. If ODOT Item 613 LSM is utilized as the backfill material, then excavations may be laid back at the angles presented in Table 6 in accordance with Occupational Safety and Health Administration (OSHA) guidelines.

Footing concrete should be placed as soon as possible following footing excavation, preferably the same day, to avoid potential water related damage. Footings should be kept dry and clean until footing concrete is placed in order to minimize damage to the bearing surface.

In order to protect against frost, exterior footings (and interior footings to be subjected to freeze-thaw effects during construction) should be placed at a minimum frost depth of 36.0 inches below the adjacent exterior grade, or in accordance with local codes. Interior footings, in heated areas not subject to freeze-thaw effects, should be placed at a minimum depth of 24.0 inches below the floor slab. A minimum width of 36.0 inches for continuous footing is recommended.

4.2 Slabs-on-Grade

Based on the soil conditions encountered at the borings, it is anticipated that the soils at the expected basement floor elevation will consist of medium dense to very dense silty gravel with sand (USCS GM). It is recommended that slabs-on-grade may be designed as “floating” slabs that are structurally independent of building foundations. Adequate expansion joints should be incorporated into the floor slabs near the foundations so that the slab-on-grade do not impose additional loads on the foundations. The expansion joints would also allow the foundations and floor slabs to settle independently of each other.

Provided that the slab-on-grade area is prepared in accordance with Section 4.4, **a modulus of subgrade reaction, K, of 150 pci can be used for the design of concrete floor slab** placed at the proposed basement floor elevations. The use of vapor barriers or capillary breaks is recommended for two reasons:

- The installation of sheet vapor barriers or capillary breaks retards moisture migration from the soil subgrade into the concrete floor slab, reducing the moisture content of the floor slab and subsequently reducing the possible problems with the adhesion of vinyl floor tile (if applicable).

- In areas where no vinyl tile will be installed, vapor barriers or granular capillary breaks will reduce the likelihood of differential shrinkage of the floor slabs that can cause floors to curl.

Therefore, per ACI specifications, it is recommended to place a 6-mil visqueen capillary break over a minimum of 6.0 inches fine aggregate below all concrete slabs.

The subgrade soils should be thoroughly proofrolled to identify any soft/wet/weak zones prior to placement of subbase stone or concrete.

4.1 Seismic Site Classification

Based on the soil conditions at the site, as indicated by the test borings and estimated from local geological references, the seismic analysis and design procedures for the proposed structure should be based on Site Class D (stiff soil profile) per the current Ohio Building Code.

4.2 Pavement Subgrade Recommendations

Based on pavement borings performed for the proposed parking lot and driveway area, the subgrade soils are anticipated to consist of natural cohesive soils, comprised of stiff to very stiff sandy lean clay and lean clay with sand (USCS CL).

Based on the subsurface conditions encountered, it is recommended that pavement design be based on a **California Bearing Ratio (CBR) value of 4,** with a corresponding resilient modulus (M_R) of 4,800 psi. Correlation charts indicate a modulus of subgrade reaction (K) equal to 120 pci and a soil support value (SSV) of 3.2.

As recommended, the subgrade soil should be thoroughly proofrolled in accordance with the recommendations presented in Section 4.4 to identify any soft, wet or weak zones prior to placement of aggregate subbase stone or pavement materials. At a minimum, the soils will likely require moisture conditioning as recommended in Section 4.4 of this report. However, if the soils continue to present evidence of deformation during the proofrolling, then it is recommended that the soils be stabilized via a 1.0-foot undercut and replacement with granular engineered fill.

Materials utilized for pavement construction should meet material and procedural details as outlined by the Ohio Department of Transportation (ODOT), the Asphalt Institute and/or the American Concrete Institute, as applicable.

Pavement design is dependent on the inclusion of adequate surface and subsurface drainage in order to maintain the compacted subgrade near optimum moisture conditions throughout the lifetime of the pavement.

Sources of borrow material, if required, should be designated in advance of construction. The material should be tested in the laboratory to verify the soil exhibits a minimum design CBR value of 6. The fill soil should be placed and compacted in accordance with the recommendations presented in Section 4.4.

4.3 Lateral Earth Pressure Parameters

Temporary retaining structures should be designed using the undrained soil parameters provided in Table 4, and the design should follow all applicable guidelines for the type of retaining structure utilized. Permanent retaining structures should be designed using the drained soil parameters provided in Table 5. Regardless of whether the retaining structure is temporary or permanent, the effective unit weight ($\gamma' = \gamma - 62.4$ pcf) plus the hydrostatic water pressure ($\gamma_w * h_w$, where h_w is the height of water behind the wall above the base of the wall) should be utilized below the design groundwater level. The lateral earth pressure coefficients should only be applied to the horizontal pressure resulting from the effective overburden pressure, and should not be applied to the hydrostatic water pressure.

For the soil types encountered in the borings, the "in-situ" unit weight (γ), cohesion (c), effective angle of friction (φ'), and lateral earth pressure coefficients for at-rest conditions (k_o), active conditions (k_a), and passive conditions (k_p) have been estimated and are provided in Table 4 and Table 5.

Table 4. Estimated Undrained Soil Parameters for Design

Soil Type	**γ (pcf)[1]**	**c (psf)**	**φ**	**k_a**	**k_o**	**k_p**
Stiff Cohesive Soil	115	1,250	0°	NA	NA	NA
Very Stiff to Hard Cohesive Soil	120	3,000	0°	NA	NA	NA
Medium Dense Granular Soil	125	0	30°	0.33	0.50	3.00
Very Dense Granular Soil	135	0	35°	0.27	0.43	3.69
Compacted Cohesive Engineered Fill	120	1,500	0°	1.0	1.0	1.0
Compacted Granular Engineered Fill	130	0	33°	0.30	0.46	3.39

1. *When below groundwater table, use effective unit weight, $\gamma' = \gamma - 62.4$ pcf and add hydrostatic water pressure.*

Table 5. Estimated Drained Soil Parameters for Design

Soil Type	**γ (pcf)[1]**	**c (psf)**	**φ'**	**k_a**	**k_o**	**k_p**
Natural Cohesive Soil	120	0	26°	0.39	0.56	2.56
Medium Dense to Dense Granular Soil	130	0	32°	0.31	0.47	3.25
Very Dense Granular Soil	135	0	35°	0.27	0.43	3.69
Compacted Cohesive Engineered Fill	120	0	28°	0.36	0.53	2.77
Compacted Granular Engineered Fill	130	0	33°	0.30	0.46	3.39

1. *When below groundwater table, use effective unit weight, $\gamma' = \gamma - 62.4$ pcf and add hydrostatic water pressure.*

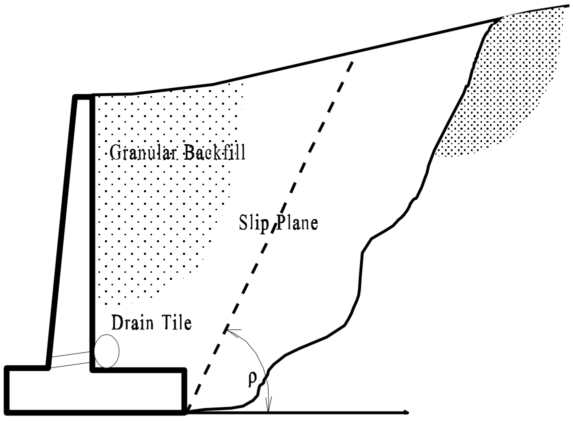
These parameters are considered appropriate for the design of all subsurface structures, and any excavation support systems. Subsurface structures (where the top of the structure is restrained from movement) should be designed based on at-rest conditions (k_o). For any temporary retaining structures (where the top of the structure is allowed to move), earth pressure distributions should be based on active conditions (k_a) and passive pressure (k_p). The values in this table have been estimated from correlation charts based on minimum standards specified for compacted engineered fill materials. These recommendations do not take into consideration the effect of any surcharge loading or a sloped ground surface (a flat surface is considered). Earth pressures on excavation support systems will be dependent on the type of sheeting and method of bracing or anchorage.

For design of the backfill between the shoring wall and the basement walls parameters pertaining to natural cohesive soils in Table 5 is acceptable. Note that granular materials should not be expected to retain vertical cuts without proper excavation support.

In order to alleviate the build-up of hydrostatic pressure above the flow line of the stream behind the walls a minimum of 2.0 feet of clean free-draining granular fill (i.e., No. 57 gravel) should be placed full depth behind the walls. If granular fill other than No. 57 gravel is used, it should not have more than 8 percent (by weight) passing the No. 200 screen, and should be compacted to 95 percent of the maximum dry density as determined by the Standard Proctor Test (ASTM D698). A perforated, corrugated drain tile, wrapped with filter fabric, should be placed along the perimeter at the base of the walls or at the design flow line/flood line for drainage purposes. A clay cap (minimum 1.0-foot thick) should be placed overtop the granular backfill to deter inflow of the surface water. The drainage system should properly outlet to a sewer or to a properly sized sump pump system.

The 2.0 feet of free draining material placed behind the wall prevents the formation of hydrostatic pressures as noted above. However, unless the free draining granular backfill is placed beyond the slip plane (see Figure 1), it has no influence on the equivalent fluid weight of the soil. If free draining granular fill (meeting the requirements listed above) is to be placed beyond the slip plane ($\rho=45^{\circ}$ for at-rest conditions; $\rho=45^{\circ}+\varphi/2$ for active conditions), the values presented for the compacted granular engineered fill can be employed, consequently lowering the pressures on the wall.

Figure 1. Slip Plane



Backfill Rankine Zone with Select Backfill

4.4 Detention Basin Recommendations

As part of this geotechnical investigation, boring D-1 was performed to depth of 15.0 feet below existing grade for a proposed detention pond. Based on subsurface condition encountered, primarily cohesive soils were encountered to a depth of 7.0 feet below the existing ground surface, identified as sandy lean clay and sandy silt (USCS ML, CL). Below this depth, granular soils were encountered consisting of sand and gravel (USCS GP, GM, SW-SM).

A laboratory permeability was performed on the cohesive soils at a depth of 2 to 4 feet below existing grade. The results of the laboratory testing was a hydraulic conductivity of 2.28 x 10^{-7} cm/s. As a reference, the typical hydraulic conductivity for a soil used in a clay liner is 1 x 10^{-7} cm/s. Based on these characteristics, design of a dry pond (detention pond) at this depth may not be ideal. Alternatively a wet pond (retention pond) could be a design consideration. However, the granular material encountered below approximately 7 feet below grade would likely be more permeable and favorable for infiltration. Estimated permeability of this material is between 1x10^{-3} and 1x10^{-5} cm/s It is recommended that the side slopes of the pond be graded at no steeper than 3H:1V.

4.5 Construction Considerations

The site work shall conform to the latest ODOT CMS. Site preparation should begin with general clearing including the complete removal of all topsoil and unsuitable fill materials (as determined by a geotechnical engineer or an experienced soil technician), vegetation, debris, saturated and/or soft/loose soils and/or existing pavement sections where applicable) within the footprint of the structure.

Prior to placing engineered fill and/or the slab-on-grade, the proposed subgrade surfaces should be proofrolled, where accessible, with sufficient proofrolling apparatus (preferably a fully loaded tandem axle dump truck). A geotechnical engineer or an experienced soil technician should be present during proofrolling. Deflection, cracking or rutting of the subgrade surface during a proofroll indicates inadequate subgrade stability. Areas of excess yielding should be over excavated and backfilled with engineered fill. After materials are excavated to design grade, proper control of subgrade and new fill compaction should be performed by the geotechnical engineer and/or his/her representative. Prior to placing engineered fill and/or the pavement, the proposed subgrade surfaces should be proof rolled with a sufficient proof rolling apparatus (preferably a fully loaded tandem axle dump truck).

Areas of excess yielding should be stabilized using one of the following options: 1) scarifying, drying and recompacting, 2) mixing wet soil with dry soil, 3) undercutting unsuitable surficial soil and replacing it with controlled granular fill, 4) modifying the soil by adding a chemical such as lime or cement, or 5) a geogrid subgrade reinforcement system in conjunction with granular fill. Other methods of subgrade stabilization are available and certainly may be effective (both physically and economically) in stabilizing the soil. The adequacy of any stabilization method should be verified through the construction of a test section. All proposed subgrade surfaces should be shaped to promote positive drainage, with a minimum slope of 2.0 percent or 0.25 inches per foot. Adequate drainage is necessary for maintaining the stability of the subgrade. Care should be taken during final grading so that no areas of potential ponding or standing water remain at the subgrade surface.

After materials are excavated to design grade, proper control of subgrade and new fill compaction should be performed by the geotechnical engineer and/or his/her representative. Materials utilized for engineered fill should be free of waste construction debris and other deleterious materials and meet the following requirements:

• Maximum Dry Density per ASTM D698	> 110 pcf
• Liquid Limit	< 40
• Plasticity Index	< 15
• Organic Matter	< 3 percent
• Maximum Particle Size	< 3 inches
• Silt Content (between 0.075 and 0.005 mm)	< 45 percent

Compacted granular fill shall meet the above specification and additionally shall have a maximum 35 percent passing the No. 200 sieve.

The majority of the site soil (excluding sod, topsoil, and/or organic containing materials) is generally considered suitable for structural support when compacted at its optimum moisture content. However, any construction debris encountered (such as brick, asphalt, metal, wood, etc.), as well as any boulders or cobbles greater than 3.0 inches in diameter, should not be placed as structural fill, but be removed and wasted.

Fill soil placed for foundation support should be placed in loose lifts not to exceed 8.0 inches. Fill soil placed under structures shall be compacted to not less than 100 percent of maximum dry density obtained by a Standard Proctor Test (ASTM D698), and fill soil placed beneath pavement sections shall be compacted to not less than 98 percent of maximum dry density. Fill soil containing excess moisture shall be required to dry prior to or during compaction to a moisture content not greater than 3.0 percent above or below optimum. However, for material which displays pronounced elasticity or deformation under the action of loaded rubber tire construction equipment, the moisture content shall be reduced to optimum if necessary to secure stability. Drying of wet soil shall be expedited by the use of plows, discs, or by other approved methods when so ordered by the geotechnical engineer or site representative. Fill soil should not be placed in a frozen condition, and fill soil should not be placed on a frozen subgrade.

Any underground utilities installed through open cut should be bedded in crushed granular stone, such as No. 57 or No. 8 stone, extending from 4.0 inches below the pipe to the springline of the pipe or 12.0 inches above the pipe for concrete and PVC pipe, respectively. The stone will serve as a leveling course and will provide a stable working platform. If soft bedding soils are encountered at the planned invert depth of the utilities, crushed stone may be used to bridge or replace the soft materials. Compaction for the crushed stone should proceed at no less than 95 percent of the maximum dry density obtained by the Standard Proctor Test. Compaction of backfill material beneath any paved section should be performed at no less than 98 percent of Standard Proctor using granular backfill placed in lifts no thicker than 8.0 inches.

4.5.1 Excavation Considerations

All excavations should be shored / braced or laid back at a safe angle in accordance to OSHA guidelines. During excavation, if slopes cannot be laid back to OSHA Standards due to adjacent structures or other obstructions, temporary shoring or sheeting may be required. The following table should be utilized as a general guide for implementing OSHA guidelines when estimating excavation back slopes at the various boring locations. Actual excavation back slopes must be field verified by qualified personnel at the time of excavation in strict accordance with OSHA guidelines.

Table 6. Excavation Back Slopes

Soil	Maximum Back Slope	Notes
Soft to Medium Stiff Cohesive	1.5 : 1.0	Above Ground Water Table and No Seepage
Stiff Cohesive	1.0 : 1.0	Above Ground Water Table and No Seepage
Very Stiff to Hard Cohesive	0.75 : 1.0	Above Ground Water Table and No Seepage
All Granular & Cohesive Soil Below Ground Water Table or with Seepage	1.5 : 1.0	None

4.5.2 Groundwater Considerations

Based on the groundwater observations made during drilling, little to no seepage or groundwater anticipated during foundation construction. If, however, groundwater is encountered, proper groundwater control should be employed and maintained to prevent disturbance to excavation bottoms consisting of cohesive soil, and to prevent the possible development of a quick or "boiling" condition where soft silts and/or fine sands are encountered. It is preferable that the groundwater level, if encountered, be maintained at least 36 inches below the deepest excavation. Based on the soil conditions encountered at borings, Rii anticipates conventional sump and pump methods may be sufficient for groundwater control in local area. Note that determining and maintaining actual groundwater levels during construction is the responsibility of the contractor.

5.0 LIMITATIONS OF STUDY

The above recommendations are predicated upon construction observation and testing performed by a qualified soil technician under the direct supervision of a professional geotechnical engineer. Adequate testing and observation during construction are considered necessary to ensure quality service and are part of our recommendations.

The recommendations for this project were developed utilizing soil information obtained from the test borings that were made at the proposed site. At this time we would like to point out that soil borings only depict the soil conditions at the specific locations and time at which they were made. The conditions at other locations on the site may differ from those occurring at the boring locations.

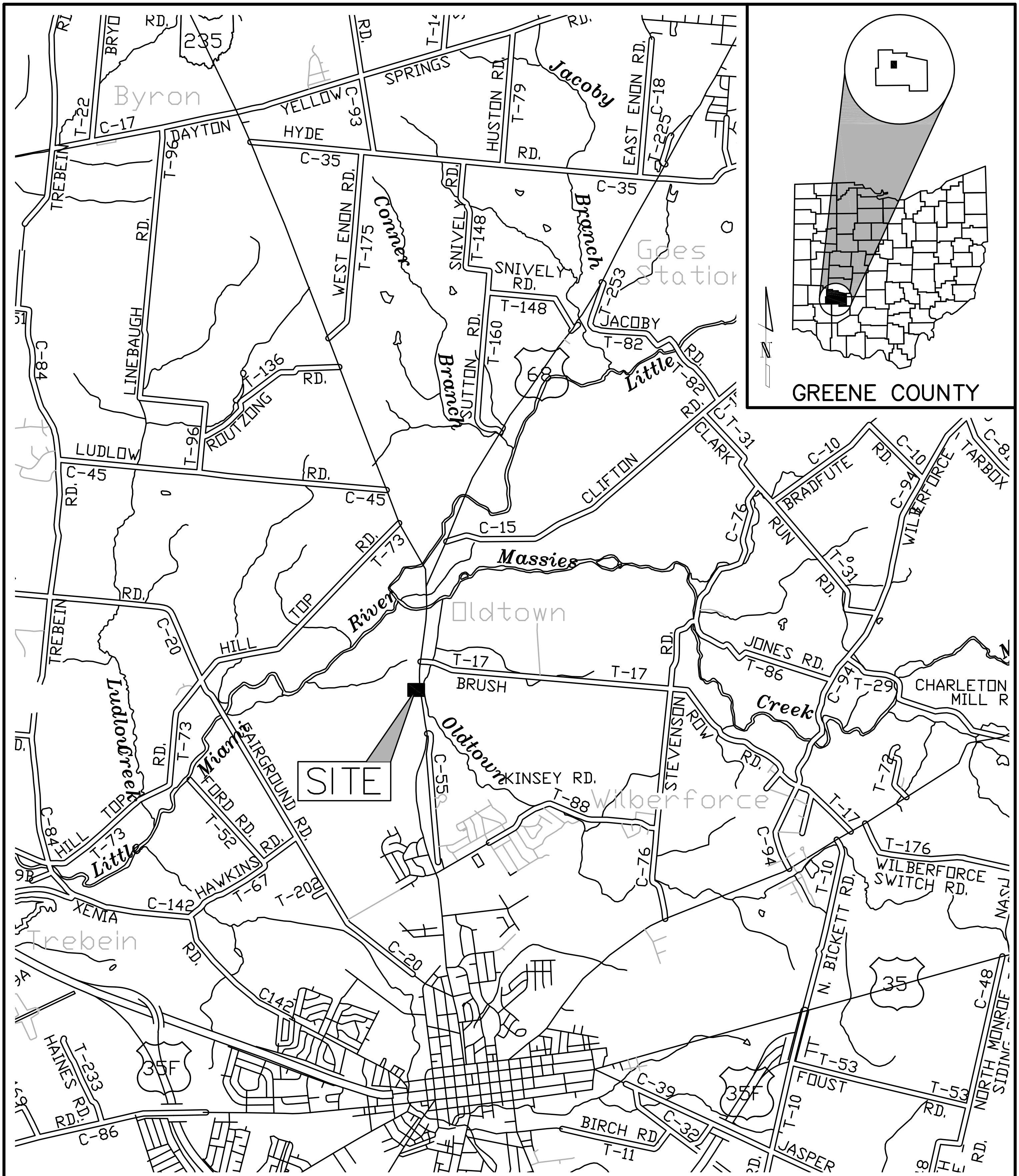
The conclusions and recommendations herein have been based upon the available soil information and the preliminary design details furnished by a representative of the owner of the proposed project. Any revision in the plans for the proposed construction from those anticipated in this report should be brought to the attention of the geotechnical engineer to determine whether any changes in the pavement or earthwork recommendations are necessary. If deviations from the noted subsurface conditions are encountered during construction, they should also be brought to the attention of the geotechnical engineer.

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. Any statements in this report or on the test boring logs regarding odors, staining of soils or other unusual conditions observed are strictly for the information of our client.

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

APPENDIX I

VICINITY MAP AND BORING PLAN



VICINITY MAP
OHIO DEPARTMENT OF NATURAL RESOURCES
HISTORIC OLDTOWN – DNR– 210003
GREENE COUNTY, OHIO

RII PROJECT NO.
W–22–005

SCALE: 1"=5000'
0 2500 5000

DRAWN
JAS

REVIEWED
JGR

DATE
3/10/2022

BORING PLAN
OHIO DEPARTMENT OF NATURAL RESOURCES
HISTORIC OLDTOWN – DNR- 210003
GREENE COUNTY, OHIO

RII PROJECT NO.
W-22-005

SCALE: 1"=30'

0 15 30

N

DRAWN
JAS

REVIEWED
JGR

DATE
3/10/2022

RESOURCE INTERNATIONAL
Rii

APPENDIX II

DESCRIPTION OF SOIL TERMS

DESCRIPTION OF SOIL TERMS

The following terminology was used to describe soils throughout this report and is generally adapted from ASTM 2487/2488.

Granular Soils – USCS GW, GP, GM, GC, SW, SP, SM, SC, ML (non-plastic)
The relative compactness of granular soils is described as:

Description	Blows per foot – SPT (N_{60})		
Very Loose	Below		5
Loose	5	-	10
Medium Dense	11	-	30
Dense	31	-	50
Very Dense	Over		50

Cohesive Soils – USCS ML, CL, OL, MH, CH, OH, PT
The relative consistency of cohesive soils is described as:

Description	Unconfined Compression (tsf)		
Very Soft	Less than		0.25
Soft	0.25	-	0.5
Medium Stiff	0.5	-	1.0
Stiff	1.0	-	2.0
Very Stiff	2.0	-	4.0
Hard	Over		4.0

Gradation - The following size-related denominations are used to describe soils:

Soil Fraction		Size
Boulders		Larger than 12”
Cobbles		12” to 3”
Gravel	coarse	3” to ¾”
	fine	¾” to 4.75 mm (¾” to #4 Sieve)
Sand	coarse	4.75 mm to 2.0 mm (#4 to #10 Sieve)
	medium	2.0 mm to 0.42 mm (#10 to #40 Sieve)
	fine	0.42 mm to 0.074 mm (#40 to #200 Sieve)
Silt		0.074 mm to 0.005 mm (#200 to 0.005 mm)
Clay		Smaller than 0.005 mm

Modifiers of Components – The following modifiers indicate the range of percentages of the minor soil components:

Term	Range		
Trace	0%	-	10%
Little	10%	-	20%
Some	20%	-	35%
And	35%	-	50%

Moisture Table - The following moisture-related denominations are used to describe cohesive soils:

Term	Range
Dry	0% to 10%
Damp	>2% below Plastic Limit
Moist	2% below to 2% above Plastic Limit
Very Moist	>2% above Plastic Limit
Wet	≥ Liquid Limit

Organic Content – The following terms are used to describe organic soils:

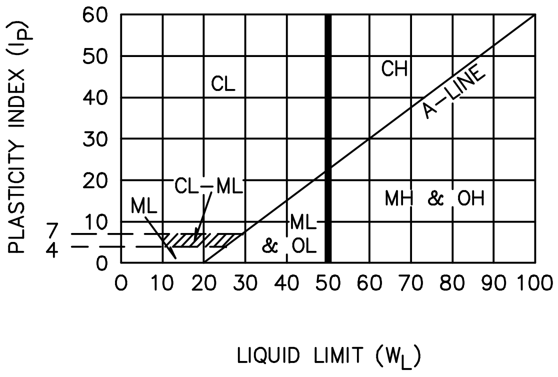
Term	Organic Content (%)
Slightly organic	2-4
Moderately organic	4-10
Highly organic	>10

Bedrock – The following terms are used to describe bedrock hardness:

Term	Parameter
Very Weak	Can be carved with knife and scratched by fingernail.
Weak	Can be grooved or gouged with knife readily.
Slightly Strong	Can be grooved or gouged 0.05 in deep with knife.
Moderately Strong	Can be scratched with knife or pick.
Strong	Can be scratched with knife or pick with difficulty.
Very Strong	Cannot be scratched by knife or pick. Hard repeated blows of hammer to detach specimen.
Extremely Strong	Cannot be scratched by knife or pick. Hard repeated blows of hammer to chip hand specimen.

UNIFIED SOIL CLASSIFICATION SYSTEM
(ASTM D 2487)

MAJOR DIVISION			GROUP SYMBOLS	TYPICAL NAMES	CLASSIFICATION CRITERIA	
COARSE-GRAINED SOILS MORE THAN 50% RETAINED ON 75µm (NO. 200) SIEVE	GRAVELS 50% OR MORE OF COARSE FRACTION RETAINED ON 4.75 mm (NO. 4) SIEVE	CLEAN GRAVELS	GW	WELL-GRADED GRAVELS AND GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	CLASSIFICATION ON BASIS PERCENTAGE OF FINES LESS THAN 5% PASS 75 µm SIEVE GW, GP, SW, SP MORE THAN 12% PASS 75 µm SIEVE GM, GC, SM, SC 5% TO 12% PASS 75 µm SIEVE BORDERLINE CLASSIFICATION REQUIRING USE OF DUAL SYMBOLS	$C_U=D_{60}/D_{10}$ GREATER THAN 4 $C_Z=\frac{(D_{30})^2}{D_{10}*D_{60}}$ BETWEEN 1 AND 3
			GP	POORLY GRADED GRAVELS AND GRAVEL-SAND MIXTURES, LITTLE OR NO FINES		NOT MEETING BOTH CRITERIA FOR GW
		GRAVELS WITH FINES	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES		ATTERBERG LIMITS PLOT BELOW "A" LINE OR PLASTICITY INDEX LESS THAN 4
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES		ATTERBERG LIMITS PLOT ABOVE "A" LINE AND PLASTICITY INDEX GREATER THAN 7
	SANDS MORE THAN 50% OF COARSE FRACTION PASSES 4.75 mm (NO. 4) SIEVE	CLEAN SANDS	SW	WELL-GRADED SAND AND GRAVELLY SANDS, LITTLE OR NO FINES		$C_U=D_{60}/D_{10}$ GREATER THAN 6 $C_Z=\frac{(D_{30})^2}{D_{10}*D_{60}}$ BETWEEN 1 AND 3
			SP	POORLY GRADED SANDS AND GRAVELLY SANDS, LITTLE OR NO FINES		NOT MEETING BOTH CRITERIA FOR SW
		SANDS WITH FINES	SM	SILTY SANDS, SAND-SILT MIXTURES		ATTERBERG LIMITS PLOT BELOW "A" LINE OR PLASTICITY INDEX LESS THAN 4
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES		ATTERBERG LIMITS PLOT ABOVE "A" LINE AND PLASTICITY INDEX GREATER THAN 7

MAJOR DIVISION		GROUP SYMBOLS	TYPICAL NAMES	CLASSIFICATION CRITERIA
FINE-GRAINED SOILS 50% OR MORE PASSES 75 µm (NO. 200) SIEVE	SILTS AND CLAYS LIQUID LIMIT 50% OR LESS	ML	INORGANIC SILTS, VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS	 PLASTICITY CHART FOR THE CLASSIFICATION OF FINE-GRAINED SOILS
		CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS	
		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50%	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDS OR SILTS, ELASTIC SILTS	
		CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
		OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY	
HIGHLY ORGANIC SOILS		PT	PEAT, MUCK AND OTHER HIGHLY ORGANIC SOILS	FIBROUS ORGANIC MATTER; WILL CHAR, BURN, OR GLOW

APPENDIX III

BORING LOGS:

B-1 through B-4, D-1, P-1 and P-2

BORING LOGS

Definitions of Abbreviations

AS = Auger sample

GI = Group index as determined from the Ohio Department of Transportation classification system

HP = Unconfined compressive strength as determined by a hand penetrometer (tons per square foot)

LL_o = Oven-dried liquid limit as determined by ASTM D4318. Per ASTM D2487, if LL_o/LL is less than 75 percent, soil is classified as “organic”.

LOI = Percent organic content (by weight) as determined by ASTM D2974 (loss on ignition test)

PID = Photo-ionization detector reading (parts per million)

QR = Unconfined compressive strength of intact rock core sample as determined by ASTM D2938 (pounds per square inch)

QU = Unconfined compressive strength of soil sample as determined by ASTM D2166 (pounds per square foot)

RC = Rock core sample

REC = Ratio of total length of recovered soil or rock to the total sample length, expressed as a percentage

RQD = Rock quality designation – estimate of the degree of jointing or fracture in a rock mass, expressed as a percentage:

$$\frac{\sum \text{segments equal to or longer than 4.0 inches}}{\text{core run length}} \text{x} 100$$

S = Sulfate content (parts per million)

SPT = Standard penetration test blow counts, per ASTM D1586. Driving resistance recorded in terms of blows per 6-inch interval while letting a 140-pound hammer free fall 30 inches to drive a 2-inch outer diameter (O.D.) split spoon sampler a total of 18 inches. The second and third intervals are added to obtain the number of blows per foot (N_m).

N_{60} = Measured blow counts corrected to an equivalent (60 percent) energy ratio (ER) by the following equation: $N_{60} = N_m*(ER/60)$

SS = Split spoon sample

2S = For instances of no recovery from standard SS interval, a 2.5 inch O.D. split spoon is driven the full length of the standard SS interval plus an additional 6.0 inches to obtain a representative sample. Only the final 6.0 inches of sample is retained. Blow counts from 2S sampling are not correlated with N_{60} values.

3S = Same as 2S, but using a 3.0 inch O.D. split spoon sampler.

TR = Top of rock

W = Initial water level measured during drilling

▼ = Water level measured at completion of drilling

Classification Test Data

Gradation (as defined on Description of Soil Terms):

GR = % Gravel
SA = % Sand
SI = % Silt
CL = % Clay

Atterberg Limits:

LL = Liquid limit
PL = Plastic limit
PI = Plasticity Index

WC = Water content (%)

RESOURCE INTERNATIONAL, INC.

PROJECT: W-22-005
NAME: ODNR Historic Oldtown
CLIENT: Abbot Studios
START: 2-8-22 END: 2-8-22

DRILLING FIRM / OPERATOR: RII / LH/KC
SAMPLING FIRM / LOGGER: RII / MJ
DRILLING METHOD: 3.25" HSA
SAMPLING METHOD: SPT

DRILL RIG: CME 55 (386345)
HAMMER: Automatic
CALIBRATION DATE: 9/14/20
ENERGY RATIO (%): 84.2

NORTHING 632984.790
EASTING: 1564374.430
ELEVATION: 837.4 ft.
COMPLETION DEPTH: 35.0 ft.

EXPLORATION ID
B-1
PAGE
1 OF 2

ELEV. 837.4	DEPTHS	SAMPLE ID	SPT/ RQD	N_{60}	REC (%)	HP (tsf)	***MATERIAL DESCRIPTION AND NOTES***	GRADATION (%) GR	SA	SI	CL	ATTERBERG LL	PL	PI	WC	USCS CLASS	BACK FILL
836.8							0.6' - Topsoil (7.0")										
	1 2	SS-1	4 3 3	8	72	1.75	Stiff, dark brown to brown **SANDY LEAN CLAY**, very moist.									CL (V)	
	3 4 5	SS-2	5 5 5	14	100	2.0		0.0	49.4	34.8	15.8	38	14	24	19	CL	
	6 7	SS-3	2 2 3	7	0												
828.9	8	SS-3A	5	-	100	1.5									21	CL (V)	
826.9	9 10	SS-4	3 6 5	15	33		Medium dense, gray **POORLY GRADED GRAVEL**, very moist.									GP (V)	
824.4	11 12	SS-5	2 3 8	15	78		Medium dense, brownish gray **SILTY GRAVEL WITH SAND**, very moist.									GM (V)	
821.9	13 14 15	SS-6	10 8 12	28	67		Medium dense, grayish brown **POORLY GRADED SAND**, very moist. -Stone fragments in SS-6									SP (V)	
	16 17	SS-7	5 11 14	35	69		Medium dense to dense, brown to brownish gray and gray **SILTY GRAVEL WITH SAND**, very moist to wet.									GM (V)	
	18 19 20	SS-8	15 8 10	25	72											GM (V)	
	21 22	SS-9	13 7 10	24	83										7	GM (V)	
	23 24 ∇ 25	SS-10	10 16 19	49	89											GM (V)	
	26 27	SS-11	13 11 14	35	61											GM (V)	
	28 29	SS-12	12 12 18	42	100											GM (V)	

NAME: ODNR Historic Oldtown	PROJECT NO.: W-22-005	ELEVATION: 837.4 ft.	START: 2/8/22	END: 2/8/22	PG 2 OF 2	B-1

ELEV. 807.4	DEPTHS	SAMPLE ID	SPT/ RQD	N_{60}	REC (%)	HP (tsf)	***MATERIAL DESCRIPTION AND NOTES***	GRADATION (%)				ATTERBERG			WC	USCS CLASS	BACK FILL
								GR	SA	SI	CL	LL	PL	PI			
	31 32 33						Medium dense to dense, brown to brownish gray and gray **SILTY GRAVEL WITH SAND**, very moist to wet. *(same as above)*										
802.4	EOB 34 35	SS-13	14 7 8	21	100											GM (V)	

NOTES: Groundwater encountered initially @ 25.0'; Cave-in depth @ 12.0'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: Compacted with the auger 75 lbs bentonite chips and soil cuttings

RESOURCE INTERNATIONAL, INC.

PROJECT: W-22-005	DRILLING FIRM / OPERATOR: RII / LH/KC	DRILL RIG: CME 55 (386345)	NORTHING 632973.700
NAME: ODNR Historic Oldtown	SAMPLING FIRM / LOGGER: RII / MJ	HAMMER: Automatic	EASTING: 1564419.780
CLIENT: Abbot Studios	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 9/14/20	ELEVATION: 835.6 ft.
START: 2-8-22 END: 2-8-22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 84.2	COMPLETION DEPTH: 35.0 ft.

EXPLORATION ID
B-2
PAGE
1 OF 2

ELEV. 835.6	DEPTHS	SAMPLE ID	SPT/ RQD	N_{60}	REC (%)	HP (tsf)	***MATERIAL DESCRIPTION AND NOTES***		GRADATION (%)				ATTERBERG			WC	USCS CLASS	BACK FILL
									GR	SA	SI	CL	LL	PL	PI			
835.3							0.3' - Asphalt (4.0")											
	1 2	SS-1	2 1 1	3	100	0.5	Soft, gray to brown **SANDY SILT**, very moist.										ML (V)	
832.6	3																	
	4 5	SS-2	1 2 4	8	83	1.5	Medium stiff to stiff, brown **SANDY LEAN CLAY**, very moist.										CL (V)	
	6 7	SS-3	3 4 5	13	72	0.75			0.0	35.3	47.1	17.6	37	15	22	20	CL	
827.6	8																	
	9 10	SS-4	7 30 50/2"	-	11		Very dense, gray **POORLY GRADED GRAVEL**, moist. -Cobbles @ 9.5'										GP (V)	
825.1																		
	11 12	SS-5	9 11 14	35	72		Medium dense to very dense, gray to brownish gray **SILTY GRAVEL WITH SAND**, very moist to wet.										GM (V)	
	13																	
	14 15	SS-6	12 13 18	44	58												GM (V)	
	16 17	SS-7	17 21 21	59	44												GM (V)	
	18																	
	19 20	SS-8	9 11 10	29	58											6	GM (V)	
	21 22	SS-9	10 10 11	29	61												GM (V)	
	∇ 23																	
	24 25	SS-10	12 14 12	36	100												GM (V)	
810.1																		
	26 27	SS-11	4 8 10	25	100		Medium dense, brown **POORLY GRADED SAND**, wet.									16	SP (V)	
807.6	28																	
	29	SS-12	13 11 15	36	89		Dense, gray **SILTY GRAVEL WITH SAND**, wet.										GM (V)	

NAME: ODNR Historic Oldtown	PROJECT NO.: W-22-005	ELEVATION: 835.6 ft.	START: 2/8/22	END: 2/8/22	PG 2 OF 2	B-2

ELEV. 805.6	DEPTHS	SAMPLE ID	SPT/ RQD	N_{60}	REC (%)	HP (tsf)	***MATERIAL DESCRIPTION AND NOTES***	GRADATION (%)				ATTERBERG			WC	USCS CLASS	BACK FILL
								GR	SA	SI	CL	LL	PL	PI			
803.6	31 32						Dense, gray **SILTY GRAVEL WITH SAND**, wet. *(same as above)*										
800.6	33 34 EOB 35	SS-13	16 10 13	32	94		Dense, gray **POORLY GRADED SAND**, wet.									SP (V)	

NOTES: Groundwater encountered initially @ 23.0'; Cave-in depth @ 18.0'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: Compacted with the auger 75 lb. bentonite chips and soil cuttings. Pavement patched with asphalt cold patch

RESOURCE INTERNATIONAL, INC.

PROJECT: W-22-005	DRILLING FIRM / OPERATOR: RII / LH/KC	DRILL RIG: CME 55 (386345)	NORTHING 632914.850	**EXPLORATION ID**
NAME: ODNR Historic Oldtown	SAMPLING FIRM / LOGGER: RII / MJ	HAMMER: Automatic	EASTING: 1564375.060	**B-3**
CLIENT: Abbot Studios	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 9/14/20	ELEVATION: 837.2 ft.	PAGE
START: 2-7-22 END: 2-7-22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 84.2	COMPLETION DEPTH: 40.0 ft.	1 OF 2

ELEV. 837.2	DEPTHS	SAMPLE ID	SPT/ RQD	N_{60}	REC (%)	HP (tsf)	***MATERIAL DESCRIPTION AND NOTES***	GRADATION (%) GR	SA	SI	CL	ATTERBERG LL	PL	PI	WC	USCS CLASS
836.9							0.3' - Asphalt (4.0")									
835.9	1						1.0' - Aggregate Base (12.0")									
	2	SS-1	2 2 2	6	78	0.75	Medium stiff to stiff, gray to brown and dark brown **SANDY LEAN CLAY**, moist to very moist.	3.3	40.2	47.8	8.8	27	17	10	20	CL
	3															
	4 5	SS-2	2 3 4	10	100	1.5										CL (V)
	6 7	SS-3	4 4 5	13	53	1.25		3.7	44.8	36.5	15.0	32	14	18	15	CL
829.2	8						Medium dense to very dense, brownish gray to gray **SILTY GRAVEL WITH SAND**, very moist.									
	9	SS-4	8 15 35	70	0											
	10	2S-4A	20	-	100											GM (V)
	11 12	SS-5	7 7 11	25	75											GM (V)
	13 14 15	SS-6	9 12 16	39	89											GM (V)
821.7	16 17	SS-7	6 6 10	22	67		Medium dense, brown **POORLY GRADED SAND WITH SILT**, very moist.									SP-SM (V)
819.2	18 19	SS-8	9 9 16	35	0		Medium dense to dense, gray to brownish gray and brown **SILTY GRAVEL WITH SAND**, very moist to wet.									
	20	2S-8A	24	-	100											GM (V)
	21 ∇ 22	SS-9	14 9 8	24	89											GM (V)
	23 24 25	SS-10	13 11 8	27	100											GM (V)
811.7	26 27	SS-11	9 7 18	35	72		Dense, brown **SILTY, CLAYEY SAND WITH GRAVEL**, moist.	26.4	52.5	18.9	2.2	21	14	7	14	SC-SM
809.2	28 29	SS-12	16 12 14	36	100		Dense, gray **SILTY GRAVEL WITH SAND**, wet.									GM (V)

NAME:	ODNR Historic Oldtown	PROJECT NO.:	W-22-005	ELEVATION:	837.2 ft.	START:	2/7/22	END:	2/7/22	PG 2 OF 2	B-3

ELEV. 807.2	DEPTHS	SAMPLE ID	SPT/ RQD	N_{60}	REC (%)	HP (tsf)	***MATERIAL DESCRIPTION AND NOTES***	GRADATION (%) GR	SA	SI	CL	ATTERBERG LL	PL	PI	WC	USCS CLASS	BACK FILL
805.2	31 32						Dense, gray **SILTY GRAVEL WITH SAND**, wet. *(same as above)*										
800.2	33 34 35 36 37	SS-13	16 24 16	56	100		Very dense, brown **POORLY GRADED SAND**, wet.									SP (V)	
797.2	38 39 EOB 40	SS-14	23 13 17	42	100		Dense, brownish gray **SILTY GRAVEL WITH SAND**, wet.									GM (V)	

NOTES: Groundwater encountered initially @ 22.0'; Cave-in depth @ 19.0'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: Compacted with the auger 75 lb. bentonite chips and soil cuttings. Pavement patched with asphalt cold patch

RESOURCE INTERNATIONAL, INC.

PROJECT: W-22-005	DRILLING FIRM / OPERATOR: RII / LH/KC	DRILL RIG: CME 55 (386345)	NORTHING 632886.450
NAME: ODNR Historic Oldtown	SAMPLING FIRM / LOGGER: RII / MJ	HAMMER: Automatic	EASTING: 1564415.110
CLIENT: Abbot Studios	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 9/14/20	ELEVATION: 836.0 ft.
START: 2-7-22 END: 2-7-22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 84.2	COMPLETION DEPTH: 35.0 ft.

EXPLORATION ID

B-4

PAGE

1 OF 2

ELEV. 836.0	DEPTHS	SAMPLE ID	SPT/ RQD	N_{60}	REC (%)	HP (tsf)	***MATERIAL DESCRIPTION AND NOTES***	GRADATION (%) GR	SA	SI	CL	ATTERBERG LL	PL	PI	WC	USCS CLASS
835.7							0.3' - Asphalt (4.0")									
834.7							1.0' - Aggregate Base (11.8")									
	1 2 3	SS-1	4 2 2	6	44	2.0	Stiff, brown **SANDY LEAN CLAY**, very moist.									CL (V)
	4 5	SS-2	3 4 5	13	100	1.5		0.0	35.4	45.4	19.2	43	15	28	19	CL
830.5	6 7 8	SS-3	5 6 8	20	50		Medium dense, brownish gray **CLAYEY SAND WITH GRAVEL**, damp.	17.3	34.6	29.3	18.8	23	14	9	10	SC
828.0	9 10	SS-4	20 29 17	65	39		Medium dense to very dense, gray to brownish gray and dark brown **SILTY GRAVEL WITH SAND**, very moist.									GM (V)
	11 12 13	SS-5	14 13 10	32	72											GM (V)
	14 15	SS-6	11 12 17	41	89											GM (V)
	16 17 18	SS-7	5 6 6	17	67											GM (V)
	19 20	SS-8	8 10 13	32	78											GM (V)
	∇ 21 22 23	SS-9	4 7 11	25	78											GM (V)
813.0	24 25	SS-10	10 13 12	35	100		Medium dense to dense, brownish gray **SILTY SAND WITH GRAVEL**, wet.									SM (V)
	26 27 28	SS-11	13 10 11	29	100			25.1	54.6	17.8	2.5	NP	NP	NP	12	SM (V)
808.0	29	SS-12	18 14 13	38	100		Dense, brownish gray **SILTY GRAVEL WITH SAND**, wet.									GM (V)

NAME: ODNR Historic Oldtown | PROJECT NO.: W-22-005 | ELEVATION: 836.0 ft. | START: 2/7/22 | END: 2/7/22 | PG 2 OF 2 | B-4

ELEV. 806.0	DEPTHS	SAMPLE ID	SPT/ RQD	N_{60}	REC (%)	HP (tsf)	*MATERIAL DESCRIPTION AND NOTES*	GRADATION (%)				ATTERBERG			WC	USCS CLASS	BACK FILL
								GR	SA	SI	CL	LL	PL	PI			
804.0	31 32						Dense, brownish gray **SILTY GRAVEL WITH SAND**, wet. *(same as above)*										
801.0	33 34 EOB 35	SS-13	10 11 10	29	100		Medium dense, brown **POORLY GRADED SAND**, wet.									SP (V)	

NOTES: Groundwater encountered initially @ 21.0'; Cave-in depth @ 13.0'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: Compacted with the auger 75 lb. bentonite chips and soil cuttings. Pavement patched with asphalt cold patch

RESOURCE INTERNATIONAL, INC.

PROJECT: W-22-005	DRILLING FIRM / OPERATOR: RII / TG	DRILL RIG: DIEDRICH D-50	NORTHING 632839.940	**EXPLORATION ID**
NAME: ODNR Historic Oldtown	SAMPLING FIRM / LOGGER: RII / SB	HAMMER: Automatic	EASTING: 1564392.820	**D-1**
CLIENT: Abbot Studios	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 1/20/22	ELEVATION: 835.4 ft.	PAGE
START: 2-2-22 END: 2-2-22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 82.6	COMPLETION DEPTH: 15.0 ft.	1 OF 1

ELEV. 835.4	DEPTHS	SAMPLE ID	SPT/ RQD	N_{60}	REC (%)	HP (tsf)	***MATERIAL DESCRIPTION AND NOTES***	GRADATION (%)				ATTERBERG			WC	USCS CLASS	BACK FILL
								GR	SA	SI	CL	LL	PL	PI			
835.1							0.3' - Topsoil (4.0")										
	1	SS-1	6 3 3	8	67	1.75	Stiff, to brown and dark brown **SANDY LEAN CLAY**, moist to very moist.	8.2	35.7	45.0	11.1	33	19	14	21	CL	
	2	SS-2	2 3 4	10	67	1.5										CL (V)	
	3 4	SS-3	5 5 11	22	100	1.5		0.0	43.1	37.9	19.0	34	14	20	20	CL	
829.4	5 6	SS-4	5 5 10	21	56	1.25	-Cobbles @ 5.5'									CL (V)	
828.4	7	SS-5A	14 12	34	67	1.5	Medium stiff, gray **SANDY SILT**, very moist.									ML (V)	
827.4	8	SS-5B	13				Dense, gray **POORLY GRADED GRAVEL WITH SAND**, very moist.									GP (V)	
824.9	9 10	SS-6	5 6 8	19	100		Medium dense, gray **SILTY GRAVEL WITH SAND**, very moist.									GM (V)	
	11 12 13	SS-7	6 6 7	18	83		Medium dense to very dense, brown to gray **WELL GRADED SAND WITH SILT AND GRAVEL**, wet.	27.0	63.4	9.7		NP	NP	NP		SW-SM	
820.4	14 EOB 15	SS-8	10 8 10	25	44			42.7	48.3	8.9		NP	NP	NP		SW-SM	

NOTES: Groundwater not encountered during drilling; Cave-in depth @ 8.0'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: Compacted with the auger 50 lbs bentonite chips and soil cuttings

RESOURCE INTERNATIONAL, INC.

PROJECT: W-22-005	DRILLING FIRM / OPERATOR: RII / TG	DRILL RIG: DIEDRICH D-50	NORTHING 632839.940	**EXPLORATION ID**
NAME: ODNR Historic Oldtown	SAMPLING FIRM / LOGGER: RII / SB	HAMMER: Automatic	EASTING: 1564397.820	**D-1A**
CLIENT: Abbot Studios	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 1/20/22	ELEVATION: 835.4 ft.	PAGE
START: 2-2-22 END: 2-2-22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 82.6	COMPLETION DEPTH: 4.0 ft.	1 OF 1

ELEV. 835.4	DEPTHS	SAMPLE ID	SPT/ RQD	N_{60}	REC (%)	HP (tsf)	***MATERIAL DESCRIPTION AND NOTES***	GRADATION (%)				ATTERBERG			WC	USCS CLASS	BACK FILL
								GR	SA	SI	CL	LL	PL	PI			
835.1							0.3' - Topsoil (4.0")										
	1						Very stiff, brown **SANDY LEAN CLAY**, very moist.										
	2																
	3	ST-1			100	3.25		1.9	41.1	27.1	29.9	34	14	20	19	CL	
831.4	EOB 4																

NOTES: Groundwater not encountered during drilling

ABANDONMENT METHODS, MATERIALS, QUANTITIES: Compacted with the auger 50 lbs bentonite chips and soil cuttings

RESOURCE INTERNATIONAL, INC.

PROJECT: W-22-005
NAME: ODNR Historic Oldtown
CLIENT: Abbot Studios
START: 2-7-22 END: 2-7-22

DRILLING FIRM / OPERATOR: RII / LH/KC
SAMPLING FIRM / LOGGER: RII / MJ
DRILLING METHOD: 3.25" HSA
SAMPLING METHOD: SPT

DRILL RIG: CME 55 (386345)
HAMMER: Automatic
CALIBRATION DATE: 9/14/20
ENERGY RATIO (%): 84.2

NORTHING 633054.030
EASTING: 1564372.330
ELEVATION: 838.7 ft.
COMPLETION DEPTH: 15.0 ft.

EXPLORATION ID
P-1
PAGE
1 OF 1

ELEV. 838.7	DEPTHS	SAMPLE ID	SPT/ RQD	N_{60}	REC (%)	HP (tsf)	***MATERIAL DESCRIPTION AND NOTES***	GRADATION (%) GR	SA	SI	CL	ATTERBERG LL	PL	PI	WC	USCS CLASS	BACK FILL
838.1							0.6' - Topsoil (7.5")										
	1 2	SS-1	6 4 4	11	100	2.5	Very stiff, brown to dark brownish gray **SANDY LEAN CLAY**, moist.	3.5	42.5	30.4	23.7	39	17	22	19	CL	
835.7	3																
	4 5	SS-2	6 6 12	25	100		Medium dense to very dense, brown to brownish gray **SILTY GRAVEL WITH SAND**, very moist to wet.								6	GM (V)	
	6 7	SS-3	3 11 10	29	83											GM (V)	
	8 9	SS-4	5 18 32	70	44											GM (V)	
	10 11 12	SS-5	10 6 10	22	50											GM (V)	
	13 14	SS-6	10 9 11	28	78											GM (V)	
823.7	EOB 15																

NOTES: Seepage @ 6.5'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: Compacted with the auger 25 lbs bentonite chips and soil cuttings

RESOURCE INTERNATIONAL, INC.

PROJECT: W-22-005	DRILLING FIRM / OPERATOR: RII / LH/KC	DRILL RIG: CME 55 (386345)	NORTHING 632935.240
NAME: ODNR Historic Oldtown	SAMPLING FIRM / LOGGER: RII / MJ	HAMMER: Automatic	EASTING: 1564450.520
CLIENT: Abbot Studios	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 9/14/20	ELEVATION: 835.3 ft.
START: 2-7-22 END: 2-7-22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 84.2	COMPLETION DEPTH: 15.0 ft.

EXPLORATION ID

P-2

PAGE 1 OF 1

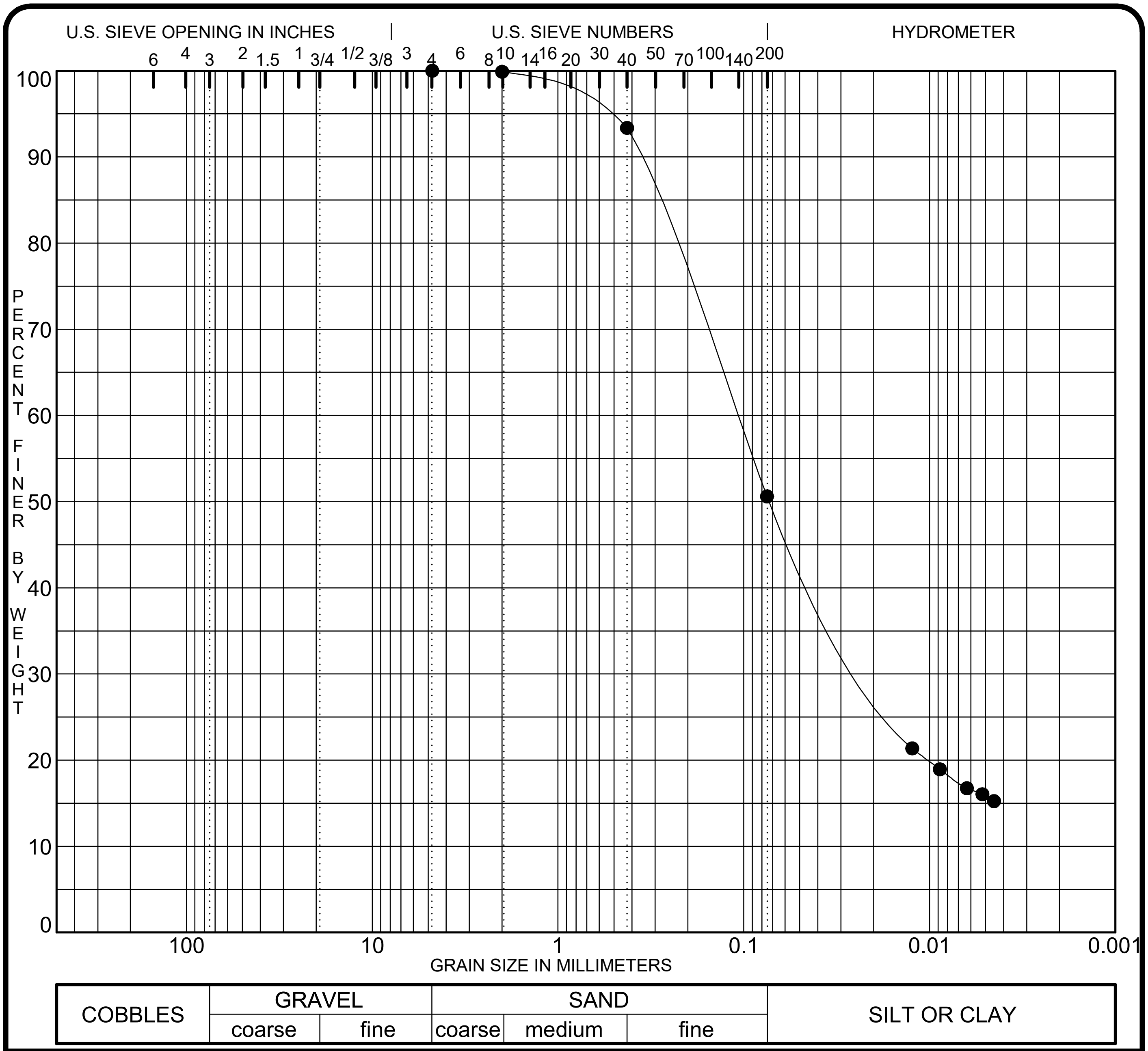
ELEV. 835.3	DEPTHS	SAMPLE ID	SPT/ RQD	N_{60}	REC (%)	HP (tsf)	***MATERIAL DESCRIPTION AND NOTES***	GRADATION (%) GR	SA	SI	CL	ATTERBERG LL	PL	PI	WC	USCS CLASS	BACK FILL
835.0							0.3' - Asphalt (4.0")										
834.2							0.8' - Aggregate Base (9.0")										
832.3	1 2 3	SS-1	4 2 3	7	100	3.0	Very stiff, grayish brown **LEAN CLAY WITH SAND**, moist.	2.4	24.7	58.1	14.9	27	18	9	19	CL	
829.8	4 5	SS-2	3 5 3	11	89	1.75	Stiff, brown **SANDY LEAN CLAY**, very moist.	0.3	31.0	45.8	22.8	42	15	27	22	CL	
	6 7 8	SS-3	3 8 16	34	50		Medium dense to very dense, brownish gray to brown and dark brownish gray **SILTY GRAVEL WITH SAND**, very moist.									GM (V)	
	9 10	SS-4	12 28 28	79	94											GM (V)	
	11 12 13	SS-5	8 11 12	32	78											GM (V)	
820.3	14 EOB 15	SS-6	5 5 8	18	89											GM (V)	

NOTES: Groundwater not encountered during drilling; Cave-in depth @ 8.5'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: Compacted with the auger 25 lbs bentonite chips and soil cuttings. Pavement patched with asphalt cold patch.

APPENDIX IV

LABORATORY TEST RESULTS



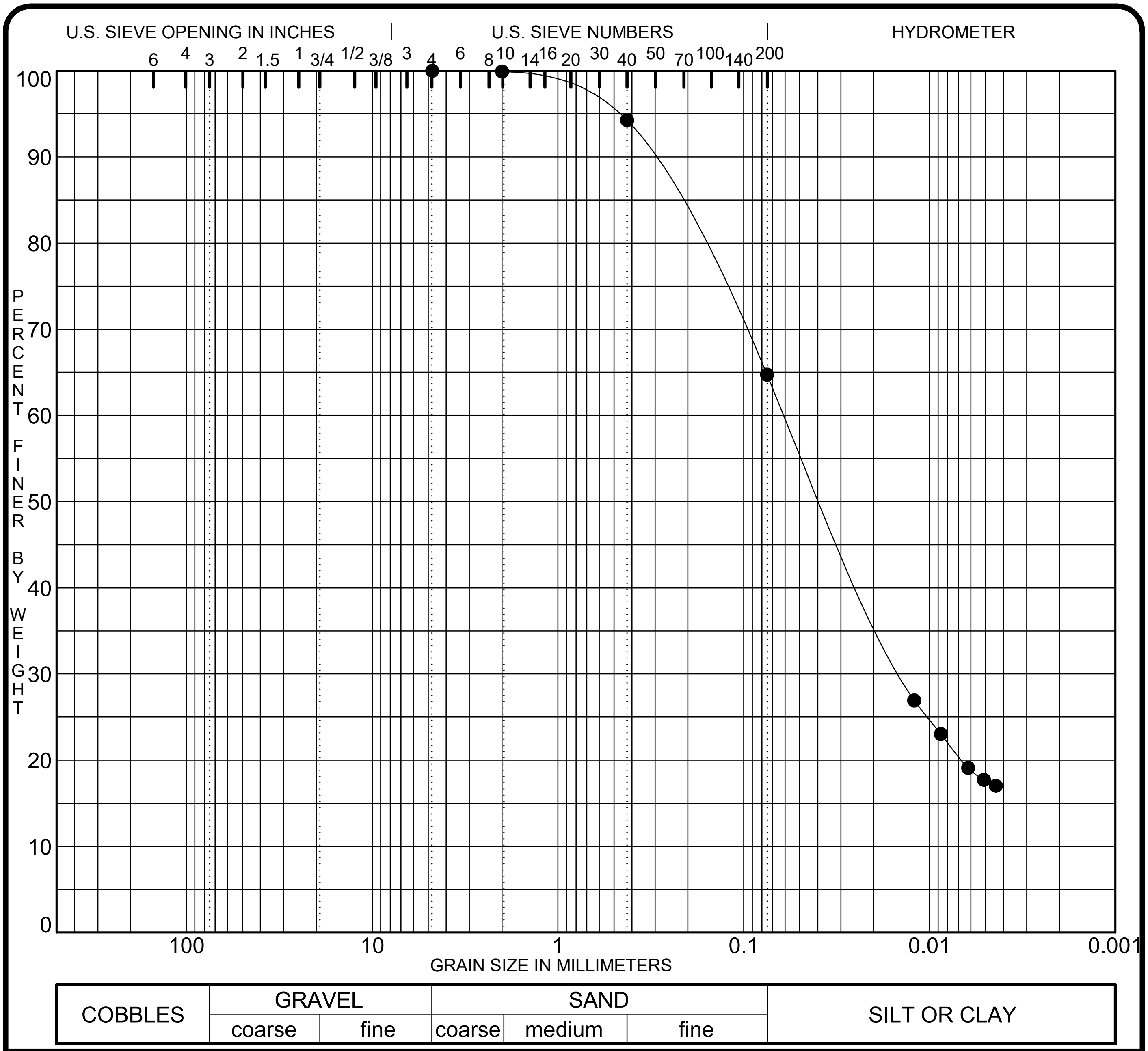
	Specimen ID	Depth	Classification	MC%	LL	PL	PI	Cc	Cu
●	**B-1**	**3.5**	**SANDY LEAN CLAY CL**	**19**	**38**	**14**	**24**		

	Specimen ID	Depth	D100	D60	D30	D10	%Gravel		%Sand			%Silt	%Clay
							coarse	fine	coarse	medium	fine		
●	**B-1**	**3.5**	**4.75**	**0.11**	**0.021**		**0.0**	**0.0**	**0.1**	**6.5**	**42.8**	**34.8**	**15.8**

PROJECT **ODNR Historic Oldtown** PROJECT NO. **W-22-005**

GRADATION CURVES

Resource International, Inc.



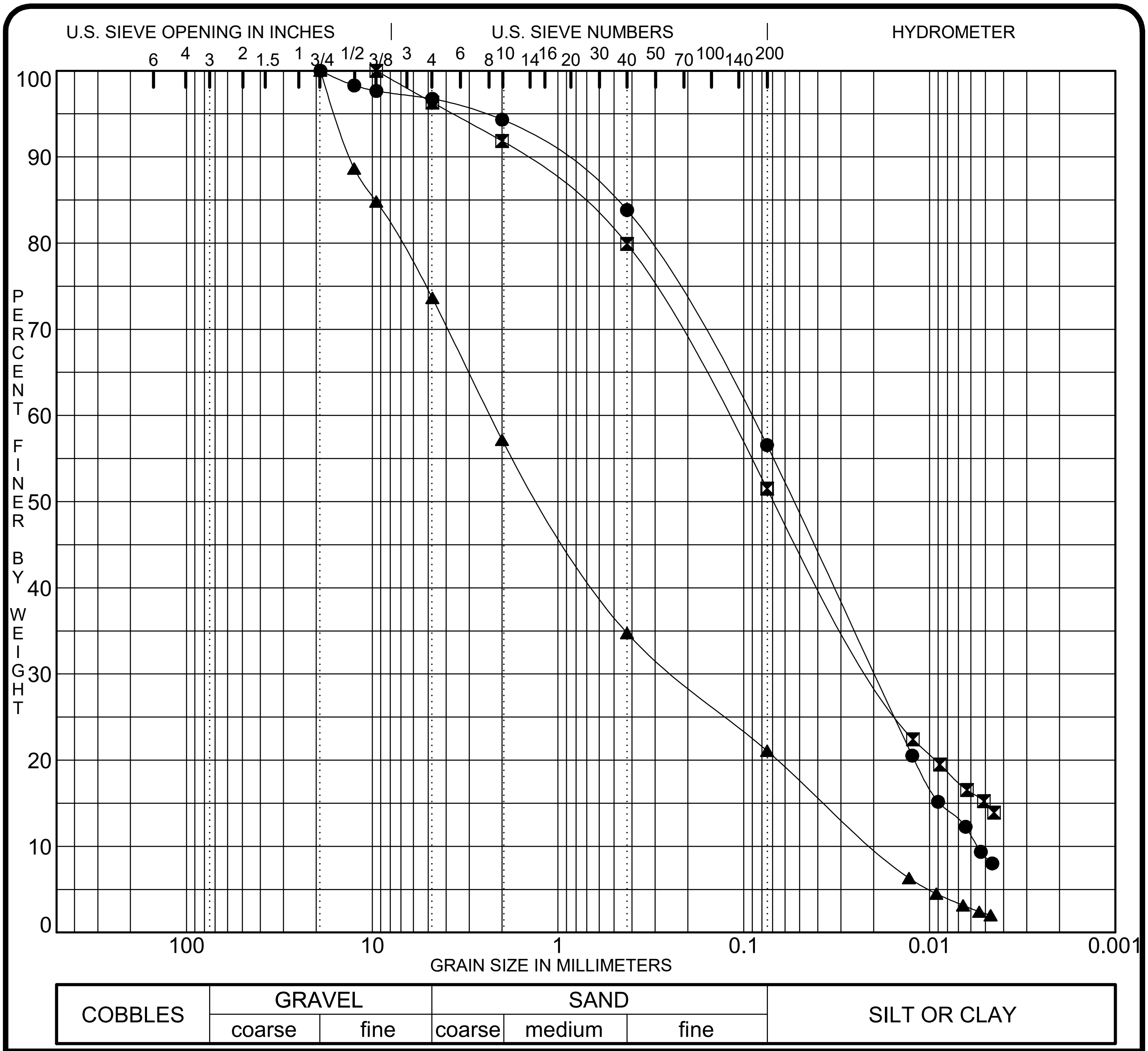
	Specimen ID	Depth	Classification	MC%	LL	PL	PI	Cc	Cu
●	**B-2**	**6.0**	**SANDY LEAN CLAY CL**	**20**	**37**	**15**	**22**		

	Specimen ID	Depth	D100	D60	D30	D10	%Gravel		%Sand			%Silt	%Clay
							coarse	fine	coarse	medium	fine		
●	**B-2**	**6.0**	**4.75**	**0.06**	**0.014**		**0.0**	**0.0**	**0.1**	**5.7**	**29.5**	**47.1**	**17.6**

PROJECT **ODNR Historic Oldtown** PROJECT NO. **W-22-005**

GRADATION CURVES

Resource International, Inc.



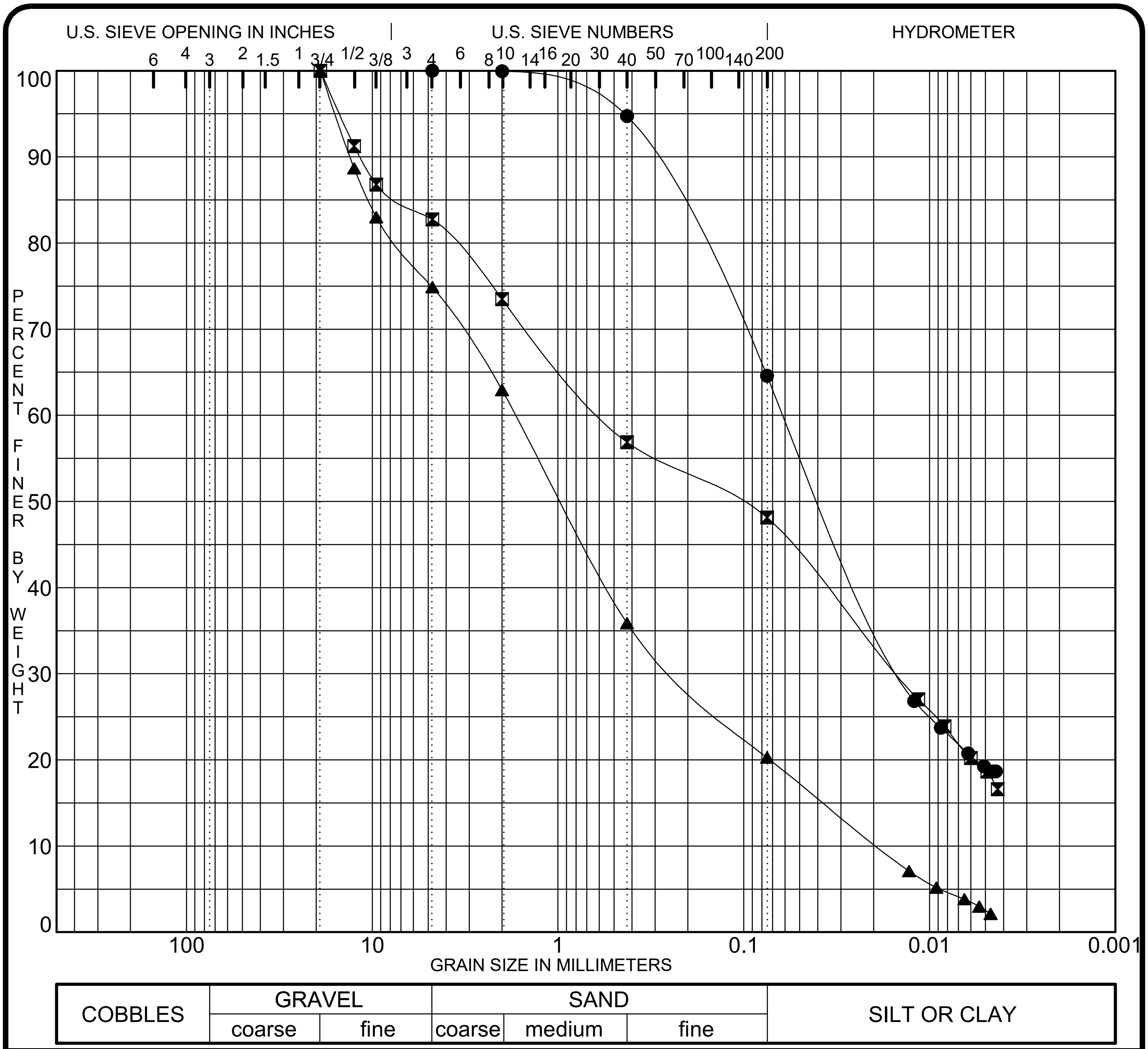
	Specimen ID	Depth	Classification	MC%	LL	PL	PI	Cc	Cu
●	B-3	1.0	SANDY LEAN CLAY CL	20	27	17	10	0.77	16.9
☒	B-3	6.0	SANDY LEAN CLAY CL	15	32	14	18		
▲	B-3	26.0	SILTY, CLAYEY SAND with GRAVEL SC-SM	14	21	14	7	1.16	116.0

	Specimen ID	Depth	D100	D60	D30	D10	%Gravel		%Sand			%Silt	%Clay
							coarse	fine	coarse	medium	fine		
●	B-3	1.0	19.00	0.09	0.020	0.0055	0.0	3.3	2.4	10.5	27.3	47.8	8.8
☒	B-3	6.0	9.50	0.13	0.020		0.0	3.7	4.5	11.9	28.4	36.5	15.0
▲	B-3	26.0	19.00	2.32	0.232	0.0200	0.0	26.4	16.5	22.4	13.7	18.9	2.2

PROJECT **ODNR Historic Oldtown** PROJECT NO. **W-22-005**

GRADATION CURVES

Resource International, Inc.



	Specimen ID	Depth	Classification	MC%	LL	PL	PI	Cc	Cu
●	**B-4**	**3.5**	**SANDY LEAN CLAY CL**	**19**	**43**	**15**	**28**		
⧗	**B-4**	**6.0**	**CLAYEY SAND with GRAVEL SC**	**10**	**23**	**14**	**9**		
▲	**B-4**	**26.0**	**SILTY SAND with GRAVEL SM**	**12**	**NP**	**NP**	**NP**	**1.52**	**88.9**

	Specimen ID	Depth	D100	D60	D30	D10	%Gravel		%Sand			%Silt	%Clay
							coarse	fine	coarse	medium	fine		
●	**B-4**	**3.5**	**4.75**	**0.06**	**0.014**		**0.0**	**0.0**	**0.1**	**5.2**	**30.2**	**45.4**	**19.2**
⧗	**B-4**	**6.0**	**19.00**	**0.57**	**0.015**		**0.0**	**17.3**	**9.3**	**16.6**	**8.8**	**29.3**	**18.8**
▲	**B-4**	**26.0**	**19.00**	**1.69**	**0.221**	**0.0190**	**0.0**	**25.1**	**11.9**	**27.1**	**15.6**	**17.8**	**2.5**

PROJECT **ODNR Historic Oldtown** PROJECT NO. **W-22-005**

GRADATION CURVES

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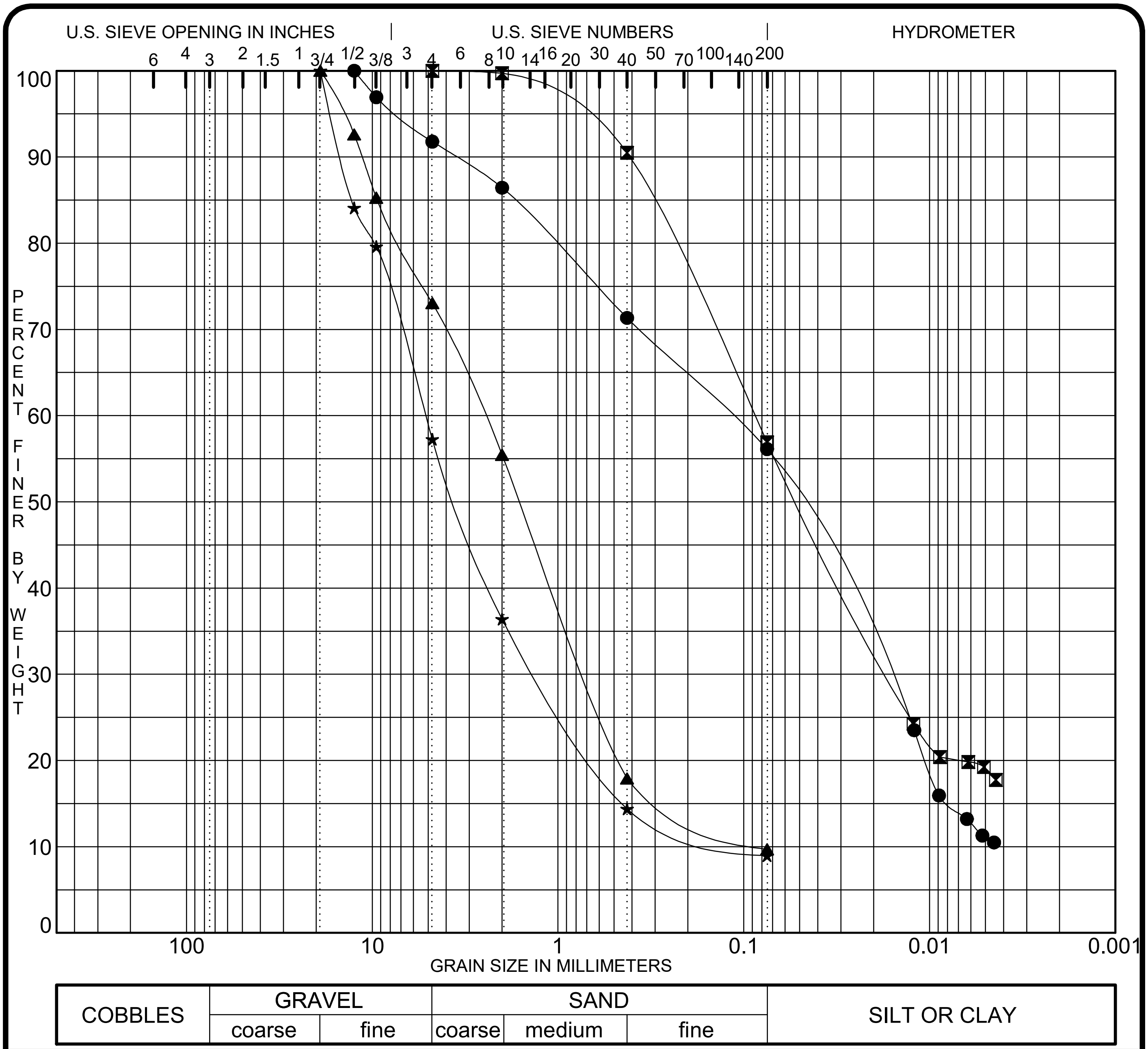

	Specimen ID	Depth	Classification	MC%	LL	PL	PI	Cc	Cu
●	**D-1**	**0.0**	**SANDY LEAN CLAY CL**	**21**	**33**	**19**	**14**		
⧗	**D-1**	**3.0**	**SANDY LEAN CLAY CL**	**20**	**34**	**14**	**20**		
▲	**D-1**	**11.0**	**WELL-GRADED SAND with SILT and GRAVEL SW-SM**		**NP**	**NP**	**NP**	**2.45**	**31.3**
★	**D-1**	**13.5**	**WELL-GRADED SAND with SILT and GRAVEL SW-SM**		**NP**	**NP**	**NP**	**2.99**	**49.3**

	Specimen ID	Depth	D100	D60	D30	D10	%Gravel coarse	%Gravel fine	%Sand coarse	%Sand medium	%Sand fine	%Silt	%Clay
●	**D-1**	**0.0**	**12.50**	**0.12**	**0.017**		**0.0**	**8.2**	**5.4**	**15.1**	**15.2**	**45.0**	**11.1**
⧗	**D-1**	**3.0**	**4.75**	**0.09**	**0.017**		**0.0**	**0.0**	**0.3**	**9.2**	**33.6**	**37.9**	**19.0**
▲	**D-1**	**11.0**	**19.00**	**2.50**	**0.700**	**0.0800**	**0.0**	**27.0**	**17.6**	**37.6**	**8.2**	**9.7**	
★	**D-1**	**13.5**	**19.00**	**5.17**	**1.275**	**0.1050**	**0.0**	**42.7**	**20.9**	**22.0**	**5.4**	**8.9**	

PROJECT **ODNR Historic Oldtown** PROJECT NO. **W-22-005**

GRADATION CURVES

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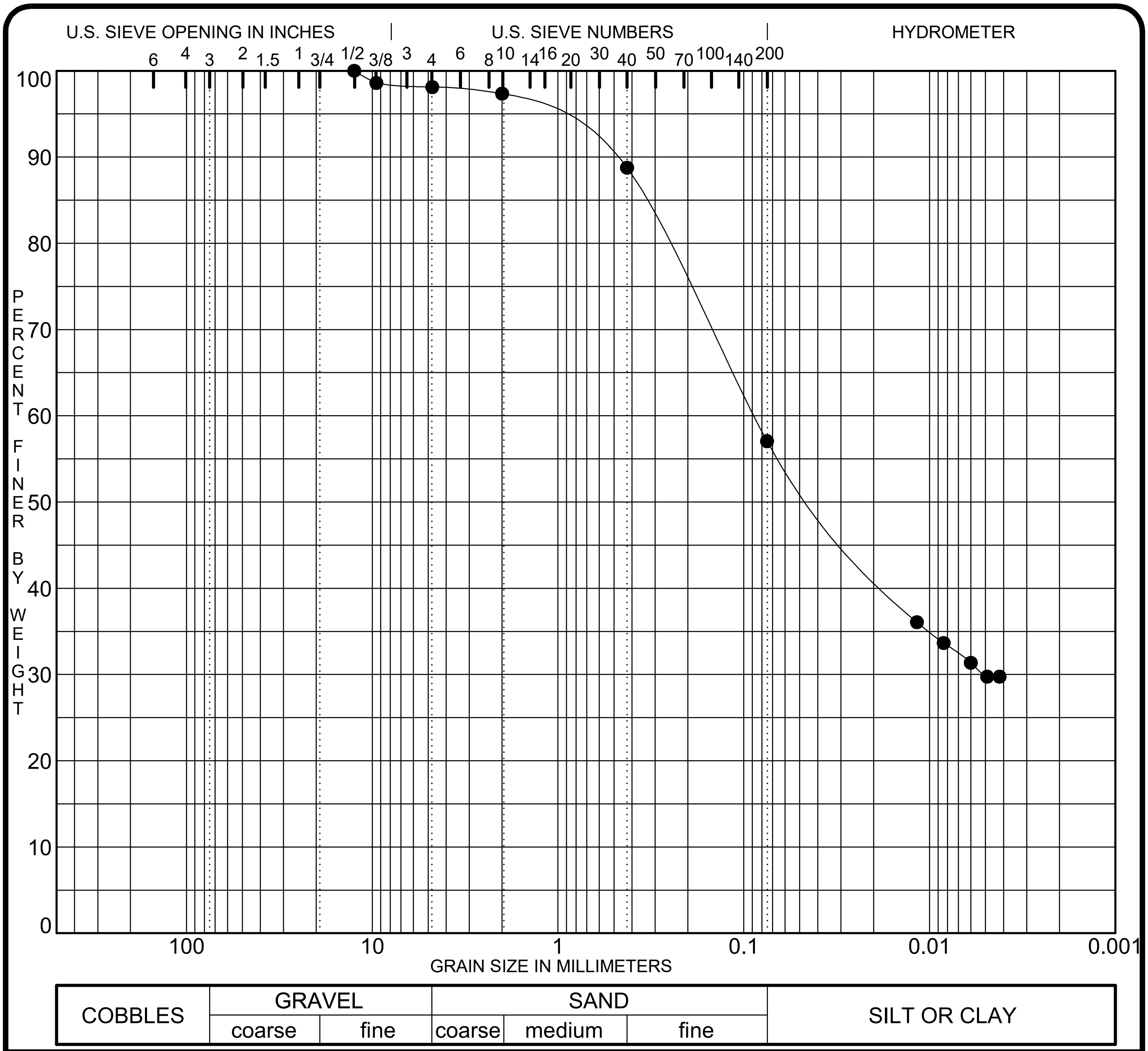


	Specimen ID	Depth	Classification	MC%	LL	PL	PI	Cc	Cu
●	**D-1A**	**2.0**	**SANDY LEAN CLAY CL**	**19**	**34**	**14**	**20**		

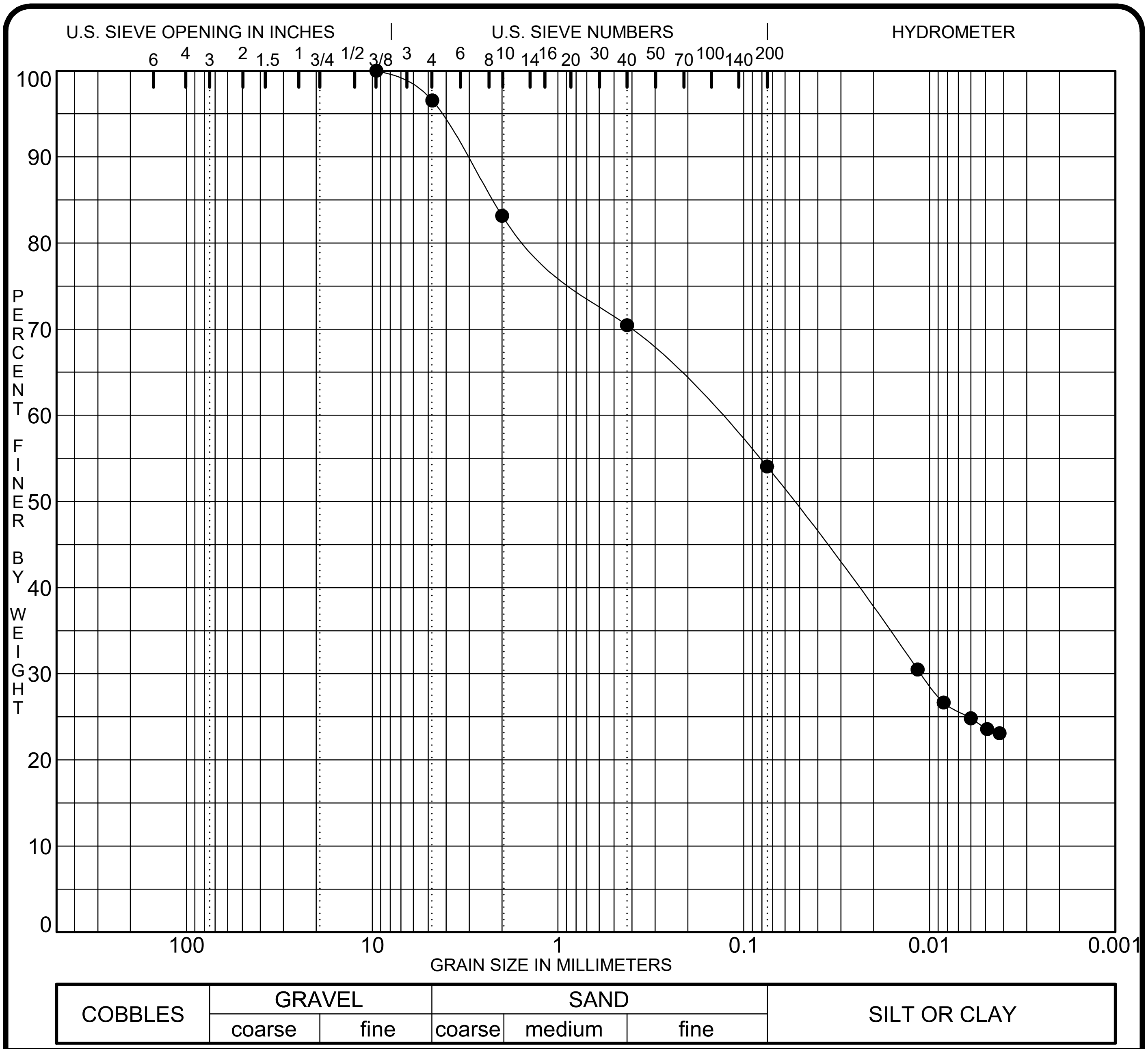
	Specimen ID	Depth	D100	D60	D30	D10	%Gravel		%Sand			%Silt	%Clay
							coarse	fine	coarse	medium	fine		
●	**D-1A**	**2.0**	**12.50**	**0.09**	**0.005**		**0.0**	**1.9**	**0.8**	**8.6**	**31.7**	**27.1**	**29.9**

PROJECT **ODNR Historic Oldtown**

PROJECT NO. **W-22-005**

GRADATION CURVES

Resource International, Inc.



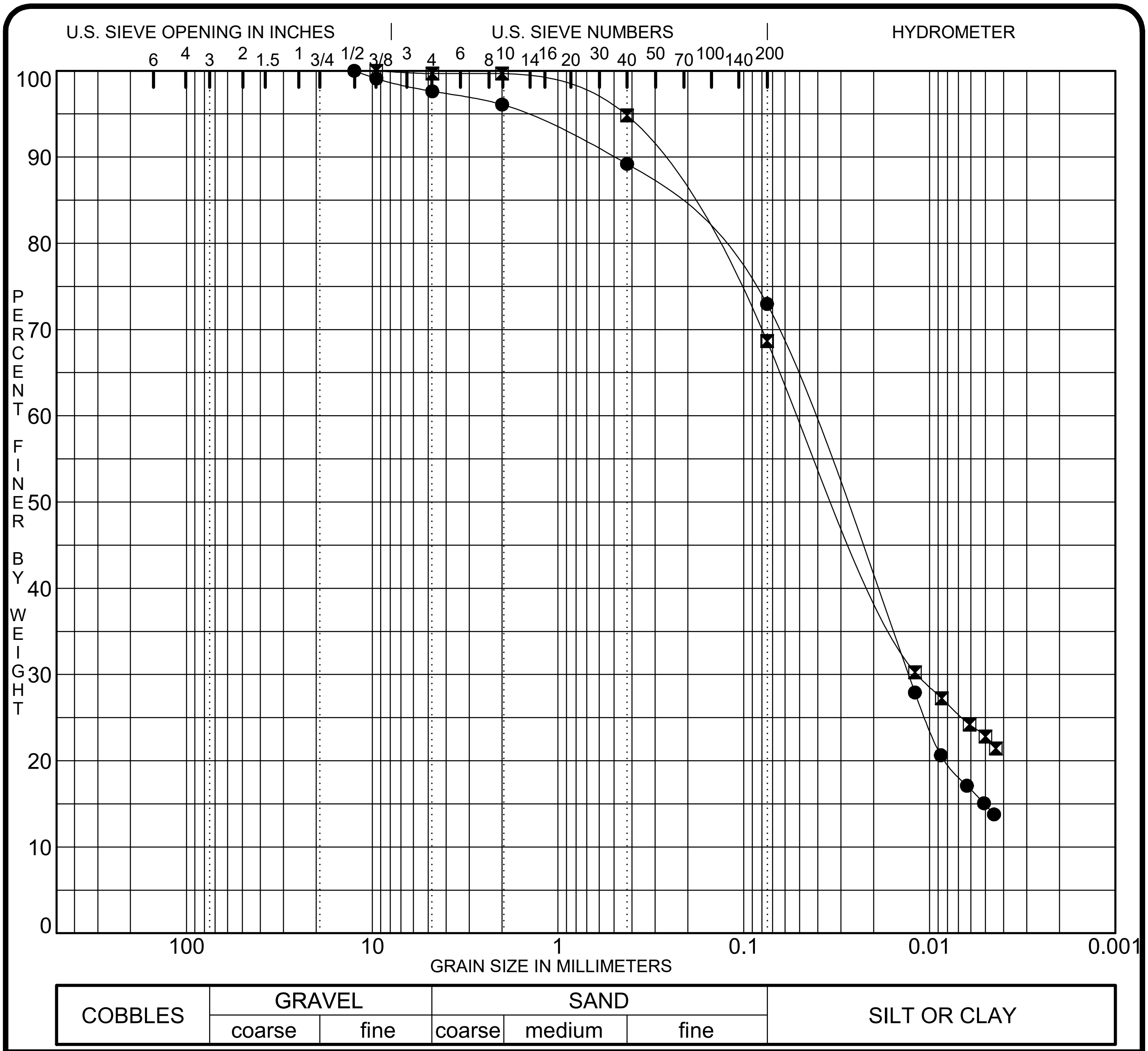
	Specimen ID	Depth	Classification	MC%	LL	PL	PI	Cc	Cu
●	**P-1**	**1.0**	**SANDY LEAN CLAY CL**	**19**	**39**	**17**	**22**		

	Specimen ID	Depth	D100	D60	D30	D10	%Gravel		%Sand			%Silt	%Clay
							coarse	fine	coarse	medium	fine		
●	**P-1**	**1.0**	**9.50**	**0.14**	**0.011**		**0.0**	**3.5**	**13.4**	**12.7**	**16.4**	**30.4**	**23.7**

PROJECT **ODNR Historic Oldtown** PROJECT NO. **W-22-005**

GRADATION CURVES

Resource International, Inc.



	Specimen ID	Depth	Classification	MC%	LL	PL	PI	Cc	Cu
●	**P-2**	**1.0**	**LEAN CLAY with SAND CL**	**19**	**27**	**18**	**9**		
☒	**P-2**	**3.5**	**SANDY LEAN CLAY CL**	**22**	**42**	**15**	**27**		

	Specimen ID	Depth	D100	D60	D30	D10	%Gravel		%Sand			%Silt	%Clay
							coarse	fine	coarse	medium	fine		
●	**P-2**	**1.0**	**12.50**	**0.04**	**0.013**		**0.0**	**2.4**	**1.5**	**6.9**	**16.2**	**58.1**	**14.9**
☒	**P-2**	**3.5**	**9.50**	**0.05**	**0.012**		**0.0**	**0.3**	**0.0**	**4.8**	**26.2**	**45.8**	**22.8**

PROJECT **ODNR Historic Oldtown** PROJECT NO. **W-22-005**

GRADATION CURVES

Resource International, Inc.

RESOURCE INTERNATIONAL, INC.
Engineering Consultants

6350 Presidential Gateway
Columbus, Ohio 43231
Telephone: (614) 823-4949
Fax Number: (614) 823-4990

SUMMARY OF TRIAXIAL PERMEABILITY TEST RESULTS
ASTM D 5084, Falling Head Test, Method B

Project Name : **ODNR Historic Oldtown**
RI Project Number : **W-22-005**
Sample Number : **D-1A, ST-1 @ 3.65-3.9**
Depth : **3.7'-3.9'**
Soil Description : **Brown Sandy Lean Clay, USCS CL**
Type of Sample : **Undisturbed, Shelby Tube**

Physical Property Data

Intial Height (cm)	7.98	Final Height (cm)	7.95
Initial Diameter (cm)	7.25	Final Diameter (cm)	7.28
Initial Wet Weight (g)	688.80	Final Wet Weight (g)	696.60
Wet Density (pcf)	130.65	Wet Density (pcf)	131.20
Moisture Content %	18.61	Moisture Content %	20.10
Dry Density (pcf)	110.15	Dry Density (pcf)	109.24

Test Parameters

Fluid	Deaired water	Effective Confining Pressure (psi)	6.70
Cell Pressure (psi)	107.00	Initial Gradient	7.31
Applied Head Water Pressure (psi)	100.60	Final Gradient	6.25
Applied Tail Water Pressure (psi)	100.00		

Permeability Input Data

Flow, Q (cc) : 4.20
Final Length, L (cm) : 7.95
Final Area, A (cm^2) : 41.68
Initial Head, h(1) (cm) : 58.10
Final Head, h(2) (cm) : 49.70
Time, t (sec) : 63600.00
Temp, T (deg C) : 21.20

Computed Permeability

PERMEABILITY, K = 2.28E-07 (cm/sec) at 20 Degrees C