EARTH ENGINEERING INCORPORATED

Geotechnical Engineers & Geologists

REPORT OF GEOTECHNICAL INVESTIGATION

TRAINER BOROUGH AND COMMUNITY BUILDINGS

5005 & 5105 TOWNSHIP LINE ROAD

TRAINER BOROUGH, DELAWARE COUNTY, PENNSYLVANIA

Prepared For:

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EEI Project No. 32036.00

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I. INTRODUCTION AND BACKGROUND

A. PROJECT OBJECTIVE AND SCOPE OF WORK

Earth Engineering Incorporated (EEI) has completed the geotechnical investigation for two proposed one-story buildings to be located at 5005 and 5105 Township Line Road (SR 3008) in Trainer Borough, Delaware County, Pennsylvania. The objective of this investigation was to evaluate the subsurface soil conditions within the proposed development area. Based on the encountered conditions and the results of geotechnical analyses performed for this project, EEI has developed geotechnical recommendations for the design and construction of a suitable foundation system. EEI also provided general construction guidelines for the development of the site.

The scope of work for the project included a test boring investigation, a geologic analysis of the site conditions, laboratory testing of soil samples, and a geotechnical engineering analysis of the data obtained as it pertains to the current development concept. This investigation was performed in general accordance with EEI Proposal No. BB-17833, dated April 10, 2019. The following report sections present the results of the field and laboratory investigations and document recommendations regarding the geotechnical aspects of the current development plans for this project.

B. EXISTING FEATURES AND PROJECT DESCRIPTION

The proposed development area is adjacent to Township Line Road in Trainer Borough, Delaware County, Pennsylvania. The subject site is currently occupied by thick brush and wooded areas. The site is bordered to the north and west by Township Line Road, to the east by a warehouse facility, and to the south and east by an unnamed tributary to Marcus Hook Creek. Upon arrival to the site, the majority of the area was covered with thick brush. The client provided an excavator to clear the site prior to drilling.

As shown on the *Grading Plan, Preliminary/Final Land Development Plans* prepared by Kelly & Close (K&C) Engineers, dated February 27, 2019, last revised August 15, 2019, there are two proposed one-story buildings and associated parking and access driveways. The proposed Trainer Borough Municipal Building, located in the northeastern half of the site, has a 10,046 square foot (sf) footprint, with a finished floor elevation (FFE) of 52.75 feet. On the southwestern half of the site the proposed Trainer Community Center has a footprint of 11,970 sf and an FFE of 52.50. Historical photos and topographic maps dating to 1940 show thick brush and mature

trees that were present on the subject site. Figure 1 below shows a current aerial photograph of the subject site.

Figure 1 - Site Location (Google 2018)

The proposed development area slopes downward generally from the west to the east, and north to south. Localized piles of fill and debris are located among the site. *Plate 1*, included within the FIGURES AND DRAWINGS section of this report, shows the general location of the site on a topographic map of the area.

The proposed development of this site includes the construction of two one-story buildings will both consist of slab on grade construction, a stormwater management facility, parking areas,

driveway relocation, and walkway areas. A proposed retaining wall 242 feet long at the southern perimeter of the site, appears to help maintain a riparian buffer at the edge of the developed area. The retaining wall height varies from 9.8 feet to 11.3 feet with an average height of 10.7 feet. At this time the type of retaining wall has not been provided. A stormwater management facility including 3 horizontal to 1 vertical (3H:1V) permanent slopes are planned at the southeast side of the site. The proposed layout for the site development is shown on the *Testing Location Plan*, EEI Drawing No. 32036.00-B-101, included in the FIGURES AND DRAWINGS section of this report.

Proposed grading and finished floor elevations for each of the two buildings were provided to EEI. The grading plan was entitled, *Grading Plan, Preliminary/Final Land Development Plans* prepared by Kelly & Close (K&C) Engineers, dated February 27, 2019, last revised August 15, 2019, Elevations referenced throughout this report for planned and existing grade elevations are based on the existing and proposed topography from this grading plan. Interpolated elevations or spot elevations were used to determine elevations where contours did not match specific contours. Anticipated finish floor elevations (FFE) for the two buildings were shown on the grading plans. For frost protection the bottom of footing (BFE) should be a minimum of 36 inches below lowest adjacent exterior grade.

TD& H Engineering, Media, PA provided EEI with anticipated maximum column loads and maximum wall footing loads determined from combined dead and live loads. The provided maximum loads are summarized in Table 1. Proposed grades for the Trainer Borough Municipal Building will remain approximately similar to existing grades. The Trainer Community Center will require up to 8 feet of fill to achieve the proposed bottom of footing elevation of 49.5 feet at the southwest side of the building. Should the final loads vary significantly from these loads, EEI should be contacted immediately so that the recommendations provided herein can be verified.

TABLE 1
SUMMARY OF PROPOSED STRUCTURE CHARACTERISTICS

BUILDING	FFE (ft)[1]	Min. BFE (ft)[2]	Assumed Column Load (kips)	Assumed Wall Load (kips/ft)
Trainer Borough Municipal Building	52.75	49.75	14	2
Trainer Community Center	52.5	49.5	51	3

1 – Finished floor elevation (FFE) from grading plans by K&C, Kelly & Close Engineers.
2 – Minimum bottom of footing elevation (BFE) based on minimum frost protection of 36 inches.

II. FIELD INVESTIGATION, OBSERVATIONS, AND DATA

A. FIELD ACTIVITIES AND PROCEDURES

1. Test Borings

Eight (8) test borings, denoted in this report as B-1 through B-8, were conducted for this investigation to obtain geotechnical data for the proposed development. Borings B-1 through B-4 were drilled within the footprint of the proposed Trainer Building Municipal building location, and borings B-5 through B-8 were drilled within the footprint of the proposed Trainer Community Center. These borings are shown on the *Testing Location Plan,* included in the FIGURES AND DRAWINGS section of this report. The borings were drilled on August 28th to August 29th, 2019, by SANO Drilling, Inc. of Sewell, New Jersey using a track mounted drill rig. An EEI representative supervised and monitored the test boring program. The EEI representative field located the test borings at the time of the investigation using proposed development plans and existing features. The test boring elevations were estimated from the grading plan prepared by K&C and provided to EEI.

The borings were advanced using 2-inch outer-diameter, split-barrel (spoon) samplers and 3.25 inch inner-diameter hollow-stem augers. Split-barrel sampling, conducted in accordance with ASTM standard D1586, were taken at continuous 2.0 feet intervals to a depth of 10.0 feet below existing grades at each test boring, and at five (5) foot intervals thereafter, where feasible. The SPT values, which are a measure of soil density and consistency, are the number of blows required to drive the 2-inch outer diameter split-barrel sampler 1 foot using a 140-pound weight dropped 30 inches. The number of blows required to advance the sampler over the 12-inch interval from 6 to 18 inches is considered the "N" value, or the SPT value.

The maximum depths to which the borings were advanced ranged from 13.3 feet to 25.0 feet below the existing grade. Auger refusal was encountered in each of the borings except B-8. Auger refusal is generally interpreted as the drilling apparatus encountering the moderately weathered to fresh bedrock surface. Groundwater was encountered during drilling at depths ranging from 7.6 feet to 18.5 feet below ground surface. The total depth and subsurface conditions encountered are detailed on the *Boring Logs* and graphically displayed on the *Boring Profiles*, which are included in the APPENDIX and FIGURES AND DRAWINGS, respectively.

2. Groundwater Observations

At the time of investigation, groundwater was encountered during drilling in all borings except B-1, B-5 and B-6. Groundwater was encountered at depths ranging from 7.6 feet to 18.5 feet below existing ground surface. It should be noted that the groundwater observations were made at the time of the subsurface investigation and no long-term groundwater readings were taken. Groundwater table elevations may fluctuate with daily, seasonal, and climatic variations. The contractor should be advised that they may conduct their own investigations to verify groundwater elevations prior to performing excavations on site.

B. GEOTECHNICAL LABORATORY TESTING

Three (3) representative samples of the soils recovered from the field investigation were submitted for laboratory testing. [Laboratory Results are pending] The laboratory testing conducted on the samples consisted of classification, in accordance with ASTM standard D2487-00, to verify visual classifications and to establish engineering parameters required for analyses. The tests performed included Particle Size Analysis (ASTM D422) and Natural Moisture Content (ASTM D2216). A Unified Soil Classification System (USCS) Group Symbol and ASTM Group Name has been assigned to the soil based upon the laboratory testing. The results of the laboratory testing conducted are presented in Table 2. Gradation curves, graphically and numerically depicting the results of the analyses, are included in the APPENDIX of this report.

TABLE 2
LABORATORY CLASSIFICATION TEST RESULTS

Boring	**Sample**	Stratum	Depth	Moisture Content (%)	Percent Finer #200 Sieve (%)	Atterberg Limits (LL/PL)	Description
B-2	S-3 & S-4	Stratum II	4.0’ – 8.0’	19.7	38.3	NP	SM, Silty sand
B-4	S-3 & S-4	Stratum I	4.0’ – 8.0’	21.5	63.2	NP	ML, Sandy silt
B-8	S-4 & S-5	Stratum I	6.0’-10.0’	19.4	75.0	NP	ML, Silt with sand

C. PUBLISHED GEOLOGICAL INFORMATION

According to the Commonwealth of Pennsylvania, Topographic and Geologic Survey, Atlas of Preliminary Geologic Quadrangle Maps of Pennsylvania, 1966, Revised 1978, Lansdowne Quadrangle, the investigated site is underlain by the Lower Paleozoic Period

Wissahickon Formation (Geologic Symbol: Xw). Plate 2, included in the APPENDIX, shows the location of the site on a geologic map of the area.

As noted in the Commonwealth of Pennsylvania, Topographic and Geologic Survey, Engineering Characteristics of The Rocks of Pennsylvania, Fourth (4th) Series, Revised 1982, the metamorphic Wissahickon Formation (Xw) is typically composed of a mica-schist. This rock is characterized by its distinct foliation which is caused by the preferential orientation of muscovite, feldspar and quartz. The foliation within this formation is typically well developed, fissile to thin. This rock type is moderately resistant to weathering and the overlying soil mantle is typically thin. In comparison to other rock types, the ease of excavation ranges from easy in completely weathered rock to difficult in slightly to fresh weathered rock. Groundwater springs and quartz boulders are common occurrences within this formation.

Based upon the materials observed during the field investigation, the residual soil conditions at the site appeared typical of the weathering of the schist of the Wissahickon Formation. Based upon the materials observed during the field investigation, the residual soil conditions at the site appeared typical of the weathering of the schist bedrock of the Wissahickon Formation.

III. INTERPRETATION OF INFORMATION AND DATA

A. STRATIFICATION AND SUBSURFACE CONDITIONS

The samples of soil obtained during the field investigation were examined and classified by EEI, both in the field and in the laboratory in order to develop a generalized subsurface profile for the investigated area. EEI identified and characterized three (3) naturally occurring strata below an existing Fill layer. A surface layer of asphalt and subbase stone underneath (0.5 to 1.0 feet thick) was observed at each boring location. Topsoil was not encountered.

Cross-sections of the borings, which graphically depict the subsurface, and other information obtained from the field investigations are shown on the *Subsurface Profiles,* which are included in the APPENDIX section of this report. Detailed descriptions and data regarding the subsurface conditions are shown on the *Boring Logs* in the APPENDIX. The following subsections provide general descriptions of the materials encountered.

1. Existing FILL

The existing Fill materials consist of sandy silt to silty fine sand, brown with fragments of brick, and glass. The existing Fill material was encountered in three of the eight borings, B-1, B-2, and B-4 and extended to depths ranging from 1.0 to 2.5 feet. A topsoil surface layer of 3 to 4

inches thick was encountered in two of the eight borings, B-2 and B-8. The USCS Group Symbol for representative samples of this soil is ML to *SM.* The assigned ASTM Group Name for the samples tested is sandy silty to *silty sand*.

The SPT value recorded during the sampling of the existing FILL was 9 blows per foot of penetration (B-4). Based on these values, the relative density of the FILL material is loose. These materials were encountered in a moist state during the field investigation.

2. Stratum I – Alluvium / Residual Soils

The soil designated as Stratum I consists of silty sand to sandy silt, and poorly-graded sand with trace to some amounts of gravel, brown to orange brown. The depth of Stratum I soils ranges from 2.0 ft (B-3) to 11.0 ft (B-7 & B-8) below existing grade. Where mottling of the soil occurs, as encountered in borings B-6, B-7, & B-8, the soil colors varied tan, gray, pale brown. As determined by laboratory testing, the USCS Group Symbol for representative samples recovered from these soils is ML. The corresponding ASTM Group Name is *Sandy Silt*. Stratum I is a possible alluvium soil deposited by water or residual soil produced by the in-place decomposition and/or advanced weathering of the underlying bedrock. EEI encountered these soils at each of boring locations, except boring B-2, and they lie immediately beneath the existing FILL, where encountered, or below the existing grade.

The SPT (N) values recorded during the sampling of this soil ranged from 7 blows per foot (B-4) to 28 blows per foot of penetration (B-7). Although the SPT values generally indicate that the Stratum I soils range from loose to medium dense, the stratum is generally medium dense. The moisture level of this material was observed to be generally moist. The laboratory measured natural moisture contents for this layer ranged from 19.4 percent to 21.5 percent.

3. Stratum II – Decomposed Schist

The material designated as Stratum II consists of decomposed schist in the form of silty micaceous sand, trace to some gravel, trace cobbles, dark gray, black and dark tan, sandy silt to silty sand. As determined by laboratory testing, the USCS Group Symbol for representative samples recovered from these soils is SM. The corresponding ASTM Group Name is *Silty Sand*. This stratum was encountered immediately beneath Stratum I at each of the boring locations, except boring B-2, which immediately below the FILL. Stratum II extends to a depth ranging from 8.0 ft (B-5) to more than 25.0 (B-8) feet below the existing grade. Stratum II is a weathered product from the underlying schist bedrock.

The SPT (N) values recorded during the sampling of this material ranged from 8 blows per foot of penetration to more than 50 blows per foot. These SPT values indicate that Stratum II is

loose to very dense. These materials were encountered in a moist to wet state during the field investigation. The laboratory measured natural moisture contents for this layer was 19.7percent.

4. Stratum III – Weathered Schist

The material designated as Stratum III consists of weathered schist in the form of silty micaceous sand, some gravel fragments of schist, trace cobbles, brown, gray-brown, grey, black. This stratum was encountered immediately beneath Stratum II at each of the boring locations, except boring B-8. Stratum III extends to depths ranging from 13.3 to more than 25.0 feet below the existing grade.

The SPT (N) values recorded during the sampling of this material range from 44 blows per foot, to exceeding 50 blows per foot of penetration. These SPT values indicate that Stratum III relative density is dense to very dense. Difficult drilling, which is also indicative of very dense conditions, was initially encountered at depths ranging from 8.0 feet to more than 25.0 feet below the existing grade. These materials were encountered in a moist to wet state during the field investigation.

5. Bedrock

Bedrock, in the form of auger refusal, was encountered at each of the borings except B-8 at depths ranging from 13.3 feet to 22 feet below existing ground surface. Based on the subsurface information collected, the encountered soils are consistent with the underlying Wissahickon Schist Formation. The depths to very dense weathered rock, and bedrock with corresponding elevations are shown in the following table.

TABLE 3
DEPTHS TO VERY DENSE WEATHERED ROCK AND BEDROCK

Development Area	Boring Location	[1.] Ground Surface Elevation (feet)	[1.] Proposed Finish Grade Elevation at Boring Location (feet)	[2.] [3.] Depth to Very Dense Weathered Rock (feet)	[1.] Very Dense Weathered Rock Elevation (feet)	[2.] Depth to Bedrock (Auger Refusal) (feet)	[1.] Bedrock Elevation (feet)
Muni. Bldg.	B-1	56.0	52.75	18.5	37.5	22.0	34.0
Muni. Bldg.	B-2	51.5	52.75	12.0	39.5	14.0	37.5
Muni. Bldg.	B-3	51.0	52.75	17.5	33.5	19.0	32.0
Muni. Bldg.	B-4	54.0	52.75	19.5	34.5	22.0	32.0
Comm. Ctr.	B-5	50.0	52.5	8.0	42.0	13.3	36.7

TABLE 3 DEPTHS TO VERY DENSE WEATHERED ROCK AND BEDROCK							
Development Area	**Boring Location**	**[1.] Ground Surface Elevation (feet)**	**[1.] Proposed Finish Grade Elevation at Boring Location (feet)**	**[2.] [3.] Depth to Very Dense Weathered Rock (feet)**	**[1.] Very Dense Weathered Rock Elevation (feet)**	**[2.] Depth to Bedrock (Auger Refusal) (feet)**	**[1.] Bedrock Elevation (feet)**
Comm. Ctr.	B-6	48.0	52.5	11.0	37.0	15.0	33.0
Comm. Ctr.	B-7	43.0	52.5	15.0	28	16.5	26.5
Comm. Ctr.	B-8	40.5	52.5	[4.] N/E	[4.] N/A	[4.] N/E	[4.] N/A

[1.] Ground surface elevations were estimated from available existing & proposed topographic plans provided to EEI.
[2.] Depths were measured from existing site grades at the time of the investigation.
[3] Depths to Very Dense Weathered Rock is estimated at SPT> 50/ft, or difficult drilling.
[4] N/E = Not Encountered within the depth of boring. N/A – Not Available.

IV. GEOTECHNICAL RECOMMENDATIONS

A. GEOTECHNICAL ANALYSES

EEI has completed the geotechnical analyses in order to provide foundation design recommendations. The analyses are based on the conditions encountered in the field and laboratory analyses. EEI has evaluated the subsurface conditions and provides the following soil parameters utilized for foundation analyses in the following table.

TABLE 4 GEOTECHNICAL SOIL PROPERTIES			
Soil Stratum	Fill	Stratum I	Stratum II
Moist Unit Weight - γ_m (pcf)	120	120	130
Effective Stress Angle of Internal Friction - ϕ' (deg)	28	30	34
Cohesion – c (psf)	0	0	0

As previously mentioned, the proposed construction will include two proposed one-story buildings and associated parking and access driveways. The provided grading plan includes FFE for the two buildings. The Trainer Borough Municipal building will have an FFE of 52.75 feet. The Trainer Community Center building will have an FFE of 52.5 feet. The unfactored structural loads were provided by TD& H, which were determined from dead and live load. For the Trainer Borough Municipal building the maximum column load is 14 kips with a maximum wall load of 2

kips /ft. For the Trainer Community Center, the maximum column load is 51 kips with a maximum wall load of 3 kips/ft. These loads were used for developing the following foundation recommendations.

B. FOUNDATION SUPPORT RECOMMENDATIONS

The geotechnical investigation revealed a subsurface profile that would not allow for support of the proposed structures by the soil in their current state. Therefore, two alternative options for foundation support are detailed below.

Based on the results of the geotechnical subsurface investigation, assumed structural loads, laboratory analyses, and subsequent calculations, EEI recommends that the proposed building be supported on standard strip and spread footings at a minimum depth of 3.0 feet below the provided FFE for each building, or at least 3.0 feet below lowest adjacent exterior grade.

- **Trainer Borough Municipal Building**

The existing FILL in borings B-1, B-2 and B-4 will be removed to achieve the BFE. However, weak upper portions of Stratum I soils, particularly soils in the vicinity of borings B-4, may not be suitable for foundation construction and should be undercut and replaced with more suitable soil. Soils at foundation subgrade should be evaluated using proofrolling (see SITE PREPARATION section) by the on-site representative of Geotechnical Engineer.

According to the proposed construction and the subsurface profile, the proposed Trainer Borough Municipal building foundation is anticipated to bear on either Stratum I (as seen in borings B-3 and B-4) or Stratum II soils (as seen in B-1 and B-2).

- **Trainer Community Center**

Significant fill will be needed to achieve the proposed FFE for the Trainer Community Center. Prior to placing and compacting the structural fill to meet the proposed BFE for the building, the soils at structural fill subgrade should be evaluated using proofrolling (see SITE PREPARATION section) by the on-site representative of Geotechnical Engineer. Weak upper portions of Stratum I soils particularly in the vicinity of boring B-6, and other areas as determined by proofrolling may not be suitable for the structural fill placement and should be undercut and replaced with more suitable soil.

If loose/soft materials or otherwise unsuitable materials still exists at the either of the proposed building's footing subgrade elevations, they should be recompacted or undercut and replaced according to the FILL AND COMPACTION section of this report. If undercuts are

necessary, the vertical and lateral extent of undercut should be determined by on-site representative of Geotechnical Engineer.

Foundations may be designed for an allowable bearing pressure of 3,000 psf on medium dense Stratum I, or Stratum II soils. At this bearing pressure, estimated total settlements are expected to be less than 1 inch. The following specifications assume that recognized, proper construction practices will be followed throughout construction and that a Professional Engineer qualified in Geotechnical Engineering will be retained to oversee the inspection of site preparation, proofrolling, foundation construction, and other critical earthwork operations.

1. Foundations shall bear on medium dense Stratum I or Stratum II soils, placed and compacted at least 36 inches below lowest adjacent exterior grade. Foundations shall not bear on loose/soft or wet soils. Bearing in these materials, the foundations should be designed for an allowable bearing capacity of 3,000 pounds per square foot.
2. If loose/soft or wet soils are encountered at the footing subgrade elevation they should be undercut to suitable bearing materials and replaced with structural fill or lean concrete. Alternatively, the foundation base can be lowered to a suitable soil-bearing elevation.
3. Strip and spread foundations shall be a minimum of 18 and 36 inches wide, respectively, for shear considerations.
4. All foundation and slab subgrades should be compacted with hand-operated compaction equipment (e.g., a rammer or “jumping jack”) or with a vibratory, walk-behind, trench roller or a smooth roller (e.g., Rammax, Wacker, or Bomag equipment) in accordance with the FILL & COMPACTION section of this report.
5. All footing subgrades should be dry and free of loose material or debris, as determined by the geotechnical engineer, immediately before the placement of concrete.
6. The actual bearing conditions at the footing subgrade elevation should be confirmed in the field during excavation, by inspection under the supervision of a Professional Engineer qualified in Geotechnical Engineering.

C. ADDITIONAL EVALUATIONS – SOIL SLOPES & RETAINING WALL

EEI recommends performing additional evaluations of the proposed grading, retaining walls and stormwater management facility embankments prior to construction. The proposed grading plan shows final slopes as steep as 2 horizontal to 1 vertical (2H:1V) planned at the southern perimeter adjacent to a wet area. Generally, depending on the slope height, and soil constituents, fill slopes should be no steeper than 3H:1V, and cut slopes should be no steeper than 2H:1V. At least one retaining wall is proposed at the site. The retaining wall load will be surcharged by the addition of the sloped fill behind the wall. Furthermore, the retaining wall is planned for an area of weak underlying soils, which may not adequately support the planned retaining wall. The stormwater management facility perimeter embankment slopes are planned

for permanent slopes as steep as 3H:1V, however these heavy embankments will bear on thick, weak alluvial soils and may be subject to instability.

Therefore, additional evaluations of these features should be considered prior to construction. Additional laboratory testing namely at a minimum a direct shear test (ASTM D3080), should be conducted on representative soil(s) proposed for constructing the fill slope soils, fill soils behind the retaining walls and embankment soil constituents. The testing will be used to determine specific soil strength criteria. The permanent fill slope, retaining wall and embankment slope stability should be analyzed. Furthermore, additional test borings for the retaining structures may be warranted. The results of this testing may provide more aggressive soil parameters to be used in determining an adequate permanent slope, retaining wall design, and embankment slopes. EEI would be pleased to provide a proposal that will include an additional scope and cost to evaluate the stability of these features.

D. FLOOR SLAB SUPPORT

EEI recommends, that the floor slabs for the proposed development be designed as a slab-on-grade system, and the subgrade should be prepared in accordance with the procedures described in this report. The floor slab shall be designed with a modulus of subgrade reaction of 150 psi/in. EEI recommends the placement of a granular subbase beneath the floor slab to provide uniform support distribution between the subgrade soils and the base of the concrete slab. It is recommended that a minimum of four (4) inches of crushed stone aggregate, such as AASHTO #57 or equivalent, be placed and compacted beneath all floor slab areas. The floor slabs should be suitably reinforced to control shrinkage cracks. Proper joints should be provided at the junction of the slabs and foundation system so that a small amount of independent movement can occur without causing damage.

EEI recommends a vapor retarder/barrier be installed to minimize any issues with moisture intrusion from groundwater and/or perched water within the subgrade soils. The need for a vapor retarder/barrier from a non-geotechnical perspective depends on the floor covering and/or humidity control in the proposed building space. Refer to appropriate documentation from the Portland Cement Association for guidance on the need and location of a vapor retarder/barrier. If a moisture sensitive floor covering is used, or the building space is equipped with humidity control, then a vapor retarder/barrier is recommended. Additionally, the location of the vapor retarder/barrier would depend on when slab construction is completed with respect to placement of a water tight roofing system. There is some debate in the industry on the use and location of

vapor retarder/barrier. Regardless, these issues are not of a geotechnical nature. Therefore, EEI recommends that these issues be evaluated by the Architect and/or the project structural engineer accordingly to determine the need for and location of the vapor retarder/barrier.

E. EXISTING FEATURES DEMOLITION

The proposed development area is currently occupied by tree stumps and brush, residual piles of fill soils and concrete wastage, which will need to be removed or recycled for use on site. EEI recommends the complete removal of all debris, including pavement, foundation, slab, and/or obstructions, if any, from beneath the proposed construction area. Demolition debris, where encountered, including, but not limited to, concrete and asphalt, should be processed and recycled properly if intended for reuse as *structural fill*. If the demolition debris is to be removed from the site, these materials should be disposed of properly.

EEI recommends that any existing utilities, if any, be removed and relocated to areas outside the planned construction zone. After the removal of the tree stumps the base of all excavations resulting from the removal of tree stumps, demolition debris, or existing utilities should be proofrolled and inspected by a representative of the Geotechnical Engineer of Record to confirm stability prior to backfilling. Following confirmation of a stable subgrade, the excavations should be backfilled as specified in the *FILL AND COMPACTION* section of this report.

F. SITE PREPARATION

Topsoil, where encountered, should be stripped, and vegetation cleared from the development area. Tree stumps and brush roots should be grubbed from the development area to expose the soils at the construction subgrade elevations. The subgrade should be proof-rolled and compacted in order to densify and verify the integrity of the subgrade bearing materials prior to the placement of concrete, subbase stone, or *structural fill* in the undercut areas or other areas that require *structural fill*. EEI recommends that a smooth drum vibratory roller having a minimum static weight of 10 tons be utilized for this purpose. Areas that cannot be accessed by this sized equipment should be densified and compacted by use of walk-behind or hand operated equipment. The proof-rolling and compaction activities should be observed and evaluated during construction by the on-site representative of the Geotechnical Engineer of Record. Any soft zones encountered during proof-rolling should be removed and replaced with *structural fill* as described in the *FILL AND COMPACTION* section of this report.

The site should be graded during construction to convey surface runoff away from active work areas. The work areas should be sealed by rolling on a daily basis to promote runoff. Careful grading and management of surface water runoff will help minimize disturbance of the subgrade. EEI recommends that all construction areas, including those that will be excavated to achieve the planned subgrade elevation, be proof-rolled immediately before the placement of any *structural fill* and/or the placement of subbase stone, and again before the installation of concrete or asphalt. Such preparations will allow soft and weak areas to be observed and remediated before construction.

G. GROUNDWATER CONTROL

As discussed in the "Field Activities and Procedures" section of this report, groundwater was encountered during drilling. Above the bedrock surface at 9.2 to 18.5 feet below existing grade is either perched, possibly groundwater related to the unnamed tributary to Marcus Hook Creek. Since the proposed BFE will be well above these depths it is anticipated that groundwater will not be encountered during excavations required for foundation construction and utility installation, as well as potential over-excavations of unsuitable materials. However, the contractor should be advised that additional investigations can be conducted to gather more information regarding groundwater conditions to further evaluate the proposed construction methods and costs.

H. LATERAL EARTH PRESSURE COEFFICIENTS

Should retaining walls be incorporated into the project plans, the lateral earth pressures that may be used for designing below grade building walls and site retaining walls are shown in the following table. No basements are proposed for the development; however, a retaining wall is proposed for the site. Walls that are restrained from deflection should be designed for the at-rest (K_o) condition. Walls that are free to deflect should be designed for the active (K_a) condition. Considered somewhat conservative, the earth pressure data for the on-site material was determined from the soil classification testing and visual classification of the soil samples and was compared to generally accepted and published values for the various properties.

TABLE 4 SOIL PROPERTIES FOR COMPUTATION OF LATERAL LOADS			
Stratum	Existing FILL	Stratum I	Stratum II
Effective Stress Angle of Internal Friction - ϕ'	28°	30°	32°
Moist Unit Weight - γ_m	115 pcf	120 pcf	130 pcf
Rankine Coefficient of Active Earth Pressure - K_a	0.36	0.33	0.31
Rankine Coefficient of Passive Earth Pressure - K_p	2.77	3.00	3.25
Rankine Coefficient of At-Rest Earth Pressure - K_o	0.53	0.50	0.47
Coefficient of Sliding	0.37	0.40	0.42

The coefficients presented in Table 4 are based on the assumption of vertical wall face, horizontal backfill and no wall friction. These values do not include a design safety factor. EEI typically recommends that a drainage system be installed for all walls constructed below grade. The presence of a drainage system will serve to minimize hydrostatic pressures caused by water trapped against the walls. If adequate drainage is not provided, the walls should be designed to resist hydrostatic loads. Additionally, consideration should be given to any surcharge loads at the top of walls.

A site retaining wall is proposed at the site. However, any evaluation for the proposed wall was outside the scope of the geotechnical investigation. The wall designer should determine if additional investigations and testing are warranted depending on type, size and location of the proposed walls. At a minimum, EEI recommends additional laboratory testing, namely a direct shear test (ASTM D3080), be conducted on representative soils in the areas of the proposed retaining walls for the site. The results of this test may provide more aggressive soil parameters to be used in retaining wall design, which may effectively reduce retaining wall cost.

I. PERMANENT SOIL SLOPES

The proposed grading plan shows final slopes as steep as 2 horizontal to 1 vertical (2H:1V) and 3 horizontal to 1 vertical (3H:1V) planned at the southern perimeter adjacent to a wet area. Generally, depending on the slope height, and soil constituents, should be no steeper than 3H:1V, and cut slopes should be no steeper than 2H:1V. Fill slopes consisting of on-site fine sands, silty sands, and silts will be susceptible to erosion by surface runoff; benches, paved ditches, and

plantings on the slope can help reduce runoff velocities and retard erosion. Temporary sedimentation and erosion control measures should be left in place until vegetation on the slope surface has been permanently established. We recommend a registered Professional Engineer in the Commonwealth of Pennsylvania experienced in geotechnical engineering review the cut slope condition at the time of construction, and fill slopes should be evaluated for short- and long-term stability depending on the fill material used.

J. EXCAVATIONS

Based on the existing site conditions and subsurface profiles, EEI assumes that foundation excavations will occur within the existing FILL material, Stratum I and Stratum II soils. EEI expects that the existing FILL, Stratum I, and Stratum II soils should be capable of being excavated with conventional earth excavation equipment and techniques. Vit is unlikely the very dense Stratum III (weathered rock) will be excavated, but if encountered, excavation of Stratum III soils may require the use of a late-model, high power trackhoe in lieu of a standard backhoe.

Excavations must be sloped, benched, or shored to prevent collapse during soil excavation and during construction. Sloping, benching, or shoring of all construction excavation should be conducted in accordance with 29 CFR 1926, Subpart P. A competent person as defined by the aforementioned regulation is required to confirm the stability of all excavations during construction. The actual excavation wall slopes, benching, or shoring should be determined in the field and should be based on the required depth of excavations and on the soil types encountered.

Excavations adjacent to existing, permanent structural elements should not undermine existing foundations, walls, slabs, roadways, driveways, walkways, or utilities. If excavations are required in the vicinity of these elements, EEI recommends that precautionary measures (i.e. underpinning or shoring) be implemented in the development scheme for this project. The above recommendations are provided for planning purposes only, and the contractor will remain the entity in “Responsible Charge” of all health and safety on the site.

K. FILL AND COMPACTION

1. On Site Fill Criteria

Fill material which supports foundations, slabs, and pavements, as well as material used for retaining wall backfill, is considered *structural fill*. Following site preparation measures, *structural fill* required to elevate the subgrade within structural areas may be placed. Based on

the anticipated proposed grades, portions of the *structural fill* to be placed on may consist of imported materials. However, some of the excavations required for site development are expected to make portions of the existing Fill materials and Stratum I and Stratum II soils available for reuse as *structural fill*. Portions of the existing Fill materials and Stratum I soils may be suitable for reuse as *structural fill* provided the moisture content deviates nominally from optimum levels, and any deleterious materials are removed. It is emphasized that the existing Fill, Stratum I and Stratum II material should be carefully evaluated for reuse by a Representative of the Geotechnical Engineer of Record at the time of excavation. Any large asphalt/other material, concrete, brick, or rock fragments should be properly processed or removed from the existing Fill material prior to its reuse. Any soils which are deemed unsuitable for reuse as *structural fill* should be stockpiled separately and removed from the site or placed in non-structural areas. Deleterious materials such as metals, organics, frozen, and other non-inter materials should not be included in onsite fills.

2. Imported Fill Criteria

If any *structural fill* is required to be **imported** to the site, it should meet the following criteria:

- it should be free of organic matter, ash, cinders, frozen materials, and demolition debris,
- the plasticity index should be less than 10,
- it should be less than 15 percent by weight rock fragments larger than 3 inches, less than 30 percent by weight larger than ¾ inches, and less than 30 percent by weight smaller than the No. 200 sieve.
- meets the definition of clean fill according to PA DEP Management of Fill Policy, Document Number 258-2182-773.

The above criteria are provided as a general guideline for soil materials imported to the site. Soil materials that become available for use as a *structural fill* should be submitted to the Geotechnical Engineer of Record for evaluation before they are imported to the site.

3. Compaction Criteria

Structural fill should be placed in horizontal lifts not exceeding 8 inches in loose thickness and compacted with a smooth drum vibratory roller with a minimum static weight of 10 tons. Structural fill should be placed in horizontal lifts of 6 inches loose thickness where compaction by hand-operated equipment is necessary. The optimum lift thickness and number of repetitions necessary to achieve the required percentage compaction values should be determined in the field with test passes of the chosen compaction equipment. The fill material should be placed at,

or deviate nominally from, the optimum moisture content as determined in accordance with ASTM D698 or D1557 and compacted to a minimum percentage of the maximum dry density as indicated on Table 5.

TABLE 5
COMPACTION CRITERIA

Fill Area	Percent of Maximum Dry Density Per ASTM D698 (Standard Proctor)	Percent of Maximum Dry Density Per ASTM D1557 (Modified Proctor)
Foundation Support, and Wall Backfill	98	95
Utility Trenches and Walkways	98	95
Nonstructural	92	92

L. SITE SEISMIC CLASSIFICATION

According to the 2018 International Building Code IBC Section 1613.3.2 Site Classification for Seismic Design and the information obtained from the geotechnical field investigation, the average properties in the top 100 feet correspond to Site Class D (Table 20.3-1 *Site Classification,* in Chapter 20 of ASCE 7). Therefore, Site Class D conditions should be applied for the seismic design of the proposed structures.

V. CONSTRUCTION QUALITY CONTROL

As documented within this report, the proposed construction will include earthwork procedures and foundation placement activities. The quality of these activities is an integral part of the development of this site and directly affects the validity of the recommendations presented in this report. Based on EEI's past experience, the most effective and economical earthwork inspection is obtained through the presence of a qualified representative of the Geotechnical Engineer of Record during site preparation, excavation of on-site materials, site development, proof-rolling, placement of *structural fill*, and installation of foundation elements. EEI recommends that these activities be examined, tested, and confirmed by the Geotechnical Engineer of Record.

VI. LIMITATIONS

The conclusions and recommendations presented in this report are based on the subsurface data collected, details stated in this report, and the assumption that the subsurface conditions do not deviate from those disclosed by the data acquisition activities performed. It is recommended that the final foundation plans be made available to EEI for review. Any substantial

change in the proposed plans should be brought to the attention of EEI so that the impact of the change on the recommendations presented herein may be evaluated.

Unless specifically indicated to the contrary in this report, the scope of work for this project was limited only to investigations in accessible areas of site, and evaluation of the geotechnical aspects of the site conditions and does not include any considerations of potential site pollution, contamination, or other environmental issues. This report offers no facts or opinions related to potential pollution or contamination of the site.

The recommendations provided herein are for the design of the foundations and associated structures related to the proposed development at the site. The procedures followed during the subsurface exploration, and the analyses and conclusions contained herein, have followed generally accepted practices of geotechnical engineering. EEI provides no other warranties, either expressed or implied, as to the professional advice provided under the terms of EEI's agreement and included in this report. The conclusions and recommendations presented in this report are based on the assumption that recognized, proper construction practices will be followed throughout construction and that a Professional Engineer qualified in Geotechnical Engineering will be retained to oversee the inspection of site preparation, proof-rolling, foundation construction, and other critical earthwork operations. If subsurface conditions substantially deviate during construction from those described in this report, EEI should be contacted promptly.

EEI emphasizes that geotechnical analyses made in this report are for the proposed hotel development at 5005 and 5105 Township Line Road (SR 3008) in Trainer Borough, Delaware County, Pennsylvania. EEI does not assume any responsibility for the use of this report in generating a foundation design for a site other than the one specifically addressed in this report.

Respectfully submitted,
EARTH ENGINEERING INCORPORATED

Peter Neumann, P.E.
Project Manager

Timothy B. Carlin, P.E.
Assistant Director
Geotechnical Investigations

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FIGURES AND DRAWINGS

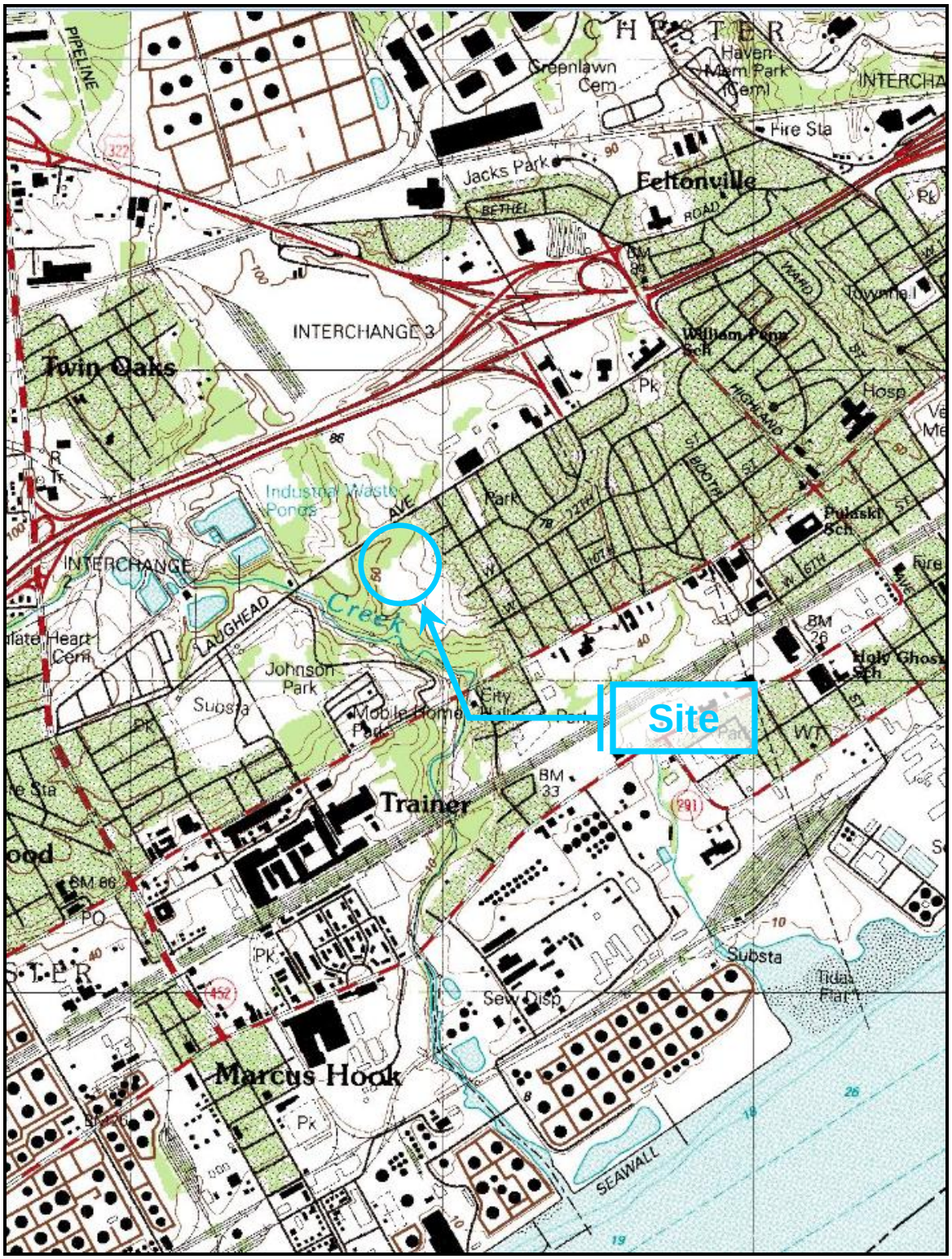


PLATE 1 – TOPOGRAPHIC MAP OF SITE

Reprinted from the United States Department of the Interior Geological Survey, Topographic Maps of Pennsylvania, Marcus Hook, PA Quadrangle, Photorevised 1993.

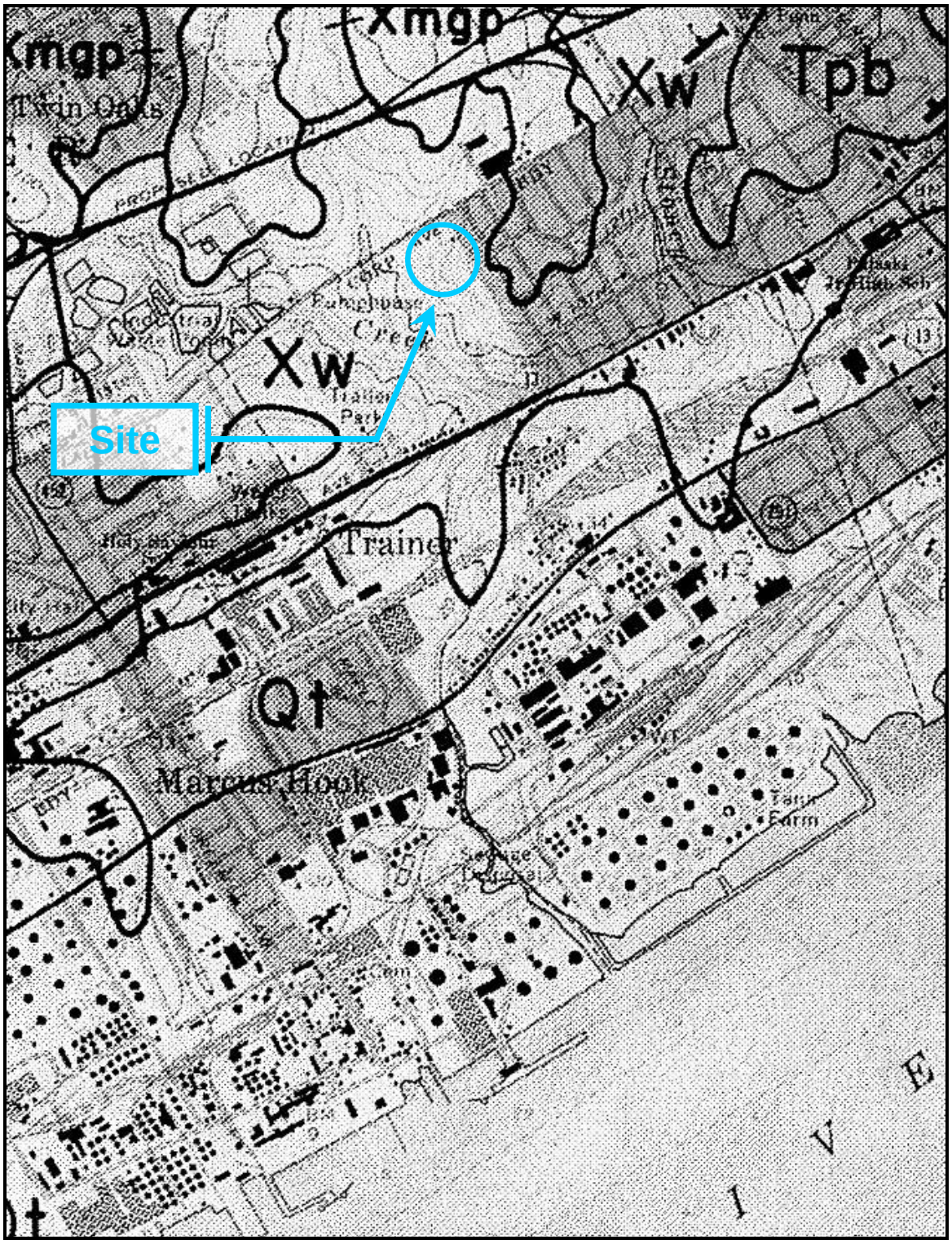
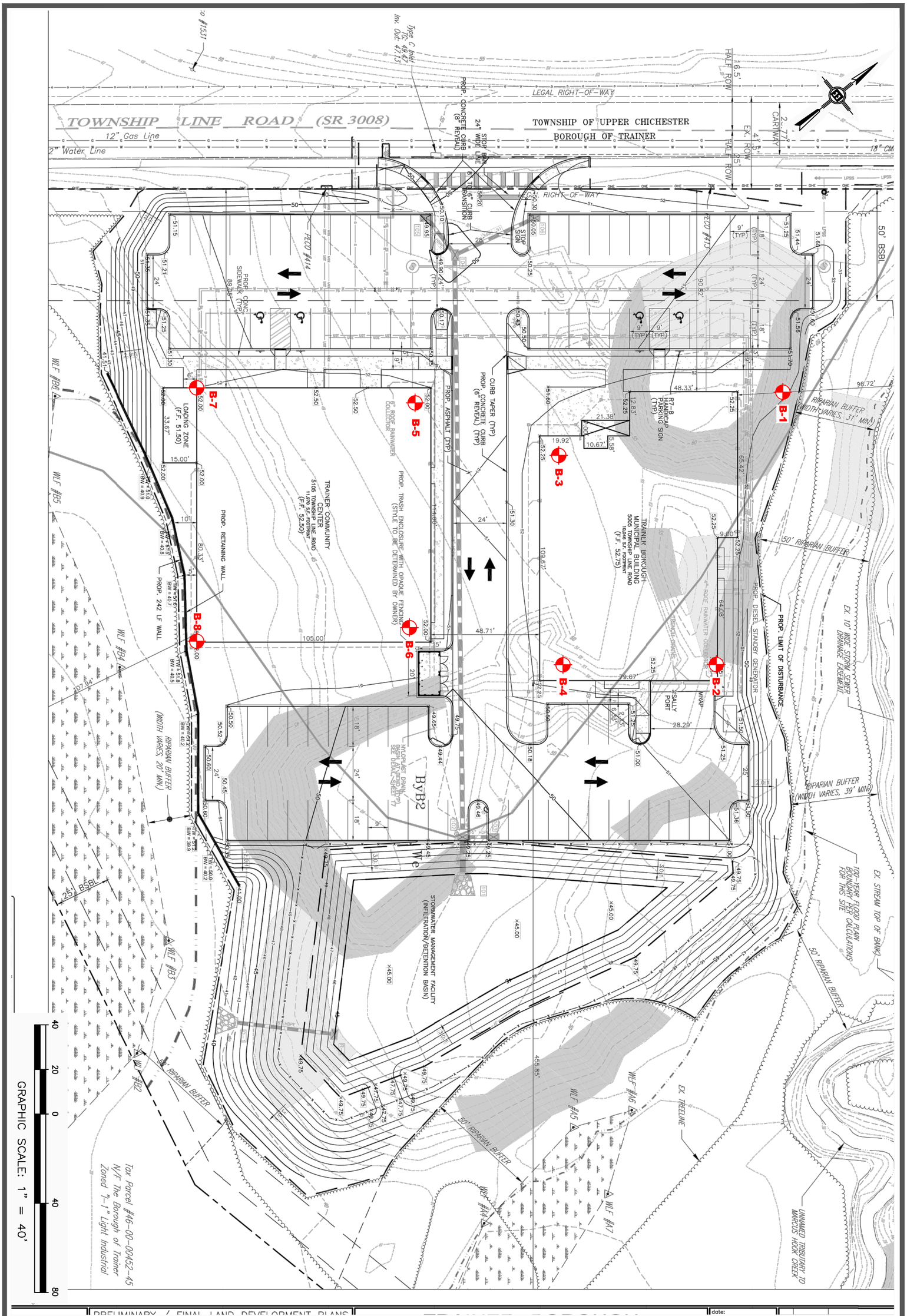


PLATE 2 - GEOLOGIC MAP OF SITE

Reprinted from the Pennsylvania Geological Survey, Atlas of Preliminary Geologic Quadrangle Maps of Pennsylvania, Marcus Hook, PA Quadrangle, 1978.



PRELIMINARY / FINAL LAND DEVELOPMENT PLANS date:

LOCATION PLAN

FOR

TRAINER BOROUGH MUNICIPAL BUILDING

TOWNSHIP LINE ROAD TRAINER BOROUGH PENNSYLVANIA

Scale: 1" = 40'	Date: 9/12/2019	Drawn By: DKY	Checked By:
Drawing Number: 32036.00-B-101		Approved By: PMM	

KEY:

BORING LOCATION

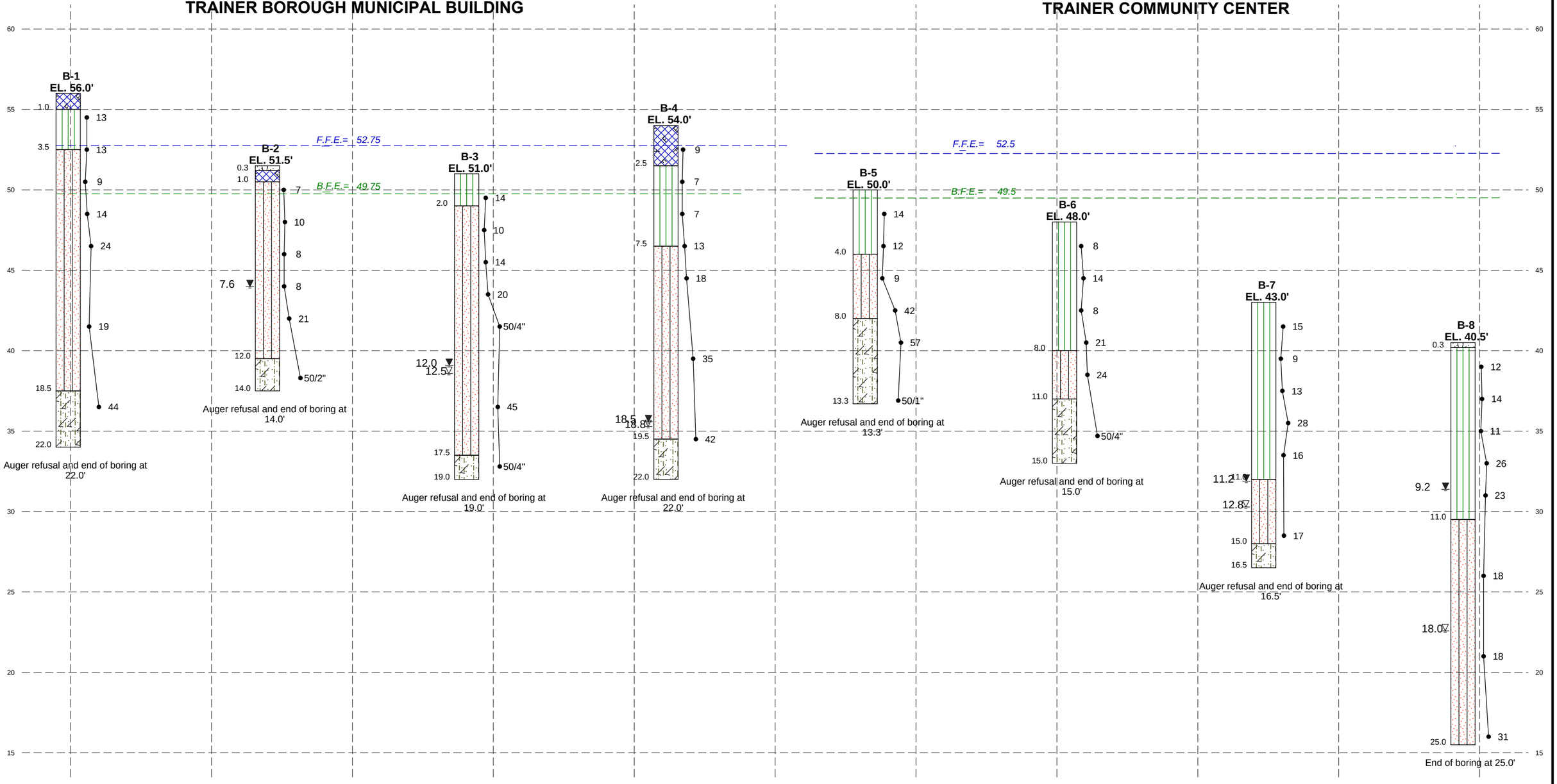
BASE PLAN PROVIDED BY:

EARTH ENGINEERING INCORPORATED
Geotechnical Engineers & Geologists
115 W. Germantown Pike
East Norriton, PA 19401
(610)277-0880
FAX (610)277-0878
www.earthengineering.com

TRAINER BOROUGH MUNICIPAL BUILDING

TRAINER COMMUNITY CENTER

ELEVATION (feet)



Lithology Graphics

- FILL -Silty Sand containing brick, concrete, glass fragments, stones (FILL)
- Topsoil
- Stratum I- Sandy silt, trace gravel; Grey, brown, orange brown (Alluvium / Residual)
- Stratum II - Silty sand trace gravel micaceous; Grey brown, orange brown (Decomposed Schist)
- Stratum III - Silty sand, some gravel, trace cobbles; Brown, grey brown, grey, black, micaceous (Weathered Schist)

- Initial Groundwater Level
- Subsequent Groundwater Level

F.F.E.= Finished Floor Elevation

B.F.E.= Bottom of Footing Elevation

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Geotechnical Engineers & Geologists

BORING PROFILES
PREPARED FOR
TRAINER MUNICIPAL BUILDINGS
TRAINER BOROUGH, DELAWARE COUNTY, PA

Project Number: 32036.00	Date: 9/2019	SHEET: 1 OF 1

APPENDICES

EARTH ENGINEERING INCORPORATED
Geotechnical Engineers & Geologists

BORING LOG

BORING NO. **B-1**
SHEET **1** OF **2**
DATE: START **8/29/19**
END **8/29/19**
SURFACE ELEV. (FT) **56.0**

PROJECT NAME **Trainer Municipal Buildings**
PROJECT LOCATION **Trainer Borough, Delaware County, PA**
PROJECT NUMBER **32036.00**
INSPECTOR NAME **J.Kufta**
EQUIPMENT USED **Diedrich D-50 with Auto trip hammer**
DRILLER NAME/COMPANY **S.Ward/SANO Drilling Inc.**
DRILLING METHODS **2" Continuous split spoon to 10', then 5' intervals thereafter**
AUGER: SIZE: **3.25 ID HSA** ; AUGER DEPTH: **22.0'** ; WATER: DEPTH: **Dry** TIME: **0.25 hrs.** DATE: **8/29/2019**
CHECKED BY: **M. Ngami** ; DATE: **9/9/2019** DEPTH: **Dry** TIME: **2.5 hrs.** DATE: **8/29/2019**
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	GRAPHIC LOG	DESCRIPTION (DEPTH / ELEVATION)	REMARKS
0.0	S-1	3 6 7 7	2.0'	100 -	sm	m		Silty sand, trace stone, brick fragments; Brown (FILL)	Easy drilling 0.0'-8.0'
1.0 / 55.0								Silty sand trace clay and gravel; Orange brown (Alluvium)	
2.0	S-2	4 5 8 7	1.5'	75 -	sm/sc	m			
3.5 / 52.5								Silty sand, trace clay and gravel; Brown, orange brown, grey brown; micaceous (Decomposed Schist)	
4.0	S-3	3 4 5 6	0.8'	40 -	sm	m			
6.0	S-4	4 6 8 9	0.7'	35 -	sm	m			
8.0	S-5	11 12 12 13	1.8'	90 -	sm	m			Easy to moderate drilling 8.0'-12.0'
10.0									Dry collapse at 12.0'
13.0	S-6	5 9 10 13	1.7'	85 -	sm	m/w			Moderate drilling 12.0'-18.5'
15.0									
18.0									
18.5 / 37.5								Silty sand, some gravel trace cobbles; Brown, grey brown, grey, black; micaceous (Weathered Schist)	
19.7	S-7	12 18 26 50/2"	1.0'	59 -	sm	w			Difficult drilling 18.5'-22.0'

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
Geotechnical Engineers & Geologists

BORING LOG

BORING NO. **B-1**
SHEET **2** OF **2**
DATE: START **8/29/19**
END **8/29/19**
SURFACE ELEV. (FT) **56.0**

PROJECT NAME **Trainer Municipal Buildings**
PROJECT LOCATION **Trainer Borough, Delaware County, PA**
PROJECT NUMBER **32036.00**
INSPECTOR NAME **J.Kufta**
EQUIPMENT USED **Diedrich D-50 with Auto trip hammer**
DRILLER NAME/COMPANY **S.Ward/SANO Drilling Inc.**
DRILLING METHODS **2" Continuous split spoon to 10', then 5' intervals thereafter**
AUGER: SIZE: **3.25 ID HSA** ; AUGER DEPTH: **22.0'** ; WATER: DEPTH: **Dry** TIME: **0.25 hrs.** DATE: **8/29/2019**
CHECKED BY: **M. Ngami** ; DATE: **9/9/2019** DEPTH: **Dry** TIME: **2.5 hrs.** DATE: **8/29/2019**
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	GRAPHIC LOG	DESCRIPTION	REMARKS
								DEPTH ELEVATION	
								Silty sand, some gravel trace cobbles; Brown, grey brown, grey, black; micaceous (Weathered Schist) *(continued)*	
								22.0 34.0	Auger refusal and end of boring at 22.0'

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
Geotechnical Engineers & Geologists

BORING LOG

BORING NO. **B-2**
SHEET **1** OF **1**
DATE: START **8/28/19**
END **8/28/19**
SURFACE ELEV. (FT) **51.5**

PROJECT NAME **Trainer Municipal Buildings**
PROJECT LOCATION **Trainer Borough, Delaware County, PA**
PROJECT NUMBER **32036.00**
INSPECTOR NAME **J.Kufta**
EQUIPMENT USED **Diedrich D-50 with Auto trip hammer**
DRILLER NAME/COMPANY **S.Ward/SANO Drilling Inc.**
DRILLING METHODS **2" Continuous split spoon to 10', then 5' intervals thereafter**
AUGER: SIZE: **3.25 ID HSA** ; AUGER DEPTH: **14.0'** ; WATER: DEPTH: **Dry** TIME: **0.25 hrs.** DATE: **8/28/2019**
CHECKED BY: **M. Ngami** ; DATE: **9/9/2019** DEPTH: **7.6'** TIME: **24 hrs.** DATE: **8/29/2019**
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	GRAPHIC LOG	DESCRIPTION	REMARKS
								DEPTH / ELEVATION	
0.0	S-1	2 3 4 5	2.0'	100 -	ml/sm	m		0.3 Topsoil (4") 51.2	Temporary Piezometer Installed
								Silty fine sand, trace fine roots and glass; Brown (FILL) 1.0 50.5	Easy drilling 0.0'-10'
2.0	S-2	4 5 5 6	1.7'	85 -	sm	m		Silty sand, trace gravel; Orange brown, brown, grey brown; micaceous (Decomposed Schist)	
4.0	S-3	3 4 4 4	2.0'	100 -	SM	m			
6.0	S-4	3 3 5 5	2.0'	100 -	SM	m/w			
8.0	S-5	7 9 12 15	1.7'	85 -	sm	m/w			
10.0									Wet spoon at 10.0' Moderate to difficult drilling 10.0'-12.0'
								12.0 39.5	
13.0				-				Silty sand, trace to some gravel; Brown, grey brown; micaceous (Weathered Schist)	Difficult drilling 12.0'-14.0'
13.2	S-6	50/2"	0.2'	100	sm	m/w		14.0 37.5	Auger refusal and end of boring at 14.0'

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
Geotechnical Engineers & Geologists

BORING LOG

BORING NO. **B-3**
SHEET **1** OF **1**
DATE: START **8/28/19**
END **8/28/19**
SURFACE ELEV. (FT) **51.0**

PROJECT NAME **Trainer Municipal Buildings**
PROJECT LOCATION **Trainer Borough, Delaware County, PA**
PROJECT NUMBER **32036.00**
INSPECTOR NAME **J.Kufta**
EQUIPMENT USED **Diedrich D-50 with Auto trip hammer**
DRILLER NAME/COMPANY **S.Ward/SANO Drilling Inc.**
DRILLING METHODS **2" Continuous split spoon to 10', then 5' intervals thereafter**
AUGER: SIZE: **3.25 ID HSA** ; AUGER DEPTH: **19.0'** ; WATER: DEPTH: **12.5'** TIME: **0.25 hrs.** DATE: **8/28/2019**
CHECKED BY: **M. Ngami** ; DATE: **9/9/2019** DEPTH: **12.0'** TIME: **6.0 hrs.** DATE: **8/28/2019**
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	GRAPHIC LOG	DESCRIPTION	REMARKS
0.0								DEPTH ELEVATION	
	S-1	4 6 8 8	1.5'	75 / -	ml/sm	m		Sandy silt to silty sand, trace fine roots; Orange brown, brown (Alluvium)	Easy drilling 0.0'-2.0'
2.0								2.0 49.0	
	S-2	3 4 6 6	1.8'	90 / -	sm	m		Silty sand trace to some gravel, trace cobbles; Tan, white, orange, brown; micaceous and saprolitic (Decomposed Schist)	Easy to moderate drilling 2.0'-7.5'
4.0									
	S-3	5 6 8 12	2.0'	100 / -	sm	m			
6.0									
	S-4	6 8 12 28	2.0'	100 / -	sm	m			Moderate drilling 7.5'-17.5'
8.0									
	S-5	50/4"	0.3'	15 / -	sm	w			
10.0									
									Cobbles at 12.0'
13.0									
	S-6	18 21 24 22	2.0'	100 / -	sm	w			
15.0									
									Wet collapse at 15.8'
								17.5 33.5	
18.0				-				Silty sand, some gravel; Orange brown, tan, white; micaceous (Weathered Schist)	Difficult drilling 17.5'-19.0'
18.2	S-7	50/4"	0.3'	150	sm	w		19.0 32.0	
									Auger refusal and end of boring at 19.0

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
Geotechnical Engineers & Geologists

BORING LOG

BORING NO. **B-4**
SHEET **1** OF **2**
DATE: START **8/28/19**
END **8/28/19**
SURFACE ELEV. (FT) **54.0**

PROJECT NAME **Trainer Municipal Buildings**
PROJECT LOCATION **Trainer Borough, Delaware County, PA**
PROJECT NUMBER **32036.00**
INSPECTOR NAME **J.Kufta**
EQUIPMENT USED **Diedrich D-50 with Auto trip hammer**
DRILLER NAME/COMPANY **S.Ward/SANO Drilling Inc.**
DRILLING METHODS **2" Continuous split spoon to 10', then 5' intervals thereafter**
AUGER: SIZE: **3.25 ID HSA** ; AUGER DEPTH: **22.0'** ; WATER: DEPTH: **18.8'** TIME: **0.25 hrs.** DATE: **8/28/2019**
CHECKED BY: **M. Ngami** ; DATE: **9/9/2019** DEPTH: **18.5'** TIME: **3.0 hrs.** DATE: **8/28/2019**
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	GRAPHIC LOG	DESCRIPTION	REMARKS
								DEPTH ELEVATION	
0.0	S-1	4 5 4 4	1.7'	85 / -	ml/sm	m		Silty fine sand, trace stone; Brown, tan (FILL)	Easy drilling 0.0'-7.5'
2.0	S-2	3 3 4 4	1.7'	85 / -	ml	m		2.5 51.5 Sandy silt, trace gravel; Orange brown, brown (Alluvium)	
4.0	S-3	2 3 4 6	2.0'	100 / -	ML	m			
6.0	S-4	4 5 8 8	2.0'	100 / -	ML	m		7.5 46.5 Silty sand, trace to some gravel, trace cobbles; Brown, brown grey; micaceous and saprolitic (Decomposed schist)	Easy to moderate drilling 7.5'-13.5'
8.0	S-5	8 8 10 10	1.8'	90 / -	sm	m			
10.0									
13.0	S-6	10 10 25 50/2"	1.7'	100 / -	sm	w			Moderate drilling 13.5'-16.0
14.7									Moderate to difficult drilling 16.0'-19.5'
18.0	S-7	17 17 25 50/2"	1.5'	88 / -	sm	w		19.5 34.5	Wet collapse at 19.0' Difficult drilling 19.5'-22.0'
19.7									

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
Geotechnical Engineers & Geologists

BORING LOG

BORING NO. **B-4**
SHEET **2** OF **2**
DATE: START **8/28/19**
END **8/28/19**
SURFACE ELEV. (FT) **54.0**

PROJECT NAME **Trainer Municipal Buildings**
PROJECT LOCATION **Trainer Borough, Delaware County, PA**
PROJECT NUMBER **32036.00**
INSPECTOR NAME **J.Kufta**
EQUIPMENT USED **Diedrich D-50 with Auto trip hammer**
DRILLER NAME/COMPANY **S.Ward/SANO Drilling Inc.**
DRILLING METHODS **2" Continuous split spoon to 10', then 5' intervals thereafter**
AUGER: SIZE: **3.25 ID HSA** ; AUGER DEPTH: **22.0'** ; WATER: DEPTH: **18.8'** TIME: **0.25 hrs.** DATE: **8/28/2019**
CHECKED BY: **M. Ngami** ; DATE: **9/9/2019** DEPTH: **18.5'** TIME: **3.0 hrs.** DATE: **8/28/2019**
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	GRAPHIC LOG	DESCRIPTION	REMARKS
								DEPTH ELEVATION	
								Silty sand, some gravel, trace cobbles; Orange brown, grey brown; micaceous (Weathered Schist) *(continued)*	
								22.0 32.0	Auger refusal and end of boring at 22.0'

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
Geotechnical Engineers & Geologists

BORING LOG

BORING NO. **B-5**
SHEET **1** OF **1**
DATE: START **8/28/19**
END **8/28/19**
SURFACE ELEV. (FT) **50.0**

PROJECT NAME **Trainer Municipal Buildings**
PROJECT LOCATION **Trainer Borough, Delaware County, PA**
PROJECT NUMBER **32036.00**
INSPECTOR NAME **J.Kufta**
EQUIPMENT USED **Diedrich D-50 with Auto trip hammer**
DRILLER NAME/COMPANY **S.Ward/SANO Drilling Inc.**
DRILLING METHODS **2" Continuous split spoon to 10', then 5' intervals thereafter**
AUGER: SIZE: **3.25 ID HSA** ; AUGER DEPTH: **13.3'** ; WATER: DEPTH: **Dry** TIME: **0.25 hrs.** DATE: **8/28/2019**
CHECKED BY: **M. Ngami** ; DATE: **9/9/2019** DEPTH: **Dry** TIME: **4.5 hrs.** DATE: **8/28/2019**
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	GRAPHIC LOG	DESCRIPTION	REMARKS
0.0	S-1	3 7 7 10	2.0'	100 -	ml/sm	m		Silty fine Sand, trace clay, gravel and roots; Brown, orange brown (Alluvium)	Easy drilling 0.0'-4.0'
2.0	S-2	5 5 7 6	1.8'	90 -	sm/sc	m			
4.0	S-3	3 4 5 8	2.0'	100 -	sm	m		Silty sand, trace clay, trace to some gravel; Brown, grey brown; micaceous and saprolitic (Decomposed Schist)	Moderate drilling 4.0'-8.0'
6.0	S-4	6 18 24 26	1.7'	85 -	sm	m			
8.0	S-5	32 31 26 40	1.6'	80 -	sm/gm	m		Silty sand, some gravel, trace cobbles; micaceous; Brown, grey brown (Weathered Schist)	Difficult drilling 8.0'-13.3'
10.0									
13.0				-					
13.1	S-6	50/1"	0.1'	100	gm	m			Dry collapse at 12.8'
									Auger refusal and end of boring at 13.3'

DEPTH 4.0 ELEVATION 46.0
DEPTH 8.0 ELEVATION 42.0
DEPTH 13.3 ELEVATION 36.7

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
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BORING LOG

BORING NO. **B-6**
SHEET **1** OF **1**
DATE: START **8/29/19**
END **8/29/19**
SURFACE ELEV. (FT) **48.0**

PROJECT NAME **Trainer Municipal Buildings**
PROJECT LOCATION **Trainer Borough, Delaware County, PA**
PROJECT NUMBER **32036.00**
INSPECTOR NAME **J.Kufta**
EQUIPMENT USED **Diedrich D-50 with Auto trip hammer**
DRILLER NAME/COMPANY **S.Ward/SANO Drilling Inc.**
DRILLING METHODS **2" Continuous split spoon to 10', then 5' intervals thereafter**
AUGER: SIZE: **3.25 ID HSA** ; AUGER DEPTH: **15.0'** ; WATER: DEPTH: **Dry** TIME: **0.25 hrs.** DATE: **8/29/2019**
CHECKED BY: **M. Ngami** ; DATE: **9/9/2019** DEPTH: **Dry** TIME: **5.5 hrs.** DATE: **8/29/2019**
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	GRAPHIC LOG	DESCRIPTION	REMARKS
0.0	S-1	3 4 4 6	1.0'	50 -	ml	m		Fine sandy silt, trace fine roots and gravel; Tan, grey, orange brown, brown (Alluvium)	Easy to moderate drilling 0.0'-8.0'
2.0	S-2	7 8 6 6	1.3'	65 -	ml	m			
4.0	S-3	4 4 4 7	1.0'	50 -	ml	m			
6.0	S-4	10 12 9 10	1.0'	50 -	ml	m/w			Dry collapse at 6.0'; mottled 6.0'-8.0'
8.0								DEPTH 8.0 ELEVATION 40.0	
10.0	S-5	10 12 12 13	1.2'	60 -	ml	w		Silty sand, trace gravel; Grey, brown grey; micaceous (Decomposed Schist)	Easy to moderate 8.0'-11.0'
11.0									
13.0								Silty sand, trace to some gravel; Brown, orange brown, brown grey; micaceous (Weathered Schist)	Difficult drilling 11.0'-15.0
13.3	S-6	50/4"	0.3'	100 -	sm	w			
15.0								DEPTH 15.0 ELEVATION 33.0	
									Auger refusal and end of boring at 15.0'

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
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BORING LOG

BORING NO. **B-7**
SHEET **1** OF **1**
DATE: START **8/29/19**
END **8/29/19**
SURFACE ELEV. (FT) **43.0**

PROJECT NAME **Trainer Municipal Buildings**
PROJECT LOCATION **Trainer Borough, Delaware County, PA**
PROJECT NUMBER **32036.00**
INSPECTOR NAME **J.Kufta**
EQUIPMENT USED **Diedrich D-50 with Auto trip hammer**
DRILLER NAME/COMPANY **S.Ward/SANO Drilling Inc.**
DRILLING METHODS **2" Continuous split spoon to 10', then 5' intervals thereafter**
AUGER: SIZE: **3.25 ID HSA** ; AUGER DEPTH: **16.5'** ; WATER: DEPTH: **12.8'** TIME: **0.25 hrs.** DATE: **8/29/2019**
CHECKED BY: **M. Ngami** ; DATE: **9/9/2019** DEPTH: **11.2'** TIME: **4.0 hrs.** DATE: **8/29/2019**
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	GRAPHIC LOG	DESCRIPTION	REMARKS
0.0	S-1	4 7 8 7	2.0'	100 -	ml	m		Sandy silt, trace fine roots and gravel; Tan, grey, orange brown, brown (Alluvium)	Temporary Piezometer Installed Easy to moderate drilling 0.0'-11.0'
2.0	S-2	5 4 5 6	1.7'	85 -	ml	m			
4.0	S-3	4 4 9 13	2.0'	100 -	ml	m			Mottled 4.0'-10.0'
6.0	S-4	13 14 14 14	2.0'	100 -	ml	m			
8.0	S-5	12 9 7 7	1.6'	80 -	ml	m/w			
10.0								11.0 32.0	
13.0								Silty sand, trace gravel; Tan, grey brown, white; micaceous (Decomposed Schist)	Water at 11.0' Moderate to difficult drilling 11.0'-15.0'
15.0	S-6	4 7 10 22	2.0'	100 -	sm	w		15.0 28.0	
								Silty sand, some gravel, trace cobbles; Grey brown, grey; micaceous (Weathered Schist)	Difficult drilling 15.0'-16.5'
								16.5 26.5	Auger refusal and end of boring at 16.5'

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
Geotechnical Engineers & Geologists

BORING LOG

BORING NO. **B-8**
SHEET **1** OF **2**
DATE: START **8/29/19**
END **8/29/19**
SURFACE ELEV. (FT) **40.5**

PROJECT NAME **Trainer Municipal Buildings**
PROJECT LOCATION **Trainer Borough, Delaware County, PA**
PROJECT NUMBER **32036.00**
INSPECTOR NAME **J.Kufta**
EQUIPMENT USED **Diedrich D-50 with Auto trip hammer**
DRILLER NAME/COMPANY **S.Ward/SANO Drilling Inc.**
DRILLING METHODS **2" Continuous split spoon to 10', then 5' intervals thereafter**
AUGER: SIZE: **3.25 ID HSA** ; AUGER DEPTH: **25.0'** ; WATER: DEPTH: **18.0'** TIME: **0.25 hrs.** DATE: **8/29/2019**
CHECKED BY: **M. Ngami** ; DATE: **9/9/2019** DEPTH: **9.2'** TIME: **7.0 hrs.** DATE: **7/31/2019**
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	GRAPHIC LOG	DESCRIPTION	REMARKS
0.0								DEPTH 0.3 Topsoil (3") ELEVATION 40.2	Temporary Piezometer Installed
	S-1	2 5 7 7	1.5'	75 -	ml	d/m		Fine sandy silt, trace gravel and fine roots; Tan, grey, pale brown, orange brown (Possible Alluvium grading to Residual)	Easy to moderate drilling 0.0'-11.0'
2.0									
	S-2	7 7 7 8	1.0'	50 -	ml	d/m			
4.0									
	S-3	4 5 6 8	1.5'	75 -	ml	m/w			Possible perched water at 4.0'
6.0									
	S-4	11 13 13 14	1.8'	90 -	ML	m			Mottled 6.0'-10.0'
8.0									
	S-5	14 13 10 8	1.6'	80 -	ML	m/w			
10.0									
								11.0 29.5	
								Silty sand, trace gravel; brown, orange brown, grey brown; micaceous and saprolitic (Decomposed Schist)	Moderate to difficult drilling 11.0'-12.0'
13.0									Chunky moderate 12.0'-25.0' smooth
	S-6	11 10 8 11	1.7'	85 -	sm	w			
15.0									
18.0									
	S-7	10 9 9 12	0.0'	0 -		NA			
20.0									

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
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BORING LOG

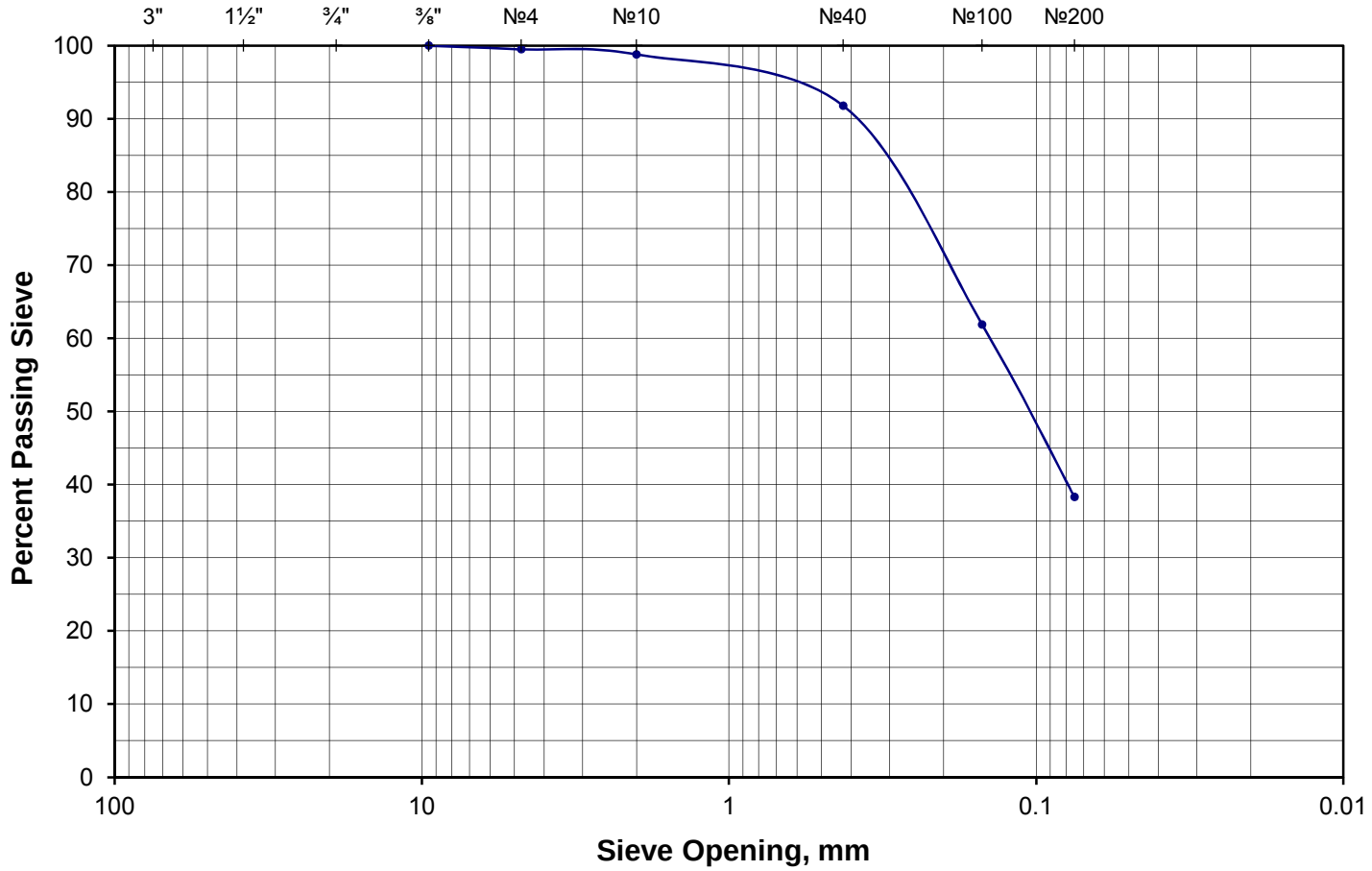
BORING NO. **B-8**
SHEET **2** OF **2**
DATE: START **8/29/19**
END **8/29/19**
SURFACE ELEV. (FT) **40.5**

PROJECT NAME **Trainer Municipal Buildings**
PROJECT LOCATION **Trainer Borough, Delaware County, PA**
PROJECT NUMBER **32036.00**
INSPECTOR NAME **J.Kufta**
EQUIPMENT USED **Diedrich D-50 with Auto trip hammer**
DRILLER NAME/COMPANY **S.Ward/SANO Drilling Inc.**
DRILLING METHODS **2" Continuous split spoon to 10', then 5' intervals thereafter**
AUGER: SIZE: **3.25 ID HSA** ; AUGER DEPTH: **25.0'** ; WATER: DEPTH: **18.0'** TIME: **0.25 hrs.** DATE: **8/29/2019**
CHECKED BY: **M. Ngami** ; DATE: **9/9/2019** DEPTH: **9.2'** TIME: **7.0 hrs.** DATE: **7/31/2019**
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	GRAPHIC LOG	DESCRIPTION	REMARKS
								DEPTH ELEVATION	
								Silty sand, trace gravel; brown, orange brown, grey brown; micaceous and saprolitic (Decomposed Schist) *(continued)*	
23.0									
	S-8	12 14 17 40	1.8'	90 -	sm	w			
25.0								25.0 15.5	End of boring at 25.0'

** D = DRY, M = MOIST, W = WET

Particle Size Analysis of Soils



As-rec'd water content: 19.7 moist **Odor:** NR

% Gravel: 0.5 **Coarse:** 0.0 **Fine:** 0.5

% Sand: 61.2 **Coarse:** 0.7 **Medium:** 7.0 **Fine:** 53.5

Gravel description: gray-brown, subangular to subrounded

Sand description: gray-brown, subangular to subrounded

Consistency: firm **Hardness:** NR

Cementation: NR **Dry Strength:** NR

Structure: homogeneous **Dilatency:** NR

Reaction to HCl: NR **Toughness:** NR

USCS Classification: **SM, silty sand**

AASHTO Classification: **A-4**

Particle Size				
US Standard Sieve Size			Diameter,	% Finer
GRAVEL	Coarse	3"	75	
		1½"	38.1	
		¾"	19.0	
	Fine	⅜"	9.5	100.0
		№ 4	4.75	99.5
SAND	Coarse	№ 10	2.00	98.8
	Medium	№ 40	0.425	91.8
	Fine	№ 100	0.150	61.9
		№ 200	0.075	38.3
Hydrometer Analysis		Clay Size	0.005	NR
		Colloids	0.001	NR

G_s: NR C_u: N/A C_c: N/A

LL: NP **PL:** NP **PI:** NP

Project: 32036.00 - Trainer Borough/ Community Blgds. - Investigation

Client: Borough of Trainer

Sample: B-2, S-3 (3-4-4-4) & S-4 (3-3-5-5)

Depth: 4.0'- 6.0', & 6.0'- 8.0'

Description: Tan to brown silty sand

Remarks:

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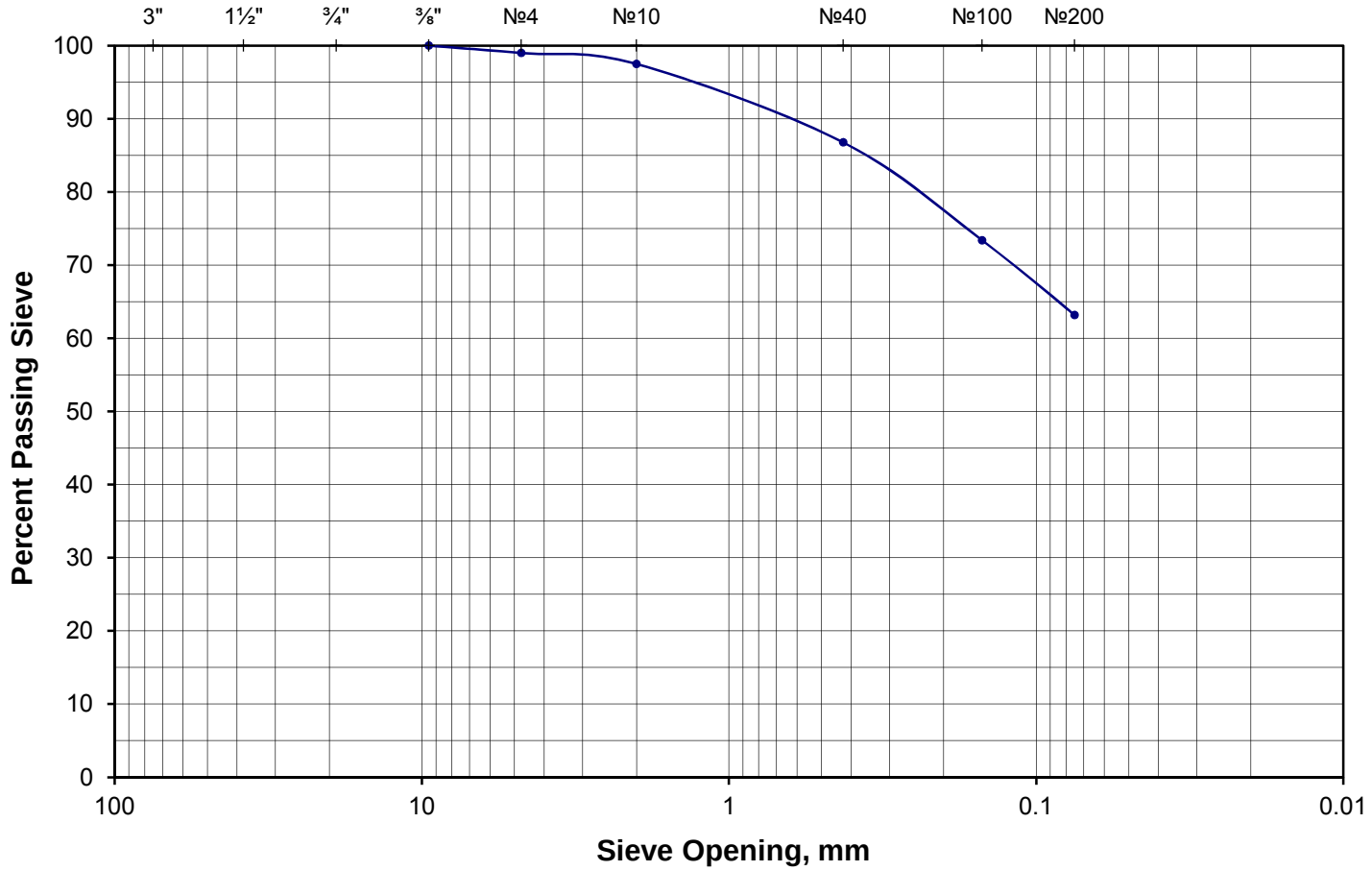
Central PA 717-697-5701

Lehigh Valley 610-967-4540

Particle Size Analysis of Soils



As-rec'd water content: 21.5 moist **Odor:** NR

% Gravel: 1.0 **Coarse:** 0.0 **Fine:** 1.0

% Sand: 35.8 **Coarse:** 1.5 **Medium:** 10.7 **Fine:** 23.6

Gravel description: brown, subangular to subrounded

Sand description: brown, with mica, subangular to subrounded

Consistency: firm **Hardness:** NR

Cementation: NR **Dry Strength:** NR

Structure: homogeneous **Dilatency:** NR

Reaction to HCl: NR **Toughness:** NR

USCS Classification: ML, sandy silt

AASHTO Classification: A-4

Particle Size				
US Standard Sieve Size			Diameter,	% Finer
GRAVEL	Coarse	3"	75	
		1½"	38.1	
		¾"	19.0	
	Fine	⅜"	9.5	100.0
		№ 4	4.75	99.0
SAND	Coarse	№ 10	2.00	97.5
	Medium	№ 40	0.425	86.8
	Fine	№ 100	0.150	73.4
		№ 200	0.075	63.2
Hydrometer Analysis		Clay Size	0.005	NR
		Colloids	0.001	NR

G_s: NR C_u: N/A C_c: N/A

LL: NP **PL:** NP **PI:** NP

Project: 32036.00 - Trainer Borough/ Community Blgds. - Investigation

Client: Borough of Trainer

Sample: B-4, S-3 (2-3-4-6) & S-4 (4-5-8-8)

Depth: 4.0'- 6.0', & 6.0'- 8.0'

Description: Tan to brown sandy silt

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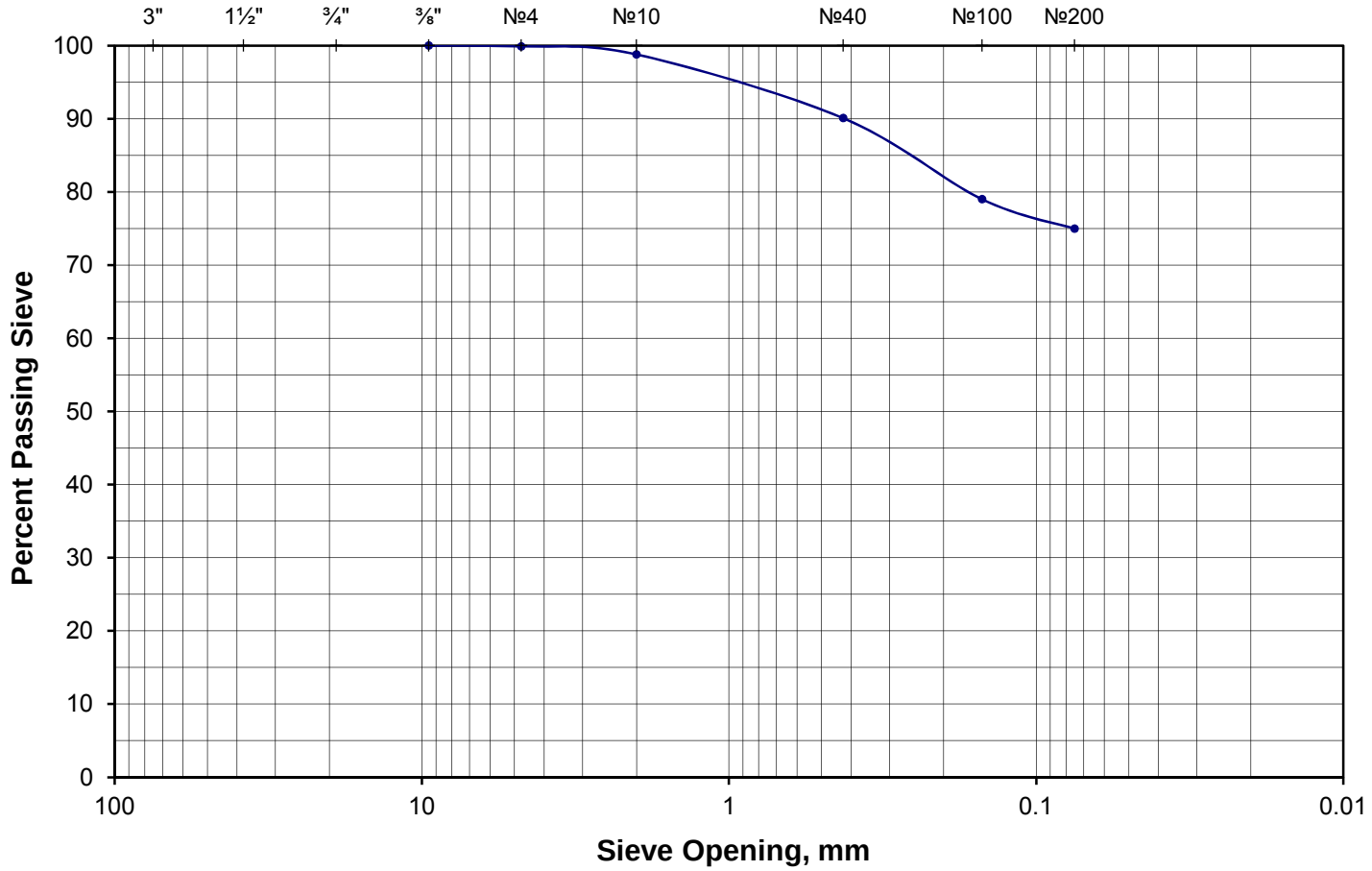
Remarks:

Classification of Soils, ASTM D 2487-11 / D 2488-09a ***September 12, 2019***

Particle Size Analysis of Soils



As-rec'd water content: 19.4 moist		**Odor:** NR		Particle Size			
% Gravel: 0.1	**Coarse:** 0.0	**Fine:** 0.1		US Standard Sieve Size		Diameter,	% Finer
% Sand: 24.9	**Coarse:** 1.1	**Medium:** 8.7	**Fine:** 15.1	GRAVEL	Coarse	3"	75	
Gravel description: brown, subangular to subrounded						1½"	38.1	
						¾"	19.0	
Sand description: brown, subangular to subrounded					Fine	⅜"	9.5	100.0
						№ 4	4.75	99.9
Consistency: firm	**Hardness:** NR			SAND	Coarse	№ 10	2.00	98.8
Cementation: NR	**Dry Strength:** NR				Medium	№ 40	0.425	90.1
Structure: homogeneous	**Dilatency:** NR				Fine	№ 100	0.150	79.0
Reaction to HCl: NR	**Toughness:** NR					№ 200	0.075	75.0
USCS Classification: ML, silt with sand				Hydrometer Analysis		Clay Size	0.005	NR
AASHTO Classification: A-4						Colloids	0.001	NR
				G_s: NR	C_u: N/A	C_c: N/A		
Project: 32036.00 - Trainer Borough/ Community Blgds. - Investigation				**LL:** NP	**PL:** NP	**PI:** NP		
Client: Borough of Trainer								
Sample: B-8, S-4 (11-13-13-14) & S-5 (14-13-10-8)								
Depth: 6.0'- 8.0',& 8.0'- 10.0'								
Description: Mottled tan, brown and gray silt with sand								

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Remarks:

Classification of Soils, ASTM D 2487-11 / D 2488-09a ***September 12, 2019***