PRELIMINARY GEOTECHNICAL ASSESSMENT REPORT

VERONA SITE
BLOCK 303, LOT 4 – TOWNSHIP OF VERONA
BLOCK 301, LOT 5 & BLOCK 401, LOT 1 – TOWNSHIP OF MONTCLAIR
ESSEX COUNTY, NEW JERSEY

MATRIXNEWORLD
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1.0 INTRODUCTION

Matrix New World Engineering, Land Surveying and Landscape Architecture, P.C. (Matrix) has completed a geotechnical assessment to support the proposed construction in the townships of Verona and Montclair in Essex County, New Jersey (Site). Matrix provided geotechnical services as a consultant to BNE Real Estate Group (BNE). The project location is shown on the attached Site Location Map (Figure 1).

The purpose of the geotechnical engineering study was to evaluate the suitability of on-site soils for the support of a proposed apartment complex at the Site. Geotechnical borings were advanced in the project area for evaluation of the subsurface conditions. A total of 11 geotechnical borings (B-1 through B-6 and B-2-1 through B-2-5) were completed to depths ranging between 7 and 17 feet below ground surface (bgs). Two permeability tests were also conducted at a depth of 4 feet bgs at two boring locations to determine the drainage characteristics of the Site's subsurface. Additionally, 10 test pits were advanced for permeability testing purposes. Refer to Figure 2 for a plan of the as-drilled soil boring and test pit locations.

Matrix's geotechnical recommendations are based on an engineering evaluation of the subsurface conditions as indicated by the field exploration data and geotechnical laboratory test results on representative soil samples. These recommendations will address the geotechnical components of the anticipated construction to ensure that the proposed loads can be safely transferred to the underlying soil.

2.0 SITE LOCATION & PROJECT DESCRIPTION

The project site is located on the border of Verona (Block 303, Lot 4) and Montclair (Block 301, Lot 5 & Block 401, Lot 1) townships in Essex County, New Jersey. The Site currently consists of a private elementary school (Academy 360) with multiple asphalt parking lots and playground areas along the west edge of the property. The soil investigation was mostly conducted within the grassy areas surrounding the parking lots.

This project involves a subsurface investigation of the property in order to construct a new multi-story apartment building to replace the existing school building. Several supplementary structures are proposed to be constructed at the Site as well, including new roadways, parking lots, retaining walls, and a multi-level parking garage.

To assist in the future design and construction within the project area, geotechnical borings were advanced in the area of proposed construction to obtain information regarding the soil's structural properties. The 11 borings were located to provide the most useful information about the subsurface conditions. Refer to Figure 2 of this report for a map of the as-drilled soil boring locations.

3.0 GEOLOGIC SETTING

According to Bedrock Geologic Map of New Jersey (dated 2014), the Site location is founded on Orange Mountain Basalt which is typically fine-grained and massive to columnar jointed.

From the Web Soil Survey provided by the United States Department of Agriculture, the soils above bedrock at the Site are till moraine consisting primarily of Silty and/or Clayey Sand, or Silt.

The documented site conditions presented above are consistent with the findings from the subsurface investigation, in which all soils encountered were predominantly Sandy in nature, with varying amounts of Silt and Gravel. Wet soils were encountered in one boring (B-1) at approximately 7.2 feet bgs.

4.0 SUBSURFACE FIELD PROGRAM

The subsurface investigation was completed by generally accepted practices in the Geotechnical Engineering field and consisted of the advancement of 11 Standard Penetration Test (SPT) borings and 2 permeability tests using mud/water rotary drilling techniques and 10 test pits for permeability testing.

A Matrix Geotechnical Engineer provided full-time drilling oversight, soil logging, and sample collection. Matrix prepared the field boring logs, which included sample depths, SPT-N blow counts, soil/rock recovery, and soil/rock descriptions based on the Burmister Soil Classification System followed by the Unified Soil Classification System (USCS) letter symbol. Soil boring logs are provided in Appendix A. Classification tables and charts used to determine the soil attributes are included in Appendix B.

Upon the completion of the field program, representative samples were subjected to geotechnical laboratory analyses. Laboratory results aided in soil and rock classification and assessing the relevant engineering properties of the stratigraphic layers which were used in developing the revised geotechnical design recommendations outlined herein. Geotechnical laboratory reports are included in Appendix D.

4.1 SPT Borings

Matrix retained Boring Brothers, Inc. (Boring Brothers), located in Egg Harbor Township, New Jersey to complete the subsurface field program under observation of a Matrix Geotechnical Engineer qualified in Geotechnical Engineering in New Jersey. Between September 16 and 17, 2019, Boring Brothers advanced 6 geotechnical borings with a CME 55 ATV-mounted drill rig using mud or water rotary drilling techniques. On May 7, 2021, Boring Brothers advanced an additional 5 geotechnical borings with the same drilling equipment and techniques.

Split spoon (SS) samples were collected in accordance with *ASTM D-1586*, *Standard Method for Penetration Test and Split-Barrel Sampling of Soils*. A standard 2-inch outer diameter split spoon, two feet in length, was used to collect the soil samples. An automatic 140-pound hammer having a 30-inch drop was used to drive the split spoon sampler. As a part of boring observation, the SPT blow counts were recorded for the 0- to 6-inch interval, the 6- to 12-inch interval, the 12- to 18-inch interval and the 18- to 24-inch interval. The SPT N-values for design purposes are reported as the sum of the SPT N values observed for the above referenced 6- to 12-inch interval and the 12- to 18-inch interval that the split spoon sampler was driven.

The Matrix Geotechnical Engineer observed the split spoon samples and collected representative samples in sealed containers for further examination. All borings were continuously sampled to 12 feet bgs and at every subsequent 5-foot interval thereafter. In five borings, five feet of rock coring was conducted to obtain the quality of the existing bedrock at the Site. All borings were backfilled with soil cuttings and bentonite hole plug upon completion of the borehole. Boring B-5, which was completed within an existing asphalt basketball court, was patched after completion of sampling to return the location to its original condition.

4.2 Test Pits

A total of 10 test pits were excavated to obtain soil profile information at the potential locations of stormwater basins. Matrix retained Heritage Contracting Company (Heritage), located in Cranbury, New Jersey to advance test pits under observation of a Matrix Geotechnical Engineer. From October 5 through 7, 2022, Heritage advanced 10 test pits with a CAT 308C excavator to depths specified by the engineer. The test pit locations of the completed test pits were identified in the field by GPS. The locations are shown on Figure 2.

4.3 Permeability Testing

Falling head permeability testing was attempted in borings B-3 and B-4 at a depth of 4 feet bgs. Four-inch steel casing was advanced to the depth required for testing, followed by approximately 6 inches of Sand poured into the bottom of the casing. The test zone was allowed to soak in water for 30 minutes before testing to ensure adequate saturation of the ground. However, no water movement was observed within the casing during the pre-soak period, prompting cancellation of permeability testing in both locations at the Site.

Additional permeability testing was conducted in October 2022 in general conformance with the NJDEP Stormwater Best Management Practices Manual via the basin flood test or the double ring infiltrometer test method. Due to shallow bedrock and varying groundwater elevations due to recent heavy precipitation, the type of permeability test was determined in the field while advancing each test pit. In test pits where shallow bedrock was encountered, a basin flood test was conducted.

Basin flood tests were performed at the depth bedrock was encountered, as noted on the test pit logs in Appendix A. A 50 square foot test pit was advanced to bedrock and filled with 12 inches of water and allowed to drain over a 24-hour period. If the time required for the basin to drain completely was greater than 24 hours, the test was terminated. If the entirety of the water dissipated after the 24-hour period, the

12 inches of water were immediately replaced and allowed to dissipate for an additional 24 hours. Upon termination of the basin flood test, results were recorded and the permeability was calculated.

Basin flood tests were performed in TP-1 through TP-7, TP-9, and TP-10. The time required for the water to fully drain exceeded 24 hours in each of the test pits, therefore all basin flood tests were terminated and the bedrock can be considered to be a massive rock substratum.

One double ring infiltrometer test was conducted in test pit TP-8 at 4.75 feet bgs. The double ring infiltrometer test was attempted at least 12 inches above where the groundwater table or mottling was encountered; however, recent heavy precipitation may have impacted these levels. The double rings were inserted 2 to 3 inches into the soil then filled with water and allowed to presoak. Presoaking was carried out in two intervals of up to 30 minutes. The rings were then refilled, and the water level was measured in 30-minute intervals. When the drop in water level was stabilized, the permeability was calculated. The permeability rate in TP-8 was recorded as 0.625 inches per hour.

The findings from the test pit exploration and permeability testing are summarized below. Basin flood tests were performed in TP-1 through TP-7, TP-9, and TP-10. One double ring infiltrometer test was performed in TP-8.

Table 4.1 – Test Pit Summary

Test Pit	**Excavation Depth (feet bgs)**	**Perched Groundwater Depth (feet bgs)***	**Mottling Starting Depth (feet bgs)**	**Test Depth (feet bgs)**	**Permeability Rate, K (in/hr) +**
TP-1	6	NE	3	6	N/A
TP-2	4	NE	3.5	4	N/A
TP-3	6	NE	2	6	N/A
TP-4	8.5	NE	3	8.5	N/A
TP-5	5	NE	5	5	N/A
TP-6	12	6	2	12	N/A
TP-7	6	2	2	6	N/A
TP-8	4.75	3.5	2.5	4.75	0.625
TP-9	7	6	3	7	N/A
TP-10	4.5	4.5	2	4.5	N/A

*NE = Not Encountered

+ N/A = Test was terminated and a permeability rate was not calculated

Based on the results of the permeability testing, the existing soils above bedrock possessed unsatisfactory drainage properties (very low permeability rates) and should not be utilized for future stormwater management practices at the Site. Permeability testing logs are provided in Appendix C of this report.

Matrix completed a separate assessment of the hydrogeological conditions at the Site and surrounding area (see Appendix E). Since the Site is located on a rocky ridge and the elevation of the Site is higher than the surrounding area and tributary, the water table can be anticipated in the valley rather than at a shallow depth on Site. Heavy rainfall was noted in the days prior to and during the test pit excavations conducted in October 2022. The saturation and soil mottling in some of the test pits can be attributed to these heavy rainfall events.

Based upon this review, the ground water and mottling encountered in the geotechnical investigation are not the result of the true groundwater level but instead a perched water condition.

4.4 Laboratory Testing

In addition to the field investigation, a laboratory testing program was conducted to determine additional pertinent engineering characteristics of representative samples of on-site soils and rock. The laboratory testing program was performed in general accordance with applicable ASTM standard test methods and included physical/textural testing of representative samples of various strata.

Upon review of the boring logs, Matrix selected representative samples for laboratory testing. Laboratory testing of selected samples was completed by TerraSense, LLC, located in Totowa, New Jersey. The following table presents a summary of the testing program. The results of the laboratory testing program were used to assist in developing geotechnical design parameters and recommendations, and are provided in Appendix D.

Table 4.3-1: Laboratory Testing Program

Test	Testing Procedure	Quantity Performed	Sample Locations and Depth Intervals
Water Content	ASTM D2216	8	B-1: 2-4’, 4-6’, 15-17’ B-2: 2-4’, 6-8’, 10.3-11.1’ B-3: 0-2’ B-5: 5-5.75’
Sieve Analysis	ASTM D422	1	B-1: 2-4’
Combined Sieve and Hydrometer	ASTM D422	1	B-3: 0-2’
Percent Fines	ASTM D1140	3	B-1: 15-17’ B-2: 2-4’, 6-8’
Atterberg Limits	ASTM D4318	3	B-1: 4-6’, 15-17’ B-2: 6-8’
Rock Unconfined Compression	ASTM D7012C	2	B-2: 10.3-11.1’ B-5: 5-5.75’

5.0 SUBSURFACE CONDITIONS

The subsurface conditions beneath the Site can be characterized by the following stratigraphy, proceeding from the surface materials downward, unless noted otherwise below. Classification tables and charts used to determine the soil attributes are included in Appendix B.

Surficial Materials

All borings, with the exception of boring B-5, were completed within grassy areas that surround the existing school building and parking lots. Boring B-5 was completed within an asphalt basketball court at the northeast corner of the Site. As such, the surficial material at this location consisted of 6” of asphalt.

Upper Stratum: Silty Sand (SM)

Beneath the surficial material in all borings is a layer of predominantly fine Sand and Silt with varying amounts of Gravel. This layer extended to depths ranging from 1.58 to 6 feet bgs.

The SPT N-values within this layer ranged from 3 to 34 blows per foot (bpf), which is indicative of very loose to dense granular soil. The SPT N-values for the Upper Stratum are summarized in the table below.

Table 5.0-1: SPT N-Values for Upper Stratum

Soil Boring Location	USCS Group Symbol	Depth Below Ground Surface	SPT N-Values
B-1	SM	0-2’	5
B-2	SM	0-6’	5-26
B-3	SM	0-4.33’	3-34
B-4	SM	0-4’	12-16
B-5	SM	0.5-4.42’	15-27
B-6	SM	0-1.58’	19
B-2-1	SM	0-9’	7-35
B-2-2	SM	0-14’	3-32
B-2-3	SM	0-9.25’	3-23

Intermediate Strata: Varies (CL, SM, SC, SP, ML)

Underlying the uniform Upper Stratum (Silty Sand) in borings B-1 and B-2, varying layers of soils were observed before bedrock was encountered. These layers were either predominantly Sand, Silt, or Clay, with little to trace amounts of Gravel observed throughout. In boring B-1, these layers began at 2 feet bgs and extended to 17 feet bgs (boring terminated at this depth). In boring B-2, these layers were encountered from 6 to 9 feet bgs, immediately underlain by bedrock.

The SPT N-values within this layer generally signified medium-dense soil material, though two loose N-values (9 and 6 bpf) were recorded in boring B-1 at 2 and 15 feet bgs, respectively. The soil classifications and SPT N-values for these Intermediate Strata are summarized in the table below.

Table 5.0-2: SPT N-Values for Intermediate Strata (Borings B-1 & B-2)

Soil Boring Location	USCS Group Symbol	Depth Below Ground Surface	SPT N-Values
B-1	CL	2-4’	9
B-1	SC	4-6’	20
B-1	SM, SP	6-13.5’	15-24
B-1	SC	13.5-17’	6
B-2	SC-SM	6-8.33’	30
B-2	SM	8.33-9’	100/6”

Decomposed Bedrock

Underlying the Upper Stratum in borings B-3, B-5, and B-6 is weathered Basalt bedrock. This decomposed bedrock had been broken down into a predominantly coarse-to-fine Gravel soil with some coarse-to-fine Sand. This layer was encountered at depths ranging from 1.58 to 4.42 feet bgs.

Split-spoon refusal was encountered at the top of the decomposed bedrock in borings B-3 and B-5, and 5 inches into the weathered rock in boring B-6. Borings B-2-1 through B-2-5 were terminated upon encountering this layer and rock cores were not collected. The SPT N-values for this Decomposed Bedrock layer are summarized in the table below.

Table 5.0-3: SPT N-Values for Decomposed Bedrock

Soil Boring Location	USCS Group Symbol	Depth Below Ground Surface	SPT N-Values
B-3	CWR	4.33-5’	N/A*
B-5	CWR	4.42-5’	N/A*
B-6	CWR	1.58-2’	100/5”
B-2-1	CWR	9’	N/A
B-2-2	CWR	14’	N/A

B-2-3	CWR	9.25’	N/A
B-2-4	CWR	0’	N/A
B-2-5	CWR	2.25’	N/A

*Split-spoon refusal encountered at top of decomposed rock – drilled through to reach top of bedrock.

Bedrock: Basalt

Beneath the Upper Strata, Intermediate Strata, or Decomposed Bedrock layer in borings B-2 through B-6, sound basalt bedrock was encountered. Rock coring was conducted within the basalt to obtain information regarding the Site’s existing underlying bedrock. Each core sample consisted of 5-foot runs and were taken from the top of sound bedrock at depths ranging from 2 to 9 feet bgs. The recovered rock was only slightly weathered in each boring, though each core possessed varying levels of fracturing. The Rock Quality Designations for the cores taken at the Site ranged from 0% (Boring B-3) to 88% (Boring B-4). Refer to the table below for the recorded bedrock core information for each borehole.

Table 5.0-4: Basalt Bedrock Coring Data

Soil Boring Location	Core Type	Run Length (ft)	Rock Type	Depth Below Ground Surface	Recovery (in)	RQD (%)
B-2	NX	5	Basalt	9-14’	55	50
B-3	NX	5	Basalt	5-10’	49	0
B-4	NX	5	Basalt	4-9’	53	88
B-5	NX	5	Basalt	5-10’	57	57
B-6	NX	5	Basalt	2-7’	49	22

Groundwater

Wet soils were encountered at approximately 7.2 feet bgs during drilling in boring B-1. This depth pertains to an elevation of +513.5 (NJ State LIDAR Datum). It should be noted that the groundwater levels will vary with temperature, precipitation, and other climatic factors.

Matrix completed a separate assessment of the hydrogeological conditions at the Site and surrounding area (see Appendix E). Since the Site is located on a rocky ridge and the elevation of the Site is higher than the surrounding area and tributary, the water table can be anticipated in the valley rather than at a shallow depth on Site. Heavy rainfall was noted in the days prior to and during the test pit excavations conducted in

October 2022. The saturation and soil mottling in some of the test pits can be attributed to these heavy rainfall events.

Based upon this review, the ground water and mottling encountered in the geotechnical investigation are not the result of the true groundwater level but instead a perched water condition.

6.0 GEOTECHNICAL DESIGN PARAMETERS

6.1 General Geotechnical Parameters

The geotechnical design parameters in this report are derived from the field investigation and are based on accepted geotechnical standards and practices. The following table summarizes the recommended geotechnical design parameters for the various soil strata encountered at the Site. The values are based on review and interpretation of the subsurface investigation and laboratory test data results.

At the time of the geotechnical investigation, loading conditions and the final proposed grading plans were not available. Therefore, certain assumptions were made for the recommendations provided in this report.

An allowable bearing capacity of 3,000 psf, as indicated in the following table, is recommended for foundations of permanent structures bearing on dense granular soils or decomposed bedrock at the Site. These values may also be used if another soil layer is encountered at the anticipated bearing stratum and replaced with Controlled Fill down to this layer.

Table 1806.2 of the 2018 International Building Code provides allowable coefficients of friction to be used in the evaluation of resistance to sliding. For the native dense granular soil and Controlled Fill, the recommended coefficient of friction against sliding is 0.25.

Table 6.0-1: Geotechnical Design Parameters

Stratum	Unit Weight	Friction Angle (Φ’)	Cohesive Strength, c_u	Earth Pressure Coefficient		Allowable Foundation Pressure*	Lateral Bearing
				Active	Passive		
	(pcf)	(deg)	(psf)	(Ka)	(Kp)	(psf)	(psf/ft bgs)
Basalt Bedrock	$\gamma = 185$ $\gamma' = 123$	50°	N/A	0.13	7.55	200,000	20,000
Controlled Fill/ Decomposed Bedrock	$\gamma = 125$ $\gamma' = 63$	32°	0	0.31	3.26	3,000	200
Existing Fill Material	$\gamma = 105$ $\gamma' = 43$	28°	0	0.36	2.77	$2,000^{+}$	100
Native Dense Granular Soil (GP, SM, SC, SP-SM, SP) [10 < SPT N]	$\gamma = 125$ $\gamma' = 63$	32°	0	0.31	3.26	3,000	200
Native Loose Granular Soil (GP, SM, SC, SP-SM, SP) [SPT N ≤ 10]	$\gamma = 120$ $\gamma' = 58$	30°	0	0.33	3.00	2,000	150
Native Medium Silt (ML) [10 < SPT N ≤ 30]	$\gamma = 115$ $\gamma' = 53$	28°	200	0.36	2.77	1,500**	100
Native Clay Material (CL) Very Stiff [15 < SPT N ≤ 30]	$\gamma = 110$ $\gamma' =48$	-	2,000	-	-	2,000**	100
Native Clay Material (CL) Stiff [8 < SPT N ≤ 15]	$\gamma = 110$ $\gamma' =48$	-	1,500	-	-	1,500**	100

Notations: γ = moist unit weight, γ' = buoyant unit weight, and c_u = average undrained shear strength.

\+ Allowable foundation pressure is contingent upon either replacement of at least two feet of existing fill below the bottom of footing by a Controlled Fill (placed and compacted as described in Section 7.5), or upon confirmation that the field density of the existing fill material down to four feet below the bottom of footing meets 95% of the maximum dry density of the existing fill material observed in Modified Proctor Tests.

* These values are based on the 2018 International Building Code, New Jersey Edition, and adjusted for field conditions encountered. To increase the allowable foundation pressure above the values recommended in the table given above, further testing of soil will be required.

** Valid only for undrained conditions in cohesive soils due to newly applied loads.

- Coefficient of earth pressure at rest may be computed using Jaky’s equation, $K_o = 1 - \sin \phi'$.

6.2 Seismic Design Parameters

Based on a review of the subsurface conditions relevant to section 1613 of the International Building Code 2018, the subject site may be classified as Site Class D. Seismic design parameters are presented in the table below.

For a Risk Category equal to I/II/III and One Second Design Acceleration (S_{D1}) equal to 0.115 g, the Site may be assigned to Seismic Design Category (SDC) B.

Table 6.2-1: Seismic Design Parameters

Parameter	Values
0.2 sec. Bedrock Acceleration, S_s	0.276 *g*
1.0 sec. Bedrock Acceleration, S_1	0.072 *g*
Peak Ground Acceleration, PGA	0.164 *g*
0.2 sec. Site Coefficient, F_a	1.579
1.0 sec. Site Coefficient, F_v	2.400
PGA Site Coefficient, F_{PGA}	1.471
0.2 sec. Design Acceleration, S_{DS}	0.291 *g*
1.0 sec. Design Acceleration, S_{D1}	0.115 *g*
Site Specific MCE Peak Ground Acceleration, PGA_M	0.242 *g*
Seismic Design Category, SDC	B

* Value(s) obtained from the Section Code 1613 Earthquake Loads; and corresponding Chapters 20 through 22 of the ASCE 7-10. The "*g*" is acceleration due to gravity, and $g = 32.2$ ft/s^2 or 9.81 m/s^2.

7.0 GEOTECHNICAL EVALUATION AND RECOMMENDATIONS

The following sections present the results of our geotechnical engineering evaluation and recommendations for support of the planned construction.

7.1 Site Preparation and Earthwork

Prior to demolition and stripping operations, all utilities should be identified and protected. Existing pavements, topsoil, trees, roots, vegetative matter, and deleterious materials should be removed at least five feet beyond the limits of the proposed structure areas.

All remaining underground utilities and utility backfill should be evaluated to determine if these elements are suitable for support of the planned loads. The Contractor must keep those utilities to be reused in workable condition and protected from damage during earthwork activities. Utilities not planned for re-use should be removed from planned structural areas, capped off at the property lines, and either removed or abandoned in place. All soils disturbed by utility abandonment operations should be removed or re-compacted in-place.

The Site shall be excavated or filled to the proposed design grades as defined by the Structural Engineer. All soils within the Upper and Intermediate Strata (see Section 5.0) are not recommended for reuse on Site for geotechnical purposes due to the high Silt and/or Clay content in these layers. Foundations may bear on any soil layers encountered at the Site, though allowable foundation pressures will vary and potentially lead to differential settlement of the proposed structures (refer to Table 6.0-1 for recommended geotechnical design parameters). Actual bearing conditions of the materials within the foundation areas should be confirmed in the field during excavation, by inspection, under the direction of a Professional Engineer registered in the State of New Jersey.

Prior to placing any fill materials to raise grades to designed and subgrade elevations as necessary, the existing exposed subgrade soils should be compacted to a firm and unyielding surface with several passes in two perpendicular directions of a minimum 10-ton vibratory, smooth drum roller. To help identify any soft or loose pockets which may require removal and replacement or further investigation after compaction of the subgrade, the surface should be proof rolled in the presence of the owner's geotechnical engineer. Typical equipment used for the proof-rolling effort consists of a fully loaded tandem axle truck; and if site constraints limit the use of this equipment, equivalent alternatives may be considered subject to engineer approval. Proof-rolling should be conducted after a suitable period of dry weather to avoid degrading an otherwise acceptable subgrade. Any fill or backfill should be placed and compacted in accordance with the recommendations provided herein. If construction activities are performed during winter months, all frozen soils encountered at or below proposed subgrade elevations should be removed and replaced with Controlled Fill in accordance with the recommendations herein.

Every effort should be made to minimize disturbance of the on-site soils by construction traffic and surface runoff. The on-site soils will deteriorate when subjected to repeated construction traffic and will likely require removal and replacement. Disturbed soils shall be re-compacted, or over-excavated down to the undisturbed soils. Any type of disturbance to moisture-sensitive soils can potentially affect settlement, bearing capacity and the shrinkage/swelling of clays. The services of a geotechnical engineer should be retained to inspect soil conditions during construction and verify the suitability of prepared foundations for support of the design loads.

Development of the Site during periods of favorable weather and stringent quality control of soil moisture will be critical to construction schedules. Construction haul roads should be constructed throughout the Site prior to the start of construction to maintain site access and construction traffic. During construction, the exposed surface soils should be regraded and sealed at the end of each day with a smooth static drum roller to prevent ponding. If subgrade soils are overly wetted, over excavation should be anticipated.

7.2 General Foundation Recommendations

At the time of the subsurface inspection, final structure layouts, elevations, and loadings were not known. From preliminary Site layout and grading plans, it appears as though significant cuts and fills of the existing grade will be required prior to construction of the proposed building, parking garage, and roadways. Matrix's foundation recommendations are based upon the existing soil conditions at the Site, though may require revision upon addition of Controlled Fill to raise Site grades as necessary.

Based on the results of the subsurface investigation, Matrix anticipates that the proposed apartment building, parking garage, and various retaining walls at the Site will be founded upon or within the existing basalt bedrock located at shallow depths throughout the property. Due to the shallow location of rock throughout, deep foundations are recommended to provide anchorage of the foundations into the bedrock to resist significant uplift loading and overturning of the proposed structures. However, shallow foundations may be preferred in areas of certain structures' footprints where uplift is not a concern. See below for a detailed description of foundation options, including feasibility analysis for each alternative.

Shallow Foundations

Based on information obtained during the current subsurface investigation, Matrix has provided an option for the proposed buildings and retaining walls to be supported by conventional shallow foundations such as strip footings, spread footings, or mat foundations.

To ensure adequate frost protection, the shallow foundation bottoms should be placed at least 42” below the finished grade, provided the respective allowable bearing capacity of the subgrade soil recommended on Table 6.1-1 meets the footing pressure. If any soft or loose soils are encountered, the unsuitable material should be removed, replaced, and compacted with new Controlled Fill as per Section 7.5 of this report. The excavated subgrade should be protected from prolonged exposure to air and water to minimize the damaging effect of weathering, to provide sufficient bearing capacity and to reduce differential settlement. To protect the subgrade material, it is recommended that the exposed subgrade be covered with at least 4” to 6” of compacted ¾” stone. All foundation bottoms should be completely cleaned of loose material or debris and maintained in a dry condition immediately prior to the placement of the subgrade base course. A professional engineer competent in the field of geotechnical engineering, and registered in the State of New Jersey, should verify the suitability of the subgrade.

Settlement of the existing Clay or Silt layers encountered within the western and southwestern portions of the Site (boring B-1 and B-2 locations) may be an issue following the placement of thick layers of Controlled Fill, as a significant new soil weight will be imposed upon these compressible soils. Excessive settlement of these layers is not expected at this project site, as the existing Clay or Silt material is typically stiff or dense in nature and above the groundwater table. Nonetheless, substantial compaction operations in conformance with Section 7.1 should be completed and benchmark elevations measured between passes to confirm no additional settlement or consolidation is encountered. Matrix would also recommend the Contractor allows sufficient time for any additional settlement or consolidation of cohesive materials as a result of the additional fill before foundation or pavement construction operations commence. Settlement should be continuously monitored during placement of fill and during construction to measure settlement, if any, of the existing compressible soil layers.

If the uncertainties and risk regarding the existing cohesive material are troublesome, potential soil settlement beneath shallow footings can be prevented by the removal of these layers to at least half of the footing’s influence depth (approximately 4 times the width of footing for strip foundations, and 2 times the footing width for square footings) or alternatively utilizing ground improvement or deep foundations. The removed soil should then be replaced with Controlled Fill material as described in section 7.5 of this report. Any over-excavation to be restored with Controlled Fill will need to extend at least one foot laterally beyond footing edges for each vertical foot of over-excavation. Lateral over-excavation can be reduced if the grade is restored with lean concrete or approved flowable fill. The bottom of over-excavations should be compacted with walk-behind compactors, vibrating plates, or plate tampers ("jumping jacks") to compact locally disturbed materials.

Actual bearing conditions of the materials within the foundation areas should be confirmed in the field during excavation, by inspection, under the direction of a Professional Engineer registered in the State of New Jersey. If unsuitable soil, varying from what was encountered during the subsurface investigation, is encountered at the Site, a deep foundation support system may be utilized for the proposed structures. If such a situation is encountered, Matrix shall assess and reevaluate a viable deep foundation system. However, Matrix does not anticipate the need for deep foundations at this Site.

If significant uplift forces are a concern for proposed structures at the Site, a micropile deep foundation system can be utilized to resist these loads. The micropiles can be utilized beneath the shallow spread or strip footings (detailed above) to provide sufficient uplift resistance and stability for structures subject to high wind or seismic loads. At this moment, Matrix rules out any such situation will be encountered.

7.3 Pavement, Slab & Utility Subbase Recommendations

The proposed redevelopment of the project site is anticipated to include slab-on-grade construction for the sidewalks and floors of the proposed structures at the Site, along with pavement construction for roadways, parking lots, and other paved areas. The bottom of the subgrade should be excavated clean, so a hard bottom is provided for the support of the structures or utility pipes. The subgrade of the finished floors or the paved areas is anticipated to be constructed either within the top four feet of existing grade or within the new fill to be placed throughout the Site to raise grades, as required. All fill used to establish the subgrade level, as necessary, should be Controlled Fill, placed and compacted under engineering controls as per Section 7.5 of this report. To protect concrete slabs exposed to frost heave, controlled crack joints and shrinkage joints should be provided at regular intervals.

An 8-inch-thick layer of ¾-inch crushed clean stone shall be placed as base course between the subgrade and the bottom of concrete slabs. The bottom and sides of the crushed clean stone layer should be separated from the underlying subgrade by installing a layer of geotextile fabric such as Mirafi 500X or equivalent, so that the voids in the crushed stone are not filled in with fines brought into the space by water. In areas where the water collected in the crushed stone layer cannot be drained freely out of the base course, an alternative drainage system may be evaluated to improve the drainage. In the absence of proper drainage, the trapped water in the stone voids may cause frost heave that can ultimately result in damage to the exposed slabs-on-grade. It should be noted that periodic repairs may be needed due to possible risks of damage in extreme weather conditions; particularly if the trapped water fully saturates the voids and freezes.

The proposed construction at the Site is not expected to change the daily vehicular traffic imposed upon the existing asphalt surfaces. For this reason, Matrix recommends that any new roadways at the Site be of similar composition that is currently in place in the existing asphalt roadways and parking lots. At a minimum, Matrix would recommend the pavement section to consist of the following composition:

- Surface Course: 1.5” minimum compacted thickness with 9.5M64 Hot Mix Asphalt (HMA)
- Base Course: 3.5” minimum compacted thickness with 19M64 HMA
- Subbase: 6” minimum compacted thickness with Dense Graded Aggregate (DGA)

The properly prepared Controlled Fill/backfill materials in paved areas are expected to yield a minimum subgrade modulus (k) of 75 psi/in. If any soft or loose soils are encountered, the unsuitable material should be removed, replaced, and compacted with new Controlled Fill as per Section 7.5 of this report. Should the thickness of unsuitable soil to be removed be greater than 3 feet in paved areas, deep foundations are recommended as a viable option. If such a situation is encountered, Matrix shall assess and reevaluate a viable deep foundation system. At this moment, Matrix rules out any such situation will be encountered.

If a utility trench excavation becomes soft due to the inflow of surface water or groundwater, a minimum of six inches of crushed stone shall be placed on the bearing soil to provide a firm base for support of the pipe.

7.4 Excavations/Dewatering/Drainage

Excavation near existing foundations shall not remove the existing lateral or vertical support without protecting the existing foundation against settlement or lateral translation by providing underpinning or shoring. Underpinning and shoring should be provided as per section 1804 of the 2018 International Building Code. The contractor is solely responsible for construction site safety, including excavation safety. Excavations should be performed in accordance with the requirements of *29 CFR Part 1926, OSHA Safety* *and Health Regulations for Construction, Excavations*. It is anticipated that excavations will generally be open cut. The fill and underlying soils, above and below the water table, are considered Type C soils. The maximum allowable slopes stipulated by OSHA for Type C soils are 1.5 H:1 V. Flatter slopes may be required based on actual conditions encountered, which should be evaluated by a competent person (as defined by OSHA) to ensure that safe excavation methods and/or shoring and bracing requirements are implemented. Sheeting and bracing, if required, should be designed by a Professional Engineer licensed in New Jersey with earth and water pressures, as well as equipment and other surcharge loads, considered.

Perched groundwater was encountered at an approximate elevation of +513.5 (NJ State LIDAR Datum) during the subsurface exploration program. This elevation is expected to be much lower than any anticipated structure or foundations at the Site. It should be noted that the true groundwater table was not identified during this investigation. Construction dewatering is not anticipated for this project. Nonetheless, presence of groundwater at foundation depths may severely impede the constructability of structures due to possible inflow of groundwater into the open excavation. As stated before, groundwater levels will vary with temperature, precipitation, and other climatic factors. The appropriate measures to be taken for groundwater control during construction, if necessary, should be determined in the field at the time of excavation and are the responsibility of the contractor.

7.5 Controlled Fill

Matrix recommends that portions of the on-site natural soil may be reused for backfilling as Controlled Fill if it meets the requirements provided within this section, is subjected to removal of all unsuitable material such as topsoil, boulders, concrete, brick, organic matter, etc. and is approved by the owner's Professional Engineer licensed in New Jersey and qualified in geotechnical engineering. If the excavated fill material and on-site natural soils cannot be reused, imported structural fill should be used as Controlled Fill. The imported Controlled Fill should be a granular, structurally sound, free-draining fill, free of organic material and any other deleterious material. Controlled Fill should be a natural Sand or Sand and Gravel mixture with no particles larger than three inches and the material passing the No. 200 sieve shall be non-plastic. The chosen Fill soil should meet the gradation of Table 7.5-1 below.

Table 7.5-1: Grain Size Distribution for Controlled Fill

Sieve Size Designation	Percentage Passing by Weight
Passing 3 inch	100
Passing 2 inch	90 – 100
Passing ¼ inch	30 – 70
Passing #10	15 – 60
Passing #40	5 – 40
Passing #200	0 – 10

Controlled Fill shall be placed in lifts not exceeding twelve (12) inches thick, in loose state. Should the Controlled Fill be compacted with a plate compactor or jumping jack compactor, the Fill must be placed in lifts not exceeding eight (8) inches thick, in loose state. Each lift of backfill should be compacted to at least 95 percent of the maximum dry density within three percent of the optimum moisture content, as determined in accordance with the procedures of ASTM D1557, *Laboratory Compaction Characteristics of Soil Using Modified Effort* (56,000 ft-lbf/ft^3 (2,700 kN-M/M^3)). Controlled Fill placed within ten feet of walls, foundations, utility lines and auxiliary structures should be compacted with plate compactors; the lift thickness should be adjusted, if necessary, to obtain the required degree of compaction. In-place density tests should be performed at a frequency of not less than one per 2,500 sf of backfill placed, and not less than one test per two feet of material placed. In addition, if compaction is being conducted near an existing foundation, the Controlled Fill shall be placed in lifts and compacted such that it does not damage the existing foundation.

Appropriate documentation, with supporting laboratory test results for proposed fill materials, should be submitted for approval prior to its use. Grain size distribution, maximum dry density, optimum water content determinations, and plasticity of the soil should be performed on representative samples of the proposed Controlled Fill.

Preparation of the subgrade and the placement of fill should be performed under the oversight of a qualified geotechnical engineer, or a technician under their direction. No fill material should be placed in areas where free water is standing, on frozen subgrade areas, or on surfaces which have not been approved by qualified geotechnical personnel.

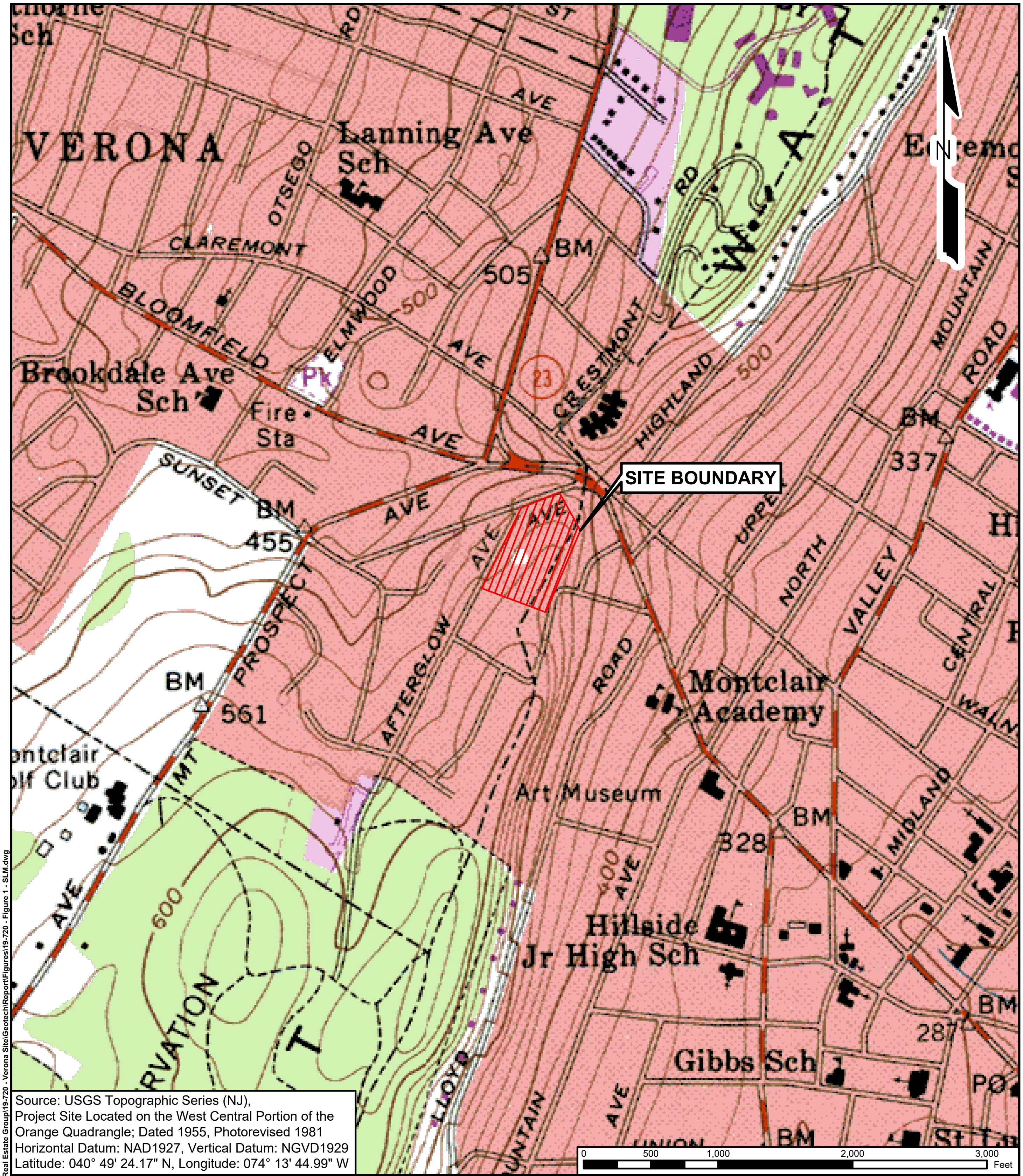
7.6 Supplemental Investigation Services

A qualified geotechnical engineer should perform inspection, testing, and consultation during construction as described in previous sections of this report. Monitoring and testing should be performed to verify that suitable materials are used for Controlled Fill, and that they are properly placed and compacted over suitable subgrade soils. The excavated materials and the on-site natural soil to be reused as Controlled Fill shall be approved for reuse by the owner's geotechnical engineer prior to reuse.

8.0 CLOSURE

This report has been prepared to assist BNE with the proposed construction at their Site in Verona and Montclair, New Jersey. The conclusions and recommendations provided within this report were prepared based on our understanding of the project and through the application of generally accepted soils and foundations engineering practices. No warranties, expressed or implied, are made. Matrix should be notified of any changes to the planned construction or if subsurface conditions differing from those described herein are encountered, so the impact on the geotechnical recommendations can be evaluated.

FIGURES



Source: USGS Topographic Series (NJ),
Project Site Located on the West Central Portion of the
Orange Quadrangle; Dated 1955, Photorevised 1981
Horizontal Datum: NAD1927, Vertical Datum: NGVD1929
Latitude: 040° 49' 24.17" N, Longitude: 074° 13' 44.99" W

SITE LOCATION MAP

MATRIXNEWORLD
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Matrix New World Engineering, Land Surveying
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BNE REAL ESTATE GROUP - VERONA SITE
BLOCK 303, LOT 4 - TOWNSHIP OF VERONA
BLOCK 301, LOT 5 & BLOCK 401, LOT 1 - TOWNSHIP OF MONTCLAIR
ESSEX COUNTY, NEW JERSEY

SCALE:	PROJECT NO.:	DATE:	FIGURE NO.:
1" = 1,000'	19-720	OCTOBER 2019	1

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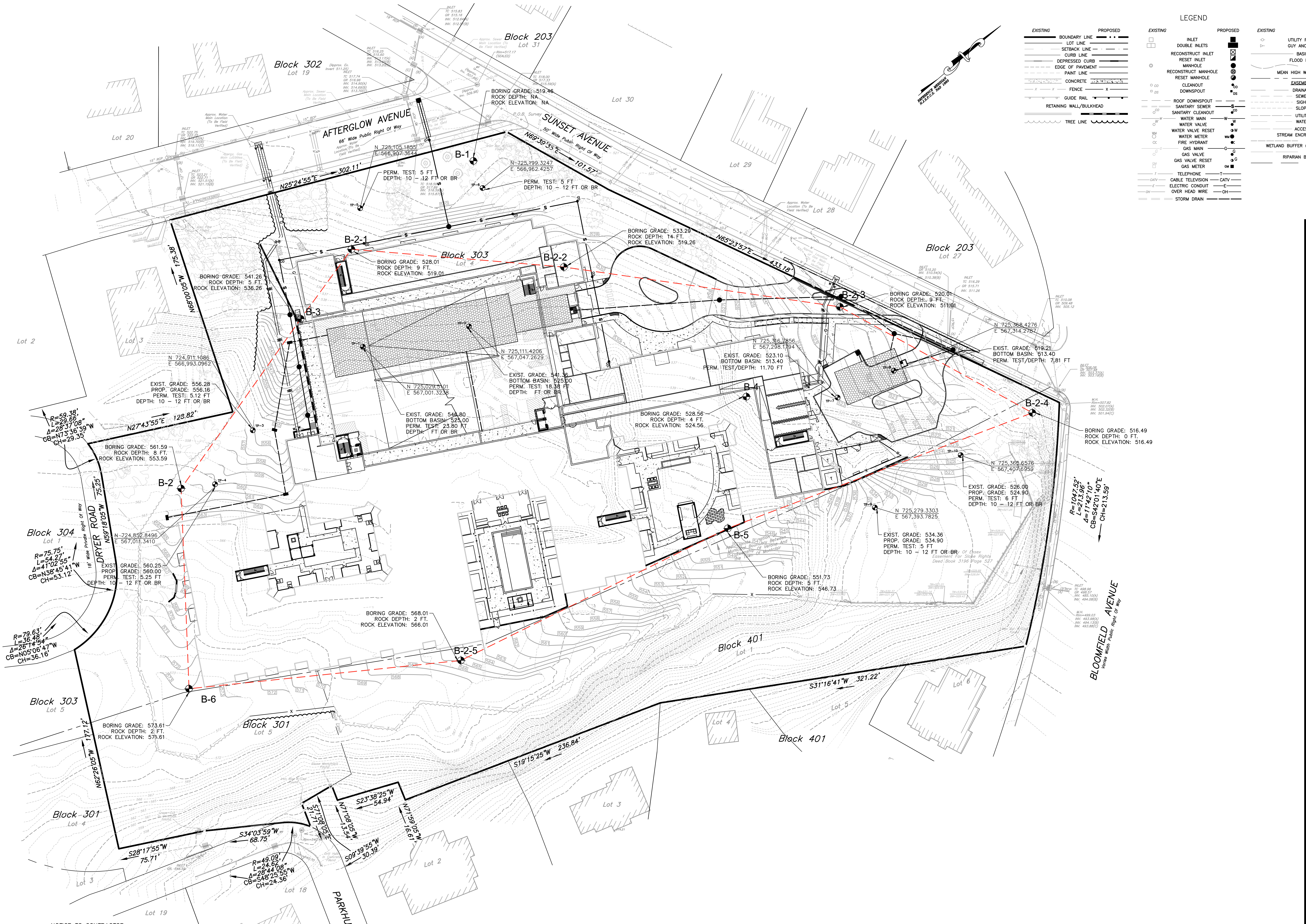

NOTICE TO CONTRACTOR

ATTENTION OF THE CONTRACTOR IS DIRECTED TO THE FACT THAT THE APPROXIMATE LOCATIONS OF KNOWN UTILITY STRUCTURES AND FACILITIES THAT MAY BE ENCOUNTERED WITHIN AND ADJACENT TO THE LIMITS OF WORK AREA ARE SHOWN ON THE PLANS. THE ACCURACY AND COMPLETENESS OF THIS INFORMATION IS NOT GUARANTEED BY THE ENGINEER, AND THE CONTRACTOR IS ADVISED TO VERIFY, IN THE FIELD, ALL THE FACTS CONCERNING THE LOCATION OF THESE UTILITIES AND OTHER CONSTRUCTION OBSTACLES PRIOR TO THE START OF CONSTRUCTION. FURTHER, THE CONTRACTOR SHALL NOTIFY THE ENGINEER, IN WRITING, PRIOR TO THE START OF CONSTRUCTION, OF ANY DISCREPANCIES WHICH MAY EFFECT THE PROJECT DESIGN.

THE CONTRACTOR SHALL CONTACT NEW JERSEY ONE CALL (1-800-272-1000 OR LATEST NUMBER) FOR UTILITY MARKOUT PRIOR TO THE START OF CONSTRUCTION.

Plotted: 9/28/2022 9:04 AM, By: Tori Massara

NO.	DESCRIPTION	DATE:	DES.:	REV.:	REL.:
	REVISIONS				

DESIGNED BY:
REVIEWED BY:
RELEASED BY:

SEAN M. SAVAGE, P.E.
NEW JERSEY PROFESSIONAL ENGINEER
LICENSE NO. 24GE04451000

DATE

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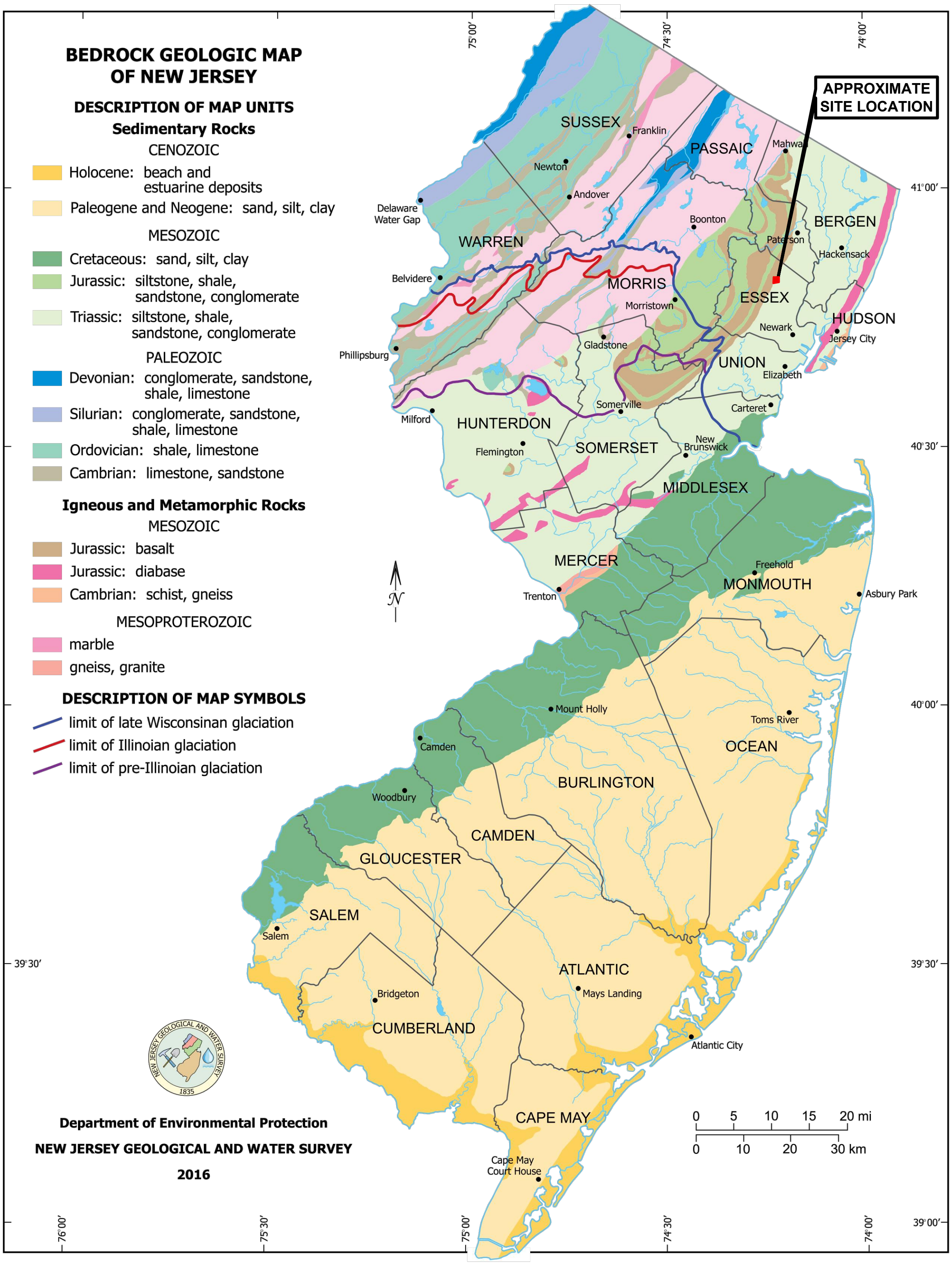
NEW JERSEY CERTIFICATE OF AUTHORIZATION No. 24GA27962300

TEST PIT LOCATION EXHIBIT

VERONA SUNSET URBAN RENEWAL, LLC
BLOCK 303, LOT 4 - TOWNSHIP OF VERONA
BLOCK 301, LOT 5 AND BLOCK 401, LOT 1 -
TOWNSHIP OF MONTCLAIR
ESSEX COUNTY, NEW JERSEY

PROJECT NUMBER: 19-720
DATE: 09/12/2022
SCALE: 1" = 30'
SHEET 1 OF 1



GEOLOGIC LOCATION MAP

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BNE REAL ESTATE GROUP - VERONA SITE
BLOCK 303, LOT 4 - TOWNSHIP OF VERONA
BLOCK 301, LOT 5 & BLOCK 401, LOT 1 - TOWNSHIP OF MONTCLAIR
ESSEX COUNTY, NEW JERSEY

SCALE:	PROJECT NO.:	DATE:	FIGURE NO.:
NTS	19-720	OCTOBER 2019	3

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APPENDIX A

SOIL BORING LOGS

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BORING LOG

BORING NO.: **B-1**

SHEET **1** OF **1**

PROJECT NO.: **19-720** PROJECT: **Verona Site** DATE: **9/16/19**
PROJECT LOCATION: **Verona, New Jersey 07044** BORING LOCATION: **Woods East of Afterglow Ave/Sunset Ave Intersection**
DRILLING EQUIPMENT: **CME 55** ANGLE: **-90.0** DIR.: **-90** ELEV.: **520.7** DATUM: **NJ STATE LIDAR**
DRILLING CONTRACTOR: **Boring Brothers, Inc.** DRILLER: **Rob Dollar** INSPECTOR: **Tim Pace**

CASING and HAMMER				SAMPLER and HAMMER				GROUNDWATER LEVELS			
Type	I.D.	Weight	Drop	Type	I.D.	Weight	Drop	Date	Time	Depth	Casing Depth
FJ Steel	**4"**			**SS**	**1 3/8"**			**9/16/19**	**10:15 am**	**7.2**	**N/A**
Auto		**140 lbs**	**30"**	**AUTO**		**140 lbs**	**30"**				

Depth Feet (Elev.)	CASING Blows/ Foot	SAMPLE No.	Type	Depth Feet	Blows/6" (REC. %) [RQD %]	Graphic Symbol	Description Of Material	Laboratory Tests
	PUSH	S-1	SS	0-2	2-3-2-3 (67%)		S-1: Brown fine SAND and Silt, trace roots, wood, dry (SM)	
(518.7)		S-2	SS	2-4	3-4-5-6 (75%)		S-2: Light Brown Silty CLAY, some fine Sand, trace fine Gravel, trace roots, dry (CL) WC: 18.0%, Gravel: 4.0%, Sand: 28.6%, Fines: 67.4%	Sieve
(516.7) 5	PUSH 50	S-3	SS	4-6	9-9-11-10 (100%)		S-3: Light Brown fine SAND and Silty Clay, trace fine Gravel, dry (SC) WC: 13.9%, LL: 25, PL: 15, PI: 10	Atterberg Limits
(514.7) ▼	50 70	S-4	SS	6-8	14-11-13-10 (92%)		S-4: Red-Brown mf SAND, little Clayey Silt, little fine Gravel, wet (SM)	
(512.7) 10	100 60	S-5	SS	8-10	10-9-6-6 (50%)		S-5: Brown cmf SAND and cf Gravel, trace Silt, wet (SP)	
(510.7)	MUD	S-6	SS	10-12	10-9-8-8 (63%)		S-6: Brown mf SAND, little Silt, little cf Gravel, wet (SM)	
(507.2) 15	MUD	S-7	SS	15-17	6-3-3-6 (50%)		S-7: Brown mf* SAND, some Clay, little fine Gravel, wet (SC) WC: 13.1%, Fines: 32.5%, LL: 19, PL: 11, PI: 8	Atterberg Limits; Pass No 200
(503.7)							4" Casing to 10 feet bgs Bottom of Borehole @ 17 ft.	

BORING LOG

BORING NO.: **B-2**

SHEET **1** OF **1**

PROJECT NO.: **19-720** PROJECT: **Verona Site** DATE: **9/17/19**
PROJECT LOCATION: **Verona, New Jersey 07044** BORING LOCATION: **Grass Area South of South Parking Lot**
DRILLING EQUIPMENT: **CME 55** ANGLE: **-90.0** DIR.: **-90** ELEV.: **562.0** DATUM: **NJ STATE LIDAR**
DRILLING CONTRACTOR: **Boring Brothers, Inc.** DRILLER: **Rob Dollar** INSPECTOR: **Tim Pace**

CASING and HAMMER				SAMPLER and HAMMER				GROUNDWATER LEVELS			
Type	I.D.	Weight	Drop	Type	I.D.	Weight	Drop	Date	Time	Depth	Casing Depth
FJ Steel	**4"**			**SS**	**1 3/8"**						
Auto		**140 lbs**	**30"**	**AUTO**		**140 lbs**	**30"**				

Depth Feet (Elev.)	CASING	SAMPLE				Graphic Symbol	Description Of Material	Laboratory Tests
	Blows/ Foot	No.	Type	Depth Feet	Blows/6" (REC. %) [RQD %]			
	PUSH	S-1	SS	0-2	1-2-3-3 (63%)		S-1: Brown fine SAND and Silt, trace fine Gravel, trace roots, moist (SM)	
	PUSH	S-2	SS	2-4	8-6-6-8 (88%)		S-2: Red-Brown mf* SAND and Silt, trace of cf Gravel, dry (SM) WC: 13.0%, Fines: 37.6%	Pass No 200
	40							
		S-3	SS	4-6	11-12-14-15 (79%)		S-3: Red-Brown mf* SAND and Silt, little cf* Gravel, dry (SM)	
5	60							
	80							
(556.0)		S-4	SS	6-8	17-15-15-13 (63%)		S-4: Red-Brown fine SAND and Silt and Clay, little cf* Gravel, dry (SC-SM) WC: 12.1%, Fines: 38.5%, LL: 21, PL: 14, PI: 7	Atterberg Limits; Pass No 200
	110							
	110							
		S-5	SS	8-9	20-100/6" (100%)		S-5A (Top 4"): Same as Above, dry (SC-SM)	
(553.7)	90						S-5B (Bottom 8"): Red-Brown mf* SAND, some Silt, trace cf Gravel, dry (SM)	
(553.0)	WATER	R-1	NX	9-14	(92%) [50%]		R-1: Dark Gray BASALT, mf grained, moderately fractured, slightly weathered (WS) (BASALT) Compressive Strength = 22,170 psi	Unconfined Comp.
10								
(548.0)	WATER						4" Casing to 9 feet bgs Bottom of Borehole @ 14 ft.	

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BORING LOG

BORING NO.: **B-2-1**

SHEET **1** OF **1**

PROJECT NO.: **19-720** PROJECT: **Verona Site** DATE: **5/07/21**
PROJECT LOCATION: **Verona, New Jersey 07044** BORING LOCATION: **Southwest of School Building**
DRILLING EQUIPMENT: **CME 55** ANGLE: **-90.0** DIR.: **-90** ELEV.: DATUM: **NJ STATE LIDAR**
DRILLING CONTRACTOR: **Boring Brothers, Inc.** DRILLER: **Rob Dollar** INSPECTOR: **Brian Young**

CASING and HAMMER				SAMPLER and HAMMER				GROUNDWATER LEVELS			
Type	I.D.	Weight	Drop	Type	I.D.	Weight	Drop	Date	Time	Depth	Casing Depth
FJ Steel	**4"**			**SS**	**1 3/8"**						
Auto		**140 lbs**	**30"**	**AUTO**		**140 lbs**	**30"**				

Depth Feet (Elev.)	CASING	SAMPLE				Graphic Symbol	Description Of Material	Laboratory Tests
	Blows/ Foot	No.	Type	Depth Feet	Blows/6" (REC. %) [RQD %]			
		S-1	SS	0-2	1-3-6-7 (33%)		S-1: Brown cmf SAND, little Silt (SM)	
		S-2	SS	2-4	3-4-3-11 (25%)		S-2: Brown cmf SAND, little Silt, trace f Gravel (SM)	
5		S-3	SS	4-6	19-20-15-18 (42%)		S-3: Brown cmf SAND, little Silt, trace f Gravel (SM)	
		S-4	SS	6-8	28-16-17-14 (54%)		S-4: Brown cmf SAND, little Silt, trace f Gravel (SM)	
		S-5	SS	8-9	32-50/3" (33%)			
							Refusal (rock) at 9 feet bgs Bottom of Borehole @ 9 ft.	

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BORING LOG

BORING NO.: **B-2-2**

SHEET **1** OF **1**

PROJECT NO.: **19-720** PROJECT: **Verona Site** DATE: **5/07/21**
PROJECT LOCATION: **Verona, New Jersey 07044** BORING LOCATION: **North of School Building**
DRILLING EQUIPMENT: **CME 55** ANGLE: **-90.0** DIR.: **-90** ELEV.: DATUM: **NJ STATE LIDAR**
DRILLING CONTRACTOR: **Boring Brothers, Inc.** DRILLER: **Rob Dollar** INSPECTOR: **Brian Young**

CASING and HAMMER				SAMPLER and HAMMER				GROUNDWATER LEVELS			
Type	I.D.	Weight	Drop	Type	I.D.	Weight	Drop	Date	Time	Depth	Casing Depth
FJ Steel	**4"**			**SS**	**1 3/8"**						
Auto		**140 lbs**	**30"**	**AUTO**		**140 lbs**	**30"**				

Depth Feet (Elev.)	CASING	SAMPLE				Graphic Symbol	Description Of Material	Laboratory Tests
	Blows/ Foot	No.	Type	Depth Feet	Blows/6" (REC. %) [RQD %]			
		S-1	SS	0-2	1-2-1-2 (25%)	░	S-1: Brown cmf SAND, little Silt (SM)	
		S-2	SS	2-4	4-4-5-13 (63%)	░	S-2: Brown cmf SAND, little Silt (SM)	
5		S-3	SS	4-6	20-6-7-6 (50%)	░	S-3: Brown cmf SAND, little Silt (SM)	
		S-4	SS	6-8	13-9-8-6 (54%)	░	S-4: Brown cmf SAND, little Silt (SM)	
		S-5	SS	8-10	4-5-7-5 (46%)	░	S-5: Brown cmf SAND, little Silt (SM)	
10		S-6	SS	10-12	8-10-12-15 (54%)	░	S-6: Brown cmf SAND, little mf Gravel (SM)	
		S-7	SS	12-14	21-17-15-20 (38%)	░	S-6: Brown cmf SAND, little mf Gravel (SM)	
		S-8	SS	14-16	50/0"		Bottom of Borehole @ 14 ft.	

BORING LOG

BORING NO.: **B-2-3**

SHEET **1** OF **1**

PROJECT NO.: **19-720** PROJECT: **Verona Site** DATE: **5/07/21**
PROJECT LOCATION: **Verona, New Jersey 07044** BORING LOCATION: **North of Parking Lot**
DRILLING EQUIPMENT: **CME 55** ANGLE: **-90.0** DIR.: **-90** ELEV.: DATUM: **NJ STATE LIDAR**
DRILLING CONTRACTOR: **Boring Brothers, Inc.** DRILLER: **Rob Dollar** INSPECTOR: **Brian Young**

CASING and HAMMER				SAMPLER and HAMMER				GROUNDWATER LEVELS			
Type	I.D.	Weight	Drop	Type	I.D.	Weight	Drop	Date	Time	Depth	Casing Depth
FJ Steel	**4"**			**SS**	**1 3/8"**						
Auto		**140 lbs**	**30"**	**AUTO**		**140 lbs**	**30"**				

Depth Feet (Elev.)	CASING	SAMPLE				Graphic Symbol	Description Of Material	Laboratory Tests
	Blows/ Foot	No.	Type	Depth Feet	Blows/6" (REC. %) [RQD %]			
		S-1	SS	0-2	1-2-1-4 (50%)		S-1: Brown cmf SAND (SM)	
		S-2	SS	2-4	4-5-6-8 (58%)		S-2: Brown cmf SAND, little Silt, trace mf Gravel (SM)	
5		S-3	SS	4-6	16-14-9-6 (46%)		S-3: Brown cmf SAND, little Silt, trace mf Gravel (SM)	
		S-4	SS	6-8	5-6-8-9 (8%)		S-4: Brown cmf SAND, little Silt, trace mf Gravel (SM)	
		S-5	SS	8-9	16-21-50/3" (33%)			
							Bottom of Borehole @ 9 ft.	

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BORING LOG

BORING NO.: **B-2-4**

SHEET **1** OF **1**

PROJECT NO.: **19-720** PROJECT: **Verona Site** DATE: **5/07/21**
PROJECT LOCATION: **Verona, New Jersey 07044** BORING LOCATION: **East Corner of Site**
DRILLING EQUIPMENT: **CME 55** ANGLE: **-90.0** DIR.: **-90** ELEV.: DATUM: **NJ STATE LIDAR**
DRILLING CONTRACTOR: **Boring Brothers, Inc.** DRILLER: **Rob Dollar** INSPECTOR: **Brian Young**

CASING and HAMMER				SAMPLER and HAMMER				GROUNDWATER LEVELS			
Type	I.D.	Weight	Drop	Type	I.D.	Weight	Drop	Date	Time	Depth	Casing Depth
				SS	**1 3/8"**						
				AUTO		**140 lbs**	**30"**				

Depth Feet (Elev.)	CASING	SAMPLE				Graphic Symbol	Description Of Material	Laboratory Tests
	Blows/ Foot	No.	Type	Depth Feet	Blows/6" (REC. %) [RQD %]			
		S-1	SS	0-2	50/0"	▨	Bottom of Borehole @ 0 ft.	

MATRIXNEWORLD
Engineering Progress

BORING LOG

BORING NO.: **B-2-5**

SHEET **1** OF **1**

PROJECT NO.: **19-720** PROJECT: **Verona Site** DATE: **5/07/21**
PROJECT LOCATION: **Verona, New Jersey 07044** BORING LOCATION: **Southeast Corner of School Building**
DRILLING EQUIPMENT: **CME 55** ANGLE: **-90.0** DIR.: **-90** ELEV.: DATUM: **NJ STATE LIDAR**
DRILLING CONTRACTOR: **Boring Brothers, Inc.** DRILLER: **Rob Dollar** INSPECTOR: **Brian Young**

CASING and HAMMER				SAMPLER and HAMMER				GROUNDWATER LEVELS			
Type	I.D.	Weight	Drop	Type	I.D.	Weight	Drop	Date	Time	Depth	Casing Depth
FJ Steel	**4"**			**SS**	**1 3/8"**						
Auto		**140 lbs**	**30"**	**AUTO**		**140 lbs**	**30"**				

Depth Feet (Elev.)	CASING	SAMPLE				Graphic Symbol	Description Of Material	Laboratory Tests
	Blows/ Foot	No.	Type	Depth Feet	Blows/6" (REC. %) [RQD %]			
		S-1	SS	0-2	1-1-1-1 (54%)	▒	S-1: Brown cmf SAND (SM)	
		S-2	SS	2-2.3	50/3" (33%)		S-2: Brown cmf SAND (SM) Bottom of Borehole @ 2 ft.	

MATRIX**NEW**ORLD
Engineering Progress

BORING LOG

BORING NO.: **B-3**

SHEET **1** OF **1**

PROJECT NO.: **19-720** PROJECT: **Verona Site** DATE: **9/16/19**
PROJECT LOCATION: **Verona, New Jersey 07044** BORING LOCATION: **Woods West of Visitor Parking Area**
DRILLING EQUIPMENT: **CME 55** ANGLE: **-90.0** DIR.: **-90** ELEV.: **542.0** DATUM: **NJ STATE LIDAR**
DRILLING CONTRACTOR: **Boring Brothers, Inc.** DRILLER: **Rob Dollar** INSPECTOR: **Tim Pace**

CASING and HAMMER				SAMPLER and HAMMER				GROUNDWATER LEVELS			
Type	I.D.	Weight	Drop	Type	I.D.	Weight	Drop	Date	Time	Depth	Casing Depth
FJ Steel	**4"**			**SS**	**1 3/8"**						
Auto		**140 lbs**	**30"**	**AUTO**		**140 lbs**	**30"**				

Depth Feet (Elev.)	CASING	SAMPLE				Graphic Symbol	Description Of Material	Laboratory Tests
	Blows/ Foot	No.	Type	Depth Feet	Blows/6" (REC. %) [RQD %]			
	10	S-1	SS	0-2	2-2-1-2 (83%)		S-1: Brown fine SAND and Clayey Silt, little fine Gravel, dry (SM) *Bottom 6" of split spoon wet WC: 14.9%, Gravel: 13.6%, Sand: 45.1%, Fines: 41.3%, <2 µm: 7%	Sieve; Hydrometer
	50							
	60	S-2	SS	2-4	10-12-22-25 (83%)		S-2: Red-Brown mf* SAND and Silt, some cf* Gravel, dry (SM) *Top 10" of split spoon wet	
	80							
(537.7)	WATER	S-3	SS	4-4.3	100/4" (100%)		S-3: Red-Brown mf* SAND, some cf* Gravel, little Silt, wet (SM)	
5 (537.0)		R-1	NX	5-10	(82%) [0%]		R-1: Dark Gray BASALT, mf* grained, closely fractured, slightly weathered (WS) (BASALT)	
10 (532.0)	WATER						4" Casing to 4 feet bgs Bottom of Borehole @ 10 ft.	

MATRIXNEWORLD
Engineering Progress

BORING LOG

BORING NO.: **B-4**

SHEET **1** OF **1**

PROJECT NO.: **19-720** PROJECT: **Verona Site** DATE: **9/16/19**
PROJECT LOCATION: **Verona, New Jersey 07044** BORING LOCATION: **South Edge of North Parking Lot**
DRILLING EQUIPMENT: **CME 55** ANGLE: **-90.0** DIR.: **-90** ELEV.: **529.0** DATUM: **NJ STATE LIDAR**
DRILLING CONTRACTOR: **Boring Brothers, Inc.** DRILLER: **Rob Dollar** INSPECTOR: **Tim Pace**

CASING and HAMMER				SAMPLER and HAMMER				GROUNDWATER LEVELS			
Type	I.D.	Weight	Drop	Type	I.D.	Weight	Drop	Date	Time	Depth	Casing Depth
FJ Steel	**4"**			**SS**	**1 3/8"**						
Auto		**140 lbs**	**30"**	**AUTO**		**140 lbs**	**30"**				

Depth Feet (Elev.)	CASING	SAMPLE				Graphic Symbol	Description Of Material	Laboratory Tests
	Blows/ Foot	No.	Type	Depth Feet	Blows/6" (REC. %) [RQD %]			
		S-1	SS	0-2	2-6-6-3 (25%)		S-1: Brown fine SAND and Silt, trace coarse Gravel, trace roots, dry (SM)	
	20							
	40							
		S-2	SS	2-4	5-6-10-13 (75%)		S-2: Red-Brown mf* SAND, some Silt, some cf Gravel, moist (SM)	
	25							
	55							
(525.0)	WATER	R-1	NX	4-9	(88%) [88%]		R-1: Dark Gray BASALT, fine grained, slightly fractured, slightly weathered (WS) (BASALT)	
5								
	WATER							
(520.0)							4" Casing to 4 feet bgs Bottom of Borehole @ 9 ft.	

BORING LOG

BORING NO.: **B-5**

SHEET **1** OF **1**

PROJECT NO.: **19-720** PROJECT: **Verona Site** DATE: **9/17/19**
PROJECT LOCATION: **Verona, New Jersey 07044** BORING LOCATION: **Southwest Corner of Basketball Court**
DRILLING EQUIPMENT: **CME 55** ANGLE: **-90.0** DIR.: **-90** ELEV.: **552.6** DATUM: **NJ STATE LIDAR**
DRILLING CONTRACTOR: **Boring Brothers, Inc.** DRILLER: **Rob Dollar** INSPECTOR: **Tim Pace**

CASING and HAMMER				SAMPLER and HAMMER				GROUNDWATER LEVELS			
Type	I.D.	Weight	Drop	Type	I.D.	Weight	Drop	Date	Time	Depth	Casing Depth
FJ Steel	**4"**			**SS**	**1 3/8"**						
Auto		**140 lbs**	**30"**	**AUTO**		**140 lbs**	**30"**				

Depth Feet (Elev.)	CASING	SAMPLE				Graphic Symbol	Description Of Material	Laboratory Tests
	Blows/ Foot	No.	Type	Depth Feet	Blows/6" (REC. %) [RQD %]			
							6" Asphalt	
(552.1)	25	S-1	SS	0.5-2	16-11-8 (39%)		S-1: Gray-Brown cmf* SAND, some Silt, little cf Gravel, dry (SM)	
	30							
		S-2	SS	2-4	7-9-6-7 (4%)		S-2: Same as Above, dry (SM)	
	30							
	30							
		S-3	SS	4-4.4	100/5" (60%)		S-3: Same as Above, dry (SM)	
(548.2)	110							
(547.6)	WATER	R-1	NX	5-10	(95%) [57%]		R-1: Dark Gray BASALT, cmf grained, moderately fractured, slightly weathered (WS) (BASALT) Compressive Strength = 13,760 psi	Unconfined Comp.
10 (542.6)	WATER						4" Casing to 5 feet bgs Bottom of Borehole @ 10 ft.	

MATRIXNEWORLD
Engineering Progress

BORING LOG

BORING NO.: **B-6**

SHEET **1** OF **1**

PROJECT NO.: **19-720** PROJECT: **Verona Site** DATE: **9/17/19**

PROJECT LOCATION: **Verona, New Jersey 07044** BORING LOCATION: **South Corner of Site**

DRILLING EQUIPMENT: **CME 55** ANGLE: **-90.0** DIR.: **-90** ELEV.: **574.9** DATUM: **NJ STATE LIDAR**

DRILLING CONTRACTOR: **Boring Brothers, Inc.** DRILLER: **Rob Dollar** INSPECTOR: **Tim Pace**

CASING and HAMMER				SAMPLER and HAMMER				GROUNDWATER LEVELS			
Type	I.D.	Weight	Drop	Type	I.D.	Weight	Drop	Date	Time	Depth	Casing Depth
FJ Steel	**4"**			**SS**	**1 3/8"**						
Auto		**140 lbs**	**30"**	**AUTO**		**140 lbs**	**30"**				

Depth Feet (Elev.)	CASING	SAMPLE				Graphic Symbol	Description Of Material	Laboratory Tests
	Blows/ Foot	No.	Type	Depth Feet	Blows/6" (REC. %) [RQD %]			
	20	S-1	SS	0-1.8	3-9-10-100/4" (41%)		S-1A (Top 4"): Brown fine SAND and Silt, trace roots, moist (SM)	
(573.5)	95						S-1B (Bottom 5"): Gray c*f GRAVEL, some cmf Sand, dry (CWR/GP)	
(572.9)	WATER	R-1	NX	2-7	(82%) [22%]		R-1: Dark Gray BASALT, mf grained, closely fractured, slightly weathered (WS) (BASALT)	
5								
	WATER							
(567.9)							4" Casing to 2 feet bgs Bottom of Borehole @ 7 ft.	

NEWORLD NO GROUT 19-720 - FINAL BORING LOGS - 06.03.21.GPJ MATRIX EGS.GDT 6/3/21

BORING NO.: **B-6**

APPENDIX B

SOIL CLASSIFICATION TABLES

LOG NOTATION

Sample Classifications

SS = Split Spoon

NR = No Recovery

NX = Rock Core

SH = Shelby Tube

REC = Soil Recovery

RQD = Rock Quality Designation

Sand Classifications

c = Coarse

m = Medium

f = Fine

* = Predominant Grain Size

Soil Properties

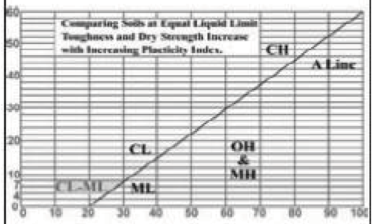
WC = Water Content

PL = Plastic Limit

LL = Liquid Limit

PI = Plasticity Index

OC = Organic Content

<table>
<tr><th colspan="3">MAJOR DIVISIONS</th><th>GROUP SYMBOLS</th><th>TYPICAL NAMES</th><th colspan="3">FIELD IDENTIFICATION PROCEDURES (EXCLUDING PARTICLES LARGER THAN 3 IN. AND BASING FRACTIONS ON ESTIMATED WEIGHTS)</th><th>INFORMATION REQUIRED FOR DESCRIBING SOILS</th><th colspan="4">LABORATORY CLASSIFICATION CRITERIA</th></tr>
<tr><td>1</td><td colspan="2">2</td><td>3</td><td>4</td><td colspan="3">5</td><td>6</td><td colspan="4">7</td></tr>
<tr><td rowspan="8">Coarse-grained Soils
More than half of material is larger than No. 200 sieve size.
The No. 200 sieve size is about the smallest visible to the naked eye.</td><td rowspan="4">Gravels
More than half of coarse fraction is larger than No. 4 sieve size.
(For visual classification, the 1/4-in. size may be used as equivalent to the No. 4 sieve size.)</td><td rowspan="2">Clean Gravels (Little or no fines)</td><td>GW</td><td>Well-graded gravels, gravel-sand mixture, little or no fines.</td><td colspan="3">Wide range in grain size and substantial amounts of all intermediate particle sizes.</td><td rowspan="2">For undisturbed soils add information on stratification, degree of compactness, cementation, moisture condition, and drainage characteristics.</td><td rowspan="16">Use grain-size curve in identifying the fractions as given under field identification.</td><td rowspan="8">Determine percentage of gravel and sand from grain-size curve. Depending on percentage of fine (fraction smaller than No. 200 sieve size) coarse-grained soils are classified as follows:
Less than 5% GW, GP, SW, SP;
More than 12% GM, GC, SM, SC.
5% to 12% Borderline cases requiring use of dual symbols.</td><td colspan="2">$C_u = \frac{D_{60}}{D_{10}}$ Greater than 4
$C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3</td></tr>
<tr><td>GP</td><td>Poorly graded gravels or gravel-sand mixture, little or no fines.</td><td colspan="3">Predominantly one size or a range of sizes with some intermediate sizes missing.</td><td colspan="2">Not meeting all gradation requirements for GW</td></tr>
<tr><td rowspan="2">Gravels with Fines (Appreciable amount of fines)</td><td>GM</td><td>Silty gravels, gravel and silt mixtures.</td><td colspan="3">Nonplastic fines or fines with low plasticity (for identification procedures see ML below).</td><td rowspan="3">Give typical name; indicate approximate percentages of sand and gravel, maximum size; angularity, surface condition, and hardness of the coarse grains; local or geologic name and other pertinent descriptive information; and symbol in parentheses.</td><td>Atterberg limits below “A” line or P1 less than 4</td><td rowspan="2">Above “A” line with P1 between 4 and 7 are borderline cases requiring use of dual symbols.</td></tr>
<tr><td>GC</td><td>Clayey gravels, gravel and clay mixtures.</td><td colspan="3">Plastic fines
(for identification procedures see CL below).</td><td>Atterberg limits above “A” line with P1 greater than 7</td></tr>
<tr><td rowspan="4">Sands
More than half of coarse fraction is smaller than No .4 sieve size.</td><td rowspan="2">Clean Sand (Little or no fines)</td><td>SW</td><td>Well-graded sands, gravelly sands, little or no fines.</td><td colspan="3">Wide range in grain size and substantial amounts of all intermediate particle sizes.</td><td colspan="2">$Cu = \frac{D_{60}}{D_{10}}$ Greater than 6
$C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3</td></tr>
<tr><td>SP</td><td>Poorly graded sands or gravelly sands, little or no fines.</td><td colspan="3">Predominantly one size or a range of sizes with some intermediate sizes missing.</td><td rowspan="3">Example:
Silty sand, gravelly; about 20% hard, angular gravel particles 1/2-in. maximum size; rounded and subangular sand grains, coarse to fine; about 15% nonplastic fines with low dry strength; well compacted and moist in place; alluvial sand; (SM).</td><td colspan="2">Not meeting all gradation requirements for SW</td></tr>
<tr><td rowspan="2">Sands with Fines (Appreciable amount of fines)</td><td>SM</td><td>Silty sands, sand-silt mixtures.</td><td colspan="3">Nonplastic fines or fines with low plasticity (for identification procedures see ML below).</td><td>Atterberg limits above “A” line or P1 less than 4</td><td rowspan="2">Limits plotting in hatched zone with P1 between 4 and 7 are borderline cases requiring use of dual symbols.</td></tr>
<tr><td>SC</td><td>Clayey sands, sand-clay mixtures.</td><td colspan="3">Plastic fines
(for identification procedures see CL below).</td><td>Atterberg limits above “A” line with Pl greater than 7</td></tr>
<tr><td rowspan="8">Fine-grained Soils
More than half of material is smaller than No. 200 sieve size.</td><td colspan="4" rowspan="2"></td><td colspan="3">Identification Procedure on Fraction Smaller than No. 40 Sieve Size.</td><td rowspan="2"></td><td colspan="3" rowspan="2"></td></tr>
<tr><td>Dry Strength (Crushing Characteristics)</td><td>Dilatancy (Reaction to shaking)</td><td>Toughness (Consistency near PL)</td></tr>
<tr><td colspan="2" rowspan="2">Silts and Clays Liquid limit is less than 50</td><td>ML</td><td>Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.</td><td>None to slight</td><td>Quick to slow</td><td>None</td><td rowspan="2">For undisturbed soils add information on structure, stratification, consistency in undisturbed and remolded states, moisture and drainage conditions</td><td rowspan="7">Plasticity Index</td><td colspan="2" rowspan="7">LIQUID LIMIT PLASTICITY CHART
For laboratory classification of fine-grained soils
 </td></tr>
<tr><td>CL</td><td>Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.</td><td>Medium to high</td><td>None to very slow</td><td>Medium</td></tr>
<tr><td colspan="2" rowspan="4">Silts and Clays Liquid limit is greater than 50</td><td>OL</td><td>Organic silts and organic silty clays of low plasticity.</td><td>Slight to medium</td><td>Slow</td><td>Slight</td><td rowspan="3">Give typical name; indicate degree and character of plasticity; amount and maximum size of coarse grains; color in wet condition; odor, if any; local or geologic name and other pertinent descriptive information; and symbol in parentheses.</td></tr>
<tr><td>MH</td><td>Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.</td><td>Slight to medium</td><td>Slow to none</td><td>Slight to medium</td></tr>
<tr><td>CH</td><td>Inorganic clays of high plasticity, fat clays.</td><td>High to very high</td><td>None</td><td>High</td></tr>
<tr><td>OH</td><td>Organic clays of medium to high plasticity, organic silts.</td><td>Medium to high</td><td>None to very slow</td><td>Slight to medium</td><td rowspan="2">Example:
Clayey silt, brown; slightly plastic; small percentage of fine sand; numerous vertical root holes; firm and dry in place; loess; (ML)</td></tr>
<tr><td colspan="3">Highly Organic Soils</td><td>Pt</td><td>Peat and other highly organic soils.</td><td colspan="3">Readily identified by color, odor, spongy feel and frequently by fibrous texture</td></tr>
</table>

1. Boundary classifications: Soils possessing characteristics of two groups are designed by combinations of group symbols. For example GM-GC, well-graded gravel-sand mixture with clay binder.
2. All sieve sizes on this chart are U.S. standard.
3. Adopted by Corps of Engineers and Bureau of Reclamation, January 1952.

032058C

BURMISTER SOIL IDENTIFICATION METHOD

BURMISTER SOIL IDENTIFICATION METHOD

1. SOIL MATERIAL Composition, Gradation, and Plasticity Characteristics

a) Soil Components and Soil Fractions

Sieve	3"	1"	3/8"	No. 10 2 mm	No. 30	No. 60	No. 200 0.076 mm	0.02 mm
Granular Component Fractions	GRAVEL			SAND			SILT	
	coarse	medium	fine	coarse	medium	fine	coarse	fine
Clay Soil Components							CLAY-SOIL Defined and Named on a Plasticity Basis	

b) Identifying Terms for Granular Soils
Composition and Proportion Terms for Components

Component		Proportion Terms	Defining Range of Percentages
Principal Components- GRAVEL, SAND, SILT (all Uppercase)			50% or more
Minor Components-	Gravel	and	35 to 50%
	Sand	some	20 to 35%
	Silt	little	10 to 20%
		trace	1 to 10%

Gradation Terms for Granular Soils		ORGANIC SOILS
coarse to fine	all fractions more than 10%	Plasticity Basis, as
coarse to medium	fine less than 10%	
medium to fine	coarse less than 10%	Organic SILT, H. PI
medium	coarse and fine less than 10%	
fine	coarse and medium less than 10%	Organic SILT, L. PI
PLUS or MINUS signs used to indicate upper or lower limits.		

c) Identifying Terms for CLAY SOILS. Plasticity Basis for Combined Silt and Clay Components, Expressing the Relative Dominance of Clay

Overall Plasticity	Plasticity Index	Principal Component	Minor Component
Non-Plastic	0	SILT	Silt
Slight	1 to 5	Clayey SILT	Clayey Silt
Low	5 to 10	SILT & CLAY	Silt & Clay
Medium	10 to 20	CLAY & SILT	Clay & Silt
High	20 to 40	Silty CLAY	
Very High	more than 40	CLAY	

Example: Soil 60% coarse to fine Sand, 25% medium to fine Gravel, 15% Clayey Silt and color-brown.

Identification: Br. coarse to fine SAND, some medium to fine Gravel, little Clayey Silt.

References:
1) D. M. Burmister, “Principles and Techniques of Soil Identification” 29th Highway Research Board Proceedings, 1949.
2) “Identification and Classification of Soils – An appraisal and Statement of Principles”, ASTM Special Technical Publication No. 113, 1951.

Field Classification of Soil Using the USCS

Apparent Density of Coarse-Grained Soils

SPT N-Value (corrected)	Apparent Density
0 - 4	Very loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
> 50	Very Dense

Consistency of Fine-Grained Soils

SPT N-Value (uncorrected)	Consistency	Compressive Strength (ksf)	Results of Manual Manipulation
< 2	Very Soft	< 0.5	Specimen (height = twice the diameter) sags under its own weight; extrudes between fingers when squeezed
3 - 4	Soft	> 0.5 - 1.0	Speciment can be pinched in to between the thumb and forefinger; remolded by light finger pressure
5 - 8	Medium stiff	> 1.0 - 2.0	Can be imprinted easily with fingers; remolded by strong finger pressure
9 - 15	Stiff	> 2.0 - 4.0	Can be imprinted with considerable pressure from fingers or indented by thumbnail
16 - 30	Very stiff	> 4.0 - 8.0	Can be barely imprinted by pressure from the fingers or indented by thumbnail
> 30	Hard	> 8.0	Cannot be imprinted by fingers or difficult to indent by thumbnail

APPENDIX C

PERMEABILITY TEST LOGS

MATRIXNEWORLD
Engineering Progress

PT ID No.	PT- 1		
Sheet	1	of	1

Prepared for:	**BNE Real Estate Group**	PROJECT:	19-720 - Verona Site
		LOCATION:	Woods West of Visitor Parking Lot (Boring B-3)

INSPECTOR:	Tim Pace	DRILLER:	Rob Dollar	Start Date:	9/16/2019	Weather:	70°F, Cloudy
CONTRACTOR:	Boring Brothers, Inc.	HELPER:	Matt	Start Time:	11:30 AM		
P.E./REP.:	Mike Soltys						

Depth of PT:	4	ft	Drill Bit Type:	Tri-Cone		Weight of Hammer for casing:	140	lbs
Rig Type:	CME 55		Casing Internal Diameter:	4	in	Type of Hammer:	Auto	
			Casing Length:	66	in			

ASTM D-6391 – 11
PERMEABILITY COEFFICIENT (Km) FORMULA:

General Formula:

$$K_m = \pi R_t \times \frac{\left[D\left\{Ln\left(\frac{h_1}{h_2}\right)\right\}\right]}{11 \times (t_2 - t_1)}$$

Formula for 4" internal diameter casing (in/hr):

$$K_m = 1.142 R_t \times \frac{\left[Ln\left(\frac{h_1}{h_2}\right)\right]}{(t_2 - t_1)}$$

where:

$$R_t = {}^{2.2902(0.9842^T)}/_{T^{0.1702}}$$

PT-1 @ 4 ft

TEST 1

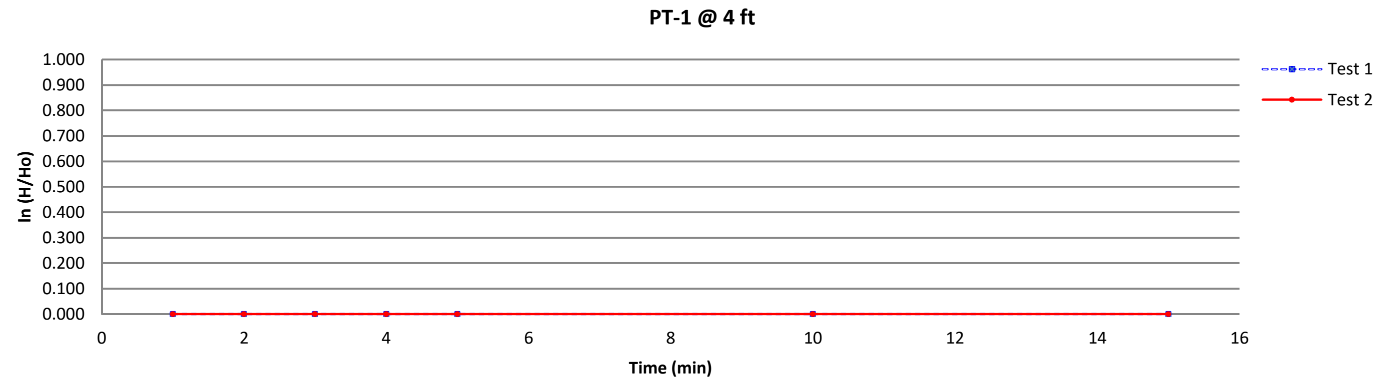
Water temperature (°C), T: Rt= -

FIELD DATA		CALCULATED DATA			
Time (min)	Depth (in)	Height (in)	Ln (H/Ho)	(t_1-t_2)	*Kv (in/hr)
1		66.000	0.000	0.017	-
2		66.000	0.000	0.017	-
3		66.000	0.000	0.017	-
4		66.000	0.000	0.017	-
5		66.000	0.000	0.017	-
10		66.000	0.000	0.083	-
15		66.000	0.000	0.083	-

TEST 2

Water temperature (°C), T: Rt= -

FIELD DATA		CALCULATED DATA			
Time (min)	Depth (in)	Height (in)	Ln (H/Ho)	(t_1-t_2)	*Kv (in/hr)
1		66.000	0.000	0.017	-
2		66.000	0.000	0.017	-
3		66.000	0.000	0.017	-
4		66.000	0.000	0.017	-
5		66.000	0.000	0.017	-
10		66.000	0.000	0.083	-
15		66.000	0.000	0.083	-



TEST 1 FINAL RESULTS

Time Weighted Average Permeability Coefficient **Km=** 0.0000 in/hr

TEST 2 FINAL RESULTS

Time Weighted Average Permeability Coefficient **Km=** 0.0000 in/hr

AVERAGE PT-1 @ 4 ft

Time Weighted Average Permeability Coefficient	**Km=**	0.0000	in/hr
		0.00E+00	ft/min

Inspectors Remarks:

No movement of water during 30-minute soak - PT cancelled at this depth.

DEFINITION OF VARIABLES

*Km= Mean permeability

T = Temperature of permeant (water), in °C

Ln = Natural Logarithmic

t1 = Time at the start of the test in the same units selected for Km

Rt = Ratio of viscosity of water at test temperature to the viscosity of water at 20°C

t2= Time at the end of the test in the units selected for Km

h1= Height of the water above the bottom of the casing at the start of the test in the same units selected for Km

h2= Height of the water above the bottom of the casing at the end of the test in the same units selected for Km

MATRIXNEWORLD
Engineering Progress

PT ID No. PT- 2
Sheet 1 of 1

Prepared for:	**BNE Real Estate Group**	PROJECT:	19-720 - Verona Site
		LOCATION:	South Edge of North Parking Lot (Boring B-4)

INSPECTOR:	Tim Pace	DRILLER:	Rob Dollar	Start Date:	9/16/2019	Weather:	70°F, Cloudy
CONTRACTOR:	Boring Brothers, Inc.	HELPER:	Matt	Start Time:	1:40 PM		
P.E./REP.:	Mike Soltys						

Depth of PT:	4 ft	Drill Bit Type:	Tri-Cone	Weight of Hammer for casing:	140 lbs
Rig Type:	CME 55	Casing Internal Diameter:	4 in	Type of Hammer:	Auto
		Casing Length:	66 in		

ASTM D-6391 – 11
PERMEABILITY COEFFICIENT (Km) FORMULA:

General Formula:

$$K_m = \pi R_t \times \frac{\left[D\left\{Ln\left(\frac{h_1}{h_2}\right)\right\}\right]}{11 \times (t_2 - t_1)}$$

Formula for 4" internal diameter casing (in/hr):

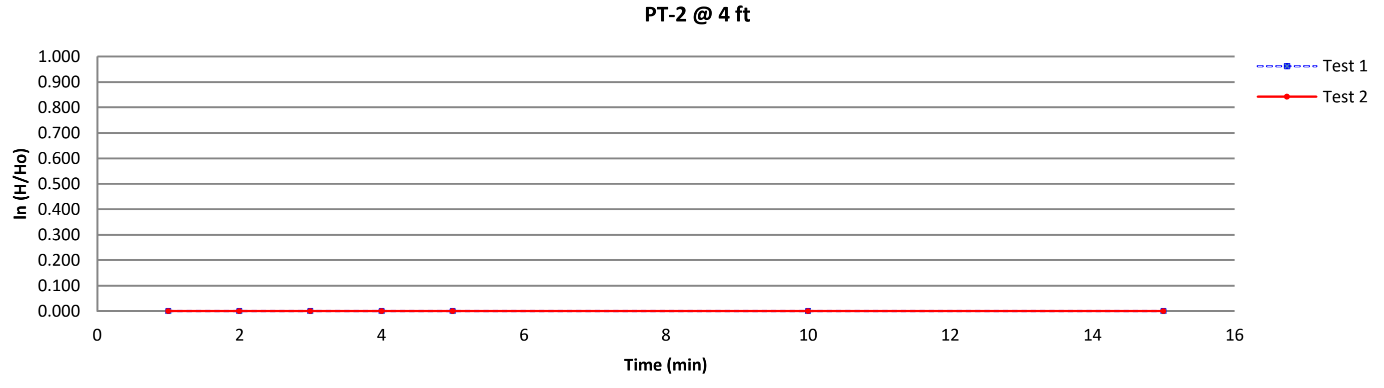
$$K_m = 1.142 R_t \times \frac{\left[Ln\left(\frac{h_1}{h_2}\right)\right]}{(t_2 - t_1)}$$

where:

$$R_t = {2.2902(0.9842^{T})}/{T^{0.1702}}$$

PT-2 @ 4 ft

TEST 1						TEST 2					
Water temperature (°C), T:	24.1		Rt=	0.91		Water temperature (°C), T:			Rt=	-	
FIELD DATA		CALCULATED DATA				FIELD DATA		CALCULATED DATA			
Time (min)	Depth (in)	Height (in)	Ln (H/Ho)	(t_1-t_2)	*Kv (in/hr)	Time (min)	Depth (in)	Height (in)	Ln (H/Ho)	(t_1-t_2)	*Kv (in/hr)
1	0.000	66.000	0.000	0.017	0.0000	1		66.000	0.000	0.017	-
2	0.000	66.000	0.000	0.017	0.0000	2		66.000	0.000	0.017	-
3	0.000	66.000	0.000	0.017	0.0000	3		66.000	0.000	0.017	-
4	0.000	66.000	0.000	0.017	0.0000	4		66.000	0.000	0.017	-
5	0.000	66.000	0.000	0.017	0.0000	5		66.000	0.000	0.017	-
10	0.000	66.000	0.000	0.083	0.0000	10		66.000	0.000	0.083	-
15	0.000	66.000	0.000	0.083	0.0000	15		66.000	0.000	0.083	-


PT-2 @ 4 ft

TEST 1 FINAL RESULTS			TEST 2 FINAL RESULTS		
Time Weighted Average Permeability Coefficient	**Km=**	0.0000 in/hr	Time Weighted Average Permeability Coefficient	**Km=**	0.0000 in/hr

AVERAGE	**PT-2 @ 4 ft**		
Time Weighted Average Permeability Coefficient	**Km=**	0.0000	in/hr
		0.00E+00	ft/min

Inspectors Remarks:

Test #2 cancelled - no water movement during Test #1.

DEFINITION OF VARIABLES
*Km= Mean permeability
T = Temperature of permeant (water), in °C
Ln = Natural Logarithmic
t1 = Time at the start of the test in the same units selected for Km
Rt = Ratio of viscosity of water at test temperature to the viscosity of water at 20°C
t2= Time at the end of the test in the units selected for Km
h1= Height of the water above the bottom of the casing at the start of the test in the same units selected for Km
h2= Height of the water above the bottom of the casing at the end of the test in the same units selected for Km

MATRIX**NEW**ORLD
Engineering Progress

TEST PIT LOG

TEST PIT NO.: **TP-1**

SHEET **1** OF **1**

PROJECT NO.: **19-720** PROJECT: **Verona Site** DATE: **10/5/2022**

PROJECT LOCATION: **Verona, New Jersey** ELEV.: TIME STARTED: **10:00:00 AM**

TEST PIT LOCATION: **West of Existing School Buidling** DATUM: TIME FINISHED: **10:30:00 AM**

CONTRACTOR: **Heritage Contracting Co.** GROUNDWATER LEVEL (IN): **Not Encountered**

EQUIPMENT: **CAT 308** OPERATOR: **T. Berking** INSPECTOR: **A. Radiola**

Depth Inches (Elev)	Sample No.	Depth Inches	Graphic Symbol	Description Of Material	Laboratory Tests
5 10 15 20				Brown mf SAND and Silt, little cf Gravel, wet (SM)	
25 30				Brown mf SAND, some Clay, trace cf Gravel, slight mottling, wet (SC)	
35 40 45 50 55 60 65 70				Brown mf SAND, some Silt, trace cf Gravel, wet (SM)	
				Bedrock at 6 feet bgs. Bottom of Test pit @ 72 in. Test Pit Backfilled.	

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TEST PIT LOG

TEST PIT NO.: **TP-2**

SHEET **1** OF **1**

PROJECT NO.: **19-720** PROJECT: **Verona Site** DATE: **10/5/2022**

PROJECT LOCATION: **Verona, New Jersey** ELEV.: TIME STARTED: **9:00:00 AM**

TEST PIT LOCATION: **West of Existing School Buidling** DATUM: TIME FINISHED: **9:30:00 AM**

CONTRACTOR: **Heritage Contracting Co.** GROUNDWATER LEVEL (IN): **Not Encountered**

EQUIPMENT: **CAT 308** OPERATOR: **T. Berking** INSPECTOR: **A. Radiola**

Depth Inches (Elev)	Sample No.	Depth Inches	Graphic Symbol	Description Of Material	Laboratory Tests
5 10 15 20 25 30 35			░	Brown mf SAND and Silt, little cf Gravel, wet (SM)	
40 45			▨	Brown CLAY, little mf Sand, trace cf Gravel, slight mottling, wet (CL)	
				Bedrock at 4 feet bgs. Bottom of Test pit @ 48 in. Test Pit Backfilled.	

TEST PIT NO.: **TP-2**

TEST PIT LOG

TEST PIT NO.: **TP-3**

SHEET **1** OF **1**

PROJECT NO.: **19-720** PROJECT: **Verona Site** DATE: **10/5/2022**

PROJECT LOCATION: **Verona, New Jersey** ELEV.: TIME STARTED: **10:30:00 AM**

TEST PIT LOCATION: **Southwest of Existing School Buidling** DATUM: TIME FINISHED: **11:00:00 AM**

CONTRACTOR: **Heritage Contracting Co.** GROUNDWATER LEVEL (IN): **72**

EQUIPMENT: **CAT 308** OPERATOR: **T. Berking** INSPECTOR: **A. Radiola**

Depth Inches (Elev)	Sample No.	Depth Inches	Graphic Symbol	Description Of Material	Laboratory Tests
5 10			░	Brown mf SAND and Silt, little cf Gravel, wet (SM)	
15			▨	Brown mf SAND, some Clay, trace cf Gravel, wet (SC)	
20 25 30 35 40 45 50 55 60 65 70			░	Brown mf SAND and Silt, little cf Gravel, slight mottling, wet (SM)	
▼				Bedrock at 6 feet bgs. Bottom of Test pit @ 72 in. Test Pit Backfilled.	

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Engineering Progress

TEST PIT LOG

TEST PIT NO.: **TP-4**

SHEET **1** OF **1**

PROJECT NO.: **19-720** PROJECT: **Verona Site** DATE: **10/5/2022**

PROJECT LOCATION: **Verona, New Jersey** ELEV.: DATUM:

TEST PIT LOCATION: **Southwest of Existing School Buidling**

TIME STARTED: **1:30:00 PM**

TIME FINISHED: **2:15:00 PM**

CONTRACTOR: **Heritage Contracting Co.** GROUNDWATER LEVEL (IN): **Not Encountered**

EQUIPMENT: **CAT 308** OPERATOR: **T. Berking** INSPECTOR: **A. Radiola**

Depth Inches (Elev)	Sample No.	Depth Inches	Graphic Symbol	Description Of Material	Laboratory Tests
5 10 15 20 25 30 35 40 45 50 55 60			░	Brown mf SAND and Silt, little cf Gravel, precipitation seeping from multiple depths, slight mottling, wet (SM)	
65 70 75 80 85 90 95			▨	Dark Brown mf SAND and CLAY, little cf Gravel, slight mottling, wet (SC)	
100			░	Brown mf SAND and Silt, little cf Gravel, wet (SM)	
				Bedrock at 8.5 feet bgs. Bottom of Test pit @ 102 in. Test Pit Backfilled.	

TEST PIT NO.: **TP-4**

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TEST PIT LOG

TEST PIT NO.: **TP-5**

SHEET **1** OF **1**

PROJECT NO.: **19-720** PROJECT: **Verona Site** DATE: **10/5/2022**

PROJECT LOCATION: **Verona, New Jersey** ELEV.: TIME STARTED: **2:45:00 PM**

TEST PIT LOCATION: **East of Afterglow Avenue** DATUM: TIME FINISHED: **3:00:00 PM**

CONTRACTOR: **Heritage Contracting Co.** GROUNDWATER LEVEL (IN): **Not Encountered**

EQUIPMENT: **CAT 308** OPERATOR: **T. Berking** INSPECTOR: **A. Radiola**

Depth Inches (Elev)	Sample No.	Depth Inches	Graphic Symbol	Description Of Material	Laboratory Tests
5 10 15 20 25 30 35 40 45 50 55 60			░	Brown mf SAND and Silt, little cf Gravel, slight mottling, wet (SM)	
				Bedrock at 5 feet bgs. Bottom of Test pit @ 60 in. Test Pit Backfilled.	

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Engineering Progress

TEST PIT LOG

TEST PIT NO.: **TP-6**

SHEET **1** OF **1**

PROJECT NO.: **19-720** PROJECT: **Verona Site** DATE: **10/5/2022**

PROJECT LOCATION: **Verona, New Jersey** ELEV.: DATUM: TIME STARTED: **3:00:00 PM**

TEST PIT LOCATION: **East of Afterglow Avenue** TIME FINISHED: **3:30:00 PM**

CONTRACTOR: **Heritage Contracting Co.** GROUNDWATER LEVEL (IN): **72**

EQUIPMENT: **CAT 308** OPERATOR: **T. Berking** INSPECTOR: **A. Radiola**

Depth Inches (Elev)	Sample No.	Depth Inches	Graphic Symbol	Description Of Material	Laboratory Tests
5 10 15 20 25 30 35 40			░	Brown mf SAND and Silt, little cf Gravel, slight precipitation seepage, mottling, wet (SM)	
45 50 55 60 65 70 ▼ 75 80 85 90 95 100 105 110 115 120			▨	Brown mf SAND and Silt, little Clay, little cf Gravel, precipitation seepage, slight mottling, wet (SM)	
125 130 135 140			░	Brown mf SAND and Silt, little cf Gravel, wet (SM)	
				Bedrock at 12 feet bgs. Bottom of Test pit @ 144 in. Test Pit Backfilled.	

TEST PIT NO.: **TP-6**

MATRIX**NEW**ORLD
Engineering Progress

TEST PIT LOG

TEST PIT NO.: **TP-7**

SHEET **1** OF **1**

PROJECT NO.: **19-720** PROJECT: **Verona Site** DATE: **10/6/2022**

PROJECT LOCATION: **Verona, New Jersey** ELEV.: TIME STARTED: **9:30:00 AM**

TEST PIT LOCATION: **Northern Parking Lot** DATUM: TIME FINISHED: **10:00:00 AM**

CONTRACTOR: **Heritage Contracting Co.** GROUNDWATER LEVEL (IN): **24**

EQUIPMENT: **CAT 308** OPERATOR: **T. Berking** INSPECTOR: **A. Radiola**

Depth Inches (Elev)	Sample No.	Depth Inches	Graphic Symbol	Description Of Material	Laboratory Tests
5			■	Asphalt	
10			▩	Grey cf GRAVEL	
15 20 ▼ 25 30 35			▨	Brown mf SAND and CLAY, little cf Gravel, mottiling, wet (SC)	
40 45 50 55 60 65 70			░	Brown mf SAND and Silt, little cf Gravel, precipitation seeping, slight mottling, wet (SM)	
				Bedrock at 6 feet bgs. Bottom of Test pit @ 72 in. Test Pit Backfilled.	

TEST PIT LOG

TEST PIT NO.: **TP-8**

SHEET **1** OF **1**

PROJECT NO.: **19-720** PROJECT: **Verona Site** DATE: **10/6/2022**

PROJECT LOCATION: **Verona, New Jersey** ELEV.: TIME STARTED: **11:00:00 AM**

TEST PIT LOCATION: **West of Fenced in Field** DATUM: TIME FINISHED: **11:30:00 AM**

CONTRACTOR: **Heritage Contracting Co.** GROUNDWATER LEVEL (IN): **42**

EQUIPMENT: **CAT 308** OPERATOR: **T. Berking** INSPECTOR: **A. Radiola**

Depth Inches (Elev)	Sample No.	Depth Inches	Graphic Symbol	Description Of Material	Laboratory Tests
5			■	Asphalt	
10			▩	Grey cf GRAVEL	
15			⁙	Brown mf SAND and Silt, little cf Gravel, slight precipitation seepage, wet (SM)	
20 25 30 35 40 ▼			▨	Brown/Grey CLAY, some mf Sand, little cf Gravel, slight mottling, wet (CL)	
45 50 55			⁙	Brown mf SAND and Silt, little cf Gravel, slight precipitation seepage, wet (SM)	
				Bottom of Test pit @ 57 in. Test Pit Backfilled.	

MATRIXNEWORLD
Engineering Progress

TEST PIT LOG

TEST PIT NO.: **TP-9**

SHEET **1** OF **1**

PROJECT NO.: **19-720** PROJECT: **Verona Site** DATE: **10/5/2022**

PROJECT LOCATION: **Verona, New Jersey** ELEV.: TIME STARTED: **11:30:00 AM**

TEST PIT LOCATION: **Inside Fenced in Field** DATUM: TIME FINISHED: **12:00:00 PM**

CONTRACTOR: **Heritage Contracting Co.** GROUNDWATER LEVEL (IN): **72**

EQUIPMENT: **CAT 308** OPERATOR: **T. Berking** INSPECTOR: **A. Radiola**

Depth Inches (Elev)	Sample No.	Depth Inches	Graphic Symbol	Description Of Material	Laboratory Tests
5 10 15 20 25 30 35			▩	Brown mf SAND and Silt, little cf Gravel, trace debris, wet (SM)	
40 45 50 55 60 65 70 ▼ 75 80			⁘	Brown mf SAND and Silt, little cf Gravel, slight mottling, wet (SM)	
				Bedrock at 7 feet bgs. Bottom of Test pit @ 84 in. Test Pit Backfilled.	

MATRIXNEWORLD
Engineering Progress

TEST PIT LOG

TEST PIT NO.: **TP-10**

SHEET **1** OF **1**

PROJECT NO.: **19-720** PROJECT: **Verona Site** DATE: **10/5/2022**

PROJECT LOCATION: **Verona, New Jersey** ELEV.: TIME STARTED: **12:30:00 PM**

TEST PIT LOCATION: **Northern Parking Lot** DATUM: TIME FINISHED: **1:00:00 AM**

CONTRACTOR: **Heritage Contracting Co.** GROUNDWATER LEVEL (IN): **54**

EQUIPMENT: **CAT 308** OPERATOR: **T. Berking** INSPECTOR: **A. Radiola**

Depth Inches (Elev)	Sample No.	Depth Inches	Graphic Symbol	Description Of Material	Laboratory Tests
5 10 15 20 25 30 35 40 45 50			▨	Brown mf SAND and Silt, little cf Gravel, precipitation leaking from multiple depths, slight mottling, wet (SM)	
▼				Bedrock at 4.5 feet bgs. Bottom of Test pit @ 54 in. Test Pit Backfilled.	

APPENDIX D

GEOTECHNICAL LABORATORY TESTING RESULTS

Matrix New World #19-720
Verona Site (BNE Real Estate Group)
LABORATORY SOIL TESTING DATA SUMMARY

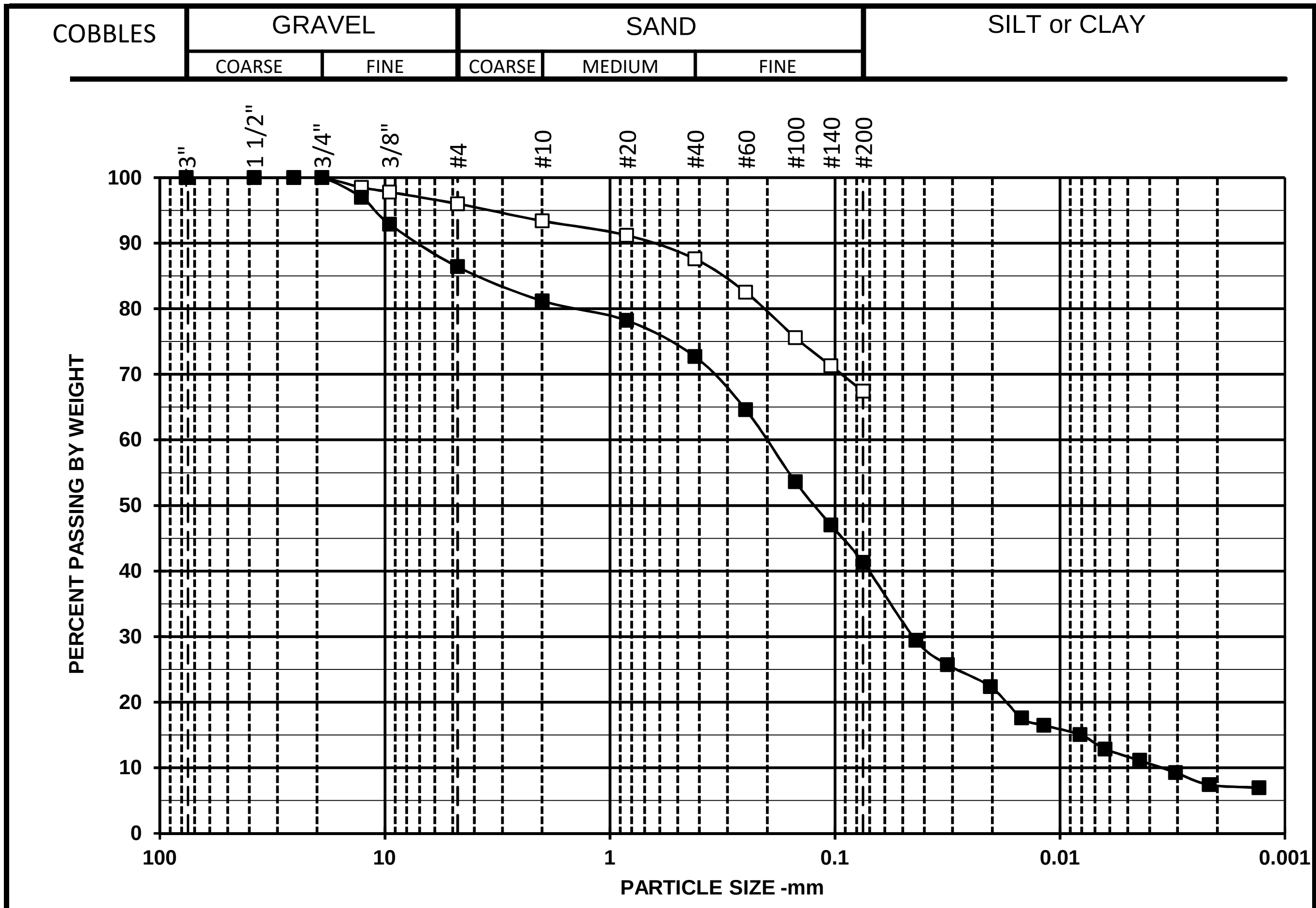
BORING	SAMPLE	DEPTH	IDENTIFICATION TESTS							REMARKS
NO.	NO.	(ft)	WATER CONTENT (%)	LIQUID LIMIT (-)	PLASTIC LIMIT (-)	PLAS. INDEX (-)	USCS SYMB. (1)	SIEVE MINUS NO. 200 (%)	HYDRO. % MINUS 2 μm (%)	
B-1	S-2	2-4	18.0				CL	67.4		
B-1	S-3	4-6	13.9	25	15	10	SC			
B-1	S-7	15-17	13.1	19	11	8	SC	32.5		
B-2	S-2	2-4	13.0				SM	37.6		
B-2	S-4	6-8	12.1	21	14	7	SC-SM	38.5		
B-3	S-1	0-2	14.9				SM	41.3	7	

Note: (1) USCS symbol based on visual observation and Sieve and Atterberg limits reported.

Prepared by: NG
Reviewed by: GET
Date: 10/2/2019

TerraSense, LLC
45H Commerce Way
Totowa, NJ 07512

Project No.: 7783-19028
File: Indx28.xlsx



Symbol	□	■	○
Boring	B-1	B-3	
Sample	S-2	S-1	
Depth	2-4	0-2	
% +3"	0.0	0.0	
% Gravel	4.0	13.6	
% SAND	28.6	45.1	
%C SAND	2.6	5.2	
%M SAND	5.8	8.5	
%F SAND	20.2	31.4	
% FINES	67.4	41.3	
D_{100} (mm)	19.050	19.050	
D_{60} (mm)		0.201	
D_{30} (mm)		0.045	
D_{10} (mm)		0.004	
Cc		2.800	
Cu		56.8	

Sieve Size/ID #	Percent Finer Data		
6"	100.0	100.0	
4"	100.0	100.0	
3"	100.0	100.0	
1 1/2"	100.0	100.0	
1"	100.0	100.0	
3/4"	100.0	100.0	
1/2"	98.5	97.0	
3/8"	97.8	92.9	
#4	96.0	86.4	
#10	93.4	81.2	
#20	91.2	78.2	
#40	87.6	72.7	
#60	82.5	64.6	
#100	75.6	53.6	
#140	71.3	47.0	
#200	67.4	41.3	
5µ m		12	
2µ m		7	
1µ m		7	

SYMBOL	w (%)	LL	PL	PI	USCS	AASHTO	USCS DESCRIPTION AND REMARKS	DATE
□	18.0				CL		Brown, Sandy lean clay	09/19/19
■	14.9				SM		Brown, Silty sand shale & roots noted	09/19/19
○								

Matrix New World #19-720

TerraSense, LLC #7783-19028

Verona Site (BNE Real Estate Group)

PARTICLE SIZE DISTRIBUTION
ASTM D6913 & ASTM D7928

TerraSense Analysis File: GrainSizeV5Rev1 (5/19)

Siev28a.xlsx 10/2/2019

Matrix New World
Verona Site (BNE Real Estate Group)
SUMMARY OF ROCK TESTING

SAMPLE IDENTIFICATION			STATE PROPERTIES			ENGINEERING PROPERTY TESTS				REMARKS
Boring	Run	Depth	WATER CONTENT (1) (%)	TOTAL UNIT WGT. (pcf)	DRY UNIT WGT. (pcf)	TEST TYPE (2)	UNCONFINED COMPRESSION TESTS (ASTM D7012)			
							COMPRESSIVE STRENGTH (psi)	AXIAL STRAIN @ FAILURE (%)	ESTIMATED (5) ELASTIC MODULUS (psi)	
B-2	R-1	10.4-10.8	0.8	181	180	UC	22170	0.38	6E+06	
B-5	R-1	5.1-5.5	0.9	182	180	UC	13760	0.15	9E+06	

Notes: (1) Water contents determined after trimming and shearing.

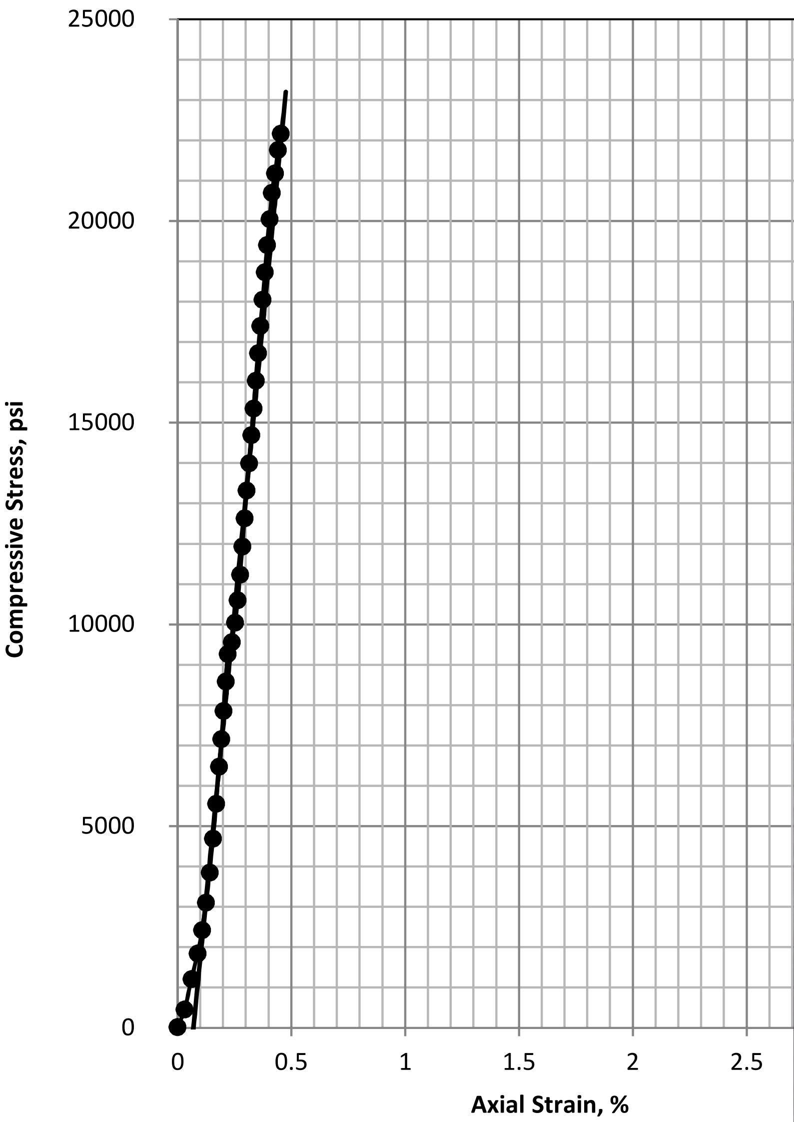
(2) Test Type Abbreviations: UC: Unconfined Compression test with estimated elastic moduli determination

(5) Modulus estimated based on corrected gross deformations.

Prepared by: DM
Reviewed by: GET
Date: 10/2/2019

TerraSense, LLC
45H Commerce Way
Totowa, NJ 07512

Project No.: 7783-19028
File: RockSummary.xlsx



Specimen Information

Water Content (%)	Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Length (inch)	Diameter (inch)
0.79	181	180	4.350	1.970

Specimen meets ASTM D4543 shape tolerances

FAILURE PHOTO

Test Summary

Strain Rate (%/min)	Corrected Strain Strain to Peak (%)	q_u (psi)	Estimated (shown) Elastic Modulus (psi)
0.11	0.38	22170	6E+06

Test by: DM
Test Date: Sep-26-19

Reviewed by: GET

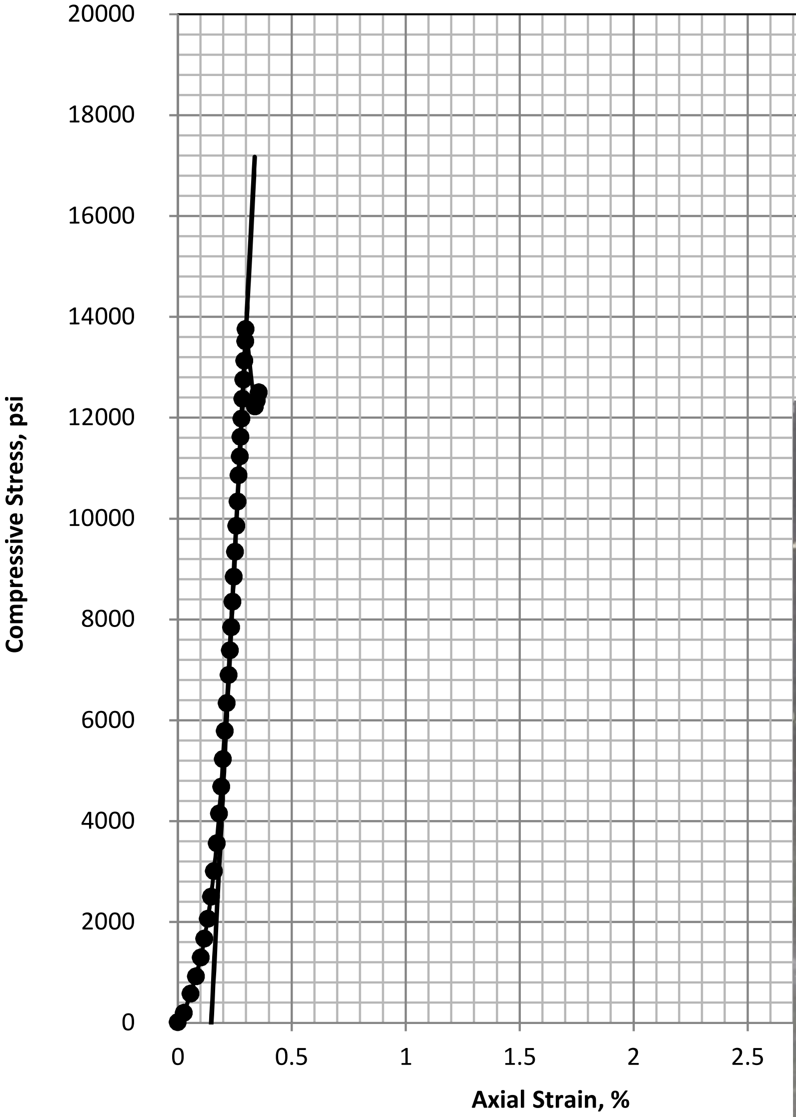
Matrix New World
Project # 19-720

TerraSense, LLC
Project # 7783-19028

Verona Site (BNE Real Estate Group)

COMPRESSIVE STRESS VS STRAIN UNCONFINED COMPRESSIVE STRENGTH TEST

Boring: B-2 Run: R-1
Depth 10.4-10.8 ft.



FAILURE PHOTO

Specimen Information

Water Content (%)	Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Length (inch)	Diameter (inch)
0.90	182	180	4.520	1.972

Specimen meets ASTM D4543 shape tolerances

Test Summary

Strain Rate (%/min)	Corrected Strain Strain to Peak (%)	q_u (psi)	Estimated (shown) Elastic Modulus (psi)
0.08	0.15	13760	9E+06

Test by: DM
Test Date: Sep-26-19
Reviewed by: GET

Matrix New World **Project # 19-720**	**Verona Site (BNE Real Estate Group)**	**COMPRESSIVE STRESS VS STRAIN UNCONFINED COMPRESSIVE STRENGTH TEST**
TerraSense, LLC **Project # 7783-19028**		**Boring: B-5 Run: R-1** **Depth 5.1-5.5 ft.**

APPENDIX E

GROUNDWATER ASSESSMENT

Matrix New World Engineering, Land Surveying
and Landscape Architecture, PC
442 State Route 35, 2^{nd} Floor
Eatontown, NJ 07724
732.588.2999 F: 973.240.1818
www.mnwe.com Certified WBE

MATRIXNEWORLD
Engineering Progress

MEMORANDUM

TO:	Ashley Neale, Board Secretary	**DATE**:	June 21, 2023
FROM:	Richard Britton P.G., LSRP	**PROJECT NO.**:	19-720
SUBJECT:	Groundwater Memo	**PROJECT NAME:**	1 Sunset Avenue

This memo has been prepared to address comments in the Township of Verona Engineer's review letter dated June 6, 2023 and emailed comments on June 21, 2023 concerning the geotechnical report and indications of groundwater and seasonal high water level as evidenced by mottling. Matrix reviewed the findings of the geotechnical report and in particular those test pits or borings in which ground water or mottling were found. Based upon this review, it is our position that the ground water and mottling encountered are not the result of the true groundwater level but instead represent a temporary perched water condition. The following is an explanation of the above finding.

Based on my years of experience I would not expect a true water table to occur atop a rocky ridge (the First Watchung Mountain, aka Orange Mountain Basalt) with a thin overburden cover. In the specific setting of the Site (1 Sunset Avenue), the water table would be expected to occur at lower elevations in the valley formed between the First and Second Watchung Mountains (aka Preakness Basalt). Verona Lake and the Peckman River occur in this valley and the true water table in the valley discharges to and sustains these surface water bodies.

The elevation of the Site ranges from 520 to 570 feet above mean sea level (msl). The elevation of a tributary to the Peckman River that is closest to the Site occurs at approximately 440 feet above msl. This 100+ foot elevation difference is another reason to not to anticipate a true water table at the Site.

The observation of soil mottling in some test pits excavated on October 5, 2022, and October 6, 2022, is likely due to occasional and temporary saturated conditions that occur after heavy rainfall events.

Rainfall infiltrates unpaved/permeable areas of the Site, but there is a delay in the underlying bedrock accepting the rainfall due to its lower permeability which results in periodic and temporary saturated conditions. After a short period of time without rain, infiltrated rainwater has time to dissipate downward into the underlying bedrock leaving the thin overburden materials unsaturated again.

This differential recharge dynamic between overburden and bedrock was magnified by the unusually heavy rainfall received the day prior to, and during the test pit excavations, as illustrated by the rainfall data presented below.

Date	Range of Rainfall Reported in Essex County (inches)	Test Pits Excavated
October 4, 2022	1.45 to 2.38	No test pits excavated

October 5, 2022	0.5 to 0.8	TP-1 though TP-6 and TP-9, TP-10
October 6, 2022	0.16 to 0.53	TP-7, TP-8
Three Day Rainfall Total	**2.11 to 3.71**	

In my opinion, it is the unusually heavy rainfall that caused the observed saturated conditions on October 5th and 6th, 2022 in some test pits. I believe this condition to be transient and I would expect that overburden materials are unsaturated most of the time.