# G GZA Preliminary Geotechnical Report

*Proactive by Design*

GEOTECHNICAL
ENVIRONMENTAL
ECOLOGICAL
WATER
CONSTRUCTION MANAGEMENT

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March 18, 2016
GZA Project No.: 41.0162403.10

Mr. Michael W. Junghans
VHB
50 Main Street, Suite 360
White Plains, NY 10606

Re: Preliminary Geotechnical Engineering Report
Hampshire Country Club
1025 Cove Road
Mamaroneck, New York

Dear Mr. Junghans:

GZA GeoEnvironmental of New York (GZA) is pleased to submit this preliminary geotechnical report for the proposed development at Hampshire Country Club at 1025 Cove Road, Mamaroneck, New York. Our objective was to evaluate the general subsurface conditions and to provide preliminary geotechnical design and construction recommendations for this project.

Our scope of services consisted of the observation and documentation of six (6) test borings performed by GZA's subcontractor, research of readily available subsurface data in the project vicinity, geotechnical analyses, and preparation of this report summarizing our observations and preliminary geotechnical recommendations.

Our services were performed in accordance with our revised proposal number 41.P000345.16R2, dated February 2, 2016, executed by you on February 3, 2016, and are subject to the terms of our proposal and the limitations presented in Appendix A.

## PROJECT BACKGROUND

The site has an area of approximately 105 acres and is currently occupied by a country club consisting of two single story buildings, five tennis courts and a golf course with six ponds occupying the remainder of the site. The site is bounded by Delancey Cove to the south and residential neighborhoods to the north, west, and east. The site location plan is shown on Figure 1.

The Existing Conditions Plan, provided by you and dated September 8, 2014, indicates that the elevation of the ground surface at the site ranges from approximately -0.4 to 27.6 feet (NAVD, 1988).

We understand that the proposed conceptual site plan consists of the development of 105 units to include single family homes and town homes, roadways, utilities, detention ponds, and recreational facilities. It is also our understanding that certain areas of the proposed site grades will be raised by up to 10 feet from existing grade and the total building footprint will be approximately 500,000 square feet. Proposed structural loads have not yet been provided to us.

## FLOOD ELEVATION

According to the preliminary flood insurance rate maps (FIRM) released by Federal Emergency Management Agency (FEMA) on September 28, 2007, the base flood elevation (BFE) at the site is El. 12 (NAVD88), which is approximately 12 and 16 feet below and above existing site grades, respectively.

Because of the proximity to Delancey Cove, the majority of the site is located in Zone AE, which is a Special Flood Hazard Area as established by the FEMA flood maps for the Village of Mamaroneck. This designation means that certain areas of the site is subject to inundation by the 1-percent-annual-chance flood event (100-year flood event).

## SUBSURFACE EXPLORATION

Six (6) test borings (GZ-1 through GZ-6) were drilled by Soil Testing, Inc. of Oxford, Connecticut, between February 29 and March 1, 2016 using hallow-stem auger drilling techniques. The test borings were logged by a GZA field observer and the locations were tape-measured from existing site features. Refer to Figure 2 for the measured locations of the GZA test borings.

The GZA borings were performed throughout the golf course portion of the site using an ATV-mounted drill rig. The borings extended to depths ranging from 3 to 17.5 feet below ground surface. A 17-foot-deep groundwater observation well was installed in boring GZ-4. Upon completion, borings GZ-1, 2, 3, 5, and 6 were backfilled with soil cuttings.

Standard Penetration Test (SPT) samples were collected continuously within the top 12 feet and at five-foot intervals thereafter in general accordance with ASTM D-1586. A 140-pound safety hammer was used to drive the split spoon sampler through a distance of 24 inches for each SPT sample. The number of blows required to drive the split spoon sampler from 6 to 18 inches is the SPT N-value, a commonly used indicator of soil density and consistency.

Soil samples collected from the split spoons were described in accordance with a modified Burmister soil classification system. The description of each soil sample was based on visual identification. The SPT N-values at various depths are recorded on the boring logs. The test boring logs are included in Appendix B. Refer to the Log Key in Appendix B for definitions of symbols and terms used in our test boring logs.

After practical split-spoon refusal[1] in boring GZ-2, rock coring was performed using a nominal 2-inch diameter double tube rock core barrel. The recovered rock core was described using a modified International Society for Rock Mechanics (ISRM) system. Recovery, Rock Quality Designation (RQD), and joints/fractures were recorded on the boring logs, included in Appendix B. The recovered rock core was placed in a wooden core box and photographed at the site. The rock core photographs are included in Appendix C.

Four soil samples were sent to Thielsch Engineering, LLC of Cranston, Rhode Island for grain size distribution testing (ASTM D-422) and Atterberg Limit testing (ASTM D-4318). Laboratory test results are included in Appendix D and incorporated in the logs.

## SUBSURFACE CONDITIONS

Based on the results of our subsurface exploration program, the subsurface conditions at the site generally consist of the following, in order of increasing depth:

- SURFACE COVER – A one-inch thick gravel layer was observed at the ground surface in boring GZ-1. A four-inch thick topsoil/sod layer was observed at the ground surface in borings GZ-2 through GZ-6.

[1] Practical split-spoon refusal was considered when split-spoon advancement of less than 6-inches was achieved with greater than 50 blows of the 140-pound hammer.

- FILL – Fill, consisting of gray/tan, fine to coarse sand, with up to 20 percent gravel, up to 10 percent silt, and occasional asphalt pavement fragments, was encountered in test boring GZ-1 to a depth of approximately 2 feet below ground surface. The Fill was medium dense in consistency with a measured SPT N-value of 27 blows per foot (bpf). Fill was not encountered in any other test borings.

  SILT AND CLAY – A Silt and Clay stratum, consisting of gray, silt and clay, with up to 35 percent fine sand and up to 20 percent gravel, was encountered in test borings GZ-3, GZ-4, and GZ-5 immediately below the surface cover to depths ranging between 2 and 4 feet below ground surface. The Unified Soil Classification System (USCS) symbol for this stratum is CL-ML. The Silt and Clay stratum was found to be medium still to hard in consistency with measured SPT N-values ranging between 5 and 37 bpf. The average measured SPT N-value in the Silt and Clay stratum was approximately 13 bpf.
- SAND – A Sand stratum, consisting of gray/brown, fine to coarse sand, with up to 50 percent silt and up to 30 percent gravel, was encountered in each test boring below the Surface Cover, Fill, or Silt and Clay layers to depths ranging from 3 to 17.5 feet below ground surface. The Sand stratum extended to the top of bedrock in each exploration. The USCS symbol for this stratum is SM, SM-ML. The Sand stratum was found to be loose to very dense in consistency with measured SPT N-values ranging between 5 bpf and refusal. The average measured SPT N-value in the Sand stratum was approximately 41 bpf.

- BEDROCK – Refusal (presumed to be top of bedrock) was encountered at all of the test borings at depths ranging from 3 to 17.5 feet below existing ground surface. Rock was cored at boring location GZ-2. The bedrock encountered consisted of slightly fractured, moderately weathered Gneiss. Recovery was 70% and the RQD was 47%.

Groundwater: A groundwater observation well was installed in boring GZ-4 on March 1, 2016 to a depth of approximately 17 feet below ground surface. The measured depth to groundwater at the monitoring well ranged between approximately 1.4 and 0.5 feet below ground surface (El. 0.7 and 1.6; NAVD 1988). It should be noted that changes in groundwater levels will occur due to variations in seasonal influences, tidal fluctuations, precipitation amounts, local pumping, utility leakage, and other factors different from those existing at the time the observations were made.

Based on the results of our environmental exploration (to be submitted under a separate cover) and previous exploration at the project site by East Coast Geoservices, LLC, (boring logs dated March 29, 2012), a fibrous peat layer was encountered to a depth of up to 5 feet below ground surface in several areas throughout the site.

## PRELIMINARY GEOTECHNICAL RECOMMENDATIONS

### Foundation Recommendations

Based on the subsurface conditions encountered during the preliminary subsurface exploration program, mat, spread or strip footings bearing in Silt and Clay, Sand, newly placed Structural Fill, or on Bedrock are recommended to support the proposed development. Top soil, fill and fibrous peat are not approved for bearing material.

In an unimproved state, it is recommended that the following properties of subsurface materials be used for preliminary design purposes:

| *Soil or Rock Stratum* | *Total Unit Weight* | *Friction Angle* | *Allowable Bearing Capacity* |
|---|---|---|---|
| SILT and CLAY | 115 pcf | NA | 1.5 tsf |
| Sand or Structural Fill[1] | 125 pcf | 32° | 3 tsf |
| Bedrock | 145 pcf | NA | 10 tsf |

Notes: pcf= pounds per cubic foot; tsf= tons per square foot, NA= Not Applicable
[1] See Table 1 for Structural (Granular) Fill gradation criteria

Foundations should be designed in accordance with the latest NYSBC utilizing the design soil parameters defined above and providing that the subgrade is prepared as described in this report. The recommended allowable bearing capacity for Silt and Clay, Sand or Structural Fill shown above are for footings with a minimum dimension of 2 feet. For continuous wall footings supported on soil, the minimum dimension is 18 inches. For isolated wall footings supported on soil, the minimum dimension is 24 inches. For footings supported on Bedrock, continuous wall footings should be at least 12 inches wide and isolated footings should be at least 18 inches wide. The allowable bearing pressure for foundations smaller than 2 feet in least lateral dimension should be reduced to one third of the recommended value multiplied by the least lateral dimension, in feet.

Isolated footings should bear entirely on soil or rock. We recommend a transition zone be provided for continuous footings where subgrade changes from natural soil or Structural Fill to Bedrock. The transition zone should be constructed by excavating bedrock 12 inches below the bottom of footing at the change in bearing material. Taper this Bedrock excavation to 6 inches below the footing at 10 feet from the subgrade change and backfill with compacted Structural Fill or Crushed Stone. Alternatively, provide a vertical construction joint in the foundation and building wall at the location of the subgrade change or provide additional reinforcement in the footing at the change in bearing material to accommodate potential differential settlement.

For frost protection, all new footings shall bear at or below a depth of 3.5 feet below the lowest adjacent exposed ground surface.

The recommended coefficient of friction for sliding resistance between concrete footings and natural soils or structural fill is 0.4. The recommended coefficient of friction between concrete and rock is 0.7.

**Base Flood Elevation**

Based on our understanding of the proposed development, we recommend a design flood elevation (DFE) of El. 13 (NAVD88), or 1 foot above the base flood elevation in accordance with the requirements of the NYSBC. We recommend waterproofing of the cellar to protect against water intrusion from localized flooding due to weather conditions or utility ruptures.

**Foundation Settlement**

For shallow foundations, immediate (elastic) settlement may occur as loads are applied, but is not expected to exceed 1 inch where the subgrade is prepared in accordance with the recommendations of this report. The majority of this elastic settlement will occur during construction and at footing transition zones, post-construction differential settlement between footings is anticipated to be approximately ½ inch.

**Seismic Design Parameters**

Based on the soil types encountered and in accordance with the NYSBC, we recommend adopting a Site Class D for calculation of seismic loading and the corresponding response spectrum as defined in the Code. Based on the soil types encountered, we do not anticipate that the likelihood of soil liquefaction due to a seismic event will be relevant to the design of this structure.

Based on the results of our preliminary subgrade investigation, we recommend the following seismic design parameters be used for design:

- Site Class D
- Maximum considered spectral response acceleration at short period, $S_S$=0.271g and at 1-second, $S_1$=0.071g
- The maximum considered spectral response acceleration parameters can be adjusted for site class effects using site class coefficients $F_a$=1.60 and $F_v$=2.4

**Slab Recommendations**

We recommend slabs-on-grade for building interiors following removal of unsuitable soils and proper preparation of subgrade. A 6-inch-thick base course consisting of compacted Sand-Gravel should be provided below the slab. Recommended fill gradations are presented in Table 1. We recommend installing a water/moisture barrier below the proposed slabs. Slabs-on-grade bearing on compacted Sand-Gravel may be designed assuming a modulus of subgrade reaction of 120 pounds per cubic inch (pci).

We recommend adherence to the guidelines presented in ACI 302.1R04 to limit the migration of moisture into occupied building space.

**PRELIMINARY CONSTRUCTION RECOMMENDATIONS**

**Site and Subgrade Preparation**

After deconstruction of existing structures, existing surface cover, topsoil, fill material, existing utilities, and unsuitable load-bearing soils should be removed from areas beneath footings and within the footing influence area, which is defined as the area within the lines made by a 45 degree angle extending outward and downward from each footing bottom edge. All excavations should be backfilled with approved on-site soil or imported granular (structural) fill and compacted in accordance with the recommendations provided in Table 2 of this report.

Where foundations will be supported directly on the undisturbed, Silt and Clay or Sand, the final six inches of excavation should be performed with a smooth-edged blade attached to the bucket of the excavator, or by hand-shoveling any loose disturbed material over the bearing layer.

Where foundations will be supported directly on bedrock, rock excavation should be planned to reduce disturbance to the foundation subgrade and final rock removal should be performed by mechanical methods. Any disturbed or loose rock fragments must be removed from the final subgrade.

The subgrade should be proof-rolled to a stable and firm consistency with a minimum of four passes of a vibratory walk behind, double-drum roller. Areas of unstable ground observed during proof-rolling should be over-excavated until the exposed ground is stable and firm. The over-excavated soils should be replaced with compacted structural fill. Subgrades should be protected from frost and fill should not be placed over frozen soil.

The slab base course subgrade should be adequately compacted using several passes of a vibratory smooth-drum roller and should be free of debris, standing water, and ice. The slab and foundation subgrades should be protected in their as-approved condition until concrete pour.

**Pavement Subgrade Preparation**

Existing asphalt pavement where present below the new proposed pavement should be removed. Existing utilities and structures within 3 feet of bottom of pavement subgrade should be completely removed. Deeper utilities within the proposed pavement areas can be either removed or abandoned in-place by filling with cement grout or flowable fill. Any weak or soft soil identified during proof-compaction should be excavated and replaced with compacted granular fill and proof-rolled as described below.

**Fill Material and Compaction**

Compacted structural fill placed below the foundations and floor slab should consist of Granular or Sand-Gravel fill meeting the gradations outlined in Table 1. The fill should be compacted to at least 95 percent of its maximum dry density, as measured by the Modified Proctor Test (ASTM D-1557). The recommended maximum loose lift thickness of fill and minimum number of passes of compaction equipment are given in Table 2.

**Temporary Groundwater Control**

Groundwater may be encountered during subgrade preparation or temporary foundation excavation, and water from various sources may accumulate in excavations. The Contractor should be prepared to evacuate water with submersible pumps in a manner that will not destabilize the surrounding soil. Off-site discharge of groundwater and surface water must be according to local, state and federal regulations, and may require special permits.

**Bedrock Excavation**

Bedrock is present at or near the ground surface at some areas of the project site (top of presumed rock was encountered at depth of 3 feet below existing ground surface in boring GZ-06). Bedrock excavation for the proposed construction may be required and may entail extensive mechanical excavation with hydraulic hoe-ram/breakers, bulldozers, and/or rock drilling/splitting/blasting. The method of excavation is typically a function of the Contractor's ability, preference, and cost analysis.

Mechanical chipping will impart a significant amount of low frequency vibrations into the ground which will be transmitted to neighboring structures, as it is probable that they are also founded directly on the bedrock. The imparted energy will be attenuated over the distance to neighboring structures and it is not likely that the work would be structurally damaging. However, the vibration threshold of human perception is much lower than that of potential structural damage.

The use of explosives is often less problematic with regards to vibrations when performed properly due to the high frequency of the blast. However, blasting often encounters resistance by the local community. Chemical splitting is the most expensive option, requires extensive rock drilling as does blasting, but it minimally intrusive in terms of vibrations.

**Utilities**

Underground pipes and utilities should be placed on bedding in accordance with the manufacturer's specifications. Granular fill should be placed in lifts on the sides and above the utilities and compacted to at least 92% of the maximum dry density as determined in accordance with ASTM D-1557 (modified proctor test). Compaction should be performed with hand-operated equipment with lift thickness depending on the size of equipment used and in accordance with requirements provided in Table 2. Should utilities be placed below building slabs and foundations, backfill material should be compacted to at least 95% of the maximum dry density. The 95% compaction should also be carried out on the base and subbase courses, where utilities are placed below pavements.

**Temporary Excavation Support**

The overburden soils may be sloped away from the bedrock excavation. We recommend creating an approximate 5-foot wide bend between the toe of soil slope and the outer limit of rock excavation to protect against soil caving. Support of excavation design, if necessary, must be performed by a Professional Engineer, using the following criteria:

- A soil unit weight of at least 125 pounds per cubic foot
- An effective soil friction angle of no greater than 32 degrees
- An at-rest lateral earth pressure coefficient ($K_o$) of 0.5
- Surcharge pressures from sidewalks, construction equipment, adjacent buildings, etc.

The Owner and the Contractor should make themselves aware of and become familiar with applicable local, state, and federal safety regulations, including the current Occupational Safety and Health Administration (OSHA) Excavation and Trench Safety Standards. Construction site safety generally is the sole responsibility of the Contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations. We are providing this information solely as a service to our Client. Under no circumstances should the information provided herein be interpreted to mean that GZA is assuming responsibility for construction site safety or the Contractor's activities; such responsibility is not being implied and shall not be inferred.

The Contractor should be aware that slope height, slope inclination, or excavation depth should in no case exceed those specified in local, state, or federal safety regulations, e.g. OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations. Such regulations are strictly enforced and, if they are not followed, the Owner, Contractor, and/or earthwork and utility subcontractors could be liable for substantial penalties.

As an alternative to temporary slopes, vertical excavations can be temporarily shored. The Contractor or the Contractor's specialty subcontractor would be responsible for the design of the temporary shoring in accordance with applicable regulatory requirements but the recommendations of this report will serve as a minimum requirement. Per OSHA requirements, if any excavation is extended to a depth of more than 20 feet, it will be necessary to have the side slopes and shoring designed by a Professional Engineer.

As a safety measure, it is recommended that all vehicles and soil piles be kept a minimum lateral distance from the crest of slopes equal to no less than one half of the slope height. Exposed slope faces should also be protected against the elements.

## SUPPLEMENTAL SUBSURFACE EXPLORATION

The purpose of the preliminary exploration program is to provide conceptual recommendations for design and construction of proposed structures foundations and pavement considerations. An additional exploration program is required to fill in the gaps between these widely spaced preliminary borings and gather additional required data. Considering a construction footprint area of approximately 500,000 square feet, an additional 28 borings with supplementary test pits to confirm the depth to top of bedrock are recommended (one boring per 15,000 square feet of area).

We appreciate the opportunity to work with you on this project. Should you have any questions, please contact us.

Very truly yours,
**GZA GEOENVIRONMENTAL OF NEW YORK**

Kayla B. Newton
Engineer I

Muktar H. Khatari, P.E.
Senior Project Manager

Cassandra A. Wetzel, P.E.
Associate Principal

Douglas S. Roy, P.E.
Consultant Reviewer

Attachments:
Table 1 – Recommended Use and Gradation Criteria for Fill Materials
Table 2 – Suggested Compaction Methods
Figure 1 – Site Location Plan
Figure 2 – Exploration Location Plan
Appendix A – Geotechnical Limitations
Appendix B – Boring Logs
Appendix C – Rock Core Photographs
Appendix D – Laboratory Testing Results

# TABLES

**Table 1: Recommended Use and Gradation Criteria For Fill Materials**

## USE OF FILL MATERIAL

| | |
|---|---|
| Granular Fill: | Below footings and slab base course, and 3 feet laterally behind walls provided that amount passing Sieve No. 200 is less than 8 percent. |
| Sand-Gravel: | Slab base course and 3 feet laterally behind walls |
| Crushed Stone: | Drain line backfill and foundation protective layer. Crushed stone should be wrapped in non-woven filter fabric. |

## GRADATION REQUIREMENTS

| Sieve Size | Percent Finer by Weight |
|---|---|
| | |
| Granular Fill | Shall be free from ice and snow, roots, sod, rubbish and other deleterious or organic matter. Granular Fill shall conform to the following gradation requirements: |
| 2/3 of the loose lift thickness | 100 |
| No. 10 | 30 – 95 |
| No. 40 | 10 – 70 |
| No. 200 | *0 – 15<br>*0 – 8 where used behind walls |
| | |
| Sand-Gravel | Shall consist of durable sand and gravel and shall be free from ice and snow, roots, sod, rubbish and other deleterious or organic matter. Sand-Gravel shall conform to the following gradation requirements: |
| 3 inch | 100 |
| ½ inch | 50 – 85 |
| No. 4 | 40 – 75 |
| No. 40 | 10 – 35 |
| No. 200 | 0 – 8 |
| | |
| Crushed Stone | Shall consist of durable crushed rock or durable crushed gravel stone and shall be free from ice and snow, roots, sod, rubbish and other deleterious or organic matter or material. Crushed Stone shall conform to the following gradation requirements: |
| 1 inch | 100 |
| ¾ inch | 90 – 100 |
| ½ inch | 10 – 50 |
| 3/8 inch | 0 – 20 |
| No. 4 | 0 – 5 |
| No. 200 | 0 – 1 |

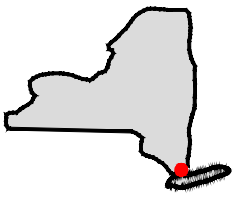
**Table 2: Compaction Methods**

| Compaction Method | Max. Stone Size* | Maximum Loose Lift Thickness | | Minimum Number of Passes | |
|---|---|---|---|---|---|
| | | Below Structures and Pavement | Less Critical Area | Below Structures and Pavement | Less Critical Area |
| GRANULAR FILL, SAND-GRAVEL FILL, CRUSHED STONE | | | | | |
| Hand-operated vibratory plate or light roller in confined areas | 4″ | 6″ | 8″ | 4 | 4 |
| Hand-operated vibratory drum rollers weighing at least 1,000# in confined areas | 6″ | 10″ | 12″ | 4 | 4 |
| Light vibratory drum roller Min. weight at drum 3000# Min dynamic force 10,000# | 8″ | 12″ | 18″ | 4 | 4 |
| Medium vibratory drum roller Min. weight at drum 10,000# Min dynamic force 20,000# | 8″ | 18″ | 24″ | 6 | 6 |

* Indicates not to exceed more than 2/3 the lift thickness

FIGURES


NEW YORK



QUADRANGLE LOCATION

SOURCE:

USGS TOPOGRAPHIC MAP: MAMARONECK, NY–CT (2013). CONTOUR INTERVAL 10FT., NAVD–1988, ORIGINAL SCALE 1:24,000 (1"=2,000FT.)

N
W E
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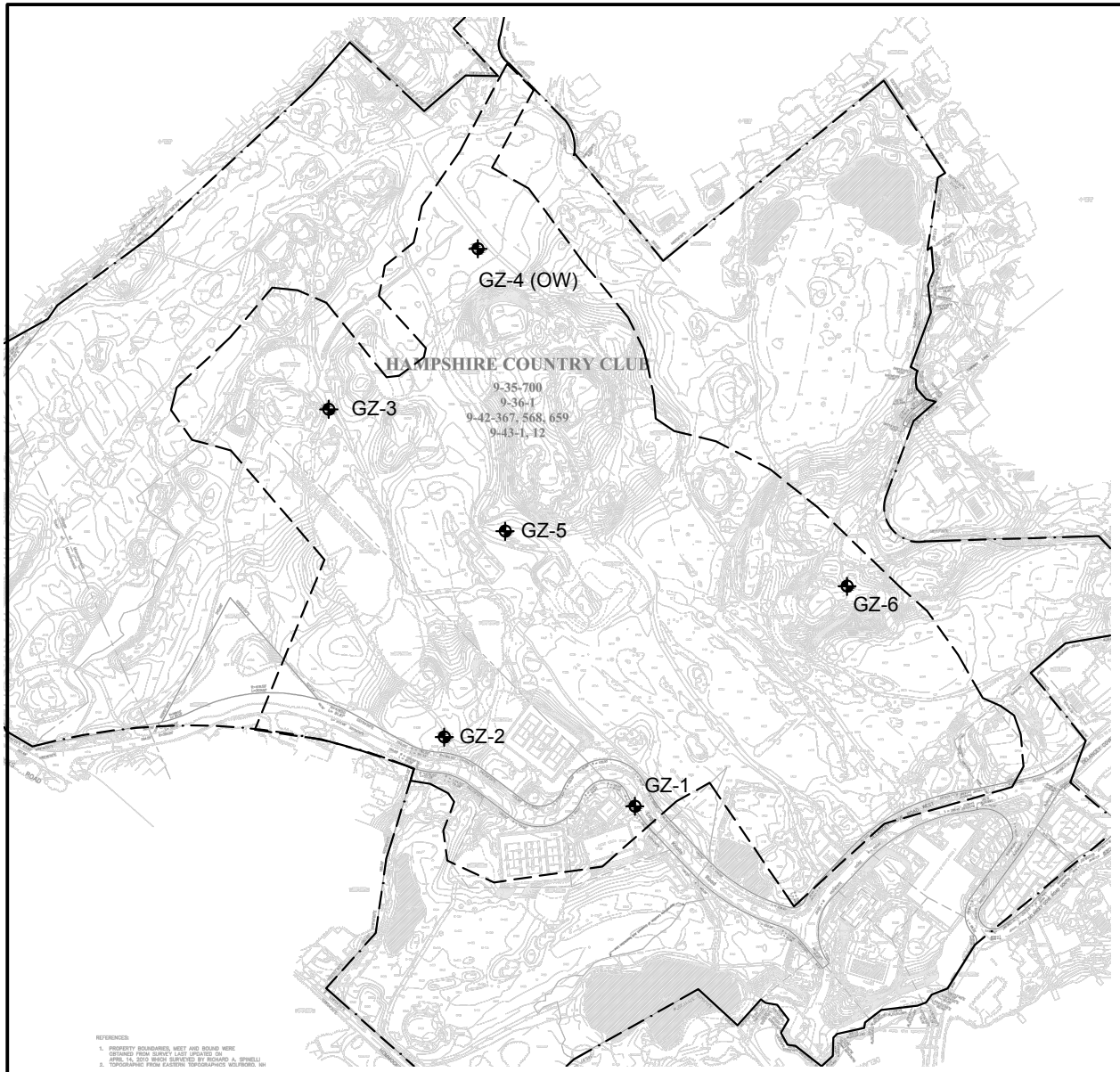
HAMPSHIRE COUNTRY CLUB
1025 COVE ROAD
MAMARONECK, NY

PREPARED BY:
GZA GeoEnvironmental of NY
Engineers and Scientists
www.gza.com

PREPARED FOR:
VHB
50 MAIN STREET, SUITE 360
WHITE PLAINS, NY 10606

**SITE LOCATION PLAN**

| | | | |
|---|---|---|---|
| PROJ MGR: MK | REVIEWED BY: CAW | CHECKED BY: DSR | FIGURE 1 |
| DESIGNED BY: KN | DRAWN BY: KN | SCALE: 1"=2000' | |
| DATE: MARCH 17, 2016 | PROJECT NO. 41.0162403.10 | REVISION NO. 0 | SHEET NO. 01 OF 02 |




NOTES:

1. BASE MAP DEVELOPED FROM PLAN PROVIDED BY VHB ENTITLED "EXISTING CONDITIONS PLAN" DATED SEPTEMBER 8, 2014, ORIGINAL SCALE 1"=100'
2. SOIL BORING LOCATIONS WERE APPROXIMATELY DETERMINED BY TAPE MEASUREMENTS FROM EXISTING TOPOGRAPHIC FEATURES. THIS DATA SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHOD USED.
3. TEST BORINGS WERE PERFORMED BY SOIL TESTING INC. OF OXFORD, CONNECTICUT BETWEEN FEBRUARY 29 AND MARCH 1, 2016. OBSERVED AND LOGGED BY GZA PERSONNEL.

LEGEND:

GZ-1 APPROXIMATE GZA SOIL BORING LOCATION

SITE PERIMETER

PROPOSED CONSTRUCTION PERIMETER

(OW) OBSERVATION WELL

N

0 200' 400' 800'

SCALE IN FEET

| NO. | ISSUE/DESCRIPTION | BY | DATE |
|---|---|---|---|
| | | | |



HAMPSHIRE COUNTRY CLUB
1025 COVE ROAD
MAMARONECK, NY

**EXPLORATION LOCATION PLAN**

PREPARED BY:
GZA GeoEnvironmental of NY
Engineers and Scientists
www.gza.com

PREPARED FOR:
VHB
50 MAIN STREET, SUITE 360
WHITE PLAINS, NY 10606

| | | | | | |
|---|---|---|---|---|---|
| PROJ MGR: MK | REVIEWED BY: CAW | CHECKED BY: DSR | FIGURE 2 |
| DESIGNED BY: KN | DRAWN BY: KN | SCALE: 1"=5000' | |
| DATE: MARCH 17, 2016 | PROJECT NO. 41.0162403.10 | REVISION NO. 0 | SHEET NO. 01 OF 02 |

# APPENDIX A

# LIMITATIONS

## GEOTECHNICAL LIMITATIONS

Use of Report

1. GZA prepared this report on behalf of, and for the exclusive use of our Client for the stated purpose(s) and location(s) identified in the Proposal for Services and/or Report. Use of this report, in whole or in part, at other locations, or for other purposes, may lead to inappropriate conclusions; and we do not accept any responsibility for the consequences of such use(s). Further, reliance by any party not expressly identified in the agreement, for any use, without our prior written permission, shall be at that party's sole risk, and without any liability to GZA.

Standard of Care

2. GZA's findings and conclusions are based on the work conducted as part of the Scope of Services set forth in Proposal for Services and/or Report, and reflect our professional judgment. These findings and conclusions must be considered not as scientific or engineering certainties, but rather as our professional opinions concerning the limited data gathered during the course of our work. If conditions other than those described in this report are found at the subject location(s), or the design has been altered in any way, GZA shall be so notified and afforded the opportunity to revise the report, as appropriate, to reflect the unanticipated changed conditions .

3. GZA's services were performed using the degree of skill and care ordinarily exercised by qualified professionals performing the same type of services, at the same time, under similar conditions, at the same or a similar property. No warranty, expressed or implied, is made.

Subsurface Conditions

4. The generalized subsurface conditions provided in our Report are based on widely-spaced subsurface explorations and are intended only to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized, and were based on our assessment of subsurface conditions. The composition of strata, and the transitions between strata, may be more variable and more complex than indicated. For more specific information on soil conditions at a specific location refer to the exploration logs.

5. In preparing this report, GZA relied on certain information provided by the Client, state and local officials, and other parties referenced therein which were made available to GZA at the time of our evaluation. GZA did not attempt to independently verify the accuracy or completeness of all information reviewed or received during the course of this evaluation.

6. Water level readings have been made in test holes (as described in the Report) and monitoring wells at the specified times and under the stated conditions. These data have been reviewed and interpretations have been made in this Report. Fluctuations in the level of the groundwater however occur due to temporal or spatial variations in areal recharge rates, soil heterogeneities, the presence of subsurface utilities, and/or natural or artificially induced perturbations. The water

table encountered in the course of the work may differ from that indicated in the Report.

7. GZA's services did not include an assessment of the presence of oil or hazardous materials at the property. Consequently, we did not consider the potential impacts (if any) that contaminants in soil or groundwater may have on construction activities, or the use of structures on the property.

8. Recommendations for foundation drainage, waterproofing, and moisture control address the conventional geotechnical engineering aspects of seepage control. These recommendations may not preclude an environment that allows the infestation of mold or other biological pollutants.

Compliance with Codes and Regulations

9. We used reasonable care in identifying and interpreting applicable codes and regulations. These codes and regulations are subject to various, and possibly contradictory, interpretations. Compliance with codes and regulations by other parties is beyond our control.

Additional Services

10. GZA recommends that we be retained to provide services during any future: site observations, design, implementation activities, construction and/or property development/redevelopment. This will allow us the opportunity to: i) observe conditions and compliance with our design concepts and opinions; ii) allow for changes in the event that conditions are other than anticipated; iii) provide modifications to our design; and iv) assess the consequences of changes in technologies and/or regulations.

# APPENDIX B

# BORING LOGS

# LOG KEY

**GZA**
**Geo Environmental, Inc.**
*Engineers and Scientists*

## BURMISTER SOIL CLASSIFICATION (INORGANIC)

| COMPONENT | NAME | PROPORTIONAL TERM | PERCENT BY WEIGHT |
|---|---|---|---|
| MAJOR | GRAVEL, SAND, FINES* | | >50 |
| Minor | Gravel, Sand, Fines* | and | 35 - 50 |
| | | some | 20-35 |
| | | little | 10-20 |
| | | trace | 0-10 |

*See identification of fines table.

**IDENTIFICATION OF FINES**

| Material | PI | Atterberg Thread Dia. |
|---|---|---|
| SILT | 0 | Cannot Roll |
| Clayey SILT | 1-5 | 1/4" |
| SILT & CLAY | 5-10 | 1/8" |
| CLAY & SILT | 10-20 | 1/16" |
| Silty CLAY | 20-40 | 1/32" |
| CLAY | >40 | 1/64" |

| GRADATION DESIGNATION | PROPORTION OF COMPONENT |
|---|---|
| Fine to coarse | All fractions > 10% |
| Medium to coarse | <10% fine |
| Fine to medium | <10% coarse |
| Coarse | <10% fine and medium |
| Medium | <10% coarse and fine |
| Fine | <10% coarse and medium |

**PLASTIC SOILS**

| Consistency | Blows/Ft. SPT N-Value |
|---|---|
| Very Soft | < 2 |
| Soft | 2 - 4 |
| Medium Stiff | 4 - 8 |
| Stiff | 8 - 15 |
| Very Stiff | 15 - 30 |
| Hard | >30 |

**GRAVEL & SAND**

| Density | Blows/Ft. SPT N-Value |
|---|---|
| Very Loose | < 4 |
| Loose | 4 - 10 |
| Medium Dense | 10 - 30 |
| Dense | 30 - 50 |
| Very Dense | > 50 |

## BURMISTER SOIL CLASSIFICATION (ORGANIC)

Fibrous PEAT (Pt) - Lightweight, spongy, mostly visible organic matter, water squeezes readily from sample. Typically near top of deposit.
Fine Grained PEAT (Pt) - Lightweight, spongy, little visible organic matter, water squeezes reqdily from sample. Typically below fibrous peat.
Organic Silt (OL) - Typically gray to dark gray, often has strong H2S odor. Typically contains shells or shell fragments. Lightweight. Usually found near coastal regions. May contain wide range of sand fractions.
Organic Clay (OH) - Typically gray to dark gray, high plasticity. Usually found near coastal regions. May contain wide range of sand fractions. Need organic content test for final identification.

## UNIFIED SOIL CLASSIFICATION SYSTEM (USCS) (ASTM D 2487)

| MAJOR DIVISIONS | | | Group Symbols |
|---|---|---|---|
| Coarse Grained Soils More than 50% of material larger than No. 200 sieve. | Gravel More than 50% larger than No. 4 sieve. | Clean Gravels (Little or no fines) | GW GP |
| | | Gravels with Fines (Appreciable amount of fines) | GM GC |
| | Sand More than 50% smaller than No. 4 sieve. | Clean Sands (Little or no fines) | SW SP |
| | | Sands with Fines (Appreciable amount of fines) | SM SC |
| Fine Grained Soils More than 50% of material smaller than No. 200 sieve. | | Silts and Clays Liquid Limit <50 | ML CL |
| | | Silts and CLays Liquid Limit >50 | OL MH CH OH |
| | | Highly Organic Soils | Pt |

## ABBREVIATIONS

MR = Mud Rotary
HSA = Hollow Stem Auger
SSA = Solid Stem Auger
SS = Split Spoon Sampler
U = Undisturbed Sample (Shelby Tube)
MC = Modified California Sampler
V = Vibracore
M = Macrocore

USCS = Unified Soil Classification System (ASTM D2487)
NYCBC = New York City Building Code
WOR = Weight of Rods
WOH= Weight of Hammer
SPT = Standard Penetration Test (ASTM D1586)
N-Value = Cumulative number of uncorrected blows for the middle two six-inch intervals (blows/foot).

Tv = Field Vane Shear Test (Torvane)
PP = Pocket Penetrometer
PI = Plasticity Index
MC = Moisture Content
CO = Consolidation
UC = Unconfined Compression Test
SI = Sieve Analysis
DS = Direct Shear
PID = Photoionization Detector
ppm = Parts Per Million
REC = Recovery
RQD = Rock Quality Designation
▼ = Measured Water Level

# Modified ISRM Rock Classification

Rock cores are visually classified by the Modified ISRM System using the following format and order: Field hardness, weathering, grain size, color, ROCK TYPE, foliation thickness, foliation dip angle, foliation joint/fracture shape and roughness, foliation joint/fracture spacing, dip angle of other joints and fractures, condition of joint surfaces, other features such as minerals.

**FIELD HARDNESS**:
**Very Hard** – Cannot be scratched with knife or sharp pick. Breaking of hand specimens requires several hard blows of geologists pick.
**Hard** – Can be scratched with knife or pick only with difficulty. Hard blow of hammer required to detach hand specimen.
**Medium** – Can be grooved or gouged 1/16 in. deep by firm pressure on knife or pick point. Can be excavated in small chips to pieces about 1 in. maximum size by hard blows from the point of a geologist's pick.
**Soft** – Can be gouged or grooved readily with knife or pick point. Can be excavated in chips to pieces several inches in size by moderate blows of a pick point. Small thin pieces can be broken by finger pressure.
**Very Soft** – Can be carved with knife. Can be excavated readily with point of pick. Pieces 1 in. or more in thickness can be broken with finger pressure. Can be scratched readily by fingernail.

**WEATHERING**:
**Fresh** – Rock fresh, crystals bright, few joints may show slight staining. Rock rings under hammer if crystalline.
**Slight** – Rock generally fresh, joints stained, and discoloration and weathering effects. In granitoid rocks some occasional feldspar crystals are dull and discolored. Crystalline rocks ring under hammer.
**Moderate** – Significant portions of rock show discoloration and weathering effects. In granitoid rock, most feldspars are dull and discolored; some show clayey. Rock has dull sound under hammer and shows significant loss of strength as compared with fresh rock.
**Severe** – All rock except quartz discolored or stained. Rock "fabric" clear and evident, but reduced in strength to strong soil. In granitoid rocks, all feldspars kaolinized to some extent. Some fragments of strong rock usually left.
**Complete** – Rock reduced to "soil". Rock "fabric" not discernible or discernible only in small scattered locations. Quartz may be present as dikes or Stringers.

**GRAIN SIZE:**
**Fine Grained** – Barely seen with naked eye.
**Coarse Grained**: 1/8 in. to 1/4 in.
**Amorphous**: Too small to be seen with naked eye.
**Medium Grained**: Barely seen with naked eye to 1/8 in.
**Very Coarse Grained**: >1/4 in.

**DISCONTINUITIES:**
**Healed Joi**nt – A partial or incomplete fracture.
**Joint/Fracture** – A simple fracture along which no shear displacement has occurred. May form sets.
**Shear** – A zone of fractures along which differential movement has taken place parallel to the surface sufficient to produce slickensides, striations, or polishing. May be accompanied by a zone of fractured rock up to a few inches wide.
**Faul**t – A fracture along which there has been displacement and accompanying slickensides, striations, or polishing by gouge and/or severely fractured adjacent zone.
**Shear or Fault Zone** – A band or zone of parallel, closely spaced shears or faults accompanied by gouge, maylonite, and breccia.

Table A-5: Fractures and Foliation Spacing and Attitude

| Fractures | Foliation | Spacing | Attitude | Angle |
|---|---|---|---|---|
| Very close | Very thin | Less than 2 in. | Horizontal | 0° - 5° |
| Close | Thin | 2 in. - 1 ft. | Subhorizontal | 5° - 35° |
| Moderately close | Medium | 1 ft. - 3 ft. | Moderately dipping | 35° - 55° |
| Wide | Thick | 3 ft. - 10 ft. | Subvertical | 55° - 85° |
| Very Wide | Very thick | More than 10 ft. | Vertical | 85° - 90° |

Table A-6: Condition of Joint/Fracture Surfaces

| Descriptive Term | Conditions |
|---|---|
| Planar | A flat surface |
| Curved | A curved surface |
| Irregular | Multi-curved surface |
| Slick | A polished and striated surface indicating sliding along a plane; also referred to as slickensided. |
| Smooth | Few irregularities, but no obvious indication of sliding; adjacent pieces of core can be slid past on another with relative ease. |
| Rough | Many irregularities; difficult to slide adjacent pieces of core by each other. |

GZA reports the total core recovery and rock quality designation for each core run* on the boring logs. The definitions of these terms are as follows:

**TOTAL CORE RECOVERY (REC)**

$$\textbf{REC (\%)} = \frac{\text{Sum of Recovered Core}}{\text{Length of Core Run}} \times 100$$

**ROCK QUALITY DESIGNATION (RQD)**

$$\textbf{RQD (\%)} = \frac{\text{Sum of Lengths of intact Core with Full Diameter in Pieces 4 in. and Longer}}{\text{Length of Core Run}} \times 100$$

The RQD is in general accordance with methodology described by Deere and Deere (1988). In addition, significant vertical to sub-vertical foliation/cross-foliation joints/fractures occur within the rock mass and influence ground behavior. The length of core exhibiting the vertical to sub-vertical joints/fractures has been deducted from the RQD, which is consistent with the "pieces of intact rock core" criteria. The vertical to sub-vertical joints/fractures have been identified on the rock core or the upside divider in the core box with permanent "dots" spaced every 0.1 feet apart. These dots have been counted and entered in the fractures per foot column on the boring log.

* - RQD not reported for severely and/or completely weathered rock or core runs with length of 2.0 feet or less.

# TEST BORING LOG

**GZA GeoEnvironmental, Inc**
*Engineers and Scientists*

**Hampshire Country Club**
**1025 Cove Road**
**Mamaroneck, NY**

**EXPLORATION NO.:** GZ-01
**SHEET:** 1 of 1
**PROJECT NO:** 41.0162403.10
**REVIEWED BY:** M. Khatari

**Logged By:** K. Newton
**Drilling Co.:** STI
**Foreman:** Brock

**Type of Rig:** ATV
**Rig Model:** CME-550X
**Drilling Method:** HSA

**Boring Location:** See Plan
**Ground Surface Elev. (ft.):** 12.4
**Final Boring Depth (ft.):** 17
**Date Start - Finish:** 2/29/2016 - 2/29/2016

**H. Datum:**
**V. Datum:** NAVD 88

**Hammer Type:** Safety Hammer
**Hammer Weight (lb.):** 140
**Hammer Fall (in.):** 30
**Auger or Casing O.D./I.D Dia (in.):** 4

**Sampler Type:** SS
**Sampler O.D. (in.):** 2.0
**Sampler Length (in.):** 24
**Rock Core Size:** N/A

**Groundwater Depth (ft.)**

| Date | Time | Water Depth | Stab. Time |
|---|---|---|---|
| 2/29/16 | 10:40am | 14.6 | 10 minutes |

| Depth (ft) | Casing Blows/ Core Rate | Sample No. | Sample Depth (ft.) | Sample Pen. (in) | Sample Rec. (in) | Sample Blows (per 6 in.) | Sample SPT Value | Sample Description and Identification (Modified Burmister Procedure) | Remark | Field Test Data | Stratum Depth (ft.) | Stratum Description | Stratum Elev. (ft.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | S-1 | 0-2 | 24 | 6 | 12 14<br>13 11 | 27 | S-1 : Medium dense, gray/tan, fine to coarse SAND, little Gravel, trace Silt, occasional Asphalt fragments. | | | 0.1 | GRAVEL | 12.3 |
| | | | | | | | | | | | 2 | FILL | 10.4 |
| | | S-2 | 2-4 | 24 | 1 | 5 4<br>7 5 | 11 | S-2 : Medium dense, gray/tan, fine to coarse SAND, little Gravel, trace Silt. | | | | | |
| 5 | | S-3 | 4-6 | 24 | 8 | 4 2<br>3 5 | 5 | S-3 : Loose, brown, fine to medium SAND and SILT. | | | | SILTY SAND | |
| | | S-4 | 6-8 | 24 | 8 | 6 8<br>9 12 | 17 | S-4 : Medium dense, brown, fine to medium SAND and SILT, trace Gravel. | | | 7 | | 5.4 |
| | | S-5 | 8-10 | 24 | 10 | 8 20<br>27 34 | 47 | S-5 : Dense, brown, fine to medium SAND, little Silt, little Gravel. | | | | | |
| 10 | | S-6 | 10-12 | 24 | 14 | 34 41<br>49 78 | 90 | S-6 : Very dense, brown, fine to coarse SAND and GRAVEL, little Silt. | | | | SAND | |
| 15 | | S-7 | 15-15.8 | 10 | 10 | 16 50/4" | R | S-7 : Very dense, brown/black, fine to coarse SAND, little Gravel, trace Silt. | | | | | |
| | | | | | | | | | 1 | | 17 | | -4.6 |
| | | | | | | | | End of exploration at 17 feet. | 2,3 | | | | |
| 20 | | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | |

**REMARKS**

1 - Sample wet, groundwater encountered
2 - Auger refusal at 17 feet bgs.
3 - Upon completion, borehole backfilled with soil cuttings.

See Log Key for exploration of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

**Exploration No.: GZ-01**

GZA TEMPLATE TEST BORING; 3/9/2016; 2:31:17 PM

# TEST BORING LOG

**GZA GeoEnvironmental, Inc**
*Engineers and Scientists*

**Hampshire Country Club**
**1025 Cove Road**
**Mamaroneck, NY**

**EXPLORATION NO.:** GZ-02
**SHEET:** 1 of 1
**PROJECT NO:** 41.0162403.10
**REVIEWED BY:** M. Khatari

**Logged By:** K. Newton
**Drilling Co.:** STI
**Foreman:** Brock

**Type of Rig:** ATV
**Rig Model:** CME-550X
**Drilling Method:** HSA

**Boring Location:** See Plan
**Ground Surface Elev. (ft.):** 20.5
**Final Boring Depth (ft.):** 9
**Date Start - Finish:** 2/29/2016 - 2/29/2016

**H. Datum:**
**V. Datum:** NAVD 88

**Hammer Type:** Safety Hammer
**Hammer Weight (lb.):** 140
**Hammer Fall (in.):** 30
**Auger or Casing O.D./I.D Dia (in.):** 4

**Sampler Type:** SS
**Sampler O.D. (in.):** 2.0
**Sampler Length (in.):** 24
**Rock Core Size:** N/A

**Groundwater Depth (ft.)**

| Date | Time | Water Depth | Stab. Time |
|---|---|---|---|
| No | Observ. | Made | |

| Depth (ft) | Casing Blows/ Core Rate | Sample No. | Sample Depth (ft.) | Sample Pen. (in) | Sample Rec. (in) | Sample Blows (per 6 in.) | Sample SPT Value | Sample Description and Identification (Modified Burmister Procedure) | Remark | Field Test Data | Stratum Depth (ft.) | Stratum Description | Stratum Elev. (ft.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | S-1 | 0-2 | 24 | 10 | 3 4<br>3 3 | 7 | S-1 : Loose, brown, fine to medium SAND and SILT, trace Gravel, roots. | | | 0.3 | TOPSOIL | 20.2 |
| | | S-2 | 2-3.8 | 21 | 18 | 12 33<br>38 50/3" | 71 | S-2 : Very dense, brown, fine to medium SAND, little Gravel, trace Silt. | | | | SAND | |
| 5 | 1;18<br>2:37<br>2:50<br>3:17<br>3:10 | C-1 | 4-9 | 60 | 42 | | | C-1 : Hard. moderately weathered, gray GNEISS, slightly fractured. (REC = 70%, RQD = 47%) | 1 | | 4 | BEDROCK | 16.5 |
| 10 | | | | | | | | End of exploration at 9 feet. | 2 | | 9 | | 11.5 |
| 15 | | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | |

**REMARKS**

1 - Auger refusal at 4 feet bgs.
2 - Upon completion, borehole backfilled with soil cuttings.

See Log Key for exploration of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

**Exploration No.: GZ-02**

GZA TEMPLATE TEST BORING; 3/9/2016; 2:31:17 PM

# TEST BORING LOG

**GZA GeoEnvironmental, Inc**
*Engineers and Scientists*

**Hampshire Country Club**
**1025 Cove Road**
**Mamaroneck, NY**

**EXPLORATION NO.:** GZ-03
**SHEET:** 1 of 1
**PROJECT NO:** 41.0162403.10
**REVIEWED BY:** M. Khatari

**Logged By:** K. Newton
**Drilling Co.:** STI
**Foreman:** Brock

**Type of Rig:** ATV
**Rig Model:** CME-550X
**Drilling Method:** HSA

**Boring Location:** See Plan
**Ground Surface Elev. (ft.):** 6.5
**Final Boring Depth (ft.):** 10
**Date Start - Finish:** 2/29/2016 - 2/29/2016

**H. Datum:**
**V. Datum:** NAVD 88

**Hammer Type:** Safety Hammer
**Hammer Weight (lb.):** 140
**Hammer Fall (in.):** 30
**Auger or Casing O.D./I.D Dia (in.):** 4

**Sampler Type:** SS
**Sampler O.D. (in.):** 2.0
**Sampler Length (in.):** 24
**Rock Core Size:** N/A

**Groundwater Depth (ft.)**

| Date | Time | Water Depth | Stab. Time |
|---|---|---|---|
| No | Observ. | Made | |

| Depth (ft) | Casing Blows/ Core Rate | Sample No. | Sample Depth (ft.) | Pen. (in) | Rec. (in) | Blows (per 6 in.) | SPT Value | Sample Description and Identification (Modified Burmister Procedure) | Remark | Field Test Data | Stratum Depth (ft.) | Stratum Description | Stratum Elev. (ft.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | S-1 | 0-2 | 24 | 12 | 4 5<br>6 9 | 11 | S-1 : Stiff, gray SILT and CLAY, trace fine Sand. | | TV=1.6<br>PP=1.5 | 0.3 | TOPSOIL | 6.2 |
| | | | | | | | | | | | 2 | SILT AND CLAY | 4.5 |
| | | S-2 | 2-4 | 24 | 6 | 5 6<br>5 5 | 11 | S-2 : Medium dense, gray/brown, fine to medium SAND, little Clayey Silt, trace Gravel. | | | | | |
| 5 | | S-3 | 4-6 | 24 | 14 | 7 10<br>15 20 | 25 | S-3 : Medium dense, brown, fine to medium SAND, little Silt, trace Gravel. | | | | | |
| | | S-4 | 6-8 | 24 | 16 | 14 14<br>18 12 | 32 | S-4 : Dense, brown, fine to medium SAND, little Silt, trace Gravel. | | | | SILTY SAND | |
| 10 | | S-5 | 8-9.1 | 13 | 0 | 20 24<br>50/1" | R | S-5 : (No Recovery) | 1 | | 10 | | -3.5 |
| | | | | | | | | End of exploration at 10 feet. | 2<br>3 | | | | |
| 15 | | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | |

**REMARKS**

1 - Rock at top of sampler.
2 - Auger refusal at 10 feet bgs.
3 - Upon completion, borehole backfilled with soil cuttings.

See Log Key for exploration of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

**Exploration No.: GZ-03**

GZA TEMPLATE TEST BORING; 3/9/2016; 2:31:18 PM

# TEST BORING LOG

**GZA GeoEnvironmental, Inc**
*Engineers and Scientists*

**Hampshire Country Club**
**1025 Cove Road**
**Mamaroneck, NY**

**EXPLORATION NO.:** GZ-04
**SHEET:** 1 of 1
**PROJECT NO:** 41.0162403.10
**REVIEWED BY:** M. Khatari

**Logged By:** K. Newton
**Drilling Co.:** STI
**Foreman:** Brock

**Type of Rig:** ATV
**Rig Model:** CME-550X
**Drilling Method:** HSA

**Boring Location:** See Plan
**Ground Surface Elev. (ft.):** 2.1
**Final Boring Depth (ft.):** 17.5
**Date Start - Finish:** 3/1/2016 - 3/1/2016

**H. Datum:**
**V. Datum:** NAVD 88

**Hammer Type:** Safety Hammer
**Hammer Weight (lb.):** 140
**Hammer Fall (in.):** 30
**Auger or Casing O.D./I.D Dia (in.):** 4

**Sampler Type:** SS
**Sampler O.D. (in.):** 2.0
**Sampler Length (in.):** 24
**Rock Core Size:** N/A

**Groundwater Depth (ft.)**

| Date | Time | Water Depth | Stab. Time |
|---|---|---|---|
| 3/1/16 | 12:00pm | 1.3 | 0.5 hours |
| 3/1/16 | 3:00pm | 1.6 | 3.5 hours |
| 3/16/16 | 3:00pm | 0.5 | 15 days |

| Depth (ft) | Casing Blows/ Core Rate | Sample No. | Sample Depth (ft.) | Pen. (in) | Rec. (in) | Blows (per 6 in.) | SPT Value | Sample Description and Identification (Modified Burmister Procedure) | Remark | Field Test Data | Stratum Depth (ft.) | Stratum Description | Stratum Elev. (ft.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | S-1 | 0-2 | 24 | 16 | 1 2<br>3 3 | 5 | S-1 : Medium stiff, gray, SILT and CLAY, trace fine Sand. | | TV=2.0<br>PP=1.5 | 0.3 | TOPSOIL | 1.8 |
| | | S-2 | 2-4 | 24 | 10 | 4 4<br>4 6 | 8 | S-2 : Stiff, gray SILT and CLAY, some fine Sand, trace Gravel. | | TV=2.5<br>PP=1.25 | | SILT AND CLAY | |
| 5 | | S-3 | 4-6 | 24 | 10 | 7 4<br>4 9 | 8 | S-3 : Loose, gray/brown SILT, some fine to medium Sand. | | | 4 | | -1.9 |
| | | S-4 | 6-8 | 24 | 12 | 5 8<br>7 5 | 15 | S-4 : Medium dense, gray, fine SAND and SILT. | | | | | |
| | | S-5 | 8-10 | 24 | 16 | 2 2<br>3 3 | 5 | S-5 : Medium stiff, gray, SILT and CLAY, little fine to medium Sand. | | TV=2.0<br>PP=1.5 | | | |
| 10 | | S-6 | 10-12 | 24 | 22 | 3 5<br>6 8 | 11 | S-6 : Medium dense, gray, fine SAND and SILT. | | | | SILTY SAND | |
| 15 | | S-7 | 15-17 | 24 | 12 | 9 17<br>48 48 | 65 | S-7 : Very dense, gray, fine SAND and SILT, some weathered rock. | | | 17.5 | | -15.4 |
| | | | | | | | | End of exploration at 17.5 feet. | 1<br>2 | | | | |
| 20 | | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | |

**REMARKS**

1 - Auger refusal at 17.5 feet bgs.
2 - Observation well installed to depth of 17 feet (10' screen, 7' riser).

See Log Key for exploration of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

**Exploration No.: GZ-04**

GZA TEMPLATE TEST BORING; 3/16/2016; 4:46:35 PM

# TEST BORING LOG

**GZA GeoEnvironmental, Inc**
*Engineers and Scientists*

**Hampshire Country Club**
**1025 Cove Road**
**Mamaroneck, NY**

**EXPLORATION NO.:** GZ-05
**SHEET:** 1 of 1
**PROJECT NO:** 41.0162403.10
**REVIEWED BY:** M. Khatari

**Logged By:** K. Newton
**Drilling Co.:** STI
**Foreman:** Brock

**Type of Rig:** ATV
**Rig Model:** CME-550X
**Drilling Method:** HSA

**Boring Location:** See Plan
**Ground Surface Elev. (ft.):** 4.5
**Final Boring Depth (ft.):** 9.5
**Date Start - Finish:** 3/1/2016 - 3/1/2016

**H. Datum:**
**V. Datum:** NAVD 88

**Hammer Type:** Safety Hammer
**Hammer Weight (lb.):** 140
**Hammer Fall (in.):** 30
**Auger or Casing O.D./I.D Dia (in.):** 4

**Sampler Type:** SS
**Sampler O.D. (in.):** 2.0
**Sampler Length (in.):** 24
**Rock Core Size:** N/A

**Groundwater Depth (ft.)**

| Date | Time | Water Depth | Stab. Time |
|---|---|---|---|
| No | Observ. | Made | |

| Depth (ft) | Casing Blows/ Core Rate | Sample No. | Sample Depth (ft.) | Pen. (in) | Rec. (in) | Blows (per 6 in.) | SPT Value | Sample Description and Identification (Modified Burmister Procedure) | Remark | Field Test Data | Stratum Depth (ft.) | Stratum Description | Stratum Elev. (ft.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | S-1 | 0-2 | 24 | 14 | 2 3<br>3 4 | 6 | S-1 : Medium stiff, gray SILT and CLAY, some Sand. | | TV=2.5<br>PP=1.75 | 0.3 | TOPSOIL | 4.2 |
| | | S-2 | 2-4 | 24 | 18 | 5 25<br>12 13 | 37 | S-2 : Hard, gray SILT and CLAY, little Gravel, little Sand. | | | | SILT AND CLAY | |
| | | S-3 | 4-6 | 24 | 16 | 14 19<br>18 24 | 37 | S-3 : Dense, brown, fine to medium SAND, little Silt, trace Gravel. | | | 4 | | 0.5 |
| 5 | | S-4 | 6-8 | 24 | 18 | 15 14<br>14 18 | 28 | S-4 : Medium dense, brown, fine to medium SAND, little Gravel, little Silt. | | | | SAND | |
| | | S-5 | 8-8.1 | 1 | 0 | 50/1" | R | S-5 : (No Recovery) | | | 9.5 | | -5.0 |
| 10 | | | | | | | | End of exploration at 9.5 feet. | 1<br>2 | | | | |
| 15 | | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | |

**REMARKS**

1 - Auger refusal at depth of 9.5 feet bgs.
2 - Upon completion, borehole backfilled with soil cuttings.

See Log Key for exploration of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

**Exploration No.: GZ-05**

GZA TEMPLATE TEST BORING; 3/9/2016; 2:31:19 PM

# TEST BORING LOG

**GZA GeoEnvironmental, Inc**
*Engineers and Scientists*

**Hampshire Country Club**
**1025 Cove Road**
**Mamaroneck, NY**

**EXPLORATION NO.:** GZ-06
**SHEET:** 1 of 1
**PROJECT NO:** 41.0162403.10
**REVIEWED BY:** M. Khatari

**Logged By:** K. Newton
**Drilling Co.:** STI
**Foreman:** Brock

**Type of Rig:** ATV
**Rig Model:** CME-550X
**Drilling Method:** HSA

**Boring Location:** See Plan
**Ground Surface Elev. (ft.):** 24.1
**Final Boring Depth (ft.):** 3
**Date Start - Finish:** 3/1/2016 - 3/1/2016

**H. Datum:**
**V. Datum:** NAVD 88

**Hammer Type:** Safety Hammer
**Hammer Weight (lb.):** 140
**Hammer Fall (in.):** 30
**Auger or Casing O.D./I.D Dia (in.):** 4

**Sampler Type:** SS
**Sampler O.D. (in.):** 2.0
**Sampler Length (in.):** 24
**Rock Core Size:** N/A

**Groundwater Depth (ft.)**

| Date | Time | Water Depth | Stab. Time |
|---|---|---|---|
| No | Observ. | Made | |

| Depth (ft) | Casing Blows/ Core Rate | Sample No. | Sample Depth (ft.) | Sample Pen. (in) | Sample Rec. (in) | Sample Blows (per 6 in.) | Sample SPT Value | Sample Description and Identification (Modified Burmister Procedure) | Remark | Field Test Data | Stratum Depth (ft.) | Stratum Description | Stratum Elev. (ft.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | S-1 | 0-2 | 24 | 12 | 3 3<br>5 13 | 8 | S-1 : Loose, brown, fine to medium SAND, some Gravel, trace Silt. | | | 0.3 | TOPSOIL | 23.8 |
| | | S-2 | 2-2.4 | 5 | 3 | 50/5" | R | S-2 : Very dense, brown, fine to medium SAND, some Gravel, trace Silt. | | | | SAND | |
| | | | | | | | | End of exploration at 3 feet. | 1<br>2 | | 3 | | 21.1 |
| 5 | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | |

**REMARKS**

1 - Auger refusal at depth of 3 feet bgs.
2 - Upon completion, borehole backfilled with soil cuttings.

See Log Key for exploration of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

**Exploration No.: GZ-06**

GZA TEMPLATE TEST BORING; 3/9/2016; 2:31:20 PM

# APPENDIX C

# ROCK CORE PHOTOGRAPHS

# ROCK CORE PHOTOGRAPHS
# HAMPSHIRE COUNTRY CLUB
# 1025 COVE ROAD
# MAMARONECK, NEW YORK

**GZ-2, C-1 (4’-9’, REC=70%, RQD=47%)**

| JOB NUMBER: | TAKEN BY: | DATE TAKEN: |
|---|---|---|
| 41.0162403.10 | K. Newton | 2/29/2016 |

# APPENDIX D

# LABORATORY TESTING RESULTS

# LABORATORY TESTING DATA SHEET

Project Name Hampshire Country Club | Location Mamaroneck, NY | Reviewed By

Project No. 41.0162403.10 | Assigned By K. Newton

Project Manager M. Khatari | Date 3/8/16 | Date Reviewed 3/8/2016

| Boring/ Test Pit No. | Sample No. | Depth ft. | Lab No. | Identification Tests | | | | | | | Strength Tests | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Natural Water Content % | LL % | PL % | Gravel % | Sand % | Fines % | Org. % | CBR Setup as % of Proctor | CBR Dry unit wt. pcf | CBR Water Content % | CBR @ 0.1" @ 0.2" | $\sigma_1 - \sigma_3$ or $\tau$ psf | Strain % | Laboratory Log and Soil Description |
| GZ-1 | S-6 | 10-12' | 1 | | | | 36.9 | 50.5 | 12.6 | | | | | | | | Red-brown f-c SAND and f-c GRAVEL, little Silt |
| GZ-4 | S-3 | 4-6' | 2 | | | | 0.9 | 26.4 | 72.7 | | | | | | | | Brown SILT, some f-m Sand |
| GZ-4 | S-5 | 8-10' | 3 | 28.4 | 28 | 20 | | | | | | | | | | | Gray SILT & CLAY, little f-m Sand |
| GZ-5 | S-2 | 2-4' | 4 | 27.8 | 30 | 22 | | | | | | | | | | | Gray & Brown SILT & CLAY, little f-m Sand |
| | | | | | | | | | | | | | | | | | |
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THIELSCH ENGINEERING

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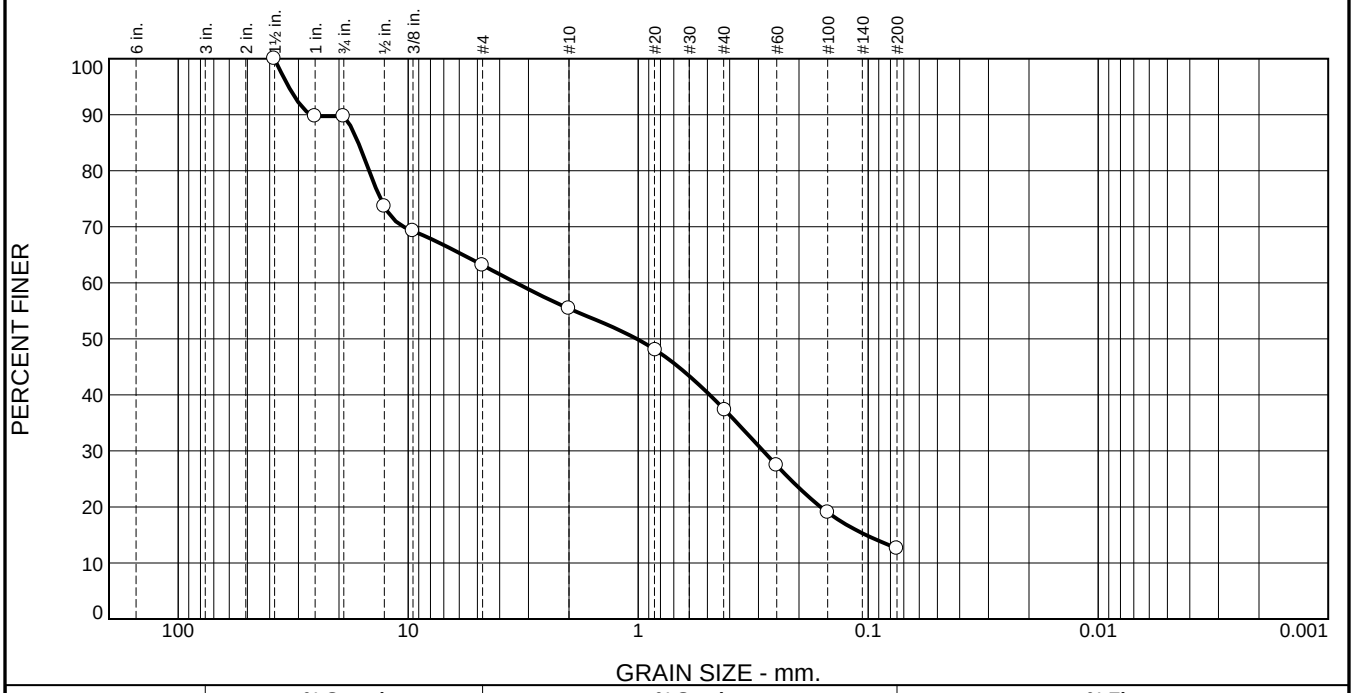
Cranston, RI 02910

401-467-6454

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 10.3 | 26.6 | 7.7 | 17.9 | 24.9 | 12.6 | |

**TEST RESULTS (D422)**

| Opening Size | Percent Finer | Spec.* (Percent) | Pass? (X=Fail) |
|---|---|---|---|
| 1.5" | 100.0 | | |
| 1" | 89.7 | | |
| 0.75" | 89.7 | | |
| .5" | 73.7 | | |
| .375" | 69.3 | | |
| #4 | 63.1 | | |
| #10 | 55.4 | | |
| #20 | 48.0 | | |
| #40 | 37.3 | | |
| #60 | 27.4 | | |
| #100 | 19.0 | | |
| #200 | 12.6 | | |

* (no specification provided)

**Material Description**

Red-brown f-c SAND and f-c GRAVEL, little Silt

**Atterberg Limits (ASTM D 4318)**

**PL=** **LL=** **PI=**

**Classification**

**USCS (D 2487)=** SM **AASHTO (M 145)=** A-1-b

**Coefficients**

$D_{90}$= 26.4793 $D_{85}$= 16.4647 $D_{60}$= 3.3991
$D_{50}$= 1.0143 $D_{30}$= 0.2863 $D_{15}$= 0.1023
$D_{10}$= $C_u$= $C_c$=

**Remarks**

**Date Received:** 3/3/16 **Date Tested:** 3/4/16

**Tested By:** MS/JE

**Checked By:** Matthew Polsky

**Title:** Laboratory Manager

**Source of Sample:** Borings **Depth:** 10-12' **Date Sampled:**

**Sample Number:** GZ-1: S-6

**Thielsch Engineering Inc.**

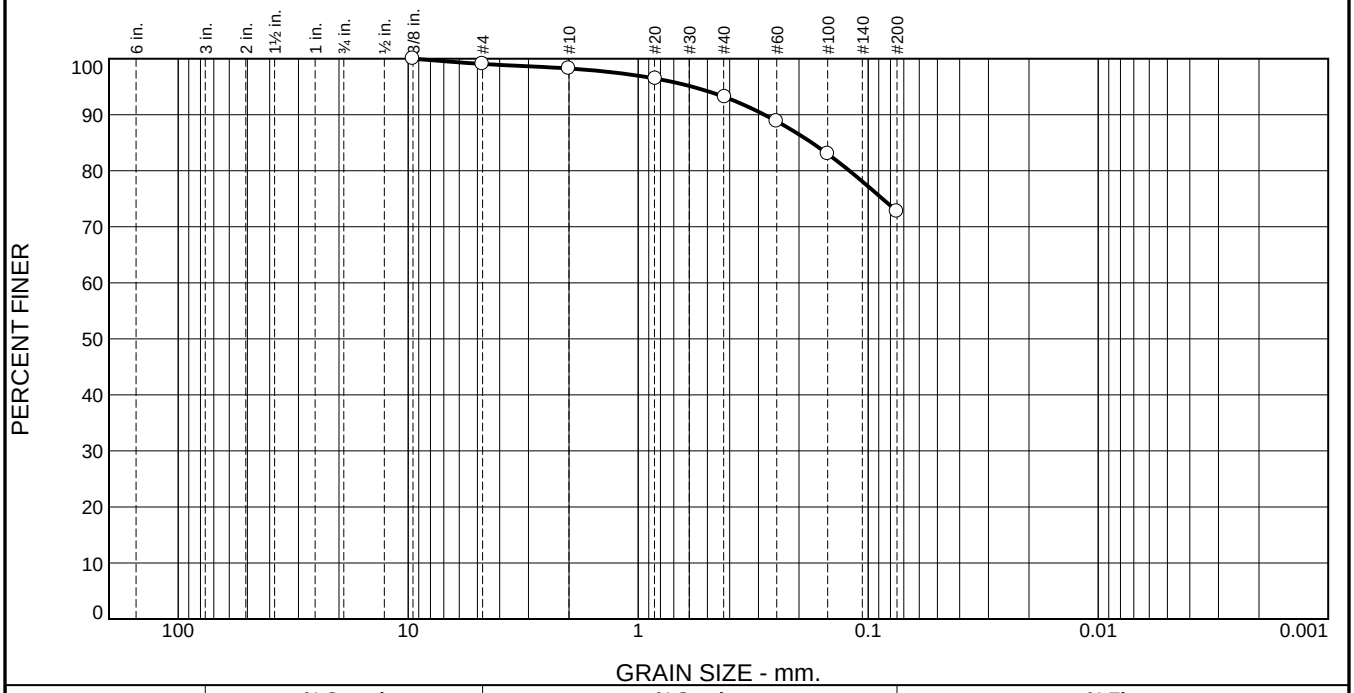
**Cranston, RI**

**Client:** GZA GeoEnvironmental, Inc.

**Project:** Hampshire Country Club
Mamaroneck, NY

**Project No:** 41.0162403.10 **Figure** 1

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 0.0 | 0.9 | 0.9 | 5.0 | 20.5 | 72.7 | |

**TEST RESULTS (D422)**

| Opening Size | Percent Finer | Spec.* (Percent) | Pass? (X=Fail) |
|---|---|---|---|
| .375" | 100.0 | | |
| #4 | 99.1 | | |
| #10 | 98.2 | | |
| #20 | 96.4 | | |
| #40 | 93.1 | | |
| #60 | 88.8 | | |
| #100 | 83.0 | | |
| #200 | 72.7 | | |

* (no specification provided)

**Material Description**

Brown SILT, some f-m Sand

**Atterberg Limits (ASTM D 4318)**

**PL=** **LL=** **PI=**

**Classification**

**USCS (D 2487)=** ML **AASHTO (M 145)=** A-4(0)

**Coefficients**

$D_{90}$= 0.2828 $D_{85}$= 0.1758 $D_{60}$=
$D_{50}$= $D_{30}$= $D_{15}$=
$D_{10}$= $C_u$= $C_c$=

**Remarks**

**Date Received:** 3/3/16 **Date Tested:** 3/4/16

**Tested By:** MS/JE

**Checked By:** Matthew Polsky

**Title:** Laboratory Manager

**Source of Sample:** Borings **Depth:** 4-6' **Date Sampled:**

**Sample Number:** GZ-4: S-3

**Thielsch Engineering Inc.**

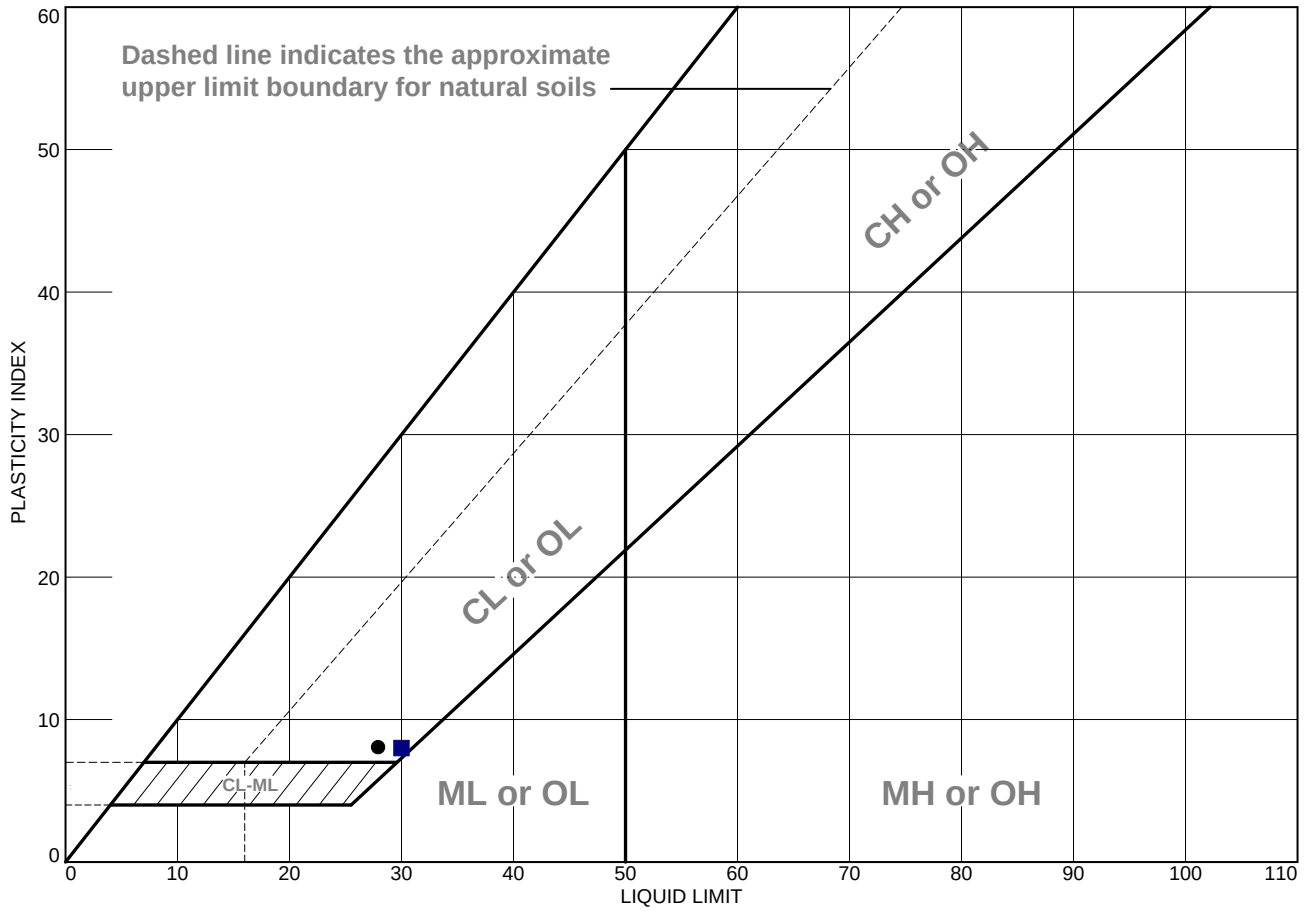
**Cranston, RI**

**Client:** GZA GeoEnvironmental, Inc.

**Project:** Hampshire Country Club
Mamaroneck, NY

**Project No:** 41.0162403.10 **Figure** 2

# LIQUID AND PLASTIC LIMITS TEST REPORT




| | MATERIAL DESCRIPTION | LL | PL | PI | %<#40 | %<#200 | USCS |
|---|---|---|---|---|---|---|---|
| ● | Gray | 28 | 20 | 8 | | | |
| ■ | Gray & Brown | 30 | 22 | 8 | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

**Project No.** 41.0162403.10 **Client:** GZA GeoEnvironmental, Inc.

**Project:** Hampshire Country Club
Mamaroneck, NY

●**Source of Sample:** Borings **Depth:** 8-10' **Sample Number:** GZ-4: S-5

■**Source of Sample:** Borings **Depth:** 2-4' **Sample Number:** GZ-5: S-2

**Remarks:**

**Thielsch Engineering Inc.**

**Cranston, RI**

**Figure** 3-4

**Tested By:** GG **Checked By:** Matthew Polsky