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October 12, 2016

Village of Scarsdale
1001 Post Road
Scarsdale, NY 10583-4303

ATT: Paul G. Zaicek
Director of Capital Projects

RE: Project No. **16-511-01**
Subsurface Investigation and Analysis
Proposed Building Additions
Scarsdale Public Library
Scarsdale, New York

Dear Mr. Zaicek:

According to our May 18 & June 21, 2016 agreements covering the services to be provided for this project, a subsurface investigation and analysis including a program of 12 borings has been conducted by this Office at the site of the proposed additions, including site improvements, for the existing Scarsdale Public Library located west of the intersection of Olmsted and Post Roads (54 Olmsted Road) in Scarsdale, New York.

Attached is a report presenting the results of this investigation and analysis. Please contact this Office if you have any questions concerning this report.

Very truly yours,

Richard S. Kessler, P.E., D.GE
NY License No. 047187-1

cc: Daniel Heuberger, R.A.
Andrew V. Tung, ASLA, Esq.
Andrew Cilley, P.E.

SUBSURFACE INVESTIGATION AND ANALYSIS

Proposed Additions

Scarsdale Public Library

54 Olmsted Road; Scarsdale, New York

Prepared By

Richard S. Kessler, P.E.

Consulting Geotechnical Engineer

Little Falls, New Jersey

1.0 INTRODUCTION

The purpose of this report is to describe the results of a subsurface investigation and analysis conducted on the site of the proposed additions, including site improvements, for the existing Scarsdale Public Library located west of the intersection of Olmsted and Post Roads (54 Olmsted Road) in Scarsdale, New York. This analysis, which is based on a field reconnaissance, a subsurface investigation program, a field testing program, a laboratory testing program, and an engineering study to determine the properties of the subsurface materials present at the site, serves as the basis for detailed recommendations concerning:

- The depth, type, and minimum size of foundations;
- Allowable loadings to be used in foundation design for most of the additions;
- Allowable bearing capacities to be used in foundation design for a portion of the additions;
- Groundwater control measures;
- Guideline construction procedures;
- Other Geotechnical Engineering aspects of the project.

All services provided for this project have been conducted in accordance with the terms of the May 18, 2016 and June 21, 2016 agreements. The services covered by the original agreement were authorized on May 19, 2016 and your authorization to proceed with the additional services of the June 21, 2016 agreement was received on August 24, 2016.

2.0 PROJECT DESCRIPTION

The proposed additions will wrap around portions of the south, west, north, and east sides of the 1970s era addition to the original 1950's era building. The proposed additions will consist of single story structures with a total footprint area of 7,500± square feet. The eastern addition may have a 1,400± square foot below grade book vault within the proposed addition. An elevator serving the below grade and ground floor levels may be included in the vault area. Proposed ground floor finished floor levels for the proposed additions will match the existing ground floor level of elevation +199± feet. The potential below grade level of the book vault in the eastern addition area will have a finished floor level of elevation +190± feet. The potential elevator pit could extend up to four feet below basement finished floor grade of +190± feet, i.e., elevation +186± feet.

A new retaining wall and areaway stairs to the existing building below grade level will be located at the eastern end of the proposed addition on the north side of the existing building.

Review of the available plans, described in a following section of this report, indicates that the proposed addition ground finished floor levels on the south and west sides of the existing building will be very close to the existing site grade near the existing building walls but could require up to five feet of new fill at their furthest point away from the existing building. Finished ground floor level for the eastern addition will be very close to the present existing site grades.

3.0 DATA

Twelve borings were drilled to a maximum depth of 88.0 feet below the ground surface at selected locations within the area of the proposed addition structures and site. Six of these borings were intended to specifically provide information for investigation and analysis of subsurface conditions impacting foundation design and construction. Five of these borings were intended to provide subsurface data for site design purposes. A total of fifteen borings were originally proposed for this project. However, one of these fifteen borings was deleted due to similar subsurface conditions encountered in adjacent borings and two borings were not drilled due to uncertainty concerning the location of a deep utility line.

The boring operations for the subsurface investigation were conducted in two stages, one in June and the second in September 2016. This dual stage was recommended and accepted by your office in order to evaluate foundation systems different from the one anticipated at the time the original proposal for the services was submitted in May 2016.

Four of the borings core drilled bedrock or boulders for a maximum length of 10 feet. Groundwater observation well pipe was installed in three of the borings to a maximum depth of 20 feet.

The borings, as conducted by Environmental Technical Drilling, Inc., were made in a standard manner with standard equipment and methods. The size of the borings, type of sampling device, and details of the sampling procedures are shown on the attached boring logs. The ground surface elevations shown on these logs were obtained from available topographic data provided by others. Included with this report is a plan indicating the location of the borings.

Copies of the following documents have been provided in digital format for use in this analysis by your office or one of your consultants:

- Topography Prepared for Village of Scarsdale, Situate in the Village of Scarsdale, Town of Scarsdale Westchester County, New York; dated June 19, 2015, latest revision July 15, 2015; prepared by Thomas C. Merritts Land Surveyors, P.C.

- Proposed Boring and Percolation Test Locations, Scarsdale Public Library, Village of Scarsdale, NY; dated 6/30/15; prepared by Divney Tung Schwalbe.

- Scanned 1950s Era Plans for the original Scarsdale Public Library, Village of Scarsdale, New York; dated June 15, 1945, revised January 16, 1950; prepared by Alfred Morton Cithens & Raphael Hume Associated Architects, 17 East 49th Street, New York (some drawings by Elwyn E. Seeleye, Consulting Engineers); 19 drawing sheets. Foundation & First Floor Framing Plan, Drawing Number S-1 indicates boring profiles and locations; unspecified date and driller).

- Scanned 1970s Era Plans for the addition to the Scarsdale Public Library, Scarsdale, NY; dated 8-30-73, latest revision Nov. 19, 1973; prepared by Gibbons, Heidtmann & Salvador & Planners; 22 drawings.

- Schematic Plans & Sections, Scarsdale Public Library; undated; prepared by Dattner Architects, D.P.C.; 12 sheets.

These documents indicate the location of the original 1950s era library, the 1970s era addition to the library, the location of the presently proposed additions, exiting site topography, selected topographic features, selected existing subsurface utility locations, and Architectural and Structural information for both the original 1950s era library, and 1970s era addition plus schematic Architectural information for the presently proposed additions.

4.0 FIELD TEST DATA & RESULTS

Infiltration tests were conducted at a depth of 4 feet below the existing ground surface in seven of the borings. The infiltration tests were conducted in 6" diameter casing according to procedures outlined by New York State Stormwater Design Manual. The location of these tests were coordinated with the Project Site Engineer, Divney Tung Schwalbe. The results of this field testing are presented in the following table:

BORING NO.	SPT*	INFILTRATION RATE (in/hr>)	SOIL DESCRIPTION @ TEST DEPTH
B-3	8	6	FILL: Brown & grey Cinders & Ash [FILL]
B-4	12	2	FILL: Grey brown mf Sand, little Silt w/ Cinders & Ash [FILL]
B-10	15	0.5	FILL: Brown cf Sand, some f Gravel, little(+) Silt [FILL]
B-12	7	0.5	FILL: Grey & white Cinders & Ash [FILL]
B-13	9	3	FILL: Brown mf Sand, some(+) Silt, trace(+) f Gravel [FILL]
B-14	7	3	FILL: Brown mf Sand, some(-) Silt, little f Gravel [FILL]
B-15	15	0.5	FILL: Brown mf Sand, some Silt w/ Cinders & Ash [FILL]

* SPT = Standard Penetration Test Value (or "Blow Count") adjusted for use of an automatic hammer

An explanation of the soil descriptions in the above table is presented in one of the appendices to this report.

5.0 LABORATORY TEST DATA

All boring samples were visually examined in the laboratory to develop soil and rock descriptions shown on the attached boring logs according to:

- ASTM D2487-11 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).

- Table 2 of the 1976 edition of ASCE- Manuals and Reports on Engineering Practice- No. 56.

Note that a detailed description of this these classification systems are included as appendices to this report.

6.0 SITE DESCRIPTION

The site is located on the west corner of the intersection of Olmsted and Post Roads. The regional slope of the ground surface is down to the north. The ground slope across the library site has a similar slope and the southeast portion of the site is depressed up to 10± feet below Post Road. The site then continues down to the northwest to a stream along the northwestern limit of the library property. The maximum difference in ground surface elevation across the present library and proposed addition structure site is estimated to be 6± feet. The ground surface in the proposed addition areas on the south and west sides of the existing building slopes down away from the existing building walls a maximum of 5± feet within the proposed width of the additions. A similar ground surface configuration is located in the area of the north addition but the estimated difference in elevation is only a maximum of 2± feet. The existing building is surrounded by lawn and landscaping including rain gardens apparently handling a portion of the site storm water. Asphalt paved parking areas and access and egress drives are located on the south, west, and east sides of the existing buildings.

Known subsurface utilities present at this site include, electric lines, gas lines, sanitary sewer lines, and storm sewer lines. A data line enters the existing library near the southwest corner of the north proposed addition area.

The original 1950s era library building consists of one and two story structures with a full below grade or basement level. This stone and masonry structure is supported on spread footing and grade beam foundations designed for a maximum allowable bearing pressure of 4,000 psf as indicated on the revised June 1950 design drawings provided for use in this analysis. The basement slab in the northwestern section of this original building slopes down from elevation +195± feet at the south, west, and north building walls to a central portion as shown on the attached Boring Location Plan at an elevation of +190± feet. The horizontal length of this sloping floor is approximately 10 to 12 feet. The reason for this basement floor slab configuration in this area of the original building is unknown. A 24" diameter sewer line cuts across the basement area in the western portion of the original building in a roughly north-south direction at a reported invert of elevation +178 feet.

The 1970s era addition to the original building consists of a single story structure located south and west of the original 1950's era building. The addition structure is similar to the original building, i.e., mostly of masonry and stone construction, but does include a steel frame. The addition is reportedly supported on treated timber piles having a minimum tip diameter of 8 inches and a minimum butt diameter of 12 inches. The structural load carrying capacity of these piles is specified as 20 tons per pile. The piles reportedly support both the addition structure and the ground floor slab. Information concerning the installed length of these timber piles plus other design details were not available for this analysis.

Brief visual inspection of the interior and exterior of both the original building and the 1970s era addition did not disclose overt evidence of foundation distress.

7.0 AVAILABLE SUBSURFACE DATA

The available subsurface information was obtained from two primary sources, the first being published sources and the second, soil borings conducted as part of the design of the 1950s era original building as follows:

> Published Sources:
> This data indicates that the site is located in an area where glacial till deposits are reported to be present overlying bedrock often encountered at depths of less than 10± feet below the ground surface. Reported soil types present within the till deposits most often consist of silty and/or clayey sands an gravels. Perched and/or shallow groundwater tables may be present at the site. Inspection of the site and general area suggests that cobbles and boulders will be scattered throughout the soil profile and that fill materials are likely present overlying the till deposits resulting from previous periods of site development.
>
> 1950s Era Soil Borings:
> A total of 11 soil borings were reportedly drilled in the area of the 1950s era structure footprint. The borings were not drilled using "present day" procedures since the logs do not include the results of Standard Penetration Testing that would quantitatively indicate the strength (load carrying capacity) of the penetrated materials. In general terms, the borings penetrated a maximum of 14± feet of cinder, ash, and other miscellaneous fill materials overlying what was likely virgin subsurface materials consisting of sands and gravels. Refusal of the borings, which was likely refusal of augers used to penetrate the subsoils, was reported at depths ranging between 10± and 32± feet below the ground surface at the time the borings were drilled. These refusal levels reportedly corresponded to elevations of 163± and 187± feet. Groundwater was reported in the borings at depths ranging between 5± and 14± feet below the ground surface at the time the borings were drilled, elevation 182± and 192± feet.

Seven borings conducted as part of the design and construction of the 1970s era addition were reportedly drilled by Atlantic Drilling, Inc. However, the logs for these borings and the subsurface conditions encountered in the borings were not available for this investigation and analysis.

8.0 SUBSURFACE CONDITIONS

In general terms, the subsurface conditions within the proposed addition sites consisted of fill materials overlying virgin materials consisting of soil aggregate based materials and, most often, swamp type deposits consisting of peat and organic silts and clays. The swamp type deposits were underlain by: virgin soil aggregate materials, silts and clays, and bedrock. A detailed description of the subsurface conditions encountered in specific areas of the addition sites is presented below.

South, West & North Addition Sites
The borings drilled for the south, west and north additions encountered up to 14± feet of fill material overlying a layer of very soft to stiff interbedded peat and organic silts and clays extending to a maximum depth of 39± feet below the ground surface. Occasional layers of loose to medium compact silty sands up to 6± feet thick were present on top of the interbedded peat and organic silts and clays. The fill was observed to be: in a very loose to medium compact state; primarily consisted of silty sands and gravels; and contained cinders, ash, and clay tile fragments. A very soft layer of inorganic silts and clays was present in one of the borings extending to a depth of 48± feet below the ground surface.

Loose to compact silty sands were present in the borings below the interbedded peat and organic silts and clays and inorganic silts and clays. These deeper silty sands were underlain by hard silts and clays in one boring and bedrock in two of the borings. The bedrock was encountered at depths varying between 45± and 65± feet below the ground surface and consisted of medium hard to hard, moderately to slightly weathered, very closely to closely jointed Micaceous Gneiss. The bedrock had several layers of soil within the rock and, in particular, a 15± foot thick layer of very compact silty sands in one of the borings.

East Addition Site
The borings located in the area of the proposed east addition site encountered up to 8± feet of fill materials overlying loose to very compact silty sands and gravels. The fill consisted of loose to compact silty sands and gravels with cinders and ash scattered throughout the soil profile. An approximately 2-foot thick layer of very stiff silts and clays was present in one of the two borings drilled in this addition site area. One of the borings encountered bedrock at a depth of 23± feet below the ground surface. The bedrock in this boring consisted of medium hard, slightly to moderately weathered, very closely jointed Micaceous Gneiss.

The shallow borings drilled for site design purposes generally encountered fill materials consisting of silty sands mixed with layers of slightly organic and inorganic silts and clays, cinders, ash, and glass fragments.

Groundwater observation well pipe was installed in three of the borings to allow for long-term monitoring of the groundwater level. These wells recorded groundwater levels at depths ranging between 9.5± and 12± feet below the ground surface, elevation +187± and +189.5± feet.

Detailed subsurface conditions at the boring locations are shown on the attached logs.

9.0 DISCUSSION & CONCLUSIONS

Development of recommendations for the design of foundation systems based on the performance of a subsurface investigation and analysis must, as a minimum, fulfill the following requirements:

1. The foundations must have adequate safety against a failure caused by shearing of the subsoils.
2. The total uniform and differential foundation settlement and/or movement of the structure must not exceed tolerable limits.

It must also be possible to construct the recommended foundation system in an efficient and cost effective manner.

The subsurface profiles present at this site consist of fill materials, highly organic materials, and both cohesive silt and clay and noncohesive granular silty sand soils. Therefore, the behavior of foundations must be analyzed considering the engineering characteristics of each of these materials. The supporting capacity of a cohesive silt and clay material is related to both the shear strength of the soil and the anticipated amount of foundation movement relative to the magnitude of tolerable structure settlement. The supporting capacity of a noncohesive, granular soil is normally governed by the anticipated amount of foundation movement relative to tolerable structure settlement. Highly organic materials have little or no ability to support imposed loads due to their normally high short- and long-term compressibility and low strength. The supporting capacity of a fill material is dependent on both the type of material and the method of placement. Fill materials frequently have very irregular supporting capacities, which can result in detrimental structure settlement unless the fill was placed in a controlled compacted manner.

The primary problem subsurface conditions at this site involve the presence of the existing fill materials, peat, and both organic and inorganic very soft silts and clays. These materials mus be considered as totally unsuitable for support of structures and floor slabs, i.e., nominally unsuitable bearing materials, due to their low load carrying capacity and both anticipated large short-term and long-term settlement that would be detrimental to the proposed addition structures and floor slabs should they be relied upon for support of the additions. Therefore, all foundation loads must be transmitted through these nominally unsuitable bearing materials to more suitable bearing materials at relatively large depths below the ground surface for most of the proposed additions. Because of the depth and extent of these materials, it is the opinion of this office that the most suitable and cost effective procedure for accomplishing this objective involves the use of a pile foundation system for support of three of the four proposed addition structures and floor slabs.

Both steel and treated timber piles were considered for use at this site for support of the foundation and floor slab loads. It is anticipated that the use of steel piles are better suited to this site and will be more cost effective than timber piles since the depth to bearing material is relatively large; the loads to be supported although not particularly large are arranged such that efficient use of the higher available capacity of steel piles is possible; and the higher capacity of a steel pile is desired to accommodate downdrag loads on the piles.

Piles at this site must be driven to support a total load carrying capacity greater than their structural load carrying capacity to compensate for downdrag loads. Downdrag is caused by the loads from fill placed to achieve desired finished grades and the pile driving operations. Fill loads and pile driving operations will cause consolidation and compression of the loose fill materials and compression and remolding of the underlying soft (organic) silts and clays resulting in relative movement between the pile and the surrounding soils. Long-term settlement caused by creep and material decomposition of the organic materials also contributes to this problematic movement. The downward relative movement of the soil tends to drag the pile down by shear along the pile surfaces. However, the pile tends to resist this downward movement of the soil which imposes a load on the pile independent of the structure. If the piles are not designed to carry the additional downdrag loads, excessive settlement of the pile and structure can occur. The recommended structural load carrying capacity and the total load carrying capacity for the piles presented in the following section of this report have been formulated to account for this downdrag phenomena.

Other issues that require special attention relative to design and construction of foundations for this project include:

- Any settlement of the new foundation systems will be expressed as differential settlement relative to the new additions and the presently existing structures. Therefore, stricter limits of settlement of the new foundations must be applied.
- The impact of the loads of any new fill placed for and around the new additions on the magnitude of the above discussed downdrag loads on piles. There are two approaches for dealing with this issue. The first involves designing extra capacity into the new piles to account for anticipated downdrag loads. The second would involve restricting the placement of new fill below and around the proposed new additions in order to minimize downdrag loads on the piles.

- Potential disturbance to the existing building resulting from driving piles. It is anticipated that this can be minimized by placing piles a minimum distance away from the existing building and requiring the use of pre-drilling to reduce vibrations transmitting to the existing building during pile driving.

Detailed recommendations for the design and construction of the foundations for the proposed new additions are presented in the following section of this report.

10.0 RECOMMENDATIONS

The subsurface conditions and load carrying capacity of the subsurface materials at the southern, western, northern, and eastern proposed additions are sufficiently different to allow for the use of significantly different foundation systems for the south, west, and northern additions, Group 1, and the eastern addition, Group 2. Therefore, the detailed recommendations for design of foundations will be presented in different subsections of this report. A final subsection of this report will present recommendations common to all four of the proposed additions.

10.1 Group 1: South, West & North Addition Recommendations

No new fill should be placed within and outside of these addition areas in order to minimize the impact of downdrag phenomena on the load carrying capacity of the recommended piles. See the previous section of this report for a discussion of downdrag phenomena and its impact on the load carrying capacity of piles. This, in part, means that all structural elements must be formed without the benefit of ground support during construction. IMPLEMENTATION OF THIS RECOMMENDATION IS CRITICAL TO THE SUCCESSFUL PERFORMANCE OF THE PILES TO BE RECOMMENDED BELOW.

The proposed south, west, and north structure addition and floor slabs should be supported on concrete filled steel pipe piles. A minimum pipe pile section with a 12 3/4" O.D. and a minimum 0.5" wall filled with concrete having a 28-day compressive strength of 4,000 psi is recommended for these additions. The piles should be driven closed-end and all splices should be fully welded for water tightness. Piles should be driven to practical refusal as outlined in the attached Guide Specifications for Piling and assigned a total load carrying capacity of 60 tons and designed to carry a compressive structural load of 40 tons per pile. The piles may be designed to carry a maximum tension load of 30 tons, and a maximum lateral load of 7 tons given that a total lateral displacement of 1/4" is acceptable.

It is anticipated that estimated pile lengths will range between in accord with the following table:

BORING NUMBER	ESTIMATED PILE LENGTH (feet below existing ground surface)
B-1	65 ±
B-3	55 ±
B-5	35 ±
B-6	50 ±

Preparation of budgetary cost estimates for the piles should be based on a pile length of 60 feet. The actual length of the driven piles at each location will vary from this length with changes in driving and subsurface conditions throughout the addition sites.

Pile driving operations may cause damage to adjacent existing structures consisting of minor cracking and/or settlement. Pile driving operations should be staged such that all pile driving start closest to the existing buildings and, at all times, move away from the existing buildings. It is recommended that no pile be driven closer than five feet from the existing buildings and that all piles be pre-drilled to a minimum depth of 20 feet below the ground surface. It is anticipated that implementation of both of these recommendations will assist in minimizing vibrations from pile driving operations in the existing building and reduce the risk of potential damage to the existing buildings.

All piling materials and driving operations should satisfy the requirements of the attached Guide Specifications for Piling.

A Site Class of F determined in accordance with the requirements of the Building Code of New York State, 2016, i.e., the International Building Code, 2015, 3rd Printing (2016NYSBC) and Minimum Design Loads for Buildings and Other Structures, ASCE Standard 7-10 (ASCE 7-10) must be assigned to these additions based on the presence of more than 10 feet of peats and/or highly organic soils. Therefore, a site specific ground response analysis must be conducted in order to establish seismic design parameters for these proposed additions. The required ground response analysis should include a site specific seismic survey. Please note that the required site specific ground response analysis and site specific seismic survey are both beyond the scope of this subsurface investigation and analysis.

Assignment of a Site Class of F requires an evaluation of potential hazards resulting from earthquake motions impacting slope stability, liquefaction, and surface rupture. However, such an evaluation depends on the results of the required site specific ground response analysis and cannot be conducted based on the presently available subsurface data.

Problems involving a high groundwater table during construction are not anticipated as long as excavations are less than approximately 5 feet below the existing ground surface. Sumps and pumps should be provided when necessary to maintain excavations in a "dry" state during construction.

All pile driving operations should be conducted under the observation of a Geotechnical Engineer.

10.2 Group 2: East Addition Recommendations

It is understood that the presently proposed below grade level, book vault, for this addition may be deleted from the project scope based on economic considerations. Therefore, recommendations for the east addition must be provided based on both the presence or absence of the presently proposed below grade level. Detailed recommendations for the design and construction of foundations for this addition given both of these design conditions, i.e., presence of a below grade level and absence of a below grade level, are presented in the following subsections of this section.

10.2.1 Group 2: East Addition, with Below Grade Level, Recommendations

The proposed east building addition foundation system should consist of a reinforced concrete mat given that the proposed below grade level is designed and constructed. The mat should be designed on the basis of the following soil supporting parameters (1 Kip = 1,000 Pounds):

- Maximum Allowable Soil
  Bearing Capacity... 3.0 Kips/Square Foot
- Modulus of Subgrade
  Reaction... 400 Kips/Cubic Foot

The mat subgrade should be compacted with a minimum of six passes of large double-drum walk behind compactor equivalent to a Dynapac LP-750 Walk-Behind Vibratory Compactor before placement of reinforcing steel. Materials that cannot be compacted in-place should be excavated and replaced with 3/4-inch size clean crushed stone (No. 57 or 67 Stone as per AASHTO Specifications).

The soils at the bottom of the mat excavation should not be exposed to the weather for abnormally long periods. Care must be taken to preserve the natural state and supporting capacity of the foundation soils. These soils will loosen and soften rapidly in the presence of excess water. Agitation caused by workers or machines will significantly increase the rate of deterioration of the soil(s). For these reasons, any water collecting in excavations must be removed as quickly as possible. If the foundation soils are disturbed, they should be removed until a firm undisturbed material is encountered as directed by a Geotechnical Engineer. It would be advisable to place a minimum of six inches of 3/4-inch size clean crushed stone (No. 57 or 67 Stone as per AASHTO Specifications) on the bottom of the mat excavation to assist in maintaining bearing conditions during reinforcing steel placement.

A Site Class of D determined in accordance with the 2016NYSBC and ASCE 7-10 may be used in seismic analysis for the design of the eastern addition structure. Potential hazards resulting from earthquake motions impacting slope stability, liquefaction, and surface rupture are not anticipated at this addition site based on the observed subsurface conditions and implementation of the recommendations of this report.

Below grade walls should be designed to withstand all anticipated soil, water and surcharge loadings. It is recommended that the following soil parameters be used in the computation of earth pressures on walls, assuming a level backfill surface:

Moist (total) Soil Unit Weight =	130.0 pcf
Coefficient of Active Lateral Earth Pressure =	0.3
Coefficient of At-rest Lateral Earth Pressure =	0.5
Coefficient of Passive Lateral Earth Pressure =	3.0

The resulting lateral pressures on below grade walls could be reduced approximately 20 percent if the walls are backfilled under the resident observation of a Geotechnical Engineer in a controlled, compacted manner to a minimum of 95 percent of the maximum Modified Proctor density of the material used for backfill.

Groundwater levels encountered during and after construction will vary from the levels shown on the test hole logs due to seasonal variations in rainfall, temperature, variations in soil permeability, and the use of water in the boring operations. A system of sumps, ditches, and pumps should be provided during construction to maintain the groundwater level a minimum of two feet below the bottom of all excavations.

Permanent, long-term groundwater control systems should be included in the building design. It is recommended that the required long-term groundwater control system consist of monolithic waterproofing and design of the structure elements to resist anticipated water pressures. It is recommended that a long-term groundwater level of elevation + 192 feet should be used in foundation design.

It would be advisable to construct a series of ditches and dikes to divert surface water away from all excavations and controlled fill areas. Water from the roof leaders from the existing building should be diverted away from the proposed addition area.

Excavation for placement of footings adjacent to the 1950s era existing footings should be conducted in a manner that will not reduce the supporting capacity of the subsurface materials supporting the existing footings. Excavation below existing footing levels may require underpinning of the existing footings.

Excavation slopes and support systems during construction should meet all requirements of the Occupational Safety and Health Administration (OSHA). The existing site soils in this addition area may be considered a Class C type soil for application of these requirements.

The bottom of the mat excavation should be inspected during subgrade compaction by a Geotechnical Engineer prior to either clean crushed stone or reinforcing steel placement.

10.2.2 Group 2: East Addition, No Below Grade Level, Recommendations

The proposed east building addition foundation system should consist of driven steel pipe piles designed and constructed in accordance with the recommendations presented above in Section 10.1 Group 1: South, West & North Addition Recommendations with the following modifications:

1. A minimum pipe pile section with a 9 5/8" O.D. and a minimum 0.5" wall filled with concrete having a 28-day compressive strength of 4,000 psi is recommended for this addition. The piles may be assigned a load carrying capacity of 35 tons per pile. The piles may be designed to carry a maximum tension load of 5 tons, and a maximum lateral load of 5 tons given that a total lateral displacement of 1/4" is acceptable.

2. Preparation of budgetary cost estimates for the piles should be based on a pile length of 30 feet. The actual length of the driven piles at each location will vary from this length with changes in driving and subsurface conditions throughout the addition sites.

3. All piles pre-drilled to a minimum depth of 10 feet below the ground surface.

A Site Class of D determined in accordance with the 2016NYSBC and ASCE 7-10 may be used in seismic analysis for the design of the eastern addition site structure. Potential hazards resulting from earthquake motions impacting slope stability, liquefaction, and surface rupture are not anticipated at this site based on the observed subsurface conditions and implementation of the recommendations of this report.

10.3 Common Recommendations

All existing utilities less than ten feet below the proposed new structure additions should be relocated before the start of foundation construction operations. Consideration to relocation of utilities at depths greater than this limit should also be considered since the presence of the existing and proposed new structures limit the methods available for maintaining the utilities.

Observation/inspection of earthwork and foundation construction operations, although often provided as part of testing of other construction materials, should be conducted as a separate quality control item of service. Such observation/inspection is actually an Engineering service that is often unique to each project and requires specialized, non-standardized training and skills as opposed to testing services. In addition, only one opportunity to accomplish the required observation/inspection is available since Geotechnical related construction operations are most often buried and no longer available for comprehensive observation/inspection and testing after completion. For these and several other important reasons, a Geotechnical Engineer is strongly recommended for observation/inspection of all earthwork and foundation construction operations as opposed to a testing laboratory. It has been the experience of this Office that engagement of a Geotechnical Engineer for resident, full-time observation/inspection of earthwork and foundation construction operations directly through the Owner as a separate quality control item of service provides the greatest short- and long-term benefits to project quality, cost, and completion.

Settlement was considered in this analysis. It is estimated that maximum uniform post-construction addition building settlement will be less than one-half inch given satisfactory foundation system installation and performance. These values are generally within tolerable limits for this type of structure. Movement control joints should be placed between the proposed new additions and the existing building structures.