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MEMORANDUM

TO: Paul Apple
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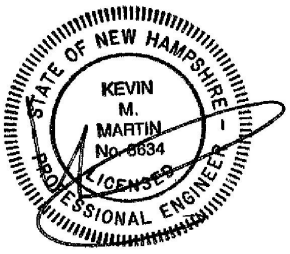

FROM: Angus Strachan, E.I.T. — Staff Engineer
Kevin Martin, P.E. — Geotechnical Engineer

DATE: September 24, 2013

RE: **GEOTECHNICAL SUMMARY REPORT**
PROPOSED MUNICIPAL BUILDING
239 ATLANTIC AVENUE
NORTH HAMPTON, NEW HAMPSHIRE Project No. 13-15-0039

This memorandum serves as a Geotechnical Summary Report for the referenced project. The contents of this report are subject to the attached ***Limitations***.

SITE & PROJECT DESCRIPTION

The project site is located along Atlantic Avenue near the intersection with Alden Road. A residential structure recently occupied the site. This building has been removed and the property is vacant. We understand a septic system remains on the property. We were provided with limited Plans. Based on visual assessment, the site is relatively level with gradual slope. Some ledge outcrops are apparent towards the rear of the property. JTC has no further knowledge of past construction or development on the property.

The project includes a new municipal building. The building is still in the conceptual stage and final plans are not available at this time. The building will likely include a single-story, wood-framed structure supported on a conventional spread footing foundation with a concrete floor slab-on-grade (no basement). Shallow bedrock may impact the final site grading. We expect shallow cuts and fills (less than ≈1-3 ft) to achieve final grade.

The purpose of this study is to provide a geotechnical evaluation as it pertains to foundation design and associated construction as required by the *State Building Code*. This study should be considered preliminary given lack of plans and grading at this time. This report does not include an environmental assessment relative to oil, gasoline, solid waste and/or other hazardous materials. The environmental conditions of the property should be addressed by others as necessary.

SUBSURFACE EXPLORATIONS & LABORATORY TESTING

Test Borings/ Ledge Probes

The subgrade conditions were reviewed with the completion of seven (7) test borings and twenty (20) ledge probes. The test borings (identified as B1 to B7) were advanced to refusal depths of about ≈2-10 ft utilizing 2¼ inch continuous flight hollow stem augers. Soil samples were typically retrieved at no greater than 5 ft intervals with a 2-inch diameter split-spoon sampler. Standard Penetration Tests (SPTs) were performed at the sampling intervals in general accordance with ASTM-D1586 (*Standard Method for Penetration Test and Split-Barrel Sampling of Soils*). Given shallow refusal, several ledge probes were completed to further review the depth to refusal. The ledge probes involved advancement of the solid stem augers fitted with a tungsten carbide cutting head until refusal was met. Field descriptions and penetration resistance of the soils encountered, observed depth to groundwater, depth to apparent bedrock refusal and other pertinent data are contained on the attached *Test Boring Logs*. The test borings were located by referencing existing site features as shown on the *Test Boring Location Plan*.

Laboratory Testing

Three (3) selected split-samples obtained from the test bores were submitted to our laboratory for sieve analyses per ASTM Standards. The purpose of the testing was to assess engineering characteristics for design and to assess the suitability of the site soils for re-use as structural fill on the project. The test results are attached for review.

SUBGRADE CONDITIONS

The site subsurface conditions below the surface Organic soils include a thin Glacial Overburden then shallow Bedrock refusal. Some shallow Fill should also be expected around the site being associated with past construction and utilities.

The majority of the site is blanketed with a surface Topsoil and underlying Subsoil Horizon. The Topsoil varies from about ≈5-8 inches in thickness. The Subsoil, which extends about ≈18-24 inches below grade, includes a rust brown, loamy, silty Sand, trace gravel, roots.

The shallow Overburden soils include a well-graded, fine to medium Sand with some gravel, some to little silt. Fill soils should also be expected being associated with the prior building construction and associated utilities.

Shallow Bedrock was encountered about ≈2-9 ft below grade (typically between ≈3-6 ft). The attached *Summary* outlines the depth to refusal at the respective test locations. The attached *Sketch* shows the depth to bedrock. Given the variable depth to refusal, the bedrock appears to have an undulating and sloping contour. The *USGS Bedrock Geologic Map of New Hampshire (1997)* depicts bedrock in the area to include granite (Breakfast Hill Granite), gneiss, schist and/or quartzite associated with the Rye Complex. Such rock types are characteristically hard and of sound quality. In some cases, there was about ≈1-2 ft of penetration with the augers suggesting occasional weathered ledge. For the most part, the ledge is expected to be massive and hard.

Groundwater was not encountered in the test bores. Seasonally perched water should be expected atop the shallow ledge. Fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, utilities and other factors differing from the time of the measurements. This study was completed at a time of seasonally low groundwater.

FOUNDATION SUBGRADE RECOMMENDATIONS

The subgrade conditions are favorable for supporting the proposed building on a conventional spread footing foundation. The footings should gain bearing support atop the shallow Bedrock or parent Glacial soils. The surface organic soils, undocumented fill, intersecting utilities, abandoned foundations, etc. should be fully removed from the building pad plus ≈10 ft laterally around the foundation perimeter. There is expected to be about ≈12-18 inches of organic laden soils to the stripped in this regard. Over-excavations below foundation grade, as necessary, shall be replaced with Structural Fill (Table 1).

The parent subgrade soils should be exposed in the foundation areas prior to casting the footings or placing structural fill. It is recommended that the parent subgrade soils be proof-rolled with vibratory densification and exhibit stable and compact conditions. The purpose of the proof-rolling is to densify the site soils and identify potential loose or unstable areas which should be removed as necessary. Proof-rolling should involve at least 4-5 passes with a vibratory compactor (minimum 750 pound static weight) operating at peak energy. During the proof rolling process, the subgrade should be observed by an Engineer to identify areas exhibiting weaving or instability. It will be necessary to remove weakened or unstable soils and replace with a Structural Fill. Proper groundwater control and storm water management are also necessary to maintain site stability.

Bedrock conditions are expected to be encountered in areas during foundation construction. The bedrock surface should be relatively level with a slope no greater than ≈15%. It is recommended that a minimum ≈10 inch lift of one inch minus crushed stone be placed between the footing and the bedrock surface to provide a more uniform and elastic bearing subgrade. The purpose of the gravel

base ("cushion base") is to mitigate differential settlements throughout the foundation. Following a ledge blast within the building footprint, the heaved/disturbed over-blast should be fully removed exposing the underlying intact/competent ledge. This is especially important in the building area for support of the spread footing foundation. It should be noted that drill holes at least ≈6-8 ft in depth are typically necessary in order to remove ledge with explosive blasting. This may generate additional over-blast that should require engineering review. It may be possible to leave some of the over-blast in-place, however, this will require engineering review (via test pits) during construction. Extensively heaved/disturbed over-blast will not be considered a suitable subgrade as potential subsidence may be experienced when loaded. Our experience with similar projects suggests that the overblast may remain below the foundation limits. This is contingent upon a one foot base of one inch minus crushed stone being placed a minimum one foot below and laterally beyond the footing limits in order to provide a more uniform subgrade. The over-blast to remain will need to be densified and/or compacted prior to the placement of the specified stone base. This may be accomplished with a thin leveling base of one inch minus stone to fill surface irregularities then densification with a minimum one-ton vibratory compactor operating at peak frequency making at least 4-5 passes across the bearing subgrade. The blasting contractor should understand the concerns associated with the over-blast conditions and provide an appropriate drilling/blast pattern. Removal of the bedrock with a hoe ram (if feasible) should mitigate bedrock disturbance.

Footings may be designed to bear atop intact ledge. Our experience suggests that the work involved to prepare the ledge is generally not feasible in this regard. Specifically, the ledge needs to be cleaned of ALL loose soil and rock and possess a slope no greater than ≈10%. Concrete may be used to fill surface irregularities. Rock pins may also be necessary. It is also preferable that ALL footings bear on ledge to provide uniform conditions and settlement control. The undulating bedrock complicates bedrock support in the regard. One potential advantage with placing the footing on ledge is that the frost embedment may be reduced to ≈2 ft. Again, this is contingent upon the bedrock being intact and free of any fractures (ie: no potential source of water or infiltration).

The bearing subgrade should ultimately be stable, dewatered, protected from frost and compact throughout construction. An Engineer from JTC should be scheduled to review the foundation subgrade conditions and preparation during construction.

FOUNDATION DESIGN RECOMMENDATIONS

The footings are expected to gain bearing support atop the parent glacial soils and/or compacted structural fill and indirectly atop bedrock. Footings may be designed using an allowable bearing capacity of 5 ksf (FS=3). The allowable bearing capacity may be increased a third (⅓) when considering transient loads such as wind or seismic. The bearing capacity is contingent upon the perimeter strip footings and isolated column footings being no less than 2 ft and 3 ft in width respectively. For footings less than 3 ft in lateral dimension, the net allowable bearing capacity should be reduced to one-third and multiplied by the least lateral footing dimension in feet.

Foundation settlement should be less than ¾ inch with differential settlement less than ½ inch. Settlement should be negligible where bedrock is within ≈1-2 ft of the foundation. The settlement should be elastic and occur during construction. Exterior footings shall be provided with at least 4 ft frost protection. Proper frost protection should be necessary during winter construction.

The subsurface conditions were reviewed with respect to seismic criteria set forth in the *International Building Code (2012)*. Based on the relative density of the site soils, the site is not susceptible to liquefaction (complete loss of shear resistance) in the event of an earthquake. Based on interpretation of the *Building Code* together with the project and site conditions, the *Site Classification* is "B" (Rock).

It is recommended that a minimum 8-inch base of *Clean Granular Fill* (Table 1) be placed below the concrete floor slab for moisture and frost control. The gravel base shall be increased to no less than 12 inches for exterior concrete slabs exposed to frost. A vapor retarder should be used below the floor slab dependent upon the floor treatment. A vapor barrier is expected to be necessary given the public use of the building. The vapor retarder may include a minimum 10-mil polyethylene or Stegowrap™ installed per ACI Standards. Structural fill necessary within and below the foundation should also conform to the attached *Specifications* (Table 1). The Glacial soil (silty Sand w/ gravel) should not be used for Structural Fill but rather Common Fill in pavement areas or foundation backfill. The site soils will need to be segregated from the organic laden soils, screened of large stones and compacted within ±2% of optimum moisture content per the Modified Proctor Test.

CONSTRUCTION CONCERNS

The contractor should be required to maintain a stable-dewatered subgrade for the building foundations and other concerned areas during construction. Subgrade disturbance may be influenced by excavation methods, moisture, precipitation, groundwater control and construction activities. The site soils (Glacial Till) are considered moisture sensitive and may become disturbed if exposed to wet conditions and construction activities. The contractor should take precautions to reduce subgrade disturbance. Such precautions may include limiting the extent of exposed subgrade if inclement weather is forecast, diverting storm run-off away from construction areas, reducing traffic in sensitive areas, backfilling footings as soon as practicable and maintaining an effective dewatering program. Soils exhibiting weaving or instability should be over-excavated to a competent bearing subgrade and replaced with a free draining structural fill. The moisture concerns are generally more problematic during the winter/spring season or other periods of inclement weather. A base of ¾-inch minus crushed stone may be considered atop the subgrade for protection during construction. The stone base is to protect the site soils, facilitate any necessary dewatering and provide a dry/stable base upon which to progress foundation construction. The protective stone base shall be tamped with a plate compactor and exhibit stable conditions. The stone base should be considered elective and dependent upon the subgrade conditions. The stone base should be considered necessary if wet conditions are present during construction. The stone base should be considered if construction takes place during the winter/spring season or other periods of inclement weather.

The groundwater table or puddled storm water, if encountered, should be continuously maintained at least one foot below construction grade until the area is backfilled. It is expected that the wet conditions may be controlled with conventional sumps and pumps together with a base of crushed drainage stone. Proper groundwater control and storm water management will be necessary to protect the subgrade soils. Subgrades that become weakened or disturbed due to excess moisture or other cause will be rendered unsuitable for structural support. An Engineer from JTC shall be scheduled to review the subgrade conditions and footing subgrade preparation during construction.

Bedrock Excavation

Bedrock excavation is expected to be required for foundation construction and site improvements. Based on our general experience with bedrock in the area, it is expected to be hard and of sound quality. As such, bedrock removal will likely involve blasting or mechanical hoe rams.

Given the proximity of existing structures and utilities in the area, the contractor should take precautions to limit vibrations, air-blast and fly-rock from disturbing adjacent structures and the public as a result of rock excavation. The contractor should perform rock excavation in accordance with all federal, state and local regulations. If blasting is used, it is recommended that a pre-blast and post-blast survey of existing structures/utilities within 250 ft be performed to mitigate potential claims. Seismographs should also be placed adjacent to existing structures to monitor blast vibrations. Vibrations should be limited to a peak particle velocity of less than 2 inch per second for vibrations having a frequency greater than 30 Hz. Blasting should also be sensitive with respect to fresh concrete. In general, the concrete should achieve at least ⅔ of the design strength prior to being subject to vibrations. The vibrations should also be limited to a peak particle velocity less than 1 inch per second especially for recent wall pours. Blasting should not be permitted within 25 ft of fresh concrete poured within 24 hours. The protection of existing structures/utilities as well as the new foundation construction is ultimately the responsibility of the site/blasting contractor.

Following a ledge blast within the building footprints, the heaved/disturbed over-blast should be fully removed exposing the underlying intact/competent ledge. This is especially important in the building areas for support of the spread footing foundation. It may be possible to leave some of the over-blast in-place, however, this will require engineering review (via test pits) during construction. Extensively heaved/disturbed over-blast will not be considered a suitable subgrade as potential subsidence may be experienced when loaded. Our experience with similar projects suggests that the overblast may remain below the foundation limits. This is contingent upon a one foot base of one inch minus crushed stone being placed a minimum one foot below and laterally beyond the footing limits in order to provide a more uniform subgrade. The over-blast to remain will need to be densified and/or compacted prior to the placement of the specified stone base. This may be accomplished with a thin leveling base of one inch minus stone to fill surface irregularities then densification with a minimum one-ton vibratory compactor operating at peak frequency making at least 4-5 passes across the bearing subgrade. The blasting contractor should understand the concerns associated with the over-blast conditions and provide an appropriate drilling/blast pattern.

CONSTRUCTION MONITORING

It is recommended that a qualified engineer or representative be retained to review earthwork activities such as the preparation of the foundation bearing subgrade and the placement/compaction of Structural Fill. It is recommended that JTC be retained to provide construction monitoring services. This is to observe compliance with the design concepts presented herein.

We trust the contents of this memorandum report are responsive to your needs at this time. Should you have any questions or require additional assistance, please do not hesitate to contact our office.

kmm50/jtc13/NorthHamptonMunicipal.wpd

LIMITATIONS

Explorations

1. The analyses, recommendations and designs submitted in this report are based in part upon the data obtained from preliminary subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations of this report.

2. The generalized soil profile described in the text is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized and have been developed by interpretation of widely spaced explorations and samples; actual soil transitions are probably more gradual. For specific information, refer to the individual test pit and/or boring logs.

3. Water level readings have been made in the test pits and/or test borings under conditions stated on the logs. These data have been reviewed and interpretations have been made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, and other factors differing from the time the measurements were made.

Review

4. It is recommended that this firm be given the opportunity to review final design drawings and specifications to evaluate the appropriate implementation of the recommendations provided herein.

5. In the event that any changes in the nature, design, or location of the proposed areas are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of the report modified or verified in writing by John Turner Consulting, Inc.

Construction

6. It is recommended that this firm be retained to provide geotechnical engineering services during the earthwork phases of the work. This is to observe compliance with the design concepts, specifications, and recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction.

Use of Report

7. This report has been prepared for the exclusive use of the Town of North Hampton in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made.

8. This report has been prepared for this project by John Turner Consulting, Inc. This report was completed for preliminary design purposes and may be limited in its scope to complete an accurate bid. Contractors wishing a copy of the report may secure it with the understanding that its scope is limited to geotechnical design considerations.

TABLE 1

Municipal Building
239 Atlantic Avenue
North Hampton, NH

Recommended Soil Gradation & Compaction Specifications

Clean Granular Fill
(Select Gravel Fill)

SIEVE SIZE	PERCENT PASSING BY WEIGHT
3 inch	100
3/4 inch	60-90
No. 4	20-70
No. 200	2-8

NOTE: For minimum 8-inch base below Concrete Floor Slab-on-Grade
For minimum 12-inch base for exterior concrete slabs exposed to frost
Shall have less than 12% fines (No. 200 sieve) based on the Sand fraction
Compact to at least 95% relative compaction per ASTM D1557

Structural Fill
(Gravelly SAND, trace Silt)

SIEVE SIZE	PERCENT PASSING BY WEIGHT
5 inch	100
3/4 inch	60-100
No. 4	20-80
No. 200	0-12

NOTE: For use as structural load support below the foundations
For use as backfill behind unbalanced foundation/retaining walls
A ¾-inch crushed stone may be used in wet conditions
Shall have less than 20% fines (No. 200 sieve) based on the Sand fraction
Compact to at least 95% relative compaction per ASTM D1557

TABLE 1

Municipal Building
239 Atlantic Avenue
North Hampton, NH

Recommended Soil Gradation & Compaction Specifications

Common Fill
(Silty SAND, little Gravel)

SIEVE SIZE	PERCENT PASSING BY WEIGHT
6-8 inch	100
3/4 inch	60-100
No. 4	20-85
No. 200	0-25

NOTE: For use as roadway embankment fill is deep pavement areas.
Maximum stone size should be ⅔ the maximum lift thickness
Compact to at least 93% relative compaction per ASTM D1557

Structural Fill placed beneath the foundation should include the *Footing Zone of Influence* which is defined as that area extending laterally one foot from the edge of the footing then outward and downward at a 1H:1V splay. Structural Fill should be placed in loose lifts not exceeding 12 inches for heavy vibratory rollers and 8 inches for vibratory plate compactors. All Structural Fill should be compacted to at least 95 percent of maximum dry density as determined by the Modified Proctor Test (ASTM-D1557). Structural Fill should be compacted within ±3% of optimum moisture content. The adequacy of the compaction efforts should be verified by field density testing which is also a requirement of the *State Building Code*.