

Memorandum

Date: November 17, 2022

Project #: 2206301

To: Melissa Halford, MCIP, RPP
Director of Development Services, Town of Gravenhurst

From: Alonzo Rowe, P.Eng., Geotechnical Engineer
Matthew D. St Denis, P.Eng., Team Lead, Geotechnical Engineering
Chi Cheng (Dennis) Tseng, M.Sc., P.Eng., Principal Geotechnical Engineer
Sarah Sipak, B.Sc., P.Geo (limited), QP_{ESA}, Environmental Geoscience Team Lead

Re: **Peer Review of Geotechnical Report for Proposed Official Plan Amendment and Zoning Amendment (OPA 01-2022 and ZA 11-202)**

Dear Melissa,

Palmer was retained by The Town of Gravenhurst (Client) to provide peer review of a previously completed geotechnical study completed to aid the permitting process for the proposed seven-story mixed use building at the Muskoka Wharf, The Starboard (the 'project'). The geotechnical report provided by the Client for review are:

- "Geotechnical Report – The Starboard, 205 Cherokee Lane", dated October 20, 2021, prepared by GEI Consultants and submitted to TRG (Cherokee) Holdings Inc.

This memorandum (memo) is provided on the basis of the terms presented above, and on the assumption that design will be in accordance with applicable codes and standards. If it can be reasonably foreseen that changes in the proposed design should require a geotechnical re-evaluation, or if questions arise concerning geotechnical aspects of the applicable codes and standards, Palmer must be made aware. It may then be necessary to carry out additional review before the findings provided in this memo can be relied upon. This report is subject to the Statement of Limitations provided at the end of this memo.

Palmer understands that the geotechnical investigation was to support the conceptual design process including construction sequencing. Palmer also understands that this study was conducted to enhance a previously completed geotechnical report by GEI that assumed different building design criteria. This report served to narrow in on cost estimates and appropriate construction methods for the proposed seven-story building with a single level underground parking garage.

1. Summary of Provided Geotechnical Report

The study by GEI Consultants was conducted during the planning phase. It generalizes the subsurface conditions as surficial topsoil and fill overlying native glaciolacustrine sand, silt and clay mantling granite bedrock. The report discusses potential foundation options for the seven-story building with a single level underground parking as well as potential methods for shoring design and groundwater control. The report recognizes the limited design data available and recommends that all designs should be reviewed by GEI to provide additional recommendations if required. The proposed finished floor slab is to be constructed at elevation 223.8.

The geotechnical investigation conducted by GEI consists of drilling of ten (10) boreholes at selected locations within the property and building footprint. This data was supplemented by a previous study where 5 boreholes were drilled by Central Earth Engineering. The boreholes ranged in depths from 3.0 to 19.4 metres below ground surface (mbgs). The boreholes revealed subsurface profiles generally consisting of topsoil over fill material extending to depths varying from 0.75 to 2.3 mbgs. The fill and organic material is underlain by loose to compact silts and sands extending to depths ranging from 1.5 to 5.3 mbgs. Clayey cohesive soil was encountered below the silt and sands and was considered very soft to stiff in consistency extending to depths from 3.0 to 8.8 mbgs. A second lower sand and silt deposit was encountered below the cohesive soils in Boreholes 2A, 5A, 7, 9 and 10 and extended until borehole termination from 7.3 to 19.1 mbgs. This second sand and silt layer was considered very loose to dense.

Bedrock was encountered and inferred in Boreholes 2A, 4A, 6 to 10 at depths ranging from 3.0 to 19.4 mbgs. Bedrock was proven by NQ size rock coring in Boreholes 8 and 10. The bedrock across the Site has been identified as Precambrian granite.

Groundwater measurements were made on September 16, 2021 in the three (3) monitoring wells installed across the Site in Boreholes 8, 9 and 10. Measurements of the groundwater were also completed in the 2 Boreholes completed in the previous study in boreholes CEE1 and CEE5. Groundwater levels ranged from 0.0 to 1.2 mbgs, corresponding to elevations ranging from 225.5 to 226.2 masl.

GEI's report includes a geophysical investigation to assess the seismic site classification of the property. This study was completed by Frontwave Geophysics and conclusions were prepared in a separate report.

GEI's report provides the anticipated soil behaviour in open cut conditions and recommended soil parameters for the types of soils encountered at the Site. General recommendations regarding open cut construction, including site grading excavation, foundation design, shoring design, backfilling, pavement design, pipe support and bedding have been provided.

The report considers two methods for shoring design: Interlocking Caisson Walls installed in the cohesive material or Interlocking Caisson Walls installed in bedrock.

The report considers micropiles as suitable deep foundation method for the proposed seven-story building. For micropiles with a nominal diameter of 200 mm driven to at least 4 m into the bedrock, the geotechnical reaction of 1300 kN per pile at the Ultimate Limit States (ULS) has been provided with no resistance considered through the overburden soils.

The approximate locations and the borehole log sheets of the boreholes conducted by GEI (Borehole 1A, 2A, 3A, 4A and 5A to 10) are appended to this report along with boreholes from the previous study conducted by Central Earth Engineering (Borehole CEE1 to CEE5).

It is our opinion that the GEI investigation and report presented above follow generally accepted practice for geotechnical investigations.

2. Geotechnical Review and Recommendations

Based on a review of this report, Palmer provides the following comments and recommendations:

- Groundwater is a major factor on the proposed site with the water level ranging from ground surface to about 1.2 m below ground surface (elevation 225.5 to 226.2). With the proposed basement floor elevation being at 223.8 m, it would be considered prudent to determine hydraulic conductivity of the soils within the excavation sidewalls. Palmer recommends that testing should be conducted to determine the hydraulic conductivity of the native sands and cohesive materials from elevation 222.0 to the ground surface. Hydraulic conductivity can be determined directly from field tests such as through slug tests or through empirical methods using the grain size analysis testing already completed. In summary, Palmer recommends a full hydrogeological study to fully assess the groundwater.

The hydrogeological assessment would following applicable guidelines and contain the following major components:

- Inventory of existing monitoring wells and reactivate and upgrade monitoring network;
 - Groundwater monitoring to determine groundwater level fluctuation and trend;
 - Groundwater sampling to determine groundwater quality;
 - Hydraulic tests to determine hydraulic conductivity of formations;
 - Dewatering rate and influence zone calculation based on hydraulic conductivity and hydrostratigraphy structure;
 - PTTW and EASR recommendations based on calculated dewatering rate;
 - Dewatering methodology recommendations;
 - Dewatering impact assessment.
- The proposed finished floor elevation for the single level basement garage is elevation 223.8. Based on observed water levels recorded by GEI, the basement will be below the water table and will be within saturated soils. For basement drainage design, Palmer recommends that only fully

waterproofed designs be considered. The recommended option of perimeter and subfloor drainage (options 1A and 2) are not suitable for this site as these methods will not sufficiently waterproof the structure from the water seepage from the saturated sands.

- Hydrostatic uplift should be considered in the design of the building.
- The proposed option for Interlocking Caisson Walls into Bedrock may be difficult because of the nature of the bedrock encountered. The unconfined compressive strength (UCS) of granite is very high (above 100 MPa) and would present challenges when socketing the caissons. Consideration must be made for the hardness of the bedrock and the challenges of drilling into it to create a proper seal at the caisson and bedrock interface. Additional lab testing could be completed to consider the hardness and strength of the rock.
- The report recommends micropiles to support the building and floor slab loads. Other foundation or ground improvement options may be considered for this site as an alternative to the preferred option. Soil and groundwater conditions present constructability issues with many conventional foundation options.
- There exists a weak silty clay layer on the site as encountered in all boreholes. When installing the proposed deep foundation of micropiles, the casing may have to be left in place to protect the micropiles due to the potential of down drag from the cohesive or compressible soils.
- It is noted that in Borehole 2 from the original study completed by Central Earth Engineering, spoon refusal was encountered in the fill. It is important that the possibility of large debris in the overburden including cobbles and/or boulders are not overlooked and the appropriate equipment be considered before the general excavation commences.
- The report recommends blasting as a method to excavate the granite bedrock. It should be noted that blasting may not be permitted in within the town limits of Gravenhurst. Other excavation methods such as the usage of heavy-duty hydraulic breakers may need to be considered. In general, it should be anticipated that with increasing depth into the bedrock the excavation will become progressively more difficult.

3. Excess Soil Review and Recommendations

As noted in the 2021 GEI Geotechnical Report, chemical sampling was conducted to provide a general characterization of the chemical composition of the existing soil on-site during this investigation. Palmer notes that recommendations regarding disposal and/or re-use were not incorporated into the report.

Six (6) samples were collected for analysis of Metals, Electrical Conductivity (EC), and Sodium Adsorption Ratio (SAR), three (3) samples were collected for analysis of Petroleum Hydrocarbons (PHCs), and

Benzene, Toluene, Ethylbenzene, and Xylene (BTEX), three (3) samples were collected for analysis of Volatile Organic Compounds (VOCs), and three (3) samples were collected for Polycyclic Aromatic Hydrocarbons (PAHs). The analytical results were compared to O. Reg. 153/04 Table 1 Site Condition Standards (SCS) for residential/parkland/institutional/industrial/commercial/community (RPIICC) property uses. In comparison with the Table 1 SCS, one (1) soil sample was noted to exceed for Metals (Barium). In comparison with the Table 2 SCS for RPI property uses, all soil samples were noted to meet the SCS. Palmer noted that comparison of analytical results to the applicable Excess Soil Quality Standards (ESQS) was not discussed in the provided report.

As Ontario Regulation 406/19 is now in effect, the Excess Soil Reuse Planning will be required to identify and assess any areas of potential environmental concern within the project area and to determine the chemical quality and appropriate reuse of soil and/or rock that is to be excavated or tunneled and hauled off-site. The excess soil planning requirements will vary depending on the anticipated volume of soil and/or rock that will require re-use off-Site.

Should more than 2,000 m³ of excess soil be generated during construction, a Qualified Person (QP) will need to be retained to complete the following prior to and during construction activities:

- Assessment of Past Uses;
- Sampling and Analysis Plan;
- Soil Characterization;
- Excess Soil Destination Assessment;
- Tracking System;
- Excess Soil Registry;
- Soil Management Plan; and,
- Fill Management Plan.

4. Certification

We trust that the information contained in this memo is satisfactory. Should you have any questions, please do not hesitate to contact this office. This report is subject to the Statement of Limitations provided at the end of this memo.

This memo was prepared and reviewed by the undersigned:

Prepared By:

Alonzo Rowe, P.Eng.
Geotechnical Engineer

Sarah Sipak, B.Sc., P.Geo (limited), QP_{ESA}
Environmental Geoscience Team Lead

Reviewed By:

Matthew D. St Denis, P.Eng.
Team Lead, Geotechnical Engineering

Chi Cheng (Dennis) Tseng, M.Sc., P.Eng.
Principal Geotechnical Engineer

Statement of Limitations

This memo has been prepared for the Niagara Region and their designers. Third party use of this memo without Palmer's consent is prohibited. Any use which a third party makes of this memo, or any reliance on or decisions made based on it, are the responsibility of such third parties. Palmer accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this memo. The limitations presented herein form an integral part of this memo and must be considered in conjunction with the rest of the document.

Subsurface conditions between and beyond the test holes may differ from those encountered at the test hole locations, and conditions may become apparent during construction, which could not be detected or anticipated at the time of the site investigation. The benchmark and elevations used in this memo are primarily to establish relative elevation differences between the test hole locations and should not be used for other purposes, such as grading, excavating, planning, development, etc.

Palmer is not a guarantor of the environmental conditions at the subject site, but warrants only that its work was undertaken and its memo prepared in a manner consistent with the level of skill and diligence normally exercised by competent geoscience and geotechnical professionals practicing in the Province of Ontario. Our findings should be evaluated in light of the limited scope of our work. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work.

This memo is intended solely for the Client named. The material in it reflects our best judgment in light of the information available to Palmer at the time of preparation. Unless otherwise agreed in writing by Palmer, it shall not be used to express or imply warranty as to the fitness of the property for a particular purpose. No portion of this memo may be used as a separate entity, it is written to be read in its entirety.