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Polygon Development 233 Ltd.
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Vancouver, B.C.
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December 14, 2022
File: 22233
R0

Attention: Sarah Christianson

Re: Preliminary Geotechnical Report – Proposed Residential Development
Lot 26, Wesbrook Place, UBC South Campus, Vancouver, B.C.

1.0 INTRODUCTION

We understand that a new residential development is proposed for the above referenced site at UBC South Campus. Based on preliminary information provided to us, the proposed development will consist of one 16-storey tower and several city homes, all over 2-3 levels of common underground parking. It is anticipated that excavation to depths of up to 9 m below grade will be required to accommodate the proposed underground parking.

We expect reinforced concrete construction for the 16-storey tower, the common underground parking, and foundations. For the single 16-storey residential tower, we would anticipate loading to be heavy, with column loads in the range of up to 16,000 kN and wall loads of up to 150 kN/m. Floor loading is expected to be relatively light.

This report presents our preliminary recommendations for the design and construction of the proposed development and temporary excavations, based on the expected subsurface conditions from our experience in the immediate area. This report has been prepared exclusively for our client, for their use, the use of others on their design team as well as for the University Endowment Lands (UEL) for use in the development and permitting process.

2.0 SITE DESCRIPTION

The site is located at the southeast corner of Ross Drive and Gray Avenue in Vancouver, B.C., and is partially improved with a single-storey development presentation centre at the west of the site, with the rest of the site unimproved. The site is irregular in shape, with an approximate area of 1.1 acres, and an average elevation of approximately 77 m geodetic. The site slopes gently from north to south by approximately 2 m. The site is bounded by Webber Lane to the east, Gray Avenue to the north, and Ross Drive to the south and west.

The location of the site as well as existing on-site improvements are shown on the attached plan, our Drawing No. 22233-01, following the text of this report.

3.0 ANTICIPATED SUBSURFACE CONDITIONS

3.1 Published geology

According to the Geological Survey of Canada Surficial Geology Map 1486A, the surficial soils consist of the Vashon Drift and Capilano Sediments. The Vashon Drift and Capilano sediments are described as "glacial drift including: lodgement and minor flow till, lenses and interbeds of substratified glaciofluvial sand to gravel, and lenses and interbeds of glaciolacustrine laminated stony silt: up to 25 m thick."

4.2 Soil Conditions

A general description of the soils expected at the site based on our experience in the area is provided below.

GRASS/TOPSOIL

The ground surface is anticipated to consist of grass and topsoil, extending up to 1.5 m below grade.

SANDY SILT/SAND with GRAVEL (WEATHERED TILL)

Sandy silt to silty sand or sand with gravel are expected underlying the grass/topsoil. The sandy silt/sand with gravel is expected to extend up to 7 m below grade and to be compact to dense, moist and grey-brown in colour.

SILTY SAND (GLACIAL TILL)

Silty sand to sand with trace to some gravel is expected beneath the sandy silt. This layer is expected to extend to at least 9 m below grade and to be dense to very dense, moist, and grey in colour.

4.3 Groundwater Conditions

The static groundwater table is expected to be well below the proposed development grades for this site. Based on our experience in the area, some perched groundwater may be observed coinciding with the sandy silt-glacial till interface. Perched groundwater can also be expected to form within the topsoil and within cleaner sand lenses of the glaciomarine deposits. Seepage from these lenses is expected to be light until drained and will vary seasonally. We expect any groundwater seepage flows could be controlled using conventional sumps and sump pumps.

5.0 DISCUSSION

5.1 General

Based on preliminary information provided to us, the proposed development will consist of consist of one 16-storey tower and several city homes, all over 2-3 levels of common underground parking.

We expect reinforced concrete construction for the 16-storey tower, the common underground parking, and foundations.

We have no detailed structural information at present, however, for the 16-storey residential tower, we would anticipate loading to be heavy, with column loads in the range of up to 16,000 kN and wall loads of up to 150 kN/m. Floor loading is expected to be relatively light.

Based on the anticipated foundation elevations and observed ground conditions, we expect that the buildings can be supported on conventional spread and strip footings founded on dense sandy silt/sand with gravel as described in Section 4.0. Our recommendations for foundation support are provided in Section 6.2.

To accommodate the proposed underground structure, we anticipate that temporary excavation depths will be up to 9 m below adjacent grades. We expect that temporary excavations would be sloped where possible since it is more economical to do so. However, temporary shoring could be required to facilitate excavations in close proximity to property lines, building structures, or nearby utilities. Shoring requirements will ultimately depend

on the final parking layout, footing elevations and presence of underground utilities. Our design recommendations for temporary excavations and shoring are provided in Section 6.6.

The subsurface soils are not expected to be prone to liquefaction or other forms of ground softening under the design earthquake defined under the 2018 BC Building Code.

We confirm, from a geotechnical point of view, that the proposed development is feasible provided that the recommendations outlined in the following sections are incorporated into the overall design and construction.

5.2 Natural Exfiltration of Storm Water

We understand that the University of British Columbia is advocating the incorporation of natural storm water exfiltration into some of the new developments on campus through its UBC LEED Implementation Guide. Our experience in the area indicates that the onsite soils in the upper 1.5 to 4 m may contain sand, and could potentially support storm water dispersion using an exfiltration system. Exfiltration testing can be undertaken onsite to obtain parameters for design of the system.

6.0 RECOMMENDATIONS

6.1 Site Preparation

Prior to the construction of new foundations or floor slabs, all organic materials, fills, and loose or otherwise disturbed soils must be removed from the construction area to expose a subgrade of *dense sandy silt/sand with gravel.*

The subgrade should be blinded and protected with lean mix concrete immediately after final trimming and review to preserve its bearing qualities. The lean mix concrete should have a compressive strength of at least 5 MPa. Grade reinstatement beneath the floor slabs and any non-structural walls can be done using engineered fill.

"Engineered Fill" is generally defined as clean sand to sand and gravel fill with less than 5% passing the No. 200 sieve by weight, compacted in 300 mm loose lifts to a minimum of 95% of the ASTM D1557 (Modified Proctor) maximum dry density at a moisture content within 2% of optimum for compaction.

Foundation subgrades must be reviewed by the geotechnical engineer prior to the placement of lean mix concrete.

6.2 Foundations and Bearing Capacity

Footings which are founded on competent native *dense to very dense sandy silt/sand with gravel* can be designed for a Serviceability Limit States (SLS) bearing pressure of 500 kPa. Factored ultimate limit state (ULS) bearing pressures, for transient loads such as those induced by wind and earthquakes, may be taken as 1.5 x the SLS bearing pressures provided above.

Irrespective of the allowable bearing pressures given, pad footings should not be less than 600 mm by 600 mm and strip footings should not be less than 450 mm in width. Foundations should also be buried a minimum of 450 mm below the surface for frost protection.

Post construction settlement of foundations designed as recommended should be less than 25 mm total and 20 mm over a 10 m differential.

The exposed subgrade soils should be protected by lean mix concrete to preserve its bearing qualities and that it remains free of ponded water prior to pouring concrete for footings. Any softened, disturbed subgrade should be removed and replaced with lean mix concrete with a minimum compressive strength of 5 MPa beneath the foundations. Crushed gravel or engineered fill can be placed beneath the slab-on-grade only.

Foundation subgrades must be inspected by GeoPacific prior to footing construction.

6.3 Seismic Design of Foundations

Based on the anticipated subsurface conditions, we recommend that the building be designed in accordance with Site Class C spectral parameters as defined in Table 4.1.8.4.A of the 2018 BC Building Code. According to Natural Resource Canada, peak ground acceleration on firm ground for the approximate site location is 0.38 g.

The soils beyond the depth of foundations are not considered prone to ground liquefaction or other forms of ground softening caused by earthquake induced ground motions.

6.4 Slab-On-Grade Floors Preparation

In order to provide suitable support for slab-on-grade floors, we recommend that any fill placed under the slab should consist of "engineered fill" as described in Section 5.1 above. This granular fill must be compacted to a minimum of 95% Modified Proctor maximum dry density (ASTM D1557) with water content within 2% of optimum for compaction.

The floor slab should be underlain by a minimum of 150 mm of 19 mm clear crushed gravel fill to inhibit upward migration of moisture beneath the slab. The crushed gravel fill should be compacted to a minimum of 95% of the ASTM D1557 (Modified Proctor) maximum dry density at a moisture content that is within 2% of optimum for compaction and should be hydraulically connected to the perimeter drain.

Compaction of the slab-on-grade fill must be reviewed by GeoPacific.

6.5 Foundation Drainage

A perimeter drainage system will be required for the below grade structures to prevent the development of water pressure on the foundation walls and floor slab.

All drains should be designed to prevent migration of fines and should be hydraulically connected to the under-slab fill to ensure that water pressures cannot develop beneath the slab. Very light groundwater flows are expected and we suggest that the perimeter drainage system be preliminarily designed for a groundwater inflow rate of 10-15 litres/minute, for the entire excavation.

The mechanical designer should confirm the actual groundwater flow during construction at the end of the subgrade preparation.

6.6 Temporary Excavation & Shoring

As indicated above, we expect that temporary excavations would be sloped where possible since it is more economical to do so. Slope cuts may be cut at a slope no steeper than 1:1 (H:V) in the surficial fills and glaciomarine soils and 3:4 (H:V) in the dense to very dense silty sand/glacial till where space permits. Slopes are to be covered with poly sheeting for protection against erosion induced instability.

Any temporary cut in excess of 1.2 metres in height requires inspections by a geotechnical engineer in accordance with Worker's Compensation Board guidelines.

Where open cuts are not feasible, temporary shoring may be required to facilitate excavations to foundation depths in close proximity to property lines. The extent of the shored section of the excavation will depend on the existing topography as well as the final design layout and elevations for the proposed structure and adjacent structures. We expect that vertical cuts may be supported with the use of a shotcrete membrane tied back with post-tensioned soil anchors, which is the most economical system available in the Greater Vancouver area. Hollow core (self-drilling) anchors should be anticipated in sandy zones within the excavation.

In the near-surface fills and where saturated sand layers may be encountered, the use of face-saving measures such as extra welded wire mesh, sandbags, drainage mats, or plywood, for example, may be required for stabilization of individual shoring panels.

The geotechnical engineer shall be contacted for the review of shoring installation and temporary excavations.

Our experience in this area indicates that cobbles and boulders may be present within the native soils. Cobbles and small boulders can typically be removed with conventional excavation equipment. However, large boulders may require splitting to facilitate their removal from the site.

Some normal and unavoidable excavation related movements should be expected due to elastic relaxation of the soil. Experience with similar excavation depths and soils indicates that vertical and horizontal movements at the excavation face are unlikely to exceed 15 mm, decreasing to less than half of that 3 m back of the cut. Structural damage is not common at this magnitude of movement, though some minor cosmetic damage is possible to adjacent structures.

Seepage from the surficial soils, Vashon Drift, and perched groundwater is expected to be relatively light. Seepage volumes may be elevated where saturated sand seams are encountered in the glacial deposits. It is our past experience that these deposits are typically discontinuous and result in temporary elevated seepage rates until they drain with light seepage occurring thereafter. We expect that excavation inflows may be handled with conventional sumps and sump pumps.

The geotechnical engineer shall be contacted for the review of shoring installation and temporary excavations.

6.7 Lateral Pressures on Foundation Walls

Earth pressures against the foundation walls are dependent on factors such as, available lateral restraint along the wall, surcharge loads, backfill materials, compaction of the backfill and drainage conditions. We recommend that the foundation walls be designed to resist the following lateral earth pressures:

Static: Triangular soil pressure distribution of 4.0 H kPa, where H is equal to the total wall height in metres.

Seismic: Inverted triangular soil pressure distribution of 2.0 H kPa, where H is equal to the total wall height in metres

The preceding loading recommendations assume that the synthetic drainage material provides a drained cavity around the perimeter of the foundation. We expect that the perimeter drainage system will be hydraulically connected to the synthetic drainage material and sufficiently lower the groundwater level such that hydrostatic pressures against the foundation walls are eliminated.

Any additional surcharge loads not specifically described herein should be added to the earth pressure given. All earth pressures are based upon unfactored soil parameters and are assumed to be unfactored loads.
The geotechnical engineer should be contacted for the review of all backfill materials and procedures.

6.8 Utility Design and Installation

Site utilities will be required beneath the slabs-on-grade. The design of these systems must consider the locations and elevations of the foundations. The service trenches and excavations required for the installation of the underground pipes, vaults and/or manholes must be located outside of a 1.5:1 (H:V) slope measured downward from the edge of adjacent foundations.

All excavations and trenches must conform to the latest Occupational Health and Safety Regulation supplied by the Worker Compensation Board of British Columbia. Any excavation in excess of 1.2 m in depth requiring worker entry must be reviewed by a professional geotechnical engineer.

All excavations and trenching must conform to the latest WorkSafeBC requirements.

6.9 Pavement Structures

We expect that some reinstatement of pavement structures will be required as part of the proposed development.

We expect that the pavement structure provided in Table 1 below would be suitable to support the anticipated vehicle loading.

Table 1: Recommended Minimum Pavement Structure for On-Site Drive Aisles and Parking

Material	Thickness (mm)
Asphaltic Concrete	65
19 mm minus crushed gravel base course	100
75 mm minus, well graded, clean, sand and gravel subbase course	150

All fill materials should be compacted to a minimum of 95% of their maximum dry density in accordance with ASTM D1557 (Modified Proctor) that is within 2% of their optimum moisture content.

7.0 DESIGN REVIEWS AND CONSTRUCTION REVIEWS

As required for Municipal "Letters of Assurance", GeoPacific Consultants Ltd. will carry out sufficient field reviews during construction to ensure that the geotechnical design recommendations contained within this report have been adequately communicated to the design team and to the contractors implementing the design. These field reviews are not carried out for the benefit of the contractors and therefore do not in any way effect the contractors' obligations to perform under the terms of his/her contract.

It is the contractors' responsibility to advise GeoPacific Consultants Ltd. (a minimum of 48 hours in advance) that a field review is required. Field reviews are normally required at the time of the following activities:

1. Site Stripping	Review of temporary slopes and soil conditions.
2. Temporary Excavation and Shoring	Review of shoring installation and tests.
3. Engineered Fill	Review of materials and compaction degree.
4. Foundation	Review of foundation subgrade.
5. Slab-on Grade	Review of under slab fill materials and compaction.
6. Backfill	Review of placement of backfill along foundation walls.

It is critical that these reviews are carried out to ensure that our intentions have been adequately communicated. It is also critical that contractors working on the site view this document in advance of any work being carried out so that they become familiar with the sensitive aspects of the works proposed. It is the responsibility of the developer to notify GeoPacific Consultants Ltd. when conditions or situations not outlined within this document are encountered.

8.0 CLOSURE

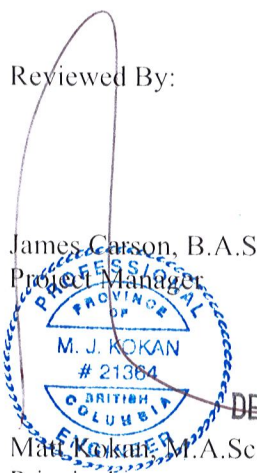
This report has been prepared exclusively for our client for the purpose of providing preliminary geotechnical recommendations for the design and construction of the proposed development. The report remains the property of GeoPacific Consultants Ltd. and unauthorized use of, or duplication of this report is prohibited.

We are pleased to be of assistance to you on this project and we trust that our comments and recommendations are both helpful and sufficient for your current purposes. If you would like further details or would like clarification of any of the above, please do not hesitate to call.

For:
GeoPacific Consultants Ltd.

Ciaran Robinson, B.A.Sc., EIT
Geotechnical Engineer in Training

Reviewed By:



James Carson, B.A.Sc., E.I.T.
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Permit to Practice EGBC
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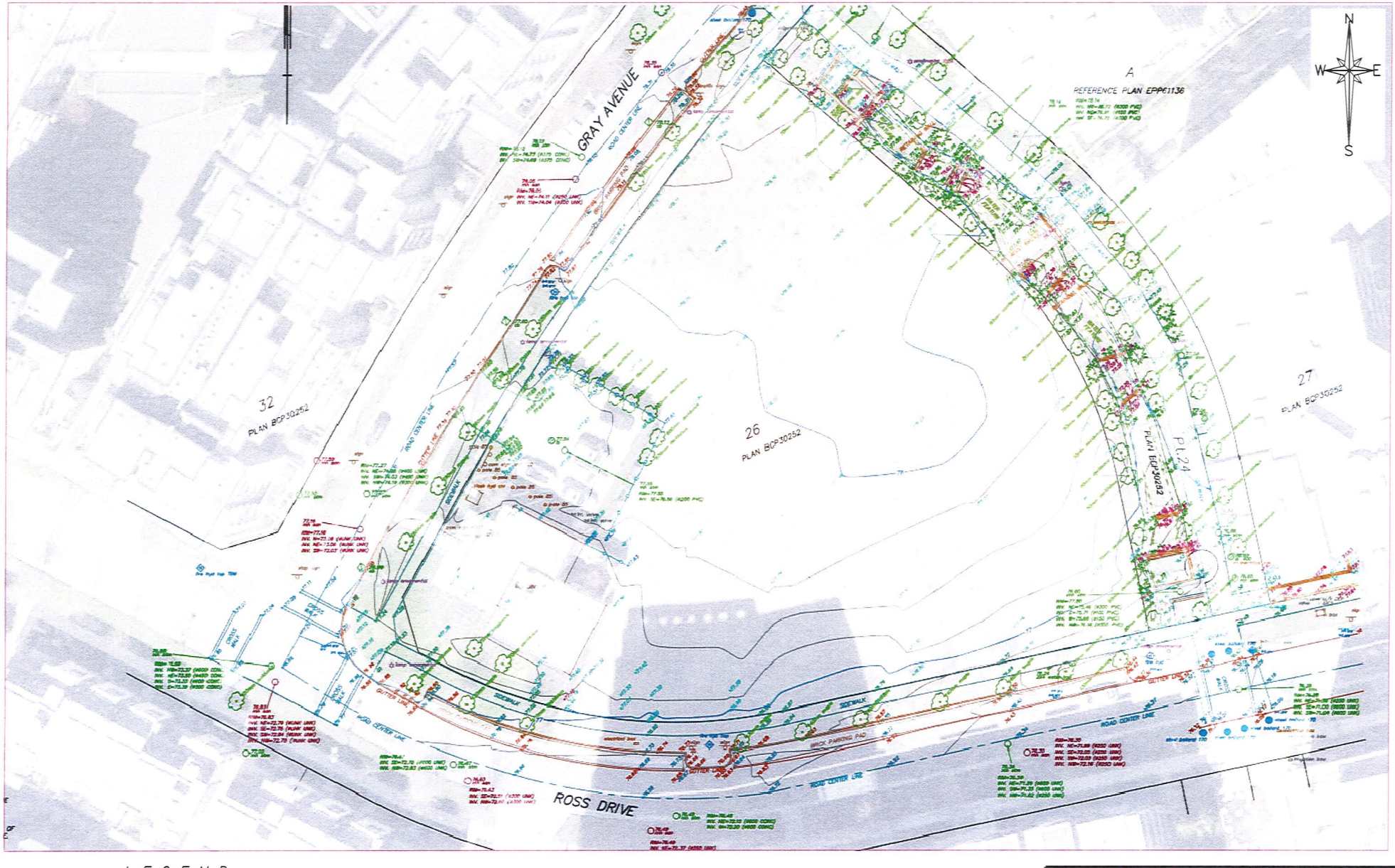
Matt Kokan, M.A.Sc., P.Eng.
Principal



LEGEND:

- SCPT#-# – SEISMIC CONE PENETRATION TEST (SCPT) LOCATION
- CPT#-# – CONE PENETRATION TEST (CPT) LOCATION
- TH#-# – TEST HOLE (TH) LOCATION

SITE PLAN

*TEST LOCATIONS ARE APPROXIMATE

REFERENCE:

VanMap GIS and Aplin Martin
(UBC26 TOPO SURVEY 2022-08-22)

GEOPACIFIC CONSULTANTS

DATE:	2022-12-08	
DRAWN BY:	APPROVED BY:	REVIEWED BY:
BE	JC	JC
SCALE:	NTS	

RESIDENTIAL DEVELOPMENT

LOT 26, WESBROOK PLACE, UBC, VANCOUVER BC
TEST HOLE SITE PLAN

FILE NO.: 22233

DWG NO.: 22233-01

REVISIONS
A
B
C