

File No. 04-1000-20-2016-449

December 14, 2016

s.22(1)

Dear s.22(1)

Re: **Request for Access to Records under the Freedom of Information and Protection of Privacy Act (the "Act")**

I am responding to your request of November 29, 2016 for:

**Information regarding any environmental assessments to assess the dangers to 3038 SE Kent Avenue in relation to the site preparation and building of 3010 Kent Avenue.**

There are no records responsive to your request.

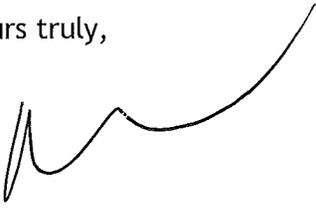
**Please note:** The Manager of Environmental Services confirms you were provided with all responsive records in relation to your previous FOI request 2016-330. As a courtesy, the Manager is also providing two additional reports in relation to the environmental assessments of 3010 Kent Avenue.

Under section 52 of the Act you may ask the Information & Privacy Commissioner to review any matter related to the City's response to your request. The Act allows you 30 business days from the date you receive this notice to request a review by writing to: Office of the Information & Privacy Commissioner, [info@oipc.bc.ca](mailto:info@oipc.bc.ca) or by phoning 250-387-5629.

If you request a review, please provide the Commissioner's office with: 1) the request number assigned to your request (#04-1000-20-2016-449); 2) a copy of this letter; 3) a copy of your original request for information sent to the City of Vancouver; and 4) detailed reasons or grounds on which you are seeking the review.

Please do not hesitate to contact the Freedom of Information Office at [foi@vancouver.ca](mailto:foi@vancouver.ca) if you have any questions.

Yours truly,

A handwritten signature in black ink, consisting of a series of connected loops and curves, positioned to the right of the text 'Yours truly,'.

Barbara J. Van Fraassen, BA  
Director, Access to Information  
*City Clerk's Department, City of Vancouver*  
Email: [Barbara.vanfraassen@vancouver.ca](mailto:Barbara.vanfraassen@vancouver.ca)  
Telephone: 604.873.7999

Encl.

:cf

March 16, 2016

City of Vancouver  
320 – 507 W Broadway  
Vancouver, BC V5Z 0B4

ISSUED FOR USE  
704-ENV.VENV03059-01  
Via Email: Amber.Bongiovanni@vancouver.ca

**Attention:** Ms. Amber Bongiovanni, B.Sc., GradTech, EP  
Project Manager

**Subject:** Preliminary Geotechnical Report for 3010 East Kent Ave South, Vancouver, BC

## 1.0 INTRODUCTION

Tetra Tech EBA Inc. (Tetra Tech EBA) has been retained by the City of Vancouver (CoV) to provide a geotechnical site exploration and preliminary geotechnical report for the potential development of 3010 East Kent Ave South in Vancouver BC. The purpose of this report is to summarize the results of the geotechnical site exploration and to provide preliminary geotechnical design recommendations for the proposed project. The General Conditions provided in Appendix A form an integral part of this report.

The scope of this report is limited to geotechnical recommendations only. Tetra Tech EBA will provide the CoV with an environmental report that discusses the environmental soil and groundwater considerations.

Tetra Tech EBA previously provided a preliminary desktop geotechnical report for this site, which should be read in conjunction with this report.

## 2.0 PROJECT DESCRIPTION

The proposed project site is bordered by East Kent Ave South to the north, an existing three-storey residential complex to the east, the Fraser River to the south, and a vacant lot to the west. The site is relatively flat and is currently vacant, covered with grass, and used as a park / playing field.

We understand that the CoV is considering developing the project site by constructing a single-storey, wood-framed, at-grade childcare building. According to the CoV, we understand that the building will have approximate dimensions of 30 m by 30 m. We expect that the finished floor slab elevation of the proposed building will be at or near existing site grades; however, the CoV should review the flood plain elevation and confirm if the site and/or building grades need to be raised to achieve the minimum flood construction level for development. Hydrotechnical considerations for the development of the site, including flooding and scour protection are outside the scope of this report.

We expect that the proposed development will be designed in accordance with the requirements of Part 4 of the 2014 Vancouver Building Bylaw (VBBL).

## 3.0 REFERENCE DOCUMENTS

The following documentation was obtained by Tetra Tech EBA or provided by CoV and was reviewed by Tetra Tech EBA in the preparation of this report:

- Historic aerial photographs of the site (period 1938 to 2004), obtained from the UBC Department of Geography Air Photo Library.

- Geological Survey of Canada. 1980. Surficial Geology, Vancouver, British Columbia. Map 1486A, 1:50,000 Scale.
- Geotechnical Investigation Report: Proposed Affordable Housing Site 4/5, 2801 East Kent Avenue North, Vancouver, BC, prepared by GeoPacific Consultants Ltd., dated September 19, 2014.
- Geotechnical Investigation Report: Proposed Affordable Housing Site 6, 2910 East Kent Avenue South, Vancouver, BC, prepared by GeoPacific Consultants Ltd., dated September 25, 2014.

## 4.0 SITE DEVELOPMENT HISTORY

Based on our review of the historic aerial photographs, the site was occupied by several industrial developments between the 1940s and the 1980s.

In addition to the previous development, portions of the Fraser River shoreline have been infilled and the shoreline modified. The oldest aerial photographs from 1938 show that the southern portion of the property contained a small island within the Fraser River, separated from the shore by an approximately 20 m wide back channel. The back channel was largely infilled by the 1950s, followed by further infilling and extending of the shoreline towards the south during the 1960s. The shoreline was further modified and reshaped during the 1990s as part of the development of Riverfront Park. Based on the above, we expect that the southern 30 m to 60 m of the site is largely comprised of fill material.

## 5.0 GEOTECHNICAL EXPLORATION PROGRAM

To assess soil and groundwater conditions at the site, Tetra Tech EBA completed a limited geotechnical subsurface exploration program at the site on February 11 and 12, 2016. The geotechnical exploration consisted of eight test pits (TP16-05 through TP16-12), and two geotechnical test holes (BH16-02 and BH16-04). The approximate location of the test holes and testpits are shown on Figure 1. Test pit and test hole logs are attached in Appendix B.

The test pits were dug to depths ranging from 1.0 m to 3.1 m below existing grade. The test holes BH16-02 and BH16-04 were advanced to 7.62 m and 4.57 m below existing grades, respectively. At BH16-02, a Dynamic Cone Penetration Test (DCPT) was completed to a depth of 12.2 m below existing grade.

Tetra Tech EBA personnel were on site during completion of the geotechnical exploration to log the soil stratigraphy and to collect disturbed soil samples. The test pits were backfilled with excavated material and the test holes were backfilled to surface with bentonite seals in accordance with the British Columbia Groundwater Protection Regulations.

Soil samples collected during the site exploration program were sent to Tetra Tech EBA's soils laboratory in Nanaimo, BC for natural water content testing and additional visual classification. The results of the laboratory testing are provided on the test hole logs in Appendix B.

## 6.0 SUBSURFACE CONDITIONS

### 6.1 Surficial Geology

Based on our review of Geological Survey of Canada Map 1486A, available geotechnical reports, and our previous project experience in the area the soil conditions at the project site are anticipated to consist of Fraser River Sediments comprised of silt clay loam overlying interbedded fine to medium sand and minor silt beds. These soils are underlain by dense glacial sediments (Vashon Drift), comprised of lodgement and minor flow till with lenses and interbeds of substratified glaciofluvial sand to gravel.

The existing geotechnical reports indicate that the adjacent vacant property to the west is mantled by up to 2.3 m of fill material, underlain by topsoil and organic silt in some locations. These materials are underlain by approximately 2 m to 4 m of firm to stiff silt and then up to 7 m of loose to compact sand with interbeds of clayey silt to silty sand. Dense glacial till was encountered at the adjacent vacant property at depths ranging from 6.4 m at the northwest portion of the site to 12.8 m at the southeast portion of the site.

## 6.2 Interpreted Soil Stratigraphy

The soil conditions encountered during the February 11 and 12, 2016 geotechnical exploration are generally consistent with the anticipated surficial geology discussed in Section 6.1, and are summarized as follows:

- **FILL:** Variable fill was encountered within all of the test pits and test holes. The fill generally consists of a 0.1 m thick layer of topsoil underlain by loose to compact sand, silt, gravel, cobbles, asphalt, concrete, organics, and woodwaste. Due to the presence of the concrete and asphalt, 6 of the 8 test pits achieved refusal and were unable to advance through the fill. In addition, the other 2 test pits were also not able to advance through the fill due to encountering the groundwater, which resulted in caving in of the test pit side walls. The fill thickness was measured to be 1.9 m and 6.1 m within BH16-02 and BH16-04, respectively. At BH16-02, the woodwaste was measured to be approximately 2 m thick.
- **SILT:** The fill material is underlain by low to medium-plastic, firm to stiff silt. At BH16-02, the silt contains several sand lenses. At BH16-04, the upper 300 mm of silt contains a trace of organics/wood. The natural water content of the silt at BH16-04 is 85.3% in the upper 300 mm that contains the organics/wood and 42.5% in the lower portion of the deposit, which is consistent with the previous report for the site to the west.

The test holes did not extend through the silt and into the compact sands or glacial till-like material known to underlie this area. However, based on the existing soil information available from the nearby site to the west, visual review of excavations currently being undertaken approximately 300 m east of the site, and the DCPT completed at BH16-02, we expect that the silt is underlain by compact sands, and that glacial till-like soil will likely be located at depths ranging from approximately 6 m to 13 m below grade. The glacial till-like soil is expected to be shallower on the northern portion of the site and dipping downward towards the Fraser River.

## 6.3 Groundwater

Groundwater was encountered within TP16-07, TP16-12, BH16-02, and BH16-04 at depths ranging from 1.8 m to 3.1 m below the current site grades. Due to the proximity of the Fraser River, and the soil conditions that underlie the site, groundwater levels are anticipated to vary seasonally and may be strongly influenced by the Fraser River.

## 7.0 PRELIMINARY GEOTECHNICAL RECOMMENDATIONS

The following sections outline the preliminary geotechnical recommendations that are suitable for preliminary site planning, architectural and structural design, and pricing. However, we note that an additional geotechnical exploration may be required depending on the finalized architectural and structural designs as well as the finalized building location.

Based on the results of the geotechnical exploration and subsequent engineering analysis, the key geotechnical considerations for the proposed development are as follows:

- **Liquefaction:** The underlying soil conditions at the site are expected to consist of compact sands and firm to stiff silts. These soils are prone to liquefaction under the 2014 VBBL design earthquake, which will result in post-liquefaction settlement and lateral spreading.

- **Consolidation Settlement:** The soil conditions at the project site include layers of fine-grained soils that are susceptible to long-term consolidation settlement when subject to a loading higher than the existing load from the existing overburden soil.
- **Existing Fill:** The fill materials that cover the site include buried concrete and asphalt materials as well as woodwaste, cobbles and poor quality sands and silts. These materials will not be suitable to underlie building foundations or floor slabs and should be removed and replaced with compacted structural fill.

Based on the results of the exploration and subsequent analysis, we consider that it is feasible to support the proposed building on shallow foundations that are structurally tied together. The following sections provide our geotechnical recommendations for the proposed development.

## 7.1 Liquefaction Assessment

Liquefaction susceptibility of the subsurface soils encountered during the geotechnical exploration was assessed using the procedures given by Idriss and Boulanger (2008). The assessment was completed based on the 1:2475 year design earthquake event, which is required by the 2014 VBBL. The results of the analysis indicate that the sand fill material that underlies the site is susceptible to liquefaction. We note that the test holes did not extend into the dense glacial till-like material, and as such, the presence and thickness of any additional liquefiable layers is not known. However, based on the testhole information provided by the CoV for the adjacent site to the west, liquefiable sand layers were encountered above the glacial till-like material.

Post-liquefaction settlement and lateral spreading is expected to occur as a result of the earthquake-induced liquefaction. The post-liquefaction settlement is expected to be in the order of 100 mm to 300 mm. The magnitude of the lateral spreading could be in the order of 500 mm to 1000 mm due to the proximity of the Fraser River. These ground movements are expected to be differential by approximately 50% of the total. Generally speaking, the magnitude of these movements is expected to increase to the south (i.e. towards the Fraser River shoreline).

The anticipated liquefaction induced ground movements can be reduced if ground improvement in the form of soil densification with stone columns, vibro-replacement/vibro-floatation, or Rapid Impact Compaction is undertaken. However, given the size of the proposed building, we expect it will be more cost effective to tie the foundations together in accordance with VBBL requirements or construct a raft foundation and design the building to accommodate the movements and allow for safe egress from the building as required by the 2014 VBBL.

Provided that the site preparation is undertaken as outlined in Section 7.3, and that the foundations are designed based on the parameters provided in Section 7.5, punching failure of the building foundations is not expected.

## 7.2 Site Classification

The 2014 VBBL Table 4.1.8.4.A specifies that if any soil layer within the top 30 m of the ground is susceptible to seismic liquefaction, then the site would be classified as Site Class "F" and a site-specific ground response analysis would be required to determine the acceleration-based and velocity-based seismic coefficients,  $F_a$  and  $F_v$ . As noted in Section 7.1, the site is expected to be underlain by liquefiable layers, and therefore, the site is considered as Site Class "F".

However, the 2014 VBBL includes a provision that for structures with a fundamental period of vibration equal to or less than 0.5 seconds, the values of  $F_a$  and  $F_v$  may be determined using the site class definitions and criteria assuming liquefaction does not occur. For this site, we would recommend that the Structural Engineer design the foundations based on either Site Class "D" or "E", whichever is more conservative.

Tetra Tech EBA should be contacted to complete a site-specific ground response analysis if the Structural Engineer determines that the building is expected to have a fundamental period of vibration greater than 0.5 seconds.

### 7.3 Site Preparation

The geotechnical exploration encountered fill with variable thickness and composition that included abandoned building foundations, timber pilings, pavement, construction debris, woodwaste, etc. This variable fill is not suitable to support the shallow foundations of the proposed building foundations or floor slabs and should be removed and replaced with compacted structural fill material (free-draining sand or sand and gravel). However, we note that since the test pits did not extend through the fill, an additional exploration consisting of sonic-drilled or ODEX test holes should be completed to confirm the thickness of the fill in order to finalize the proposed building location.

Depending on the thickness and composition of the fill at the building location, the excavation of the poor quality material may need to extend below the groundwater table, which may require dewatering. If dewatering is necessary, the excavation contractor should use extreme caution to not temporarily or permanently lower the groundwater in the vicinity of the existing buildings to the east of the site. If the groundwater is lowered, potential settlement and damage to the existing buildings may occur.

Consideration could be given to leaving the fill in place and supporting the proposed building foundations and floor slabs on deep piled foundations; however, given the extent of the concrete, asphalt, boulders, and other obstructions, it would likely be difficult and expensive to install piles through the fill.

### 7.4 Preload Treatment

The soil conditions at the project site include layers of fine-grained soils that are susceptible to long-term consolidation settlement when subject to a loading higher than the existing load from the existing overburden soil. The replacement of the existing fill with heavier structural fill, in addition to any soil loads due to raising the site grades for flood protection purposes (if necessary) as well as the proposed building loads may result in post-construction settlement in the order of 100 mm with differential settlements of approximately 30 mm to 60 mm over a horizontal distance of about 10 m. In order to limit the settlements, the site may need to be preloaded. Tetra Tech EBA should be contacted to review the design site grades and building loads to confirm if preloading will be required, and if so, to provide a preload design.

Although previous developments on the site included several buildings and stockpiles which would have provided some preloading effect, the previous developments ranged in size, load, and duration. As such, the preload effects of the previous developments are not consistent across the site, which could result in differential settlement across the proposed building unless additional preloading is undertaken.

We recommend that the proposed building be located at least 8 m away from the property line to the east to reduce the potential for settlement of the existing buildings during preloading (if necessary) or due to the permanent proposed building loads.

### 7.5 Foundation Design

Provided the site preparation and preloading (if required) are completed, we recommend that the proposed building be supported on strip and spread footings (tied together in accordance with the 2014 VBBL) or on a raft foundation constructed on either structural fill or natural firm to stiff silt.

The preliminary structural design of the foundation should be based on the following:

- Serviceability Limit States bearing pressure in the range of 50 kPa to 100 kPa
- Factored Ultimate Limit States bearing resistance in the range of 100 kPa to 200 kPa.

- If a raft foundation is chosen, Tetra Tech EBA should be contacted to provide a modulus of subgrade reaction for structural design of the raft, which will need to be determined after the building location is finalized and the soil conditions at the location are determined with an additional geotechnical exploration.

Strip footings should be at least 600 mm wide and spread footings should have a minimum dimension of 1.0 m. For confinement and frost protection, all footings should be at least 600 mm below finished grade.

## 8.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of the City of Vancouver and their agents. Tetra Tech EBA Inc. (Tetra Tech EBA) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than the City of Vancouver, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Tetra Tech EBA's General Conditions are provided in Appendix A of this report.

## 9.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,  
Tetra Tech EBA Inc.



Prepared by:  
Conrad Tench, P.Eng.  
Senior Geotechnical Engineer  
Direct Line: 778.945.5787  
Conrad.Tench@tetrattech.com

CT/AA/db

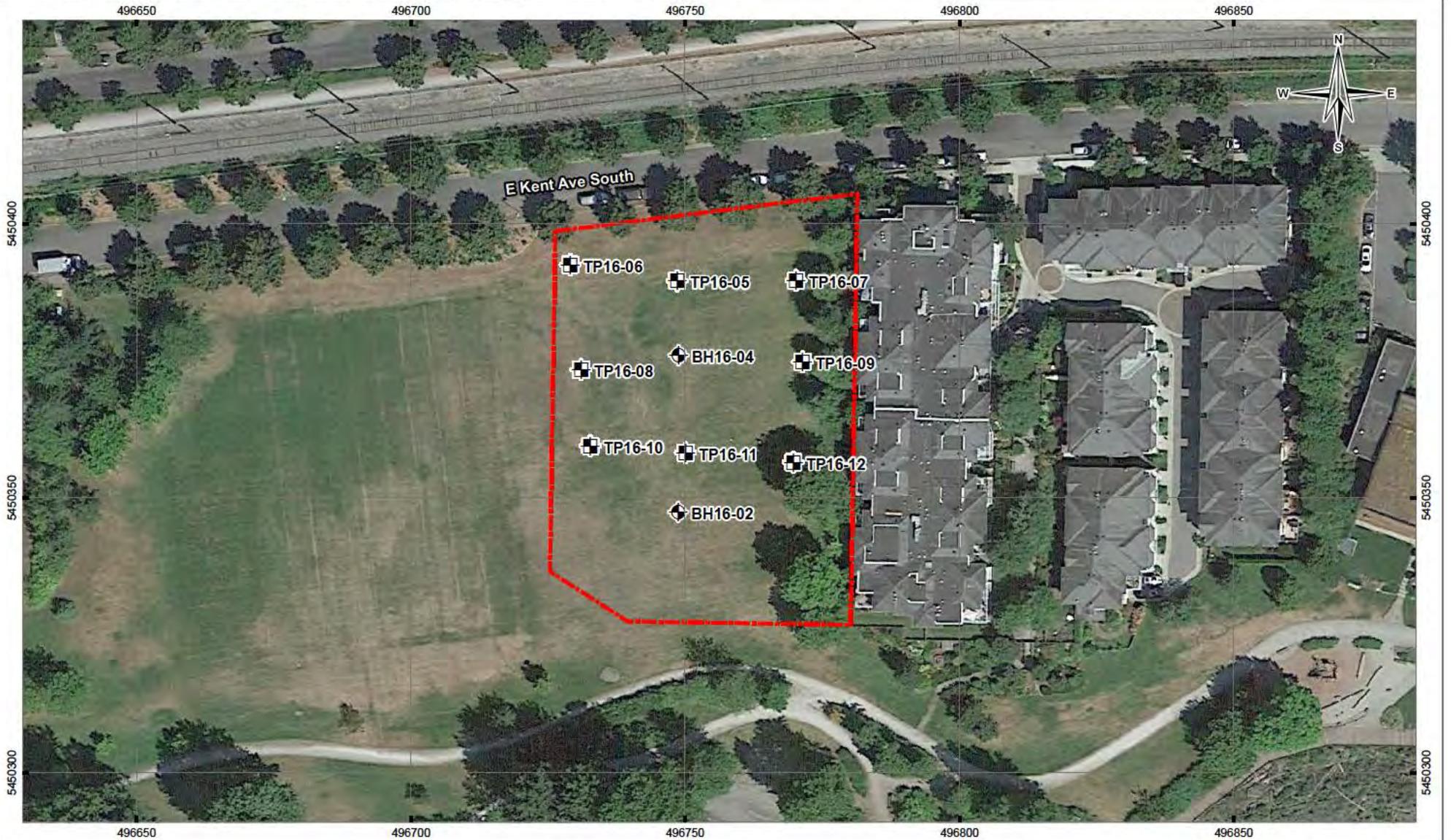
A handwritten signature in blue ink, likely belonging to Ali Azizian.

Reviewed by:  
for Ali Azizian, Ph.D., P.Eng.  
Principal Specialist – Geotechnical/Seismic  
Direct Line: 778.945.5733  
Ali.Azizian@tetrattech.com

# FIGURES

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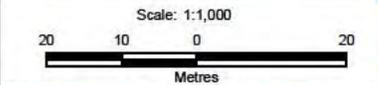
Figure 1      Testhole Location Plan



**LEGEND**

- Subject Property
- Borehole
- Testpit

**NOTES**  
 Base data source:  
 Imagery from Google; DigitalGlobe (2014)  
 Property boundary from City of Vancouver  
 open data (2015)



<b>PROJECTION</b> UTM Zone 10	<b>DATUM</b> NAD83
<b>FILE NO.</b> VENV03059-01_Figure01_Sampling.mxd	

**CLIENT**

**City of Vancouver**

**GEOTECHNICAL INVESTIGATION 3010  
 EAST KENT AVENUE SOUTH  
 VANCOUVER, BC**

**Test Hole Location Plan**

<b>PROJECT NO.</b> ENV.VEN\03059-01	<b>DWN</b> MEZ	<b>CKD</b> SL	<b>APVD</b> AD	<b>REV</b> 0
<b>OFFICE</b> Tt EBA-VANC	<b>DATE</b> March 3, 2016			

**Figure 1**

**STATUS**  
ISSUED FOR USE

# APPENDIX A

## TETRA TECH EBA'S GENERAL CONDITIONS

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# GENERAL CONDITIONS

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## GEOTECHNICAL REPORT

This report incorporates and is subject to these “General Conditions”.

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### 1.0 USE OF REPORT AND OWNERSHIP

This geotechnical report pertains to a specific site, a specific development and a specific scope of work. It is not applicable to any other sites nor should it be relied upon for types of development other than that to which it refers. Any variation from the site or development would necessitate a supplementary geotechnical assessment.

This report and the recommendations contained in it are intended for the sole use of Tetra Tech EBA's Client. Tetra Tech EBA does not accept any responsibility for the accuracy of any of the data, the analyses or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than Tetra Tech EBA's Client unless otherwise authorized in writing by Tetra Tech EBA. Any unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of Tetra Tech EBA. Additional copies of the report, if required, may be obtained upon request.

### 2.0 ALTERNATE REPORT FORMAT

Where Tetra Tech EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed Tetra Tech EBA's instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by Tetra Tech EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of Tetra Tech EBA's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except Tetra Tech EBA. Tetra Tech EBA's instruments of professional service will be used only and exactly as submitted by Tetra Tech EBA.

Electronic files submitted by Tetra Tech EBA have been prepared and submitted using specific software and hardware systems. Tetra Tech EBA makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

### 3.0 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, Tetra Tech EBA has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

### 4.0 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. Tetra Tech EBA does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

### 5.0 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

### 6.0 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. Tetra Tech EBA does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

#### 7.0 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

#### 8.0 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

#### 9.0 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

#### 10.0 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

#### 11.0 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

#### 12.0 BEARING CAPACITY

Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

#### 13.0 SAMPLES

Tetra Tech EBA will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

#### 14.0 INFORMATION PROVIDED TO TETRA TECH EBA BY OTHERS

During the performance of the work and the preparation of the report, Tetra Tech EBA may rely on information provided by persons other than the Client. While Tetra Tech EBA endeavours to verify the accuracy of such information when instructed to do so by the Client, Tetra Tech EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.

# APPENDIX B

## TEST PIT AND TESTHOLE LOGS

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**TP16-05**

**Date:** 11-Feb-16

**Logged By:** Antone Dabeet

Depth (m)		Soil Description
From	To	
0	0.1	SILT (TOP SOIL), sandy, some grass-root organics, moist, dark brown
0.1	1.2	SAND (FILL), some gravel, trace silt, trace organics, occasional cobbles and boulders, occasional asphalt pieces, moist, loose, dark brown; sand is medium poorly-graded subangluar; cobbles and boulders up to 40 cm diameter; asphalt pieces up to 10 cm diameter



**Notes:**  
 Excavator refusal at depth of 1.2 m as hard layer (assumed to be a concrete slab) was encountered. About 10 m long trench was excavated. Concrete slab was encountered over the entire length of the trench.  
 No groundwater was observed during excavation.

**TP16-06**

**Date:** 11-Feb-16

**Logged By:** Antone Dabeet

Depth (m)		Soil Description
From	To	
0	0.1	SILT (TOP SOIL), sandy, some grass-root organics, moist, dark brown
0.1	1	SAND (FILL), some gravel, trace silt, trace organics, occasional cobbles and boulders, moist, loose, brown; sand is medium to coarse, poorly-graded, subangular; cobbles and boulders up to 60 cm diameter
1	1.5	SAND (FILL), gravelly, trace silt, trace organics, occasional cobbles, moist, loose, grey; sand is fine to medium, well graded, subangular; cobbles up to 20 cm diameter



**Notes:**  
 Excavator refusal at depth of 1.5 m as hard layer (assumed to be a concrete slab) was encountered.  
 No groundwater was observed during excavation.

**TP16-07**

**Date:** 11-Feb-16

**Logged By:** Antone Dabeet

Depth (m)		Soil Description
From	To	
0	0.2	SILT (TOP SOIL), sandy, some grass-root organics, moist, dark brown
0.2	1.3	SAND (FILL), silty, trace gravel, trace organic roots, occasional cobbles, moist, loose, brown; sand is medium, poorly-graded, subround; cobbles and boulders up to 40 cm diameter
1.3	1.6	SILT (FILL), sandy, some gravel, trace organics, occasional cobbles, moist, firm, low plasticity, grey with brown mottling; sand is fine, poorly-graded, subrounded to subangular; cobbles up to 15 cm diameter
1.6	1.9	GRAVEL (FILL), sandy, trace silt, occasional cobbles, wet, compact, grey; gravel is fine to coarse, well-graded, angular; sand is medium to coarse, poorly-graded, subangular



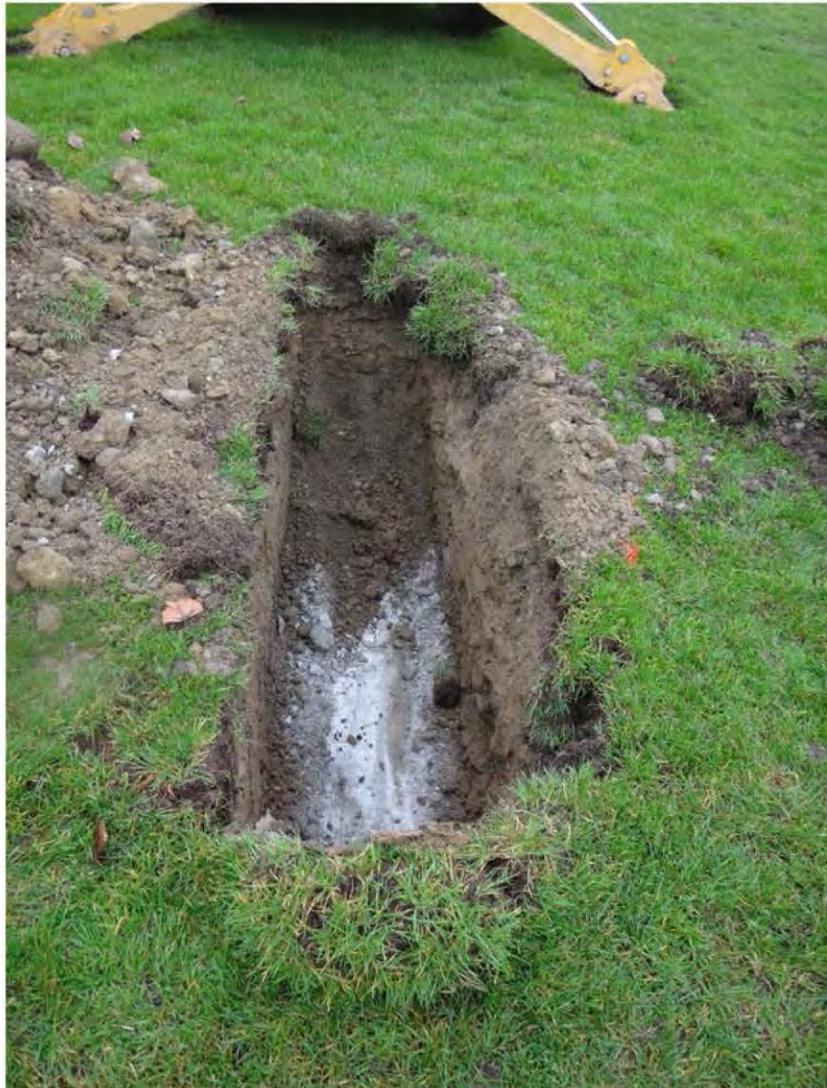
**Notes:**  
 Groundwater seeped into excavation at depth of 1.9 m.

**TP16-08**

**Date:** 11-Feb-16

**Logged By:** Antone Dabeet

Depth (m)		Soil Description
From	To	
0	0.2	SILT (TOP SOIL), sandy, some grass-root organics, moist, dark brown
0.2	1.2	SAND (FILL), some silt, trace gravel, trace organics, occasional cobbles, moist, loose, brown; sand is fine to medium well-graded subangular; cobbles are up to 20 cm diameter



**Notes:**

Excavator refusal at depth of 1.2 m as hard layer (assumed to be a concrete slab) was encountered.  
 No groundwater was observed during excavation.

**TP16-09**

**Date:** 11-Feb-16

**Logged By:** Antone Dabeet

Depth (m)		Soil Description
From	To	
0	0.1	SILT (TOP SOIL), sandy, some grass-root organics, moist, dark brown
0.1	1.3	SAND (FILL), gravelly, some silt, trace organics, occasional cobbles, moist, loose, brown; sand is medium to coarse poorly-graded, subangular; cobbles up to 20 cm diameter



**Notes:**  
 Excavator refusal at depth of 1.3 m as hard layer (assumed to be asphalt) was encountered.  
 No groundwater was observed during excavation.

**TP16-10**

**Date:** 11-Feb-16

**Logged By:** Antone Dabeet

Depth (m)		Soil Description
From	To	
0	0.2	SILT (TOP SOIL), sandy, some grass-root organics, moist, dark brown
0.2	1	SAND and GRAVEL (FILL), trace silt, trace organics, occasional cobbles, moist, loose, brown; sand is medium poorly-graded subangular; cobbles up to 30 cm diameter



**Notes:**

Excavator refusal at depth of 1 m as hard layer (assumed to be a concrete slab) was encountered.  
 No groundwater was observed during excavation.

**TP16-11**

**Date:** 11-Feb-16

**Logged By:** Antone Dabeet

Depth (m)		Soil Description
From	To	
0	0.1	SILT (TOP SOIL), sandy, some grass-root organics, moist, dark brown
0.1	0.5	SAND (FILL), some gravel, trace silt, trace organics, occasional cobbles, moist, loose, brown; sand is medium to coarse, poorly-graded, subangular; cobbles up to 20 cm diameter
0.5	1.1	SAND (FILL), gravelly, trace silt, trace organics, occasional cobbles and boulders, moist, loose, grey; sand is fine to medium, well-graded, subangular; cobbles and boulders up to 40 cm diameter



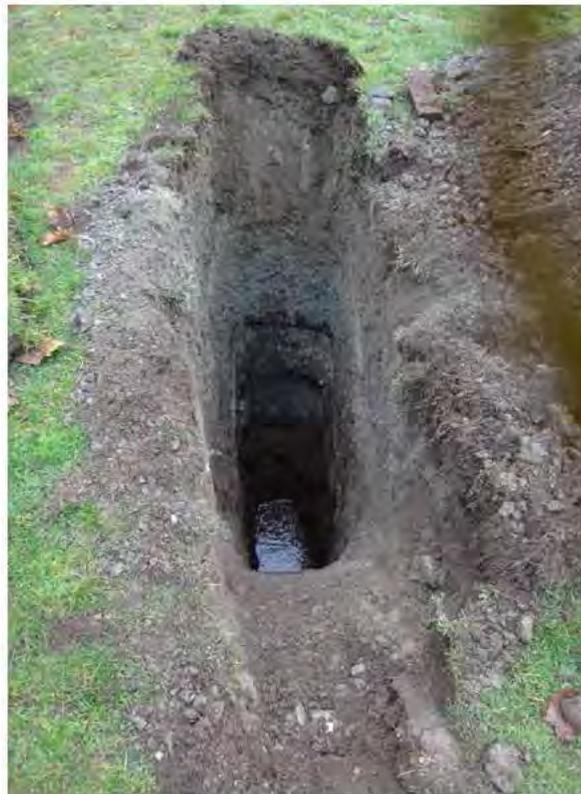
**Notes:**  
 Excavator refusal at depth of 1.1 m as hard layer (assumed to be asphalt) was encountered.  
 No groundwater was observed during excavation.

**TP16-12**

**Date:** 11-Feb-16

**Logged By:** Antone Dabeet

Depth (m)		Soil Description
From	To	
0	0.1	SILT (TOP SOIL), sandy, some grass-root organics, moist, dark brown
0.1	1	SAND (FILL), some gravel, some silt, trace organics, occasional cobbles, moist, loose, brown; sand is medium to coarse poorly-graded, subangular; cobbles are up to 15 cm diameter
1	1.5	SAND (FILL), gravelly, trace silt, occasional cobbles, moist, loose, grey; sand is medium, poorly-graded, subrounded; cobbles up to 15 cm diameter
1.5	2	Asphalt and aggregates layers (3 layers)
2	3.1	Wooden pieces up to 20 cm long and saw dust



**Notes:**  
 Groundwater seeped into excavation at depth of 3.1 m.

Depth (m)	Method	Soil Description	Graphical Representation	DCPT (N)	Moisture Content (%)	Plasticity Chart			DCPT (N)	Depth (ft)
						Plastic Limit	Moisture Content	Liquid Limit		
0						20	40	60	80	0
0 to 1.5	Solid Stem Auger/DCPT	SAND and GRAVEL (FILL), well graded, moist, loose, light grey, fine to coarse, subangular to rounded gravel, 80 mm max particle size, medium to coarse sand.	[Cross-hatched pattern]	11						1
1.5 to 2.0				17						2
2.0 to 2.5				9						3
2.5 to 3.0				40						4
3.0 to 3.5				24						5
3.5 to 4.0		SAND (FILL), gravelly, trace silt, trace organics, well graded, moist to wet, subangular to subrounded gravel, organic odour.		21						6
4.0 to 4.5				9						7
4.5 to 5.0				10						8
5.0 to 5.5		Wooden pieces and saw dust (FILL).		16						9
5.5 to 6.0				11						10
6.0 to 6.5				11						11
6.5 to 7.0				11						12
7.0 to 7.5				71						13
7.5 to 8.0		29						14		
8.0 to 8.5		18						15		
8.5 to 9.0		59						16		
9.0 to 9.5		28						17		
9.5 to 10.0		27						18		
10.0 to 10.5		98						19		
10.5 to 11.0		31						20		
11.0 to 11.5	SILT, clayey, trace sand, trace gravel, trace organic wood material, homogeneous, moist to wet, firm to stiff, low to medium plastic, grey, poorly graded fine sand.	30						21		
11.5 to 12.0		40						22		
12.0 to 12.5		35						23		
12.5 to 13.0		47						24		
13.0 to 13.5		30						25		
13.5 to 14.0		54						26		
14.0 to 14.5		33						27		
14.5 to 15.0		32						28		
15.0 to 15.5		33						29		
15.5 to 16.0		33						30		
16.0 to 16.5		46						31		
16.5 to 17.0		39						32		
17.0 to 17.5								33		
17.5 to 18.0	DCPT									



Contractor: Omega Drilling Ltd.	Completion Depth: 7.62 m
Drilling Rig Type: Track mounted	Start Date: 2016 February 12
Logged By: AD	Completion Date: 2016 February 12
Reviewed By: RC	Page 1 of 2

City of Vancouver

# Borehole No: BH16-02

Project: Geotechnical report for 3010 East Kent Ave.

Project No: ENV.VENV03059-01

Location: 3010 East Kent Avenue South

Vancouver, BC

UTM: 496747 E; 5450347 N; Z

Depth (m)	Method	Soil Description	Graphical Representation	DCPT (N)	Moisture Content (%)	Plasticity Chart			DCPT (N) 40 80 120 160	Depth (ft)
						Plastic Limit	Moisture Content	Liquid Limit		
10						20	40	60	80	
11	DCPT			35						33
				49						34
				62						35
				55						36
				74						37
				61						38
				61						39
				69						40
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Contractor: Omega Drilling Ltd.	Completion Depth: 7.62 m
Drilling Rig Type: Track mounted	Start Date: 2016 February 12
Logged By: AD	Completion Date: 2016 February 12
Reviewed By: RC	Page 2 of 2

Depth (m)	Method	Soil Description	Graphical Representation	Sample Number	Moisture Content (%)	Plastic Limit	Moisture Content	Liquid Limit	Depth (ft)
0						20	40	80	0
0 - 1	Solid Stem Auger	SAND (FILL), some gravel, poorly graded, wet, loose, grey, fine to medium sand, well graded subangular to rounded gravel.							1
1 - 2		SAND and GRAVEL (FILL), well graded, moist, grey, poorly graded medium sand, well graded angular to rounded gravel.							2
2 - 4.57		SAND and wood waste (FILL), trace gravel, poorly graded, wet, loose, grey, fine to medium sand, well graded subrounded to rounded gravel to 50 mm diameter.							3
4.57 - 4.7		SILT, clayey, trace sand, trace gravel, trace organic wood material, homogeneous, moist to wet, firm to stiff, low to medium plastic, grey, poorly graded fine sand.		SA1	85.3				4
4.7 - 4.8				SA2	42.5				5



Contractor: Omega Drilling Ltd.  
 Drilling Rig Type: Track mounted  
 Logged By: AD  
 Reviewed By: RC

Completion Depth: 4.57 m  
 Start Date: 2016 February 12  
 Completion Date: 2016 February 12  
 Page 1 of 1

March 16, 2016

City of Vancouver  
320 – 507 W Broadway  
Vancouver, BC V5Z 0B4

ISSUED FOR USE  
FILE: 704-ENV.VENV03059-01  
Via Email: Amber.Bongiovanni@vancouver.ca

**Attention:** Ms. Amber Bongiovanni, B.Sc., GradTech, EP  
Project Manager

**Subject:** Preliminary Desktop Geotechnical Report for 3010 E Kent Ave South  
Vancouver, B.C.

## 1.0 INTRODUCTION AND PROJECT DESCRIPTION

Tetra Tech EBA Inc. (Tetra Tech EBA) has been retained by the City of Vancouver (CoV) to provide a preliminary desktop geotechnical report for the potential development of 3010 E Kent Ave South in Vancouver BC. The purpose of this report is to summarize our review of available existing soil and groundwater information in the vicinity of the site and to provide preliminary, overview comments on the feasibility of developing the site from a geotechnical perspective.

The proposed project site is bordered by E Kent Ave South to the north, an existing three-storey residential complex to the east, the Fraser River to the south, and a vacant lot to the west.

We understand that the CoV is considering developing the project site by constructing a single-storey, wood-framed, at-grade daycare building. According to the CoV, we understand that the building will have approximate dimensions of 30 m by 30 m. We expect that the finished floor slab elevation of the proposed building will be at or near existing site grades; however, the CoV should review the flood plain elevation and confirm if the site and/or building grades need to be raised to achieve the minimum flood construction level for development. Hydrotechnical considerations in the development of the site, including flooding and scour protection are outside the scope of this report.

We expect that the proposed development will be designed in accordance with the requirements of Part 4 of the 2014 Vancouver Building Bylaw (VBBL).

## 2.0 REFERENCE DOCUMENTS

The following documentation was reviewed in the preparation of this report:

- Geological Survey of Canada. 1980. Surficial Geology, Vancouver, British Columbia. Map 1486A, 1:50,000 Scale.
- Geotechnical Investigation Report: Proposed Affordable Housing Site 4/5, 2801 East Kent Avenue North, Vancouver, B.C., prepared by GeoPacific Consultants Ltd., dated September 19, 2014.
- Geotechnical Investigation Report: Proposed Affordable Housing Site 6, 2910 East Kent Avenue South, Vancouver, B.C., prepared by GeoPacific Consultants Ltd., dated September 25, 2014.
- Historic aerial photographs of the site (period 1938 to 2004), obtained from the UBC Department of Geography Air Photo Library.

## 3.0 ANTICIPATED SUBSURFACE CONDITIONS

### 3.1 Soil Stratigraphy

Based on our review of Geological Survey of Canada Map 1486A, available geotechnical reports, and our previous project experience in the area the soil conditions at the project site are anticipated to consist of Fraser River Sediments comprised of silt clay loam overlying interbedded fine to medium sand and minor silt beds. These soils are underlain by dense glacial sediments (Vashon Drift), comprised of lodgement and minor flow till with lenses and interbeds of substratified glaciofluvial sand to gravel.

The existing geotechnical reports indicate that the adjacent vacant property to the west is mantled by up to 2.3 m of fill material, underlain by topsoil and organic silt in some locations. These materials are underlain by approximately 2 m to 4 m of firm to stiff silt and then up to 7 m of loose to compact sand with interbeds of clayey silt to silty sand. Dense glacial till was encountered at the adjacent vacant property at depths ranging from 6.4 m at the northwest portion of the site to 12.8 m at the southeast portion of the site.

### 3.2 Groundwater

Groundwater was encountered on the adjacent vacant property to the west at a depth of approximately 2 m below the current site grades. Groundwater levels are anticipated to vary seasonally and are likely influenced by the Fraser River.

## 4.0 SITE DEVELOPMENT HISTORY

Based on our review of the historic aerial photographs, the site was occupied by several industrial developments between the 1940s and the 1980s.

In addition to the previous development, portions of the Fraser River shoreline have been infilled and the shoreline modified. The oldest aerial photographs from 1938 show that the southern portion of the property contained a small island within the Fraser River, separated from the shore by an approximately 20 m wide back channel. The back channel was largely infilled by the 1950s, followed by further infilling and extending of the shoreline towards the south during the 1960s. The shoreline was further modified and reshaped during the 1990s as part of the development of Riverfront Park. Based on the above, we expect that the southern 30 m to 60 m of the site is largely comprised of fill material.

## 5.0 KEY GEOTECHNICAL CONSIDERATIONS

Based on our understanding of the subsurface conditions and the development history of the site, the following key geotechnical issues should be addressed as part of the proposed building development of the site:

- **Variable Fill:** The site is likely underlain by fills of variable thickness and composition that may include abandoned building foundations, timber pilings, pavement, construction debris, etc. These fill materials are unlikely to be suitable to support the proposed building and may need to be removed. Large obstructions such as concrete rubble, logs and boulders, if present in the fill, could impede the construction of deep foundations or ground improvement works.
- **Settlement:** Review of the available documentation indicates that the site may be underlain by settlement sensitive fine-grained silt, sandy silt, and/or organic silt. The additional loads resulting from raising site grades and construction of the proposed building development are expected to result in post-construction settlement of these fine-grained soils. The magnitude of the post-construction settlement will depend on the thickness and compressibility of the soil, the location and loads imparted from previous developments, and the magnitude of the additional loading applied.

In the event that the anticipated post-construction settlement is significant, ground improvement in the form of preloading may be required to reduce the total and differential post-construction settlements. Although previous developments on the site included several buildings and stockpiles which would have provided some preloading effect, the previous developments ranged in size, load, and duration. As such, the preload effect of the previous developments is not consistent across the site, which could result in differential settlement across the proposed building unless additional preloading is undertaken.

- **Liquefaction:** The subsurface soils may contain layers of loose to compact silty sand and sand, which are expected to be susceptible to liquefaction under the influence of the 2014 VBBL design earthquake. In addition, the firm to stiff silt layers may also be susceptible to strain softening under the influence of the design earthquake. Liquefaction and strain softening will result in strength reduction of these soils. The foundation of the proposed building will have to be designed such that punching failure of the foundation will not occur as a result of the reduced soil strength.

Liquefaction of the silty sand and sand layers are expected to result in vertical and horizontal ground displacements which will affect the proposed building. The magnitude of the movements at the proposed building will depend on the thickness of the liquefiable layers and the location of the building on the property. Generally speaking, the magnitude of these movements is expected to increase to the south (i.e. towards the Fraser River shoreline). In the event that the anticipated liquefaction induced ground movements are significant, ground improvement in the form of soil densification with stone columns, vibro-replacement / vibro-floatation, or rapid-impact-compaction may be required. The extent of the ground improvement, if necessary, will depend on the thickness of the liquefiable layers present. Alternatively, the proposed building foundation may be structurally designed to accommodate the movements and allow for egress as required by the 2014 VBBL.

- **Shallow Groundwater:** Difficulties during construction could arise due to the shallow depth to groundwater, which could include significant water inflow and/or sloughing into utility trench and drainage excavations below the water table.

## 6.0 DISCUSSION AND RECOMMENDATIONS

As outlined above, several geotechnical considerations need to be evaluated for the proposed development. From a geotechnical perspective, the proposed building development is considered feasible, provided that the geotechnical considerations are incorporated into the design and construction of the building.

### 6.1 Building Location

At this preliminary stage, we expect that the most appropriate location for the proposed building from a geotechnical perspective will be along the northernmost perimeter of the site, where the dense glacial soils are likely closest to the ground surface. Site preparation will likely require the removal of fill material and replacement with compacted structural fill (free-draining sand or sand and gravel). Preloading of the building area to reduce post-construction settlements may also be required. We further expect that the proposed building could likely be founded on a shallow modified raft slab to tolerate post-liquefaction ground movements.

### 6.2 Geotechnical Site Exploration

A geotechnical site exploration comprised of auger-drilled test holes and seismic cone penetration tests should be undertaken to verify the subsurface conditions at the site and to provide sufficient information for design of the building foundations. In addition, a series of excavator-dug test pits and/or shallower machine-augered test holes should be completed to evaluate the thickness and quality of the fill material across the site. We note that due to the potential for obstructions, excavator-dug test pits may be the most practical initial exploration method.

## 7.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of the City of Vancouver and their appointed agents. Tetra Tech EBA Inc. (Tetra Tech EBA) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than the City of Vancouver, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Tetra Tech EBA's General Conditions are provided in Appendix A of this report.

## 8.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,  
Tetra Tech EBA Inc.



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# APPENDIX A

## TETRA TECH EBA'S GENERAL CONDITIONS

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# GENERAL CONDITIONS

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## GEOTECHNICAL REPORT

This report incorporates and is subject to these “General Conditions”.

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### 1.0 USE OF REPORT AND OWNERSHIP

This geotechnical report pertains to a specific site, a specific development and a specific scope of work. It is not applicable to any other sites nor should it be relied upon for types of development other than that to which it refers. Any variation from the site or development would necessitate a supplementary geotechnical assessment.

This report and the recommendations contained in it are intended for the sole use of Tetra Tech EBA's Client. Tetra Tech EBA does not accept any responsibility for the accuracy of any of the data, the analyses or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than Tetra Tech EBA's Client unless otherwise authorized in writing by Tetra Tech EBA. Any unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of Tetra Tech EBA. Additional copies of the report, if required, may be obtained upon request.

### 2.0 ALTERNATE REPORT FORMAT

Where Tetra Tech EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed Tetra Tech EBA's instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by Tetra Tech EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of Tetra Tech EBA's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except Tetra Tech EBA. Tetra Tech EBA's instruments of professional service will be used only and exactly as submitted by Tetra Tech EBA.

Electronic files submitted by Tetra Tech EBA have been prepared and submitted using specific software and hardware systems. Tetra Tech EBA makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

### 3.0 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, Tetra Tech EBA has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

### 4.0 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. Tetra Tech EBA does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

### 5.0 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

### 6.0 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. Tetra Tech EBA does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

#### 7.0 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

#### 8.0 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

#### 9.0 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

#### 10.0 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

#### 11.0 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

#### 12.0 BEARING CAPACITY

Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

#### 13.0 SAMPLES

Tetra Tech EBA will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

#### 14.0 INFORMATION PROVIDED TO TETRA TECH EBA BY OTHERS

During the performance of the work and the preparation of the report, Tetra Tech EBA may rely on information provided by persons other than the Client. While Tetra Tech EBA endeavours to verify the accuracy of such information when instructed to do so by the Client, Tetra Tech EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.