CHUNG & VANDER DOELEN
ENGINEERING LTD.

GEOTECHNICAL INVESTIGATION
PROPOSED 25-STOREY APARTMENT BUILDING
177 and 179 Albert Street
Waterloo, Ontario

SUBMITTED TO:
14688210 Canada Inc.
316 Batavia Place
Waterloo, Ontario
N2L 3W1

ATTENTION:
Mr. Parker Zhang

FILE NO /1073**/**July 28, 2023

CHUNG & VANDER DOELEN
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July 28, 2023
File No.: 1073

14688210 Canada Inc.
316 Batavia Place
Waterloo, Ontario
N2L 3W1

Attention: Mr. Parker Zhang

RE: Geotechnical Investigation
Proposed 25-Storey Apartment Building
177 and 179 Albert Street, Waterloo, Ontario

We take pleasure in enclosing one (1) copy of our Geotechnical Investigation Report carried out at the above-referenced Site. Soil samples will be retained for a period of three (3) months and will thereafter be disposed of unless we are otherwise instructed.

If you have any questions or clarifications are required, please contact the undersigned at your convenience.

We thank you for giving us this opportunity to be of service to you.

Yours truly,
CHUNG & VANDER DOELEN ENGINEERING LTD.

Eric Y. Chung, M.Eng., P.Eng.
Principal Engineer

TABLE OF CONTENTS

Page

Letter of Transmittal i
Table of Contents ii
List of Enclosures iii

1.0 INTRODUCTION 1
2.0 FIELD WORK 1
3.0 LABORATORY TESTING 2
3.1 Geotechnical Laboratory Testing 2
3.2 Analytical Laboratory Testing 2
4.0 EXISTING SITE CONDITIONS 3
5.0 SUBSURFACE CONDITIONS 3
5.1 Pavement and Topsoil 3
5.2 Fill 4
5.3 Fine Granular Deposits 4
5.4 Clayey Silt Till 4
5.5 Sand 5
5.6 Groundwater 5
5.7 Hydraulic Testing 6
6.0 DISCUSSION AND RECOMMENDATIONS 7
6.1 General 7
6.2 Two-Level Underground Parking 7
6.3 Conventional Footing Foundations – Podium 8
6.4 Tower Raft Foundation 9
6.5 Earthquake Considerations 10
6.6 Open Cut Excavation and Groundwater Control 10
6.7 Floor Slab Design Against Hydrostatic Pressure 11
6.8 Hydrogeological Assessment and Dewatering 11
6.9 Floor Slab Construction 13
6.10 Shored Excavation 13
6.11 Site Servicing 14
6.11.1 Excavation Conditions 14
6.11.2 Pipe Bedding 15
6.11.3 Trench Backfill 15
6.11.4 Corrosion Potential and Cement Type 16
6.12 Lateral Earth Pressure 17
6.13 Access Driveway and Paved Parking Areas 18
6.13.1 Access Driveways Pavement 18
6.13.2 Pavement Above Underground Parking Garage 19

7.0 GEO-ENVIRONMENTAL CONSIDERATIONS 19
7.1 Applicable Regulatory Standards 20
7.2 Handling of Excess Soils 20
8.0 CLOSURE 22

LIST OF ENCLOSURES

Appendix A	Limitations of Report
Appendix B	Soil Chemistry Results (ALS Laboratories)
Appendix C	Comparison of the Soil Chemistry Results to the Applicable Regulatory Criteria
Appendix D	Slug Test Analysis Reports
Enclosure A	Soil Abbreviations and Terms Used on Record of Borehole Log Sheets
Enclosures 1 to 4	Borehole Log Sheets 1 to 4
Enclosures 5 to 8	Grain Size Distribution Charts
Drawing No. 1	Borehole Location Plan

1.0 INTRODUCTION

CHUNG & VANDER DOELEN ENGINEERING LTD. (CVD) has been retained by 14688210 Canada Inc. to carry out a geotechnical investigation for the proposed residential development to be located at 177 and 179 Albert Street, Waterloo, Ontario.

It is understood that the proposed development would consist of a 25-storey residential tower with 2 levels of underground parking and a 6-level attached podium. The finished ground floor elevation is anticipated to lie at 338.2± m, slightly above the southwest site corner existing grade. The finished P2 elevation is anticipated to lie at elevation 332.2± m. The finished floor elevations and site grading plan were not available at the time of reporting.

The purpose of this investigation was to determine the subsurface conditions at the site and, based on the findings, to make geotechnical recommendations for:

- Foundation design recommendations;
- Settlement assessment, provide magnitude of settlement and its impact on construction;
- Excavation condition;
- Groundwater control during construction;
- Backfilling recommendations;
- Shoring design;
- Foundation soil classification for seismic design per OBC 2012; and
- Foundation walls and shoring design.

2.0 FIELD WORK

To investigate the subsurface conditions at the site, four (4) boreholes were advanced to depths between 24.60 and 24.85 m below ground surface between June 14 and 22, 2023. The borehole locations are indicated on the Borehole Location Plan, Drawing No. 1.

The field work was carried out under the supervision of a member of our engineering team, who logged the boreholes in the field, effected the subsurface sampling, and monitored the groundwater conditions. Monitoring wells were installed in Boreholes 1, 3 and 4.

The boreholes were advanced using a truck mounted drill rig, supplied, and operated by a specialized contractor. The drill rig was equipped with mud rotary tooling and standard soil sampling equipment. Standard penetration tests (SPTs) in accordance with ASTM Specification D1586, were carried out at frequent intervals of depth, and the results are shown on the Borehole Logs as Penetration Resistance or “N”-values. The undrained shear strength of the cohesive soil deposit was determined on the slightly disturbed SPT samples using a field pocket penetrometer. The compactness condition or consistency of the soil strata has been inferred from these test results.

The location and ground surface elevation of the boreholes were surveyed by CVD for the purpose of this report. The ground surface elevations were referenced to a temporary benchmark (TBM) which is shown on Drawing No. 1 and described below:



TBM: Top of catch basin at road edge in westbound lane on Seagram Drive, just west of intersection with Albert Street, as shown on Drawing No. 1

Elevation: 339.11 m (Geodetic)

3.0 LABORATORY TESTING

3.1 Geotechnical Laboratory Testing

Soil samples obtained from the in-situ tests were examined in the field and subsequently brought to our laboratory for visual and tactile examination to confirm field classification. Moisture content determination of all retrieved samples occurred.

In addition, four (4) grain size distribution analyses tests were carried out on representative soil samples of the major soil deposits to establish the physical and engineering properties.

3.2 Analytical Laboratory Testing

Two (2) soil samples were submitted to ALS Laboratory Group of Waterloo, Ontario for corrosion potential to ductile iron (to support watermain anode sizing) and buried concrete. The samples were tested for conductivity, moisture content, pH, redox potential, resistivity, chloride, sulphate, and sulphides.

The following table presents the location, depth and description for each soil sample collected and submitted.

Sample I.D.	Sample Depth	Sample Description
BH 2 – SA 3	1.50 to 1.95 mbeg	Sandy Silt Fill
BH 4 – SA 3	1.50 to 1.95 mbeg	Sandy Silt

*mbeg denotes metres below existing grade

The laboratory certificates of chemical analysis and results provided by ALS Laboratory Group of Waterloo are enclosed in Appendix “B”.

Four (4) soil samples were submitted to ALS Laboratory Group of Waterloo, Ontario for analysis of metals and inorganics, benzene, ethylbenzene, toluene, and xylene (BTEX), and Petroleum Hydrocarbons (PHCs F1-F4). The chemical testing was conducted to provide a preliminary assessment of the environmental quality of potential excess soil which may be generated and removed off-site during construction.

The following table presents the location, depth and description for each soil sample collected and submitted.

Sample I.D.	Sample Depth	Sample Description
BH 1 – SA 2	0.75 to 1.20 mbeg	Sand and Silt
BH 2 – SA 1	0.00 to 0.60 mbeg	Sandy Silt Fill
BH 3 – SA 3	1.50 to 1.95 mbeg	Sandy Silt
BH 4 – SA 1	0.05 to 0.45 mbeg	Granular Base

*mbeg denotes metres below existing grade

4.0 EXISTING SITE CONDITIONS

The site consists of two (2) residential dwellings (177 and 179 Albert Street). The site is bounded by Albert Street to the east, Seagram Drive to the south and residential properties to the north and west.

The ground surface gradually decreases in southerly direction. The ground surface elevations at the borehole locations ranged between 338.17 and 340.28 m.

5.0 SUBSURFACE CONDITIONS

The detailed subsurface conditions encountered in the four (4) boreholes advanced as part of this investigations are shown on the Borehole Log Sheets, Enclosures 1 to 4. The following sections provide descriptions of the major soil deposits encountered in the boreholes.

The stratigraphic boundaries shown on the borehole logs are inferred from non-continuous sampling conducted during advancement of the borehole drilling procedures and, therefore, represent transitions between soil types rather than exact planes of geologic change. The subsurface conditions will vary between and beyond the borehole locations.

In general, the surficial pavement, topsoil and fill materials were underlain by very loose to compact fine granular deposits. The fine granular deposits were underlain by a very stiff to hard clayey silt till. Very dense, saturated sand layers/lenses were encountered within the clayey silt till.

5.1 Pavement and Topsoil

Topsoil was encountered at the ground surface at Boreholes 1, 2 and 3 with a measured thicknesses between 200 and 250 mm below existing grade. Asphalt pavement was contacted at the ground surface at Borehole 4 with an asphalt thickness of 50 mm, and granular base thickness of 480 mm.

5.2 Fill

A layer of fill materials was encountered underlying the topsoil and asphalt pavement at all boreholes. The fill layer extended to depths between 0.70 and 2.15 m below ground surface. The fill materials generally comprised of varying amounts of sand and silt, with trace organics.

The SPT "N"-values measured within the fill materials ranged from 2 to 14 blows per 300 mm of penetration, indicating a variable very loose to compact compactness condition. The measured water content of the samples collected from this deposit ranged between 5 and 19%, indicating a moist to wet moisture condition.

5.3 Fine Granular Deposits

A layer of fine granular deposits was encountered at all borehole locations below the fill materials and extended to depths between 5.95 and 8.55 m below ground surface.

The composition of the fine granular deposits, as the name suggested, varied throughout the stratum and comprised of layers of sand and silt, sand, silt, and sandy silt deposits which were in various thicknesses. Results of two (2) grain size distribution analyses from Boreholes 1 and 4 are shown graphically on Enclosures 5 and 8.

The SPT "N"-values measured within the fine granular deposits ranged from 9 to 68 blows per 300 mm of penetration, indicating a variable loose to very dense condition. The water content of the samples collected from this deposit were measured between 3 and 23%, indicating a damp to saturated moisture condition.

5.4 Clayey Silt Till

A deposit of clayey silt till was encountered below the fine granular deposits at all borehole locations which were terminated within the deposit at depths between 24.60 and 24.85 m. The clayey silt till contained trace sand to sandy, trace gravel and occasional saturated sand deposits within the layer. Results of one (1) grain size distribution analysis from Borehole 3 are shown graphically on Enclosure 6.

The SPT "N"-values measured within the deposit ranged from 28 to 50 blows per 75 mm of penetration. The undrained shear strength obtained on the retrieved samples was between 144 and over 250 kPa. Based on the above test results and tactile examination, the deposit is considered to have very stiff to hard consistency. Natural moisture contents were measured between 11 and 30%, indicating a DTPL to WTPL (Dryer Than Plastic Limit to Wetter Than Plastic Limit) moisture condition.

5.5 Sand

Fine to medium sand deposits were encountered within the clayey silt layer in Boreholes 1 to 3 which extended from 8.40 m to 16.15 m below ground surface. The deposits contained trace to some silt in Boreholes 1 to 3 and occasional clay seams at Borehole 3. Results of one (1) grain size distribution analyses from Borehole 3 are shown graphically on Enclosure 7.

The SPT "N"-values measured within the sand deposits ranged from 60 blows per 300 mm to 50 blows per 125 mm of penetration, indicating a very dense condition. The water content of the samples collected from this deposit were measured between 17 and 20%, indicating a saturated moisture condition.

5.6 Groundwater

Groundwater conditions were monitored during and following completion of borehole sampling.

Monitoring wells were installed in Boreholes 1, 3 and 4. The table below summarizes the stabilized static water level readings in the monitoring wells:

Borehole No.	Ground Surface Elevation (m)	Date	Water Level Below Existing Ground Surface (m)	Water Level Elevation (m)
1	340.28	July 4, 2023	5.22	335.06
3	339.04	July 4, 2023	4.98	334.06
4	338.17	July 4, 2023	3.75	334.42

The water levels measured in the monitoring wells ranged in depths between 3.75 and 5.22 m, corresponding to elevations 334.06 and 335.06 m. The water levels observed during and following the completion of drilling in the remaining boreholes were generally consistent with the water level elevations observed in the monitoring wells.

It is noted that the observed groundwater table will fluctuate seasonally and in response to major weather events.

5.7 Hydraulic Testing

Appendix D provides well response recovery test (slug test) data collected on July 4, 2023, from the three (3) monitoring wells installed at Boreholes 1, 3 and 4. The monitoring wells were purged by hand using polyethylene tubing and check valves. The water in the test well was lowered by pumping and the subsequent water recovery was measured over time. The response test was analyzed using AquiferTest software.

The following table summarizes the depth/elevation of the well screen and the materials screened/tested:

Borehole No.	Existing Ground Elevation (m)	Screened depth/Elevation (m)	Material Screened	Estimated Hydraulic Conductivity (m/sec)
1	340.28	4.60 to 7.60 (335.68 to 332.68)	Sand and Silt	1.53×10^{-6}
3	339.04	9.90 to 11.45 (329.14 to 327.59)	Sand	9.28×10^{-6}
4	338.17	3.05 to 6.10 (335.12 to 332.07)	Sandy Silt	6.86×10^{-6}

The hydraulic conductivity (permeability) of the native sand and silt deposit at the Boreholes 1 and 4 monitoring well locations was in the range of 1.53×10^{-6} to 6.86×10^{-6} m/sec. Whilst permeability of the saturated sand deposit within the clayey silt till layers at Borehole 3 monitoring well was at 9.28×10^{-6} m/sec.

6.0 DISCUSSION AND RECOMMENDATIONS

6.1 General

It is understood that the proposed development would consist of a 25-storey residential tower with 2 levels of underground parking and a 6-level attached podium. The finished ground floor elevation is anticipated to lie at 338.2± m, slightly above the southwest site corner existing grade. The finished P2 elevation is anticipated to lie at elevation 332.2± m. The finished floor elevations and site grading plan were not available at the time of reporting.

In general, the surficial pavement, topsoil and fill materials were underlain by very loose to compact fine granular deposits. The fine granular deposits were underlain by a very stiff to hard clayey silt till. Very dense, saturated sand layers/lenses were encountered within the clayey silt till.

The water levels measured in the monitoring wells ranged in depths between 3.75 and 5.22 m, corresponding to elevations 334.06 and 335.06 m. The water levels observed during and following the completion of drilling in the remaining boreholes were generally consistent with the water level elevations observed in the monitoring wells. It is noted that the observed groundwater table will fluctuate seasonally and in response to major weather events.

6.2 Two-Level Underground Parking

It is understood that two (2) levels of underground parking are proposed at the site. The lower portion of P2 level has been anticipated at elevation 332.2± m, therefore, the maximum depths of excavation could be in the range of 7.0± to 9.0± m, considering the additional depths of excavations for raft/footings and elevator pit.

The water levels in the installed monitoring wells ranged between 3.8± and 5.2± m, corresponding to elevations 334.1± and 335.1± m. Since the proposed underground parking will be below the groundwater table, the basement walls and floor slabs will have to be water-proofed. The basement floor slabs will need to be structurally reinforced to withstand the hydrostatic pressure and may require to be anchored down dependent on the final structural design and analysis.

Foundation excavations will be made in the moist fill, moist to saturated fine granular deposits and DTPL to WTPL cohesive deposits. Considering the saturated fine granular soil deposits underlying the site, the excavation will need to be pre-drained, and it will require a dewatering system in order to work in a “dry condition” and to maintain the integrity of the fine granular foundation soils from becoming “quick”. It is also anticipated that localized depressurization may be required in some areas (i.e., BH 3) as the excavations will be made within or below the cohesive deposits.

There is insufficient space for open cut excavations based on the footprint of the proposed building on the site. Therefore, a shoring system will be required to support the excavation and not compromise the foundations of the bordering roadways and neighbouring properties.

6.3 Conventional Footing Foundations – Podium

Conventional strip and spread footing foundations can be used to support the proposed 6 level podium and underground garage. With the planned 2 level of underground parking the founding elevation for the footings will be about 6.0± to 7.0± m below the existing grades.

Conventional strip and spread footing foundations can be used to support the proposed podium next to the 25-storey tower. Footings cast on competent native compact to very dense fine granular deposits and very stiff to hard clayey silt till can be designed using a Geotechnical Reaction at SLS of 250 kPa. The SLS value given above is based on a maximum settlement of 25 mm under the footing foundations. The Factored Geotechnical Resistance at ULS is 400 kPa.

The following table summarizes the highest founding level and elevation for the footing at each borehole location:

Borehole No.	Existing Ground Elevation (m)	Highest Founding Depth (m)	Highest Founding Elevation (m)
1	340.28	0.88	339.40
2	339.59	3.09	336.50
3	339.04	1.54	337.50
4	338.17	2.37	335.80

These soil bearing pressures can be achieved provided that the founding subgrade is undisturbed during construction. The majority of the settlements will take place during construction and the first loading cycle of the building.

It is recommended that a lean concrete mat be placed over approved footing subgrade to prevent further disturbance to the bearing soils resulting from construction activities.

In addition, the footings should be founded below any existing fill materials, on competent native undisturbed soils. Spacing between adjacent footing steps should not be steeper than 10H to 7V.

Adjacent to the raft foundation which will be used to support the apartment tower, footings must be founded below any disturbed soil and must be located below a 1H : 1V slope projected from the base of the adjacent excavation.

The maximum total and differential settlements of footings designed to the above recommended soil bearing pressure are expected to be less than 25 and 20 mm, respectively, and these are considered tolerable for the structure being contemplated.

Exterior footings and footings in unheated portions of the building should be provided with a soil cover of not less than 1.2 m or equivalent synthetic thermal insulation for adequate frost protection. The founding subgrade soils must be protected from frost penetration during winter construction.

It is recommended that the footing excavations be inspected by the geotechnical engineer to ensure adequate soil bearing and proper subgrade preparation.

6.4 Tower Raft Foundation

The 25-storey residential tower can be supported on a raft foundation. It is understood that the tower footprint will be approximately 21 by 21 m. The raft will likely have dimensions similar to the tower footprint.

With 2 levels of underground parking, the raft foundation would be founded approximately 1.8 m below finished P2 level (proposed to lie at elevation 332.2± m) on compact to very dense fine granular deposits and very stiff to hard clayey silt till.

A preliminary settlement analysis has been undertaken in order to estimate raft settlement for the purposes of preliminary design considerations. Using the soil parameters obtained from SPT values correlations and a soil pressure assumed to be up to approximately 300 kPa (12 kPa per level) the total settlements due to live load and dead load were calculated for the apartment tower. The preliminary analysis results indicate that the maximum total settlements of a rigid raft supporting the 25-level building could be up to approximately 20 to 30 mm. The settlement response will be “immediate” once the loading is imposed.

The following design and construction criteria are recommended:

- Modulus of vertical subgrade reaction of 21 MPa/m can be used for preliminary structural design of the raft foundation.
- Garage footings located adjacent to the apartment tower could be affected by the settlement of the raft foundation.
- It may be required to design the structures to accommodate the relative movement between the apartment tower and podium/parking garage.
- Accommodate relative movements for services connecting to the building.
- Remove any loose or soft soils exposed at the raft founding subgrade and replace such materials with lean concrete.
- Place a 50 to 100 mm thick lean concrete working pad to facilitate placement of reinforcement steel.
- Groundwater must be properly controlled during the raft slab construction.

Final design will be completed once the actual pressure distribution under the raft is established by the structural engineer. CVD will update the preliminary settlement model and provide a refined modulus of subgrade reaction and settlement estimate for the final raft design.

Monitoring of the tower settlement will be required in order to ensure that the majority of settlement due to the dead loads has completed. It may be necessary (pending final analysis and design) to wait until the settlement is completed before the connection of the tower to the podium can be made.

Assuming the dead load of the apartment will be 80±% of the total loading, settlement due to live loading will be minimal (less than 6 mm). The designer must take into consideration that the relative settlement between the apartment tower and the podium/garage structure could be up to 6 mm due to the live loads if the underground garage structure is connected to the apartment tower at the end of construction.

It is recommended that the foundation excavations be inspected by the geotechnical engineer to ensure adequate soil bearing and proper subgrade preparation.

6.5 Earthquake Considerations

In accordance with The Ontario Building Code 2012 (OBC), the proposed structure should be designed to resist earthquake load and effects as per OBC Subsection 4.1.8.

Based on the anticipated condition of the engineered fill materials and the underlying soil condition encountered at the boreholes, the site can be classified as a Site Class C as per OBC Table 4.1.8.4.A (Page B4-24).

6.6 Open Cut Excavation and Groundwater Control

The maximum depth of excavation could be in the range of 7.0± to 9.0± m, considering the additional depths of excavations on the northern site corner, raft foundation and elevator pit. The excavations will penetrate very loose to compact sand and silt fill, very loose to compact fine granular deposits, and very stiff to hard clayey silt till.

Above the groundwater table, these materials are considered to be Type 3 Soils in accordance with the latest Occupational Health and Safety Act. Excavations in the Type 3 Soils are expected to remain stable during the construction period provided that side slopes are cut to 1H : 1V from the bottom of the excavation. Where seepage or perched groundwater is encountered, side slopes should be cut to more stable angles of 3H : 1V. The side slopes should be suitably protected from erosion processes.

Above the groundwater table, rainwater or local perched groundwater can be controlled by pumping from filtered sump pits as and where required. It is recommended that excavation for the future development be done during the typically drier summer months when ground water conditions would be expected to lie at lower elevations.

Dewatering will be required for any excavations carried out below the water table, as the fine granular soils will become "quick" and lose its integrity to support loads. The groundwater table must be lowered and controlled to at least 600 mm below the excavation level to facilitate the excavation and construction of footing and raft foundations, and foundation walls to be carried out in the dry condition.

In wet to saturated subgrade condition, it will be necessary to excavate below founding level and pour a 50 to 100 mm thick mud slab of lean concrete to protect the founding soil from disturbance during the installation of reinforcing steel bars and form work.

6.7 Floor Slab Design Against Hydrostatic Pressure

Since the proposed P2 level is below the measured groundwater table, the basement walls and floor slabs will have to be water-proofed. The basement floor slabs will need to be structurally reinforced to withstand the hydrostatic pressure and may require to be anchored down dependent on the final structural design and analysis.

6.8 Hydrogeological Assessment and Dewatering

The finished floor elevations and site grading plan were not available at the writing of this report. For the purpose of this preliminary analysis, the finished ground floor elevation is anticipated to lie at 338.2± m, slightly above the southwest site corner existing grade. The finished P2 elevation is proposed to lie at elevation 332.2± m. Based upon this assumption, it is noted that the building foundations will be founded below the groundwater table, and dewatering will be required during construction. A dewatering system must be installed to lower the groundwater table to at least 600 mm below the footing founding levels to enable construction to be carried out in a relatively dry condition.

Two aquifers – a water table aquifer and a confined aquifer – were encountered during the field investigation. Based upon the encountered geological conditions, and CVD's experience in the surrounding area, the two aquifers are expected to be partially connected.

Appendix D provides well response recovery test (slug test) data collected on July 4, 2023, from the monitoring wells at Boreholes 1, 3 and 4. The water levels of the water table aquifer were measured between 335.06 and 334.43 m at Boreholes 1 and 4, and the potentiometric elevation of the confined aquifer in Borehole 3 was measured at 334.06 m. Additionally, well response tests were performed on all three (3) wells and analysed using the Bower and Rice Method through the AquiferTest software.

Based upon these results and those estimated from the grain sizes of the samples located in the screened depths, the hydraulic conductivity ranged from 1.53×10^{-6} to 9.28×10^{-6} m/s, with the higher estimate corresponding to that of the confined fine to medium sand deposits (Borehole 3). These estimates correspond with the typical ranges of the encountered sand and silt to sandy silt and fine to medium sand with some silt deposits (Freeze and Cherry, 1979). It should be noted that the confined aquifer located in the fine to medium sand layer was encountered in three (3) out of four (4) drilled boreholes.

The saturated fine to medium grained sand layer (encountered between elevation 328.7± and 330.7± m) underlying the clayey silt deposit is under hydrostatic pressure. Depending upon the finalized footing/raft and elevator pit elevations, it will need to be depressurized to allow excavations to be carried out. The requirement for depressurization depends on the depth of excavation and the hydrostatic head in the deposit, both of which are to be finalized/determined when the building design progresses.

The objective of a properly installed and operated dewatering system, to be designed by the dewatering contractor, should:

- Lower the water table inside the excavation and intercept seepage which will emerge from the banks and the bottom of the excavation.
- Improve the stability of the bottom of the excavation to prevent disturbance due to hydrostatic pressure.
- Provide a reasonably dry working area in the bottom of the excavation.
- Provide for the collection and removal of surface runoff water and rainfall.

The dewatering system should be monitored to ensure that "silt" is not removed during pumping. It is noted that the selection of the appropriate dewatering system is the responsibility of the contractor. The dewatering system proposed by the contractor should be reviewed by the geotechnical engineer.

The dewatering system should be kept effective until backfilling to the foundations is completed. The dewatering system should be decommissioned gradually.

In light of the expected construction excavation (1,018 m^2 – the footprint of the podium, including the tower), the amount of groundwater to dewatered is expected to exceed 50,000 litres/day. This pumping is considered to be a "water taking" by the Ministry of Environment, Conservation and Parks (MECP) and is subject to the ministry's "Permit To Take Water (PTTW)" requirements. In March 2016, the Ministry provided an exemption from the permitting requirements for "construction-only" water takings that do not exceed 400,000 L/day.

For these modest "construction-only" water takings, the water taking must still be "registered" on the MECP "Environmental Activity and Sector Registry (EASR)", but nevertheless a quicker and less formal process is now available to allow pumping to proceed. A qualified person (QP) must still evaluate the water taking for all the same environmental impact issues and then indicate this through the on-line registration procedure. For all other water takings and construction water takings exceeding 400,000 L/day, a PTTW is still required along with a 90-day review process.

In order to better understand the expected conditions, a preliminary analysis was conducted to estimate the quantity of water to be pumped. The following assumptions were applied:

- 1,018 m^2 excavation
- Finished FFE at 338.2 mASL
- Bottom of P2 raft foundation beneath building to a maximum elevation of 332.2 mASL

Based upon the preliminary analysis, it is expected that the water taking will fall under the category of an EASR (50,000 to 400,000 L/day). Appendix D provides the three (3) well response recovery tests (slug tests), as well as both preliminary dewatering models.

A more detailed assessment by a QP is required to determine the water taking at this site when details of the building design are available. CVD can provide further assistance in preparing a supplemental hydrogeological report to support application the expected EASR.

6.9 Floor Slab Construction

The basement floor slab will be constructed as slab on grade, on the 450 to 600 mm thick granular fill which will be placed on top of the raft foundation and/or the water-proofed basement floor slab. The granular fill layer is intended to allow utilities to be buried between the slab on grade and raft.

It is recommended that the granular fill layer be consisted of clear crushed stone (9 mm size preferred for the ease of handling and installing utilities). The clear crushed stone should be suitably compacted/densified to ensure settlement does not take place.

At the time of floor slab construction, the exposed clear crushed stone subgrade should be proof-rolled with a heavy roller in conjunction with an inspection by the geotechnical engineer.

A modulus of subgrade reaction (k_s) of 80 MN/m^3 may be used for the design of the floor slabs, considering the floor subgrade will consist of clear crushed stone.

The floor slabs should be separated structurally from the columns and foundation walls. Sawcut control joints should be provided at regular spacing (less than 30 times the concrete slab thickness) and to depths between one-third to one-quarter of the slab thickness.

6.10 Shored Excavation

As excavation is expected to be between 7.0± to 9.0± m deep, a shoring system will be required for temporary excavation support during construction where sufficient space is not available for open cut excavation and to support the adjacent structures. Possible shoring supports include soldier pile and timber lagging system, caisson wall or soil nail retaining system with shotcrete facing.

The shoring system is generally designed and built by a specialized shoring contractor. The shoring system should be designed in accordance with the guidelines provided in the Canadian foundation Engineering Manual (CFEM) 4th Edition.

The shoring system will have to withstand the lateral earth pressure, the adjacent roadways, buried services and the traffic loads as well as the adjacent building structures. Frost pressures on the shoring system should be considered if the system is exposed to winter freezing condition. The shoring system should be monitored to ensure deflection and lateral movements are acceptable, and modifications made to the shoring system if deflection and lateral movements become a problem.

The following soil parameters may be used in the design of shoring. K_o (at rest condition) should be used where the shoring will need to support any existing building/structure.

Soil	Unit Weight (kN/m^3)	Friction Angle (ϕ^o)	K_o	Ka	Kp
Loose to compact Fill Materials	19	28	0.53	0.36	2.77
Compact to dense Silty Sand to Sandy Silt	21	32	0.47	0.31	3.23
Firm to Hard Silty Clay	21	29	0.52	0.35	2.85

The shoring system can be supported by soil anchor tie-backs and/or raker footings. Soil anchors will provide an unobstructed open space for construction whereas raker supports will obstruct the forming and construction of footings and foundation walls.

If a soldier pile and timber lagging system is adopted, the augering/installation of the soldier piles and timber laggings, especially where they are located adjacent existing structures, should be carried out with caution such that the installation process will not cause future settlements to the adjacent existing structures. The geotechnical engineer should be retained to perform inspection during the installation.

6.11 Site Servicing

It is anticipated that water and sewer servicing will generally be in the range of 1.5 to 2.5 m deep.

6.11.1 Excavation Conditions

Trenching can be carried out using conventional open cut procedures. The excavations will generally intersect very loose to compact fill, and loose to very dense native fine granular deposits. The loose, unstable, and/or organic soils encountered at or below the pipe invert should be sub-excavated and replaced with well compacted OPSS Granular "A" which should be placed in 150 mm thick layers and

compacted to at least 95% SPMDD. The support of pipes in these areas can also be achieved with non-shrinkable fill if poor soil is encountered at the subgrade level and fully removed.

As described in Section 6.6, the soils encountered at the boreholes are generally considered to be Type 3 Soils in accordance with the latest Occupational Health and Safety Act and trenches should be cut to 1H to 1V throughout. The side slopes should be suitably protected from erosion processes. Where seepage zones are intersected, side slopes are to be flattened locally and the groundwater controlled by suitable means. Excavations can also be supported using trench box or timber lagging.

6.11.2 Pipe Bedding

As noted in Section 6.11.1, any unsuitable soils exposed at the pipe subgrade should be sub-excavated and replaced with imported Granular "A", placed in thin layers, and compacted to at least 95% SPMDD, or can be removed and supported on non-shrinkable fill.

The bedding requirements for the services should be in accordance with Ontario Provincial Standard Drawings OPSD - 802 for flexible and rigid pipes. The bedding shall be a Class "B" and consist of at least 150 mm thick Granular "A" compacted to at least 95% SPMDD. Granular "A" should be used to backfill around the pipe to at least 150 mm above the top of the pipe.

Particular attention should be given to ensure material placed beneath the haunches of the pipe is adequately compacted. Recycled asphalt will not be allowed to be used in Granular “A” bedding material.

6.11.3 Trench Backfill

Excavated inorganic materials are considered suitable for reuse as trench backfill. If necessary, potential mixing of drier and wetter excavated soils in proper ratios can be done to produce a suitable mixture near the material’s optimum moisture content in order to achieve the required compaction specification. Conversely, judicious addition of water may be required if the soils are significantly drier than their optimum moisture content in order to facilitate suitable compaction.

The backfill should be placed in thin layers, 300 mm thick or less dependant on the demonstrated success of compaction based on in-situ density test results. Other types of materials such as organic soils, overly wet soils, and frozen materials (if work is carried out in the winter months) should not be used for backfilling. All backfill should be compacted to at least 95% SPMDD.

Backfilling operations should follow closely after excavation so that only a minimal length of trench slope is exposed at any one time so as to minimize potential problems. This will potentially minimize over-wetting of the subgrade material. Particular attention should be given to make sure frozen material is not used as backfill should construction extend into the winter season.

6.11.4 Corrosion Potential and Cement Type

Two (2) soil samples were submitted to ALS Laboratory Group of Waterloo, Ontario for analysis of resistivity, pH, redox potential, concentration of sulphides and concentration of water-soluble sulphates. The testing was conducted to assess the conditions associated with the potential for degradation of buried concrete in the presence of soluble sulphates and the corrosion potential to watermain/metal fittings.

The corrosion potential test results of two (2) selected soil sample are included in Appendix and are summarized below with reference to "AWWA C105 Appendix A":

Soil Characteristics	**BH 2 – SA 3 1.5 to 1.95 mbeg (Sandy Silt Fill)**	**BH 4 – SA 3 1.5 to 1.95 mbeg (Sandy Silt)**
Resistivity (Ω-cm)	6,330 (0)	930 (10)
pH	7.55 (0)	8.10 (0)
Redox Potential (mV)	281 (0)	218 (0)
Sulphides (ppm*)	Trace (2)	Positive (3.5)
Moisture	Fair Drainage (1)	Fair Drainage (1)
Total Points	**3**	**14.5**

*1 mg/kg = 1 ppm

In accordance with "AWWA C105 Appendix A", when the total point counts are then (10) points or greater, the soil is corrosive to ductile iron and protection is needed.

The Canadian Standards Association (CSA) recognizes four (4) categories of potential sulphate attack of buried concrete based on percent sulphate in soil. From 0 to 0.10% the potential is negligible, from 0.10 to 0.20% the potential is mild but positive, from 0.20 to 0.50% the potential is considerable, and 0.50% and greater the potential is severe. Sulphate concentrations of 32 mg/kg (0.0032%) and less than 20 mg/kg (<0.002%) were measured on the two (2) samples submitted for analysis which are considered negligible for sulphate attack on buried concrete.

6.12 Lateral Earth Pressure

The unbalanced foundation walls and any other soil retaining structures should be designed to resist the lateral earth pressure acting against these walls. The following formula may be used to calculate the unfactored earth pressure distribution. The factored resistance can be calculated by using a factor of 0.8.

$$P = K (\gamma h_1 + \gamma' h_2 + q) + \gamma_w h_2$$

Where:

P	=	lateral earth pressure, kPa
K	=	theoretical earth pressure coefficient (0.5 for level free-draining granular backfill)
γ	=	unit weight of retained soil, 20.0 kN/m^3
γ'	=	submerged unit weight of backfill, 10.2 kN/m^3
γ_w	=	unit weight of water, 9.8 kN/m^3
h_1	=	depth below top of backfill to water table, m
h_2	=	depth below water table to bottom of wall, m
q	=	surcharge, kPa

The backfill for the foundation walls and retaining walls should be free-draining granular materials which should have less than 8% silt particles (OPSS Granular "B" Type I). The backfill should be placed in thin layers and compacted to 95% SPMDD. Over-compaction adjacent to the foundation/retaining walls should be avoided. Compaction should be carried out with hand operated equipment within 1 m of the foundation wall or retaining wall. Weeping tiles leading to a frost-free outlet or weep holes should be installed to effect drainage behind the retaining wall.

The sliding resistance of the retaining wall footings should be checked. The unfactored horizontal resistance against sliding between cast-in-place concrete and the various soils can be calculated using a friction coefficient as follows:

Soil	Unit Weight (kN/m^3)	Friction Coefficient
Well-compacted granular backfill	21	0.45
Compact to dense sand and silt	21	0.40
Firm to hard clayey silt	20	0.45

6.13 Access Driveway and Paved Parking Areas

6.13.1 Access Driveways Pavement

Based on the results of the field work, the predominant subgrade materials at the site will consist of fill materials and fine granular deposits. All topsoil should be removed under pavement areas and replaced with on site fill, placed in 300 mm thick lift and each lift compacted to at least 95% SPMDD.

The following flexible pavement structures are recommended based on the results of grain size distribution, assumed CBR values, groundwater table, frost susceptibility of subgrade soils and traffic volume.

Component	Light Duty Pavement (mm)	Heavy Duty Pavement (mm)
Asphaltic Concrete HL3 Asphaltic Concrete HL8	40 50	50 50
Granular "A" Base	150	150
Granular "B" Sub-base	300	400

The pavement design considers that pavement construction will be carried out during the drier time of the year and that the subgrade is stable, not heaving under construction equipment traffic. If the subgrade is wet or unstable, additional granular sub-base may be required.

Prior to the placement of the granular base, the subgrade will be stripped of existing pavements, topsoil, and deleterious materials. The exposed subgrade should be thoroughly recompacted with a heavy vibratory compactor and inspected by a qualified geotechnical inspector. Any soft spots encountered during the process should be excavated to the level of competent soil. The required grades can then be achieved by placing approved on-site soils in maximum 200 to 300 thick lifts which should be compacted to 95% SPMDD.

The base and sub-base materials should be produced in accordance with the current OPSS specifications and placed and uniformly compacted to at least 100% SPMDD. The asphaltic concrete should be placed and compacted in accordance with OPSS Form 310 and to at least 92% of the Marshall Density (MRD). Frequent in situ density testing by this office should be carried out to verify that the specified degree of compaction is being achieved and maintained.

It should be noted that even well compacted trench backfill could settle for a period of time after construction. In this regard, the surface course of the asphaltic concrete should be placed at least one (1) year after trench backfill is completed to allow any minor settlements to occur within the trench backfill. The incomplete pavement structure may not be capable of supporting construction traffic. Consequently, minor repairs of the sub-base, base and asphaltic concrete may be required prior to paving with the base course and/or the surface course asphaltic concrete.

6.13.2 Pavement Above Underground Parking Garage

It is anticipated that asphalt pavement may be constructed above the underground garage on concrete slab and the following pavement structure is recommended:

Component	Component Thickness (mm)
Superpave 12.5 Surface Course	45
Asphaltic Concrete HL4 Base Course	45
Granular "A" Base (less than 5% silt)	Variable

A water-proofing membrane should be installed above the concrete slab to prevent moisture migration into the underground parking level, protect the concrete slab and reinforcing steel rebar, and aid the drainage of infiltrated water from the Granular "A" base layer to area drains. The structural concrete slab should be sloped to direct water runoff to area drains.

Protection board should be installed above the waterproofing membrane in order protect it from damage and improve the durability and performance of the pavement structure.

The granular base thickness above the underground parking structure will be variable. The granular base materials should contain less than 5% silt and be uniformly compacted to at least 100% SPMDD. The prepared earth subgrade and final pavement surfaces should be graded to direct water runoff to area drains.

7.0 GEO-ENVIRONMENTAL CONSIDERATIONS

Excess soil may be generated and removed off-site during the construction activities associated with the proposed site works. The management of excess soil is now governed by O.Reg. 406/19, MECP document entitled "On-Site and Excess Soil Management Regulation". In accordance with the regulation, the Project Leader is responsible for the handling, storage, reuse, transportation, and removal of all soil. To support off-site removal of excess soil, the following is required:

- Planning Documentation
  - Assessment of Past Use
  - Sampling and Analysis Plan
  - Excess Soil Characterization Report
  - Excess Soil Destination Report
- Tracking
- Registry
- Record Keeping

An initial testing program was conducted during the geotechnical investigation and the analytical results are discussed in the following sections of this report. Additional soil sampling and analysis may be required as per the above-noted MECP document and/or as per the requirement of the receiving site owner(s), depending on the volume of excess soil generated during construction. The analytical results and environmental assessment findings must be disclosed to the receiving site owner(s) and approval by the receiving site owner(s) be obtained prior to exporting/transferring the materials.

It is noted that the soils condition may differ between and beyond the sampled locations. If any impacted soils are discovered during construction, CVD should be contacted for further sampling and testing to determine the limit of the impacted soils.

Any soils identified during construction to have been environmentally impacted are to be separately stockpiled and analysed to determine the appropriate measures for handling and disposal. Waste characterization testing (TCLP) to classify the material for disposal as prescribed in O.Reg. 347/558 is required. Leachate analysis (mSPLP) is to be carried out if the excess soil is to be disposed to receiving sites under O.Reg. 406/19.

Similarly, groundwater encountered during construction works must also be suitably assessed and handled.

7.1 Applicable Regulatory Standards

The Soil, Ground Water and Sediment Standards for Use Under the New Soil Rules and Excess Soil Quality Standards established in accordance with the O.Reg. 406/19 as amended were consulted in the assessment of the soil at the project site.

The analytical results for soils were compared to the following “applicable regulatory standards”:

• Table 1 (Full Depth Background Site Condition Standards) for Residential/Parkland/Institutional/ Industrial/Commercial/Community Property Use

• Table 2.1 (Full Depth Generic Site Condition Standards in a Potable Ground Water Condition) for Residential/Parkland/Institutional Property Use

• Table 2.1 (Full Depth Generic Site Condition Standards in a Potable Ground Water Condition) for Industrial/Commercial/Community Property Use

7.2 Handling of Excess Soils

Four (4) soil samples were submitted to ALS Laboratory Group, Waterloo for analysis of Metals and Inorganics, Petroleum Hydrocarbons (PHCs F1 to F4), and Benzene, Toluene, Ethylbenzene and Xylene (BTEX). The chemical testing was conducted to initially assess the environmental quality of potential excess soil which may be generated and removed off-site during construction activities.

The results and laboratory certificates of chemical analysis are enclosed in Appendix B. A comparison of the soil chemistry results to the applicable regulatory standard is included in Appendix C.

The analytical results for electrical conductivity (EC) indicate that the tested soils from Borehole 4, Sample 1 exceed the allowable concentration limits under Table 2.1 RPI standards.

The analytical results for sodium adsorption ratio (SAR) indicate that the tested soils from Borehole 3, Sample 3 and Borehole 4, Sample 1 exceed the allowable concentration limits under Table 2.1 RPI standards.

The analytical results for metals and inorganics indicate that the tested soils from Borehole 4, Sample 1 exceed the allowable concentration limits for Barium (Ba) under Table 1 standards and Lead (Lb) under Table 2.1 standards.

The analytical results for PHCs (F1-F4) indicate that the tested soils from Borehole 4, Sample 1 exceed the allowable concentration limits for F4 (C34-C50) under Table 1 standards.

The analytical results for BTEX indicate that the tested soils do not exceed the allowable concentration limits under Table 1 and Table 2.1 standards.

Any soils identified during construction to have been environmentally impacted are to be separately stockpiled and analysed to determine appropriate measures for handling and disposal. Waste characterization testing (TCLP) to classify the material for disposal as prescribed in Ontario Regulation 347/558 is required.

CVD further recommends that a disposal plan for excess soils be established to manage the quantity, as well as where and how the excess soils can be disposed of off-site.

8.0 CLOSURE

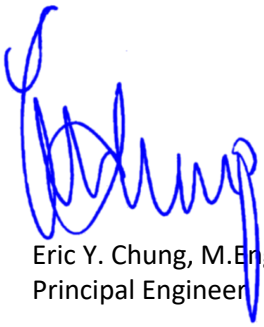
The Limitations of Report, as quoted in Appendix A, is an integral part of this report.

We trust that the information presented in this report is complete within our terms of reference. If there are any further questions concerning this report, please do not hesitate to contact our office.

Yours truly,
CHUNG & VANDER DOELEN ENGINEERING LTD.



Marcelo Pereira, M.Sc.
Geotechnical Engineering Intern





Eric Y. Chung, M.Eng., P. Eng.
Principal Engineer

encls.

APPENDIX A

LIMITATIONS OF REPORT

APPENDIX "A"

LIMITATIONS OF REPORT

The conclusions and recommendations given in this report are based on information determined at the testhole locations. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the testhole locations, and conditions may become apparent during construction which could not be detected or anticipated at the time of the site investigation. It is recommended practice that the Soils Engineer be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered in the testholes.

The comments made in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of testholes and their respective depths may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. 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 conclusion as to how the subsurface conditions may affect their work.

The benchmark and elevations mentioned in this report were obtained strictly for use in the geotechnical design of the project and by this office only, and should not be used by any other parties for any other purposes.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. CHUNG & VANDER DOELEN ENGINEERING LIMITED accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report. Since all details of the design may not be known, we recommend that we be retained during the final design stage to verify that the design is consistent with our recommendations, and that assumptions made in our analysis are valid.

This report does not reflect the environmental issues or concerns unless otherwise stated in the report.

APPENDIX B

SOIL CHEMISTRY RESULTS

ALS Canada Ltd.

right solutions.
right partner.

CERTIFICATE OF ANALYSIS (GUIDELINE EVALUATION)

Work Order	: **WT2318555**	Page	: 1 of 14
Client	: **Chung and Vander Doelen Engineering Ltd.**	Laboratory	: Waterloo - Environmental
Contact	: Brianna Cobbe	Account Manager	: Andrew Martin
Address	: 311 Victoria St. N. Kitchener ON Canada N2H 5E1	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: ----	Telephone	: +1 519 886 6910
Project	: 1073	Date Samples Received	: 23-Jun-2023 13:00
PO	: ----	Date Analysis Commenced	: 24-Jun-2023
C-O-C number	: 20-1048903	Issue Date	: 30-Jun-2023 19:29
Sampler	: EP		
Site	: ----		
Quote number	: Q84362 - Excess Soils		
No. of samples received	: 6		
No. of samples analysed	: 6		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Guideline Comparison

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Amanda Ganouri-Lumsden	Department Manager - Microbiology and Prep	Centralized Prep, Waterloo, Ontario
Greg Pokocky	Manager - Inorganics	Inorganics, Waterloo, Ontario
Greg Pokocky	Manager - Inorganics	Metals, Waterloo, Ontario
Jocelyn Kennedy	Department Manager - Semi-Volatile Organics	Organics, Waterloo, Ontario
Sarah Birch	VOC Section Supervisor	VOC, Waterloo, Ontario

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.
Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guidelines are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

Key : LOR: Limit of Reporting (detection limit).

Unit	*Description*
-	no units
%	percent
µS/cm	microsiemens per centimetre
mg/kg	milligrams per kilogram
mg/L	milligrams per litre
mS/cm	millisiemens per centimetre
mV	millivolts
ohm cm	ohm centimetres (resistivity)
pH units	pH units

>: greater than.
<: less than.
Red shading is applied where the result or the LOR is greater than the Guideline Upper Limit (or lower than the Guideline Lower Limit, if applicable).
For drinking water samples, Red shading is applied where the result for E.coli, fecal or total coliforms is greater than or equal to the Guideline Upper Limit .

Analytical Results

Sub-Matrix: **Soil/Solid**
(Matrix: **Soil/Solid**)

Analyte	Method/Lab	LOR	Unit	Client sample ID: BH1- SA2 Sampling date/time: 19-Jun-2023 00:00 WT2318555-001	ON406/20 T1-RPIICC	ON406/20 T2.1-S-ICC	ON406/20 T2.1-S-RPI	--	--	--
Physical Tests										
Conductivity (1:2 leachate)	E100-L/WT	0.00500	mS/cm	0.0803	**0.57 mS/cm**	**1.4 mS/cm**	**0.7 mS/cm**	--	--	--
Moisture	E144/WT	0.25	%	6.28	--	--	--	--	--	--
pH (1:2 soil:CaCl2-aq)	E108A/WT	0.10	pH units	8.01	--	--	--	--	--	--
Cyanides										
Cyanide, weak acid dissociable	E336A/WT	0.050	mg/kg	<0.050	**0.051 mg/kg**	**0.051 mg/kg**	**0.051 mg/kg**	--	--	--
Fixed-Ratio Extractables										
Calcium, soluble ion content	E484/WT	0.50	mg/L	3.54	--	--	--	--	--	--
Magnesium, soluble ion content	E484/WT	0.50	mg/L	0.52	--	--	--	--	--	--
Sodium, soluble ion content	E484/WT	0.50	mg/L	2.39	--	--	--	--	--	--
Sodium adsorption ratio [SAR]	E484/WT	0.10	-	0.31	**2.4 -**	**12 -**	**5 -**	--	--	--
Metals										
Antimony	E440C/WT	0.10	mg/kg	<0.10	**1.3 mg/kg**	**40 mg/kg**	**7.5 mg/kg**	--	--	--
Arsenic	E440C/WT	0.10	mg/kg	1.46	**18 mg/kg**	**18 mg/kg**	**18 mg/kg**	--	--	--
Barium	E440C/WT	0.50	mg/kg	9.26	**220 mg/kg**	**670 mg/kg**	**390 mg/kg**	--	--	--
Beryllium	E440C/WT	0.10	mg/kg	0.12	**2.5 mg/kg**	**8 mg/kg**	**4 mg/kg**	--	--	--
Boron, hot water soluble	E487/WT	0.10	mg/kg	<0.10	--	**2 mg/kg**	**1.5 mg/kg**	--	--	--
Boron	E440C/WT	5.0	mg/kg	<5.0	**36 mg/kg**	**120 mg/kg**	**120 mg/kg**	--	--	--
Cadmium	E440C/WT	0.020	mg/kg	0.094	**1.2 mg/kg**	**1.9 mg/kg**	**1.2 mg/kg**	--	--	--
Chromium	E440C/WT	0.50	mg/kg	6.88	**70 mg/kg**	**160 mg/kg**	**160 mg/kg**	--	--	--
Cobalt	E440C/WT	0.10	mg/kg	1.98	**21 mg/kg**	**80 mg/kg**	**22 mg/kg**	--	--	--
Copper	E440C/WT	0.50	mg/kg	3.91	**92 mg/kg**	**230 mg/kg**	**140 mg/kg**	--	--	--
Lead	E440C/WT	0.50	mg/kg	5.17	**120 mg/kg**	**120 mg/kg**	**120 mg/kg**	--	--	--
Mercury	E510C/WT	0.0050	mg/kg	<0.0050	**0.27 mg/kg**	**0.27 mg/kg**	**0.27 mg/kg**	--	--	--
Molybdenum	E440C/WT	0.10	mg/kg	0.22	**2 mg/kg**	**40 mg/kg**	**6.9 mg/kg**	--	--	--
Nickel	E440C/WT	0.50	mg/kg	3.86	**82 mg/kg**	**270 mg/kg**	**100 mg/kg**	--	--	--
Selenium	E440C/WT	0.20	mg/kg	<0.20	**1.5 mg/kg**	**5.5 mg/kg**	**2.4 mg/kg**	--	--	--
Silver	E440C/WT	0.10	mg/kg	<0.10	**0.5 mg/kg**	**40 mg/kg**	**20 mg/kg**	--	--	--
Thallium	E440C/WT	0.050	mg/kg	<0.050	**1 mg/kg**	**3.3 mg/kg**	**1 mg/kg**	--	--	--
Uranium	E440C/WT	0.050	mg/kg	0.408	**2.5 mg/kg**	**33 mg/kg**	**23 mg/kg**	--	--	--
Vanadium	E440C/WT	0.20	mg/kg	17.7	**86 mg/kg**	**86 mg/kg**	**86 mg/kg**	--	--	--
Zinc	E440C/WT	2.0	mg/kg	39.3	**290 mg/kg**	**340 mg/kg**	**340 mg/kg**	--	--	--

Analyte	Method/Lab	LOR	Unit	WT2318555-001 (Continued)	ON406/20 T1-RPIICC	ON406/20 T2.1-S-ICC	ON406/20 T2.1-S-RPI	--	--	--
Speciated Metals										
Chromium, hexavalent [Cr VI]	E532/WT	0.10	mg/kg	<0.10	**0.66 mg/kg**	**8 mg/kg**	**8 mg/kg**	--	--	--
Volatile Organic Compounds										
Benzene	E611A/WT	0.0050	mg/kg	<0.0050	**0.02 mg/kg**	**0.02 mg/kg**	**0.02 mg/kg**	--	--	--
Ethylbenzene	E611A/WT	0.015	mg/kg	<0.015	**0.05 mg/kg**	**0.05 mg/kg**	**0.05 mg/kg**	--	--	--
Toluene	E611A/WT	0.050	mg/kg	<0.050	**0.2 mg/kg**	**0.2 mg/kg**	**0.2 mg/kg**	--	--	--
Xylene, m+p-	E611A/WT	0.030	mg/kg	<0.030	--	--	--	--	--	--
Xylene, o-	E611A/WT	0.030	mg/kg	<0.030	--	--	--	--	--	--
Xylenes, total	E611A/WT	0.050	mg/kg	<0.050	**0.05 mg/kg**	**0.091 mg/kg**	**0.091 mg/kg**	--	--	--
BTEX, total	E611A/WT	0.10	mg/kg	<0.10	--	--	--	--	--	--
Hydrocarbons										
F1 (C6-C10)	E581.F1/WT	5.0	mg/kg	<5.0	**25 mg/kg**	**25 mg/kg**	**25 mg/kg**	--	--	--
F2 (C10-C16)	E601.SG-L/WT	10	mg/kg	<10	**10 mg/kg**	**26 mg/kg**	**10 mg/kg**	--	--	--
F3 (C16-C34)	E601.SG-L/WT	50	mg/kg	<50	**240 mg/kg**	**240 mg/kg**	**240 mg/kg**	--	--	--
F4 (C34-C50)	E601.SG-L/WT	50	mg/kg	<50	**120 mg/kg**	**3300 mg/kg**	**2800 mg/kg**	--	--	--
F1-BTEX	EC580/WT	5.0	mg/kg	<5.0	**25 mg/kg**	**25 mg/kg**	**25 mg/kg**	--	--	--
Hydrocarbons, total (C6-C50)	EC581/WT	80	mg/kg	<80	--	--	--	--	--	--
Chromatogram to baseline at nC50	E601.SG-L/WT		-	YES	--	--	--	--	--	--
Bromobenzotrifluoride, 2- (F2-F4 surrogate)	E601.SG-L/WT	1.0	%	90.2	--	--	--	--	--	--
Dichlorotoluene, 3,4-	E581.F1/WT	1.0	%	112	--	--	--	--	--	--
Bromofluorobenzene, 4-	E611A/WT	0.10	%	113	--	--	--	--	--	--
Difluorobenzene, 1,4-	E611A/WT	0.10	%	117	--	--	--	--	--	--

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.

No Breaches Found

Key:

ON406/20	Ontario Regulation 406/19 - Excess Soils - 17-December-20
T1-RPIICC	406 T1 - Soil - Res/Park/Inst/Ind/Com/Commu Property Use
T2.1-S-ICC	406 T2.1 - Volume Independent Soil - Ind/Com/Commu Property Use
T2.1-S-RPI	406 T2.1 - Volume Independent Soil - Res/Park/Inst Property Use

Analytical Results

Sub-Matrix: **Soil/Solid**
(Matrix: **Soil/Solid**)

Analyte	Method/Lab	LOR	Unit	Client sample ID: BH2- SA1 Sampling date/time: 20-Jun-2023 00:00 WT2318555-002	ON406/20 T1-RPIICC	ON406/20 T2.1-S-ICC	ON406/20 T2.1-S-RPI	--	--	--
Physical Tests										
Conductivity (1:2 leachate)	E100-L/WT	0.00500	mS/cm	0.147	**0.57 mS/cm**	**1.4 mS/cm**	**0.7 mS/cm**	--	--	--
Moisture	E144/WT	0.25	%	7.97	--	--	--	--	--	--
pH (1:2 soil:CaCl2-aq)	E108A/WT	0.10	pH units	7.43	--	--	--	--	--	--
Cyanides										
Cyanide, weak acid dissociable	E336A/WT	0.050	mg/kg	<0.050	**0.051 mg/kg**	**0.051 mg/kg**	**0.051 mg/kg**	--	--	--
Fixed-Ratio Extractables										
Calcium, soluble ion content	E484/WT	0.50	mg/L	10.6	--	--	--	--	--	--
Magnesium, soluble ion content	E484/WT	0.50	mg/L	1.98	--	--	--	--	--	--
Sodium, soluble ion content	E484/WT	0.50	mg/L	3.16	--	--	--	--	--	--
Sodium adsorption ratio [SAR]	E484/WT	0.10	-	0.23	**2.4 -**	**12 -**	**5 -**	--	--	--
Metals										
Antimony	E440C/WT	0.10	mg/kg	0.18	**1.3 mg/kg**	**40 mg/kg**	**7.5 mg/kg**	--	--	--
Arsenic	E440C/WT	0.10	mg/kg	2.64	**18 mg/kg**	**18 mg/kg**	**18 mg/kg**	--	--	--
Barium	E440C/WT	0.50	mg/kg	50.5	**220 mg/kg**	**670 mg/kg**	**390 mg/kg**	--	--	--
Beryllium	E440C/WT	0.10	mg/kg	0.27	**2.5 mg/kg**	**8 mg/kg**	**4 mg/kg**	--	--	--
Boron, hot water soluble	E487/WT	0.10	mg/kg	0.17	--	**2 mg/kg**	**1.5 mg/kg**	--	--	--
Boron	E440C/WT	5.0	mg/kg	<5.0	**36 mg/kg**	**120 mg/kg**	**120 mg/kg**	--	--	--
Cadmium	E440C/WT	0.020	mg/kg	0.278	**1.2 mg/kg**	**1.9 mg/kg**	**1.2 mg/kg**	--	--	--
Chromium	E440C/WT	0.50	mg/kg	11.6	**70 mg/kg**	**160 mg/kg**	**160 mg/kg**	--	--	--
Cobalt	E440C/WT	0.10	mg/kg	3.49	**21 mg/kg**	**80 mg/kg**	**22 mg/kg**	--	--	--
Copper	E440C/WT	0.50	mg/kg	7.72	**92 mg/kg**	**230 mg/kg**	**140 mg/kg**	--	--	--
Lead	E440C/WT	0.50	mg/kg	50.9	**120 mg/kg**	**120 mg/kg**	**120 mg/kg**	--	--	--
Mercury	E510C/WT	0.0050	mg/kg	0.127	**0.27 mg/kg**	**0.27 mg/kg**	**0.27 mg/kg**	--	--	--
Molybdenum	E440C/WT	0.10	mg/kg	0.29	**2 mg/kg**	**40 mg/kg**	**6.9 mg/kg**	--	--	--
Nickel	E440C/WT	0.50	mg/kg	6.40	**82 mg/kg**	**270 mg/kg**	**100 mg/kg**	--	--	--
Selenium	E440C/WT	0.20	mg/kg	0.23	**1.5 mg/kg**	**5.5 mg/kg**	**2.4 mg/kg**	--	--	--
Silver	E440C/WT	0.10	mg/kg	<0.10	**0.5 mg/kg**	**40 mg/kg**	**20 mg/kg**	--	--	--
Thallium	E440C/WT	0.050	mg/kg	0.075	**1 mg/kg**	**3.3 mg/kg**	**1 mg/kg**	--	--	--
Uranium	E440C/WT	0.050	mg/kg	0.362	**2.5 mg/kg**	**33 mg/kg**	**23 mg/kg**	--	--	--
Vanadium	E440C/WT	0.20	mg/kg	22.0	**86 mg/kg**	**86 mg/kg**	**86 mg/kg**	--	--	--
Zinc	E440C/WT	2.0	mg/kg	85.5	**290 mg/kg**	**340 mg/kg**	**340 mg/kg**	--	--	--

Analyte	Method/Lab	LOR	Unit	WT2318555-002 (Continued)	ON406/20 T1-RPIICC	ON406/20 T2.1-S-ICC	ON406/20 T2.1-S-RPI	--	--	--
Speciated Metals										
Chromium, hexavalent [Cr VI]	E532/WT	0.10	mg/kg	<0.10	**0.66 mg/kg**	**8 mg/kg**	**8 mg/kg**	--	--	--
Volatile Organic Compounds										
Benzene	E611A/WT	0.0050	mg/kg	<0.0050	**0.02 mg/kg**	**0.02 mg/kg**	**0.02 mg/kg**	--	--	--
Ethylbenzene	E611A/WT	0.015	mg/kg	<0.015	**0.05 mg/kg**	**0.05 mg/kg**	**0.05 mg/kg**	--	--	--
Toluene	E611A/WT	0.050	mg/kg	<0.050	**0.2 mg/kg**	**0.2 mg/kg**	**0.2 mg/kg**	--	--	--
Xylene, m+p-	E611A/WT	0.030	mg/kg	<0.030	--	--	--	--	--	--
Xylene, o-	E611A/WT	0.030	mg/kg	<0.030	--	--	--	--	--	--
Xylenes, total	E611A/WT	0.050	mg/kg	<0.050	**0.05 mg/kg**	**0.091 mg/kg**	**0.091 mg/kg**	--	--	--
BTEX, total	E611A/WT	0.10	mg/kg	<0.10	--	--	--	--	--	--
Hydrocarbons										
F1 (C6-C10)	E581.F1/WT	5.0	mg/kg	<5.0	**25 mg/kg**	**25 mg/kg**	**25 mg/kg**	--	--	--
F2 (C10-C16)	E601.SG-L/WT	10	mg/kg	<10	**10 mg/kg**	**26 mg/kg**	**10 mg/kg**	--	--	--
F3 (C16-C34)	E601.SG-L/WT	50	mg/kg	<50	**240 mg/kg**	**240 mg/kg**	**240 mg/kg**	--	--	--
F4 (C34-C50)	E601.SG-L/WT	50	mg/kg	<50	**120 mg/kg**	**3300 mg/kg**	**2800 mg/kg**	--	--	--
F1-BTEX	EC580/WT	5.0	mg/kg	<5.0	**25 mg/kg**	**25 mg/kg**	**25 mg/kg**	--	--	--
Hydrocarbons, total (C6-C50)	EC581/WT	80	mg/kg	<80	--	--	--	--	--	--
Chromatogram to baseline at nC50	E601.SG-L/WT		-	YES	--	--	--	--	--	--
Bromobenzotrifluoride, 2- (F2-F4 surrogate)	E601.SG-L/WT	1.0	%	97.3	--	--	--	--	--	--
Dichlorotoluene, 3,4-	E581.F1/WT	1.0	%	98.8	--	--	--	--	--	--
Bromofluorobenzene, 4-	E611A/WT	0.10	%	98.5	--	--	--	--	--	--
Difluorobenzene, 1,4-	E611A/WT	0.10	%	102	--	--	--	--	--	--

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.

No Breaches Found

Key:

ON406/20	Ontario Regulation 406/19 - Excess Soils - 17-December-20
T1-RPIICC	406 T1 - Soil - Res/Park/Inst/Ind/Com/Commu Property Use
T2.1-S-ICC	406 T2.1 - Volume Independent Soil - Ind/Com/Commu Property Use
T2.1-S-RPI	406 T2.1 - Volume Independent Soil - Res/Park/Inst Property Use

Analytical Results

Sub-Matrix: **Soil/Solid**
(Matrix: **Soil/Solid**)

Analyte	Method/Lab	LOR	Unit	Client sample ID: BH3- SA3 Sampling date/time: 14-Jun-2023 00:00 WT2318555-003	ON406/20 T1-RPIICC	ON406/20 T2.1-S-ICC	ON406/20 T2.1-S-RPI	--	--	--
Physical Tests										
Conductivity (1:2 leachate)	E100-L/WT	0.00500	mS/cm	0.375	**0.57 mS/cm**	**1.4 mS/cm**	**0.7 mS/cm**	--	--	--
Moisture	E144/WT	0.25	%	12.4	--	--	--	--	--	--
pH (1:2 soil:CaCl2-aq)	E108A/WT	0.10	pH units	7.84	--	--	--	--	--	--
Cyanides										
Cyanide, weak acid dissociable	E336A/WT	0.050	mg/kg	<0.050	**0.051 mg/kg**	**0.051 mg/kg**	**0.051 mg/kg**	--	--	--
Fixed-Ratio Extractables										
Calcium, soluble ion content	E484/WT	0.50	mg/L	1.99	--	--	--	--	--	--
Magnesium, soluble ion content	E484/WT	0.50	mg/L	1.35	--	--	--	--	--	--
Sodium, soluble ion content	E484/WT	0.50	mg/L	75.4	--	--	--	--	--	--
Sodium adsorption ratio [SAR]	E484/WT	0.10	-	10.1	**2.4 -**	**12 -**	**5 -**	--	--	--
Metals										
Antimony	E440C/WT	0.10	mg/kg	<0.10	**1.3 mg/kg**	**40 mg/kg**	**7.5 mg/kg**	--	--	--
Arsenic	E440C/WT	0.10	mg/kg	1.98	**18 mg/kg**	**18 mg/kg**	**18 mg/kg**	--	--	--
Barium	E440C/WT	0.50	mg/kg	10.8	**220 mg/kg**	**670 mg/kg**	**390 mg/kg**	--	--	--
Beryllium	E440C/WT	0.10	mg/kg	0.16	**2.5 mg/kg**	**8 mg/kg**	**4 mg/kg**	--	--	--
Boron, hot water soluble	E487/WT	0.10	mg/kg	<0.10	--	**2 mg/kg**	**1.5 mg/kg**	--	--	--
Boron	E440C/WT	5.0	mg/kg	5.5	**36 mg/kg**	**120 mg/kg**	**120 mg/kg**	--	--	--
Cadmium	E440C/WT	0.020	mg/kg	0.092	**1.2 mg/kg**	**1.9 mg/kg**	**1.2 mg/kg**	--	--	--
Chromium	E440C/WT	0.50	mg/kg	7.96	**70 mg/kg**	**160 mg/kg**	**160 mg/kg**	--	--	--
Cobalt	E440C/WT	0.10	mg/kg	2.69	**21 mg/kg**	**80 mg/kg**	**22 mg/kg**	--	--	--
Copper	E440C/WT	0.50	mg/kg	8.37	**92 mg/kg**	**230 mg/kg**	**140 mg/kg**	--	--	--
Lead	E440C/WT	0.50	mg/kg	6.04	**120 mg/kg**	**120 mg/kg**	**120 mg/kg**	--	--	--
Mercury	E510C/WT	0.0050	mg/kg	0.0081	**0.27 mg/kg**	**0.27 mg/kg**	**0.27 mg/kg**	--	--	--
Molybdenum	E440C/WT	0.10	mg/kg	0.27	**2 mg/kg**	**40 mg/kg**	**6.9 mg/kg**	--	--	--
Nickel	E440C/WT	0.50	mg/kg	5.34	**82 mg/kg**	**270 mg/kg**	**100 mg/kg**	--	--	--
Selenium	E440C/WT	0.20	mg/kg	<0.20	**1.5 mg/kg**	**5.5 mg/kg**	**2.4 mg/kg**	--	--	--
Silver	E440C/WT	0.10	mg/kg	<0.10	**0.5 mg/kg**	**40 mg/kg**	**20 mg/kg**	--	--	--
Thallium	E440C/WT	0.050	mg/kg	<0.050	**1 mg/kg**	**3.3 mg/kg**	**1 mg/kg**	--	--	--
Uranium	E440C/WT	0.050	mg/kg	0.484	**2.5 mg/kg**	**33 mg/kg**	**23 mg/kg**	--	--	--
Vanadium	E440C/WT	0.20	mg/kg	18.5	**86 mg/kg**	**86 mg/kg**	**86 mg/kg**	--	--	--
Zinc	E440C/WT	2.0	mg/kg	38.3	**290 mg/kg**	**340 mg/kg**	**340 mg/kg**	--	--	--

Analyte	Method/Lab	LOR	Unit	WT2318555-003 (Continued)	ON406/20 T1-RPIICC	ON406/20 T2.1-S-ICC	ON406/20 T2.1-S-RPI	--	--	--
Speciated Metals										
Chromium, hexavalent [Cr VI]	E532/WT	0.10	mg/kg	<0.10	**0.66 mg/kg**	**8 mg/kg**	**8 mg/kg**	--	--	--
Volatile Organic Compounds										
Benzene	E611A/WT	0.0050	mg/kg	<0.0050	**0.02 mg/kg**	**0.02 mg/kg**	**0.02 mg/kg**	--	--	--
Ethylbenzene	E611A/WT	0.015	mg/kg	<0.015	**0.05 mg/kg**	**0.05 mg/kg**	**0.05 mg/kg**	--	--	--
Toluene	E611A/WT	0.050	mg/kg	<0.050	**0.2 mg/kg**	**0.2 mg/kg**	**0.2 mg/kg**	--	--	--
Xylene, m+p-	E611A/WT	0.030	mg/kg	<0.030	--	--	--	--	--	--
Xylene, o-	E611A/WT	0.030	mg/kg	<0.030	--	--	--	--	--	--
Xylenes, total	E611A/WT	0.050	mg/kg	<0.050	**0.05 mg/kg**	**0.091 mg/kg**	**0.091 mg/kg**	--	--	--
BTEX, total	E611A/WT	0.10	mg/kg	<0.10	--	--	--	--	--	--
Hydrocarbons										
F1 (C6-C10)	E581.F1/WT	5.0	mg/kg	<5.0	**25 mg/kg**	**25 mg/kg**	**25 mg/kg**	--	--	--
F2 (C10-C16)	E601.SG-L/WT	10	mg/kg	<10	**10 mg/kg**	**26 mg/kg**	**10 mg/kg**	--	--	--
F3 (C16-C34)	E601.SG-L/WT	50	mg/kg	<50	**240 mg/kg**	**240 mg/kg**	**240 mg/kg**	--	--	--
F4 (C34-C50)	E601.SG-L/WT	50	mg/kg	<50	**120 mg/kg**	**3300 mg/kg**	**2800 mg/kg**	--	--	--
F1-BTEX	EC580/WT	5.0	mg/kg	<5.0	**25 mg/kg**	**25 mg/kg**	**25 mg/kg**	--	--	--
Hydrocarbons, total (C6-C50)	EC581/WT	80	mg/kg	<80	--	--	--	--	--	--
Chromatogram to baseline at nC50	E601.SG-L/WT		-	YES	--	--	--	--	--	--
Bromobenzotrifluoride, 2- (F2-F4 surrogate)	E601.SG-L/WT	1.0	%	101	--	--	--	--	--	--
Dichlorotoluene, 3,4-	E581.F1/WT	1.0	%	84.7	--	--	--	--	--	--
Bromofluorobenzene, 4-	E611A/WT	0.10	%	98.0	--	--	--	--	--	--
Difluorobenzene, 1,4-	E611A/WT	0.10	%	108	--	--	--	--	--	--

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.

Summary of Guideline Breaches by Sample

SampleID/Client ID	Matrix	Analyte	Analyte Summary	Guideline	Category	Result	Limit
BH3- SA3	Soil/Solid	Sodium adsorption ratio [SAR]		ON406/20	T1-RPIICC	10.1 -	2.4 -
	Soil/Solid	Sodium adsorption ratio [SAR]		ON406/20	T2.1-S-RPI	10.1 -	5 -

Key:

ON406/20	Ontario Regulation 406/19 - Excess Soils - 17-December-20
T1-RPIICC	406 T1 - Soil - Res/Park/Inst/Ind/Com/Commu Property Use
T2.1-S-ICC	406 T2.1 - Volume Independent Soil - Ind/Com/Commu Property Use
T2.1-S-RPI	406 T2.1 - Volume Independent Soil - Res/Park/Inst Property Use

Analytical Results

Sub-Matrix: **Soil/Solid**
(Matrix: **Soil/Solid**)

Analyte	Method/Lab	LOR	Unit	Client sample ID: BH4- SA1 Sampling date/time: 15-Jun-2023 00:00 WT2318555-004	ON406/20 T1-RPIICC	ON406/20 T2.1-S-ICC	ON406/20 T2.1-S-RPI	--	--	--
Physical Tests										
Conductivity (1:2 leachate)	E100-L/WT	0.00500	mS/cm	0.717	**0.57 mS/cm**	**1.4 mS/cm**	**0.7 mS/cm**	--	--	--
Moisture	E144/WT	0.25	%	10.8	--	--	--	--	--	--
pH (1:2 soil:CaCl2-aq)	E108A/WT	0.10	pH units	7.84	--	--	--	--	--	--
Cyanides										
Cyanide, weak acid dissociable	E336A/WT	0.050	mg/kg	<0.050	**0.051 mg/kg**	**0.051 mg/kg**	**0.051 mg/kg**	--	--	--
Fixed-Ratio Extractables										
Calcium, soluble ion content	E484/WT	0.50	mg/L	7.16	--	--	--	--	--	--
Magnesium, soluble ion content	E484/WT	0.50	mg/L	3.30	--	--	--	--	--	--
Sodium, soluble ion content	E484/WT	0.50	mg/L	149	--	--	--	--	--	--
Sodium adsorption ratio [SAR]	E484/WT	0.10	-	11.6	**2.4 -**	**12 -**	**5 -**	--	--	--
Metals										
Antimony	E440C/WT	0.10	mg/kg	0.31	**1.3 mg/kg**	**40 mg/kg**	**7.5 mg/kg**	--	--	--
Arsenic	E440C/WT	0.10	mg/kg	3.93	**18 mg/kg**	**18 mg/kg**	**18 mg/kg**	--	--	--
Barium	E440C/WT	0.50	mg/kg	270	**220 mg/kg**	**670 mg/kg**	**390 mg/kg**	--	--	--
Beryllium	E440C/WT	0.10	mg/kg	0.31	**2.5 mg/kg**	**8 mg/kg**	**4 mg/kg**	--	--	--
Boron, hot water soluble	E487/WT	0.10	mg/kg	0.28	--	**2 mg/kg**	**1.5 mg/kg**	--	--	--
Boron	E440C/WT	5.0	mg/kg	<5.0	**36 mg/kg**	**120 mg/kg**	**120 mg/kg**	--	--	--
Cadmium	E440C/WT	0.020	mg/kg	0.292	**1.2 mg/kg**	**1.9 mg/kg**	**1.2 mg/kg**	--	--	--
Chromium	E440C/WT	0.50	mg/kg	18.4	**70 mg/kg**	**160 mg/kg**	**160 mg/kg**	--	--	--
Cobalt	E440C/WT	0.10	mg/kg	3.20	**21 mg/kg**	**80 mg/kg**	**22 mg/kg**	--	--	--
Copper	E440C/WT	0.50	mg/kg	13.7	**92 mg/kg**	**230 mg/kg**	**140 mg/kg**	--	--	--
Lead	E440C/WT	0.50	mg/kg	127	**120 mg/kg**	**120 mg/kg**	**120 mg/kg**	--	--	--
Mercury	E510C/WT	0.0050	mg/kg	0.0872	**0.27 mg/kg**	**0.27 mg/kg**	**0.27 mg/kg**	--	--	--
Molybdenum	E440C/WT	0.10	mg/kg	0.35	**2 mg/kg**	**40 mg/kg**	**6.9 mg/kg**	--	--	--
Nickel	E440C/WT	0.50	mg/kg	8.16	**82 mg/kg**	**270 mg/kg**	**100 mg/kg**	--	--	--
Selenium	E440C/WT	0.20	mg/kg	0.22	**1.5 mg/kg**	**5.5 mg/kg**	**2.4 mg/kg**	--	--	--
Silver	E440C/WT	0.10	mg/kg	0.17	**0.5 mg/kg**	**40 mg/kg**	**20 mg/kg**	--	--	--
Thallium	E440C/WT	0.050	mg/kg	0.090	**1 mg/kg**	**3.3 mg/kg**	**1 mg/kg**	--	--	--
Uranium	E440C/WT	0.050	mg/kg	0.357	**2.5 mg/kg**	**33 mg/kg**	**23 mg/kg**	--	--	--
Vanadium	E440C/WT	0.20	mg/kg	18.8	**86 mg/kg**	**86 mg/kg**	**86 mg/kg**	--	--	--
Zinc	E440C/WT	2.0	mg/kg	186	**290 mg/kg**	**340 mg/kg**	**340 mg/kg**	--	--	--

Analyte	Method/Lab	LOR	Unit	WT2318555-004 (Continued)	ON406/20 T1-RPIICC	ON406/20 T2.1-S-ICC	ON406/20 T2.1-S-RPI	--	--	--
Speciated Metals										
Chromium, hexavalent [Cr VI]	E532/WT	0.10	mg/kg	0.35	**0.66 mg/kg**	**8 mg/kg**	**8 mg/kg**	--	--	--
Volatile Organic Compounds										
Benzene	E611A/WT	0.0050	mg/kg	<0.0050	**0.02 mg/kg**	**0.02 mg/kg**	**0.02 mg/kg**	--	--	--
Ethylbenzene	E611A/WT	0.015	mg/kg	<0.015	**0.05 mg/kg**	**0.05 mg/kg**	**0.05 mg/kg**	--	--	--
Toluene	E611A/WT	0.050	mg/kg	<0.050	**0.2 mg/kg**	**0.2 mg/kg**	**0.2 mg/kg**	--	--	--
Xylene, m+p-	E611A/WT	0.030	mg/kg	<0.030	--	--	--	--	--	--
Xylene, o-	E611A/WT	0.030	mg/kg	<0.030	--	--	--	--	--	--
Xylenes, total	E611A/WT	0.050	mg/kg	<0.050	**0.05 mg/kg**	**0.091 mg/kg**	**0.091 mg/kg**	--	--	--
BTEX, total	E611A/WT	0.10	mg/kg	<0.10	--	--	--	--	--	--
Hydrocarbons										
F1 (C6-C10)	E581.F1/WT	5.0	mg/kg	<5.0	**25 mg/kg**	**25 mg/kg**	**25 mg/kg**	--	--	--
F2 (C10-C16)	E601.SG-L/WT	10	mg/kg	<10	**10 mg/kg**	**26 mg/kg**	**10 mg/kg**	--	--	--
F3 (C16-C34)	E601.SG-L/WT	50	mg/kg	96	**240 mg/kg**	**240 mg/kg**	**240 mg/kg**	--	--	--
F4 (C34-C50)	E601.SG-L/WT	50	mg/kg	172	**120 mg/kg**	**3300 mg/kg**	**2800 mg/kg**	--	--	--
F4G-sg	E601.F4G-L/WT	250	mg/kg	520	**120 mg/kg**	**3300 mg/kg**	**2800 mg/kg**	--	--	--
F1-BTEX	EC580/WT	5.0	mg/kg	<5.0	**25 mg/kg**	**25 mg/kg**	**25 mg/kg**	--	--	--
Hydrocarbons, total (C6-C50)	EC581/WT	80	mg/kg	268	--	--	--	--	--	--
Chromatogram to baseline at nC50	E601.SG-L/WT		-	NO	--	--	--	--	--	--
Bromobenzotrifluoride, 2- (F2-F4 surrogate)	E601.SG-L/WT	1.0	%	98.4	--	--	--	--	--	--
Dichlorotoluene, 3,4-	E581.F1/WT	1.0	%	78.7	--	--	--	--	--	--
Bromofluorobenzene, 4-	E611A/WT	0.10	%	99.9	--	--	--	--	--	--
Difluorobenzene, 1,4-	E611A/WT	0.10	%	105	--	--	--	--	--	--

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.

Summary of Guideline Breaches by Sample

SampleID/Client ID	Matrix	Analyte	Analyte Summary	Guideline	Category	Result	Limit
BH4- SA1	Soil/Solid	Conductivity (1:2 leachate)		ON406/20	T1-RPIICC	0.717 mS/cm	0.57 mS/cm
	Soil/Solid	Sodium adsorption ratio [SAR]		ON406/20	T1-RPIICC	11.6 -	2.4 -
	Soil/Solid	Barium		ON406/20	T1-RPIICC	270 mg/kg	220 mg/kg
	Soil/Solid	Lead		ON406/20	T1-RPIICC	127 mg/kg	120 mg/kg
	Soil/Solid	F4 (C34-C50)		ON406/20	T1-RPIICC	172 mg/kg	120 mg/kg
	Soil/Solid	F4G-sg		ON406/20	T1-RPIICC	520 mg/kg	120 mg/kg
	Soil/Solid	Lead		ON406/20	T2.1-S-ICC	127 mg/kg	120 mg/kg
	Soil/Solid	Conductivity (1:2 leachate)		ON406/20	T2.1-S-RPI	0.717 mS/cm	0.7 mS/cm
	Soil/Solid	Sodium adsorption ratio [SAR]		ON406/20	T2.1-S-RPI	11.6 -	5 -
	Soil/Solid	Lead		ON406/20	T2.1-S-RPI	127 mg/kg	120 mg/kg

Key:

ON406/20	Ontario Regulation 406/19 - Excess Soils - 17-December-20
T1-RPIICC	406 T1 - Soil - Res/Park/Inst/Ind/Com/Commu Property Use
T2.1-S-ICC	406 T2.1 - Volume Independent Soil - Ind/Com/Commu Property Use
T2.1-S-RPI	406 T2.1 - Volume Independent Soil - Res/Park/Inst Property Use

Analytical Results

Sub-Matrix: **Soil/Solid**
(Matrix: **Soil/Solid**)

Analyte	Method/Lab	LOR	Unit	Client sample ID: BH2- SA3 Sampling date/time: 20-Jun-2023 00:00 WT2318555-005	ON406/20 T1-RPIICC	ON406/20 T2.1-S-ICC	ON406/20 T2.1-S-RPI	--	--	--
Physical Tests										
Conductivity (1:2 leachate)	E100-L/WT	5.00	µS/cm	158	**570 µS/cm**	**1400 µS/cm**	**700 µS/cm**	--	--	--
Moisture	E144/WT	0.25	%	13.1	--	--	--	--	--	--
Oxidation-reduction potential [ORP]	E125/WT	0.10	mV	281	--	--	--	--	--	--
pH (1:2 soil:CaCl2-aq)	E108A/WT	0.10	pH units	7.55	--	--	--	--	--	--
Resistivity	EC100R/WT	100	ohm cm	6330	--	--	--	--	--	--
Inorganics										
Sulfides, acid volatile	E396-L/WT	0.20	mg/kg	<0.23	--	--	--	--	--	--
Leachable Anions & Nutrients										
Chloride, soluble ion content	E236.Cl/WT	5.0	mg/kg	26.6	--	--	--	--	--	--
Sulfate, soluble ion content	E236.SO4/WT	20	mg/kg	<20	--	--	--	--	--	--

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.

No Breaches Found

Key:

ON406/20	Ontario Regulation 406/19 - Excess Soils - 17-December-20
T1-RPIICC	406 T1 - Soil - Res/Park/Inst/Ind/Com/Commu Property Use
T2.1-S-ICC	406 T2.1 - Volume Independent Soil - Ind/Com/Commu Property Use
T2.1-S-RPI	406 T2.1 - Volume Independent Soil - Res/Park/Inst Property Use

Analytical Results

Sub-Matrix: **Soil/Solid**
(Matrix: **Soil/Solid**)

Analyte	Method/Lab	LOR	Unit	Client sample ID: BH4- SA3 Sampling date/time: 15-Jun-2023 00:00 WT2318555-006	ON406/20 T1-RPIICC	ON406/20 T2.1-S-ICC	ON406/20 T2.1-S-RPI	--	--	--
Physical Tests										
Conductivity (1:2 leachate)	E100-L/WT	5.00	µS/cm	1070	**570 µS/cm**	**1400 µS/cm**	**700 µS/cm**	--	--	--
Moisture	E144/WT	0.25	%	12.9	--	--	--	--	--	--
Oxidation-reduction potential [ORP]	E125/WT	0.10	mV	218	--	--	--	--	--	--
pH (1:2 soil:CaCl2-aq)	E108A/WT	0.10	pH units	8.10	--	--	--	--	--	--
Resistivity	EC100R/WT	100	ohm cm	930	--	--	--	--	--	--
Inorganics										
Sulfides, acid volatile	E396-L/WT	0.20	mg/kg	0.27	--	--	--	--	--	--
Leachable Anions & Nutrients										
Chloride, soluble ion content	E236.Cl/WT	5.0	mg/kg	571	--	--	--	--	--	--
Sulfate, soluble ion content	E236.SO4/WT	20	mg/kg	32	--	--	--	--	--	--

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.

Summary of Guideline Breaches by Sample

SampleID/Client ID	Matrix	Analyte	Analyte Summary	Guideline	Category	Result	Limit
BH4- SA3	Soil/Solid	Conductivity (1:2 leachate)		ON406/20	T1-RPIICC	1070 µS/cm	570 µS/cm
	Soil/Solid	Conductivity (1:2 leachate)		ON406/20	T2.1-S-RPI	1070 µS/cm	700 µS/cm

Key:

ON406/20	Ontario Regulation 406/19 - Excess Soils - 17-December-20
T1-RPIICC	406 T1 - Soil - Res/Park/Inst/Ind/Com/Commu Property Use
T2.1-S-ICC	406 T2.1 - Volume Independent Soil - Ind/Com/Commu Property Use
T2.1-S-RPI	406 T2.1 - Volume Independent Soil - Res/Park/Inst Property Use

CERTIFICATE OF ANALYSIS

Work Order	: **WT2318555**	Page	: 1 of 9
Client	: **Chung and Vander Doelen Engineering Ltd.**	Laboratory	: Waterloo - Environmental
Contact	: Brianna Cobbe	Account Manager	: Andrew Martin
Address	: 311 Victoria St. N. Kitchener ON Canada N2H 5E1	Address	: 60 Northland Road, Unit 1 Waterloo ON Canada N2V 2B8
Telephone	: ----	Telephone	: +1 519 886 6910
Project	: 1073	Date Samples Received	: 23-Jun-2023 13:00
PO	: ----	Date Analysis Commenced	: 24-Jun-2023
C-O-C number	: 20-1048903	Issue Date	: 30-Jun-2023 19:29
Sampler	: EP		
Site	: ----		
Quote number	: Q84362 - Excess Soils		
No. of samples received	: 6		
No. of samples analysed	: 6		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Amanda Ganouri-Lumsden	Department Manager - Microbiology and Prep	Centralized Prep, Waterloo, Ontario
Greg Pokocky	Manager - Inorganics	Inorganics, Waterloo, Ontario
Greg Pokocky	Manager - Inorganics	Metals, Waterloo, Ontario
Jocelyn Kennedy	Department Manager - Semi-Volatile Organics	Organics, Waterloo, Ontario
Sarah Birch	VOC Section Supervisor	VOC, Waterloo, Ontario

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.
Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
LOR: Limit of Reporting (detection limit).
Measurement Uncertainty: The reported uncertainties in this report are expanded uncertainties calculated using a coverage factor of 2, which gives a level of confidence of approximately 95%.
Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Unit	*Description*
-	no units
%	percent
µS/cm	microsiemens per centimetre
mg/kg	milligrams per kilogram
mg/L	milligrams per litre
mS/cm	millisiemens per centimetre
mV	millivolts
ohm cm	ohm centimetres (resistivity)
pH units	pH units

>: greater than.
<: less than.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical Results

WT2318555-001

Sub-Matrix: **Soil/Solid**
(Matrix: **Soil/Solid**)

Client sample ID: BH1- SA2
Client sampling date / time: 19-Jun-2023

Analyte	CAS Number	Result	LOR	Unit	Method/Lab	Prep Date	Analysis Date	QCLot
Physical Tests								
Conductivity (1:2 leachate)	----	0.0803	0.00500	mS/cm	E100-L/WT	28-Jun-2023	29-Jun-2023	1007675
Moisture	----	6.28	0.25	%	E144/WT	-	24-Jun-2023	1007270
pH (1:2 soil:CaCl2-aq)	----	8.01	0.10	pH units	E108A/WT	25-Jun-2023	26-Jun-2023	1007622
Cyanides								
Cyanide, weak acid dissociable	----	<0.050	0.050	mg/kg	E336A/WT	25-Jun-2023	27-Jun-2023	1007624
Fixed-Ratio Extractables								
Calcium, soluble ion content	7440-70-2	3.54	0.50	mg/L	E484/WT	28-Jun-2023	29-Jun-2023	1007676
Magnesium, soluble ion content	7439-95-4	0.52	0.50	mg/L	E484/WT	28-Jun-2023	29-Jun-2023	1007676
Sodium, soluble ion content	17341-25-2	2.39	0.50	mg/L	E484/WT	28-Jun-2023	29-Jun-2023	1007676
Sodium adsorption ratio [SAR]	----	0.31	0.10	-	E484/WT	28-Jun-2023	29-Jun-2023	1007676
Metals								
Antimony	7440-36-0	<0.10	0.10	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Arsenic	7440-38-2	1.46	0.10	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Barium	7440-39-3	9.26	0.50	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Beryllium	7440-41-7	0.12	0.10	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Boron	7440-42-8	<5.0	5.0	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Boron, hot water soluble	7440-42-8	<0.10	0.10	mg/kg	E487/WT	28-Jun-2023	28-Jun-2023	1007677
Cadmium	7440-43-9	0.094	0.020	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Chromium	7440-47-3	6.88	0.50	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Cobalt	7440-48-4	1.98	0.10	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Copper	7440-50-8	3.91	0.50	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Lead	7439-92-1	5.17	0.50	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Mercury	7439-97-6	<0.0050	0.0050	mg/kg	E510C/WT	28-Jun-2023	29-Jun-2023	1007679
Molybdenum	7439-98-7	0.22	0.10	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Nickel	7440-02-0	3.86	0.50	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Selenium	7782-49-2	<0.20	0.20	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Silver	7440-22-4	<0.10	0.10	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Thallium	7440-28-0	<0.050	0.050	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Uranium	7440-61-1	0.408	0.050	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Vanadium	7440-62-2	17.7	0.20	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Zinc	7440-66-6	39.3	2.0	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Speciated Metals								
Chromium, hexavalent [Cr VI]	18540-29-9	<0.10	0.10	mg/kg	E532/WT	25-Jun-2023	27-Jun-2023	1007623
Volatile Organic Compounds								
Benzene	71-43-2	<0.0050	0.0050	mg/kg	E611A/WT	27-Jun-2023	27-Jun-2023	1011443
Ethylbenzene	100-41-4	<0.015	0.015	mg/kg	E611A/WT	27-Jun-2023	27-Jun-2023	1011443
Toluene	108-88-3	<0.050	0.050	mg/kg	E611A/WT	27-Jun-2023	27-Jun-2023	1011443
Xylene, m+p-	179601-23-1	<0.030	0.030	mg/kg	E611A/WT	27-Jun-2023	27-Jun-2023	1011443
Xylene, o-	95-47-6	<0.030	0.030	mg/kg	E611A/WT	27-Jun-2023	27-Jun-2023	1011443
Xylenes, total	1330-20-7	<0.050	0.05	mg/kg	E611A/WT	27-Jun-2023	27-Jun-2023	1011443
BTEX, total	----	<0.10	0.1	mg/kg	E611A/WT	27-Jun-2023	27-Jun-2023	1011443
Hydrocarbons								
F1 (C6-C10)	----	<5.0	5.0	mg/kg	E581.F1/WT	27-Jun-2023	27-Jun-2023	1011444
F2 (C10-C16)	----	<10	10	mg/kg	E601.SG-L/WT	26-Jun-2023	27-Jun-2023	1007625
F3 (C16-C34)	----	<50	50	mg/kg	E601.SG-L/WT	26-Jun-2023	27-Jun-2023	1007625

Analytical Results

WT2318555-001

Sub-Matrix:**Soil/Solid** *Client sample ID:* BH1- SA2

(Matrix: **Soil/Solid**) *Client sampling date / time:* 19-Jun-2023

Analyte	CAS Number	Result	LOR	Unit	Method/Lab	Prep Date	Analysis Date	QCLot
Hydrocarbons								
F4 (C34-C50)	----	<50	50	mg/kg	E601.SG-L/WT	26-Jun-2023	27-Jun-2023	1007625
F1-BTEX	----	<5.0	5	mg/kg	EC580/WT	-	28-Jun-2023	-
Hydrocarbons, total (C6-C50)	----	<80	80	mg/kg	EC581/WT	-	28-Jun-2023	-
Chromatogram to baseline at nC50	n/a	YES	-	-	E601.SG-L/WT	26-Jun-2023	27-Jun-2023	1007625
Hydrocarbons Surrogates								
Bromobenzotrifluoride, 2- (F2-F4 surrogate)	392-83-6	90.2	1.0	%	E601.SG-L/WT	26-Jun-2023	27-Jun-2023	1007625
Dichlorotoluene, 3,4-	95-75-0	112	1.0	%	E581.F1/WT	27-Jun-2023	27-Jun-2023	1011444
Volatile Organic Compounds Surrogates								
Bromofluorobenzene, 4-	460-00-4	113	0.10	%	E611A/WT	27-Jun-2023	27-Jun-2023	1011443
Difluorobenzene, 1,4-	540-36-3	117	0.10	%	E611A/WT	27-Jun-2023	27-Jun-2023	1011443

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.

Analytical Results

WT2318555-002

Sub-Matrix:**Soil/Solid** *Client sample ID:* BH2- SA1

(Matrix: **Soil/Solid**) *Client sampling date / time:* 20-Jun-2023

Analyte	CAS Number	Result	LOR	Unit	Method/Lab	Prep Date	Analysis Date	QCLot
Physical Tests								
Conductivity (1:2 leachate)	----	0.147	0.00500	mS/cm	E100-L/WT	28-Jun-2023	29-Jun-2023	1007675
Moisture	----	7.97	0.25	%	E144/WT	-	24-Jun-2023	1007270
pH (1:2 soil:CaCl2-aq)	----	7.43	0.10	pH units	E108A/WT	26-Jun-2023	26-Jun-2023	1008155
Cyanides								
Cyanide, weak acid dissociable	----	<0.050	0.050	mg/kg	E336A/WT	26-Jun-2023	29-Jun-2023	1008182
Fixed-Ratio Extractables								
Calcium, soluble ion content	7440-70-2	10.6	0.50	mg/L	E484/WT	28-Jun-2023	29-Jun-2023	1007676
Magnesium, soluble ion content	7439-95-4	1.98	0.50	mg/L	E484/WT	28-Jun-2023	29-Jun-2023	1007676
Sodium, soluble ion content	17341-25-2	3.16	0.50	mg/L	E484/WT	28-Jun-2023	29-Jun-2023	1007676
Sodium adsorption ratio [SAR]	----	0.23	0.10	-	E484/WT	28-Jun-2023	29-Jun-2023	1007676
Metals								
Antimony	7440-36-0	0.18	0.10	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Arsenic	7440-38-2	2.64	0.10	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Barium	7440-39-3	50.5	0.50	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Beryllium	7440-41-7	0.27	0.10	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Boron	7440-42-8	<5.0	5.0	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Boron, hot water soluble	7440-42-8	0.17	0.10	mg/kg	E487/WT	28-Jun-2023	28-Jun-2023	1007677
Cadmium	7440-43-9	0.278	0.020	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Chromium	7440-47-3	11.6	0.50	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Cobalt	7440-48-4	3.49	0.10	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Copper	7440-50-8	7.72	0.50	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Lead	7439-92-1	50.9	0.50	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Mercury	7439-97-6	0.127	0.0050	mg/kg	E510C/WT	28-Jun-2023	29-Jun-2023	1007679
Molybdenum	7439-98-7	0.29	0.10	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678

Analytical Results

WT2318555-002

Sub-Matrix:**Soil/Solid** *Client sample ID:* BH2- SA1

(Matrix: **Soil/Solid**) *Client sampling date / time:* 20-Jun-2023

Analyte	CAS Number	Result	LOR	Unit	Method/Lab	Prep Date	Analysis Date	QCLot
Metals								
Nickel	7440-02-0	6.40	0.50	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Selenium	7782-49-2	0.23	0.20	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Silver	7440-22-4	<0.10	0.10	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Thallium	7440-28-0	0.075	0.050	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Uranium	7440-61-1	0.362	0.050	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Vanadium	7440-62-2	22.0	0.20	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Zinc	7440-66-6	85.5	2.0	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Speciated Metals								
Chromium, hexavalent [Cr VI]	18540-29-9	<0.10	0.10	mg/kg	E532/WT	25-Jun-2023	27-Jun-2023	1007833
Volatile Organic Compounds								
Benzene	71-43-2	<0.0050	0.0050	mg/kg	E611A/WT	27-Jun-2023	27-Jun-2023	1011443
Ethylbenzene	100-41-4	<0.015	0.015	mg/kg	E611A/WT	27-Jun-2023	27-Jun-2023	1011443
Toluene	108-88-3	<0.050	0.050	mg/kg	E611A/WT	27-Jun-2023	27-Jun-2023	1011443
Xylene, m+p-	179601-23-1	<0.030	0.030	mg/kg	E611A/WT	27-Jun-2023	27-Jun-2023	1011443
Xylene, o-	95-47-6	<0.030	0.030	mg/kg	E611A/WT	27-Jun-2023	27-Jun-2023	1011443
Xylenes, total	1330-20-7	<0.050	0.05	mg/kg	E611A/WT	27-Jun-2023	27-Jun-2023	1011443
BTEX, total	----	<0.10	0.1	mg/kg	E611A/WT	27-Jun-2023	27-Jun-2023	1011443
Hydrocarbons								
F1 (C6-C10)	----	<5.0	5.0	mg/kg	E581.F1/WT	27-Jun-2023	27-Jun-2023	1011444
F2 (C10-C16)	----	<10	10	mg/kg	E601.SG-L/WT	26-Jun-2023	27-Jun-2023	1008153
F3 (C16-C34)	----	<50	50	mg/kg	E601.SG-L/WT	26-Jun-2023	27-Jun-2023	1008153
F4 (C34-C50)	----	<50	50	mg/kg	E601.SG-L/WT	26-Jun-2023	27-Jun-2023	1008153
F1-BTEX	----	<5.0	5	mg/kg	EC580/WT	-	28-Jun-2023	-
Hydrocarbons, total (C6-C50)	----	<80	80	mg/kg	EC581/WT	-	28-Jun-2023	-
Chromatogram to baseline at nC50	n/a	YES	-	-	E601.SG-L/WT	26-Jun-2023	27-Jun-2023	1008153
Hydrocarbons Surrogates								
Bromobenzotrifluoride, 2- (F2-F4 surrogate)	392-83-6	97.3	1.0	%	E601.SG-L/WT	26-Jun-2023	27-Jun-2023	1008153
Dichlorotoluene, 3,4-	95-75-0	98.8	1.0	%	E581.F1/WT	27-Jun-2023	27-Jun-2023	1011444
Volatile Organic Compounds Surrogates								
Bromofluorobenzene, 4-	460-00-4	98.5	0.10	%	E611A/WT	27-Jun-2023	27-Jun-2023	1011443
Difluorobenzene, 1,4-	540-36-3	102	0.10	%	E611A/WT	27-Jun-2023	27-Jun-2023	1011443

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.

Analytical Results

WT2318555-003

Sub-Matrix:**Soil/Solid** *Client sample ID:* BH3- SA3

(Matrix: **Soil/Solid**) *Client sampling date / time:* 14-Jun-2023

Analyte	CAS Number	Result	LOR	Unit	Method/Lab	Prep Date	Analysis Date	QCLot
Physical Tests								
Conductivity (1:2 leachate)	----	0.375	0.00500	mS/cm	E100-L/WT	28-Jun-2023	29-Jun-2023	1007675
Moisture	----	12.4	0.25	%	E144/WT	-	25-Jun-2023	1007682
pH (1:2 soil:CaCl2-aq)	----	7.84	0.10	pH units	E108A/WT	26-Jun-2023	26-Jun-2023	1008155

Analytical Results

WT2318555-003

Sub-Matrix:**Soil/Solid**

(Matrix: **Soil/Solid**)

Client sample ID: BH3- SA3

Client sampling date / time: 14-Jun-2023

Analyte	CAS Number	Result	LOR	Unit	Method/Lab	Prep Date	Analysis Date	QCLot
Cyanides								
Cyanide, weak acid dissociable	----	<0.050	0.050	mg/kg	E336A/WT	26-Jun-2023	29-Jun-2023	1008182
Fixed-Ratio Extractables								
Calcium, soluble ion content	7440-70-2	1.99	0.50	mg/L	E484/WT	28-Jun-2023	29-Jun-2023	1007676
Magnesium, soluble ion content	7439-95-4	1.35	0.50	mg/L	E484/WT	28-Jun-2023	29-Jun-2023	1007676
Sodium, soluble ion content	17341-25-2	75.4	0.50	mg/L	E484/WT	28-Jun-2023	29-Jun-2023	1007676
Sodium adsorption ratio [SAR]	----	10.1	0.10	-	E484/WT	28-Jun-2023	29-Jun-2023	1007676
Metals								
Antimony	7440-36-0	<0.10	0.10	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Arsenic	7440-38-2	1.98	0.10	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Barium	7440-39-3	10.8	0.50	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Beryllium	7440-41-7	0.16	0.10	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Boron	7440-42-8	5.5	5.0	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Boron, hot water soluble	7440-42-8	<0.10	0.10	mg/kg	E487/WT	28-Jun-2023	28-Jun-2023	1007677
Cadmium	7440-43-9	0.092	0.020	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Chromium	7440-47-3	7.96	0.50	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Cobalt	7440-48-4	2.69	0.10	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Copper	7440-50-8	8.37	0.50	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Lead	7439-92-1	6.04	0.50	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Mercury	7439-97-6	0.0081	0.0050	mg/kg	E510C/WT	28-Jun-2023	29-Jun-2023	1007679
Molybdenum	7439-98-7	0.27	0.10	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Nickel	7440-02-0	5.34	0.50	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Selenium	7782-49-2	<0.20	0.20	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Silver	7440-22-4	<0.10	0.10	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Thallium	7440-28-0	<0.050	0.050	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Uranium	7440-61-1	0.484	0.050	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Vanadium	7440-62-2	18.5	0.20	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Zinc	7440-66-6	38.3	2.0	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Speciated Metals								
Chromium, hexavalent [Cr VI]	18540-29-9	<0.10	0.10	mg/kg	E532/WT	25-Jun-2023	27-Jun-2023	1007833
Volatile Organic Compounds								
Benzene	71-43-2	<0.0050	0.0050	mg/kg	E611A/WT	27-Jun-2023	27-Jun-2023	1010007
Ethylbenzene	100-41-4	<0.015	0.015	mg/kg	E611A/WT	27-Jun-2023	27-Jun-2023	1010007
Toluene	108-88-3	<0.050	0.050	mg/kg	E611A/WT	27-Jun-2023	27-Jun-2023	1010007
Xylene, m+p-	179601-23-1	<0.030	0.030	mg/kg	E611A/WT	27-Jun-2023	27-Jun-2023	1010007
Xylene, o-	95-47-6	<0.030	0.030	mg/kg	E611A/WT	27-Jun-2023	27-Jun-2023	1010007
Xylenes, total	1330-20-7	<0.050	0.05	mg/kg	E611A/WT	27-Jun-2023	27-Jun-2023	1010007
BTEX, total	----	<0.10	0.1	mg/kg	E611A/WT	27-Jun-2023	27-Jun-2023	1010007
Hydrocarbons								
F1 (C6-C10)	----	<5.0	5.0	mg/kg	E581.F1/WT	27-Jun-2023	27-Jun-2023	1010008
F2 (C10-C16)	----	<10	10	mg/kg	E601.SG-L/WT	26-Jun-2023	27-Jun-2023	1008153
F3 (C16-C34)	----	<50	50	mg/kg	E601.SG-L/WT	26-Jun-2023	27-Jun-2023	1008153
F4 (C34-C50)	----	<50	50	mg/kg	E601.SG-L/WT	26-Jun-2023	27-Jun-2023	1008153
F1-BTEX	----	<5.0	5	mg/kg	EC580/WT	-	28-Jun-2023	-
Hydrocarbons, total (C6-C50)	----	<80	80	mg/kg	EC581/WT	-	28-Jun-2023	-
Chromatogram to baseline at nC50	n/a	YES	-	-	E601.SG-L/WT	26-Jun-2023	27-Jun-2023	1008153

Analytical Results

WT2318555-003

Sub-Matrix:**Soil/Solid** *Client sample ID:* BH3- SA3

(Matrix: **Soil/Solid**) *Client sampling date / time:* 14-Jun-2023

Analyte	CAS Number	Result	LOR	Unit	Method/Lab	Prep Date	Analysis Date	QCLot
Hydrocarbons Surrogates								
Bromobenzotrifluoride, 2- (F2-F4 surrogate)	392-83-6	101	1.0	%	E601.SG-L/WT	26-Jun-2023	27-Jun-2023	1008153
Dichlorotoluene, 3,4-	95-75-0	84.7	1.0	%	E581.F1/WT	27-Jun-2023	27-Jun-2023	1010008
Volatile Organic Compounds Surrogates								
Bromofluorobenzene, 4-	460-00-4	98.0	0.10	%	E611A/WT	27-Jun-2023	27-Jun-2023	1010007
Difluorobenzene, 1,4-	540-36-3	108	0.10	%	E611A/WT	27-Jun-2023	27-Jun-2023	1010007

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.

Analytical Results

WT2318555-004

Sub-Matrix:**Soil/Solid** *Client sample ID:* BH4- SA1

(Matrix: **Soil/Solid**) *Client sampling date / time:* 15-Jun-2023

Analyte	CAS Number	Result	LOR	Unit	Method/Lab	Prep Date	Analysis Date	QCLot
Physical Tests								
Conductivity (1:2 leachate)	----	0.717	0.00500	mS/cm	E100-L/WT	28-Jun-2023	29-Jun-2023	1007675
Moisture	----	10.8	0.25	%	E144/WT	-	25-Jun-2023	1007682
pH (1:2 soil:CaCl2-aq)	----	7.84	0.10	pH units	E108A/WT	26-Jun-2023	26-Jun-2023	1008155
Cyanides								
Cyanide, weak acid dissociable	----	<0.050	0.050	mg/kg	E336A/WT	26-Jun-2023	29-Jun-2023	1008182
Fixed-Ratio Extractables								
Calcium, soluble ion content	7440-70-2	7.16	0.50	mg/L	E484/WT	28-Jun-2023	29-Jun-2023	1007676
Magnesium, soluble ion content	7439-95-4	3.30	0.50	mg/L	E484/WT	28-Jun-2023	29-Jun-2023	1007676
Sodium, soluble ion content	17341-25-2	149	0.50	mg/L	E484/WT	28-Jun-2023	29-Jun-2023	1007676
Sodium adsorption ratio [SAR]	----	11.6	0.10	-	E484/WT	28-Jun-2023	29-Jun-2023	1007676
Metals								
Antimony	7440-36-0	0.31	0.10	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Arsenic	7440-38-2	3.93	0.10	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Barium	7440-39-3	270	0.50	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Beryllium	7440-41-7	0.31	0.10	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Boron	7440-42-8	<5.0	5.0	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Boron, hot water soluble	7440-42-8	0.28	0.10	mg/kg	E487/WT	28-Jun-2023	28-Jun-2023	1007677
Cadmium	7440-43-9	0.292	0.020	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Chromium	7440-47-3	18.4	0.50	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Cobalt	7440-48-4	3.20	0.10	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Copper	7440-50-8	13.7	0.50	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Lead	7439-92-1	127	0.50	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Mercury	7439-97-6	0.0872	0.0050	mg/kg	E510C/WT	28-Jun-2023	29-Jun-2023	1007679
Molybdenum	7439-98-7	0.35	0.10	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Nickel	7440-02-0	8.16	0.50	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Selenium	7782-49-2	0.22	0.20	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Silver	7440-22-4	0.17	0.10	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Thallium	7440-28-0	0.090	0.050	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Uranium	7440-61-1	0.357	0.050	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678

Analytical Results

WT2318555-004

Sub-Matrix:**Soil/Solid** *Client sample ID:* BH4- SA1

(Matrix: **Soil/Solid**) *Client sampling date / time:* 15-Jun-2023

Analyte	CAS Number	Result	LOR	Unit	Method/Lab	Prep Date	Analysis Date	QCLot
Metals								
Vanadium	7440-62-2	18.8	0.20	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Zinc	7440-66-6	186	2.0	mg/kg	E440C/WT	28-Jun-2023	29-Jun-2023	1007678
Speciated Metals								
Chromium, hexavalent [Cr VI]	18540-29-9	0.35	0.10	mg/kg	E532/WT	25-Jun-2023	27-Jun-2023	1007833
Volatile Organic Compounds								
Benzene	71-43-2	<0.0050	0.0050	mg/kg	E611A/WT	27-Jun-2023	27-Jun-2023	1011443
Ethylbenzene	100-41-4	<0.015	0.015	mg/kg	E611A/WT	27-Jun-2023	27-Jun-2023	1011443
Toluene	108-88-3	<0.050	0.050	mg/kg	E611A/WT	27-Jun-2023	27-Jun-2023	1011443
Xylene, m+p-	179601-23-1	<0.030	0.030	mg/kg	E611A/WT	27-Jun-2023	27-Jun-2023	1011443
Xylene, o-	95-47-6	<0.030	0.030	mg/kg	E611A/WT	27-Jun-2023	27-Jun-2023	1011443
Xylenes, total	1330-20-7	<0.050	0.05	mg/kg	E611A/WT	27-Jun-2023	27-Jun-2023	1011443
BTEX, total	----	<0.10	0.1	mg/kg	E611A/WT	27-Jun-2023	27-Jun-2023	1011443
Hydrocarbons								
F1 (C6-C10)	----	<5.0	5.0	mg/kg	E581.F1/WT	27-Jun-2023	27-Jun-2023	1011444
F2 (C10-C16)	----	<10	10	mg/kg	E601.SG-L/WT	26-Jun-2023	27-Jun-2023	1008153
F3 (C16-C34)	----	96	50	mg/kg	E601.SG-L/WT	26-Jun-2023	27-Jun-2023	1008153
F4 (C34-C50)	----	172	50	mg/kg	E601.SG-L/WT	26-Jun-2023	27-Jun-2023	1008153
F4G-sg	----	520	250	mg/kg	E601.F4G-L/WT	27-Jun-2023	30-Jun-2023	1017844
F1-BTEX	----	<5.0	5	mg/kg	EC580/WT	-	28-Jun-2023	-
Hydrocarbons, total (C6-C50)	----	268	80	mg/kg	EC581/WT	-	28-Jun-2023	-
Chromatogram to baseline at nC50	n/a	NO	-	-	E601.SG-L/WT	26-Jun-2023	27-Jun-2023	1008153
Hydrocarbons Surrogates								
Bromobenzotrifluoride, 2- (F2-F4 surrogate)	392-83-6	98.4	1.0	%	E601.SG-L/WT	26-Jun-2023	27-Jun-2023	1008153
Dichlorotoluene, 3,4-	95-75-0	78.7	1.0	%	E581.F1/WT	27-Jun-2023	27-Jun-2023	1011444
Volatile Organic Compounds Surrogates								
Bromofluorobenzene, 4-	460-00-4	99.9	0.10	%	E611A/WT	27-Jun-2023	27-Jun-2023	1011443
Difluorobenzene, 1,4-	540-36-3	105	0.10	%	E611A/WT	27-Jun-2023	27-Jun-2023	1011443

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.

Analytical Results

WT2318555-005

Sub-Matrix:**Soil/Solid** *Client sample ID:* BH2- SA3

(Matrix: **Soil/Solid**) *Client sampling date / time:* 20-Jun-2023

Analyte	CAS Number	Result	LOR	Unit	Method/Lab	Prep Date	Analysis Date	QCLot
Physical Tests								
Conductivity (1:2 leachate)	----	158	5.00	µS/cm	E100-L/WT	28-Jun-2023	29-Jun-2023	1007675
Moisture	----	13.1	0.25	%	E144/WT	-	25-Jun-2023	1007682
Oxidation-reduction potential [ORP]	----	281	0.10	mV	E125/WT	27-Jun-2023	27-Jun-2023	1009933
pH (1:2 soil:CaCl2-aq)	----	7.55	0.10	pH units	E108A/WT	26-Jun-2023	27-Jun-2023	1008921
Resistivity	----	6330	100	ohm cm	EC100R/WT	-	29-Jun-2023	-
Inorganics								
Sulfides, acid volatile	----	<0.23	0.23	mg/kg	E396-L/WT	26-Jun-2023	26-Jun-2023	1009312

Analytical Results

WT2318555-005

Sub-Matrix:**Soil/Solid** *Client sample ID:* BH2- SA3

(Matrix: **Soil/Solid**) *Client sampling date / time:* 20-Jun-2023

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method/Lab*	*Prep Date*	*Analysis Date*	*QCLot*
Leachable Anions & Nutrients								
Chloride, soluble ion content	16887-00-6	26.6	5.0	mg/kg	E236.Cl/WT	29-Jun-2023	29-Jun-2023	1015824
Sulfate, soluble ion content	14808-79-8	<20	20	mg/kg	E236.SO4/WT	29-Jun-2023	29-Jun-2023	1015823

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.

Analytical Results

WT2318555-006

Sub-Matrix:**Soil/Solid** *Client sample ID:* BH4- SA3

(Matrix: **Soil/Solid**) *Client sampling date / time:* 15-Jun-2023

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method/Lab*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
Conductivity (1:2 leachate)	----	1070	5.00	µS/cm	E100-L/WT	28-Jun-2023	29-Jun-2023	1007675
Moisture	----	12.9	0.25	%	E144/WT	-	25-Jun-2023	1007682
Oxidation-reduction potential [ORP]	----	218	0.10	mV	E125/WT	27-Jun-2023	27-Jun-2023	1009933
pH (1:2 soil:CaCl2-aq)	----	8.10	0.10	pH units	E108A/WT	26-Jun-2023	27-Jun-2023	1008921
Resistivity	----	930	100	ohm cm	EC100R/WT	-	29-Jun-2023	-
Inorganics								
Sulfides, acid volatile	----	0.27	0.23	mg/kg	E396-L/WT	26-Jun-2023	26-Jun-2023	1009312
Leachable Anions & Nutrients								
Chloride, soluble ion content	16887-00-6	571	5.0	mg/kg	E236.Cl/WT	29-Jun-2023	29-Jun-2023	1015824
Sulfate, soluble ion content	14808-79-8	32	20	mg/kg	E236.SO4/WT	29-Jun-2023	29-Jun-2023	1015823

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.

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QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: **WT2318555**	Page	: 1 of 17
Client	: **Chung and Vander Doelen Engineering Ltd.**	Laboratory	: Waterloo - Environmental
Contact	: Brianna Cobbe	Account Manager	: Andrew Martin
Address	: 311 Victoria St. N. Kitchener ON Canada N2H 5E1	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: ----	Telephone	: +1 519 886 6910
Project	: 1073	Date Samples Received	: 23-Jun-2023 13:00
PO	: ----	Issue Date	: 30-Jun-2023 19:30
C-O-C number	: 20-1048903		
Sampler	: EP		
Site	: ----		
Quote number	: Q84362 - Excess Soils		
No. of samples received	: 6		
No. of samples analysed	: 6		

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO: Data Quality Objective.
LOR: Limit of Reporting (detection limit).
RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- Matrix Spike outliers occur - please see following pages for full details.
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- Reference Material (RM) Sample outliers occur - please see the following pages for full details.

Outliers : Analysis Holding Time Compliance (Breaches)

- No Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- Quality Control Sample Frequency Outliers occur - please see following pages for full details.

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **Soil/Solid**

Analyte Group	Laboratory sample ID	Client/Ref Sample ID	Analyte	CAS Number	Method	Result	Limits	Comment
Reference Material (RM) Sample								
Metals	QC-MRG2-1007678 003	----	Molybdenum	7439-98-7	E440C	136 % MES	70.0-130%	Recovery greater than upper control limit

Result Qualifiers

Qualifier	Description
MES	*Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).*

Matrix Spike (MS) Recoveries								
Hydrocarbons	Anonymous	Anonymous	F3 (C16-C34)	----	E601.SG-L	151 % E	60.0-140%	Recovery greater than upper data quality objective

Result Qualifiers

Qualifier	Description
E	*Matrix Spike recovery outside ALS DQO due to heterogeneous analyte background in sample.*

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Cyanides : WAD Cyanide (0.01M NaOH Extraction)										
Glass soil jar/Teflon lined cap [ON MECP] BH4- SA1	E336A	15-Jun-2023	26-Jun-2023	14 days	11 days	✓	29-Jun-2023	14 days	3 days	✓
Cyanides : WAD Cyanide (0.01M NaOH Extraction)										
Glass soil jar/Teflon lined cap [ON MECP] BH3- SA3	E336A	14-Jun-2023	26-Jun-2023	14 days	12 days	✓	29-Jun-2023	14 days	3 days	✓
Cyanides : WAD Cyanide (0.01M NaOH Extraction)										
Glass soil jar/Teflon lined cap [ON MECP] BH1- SA2	E336A	19-Jun-2023	25-Jun-2023	14 days	6 days	✓	27-Jun-2023	14 days	2 days	✓
Cyanides : WAD Cyanide (0.01M NaOH Extraction)										
Glass soil jar/Teflon lined cap [ON MECP] BH2- SA1	E336A	20-Jun-2023	26-Jun-2023	14 days	6 days	✓	29-Jun-2023	14 days	3 days	✓
Fixed-Ratio Extractables : Sodium Adsorption Ratio (SAR) - 1:2 Soil:Water (Dry)										
Glass soil jar/Teflon lined cap [ON MECP] BH1- SA2	E484	19-Jun-2023	28-Jun-2023	180 days	10 days	✓	29-Jun-2023	180 days	1 days	✓
Fixed-Ratio Extractables : Sodium Adsorption Ratio (SAR) - 1:2 Soil:Water (Dry)										
Glass soil jar/Teflon lined cap [ON MECP] BH4- SA1	E484	15-Jun-2023	28-Jun-2023	180 days	14 days	✓	29-Jun-2023	180 days	1 days	✓
Fixed-Ratio Extractables : Sodium Adsorption Ratio (SAR) - 1:2 Soil:Water (Dry)										
Glass soil jar/Teflon lined cap [ON MECP] BH3- SA3	E484	14-Jun-2023	28-Jun-2023	180 days	15 days	✓	29-Jun-2023	180 days	1 days	✓

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Fixed-Ratio Extractables : Sodium Adsorption Ratio (SAR) - 1:2 Soil:Water (Dry)										
Glass soil jar/Teflon lined cap [ON MECP] BH2- SA1	E484	20-Jun-2023	28-Jun-2023	180 days	9 days	✓	29-Jun-2023	180 days	1 days	✓
Hydrocarbons : CCME PHC - F1 by Headspace GC-FID										
Glass soil methanol vial [ON MECP] BH4- SA1	E581.F1	15-Jun-2023	27-Jun-2023	14 days	13 days	✓	27-Jun-2023	40 days	0 days	✓
Hydrocarbons : CCME PHC - F1 by Headspace GC-FID										
Glass soil methanol vial [ON MECP] BH3- SA3	E581.F1	14-Jun-2023	27-Jun-2023	14 days	13 days	✓	27-Jun-2023	40 days	1 days	✓
Hydrocarbons : CCME PHC - F1 by Headspace GC-FID										
Glass soil methanol vial [ON MECP] BH2- SA1	E581.F1	20-Jun-2023	27-Jun-2023	14 days	8 days	✓	27-Jun-2023	40 days	0 days	✓
Hydrocarbons : CCME PHC - F1 by Headspace GC-FID										
Glass soil methanol vial [ON MECP] BH1- SA2	E581.F1	19-Jun-2023	27-Jun-2023	14 days	9 days	✓	27-Jun-2023	40 days	0 days	✓
Hydrocarbons : CCME PHCs - F4G by Gravimetry (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] BH4- SA1	E601.F4G-L	15-Jun-2023	27-Jun-2023	14 days	13 days	✓	30-Jun-2023	40 days	3 days	✓
Hydrocarbons : CCME PHCs - F2-F4 by GC-FID (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] BH4- SA1	E601.SG-L	15-Jun-2023	26-Jun-2023	14 days	11 days	✓	27-Jun-2023	40 days	2 days	✓
Hydrocarbons : CCME PHCs - F2-F4 by GC-FID (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] BH3- SA3	E601.SG-L	14-Jun-2023	26-Jun-2023	14 days	12 days	✓	27-Jun-2023	40 days	2 days	✓
Hydrocarbons : CCME PHCs - F2-F4 by GC-FID (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] BH2- SA1	E601.SG-L	20-Jun-2023	26-Jun-2023	14 days	6 days	✓	27-Jun-2023	40 days	2 days	✓

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Hydrocarbons : CCME PHCs - F2-F4 by GC-FID (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP]										
BH1- SA2	E601.SG-L	19-Jun-2023	26-Jun-2023	14 days	8 days	✓	27-Jun-2023	40 days	1 days	✓
Inorganics : Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)										
Glass soil jar/Teflon lined cap [ON MECP]										
BH4- SA3	E396-L	15-Jun-2023	26-Jun-2023	14 days	12 days	✓	26-Jun-2023	7 days	0 days	✓
Inorganics : Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)										
Glass soil jar/Teflon lined cap [ON MECP]										
BH2- SA3	E396-L	20-Jun-2023	26-Jun-2023	14 days	7 days	✓	26-Jun-2023	7 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Chloride by IC										
Glass soil jar/Teflon lined cap [ON MECP]										
BH2- SA3	E236.Cl	20-Jun-2023	29-Jun-2023	30 days	10 days	✓	29-Jun-2023	28 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Chloride by IC										
Glass soil jar/Teflon lined cap [ON MECP]										
BH4- SA3	E236.Cl	15-Jun-2023	29-Jun-2023	30 days	15 days	✓	29-Jun-2023	28 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Sulfate by IC										
Glass soil jar/Teflon lined cap [ON MECP]										
BH2- SA3	E236.SO4	20-Jun-2023	29-Jun-2023	30 days	10 days	✓	29-Jun-2023	28 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Sulfate by IC										
Glass soil jar/Teflon lined cap [ON MECP]										
BH4- SA3	E236.SO4	15-Jun-2023	29-Jun-2023	30 days	15 days	✓	29-Jun-2023	28 days	0 days	✓
Metals : Boron-Hot Water Extractable by ICPOES										
Glass soil jar/Teflon lined cap [ON MECP]										
BH1- SA2	E487	19-Jun-2023	28-Jun-2023	180 days	10 days	✓	28-Jun-2023	180 days	0 days	✓
Metals : Boron-Hot Water Extractable by ICPOES										
Glass soil jar/Teflon lined cap [ON MECP]										
BH4- SA1	E487	15-Jun-2023	28-Jun-2023	180 days	14 days	✓	28-Jun-2023	180 days	0 days	✓

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Metals : Boron-Hot Water Extractable by ICPOES										
Glass soil jar/Teflon lined cap [ON MECP]										
BH3- SA3	E487	14-Jun-2023	28-Jun-2023	180 days	15 days	✓	28-Jun-2023	180 days	0 days	✓
Metals : Boron-Hot Water Extractable by ICPOES										
Glass soil jar/Teflon lined cap [ON MECP]										
BH2- SA1	E487	20-Jun-2023	28-Jun-2023	180 days	9 days	✓	28-Jun-2023	180 days	0 days	✓
Metals : Mercury in Soil/Solid by CVAAS (<355 µm)										
Glass soil jar/Teflon lined cap [ON MECP]										
BH2- SA1	E510C	20-Jun-2023	28-Jun-2023	----	----		29-Jun-2023	28 days	10 days	✓
Metals : Mercury in Soil/Solid by CVAAS (<355 µm)										
Glass soil jar/Teflon lined cap [ON MECP]										
BH1- SA2	E510C	19-Jun-2023	28-Jun-2023	----	----		29-Jun-2023	28 days	11 days	✓
Metals : Mercury in Soil/Solid by CVAAS (<355 µm)										
Glass soil jar/Teflon lined cap [ON MECP]										
BH4- SA1	E510C	15-Jun-2023	28-Jun-2023	----	----		29-Jun-2023	28 days	15 days	✓
Metals : Mercury in Soil/Solid by CVAAS (<355 µm)										
Glass soil jar/Teflon lined cap [ON MECP]										
BH3- SA3	E510C	14-Jun-2023	28-Jun-2023	----	----		29-Jun-2023	28 days	16 days	✓
Metals : Metals in Soil/Solid by CRC ICPMS (<355 µm)										
Glass soil jar/Teflon lined cap [ON MECP]										
BH2- SA1	E440C	20-Jun-2023	28-Jun-2023	----	----		29-Jun-2023	180 days	10 days	✓
Metals : Metals in Soil/Solid by CRC ICPMS (<355 µm)										
Glass soil jar/Teflon lined cap [ON MECP]										
BH1- SA2	E440C	19-Jun-2023	28-Jun-2023	----	----		29-Jun-2023	180 days	11 days	✓
Metals : Metals in Soil/Solid by CRC ICPMS (<355 µm)										
Glass soil jar/Teflon lined cap [ON MECP]										
BH4- SA1	E440C	15-Jun-2023	28-Jun-2023	----	----		29-Jun-2023	180 days	15 days	✓

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Metals : Metals in Soil/Solid by CRC ICPMS (<355 µm)										
Glass soil jar/Teflon lined cap [ON MECP] BH3- SA3	E440C	14-Jun-2023	28-Jun-2023	----	----		29-Jun-2023	180 days	16 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] BH2- SA1	E100-L	20-Jun-2023	28-Jun-2023	----	----		29-Jun-2023	30 days	10 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] BH2- SA3	E100-L	20-Jun-2023	28-Jun-2023	----	----		29-Jun-2023	30 days	10 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] BH1- SA2	E100-L	19-Jun-2023	28-Jun-2023	----	----		29-Jun-2023	30 days	11 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] BH4- SA1	E100-L	15-Jun-2023	28-Jun-2023	----	----		29-Jun-2023	30 days	15 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] BH4- SA3	E100-L	15-Jun-2023	28-Jun-2023	----	----		29-Jun-2023	30 days	15 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] BH3- SA3	E100-L	14-Jun-2023	28-Jun-2023	----	----		29-Jun-2023	30 days	16 days	✓
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap [ON MECP] BH1- SA2	E144	19-Jun-2023	----	----	----		24-Jun-2023	----	----	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap [ON MECP] BH2- SA1	E144	20-Jun-2023	----	----	----		24-Jun-2023	----	----	

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap [ON MECP]										
BH2- SA3	E144	20-Jun-2023	----	----	----		25-Jun-2023	----	----	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap [ON MECP]										
BH3- SA3	E144	14-Jun-2023	----	----	----		25-Jun-2023	----	----	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap [ON MECP]										
BH4- SA1	E144	15-Jun-2023	----	----	----		25-Jun-2023	----	----	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap [ON MECP]										
BH4- SA3	E144	15-Jun-2023	----	----	----		25-Jun-2023	----	----	
Physical Tests : ORP by Electrode										
Glass soil jar/Teflon lined cap [ON MECP]										
BH4- SA3	E125	15-Jun-2023	27-Jun-2023	----	----		27-Jun-2023	180 days	13 days	✓
Physical Tests : ORP by Electrode										
Glass soil jar/Teflon lined cap [ON MECP]										
BH2- SA3	E125	20-Jun-2023	27-Jun-2023	----	----		27-Jun-2023	180 days	8 days	✓
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap [ON MECP]										
BH4- SA1	E108A	15-Jun-2023	26-Jun-2023	----	----		26-Jun-2023	30 days	12 days	✓
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap [ON MECP]										
BH3- SA3	E108A	14-Jun-2023	26-Jun-2023	----	----		26-Jun-2023	30 days	13 days	✓
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap [ON MECP]										
BH4- SA3	E108A	15-Jun-2023	26-Jun-2023	----	----		27-Jun-2023	30 days	13 days	✓

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap [ON MECP]										
BH1- SA2	E108A	19-Jun-2023	25-Jun-2023	----	----		26-Jun-2023	30 days	7 days	✓
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap [ON MECP]										
BH2- SA1	E108A	20-Jun-2023	26-Jun-2023	----	----		26-Jun-2023	30 days	7 days	✓
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap [ON MECP]										
BH2- SA3	E108A	20-Jun-2023	26-Jun-2023	----	----		27-Jun-2023	30 days	8 days	✓
Speciated Metals : Hexavalent Chromium (Cr VI) by IC										
Glass soil jar/Teflon lined cap [ON MECP]										
BH4- SA1	E532	15-Jun-2023	25-Jun-2023	30 days	11 days	✓	27-Jun-2023	7 days	2 days	✓
Speciated Metals : Hexavalent Chromium (Cr VI) by IC										
Glass soil jar/Teflon lined cap [ON MECP]										
BH3- SA3	E532	14-Jun-2023	25-Jun-2023	30 days	12 days	✓	27-Jun-2023	7 days	2 days	✓
Speciated Metals : Hexavalent Chromium (Cr VI) by IC										
Glass soil jar/Teflon lined cap [ON MECP]										
BH1- SA2	E532	19-Jun-2023	25-Jun-2023	30 days	6 days	✓	27-Jun-2023	7 days	2 days	✓
Speciated Metals : Hexavalent Chromium (Cr VI) by IC										
Glass soil jar/Teflon lined cap [ON MECP]										
BH2- SA1	E532	20-Jun-2023	25-Jun-2023	30 days	6 days	✓	27-Jun-2023	7 days	2 days	✓
Volatile Organic Compounds : BTEX by Headspace GC-MS										
Glass soil methanol vial [ON MECP]										
BH4- SA1	E611A	15-Jun-2023	27-Jun-2023	14 days	13 days	✓	27-Jun-2023	40 days	0 days	✓
Volatile Organic Compounds : BTEX by Headspace GC-MS										
Glass soil methanol vial [ON MECP]										
BH3- SA3	E611A	14-Jun-2023	27-Jun-2023	14 days	13 days	✓	27-Jun-2023	40 days	1 days	✓

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Volatile Organic Compounds : BTEX by Headspace GC-MS										
Glass soil methanol vial [ON MECP]										
BH2- SA1	E611A	20-Jun-2023	27-Jun-2023	14 days	8 days	✓	27-Jun-2023	40 days	0 days	✓
Volatile Organic Compounds : BTEX by Headspace GC-MS										
Glass soil methanol vial [ON MECP]										
BH1- SA2	E611A	19-Jun-2023	27-Jun-2023	14 days	9 days	✓	27-Jun-2023	40 days	0 days	✓

Legend & Qualifier Definitions

Rec. HT: ALS recommended hold time (see units).

Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Soil/Solid**

Evaluation: ✗ = *QC frequency outside specification*; ✓ = *QC frequency within specification.*

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Laboratory Duplicates (DUP)							
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L	1009312	1	8	12.5	4.7	✓
Boron-Hot Water Extractable by ICPOES	E487	1007677	1	13	7.6	5.0	✓
BTEX by Headspace GC-MS	E611A	1010007	2	40	5.0	5.0	✓
CCME PHC - F1 by Headspace GC-FID	E581.F1	1010008	2	40	5.0	5.0	✓
CCME PHCs - F4G by Gravimetry (Low Level)	E601.F4G-L	1017844	0	6	0.0	5.0	✗
CCME PHCs - F2-F4 by GC-FID (Low Level)	E601.SG-L	1007625	2	39	5.1	5.0	✓
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	1007675	1	18	5.5	5.0	✓
Hexavalent Chromium (Cr VI) by IC	E532	1007623	2	40	5.0	5.0	✓
Mercury in Soil/Solid by CVAAS (<355 µm)	E510C	1007679	1	13	7.6	5.0	✓
Metals in Soil/Solid by CRC ICPMS (<355 µm)	E440C	1007678	1	16	6.2	5.0	✓
Moisture Content by Gravimetry	E144	1007270	1	34	2.9	5.0	✗
ORP by Electrode	E125	1009933	1	8	12.5	5.0	✓
pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received	E108A	1007622	3	58	5.1	5.0	✓
Sodium Adsorption Ratio (SAR) - 1:2 Soil:Water (Dry)	E484	1007676	1	16	6.2	5.0	✓
WAD Cyanide (0.01M NaOH Extraction)	E336A	1007624	2	40	5.0	5.0	✓
Water Extractable Chloride by IC	E236.Cl	1015824	1	13	7.6	5.0	✓
Water Extractable Sulfate by IC	E236.SO4	1015823	1	13	7.6	5.0	✓
Laboratory Control Samples (LCS)							
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L	1009312	1	8	12.5	4.7	✓
Boron-Hot Water Extractable by ICPOES	E487	1007677	2	13	15.3	10.0	✓
BTEX by Headspace GC-MS	E611A	1010007	2	40	5.0	5.0	✓
CCME PHC - F1 by Headspace GC-FID	E581.F1	1010008	2	40	5.0	5.0	✓
CCME PHCs - F4G by Gravimetry (Low Level)	E601.F4G-L	1017844	1	6	16.6	5.0	✓
CCME PHCs - F2-F4 by GC-FID (Low Level)	E601.SG-L	1007625	2	39	5.1	5.0	✓
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	1007675	2	18	11.1	10.0	✓
Hexavalent Chromium (Cr VI) by IC	E532	1007623	4	40	10.0	10.0	✓
Mercury in Soil/Solid by CVAAS (<355 µm)	E510C	1007679	2	13	15.3	10.0	✓
Metals in Soil/Solid by CRC ICPMS (<355 µm)	E440C	1007678	2	16	12.5	10.0	✓
Moisture Content by Gravimetry	E144	1007270	2	34	5.8	5.0	✓
ORP by Electrode	E125	1009933	1	8	12.5	5.0	✓
pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received	E108A	1007622	3	58	5.1	5.0	✓
Sodium Adsorption Ratio (SAR) - 1:2 Soil:Water (Dry)	E484	1007676	2	16	12.5	10.0	✓
WAD Cyanide (0.01M NaOH Extraction)	E336A	1007624	2	40	5.0	5.0	✓
Water Extractable Chloride by IC	E236.Cl	1015824	2	13	15.3	10.0	✓
Water Extractable Sulfate by IC	E236.SO4	1015823	2	13	15.3	10.0	✓

Matrix: **Soil/Solid**

Evaluation: × = *QC frequency outside specification*; ✓ = *QC frequency within specification.*

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Method Blanks (MB)							
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L	1009312	1	8	12.5	4.7	✓
Boron-Hot Water Extractable by ICPOES	E487	1007677	1	13	7.6	5.0	✓
BTEX by Headspace GC-MS	E611A	1010007	2	40	5.0	5.0	✓
CCME PHC - F1 by Headspace GC-FID	E581.F1	1010008	2	40	5.0	5.0	✓
CCME PHCs - F4G by Gravimetry (Low Level)	E601.F4G-L	1017844	1	6	16.6	5.0	✓
CCME PHCs - F2-F4 by GC-FID (Low Level)	E601.SG-L	1007625	2	39	5.1	5.0	✓
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	1007675	1	18	5.5	5.0	✓
Hexavalent Chromium (Cr VI) by IC	E532	1007623	2	40	5.0	5.0	✓
Mercury in Soil/Solid by CVAAS (<355 µm)	E510C	1007679	1	13	7.6	5.0	✓
Metals in Soil/Solid by CRC ICPMS (<355 µm)	E440C	1007678	1	16	6.2	5.0	✓
Moisture Content by Gravimetry	E144	1007270	2	34	5.8	5.0	✓
Sodium Adsorption Ratio (SAR) - 1:2 Soil:Water (Dry)	E484	1007676	1	16	6.2	5.0	✓
WAD Cyanide (0.01M NaOH Extraction)	E336A	1007624	2	40	5.0	5.0	✓
Water Extractable Chloride by IC	E236.Cl	1015824	1	13	7.6	5.0	✓
Water Extractable Sulfate by IC	E236.SO4	1015823	1	13	7.6	5.0	✓
Matrix Spikes (MS)							
BTEX by Headspace GC-MS	E611A	1010007	2	40	5.0	5.0	✓
CCME PHC - F1 by Headspace GC-FID	E581.F1	1010008	2	40	5.0	5.0	✓
CCME PHCs - F4G by Gravimetry (Low Level)	E601.F4G-L	1017844	0	6	0.0	5.0	×
CCME PHCs - F2-F4 by GC-FID (Low Level)	E601.SG-L	1007625	2	39	5.1	5.0	✓
WAD Cyanide (0.01M NaOH Extraction)	E336A	1007624	2	40	5.0	5.0	✓

Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L Waterloo - Environmental	Soil/Solid	CSSS Ch. 15 (mod)/APHA 2510 (mod)	Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a soil sample that has been added in a defined ratio of soil to deionized water, then shaken well and allowed to settle. Conductance is measured in the fluid that is observed in the upper layer.
pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received	E108A Waterloo - Environmental	Soil/Solid	MECP E3137A	pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally 20 ± 5°C) and is carried out in accordance with procedures described in the Analytical Protocol (prescriptive method). A minimum 10g portion of the sample, as received, is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil by centrifuging, settling, or decanting and then analyzed using a pH meter and electrode.
ORP by Electrode	E125 Waterloo - Environmental	Soil/Solid	APHA 2580 (mod)	Oxidation Redution Potential (ORP) is reported as the oxidation-reduction potential of the platinum metal-reference electrode employed in the analysis, measured in mV.
Moisture Content by Gravimetry	E144 Waterloo - Environmental	Soil/Solid	CCME PHC in Soil - Tier 1	Moisture is measured gravimetrically by drying the sample at 105°C. Moisture content is calculated as the weight loss (due to water) divided by the wet weight of the sample, expressed as a percentage.
Water Extractable Chloride by IC	E236.Cl Waterloo - Environmental	Soil/Solid	EPA 300.1	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection using a soil sample that has been added in a defined ratio of soil to deionized water, then shaken well and allowed to settle. Anions are measured in the fluid that is observed in the upper layer.
Water Extractable Sulfate by IC	E236.SO4 Waterloo - Environmental	Soil/Solid	EPA 300.1	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection using a soil sample that has been added in a defined ratio of soil to deionized water, then shaken well and allowed to settle. Anions are measured in the fluid that is observed in the upper layer.
WAD Cyanide (0.01M NaOH Extraction)	E336A Waterloo - Environmental	Soil/Solid	APHA 4500-CN I (mod)	Weak Acid Dissociable (WAD) cyanide is determined after extraction by Continuous Flow Analyzer (CFA) with in-line distillation followed by colourmetric analysis.
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L Waterloo - Environmental	Soil/Solid	APHA 4500S2J	This analysis is carried out in accordance with the method described in APHA 4500 S2-J. After extraction the Acid Volatile Sulphide is determined colourimetrically.

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Metals in Soil/Solid by CRC ICPMS (<355 µm)	E440C Waterloo - Environmental	Soil/Solid	EPA 6020B (mod)	This method is intended to liberate metals that may be environmentally available. Samples are dried, then sieved through a 355 µm sieve, and digested with HNO3 and HCl. Dependent on sample matrix, some metals may be only partially recovered, including Al, Ba, Be, Cr, Sr, Ti, Tl, V, W, and Zr. Silicate minerals are not solubilized. Volatile forms of sulfur (including sulfide) may not be captured, as they may be lost during sampling, storage, or digestion. This method does not adequately recover elemental sulfur, and is unsuitable for assessment of elemental sulfur standards or guidelines. Analysis is by Collision/Reaction Cell ICPMS.
Sodium Adsorption Ratio (SAR) - 1:2 Soil:Water (Dry)	E484 Waterloo - Environmental	Soil/Solid	SW846 6010C	A dried, disaggregated solid sample is extracted with deionized water, the aqueous extract is separated from the solid, acidified and then analyzed using a ICP/OES. The concentrations of Na, Ca and Mg are reported as per CALA requirements for calculated parameters. These individual parameters are not for comparison to any guideline.
Boron-Hot Water Extractable by ICPOES	E487 Waterloo - Environmental	Soil/Solid	HW EXTR, EPA 6010B	A dried solid sample is extracted with calcium chloride, the sample undergoes a heating process. After cooling the sample is filtered and analyzed by ICP/OES. Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).
Mercury in Soil/Solid by CVAAS (<355 µm)	E510C Waterloo - Environmental	Soil/Solid	EPA 200.2/1631 Appendix (mod)	Samples are sieved through a 355 µm sieve, and digested with HNO3 and HCl, followed by CVAAS analysis.
Hexavalent Chromium (Cr VI) by IC	E532 Waterloo - Environmental	Soil/Solid	APHA 3500-CR C	Instrumental analysis is performed by ion chromatography with UV detection.
CCME PHC - F1 by Headspace GC-FID	E581.F1 Waterloo - Environmental	Soil/Solid	CCME PHC in Soil - Tier 1	CCME Fraction 1 (F1) is analyzed by static headspace GC-FID. Samples are prepared in headspace vials and are heated and agitated on the headspace autosampler, causing VOCs to partition between the aqueous phase and the headspace in accordance with Henry's law. Analytical methods for CCME Petroleum Hydrocarbons (PHCs) are validated to comply fully with the Reference Method for the Canada-Wide Standard for PHC. Test results are expressed on a dry weight basis. Unless qualified, all required quality control criteria of the CCME PHC method have been met, including response factor and linearity requirements.

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
CCME PHCs - F4G by Gravimetry (Low Level)	E601.F4G-L Waterloo - Environmental	Soil/Solid	CCME PHC in Soil - Tier 1	A portion of the silica gel treated sample extract is filtered and dried at 105°C and the mass of the residual gravimetric heavy hydrocarbons (F4G) is determined gravimetrically. Where both F4 and F4G are reported, the greater of both results must be used for comparison to CWS PHC F4 guidelines.
CCME PHCs - F2-F4 by GC-FID (Low Level)	E601.SG-L Waterloo - Environmental	Soil/Solid	CCME PHC in Soil - Tier 1	Sample extracts are subjected to in-situ silica gel treatment prior to analysis by GC-FID for CCME hydrocarbon fractions (F2-F4). Analytical methods for CCME Petroleum Hydrocarbons (PHCs) are validated to comply fully with the Reference Method for the Canada-Wide Standard for PHC. Test results are expressed on a dry weight basis. Unless qualified, all required quality control criteria of the CCME PHC method have been met, including response factor and linearity requirements.
BTEX by Headspace GC-MS	E611A Waterloo - Environmental	Soil/Solid	EPA 8260D (mod)	Volatile Organic Compounds (VOCs) are analyzed by static headspace GC-MS. Samples are prepared in headspace vials and are heated and agitated on the headspace autosampler, causing VOCs to partition between the aqueous phase and the headspace in accordance with Henry's law.
Resistivity Calculation for Soil Using E100-L	EC100R Waterloo - Environmental	Soil/Solid	APHA 2510 B	Soil Resistivity (calculated) is determined as the inverse of the conductivity of a 2:1 water:soil leachate (dry weight). This method is intended as a rapid approximation for Soil Resistivity. Where high accuracy results are required, direct measurement of Soil Resistivity by the Wenner Four-Electrode Method (ASTM G57) is recommended.
F1-BTEX	EC580 Waterloo - Environmental	Soil/Solid	CCME PHC in Soil - Tier 1	F1-BTEX is calculated as follows: F1-BTEX = F1 (C6-C10) minus benzene, toluene, ethylbenzene and xylenes (BTEX).
Sum F1 to F4 (C6-C50)	EC581 Waterloo - Environmental	Soil/Solid	CCME PHC in Soil - Tier 1	Hydrocarbons, total (C6-C50) is the sum of CCME Fractions F1(C6-C10), F2(C10-C16), F3(C16-C34), and F4(C34-C50). F4G-sg is not used within this calculation due to overlap with other fractions.

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Leach 1:2 Soil:Water for pH/EC	EP108 Waterloo - Environmental	Soil/Solid	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL	The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water.
Leach 1:2 Soil : 0.01CaCl2 - As Received for pH	EP108A Waterloo - Environmental	Soil/Solid	MOEE E3137A	A minimum 10g portion of the sample, as received, is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil by centrifuging, settling or decanting and then analyzed using a pH meter and electrode.
Preparation of ORP by Electrode	EP125 Waterloo - Environmental	Soil/Solid	APHA 2580 (mod)	Field-moist sample is extracted in a 1:2 ratio with DI water and then analyzed by ORP meter.

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Anions Leach 1:10 Soil:Water (Dry)	EP236 Waterloo - Environmental	Soil/Solid	EPA 300.1	5 grams of dried soil is mixed with 50 grams of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.
Cyanide Extraction for CFA (0.01M NaOH)	EP333A Waterloo - Environmental	Soil/Solid	ON MECP E3015 (mod)	Extraction for various cyanide analysis is by rotary extraction of the soil with 0.01M Sodium Hydroxide.
Distillation for Acid Volatile Sulfide in Soil	EP396-L Waterloo - Environmental	Soil/Solid	APHA 4500S2J	Acid Volatile Sulfide is determined by colourimetric measurement on a sediment sample that has been treated with hydrochloric acid within a purge and trap system, where the evolved hydrogen sulfide gas is carried into a basic solution by argon gas for analysis.
Digestion for Metals and Mercury (355 µm Sieve)	EP440C Waterloo - Environmental	Soil/Solid	EPA 200.2 (mod)	Samples are sieved through a 355 µm sieve, and digested with HNO_3 and HCl. This method is intended to liberate metals that may be environmentally available.
Boron-Hot Water Extractable	EP487 Waterloo - Environmental	Soil/Solid	HW EXTR, EPA 6010B	A dried solid sample is extracted with weak calcium chloride, the sample undergoes a heating process. After cooling the sample is filtered and analyzed by ICP/OES. Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011)
Preparation of Hexavalent Chromium (Cr VI) for IC	EP532 Waterloo - Environmental	Soil/Solid	EPA 3060A	Field moist samples are digested with a sodium hydroxide/sodium carbonate solution as described in EPA 3060A.
VOCs Methanol Extraction for Headspace Analysis	EP581 Waterloo - Environmental	Soil/Solid	EPA 5035A (mod)	VOCs in samples are extracted with methanol. Extracts are then prepared in headspace vials and are heated and agitated on the headspace autosampler, causing VOCs to partition between the aqueous phase and the headspace in accordance with Henry's law.
PHCs and PAHs Hexane-Acetone Tumbler Extraction	EP601 Waterloo - Environmental	Soil/Solid	CCME PHC in Soil - Tier 1 (mod)	Samples are subsampled and Petroleum Hydrocarbons (PHC) and PAHs are extracted with 1:1 hexane:acetone using a rotary extractor.

QUALITY CONTROL REPORT

Work Order	: **WT2318555**	Page	: 1 of 15
Client	: Chung and Vander Doelen Engineering Ltd.	Laboratory	: Waterloo - Environmental
Contact	: Brianna Cobbe	Account Manager	: Andrew Martin
Address	: 311 Victoria St. N. Kitchener ON Canada N2H 5E1	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	:	Telephone	: +1 519 886 6910
Project	: 1073	Date Samples Received	: 23-Jun-2023 13:00
PO	: ----	Date Analysis Commenced	: 24-Jun-2023
C-O-C number	: 20-1048903	Issue Date	: 30-Jun-2023 19:36
Sampler	: EP ----		
Site	: ----		
Quote number	: Q84362 - Excess Soils		
No. of samples received	: 6		
No. of samples analysed	: 6		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Matrix Spike (MS) Report; Recovery and Data Quality Objectives
- Reference Material (RM) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Amanda Ganouri-Lumsden	Department Manager - Microbiology and Prep	Waterloo Centralized Prep, Waterloo, Ontario
Greg Pokocky	Manager - Inorganics	Waterloo Inorganics, Waterloo, Ontario
Greg Pokocky	Manager - Inorganics	Waterloo Metals, Waterloo, Ontario
Jocelyn Kennedy	Department Manager - Semi-Volatile Organics	Waterloo Organics, Waterloo, Ontario
Sarah Birch	VOC Section Supervisor	Waterloo VOC, Waterloo, Ontario

General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO = Data Quality Objective.
LOR = Limit of Reporting (detection limit).
RPD = Relative Percent Difference
# = Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: **Soil/Solid**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Physical Tests (QC Lot: 1007270)											
WT2318379-027	Anonymous	Moisture	----	E144	0.25	%	7.04	7.01	0.398%	20%	----
Physical Tests (QC Lot: 1007622)											
WT2318379-011	Anonymous	pH (1:2 soil:CaCl2-aq)	----	E108A	0.10	pH units	9.66	9.66	0.00%	5%	----
Physical Tests (QC Lot: 1007675)											
WT2318542-003	Anonymous	Conductivity (1:2 leachate)	----	E100-L	5.00	µS/cm	1.29 mS/cm	1310	2.15%	20%	----
Physical Tests (QC Lot: 1008155)											
WT2317624-001	Anonymous	pH (1:2 soil:CaCl2-aq)	----	E108A	0.10	pH units	9.17	9.10	0.766%	5%	----
Physical Tests (QC Lot: 1008921)											
WT2315856-021	Anonymous	pH (1:2 soil:CaCl2-aq)	----	E108A	0.10	pH units	7.20	7.49	3.95%	5%	----
Physical Tests (QC Lot: 1009933)											
WT2318494-001	Anonymous	Oxidation-reduction potential [ORP]	----	E125	0.10	mV	237	225	5.19%	25%	----
Cyanides (QC Lot: 1007624)											
WT2318379-013	Anonymous	Cyanide, weak acid dissociable	----	E336A	0.050	mg/kg	<0.050	<0.050	0	Diff <2x LOR	----
Cyanides (QC Lot: 1008182)											
WT2318361-002	Anonymous	Cyanide, weak acid dissociable	----	E336A	0.050	mg/kg	<0.050	<0.050	0	Diff <2x LOR	----
Inorganics (QC Lot: 1009312)											
WT2318047-011	Anonymous	Sulfides, acid volatile	----	E396-L	0.23	mg/kg	0.36	0.53	0.17	Diff <2x LOR	----
Metals (QC Lot: 1007676)											
WT2318542-003	Anonymous	Calcium, soluble ion content	7440-70-2	E484	0.50	mg/L	8.28	9.80	16.8%	30%	----
		Magnesium, soluble ion content	7439-95-4	E484	0.50	mg/L	9.58	12.9	29.5%	30%	----
		Sodium, soluble ion content	17341-25-2	E484	0.50	mg/L	274	280	2.17%	30%	----
Metals (QC Lot: 1007677)											
WT2318542-003	Anonymous	Boron, hot water soluble	7440-42-8	E487	0.10	mg/kg	0.13	0.12	0.005	Diff <2x LOR	----
Metals (QC Lot: 1007678)											
WT2318542-003	Anonymous	Antimony	7440-36-0	E440C	0.10	mg/kg	0.14	0.15	0.007	Diff <2x LOR	----
		Arsenic	7440-38-2	E440C	0.10	mg/kg	2.83	3.04	7.25%	30%	----
		Barium	7440-39-3	E440C	0.50	mg/kg	47.0	49.7	5.49%	40%	----
		Beryllium	7440-41-7	E440C	0.10	mg/kg	0.36	0.39	0.03	Diff <2x LOR	----
		Boron	7440-42-8	E440C	5.0	mg/kg	<5.0	<5.0	0	Diff <2x LOR	----
		Cadmium	7440-43-9	E440C	0.020	mg/kg	0.167	0.174	3.65%	30%	----

Sub-Matrix: **Soil/Solid**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Metals (QC Lot: 1007678) - continued											
WT2318542-003	Anonymous	Chromium	7440-47-3	E440C	0.50	mg/kg	32.0	35.5	10.6%	30%	----
		Cobalt	7440-48-4	E440C	0.10	mg/kg	4.16	4.48	7.44%	30%	----
		Copper	7440-50-8	E440C	0.50	mg/kg	9.34	10.2	9.08%	30%	----
		Lead	7439-92-1	E440C	0.50	mg/kg	16.2	16.7	2.84%	40%	----
		Molybdenum	7439-98-7	E440C	0.10	mg/kg	0.38	0.40	0.02	Diff <2x LOR	----
		Nickel	7440-02-0	E440C	0.50	mg/kg	8.60	9.03	4.96%	30%	----
		Selenium	7782-49-2	E440C	0.20	mg/kg	<0.20	<0.20	0	Diff <2x LOR	----
		Silver	7440-22-4	E440C	0.10	mg/kg	<0.10	<0.10	0	Diff <2x LOR	----
		Thallium	7440-28-0	E440C	0.050	mg/kg	0.073	0.076	0.003	Diff <2x LOR	----
		Uranium	7440-61-1	E440C	0.050	mg/kg	0.391	0.373	4.64%	30%	----
		Vanadium	7440-62-2	E440C	0.20	mg/kg	25.7	27.0	4.75%	30%	----
		Zinc	7440-66-6	E440C	2.0	mg/kg	53.1	57.6	8.15%	30%	----
Metals (QC Lot: 1007679)											
WT2318542-003	Anonymous	Mercury	7439-97-6	E510C	0.0050	mg/kg	0.0478	0.0458	4.20%	40%	----
Speciated Metals (QC Lot: 1007623)											
WT2318379-012	Anonymous	Chromium, hexavalent [Cr VI]	18540-29-9	E532	0.10	mg/kg	<0.10	<0.10	0	Diff <2x LOR	----
Speciated Metals (QC Lot: 1007833)											
VA23B3347-018	Anonymous	Chromium, hexavalent [Cr VI]	18540-29-9	E532	0.10	mg/kg	0.47	0.56	0.09	Diff <2x LOR	----
Leachable Anions & Nutrients (QC Lot: 1015823)											
WT2318494-001	Anonymous	Sulfate, soluble ion content	14808-79-8	E236.SO4	20	mg/kg	125	125	0.1	Diff <2x LOR	----
Leachable Anions & Nutrients (QC Lot: 1015824)											
WT2318494-001	Anonymous	Chloride, soluble ion content	16887-00-6	E236.Cl	5.0	mg/kg	256	269	5.07%	30%	----
Volatile Organic Compounds (QC Lot: 1010007)											
TY2305907-001	Anonymous	Benzene	71-43-2	E611A	0.0050	mg/kg	<0.0050	<0.0050	0	Diff <2x LOR	----
		Ethylbenzene	100-41-4	E611A	0.015	mg/kg	<0.015	<0.015	0	Diff <2x LOR	----
		Toluene	108-88-3	E611A	0.050	mg/kg	<0.050	<0.050	0	Diff <2x LOR	----
		Xylene, m+p-	179601-23-1	E611A	0.030	mg/kg	<0.030	<0.030	0	Diff <2x LOR	----
		Xylene, o-	95-47-6	E611A	0.030	mg/kg	<0.030	<0.030	0	Diff <2x LOR	----
Volatile Organic Compounds (QC Lot: 1011443)											
WT2318816-009	Anonymous	Benzene	71-43-2	E611A	0.0050	mg/kg	<0.0050	<0.0050	0	Diff <2x LOR	----
		Ethylbenzene	100-41-4	E611A	0.015	mg/kg	<0.015	<0.015	0	Diff <2x LOR	----
		Toluene	108-88-3	E611A	0.050	mg/kg	<0.050	<0.050	0	Diff <2x LOR	----
		Xylene, m+p-	179601-23-1	E611A	0.030	mg/kg	<0.030	<0.030	0	Diff <2x LOR	----
		Xylene, o-	95-47-6	E611A	0.030	mg/kg	<0.030	<0.030	0	Diff <2x LOR	----

Sub-Matrix: **Soil/Solid**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Hydrocarbons (QC Lot: 1007625)											
WT2318379-014	Anonymous	F2 (C10-C16)	----	E601.SG-L	10	mg/kg	19	11	8	Diff <2x LOR	----
		F3 (C16-C34)	----	E601.SG-L	50	mg/kg	89	56	33	Diff <2x LOR	----
		F4 (C34-C50)	----	E601.SG-L	50	mg/kg	94	51	42	Diff <2x LOR	----
Hydrocarbons (QC Lot: 1008153)											
WT2318117-001	Anonymous	F2 (C10-C16)	----	E601.SG-L	10	mg/kg	<10 µg/g	<10	0	Diff <2x LOR	----
		F3 (C16-C34)	----	E601.SG-L	50	mg/kg	<50 µg/g	<50	0	Diff <2x LOR	----
		F4 (C34-C50)	----	E601.SG-L	50	mg/kg	<50 µg/g	<50	0	Diff <2x LOR	----
Hydrocarbons (QC Lot: 1010008)											
TY2305907-001	Anonymous	F1 (C6-C10)	----	E581.F1	5.0	mg/kg	<5.0	<5.0	0	Diff <2x LOR	----
Hydrocarbons (QC Lot: 1011444)											
WT2318816-009	Anonymous	F1 (C6-C10)	----	E581.F1	5.0	mg/kg	<5.0	<5.0	0	Diff <2x LOR	----

Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: **Soil/Solid**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests (QCLot: 1007270)						
Moisture	----	E144	0.25	%	<0.25	----
Physical Tests (QCLot: 1007675)						
Conductivity (1:2 leachate)	----	E100-L	5	µS/cm	<5.00	----
Physical Tests (QCLot: 1007682)						
Moisture	----	E144	0.25	%	<0.25	----
Cyanides (QCLot: 1007624)						
Cyanide, weak acid dissociable	----	E336A	0.05	mg/kg	<0.050	----
Cyanides (QCLot: 1008182)						
Cyanide, weak acid dissociable	----	E336A	0.05	mg/kg	<0.050	----
Inorganics (QCLot: 1009312)						
Sulfides, acid volatile	----	E396-L	0.2	mg/kg	<0.20	----
Metals (QCLot: 1007676)						
Calcium, soluble ion content	7440-70-2	E484	0.5	mg/L	<0.50	----
Magnesium, soluble ion content	7439-95-4	E484	0.5	mg/L	<0.50	----
Sodium, soluble ion content	17341-25-2	E484	0.5	mg/L	<0.50	----
Metals (QCLot: 1007677)						
Boron, hot water soluble	7440-42-8	E487	0.1	mg/kg	<0.10	----
Metals (QCLot: 1007678)						
Antimony	7440-36-0	E440C	0.1	mg/kg	<0.10	----
Arsenic	7440-38-2	E440C	0.1	mg/kg	<0.10	----
Barium	7440-39-3	E440C	0.5	mg/kg	<0.50	----
Beryllium	7440-41-7	E440C	0.1	mg/kg	<0.10	----
Boron	7440-42-8	E440C	5	mg/kg	<5.0	----
Cadmium	7440-43-9	E440C	0.02	mg/kg	<0.020	----
Chromium	7440-47-3	E440C	0.5	mg/kg	<0.50	----
Cobalt	7440-48-4	E440C	0.1	mg/kg	<0.10	----
Copper	7440-50-8	E440C	0.5	mg/kg	<0.50	----
Lead	7439-92-1	E440C	0.5	mg/kg	<0.50	----
Molybdenum	7439-98-7	E440C	0.1	mg/kg	<0.10	----
Nickel	7440-02-0	E440C	0.5	mg/kg	<0.50	----
Selenium	7782-49-2	E440C	0.2	mg/kg	<0.20	----
Silver	7440-22-4	E440C	0.1	mg/kg	<0.10	----

Sub-Matrix: **Soil/Solid**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Metals (QCLot: 1007678) - continued						
Thallium	7440-28-0	E440C	0.05	mg/kg	<0.050	----
Uranium	7440-61-1	E440C	0.05	mg/kg	<0.050	----
Vanadium	7440-62-2	E440C	0.2	mg/kg	<0.20	----
Zinc	7440-66-6	E440C	2	mg/kg	<2.0	----
Metals (QCLot: 1007679)						
Mercury	7439-97-6	E510C	0.005	mg/kg	<0.0050	----
Speciated Metals (QCLot: 1007623)						
Chromium, hexavalent [Cr VI]	18540-29-9	E532	0.1	mg/kg	<0.10	----
Speciated Metals (QCLot: 1007833)						
Chromium, hexavalent [Cr VI]	18540-29-9	E532	0.1	mg/kg	<0.10	----
Leachable Anions & Nutrients (QCLot: 1015823)						
Sulfate, soluble ion content	14808-79-8	E236.SO4	20	mg/kg	<20	----
Leachable Anions & Nutrients (QCLot: 1015824)						
Chloride, soluble ion content	16887-00-6	E236.Cl	5	mg/kg	<5.0	----
Volatile Organic Compounds (QCLot: 1010007)						
Benzene	71-43-2	E611A	0.005	mg/kg	<0.0050	----
Ethylbenzene	100-41-4	E611A	0.015	mg/kg	<0.015	----
Toluene	108-88-3	E611A	0.05	mg/kg	<0.050	----
Xylene, m+p-	179601-23-1	E611A	0.03	mg/kg	<0.030	----
Xylene, o-	95-47-6	E611A	0.03	mg/kg	<0.030	----
Volatile Organic Compounds (QCLot: 1011443)						
Benzene	71-43-2	E611A	0.005	mg/kg	<0.0050	----
Ethylbenzene	100-41-4	E611A	0.015	mg/kg	<0.015	----
Toluene	108-88-3	E611A	0.05	mg/kg	<0.050	----
Xylene, m+p-	179601-23-1	E611A	0.03	mg/kg	<0.030	----
Xylene, o-	95-47-6	E611A	0.03	mg/kg	<0.030	----
Hydrocarbons (QCLot: 1007625)						
F2 (C10-C16)	----	E601.SG-L	10	mg/kg	<10	----
F3 (C16-C34)	----	E601.SG-L	50	mg/kg	<50	----
F4 (C34-C50)	----	E601.SG-L	50	mg/kg	<50	----
Hydrocarbons (QCLot: 1008153)						
F2 (C10-C16)	----	E601.SG-L	10	mg/kg	<10	----
F3 (C16-C34)	----	E601.SG-L	50	mg/kg	<50	----
F4 (C34-C50)	----	E601.SG-L	50	mg/kg	<50	----
Hydrocarbons (QCLot: 1010008)						

Sub-Matrix: **Soil/Solid**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Hydrocarbons (QCLot: 1010008) - continued						
F1 (C6-C10)	----	E581.F1	5	mg/kg	<5.0	----
Hydrocarbons (QCLot: 1011444)						
F1 (C6-C10)	----	E581.F1	5	mg/kg	<5.0	----
Hydrocarbons (QCLot: 1017844)						
F4G-sg	----	E601.F4G-L	250	mg/kg	<250	----

Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: **Soil/Solid**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Physical Tests (QCLot: 1007270)									
Moisture	----	E144	0.25	%	50 %	99.8	90.0	110	----
Physical Tests (QCLot: 1007622)									
pH (1:2 soil:CaCl2-aq)	----	E108A	----	pH units	7 pH units	100	98.0	102	----
Physical Tests (QCLot: 1007675)									
Conductivity (1:2 leachate)	----	E100-L	5	µS/cm	1409 µS/cm	96.2	90.0	110	----
Physical Tests (QCLot: 1007682)									
Moisture	----	E144	0.25	%	50 %	100	90.0	110	----
Physical Tests (QCLot: 1008155)									
pH (1:2 soil:CaCl2-aq)	----	E108A	----	pH units	7 pH units	100	98.0	102	----
Physical Tests (QCLot: 1008921)									
pH (1:2 soil:CaCl2-aq)	----	E108A	----	pH units	7 pH units	99.8	98.0	102	----
Cyanides (QCLot: 1007624)									
Cyanide, weak acid dissociable	----	E336A	0.05	mg/kg	1.25 mg/kg	97.8	80.0	120	----
Cyanides (QCLot: 1008182)									
Cyanide, weak acid dissociable	----	E336A	0.05	mg/kg	1.25 mg/kg	98.4	80.0	120	----
Inorganics (QCLot: 1009312)									
Sulfides, acid volatile	----	E396-L	0.2	mg/kg	2.376 mg/kg	87.5	70.0	130	----
Metals (QCLot: 1007676)									
Calcium, soluble ion content	7440-70-2	E484	0.5	mg/L	300 mg/L	106	80.0	120	----
Magnesium, soluble ion content	7439-95-4	E484	0.5	mg/L	50 mg/L	102	80.0	120	----
Sodium, soluble ion content	17341-25-2	E484	0.5	mg/L	50 mg/L	104	80.0	120	----
Metals (QCLot: 1007677)									
Boron, hot water soluble	7440-42-8	E487	0.1	mg/kg	1.33333 mg/kg	104	70.0	130	----
Metals (QCLot: 1007678)									
Antimony	7440-36-0	E440C	0.1	mg/kg	100 mg/kg	93.5	80.0	120	----
Arsenic	7440-38-2	E440C	0.1	mg/kg	100 mg/kg	92.2	80.0	120	----
Barium	7440-39-3	E440C	0.5	mg/kg	25 mg/kg	88.4	80.0	120	----
Beryllium	7440-41-7	E440C	0.1	mg/kg	10 mg/kg	83.6	80.0	120	----
Boron	7440-42-8	E440C	5	mg/kg	100 mg/kg	84.3	80.0	120	----

Sub-Matrix: **Soil/Solid**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Metals (QCLot: 1007678) - continued									
Cadmium	7440-43-9	E440C	0.02	mg/kg	10 mg/kg	88.5	80.0	120	----
Chromium	7440-47-3	E440C	0.5	mg/kg	25 mg/kg	86.1	80.0	120	----
Cobalt	7440-48-4	E440C	0.1	mg/kg	25 mg/kg	86.4	80.0	120	----
Copper	7440-50-8	E440C	0.5	mg/kg	25 mg/kg	87.2	80.0	120	----
Lead	7439-92-1	E440C	0.5	mg/kg	50 mg/kg	92.1	80.0	120	----
Molybdenum	7439-98-7	E440C	0.1	mg/kg	25 mg/kg	90.9	80.0	120	----
Nickel	7440-02-0	E440C	0.5	mg/kg	50 mg/kg	87.0	80.0	120	----
Selenium	7782-49-2	E440C	0.2	mg/kg	100 mg/kg	92.1	80.0	120	----
Silver	7440-22-4	E440C	0.1	mg/kg	10 mg/kg	83.9	80.0	120	----
Thallium	7440-28-0	E440C	0.05	mg/kg	100 mg/kg	92.6	80.0	120	----
Uranium	7440-61-1	E440C	0.05	mg/kg	0.5 mg/kg	89.1	80.0	120	----
Vanadium	7440-62-2	E440C	0.2	mg/kg	50 mg/kg	88.1	80.0	120	----
Zinc	7440-66-6	E440C	2	mg/kg	50 mg/kg	88.9	80.0	120	----
Metals (QCLot: 1007679)									
Mercury	7439-97-6	E510C	0.005	mg/kg	0.1 mg/kg	118	80.0	120	----
Speciated Metals (QCLot: 1007623)									
Chromium, hexavalent [Cr VI]	18540-29-9	E532	0.1	mg/kg	0.8 mg/kg	96.1	80.0	120	----
Speciated Metals (QCLot: 1007833)									
Chromium, hexavalent [Cr VI]	18540-29-9	E532	0.1	mg/kg	0.8 mg/kg	92.1	80.0	120	----
Leachable Anions & Nutrients (QCLot: 1015823)									
Sulfate, soluble ion content	14808-79-8	E236.SO4	20	mg/kg	5000 mg/kg	101	80.0	120	----
Leachable Anions & Nutrients (QCLot: 1015824)									
Chloride, soluble ion content	16887-00-6	E236.Cl	5	mg/kg	5000 mg/kg	99.5	80.0	120	----
Volatile Organic Compounds (QCLot: 1010007)									
Benzene	71-43-2	E611A	0.005	mg/kg	3.475 mg/kg	103	70.0	130	----
Ethylbenzene	100-41-4	E611A	0.015	mg/kg	3.475 mg/kg	105	70.0	130	----
Toluene	108-88-3	E611A	0.05	mg/kg	3.475 mg/kg	106	70.0	130	----
Xylene, m+p-	179601-23-1	E611A	0.03	mg/kg	6.95 mg/kg	101	70.0	130	----
Xylene, o-	95-47-6	E611A	0.03	mg/kg	3.475 mg/kg	104	70.0	130	----
Volatile Organic Compounds (QCLot: 1011443)									
Benzene	71-43-2	E611A	0.005	mg/kg	3.475 mg/kg	90.7	70.0	130	----
Ethylbenzene	100-41-4	E611A	0.015	mg/kg	3.475 mg/kg	101	70.0	130	----
Toluene	108-88-3	E611A	0.05	mg/kg	3.475 mg/kg	101	70.0	130	----

Sub-Matrix: **Soil/Solid**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Volatile Organic Compounds (QCLot: 1011443) - continued									
Xylene, m+p-	179601-23-1	E611A	0.03	mg/kg	6.95 mg/kg	101	70.0	130	----
Xylene, o-	95-47-6	E611A	0.03	mg/kg	3.475 mg/kg	104	70.0	130	----
Hydrocarbons (QCLot: 1007625)									
F2 (C10-C16)	----	E601.SG-L	10	mg/kg	821.775 mg/kg	101	70.0	130	----
F3 (C16-C34)	----	E601.SG-L	50	mg/kg	1151.486 mg/kg	108	70.0	130	----
F4 (C34-C50)	----	E601.SG-L	50	mg/kg	719.6893 mg/kg	105	70.0	130	----
Hydrocarbons (QCLot: 1008153)									
F2 (C10-C16)	----	E601.SG-L	10	mg/kg	821.775 mg/kg	108	70.0	130	----
F3 (C16-C34)	----	E601.SG-L	50	mg/kg	1151.486 mg/kg	119	70.0	130	----
F4 (C34-C50)	----	E601.SG-L	50	mg/kg	719.6893 mg/kg	114	70.0	130	----
Hydrocarbons (QCLot: 1010008)									
F1 (C6-C10)	----	E581.F1	5	mg/kg	69.1875 mg/kg	108	80.0	120	----
Hydrocarbons (QCLot: 1011444)									
F1 (C6-C10)	----	E581.F1	5	mg/kg	69.1875 mg/kg	109	80.0	120	----
Hydrocarbons (QCLot: 1017844)									
F4G-sg	----	E601.F4G-L	250	mg/kg	1298.6 mg/kg	89.8	70.0	130	----

Matrix Spike (MS) Report

A Matrix Spike (MS) is a randomly selected intra-laboratory replicate sample that has been fortified (spiked) with test analytes at known concentration, and processed in an identical manner to test samples. Matrix Spikes provide information regarding analyte recovery and potential matrix effects. MS DQO exceedances due to sample matrix may sometimes be unavoidable; in such cases, test results for the associated sample (or similar samples) may be subject to bias. ND – Recovery not determined, background level >= 1x spike level.

Sub-Matrix: **Soil/Solid**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Cyanides (QCLot: 1007624)										
WT2318379-013	Anonymous	Cyanide, weak acid dissociable	----	E336A	1.29 mg/kg	1.25 mg/kg	104	70.0	130	----
Cyanides (QCLot: 1008182)										
WT2318361-002	Anonymous	Cyanide, weak acid dissociable	----	E336A	1.24 mg/kg	1.25 mg/kg	101	70.0	130	----
Volatile Organic Compounds (QCLot: 1010007)										
TY2305907-001	Anonymous	Benzene	71-43-2	E611A	2.66 mg/kg	3.125 mg/kg	103	60.0	140	----
		Ethylbenzene	100-41-4	E611A	2.63 mg/kg	3.125 mg/kg	102	60.0	140	----
		Toluene	108-88-3	E611A	2.66 mg/kg	3.125 mg/kg	103	60.0	140	----
		Xylene, m+p-	179601-23-1	E611A	5.05 mg/kg	6.25 mg/kg	97.8	60.0	140	----
		Xylene, o-	95-47-6	E611A	2.61 mg/kg	3.125 mg/kg	101	60.0	140	----
Volatile Organic Compounds (QCLot: 1011443)										
WT2318816-009	Anonymous	Benzene	71-43-2	E611A	1.75 mg/kg	3.125 mg/kg	92.0	60.0	140	----
		Ethylbenzene	100-41-4	E611A	1.81 mg/kg	3.125 mg/kg	95.2	60.0	140	----
		Toluene	108-88-3	E611A	1.81 mg/kg	3.125 mg/kg	95.0	60.0	140	----
		Xylene, m+p-	179601-23-1	E611A	3.87 mg/kg	6.25 mg/kg	102	60.0	140	----
		Xylene, o-	95-47-6	E611A	1.92 mg/kg	3.125 mg/kg	101	60.0	140	----
Hydrocarbons (QCLot: 1007625)										
WT2318379-014	Anonymous	F2 (C10-C16)	----	E601.SG-L	642 mg/kg	821.775 mg/kg	100	60.0	140	----
		F3 (C16-C34)	----	E601.SG-L	1350 mg/kg	1151.486 mg/kg	151	60.0	140	E
		F4 (C34-C50)	----	E601.SG-L	735 mg/kg	719.6893 mg/kg	131	60.0	140	----
Hydrocarbons (QCLot: 1008153)										
WT2318117-001	Anonymous	F2 (C10-C16)	----	E601.SG-L	714 mg/kg	821.775 mg/kg	104	60.0	140	----
		F3 (C16-C34)	----	E601.SG-L	1130 mg/kg	1151.486 mg/kg	117	60.0	140	----
		F4 (C34-C50)	----	E601.SG-L	677 mg/kg	719.6893 mg/kg	113	60.0	140	----
Hydrocarbons (QCLot: 1010008)										
TY2305907-001	Anonymous	F1 (C6-C10)	----	E581.F1	47.0 mg/kg	62.5 mg/kg	91.0	60.0	140	----
Hydrocarbons (QCLot: 1011444)										
WT2318816-009	Anonymous	F1 (C6-C10)	----	E581.F1	40.8 mg/kg	62.5 mg/kg	107	60.0	140	----

Qualifiers

Qualifier	Description
E	Matrix Spike recovery outside ALS DQO due to heterogeneous analyte background in sample.

Reference Material (RM) Report

A Reference Material (RM) is a homogenous material with known and well-established analyte concentrations. RMs are processed in an identical manner to test samples, and are used to monitor and control the accuracy and precision of a test method for a typical sample matrix. RM results are expressed as percent recovery of the target analyte concentration. RM targets may be certified target concentrations provided by the RM supplier, or may be ALS long-term mean values (for empirical test methods).

Sub-Matrix:

					Reference Material (RM) Report				
					RM Target	Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Reference Material ID	Analyte	CAS Number	Method	Concentration	RM	Low	High	Qualifier
Physical Tests (QCLot: 1007675)									
	RM	Conductivity (1:2 leachate)	----	E100-L	2168 µS/cm	95.0	70.0	130	----
Physical Tests (QCLot: 1009933)									
	RM	Oxidation-reduction potential [ORP]	----	E125	475 mV	95.8	90.0	110	----
Metals (QCLot: 1007676)									
	RM	Calcium, soluble ion content	7440-70-2	E484	82.58 mg/L	102	70.0	130	----
	RM	Magnesium, soluble ion content	7439-95-4	E484	25.79 mg/L	103	70.0	130	----
	RM	Sodium, soluble ion content	17341-25-2	E484	103.41 mg/L	102	70.0	130	----
Metals (QCLot: 1007677)									
	RM	Boron, hot water soluble	7440-42-8	E487	1.971 mg/kg	99.4	60.0	140	----
Metals (QCLot: 1007678)									
	RM	Antimony	7440-36-0	E440C	3.99 mg/kg	113	70.0	130	----
	RM	Arsenic	7440-38-2	E440C	3.73 mg/kg	102	70.0	130	----
	RM	Barium	7440-39-3	E440C	105 mg/kg	106	70.0	130	----
	RM	Beryllium	7440-41-7	E440C	0.349 mg/kg	96.2	70.0	130	----
	RM	Boron	7440-42-8	E440C	8.5 mg/kg	116	70.0	130	----
	RM	Cadmium	7440-43-9	E440C	0.91 mg/kg	108	70.0	130	----
	RM	Chromium	7440-47-3	E440C	101 mg/kg	106	70.0	130	----
	RM	Cobalt	7440-48-4	E440C	6.9 mg/kg	103	70.0	130	----
	RM	Copper	7440-50-8	E440C	123 mg/kg	100	70.0	130	----
	RM	Lead	7439-92-1	E440C	267 mg/kg	108	70.0	130	----
	RM	Molybdenum	7439-98-7	E440C	1.03 mg/kg	# 136	70.0	130	MES
	RM	Nickel	7440-02-0	E440C	26.7 mg/kg	107	70.0	130	----
	RM	Silver	7440-22-4	E440C	4.06 mg/kg	94.2	70.0	130	----
	RM	Thallium	7440-28-0	E440C	0.0786 mg/kg	110	70.0	130	----
	RM	Uranium	7440-61-1	E440C	0.52 mg/kg	113	70.0	130	----
	RM	Vanadium	7440-62-2	E440C	32.7 mg/kg	104	70.0	130	----
	RM	Zinc	7440-66-6	E440C	297 mg/kg	103	70.0	130	----
Metals (QCLot: 1007679)									

Sub-Matrix:

Laboratory sample ID	Reference Material ID	Analyte	CAS Number	Method	Reference Material (RM) Report: RM Target Concentration	Recovery (%): RM	Recovery Limits (%): Low	Recovery Limits (%): High	Qualifier
Metals (QCLot: 1007679) - continued									
	RM	Mercury	7439-97-6	E510C	0.0585 mg/kg	107	70.0	130	----
Speciated Metals (QCLot: 1007623)									
	RM	Chromium, hexavalent [Cr VI]	18540-29-9	E532	172 mg/kg	96.4	70.0	130	----
Speciated Metals (QCLot: 1007833)									
	RM	Chromium, hexavalent [Cr VI]	18540-29-9	E532	172 mg/kg	90.6	70.0	130	----
Leachable Anions & Nutrients (QCLot: 1015823)									
	RM	Sulfate, soluble ion content	14808-79-8	E236.SO4	1070 mg/kg	113	70.0	130	----
Leachable Anions & Nutrients (QCLot: 1015824)									
	RM	Chloride, soluble ion content	16887-00-6	E236.Cl	432 mg/kg	102	70.0	130	----

Qualifiers

Qualifier	Description
MES	*Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).*

Chain of Custody (COC) / Analytical Request Form

COC Number: 20 -

Page 2 of 2

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Canada Toll Free: 1 800 668 9878

Environmental Division Waterloo

Work Order Reference WT2318555

Telephone : +1 519 886 6910

Report To	Contact and company name below will appear on the final report
Company:	CVD Engineering
Contact:	Brianna Cobbe
Phone:	(519) 505-6180
	Company address below will appear on the final report
Street:	311 Victoria St. N.
City/Province:	Kitchener, ON
Postal Code:	N2H 5E1
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Reports / Recipients

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)

Merge QC/QCI Reports with COA ☑ YES ☐ NO ☐ N/A

☑ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: brianna.cobbe@cvdengineering.com

Email 2: nandou.zhao@cvdengineering.com

Email 3:

Invoice Recipients

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax:

Email 2:

Turnaround Time (TAT) Requested

☑ Routine [R] if received by 3pm M-F - no surcharges apply

☐ 4 day [P4] if received by 3pm M-F - 20% rush surcharge minimum

☐ 3 day [P3] if received by 3pm M-F - 25% rush surcharge minimum

☐ 2 day [P2] if received by 3pm M-F - 50% rush surcharge minimum

☐ 1 day [E] if received by 3pm M-F - 100% rush surcharge minimum

☐ Same day [E2] if received by 10am M-S - 200% rush surcharge. Additional fees may apply to rush requests on weekends, statutory holidays and non-routine tests.

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm am/pm

For all tests with rush TATs requested, please contact your AM to confirm availability.

Project Information

ALS Account # / Quote #: Q84362

Job #: 1073

PO / AFE:

LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: PO#:

Major/Minor Code: Routing Code:

Requisitioner:

Location:

ALS Lab Work Order # (ALS use only): WT2318555 FHA

ALS Contact: AM Sampler: EP

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Excess Soils 1	Corrosivity	SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)
	BH1-SA2	19-Jun-23		Soil	3	✓				
	BH2-SA1	20-Jun-23			3	✓				
	BH3-SA3	14-Jun-23			3	✓				
	BH4-SA1	15-Jun-23			3	✓				
	BH2-SA3	20-Jun-23			1		✓			
	BH4-SA3	15-Jun-23			1		✓			

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human consumption/ use? ☐ YES ☑ NO

Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)

O.Reg.406/19 Table 1 RPIICC
Table 2.1 RPI/ICC

SAMPLE RECEIPT DETAILS (ALS use only)

Cooling Method: ☑ NONE ☐ ICE ☐ ICE PACKS ☐ FROZEN ☐ COOLING INITIATED

Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO

Cooler Custody Seals Intact: ☐ YES ☑ N/A Sample Custody Seals Intact: ☐ YES ☑ N/A

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				16.9			

SHIPMENT RELEASE (client use)

Released by: [signature] Date: June 23, 2023 Time:

INITIAL SHIPMENT RECEPTION (ALS use only)

Received by: Date: Time:

FINAL SHIPMENT RECEPTION (ALS use only)

Received by: [signature] Date: Jun 23/23 Time: 13:00

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

AUG 2020 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

VS-097
SOL-019 EC

APPENDIX C

COMPARISON OF THE SOIL CHEMISTRY RESULTS TO THE APPLICABLE REGULATORY CRITERIA

ANALYTICAL RESULTS FOR SOIL

MECP Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act, December 17, 2020 (O.Reg. 406/19)

		Table 1 Residential/ Parkland/ Institutional/ Industrial/ Commercial/ Community Property Use Standard	Table 2.1 Residential/ Parkland/ Institutional Property Use Standard	Table 2.1 Industrial/ Commercial/ Community Property Use Standard	BH 1 - SA 2	BH 2 - SA 1	BH 3 - SA 3	BH 4 - SA 1
Metals & Inorganics	Conductivity (mS/cm)	0.57	0.7	1.4	0.0803	0.147	0.375	0.717
	% Moisture (%)	-	-	-	6.28	7.97	12.4	10.8
	pH (pH units)	-	-	-	8.01	7.43	7.84	7.84
	Cyanide, Weak Acid Diss. (mg/kg)	0.051	0.051	0.051	<0.050	<0.050	<0.050	<0.050
	Sodium Adsorption Ratio (SAR)	2.4	5	12	0.31	0.23	10.1	11.6
	Antimony (Sb)	1.3	7.5	40	<0.10	0.18	<0.10	0.31
	Arsenic (As)	18	18	18	1.46	2.64	1.98	3.93
	Barium (Ba)	220	390	670	9.26	50.5	10.8	270
	Beryllium (Be)	2.5	4	8	0.12	0.27	0.16	0.31
	Boron (B)	36	120	120	<5.0	<5.0	5.5	<5.0
	Boron (B), Hot Water Ext. Available	-	1.5	2	<0.10	0.17	<0.10	0.28
	Cadmium (Cd)	1.2	1.2	1.9	0.094	0.278	0.092	0.292
	Chromium (Cr)	70	160	160	6.88	11.6	7.96	18.4
	Cobalt (Co)	21	22	80	1.98	3.49	2.69	3.20
	Copper (Cu)	92	140	230	3.91	7.72	8.37	13.7
	Lead (Pb)	120	120	120	5.17	50.9	6.04	127
	Mercury (Hg)	0.27	0.27	0.27	<0.0050	0.127	0.0081	0.0872
	Molybdenum (Mo)	2	6.9	40	0.22	0.29	0.27	0.35
	Nickel (Ni)	82	100	270	3.86	6.40	5.34	8.16
	Selenium (Se)	1.5	2.4	5.5	<0.20	0.23	<0.20	0.22
	Silver (Ag)	0.5	20	40	<0.10	<0.10	<0.10	0.17
	Thallium (Tl)	1	1	3.3	<0.050	0.075	<0.050	0.090
	Uranium (U)	2.5	23	33	0.408	0.362	0.484	0.357
	Vanadium (V)	86	86	86	17.7	22.0	18.5	18.8
	Zinc (Zn)	290	340	340	39.3	85.5	38.3	186
	Chromium, Hexavalent	0.66	8	8	<0.10	<0.10	<0.10	0.35
Petroleum Hydrocarbons F1-F4	F1 (C6-C10)	25	25	25	<5	<5	<5	<5.0
	F1 (C6 to C10) minus BTEX	25	25	25	<5	<5	<5	<5.0
	F2 (C10-C16)	10	10	26	<10	<10	<10	<10
	F3 (C16-C34)	240	240	240	<50	<50	<50	96
	F4 (C34-C50)	120	2800	3300	<50	<50	<50	172
BTEX	Benzene	0.02	0.02	0.02	<0.0050	<0.0050	<0.0050	<0.0050
	Ethylbenzene	0.05	0.05	0.05	<0.015	<0.015	<0.015	<0.015
	Toluene	0.2	0.2	0.2	<0.050	<0.050	<0.050	<0.050
	Xylenes (Total)	0.05	0.091	0.091	<0.050	<0.050	<0.050	<0.050

NOTES:

1. Units = mg/kg
2. "-" - Paramater not included in chemical analysis
3. "nv" - no value
4. Test results shown in highlighted text exceed the Table 1 Standard for Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use
5. Test results shown in highlighted text exceed the Table 2.1 Standard for Volume Independent Soil for Residential/Parkland/Institutional Property Use
6. Test results shown in highlighted text exceed the Table 2.1 Standard for Volume Independent Soil for Industrial/Commercial/Community Property Use

APPENDIX D

SLUG TEST ANALYSIS REPORTS

CHUNG & VANDER DOELEN
ENGINEERING LTD.
311 Victoria Street North
Kitchener / Ontario / N2H 5E1
519-742-8979

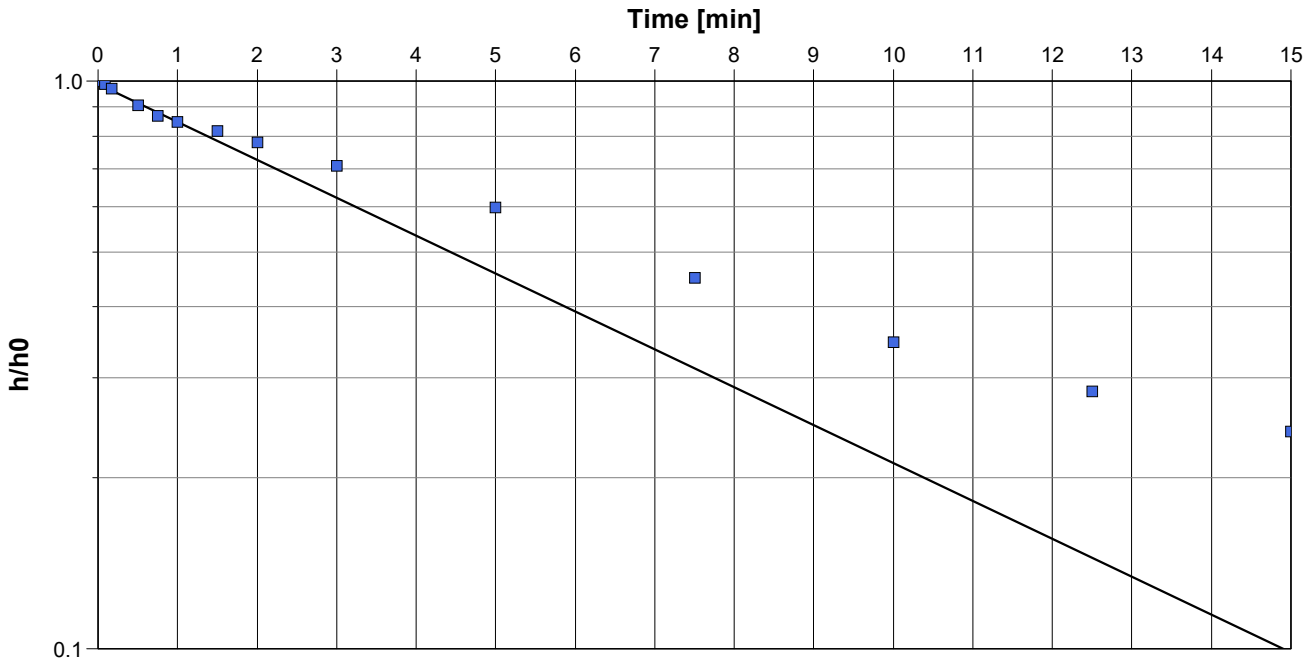
Project: Proposed 25-Storey Residential Building

Number: 1073

Client: 14688210 Canada Inc.

Location: 177 & 179 Albert Street, Waterloo, Ontario	Response Test: BH 1	Test Well: BH 1
Test Conducted by: Y.C.	Test Date: 2023-07-04	Aquifer Thickness: 1.80 m
Water level at t=0 [m]: 6.50	Static Water Level [m]: 5.22	Water level change at t=0 [m]: 1.28

	Time [min]	Water Level [m]	WL Change [m]
1	0	6.50	1.278
2	0.0833	6.485	1.263
3	0.1667	6.46	1.238
4	0.5	6.38	1.158
5	0.75	6.332	1.11
6	1	6.305	1.083
7	1.5	6.265	1.043
8	2	6.218	0.996
9	3	6.127	0.905
10	5	5.988	0.766
11	7.5	5.798	0.576
12	10	5.665	0.443
13	12.5	5.585	0.363
14	15	5.53	0.308



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH 1	1.53×10^{-6}	

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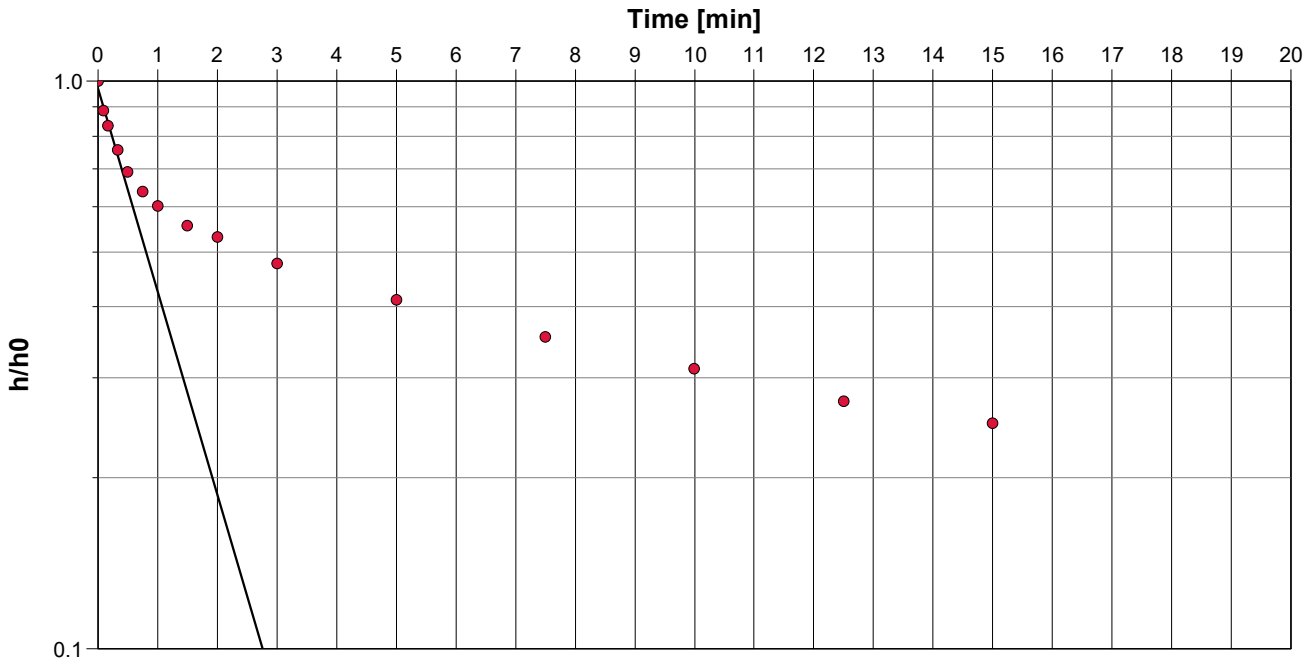
Project: Proposed 25-Storey Residential Building

Number: 1073

Client: 14688210 Canada Inc.

Location: 177 & 179 Albert Street, Waterloo, Ontario	Response Test: BH 3	Test Well: BH 3
Test Conducted by: Y.C.	Test Date: 2023-07-04	Aquifer Thickness: 6.35 m
Water level at t=0 [m]: 6.50	Static Water Level [m]: 4.98	Water level change at t=0 [m]: 1.52

	Time [min]	Water Level [m]	WL Change [m]
1	0	6.50	1.52
2	0.0833	6.33	1.35
3	0.1667	6.25	1.27
4	0.3333	6.13	1.15
5	0.5	6.03	1.05
6	0.75	5.95	0.97
7	1	5.895	0.915
8	1.5	5.825	0.845
9	2	5.788	0.808
10	3	5.705	0.725
11	5	5.605	0.625
12	7.5	5.518	0.538
13	10	5.454	0.474
14	12.5	5.395	0.415
15	15	5.36	0.38



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH 3	9.28×10^{-6}	

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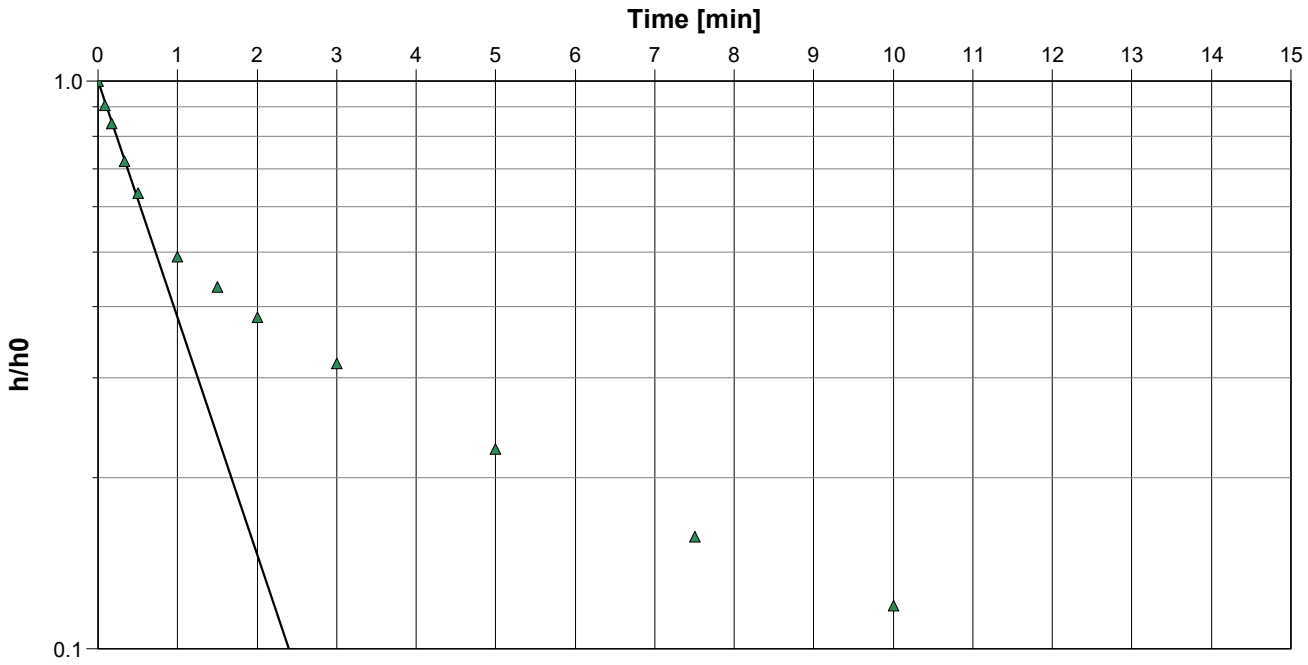
Project: Proposed 25-Storey Residential Building

Number: 1073

Client: 14688210 Canada Inc.

Location: 177 & 179 Albert Street, Waterloo, Ontario	Response Test: BH 4	Test Well: BH 4
Test Conducted by: Y.C.	Test Date: 2023-07-04	Aquifer Thickness: 4.80 m
Water level at t=0 [m]: 4.50	Static Water Level [m]: 3.75	Water level change at t=0 [m]: 0.75

	Time [min]	Water Level [m]	WL Change [m]
1	0	4.50	0.755
2	0.0833	4.43	0.685
3	0.1667	4.38	0.635
4	0.3333	4.29	0.545
5	0.5	4.225	0.48
6	1	4.115	0.37
7	1.5	4.073	0.328
8	2	4.035	0.29
9	3	3.985	0.24
10	5	3.915	0.17
11	7.5	3.864	0.119
12	10	3.835	0.09
13	12.5	3.808	0.063
14	15	3.78	0.035



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH 4	6.86×10^{-6}	

ENCLOSURES

Soil Abbreviations and Terms Used on Record of Borehole Sheets

TERMINOLOGY DESCRIBING COMMON SOIL TYPES:

Topsoil	-	mixture of soil and humus capable of supporting vegetation
Peat	-	mixture of visible and invisible fragments of decayed organic matter
Till	-	unstratified glacial deposit which may range from clay to boulders
Fill	-	soil materials identified as being placed anthropologically

CLASSIFICATION (UNIFIED SYSTEM)

Clay	<0.002mm		
Silt	0.002 to .075mm		
Sand	0.075 to 4.75mm		
		Fine	0.075 to 0.425 mm
		Medium	0.425 to 2.0 mm
		Coarse	2.0 to 4.75 mm
Gravel	4.75 to 75mm		
		Fine	4.75 to 19 mm
		Coarse	19 to 75 mm
Cobbles	75 to 300mm		
Boulders	>300mm		

TERMINOLOGY

Soil Composition	**% by Weight**
"traces"	<10%
"some"(eg. some silt)	10-20%
Adjective (eg. sandy)	20-35%
"and"(eg. sand and gravel)	35-50%

Standard Penetration Resistance (SPT): Standard Penetration Resistance ('N' Values) refers to the number of blows required to advance a standard (ASTM D1586) 51 mm Ø (2 inch) split-spoon sampler by the use of a free falling, 63.5 Kg (140lbs) hammer. The number of blows from the drop weight is recorded for every 15 cm (6 inches). The hammer is dropped from a distance of 0.76m (30 inches) providing 474.5 Joules per blow. When the sampler is driven a total of 45 cm (18 inches) into the soil, the standard penetration index ('N' Value) is the total number of blows for the last 30 cm (12 inches).

Dynamic Cone Penetration Resistance (DCPT): Dynamic Cone Penetration Resistance is similar to a SPT with the 474.5 Joule/blow impulse provided by the free falling hammer where the split-spoon sampler is replaced by a 51 mm Ø, 60˚ conical point and the number of blows is recorded continuously for every 30 cm (12 inches).

COHESIVE SOILS CONSISTENCY

	(kPa)	**(P.S.F.)**	**Nominal 'N' Value**
Very Soft	<12	<250	0-2
Soft	12-25	250-500	2-4
Firm	25-50	500-1000	4-8
Stiff	50-100	1000-2000	8-15
Very Stiff	100-200	2000-4000	15-30
Hard	>200	>4000	>30

RELATIVE DENSITY OF COHESIONLESS SOIL

	'N' Value
Very Loose	0-4
Loose	4-10
Compact	10-30
Dense	30-50
Very Dense	>50

MOISTURE CONDITIONS:

Cohesive Soil
DTPL- Drier than plastic limit
APL- About plastic limit
WTPL- Wetter than plastic limit
MWTPL- Much wetter than plastic limit

Cohesionless Soil
Damp
Moist
Wet
Saturated

SAMPLE TYPES AND ADDITIONAL FIELD TESTS

SS	Split Spoon Sample (obtained from SPT)	**GS**	Grab Sample	**PP**	Pocket Penetrometer
		BS	Bulk Sample	**VANE**	Peak & Remolded shear
AS	Auger Sample	**TW**	Thin Wall Sample or Shelby Tube	**DMT**	Flat Plate Dilatometer

LABORATORY TESTS

SG	Specific Gravity	**S**	Sieve Analysis	**W**	Water Content
H	Hydrometer	**P**	Field Permeability	**K**	Lab Permeability
W_p	Plastic Limit	**W_l**	Liquid Limit	**I_p**	Plasticity Index
GSA	Grain Size Analysis	**C**	Consolidation	**UNC**	Unconfined compression

CHUNG & VANDER DOELEN
ENGINEERING LTD.

Enclosure A

FILE No: 1073

BOREHOLE No. 1

Client: **14688210 Canada Inc.**

Project: **Proposed 25-Storey Residential Building**

Location: **177 and 179 Albert Street, Waterloo**

EQUIPMENT DATA

Machine: **CME-75**
Method: **HSA / Mud Rotary**
Size: **108 mm I.D.**
Date: **Jun 19 - 23** TO **Jun 20 - 23**

Ground Elevation: **340.28 m**

ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SAMPLE ID	TYPE	N-VALUE
340.08	200 mm TOPSOIL				
0.20	very loose, dark brown FILL, silt, some sand moist	0.5	1	SS	3
339.58					
0.70	------	1.0	2	SS	37
	silty sand layer	1.5	3	SS	24
	------	2.0			
	compact to dense	2.5	4	SS	28
	brown	3.0			
	SAND AND SILT		5	SS	39
	moist to saturated	3.5			
		4.0	6	SS	39
		4.5	7	SS	32
	------	5.0			
	sandy silt trace clay occ. clayey seams	5.5	8	SS	20
	below 5.2 m	6.0	9	SS	38
		6.5			
333.28		7.0			
7.00	occ. sand seams	7.5	10	SS	31
	------	8.0			
	very stiff to hard	8.5			
	grey	9.0			
	CLAYEY SILT TILL trace to some sand trace gravel		11	SS	29
	DTPL to APL	9.5			

SHEAR STRENGTH (kPa)
FIELD VANE: Peak ⊗ Rem. ×
LAB TEST: Unc. ■ P.P. □
50 100 150 200
PENETRATION RESISTANCE
STANDARD ● DYN. CONE ○
20 40 60 80

WATER CONTENT (%)
W_P W W_L
10 20 30

WELL DATA

DEPTH (m)

REMARKS

- at grade flushmount casing set in concrete
- bentonite seal/50 mm I.D. PVC riser
- start of mud rotary
- water level in monitoring well measured to 5.22 m bgs on July 4, 2023
- 3.0 m long, 50 mm I.D. PVC screen with sandpack

PROJECT MANAGER: **EYC**

CHUNG & VANDER DOELEN ENGINEERING LTD.
311 Victoria Street North
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ph. (519) 742-8979, fx. (519) 742-7739

FILE No: 1073

BOREHOLE No. 1

Client: **14688210 Canada Inc.**

Project: **Proposed 25-Storey Residential Building**

Location: **177 and 179 Albert Street, Waterloo**

EQUIPMENT DATA

Machine: **CME-75**
Method: **HSA / Mud Rotary**
Size: **108 mm I.D.**
Date: **Jun 19 - 23** TO **Jun 20 - 23**

ELEV./ DEPTH (m)	DESCRIPTION *(continued)*	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	SHEAR STRENGTH (kPa) / PENETRATION RESISTANCE	WATER CONTENT (%)	WELL DATA	DEPTH (m)	REMARKS
	very stiff grey CLAYEY SILT TILL trace to some sand trace gravel APL	10.5 11.0 11.5		12	SS	29					
328.68 11.60	very dense brown Fine SAND some silt saturated	12.0 12.5 13.0		13	SS	63					
327.18 13.10	hard grey CLAYEY SILT TILL some sand, trace gravel DTPL	13.5 14.0 14.5		14	SS	78					
325.63 14.65	very dense brown Fine to Medium SAND trace silt saturated	15.0 15.5 16.0		15	SS	70					
324.13 16.15	hard grey CLAYEY SILT TILL trace to some sand trace gravel APL	16.5 17.0 17.5 18.0 18.5 19.0 19.5		16 17	SS SS	61 57					

SHEAR STRENGTH (kPa)
FIELD VANE: Peak ⊗ Rem. ×
LAB TEST: Unc. ■ P.P. □
50 100 150 200
PENETRATION RESISTANCE
STANDARD ● DYN. CONE ○
20 40 60 80

WATER CONTENT (%)
W_P W W_L
10 20 30

PROJECT MANAGER: **EYC**

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FILE No: 1073

BOREHOLE No. 1

Client: **14688210 Canada Inc.**

Project: **Proposed 25-Storey Residential Building**

Location: **177 and 179 Albert Street, Waterloo**

EQUIPMENT DATA

Machine: **CME-75**
Method: **HSA / Mud Rotary**
Size: **108 mm I.D.**
Date: **Jun 19 - 23** TO **Jun 20 - 23**

ELEV./ DEPTH (m)	DESCRIPTION *(continued)*	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	SHEAR STRENGTH (kPa) FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □ 50 100 150 200 PENETRATION RESISTANCE STANDARD ● DYN. CONE ○ 20 40 60 80	WATER CONTENT (%) W_P W W_L 10 20 30	WELL DATA	DEPTH (m)	REMARKS
	hard grey CLAYEY SILT TILL trace to some sand trace gravel APL	20.5 21.0 21.5 22.0 22.5 23.0 23.5 24.0 24.5		18	SS	46				20.5 21.0 21.5 22.0 22.5 23.0 23.5 24.0 24.5	
				19	SS	44					
315.43 24.85	End of Borehole	25.0 25.5 26.0 26.5 27.0 27.5 28.0 28.5 29.0 29.5								25.0 25.5 26.0 26.5 27.0 27.5 28.0 28.5 29.0 29.5	

PROJECT MANAGER: **EYC**

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ENGINEERING LTD.
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FILE No: 1073

BOREHOLE No. 2

Client: **14688210 Canada Inc.**

Project: **Proposed 25-Storey Residential Building**

Location: **177 and 179 Albert Street, Waterloo**

EQUIPMENT DATA

Machine: **CME-75**
Method: **HSA / Mud Rotary**
Size: **108 mm I.D.**
Date: **Jun 20 - 23** TO **Jun 21 - 23**

Ground Elevation: **339.59 m**

ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE
339.39	200 mm TOPSOIL					
0.20	very loose to compact dark brown FILL, sandy silt moist ------ trace organics	0.5 1.0 1.5 2.0		1 2 3	SS SS SS	2 5 14
337.44 2.15	sandy layer ------ loose to dense brown SILT trace to some sand moist to saturated	2.5 3.0 3.5 4.0 4.5		4 5 6	SS SS SS	9 27 38
	------ occ. clayey seams/layers ------ grey below 7 m	5.0 5.5 6.0 6.5 7.0 7.5		7 8	SS SS	23 38
331.04 8.55	hard grey CLAYEY SILT TILL trace to some sand, trace gravel DTPL	8.0 8.5 9.0 9.5		9	SS	42

SHEAR STRENGTH (kPa)
FIELD VANE: Peak ⊗ Rem. ×
LAB TEST: Unc. ■ P.P. □
50 100 150 200
PENETRATION RESISTANCE
STANDARD ● DYN. CONE ○
20 40 60 80

WATER CONTENT (%)
W_P W W_L
10 20 30

WELL DATA

DEPTH (m)

REMARKS

- Borehole grouted upon completion of drilling
- start of mud rotary

PROJECT MANAGER: **EYC**

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311 Victoria Street North
Kitchener, Ontario N2H 5E1
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FILE No: 1073

BOREHOLE No. 2

Client: **14688210 Canada Inc.**

Project: **Proposed 25-Storey Residential Building**

Location: **177 and 179 Albert Street, Waterloo**

EQUIPMENT DATA

Machine: **CME-75**
Method: **HSA / Mud Rotary**
Size: **108 mm I.D.**
Date: **Jun 20 - 23** TO **Jun 21 - 23**

ELEV./ DEPTH (m)	DESCRIPTION *(continued)*	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	REMARKS
	hard grey CLAYEY SILT TILL trace to some sand, trace gravel APL	10.5 11.0 11.5		10	SS	35	
327.99 11.60	very dense brown Fine to Medium SAND some silt saturated	12.0 12.5 13.0 13.5 14.0 14.5		11 12	SS SS	88 50/ 125 mm	
324.89 14.70	hard grey CLAYEY SILT TILL trace gravel, trace sand APL	15.0 15.5 16.0 16.5 17.0 17.5 18.0 18.5 19.0 19.5		13 14 15	SS SS SS	44 54 49	

SHEAR STRENGTH (kPa)
FIELD VANE: Peak ⊗ Rem. ×
LAB TEST: Unc. ■ P.P. □
50 100 150 200
PENETRATION RESISTANCE
STANDARD ● DYN. CONE ○
20 40 60 80

WATER CONTENT (%)
W_P W W_L
10 20 30

WELL DATA

PROJECT MANAGER: **EYC**

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FILE No: 1073

BOREHOLE No. 2

Client: **14688210 Canada Inc.**

Project: **Proposed 25-Storey Residential Building**

Location: **177 and 179 Albert Street, Waterloo**

EQUIPMENT DATA

Machine: **CME-75**
Method: **HSA / Mud Rotary**
Size: **108 mm I.D.**
Date: **Jun 20 - 23** TO **Jun 21 - 23**

ELEV./ DEPTH (m)	DESCRIPTION *(continued)*	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	SHEAR STRENGTH (kPa) FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □ 50 100 150 200 PENETRATION RESISTANCE STANDARD ● DYN. CONE ○ 20 40 60 80	WATER CONTENT (%) W_P W W_L 10 20 30	WELL DATA	DEPTH (m)	REMARKS
	hard grey CLAYEY SILT TILL trace gravel, trace sand APL	20.5 21.0 21.5 22.0 22.5 23.0 23.5 24.0 24.5		16	SS	50					
				17	SS	53					
314.74 24.85	End of Borehole	25.0 25.5 26.0 26.5 27.0 27.5 28.0 28.5 29.0 29.5									

PROJECT MANAGER: **EYC**

CHUNG & VANDER DOELEN
ENGINEERING LTD.
311 Victoria Street North
Kitchener, Ontario N2H 5E1
ph. (519) 742-8979, fx. (519) 742-7739

FILE No: 1073

BOREHOLE No. 3

Client: **14688210 Canada Inc.**

Project: **Proposed 25-Storey Residential Building**

Location: **177 and 179 Albert Street, Waterloo**

EQUIPMENT DATA

Machine: **CME-75**
Method: **HSA / Mud Rotary**
Size: **108 mm I.D.**
Date: **Jun 15 - 23** TO **Jun 22 - 23**

Ground Elevation: **339.04 m**

ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SAMPLE ID	TYPE	N-VALUE
338.79	250 mm TOPSOIL				
0.25	loose, dark brown, FILL, silt, some sand, trace organics, moist	0.5	1	SS	4
338.34					
0.70	trace gravel	1.0	2	SS	9
	------	1.5			
	compact to dense		3	SS	19
	brown	2.0			
	SANDY SILT to SAND AND SILT occ. silt layer	2.5	4	SS	20
	damp to saturated	3.0			
		3.5	5	SS	37
		4.0	6	SS	44
		4.5			
			7	SS	16
	------	5.0			
	trace clay	5.5	8	SS	47
333.09					
5.95	hard	6.0			
	brown	6.5	9	SS	53
	CLAYEY SILT TILL some sand to sandy	7.0			
	DTPL to APL	7.5			
		8.0	10	SS	44
330.64					
8.40	very dense	8.5			
	brown	9.0			
	Fine to Medium SAND trace to some silt	9.5	11	SS	62
	saturated				

SHEAR STRENGTH (kPa)
FIELD VANE: Peak ⊗ Rem. ×
LAB TEST: Unc. ■ P.P. □
50 100 150 200
PENETRATION RESISTANCE
STANDARD ● DYN. CONE ○
20 40 60 80

WATER CONTENT (%)
W_P W W_L
10 20 30

WELL DATA

DEPTH (m)

REMARKS

- at grade flushmount casing set in concrete
- split spoon is dripping
- start of mud rotary
- bentonite seal/50 mm I.D. PVC riser
- water level in monitoring well measured to 4.98 m bgs on July 4, 2023

PROJECT MANAGER: **EYC**

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FILE No: 1073

BOREHOLE No. 3

Client: **14688210 Canada Inc.**

Project: **Proposed 25-Storey Residential Building**

Location: **177 and 179 Albert Street, Waterloo**

EQUIPMENT DATA

Machine: **CME-75**
Method: **HSA / Mud Rotary**
Size: **108 mm I.D.**
Date: **Jun 15 - 23** TO **Jun 22 - 23**

ELEV./ DEPTH (m)	DESCRIPTION (continued)	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE
	very dense brown Fine to Medium SAND trace to some silt saturated	10.5 11.0		12	SS	60
327.74 11.30		11.5				
	hard grey CLAYEY SILT TILL trace sand APL	12.0 12.5		13	SS	61
325.94 13.10		13.0				
	very dense brown Fine to Medium SAND trace silt occ. clayey seams saturated	13.5 14.0		14	SS	86
324.54 14.50		14.5				
	very stiff to hard grey CLAYEY SILT TILL trace sand APL	15.0 15.5		15	SS	23
		16.0 16.5				
		17.0 17.5		16	SS	32
		18.0 18.5		17	SS	28
		19.0 19.5				

SHEAR STRENGTH (kPa)
FIELD VANE: Peak ⊗ Rem. ×
LAB TEST: Unc. ■ P.P. □
50 100 150 200
PENETRATION RESISTANCE
STANDARD ● DYN. CONE ○
20 40 60 80

WATER CONTENT (%)
W_P W W_L
10 20 30

WELL DATA

DEPTH (m)

REMARKS

10.5 – 1.5 m long, 50 mm I.D. PVC screen with sandpack

PROJECT MANAGER: **EYC**

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FILE No: 1073

BOREHOLE No. 3

Client: **14688210 Canada Inc.**

Project: **Proposed 25-Storey Residential Building**

Location: **177 and 179 Albert Street, Waterloo**

EQUIPMENT DATA

Machine: **CME-75**
Method: **HSA / Mud Rotary**
Size: **108 mm I.D.**
Date: **Jun 15 - 23** TO **Jun 22 - 23**

ELEV./ DEPTH (m)	DESCRIPTION *(continued)*	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	SHEAR STRENGTH (kPa) FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □ 50 100 150 200 PENETRATION RESISTANCE STANDARD ● DYN. CONE ○ 20 40 60 80	WATER CONTENT (%) W_P W W_L 10 20 30	WELL DATA	DEPTH (m)	REMARKS
	hard grey CLAYEY SILT TILL trace sand occ. saturated silt seams APL to WTPL	20.5 21.0 21.5 22.0 22.5 23.0 23.5 24.0 24.5		18	SS	40					
				19	SS	38					
314.19 24.85	End of Borehole	25.0 25.5 26.0 26.5 27.0 27.5 28.0 28.5 29.0 29.5									

PROJECT MANAGER: **EYC**

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FILE No: 1073

BOREHOLE No. 4

Client: **14688210 Canada Inc.**

Project: **Proposed 25-Storey Residential Building**

Location: **177 and 179 Albert Street, Waterloo**

EQUIPMENT DATA

Machine: **CME-75**
Method: **HSA / Mud Rotary**
Size: **108 mm I.D.**
Date: **Jun 14 - 23** TO **Jun 15 - 23**

Ground Elevation: **338.17 m**

ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE
	50 mm ASPHALT 480 mm GRANULAR BASE			1	AS	
337.64 0.53	loose, brown FILL, sand and silt wet	0.5 1.0		2	SS	6
336.82 1.35	compact to very dense brown SANDY SILT moist to saturated ------ sand layer (fine grained) ------ silt layer ------ trace clay occ. clayey seams/layers below 5.2 m	1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5		3 4 5 6 7 8	SS SS SS SS SS SS	14 23 38 52 54 68
331.17 7.00	very dense brown Fine to Medium SAND trace silt saturated	7.0 7.5 8.0 8.5		9	SS	53
329.62 8.55	hard grey CLAYEY SILT TILL trace gravel, trace sand DTPL	9.0 9.5		10	SS	77

SHEAR STRENGTH (kPa)
FIELD VANE: Peak ⊗ Rem. ×
LAB TEST: Unc. ■ P.P. □
50 100 150 200
PENETRATION RESISTANCE
STANDARD ● DYN. CONE ○
20 40 60 80

WATER CONTENT (%)
W_P W W_L
10 20 30

WELL DATA

DEPTH (m)

REMARKS

- at grade flushmount casing set in concrete
- Borehole grouted upon completion of drilling
- bentonite seal/50 mm I.D. PVC riser
- split spoon is dripping
- water level in monitoring well measured to 3.75 m bgs on July 4, 2023
- 3.0 m long, 50 mm I.D. PVC screen with sandpack
- start of mud rotary

PROJECT MANAGER: **EYC**

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CVD BOREHOLE (2017) 1073 177 AND 179 ALBERT STREET, WATERLOO.GPJ CVD_ENG.GDT 23-7-10

FILE No: 1073

BOREHOLE No. 4

Client: **14688210 Canada Inc.**

Project: **Proposed 25-Storey Residential Building**

Location: **177 and 179 Albert Street, Waterloo**

EQUIPMENT DATA

Machine: **CME-75**
Method: **HSA / Mud Rotary**
Size: **108 mm I.D.**
Date: **Jun 14 - 23** TO **Jun 15 - 23**

ELEV./ DEPTH (m)	DESCRIPTION *(continued)*	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	REMARKS
	very stiff to hard grey CLAYEY SILT TILL trace gravel, trace sand DTPL to WTPL	10.5					
		11.0		11	SS	42	
		11.5					
		12.0					
		12.5		12	SS	29	
	------	13.0					
	occ. silt seams	13.5					
		14.0		13	SS	32	
	------	14.5					
		15.0					
		15.5		14	SS	34	
		16.0					
		16.5					
		17.0		15	SS	41	
		17.5					
		18.0					
		18.5		16	SS	38	
		19.0					
		19.5					

SHEAR STRENGTH (kPa)
FIELD VANE: Peak ⊗ Rem. ×
LAB TEST: Unc. ■ P.P. □
50 100 150 200
PENETRATION RESISTANCE
STANDARD ● DYN. CONE ○
20 40 60 80

WATER CONTENT (%)
W_P W W_L
10 20 30

WELL DATA

DEPTH (m)

PROJECT MANAGER: **EYC**

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FILE No: 1073

BOREHOLE No. 4

Client: **14688210 Canada Inc.**

Project: **Proposed 25-Storey Residential Building**

Location: **177 and 179 Albert Street, Waterloo**

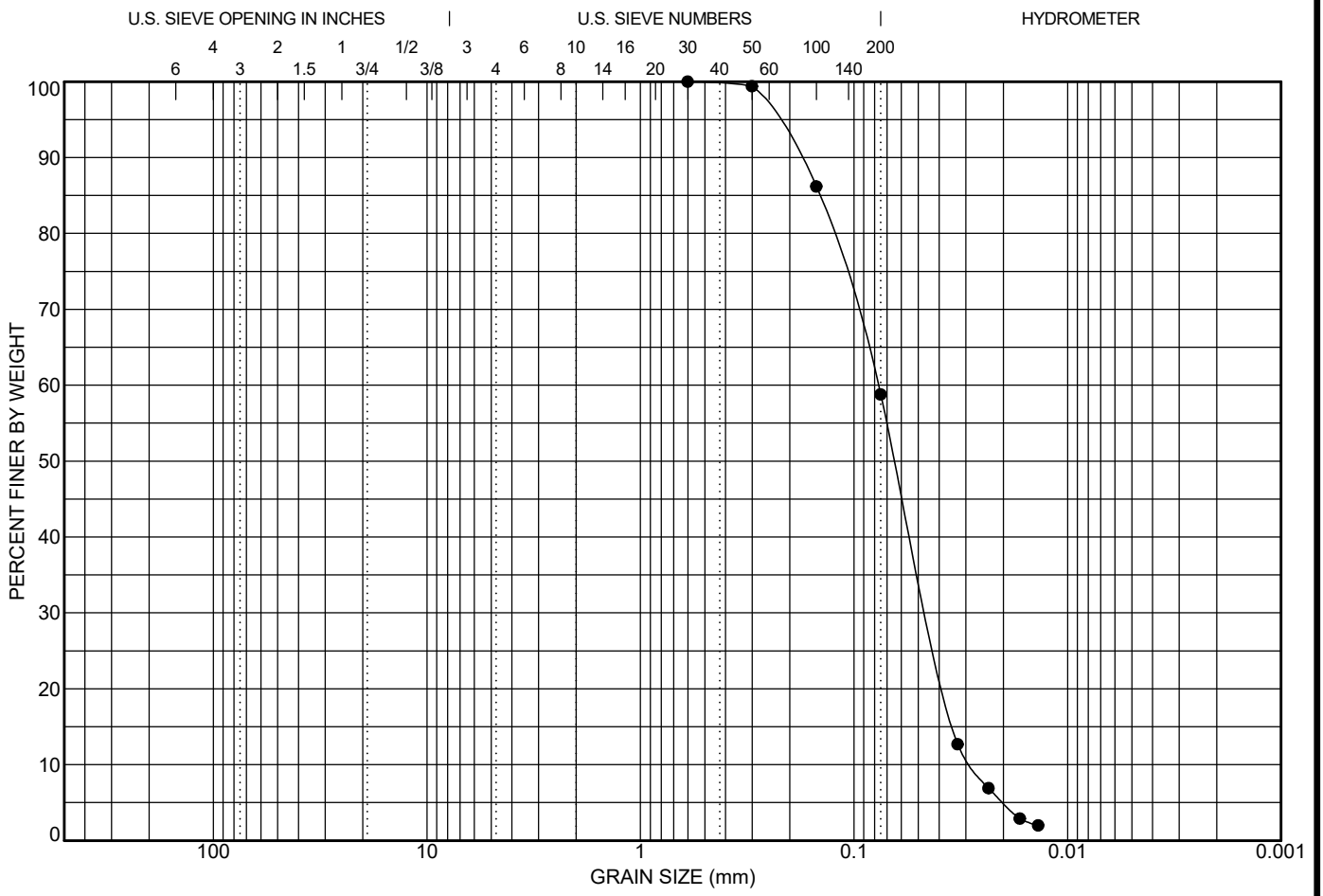
EQUIPMENT DATA

Machine: **CME-75**
Method: **HSA / Mud Rotary**
Size: **108 mm I.D.**
Date: **Jun 14 - 23** TO **Jun 15 - 23**

ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	SHEAR STRENGTH (kPa) / PENETRATION RESISTANCE	WATER CONTENT (%)	WELL DATA	DEPTH (m)	REMARKS
	(continued)						FIELD VANE: Peak ⊗ Rem. ×; LAB TEST: Unc. ■ P.P. □; 50 100 150 200; STANDARD ● DYN. CONE ○; 20 40 60 80	W_P W W_L; 10 20 30			
	hard grey CLAYEY SILT TILL trace gravel, trace sand APL	20.5 21.0 21.5		17	SS	43					
	------ gravelly layer	22.0 22.5 23.0 23.5 24.0									
313.57 24.60	End of Borehole	24.5		18	SS	50/ 75 mm					
		25.0 25.5 26.0 26.5 27.0 27.5 28.0 28.5 29.0 29.5									

PROJECT MANAGER: **EYC**

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COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

LL	PL	PI	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
			0.92	2.76	0.6	0.077	0.045	0.028	0.0	41.2	58.8	

Date: Jul. 05 - 2023
Client: 14688210 Canada Inc.
Contractor:
Source:
Sampled From: BH 1 - SA 7; 4.55 to 5.00 m depth
Sample No.: 1-7
Date Sampled: Jun. 19 - 2023
Sampled By: MP
Lab No.: 0818
Date Tested: Jun. 29 - 2023
Type of Material: Sand and Silt

Sieve Size (mm)	Percent Passing	No Specifications

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Fax: 519-742-7739
e-mail: info@cvdengineering.com

GRAIN SIZE DISTRIBUTION

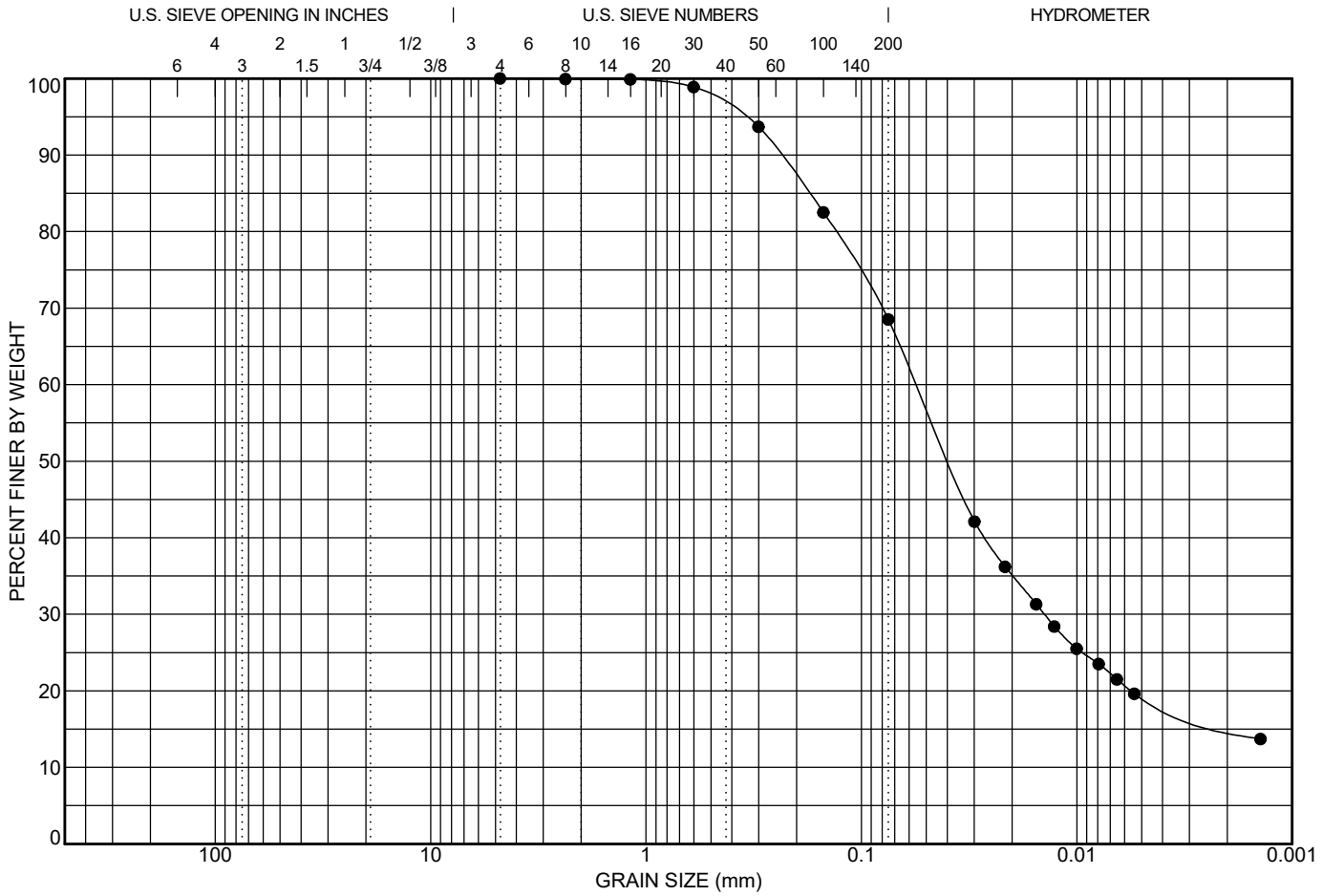
Project: Proposed 25-Storey Residential Building

Location: 177 and 179 Albert Street, Waterloo

File No.: 1073

Enclosure No.: 5

DM - NO SPECIFICATIONS 1073 177 AND 179 ALBERT STREET, WATERLOO.GPJ LAW LNDN.GDT 23-7-10



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

LL	PL	PI	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
					4.75	0.056	0.014		0.0	31.5	68.5	

Date: Jul. 05 - 2023
Client: 14688210 Canada Inc.
Contractor:
Source:
Sampled From: BH 3 - SA 9; 6.10 to 6.55 m depth
Sample No.: 3-9
Date Sampled: Jun. 15 - 2023
Sampled By: MP
Lab No.: 0819
Date Tested: Jun. 29 - 2023
Type of Material: Sandy Clayey Silt Till

Sieve Size (mm)	Percent Passing	No Specifications

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Kitchener, Ontario N2H 5E1
Telephone: 519-742-8979
Fax: 519-742-7739
e-mail: info@cvdengineering.com

GRAIN SIZE DISTRIBUTION

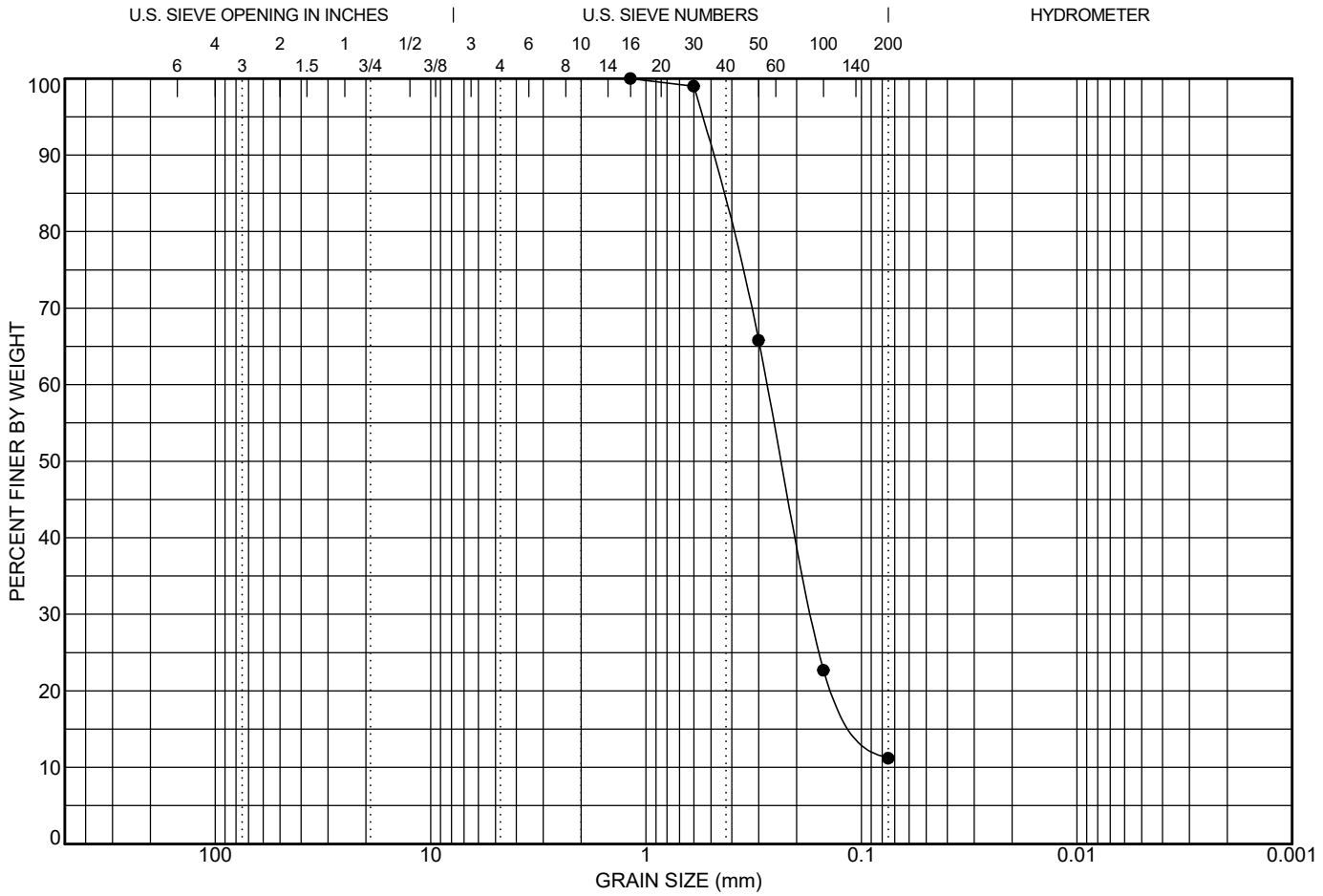
Project: Proposed 25-Storey Residential Building

Location: 177 and 179 Albert Street, Waterloo

File No.: 1073

Enclosure No.: 6

DM - NO SPECIFICATIONS 1073 177 AND 179 ALBERT STREET, WATERLOO.GPJ LAW LNDN.GDT 23-7-10



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

LL	PL	PI	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
			1.49	3.92	1.18	0.273	0.169		0.0	88.8	11.2	

Date: Jul. 05 - 2023
Client: 14688210 Canada Inc.
Contractor:
Source:
Sampled From: BH 3 - SA 11; 9.15 to 9.60 m depth
Sample No.: 3-11
Date Sampled: Jun. 15 - 2023
Sampled By: MP
Lab No.: 0820
Date Tested: Jun. 29 - 2023
Type of Material: Fine to Medium Sand, some silt

Sieve Size (mm)	Percent Passing	No Specifications

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Kitchener, Ontario N2H 5E1
Telephone: 519-742-8979
Fax: 519-742-7739
e-mail: info@cvdengineering.com

GRAIN SIZE DISTRIBUTION

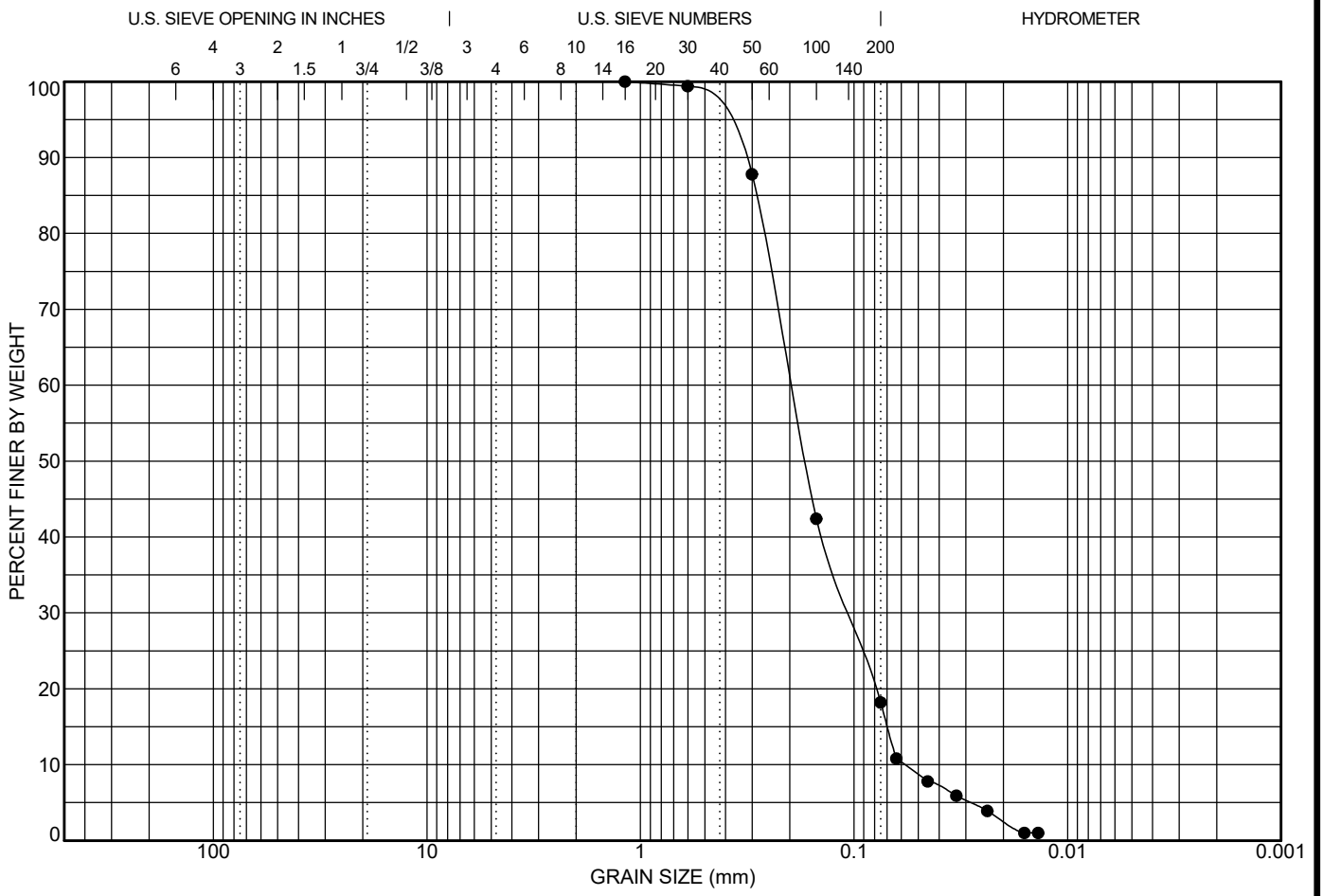
Project: Proposed 25-Storey Residential Building

Location: 177 and 179 Albert Street, Waterloo

File No.: 1073

Enclosure No.: 7

DM - NO SPECIFICATIONS 1073 177 AND 179 ALBERT STREET, WATERLOO.GPJ LAW LNDN.GDT 23-7-10



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

LL	PL	PI	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
			0.98	3.40	1.18	0.196	0.105	0.058	0.0	81.8	18.2	

Date: Jul. 05 - 2023
Client: 14688210 Canada Inc.
Contractor:
Source:
Sampled From: BH 4 - SA 5; 3.05 to 3.50 m depth
Sample No.: 4-5
Date Sampled: Jun. 14 - 2023
Sampled By: MP
Lab No.: 0821
Date Tested: Jun. 29 - 2023
Type of Material: Fine Sand, some silt

Sieve Size (mm)	Percent Passing	No Specifications

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Kitchener, Ontario N2H 5E1
Telephone: 519-742-8979
Fax: 519-742-7739
e-mail: info@cvdengineering.com

GRAIN SIZE DISTRIBUTION

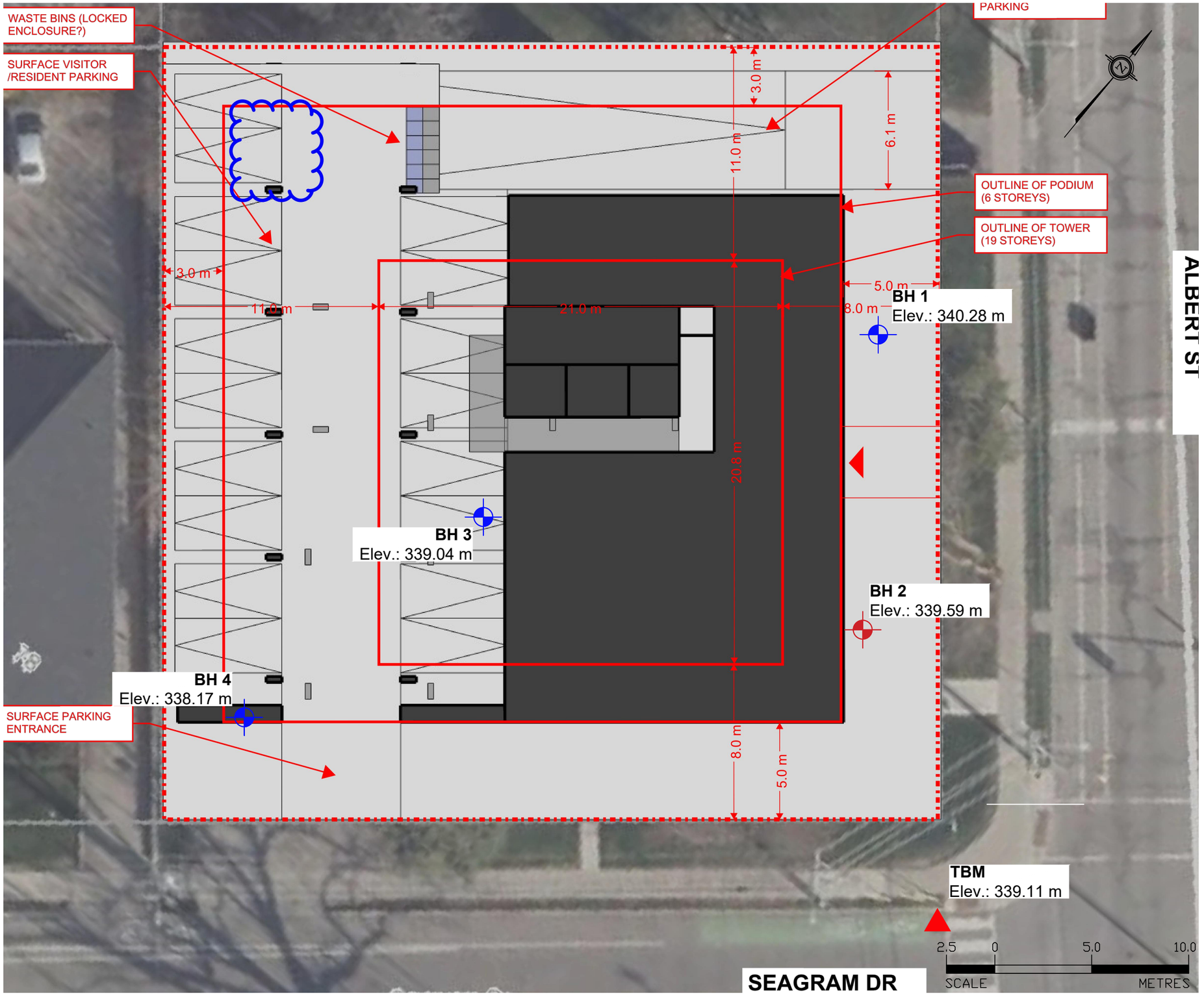
Project: Proposed 25-Storey Residential Building

Location: 177 and 179 Albert Street, Waterloo

File No.: 1073

Enclosure No.: 8

DM - NO SPECIFICATIONS 1073 177 AND 179 ALBERT STREET, WATERLOO.GPJ LAW LNDN.GDT 23-7-10





KEY PLAN **SOURCE:** Google Earth

LEGEND

TBM: Top of catch basin at road edge in westbound lane on Seagram Drive, just west of intersection with Albert Street Elev.: 339.11 m (Geodetic)

Borehole Location

Borehole and Monitoring Well Location

DWG Ref.: Site Plan Sketch provided by client.
Elev. Ref.: The borehole locations and associated ground surface elevations were surveyed using a Network RTK Global Navigation Satellite System (GNSS) Receiver. The survey data was collected using UTM Zone 17N Projection, NAD83(CSRS)v7-2010 datum and Canada Geoid Model HT2_2010v70 (CGVD28).

BOREHOLE LOCATION PLAN

Proposed 25-Storey Apartment Building

177 and 179 Albert Street
Waterloo, Ontario

CHUNG & VANDER DOELEN ENGINEERING LTD.

311 VICTORIA STREET NORTH
KITCHENER / ONTARIO / N2H 5E1 / 519-742-8979

Drawn By: MP/BC	Date: June, 2023	File No.: 1073
Checked By: EYC	Scale: 1:200	Drawing No.: 1