CHUNG & VANDER DOELEN
ENGINEERING LTD.

GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
ADELAIDE STREET EXTENSION
ARTHUR, ONTARIO

SUBMITTED TO:
2786713 Ontario Inc.
O/A VED Homes
62 Sir Jacobs Crescent
Brampton, Ontario
L7A 3V2

ATTENTION:
Mr. Hari Krishna Modi

FILE NO /G22410**/**August 17, 2022

CHUNG & VANDER DOELEN
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August 17, 2022
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O/A VED Homes
62 Sir Jacobs Crescent
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Attention: Mr. Hari Krishna Modi

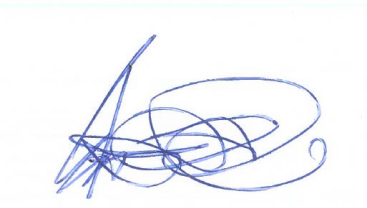
RE: Geotechnical Investigation
Proposed Residential Development
Adelaide Street Extension, Arthur, Ontario

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.



Robert Vander Doelen, P.Eng.
Senior Engineer

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1.0 INTRODUCTION

CHUNG & VANDER DOELEN ENGINEERING LTD. (CVD) has been retained by 2786713 Ontario Inc. to conduct a geotechnical investigation for the proposed residential development to be constructed along the proposed extension of Adelaide Street in Arthur, Ontario.

The 1.0± hectare site is proposed to be developed with the extension of Adelaide Street and seven blocks of townhomes (total of 35 units). Review of the Cut and Fill Volume drawing prepared by K. Smart Associates Limited indicates that the site is proposed to be raised between 0.02 and 2.83 m above current existing grades.

The purpose of this investigation was to determine the subsurface conditions and relevant soil properties at the subject site in order to provide geotechnical recommendations for the design and construction of site grading operations, site servicing, roadways, and future building foundations. Estimates of hydraulic conductivity and infiltration rates of the insitu soil deposits will be provided.

2.0 FIELD WORK

Eleven (11) boreholes were drilled and sampled to depths between 5.0 and 5.8 m below existing grade on April 12 and 13, 2022. The borehole locations are illustrated 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. The boreholes were advanced using a track-mounted drilling rig, supplied, and operated by a specialized contractor. The drill rig was equipped with continuous flight augers 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 cohesive soil deposits were determined on 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.

Groundwater conditions were monitored during borehole advancement/sampling operations and upon removal of the drilling augers at all borehole locations. 50 mm diameter monitoring wells with 3.05 m long screens and above-grade protective covers were installed at Boreholes 4, 7 and 9 to allow potential long-term monitoring of seasonal groundwater levels.

The borehole locations and associated ground surface elevations were surveyed by CVD for the purpose of this report using a Network RTK Global Navigation Satellite System (GNSS) Receiver. The survey data was collected using The UTM Zone 17N Projection, NAD83(CSRS)v7-2010 datum and Canada Geoid Model HT2_2010v70 (CGVD28).

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.

Four (4) grain size distribution analyses were performed on the major soil deposit to confirm field identification and to provide information on the soil hydraulic conductivity.

3.2 Analytical Laboratory Testing

Three (3) soil samples were submitted to ALS Laboratory Group (a CALA/SCC accredited laboratory) in Waterloo, Ontario 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 following table presents the location, depth, description, and parameters analysed for each sample collected and submitted for analysis:

Borehole No.	Sample Depth	Sample Description	Parameters Analysed
3	0.0 to 0.6 mbeg	topsoil and clayey silt	Metals and Inorganics, PHCs (F1-F4), BTEX
4	0.0 to 0.6 mbeg	topsoil and clayey silt	Metals and Inorganics, PHCs (F1-F4), BTEX
10	0.0 to 0.6 mbeg	topsoil and clayey silt	Metals and Inorganics, PHCs (F1-F4), BTEX

mbeg: metres below existing grade

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

4.0 EXISTING SITE CONDITIONS

The site currently exists as undeveloped grassed land with occasional trees and shrubs along the eastern and southern property lines. A municipal drain exists adjacent to the southern property line.

The site lies in a slightly depressed area compared to the neighbouring properties. Site topography across the site gently declines in a southwesterly direction. Ground surface elevations at the borehole locations ranged between 454.59 and 455.80 m.

5.0 SUBSURFACE CONDITIONS

The subsurface conditions encountered at the boreholes are detailed on the Borehole Log Sheets, Enclosures 1 to 11 of this report. The following notes are intended to amplify and comment on the subsurface data.

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.

5.1 Topsoil

Topsoil was encountered at the ground surface at all eleven (11) borehole locations with measured thicknesses between 150 and 275 mm.

5.2 Upper Clayey Silt

The surficial topsoil was underlain by mottled brown to grey clayey silt which extended to depths between 1.4 and 2.9 m below existing grade at Boreholes 1, 2, 3, 5, 6, 7, 8, 9 and 11. Boreholes 4 and 10 were terminated within the cohesive deposit at a depth of 5.0 m below existing grade.

The clayey silt deposit contained trace to some sand and trace gravel. Occasional wet to saturated silt lenses/seams were observed within the cohesive deposit at Boreholes 4 and 10. Locally at Borehole 6, a 1.0± m thick sandy silt layer was encountered on top of the clayey silt deposit. A grain size distribution analysis was conducted on a representative sample collected from Borehole 4 and the results are shown graphically on Enclosure 13 of this report.

The SPT “N”-values measured within the clayey silt deposit ranged from 2 to 40 blows per 300 mm of penetration. The undrained shear strength obtained on the retrieved samples ranged from 10 to greater than 250 kPa. Based on the above test results, the clayey silt deposit is considered to have a soft to hard consistency. Natural moisture contents were generally measured between 11 and 23%, indicating a moist to wet moisture condition.

5.3 Sandy Silt to Silt

The upper clayey silt deposit at Boreholes 1, 2, 3, 7, 8, 9 and 11 and the sand and gravel deposit at Borehole 5 were underlain by a layer of brown to grey of silt with varying percentage of sand which extended to depths between 3.0 and 4.4 m below existing grade at Boreholes 1, 2, 3, 8, 9 and 11. Boreholes 5 and 7 were terminated within the deposits at depths of 5.0 m below existing grade.

Trace to some clay and/or occasional sand or clayey lenses/seams were encountered within the silt deposit. Results of two (2) grain size distribution analyses selected from Boreholes 1 and 8 are shown graphically on Enclosures 12 and 14.

The SPT "N"-values measured within the silt-based deposits ranged from 12 to 40 blows per 300 mm of penetration, indicating a compact to dense compactness condition. Natural moisture contents were measured between 7 and 23%, indicating a moist to saturated moisture condition.

5.4 Sand to Sand and Gravel

Discontinuous brown sand to sand and gravel deposits with varying amount of silt were encountered beneath the sandy silt and upper clayey silt deposits at Boreholes 1, 5 and 6. The granular deposits extended to depths of 3.3 and 3.2 m below existing grade at Boreholes 5 and 6, respectively. Borehole 1 was terminated within the sand and gravel deposit at a depth of 5.0 m below existing grade.

The SPT "N"-values measured within the granular deposits ranged from 13 to 34 blows per 300 mm of penetration, indicating a compact to dense compactness condition. Natural moisture contents were measured between 10 and 19%, indicating a saturated moisture condition.

5.5 Lower Clayey Silt

The fine granular deposits at Boreholes 2, 3, 6, 8, 9 and 11 were underlain by another layer of brown/grey to grey clayey silt deposit with sand in ranged from trace sand to sandy, and trace gravel. All six (6) boreholes were terminated within the cohesive deposit at a depth of 5.0 m below existing grade. Results of one (1) grain size distribution analysis selected from Borehole 9 are shown graphically on Enclosure 15.

The SPT "N"-values measured within the lower clayey silt deposit ranged from 9 to 23 blows per 300 mm of penetration. The undrained shear strength obtained on the retrieved samples ranged from 45 to greater than 250 kPa. Based on the above test results, the lower clayey silt deposit is considered to have a stiff to very stiff consistency condition. Natural moisture contents were measured between 11 and 17%, indicating a moist moisture condition.

5.6 Groundwater

Groundwater conditions were monitored during advancement of the borehole augering and immediately following the withdrawal of the drilling augers at each borehole location. Groundwater was observed at depths between 0.3 and 3.5 m below existing grade at Boreholes 1 to 3, 5, 6, 8, 10 and 11 at withdrawal of the drilling augers,.

50 mm diameter monitoring wells with 3.05 m long screens and above-grade protective covers were installed at Boreholes 4, 7 and 9 to allow potential long-term monitoring of seasonal groundwater levels. The table below provides the various water levels measured between April 22 and July 29, 2022.

Borehole No.	Existing Ground Elevation (m)	Date	Water Level Below Existing Ground Surface (m)	Water Elevation (m)
4	454.81	April 22, 2022	0.41	454.41
		April 27, 2022	0.71	454.10
		May 25, 2022	1.21	453.60
		June 4, 2022	1.11	453.70
		July 29, 2022	1.38	453.43
7	455.39	April 22, 2022	0.11	455.28
		April 27, 2022	0.16	455.22
		May 25, 2022	0.68	454.71
		June 4, 2022	0.65	454.74
		July 29, 2022	0.82	454.57
9	455.43	April 22, 2022	1.38	454.05
		April 27, 2022	1.58	453.85
		May 25, 2022	1.95	453.48
		June 4, 2022	1.92	453.51
		July 29, 2022	2.22	453.21

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

6.0 DISCUSSION AND RECOMMENDATIONS

The 1.0± hectare site is proposed to be developed with the extension of Adelaide Street and seven blocks of townhomes (total of 35 units). Review of the Cut and Fill Volume drawing prepared by K. Smart Associates Limited indicates that the site is proposed to be raised between 0.02 and 2.83 m above current existing grades.

6.1 Site Grading and Engineered Fill Construction

Considering the entire site is to be raised by 0.02 to 2.83 m above current existing grades, it is recommended to construct engineered fill in areas to be raised to suitably support the future building structures, roadway and infrastructure servicing.

Soft to firm cohesive and loose fine granular soils were encountered at the ground surface of the various borehole locations to depths ranging from 0.3± to 2.0± m below existing grade, and are not considered suitable to support the proposed building structures. Engineered fill may prove to be the most suitable and economic option to remedy poor supporting conditions for future building construction.

Considering a “light loading” application, the following table provides the locations and depths where non-suitable soil conditions were encountered as well as corresponding elevations where suitable supporting soils to support light residential foundations were encountered:

Borehole No.	Existing Ground Elevation (m)	Thickness of Non-Suitable Founding Soils (m)	Elevation of Suitable Foundation-Foundation-Supporting Soil (m)
1	454.59	1.99	452.60
2	455.08	1.48	453.60
3	455.26	0.76	454.50
4	454.81	1.41	453.40
5	454.86	1.56	453.30
6	455.16	1.46	453.70
7	455.39	0.69	454.70
8	455.26	0.76	454.50
9	455.43	0.33	455.10
10	455.47	0.87	454.60
11	455.80	0.80	455.00

Engineered fill to be constructed below the proposed buildings is recommended to consist of imported OPSS Granular B Type I. The inorganic excavated clayey silt and other fine-grained deposits may be reused during site grading operations but should be limited to beneath pavement and landscaping areas. The moisture content of the fill soils should be within 3% below the optimum moisture content in order to achieve the specified degree of compaction.

It is recommended that any off-site borrow source materials be tested prior to importing, in order to ensure that the environmental quality of the fill meets all environmental approval criteria and to ensure that the natural moisture content of the fill is suitable for compaction.

It is recommended that engineered fill construction be conducted during the summer and early fall months when drier warmer weather conditions typically exist as the onsite soils are sensitive to moisture and will become difficult to handle and compact to the specified degree of compaction when wet.

The onsite deposits are generally considered to be frost-susceptible. Constructing engineered fill using the onsite finer grained soils during the winter months is to be avoided.

The onsite soils are susceptible to softening and deformation when exposed to excessive moisture and construction traffic. As a result, it is imperative that the grading/filling operations are planned and maintained to direct surface water run-off to low points and then be positively drained by suitable means. Construction traffic should be directed along the designated construction routes so as not to disturb and rut the exposed subgrade soil during periods of wet weather. Temporary construction roads consisting of clear crushed material (such as crushed stone or recycled concrete) may be required during poor weather conditions such as wet Spring or Fall.

The engineered fill should be constructed in accordance with the following procedures in order to support futures buildings, infrastructure servicing and roadway pavements:

1) All topsoil and other deleterious materials are to be stripped from the proposed building and pavement areas. Soft to firm cohesive and loose fine granular soils encountered within future building areas as presented in the previous table in this section are to also be removed. The inorganic soils may be salvaged for potential reuse under pavement and landscaped areas;

2) The exposed subgrade surface is to be thoroughly recompacted by large heavy compaction equipment (10 tonne compactor is recommended) if capable of supporting such equipment and remaining stable. Careful review and guidance by the geotechnical engineer is recommended should the subgrade become unstable. All subgrade areas are to be inspected by qualified geotechnical personnel prior to placement of fill;

3) The required grades can then be achieved by placing the previously described fill soils in the previously prescribed placement areas in maximum 300 mm thick loose lifts and compacting to a minimum of 98% Standard Proctor Maximum Dry Density (SPMDD);

4) The moisture content of the fill materials is recommended to be within 3% below their optimum moisture contents in order to achieve the specified degree of compaction;

5) Engineered fill used to support future buildings, infrastructure servicing and roadway pavements must be placed such that the fill pad extends horizontally outwards at least the same distance equal to the depth of fill to be placed on approved native earth subgrade;

6) Overly wet and organic materials may be placed in non-structural areas where 90% SPMDD is deemed adequate;

7) All fill placement and compaction operations must be supervised on a full-time basis by qualified geotechnical personnel to approve fill material and ensure the specified degree of compaction have been achieved.

Vibration could be generated from various construction equipment (compactors and rollers) during construction which could be harmful to surrounding structures and buildings. Peak particle velocity (PPV) of ground motion is widely accepted as the best descriptor of potential for vibration damage to structures. The safe vibration limit can be set to 10 to 20 mm/s PPV, depending on the sensitivity of surrounding structures to vibration.

Vibration monitoring can be carried out to measure the PPV of ground motion from vibration generated from typical compaction equipment at the beginning of the project in the potentially critical areas. This will set criteria and establish the type of equipment to be used for this project. It is recommended that a pre-construction condition survey be conducted to document the condition of existing structures within the possible zone of influence.

6.2 Townhome Buildings

The site is proposed to be developed with seven (7) blocks of townhomes. Review of the Proposed Grading Plan prepared by K. Smart indicates that the underside of footings (USF) for the various buildings varies between Elevation 454.6 and 456.1 m.

6.2.1 Foundations

Conventional strip and spread footing foundations can be used to support the proposed townhome buildings.

Footings cast on the approved engineered fill constructed per Section 6.1 and/or native competent native soils can be designed using a Geotechnical Reaction at SLS of 100 kPa and a Factored Geotechnical Resistance at ULS of 150 kPa.

The following table summarizes the highest founding level and elevation for conventional footing foundations on competent native soils encountered at each borehole location:

Borehole No.	Existing Ground Elevation (m)	Highest Founding Depth (m)	Highest Founding Elevation (m)
1	454.59	1.99	452.60
2	455.08	1.48	453.60
3	455.26	0.76	454.50
4	454.81	1.41	453.40
5	454.86	1.56	453.30
6	455.16	1.46	453.70
7	455.39	0.69	454.70
8	455.26	0.76	454.50
9	455.43	0.33	455.10
10	455.47	0.87	454.60
11	455.80	0.80	455.00

These soil bearing pressures can be achieved provided that the founding subgrade is undisturbed during construction. 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. Spacing between adjacent footing steps should not be steeper than 10H to 7V.

CVD recommends that the footing excavations be inspected by the geotechnical engineer to ensure adequate soil bearing and proper subgrade preparation.

The subgrade soils are considered to be frost-susceptible and must be protected from frost penetration during winter construction.

The subgrade soils at the founding grades could potentially be disturbed during construction, especially under wet conditions. In this regard, a 50 mm thick protective concrete slab could be poured and allowed to set on the prepared subgrade to further protect it from disturbance by construction traffic and the elements, if so required.

6.2.2 Earthquake Considerations

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

Based on the construction of engineered fill (as provided in Section 6.1, Site Grading and Engineered Fill Construction) and the underlying soil condition encountered at the boreholes, the site can be classified as a Site Class D as per OBC Table 4.1.8.4.A (Page B4-24).

6.2.3 Floor Slab Construction

The floor slabs for the proposed residential buildings can be constructed as conventional slab-on-grade on approved engineered fill. The exposed subgrade should be proof-rolled with a heavy roller in conjunction with an inspection by the geotechnical engineer. Any soft and/or unstable areas detected should be replaced with imported granular fill which should be compacted to at least 95% SPMDD.

It is recommended that a minimum 150 mm thick layer of OPSS Granular “A” be placed and compacted to at least 100% SPMDD beneath the concrete floor slabs to provide uniform support following proof-rolling of the prepared subgrade.

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 and one-quarter of the slab thickness.

Care should be taken to ensure that the backfill against foundation walls, interior piers/columns and below-grade pits are placed in thin layers and each layer compacted to at least 95% SPMDD. These types of confined areas should be backfilled with imported granular soils such as OPSS Granular B Type I.

Moisture migration from the underlying soils through the concrete slab-on-grade will take place via “capillary action” and “diffusion” (due to vapour pressure differential). Although, the Granular “A” layer will provide a capillary break, the low permeance of the concrete slab and floor coverings will result in 100% humidity under the concrete slab and, consequently, the moisture in the concrete will increase over time. The potential effect of the soil moisture should be considered in selecting the floor coverings. A vapour retarder material (such as a 15 mil poly, ASTM E-1745) can be placed to reduce soil moisture migration. Reference is made to ACI 302.

6.2.4 Foundation Drainage

Damp proofing of shallow building foundation walls and installation of perimeter weeping tile systems connected to permanent positive drainage outlets is recommended.

Perimeter drainage systems will prevent hydrostatic pressure from occurring beneath future building structures. The perimeter weeping tile system is to be installed at the base of the footing to direct the collected waters to sump pump installations or the storm sewer.

6.3 Underground Site Servicing

The site will be serviced with municipal services and pipe invert depths are anticipated to be in the order of 2.0 to 3.0 m below finished grades.

6.3.1 Excavation Conditions

Trenching can be carried out using conventional open cut procedures. The excavations will generally intersect newly placed and compacted fill, native soft to stiff clayey silt and/or loose sandy silt deposits. The newly compacted fill, firm to stiff cohesive soil and loose sandy silt deposit are expected to provide suitable subgrade support to sewer and watermain serving. Any unstable soil, organic soil and/or soft clayey silt encountered at the pipe invert should be sub-excavated and replaced with well compacted 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.

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 to 3H : 1V and the groundwater controlled by suitable means. Excavations can also be supported using trench box or timber lagging.

6.3.2 Pipe Bedding

As noted in Section 6.3.1, 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.

6.3.3 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, boulders, 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.

It has been our experience that excavated cohesive soils should be broken into smaller pieces (less than 150 mm diameter) before returning into the trench as backfill. This will eliminate "wedging" problems and reduce long term settlement. Particular attention must be made to backfilling the laterals where the trenches are narrow and against the manholes and catch-basins. Thinner lifts and additional compaction must be applied.

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.

Frequent inspection by experienced geotechnical personnel should be carried out to examine and approve backfill material, to carefully inspect placement, and to verify that the specified degree of compaction has been obtained by in situ density testing.

6.3.4 Groundwater Control

Uncontrollable groundwater flows are not expected to be encountered within construction excavations based on relatively shallow excavations being expected and that the site will be raised above existing grade. Subsurface seepage and surface water runoff into the excavations are generally expected to be handled by conventional sump pumping techniques, as and where required. The sump pits should be filtered.

6.4 Pavement Design

Adelaide Street will be extended west of Conestogo Street North to service the townhome development. The townhome development will have private access roadways and/or driveways to the extension of Adelaide Street.

6.4.1 Adelaide Street Extension

The earth subgrade beneath future pavements is generally expected to consist of clayey silt soil.

Cognizant of the expected traffic volume and the expected clayey silt subgrade soil, the following pavement component thicknesses are considered suitable for local residential roads and meet the minimum requirements of the Municipal Servicing Standards published by the Township of Wellington North.

Pavement Component	Component Thickness (mm)
HL3 Surface Asphaltic Concrete HL4 Binder Asphaltic Concrete	40 50
Granular "A" Base Course	150
Granular "B" Sub-Base Course	450
Granular Base Equivalency (GBE)	**630**

Note:

1. GBE denotes Granular Base Equivalency which is calculated using factors of 2 for asphaltic concrete, 1 for Granular "A" base and 0.67 for Granular "B" sub-base

6.4.2 Townhome Access Roadways

The following flexible pavement structure is recommended for the private roadways based on the expected clayey silt subgrade soil and anticipated traffic volume.

Component	Light Duty Pavement (mm)	Heavy Duty Pavement (mm)
Asphaltic Concrete HL3 Asphaltic Concrete HL8	40 40	40 50
Granular "A" Base Course	150	150
Granular "B" Sub-Base Course	300	450

6.4.3 Pavement Construction

The pavement designs consider 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 placement of the granular base layers, the subgrade is to be prepared following the procedures as presented in Section 6.1, Site Grading and Engineered Fill Construction. The exposed subgrade should be thoroughly recompacted with a heavy vibratory compactor and inspected by a qualified geotechnical inspector prior to placement of the pavement granular base and subbase layers. Any soft spots encountered during the process should be excavated to competent soil levels. The required grades can be achieved by placing approved on-site soils in maximum 200 to 300 thick lifts which should be compacted to 98% SPMDD.

The Granular "A" base and Granular "B" sub-base should meet OPSS 1010 requirements and be compacted to 100% SPMDD. The placing and rolling of the asphalt mixture should conform to OPSS.MUNI 310 Table 10 and should be compacted to no less than 92% of the Marshall Density (BRD). The surface course of the asphaltic concrete should be placed at least one (1) year after base course is placed to allow minor settlements of the trench backfill to complete. The incomplete pavement structure may not be capable of supporting the anticipated traffic. Consequently, minor repairs of the sub-base, base and asphaltic concrete may be required prior to paving the surface course asphaltic concrete.

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.

Longitudinal sub-drains with positive drainage outlets are recommended to be installed at the subgrade level along the edges of the roadway construction to enhance the performance of the pavement. Systematic drainage of the granular base materials will promote the longevity of the pavement structure.

6.5 Infiltration Rate of Soils

Based on the results of grain size analyses and our experience, the hydraulic conductivity and infiltration rate of the native inorganic soil types encountered at the boreholes are estimated and provided in the following table:

MATERIAL	PERMEABILITY (K) (cm/sec)	INFILTRATION RATE (mm/hr)
Sandy Silt (Enclosures 12 and 14)	1×10^{-5} to 5×10^{-5}	10 to 25
Clayey Silt to Sandy Clayey Silt (Enclosures 13 and 15)	1×10^{-6} to 2×10^{-6}	1 to 2
Silt, trace to some sand, trace clay	5×10^{-6}	5
Sand and Gravel, some silt	5×10^{-3}	100

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 Soil

Three (3) soil samples were submitted to ALS Laboratory Group of Waterloo, Ontario for analysis of Metals and Inorganics, PHCs (F1 to F4) and BTEX. The chemical testing was conducted to 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 provided by ALS Laboratory Group of Waterloo 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 metals and inorganics indicate that the tested soils do not exceed the allowable concentration limits under Table 1 and Table 2.1 standards.

The analytical results for PHCs (F1-F4) indicate that the tested soils do not exceed the allowable concentration limits under Table 1 and Table 2.1 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.

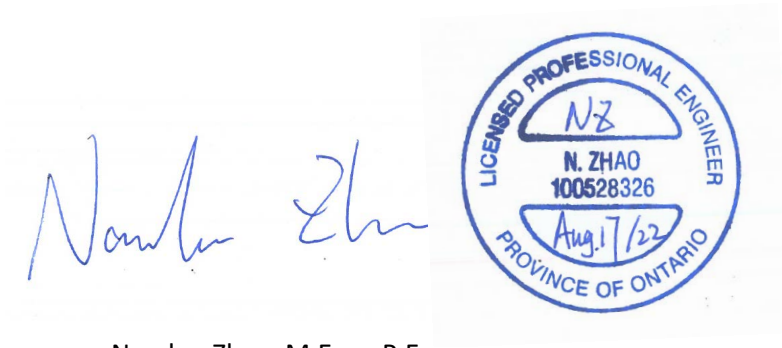
CVD further recommends that a disposal plan for excess soils be established to manage the quantity, as well as where and how the excess soils can be disposed of off-site.

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.



Nandou Zhao, M.Eng., P.Eng.
Geotechnical Engineer

Robert Vander Doelen, P.Eng.
Senior Engineer

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

CHUNG AND VANDER DOELEN
ATTN: MARCELO PEREIRA
311 VICTORIA ST. N.
KITCHENER ON N2H 5E1

Date Received: 18-APR-22
Report Date: 28-APR-22 14:45 (MT)
Version: FINAL

Client Phone: 519-742-8979

Certificate of Analysis

Lab Work Order #: L2699543

Project P.O. #: NOT SUBMITTED
Job Reference: G22410
C of C Numbers: 17-869861
Legal Site Desc:

Emily Hansen
Account Manager

Sample Details Grouping	Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2	#3
L2699543-1	BH3-SA1								
Sampled By:	CA/MP on 12-APR-22								
Matrix:	SOIL								
Physical Tests									
	Conductivity	0.119		0.0040	mS/cm	21-APR-22	0.57	0.7	1.4
	% Moisture	17.9		0.25	%	21-APR-22			
	pH	7.45		0.10	pH units	28-APR-22			
Cyanides									
	Cyanide, Weak Acid Diss	<0.050		0.050	ug/g	22-APR-22	0.051	0.051	0.051
Saturated Paste Extractables									
	SAR	0.60		0.10	SAR	21-APR-22	2.4	5	12
	Calcium (Ca)	6.12		0.50	mg/L	21-APR-22			
	Magnesium (Mg)	1.28		0.50	mg/L	21-APR-22			
	Sodium (Na)	6.22		0.50	mg/L	21-APR-22			
Metals									
	Antimony (Sb)	<1.0		1.0	ug/g	21-APR-22	1.3	7.5	40
	Arsenic (As)	2.2		1.0	ug/g	21-APR-22	18	18	18
	Barium (Ba)	41.7		1.0	ug/g	21-APR-22	220	390	670
	Beryllium (Be)	<0.50		0.50	ug/g	21-APR-22	2.5	4	8
	Boron (B)	5.6		5.0	ug/g	21-APR-22	36	120	120
	Boron (B), Hot Water Ext.	0.25		0.10	ug/g	21-APR-22	36	1.5	2
	Cadmium (Cd)	<0.50		0.50	ug/g	21-APR-22	1.2	1.2	1.9
	Chromium (Cr)	17.3		1.0	ug/g	21-APR-22	70	160	160
	Cobalt (Co)	4.0		1.0	ug/g	21-APR-22	21	22	80
	Copper (Cu)	10.3		1.0	ug/g	21-APR-22	92	140	230
	Lead (Pb)	7.7		1.0	ug/g	21-APR-22	120	120	120
	Mercury (Hg)	0.0552		0.0050	ug/g	21-APR-22	0.27	0.27	0.27
	Molybdenum (Mo)	<1.0		1.0	ug/g	21-APR-22	2	6.9	40
	Nickel (Ni)	8.9		1.0	ug/g	21-APR-22	82	100	270
	Selenium (Se)	<1.0		1.0	ug/g	21-APR-22	1.5	2.4	5.5
	Silver (Ag)	<0.20		0.20	ug/g	21-APR-22	0.5	20	40
	Thallium (Tl)	<0.50		0.50	ug/g	21-APR-22	1	1	3.3
	Uranium (U)	<1.0		1.0	ug/g	21-APR-22	2.5	23	33
	Vanadium (V)	26.9		1.0	ug/g	21-APR-22	86	86	86
	Zinc (Zn)	34.8		5.0	ug/g	21-APR-22	290	340	340
Speciated Metals									
	Chromium, Hexavalent	0.28		0.20	ug/g	22-APR-22	0.66	8	8
Volatile Organic Compounds									
	Benzene	<0.0068		0.0068	ug/g	23-APR-22	0.02	0.02	0.02
	Ethylbenzene	<0.018		0.018	ug/g	23-APR-22	0.05	0.05	0.05
	Toluene	<0.080		0.080	ug/g	23-APR-22	0.2	0.2	0.2
	o-Xylene	<0.020		0.020	ug/g	23-APR-22			
	m+p-Xylenes	<0.030		0.030	ug/g	23-APR-22			
	Xylenes (Total)	<0.050		0.050	ug/g	23-APR-22	0.05	0.091	0.091
	Surrogate: 4-Bromofluorobenzene	98.5		50-140	%	23-APR-22			
	Surrogate: 1,4-Difluorobenzene	91.9		50-140	%	23-APR-22			
Hydrocarbons									
	F1 (C6-C10)	<5.0		5.0	ug/g	23-APR-22	25	25	25
	F1-BTEX	<5.0		5.0	ug/g	23-APR-22	25	25	25

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Ontario Regulation 406/19 - Excess Soils - 17-December-20 = [Suite] - ON-406-T1/T2.1-SOIL-RPIICC

#1: T1 - Soil - Res/Park/Inst/Ind/Com/Commu Property Use

#2: T2.1 - Volume Independent Soil - Res/Park/Inst Property Use

#3: T2.1 - Volume Independent Soil - Ind/Com/Commu Property Use

Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2	#3
L2699543-1 BH3-SA1								
Sampled By: CA/MP on 12-APR-22								
Matrix: SOIL								
Hydrocarbons								
F2 (C10-C16)	<10		10	ug/g	22-APR-22	10	10	26
F3 (C16-C34)	<50		50	ug/g	22-APR-22	240	240	240
F4 (C34-C50)	<50		50	ug/g	22-APR-22	120	2800	3300
Total Hydrocarbons (C6-C50)	<72		72	ug/g	23-APR-22			
Chrom. to baseline at nC50	YES			No Unit	22-APR-22			
Surrogate: 2-Bromobenzotrifluoride	86.2		60-140	%	22-APR-22			
Surrogate: 3,4-Dichlorotoluene	80.5		60-140	%	23-APR-22			
L2699543-2 BH4-SA1								
Sampled By: CA/MP on 12-APR-22								
Matrix: SOIL						#1	#2	#3
Physical Tests								
Conductivity	0.175		0.0040	mS/cm	21-APR-22	0.57	0.7	1.4
% Moisture	27.8		0.25	%	21-APR-22			
pH	7.30		0.10	pH units	28-APR-22			
Cyanides								
Cyanide, Weak Acid Diss	<0.050		0.050	ug/g	22-APR-22	0.051	0.051	0.051
Saturated Paste Extractables								
SAR	0.14		0.10	SAR	21-APR-22	2.4	5	12
Calcium (Ca)	20.8		0.50	mg/L	21-APR-22			
Magnesium (Mg)	5.86		0.50	mg/L	21-APR-22			
Sodium (Na)	2.79		0.50	mg/L	21-APR-22			
Metals								
Antimony (Sb)	<1.0		1.0	ug/g	21-APR-22	1.3	7.5	40
Arsenic (As)	3.3		1.0	ug/g	21-APR-22	18	18	18
Barium (Ba)	56.1		1.0	ug/g	21-APR-22	220	390	670
Beryllium (Be)	<0.50		0.50	ug/g	21-APR-22	2.5	4	8
Boron (B)	6.9		5.0	ug/g	21-APR-22	36	120	120
Boron (B), Hot Water Ext.	0.45		0.10	ug/g	21-APR-22	36	1.5	2
Cadmium (Cd)	<0.50		0.50	ug/g	21-APR-22	1.2	1.2	1.9
Chromium (Cr)	17.9		1.0	ug/g	21-APR-22	70	160	160
Cobalt (Co)	5.5		1.0	ug/g	21-APR-22	21	22	80
Copper (Cu)	13.8		1.0	ug/g	21-APR-22	92	140	230
Lead (Pb)	9.5		1.0	ug/g	21-APR-22	120	120	120
Mercury (Hg)	0.0606		0.0050	ug/g	21-APR-22	0.27	0.27	0.27
Molybdenum (Mo)	<1.0		1.0	ug/g	21-APR-22	2	6.9	40
Nickel (Ni)	11.2		1.0	ug/g	21-APR-22	82	100	270
Selenium (Se)	<1.0		1.0	ug/g	21-APR-22	1.5	2.4	5.5
Silver (Ag)	<0.20		0.20	ug/g	21-APR-22	0.5	20	40
Thallium (Tl)	<0.50		0.50	ug/g	21-APR-22	1	1	3.3
Uranium (U)	<1.0		1.0	ug/g	21-APR-22	2.5	23	33
Vanadium (V)	28.7		1.0	ug/g	21-APR-22	86	86	86
Zinc (Zn)	46.7		5.0	ug/g	21-APR-22	290	340	340
Speciated Metals								
Chromium, Hexavalent	<0.20		0.20	ug/g	22-APR-22	0.66	8	8

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Ontario Regulation 406/19 - Excess Soils - 17-December-20 = [Suite] - ON-406-T1/T2.1-SOIL-RPIICC

#1: T1 - Soil - Res/Park/Inst/Ind/Com/Commu Property Use

#2: T2.1 - Volume Independent Soil - Res/Park/Inst Property Use

#3: T2.1 - Volume Independent Soil - Ind/Com/Commu Property Use

Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2	#3	
L2699543-2 BH4-SA1									
Sampled By: CA/MP on 12-APR-22									
Matrix: SOIL									
Volatile Organic Compounds									
Benzene	<0.0068		0.0068	ug/g	25-APR-22	0.02	0.02	0.02	
Ethylbenzene	<0.018		0.018	ug/g	25-APR-22	0.05	0.05	0.05	
Toluene	<0.080		0.080	ug/g	25-APR-22	0.2	0.2	0.2	
o-Xylene	<0.020		0.020	ug/g	25-APR-22				
m+p-Xylenes	<0.030		0.030	ug/g	25-APR-22				
Xylenes (Total)	<0.050		0.050	ug/g	26-APR-22	0.05	0.091	0.091	
Surrogate: 4-Bromofluorobenzene	93.8		50-140	%	25-APR-22				
Surrogate: 1,4-Difluorobenzene	102.3		50-140	%	25-APR-22				
Hydrocarbons									
F1 (C6-C10)	<5.0		5.0	ug/g	25-APR-22	25	25	25	
F1-BTEX	<5.0		5.0	ug/g	26-APR-22	25	25	25	
F2 (C10-C16)	<10		10	ug/g	22-APR-22	10	10	26	
F3 (C16-C34)	<50		50	ug/g	22-APR-22	240	240	240	
F4 (C34-C50)	<50		50	ug/g	22-APR-22	120	2800	3300	
Total Hydrocarbons (C6-C50)	<72		72	ug/g	26-APR-22				
Chrom. to baseline at nC50	YES			No Unit	22-APR-22				
Surrogate: 2-Bromobenzotrifluoride	87.4		60-140	%	22-APR-22				
Surrogate: 3,4-Dichlorotoluene	94.3		60-140	%	25-APR-22				
L2699543-3 BH10-SA1									
Sampled By: CA/MP on 12-APR-22									
Matrix: SOIL						#1	#2	#3	
Physical Tests									
Conductivity	0.147		0.0040	mS/cm	21-APR-22	0.57	0.7	1.4	
% Moisture	27.6		0.25	%	21-APR-22				
pH	7.26		0.10	pH units	28-APR-22				
Cyanides									
Cyanide, Weak Acid Diss	<0.050		0.050	ug/g	22-APR-22	0.051	0.051	0.051	
Saturated Paste Extractables									
SAR	0.52		0.10	SAR	21-APR-22	2.4	5	12	
Calcium (Ca)	11.3		0.50	mg/L	21-APR-22				
Magnesium (Mg)	2.74		0.50	mg/L	21-APR-22				
Sodium (Na)	7.52		0.50	mg/L	21-APR-22				
Metals									
Antimony (Sb)	<1.0		1.0	ug/g	21-APR-22	1.3	7.5	40	
Arsenic (As)	3.9		1.0	ug/g	21-APR-22	18	18	18	
Barium (Ba)	70.5		1.0	ug/g	21-APR-22	220	390	670	
Beryllium (Be)	<0.50		0.50	ug/g	21-APR-22	2.5	4	8	
Boron (B)	8.1		5.0	ug/g	21-APR-22	36	120	120	
Boron (B), Hot Water Ext.	0.23		0.10	ug/g	21-APR-22	36	1.5	2	
Cadmium (Cd)	<0.50		0.50	ug/g	21-APR-22	1.2	1.2	1.9	
Chromium (Cr)	20.1		1.0	ug/g	21-APR-22	70	160	160	
Cobalt (Co)	6.4		1.0	ug/g	21-APR-22	21	22	80	
Copper (Cu)	12.5		1.0	ug/g	21-APR-22	92	140	230	
Lead (Pb)	9.4		1.0	ug/g	21-APR-22	120	120	120	
Mercury (Hg)	0.0448		0.0050	ug/g	21-APR-22	0.27	0.27	0.27	

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Ontario Regulation 406/19 - Excess Soils - 17-December-20 = [Suite] - ON-406-T1/T2.1-SOIL-RPIICC

#1: T1 - Soil - Res/Park/Inst/Ind/Com/Commu Property Use

#2: T2.1 - Volume Independent Soil - Res/Park/Inst Property Use

#3: T2.1 - Volume Independent Soil - Ind/Com/Commu Property Use

Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2	#3	
L2699543-3 BH10-SA1									
Sampled By: CA/MP on 12-APR-22									
Matrix: SOIL									
Metals									
Molybdenum (Mo)	<1.0		1.0	ug/g	21-APR-22	2	6.9	40	
Nickel (Ni)	13.7		1.0	ug/g	21-APR-22	82	100	270	
Selenium (Se)	<1.0		1.0	ug/g	21-APR-22	1.5	2.4	5.5	
Silver (Ag)	<0.20		0.20	ug/g	21-APR-22	0.5	20	40	
Thallium (Tl)	<0.50		0.50	ug/g	21-APR-22	1	1	3.3	
Uranium (U)	<1.0		1.0	ug/g	21-APR-22	2.5	23	33	
Vanadium (V)	34.0		1.0	ug/g	21-APR-22	86	86	86	
Zinc (Zn)	48.6		5.0	ug/g	21-APR-22	290	340	340	
Speciated Metals									
Chromium, Hexavalent	<0.20		0.20	ug/g	22-APR-22	0.66	8	8	
Volatile Organic Compounds									
Benzene	<0.0068		0.0068	ug/g	25-APR-22	0.02	0.02	0.02	
Ethylbenzene	<0.018		0.018	ug/g	25-APR-22	0.05	0.05	0.05	
Toluene	<0.080		0.080	ug/g	25-APR-22	0.2	0.2	0.2	
o-Xylene	<0.020		0.020	ug/g	25-APR-22				
m+p-Xylenes	<0.030		0.030	ug/g	25-APR-22				
Xylenes (Total)	<0.050		0.050	ug/g	26-APR-22	0.05	0.091	0.091	
Surrogate: 4-Bromofluorobenzene	88.7		50-140	%	25-APR-22				
Surrogate: 1,4-Difluorobenzene	94.2		50-140	%	25-APR-22				
Hydrocarbons									
F1 (C6-C10)	<5.0		5.0	ug/g	25-APR-22	25	25	25	
F1-BTEX	<5.0		5.0	ug/g	26-APR-22	25	25	25	
F2 (C10-C16)	<10		10	ug/g	22-APR-22	10	10	26	
F3 (C16-C34)	<50		50	ug/g	22-APR-22	240	240	240	
F4 (C34-C50)	<50		50	ug/g	22-APR-22	120	2800	3300	
Total Hydrocarbons (C6-C50)	<72		72	ug/g	26-APR-22				
Chrom. to baseline at nC50	YES			No Unit	22-APR-22				
Surrogate: 2-Bromobenzotrifluoride	85.8		60-140	%	22-APR-22				
Surrogate: 3,4-Dichlorotoluene	77.2		60-140	%	25-APR-22				

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Ontario Regulation 406/19 - Excess Soils - 17-December-20 = [Suite] - ON-406-T1/T2.1-SOIL-RPIICC

#1: T1 - Soil - Res/Park/Inst/Ind/Com/Commu Property Use

#2: T2.1 - Volume Independent Soil - Res/Park/Inst Property Use

#3: T2.1 - Volume Independent Soil - Ind/Com/Commu Property Use

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference***
B-HWS-R511-WT	Soil	Boron-HWE-O.Reg 153/04 (July 2011)	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 and as of November 30, 2020), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

BTX-511-HS-WT	Soil	BTEX-O.Reg 153/04 (July 2011)	SW846 8260

BTX is determined by extracting a soil or sediment sample as received with methanol, then analyzing by headspace-GC/MS.

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 and as of November 30, 2020), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

CN-WAD-R511-WT	Soil	Cyanide (WAD)-O.Reg 153/04 (July 2011)	MOE 3015/APHA 4500CN I-WAD

The sample is extracted with a strong base for 16 hours, and then filtered. The filtrate is then distilled where the cyanide is converted to cyanogen chloride by reacting with chloramine-T, the cyanogen chloride then reacts with a combination of barbituric acid and isonicotinic acid to form a highly colored complex.

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 and as of November 30, 2020), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

CR-CR6-IC-WT	Soil	Hexavalent Chromium in Soil	SW846 3060A/7199

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Method 7199, published by the United States Environmental Protection Agency (EPA). The procedure involves analysis for chromium (VI) by ion chromatography using diphenylcarbazide in a sulphuric acid solution.

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).

EC-WT	Soil	Conductivity (EC)	MOEE E3138

A representative subsample is tumbled with de-ionized (DI) water. The ratio of water to soil is 2:1 v/w. After tumbling the sample is then analyzed by a conductivity meter.

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).

F1-F4-511-CALC-WT	Soil	F1-F4 Hydrocarbon Calculated Parameters	CCME CWS-PHC, Pub #1310, Dec 2001-S

Analytical methods used for analysis of CCME Petroleum Hydrocarbons have been validated and comply with the Reference Method for the CWS PHC.

Hydrocarbon results are expressed on a dry weight basis.

In cases where results for both F4 and F4G are reported, the greater of the two results must be used in any application of the CWS PHC guidelines and the gravimetric heavy hydrocarbons cannot be added to the C6 to C50 hydrocarbons.
In samples where BTEX and F1 were analyzed , F1-BTEX represents a value where the sum of Benzene, Toluene, Ethylbenzene and total Xylenes has been subtracted from F1.

In samples where PAHs, F2 and F3 were analyzed, F2-Naphth represents the result where Naphthalene has been subtracted from F2. F3-PAH represents a result where the sum of Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenzo(a,h)anthracene, Fluoranthene, Indeno(1,2,3-cd)pyrene, Phenanthrene, and Pyrene has been subtracted from F3.

Unless otherwise qualified, the following quality control criteria have been met for the F1 hydrocarbon range:
1. All extraction and analysis holding times were met.
2. Instrument performance showing response factors for C6 and C10 within 30% of the response factor for toluene.
3. Linearity of gasoline response within 15% throughout the calibration range.

Unless otherwise qualified, the following quality control criteria have been met for the F2-F4 hydrocarbon ranges:
1. All extraction and analysis holding times were met.
2. Instrument performance showing C10, C16 and C34 response factors within 10% of their average.
3. Instrument performance showing the C50 response factor within 30% of the average of the C10, C16 and C34 response factors.
4. Linearity of diesel or motor oil response within 15% throughout the calibration range.

Reference Information

F1-HS-511-WT	Soil	F1-O.Reg 153/04 (July 2011)	E3398/CCME TIER 1-HS

Fraction F1 is determined by extracting a soil or sediment sample as received with methanol, then analyzing by headspace-GC/FID.

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 and as of November 30, 2020), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

F2-F4-511-WT	Soil	F2-F4-O.Reg 153/04 (July 2011)	CCME Tier 1

Petroleum Hydrocarbons (F2-F4 fractions) are extracted from soil with 1:1 hexane:acetone using a rotary extractor. Extracts are treated with silica gel to remove polar organic interferences. F2, F3, & F4 are analyzed by GC-FID. F4G-sg is analyzed gravimetrically.

Notes:
1. F2 (C10-C16): Sum of all hydrocarbons that elute between nC10 and nC16.
2. F3 (C16-C34): Sum of all hydrocarbons that elute between nC16 and nC34.
3. F4 (C34-C50): Sum of all hydrocarbons that elute between nC34 and nC50.
4. F4G: Gravimetric Heavy Hydrocarbons
5. F4G-sg: Gravimetric Heavy Hydrocarbons (F4G) after silica gel treatment.
6. Where both F4 (C34-C50) and F4G-sg are reported for a sample, the larger of the two values is used for comparison against the relevant CCME guideline for F4.
7. F4G-sg cannot be added to the C6 to C50 hydrocarbon results to obtain an estimate of total extractable hydrocarbons.
8. This method is validated for use.
9. Data from analysis of validation and quality control samples is available upon request.
10. Reported results are expressed as milligrams per dry kilogram, unless otherwise indicated.

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 and as of November 30, 2020), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

HG-200.2-CVAA-WT	Soil	Mercury in Soil by CVAAS	EPA 200.2/1631E (mod)

Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CVAAS.

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).

MET-200.2-CCMS-WT	Soil	Metals in Soil by CRC ICPMS	EPA 200.2/6020B (mod)

Soil/sediment is dried, disaggregated, and sieved (2 mm). For tests intended to support Ontario regulations, the <2mm fraction is ground to pass through a 0.355 mm sieve. Strong Acid Leachable Metals in the <2mm fraction are solubilized by heated digestion with nitric and hydrochloric acids. Instrumental analysis is by Collision / Reaction Cell ICPMS.

Limitations: This method is intended to liberate environmentally available metals. Silicate minerals are not solubilized. Some metals may be only partially recovered (matrix dependent), including Al, Ba, Be, Cr, S, Sr, Ti, Tl, V, W, and Zr. Elemental Sulfur may be poorly recovered by this method. Volatile forms of sulfur (e.g. sulfide, H2S) may be excluded if lost during sampling, storage, or digestion.

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), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

MOISTURE-WT	Soil	% Moisture	CCME PHC in Soil - Tier 1 (mod)
PH-WT	Soil	pH	MOEE E3137A

A minimum 10g portion of the sample 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 and then analyzed using a pH meter and electrode.

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).

SAR-R511-WT	Soil	SAR-O.Reg 153/04 (July 2011)	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.

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 and as of November 30, 2020), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

Reference Information

XYLENES-SUM-CALC-WT	Soil	Sum of Xylene Isomer Concentrations	CALCULATION

Total xylenes represents the sum of o-xylene and m&p-xylene.

*** ALS test methods may incorporate modifications from specified reference methods to improve performance.

Chain of Custody numbers:

17-869861

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA		

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

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. Guideline limits 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.

Quality Control Report

Workorder: L2699543 Report Date: 28-APR-22

Client: CHUNG AND VANDER DOELEN
311 VICTORIA ST. N.
KITCHENER ON N2H 5E1
Contact: MARCELO PEREIRA

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
B-HWS-R511-WT	**Soil**							
Batch R5767444								
WG3718915-4 DUP		**L2699792-5**						
Boron (B), Hot Water Ext.		0.21	0.21		ug/g	1.1	30	21-APR-22
WG3718915-2 IRM		**WT SAR4**						
Boron (B), Hot Water Ext.			96.3		%		70-130	21-APR-22
WG3718915-3 LCS								
Boron (B), Hot Water Ext.			104.0		%		70-130	21-APR-22
WG3718915-1 MB								
Boron (B), Hot Water Ext.			<0.10		ug/g		0.1	21-APR-22
BTX-511-HS-WT	**Soil**							
Batch R5767614								
WG3718913-4 DUP		**WG3718913-3**						
Benzene		<0.0068	<0.0068	RPD-NA	ug/g	N/A	40	22-APR-22
Ethylbenzene		<0.018	<0.018	RPD-NA	ug/g	N/A	40	22-APR-22
m+p-Xylenes		<0.030	<0.030	RPD-NA	ug/g	N/A	40	22-APR-22
o-Xylene		<0.020	<0.020	RPD-NA	ug/g	N/A	40	22-APR-22
Toluene		<0.080	<0.080	RPD-NA	ug/g	N/A	40	22-APR-22
WG3718913-2 LCS								
Benzene			118.0		%		70-130	22-APR-22
Ethylbenzene			116.0		%		70-130	22-APR-22
m+p-Xylenes			106.7		%		70-130	22-APR-22
o-Xylene			107.1		%		70-130	22-APR-22
Toluene			117.5		%		70-130	22-APR-22
WG3718913-1 MB								
Benzene			<0.0068		ug/g		0.0068	22-APR-22
Ethylbenzene			<0.018		ug/g		0.018	22-APR-22
m+p-Xylenes			<0.030		ug/g		0.03	22-APR-22
o-Xylene			<0.020		ug/g		0.02	22-APR-22
Toluene			<0.080		ug/g		0.08	22-APR-22
Surrogate: 1,4-Difluorobenzene			116.3		%		50-140	22-APR-22
Surrogate: 4-Bromofluorobenzene			105.4		%		50-140	22-APR-22
WG3718913-5 MS		**WG3718913-3**						
Benzene			116.2		%		60-140	22-APR-22
Ethylbenzene			117.7		%		60-140	22-APR-22
m+p-Xylenes			108.9		%		60-140	22-APR-22
o-Xylene			109.7		%		60-140	22-APR-22
Toluene			119.6		%		60-140	22-APR-22

Quality Control Report

Client: CHUNG AND VANDER DOELEN
311 VICTORIA ST. N.
KITCHENER ON N2H 5E1
Contact: MARCELO PEREIRA

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
BTX-511-HS-WT	**Soil**							
Batch R5768245								
WG3719237-4 DUP		**WG3719237-3**						
Benzene		<0.0068	<0.0068	RPD-NA	ug/g	N/A	40	25-APR-22
Ethylbenzene		<0.018	<0.018	RPD-NA	ug/g	N/A	40	25-APR-22
m+p-Xylenes		<0.030	<0.030	RPD-NA	ug/g	N/A	40	25-APR-22
o-Xylene		<0.020	<0.020	RPD-NA	ug/g	N/A	40	25-APR-22
Toluene		<0.080	<0.080	RPD-NA	ug/g	N/A	40	25-APR-22
WG3719237-2 LCS								
Benzene			100.6		%		70-130	25-APR-22
Ethylbenzene			96.4		%		70-130	25-APR-22
m+p-Xylenes			94.6		%		70-130	25-APR-22
o-Xylene			97.8		%		70-130	25-APR-22
Toluene			90.6		%		70-130	25-APR-22
WG3719237-1 MB								
Benzene			<0.0068		ug/g		0.0068	25-APR-22
Ethylbenzene			<0.018		ug/g		0.018	25-APR-22
m+p-Xylenes			<0.030		ug/g		0.03	25-APR-22
o-Xylene			<0.020		ug/g		0.02	25-APR-22
Toluene			<0.080		ug/g		0.08	25-APR-22
Surrogate: 1,4-Difluorobenzene			138.1		%		50-140	25-APR-22
Surrogate: 4-Bromofluorobenzene			123.9		%		50-140	25-APR-22
WG3719237-5 MS		**WG3719237-3**						
Benzene			106.5		%		60-140	25-APR-22
Ethylbenzene			107.4		%		60-140	25-APR-22
m+p-Xylenes			104.9		%		60-140	25-APR-22
o-Xylene			104.8		%		60-140	25-APR-22
Toluene			106.7		%		60-140	25-APR-22
CN-WAD-R511-WT	**Soil**							
Batch R5768111								
WG3718414-3 DUP		**L2699801-2**						
Cyanide, Weak Acid Diss		<0.050	<0.050	RPD-NA	ug/g	N/A	35	22-APR-22
WG3718414-2 LCS								
Cyanide, Weak Acid Diss			93.7		%		80-120	22-APR-22
WG3718414-1 MB								
Cyanide, Weak Acid Diss			<0.050		ug/g		0.05	22-APR-22
WG3718414-4 MS		**L2699801-2**						
Cyanide, Weak Acid Diss			99.1		%		70-130	22-APR-22

Quality Control Report

Client: CHUNG AND VANDER DOELEN
311 VICTORIA ST. N.
KITCHENER ON N2H 5E1
Contact: MARCELO PEREIRA

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CR-CR6-IC-WT	**Soil**							
Batch R5768263								
WG3718816-3 DUP		**L2699837-1**						
Chromium, Hexavalent		<0.20	<0.20	RPD-NA	ug/g	N/A	35	22-APR-22
WG3718816-2 LCS								
Chromium, Hexavalent			87.7		%		80-120	22-APR-22
WG3718816-1 MB								
Chromium, Hexavalent			<0.20		ug/g		0.2	22-APR-22
WG3718816-4 MS		**L2699837-1**						
Chromium, Hexavalent			99.9		%		70-130	22-APR-22
EC-WT	**Soil**							
Batch R5767385								
WG3718919-4 DUP		**WG3718919-3**						
Conductivity		0.298	0.283		mS/cm	5.2	20	21-APR-22
WG3718919-2 IRM		**WT SAR4**						
Conductivity			109.0		%		70-130	21-APR-22
WG3719117-1 LCS								
Conductivity			97.5		%		90-110	21-APR-22
WG3718919-1 MB								
Conductivity			<0.0040		mS/cm		0.004	21-APR-22
F1-HS-511-WT	**Soil**							
Batch R5767614								
WG3718913-4 DUP		**WG3718913-3**						
F1 (C6-C10)		<5.0	<5.0	RPD-NA	ug/g	N/A	30	22-APR-22
WG3718913-2 LCS								
F1 (C6-C10)			106.4		%		80-120	22-APR-22
WG3718913-1 MB								
F1 (C6-C10)			<5.0		ug/g		5	22-APR-22
Surrogate: 3,4-Dichlorotoluene			120.8		%		60-140	22-APR-22
WG3718913-5 MS		**WG3718913-3**						
F1 (C6-C10)			102.3		%		60-140	22-APR-22
Batch R5768245								
WG3719237-4 DUP		**WG3719237-3**						
F1 (C6-C10)		<5.0	<5.0	RPD-NA	ug/g	N/A	30	25-APR-22
WG3719237-2 LCS								
F1 (C6-C10)			110.2		%		80-120	25-APR-22
WG3719237-1 MB								
F1 (C6-C10)			<5.0		ug/g		5	25-APR-22
Surrogate: 3,4-Dichlorotoluene			77.1		%		60-140	25-APR-22

Quality Control Report

Client: CHUNG AND VANDER DOELEN
311 VICTORIA ST. N.
KITCHENER ON N2H 5E1
Contact: MARCELO PEREIRA

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
F1-HS-511-WT	**Soil**							
Batch R5768245								
WG3719237-5 MS		**WG3719237-3**						
F1 (C6-C10)			117.8		%		60-140	25-APR-22
F2-F4-511-WT	**Soil**							
Batch R5767803								
WG3718535-3 DUP		**WG3718535-5**						
F2 (C10-C16)		330	379		ug/g	14	40	22-APR-22
F3 (C16-C34)		<50	<50	RPD-NA	ug/g	N/A	40	22-APR-22
F4 (C34-C50)		<50	<50	RPD-NA	ug/g	N/A	40	22-APR-22
WG3718535-2 LCS								
F2 (C10-C16)			94.4		%		70-130	22-APR-22
F3 (C16-C34)			93.6		%		70-130	22-APR-22
F4 (C34-C50)			98.7		%		70-130	22-APR-22
WG3718535-1 MB								
F2 (C10-C16)			<10		ug/g		10	22-APR-22
F3 (C16-C34)			<50		ug/g		50	22-APR-22
F4 (C34-C50)			<50		ug/g		50	22-APR-22
Surrogate: 2-Bromobenzotrifluoride			88.3		%		60-140	22-APR-22
WG3718535-4 MS		**WG3718535-5**						
F2 (C10-C16)			96.5		%		60-140	22-APR-22
F3 (C16-C34)			97.6		%		60-140	22-APR-22
F4 (C34-C50)			104.5		%		60-140	22-APR-22
HG-200.2-CVAA-WT	**Soil**							
Batch R5767314								
WG3718917-2 CRM		**WT-SS-2**						
Mercury (Hg)			104.3		%		70-130	21-APR-22
WG3718917-6 DUP		**WG3718917-5**						
Mercury (Hg)		0.0174	0.0168		ug/g	3.5	40	21-APR-22
WG3718917-3 LCS								
Mercury (Hg)			114.0		%		80-120	21-APR-22
WG3718917-1 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	21-APR-22
MET-200.2-CCMS-WT	**Soil**							

Quality Control Report

Client: CHUNG AND VANDER DOELEN
311 VICTORIA ST. N.
KITCHENER ON N2H 5E1
Contact: MARCELO PEREIRA

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-WT	**Soil**							
Batch R5767514								
WG3718917-2 CRM		**WT-SS-2**						
Antimony (Sb)			87.9		%		70-130	21-APR-22
Arsenic (As)			92.7		%		70-130	21-APR-22
Barium (Ba)			100.2		%		70-130	21-APR-22
Beryllium (Be)			85.4		%		70-130	21-APR-22
Boron (B)			7.6		mg/kg		3.5-13.5	21-APR-22
Cadmium (Cd)			100.7		%		70-130	21-APR-22
Chromium (Cr)			96.8		%		70-130	21-APR-22
Cobalt (Co)			98.1		%		70-130	21-APR-22
Copper (Cu)			99.0		%		70-130	21-APR-22
Lead (Pb)			84.3		%		70-130	21-APR-22
Molybdenum (Mo)			92.3		%		70-130	21-APR-22
Nickel (Ni)			98.0		%		70-130	21-APR-22
Selenium (Se)			0.13		mg/kg		0-0.34	21-APR-22
Silver (Ag)			97.6		%		70-130	21-APR-22
Thallium (Tl)			0.063		mg/kg		0.029-0.129	21-APR-22
Uranium (U)			82.6		%		70-130	21-APR-22
Vanadium (V)			96.7		%		70-130	21-APR-22
Zinc (Zn)			92.9		%		70-130	21-APR-22
WG3718917-6 DUP		**WG3718917-5**						
Antimony (Sb)		0.13	0.14		ug/g	7.0	30	21-APR-22
Arsenic (As)		4.87	4.93		ug/g	1.3	30	21-APR-22
Barium (Ba)		72.0	73.1		ug/g	1.5	40	21-APR-22
Beryllium (Be)		0.64	0.63		ug/g	2.3	30	21-APR-22
Boron (B)		7.0	7.3		ug/g	4.6	30	21-APR-22
Cadmium (Cd)		0.105	0.111		ug/g	5.5	30	21-APR-22
Chromium (Cr)		20.6	20.7		ug/g	0.1	30	21-APR-22
Cobalt (Co)		10.1	10.2		ug/g	1.1	30	21-APR-22
Copper (Cu)		25.4	25.5		ug/g	0.5	30	21-APR-22
Lead (Pb)		9.12	9.27		ug/g	1.6	40	21-APR-22
Molybdenum (Mo)		0.35	0.38		ug/g	9.0	40	21-APR-22
Nickel (Ni)		22.9	23.3		ug/g	1.6	30	21-APR-22
Selenium (Se)		<0.20	<0.20	RPD-NA	ug/g	N/A	30	21-APR-22
Silver (Ag)		<0.10	<0.10	RPD-NA	ug/g	N/A	40	21-APR-22

Quality Control Report

Client: CHUNG AND VANDER DOELEN
311 VICTORIA ST. N.
KITCHENER ON N2H 5E1
Contact: MARCELO PEREIRA

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-WT	**Soil**							
Batch R5767514								
WG3718917-6 DUP		**WG3718917-5**						
Thallium (Tl)		0.121	0.124		ug/g	1.8	30	21-APR-22
Uranium (U)		0.632	0.661		ug/g	4.5	30	21-APR-22
Vanadium (V)		31.1	31.3		ug/g	0.6	30	21-APR-22
Zinc (Zn)		47.3	47.3		ug/g	0.1	30	21-APR-22
WG3718917-4 LCS								
Antimony (Sb)			98.0		%		80-120	21-APR-22
Arsenic (As)			93.0		%		80-120	21-APR-22
Barium (Ba)			93.1		%		80-120	21-APR-22
Beryllium (Be)			89.2		%		80-120	21-APR-22
Boron (B)			89.6		%		80-120	21-APR-22
Cadmium (Cd)			91.9		%		80-120	21-APR-22
Chromium (Cr)			92.4		%		80-120	21-APR-22
Cobalt (Co)			90.8		%		80-120	21-APR-22
Copper (Cu)			90.5		%		80-120	21-APR-22
Lead (Pb)			92.5		%		80-120	21-APR-22
Molybdenum (Mo)			94.8		%		80-120	21-APR-22
Nickel (Ni)			91.9		%		80-120	21-APR-22
Selenium (Se)			90.3		%		80-120	21-APR-22
Silver (Ag)			85.8		%		80-120	21-APR-22
Thallium (Tl)			90.5		%		80-120	21-APR-22
Uranium (U)			90.1		%		80-120	21-APR-22
Vanadium (V)			94.1		%		80-120	21-APR-22
Zinc (Zn)			89.3		%		80-120	21-APR-22
WG3718917-1 MB								
Antimony (Sb)			<0.10		mg/kg		0.1	21-APR-22
Arsenic (As)			<0.10		mg/kg		0.1	21-APR-22
Barium (Ba)			<0.50		mg/kg		0.5	21-APR-22
Beryllium (Be)			<0.10		mg/kg		0.1	21-APR-22
Boron (B)			<5.0		mg/kg		5	21-APR-22
Cadmium (Cd)			<0.020		mg/kg		0.02	21-APR-22
Chromium (Cr)			<0.50		mg/kg		0.5	21-APR-22
Cobalt (Co)			<0.10		mg/kg		0.1	21-APR-22
Copper (Cu)			<0.50		mg/kg		0.5	21-APR-22
Lead (Pb)			<0.50		mg/kg		0.5	21-APR-22

Quality Control Report

Client: CHUNG AND VANDER DOELEN
311 VICTORIA ST. N.
KITCHENER ON N2H 5E1
Contact: MARCELO PEREIRA

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-WT	**Soil**							
Batch R5767514								
WG3718917-1 MB								
Molybdenum (Mo)			<0.10		mg/kg		0.1	21-APR-22
Nickel (Ni)			<0.50		mg/kg		0.5	21-APR-22
Selenium (Se)			<0.20		mg/kg		0.2	21-APR-22
Silver (Ag)			<0.10		mg/kg		0.1	21-APR-22
Thallium (Tl)			<0.050		mg/kg		0.05	21-APR-22
Uranium (U)			<0.050		mg/kg		0.05	21-APR-22
Vanadium (V)			<0.20		mg/kg		0.2	21-APR-22
Zinc (Zn)			<2.0		mg/kg		2	21-APR-22
MOISTURE-WT	**Soil**							
Batch R5766977								
WG3718478-3 DUP		**L2699543-1**						
% Moisture		17.9	18.1		%	1.0	20	21-APR-22
WG3718478-2 LCS								
% Moisture			99.1		%		90-110	21-APR-22
WG3718478-1 MB								
% Moisture			<0.25		%		0.25	21-APR-22
PH-WT	**Soil**							
Batch R5769472								
WG3720433-1 DUP		**L2699541-1**						
pH		7.81	7.84	J	pH units	0.03	0.3	28-APR-22
WG3721336-1 LCS								
pH			6.98		pH units		6.9-7.1	28-APR-22
SAR-R511-WT	**Soil**							
Batch R5767499								
WG3718919-4 DUP		**WG3718919-3**						
Calcium (Ca)		38.2	35.4		mg/L	7.6	30	21-APR-22
Sodium (Na)		16.2	16.0		mg/L	1.2	30	21-APR-22
Magnesium (Mg)		1.90	1.83		mg/L	3.8	30	21-APR-22
WG3718919-2 IRM		**WT SAR4**						
Calcium (Ca)			113.9		%		70-130	21-APR-22
Sodium (Na)			117.9		%		70-130	21-APR-22
Magnesium (Mg)			116.7		%		70-130	21-APR-22
WG3718919-5 LCS								
Calcium (Ca)			108.0		%		80-120	21-APR-22
Sodium (Na)			104.0		%		80-120	21-APR-22

Quality Control Report

Client: CHUNG AND VANDER DOELEN
311 VICTORIA ST. N.
KITCHENER ON N2H 5E1
Contact: MARCELO PEREIRA

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SAR-R511-WT	**Soil**							
Batch R5767499								
WG3718919-5 LCS								
Magnesium (Mg)			105.2		%		80-120	21-APR-22
WG3718919-1 MB								
Calcium (Ca)			<0.50		mg/L		0.5	21-APR-22
Sodium (Na)			<0.50		mg/L		0.5	21-APR-22
Magnesium (Mg)			<0.50		mg/L		0.5	21-APR-22

Quality Control Report

Workorder: L2699543 Report Date: 28-APR-22

Client: CHUNG AND VANDER DOELEN
311 VICTORIA ST. N.
KITCHENER ON N2H 5E1
Contact: MARCELO PEREIRA

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

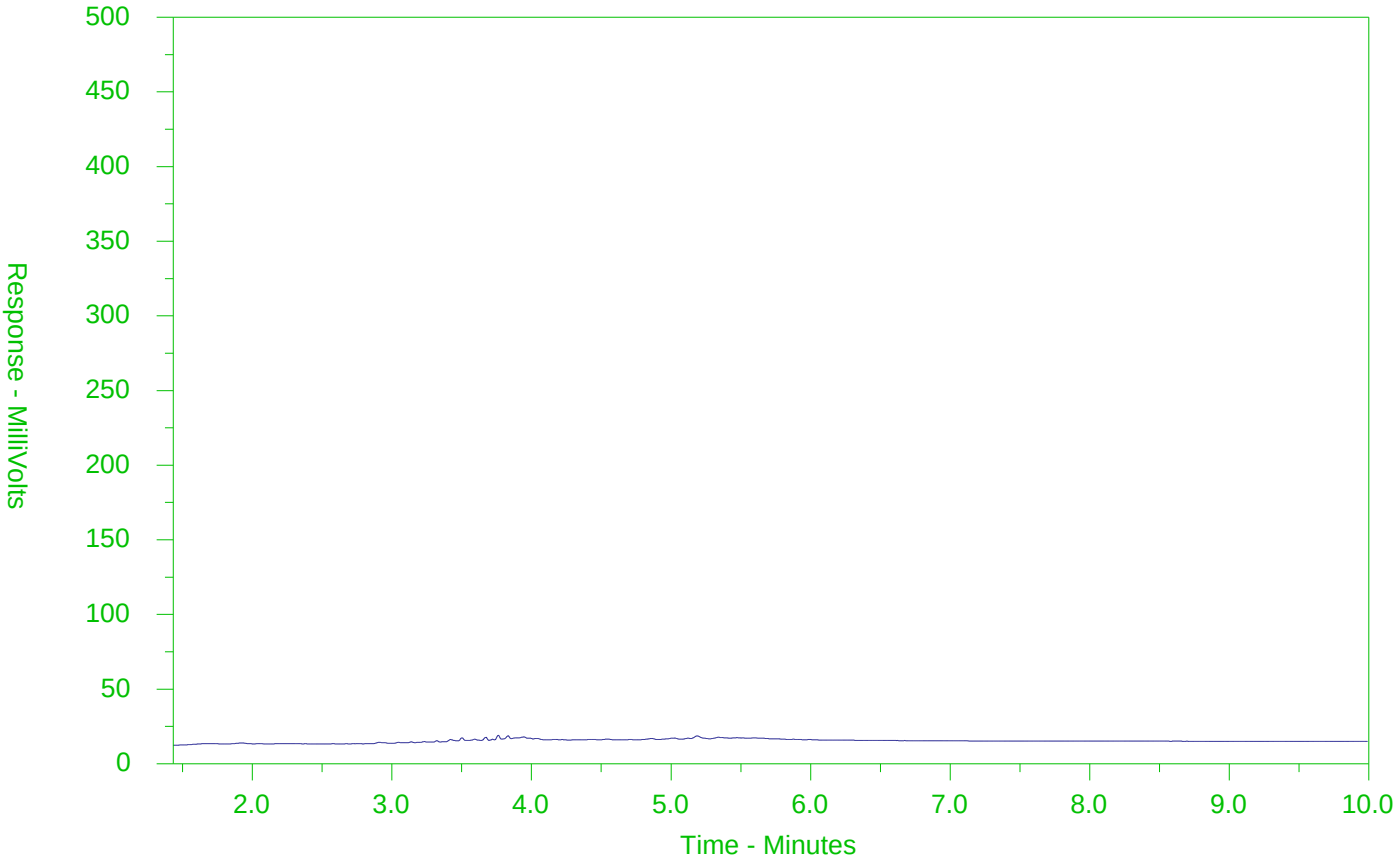
ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes 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 pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2699543-1
Client Sample ID: BH3-SA1



←F2→	←F3→	←F4→	
nC10	nC16	nC34	nC50
174°C	287°C	481°C	575°C
346°F	549°F	898°F	1067°F
Gasoline →		← Motor Oils/Lube Oils/Grease →	
← Diesel/Jet Fuels →			

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

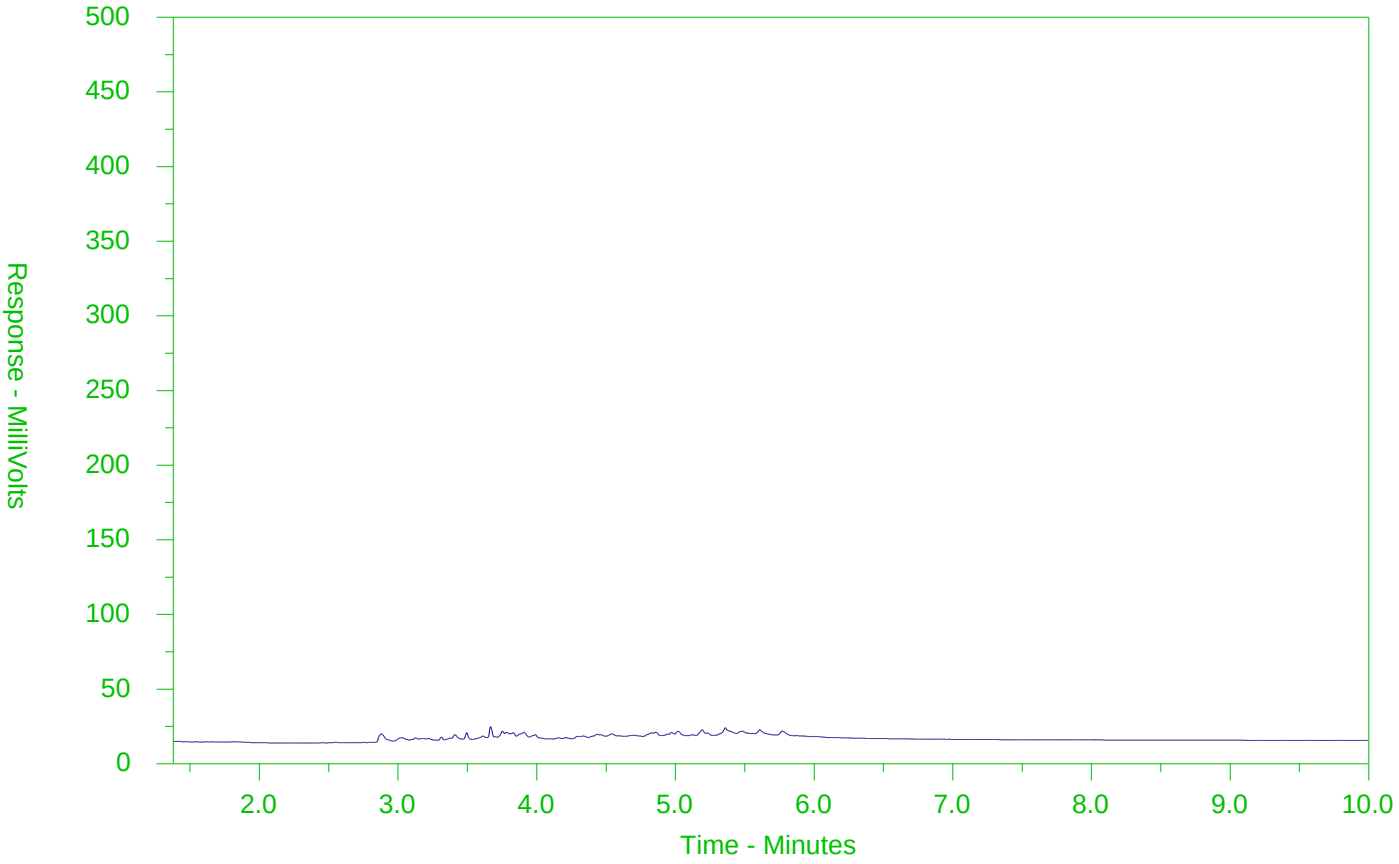
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2699543-2
Client Sample ID: BH4-SA1



←F2→	←F3→	←F4→	
nC10	nC16	nC34	nC50
174°C	287°C	481°C	575°C
346°F	549°F	898°F	1067°F
Gasoline →	← Motor Oils/Lube Oils/Grease →		
← Diesel/Jet Fuels →			

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

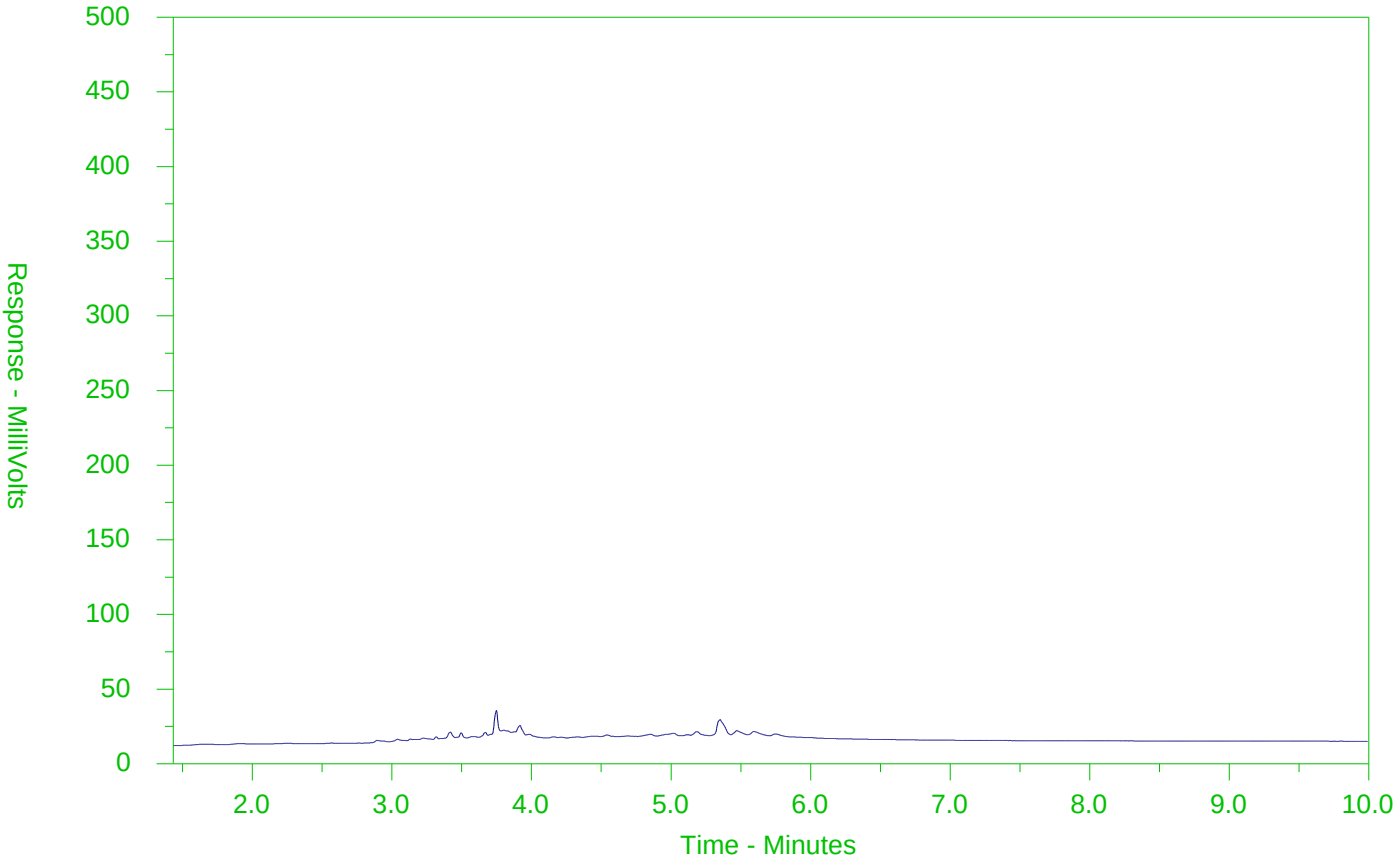
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2699543-3
Client Sample ID: BH10-SA1



←F2→	←F3→	←F4→	
nC10	nC16	nC34	nC50
174°C	287°C	481°C	575°C
346°F	549°F	898°F	1067°F
Gasoline →		← Motor Oils/Lube Oils/Grease →	
← Diesel/Jet Fuels →			

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analy Request Form

Canada Toll Free: 1 800 668 9878

L2699543-COFC

COC Number: 17 - 869861

Page of

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	CVD Engineering	Select Report Format: [x] PDF [x] EXCEL [ ] EDD (DIGITAL)	Regular [R] [x] Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	Marcelo Pereira	Quality Control (QC) Report with Report [x] YES [ ] NO	PRIORITY (Business Days): 4 day [P4-20%] [ ]; 3 day [P3-25%] [ ]; 2 day [P2-50%] [ ]
Phone:	514 656 4197	[x] Compare Results to Criteria on Report - provide details below if box checked	EMERGENCY: 1 Business day [E - 100%] [ ]; Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] [ ]
	Company address below will appear on the final report	Select Distribution: [x] EMAIL [ ] MAIL [ ] FAX	Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm
Street:		Email 1 or Fax MARCELO.PEREIRA@CVDENGINEERING.COM	For tests that can not be performed according to the service level selected, you will be contacted.
City/Province:		Email 2 nandou.zhao@cvdengineering.com	
Postal Code:		Email 3 rob.v@cvdengineering.com	

Invoice To		Invoice Distribution	
	Same as Report To [x] YES [ ] NO	Select Invoice Distribution: [x] EMAIL [ ] MAIL [ ] FAX	
	Copy of Invoice with Report [x] YES [ ] NO		
Company:		Email 1 or Fax	
Contact:		Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:	Q84362	AFE/Cost Center:	PO#
Job #:	G22410	Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):	L2699543	ALS Contact: EH	Sampler: CA/MP

Analysis Request

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

ALS Sample # (lab 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	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	BH3-SA1	12-04-22		Soil	3	✓		
	BH4-SA1	12-04-22		Soil	1	✓		
	BH10-SA1	12-04-22		Soil	1	✓		

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? [ ] YES [x] NO	O. Reg. 406/19 Table 1
Are samples for human consumption/ use? [ ] YES [x] NO	Table 2.1 ICL & RPI

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen [ ] SIF Observations Yes [ ] No [ ]

Ice Packs [ ] Ice Cubes [ ] Custody seal intact Yes [ ] No [ ]

Cooling Initiated [ ]

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				14.3			

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by: AP	Date: 18 APR 22	Time: 18:00

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

JUNE 2018 FRONT

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

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 3 - SA 1	BH 4 - SA 1	BH 10 - SA 1
Metals & Inorganics	Conductivity (mS/cm)	*0.57*	*0.7*	*1.4*	0.119	0.175	0.147
	% Moisture (%)	-	-	-	17.9	27.8	27.6
	pH (pH units)	-	-	-	7.45	7.3	7.26
	Cyanide, Weak Acid Diss (ug/g)	*0.051*	*0.051*	*0.051*	<0.050	<0.050	<0.050
	SAR	*2.4*	*5*	*12*	0.6	0.14	0.52
	Calcium (Ca) (mg/L)	-	-	-	6.12	20.8	11.3
	Magnesium (Mg) (mg/L)	-	-	-	1.28	5.86	2.74
	Sodium (Na) (mg/L)	-	-	-	6.22	2.79	7.52
	Antimony (Sb)	*1.3*	*7.5*	*40*	<1.0	<1.0	<1.0
	Arsenic (As)	*18*	*18*	*18*	2.2	3.3	3.9
	Barium (Ba)	*220*	*390*	*670*	41.7	56.1	70.5
	Beryllium (Be)	*2.5*	*4*	*8*	<0.50	<0.50	<0.50
	Boron (B)	*36*	*120*	*120*	5.6	6.9	8.1
	Boron (B), Hot Water Ext. Available	*36*	*1.5*	*2*	0.25	0.45	0.23
	Cadmium (Cd)	*1.2*	*1.2*	*1.9*	<0.50	<0.50	<0.50
	Chromium (Cr)	*70*	*160*	*160*	17.3	17.9	20.1
	Cobalt (Co)	*21*	*22*	*80*	4	5.5	6.4
	Copper (Cu)	*92*	*140*	*230*	10.3	13.8	12.5
	Lead (Pb)	*120*	*120*	*120*	7.7	9.5	9.4
	Mercury (Hg)	*0.27*	*0.27*	*0.27*	0.0552	0.0606	0.0448
	Molybdenum (Mo)	*2*	*6.9*	*40*	<1.0	<1.0	<1.0
	Nickel (Ni)	*82*	*100*	*270*	8.9	11.2	13.7
	Selenium (Se)	*1.5*	*2.4*	*5.5*	<1.0	<1.0	<1.0
	Silver (Ag)	*0.5*	*20*	*40*	<0.20	<0.20	<0.20
	Thallium (Tl)	*1*	*1*	*3.3*	<0.50	<0.50	<0.50
	Uranium (U)	*2.5*	*23*	*33*	<1.0	<1.0	<1.0
	Vanadium (V)	*86*	*86*	*86*	26.9	28.7	34
	Zinc (Zn)	*290*	*340*	*340*	34.8	46.7	48.6
	Chromium, Hexavalent	*0.66*	*8*	*8*	0.28	<0.20	<0.20
Petroleum Hydrocarbons F1-F4	F1 (C6-C10)	*25*	*25*	*25*	<5.0	<5.0	<5.0
	F1-BTEX	*25*	*25*	*25*	<5.0	<5.0	<5.0
	F2 (C10-C16)	*10*	*10*	*26*	<10	<10	<10
	F3 (C16-C34)	*240*	*240*	*240*	<50	<50	<50
	F4 (C34-C50)	*120*	*2800*	*3300*	<50	<50	<50
	Total Hydrocarbons (C6-C50)	-	-	-	<72	<72	<72
BTEX	Benzene	*0.02*	*0.02*	*0.02*	<0.0068	<0.0068	<0.0068
	Ethylbenzene	*0.05*	*0.05*	*0.05*	<0.018	<0.018	<0.018
	Toluene	*0.2*	*0.2*	*0.2*	<0.080	<0.080	<0.080
	Xylenes (Total)	*0.05*	*0.091*	*0.091*	<0.050	<0.050	<0.050

NOTES:

1. Units = ug/g
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

ENCLOSURES

FILE No: G22410

BOREHOLE No. 1

Client: **2786713 Ontario Inc.**

Project: **Proposed Residential Development**

Location: **Adelaide Street Extension, Arthur**

EQUIPMENT DATA

Machine: **Mobile B57**
Method: **Solid Stem Auger**
Size: **152 mm I.D.**
Date: **Apr 13 - 22** TO **Apr 13 - 22**

Ground Elevation: **454.59 m**

ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SAMPLE ID	TYPE	N-VALUE
454.31	275mm TOPSOIL				
0.28	firm mottled brown CLAYEY SILT trace gravel and sand -fissured structure moist to wet	0.5	1	SS	6
		1.0	2	SS	4
		1.5	3	SS	6
452.59		2.0			
2.00	compact brown SANDY SILT saturated	2.5	4	SS	16
		3.0	5	SS	26
		3.5			
		4.0	6	SS	17
450.39					
4.20	dense brown SAND AND GRAVEL trace silt saturated	4.5	7	SS	34
449.59		5.0			
5.00	End of Borehole	5.5			
		6.0			

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

- water level at 2.1 m depth at withdrawal of drilling augers
- split spoon is dripping

PROJECT MANAGER: **RVD**

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

FILE No: G22410

BOREHOLE No. 2

Client: **2786713 Ontario Inc.**

Project: **Proposed Residential Development**

Location: **Adelaide Street Extension, Arthur**

EQUIPMENT DATA

Machine: **Diedrich D50T**
Method: **Solid Stem Auger**
Size: **152 mm I.D.**
Date: **Apr 12 - 22** TO **Apr 12 - 22**

Ground Elevation: **455.08 m**

ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SAMPLE ID	TYPE	N-VALUE
454.85	225mm TOPSOIL	0			
0.23	firm to stiff mottled brown CLAYEY SILT trace gravel and sand -fissured structure moist to wet	0.5	1	SS	6
		1.0	2	SS	5
		1.5	3	SS	11
		2.0			
452.48		2.5	4	SS	18
2.60	compact brown SANDY SILT saturated	3.0			
451.78			5	SS	33
3.30	compact to dense brown SILT trace clay occ. clayey seams/lenses moist	3.5			
		4.0	6	SS	24
450.68					
4.40	very stiff brown/grey CLAYEY SILT trace gravel and sand moist	4.5	7	SS	21
450.08		5.0			
5.00	End of Borehole	5.5			
		6.0			

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

REMARKS
- water level at 2.1 m depth at withdrawal of drilling augers
- split spoon is dripping

PROJECT MANAGER: **RVD**

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

FILE No: G22410

BOREHOLE No. 3

Client: **2786713 Ontario Inc.**

Project: **Proposed Residential Development**

Location: **Adelaide Street Extension, Arthur**

EQUIPMENT DATA

Machine: **Diedrich D50T**
Method: **Solid Stem Auger**
Size: **152 mm I.D.**
Date: **Apr 12 - 22** TO **Apr 12 - 22**

ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	WELL DATA	DEPTH (m)	REMARKS
	Ground Elevation: **455.26 m**								
455.06	200mm TOPSOIL								
0.20	soft to stiff brown CLAYEY SILT trace gravel, some sand -fissured structure moist	0.5		1	SS	2		0.5	
		1.0		2	SS	8		1.0	
		1.5		3	SS	14	▽	1.5	water level at 1.5 m depth at withdrawal of drilling augers
453.26									
2.00	compact brown SILT trace sand and clay occ. clayey seams/lenses wet to saturated	2.0						2.0	
		2.5		4	SS	20		2.5	split spoon is dripping
452.26									
3.00	very stiff brown/grey CLAYEY SILT trace gravel and sand moist	3.0						3.0	
		3.5		5	SS	24		3.5	
		4.0		6	SS	17		4.0	
		4.5		7	SS	23		4.5	
450.26									
5.00	End of Borehole	5.0						5.0	
		5.5						5.5	
		6.0						6.0	

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: **RVD**

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FILE No: G22410

BOREHOLE No. 4

Client: **2786713 Ontario Inc.**

Project: **Proposed Residential Development**

Location: **Adelaide Street Extension, Arthur**

EQUIPMENT DATA

Machine: **Mobile B57**
Method: **Hollow Stem Auger**
Size: **108 mm I.D.**
Date: **Apr 13 - 22** TO **Apr 13 - 22**

Ground Elevation: **454.81 m**

ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SAMPLE ID	TYPE	N-VALUE	SHEAR STRENGTH (kPa) / PENETRATION RESISTANCE	WATER CONTENT (%)	WELL DATA	REMARKS
454.63	175mm TOPSOIL								above-ground protective cover at grade
0.18	soft to firm brown CLAYEY SILT trace gravel and sand occ. wet silt lenses -fissured structure moist to wet	0.5	1	SS	3				water level at 0.41 m bgs on April 22, 2022
		1.0	2	SS	5				bentonite seal
		1.5	3	SS	12				
	---- brown/grey stiff to hard	2.0							
		2.5	4	SS	30				
		3.0	5	SS	17				3.05 m long, 50 mm I.D. PVC, slotted screen with sandpack
		3.5							
		4.0	6	SS	13				
		4.5	7	SS	14				
449.81	End of Borehole	5.0							
5.00		5.5							
		6.0							

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: **RVD**

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FILE No: G22410

BOREHOLE No. 5

Client: **2786713 Ontario Inc.**

Project: **Proposed Residential Development**

Location: **Adelaide Street Extension, Arthur**

EQUIPMENT DATA

Machine: **Mobile B57**
Method: **Solid Stem Auger**
Size: **152 mm I.D.**
Date: **Apr 13 - 22** TO **Apr 13 - 22**

Ground Elevation: **454.86 m**

ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SAMPLE ID	TYPE	N-VALUE
454.68	175mm TOPSOIL				
0.18	firm to stiff mottled brown CLAYEY SILT some sand, trace gravel -fissured structure moist to wet	0.5	1	SS	8
		1.0	2	SS	4
		1.5	3	SS	7
452.86		2.0			
2.00	compact brown SAND AND GRAVEL some silt saturated	2.5	4	SS	22
		3.0			
451.56			5	SS	13
3.30	stiff to very stiff brown SILT trace to some clay occ. clayey seams/lenses moist to wet	3.5			
		4.0	6	SS	25
		4.5			
			7	SS	25
449.86		5.0			
5.00	End of Borehole				
		5.5			
		6.0			

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

REMARKS
- water level at 2.1 m depth at withdrawal of drilling augers
- split spoon is dripping

PROJECT MANAGER: **RVD**

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Enclosure No.: 6
Sheet 1 of 1

FILE No: G22410

BOREHOLE No. 6

Client: **2786713 Ontario Inc.**

Project: **Proposed Residential Development**

Location: **Adelaide Street Extension, Arthur**

EQUIPMENT DATA

Machine: **Diedrich D50T**
Method: **Solid Stem Auger**
Size: **152 mm I.D.**
Date: **Apr 12 - 22** TO **Apr 12 - 22**

ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	SHEAR STRENGTH (kPa) / PENETRATION RESISTANCE	WATER CONTENT (%)	WELL DATA	DEPTH (m)	REMARKS
	Ground Elevation: **455.16 m**						FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □ (50 100 150 200) PENETRATION RESISTANCE STANDARD ● DYN. CONE ○ (20 40 60 80)	W_P W W_L (10 20 30)			
454.98	175mm TOPSOIL										
0.18	loose mottled brown SANDY SILT trace gravel wet	0.5		1	SS	4			▽	0.5	water level at 0.3 m depth at withdrawal of drilling augers
453.96		1.0		2	SS	6				1.0	
1.20	very stiff brown CLAYEY SILT trace gravel and sand moist to wet	1.5		3	SS	18				1.5	
452.96		2.0								2.0	
2.20	compact brown Fine SAND some silty to silty saturated	2.5		4	SS	17				2.5	split spoon is dripping
451.96		3.0								3.0	
3.20	stiff to very stiff brown/grey CLAYEY SILT trace gravel and sand moist	3.5		5	SS	16				3.5	
		4.0		6	SS	9				4.0	
		4.5		7	SS	12				4.5	
450.16		5.0								5.0	
5.00	End of Borehole	5.5								5.5	
		6.0								6.0	

PROJECT MANAGER: **RVD**

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FILE No: G22410

BOREHOLE No. 7

Client: **2786713 Ontario Inc.**

Project: **Proposed Residential Development**

Location: **Adelaide Street Extension, Arthur**

EQUIPMENT DATA

Machine: **Diedrich D50T**
Method: **Hollow Stem Auger**
Size: **108 mm I.D.**
Date: **Apr 12 - 22** TO **Apr 12 - 22**

ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	WELL DATA	DEPTH (m)	REMARKS
	Ground Elevation: **455.39 m**								
455.24	150mm TOPSOIL								
0.15	firm to very stiff mottled brown CLAYEY SILT some sand, trace gravel moist	0.5		1	SS	5		0.5	above-ground protective cover at grade water level at 0.11 m bgs on April 22, 2022 bentonite seal
		1.0		2	SS	12		1.0	
		1.5		3	SS	25		1.5	
453.29		2.0						2.0	
2.10	compact to dense brown SANDY SILT to SILT, some sand occ. saturated sand lenses moist	2.5		4	SS	25		2.5	
		3.0		5	SS	40		3.0	3.05 m long, 50 mm I.D. PVC, slotted screen with sandpack
451.89		3.5						3.5	
3.50	compact grey SILT trace clay and sand occ. clayey seams/lenses moist	4.0		6	SS	27		4.0	
		4.5		7	SS	16		4.5	
450.39		5.0						5.0	
5.00	End of Borehole	5.5						5.5	
		6.0						6.0	

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: **RVD**

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FILE No: G22410

BOREHOLE No. 8

Client: **2786713 Ontario Inc.**

Project: **Proposed Residential Development**

Location: **Adelaide Street Extension, Arthur**

EQUIPMENT DATA

Machine: **Diedrich D50T**
Method: **Solid Stem Auger**
Size: **152 mm I.D.**
Date: **Apr 12 - 22** TO **Apr 12 - 22**

ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	REMARKS
	Ground Elevation: **455.26 m**						
454.98	275mm TOPSOIL						
0.28	firm to stiff mottled brown CLAYEY SILT trace gravel and sand -fissured structure moist to wet ---- hard till-like	0.5		1	SS	6	
		1.0		2	SS	9	
		1.5		3	SS	29	
		2.0					
		2.5		4	SS	40	water level at 2.4 m depth at withdrawal of drilling augers
452.36							
2.90	dense brown SANDY SILT saturated	3.0		5	SS	34	split spoon is dripping
		3.5					
451.46							
3.80	stiff to very stiff brown/grey CLAYEY SILT trace gravel and sand moist	4.0		6	SS	12	
		4.5		7	SS	22	
450.26							
5.00	End of Borehole	5.0					
		5.5					
		6.0					

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: **RVD**

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Enclosure No.: 9
Sheet 1 of 1

FILE No: G22410

BOREHOLE No. 9

Client: **2786713 Ontario Inc.**

Project: **Proposed Residential Development**

Location: **Adelaide Street Extension, Arthur**

EQUIPMENT DATA

Machine: **Mobile B57**
Method: **Hollow Stem Auger**
Size: **108 mm I.D.**
Date: **Apr 13 - 22** TO **Apr 13 - 22**

ELEV./ DEPTH (m)	DESCRIPTION (Ground Elevation: **455.43 m**)	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE
455.15	275mm TOPSOIL			1	SS	9
0.28	stiff brown CLAYEY SILT trace gravel and sand -fissured structure moist to wet	0.5 1.0 1.5		2	SS	8
				3	SS	10
453.33 2.10	compact brown SANDY SILT saturated	2.0 2.5 3.0		4	SS	12
				5	SS	16
451.83 3.60	compact, grey SILT trace clay moist	3.5 4.0		6	SS	14
451.13 4.30	very stiff grey CLAYEY SILT some sand to sandy trace gravel moist	4.5 5.0 5.5		7	SS	17
				8	SS	19
449.63 5.80	End of Borehole	6.0				

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

- above-ground protective cover at grade
- bentonite seal
- water level at 1.38 m bgs on April 22, 2022
- split spoon is dripping
- 3.05 m long, 50 mm I.D. PVC, slotted screen with sandpack

PROJECT MANAGER: **RVD**

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FILE No: G22410

BOREHOLE No. 10

Client: **2786713 Ontario Inc.**

Project: **Proposed Residential Development**

Location: **Adelaide Street Extension, Arthur**

EQUIPMENT DATA

Machine: **Diedrich D50T**
Method: **Solid Stem Auger**
Size: **152 mm I.D.**
Date: **Apr 12 - 22** TO **Apr 12 - 22**

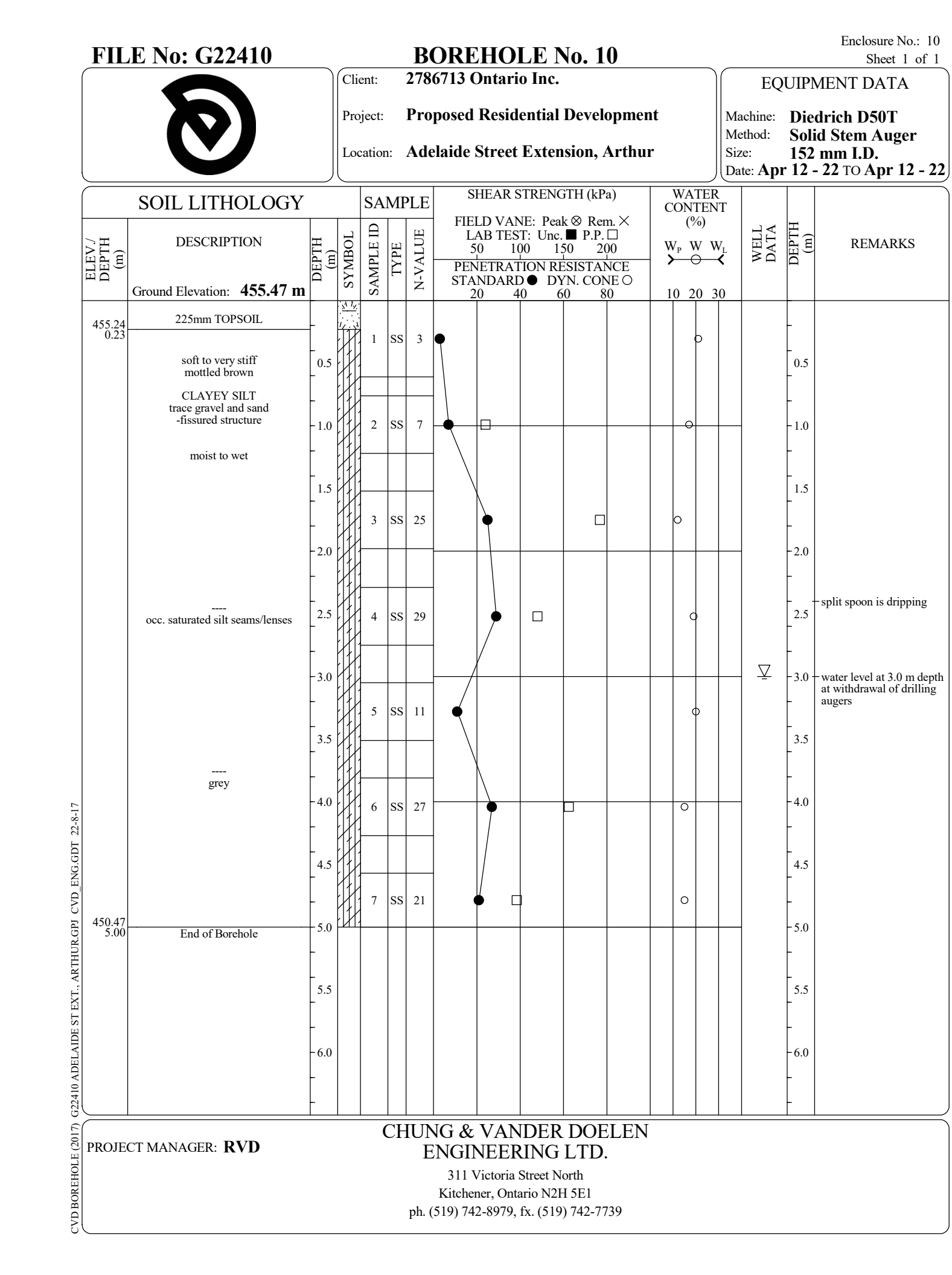
ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	REMARKS
	Ground Elevation: **455.47 m**						
455.24	225mm TOPSOIL						
0.23	soft to very stiff mottled brown CLAYEY SILT trace gravel and sand -fissured structure moist to wet	0.5		1	SS	3	
		1.0		2	SS	7	
		1.5		3	SS	25	
	---- occ. saturated silt seams/lenses	2.0		4	SS	29	split spoon is dripping
		2.5		5	SS	11	water level at 3.0 m depth at withdrawal of drilling augers
	---- grey	3.0		6	SS	27	
		3.5		7	SS	21	
450.47		4.0					
5.00	End of Borehole	4.5					
		5.0					
		5.5					
		6.0					

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)



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FILE No: G22410

BOREHOLE No. 11

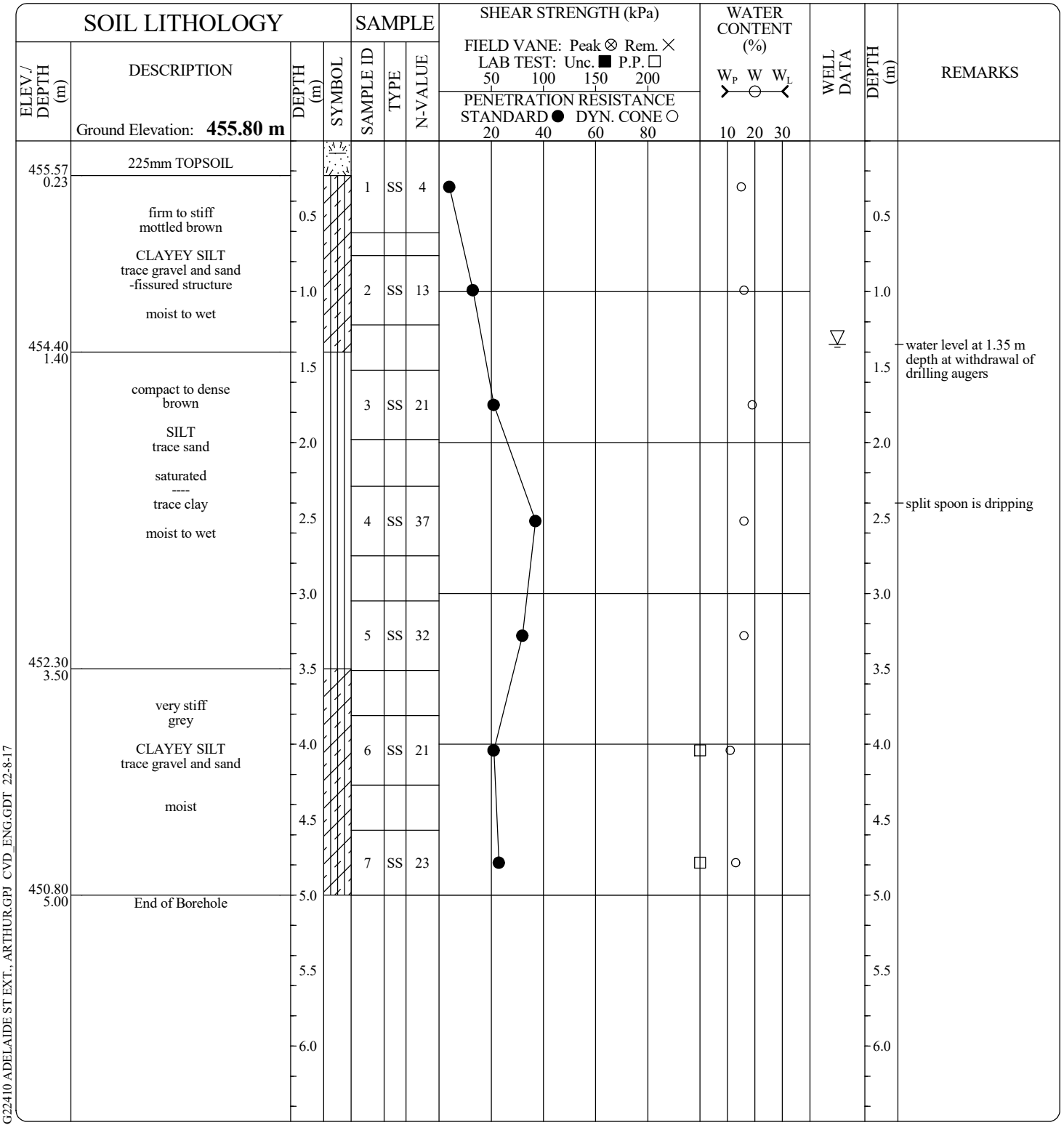
Client: **2786713 Ontario Inc.**

Project: **Proposed Residential Development**

Location: **Adelaide Street Extension, Arthur**

EQUIPMENT DATA

Machine: **Diedrich D50T**
Method: **Solid Stem Auger**
Size: **152 mm I.D.**
Date: **Apr 12 - 22** TO **Apr 12 - 22**



PROJECT MANAGER: **RVD**

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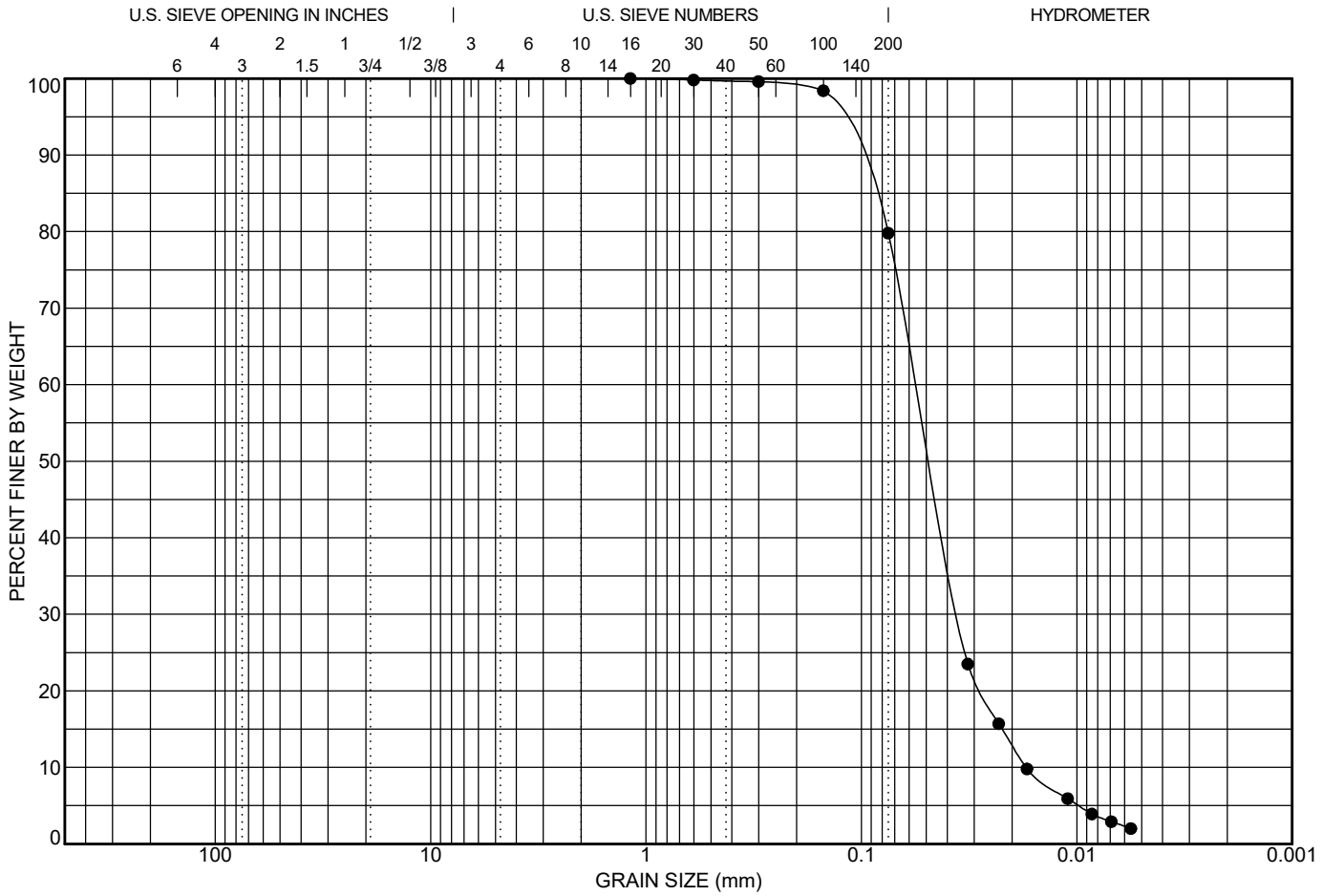

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

LL	PL	PI	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
			1.31	3.24	1.18	0.056	0.035	0.017	0.0	20.2	79.8	

Date: Apr. 27 - 2022
Client: 2786713 Ontario Inc.
Contractor:
Source:
Sampled From: BH 1 - SA 5; 3.05 to 3.50 m depth
Sample No.: 1-5
Date Sampled: Apr. 13 - 2022
Sampled By: CA
Lab No.: 0350
Date Tested: Apr. 26 - 2022
Type of Material: Sandy Silt

Sieve Size (mm)	Percent Passing	No Specifications

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e-mail: info@cvdengineering.com

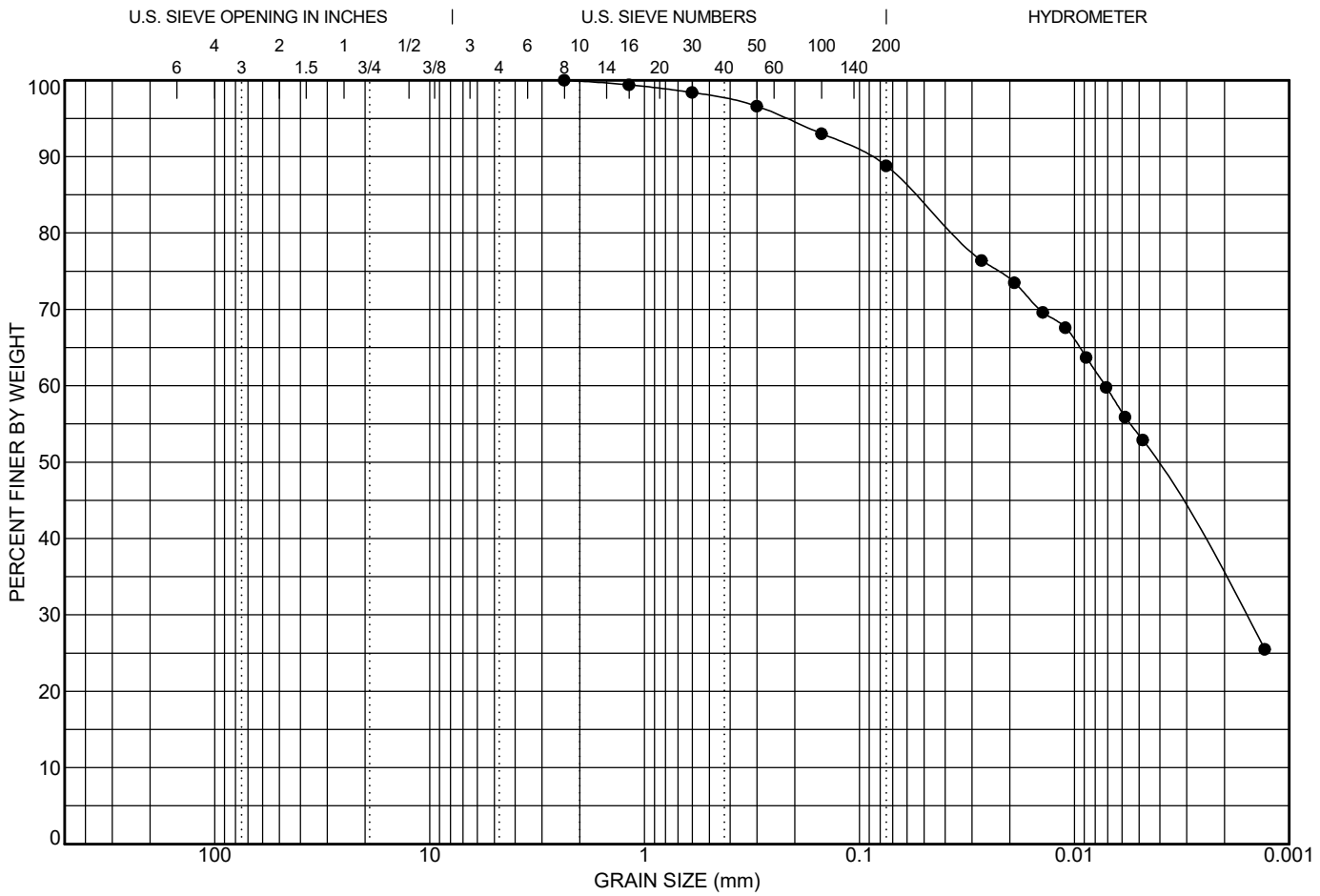
GRAIN SIZE DISTRIBUTION

Project: Proposed Residential Development

Location: Adelaide Street Extension, Arthur

File No.: G22410

Enclosure No.: 12



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

LL	PL	PI	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
					2.36	0.007	0.002		0.0	11.2	88.8	

Date: Apr. 27 - 2022
Client: 2786713 Ontario Inc.
Contractor:
Source:
Sampled From: BH 4 - SA 3; 1.50 to 1.95 m depth
Sample No.: 4-3
Date Sampled: Apr. 13 - 2022
Sampled By: CA
Lab No.: 0351
Date Tested: Apr. 26 - 2022
Type of Material: Clayey Silt, some sand

Sieve Size (mm)	Percent Passing	No Specifications

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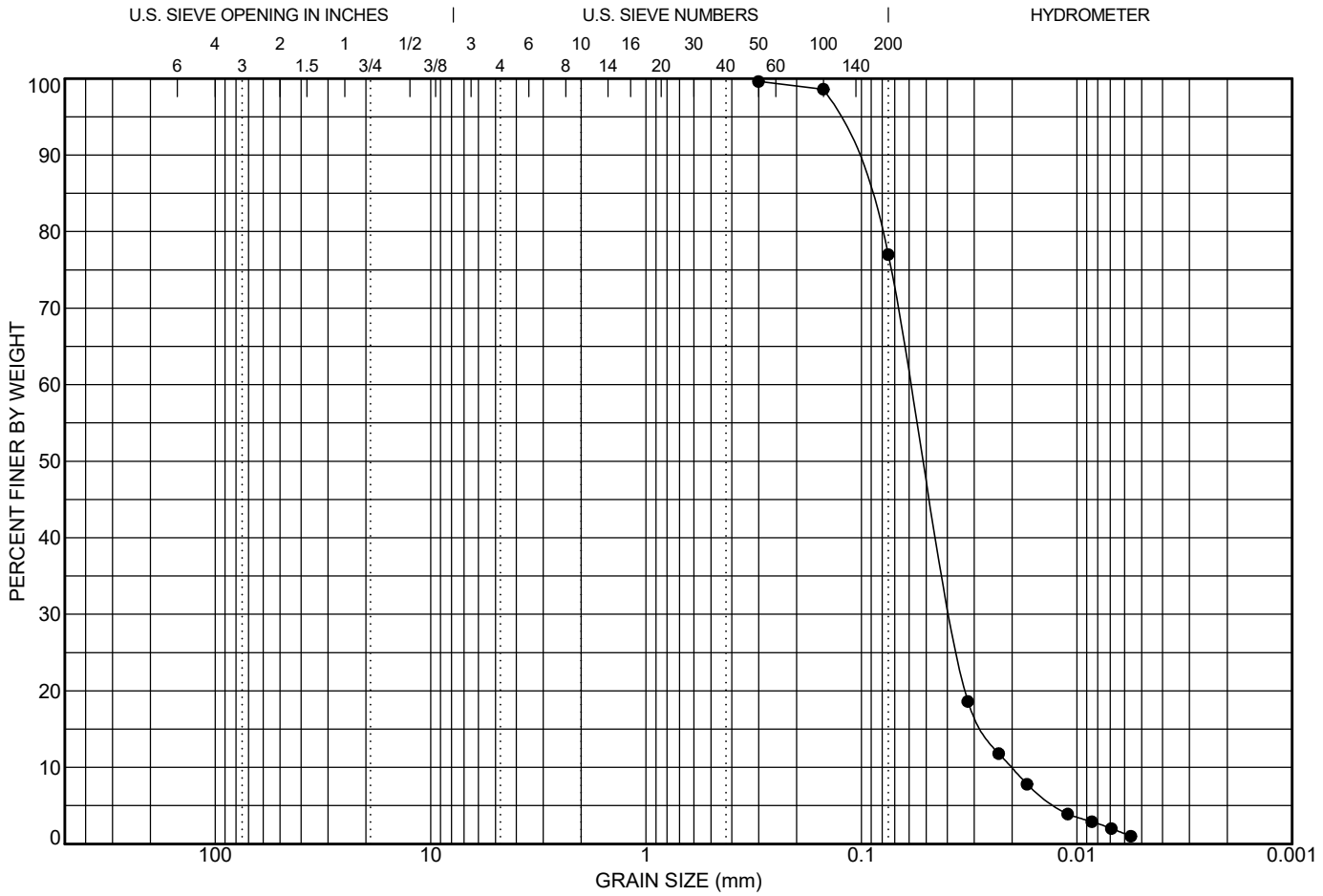
GRAIN SIZE DISTRIBUTION

Project: Proposed Residential Development

Location: Adelaide Street Extension, Arthur

File No.: G22410

Enclosure No.: 13



LL	PL	PI	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
			1.22	2.92	0.3	0.059	0.038	0.02	0.0	22.6	77.0	

Date: Apr. 27 - 2022
Client: 2786713 Ontario Inc.
Contractor:
Source:
Sampled From: BH 9 - SA 4; 2.30 to 2.75 m depth
Sample No.: 9-4
Date Sampled: Apr. 13 - 2022
Sampled By: CA
Lab No.: 0352
Date Tested: Apr. 26 - 2022
Type of Material: Sandy Silt

Sieve Size (mm)	Percent Passing	No Specifications

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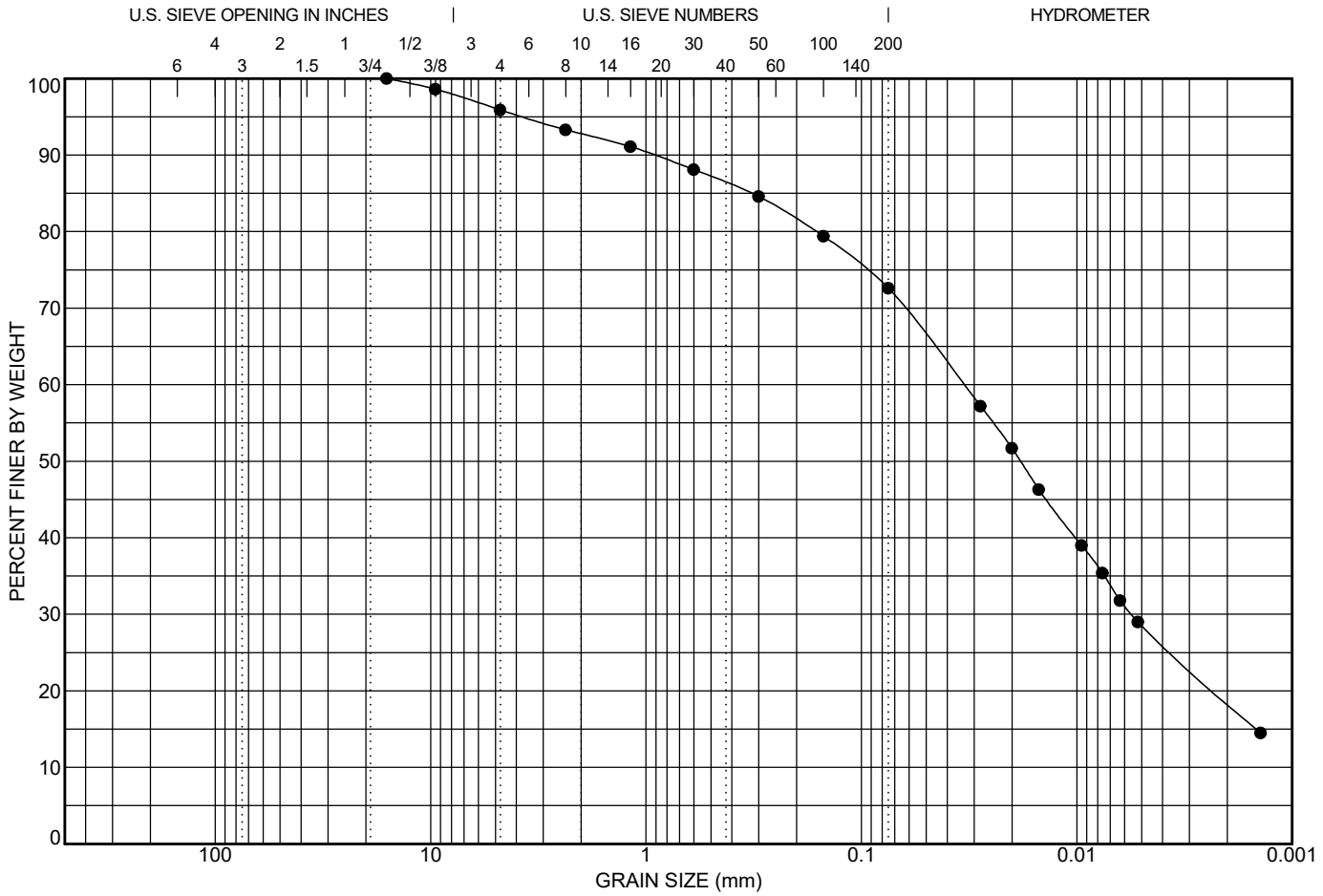
GRAIN SIZE DISTRIBUTION

Project: Proposed Residential Development

Location: Adelaide Street Extension, Arthur

File No.: G22410

Enclosure No.: 14



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

LL	PL	PI	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
					16	0.033	0.006		4.1	23.3	72.6	

Date: Apr. 27 - 2022
Client: 2786713 Ontario Inc.
Contractor:
Source:
Sampled From: BH 9 - SA 7; 4.55 to 5.00 m depth
Sample No.: 9-7
Date Sampled: Apr. 13 - 2022
Sampled By: CA
Lab No.: 0353
Date Tested: Apr. 26 - 2022
Type of Material: Sandy Clayey Silt, trace gravel

Sieve Size (mm)	Percent Passing	No Specifications

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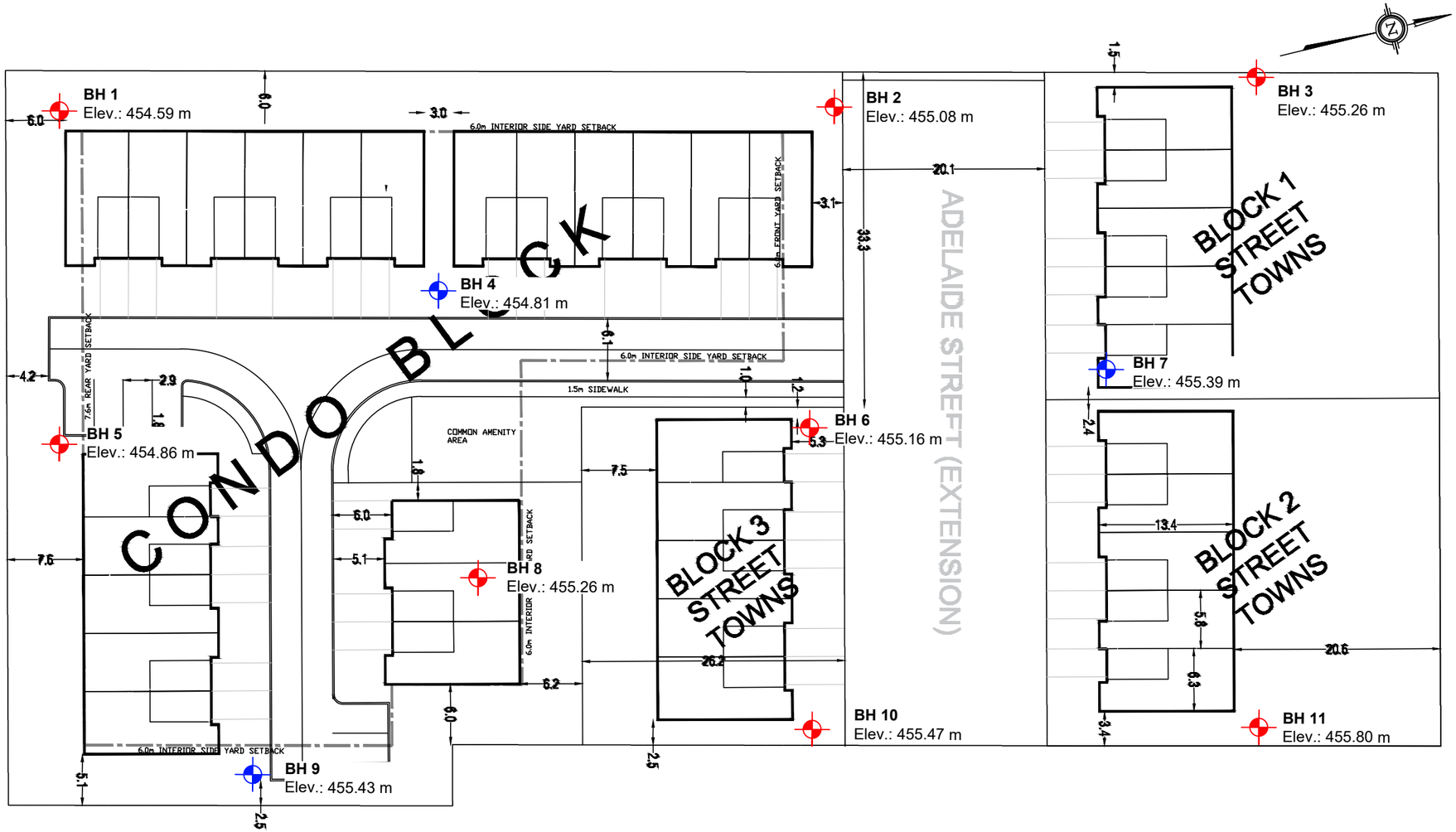
GRAIN SIZE DISTRIBUTION

Project: Proposed Residential Development

Location: Adelaide Street Extension, Arthur

File No.: G22410

Enclosure No.: 15



KEY PLAN **SOURCE:** Google Earth

LEGEND

TBM: Top of manhole at the intersection of Conestoga Street North and Adelaide Street
Elev.: 456.52 m (Geodetic)

Borehole Location

Borehole and Monitoring Well Location

The borehole locations and associated ground surface elevations were surveyed by CVD for the purpose of this report using a Network RTK Global Navigation Satellite System (GNSS) Receiver. The survey data was collected using The UTM Zone 17N Projection, NAD83(CSRS)v7-2010 datum and Canada Geoid Model HT2_2010v70 (CGVD28).

DWG Ref.: *Patterson Planning Consultants Inc.; VED Homes - Concept Plan, Adelaide St. Extension - Arthur, Wellington North (County of Wellington); Project No. P-107*

BOREHOLE LOCATION PLAN

Proposed Residential Development

Adelaide Street Extension
Arthur, Ontario

CHUNG & VANDER DOELEN ENGINEERING LTD.

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

Drawn By: CA/NZ	Date: August, 2022	File No.: G22410
Checked By: RVD	Scale: N.T.S.	Drawing No.: 1