Oakville Municipal Development Corporation

Preliminary Geotechnical Investigation Report

125 Randall Street, Oakville, Ontario

March 2025

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March 20, 2025

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Acronyms and Abbreviations

Arcadis	Arcadis Canada Inc.
COPE	Construction, Occupancy, Protection, Exposure
CSA	Canadian Standards Association
DCPT	dynamic cone penetration testing
ESA	Environmental Site Assessment
FIP	Fire Insurance Plan
HASP	Health and Safety Plan
HAS	hollow-stem augers
LDPE	Low-density polyethylene
masl	metres above sea level
mald	metres above local datum
mbgs	metres below ground surface
MECP	Ontario Ministry of the Environment, Conservation and Parks
PCA	Potentially Contaminating Activity
PHC	Petroleum hydrocarbons
PVC	Polyvinyl chloride
QA/QC	Quality assurance/quality control
RDL	Reportable detection limit
RPD	Relative percent difference
SCS	Site Condition Standards
SLS	Serviceability Limit State
SPMDD	Standard Proctor Maximum Dry Density
SPT	standard penetration testing
TOC	Top of Casing

ULS	Ultimate Limit State
VOCs	Volatile Organic Compound

1 Introduction

Arcadis Canada Inc. (Arcadis) was retained by Oakville Municipal Development Corporation to complete a preliminary geotechnical investigation of the property located at 125 Randall Street in Oakville, Ontario (the site).

The site location is shown on **Figure** 1, and the current site configuration is shown on **Figure 2** at the rear of this report. It is understood that the existing building and infrastructure are to be removed and replaced.

The scope of work for this geotechnical program included field investigation, geotechnical laboratory testing, data analyses and interpretation, and preliminary geotechnical evaluation of the site. The investigation was carried out to obtain preliminary geotechnical information to guide design and construction of the foundation for the proposed structure.

The purpose of the geotechnical investigation was to determine the soil and groundwater conditions at the site. The following report has been prepared specifically and solely for the aforementioned project which is described herein. It contains our preliminary findings and geotechnical recommendations pertaining to the design and construction of the subject development as they are understood at the time of writing this report. We note that the recommendations provided in this report are intended solely for the preliminary planning of this development. Geotechnical recommendations may change with proposed design changes. Further investigation will be required before more detailed geotechnical parameters can be provided.

This geotechnical report does not comment on environmental aspects of the Site, unless specifically noted.

1.1 Site Description

Information pertaining to the Site is provided below.

Detail	Information
Municipal Address	125 Randall Street Oakville, Ontario L6J 1P3
Property Owner	Mark Meneray Oakville Municipal Development Corporation
Legal Description	Parts 1 and 2 on Plan 20R-22155 Oakville Region of Halton
Approximate Area of Property	3106 m^2 (0.31 hectares)

The site is irregular in shape, with the municipal address of 125 Randall Street in Oakville, Ontario, located southwest of the intersection of Navy Street and Randall Street.

The site measures approximately 50 m frontage along Randall Street and approximately 100 m frontage along Navy Street. The site is located in an area with a mix of residential, commercial, community (roadways) and parkland property use.

1.2 Current and Proposed Future Uses

The property at 125 Randall Street in Oakville, Ontario, is a municipally owned site located at the corner of Randall and Navy Streets, in the downtown area. Formerly housing the Town's Fire Hall No. 3, this two-story, 1967 brick building has a ground floor area of approximately 779 square meters (8,385 square feet) and was founded on a slab on grade with no basement. The site is located close to Sixteen Mile Creek, with the northern and western property limits sloping downward towards the waterway. Given the proximity to the creek, Conservation Halton has mapped the stable top of bank, limiting construction to Part 1 on survey plan 20R-22155, with possible minor encroachments into Part 2, designated for greenspace buffering.

The Oakville MDC envisions the redevelopment of this property into a high-rise, residential condominium tower (potentially reaching 17 floors), incorporating commercial or municipal programming spaces on the first two floors. Underground parking access would be located on Navy Street, with the proposed buildable footprint restricted to 1,168 square meters (12,575 square feet) within the designated buildable area. While the Official Plan (OP) and zoning currently allows up to 12 floors, the Town has indicated it may support a building of up to 17-storeys. The project is in the conceptual stage with no finalized architectural or structural designs, and the Town anticipates marketing the property in 2025. Figure 1 shows existing site features and the buffer zone.

The property spans approximately 3,106 square meters, with Conservation Authority regulations permitting a maximum building footprint of 1,168 square meters. The planned redevelopment envisions a residential tower which may be constructed of up to 17 floors, along with two to three levels of underground parking.

1.3 Topography and Hydrology

A review of the topographic map indicates that the regional topography slopes gently from northeast to southwest toward Lake Ontario, located approximately 670 m southwest of the site. Surface water in the area ultimately discharges into Lake Ontario via Sixteen Mile Creek, which flows approximately 150 m southwest of the site.

The site's topography and regional gradients suggest shallow groundwater flow is likely to trend southeast toward Lake Ontario. However, groundwater flow on the site itself may locally follow a southwest direction toward Bronte Creek, with potential influences from subsurface utilities, preferential pathways, or historical fill materials.

1.4 Local Geology

Bedrock geology mapping for the site indicates that the local bedrock is of the Georgian Bay Formation comprising interbedded Shale, limestone, dolostone, and siltstone (OGS, 2011).

The Ontario Geological Survey reports that the site quaternary geology is comprised of Lower Newmarket Till above the bedrock. This unit is described as low-permeability glacial till, it consists of clay-rich, silty material with occasional sand or gravel lenses formed by erosional channels infilled with fluvial deposits.

1.5 Past Investigations

No previous geotechnical reports were provided by Oakville Municipal Development Corp. for review. Based on MECP water well records for the area of the site, bedrock was encountered at 6 mbgs. Local geotechnical experience, however, suggests significant variability in the bedrock depth within this area, with bedrock surface depths ranging between 8 to 10 meters. Data obtained from the OakRidges Moraine platform for the site location indicates that bedrock depth can vary up to 13 meters below the ground surface. Groundwater was encountered at an elevation of approximately 72 meters, corresponding to 13.7 meters below the ground surface at a site elevation of 85.7 meters. It is important to note that the Oak Ridges Moraine platform is based on a trained model that aggregates data from various sources. As such, this information may not be entirely reliable, and we cannot rely solely on it for precise subsurface conditions.

2 Scope of Work

The scope of work for the geotechnical investigation conducted on-site consisted of the following:

- Developed and implemented a site-specific health and safety plan (HASP);
- Completed public and private utilities clearances at site;
- Drilled the five (5) borehole locations (BH25-1 to BH25-5) to a maximum depth of 14.3 m bgs between January 28 and January 30, 2025;
- Installed ground water monitoring wells in the three (3) drilled boreholes between January 28 and January 30, 2025;
- Collected soil samples from the boreholes for field logging/screening and geotechnical testing;
- Submitted soil samples to an accredited laboratory for geotechnical analyses;
- Conducted an elevation survey relative to a geodetic benchmark on January 30, 2025;
- Monitored monitoring wells MW25-2, MW25-3 and MW25-4 on January 30, 2025, and March 4, 2025;
- A waste removal/disposal contractor retained to dispose an excess soil cutting that are not used as backfill into drilling locations. Leachability test (TCLP analyses) conducted to determine the appropriate disposal location
- Prepared this report documenting the methodology and findings of the completed work program.

2.1 Media Investigated

Soil was investigated through the drilling and/or sampling of five (5) boreholes. Select soil samples were analysed for grain size analyses, hydrometer, Atterberg limit testing, unit weight, uniaxial compressive strength, TCLP and corrosivity.

Ground water was investigated through the installation and sampling of three (3) ground water monitoring wells.

Bedrock samples were obtained and sampled as part of this investigation.

3 Methodologies

3.1 General

The investigation included: borehole drilling, soil sampling, monitoring well installation, and ground water monitoring.

The field work was conducted in accordance with Arcadis' standard operating procedures (SOPs), which have been developed in accordance with relevant procedures and protocols, geotechnical. There were no deviations from Arcadis' SOPs.

3.2 Drilling Auguring and Coring

During the advancement of the boreholes, subsurface conditions were logged for soil characteristics, olfactory observations and apparent evidence of contamination. Disposable nitrile gloves, replaced after collecting each sample, were worn when handling sampling tools and samples. Sampling tools were decontaminated with an Alconox wash and a distilled water rinse between sampling locations.

Between January 28 and 30, 2030, five (5) boreholes were advanced on the site (i.e. BH25-1 to BH25-5). The boreholes were advanced using a truck mounted Geoprobe 7822 DT drill rig equipped with hollow stem augers until the bedrock then coring and operated by Strata Drilling Group under the supervision of Arcadis personnel. Three (3) boreholes were completed as monitoring wells. Soil samples were collected continuously in all boreholes.

Table 3-1: Subsurface Investigation Summary: Borehole Drilling and Monitoring Well Installation

Sample ID	Maximum Depth (m bgs)	Drilling Method	Monitoring Wells
BH25-01	7.3	Hollow Stem Auger	No
BH25-02	6.5	Hollow Stem Auger until Bedrock then coring	Yes
BH25-03	10.8	Hollow Stem Auger until Bedrock then coring	Yes
BH25-04	8.2	Hollow Stem Auger	Yes
BH25-05	14.3	Hollow Stem Auger until Bedrock then coring	No

Borehole locations are shown in **Figure 2**. Borehole logs for BH25-1 to BH25-5 are provided in **Appendix B**.

3.3 Soil Sampling

Sampling in the drilled boreholes was carried out using a 50.8 mm (2 inch) diameter split-spoon sampler on a continuous basis to the end of the borehole. Standard Penetration Tests (SPTs) were conducted in the boreholes in conjunction with the split spoon sampling with the resulting blows per 150 mm of split spoon advance recorded on the borehole logs. The 'N' value, used in geotechnical analyses, refers to the number of blows required to drive a split-spoon sampler 300 mm into the soil after an initial 150 mm penetration using a 63.5 kg hammer free falling from a height of 760 mm.

Rock cores were obtained using a diamond bit core barrel in accordance with ASTM designation D 2113 (Standard Practice for Rock Core Drilling and Sampling of Rock for Site Exploration). Rock Quality Designations (RQD's) were determined in accordance with ASTM D 6032 (Standard Test Method for Determining Rock Quality Designation (RQD) of Rock Core) and are provided on the boring logs within the appendix of this report. RQD is defined as the sum of the length of core fragments four inches or greater between natural breaks divided by the length of the core run and is expressed as a percentage. RQD is an indication of the relative frequency of jointing or natural fracturing of the bedrock.

All soil samples were visually inspected and initially classified on site. Field tests for plasticity, dilatancy, etc. were conducted where appropriate. The recovered soil samples were sealed in clean, airtight plastic bags and rock-core samples were stored in wooden boxes, both transferred to the PNJ Engineering INC. Laboratory for further examination and laboratory testing. Borehole logs were prepared on the basis of sample and drilling process observations in the field describing the encountered strata and are presented in **Appendix B**.

Samples were selected and submitted to PNJ Engineering INC. laboratories in Toronto, Ontario, for the selected geotechnical testing parameters. Laboratory certificates are provided in **Appendices C and D**.

3.4 Ground Water Monitoring Well Installation

Boreholes MW25-2, MW25-3 and MW25-4 were completed as monitoring wells. The monitoring wells comprise 50 mm diameter Schedule 40 PVC riser pipes with a 3.05 m long No. 10 slot intake zone (well screen). Silica sand was placed around the piping to a height of at least 300 mm above the top of the well screen as filter pack. The remaining annular space was filled with a bentonite clay seal. A protective aluminum flush-mount casing was then cemented in place at the top of the instrument for all wells.

Monitoring well construction details are provided on the borehole logs in **Appendix B**.

3.5 Groundwater Monitoring

Ground water monitoring was completed on January 30, 2025. Monitoring activities included measuring the depth to any free phase product and measuring the depth to ground water at each monitoring well location. Ground water monitoring results are summarized in **Table 4** at the rear of this report. The depths to ground water were measured using an interface probe, relative to the top of casing.

Monitoring wells MW25-2, MW25-3, and MW25-4 were installed at depths ranging from 2.32 to 2.49 m bgs. The ground water elevations at each newly installed monitoring well were established by subtracting the measured depth to water from the ground surface elevation at each location. Ground surface elevations at these locations were established relative to the benchmarks used (On site Catch Basin 1 near BH25-1 at 85.27 m asl and Catch Basin 2 near BH25-4 at 86.34 m asl) using standard geodetic surveying techniques.

3.6 Elevation Surveying

An elevation survey for the monitoring wells was conducted by Arcadis on January 30, 2025. Elevations and Latitude/Longitude coordinates for all boreholes were surveyed using a Trimble GPSS TSC5 survey system with accuracy of 10±cm. The elevations were surveyed relative to benchmarks with known geodetic elevations.

4 Geotechnical Laboratory Testing Program

Geotechnical laboratory testing was conducted on representative samples recovered from the boreholes, to effectively classify the soil strata observed in the field. This program included:

- Natural moisture content on all recovered samples where feasible;
- Grain size: sieve analyses on six soil samples and hydrometer analyses on another five samples;
- Atterberg Limit testing on five soil samples;
- Bulk Relative Density of Soil Specimens Using Paraffin
- Rock Core Compressive Strength on two samples;
- Unconfined compressive strength (UCS) Test (Rock) with MOE on one sample;
- Split Tensile Test on one sample;
- Corrosivity suite testing on one soil sample; and
- Leachability test (TCLP analyses) conducted to determine the appropriate disposal location.

The results of the testing program have been summarized in tabular format following the text of this report. Samples subjected to geotechnical testing have been identified on the borehole logs presented as **Appendix B**. Where applicable, the results of the index testing have been included on the borehole logs.

The laboratory certificates of analyses are presented in **Appendix C** (geotechnical analyses) and **Appendix D** (corrosivity analyses).

5 Subsurface Conditions

A summary of the subsurface conditions encountered in the boreholes is presented in the following paragraphs. Detailed logs of the boreholes are provided in **Appendix B**. The reader is cautioned that conditions between and beyond boreholes may vary.

Generally, the subsurface profile encountered consists of fill layer on top of a native stratum (Lower Newmarket Till) following by bedrock. The fill strata are underlain by native soil (silty sand to sandy silt soil, following by silty clay). Bedrock was observed at a depth range from 3.4 to 7.9 m bgs (elevations ranges from 78.1 to 81 mbgs).

Generally, the subsurface profile encountered consists of fill material overlying a native stratum (Lower Newmarket Till), followed by bedrock. The fill layer is underlain by native soil, transitioning from silty sand to sandy-silt and then to silty clay. Bedrock was observed at depths ranging from 3.4 to 7.9 m bgs, corresponding to elevations of 78.1 to 81 m bgs.

5.1 Fill Soils

5.1.1 Topsoil

Organic topsoil was encountered at location MW24-3. This unit ranged in thickness is 0.69 m. This layer was described as dark brown and moist with organic matter including grass and rootlets. SPT ‘N’ value is18 blows per 300 mm, indicating a very loose to compact condition for this unit.

5.1.2 Asphalt

Asphalt surfacing was encountered at all borehole locations except BH25-3 and -5. Thickness was typically less than 10 cm, although particulate was encountered at depths of up to 20 cmbgs. No testing was performed on the pavement material.

5.1.3 Pavement Base and Subbase

Asphalt base and subbase material/construction fill (gravelly sand fill layer) was encountered in all boreholes drilled except BH24-3 and -5. This unit was encountered from the surface to depths ranging from 0.36 to 0.61 mbgs (elevations ranging from 82.84 to 87.11 m). Further examination of the recovered samples indicate that the layer is brown and dry to moist.

SPT ‘N’ values ranged from 19 to 31 blows per 300 mm, indicating a very loose to compact condition for this unit.

5.1.4 Silty Sand with Gravel Fill

Fill (Silty sand with gravel/Gravelly Sand) was encountered in boreholes BH25-1 and -4. This unit was encountered from the surface to depths ranging from 0.61 to 1.88 mbgs (elevations ranging from 85.73 to 85.84 m). Inorganics and Piece of Plastic were noted within the soil layer. Further examination of the recovered samples indicate that the layer is brown and moist.

The moisture content of this stratum ranged from 3.5 to 17.2%. SPT ‘N’ values ranged from 19 to 31 blows per 300 mm, indicating a medium dense to dense condition for this unit.

5.2 Native Soils

The native soils onsite consist of silty sand/sandy silt following by silty clay. Soil composition classification ranges from silty sand with no/trace gravel, to sandy silt with no/trace gravel, to silty clay with no/some gravel – all interbedded across the site but generally fining upwards. Gravel fractions were trace or non-existent.

5.2.1 Silty Sand

A layer of silty sand with little clay was encountered in all boreholes except BH25-01, extending to depths ranging from 1.5 to 4.57 mbgs (to elevations ranging from 81.8 to 82.31m). Traces of gravel and orange and reddish oxidation were noted within the soil layer, and gravel was noted within the soil layer at BH25-3. Field classification of the recovered samples indicate that the layer is brown to grey and dry to moist.

The moisture content of this stratum ranged from 6.6 to 15%. Standard Penetration Test ‘N’ values obtained in this stratum in conjunction with sampling ranged from 2 to 27 blows per 300 mm, indicating a very loose to medium dense state of relative density.

5.2.2 Sandy Silt

A layer of Sandy silty with trace clay was encountered beneath the fill layer in all boreholes, extending to depths ranging from 2.9 to 6.15 mbgs (to elevations ranging from 79.8 to 83m). Trace gravel and oxidation was noted within the soil layer, and gravel was noted within the soil layer at BH25-3. Field classification of this stratum indicates that the layer is dark reddish brown to brown and moist to wet. Sand Lense was noted within the soil layer at BH25-02. A PHC (petroleum hydrocarbon) odor was detected in the soil layer within borehole BH25-01. The results of the grain size analyses performed on this unit are summarized below.

Table 5-1: Sandy Silt Grain Size Analyses

Sample ID	Depth (m)	Gravel	Sand	Silt	Clay
BH-01-04	1.88-2.44	0	25	75	--
BH-02-04	2.13-2.73	5	40	55	--
BH-03-06	4.5-5.1	0.2	4.1	84.6	11.3
BH-05-05	3.0-3.6	1	28.6	64.1	6.3

Table 5-2: Atterberg Limit Test Result

Sample ID	Depth (m)	Liquid Limit	Plastic Limit	Plasticity Index	Classification
BH25-03-06	4.6 – 5.2	20	15.6	4.4	CL-ML

The moisture content of this stratum ranged from 8.4 to 20.5%. Standard Penetration Test ‘N’ values obtained in this stratum in conjunction with sampling ranged from 2 to 23 blows per 300 mm, indicating a very soft to very stiff state of relative density.

An Atterberg limit test was performed on a sample retrieved from this stratum and the soil was determined to be low plastic.

5.2.3 Silt Clay

A layer of sandy silt with little clay was encountered in all boreholes, extending to depths ranging from 3.3 to 7.9 mbgs (to elevations ranging from 78.1 to 81m). Trace gravels were noted within the soil layer, and limestone/shale rock was noted with the soil layer at BH25-5. Wet density equal Field classification of the recovered samples indicate that the layer is grey and moist to wet. The results of the grain size analyses performed on this unit are summarized below.

Table 5-3: Silty Clay Grain Size Analyses

Sample ID	Depth (m)	Gravel	Sand	Silt	Clay
BH-01-07	6.1 – 6.7	14.5	19.3	44.9	21.3
BH-03-07	6.1 – 6.7	7.6	25.2	48.7	18.4
BH-04-07	6.1 – 6.7	0.1	4	46.8	49

The moisture content of this stratum ranged from 9.1 to 22.1%. Standard Penetration Test ‘N’ values obtained in this stratum in conjunction with sampling ranged from 1 to 32 blows per 300 mm, indicating a very soft to hard state of relative density.

An Atterberg limit test was performed on a sample retrieved from this unit, the results of which are summarized below and in **Table 2** at the rear of this report and the soil was determined to be low plastic.

Table 5-4: Atterberg Limit Test Result

Sample ID	Depth (m)	Liquid Limit	Plastic Limit	Plasticity Index	Classification
BH25-01-03	6.1 – 6.7	25.3	10.5	10.5	CL
BH25-03-07	6.1 – 6.7	21.3	7.6	7.6	CL
BH25-04-07	6.1 – 6.7	34.7	17.8	17.8	CL

Bulk Relative Density of Soil Specimens Using Paraffin test was performed at SS-5-5 at depth of 4.7m.

Table 5-5: Bulk relative density Test Result

Sample ID	Depth (m)	Wet density (g/cm^3)	Dry density (g/cm^3)
BH25-05-06	4.7	2.09	1.85

5.3 Bedrock

A layer of highly weathered shale bedrock was encountered in all boreholes, extending to the end of the boreholes. Trace clay and gravel were noted within the soil layer, and crushed rock was noted. Field classification of the recovered samples indicate that the layer is grey and dry. Standard Penetration Test ‘N’ values obtained in this stratum in conjunction with sampling are >50 blows per 300 mm.

Rotary coring was conducted to confirm bedrock quality in boreholes BH25-2, BH25-3, and BH25-5, the information indicates that the shale is generally very weak and completely weathered in the upper layers and becomes more competent at depth. The competent shale in the site is typically classified under the Canadian Foundation Engineering Manual classification rating criteria as being a Grade R5 rock which is very strong rock.

Rock Quality Designation (RQD) values obtained in this stratum, in conjunction with sampling, ranged from 23% to 72%, indicating a very poor to fair state of rock quality. The compressive strength of this stratum obtained by Rock Core Compressive Strength testing ranged from 93.7 to100.9 Mpa. The results of the USC performed on this unit are summarized below. Photographs of the bedrock cores are also presented in Appendix F of the report. The descriptive terms used on the record of rock cores and throughout this report are explained on the “Explanation of Terms Used in the Bedrock Core Log” sheet in Appendix F.

Table 5-6: Summary of UCS Test (Rock) with MOE (ASTM D7012)

Sample ID	Depth (m)	Material Description	UCS (MPa)	MOE (GPa)
BH25-05-09	8.3 – 8.5	Shale	197.2	34.5

Table 5-7: Summary of Split Tensile Testing (ASTM D3967)

Sample ID	Depth (m)	Material Description	Tensile strength (MPa)
BH25-05-09	8.3 – 8.5	Shale	17.8

5.4 Groundwater

On January 30th, 2025, depths to ground water in the shallow wells range from 2.32 m bgs at MW25-3 to 2.49 m bgs at MW25-2, and ground water elevations ranged from 80.83 m asl at MW25-2 to 83.63 m asl at MW25-3. On March 4th, 2025, depths to ground water in the shallow wells range from 3.52 m bgs at MW25-4 to 4.2 m bgs at MW25-3, and ground water elevations ranged from 79.72 m asl at MW25-2 to 83.36 m asl at MW25-4.

The ground water elevations at each newly installed monitoring well were established by subtracting the measured depth to water from the ground surface elevation at each location. Ground surface elevations at these locations were established relative to the arbitrary benchmarks used (On site Catch Basin 1 near BH25-1 at 85.27 m asl and Catch Basin 2 near BH25-5 at 86.34 m asl) using standard geodetic surveying techniques. Depth to groundwater and depth to well bottom, screen heights, etc., are presented in **Table 4** at the rear of this report.

Groundwater extraction rates of greater than 50,000 L/day will require a Permit to Take Water from the Ministry of the Environment and Climate Change. This permit is not expected to be required.

It is recommended that groundwater levels at the site be checked in the fall and spring to confirm seasonal fluctuation in groundwater levels. Addition hydraulic conductivity field tests should be conducted in deep foundation locations.

5.5 Soil Corrosivity

One sample from BH25-05, at depth of 1.8 mbgs, was submitted for corrosivity testing. The results of the analyses are summarized in Table 4 at the rear of this report.

The sulphate concentrations for the examined sample (BH25-05 SS-4) were higher than the reportable detection limit of 20 ug/g. Compared with Table 3 specified in the Canadian Standards Association (CS) “Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete, CSA Standard A23.1:19/CSA A23.2:19 (CSA, 2019), the test results show that the water-soluble sulphate contents of the soil samples analyzed is below the S-3 class of exposure (moderate degree of exposure) which ranges from 0.1 to 0.2%. The laboratory results on soil indicate that the sulphate content detected in the sample submitted is 100 µg/g, indicating negligible corrosive impacts. The threshold for chloride content requiring amended concrete is 0.2%, while the maximum concentration observed was at 0.008% (80 µg/g), which is acceptable. The neutral pH levels (value of 8.73) predominate in the samples analyzed which indicate that this is not a contributing factor in creating a corrosive environmental for exposed ferrous metals at this site.

Based on the National Corrugated Steel Pipe Association, a low soil resistivity relates to increased potential corrosion activity and is governed by the content of electrolytes (consisting of moisture, minerals and dissolved salts) which can vary throughout the seasons. Typically, the lower the resistivity, the higher will be the soil corrosivity. Corrosive soil environments occur with a resistivity between 30 and 50 Ohm-m, and much lower values will be considered highly corrosive. Based on the soil samples tested with a resulting resistivity of 4762 Ohm-cm (or 47.62 Ohm-m), the foundation soil for this site could be classified as moderate corrosive to corrosive.

6 Discussion and Recommendations

It is understood that the Site is currently ongoing commercial/office building, which is intended to be developed with one 17-story residential towers as well as one to two levels of underground parking beneath a majority of the built area footprint. However, this has not been confirmed at the time of writing this report. No plans for the new building layout were provided to Arcadis.

Detailed borehole logs are provided in **Appendix B**. The reader is cautioned that conditions between and beyond boreholes may vary. The summary of the SPT numbers obtained during field investigation is presented below:

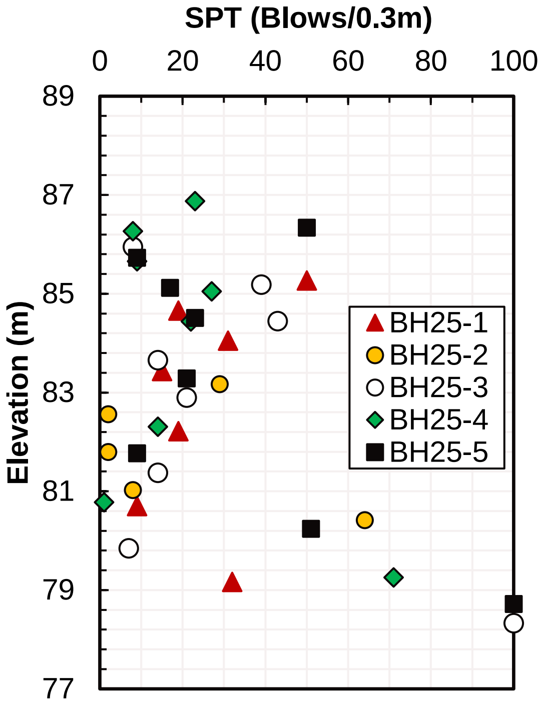

Figure 6-1: SPT 'N' Values vs. Elevation

- Es = 7*N for sand soils for NC sand with silt/ clayey sand
- Es = 1.2*N for sand with Gravel soils for NC sand
- Es = 4.45 to 6*N for hard Clay/Silty Clay (considered 5*N)

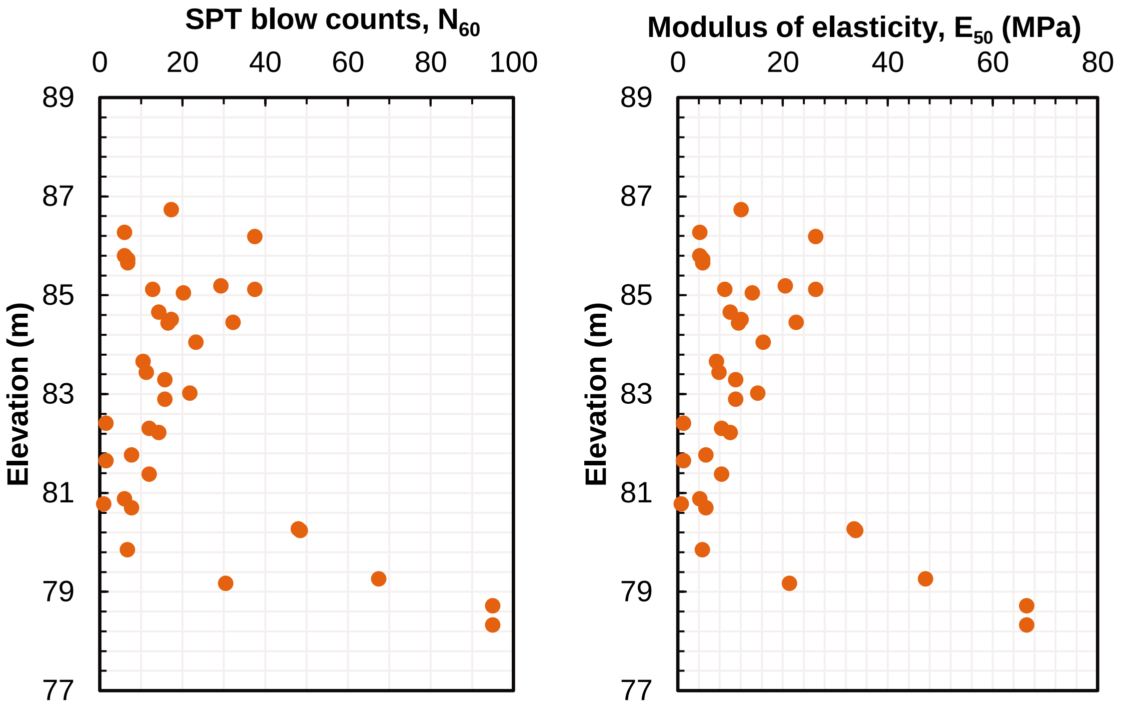

Figure 6-2: SPT 'N_{60}' and Modulus of elasticity E_{50} Values vs. Elevation

From a geotechnical perspective, the site condition at the project location is satisfactory for the development of the proposed residential towers. The geotechnical recommendations provided herein are to assist preliminary foundation and building design, and they are general in nature as limited details are available regarding the proposed structures. The recommendations should be reviewed by Arcadis prior to final design and construction to assess their applicability to the actual structure design. Further engineering, analyses and investigation work may be required once the final building parameters and configurations are known. Based on the results of the field investigation program carried out during this study, the following geotechnical recommendations are provided

6.1 Site Grading and Preparation

Prior to construction at the site, geotechnical improvements are recommended.

6.1.1 Clearing and Grubbing / Soil Removal

Asphalt, topsoil, deleterious fill (such as material containing high content of organic materials or construction remnants), and contaminated soils should be stripped entirely from under the proposed building footprint and other settlement sensitive structures (e.g. pavement structures). All soft overburden at the subject property within the proposed building footprints are expected to be removed. Further geotechnical analyses on the stratum will be required if the fill is to be considered for construction use (founding surface, backfill, etc.) on site.

Any exposed surfaces should be proof rolled to identify weak or loose areas, which should be removed and replaced with engineered fill.

6.1.2 Engineered and Native Fill

Clean sand soils may be used as engineered fill on site pending the results of Standard Proctor and grain size testing. It is recommended to avoid the use of silty soils, due to frost susceptibility. Wet silty soils are difficult to place and compact. Reworked native soils may have limited utility as backfill onsite (e.g., in landscaped areas) pending further geotechnical testing.

An appropriate engineered fill for the site would consist of OPSS Granular A or B Type II material compacted to at least 95% of Standard Proctor Maximum Dry Density (SPMDD) and placed in loose lifts with a maximum 300 mm thickness. Granular fill should be within 2% of optimum moisture content prior to placement and compaction. Alternatively, minus 50mm crushed stone would also be acceptable.

Pipe bedding should follow manufacturer recommendations per the specific pipe selected. It is also recommended that Ontario Provincial Standard Specifications (OPSS) be followed and any other applicable local standards from the City of Oakville.

6.1.3 Excess Soils

The removal of any excess soil from the site should follow the requirements of O.Reg. 406/19- ***On-Site and Excess Soil Management***, issued under the Environmental Protection Act.

6.2 Foundation Considerations

It is understood that the proposed development will include one to two levels of underground basement parking; however, this has not been confirmed yet. On this basis, it is anticipated that the foundations for structures with one to two basement levels will be seated at depths of approximately 7.0 m below the existing ground level The fill/native soils (silt/clay) encountered at the site are not suitable as bearing strata due to their poor vertical and lateral strength, as well as the unacceptable risk associated with high immediate (Elastic) and long term (Consolidation) settlement.

Lowest Elevation as P2 Elevation

Bedrock was encountered in each borehole at depth ranging from approximately 3.4 and 7.9 mbgs (elevations ranging from approximately 78.1 to 81.0 mbgs). The geotechnical foundation capacity is calculated based on a strip footing of width B rests upon a jointed rock mass with an intact uniaxial compressive strength σ_c, geological strength index GSI, rock mass unit weight γ, and intact rock yield parameter mi. The ultimate capacity can be written as follow:

$$q_u = \sigma_c \, N_\sigma$$

where N_σ is defined as the bearing capacity factor, and it depend on the GSI and Hoek-Brown constant mi.

$$GSI = 1.5JCond_{89} + \frac{RQD}{2}$$

The $JCond_{89}$ is the joint condition rating by Bieniawski (1989) (dimensionless), and it is assumed Slickensided surfaces or Gouge < 5 mm thick or Separation (1 – 5) mm Continuous and the rating is 10. The RQD is assumed 24 based on the investigation. Therefore, the GSI is 27. Values of Hoek-Brown constant mi for intact rock by rock group (data from Marinos and Hoek 2001) is assumed as per the Canadian foundation manual for sedimentary rock soft shale to be 8. Based on the study done by Merifield, Richard S et. al. (2006), N_σ is interpolated as 0.25.

The compressive strength of this stratum obtained by Rock Core Compressive Strength testing ranged from 93.7 to100.9 Mpa (Average 95Mpa). Thus, the allowable bearing capacity is calculated as 10MPa (assuming 2.5 factor of safety).

Based on the ground conditions observed at the borehole locations, the anticipated moderate-to-high loading of the proposed mid- and high-rise structures can be supported by the shallow bedrock underlying the site using reinforced concrete spread footings or pad foundations with a maximum allowable bearing pressure of 10MPa. Depending on the final elevation of the lowest basement floor, the proposed buildings may be supported by conventional spread footings or mat foundations.

The bearing resistance values provided assumes the bedrock is cleaned of debris and any loose rock pieces. The bedrock should be cleaned with air or water exposing the clean slightly weathered to sound bedrock. If construction proceeds during freezing weather conditions, water should not be allowed to pool and freeze in bedrock depressions. In no case should the footing be placed on disturbed bedrock subgrade. The inspected and approved footing base should be covered with 50 mm thick mud slab immediately in order to avoid disturbance of the founding soil due to construction activity and weathering /drying. The shale bedrock, if left exposed, will slake. Therefore, we recommend that the foundations be poured as soon as possible upon completion of excavation, or the base of the excavation should be skim-coated with a lean mix concrete, minimum 75 mm thick, to level and protect the integrity of the exposed subgrade. Prior to the placement of concrete, all foundation must be inspected and approved by a geotechnical engineer from Arcadis to ensure the founding soil are similar to those identified in the boreholes.

Where, it is necessary to place at different levels, the upper foundation must be founded below an imaginary 10 horizontal to 7 vertical lines drawn up from the base of the lower foundation. The lower footing must be installed first to help minimize the risk of undermining the upper footings/foundations.

A temporary groundwater system should be in place prior to excavation and groundwater should be kept at least 1 m below the base of excavation (i.e., lowest depth of excavation). The base of excavation should be kept dry all the time for the duration of below grade construction works, in order to preserve the structural integrity of the founding bedrock.

Total and differential settlements for footings founded on shale bedrock and designed as outlined above should not exceed 25 and 19 mm respectively, provided that the founding subgrade is not loosed or softened by construction activities or prolonged exposure to the weather. However, for sound shale bedrock, the foundation design is not governed by resistance at serviceability Limit State (SLS) since the stress required to produce 25 mm of deformation will generally be much larger than the factored resistance at ULS.

Highest Elevation (no basement)

It is expected that the lowest P1/P2 parking garage level will likely be heated and associated footings will not be susceptible to frost impact. Where foundations are potentially exposed to outdoor conditions, a minimum 1.2 m of earth cover is required for frost protection. Founding shallow footings at depths less than 1.2 m bgs will require use of Styrofoam SM or similar product to provide an equivalent of 1.2 m soil depth for frost protection. Final construction grades would have to be reviewed to determine appropriate shallow footing invert depths.

Shallow foundations may be considered an appropriate option; however, the acceptability of the shallow footings will depend on design factors such as the elevation of the lowest floor level and the structural loading. If the footing design criteria outlined in this report cannot be satisfied, an alternative solution, such as a piled foundation, may need to be considered particularly if the proposed structures are subject to higher-than-anticipated loading or if the lowest floor level is to be constructed within the silt/clay layers.

For instance, at borehole BH 25-4, the Standard Penetration Test (SPT) N-value was recorded as 1 at an elevation of 81 m below ground surface (mbgs), indicating that the soil at this depth is very soft. To address the potential risk of high settlement of the proposed development if the foundation will be within the top weak layers, ground improvement techniques such as rammed aggregate piers, controlled modulus columns (CMC), or deep foundation are recommended.

Piles into shale bedrock are also suitable for the support of structural loads at this site. Any piled foundation should be seated at a depth to provide a minimum 3 m rock socket (i.e., founded at a minimum of 3 m penetration depth into the weathered shale).

The end bearing resistance of rock socket piles was estimated according to CFEM (2023):

$$q_a = \sigma_c K_{sp} d$$

Where q_a is allowable bearing pressure (kPa); σ_c is average unconfined compressive strength of the rock core; K_{sp} is an empirical factor that varies from 0.1 to 0.4 depending on the bedrock discontinuity spacing; d = 1+0.4 (L_s/B_s) ≤ 3, where L_s is depth (length of the socket) (m) and B_s is diameter of the socket (m).

Ultimate shaft resistance of rock socket was calculated using

$$\frac{f_{max}}{p_a} = b\,(\frac{q_u}{p_a})^{0.5}$$

Where: f_{max} is the ultimate average unit skin friction along the rock socket, P_a is the atmospheric pressure, and b is an empirical factor which can be taken as 0.65 as a conservative lower bound value.

Table 6-1: Pile Geotechncial Capacity

Pile Diameter (m)	Allowable Shaft Friction (MPa)	Allowable End Bearing (MPa)
0.6	0.7	10.0
0.8	0.7	8.0
1	0.7	7.0

The following parameters should be applied for the bedrock when considering lateral pressures on loaded piles:

K_p = Rankine passive pressure coefficient = $\tan^2(45 + \phi/2)$

For the completely and highly weathered shale (residual soil):

ϕ = Internal angle of friction should be taken as 26°; and,

ϒ = Bulk unit weight should be taken as 22 kN/m^3.

For the weathered shale:

ϕ = Internal angle of friction should be taken as 26°; and,

ϒ = Bulk unit weight should be taken as 25.5 kN/m^3.

For comparison purposes, values of the allowable bearing pressures have been used to obtain equivalent ultimate bearing pressures, assuming a factor of safety of 3.

6.3 Slabs on Grade

Slab-on-grade floor could be used for light outbuildings or other infrastructure. The surficial Fill layer is considered unsuitable for support of building floor slabs due to its compressible nature and should be excavated and removed.

Any underlying native silts/sands or silty sand are considered adequate for support of building flooring slabs. Prior to use, the exposed subgrade will require proof-rolling and geotechnical inspection to ensure that founding surfaces are acceptable prior to placing stone, engineered fill, or concrete. Any soft spots should be replaced with OPSS Granular B materials and compacted as engineered fill to achieve 98% SPMDD.

Any building floor slabs should typically be constructed to be independent of building foundation walls, or any other part of the structure founded on different soils/foundations to minimize differential settlement.

Based on the borehole soil conditions, it should be possible to construct the lowest (i.e., basement) floor slab level using slab-on-grade methods. The subgrade support conditions are anticipated to be weathered shale, which should provide competent conditions for placing the vapour barrier material. However, after the subgrade has been prepared to the underfloor design elevation it is recommended that the area be assessed by Arcadis to determine if there is a need for any remedial work. It is recommended that a minimum 200 mm layer of clear, 19 mm crushed quarried stone be used as the vapour barrier under the floor slab. The vapour barrier stone should meet the requirements of Ontario Provincial Standard Specifications (herein “OPSS”) 1004 for 19 mm Type II clear stone. If a graded crushed stone is substituted for clear stone, the material should be limited to a maximum of 5 % fines (passing the 0.075 mm sieve). The floor slab thickness should meet the specifications of the project based on anticipated floor loadings.

It is recommended that a minimum 200 mm layer of clear, 19 mm crushed quarried stone be used as the vapour barrier under the floor slab. The vapour barrier stone should meet the requirements of Ontario Provincial Standard Specifications (herein “OPSS”) 1004 for 19 mm Type II clear stone. If a graded crushed stone is substituted for clear stone, the material should be limited to a maximum of 5 % fines (passing the 0.075 mm sieve). The floor slab thickness should meet the specifications of the project based on anticipated floor loadings.

After the subgrade has been prepared to the underfloor design elevation it is recommended that the area be proof rolled with a loaded tandem axle dump truck to delineate if there are soft or unstable ground conditions that require repair. This operation should be completed before the underfloor vapour barrier granular material is placed. A polyethylene vapour barrier or equivalent barrier or equivalent may be placed on the granular bedding if a moisture sensitive finish is to be placed on the floor.

The finished exterior ground surface should be sloped away from the buildings at a grade in the order of 2 %.

The design of concrete slabs on native soils may be made on the basis of a value of modulus of subgrade reaction of 20 MPa/m for native silty sand/sandy silt soils and 400 MPa/m for weathered shale.

A perimeter and underfloor drainage system will be required for buildings with basements.

6.4 Frost Protection

All foundations of heated structures should be provided with a minimum of 1.2 m soil cover (or equivalent using expanded polystyrene foam (EPS) and minimum of 0.5 m soil cover) to provide required frost protection. Frost protection should also be provided for any slabs exposed to the elements. Frost protection is required for footings founded on shale bedrock.

Native soils are considered to be frost susceptible. Due to its freezing potential, the native soils are not recommended as backfill adjacent to exterior building walls.

Unheated structures, such as those for retaining walls, require additional protection. Soil cover of 1.6 m thickness or a combination of soil cover and EPS foundation insulation is recommended.

Trench excavations and pavement construction are difficult activities to complete during freezing conditions without introducing frost in the sub-grade or in the excavation walls and bottoms. Precautions should be taken if such activities are to be carried out during freezing conditions.

6.5 Seismic Considerations

6.5.1 Seismic Hazard

According to the Geological Survey of Canada, the City of Oakville falls within the Southern Great Lakes Seismic Zone (SGLSZ), which is far from any known active tectonic plate boundaries. Based on the recorded seismic activity by the Canadian Seismograph Network in recent years, this region has a low to moderate level of seismicity when compared to the more active seismic zones to the east, such as along the Ottawa River and in Quebec. Under the 2020 Ontario Building Code, a seismic hazard with a 2% probability of exceedance in 50 years has been retained for design of the building structure. The Sa (4.0, Xc) is 0.0168 for the 2%/50 year. Geohazard study may be required in order to identify accurately the seismic parameters for design stage.

6.5.2 Liquefaction Assessment

In the event of a strong seismic activity, certain types of saturated soils may lose their bearing strength due to excess pore pressures, which may lead to excessive settlements of buildings. This phenomenon is more prevalent in cohesionless soils, often found alongside rivers or shorelines. The shallow overburden, the sandy silt, and silty clay soils at the project site are not potentially liquifiable.

6.5.3 Seismic Site Classification

The Ontario Building Code (2012) provides the methodology for determining the site classification for seismic response which is based on shear wave velocity (Vs) measurements along the top 30 m of the stratigraphy. However, since no measurements of Vs were conducted, the classification is based on the penetration resistance (N-values) obtained during this geotechnical investigation.

The site class for seismic site response should be taken as Class E (soft soil) for the foundations bearing on native soil profile materials with an average N_{60} blow counts between <15, per Table 4.1.8.4A of the Ontario Building Code. Seismic classifications may be field verified at a later date by using field MASW/ESPAC seismic refraction methods, if desired. The design values of Fa and Fv for the project site should be calculated in accordance with Table 4.1.8.4 B and C in the same code, respectively.

If the proposed buildings has one or more levels of basement and founded on sound shale bedrock, it may be possible to classify the site as “Class B” for seismic site response. This should be further confirmed during the detail design stage.

6.6 Temporary Excavations

Temporary excavations are expected to be shallow and must conform to the stipulations by O.Reg. 213/91 promulgated under the Occupational Health and Safety Act. Most soils that will be encountered in temporary excavations depth are anticipated to be Type 3 (stiff to firm soil) at depths less than 1.5 m bgs and Type 2 (very dense soil) at greater depths. Shallow soils may lose its integrity if the water content increases (silty and clayey soils), as defined under the Regulation. Therefore, open cut side slopes would need to be supported with trench box equipment or maintained at 3H:1V slopes, especially those advanced beneath the static water table.

Several soil samples examined show moisture contents much less than the liquid limits, as determined by Atterberg limit testing. Nevertheless, excavations should proceed carefully, and precautions should be taken with respect to open excavations. No water should be allowed to accumulate in excavations onsite from surficial or subsurface sources.

In accordance with Ontario Regulation 213/91, excavations slopes should be sloped according to Soil Type. Maximum support system requirements for steeper excavations are provided in the Regulation and cover moveable trench boxes and shoring.

6.6.1 Earth Pressure Parameters and Bulk Unit Weights

Retaining walls as well as any temporary shoring should be designed to resist lateral earth pressures of retained soils. The parameters used in the determination of unbalanced earth pressures are defined as:

Table 6-2: Earth Pressure Calculation Parameters

Parameter	Definition	Units
φ	internal angle of friction	degrees
γ	bulk unit weight of soil	kN/m^3
K_a	active earth pressure coefficient (Rankin)	dimensionless
K_o	at-rest earth pressure coefficient (Rankin)	dimensionless
K_p	passive earth pressure coefficient (Rankin)	dimensionless

The recommended design parameters for structures subjected to earth pressures are provided in the table below.

Table 6-3: Recommended drained Earth Pressure Design Parameters

Soil Type	γ	Φ	K_a	K_o	K_p
Earth Fill	18	29	0.35	0.52	2.88
Sand Silt	17	25	0.4	0.58	2.46

Soil Type	γ	Φ	K_a	K_o	K_p
Silty sand	19	32	0.31	0.47	3.25
Gran B compacted	21	32	0.31	0.47	3.25

Arcadis should be contacted if unbalanced earth pressure design calculations are required.

6.6.2 Earth-Retaining Shoring Systems

As the site is situated next to Randall Street, Navy Street and other residential infrastructure, it is recommended that all excavation work be provided with excavation wall supports.

The design of basement walls can incorporate the conventional design in the overburden using the earth pressure coefficient K1=0.40. In the rock, the earth pressure coefficient K can be reduced to K_2=0.20.

The lateral earth/rock pressure acting at any depth on basement walls can be calculated as follows:

In soil: $P= k_1 [\gamma_1 h_1+q) + P_w$

In Rock: $P= k_2 [\gamma_2 H_1+q+ \gamma_2 h_2) + P_w$

where p = lateral earth and water pressure in kPa acting at depth h_1 or h_2

K_1, K_2 = earth pressure coefficients, K_1=0.40 for overburden soil; K_2=0.20 for rock

γ_1 = unit weight of overburden soil, assuming 19 kN/m^3 above the water table and 11 kN/m^3 below the water table

γ_2 = unit weight of rock below water, assuming 15 kN/m^3

h_1 = Depth in overburden soil, below ground surface

H_1 = thickness of soil above rock

h_2 = Depth in rock, below rock surface

q = value of surcharge in kPa

p_w = hydrostatic water pressure.

In the situation that shoring is to be supported by a single level of bracing or earth anchors, a triangular earth pressure distribution is appropriate for design, similar to that of basement building wall designs.

Where multiple rows of lateral support systems are envisaged to support shoring walls, a distributed pressure diagram should be employed to approximate earth pressures when restrained by pre-tensioned anchors. Such a multi-level support system should be designed based on the following earth pressure distribution which provides maximum pressures calculated as:

$$P= 0.65 L[\gamma H+q) + \gamma_w h_w$$

P= maximum horizontal pressure (kPa)

H= total depth of excavation (m)

K= earth pressure coefficient

6.6.3 Shoring considerations

In areas where an open excavation slope cannot be maintained, the excavation within the overburden should be supported by using a shoring system. Where settlement sensitive structures are located at the close proximity of the proposed excavation, a series of caisson walls embedded sufficiently below the bottom of the excavation, will have to be used to prevent any movement in the adjacent properties. Shoring system consisting of soldier piles and timber laggings can be used, on the other sides, where slight movement in the ground surface can be tolerated, i.e., where non-sensitive structures exist.

The shoring system should be designed by an experienced shoring consultant in accordance with the guidelines provided in the latest edition of the Canadian Foundation Engineering Manual (Manual). Similarly, the construction of the shoring system should also be carried out by a contractor, experienced in this type of construction. The soldier piles should be installed in pre-augured holes which should be filled up to excavation level with 20 MPa (3000 psi) concrete and above that with 1-1/2 bag mix.

When designing a temporary or permanent subsurface wall within bedrock, a uniform pressure distribution is assumed and is consistent with the maximum earth pressure calculated for the wall where in soil. However, below the weathered bedrock zone, the design does not accommodate for lateral rock swell.

Lateral rock swell will be of concern as fresh bedrock will be exposed in the excavation faces and will be more prone to swell than the shallower, more weathered bedrock zone. No real rate of swell can be put on the bedrock as it is very variable.

There are various approaches to overcome rock swell in design and excavation. There is a generally accepted industry practice which assumes that bedrock exposed for a period of more than 120 days will have swelled such that no significant stresses will be exerted upon foundation walls. Alternatively, a number of methods of mitigation are generally accepted to include.

- The limiting of bedrock exposure to no more than 7 days;
- The application of a mud-mat/shotcrete onto the exposed rock face once excavated;
- The installation of a layer of compressible fill material (e.g. Ethafoam Plank products) between the rock face and the back of the structural wall; and/or,
- The over-excavation of the bedrock ±0.6 m and backfilling the void space with 19 mm Clear Stone

It should be noted that the variability of the Georgian Bay Formation shale means that, without site-specific testing, no definitive time at which point the swell becomes negligible can be assigned

6.6.4 Excavation Considerations for Bedrock

In accordance with the standards set out in the OHSA, the more competent “shale bedrock” encountered underlying the site has strength properties that exceed a Type 1 soil, though may be encountered on site at relatively shallow depths as a “residual soil”.

For any required bedrock excavation, a backhoe equipped with a hydraulic breaker and/or a bucket with rock-ripping ‘tiger teeth’ may be required in the shale bedrock, particularly when encountering harder siltstone or limestone bands. The blasting of bedrock will not be permitted by the Corporation of the town of Oakville (herein “town of Oakville”). Significant ground vibrations resulting from excavation works are not anticipated, though may be elevated above those associated with normal construction activities. As such, a period of ground vibration monitoring may be required to determine the peak vibration levels and any remedial measures or limitations required.

A backhoe equipped with a hydraulic breaker and/or a bucket with rock-ripping ‘tiger teeth’ may be required in the shale strata. Significant ground vibrations resulting from excavation works are not anticipated other than those associated with normal construction activities.

Slightly weathered and competent shale of the Georgian Bay Formation has the characteristics of becoming soft or degraded after excavation and subsequent exposure to the elements, the results of which would be basal heaving and compression from rock squeezing along excavation side walls. As such, these effects should be minimized during construction and requires a well-planned construction program to ensure that the exposure of the shale bedrock is kept to a minimum.

Methane gas exists in the bedrock, normally below the top 1m and more concentrated with depth. Appropriate care and monitoring are essential in all confined bedrock excavations, particularly caissons and tunnels. As such, the potential could exist for the development of an explosive or oxygen-depleted air environment. Therefore, Arcadis recommends that the appropriate air space monitoring is undertaken within all confined excavations, particularly those located close to or within bedrock, as defined by the OHSA.

6.7 Pavements

Preparation for construction of the new pavement should include the removal of existing pavement components (asphaltic concrete and granular materials) and any unsuitable materials such as weak/softened and/or disturbed soils. After removal of all unsuitable soils, the subgrade should be proof rolled with heavy rubber-tired equipment and inspected by qualified personnel prior to pavement structure construction. Where required at the subject site, generic examples of pavement structures for parking areas and access lanes are shown below:

Founding soils for pavements structure must be proof-rolled and inspected by qualified personnel prior to pavement structure construction. Where required at the subject site, the recommended pavement structures for parking areas and access lanes are shown below:

Table 6-4: Recommended Pavement Structure-Car Only Parking Areas

Thickness (mm)	Material Description
40	**Asphalt Wear Course**: HL-3 or Superpave 12.5 B Asphaltic Concrete
60	**Asphalt Binder Course: HL-8** Superpave 19.0 B Asphaltic Concrete
150	**Base**: TS 1010 Granular A Crushed Stone base
150	**Subbase**: TS 1010 Granular B Type II
Subgrade: Either fill, competent in-situ soil or TS 1010 Granular B Type I or II material placed over competent in-situ soil or fill.	

Table 6-5: Recommended Pavement Structure- Access Lanes -Heavy Truck Parking/Loading Areas

Thickness (mm)	Material Description
40	**Asphalt Wear Course**: HL-3 or Superpave 12.5 Asphaltic Concrete
80	**Asphalt Binder Course**: HL-8 or Superpave 19.0 Asphaltic Concrete

Thickness (mm)	Material Description
150	**Base**: OPSS Granular A Crushed Stone base
150	**Subbase**: OPSS Granular B Type II
Subgrade: Either fill, in-situ soil or TS 1010 Granular B Type I or II material placed over in-situ soil or fill.	

Minimum Performance Graded (PG) 58-34 asphalt cement is recommended for this project.

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with compacted OPSS Granular B Type II material. Weak subgrade conditions may be experienced over service trench fill materials. This may require the use of a geotextile, such as Terrafix 270R or equivalent, thicker subbase or other measures that can be recommended at the time of construction as part of the field observation program.

Sub-excavated areas may be backfilled with excavated material from the site or similar clean imported fill material, free from topsoil, organic, high plasticity silty clay or other deleterious matter, provided the material is placed in large areas where it can be compacted with heavy compactors. Oversize particles (cobbles, boulders) larger than 150 mm should be discarded from fill materials. Fill materials should not be frozen and should not be too wet for efficient compaction (water content at optimum or within 2 % of optimum). The fill placement should not be performed during winter months when freezing temperatures occur persistently or intermittently. All fills must be placed in lifts not exceeding 200 mm in thickness and compacted to at least 98% of the material’s SPMDD.

The pavement granular base and subbase should be placed in maximum 200 mm thick lifts and compacted to a minimum of 100% of the material’s SPMDD using suitable vibratory equipment. Surficial topsoil should be stripped and removed from the proposed roadway. The exposed subgrade should be proof rolled to meet at least 95% Standard Proctor Maximum Dry Density (SPMDD), inspected, and any weak or deleterious material excavated and replaced. The subgrade can be raised by placement of approved site derived imported granular fill. Geotechnical testing should be carried out at the time of construction to ensure optimum moisture content and density of the granular fill upon placement and compaction. Any engineered site derived fill should be compacted to at least 95% SPMDD.

Concrete (rigid) pavement is proposed in the area of the pump islands. It is recommended that the granular components placed at the underside of the concrete pavement are laid and compacted in accordance with the granular component layers recommended for the asphaltic concrete (flexible) pavement such that the subgrade profile is maintained at the interface between rigid and flexible pavement structures.

The surface of the subgrade should be shaped to promote drainage to the edge of the paved areas. Perimeter ditches or storm sewer catch basins should be installed to remove surface runoff from the area. Groundwater drainage is not expected to be a concern due to the observed deep groundwater table.

6.7.1 Cement Type and Corrosion

Based on the test results and construction requirements, general use hydraulic cement (GU) or high-early-strength hydraulic cement (HE) could be used for the design of the concrete mix as far as soil exposure is concerned. For more information regarding the degree of exposure and type of cement required, reference should be made to the CSA Standard (see Section A23.1). There is negligible potential for sulphate attack on concrete at this site.

Based on the soil samples tested with a resulting minimum resistivity of 4762 Ohm-cm (or 47.62 Ohm-m), the foundation soil for this site could be classified as moderately corrosive to corrosive. It should be noted that there may be other overriding factors in the assessment of corrosion potential, such as the nature of effluent conveyed, the application of de-icing salts on the roadway and subsequent leaching into the subsoils, the use of fertilizers, pesticides and soil conditioners for agricultural purposes, stray currents, etc.

6.8 Foundation Drainage – Groundwater Control

6.8.1 Pre-Construction Groundwater Control

Foundation excavations are expected to be primarily below the anticipated static groundwater table. Excavation into the upper sand and silt unit may encounter free-flowing water at depths below the groundwater table. It will be necessary to dewater any foundation excavations that might extend below a depth of Elev. 83.4 m.

Dewatering may be affected through the installation of a series of wellpoints driven to the target dewatering depth, or with sumps designed to managed flow; the dewatering contractor shall be responsible for dewatering method design and implementation. Groundwater is to be lowered at least 1.2 m beyond the base of the excavation (i.e., below any founding surface. No compaction should be carried out within 1 m vertical distance of the groundwater table.

It is likely that a Ministry of the Environment, Conservation and Parks (MECP) permit to take water (PTTW) is required for this site (typically required if more than 400,000 L/day of ground and/or surface water is to be pumped during the construction phase) to cover dewatering operations. For typical ground or surface water volumes being pumped during the construction phase, typically between 50,000 to 400,000 L/day, it is required to register on the Environmental Activity and Sector Registry (EASR). A minimum of two to four weeks should be allotted for the completion of the EASR registration and the Water Taking and Discharge Plan to be prepared by a Qualified Person as stipulated under O. Reg. 63/16.

6.8.2 Foundation Wall Seepage Control

Perimeter and subfloor drainage systems are required for the underground parking structure. Subfloor drainage is used to collect and remove any seepage that infiltrates under the floor. Perimeter drainage collects and removes seepage that infiltrates at the foundation wall.

A subfloor drainage system is recommended to comprise laterals spaced at approximate 6 m centre on centre distances apart. Subfloor drains are typically installed in trenches below the granular drainage layer but may be incorporated into the drainage layer, if needed. The subfloor drainage system may be laid directly over the prepared subgrade (with a non-woven geotextile layer separation) and backfilled with a minimum 300 mm thickness of clear stone, HPB or HL8 aggregate. All collection piping should be provided with 2% sloping to discharge towards discharge sumps.

The substructure walls should be made to be fully drained to eliminate hydrostatic pressures. Prefabricated composite drainage panels may be used to provide such drainage. Seepage quantities from the drainage panels are to be collected and discharged through the basement walls using solid piping through wall ports with connection to sumps. Waterproofing should be installed between the drainage core product and the basement wall to protect against interior moisture build-up.

Subfloor drainage and perimeter drainage elements should include duplexed pump systems which are provided with an emergency power supply.

6.9 Pipe Bedding and Backfill

Bedding and backfill materials should be in accordance with the most recent Standards for Designing and Constructing City Infrastructure from the Engineering and Construction Services, City of Oakville.

A minimum of 150 mm of TS 1010 Granular A Native or Granular A RCM should be placed for bedding for sewer or water pipes when placed on soil subgrade. The bedding should extend to the spring line of the pipe. The material should be placed in a maximum 200 mm thick loose lifts and compacted to a minimum of 95% of its SPMDD and in accordance with TS 501.

The cover material, which should consist of TS 1010 Granular A, should extend from the spring line of the pipe to at least 300 mm above the obvert of the pipe. The material should be placed in a maximum 200 mm thick loose lifts and compacted to a minimum of 95% of its SPMDD and in accordance with TS 501.

Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone (to about 1.8 m below finished grade) should match the soils exposed at the trench walls to minimize differential frost heaving. The trench backfill should be placed in a maximum 300 mm thick loose lifts and compacted to a minimum of 95% of the material's SPMDD and in accordance with TS 501.

If required, frost depth protection can be provided to duct banks or similar using an overlay of Styrofoam SM insulation. Insulation overlay design and backfill parameters can be provided by Arcadis once embedment depths have been confirmed.

6.10 Winter Construction

The subsoil fill conditions at this site mostly consist of frost susceptible materials. In presence of water and freezing conditions, ice could form within the soil mass. Heaving upon freezing and settlement upon thawing could occur. Precautions should be taken if winter construction is considered for this project.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures using a straw, propane heaters, tarpaulins, or other suitable means. In this regard, the base of the excavations should be insulated from sub-zero temperatures immediately upon exposure and until such time as heat is adequately supplied to the building and the footings are protected with sufficient soil cover to prevent freezing at founding level.

Any trench excavations should be carried out in a manner that will avoid the introduction of frozen materials into the trenches. As well, pavement construction is difficult during winter. The subgrade consists of frost susceptible soil which will experience total and differential frost heaving as the work takes place. In addition, the introduction of frost, snow, or ice into the pavement materials, which is difficult to avoid, could adversely affect the performance of the pavement structure. Additional information and recommendations can be provided during the design and construction project phases if requested.

6.11 Surface Water Considerations

A temporary surface water management plan will need to be developed for use during construction. A permanent stormwater management plan will also need to be developed based on the final site configuration. There may be a need to pump accumulated water from construction site sumps.

Discharge to the municipal sewer system will require an agreement with the City of Oakville.

6.12 Future Recommendations

6.12.1 Onsite Work

Recommendations for future geotechnical related work to support the structure design process include the following:

- A surface water monitoring program will need to be implemented in the pre-construction, during construction and post construction phases. The monitoring program should include water quality monitoring and any other requirements of the City of Oakville;
- Preconstruction utility, and if applicable adjacent building/structure, condition surveys may need to be carried out to confirm that no adverse effects result from subsurface excavation and overall building construction;
- A Soil Management Plan should be developed in accordance with O.Reg. 406/19 to effectively manage site soils during excavation and construction onsite; and
- Groundwater monitoring wells should be decommissioned in accordance with O.Reg. 903 when no longer required.

6.12.2 Geotechnical Consultation During Design

The geotechnical recommendations provided herein to assist foundation and structure design are general in nature as full details are not available regarding the proposed structures. The recommendations should be reviewed by Arcadis prior to construction to assess their applicability to the proposed development. Site-specific foundation design recommendations may be required for components of the proposed structure(s). The construction design drawings should be reviewed by the geotechnical engineer to confirm that the guidelines presented in the geotechnical report have been interpreted as intended. Further engineering, analyses and investigation work may be required once the final structures parameters and configurations are known.

6.12.3 Geotechnical Supervision During Construction

Development of the site will require movement of a variety of soil types. It is recommended that a qualified geotechnical engineer be retained to inspect and approve temporary excavations, the subgrade prior to placement of fill, foundations, slabs, etc. Geotechnical supervision should also be provided to ensure that any engineered fill placed beneath floor slabs, utilities and parking areas is properly compacted and that any weak layers are properly removed. Geotechnical inspection of the bearing conditions for the proposed foundation system should be carried out.

Soil excavation, offsite disposal and importation of new fill should all meet O.Reg. 406/19 environmental requirements applicable at the time of the work.

Geotechnical site supervision and review is required during future construction activities. It is recommended that the following material testing and observation program be performed by a licensed geotechnical engineering consultant during construction operations:

- Observation of all bearing surfaces prior to the placement of concrete/crushed stone/engineered fill; Sampling and testing of the concrete and fill materials used;
- Periodic observation of the condition of unsupported excavation side slopes, if applicable;
- Observation of all subgrades prior to backfilling;
- Field density tests to determine the level of compaction achieved; and
- Sampling and testing of the bituminous concrete including mix design reviews.

A report confirming that these construction works have been conducted in general accordance with geotechnical recommendations would then be issued following the completion of a satisfactory material testing and observation program by the geotechnical consultant. It is recommended that all excavations be inspected by competent geotechnical personnel to ensure that a proper bearing surface has been attained and that foundation designs are suited to site conditions.

7 Statement of Limitations

This report was prepared for specifically for Oakville Municipal Development Corporation. and does not provide certification or warranty, expressed or implied, that the investigation conducted by Arcadis uncovered all potential environmental and/or geotechnical constraints at the site. The conclusions and recommendations presented in this geotechnical investigation report are based on the information determined at the borehole locations. The information contained within this report in no way reflects the environmental aspect of the site or soil, unless specifically reported upon. Subsurface and groundwater conditions between and beyond the test locations may differ from those encountered at the specific locations tested, and conditions may be encountered during construction which were not detected and could not be anticipated at the time of the site investigation.

It is recommended that Arcadis be retained during construction to confirm that the subsurface conditions throughout the site do not differ materially from those conditions encountered at the test locations. The benchmark and ground surface elevations in this report were used to establish relative elevation differences between the test locations and should not be used for other purposes, such as grading, excavating, planning, development, etc.

The design recommendations provided 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 have been available at the time this report was prepared, it is recommended that Arcadis be retained during future stages of the design process to verify that the design is consistent with the recommendations of this report, and that the assumptions made in the analyses contained in this report are still valid. The need for additional subsurface investigation work and laboratory testing should be reviewed by the retained qualified engineering consultant during the course of the detailed design work.

The comments given in this report on potential construction problems and possible methods of construction are intended only for the guidance of the designer. The number of boreholes may not be sufficient to determine all of the factors that may affect construction methods and costs (e.g., the thickness of surficial topsoil and fill layers can vary markedly and unpredictably). Contractors bidding on the project or undertaking the construction should, therefore, make their own interpretations of the factual information in this report and draw their own conclusions as to how the subsurface conditions may affect their bid or work.

Furthermore, the material in it reflects the best judgement of Arcadis based on the information available at the time of preparation. Changes to soil and/or groundwater in the areas investigated can occur following the date of testing. Any use which a third party makes of the report, or reliance on, or decisions to be based on it, is the responsibility of such third parties. Arcadis accepts no liability, whether in negligence, contract or arising on any other basis for damages or from indemnification arising from decisions or actions by others based on this report. Please note that the recommendations provided in this report are intended solely for the preliminary planning of this development. Further geotechnical investigation will be required before detailed geotechnical parameters can be established.

8 References

Budhu, M. 2006. *Soil Mechanics and Foundations.* John Wiley & Sons, NY.

Canadian Geotechnical Society. 2023. *Canadian Foundation Engineering Manual.* Fifth Edition, 888p.

Government of Canada. 2021. *2020 National Building Code of Canada Seismic Hazard Tool*. Digital resource – application.

Terzaghi, K. and Peck, R. 1976. *Soil Mechanics in Engineering Practice, 2nd Edition.* John Wiley, NY.

Government of Ontario. 2012. *Ontario Building Code*, O. O.Reg. 322/12. As amended June 2023.

Ontario Geological Survey. *1:250 000 Scale Bedrock Geology of Ontario*. Miscellaneous Release – Data. MRD-126-REV. 2011

Ontario Geological Survey. *Quaternary geology, seamless coverage of the Province of Ontario;* Ontario Geological Survey, Data Set 14---Revised. 2000.

Tables

Table 1

Elevations Summary

Borehole Number	Co-ordinates		Ground Surface Elevation (local)	Borehole Depth (mbgs)	Borehole Invert Elevation (local)
	North (m)	Easting (m)			
BH25-01	4811118.96	607431.89	85.27	7.3	77.97
BH25-02	4811088.28	607413.8	83.32	6.6	76.72
BH25-03	4811060.64	607447.19	85.95	10.8	75.15
BH25-04	4811096.88	607461.62	86.88	7.6	79.28
BH25-05	4811100.03	607433.81	86.34	13.60	72.74

Notes:

- All screen intervals are 3.05m. Elevation given is the top of the casing or ground surface elevation
- Surveying of elevations performed using Trimble GPSS unit & Antenna with <10cm accuracy

Table 2

Grain Size Analyses Results

<table>
<tr><th>Borehole Number</th><th>Sample</th><th>Gravel (%)</th><th>Sand (%)</th><th>Silt (%)</th><th>Clay (%)</th></tr>
<tr><td>BH-01</td><td>BH-01-04</td><td>0</td><td>25</td><td colspan="2">75</td></tr>
<tr><td>BH-01</td><td>BH-01-07</td><td>14.5</td><td>19.3</td><td>44.9</td><td>21.3</td></tr>
<tr><td>BH-02</td><td>BH-02-04</td><td>5</td><td>40</td><td colspan="2">55</td></tr>
<tr><td>BH-03</td><td>BH-03-06</td><td>0.2</td><td>4.1</td><td>84.6</td><td>11.3</td></tr>
<tr><td>BH-03</td><td>BH-03-07</td><td>7.6</td><td>25.2</td><td>48.7</td><td>18.4</td></tr>
<tr><td>BH-04</td><td>BH-04-07</td><td>0.2</td><td>4</td><td>46.8</td><td>49</td></tr>
<tr><td>BH-05</td><td>BH-05-05</td><td>1</td><td>28.6</td><td>64.1</td><td>6.3</td></tr>
</table>

Notes:

- Grain size analyses were performed by PNJ Engineering INC.
- Laboratory certificates are provided in the report appendices.

Table 3

Atterberg Limit Testing Results

Borehole Number	Sample	Depth (m)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index
BH-01	BH-01-07	6.1-6.7	25.3	14.8	10.5
BH-03	BH-03-06	4.6-5.2	20	15.6	4.4
BH-03	BH-03-07	6.1-6.7	21.3	13.7	7.6
BH-04	BH-04-07	6.1-6.7	34.7	16.9	17.8

Notes:

- Atterberg limit tests were performed by PNJ Engineering INC.
- Laboratory certificates are provided in the report appendices.
- Atterberg limits testing done in accordance with ASTM D4318 standard
- Soils with Plasticity Index >17 are highly plastic

Table 4

Groundwater Levels

Borehole / MW Number	Ground Surface Elevation (m)	Depth to Water (m) 2025.1.30	Water Elevation (m) 2025.1.30	Stick Up
BH25-02	83.32	2.49	80.83	0
BH25-03	85.95	2.32	83.63	0
BH25-04	86.88	NA	NA	0

Notes: - Water levels were measured using an oil-water interface probe.

Table 5

Results of Corrosivity Suite Analyses

Borehole Number	Sample	Depth (mbgs)	Sulphide (µg/g)	Chloride (20:1) (µg/g)	Sulphate (20:1) (µg/g)	pH (pH units)	Electrical Conductivity (µS/cm)	Resistivity (ohm.cm)	Redox Potential (mV)
BH25-05	BH25-05-4	1.8	<100	80.0	<100	8.73	210	4762	230

Notes:

- All tests were performed by Eurofins
- Laboratory certificates are provided in the report appendices.

Figures

Appendix A

A – Figures

LEGEND

▭ STUDY AREA

Title:

SITE PLAN

ARCADIS

Project:

PRELIMINARY GEOTECHNICAL INVESTIGATION
125 RANDALL STREET,
OAKVILLE, ON

Date:

February 2025

Client:

OAKVILLE MUNICIPAL DEVELOPMENT CORP.

0 15 30
Metres

FIGURE 1

last saved 7-Feb-25 by dlogan

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LEGEND

▭ STUDY AREA

⊕ BOREHOLE LOCATION

Title:

BOREHOLE LOCATIONS

ARCADIS

Project:

PRELIMINARY GEOTECHNICAL INVESTIGATION
125 RANDALL STREET,
OAKVILLE, ON

Date:

February 2025

Client:

OAKVILLE MUNICIPAL DEVELOPMENT CORP.

0 15 30 Metres

FIGURE 2

last saved 7-Feb-25 by dlogan

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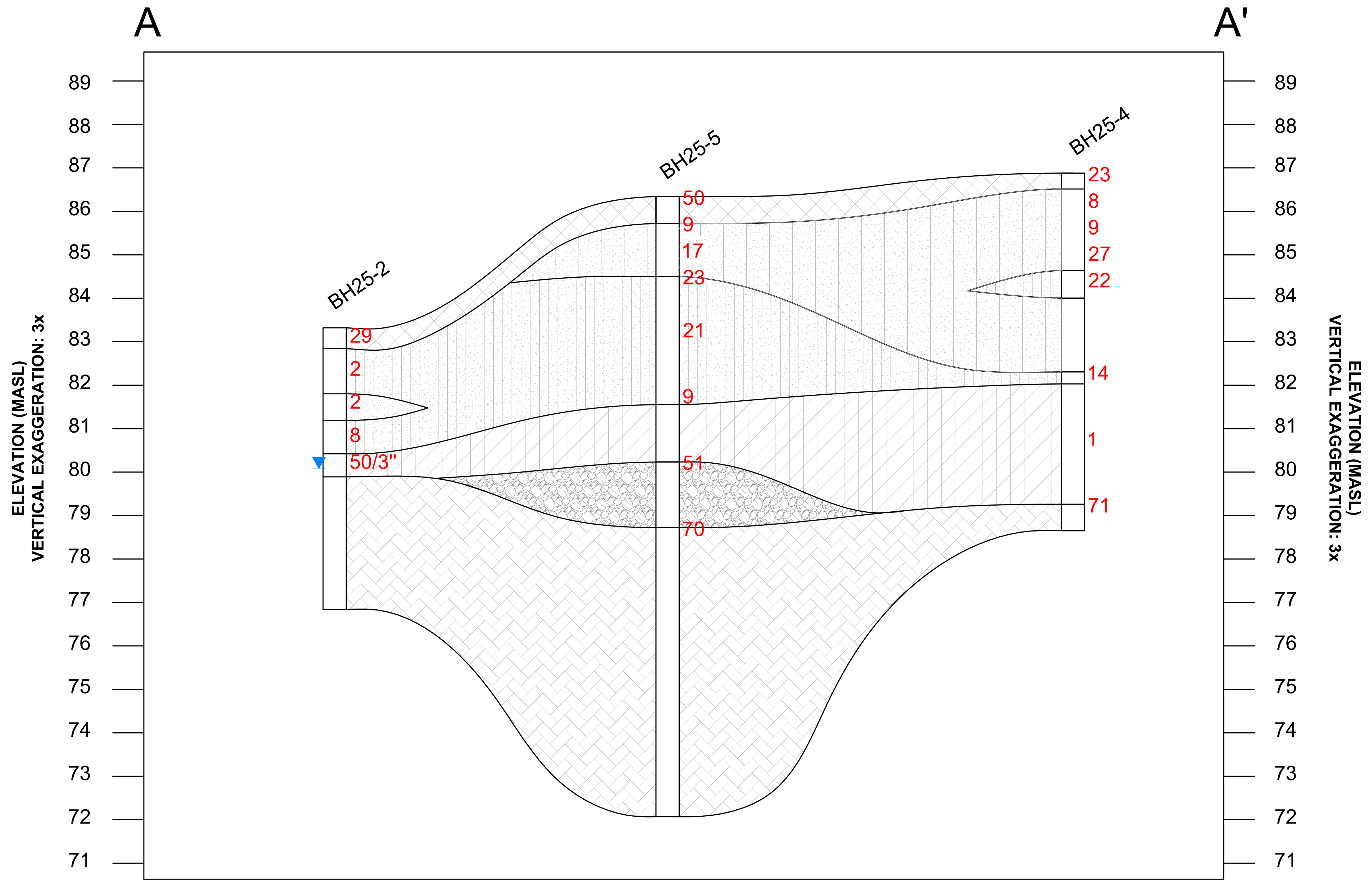
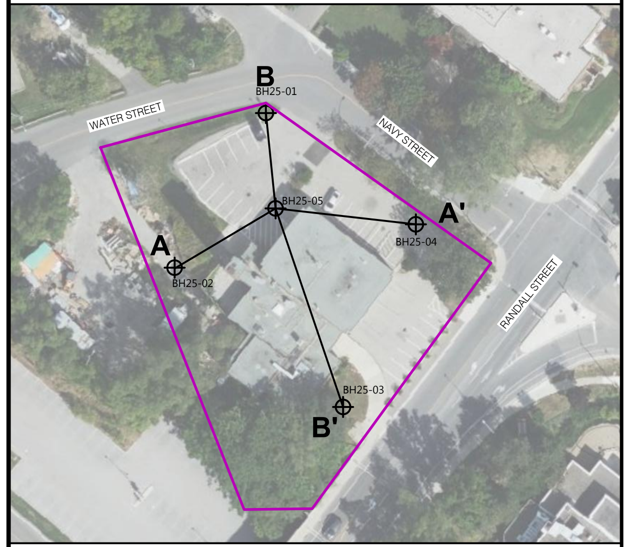
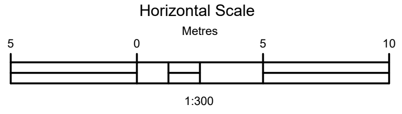


LEGEND

▨	Fill
▨	Sandy Silt
▨	Silty Clay
▨	Bedrock (shale/limestone)
▨	Silty Sand
▨	Silty Sand with Gravel
▨	Silty Clay with Gravel
⊕	Borehole
15	SPT N
▼	Ground Water Table





Title:
GEOTECHNICAL CROSS-SECTION A-A'

Project:
PRELIMINARY GEOTECHNICAL INVESTIGATION
125 RANDALL STREET,
OAKVILLE, ON

Client:
OAKVILLE MUNICIPAL
DEVELOPMENT CORP.

ARCADIS

Date:
February 2025

FIGURE 3

last saved 10-Feb-25 by dlogan

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Appendix B

B – Borehole Logs

Project: **New develoment at 125 Randall Street, Oakville, ON** Contract No: **30250694**
Boring date: **2025-1-30** Supervised by: **Grace Faraj**
Borehole Location: **N: 4811118.96 m E: 607431.89 m** Water Table: **m**
Driller: **Strata Drilling Group** WT Meas. Date:
Drilling Method: **Hollow Stem Auger**

METROLINX

Borehole: **BH25-01**
Monitoring Well: **n/a**
Sheet 1 of 1

Stratigraphy

Ground Surface Elevation:87.72m

Elev. (m) Depth (m)	Description (*DRAFT*)
87.66 0.06	**ASPHALT**
	GRAVELLY SAND FILL Dry to moist, brownish-grey, very dense
87.11 0.61	**SILTY SAND WITH GRAVEL FILL** brown, moist, compact, trace oxidation - Brown, moist, compact, no gravel - Piece of plastic at 1.17 m
85.84 1.88	**SANDY SILT** Dark reddish-brown, moist, stiff - Moist to wet, PHC odour noticed from cuttings
83.02 4.70	**SILTY CLAY** Grey, moist, stiff, trace gravel
82.54 5.18	**SILT WITH CLAY** Grey, some sand and grave, dry to moist, hard
81.01 6.71	**BEDROCK** Shale/limestone, grey, dry.
80.40 7.32	**END OF BOREHOLE @ 7.32 m**

Samples

Sample Type and Number	Blows/ 150mm	% Recovery	N value	Odour	Water Content (%)	Remarks and Sample Analyses
BH01-01	50	8	50	N	4.2	Frozen ground
BH01-02	5 7 12 24	79	19	N	9.2	
BH01-03	7 15 16 21	63	31	N	9.5	Inorganics - Piece of Plastic
BH01-04	6 7 8 8	88	15	N	20.5	G.S.
						PHCs
BH01-05	5 9 10 12	63	19	Y	14.6	
BH01-06	3 4 5 5	88	9	Y	11.4	
BH01-07	10 15 17 19	71	32	N	9.7	Atterberg limits+ G.S; CL (L.L. = 25.3%; P.L. = 14.8%)

⊕ Headspace TOV (ppm) 100 200 300 400
☐ Headspace TOV(%LEL) 20 40 60 80
△ Water Content (%) 20 40 60 80

ODOUR:
N - None
T - Trace
M - Moderate
S - Strong
VS- Very Strong

Prepared by: **Yash Solanki**
Checked by: **Mahmoud Ibrahim**
Date: **2025-01-31**

ARCADIS

Project: **New develoment at 125 Randall Street, Oakville, ON** Contract No: **30250694**
Boring date: **2025-1-28** Supervised by: **Grace Faraj**
Borehole Location: **N: 4811088.28 m E: 607413.8 m** Water Table: **2.49 m**
Driller: **Strata Drilling Group** WT Meas. Date:
Drilling Method: **Hollow Stem Auger until Bedrock then coring**

METROLINX

Borehole: **BH25-02**
Monitoring Well: **Installed**
Sheet 1 of 1

Stratigraphy

Elev. (m) Depth (m)	Description (*DRAFT*) Ground Surface Elevation:83.32m
	ASPHALT
83.19 0.13	**GRAVELLY SAND FILL** Brown, dry to moist, compact
82.84 0.48	**SANDY SILT** Dark brown, moist, compact
82.56 0.76	**SANDY SILT** Brown, moist, very soft, trace grey clay, trace rootlets
81.80 1.52	**SILTY SAND** Brown, moist, loose, trace rootlets
81.19 2.13	**SILT WITH SAND** Brown, moist, stiff, trace gravel, wet sand encountered at 2.9 m
80.42 2.90	**SILTY CLAY** trace silt and gravel, grey, moist to wet, stiff to hard
79.89 3.43	**BEDROCK** Shale/limestone, grey, dry. - 0.6m of Clay and Bedrock pieces
76.84 6.48	**END OF BOREHOLE @ 6.48 m**

Samples

Water Level	Sample Type and Number	Blows/ 150mm	% Recovery	N value	Odour	△ Water Content (%)	Remarks and Sample Analyses
	BH02-01	12 25 4 4	83	29	N	13.6	
	BH02-02	1 1 1 2	38	2	N	15.2	Organics, rootlets
	BH02-03	3 1 1 1	75	2	N	15	Organics, rootlets
▽	BH02-04	5 3 5 11	71	8	N	13.3	G.S.
	BH02-05	13 14 50	63	64	N	10.8	
	BH02-06		100		N		RQD=46% RQD=42%

⊕ Headspace TOV (ppm) 100 200 300 400
☐ Headspace TOV(%LEL) 20 40 60 80
△ Water Content (%) 20 40 60 80

ODOUR:
N - None
T - Trace
M - Moderate
S - Strong
VS- Very Strong

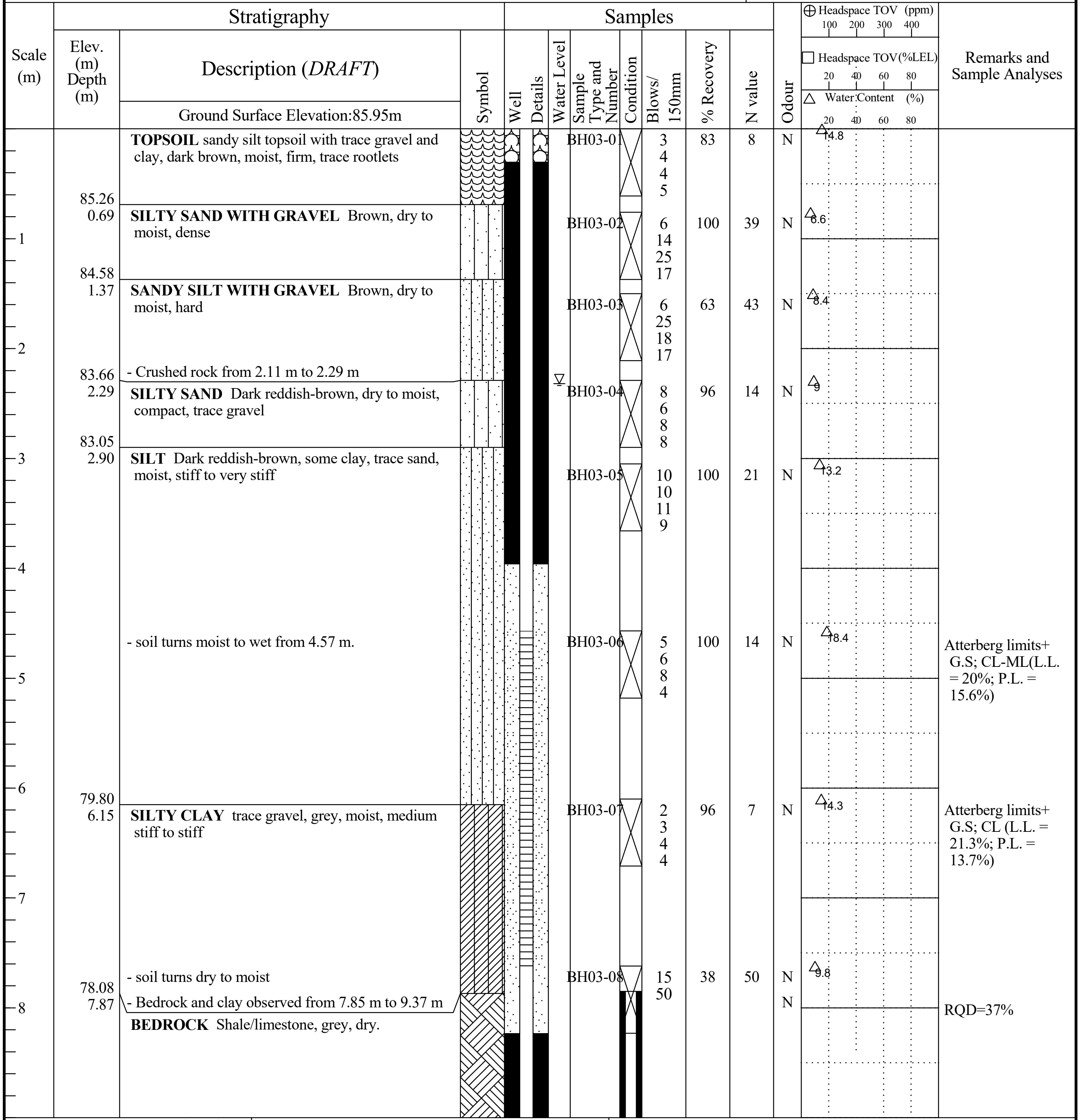
Prepared by: **Yash Solanki**
Checked by: **Mahmoud Ibrahim**
Date: **2025-01-31**

ARCADIS

Project: New develoment at 125 Randall Street, Oakville, ON
Contract No: 30250694
Boring date: 2025-1-29
Supervised by: Grace Faraj
Borehole Location: N: 4811060.64 m E: 607447.19 m
Water Table: 2.32 m
Driller: Strata Drilling Group
WT Meas. Date:
Drilling Method: Hollow Stem Auger until Bedrock then coring

METROLINX

Borehole: BH25-03
Monitoring Well: Installed
Sheet 1 of 2



Stratigraphy

Elev. (m) Depth (m)	Description (*DRAFT*)
	Ground Surface Elevation:85.95m
	TOPSOIL sandy silt topsoil with trace gravel and clay, dark brown, moist, firm, trace rootlets
85.26 0.69	**SILTY SAND WITH GRAVEL** Brown, dry to moist, dense
84.58 1.37	**SANDY SILT WITH GRAVEL** Brown, dry to moist, hard - Crushed rock from 2.11 m to 2.29 m
83.66 2.29	**SILTY SAND** Dark reddish-brown, dry to moist, compact, trace gravel
83.05 2.90	**SILT** Dark reddish-brown, some clay, trace sand, moist, stiff to very stiff - soil turns moist to wet from 4.57 m.
79.80 6.15	**SILTY CLAY** trace gravel, grey, moist, medium stiff to stiff - soil turns dry to moist - Bedrock and clay observed from 7.85 m to 9.37 m
78.08 7.87	**BEDROCK** Shale/limestone, grey, dry.

Samples

Sample Type and Number	Blows/ 150mm	% Recovery	N value	Odour	Water Content (%)	Remarks and Sample Analyses
BH03-01	3 4 4 5	83	8	N	14.8	
BH03-02	6 14 25 17	100	39	N	6.6	
BH03-03	6 25 18 17	63	43	N	8.4	
BH03-04	8 6 8 8	96	14	N	9	
BH03-05	10 10 11 9	100	21	N	13.2	
BH03-06	5 6 8 4	100	14	N	18.4	Atterberg limits+ G.S; CL-ML(L.L. = 20%; P.L. = 15.6%)
BH03-07	2 3 4 4	96	7	N	14.3	Atterberg limits+ G.S; CL (L.L. = 21.3%; P.L. = 13.7%)
BH03-08	15 50	38	50	N	9.8	
				N		RQD=37%

Continued

ODOUR:
N - None
T - Trace
M - Moderate
S - Strong
VS - Very Strong

Prepared by: Yash Solanki
Checked by: Mahmoud Ibrahim
Date: 2025-01-31

ARCADIS

Project: **New develoment at 125 Randall Street, Oakville, ON** Contract No: **30250694**

Boring date: **2025-1-29** Supervised by: **Grace Faraj**

Borehole Location: **N: 4811060.64 m E: 607447.19 m** Water Table: **2.32 m**

Driller: **Strata Drilling Group** WT Meas. Date:

Drilling Method: **Hollow Stem Auger until Bedrock then coring**

METROLINX

Borehole: **BH25-03**

Monitoring Well: **Installed**

Sheet 2 of 2

Scale (m)	Elev. (m) Depth (m)	Stratigraphy: Description (*DRAFT*)	Symbol	Samples: Well Details	Water Level	Sample Type and Number	Condition	Blows/ 150mm	% Recovery	N value	Odour	⊕ Headspace TOV (ppm) 100 200 300 400 ☐ Headspace TOV(%LEL) 20 40 60 80 △ Water Content (%) 20 40 60 80	Remarks and Sample Analyses
		BEDROCK Shale/limestone, grey, dry.									N		RQD=23%
10						BH03-09					N		Compressive strength = 97.3MPa
	75.13 10.82	**END OF BOREHOLE @ 10.82 m**											
11 12 13 14 15 16 17													

ODOUR:
N - None
T - Trace
M - Moderate
S - Strong
VS - Very Strong

Prepared by: **Yash Solanki**

Checked by: **Mahmoud Ibrahim**

Date: **2025-01-31**

ARCADIS

Project: **New develoment at 125 Randall Street, Oakville, ON** Contract No: **30250694**
Boring date: **2025-1-30** Supervised by: **Grace Faraj**
Borehole Location: **N: 4811096.88 m E: 607461.62 m** Water Table: **m**
Driller: **Strata Drilling Group** WT Meas. Date:
Drilling Method: **Hollow Stem Auger**

Borehole: **BH25-04**
Monitoring Well: **Installed**
Sheet 1 of 1

Stratigraphy

Ground Surface Elevation:86.88m

Elev. (m) Depth (m)	Description (*DRAFT*)
	ASPHALT
86.82 0.06	**SANDY SILT WITH GRAVEL FILL** Dark brown, moist, very stiff
86.52 0.36	**SILTY SAND** Brown with orange oxidation, moist, loose - soil turns wet - no orange oxidation from 1.88 m. - 0.03 m red clay pocket observed at 1.98 m
84.64 2.24	**SANDY SILT** Dark reddish-brown, very stiff, trace clay, trace gravel
84.01 2.87	**SILTY SAND** Dark reddish-brown, moist, very stiff, fine to medium
82.31 4.57	**SANDY SILT** Dark reddish-brown, moist, stiff, fine grained
82.03 4.85	**SILTY CLAY** Grey, moist, stiff, trace gravel
80.78 6.10	**SILT WITH CLAY** Grey, moist, trace sand and gravel, very soft, high plasticity
79.26 7.62	**BEDROCK** Crushed Shale/limestone, grey, dry. - Trace clay at 7.77 m
78.65 8.23	**END OF BOREHOLE @ 8.23 m**

Samples

Sample Type and Number	Blows/ 150mm	% Recovery	N value	Odour	⊕ Headspace TOV (ppm) 100 200 300 400 / ☐ Headspace TOV(%LEL) 20 40 60 80 / △ Water Content (%) 20 40 60 80	Remarks and Sample Analyses
BH04-01	18 16 7 9	88	23	N	17.2	
BH04-02	4 4 4 3	67	8	N	13.2	
BH04-03	3 4 5 12	75	9	N	11.2	
BH04-04	12 15 12 12	79	27	N	19.2	
BH04-05	5 10 12 15	79	22	N	12.1	
BH04-06	6 7 7 9	100	14	N	11.5	
BH04-07	1 0 1 1	100	1	N	22.1	Atterberg limits+ G.S; CL (L.L. = 34.7%; P.L. = 16.9%)
BH04-08	35 30 41 45	100	71	N	9.3	

ODOUR:
N - None
T - Trace
M - Moderate
S - Strong
VS - Very Strong

Prepared by: **Yash Solanki**
Checked by: **Mahmoud Ibrahim**
Date: **2025-01-31**

Project: **New develoment at 125 Randall Street, Oakville, ON** Contract No: **30250694**

Boring date: **2025-1-28 - 2025-1-29** Supervised by: **Grace Faraj**

Borehole Location: **N: 4811100.03 m E: 607433.81 m** Water Table: **m**

Driller: **Strata Drilling Group** WT Meas. Date:

Drilling Method: **Hollow Stem Auger until Bedrock then coring**

METROLINX

Borehole: **BH25-05**

Monitoring Well: **n/a**

Sheet 1 of 2

Stratigraphy

Ground Surface Elevation:86.34m

Elev. (m) Depth (m)	Description (*DRAFT*)
	GRAVELLY SAND FILL Brownish-grey, dry to moist, very dense
85.73 0.61	**SILTY SAND** Brown, dry to moist, loose, with reddish oxidation - changes to light brown silty sand
84.51 1.83	**SILT WITH SAND** trace clay and gravel, dark reddish-brown, moist, very stiff
81.56 4.78	**SILTY CLAY** trace gravel, grey, moist, stiff
80.24 6.10	**SILTY CLAY WITH GRAVEL** Grey, dry to moist, hard
78.72 7.62	**BEDROCK** Shale/limestone, grey, dry. - 0.13 m of clay zone

Samples

Sample Type and Number	Blows/ 150mm	% Recovery	N value	Odour	Water Content (%)	Remarks and Sample Analyses
BH05-01	50	33	50	N	3.5	Frozen ground resulting in high blowcount
BH05-02	7 5 4 3	58	9	N	14.9	
BH05-03	5 7 10 11	67	17	N	10.1	
BH05-04	9 12 11 9	67	23	N	12.8	
BH05-05	8 10 11 9	63	21	N	13.6	G.S
BH05-06	8 5 4 6	79	9	N	13	
BH05-07	23 22 29 26		51	N	9.1	
BH05-08	13 20 50		70	N	8.2	RQD = 33%
BH05-09				N		UCS = 197.2 MPa - Tensile strength = 17.8MPa

Headspace TOV (ppm): 100 200 300 400

Headspace TOV(%LEL): 20 40 60 80

Water Content (%): 20 40 60 80

Continued

ODOUR:
- N - None
- T - Trace
- M - Moderate
- S - Strong
- VS- Very Strong

Prepared by: **Yash Solanki**

Checked by: **Mahmoud Ibrahim**

Date: **2025-01-31**

ARCADIS

Project: **New develoment at 125 Randall Street, Oakville, ON** Contract No: **30250694**

Boring date: **2025-1-28 - 2025-1-29** Supervised by: **Grace Faraj**

Borehole Location: **N: 4811100.03 m E: 607433.81 m** Water Table: **m**

Driller: **Strata Drilling Group** WT Meas. Date:

Drilling Method: **Hollow Stem Auger until Bedrock then coring**

METROLINX

Borehole: **BH25-05**

Monitoring Well: **n/a**

Sheet 2 of 2

Scale (m)	Stratigraphy			Samples							Odour	⊕ Headspace TOV (ppm) 100 200 300 400 ☐ Headspace TOV(%LEL) 20 40 60 80 △ Water Content (%) 20 40 60 80	Remarks and Sample Analyses
	Elev. (m) Depth (m)	Description (*DRAFT*)	Symbol	Well Details	Water Level	Sample Type and Number	Condition	Blows/ 150mm	% Recovery	N value			
		BEDROCK Shale/limestone, grey, dry.	▨										
											N		RQD = 34.5%
10													
11											N		RQD = 40%
12													
13		- 0.41 m of clay zone				BH05-1					N		
14													RQD = 72%
	72.07 14.27	**END OF BOREHOLE @ 14.27 m**											
15													
16													
17													

ODOUR:
N - None
T - Trace
M - Moderate
S - Strong
VS - Very Strong

Prepared by: **Yash Solanki**

Checked by: **Mahmoud Ibrahim**

Date: **2025-01-31**

ARCADIS

Appendix C

C – Geotechnical Laboratory Analyses Certificates

Moisture Content

PNJ Project #: 24-1211-03 - Arcadis Professional Services (Canada) Inc. - 125 Randall Street, Oakville

Borehole: BH 01

Item No.	Sample No.	Depth (ft.)		Container No.	Mass (g)			Moisture Content (%)
		From	To		Wet (Soil+Tare)	Dry (Soil+Tare)	Tare	
1	01	0.0	2.0	-	71.0	68.7	13.6	4.2
2	02	2.5	4.5	-	87.3	81.1	13.6	9.2
3	03	5.0	7.0	-	93.9	87.5	19.9	9.5
4	04	7.5	9.5	-	81.2	69.7	13.6	20.5
5	05	10.0	12.0	-	73.4	65.8	13.7	14.6
6	06	15.0	17.0	-	80.1	73.3	13.7	11.4
7	07	20.0	22.0	-	75.7	70.2	13.7	9.7

Moisture Content

PNJ Project #: 24-1211-03 - Arcadis Professional Services (Canada) Inc. - 125 Randall Street, Oakville

Borehole: BH 02

Item No.	Sample No.	Depth (ft.)		Container No.	Mass (g)			Moisture Content (%)
		From	To		Wet (Soil+Tare)	Dry (Soil+Tare)	Tare	
1	01	0.0	2.0	-	79.9	72.0	13.7	13.6
2	02	2.5	4.5	-	89.5	79.5	13.8	15.2
3	03	5.0	7.0	-	78.7	70.2	13.7	15.0
4	04	7.5	9.5	-	75.8	68.5	13.8	13.3
5	05	10.0	12.0	-	79.4	73.0	13.6	10.8

Moisture Content

PNJ Project #: 24-1211-03 - Arcadis Professional Services (Canada) Inc. - 125 Randall Street, Oakville

Borehole: BH 03

Item No.	Sample No.	Depth (ft.)		Container No.	Mass (g)			Moisture Content (%)
		From	To		Wet (Soil+Tare)	Dry (Soil+Tare)	Tare	
1	01	0.0	2.0	-	56.6	50.2	7.0	14.8
2	02	2.5	4.5	-	93.3	88.4	13.7	6.6
3	03	5.0	7.0	-	92.3	86.7	19.9	8.4
4	04	7.5	9.5	-	74.5	69.5	13.7	9.0
5	05	10.0	12.0	-	84.2	76.0	13.7	13.2
6	06	15.0	17.0	-	91.0	79.0	13.8	18.4
7	07	20.0	22.0	-	86.5	77.4	13.7	14.3
8	08	25.0	27.0	-	78.5	72.7	13.7	9.8

Moisture Content

PNJ Project #: 24-1211-03 - Arcadis Professional Services (Canada) Inc. - 125 Randall Street, Oakville

Borehole: BH 04

Item No.	Sample No.	Depth (ft.)		Container No.	Mass (g)			Moisture Content (%)
		From	To		Wet (Soil+Tare)	Dry (Soil+Tare)	Tare	
1	01	0.0	2.0	-	82.6	72.5	13.7	17.2
2	02	2.5	4.5	-	72.9	66.0	13.7	13.2
3	03	5.0	7.0	-	76.3	70.0	13.8	11.2
4	04	7.5	9.5	-	95.0	81.9	13.7	19.2
5	05	10.0	12.0	-	85.7	77.9	13.7	12.1
6	06	15.0	17.0	-	88.4	80.7	13.7	11.5
7	07	20.0	22.0	-	71.0	60.6	13.6	22.1
8	08	25.0	27.0	-	85.3	79.2	13.7	9.3

Moisture Content

PNJ Project #: 24-1211-03 - Arcadis Professional Services (Canada) Inc. - 125 Randall Street, Oakville

Borehole: BH 05

Item No.	Sample No.	Depth (ft.)		Container No.	Mass (g)			Moisture Content (%)
		From	To		Wet (Soil+Tare)	Dry (Soil+Tare)	Tare	
1	01	0.0	2.0	-	80.8	78.5	13.7	3.5
2	02	2.5	4.5	-	92.2	82.8	19.6	14.9
3	03	5.0	7.0	-	84.1	78.2	19.9	10.1
4	04	7.5	9.5	-	81.6	73.9	13.7	12.8
5	05	10.0	12.0	-	89.8	80.7	13.8	13.6
6	06	15.0	17.0	-	79.8	72.2	13.6	13.0
7	07	20.0	22.0	-	78.5	73.1	13.7	9.1
8	08	25.0	27.0	-	98.3	91.9	13.7	8.2

Grain Size Analysis Test Report

Project No.: 24-1211-03 **Description:** Arcadis - Lab Testing - 125 Randall Street, Oakville **Date:** Feb 12, 2025

Location

Contract No.:

Phase: 24-1211-03

SAMPLE DATA

Material: Soil
Date Sampled: Jan 30, 2025 **Time Sampled:**
Sample Type: Borehole
Sample Location: 125 Randall Street., Oakville, ON
Lot: N/A **Sublot:** N/A **Station** N/A
Source: BH 01-04 (7.5'-9.5')
Sampled By: Client

LAB DATA

Sample No **15325** **Date Tested:** Feb 04, 2025

Specification: ,

Grain Size Analysis

Sieve Sizes (mm)	Percent Passing	
	Sample	Specification
150.0	**100**	0 - 100
106.0	**100**	-
75.0	**100**	-
53.0	**100**	-
37.5	**100**	-
26.5	**100**	-
22.4	**100**	-
19.0	**100**	-
16.0	**100**	-
13.2	**100**	-
9.5	**100**	-
6.7		-
4.75	**99.9**	-
2.36	**99.5**	-
1.18	**99.2**	-
0.600	**98.8**	-
0.300	**98.4**	-
0.150	**93.9**	-
0.075	**74.4**	0 - 100

* Indicates Out of Specification

PARTICLE ANALYSIS

TEST	Sample	Specification
Percent Crushed:		
% Asphalt Coated:		
% Flat and Elongated		

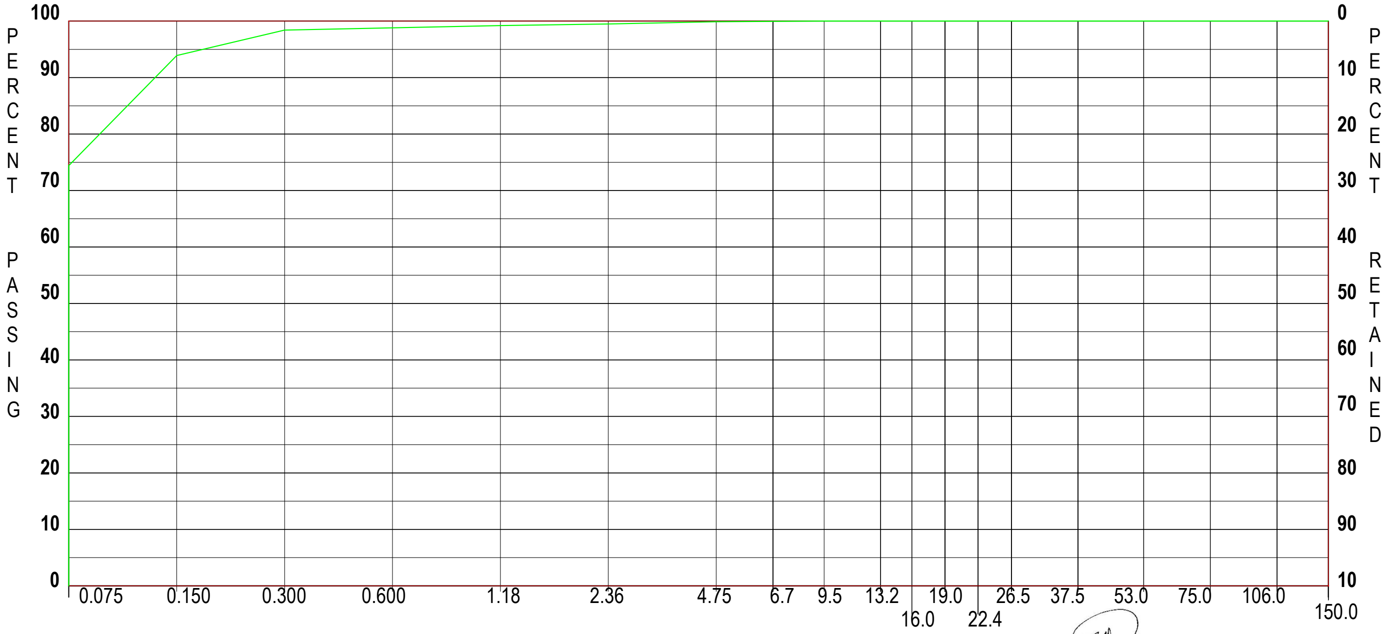
WASH PASS 0.075mm

TEST	Sample	Specs
Wash Pass 0.075 mm:		

FINENESS MODULUS	0.10

Comments:

Sample: 🟩 **Specs:** 🟥



Project Manager: Abid Sahi

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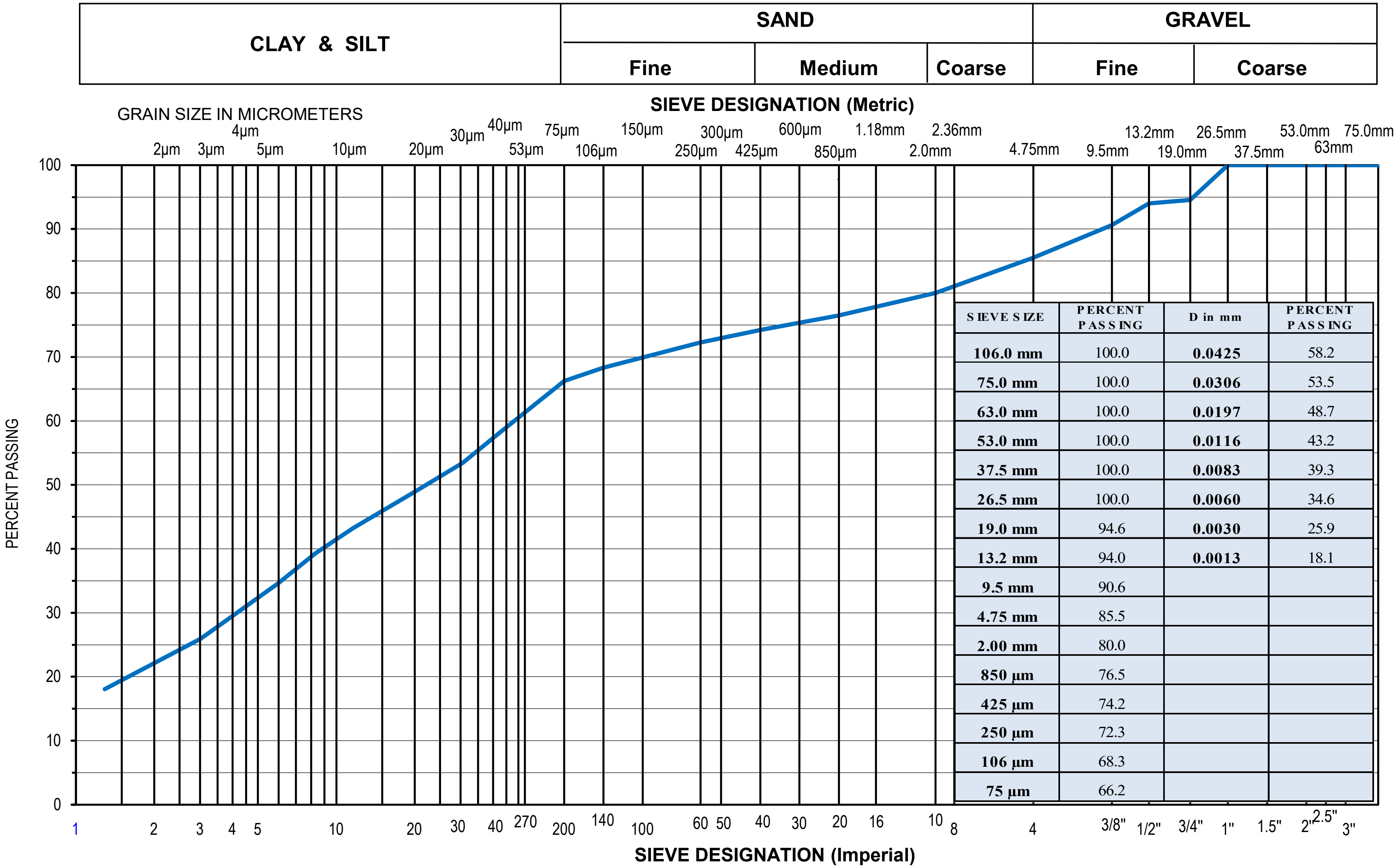
Particle Size Analysis of Soils

MTO LS-700, 702, 703/704, 705



SIEVE SIZE	PERCENT PASSING	D in mm	PERCENT PASSING
106.0 mm	100.0	0.0425	58.2
75.0 mm	100.0	0.0306	53.5
63.0 mm	100.0	0.0197	48.7
53.0 mm	100.0	0.0116	43.2
37.5 mm	100.0	0.0083	39.3
26.5 mm	100.0	0.0060	34.6
19.0 mm	94.6	0.0030	25.9
13.2 mm	94.0	0.0013	18.1
9.5 mm	90.6		
4.75 mm	85.5		
2.00 mm	80.0		
850 µm	76.5		
425 µm	74.2		
250 µm	72.3		
106 µm	68.3		
75 µm	66.2		

% Fines		% Sand			% Gravel	
Clay	Silt	Fine	Medium	Coarse	Fine	Coarse
21.3	44.9	8.0	5.8	5.5	9.1	5.4

Client:	**Arcadis Professional Services (Canada) Inc.**	**Lab No.:**	**15326**	**D10:**	**n/a**	**D30:**	**0.00441**	**D60:**	**0.0498**	**LL:**	**25.3**
Project:	**Arcadis Lab Testing**	**Project No.:**	**24-1211-03**	**D20:**	**0.00171**	**D50:**	**0.0226**			**PL:**	**14.8**
Location:	**125 Randall Street, Oakville, ON**	**Borehole:**	**BH 01**	**Classification:**	**CL**	**In-situ Moisture:**	**9.7%**			**PI:**	**10.5**
Date:	**February 12, 2025**	**Sample:**	**07 (20'-22')**	**Sample Description:**		**SILT, with clay, some sand, some gravel**					

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Grain Size Analysis Test Report

Project No.: 24-1211-03 **Description:** Arcadis - Lab Testing - 125 Randall Street, Oakville **Date:** Feb 12, 2025

Location

Contract No.:

Phase: 24-1211-03

SAMPLE DATA

Material: Soil

Date Sampled: Jan 28, 2025 **Time Sampled:**

Sample Type: Borehole

Sample Location: 125 Randall Street., Oakville, ON

Lot: N/A **Sublot:** N/A **Station** N/A

Source: BH 02-04 (7.5'-9.5')

Sampled By: Client

LAB DATA

Sample No **15327** **Date Tested:** Feb 04, 2025

Specification: ,

Grain Size Analysis		
Sieve Sizes (mm)	**Percent Passing**	
	Sample	**Specification**
150.0	**100**	0 - 100
106.0	**100**	-
75.0	**100**	-
53.0	**100**	-
37.5	**100**	-
26.5	**100**	-
22.4	**100**	-
19.0	**100**	-
16.0	**100**	-
13.2	**98.8**	-
9.5	**96.7**	-
6.7		-
4.75	**95.4**	-
2.36	**93.2**	-
1.18	**89.8**	-
0.600	**85.9**	-
0.300	**82.1**	-
0.150	**75**	-
0.075	**54.7**	0 - 100

* Indicates Out of Specification

PARTICLE ANALYSIS

TEST	Sample	Specification
Percent Crushed:		
% Asphalt Coated:		
% Flat and Elongated		

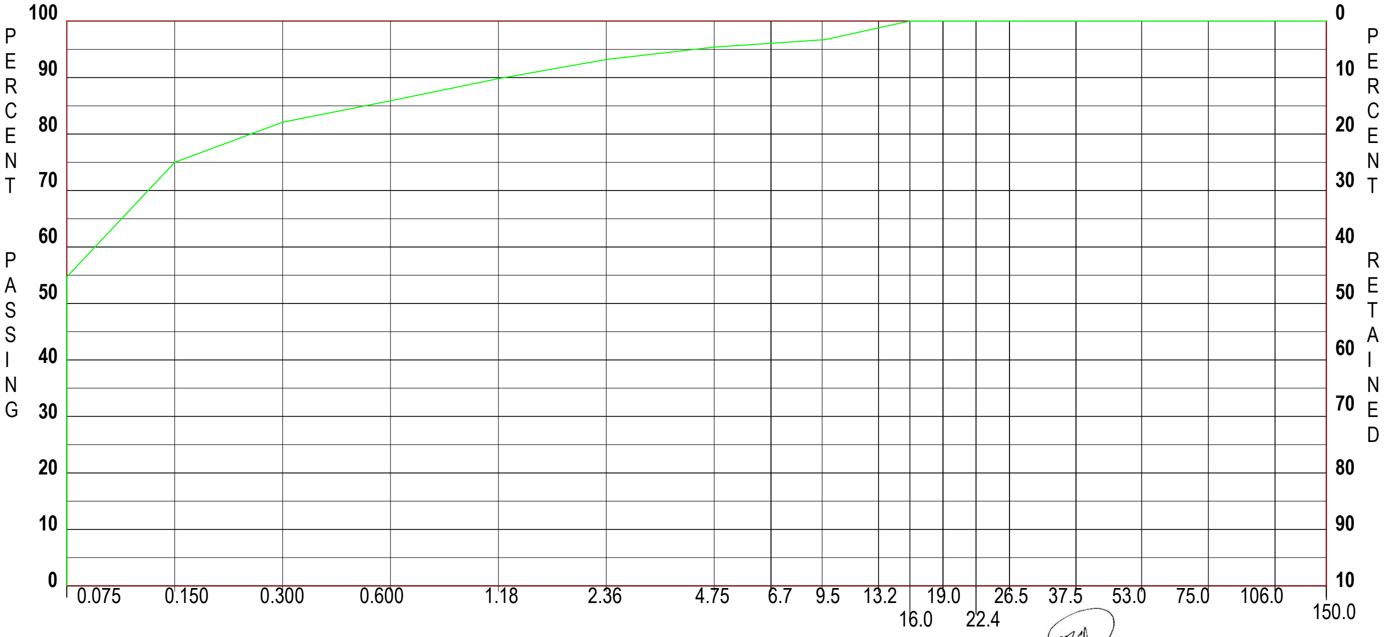
WASH PASS 0.075mm

TEST	Sample	Specs
Wash Pass 0.075 mm:		

FINENESS MODULUS	**0.82**

Comments:

Sample: 🟩 **Specs:** 🟥



Project Manager: Abid Sahi

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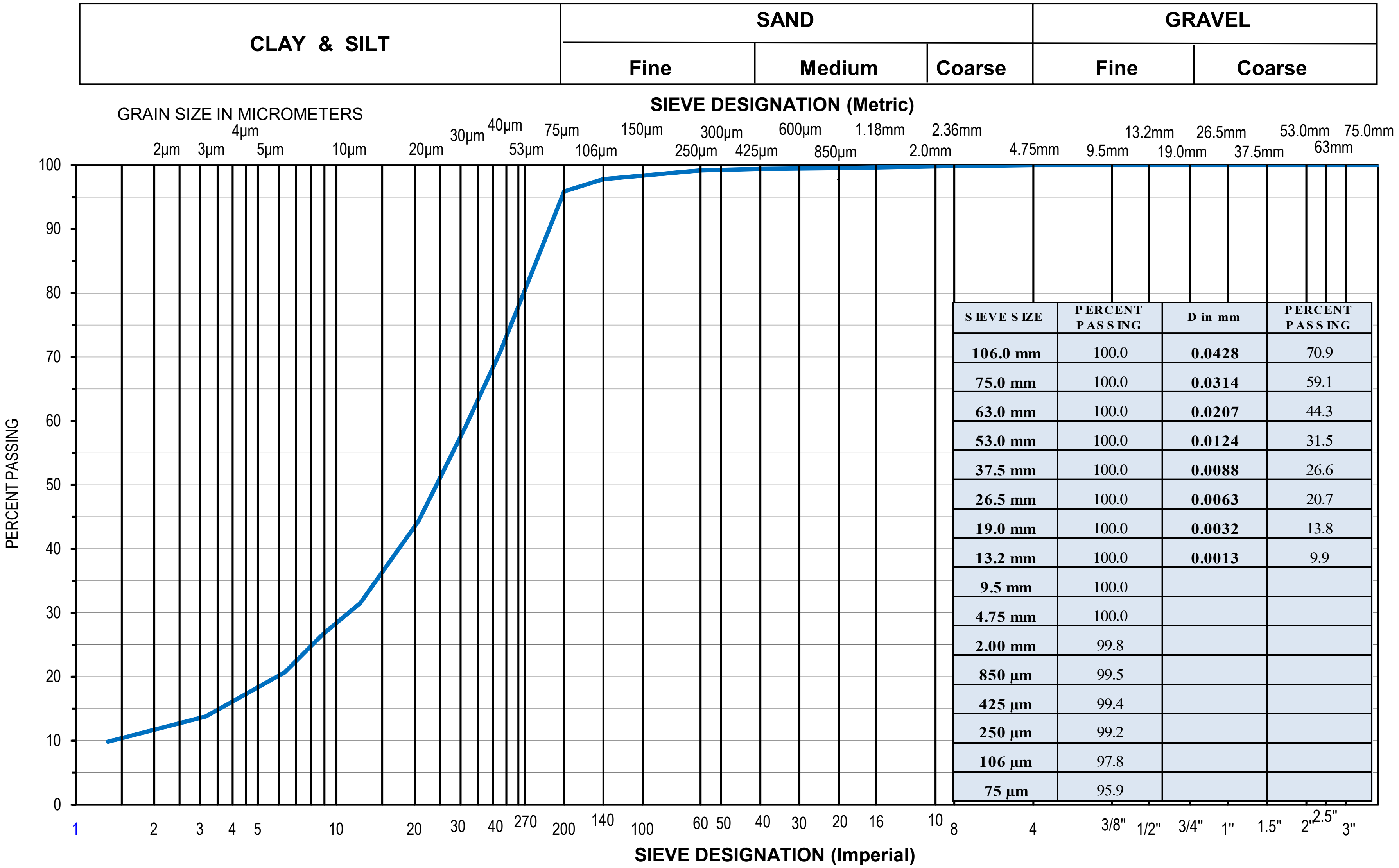
Particle Size Analysis of Soils

MTO LS-700, 702, 703/704, 705



SIEVE SIZE	PERCENT PASSING	D in mm	PERCENT PASSING
106.0 mm	100.0	0.0428	70.9
75.0 mm	100.0	0.0314	59.1
63.0 mm	100.0	0.0207	44.3
53.0 mm	100.0	0.0124	31.5
37.5 mm	100.0	0.0088	26.6
26.5 mm	100.0	0.0063	20.7
19.0 mm	100.0	0.0032	13.8
13.2 mm	100.0	0.0013	9.9
9.5 mm	100.0		
4.75 mm	100.0		
2.00 mm	99.8		
850 µm	99.5		
425 µm	99.4		
250 µm	99.2		
106 µm	97.8		
75 µm	95.9		

% Fines		% Sand			% Gravel	
Clay	Silt	Fine	Medium	Coarse	Fine	Coarse
11.3	84.6	3.5	0.4	0.2	0.0	0.0

Client:	**Arcadis Professional Services (Canada) Inc.**	**Lab No.:**	**15329**	**D10:**	**0.0014**	**D30:**	**0.01126**	**D60:**	**0.0322**
Project:	**Arcadis Lab Testing**	**Project No.:**	**24-1211-03**	**D20:**	**0.00603**	**D50:**	**0.0248**		
Location:	**125 Randall Street, Oakville, ON**	**Borehole:**	**BH 03**	**Classification:**	**CL-ML**	**In-situ Moisture:**	**18.4%**		
Date:	**February 12, 2025**	**Sample:**	**06 (15'-17')**	**Sample Description:**		**SILT, some clay, trace sand**			

LL:	**20.0**
PL:	**15.6**
PI:	**4.4**

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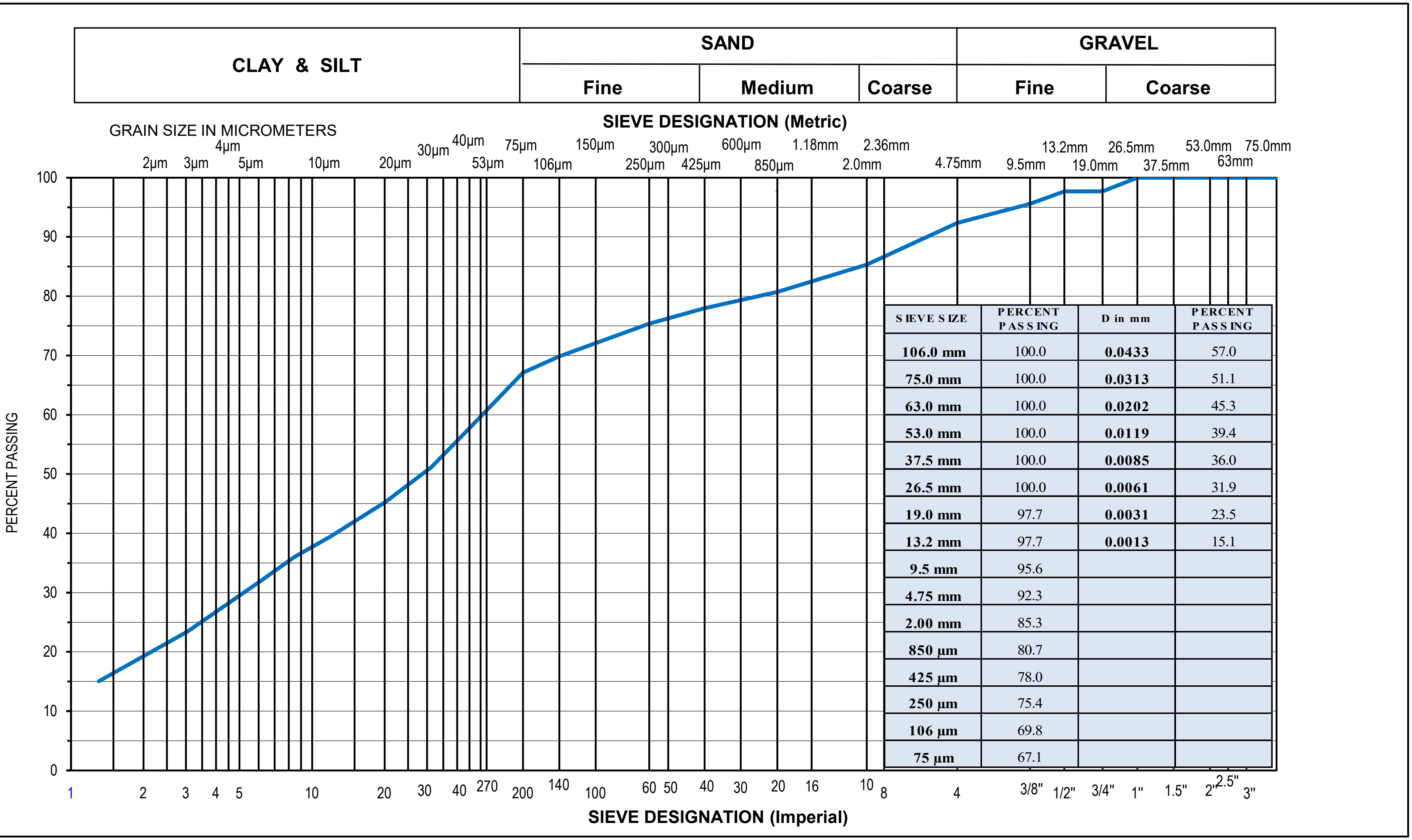
Particle Size Analysis of Soils

MTO LS-700, 702, 703/704, 705



SIEVE SIZE	PERCENT PASSING	D in mm	PERCENT PASSING
106.0 mm	100.0	0.0433	57.0
75.0 mm	100.0	0.0313	51.1
63.0 mm	100.0	0.0202	45.3
53.0 mm	100.0	0.0119	39.4
37.5 mm	100.0	0.0085	36.0
26.5 mm	100.0	0.0061	31.9
19.0 mm	97.7	0.0031	23.5
13.2 mm	97.7	0.0013	15.1
9.5 mm	95.6		
4.75 mm	92.3		
2.00 mm	85.3		
850 µm	80.7		
425 µm	78.0		
250 µm	75.4		
106 µm	69.8		
75 µm	67.1		

% Fines		% Sand			% Gravel	
Clay	Silt	Fine	Medium	Coarse	Fine	Coarse
18.4	48.7	10.9	7.3	7.0	5.3	2.3

Client:	**Arcadis Professional Services (Canada) Inc.**	**Lab No.:**	**15330**	**D10:**	**n/a**	**D30:**	**0.00541**	**D60:**	**0.0527**	**LL:**	**21.3**
Project:	**Arcadis Lab Testing**	**Project No.:**	**24-1211-03**	**D20:**	**0.00233**	**D50:**	**0.0291**			**PL:**	**13.7**
Location:	**125 Randall Street, Oakville, ON**	**Borehole:**	**BH 03**	**Classification:**	**CL**	**In-situ Moisture:**	**14.3%**			**PI:**	**7.6**
Date:	**February 12, 2025**	**Sample:**	**07 (20'-22')**	**Sample Description:**		**SILT, with sand, some clay, trace gravel**					

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Unconfined Compressive Strength of Intact Rock Core Specimens

Procedure ASTM D2938

Project Number: 24-1211-03

Date: February 11, 2025

Client Name: Arcadis Professional Services (Canada) Inc.

PNJ Lab #: 15331

Project Name: Arcadis Lab Testing

Sample location and location in structure: 125 Randall Street, Oakville, ON

Sample Type: Rock Core

Date Sampled: January 29, 2025

Date Received: January 31, 2025

Rock Core Compressive Strength Data

Core Identification:	Lab # 15331A BH03-09 (34.1' to 34.9')	Lab # 15331B BH03-09 (34.1' to 34.9')	Average
Diametre (mm)	63	63	63
Length (mm)	115	113	114
Date cored:	January 29, 2025	January 29, 2025	January 29, 2025
Date Tested:	February 6, 2025	February 6, 2025	February 6, 2025
Age in days:	n/a	n/a	n/a
Conditioning:	n/a	n/a	n/a
Compressive strength (MPa)	100.9	93.7	97.3

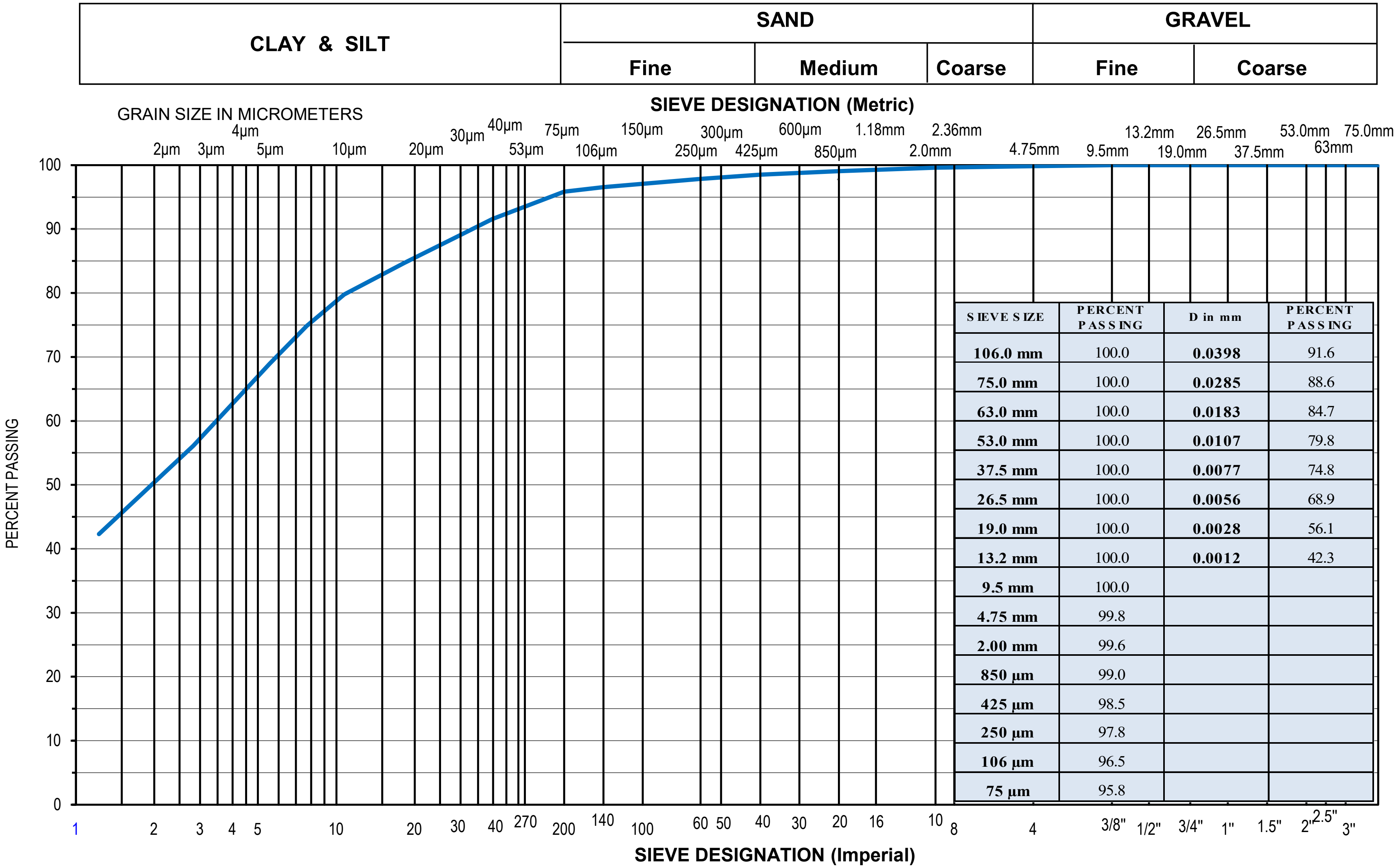
Comments: N/A

Reviewed by: Kevin Jackson

Project Manager: Abid Sahi, P.Eng.

Particle Size Analysis of Soils

MTO LS-700, 702, 703/704, 705



SIEVE SIZE	PERCENT PASSING	D in mm	PERCENT PASSING
106.0 mm	100.0	0.0398	91.6
75.0 mm	100.0	0.0285	88.6
63.0 mm	100.0	0.0183	84.7
53.0 mm	100.0	0.0107	79.8
37.5 mm	100.0	0.0077	74.8
26.5 mm	100.0	0.0056	68.9
19.0 mm	100.0	0.0028	56.1
13.2 mm	100.0	0.0012	42.3
9.5 mm	100.0		
4.75 mm	99.8		
2.00 mm	99.6		
850 µm	99.0		
425 µm	98.5		
250 µm	97.8		
106 µm	96.5		
75 µm	95.8		

% Fines		% Sand			% Gravel	
Clay	Silt	Fine	Medium	Coarse	Fine	Coarse
49.0	46.8	2.7	1.1	0.2	0.2	0.0

Client:	**Arcadis Professional Services (Canada) Inc.**	**Lab No.:**	**15332**	**D10:**	**n/a**	**D30:**	**n/a**	**D60:**	**0.0037**	**LL:**	**34.7**
Project:	**Arcadis Lab Testing**	**Project No.:**	**24-1211-03**	**D20:**	**n/a**	**D50:**	**0.0021**			**PL:**	**16.9**
Location:	**125 Randall Street, Oakville, ON**	**Borehole:**	**BH 04**	**Classification:**	**CL**		**In-situ Moisture:**		**22.1%**	**PI:**	**17.8**
Date:	**February 12, 2025**	**Sample:**	**07 (20'-22')**	**Sample Description:**		**CLAY & SILT, trace sand, trace gravel**					

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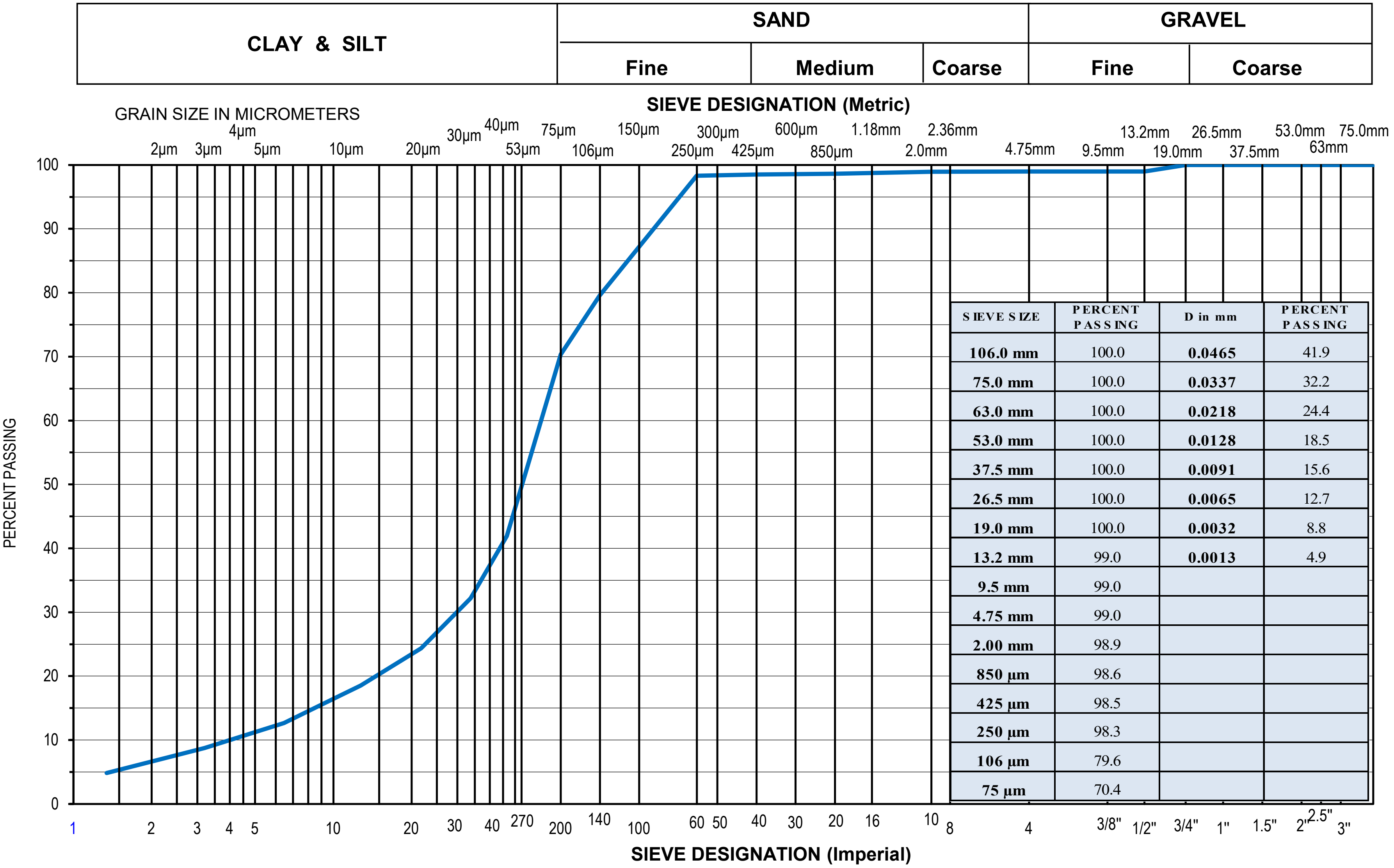
Particle Size Analysis of Soils

MTO LS-700, 702, 703/704, 705



SIEVE SIZE	PERCENT PASSING	D in mm	PERCENT PASSING
106.0 mm	100.0	0.0465	41.9
75.0 mm	100.0	0.0337	32.2
63.0 mm	100.0	0.0218	24.4
53.0 mm	100.0	0.0128	18.5
37.5 mm	100.0	0.0091	15.6
26.5 mm	100.0	0.0065	12.7
19.0 mm	100.0	0.0032	8.8
13.2 mm	99.0	0.0013	4.9
9.5 mm	99.0		
4.75 mm	99.0		
2.00 mm	98.9		
850 µm	98.6		
425 µm	98.5		
250 µm	98.3		
106 µm	79.6		
75 µm	70.4		

% Fines		% Sand			% Gravel	
Clay	Silt	Fine	Medium	Coarse	Fine	Coarse
6.3	64.1	28.1	0.4	0.1	1.0	0.0

Client:	**Arcadis Professional Services (Canada) Inc.**	**Lab No.:**	**15334**	**D10:**	**0.00422**	**D30:**	**0.0304**	**D60:**	**0.0646**	**LL:**	**n/a**
Project:	**Arcadis Lab Testing**	**Project No.:**	**24-1211-03**	**D20:**	**0.01502**	**D50:**	**0.0546**			**PL:**	**n/a**
Location:	**125 Randall Street, Oakville, ON**	**Borehole:**	**BH 05**	**Classification:**	**NP**	**In-situ Moisture:**	**13.6%**			**PI:**	**n/a**
Date:	**February 12, 2025**	**Sample:**	**05 (10'-12')**	**Sample Description:**		**SILT, with sand, trace clay, trace gravel**					

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Bulk Relative Density of Soil Specimens Using Paraffin

Test Method ASTM D7263-09

Project No: 24-1211-03

Client: Arcadis Professional Services (Canada) Inc.

Sample Location: 125 Randall Street, Oakville, ON

Date Sampled: January 28, 2025

Sample Type: Borehole

Date Tested: February 6, 2025

Field Sample ID #	**Borehole**	05	05	05	05				
	Sample	06	06	06	06				
PNJ Engineering Lab No.:		15335A	15335B	15335C	15335 (Avg)				
A - Mass of dry specimen in air (g)		128.2	72.8	78.8	-				
A_1 - Mass of specimen plus talc coating in air (g)		128.2	72.8	78.8	-				
A_2 - Mass of specimen including talc plus paraffin coating in air (g)		152.5	91.9	99.0	-				
A_3 - Surface dry mass of specimen including talc plus paraffin after immersion in water (g)		152.5	91.9	99.0	-				
B - Mass of specimen including talc and paraffin, in water (g)		63.3	36.3	38.1	-				
D_1 - Bulk relative density of talc.		2.780	2.780	2.780	2.780				
D_2 - Bulk relative density of paraffin.		0.89	0.89	0.89	0.89				
Wet Density (g/cm3)		2.071	2.132	2.063	**2.089**				
Percent Moisture (%)		13.0	13.0	13.0	**13.0**				
Dry Density (g/cm3)		1.833	1.888	1.826	**1.849**				

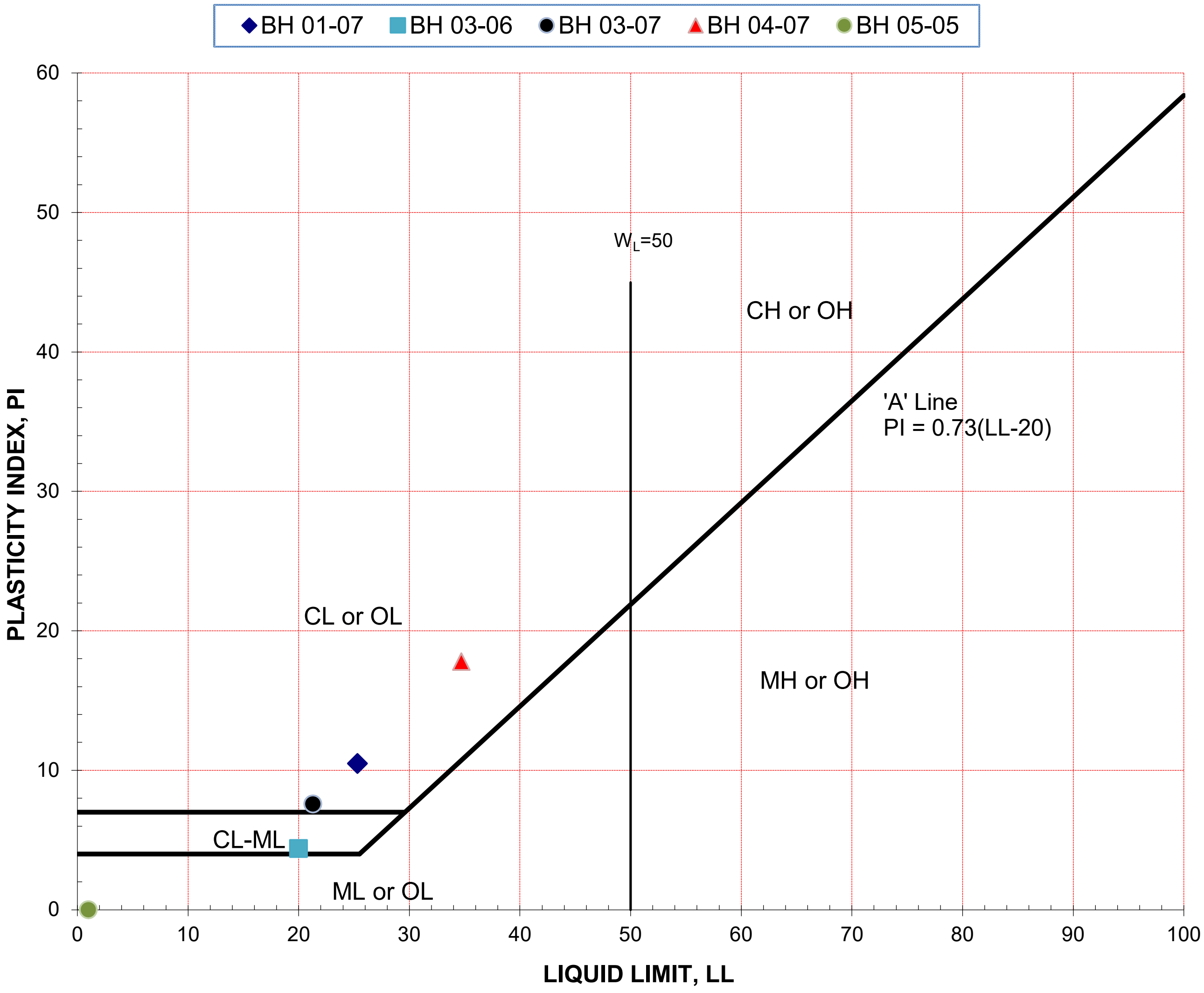
Note:

Liquid Limit, Plastic Limit and Plasticity Index

Project No. :	24-1211-03		
Project Client :	Arcadis Professional Services (Canada) Inc.	**Technician** :	K.S.
Project :	Arcadis Lab Testing	**Supervisor** :	K.J.
Location :	125 Randall Street, Oakville, ON	**Date** :	02-12-25

TEST RESULTS

Specimen #	Sample #	Depth (ft)	LL%	PL%	PI	Fines	W%	Classification	Remarks
BH 01-07	15326	20-22	25.3	14.8	10.5	-	9.7	CL	
BH 03-06	15329	15-17	20.0	15.6	4.4	-	18.4	CL-ML	
BH 03-07	15330	20-22	21.3	13.7	7.6	-	14.3	CL	
BH 04-07	15332	20-22	34.7	16.9	17.8	-	22.1	CL	
BH 05-05	15334	10-12	-	-	-	-	13.6	Non-Plastic	
-	-	-	-	-	-	-	-	-	



Split Tensile Test
ASTM D3967

SPECIMEN DATA

Specimen ID	BH 05 -09 -27.3-28	***Material type***	Rock
Specimen age [dd]		***Preparation date***	2025-02-10
Thickness (avg) (mm)	41.67	***Diameter (avg) (mm)***	63.205
Density (g/cm³)	2.647	***Area [mm²]***	8274.17
Surface preparation	Cut	***Test Location/Depth***	*05 -09 -27.3-28*
Preload [kN]	3	***Specimen type***	Core
Fiber type		***Project #***	
Sampling date	2024	***Sampling details***	Cored and Cut
Testing Machine	Controls Compression Machine CE001	***Test date***	2025-02-11

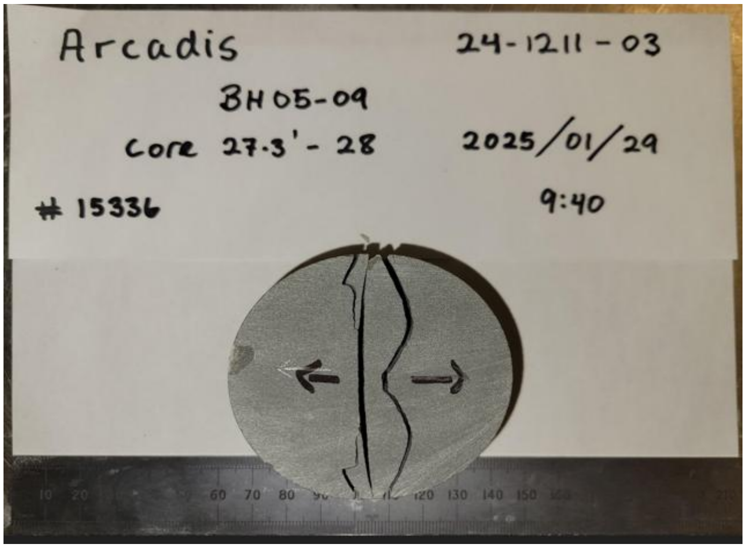
FAILURE DESCRIPTION

Certificate number	T13	***Certificate date***	2025-02-11
Client		***Reference***	ASTM D3967

TEST RESULT

Fp [kN]	73.65	***Tensile Strength (MPa)***	*17.81*
Load Rate (N/s)	100	***Reference***	
Time to Failure (s)	732		

Figure 1 Specimen Failure



Test Performed by: Kunjan Rupakheti (KR) **Project Manger:** Abid Sahi P.Geo., P.Eng

UCS Test (Rock) with MOE
ASTM D7012

SPECIMEN DATA

Specimen ID	BH 05 -09 -27.3-28	***Material type***	Rock
Specimen age [dd]		***Preparation date***	2025-02-10
Length (avg) (mm)	134.655	***Diameter (avg) (mm)***	63.2
Density (g/cm³)	2.635	***Area [mm²]***	3137.07
Surface preparation	Grinded	***Test Location/Depth***	*05 -09 -27.3-28*
Preload [kN]	3	***Specimen type***	Core
Fiber type		***Project #***	
Sampling date	2024	***Sampling details***	Cored
Testing Machine	Controls Compression Machine CE001	***Test date***	2025-02-11

FAILURE DISCRIPTION

Certificate number	T14	***Certificate date***	2025-02-11
Client		***Reference***	ASTM D7012

TEST RESULT

Fp [kN]	618.65	***MOE (GPa)***	*34.51*
UCS (Mpa)	197.21	***Reference***	*10.3.5.2 (33-86%)*
Time to Failure (s)	269		

Figure 1: Sample As Received

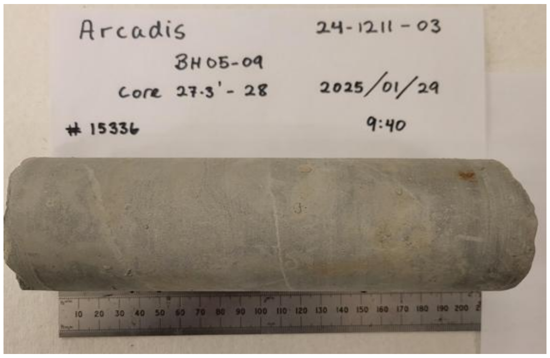
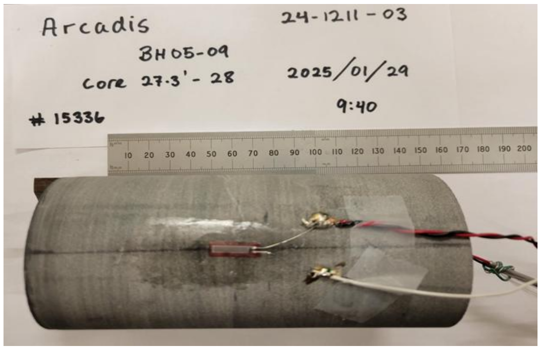
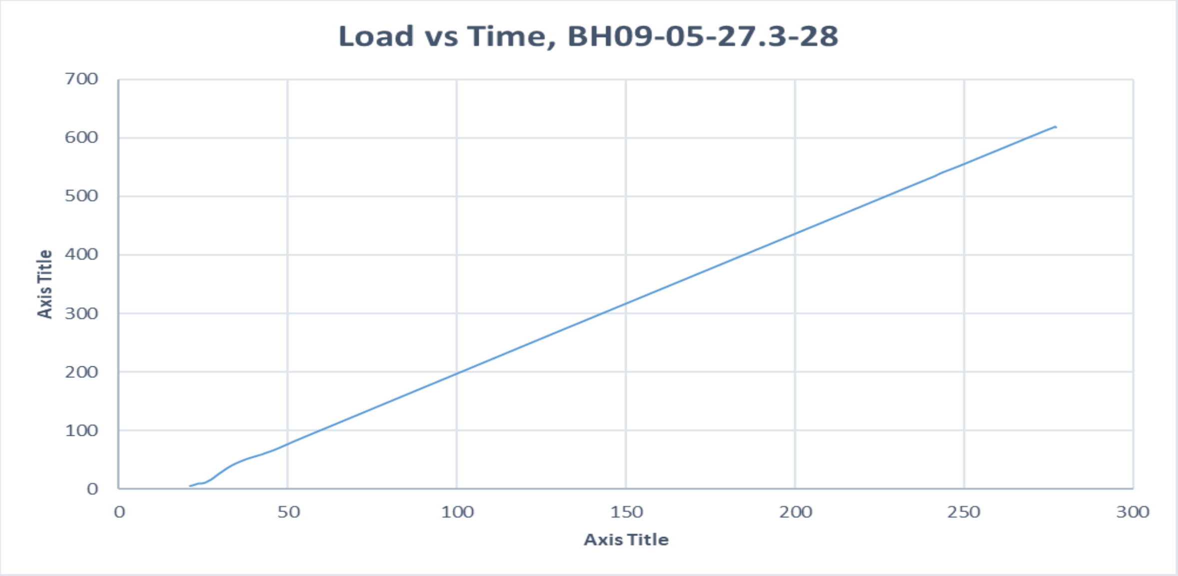
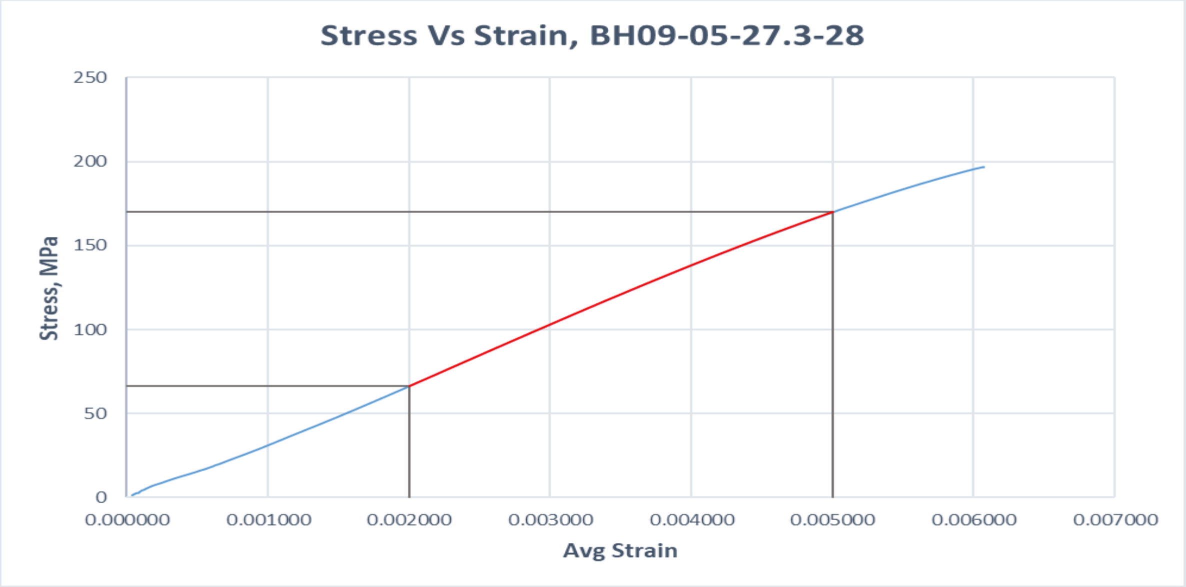


Figure 2: Sample ready for Testing



Test Performed by: Kunjan Rupakheti (KR)   **Project Manger:** Abid Sahi P.Geo., P.Eng


Load vs Time, BH09-05-27.3-28
Axis Title
0
100
200
300
400
500
600
700
0
50
100
150
200
250
300
Axis Title


Stress Vs Strain, BH09-05-27.3-28
Stress, MPa
0
50
100
150
200
250
0.000000
0.001000
0.002000
0.003000
0.004000
0.005000
0.006000
0.007000
Avg Strain

Certificate of Analysis

Client:	PNJ Engineering Inc. 70 Galaxy Blvd Suite 100, Toronto, Ontario M9W 4Y6		Report Number: Date Submitted: Date Reported: Project: COC #:	3013975 2025-02-03 2025-02-10 24-1211-03 232219
Attention:	Andrea Saltos			
PO#:				
Invoice to:	PNJ Engineering Inc.	Page 1 of 4		

Dear Andrea Saltos:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL: ______________________

Patrick Jacques, Chemist

All analysis is completed at Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) unless otherwise indicated.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by CALA, Canadian Association for Laboratory Accreditation to ISO/IEC 17025 for tests which appear on the scope of accreditation. The scope is available at: https://directory.cala.ca/.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is licensed by the Ontario Ministry of the Environment, Conservation, and Parks (MECP) for specific tests in drinking water (license #2318). A copy of the license is available upon request.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by the Ontario Ministry of Agriculture, Food, and Rural Affairs for specific tests in agricultural soils.

Please note: Field data, where presented on the report, has been provided by the client and is presented for informational purposes only. Guideline values listed on this report are provided for ease of use (informational purposes) only. Eurofins recommends consulting the official provincial or federal guideline as required. Unless otherwise stated, measurement uncertainty is not taken into account when determining guideline or regulatory exceedances.

Certificate of Analysis

Client: PNJ Engineering Inc.
70 Galaxy Blvd Suite 100,
Toronto, Ontario
M9W 4Y6
Attention: Andrea Saltos
PO#:
Invoice to: PNJ Engineering Inc.

Report Number: 3013975
Date Submitted: 2025-02-03
Date Reported: 2025-02-10
Project: 24-1211-03
COC #: 232219

				Lab I.D.	1756725
				Sample Matrix	Soil
				Sample Type	
				Sampling Date	2025-02-03
				Sample I.D.	BH 05-04
Group	**Analyte**	**MRL**	**Units**	**Guideline**	
Anions	Cl	0.002	%		0.008
	SO4	0.01	%		<0.01
General Chemistry	Electrical Conductivity	0.05	mS/cm		0.21
	pH	2.00			8.73
	Resistivity	1	ohm-cm		4762
Moisture	Moisture-Humidite	0.1	%		14.3
Redox Potential	REDOX Potential		mV		230
Subcontract	S2-	0.01	%		<0.01

Guideline = *** = Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 471576 **Analysis/Extraction Date** 2025-02-05 **Analyst** NK **Method** Cond-Soil			
Electrical Conductivity	<0.05 mS/cm	100	90-110
pH	6.12	99	90-110
Resistivity			
Run No 471580 **Analysis/Extraction Date** 2025-02-05 **Analyst** NK **Method** C SM2580B			
REDOX Potential	185 mV	99	97-103
Run No 471582 **Analysis/Extraction Date** 2025-02-05 **Analyst** NK **Method** ASTM 2216			
Moisture-Humidite			80-120
Run No 471670 **Analysis/Extraction Date** 2025-02-07 **Analyst** M B **Method** AG SOIL			
SO4	<0.01 %	99	70-130
Run No 471702 **Analysis/Extraction Date** 2025-02-10 **Analyst** IP **Method** C CSA A23.2-4B			
Chloride	<0.002 %	96	75-125
Run No 471731 **Analysis/Extraction Date** 2025-02-10 **Analyst** AET **Method** SUBCONTRACT-SGS			

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Certificate of Analysis

Client:	PNJ Engineering Inc. 70 Galaxy Blvd Suite 100, Toronto, Ontario M9W 4Y6
Attention:	Andrea Saltos
PO#:	
Invoice to:	PNJ Engineering Inc.

Report Number:	3013975
Date Submitted:	2025-02-03
Date Reported:	2025-02-10
Project:	24-1211-03
COC #:	232219

QC Summary

Analyte	Blank	QC % Rec	QC Limits
S2-			

Guideline = *** = Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

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Certificate of Analysis

Client: PNJ Engineering Inc.
70 Galaxy Blvd Suite 100,
Toronto, Ontario
M9W 4Y6
Attention: Andrea Saltos
PO#:
Invoice to: PNJ Engineering Inc.

Report Number: 3013973
Date Submitted: 2025-02-03
Date Reported: 2025-02-10
Project: 24-1211-03
COC #: 232189

Dear Andrea Saltos:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL: ______________________________
Patrick Jacques, Chemist

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Certificate of Analysis

Client: PNJ Engineering Inc.
70 Galaxy Blvd Suite 100,
Toronto, Ontario
M9W 4Y6
Attention: Andrea Saltos
PO#:
Invoice to: PNJ Engineering Inc.

Report Number: 3013973
Date Submitted: 2025-02-03
Date Reported: 2025-02-10
Project: 24-1211-03
COC #: 232189

				Lab I.D.	1756723
				Sample Matrix	R347
				Sample Type	
				Sampling Date	2025-02-03
				Sample I.D.	TCLP-01
Group	**Analyte**	**MRL**	**Units**	**Guideline**	
Anions	F	0.10	mg/L	LQC 150.0	0.29
General Chemistry	Cyanide (free)	0.05	mg/L	LQC 20.0	<0.05
Leachate	REG 558 Leach				y
	Zero Headspace Extraction				y
Mercury	Hg	0.001	mg/L	LQC 0.1	<0.001
Metals	Ag	0.01	mg/L	LQC 5	<0.01
	As	0.02	mg/L	LQC 2.5	<0.02
	B	0.1	mg/L	LQC 500.0	<0.1
	Ba	0.01	mg/L	LQC 100.0	1.39
	Cd	0.008	mg/L	LQC 0.5	<0.008
	Cr	0.05	mg/L	LQC 5.0	<0.05
	Pb	0.01	mg/L	LQC 5.0	<0.01
	Se	0.02	mg/L	LQC 1.0	<0.02
	U	0.01	mg/L	LQC 10.0	<0.01
Moisture	Moisture-Humidite	0.1	%		12.2
Others	Ignitability				neg
	NO2 + NO3 as N	1.0	mg/L	LQC 1000	<1.0
PAH	Benzo(a)pyrene	0.01	ug/L	LQC 1.0	<0.01
VOCs Surrogates	1,2-dichloroethane-d4	0	%		93
	4-bromofluorobenzene	0	%		98
	Toluene-d8	0	%		101
Volatiles	1,1-dichloroethylene	0.5	ug/L	LQC 1400	<0.5
	1,2-dichlorobenzene	0.4	ug/L	LQC 20000	<0.4
	1,2-dichloroethane	0.5	ug/L	LQC 500	<0.5
	1,4-dichlorobenzene	0.4	ug/L	LQC 500	<0.4

Guideline = REG 558

*** = Guideline Exceedence**

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

Certificate of Analysis

Client: PNJ Engineering Inc.
70 Galaxy Blvd Suite 100,
Toronto, Ontario
M9W 4Y6
Attention: Andrea Saltos
PO#:
Invoice to: PNJ Engineering Inc.

Report Number: 3013973
Date Submitted: 2025-02-03
Date Reported: 2025-02-10
Project: 24-1211-03
COC #: 232189

				Lab I.D.	1756723
				Sample Matrix	R347
				Sample Type	
				Sampling Date	2025-02-03
				Sample I.D.	TCLP-01
Group	**Analyte**	**MRL**	**Units**	**Guideline**	
Volatiles	Benzene	0.5	ug/L	LQC 500	<0.5
	Carbon Tetrachloride	0.2	ug/L	LQC 500	<0.2
	Chloroform	0.5	ug/L	LQC 10000	<0.5
	Dichloromethane	4.0	ug/L	LQC 5000	<4.0
	Methyl Ethyl Ketone (MEK)	2	ug/L	LQC 200000	<2
	Monochlorobenzene	0.5	ug/L	LQC 8000	<0.5
	Tetrachloroethylene	0.3	ug/L	LQC 3000	<0.3
	Trichloroethylene	0.3	ug/L	LQC 5000	1.4
	Vinyl Chloride	0.2	ug/L	LQC 200	<0.2

Guideline = REG 558 *** = Guideline Exceedence**

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Certificate of Analysis

Client: PNJ Engineering Inc.
70 Galaxy Blvd Suite 100,
Toronto, Ontario
M9W 4Y6
Attention: Andrea Saltos
PO#:
Invoice to: PNJ Engineering Inc.

Report Number: 3013973
Date Submitted: 2025-02-03
Date Reported: 2025-02-10
Project: 24-1211-03
COC #: 232189

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 470794 **Analysis/Extraction Date** 2025-02-07 **Analyst** C M **Method** P 8270			
Benzo[a]pyrene	<0.01 ug/L	57	50-140
Run No 471574 **Analysis/Extraction Date** 2025-02-05 **Analyst** M B **Method** SW1030			
Ignitability			
Run No 471629 **Analysis/Extraction Date** 2025-02-06 **Analyst** M B **Method** ASTM 2216			
Moisture-Humidite			80-120
Run No 471630 **Analysis/Extraction Date** 2025-02-06 **Analyst** M B **Method** EPA 1311/O. Reg 347			
REG 558 Leach			
Zero Headspace Extraction			
Run No 471632 **Analysis/Extraction Date** 2025-02-06 **Analyst** SKH **Method** C SM4500-NO3-F			
NO2 + NO3 as N	<1.0 mg/L	99	80-120
Run No 471644 **Analysis/Extraction Date** 2025-02-06 **Analyst** Z S **Method** SM4500-CNC/MOE E3015			
Cyanide (CN-)	<0.05 mg/L	82	75-125

Guideline = REG 558

*** = Guideline Exceedence**

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 471685 **Analysis/Extraction Date** 2025-02-07 **Analyst** AaN **Method** M SM3112B-3500B			
Mercury	<0.001 mg/L	116	76-123
Run No 471687 **Analysis/Extraction Date** 2025-02-07 **Analyst** AaN **Method** EPA 200.8			
Silver	<0.01 mg/L	110	70-130
Arsenic	<0.02 mg/L	115	70-130
Boron (total)	<0.1 mg/L	122	70-130
Barium	<0.01 mg/L	109	70-130
Cadmium	<0.008 mg/L	108	70-130
Chromium Total	<0.05 mg/L	110	70-130
Lead	<0.01 mg/L	108	70-130
Selenium	<0.02 mg/L	119	70-130
Uranium	<0.01 mg/L	92	70-130
Run No 471715 **Analysis/Extraction Date** 2025-02-10 **Analyst** H S **Method** EPA 8260			
Dichloroethylene, 1,1-	<0.5 ug/L	78	60-130
Dichlorobenzene, 1,2-	<0.4 ug/L	85	60-130
Dichloroethane, 1,2-	<0.5 ug/L	88	60-130

Guideline = REG 558 *** = Guideline Exceedence**

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

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Methods references and/or additional QA/QC information available on request.

eurofins | Environment Testing

Certificate of Analysis

Client:	PNJ Engineering Inc. 70 Galaxy Blvd Suite 100, Toronto, Ontario M9W 4Y6	Report Number:	3013973
Attention:	Andrea Saltos	Date Submitted:	2025-02-03
PO#:		Date Reported:	2025-02-10
Invoice to:	PNJ Engineering Inc.	Project:	24-1211-03
		COC #:	232189

QC Summary

Analyte	**Blank**	**QC % Rec**	**QC Limits**
Dichlorobenzene, 1,4-	<0.4 ug/L	85	60-130
Benzene	<0.5 ug/L	78	60-130
Carbon Tetrachloride	<0.2 ug/L	86	60-130
Chloroform	<0.5 ug/L	83	60-130
Methylene Chloride	<4.0 ug/L	80	60-130
Methyl Ethyl Ketone	<2 ug/L	97	60-130
Chlorobenzene	<0.5 ug/L	78	60-130
Tetrachloroethylene	<0.3 ug/L	71	60-130
Trichloroethylene	<0.3 ug/L	76	60-130
Vinyl Chloride	<0.2 ug/L	86	60-130
Run No 471730	**Analysis/Extraction Date** 2025-02-10	**Analyst** AET	
Method C SM4500-FC			
F	<0.10 mg/L	98	90-110

Guideline = REG 558 *** = Guideline Exceedence**

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Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Appendix D

D – Corrosivity Analyses Laboratory Certificates

eurofins 232219

STANDARD CHAIN-OF-CUSTODY

146 Colonnade Road, Unit #8, Ottawa, ON, K2E 7Y1 - Phone: 613-727-5692, Fax: 613-727-5222

3013975

CLIENT INFORMATION

Company: PNJ ENGINEERING INC

Contact: ANDREA SALTOS

Address: 70 GALAXY BLVD.

Telephone:

Cell:

Email: #1: a.saltos@pnjeng.com

Email: #2: sbowman@pnjeng.com

Project: 24-1211-03

Quote #:

INVOICE INFORMATION (SAME AS CLIENT INFORMATION: YES ☑ NO ☐)

Company:

Contact:

Email: #1: accounting@pnjeng.com

Address:

Email: #2:

Telephone:

PO #:

TURN-AROUND TIME (Business Days)

☐ 1 Day* (100%) ☐ 2 Day** (50%) ☐ 3-5 Days (25%) ☑ 5-7 Days (Standard)

Please contact Lab in advance to determine rush availability. *For results reported after rush due date, surcharges will apply: before 12:00 - 100%, after 12:00 - 50%. **For results reported after rush due date, surcharges will apply: before 12:00 - 50%, after 12:00 - 25%.

TCLP, SPLP, PFAS, and NP/NPE the rush surcharges are 100% (3 day) and 50% (4 day). For farm soils the rush surcharge is 100% (3-5 days). Regular TAT is 10 days.

REGULATION/GUIDELINE REQUIRED

☐ Sanitary Sewer, City:______________________

☐ Storm Sewer, City:______________________

☐ ODWSOG (Use DW COC if samples are for human consumption)

☐ PWQO

☐ O.Reg. 347 (TCLP)

☐ Other: ______________________

☐ **O. Reg. 153/04**

The sample results from this submission will form part of a formal Record of Site Condition (RSC) under O.Reg. 153/04.
Analysis of full parameter list only
Yes ☐ No ☐

Table # ____, Coarse / Fine, Surface / subsurface
Type: Com-Ind / Res-Park / Agri / GW / All Other / Sediment

☐ **O. Reg 406 Excess Soils**

Table # ________Full depth/Strat/Ceiling/mSPLP Leachate
Type: Com-Ind /Res-Park /Agri/All Other
Category: Surface /Subsurface

The optimal temperature conditions during transport is 4 - 10°C. Sample(s) cannot be frozen, unless otherwise indicated or agreed upon with the Laboratory. This COC must not be used for drinking water samples. The COC must be complete upon submission of the samples, there will be a $25 surcharge if required information is missing (required fields are shaded in grey).

Occasionally, situations arise in which Eurofins Environment Testing Canada (Ottawa) is unable to process a sample after receipt. By signing this chain-of-custody form, the client agrees that Eurofins Environment Testing Canada (Ottawa) may subcontract samples to a laboratory that is similarly accredited. This subcontracted laboratory will perform the same analysis using the same or similar methodology. Agreements made in advance to subcontract to a specific laboratory will be honored.

Sample Details

				O.Reg.153/04 parameters								
Field Filtered -->												
Sample ID	Date/Time Collected	Sample Matrix	# of Containers	PHC F1 - F4	BTEX	VOCs	PAHs	PCBs	Metals + Inorganics	Metals only	CORROSIVITY	RN# (Lab Use Only)
BH 05-04	25/02/03 10:30		1								✓	1756725

	PRINT NAME	LOCATION	SIGN	DATE/TIME	TEMP (°C)
Sampled By:	Samantha			25/02/03	
Relinquished By:					
Received By:	Christine Soudina	NY		03/Feb/25 4pm	8.8
Received By:					

COMMENTS:

FOR INTERNAL LAB USE ONLY

CUSTODY SEAL: ☐ YES ☐ NO Ice packs submit ☑ Yes ☐ No eurofins 232189

STANDARD CHAIN-OF-CUSTODY

146 Colonnade Road, Unit #8, Ottawa, ON, K2E 7Y1 - Phone: 613-727-5692, Fax: 613-727-5222

3013973

CLIENT INFORMATION

Company: PNJ ENGINEERING INC.
Contact: ANDREA SALTOS
Address: 70 GALAXY BLVD
Telephone:
Cell:
Email: #1: asaltos@pnjeng.com
Email: #2: sbowman@pnjeng.com
Project: 24-1211-03
Quote #:

INVOICE INFORMATION (SAME AS CLIENT INFORMATION: YES ☑ NO ☐)

Company:
Contact:
Email: #1: accounting@pnjeng.com
Address:
Email: #2:
Telephone:
PO #:

TURN-AROUND TIME (Business Days)

☐ 1 Day* (100%) ☐ 2 Day** (50%) ☐ 3-5 Days (25%) ☑ 5-7 Days (Standard)

Please contact Lab in advance to determine rush availability. *For results reported after rush due date, surcharges will apply: before 12:00 - 100%, after 12:00 - 50%. **For results reported after rush due date, surcharges will apply: before 12:00 - 50%, after 12:00 - 25%.

TCLP, SPLP, PFAS, and NP/NPE the rush surcharges are 100% (3 day) and 50% (4 day). For farm soils the rush surcharge is 100% (3-5 days). Regular TAT is 10 days.

REGULATION/GUIDELINE REQUIRED

☐ Sanitary Sewer, City:__________
☐ Storm Sewer, City:__________
☐ ODWSOG (Use DW COC if samples are for human consumption)
☐ PWQO
☐ O.Reg. 347 (TCLP)
☐ Other: __________

☐ O. Reg. 153/04
The sample results from this submission will form part of a formal Record of Site Condition (RSC) under O.Reg. 153/04.
Analysis of full parameter list only
Yes ☐ No ☐
Table # ____, Coarse / Fine, Surface / subsurface
Type: Com-Ind / Res-Park / Agri / GW / All Other / Sediment

☑ O. Reg 406 Excess Soils
Table # 2.1 [✓ Full depth]/Strat/Ceiling/mSPLP Leachate
Type: Com-Ind /[✓ Res-Park] /Agri/All Other
Category: Surface /Subsurface

The optimal temperature conditions during transport is 4 - 10°C. Sample(s) cannot be frozen, unless otherwise indicated or agreed upon with the Laboratory. This COC must not be used for drinking water samples. The COC must be complete upon submission of the samples, there will be a $25 surcharge if required information is missing (required fields are shaded in grey).

Occasionally, situations arise in which Eurofins Environment Testing Canada (Ottawa) is unable to process a sample after receipt. By signing this chain-of-custody form, the client agrees that Eurofins Environment Testing Canada (Ottawa) may subcontract samples to a laboratory that is similarly accredited. This subcontracted laboratory will perform the same analysis using the same or similar methodology. Agreements made in advance to subcontract to a specific laboratory will be honored.

Sample Details

				O.Reg.153/04 parameters																
	Field Filtered -->																			RN# (Lab Use Only)
Sample ID	Date/Time Collected	Sample Matrix	# of Containers	PHC F1 - F4	BTEX	VOCs	PAHs	PCBs	Metals + Inorganics	Metals only	TCLP - Metals, b(a)P, Benzene, Flamability									
TCLP-01	25/02/03 10:35		2								✓									1756723

	PRINT NAME	LOCATION	SIGN	DATE/TIME	TEMP (°C)
Sampled By:	Samantha			25-02/03	
Relinquished By:					
Received By:	Christine Souaina	NG		03/Feb/25 4pm	8.8
Received By:					

COMMENTS:

FOR INTERNAL LAB USE ONLY

CUSTODY SEAL: ☐ YES ☐ NO Ice packs submit ☑ Yes ☐ No

voc Metal

Appendix E

E – Photolog

Photo 1: View of drilling operation at BH-01.

Photo taken by:
Grace Faraj

Date: January 30, 2025

Photo 2: Core sample of BH-01-04, depth 7.5’-9.5’.

Photo taken by:
Grace Faraj.

Date: January 30, 2025

Photo 3: Core sample of BH-01-07, depth 20’-22’.

Photo taken by:
Grace Faraj.

Date: January 30, 2025

Photo 4: Core sample of BH-02-04, depth 7.5’-9.5’.

Photo taken by: Grace Faraj.

Date: January 28, 2025

Photo 5: Core sample of BH-02, depth 15’-20’.

Photo taken by: Grace Faraj.

Date: January 28, 2025

Photo 6: Core sample of BH-03-06, depth 15’-19’.

Photo taken by: Grace Faraj.

Date: January 29, 2025

Photo 7: Core sample of BH-04-04, depth 7.5’-9.5’.

Photo taken by:
Grace Faraj.

Date: January 30, 2025

Photo 8: Core sample of BH-04, depth 25’-27’.

Photo taken by:
Grace Faraj.

Date: January 30, 2025

Photo 9: Core sample of BH-05-10, depth 43.9’-44.7’.

Photo taken by:
Grace Faraj.

Date: January 29, 2025

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