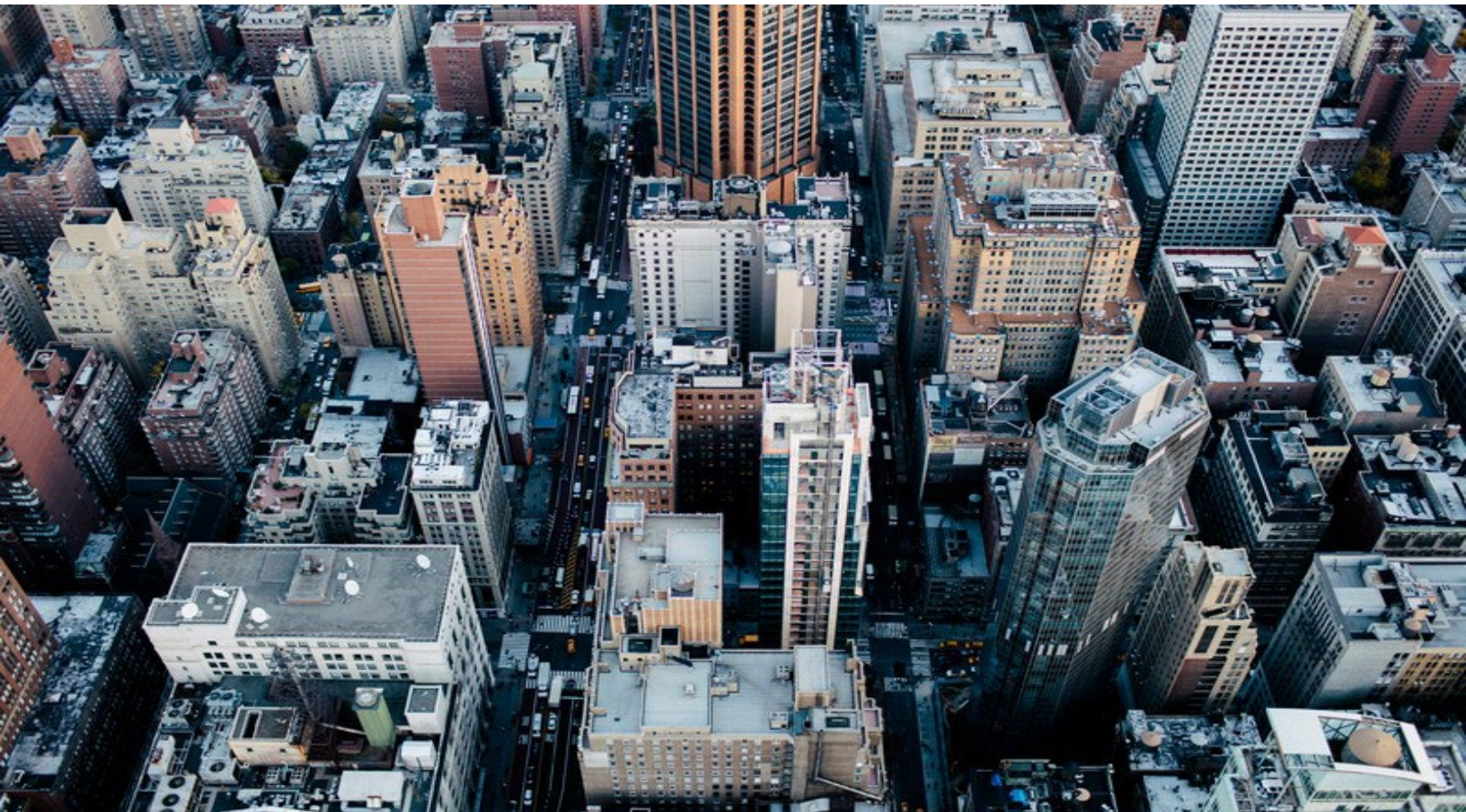
# 1Door4Care: CHEO Integrated Treatment Centre - Geotechnical Investigation Report (Parking Garage)

Children's Hospital of Eastern Ontario
Campus 401 and 407 Smyth Road
Ottawa, Ontario

Infrastructure Ontario Project # 182-OCTC

25 October 2022

→ **The Power of Commitment**



# Executive summary

GHD Limited (GHD) has been retained by Ontario Infrastructure and Lands Corporation (‘Infrastructure Ontario’) to carry out a preliminary geotechnical investigation at the location of the proposed parking and asphalt paved driveway at the Children’s Hospital of Eastern Ontario (CHEO) Campus located at 401 Smyth Road, in Ottawa, Ontario.

It was understood that the preliminary parking structure will either be a 3-storey structure (with 350 vehicles per level), or a 7-storey building (with 150 vehicles per level) with no underground levels. The parking structure was expected to have a total of 1,050 car parking spaces initially. The recently provided parking structure plan now includes an 8-storey building composed of 1,050 parking spaces and no below grade structures.

The objectives of the competed geotechnical investigation consisted of gathering information on the ground geotechnical conditions at the Site in support of the proposed development and to provide professional opinions to assist in the design and construction of the proposed structure.

The original 2021 drilling activities consisted of the advancement of eleven (11) exploratory geotechnical boreholes denoted as BH1-21, BH2-21, MW3-21, BH4-21, MW5-21, MW6-21, BH7-21, MW8-21, as well as B1-21 to B3-21 (advanced within the soil berms located along the southern, eastern, and northern perimeter of the existing parking lot) to depths varying between 1.0 and 10.1 metres below ground surface (mBGS). Four (4) monitoring wells were installed in Boreholes MW3-21, MW5-21, MW6-21, and MW8-21. A supplementary geotechnical investigation in support of the new proposed parking concept was recently completed by advancing twelve (12) boreholes in which (two) monitoring wells were installed. The scope of work also included a geophysical survey within the parking garage footprint.

The general stratigraphy at the Site consists of fill/disturbed native soils underlain by gravelly sand/ silty sand to sand and gravel deposits overlying bedrock. The measured groundwater levels within the installed monitoring wells were found to range from approximately 1.7 to 3.1 mBGS, and the groundwater elevations range from approximately 78.7 to 80.5 mAMSL. For the purpose of preliminary design, spread and strip footings placed on the weathered shale bedrock can be designed for a factored (Ø=0.5) geotechnical resistance at Ultimate Limit State (ULS) of 800 kPa, and a geotechnical reaction at Serviceability Limit State (SLS) of 600 kPa.

Based on the results of this investigation, the Site can be classified as Class 'B’ (Very Dense Soil and Soft Rock) for seismic load calculations subjected to code requirements.

The design depth of frost penetration in the area is 1.8 m as per the OPSD 3090.101. A permanent soil cover of 1.8 m or its thermal equivalent synthetic insulation is required for frost protection of foundations (foundations in unheated areas). During winter construction, exposed surfaces to support foundations must be protected against freezing by means of loose straw and tarpaulins.

It is expected that seepage rate into the excavation within the native granular deposits and the upper portions of the bedrock will be moderate to high. If the excavation is to be above the groundwater table, moderate to high groundwater ingress can readily be handled by installation of sumps and pumps at strategic locations at the base of excavation. If the excavation is to be extended to a greater depths below local groundwater table, an active pre-construction dewatering system such as well points may be required depending on the depth and size of excavations.

The possible presence of cobbles and boulders at this Site and their impact on the excavation should be expected.

Qualified geotechnical personnel should inspect all stages of the proposed development. Specifically, they should ensure that the materials and conditions comply with this geotechnical investigation report. In addition, qualified geotechnical personnel should provide material testing services prior to and during foundation preparation and construction.

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# Appendices

# 1. Introduction

GHD Limited (GHD) has been retained by Ontario Infrastructure and Lands Corporation ('Infrastructure Ontario') to carry out a geotechnical investigation at the location of the proposed parking and asphalt paved driveway at the Children's Hospital of Eastern Ontario (CHEO) Campus located at 401 Smyth Road, in Ottawa, Ontario (hereafter referred to as the 'Site' or 'Property'). A Site Location Map is provided on **Figure 1**.

It was expected that the proposed preliminary parking structure will either include a 3-storey structure (with 350 vehicles per level), or a 7-storey building (with 150 vehicles per level) with no underground levels. The parking structure was estimated to hold a total of 1,050 car parking spaces initially. The updated development concept for the parking structure now includes an 8-storey building composed of 1,050 parking spaces and no below grade structures. The location of the proposed parking structure is shown on **Figure 2**.

GHD has previously completed a geotechnical investigation and geophysical survey as well as a Multi-Channel Analysis of Surface Waves (MASW) for the 1Door4Care Facility and exterior asphalt paved parking areas between November 2019 and October of 2020, January 2021 as well as additional geotechnical work in July 2022. The proposed parking structure will be located in the existing parking lot to the east of the 1Door4Care Facility. Soil berms ranging from 2.5 m to 4.0 m width and approximately 0.6 m height are present along the southern, eastern, and northern perimeter of the existing parking lot.

A preliminary geotechnical investigation was carried out in accordance with GHD's work plan Reference No. 11221279, dated December 15, 2020, in response to a Request for Services issued by IO for the proposed parking structure. The scope of work for the preliminary geotechnical investigation included the advancement of six (6) geotechnical exploratory boreholes within the footprint of the proposed parking structure, two (2) boreholes within the proposed driveway, and three (3) shallow boreholes at or adjacent to the soil berms along the southern, eastern, and northern perimeter of the existing parking lot. In addition, four (4) monitoring wells were installed in four (4) of the drilled boreholes.

The objectives of the preliminary geotechnical investigation consisted of gathering information on the ground geotechnical conditions at the Site in support of the proposed development and to provide professional opinions to assist in the design and construction of the proposed structure.

Additional geotechnical investigation was proposed in order to supplement the limited investigation completed previously. The additional geotechnical investigation was carried out in accordance with GHD's work plan dated June 3, 2022.

The scope of work of the additional geotechnical investigation consisted of the following tasks:

– Advancing twelve (12) geotechnical exploratory boreholes
– Conduct rock coring in select boreholes to define the bedrock quality,
– Installation of monitoring wells in two (2) of the drilled boreholes for groundwater monitoring within the footprint of the proposed structure,
– A geophysical survey in the parking garage footprint to document the subsurface conditions beneath exterior portions of the proposed development area
– Laboratory testing on selected soil and rock core samples to assess the materials geotechnical properties,
– Laboratory chemical analysis on selected soil samples to assess soil potential for sulphate attack on construction concrete (class of exposure) and soil corrosivity on ductile cast iron elements and,
– Provide professional opinions and recommendations regarding the design and construction of proposed building foundations, floor slab, pavements, and to assess the anticipated construction conditions pertaining to excavation, backfilling, and groundwater control.

This report summarizes the activities and findings of the previous and additional geotechnical investigation, together with our recommendations and comments. These recommendations and comments are based on factual information and are intended only for the use of Infrastructure Ontario design engineers and their affiliates.

The anticipated construction conditions pertaining to excavation, temporary groundwater control, and backfilling are discussed also in this report, but only with regards to how these might influence the design. Construction methods described in this report must not be considered as specifications or recommendations to the contractors or as the only suitable methods. The data and their interpretation presented in this report may not be sufficient to assess all of the factors that may have an effect upon the construction. Prospective contractors, therefore, should evaluate the factual information, obtain additional subsurface data as they might deem necessary and select their construction methods, sequencing and equipment based on their own experience on similar projects.

The recommendations and opinions in this report are applicable only to the proposed development as described above and the attached 'Limitations of the Investigation' is an integral part of this report.

# 2. Field and Laboratory Work Procedures

The field investigation protocols and methodologies undertaken for the present geotechnical investigation are presented below.

## 2.1 Safety Planning and Utility Clearances

Upon project initiation, a Site-specific Health and Safety Plan (HASP) was prepared for implementation during the field investigation program. The HASP presented the visually observed Site conditions and identified potential physical hazards to field personnel. Required personal protective equipment was also listed in the HASP. The HASP was reviewed by GHD's field personnel prior to undertaking field activities and a copy of the HASP was maintained at the Site for the duration of the investigative work. Health and Safety requirements in the HASP were implemented during the field investigation program.

Prior to initiating the subsurface investigation activities GHD requested public utilities to be marked by utility operators in accordance with the Ontario One Call damage prevention laws. All applicable utility companies (gas, hydro, bell, network cables, pipeline and municipal sewers, etc.) were contacted. Additionally, GHD retained a private utility locating company (MultiView Locates, Inc.) to demarcate the locations of the privately owned utilities within the area of the boreholes.

In addition, GHD carried out a precondition survey to document the current condition of the ground surface, at and in the vicinity of the boreholes and also along the proposed travel pathway of the drilling equipment, in order to establish a baseline condition prior to the fieldwork. The precondition survey consisted of a visual walk-through inspection of the Site and documentation using photographs. The re-inspection of the Site conditions and all required remedial work was carried out upon completion of all fieldwork.

## 2.2 Borehole Advancement and Field Testing

Drilling activities for the preliminary geotechnical investigation within the parking garage structure were conducted during the period between January 12 and 19, 2021 under the full-time supervision of experienced GHD technical representatives. The drilling activities consisted of the advancement of eleven (11) exploratory geotechnical boreholes (denoted as BH1-21, BH2-21, MW3-21, BH4-21, MW5-21, MW6-21, BH7-21, MW8-21, as well as B1-21 to B3-21 (advanced within the soil berms located along the southern, eastern, and northern perimeter of the existing parking lot), to depths varying between 1.0 m and 10.1 m below ground surface (mBGS). In addition, four (4) monitoring wells were installed in select completed boreholes (MW3-21, MW5-21, MW6-21, and MW8-21).

Drilling activities for the additional geotechnical investigation was conducted between July 4 and July 19, 2022, under the full-time supervision of an experienced GHD technical representative. The drilling activities consisted of the advancement of twelve (12) exploratory geotechnical boreholes (denoted as MW9-22 to MW20-22) to approximate depths varying between 1.1 m and 8.0 mBGS. Two (2) of these boreholes were converted into monitoring wells for groundwater monitoring.

The locations of these boreholes and monitoring wells are shown on **Figure 2**.

The drilling activities were conducted utilizing a track mounted conventional drilling rig CME 55M, supplied and operated by a Ministry of the Environment, Conservation and Parks (MECP) licensed well driller (Aardvark Drilling).

The drilling method for advancing the boreholes at this Site consisted generally of continuous sampling along with using continuous flight hollow stem augers for the boreholes that contained a monitoring well, while solid stem augers were generally used for the other boreholes. All sampling was conducted using a 50 millimeter (mm) outside diameter split spoon sampler in general accordance with the specifications of the Standard Penetration Test Method (ASTM D1586). The relative density or consistency of the subsurface soil layers were measured using the Standard Penetration Test (SPT) method, by counting the number of blows ('N') required to drive a conventional split barrel soil sampler 0.30 m depth.

Six (6) monitoring wells were installed in selected boreholes (MW3-21, MW5-21, MW6-21, MW8-21, MW9-22, and MW20-22) for long term groundwater level monitoring. Each monitoring well was instrumented with a 50 mm diameter Schedule 40 PVC screen, completed with 50 mm diameter PVC riser pipe and J-plug. A silica sand pack was placed in the annular space between the PVC screen pipe and the borehole annulus to approximately 0.5 m above the top of the screen. Where possible, the monitoring was screen wase placed at appropriate depth to target those materials that had higher permeability. A bentonite seal and holeplug was installed in the remaining borehole annulus above the sand pack. A protective steel casing with a concrete collar was placed on top of each monitoring well. The well completion details for each monitoring well are presented on the borehole records provided in **Appendix A**. In accordance with O. Reg. 903, the monitoring wells have been registered with the MECP.

Upon encountering bedrock, rock coring was conducted in MW3-21, MW6-21, MW9-22, BH11-22, BH13-22, and BH18-22. At these locations, the boreholes were advanced by diamond core drilling over a length from approximately 4.7 m and 6.6 m respectively. The coring of the rock was carried out using HQ size core barrel and double tube wireline equipment, allowing recovery of 63 mm diameter rock cores. The GHD technician visually described the rock samples. For the rock cores, the Total Core Recovery (TCR), Solid Core Recovery (SCR), and Rock Quality Designation (RQD) values were recorded in accordance with the conventions used by the International Society for Rock Mechanics (ISRM). Rock core photo records are provided in **Appendix C**.

The supervising technician logged the borings and examined the soil and rock core samples as they were obtained. The soil/rock samples were transported to GHD's geotechnical laboratory where they were further reviewed by senior geotechnical personnel and representing samples were selected for laboratory testing. The detailed results of the examination are recorded on the borehole records presented in **Appendix A**.

Upon completion, boreholes that were not instrumented with monitoring wells were backfilled in accordance with O. Reg. 903. These boreholes have been grouted from the bottom upward with a cement bentonite grout to prevent future local ground settlement at the drilling locations.

At the completion of drilling activities, the plan coordinates and ground elevation at the borehole locations were surveyed by J.D Barnes Limited (Land Information Specialists) using the UTM Coordinate System (UTM18-NAD 83). A summary of the survey information is presented in the table below.

*Table 2.1 Summary of Advanced Boreholes in the parking Garage Area*

| Borehole Identification | Location – UTM-17 NAD83 Coordinate System | | Ground Elevation (mAMSL) | Total Borehole Depth, including rock coring (mBGS) | Length of Rock Coring (m) | Monitoring Well Installation Tip Depth (m) |
|---|---|---|---|---|---|---|
| | Northing | Easting | | | | |
| BH1-21 | 5027575.0 | 449073.3 | 81.4 | 3.2 | - | - |
| BH2-21 | 5027616.8 | 449071.4 | 81.4 | 2.8 | - | - |
| MW3-21 | 5027638.1 | 449119.4 | 81.4 | 10.1 | 5.5 | 4.6 |
| BH4-21 | 5027621.2 | 449159.8 | 82.2 | 2.8 | - | - |
| MW5-21 | 5027589.4 | 449128.8 | 81.8 | 1.8 | - | 1.8 |
| MW6-21 | 5027605.4 | 449245.0 | 82.2 | 10.1 | 6.5 | 7.5 |
| BH7-21 | 5027618.0 | 449176.6 | 82.2 | 2.5 | - | - |
| MW8-21 | 5027648.0 | 449211.8 | 82.2 | 2.2 | - | 2.1 |
| B1-21 | 5027580.7 | 449219.2 | 82.3 | 1.0 | - | - |
| B2-21 | 5027629.4 | 449254.4 | 82.2 | 1.5 | - | - |
| B3-21 | 5027652.0 | 449199.1 | 82.3 | 1.4 | - | - |
| MW9-22 | 5027588.5 | 449191.1 | 82.0 | 7.9 | -5.3 | 5.8 |
| BH10-22 | 5027596.9 | 449167.5 | 82.1 | 1.2 | - | - |
| BH11-22 | 5027638.0 | 449184.6 | 82.1 | 8.0 | 5.5 | - |
| BH12-22 | 5027590.3 | 449214.3 | 82.1 | 1.8 | - | - |
| BH13-22 | 5027615.5 | 449212.0 | 82.1 | 6.6 | 4.7 | - |
| BH14-22 | 5027618.1 | 449237.3 | 82.2 | 1.2 | - | - |
| BH15-22 | 5027642.6 | 449234.7 | 82.2 | 1.1 | - | - |
| BH16-22 | 5027594.4 | 449262.3 | 82.1 | 1.2 | - | - |
| BH17-22 | 5027619.3 | 449258.6 | 82.1 | 1.1 | - | - |
| BH18-22 | 5027645.0 | 449256.7 | 82.1 | 7.1 | 5.7 | - |
| BH19-22 | 5027589.0 | 449046.7 | 81.1 | 1.4 | - | - |
| MW20-22 | 5027656.1 | 449095.7 | 81.2 | 1.6 | - | 1.6 |

**Notes:**
mBGS: metres below ground surface
mAMSL: metres Above Mean Sea Level

It is noted that even though the ground surface elevations are accurate to 20±mm, these elevations should not be used for construction purposes.

All soil cuttings and purge water generated as part of the field activities have been containerized in 200 litre steel drums and stored on Site for staging prior to disposal at a MECP approved facility.

## 2.3 Geotechnical Laboratory Testing

All geotechnical laboratory testing was completed in accordance with the latest editions of the ASTM standards. Geotechnical laboratory testing consisted of moisture content tests on all recovered soil samples, as well as grain size distribution analysis (sieve and hydrometer) on twenty-one (21) select soil samples. As the obtained soil samples were generally coarse-grained, Atterberg Limit testing was conducted on four (4) single soil samples that exhibited plasticity to assess soil plasticity properties.

Laboratory uniaxial compressive strength (UCS) test were carried out on eleven (11) select rock core samples.

Unit weight tests were not carried out on soil samples due to the disturbed nature of the cohesionless samples. Intact soil samples were not available for testing.

The soil testing program and classification conformed to the latest edition of the following standards:

ASTM D6913 Standard Test Method for Particle Size Distribution (Gradation) of Soils using Sieve Analysis

MTO LS-702 Standard Test Method for Particle Size Analysis of Soils (Hydrometer Analysis)

ASTM D4318 Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils

ASTM D2487 Standard Practice for Classification of Soils for engineering purposes (Unified Soil Classification System-USCS)

The collected soil samples were classified/described in general accordance with the Unified Soil Classification System (USCS).

Geotechnical laboratory test results are discussed in **Section 3.3**. The results of moisture content determination tests, grain size analyses and Atterberg Limits are provided on the borehole records in **Appendix A**. The laboratory data sheets associate with the gradation analyses and the plasticity chart are provided in **Appendix B**.

## 2.4 Soil Corrosivity Testing

Corrosivity testing was conducted on eight (8) selected samples extracted from the drilled boreholes in accordance with ASTM and CSA Standards to assess the corrosion potential against ductile iron pipes and sulphate attack on concrete. The certificates of analysis associated with the corrosivity test results are provided in **Appendix D** and results are discussed in **Section 5.5**.

# 3. Site Geology and Subsurface Conditions

## 3.1 Regional Geology

The geological mapping of the area indicate that the subject Site is situated in an area of glaciofluvial deposits consisting of gravel, sand, silt, and clay followed by shale bedrock.

Based on the Quaternary Geology of Ontario map[1], the site is situated in an area of fluvial deposits consisting of gravel, sand, silt, and clay deposited on modern flood plains. The Bedrock Geology of Ontario map[2], indicates the Site is underlain by the upper Ordovician aged shale of the Georgian Bay Formation and Billings and Carlsbad Formations. The Georgian Bay Formation consists of interbedded grey to dark grey shale and fossiliferous calcareous siltstone to limestone. In eastern Ontario the Billings Formation and consists of dark blue-grey to brown to black shale with thin

[1] Ministry of Northern Development and Mines – Quaternary Geology of Ontario – Southern Sheet – Map 2556.
[2] Ministry of Northern Development and Mines – Bedrock Geology of Ontario – Southern Sheet – Map 2544

interbeds of limestone or calcareous siltstone. Review of the bedrock topography map and MECP well records for the Site, indicate that the bedrock surface is near the ground surface at an elevation of approximately 80 mAMSL.

## 3.2 Ground Stratigraphy

It should be noted that the subsurface conditions are confirmed at the borehole locations only and may vary at other locations. The boundaries shown on the borehole records represent an inferred transition between the various strata, rather than a precise plane of geological change. Additionally, actual contacts between deposits will typically be gradational as a result of neutral geologic processes. Variation in the deposit boundaries from those described in the borehole records is to be anticipated. Details of the subsurface conditions are provided on the borehole records presented in **Appendix A**.

The soil conditions observed in the boreholes advanced for this geotechnical investigation are generally consistent with the described geology of the region as presented in **Section 3.1** of this report. The general stratigraphy at the Site consists of fill/disturbed native soils underlain by gravelly sand/silty sand to sand and gravel deposits followed by bedrock. A brief description of each soil stratum encountered during the previous investigation is summarized below:

### 3.2.1 Ground Cover – Asphaltic Concrete

The boreholes were generally drilled on the asphaltic concrete paved areas and as such all of the drilled boreholes with the exception of Borehole B1-21 to B3-21, BH4-21, BH6-21, BH7-21, MW9-22 to BH12-22, BH14-22 to BH18-22 encountered an asphaltic concrete with a thickness that ranged between 50 mm and 175 mm.

The asphaltic concrete pavement has a base layer of gravel to sand and gravel with thickness values that ranged between 125 and 785 mm. The SPT'N' values within the pavement base and subbase materials (first split spoon sampling) ranged between 9 and 72 indicating a loose to very dense relative densities.

Gradation analysis conducted on select samples of the pavement base and subbase materials indicted that the samples contained 42 to 61 percent gravel, 33 to 50 percent sand, 4 to 13 percent silt, and 2 to 3 percent clay size particles. The fine content of the tested samples ranged between 6 and 16 percent.

### 3.2.2 Fill / Disturbed Soil

Earth fill / disturbed native soil was encountered in all boreholes at the ground surface or below the asphaltic pavement and extended to depths varying between 0.3 m and 1.1 mBGS. The fill composition is in general heterogeneous, consisting of gravelly sand/gravel/sandy gravel/silty sand to sand and gravel. Asphalt fragments were observed within the fill layer.

SPT 'N' values obtained within the earth fill layer varied between 5 and 72 blows per 0.30 m of penetration, indicating a variable degree of compaction. The elevated blow counts are likely due the presence of gravel and cobbles within the fill layer or the result of ground freezing conditions.

Water content measurements obtained from extracted fill samples indicated that the soil samples moisture content varied between 2 and 19 percent by weight. The low moisture content is likely due to the presence of gravel and cobble fragments within the tested fill samples and the high moisture content is likely due to the presence of clay and/or ice lenses within the tested soils.

Gradation analysis was completed on select samples of the earth fill indicted that the samples contained 15 to 73 percent gravel, 14 to 61 percent sand, 5 to 20 percent silt, and 1 to 8 percent clay size particles while the fine content of the tested samples ranged between 6 and 28 percent. The results are presented in the borehole records and are tabulated in Section 3.3.1. The gradation analysis curve is presented in **Appendix B**.

It is possible that the thickness and quality of the fill (presence of deleterious materials) can vary between borehole locations.

### 3.2.3 Native Soil

A granular deposit composed of gravelly sand/sand/silty sand/sand and gravel/sand and silt was encountered beneath the fill layer in all boreholes with the exception of Borehole BH1-21 to MW5-21, BH7-21 to MW8-21, and BH15-22 in which no native soil was encountered. The granular deposit extends to depths of approximately of 0.6 m to 1.2 m BGS and at inferred bedrock surface. The granular deposit soil was found to contain some silt and trace clay.

SPT 'N' values obtained within this deposit varied between 13 blows per 0.3 m of penetration and greater than 50 blows per 0.075 m of penetration (refusal), indicating a loose to very dense relative density, but generally compact to dense condition. The elevated blow counts/refusal is generally occurring near the bedrock surface. The moisture content value varies from 3 percent to 13 percent was obtained within the granular soils deposit while the sample.

Gradation analysis was completed on select samples of the granular deposit indicted that the samples contained 31 to 46 percent gravel, 39 to 46 percent sand, 9 to 16 percent silt, and 4 to 7 percent clay size particles while the fine content of the tested samples ranged between 6 and 28 percent. Atterberg limits tests performed on the soil sample obtained from B3-21 at 0.8 m to 1.1 mBGS indicated the sample had a liquid limit of 32 percent, a plastic limit of 18 percent and a plasticity index of 14 percent while the moisture content of the tested soil was 13 percent by weight.. The results for completed tests are presented in the borehole records and are tabulated in Section 3.3.2. The plasticity chart is provided in **Appendix B**.

### 3.2.4 Shale Bedrock

Bedrock was encountered/inferred in all drilled boreholes at depths ranging between 0.4 and 1.2 mBGS. The upper part of the bedrock is highly to completely weathered and locally transformed to residual soil. The boreholes within the completely weathered zones were advanced by auguring and SPT sampling for variable thicknesses, before reaching auger refusal.

The shale bedrock was cored in six boreholes, MW3-21, MW6-21, MW9-22, BH11-22, BH13-22 and BH18-22 to assess the bedrock quality. From the recovered rock cores, the bedrock was visually identified as the Georgian Bay Formation. The shale was generally observed to be dark grey in color, thinly laminated, highly to completely weathered at its surface and became gradually moderately weathered to fresh with depth. This formation consists generally of a dark grey weak to moderately strong shale interbedded with light grey color strong to very strong limestone and siltstone layer.

Due to the method of investigation and the presence of completely weathered shale at the bedrock surface, the top of the bedrock profile cannot be accurately determined. However, the estimated depths to the completely weathered shale bedrock surface from augering and coring is listed in the following table:

***Table 3.1 Depth / Elevation of Shale Bedrock Surface***

| Borehole Identification Number | Estimated Depth/Elevations of Shale Bedrock Surface (mBGS / mAMSL) |
|---|---|
| BH1-21 | 0.9 / 80.5 |
| BH2-21 | 1.1 / 80.2 |
| MW3-21 | 0.6 / 80.7 |
| BH4-21 | 0.8 / 81.4 |
| MW5-21 | 0.4 / 81.4 |
| MW6-21 | 1.2 / 80.9 |
| BH7-21 | 0.8 / 81.4 |
| MW8-21 | 0.9 / 81.3 |
| B1-21 | 1.0 / 81.0 |
| B2-21 | 0.9 / 80.5 |

| Borehole Identification Number | Estimated Depth/Elevations of Shale Bedrock Surface (mBGS / mAMSL) |
|---|---|
| B3-21 | 1.2 / 80.9 |
| MW9-22 | 0.8 / 81.2 |
| BH10-22 | 0.7 / 81.5 |
| BH11-22 | 0.9 / 81.3 |
| BH12-22 | 0.7 / 81.4 |
| BH13-22 | 1.0 / 81.2 |
| BH14-22 | 0.7 / 81.5 |
| BH15-22 | 0.6 / 81.5 |
| BH16-22 | 0.9 / 81.2 |
| BH17-22 | 1.1 / 81.0 |
| BH18-22 | 1.4 / 80.7 |
| BH19-22 | 0.9 / 80.2 |
| MW20-22 | 1.0 / 80.2 |
| **Notes:**<br>mBGS: metres Below Ground Surface<br>mAMSL metres Above Mean Sea Level | |

The Total Core Recovery (TCR) achieved with the HQ size core bit ranged from approximately 58 to 100%. The Rock Quality Designation (RQD) ranged between 0 to 100% with the lower values of RQD observed near the surface of the rock and the percentages generally increased with depth. The RQD values are a general indicator of rock mass quality; however, in horizontally laminated sedimentary rock formation such as the Georgian Bay Formation, and as a result of the fissile nature of the bedrock, the RQD values may likely underestimate the quality of the rock.

Photographs of the Rock Core samples are presented in **Appendix C**.

Eleven (11) rock core samples were submitted to the GHD geotechnical laboratory for Uniaxial Compressive Strength (UCS) testing. The obtained UCS values ranged between 80.7 and 107.6 MPa. Based on the results of the unconfined compressive strength test and in accordance with ISRM (International Society of Rock Mechanics) guidelines the tested rock core samples are classified as strong to very strong rock. However, it is believed that the samples have been selected mostly from the limestone and siltstone portion of the rock cores that has less fractures. The results of UCS testing are tabulated in Section 3.3.4 and are also presented in **Appendix B**.

. One (1) core sample from Borehole MW9 was submitted for free swelling test(FST) testing. FST testing are currently in process; upon completion, results will be provided in an addendum.

# 3.3 Geotechnical Laboratory Test Results

## 3.3.1 Grain Size Distribution

Grain size analyses consisting of sieve and hydrometer testing were carried out on twenty-one (21) select soil samples extracted from the boreholes or shallow test pits. These consisted of seventeen soil samples from the borehole split spoon (SS) samples and four (4) grab samples (GS) obtained from the near-surface soils of select boreholes. The obtained results are reported in the borehole records and are tabulated in the following table.

The obtained values have been shown on the log of the drilled boreholes and the gradation analysis curves are presented in **Appendix B**.

*Table 3.2 Gradation Analysis of Select Representative Soil Samples*

| Borehole Identification | Sample Number | Depth (mBGS) | Gravel (%) | Sand (%) | Silt (%) | Clay (%) | Fines Silt & Clay (%) |
|---|---|---|---|---|---|---|---|
| BH1-21 | GS1 | 0.1-0.3 | 48 | 41 | 8 | 3 | 11 |
| BH2-21 | GS1 | 0.1-0.3 | 42 | 50 | 6 | 2 | 8 |
| BH2-21 | SS1 | 0.5-0.8 | 15 | 61 | 18 | 6 | 24 |
| BH4-21 | SS1 | 0.2-0.5 | 46 | 41 | 10 | 3 | 13 |
| MW5-21 | GS1 | 0.1-0.3 | 43 | 41 | 13 | 3 | 16 |
| MW5-21 | SS1 | 0.5-0.8 | 23 | 49 | 20 | 8 | 28 |
| MW6-21 | SS2 | 0.8-1.1 | 32 | 45 | 16 | 7 | 23 |
| MW8-21 | GS1 | 0.0-0.3 | 61 | 33 | 4 | 2 | 6 |
| B1-21 | SS2 | 0.7–1.0 | 39 | 39 | 15 | 7 | 22 |
| B3-21 | SS2 | 0.7-1.0 | 19 | 50 | 17 | 14 | 31 |
| BH10-22 | SS1 | 0.0-0.6 | 43 | 43 | 11 | 3 | 14 |
| BH11-22 | SS1 | 0.0-0.6 | 52 | 37 | 8 | 3 | 11 |
| BH12-22 | SS1 | 0.0-0.7 | 66 | 14 | - | - | 20 |
| BH14-22 | SS1 | 0.0-0.6 | 66 | 22 | - | - | 12 |
| BH15-22 | SS1 | 0.0-0.6 | 40 | 47 | 10 | 3 | 13 |
| BH16-22 | SS1 | 0.0-0.7 | 44 | 45 | 9 | 2 | 11 |
| BH17-22 | SS1 | 0.0-0.7 | 52 | 39 | 7 | 2 | 9 |
| BH18-22 | SS1 | 0.0-0.6 | 73 | 21 | 5 | 1 | 6 |
| BH19-22 | SS2 | 0.7-0.9 | 31 | 46 | 16 | 7 | 23 |
| MW20-22 | SS1 | 0.2-0.8 | 36 | 44 | 16 | 4 | 20 |
| MW20-22 | SS2 | 0.8-1.0 | 46 | 41 | 9 | 4 | 13 |

### 3.3.2 Atterberg Limits

Atterberg limits test was conducted on four select samples. The obtained results are reported in the associated borehole records and are tabulated in the table to follow.

*Table 3.3 Atterberg Limit Test Results*

| Borehole Identification Number | Depth (mBGS) | W (%) | LL (%) | PL (%) | PI (%) | Soil Description and Classification |
|---|---|---|---|---|---|---|
| BH3-21 SS2 | 0.8-1.1 | 13 | 32 | 18 | 14 | Low Plasticity Inorganic Clay |
| BH13-22 SS2 | 0.6-1.2 | - | - | - | - | Non-Plastic |
| BH19-22 SS2 | 0.8-1.4 | - | - | - | - | Non-Plastic |
| MW20-22 SS2 | 0.6-1.2 | - | - | - | - | Non-Plastic |

Notes:
W: Natural water content in percent
LL: Liquid limit
PL: Plastic limit
PI: Plasticity index

The test results are presented in the plasticity chart in **Appendix B**.

### 3.3.3 Unconfirmed Compressive Strength of Intact Rock Core

Laboratory uniaxial compressive strength (UCS) test was carried out on eleven (11) selected rock samples extracted from the cores. The results of these tests are summarized below and are also presented in **Appendix B**.

*Table 3.4 Unconfined Compressive Strength of Rock Core Samples*

| Borehole Identification | Sample Depth (Mbgs) | Rock Density Kg/m$^3$ | UCS (Mpa) |
|---|---|---|---|
| MW3-21 RC1 | 4.88 – 5.03 | 2,646 | 80.8 |
| MW3-21 RC2 | 6.40 – 6.55 | 2,653 | 107.6 |
| MW3-21 RC3 | 7.92 – 8.07 | 2,700 | 83.4 |
| MW3-21 RC5 | 9.63 – 9.75 | 2,596 | 80.7 |
| MW6-21 RC2 | 4.75 – 4.88 | 2,620 | 94.5 |
| MW6-21 RC4 | 6.65 – 6.81 | 2,645 | 100.0 |
| MW6-21 RC5 | 7.98 – 8.10 | 2,678 | 102.2 |
| MW9-22 RC1 | 3.20 - 3.31 | 2,673 | 71.0 |
| MW9-22 RC2 | 4.04 – 4.14 | 2,667 | 56.1 |
| BH13-22 RC3 | 3.61 – 3.71 | 2,652 | 35.9 |
| MW23-22 RC2 | 6.93 – 7.03 | 2696 | 46.8 |

**Note:**
Mpa: Megapascal

Based on the results of the unconfined compressive strength test and in accordance with ISRM (International Society of Rock Mechanics) guidelines the tested rock core samples are classified as medium strong to very strong rock.

### 3.3.4 Proctor Test

Three (3) laboratory Standard Proctor compaction tests were conducted on bulk samples of the auger cuttings extracted from the surficial fill at the Site to determine the maximum dry density and optimum moisture content of the fill. The purpose of the testing was to assess the compactability during construction. The results are summarized below and are also provided in Appendix B.

*Table 3-5 Proctor Test Results*

| Borehole Identification Number | Depth (mBGS) | *Maximum Dry Density (kg/m$^3$)* | Optimum Moisture Content (%) |
|---|---|---|---|
| BH11-22 | 0.0-0.6 | 2,254 | 6.4 |
| BH18-22 | 0.0-0.6 | 2,265 | 6.2 |
| MW9-22 | 0.0-0.3 | 2,297 | 6.7 |

The tested samples maximum dry density ranged between 2,254 and 2,297 kg/m$^3$ and the optimum moisture contents varied between 6.2 and 6.7 percent by weight. The measured in-situ moisture content of the tested samples varied between 2 and 6 percent indicating the fill material are generally within +/- 3 percent of the laboratory optimum for compaction.

## 3.4 Groundwater Conditions

As part of this geotechnical investigation, six (6) monitoring wells were installed in completed boreholes MW3-21, MW5-21, MW6-21, MW8-21, MW9-22, and MW20-22. The well completion details for each monitoring well is shown on the borehole records provided in **Appendix A**.

Groundwater levels were collected on January 28, 2021, February 2, 2021, February 10, 2021, April 23, 2021, and August 24, 2021, from the Site monitoring wells. Groundwater levels measured in the monitoring wells expressed in metres below ground surface (mBGS) are presented in **Table 1a**, and levels expressed in metres above mean sea level (mAMSL) are presented in **Table 1b**. Based on the groundwater level monitoring to date, the overburden (fill and native soils) are unsaturated, and the water table is encountered in the weathered bedrock. Seasonal monitoring is needed to verify the high-water table.

Based on the January 28, 2021 to August 24, 2021 monitoring events, the groundwater levels in the monitoring wells ranged from approximately 1.7 to 3.1 mBGS, and the groundwater elevations range from approximately 78.7 to 80.5 mAMSL.

In the long term, seasonal fluctuations of the groundwater level should be expected. Perched water table condition could develop in the fill after heavy precipitation and/or during spring thaw.

# 4. Engineering Discussion and Assessment

Recommendations provided below are based on boreholes advanced and geophysical tests completed during the previous investigation.

## 4.1 General Geotechnical Evaluation

It was expected that the proposed preliminary parking structure will either include a 3-storey structure (with 350 vehicles per level), or a 7-storey building (with 150 vehicles per level) with no underground levels. The parking structure was estimated to hold a total of 1,050 car parking spaces initially. The recently provided parking structure concept now includes an 8-storey building composed of 1,050 parking spaces and no below grade structures. Further details of the proposed development activities at the Site are unknown to GHD and specific information on the design founding depth and footing loading conditions were not available at the time of preparation of this report.

Based on the borehole data, the founding subgrade for the building will generally consist of dense gravelly or sandy soils or completely to highly weathered shale bedrock. The proposed building can be supported on conventional spread and strip footings placed on the native granular soil or weathered shale bedrock.

## 4.2 Site Preparation and Grading

The ground cover and fill/disturbed materials at this Site extended to depths varying between approximately 0.3 and 1.1 mBGS. The fill/disturbed materials have variable shear strength and compressibility parameters and was observed to contain intermixed asphalt fragments.

The ground cover and any earth fill materials found to contain significant amounts of deleterious materials should be removed prior to site grading activities. The subgrade exposed after the removal of the unsuitable fill material will consist of native soils or bedrock. The subgrade soils should be visually inspected, compacted, and proof rolled using heavy equipment. Any soft, or unacceptable areas should be sub-excavated, removed as directed by the Geotechnical Engineer and replaced with clean suitable granular soil placed in thin layers (150 mm thick or less) and compacted to a minimum of 98 percent Standard Proctor Maximum Dry Density (SPMDD).

The clean earth fill/disturbed soils and native soils encountered at the Site may be suitable for reuse as backfill to raise site grades (where required) or to be used as backfill against foundations or as trench backfill during installation of buried services, provided the material is free of deleterious materials and is within the optimum moisture content. The fill soils are generally near their optimum water content for compaction. If the fill and native soils are to be reused as structural fill, it should be anticipated that reworking of the soils will be required to facilitate compaction through drying or slight wetting and use of vibratory roller compactors.

Installation of engineered fill, where required, must be continuously monitored on a full-time basis by qualified geotechnical personnel.

## 4.3 Foundations

Foundations for the proposed building at the Site will consist of conventional spread or strip footings founded on native soils or weathered shale bedrock.

The common practice for the Serviceability Limit State (SLS) design of most structure and building foundations is to limit the total and differential foundation settlements to 25 mm and 15 mm, respectively. Other serviceability criteria for the proposed building may be determined by the structural engineer considering tolerable settlement that would not restrict the use or operation of the facilities.

The foundation design options are presented in more detail below:

### 4.3.1 Conventional Spread/Strip Footings

The proposed structure will be 8-storey building with no underground levels. This would result in the proposed foundation subgrade being placed at a minimum depth of 1 m to 2 m below existing grade. Based on the borehole data, the founding subgrade for the building at this depth will generally consist of the residual soil or completely to highly weathered shale bedrock. It is recommended that the building foundations be extended to the shale bedrock in order to avoid supporting the building foundations on two different types of materials with different compressibility and deformation properties, which could consequently result in excessive differential settlements.

For the purpose of preliminary design, spread and strip footings placed on the weathered shale bedrock can be designed for a factored (Ø=0.5) geotechnical resistance at Ultimate Limit State (ULS) of 800 kPa, and a geotechnical reaction at Serviceability Limit State (SLS) of 600 kPa. The recommended bearing capacity is for footing dimension of less than 3.0 m and subject to an engineering inspection and approval by qualified geotechnical engineer for all bearing surfaces. If larger footing dimensions are required, the geotechnical engineer should be consulted.

The minimum depths at which these bearing pressures are available at the borehole locations are also shown in the table below.

*Table 4.1 Ground Geotechnical Bearing Capacity at the Locations of Boreholes/ Monitoring Wells*

| Borehole Identification Number | Minimum Founding Depth (mBGS) / Maximum Elevation (mAMSL) |
|---|---|
| MW3-21 | 0.6 / 80.7 |
| BH4-21 | 0.9 / 81.3 |
| MW5-21 | 0.9 / 80.9 |
| MW6-21 | 1.2 / 80.9 |
| BH7-21 | 0.8 / 81.4 |
| MW8-21 | 1.0 / 81.2 |
| BH11-22 | 1.3 / 80.8 |
| BH12-22 | 0.9 / 81.2 |
| BH14-22 | 0.9 / 81.3 |
| BH16-22 | 1.2 / 80.9 |
| MW20-22 | 1.1 / 80.1 |

Footings subject to frost action should have a minimum soil cover of at least 1.8 m according to Ontario Provincial Standard Drawing (OPSD) 3090.101 Frost Penetration Depths for Southern Ontario, or equivalent insulation.

During construction, the foundation subgrade should be protected from inclement weather, excessive drying, and ingress of free water.

The contractor should be prepared to deal with cobbles and boulders that may exist within the overburden or excavation of the upper part of the bedrock during construction.

It is recommended that following completion of excavation and proof rolling, a mud mat of lean mix concrete (Min. 1 MPa) is placed to prepare a levelled working area and protect the subgrade from any mechanical disturbance.

## 4.4 Slab-On-Grade

The lowermost floor slab of the proposed parking structure is to be constructed as a concrete slab-on-grade established on a properly prepared subgrade. A qualified geotechnical engineer should review the condition of the subgrade beneath the proposed slab at the time of construction.

Prior to floor slab construction, all loose fill should be removed from the floor slab area. The native compact to very dense granular deposits encountered near the ground surface at the borehole locations, or engineered fill, used to raise Site grades, are suitable to support the slab-on-grade construction.

Following completion of excavation, the subgrade should be proof rolled under the supervision of the Geotechnical Engineer. Any localized weak areas that are revealed should be sub-excavated and replaced with granular fill. the materials should be placed in thin lifts (150 mm maximum) and compacted to a minimum of 98% of the material's SPMDD.

The slab foundation should incorporate a granular base layer consisting of at least 200 mm of Granular 'A' material as per Ontario Provincial Standard Specifications (OPSS).PROV 1010, compacted to at least 98% of the material's Standard Proctor maximum dry density (SPMDD) to act as a capillary break. The granular base should be placed on competent undisturbed subgrade cleared of all deleterious material (i.e., disturbed soil, organic material, debris) and free water.

A moisture barrier such as polyethylene sheeting could be placed beneath the floor slab to inhibit moisture migration. The placement of a polyethylene vapour barrier on top of the Granular 'A' to provide a capillary break is at the discretion of the structural engineer and architect, as this may not be a requirement for a car parking structure but may have implications on slab curing and certain floor finishes are more sensitive to moisture diffusion through the slab

than others. The vapour barrier, if installed, may be covered with a minimum of 50 mm of uniform sand to promote more uniform curing of the concrete along the base of the slab and to protect the vapour barrier against construction traffic.

To minimize localized cracking due to potential differential settlement, all floor slabs should be adequately reinforced. The potential for cracking can be further reduced by using a liberal jointing pattern and structural separations at walls and columns.

Where, lightly loaded concrete masonry (CMU) block walls are to be constructed inside the building, these walls should not be structurally related to the slab-on-grade and could be installed on separate interior strip footings with attention to the comments/recommendations provided in Section 4.3.1 (Conventional Spread/Strip Footings). Supporting such CMU block walls on the slab-on-grade (thickened locally under the CMU block wall) is not recommended as settlement of such structures differ from the settlement of the slab-on-grade.

For the structural design of the concrete slab-on-grade, a combined modulus of subgrade / granular base reaction coefficient (k) of 40 MPa/m can be used.

## 4.5 Lateral Earth Pressures

Structures subject to unbalanced earth pressures such as shoring systems, retaining walls and other similar structures should be designed to resist the lateral earth pressures. If required and depending on the type of shoring used during construction, the temporary shoring system for excavation support can be designed for the lateral earth pressures given in Sections 26.8, 26.9, and 26.10 of the Canadian Foundation Engineering Manual (CFEM) - 4th Edition. Surcharge loads and hydrostatic pressures should be considered as appropriate. The following table summarizes the recommended soil parameters to be used for lateral earth pressure calculations at this Site:

*Table 4.2 Lateral Earth Pressures*

| Soil Type | Bulk Unit Weight | Effective Angle of Internal Friction (º) | Coefficient of Lateral Earth Pressure | | |
|---|---|---|---|---|---|
| | $\gamma$ (kN/m$^3$) | $\phi$' | $K_a$ | $K_o$ | $K_p$ |
| Fill / disturbed soil | 19 | 25° | 0.40 | 0.58 | 2.46 |
| Silty Sand | 20 | 30° | 0.33 | 0.50 | 3.00 |
| Gravelly Sand | 20 | 32 | 0.31 | 0.47 | 3.25 |
| Bedrock | 26 | N/A | N/A | N/A | N/A |

It is to be noted that large deformation will be required prior to the full mobilization of passive earth pressure and mobilization of full active or passive resistance requires a measurable and significant movement of soil retaining structure or its rotation. Therefore, unless the structural element can tolerate these deflections, the at-rest earth pressure should be used in design. Where movement sensitive services exist close to the shoring, the lateral pressure should be computed using the coefficient of earth pressure at rest, $K_0$.

## 4.6 Seismic Site Classification

The latest Ontario Building Code (OBC) requires the assignment of a Seismic Site Class for calculations of earthquake design forces and the structural design based on a two percent probability of exceedance in 50 years. According to the latest OBC, the Seismic Site Class is a function of soil profile and is based on the average properties of the subsoil strata to a depth of 30 m below the ground surface. The OBC provides the following three methods to obtain the average properties for the top 30 m of the subsoil strata:

– Average shear wave velocity.
– Average Standard Penetration Test (SPT) values (uncorrected for overburden).
– Average undrained shear strength.

Based on the results of this investigation, the Site can be classified as Class 'B' (Very Dense Soil and Soft Rock) for seismic load calculations subjected to code requirements.

## 4.7 Geophysical Survey

A geophysical survey was undertaken on July 4th, 2022 and completed August 2nd, 2022. The survey was conducted within the footprint area of the proposed parking garage and the eastern portion of the land currently occupied by an existing parking lot. The findings of the geophysical survey are:

– Fourteen (14) TDEM linear anomalies were detected and were only detected by the TDEM Equipment.
– Four (4) GPR linear anomalies were detected and were only detected by the GPR Equipment.
– Seven (7) linear anomalies were detected by both the TDEM and GPR Equipment.
– Two (2) TDEM zones of elevated Channel 3 data were detected but not detected by the GPR equipment.

The geophysical survey reports are provided in **Appendix E**.

## 4.8 Depth of Frost Penetration

The design depth of frost penetration in the area is 1.8 m as per the OPSD 3090.101. A permanent soil cover of 1.8 m or its thermal equivalent synthetic insulation is required for frost protection of foundations (foundations in unheated areas). During winter construction, exposed surfaces to support foundations must be protected against freezing by means of loose straw and tarpaulins.

The depth of frost penetration is also defined as the zone of active weathering where sizeable variations in the moisture content accompany the yearly temperature fluctuations. Therefore, the foundation grades should be established at or below this depth. For the light poles and other light structures that are to be installed on a single footing, if some frost heave (25 mm to 50 mm) cannot be tolerated, the foundation elements should also be provided with the above noted minimum depth of soil cover or equivalent exterior-grade insulation.

## 4.9 Pavement Design

Boreholes BH1-21, BH2-21, BH19-22, and MW20-22 have been drilled within the asphaltic pavement areas outside of the footprint of the proposed structure and provide the geotechnical data on the existing pavement structure at the Site.

The following pavement design recommendations are provided for the entrance/exit driveway for the proposed parking garage.

### 4.9.1 Pavement Design

Earth fill consisting primarily of gravelly sand to sandy gravel was encountered immediately beneath the asphaltic concrete ground cover in both drilled boreholes. The gravelly sand to sandy gravel extended to depths of 0.7 to 1.1 mBGS and were underlain by granular materials that were inferred to be the residual soil remaining from the highly weathered bedrock. The gravelly sand to sandy gravel is suitable to support for the entrance/exit driveway pavements for the proposed parking garage provided that proper compaction is applied during construction. The excavated earth fill materials can be reused as engineered fill provided it is free of any deleterious materials.

It is recommended that any subgrade comprising of existing fill be inspected for obvious soft/loose areas and presence of deleterious materials. Should such areas be found, GHD can provide appropriate advice for replacement of the material and addressing local weak areas at that time.

Engineered fill to raise the grade can consist of select excavated fill provided the soil is free of any deleterious materials. The fill should be placed in large areas where it can be compacted by a heavy roller. Any fill placed to increase or level the grade must be compacted to a minimum 98 percent of its SPMDD in lifts not exceeding 150 mm.

In-situ density testing to monitor the effectiveness of the compaction equipment in achieving the required densities is also recommended.

The most severe loading conditions on pavement areas and the subgrade may occur during construction. Consequently, special provisions such as end dumping and forward spreading of sub-base fills, restricted construction lanes, and half-loads during paving may be required, especially if construction is carried out during inclement weather conditions.

## 4.9.2 Recommended Pavement Structure

The flexible pavement design presented in the table below is recommended for the design of the entrance/exit driveway to the proposed parking garage, should a flexible pavement structure design be preferred.

*Table 4.3 Flexible Pavement Design*

| Pavement Layer | Compaction Requirements | Heavy Duty Pavement Design (Parking Garage Driveway) |
|---|---|---|
| Surface Course Asphaltic Concrete<br>HL3 (OPSS 1150) | 91% to 96.5% Maximum Relative Density (OPSS 310) | 40 mm |
| Base Course Asphaltic Concrete<br>HL8 (OPSS 1150) | 92% to 97.5% Maximum Relative Density (OPSS 310) | 80 mm |
| Base Course:<br>Granular 'A' or 19mm Crusher Run (OPSS1010) | 100% Standard Proctor Maximum Dry Density | 150 mm |
| Sub-base Course:<br>Granular B or 50mm Crusher Run (OPSS1010) | 98% Standard Proctor Maximum Dry Density | 350 mm |

It is recommended that a tack coat be applied on the asphalt base course to ensure proper bonding of the asphalt surface and base courses.

The following table summarizes the rigid pavement structures recommended for the design of the entrance/exit driveway to the proposed parking garage, should a rigid pavement structure design be preferred.

*Table 4.4 Rigid Pavement Design*

| Pavement Layer | Compaction Requirements | Rigid Pavement Design |
|---|---|---|
| Jointed Plan Concrete Pavement | N/A | 200 mm |
| Base Course:<br>Granular 'A' or 19mm Crusher Run (OPSS1010) | 100% Standard Proctor Maximum Dry Density | 150 mm |
| Sub-base Course:<br>Granular B or 50mm Crusher Run (OPSS1010) | 98% Standard Proctor Maximum Dry Density | 250 mm |

The pavement design considers that construction will be carried out during dry months, at the appropriate above-freezing temperatures, and that the subgrade is stable under construction equipment loadings. If construction is carried out during wet weather, additional thickness of granular materials, geo-grid reinforcement or a combination of the two may be required. The requirement for additional granular materials and/or utilization of geo-grids is best determined during construction under the direction of the geotechnical engineer of record.

### 4.9.3 Drainage

Grading adjacent to pavement areas should be designed so that water is not allowed to pond adjacent to the outside edges of the pavement. Also, the pavement subgrade should be free of depressions and sloped (preferably at a minimum grade of two percent) to provide effective drainage toward the edge of pavement or toward catch-basins if they are utilized. A subdrain should be placed in the up-gradient direction of all catch basins to allow for any water ponded on the subgrade surface to drain. The subdrain should be a 150 mm diameter perforated pipe, 3 m long, placed in a 0.3 m by 0.3 m trench notched into the subgrade, and backfilled with granular materials.

Good drainage in this area will ensure long term performance of flexible pavements.

# 5. Construction Considerations

## 5.1 Excavation and Temporary Shoring

The Occupational Health and Safety Act (OHSA) regulations require that if workmen must enter an unsupported excavation deeper than 1.2 m, the excavation must be suitably sloped and/or braced in accordance with the OHSA requirements. OHSA specifies maximum slope of the excavations for four broad soil types as summarized in the following table:

*Table 5.1 OHSA Excavation Recommendations*

| Soil Type | Base of Slope | Maximum Slope Inclination |
|---|---|---|
| 1 | Within 1.2 m of bottom | 1 horizontal to 1 vertical |
| 2 | Within 1.2 m of bottom of trench | 1 horizontal to 1 vertical |
| 3 | From bottom of excavation | 1 horizontal to 1 vertical |
| 4 | From bottom of excavation | 3 horizontal to 1 vertical |

Trench and foundation excavations should be carried out in strict conformance to the current Occupational Health and Safety Act (OHSA). For the purpose of interpreting the act, the fill and native soils within the Site above the groundwater table can be classified as Type 3 soils. If affected by groundwater seepage, the fill and native soils can be considered as Type 4 soils. The highest number soil type identified in an excavation must govern the excavation slopes from top to bottom of the excavation.

If the above recommended excavation side slopes cannot be maintained due to lack of space or any other reason, the excavation side walls must be supported by an engineered shoring system. The shoring system should be designed in accordance with Canadian Engineering Foundation Manual (4th Edition) and the OHSA Regulations for Construction Projects.

If a shoring system is selected to support the excavation walls, it is recommended that the expertise of an experienced shoring contractor be retained during selection of a shoring approach. It is also recommended that the shoring system required to stabilize the excavation sidewalls during construction be developed by the general and shoring contractors. Further recommendations for shoring may be required depending on the type of shoring system selected for this project.

It is anticipated that shallow foundation and utility excavations within the overburden can be made with conventional equipment. Cobbles and boulders should be expected within the overburden, and the contract should allow for the removal of construction cobbles and boulders.

If the excavation extends to the underlying shale bedrock, and where required, the bedrock may be removed with a larger excavator equipped with a ‘V’ shaped bucket equipped with a ripper and/or hoe ram. Excavation into the upper

bedrock should be carried out with consideration of the side slopes as provided in the above-noted table, while where moderately weathered or sound bedrock is encountered, excavations can be carried out at or near vertical faces.

The bedrock exposed in the excavation may degrade as it is exposed or if it becomes wet. As such, the bedrock may ravel over time if it is not protected. It recommended that exposed bedrock be protected (i.e. applying shotcrete) from weathering or deterioration if the excavation is to be left open for a long period of time. The selection of the excavation equipment to be used into the bedrock is the contractor's responsibility.

Blasting may not be permitted by the municipality and rock excavation may be carried out using mechanical equipment as stated above. However, blasting may be carried out in compliance with existing provincial environmental guideline limits with respect to ground and air vibration. The blasting operations should be carried out by an experienced contractor and ensuring that the ground and air vibration levels produced during blasting operations are within the recommended provincial guideline limits. The selection and implementation of this excavation option (blasting) is the contractor's responsibility. Vibration monitoring of the adjacent utilities and structures is recommended during excavation if a blasting option is selected.

## 5.2 Temporary Ground Water Control

Based on the January 28, 2021 to August 24, 2021 monitoring events, the groundwater levels in the installed monitoring wells ranged from approximately 1.7 to 3.1 mBGS, and the groundwater elevations range from approximately 78.7 to 80.5 mAMSL.

The amount of seepage into excavations will depend on the depth of excavation relative to the groundwater level at the time of construction and the hydraulic conductivity of the excavated materials. It is expected that seepage rate into the excavation within the native granular deposits and the upper parts of the weathered bedrock will be moderate to high. If the excavation is to be above the groundwater table, moderate to high groundwater ingress can readily be handled by installation of sumps and pumps at strategic locations at the base of excavation. If the excavation is to be extended to a greater depths below local groundwater table, an active pre-construction dewatering system such as well points may be required depending on the depth and size of excavations.

It is noted that groundwater seepage into the excavation may be most pronounced near the interface between the overburden and the bedrock and through the upper fractured zones of the bedrock. Vertical excavations through the bedrock may require some protection (i.e., shotcrete) for safety and stability of the walls that may also greatly reduce the rates of water seepage into the excavations. Please refer to the Hydrogeological Assessment Report prepared by GHD for this Site, which is provided under a separate cover.

For deep excavations, where required, it is recommended that the groundwater level be maintained at least 0.5 m below the base of excavation to provide dry and stable/safe condition. A dewatering specialist should be consulted to determine the most appropriate measures to be undertaken to sufficiently lower the groundwater table below the lowest excavation depth. The possibility of settlement from the dewatering should be part of the methodology considerations.

## 5.3 Suitability of On-Site Soils

The ground cover and any earth fill materials found to contain significant amounts of deleterious materials should be removed and should not be used as backfill in settlement sensitive areas.

The earth fill/disturbed soils and native soils encountered at the Site may be suitable for reuse as backfill to raise site grades (where required) or to be used as backfill against foundations or as trench backfill during installation of buried services, provided the material is free of organic material or other deleterious materials and is within the optimum moisture content.

It should be anticipated that reworking of the soils will be necessary to facilitate compaction through drying, wetting, and use of vibratory roller compactors. Control of moisture content during placement and compaction will also be essential for maintaining adequate compaction. If any materials are found to be wet, they may be left aside to dry, or

mixed with drier material that is to be used as backfill. All backfill materials should be placed in thin layers (150 mm thick or less) and compacted by a heavy smooth type roller to 98 percent SPMDD.

It is believed that the moderately weathered bedrock generated at the Site may not be reused as a backfill, because of the difficulties associated with breaking the intact rock fragments down, moisture conditioning, and compaction.

All backfill operations and materials should be inspected and tested by qualified geotechnical personnel to confirm that proper material is utilized, and that adequate compaction is attained.

## 5.4 Site Servicing

The native soils encountered at the Site are considered suitable to support the proposed Site services. Consideration could also be given to installing Site services within the existing fill, subject to an engineering inspection and approval by qualified geotechnical engineer for all bearing surfaces. The suitability of the subgrade to provide adequate support for buried services must be verified and confirmed on site by qualified geotechnical personnel experienced in such works.

The subgrade soils used to support the service pipes, should be visually inspected. Wet, loose, or otherwise unsuitable fills should be sub-excavated and replaced with bedding materials or clean fills compacted to minimum of 95% SPMDD.

The bedding for trenched (open cut) services should consist of well graded materials meeting City of Ottawa specifications. The bedding should have a minimum thickness of 150 mm below the pipe and 300 mm above and adjacent to the pipe and should comply with the City of Ottawa Standards. The bedding and cover materials should be compacted to a minimum of 95 percent SPMDD to provide support and protection to the service pipes.

Where wet conditions are encountered, the use of 'clear stone' bedding (such as 19 mm clear stone, OPSS.PROV 1004 - Aggregates) may be considered, only in conjunction with a suitable geotextile filter. Without proper filtering, there may be entry of fines from the existing fill or native soils and trench backfill into the bedding. This loss of fine soil particles could result in loss of support to the pipes and possible surface settlements.

## 5.5 Soil Corrosivity Potential

Corrosivity testing was conducted on eight (8) select samples from the previous investigation extracted from boreholes BH4-21, MW7-21, BH7-21, MW8-21, BH11-22, BH16-22, BH17-22, and MW09-22 in accordance with ASTM and CSA Standards. The results were compared with CSA A23.1 Standards to determine the potential of sulphate attack on concrete and with the American Water Works Association (AWWA) C105 to assess soil corrosivity potential of ductile iron pipes and fittings. Corrosivity testing as described by the American Water Works Association (AWWA) includes soil resistivity, pH, sulphide indication, redox potential, and moisture content. Points are assigned to the sample based on the results of the test. A soil that has a total point score of 10 or more is considered to be potentially corrosive to ductile iron pipe. The potential for sulphate attack on concrete (class of exposure) is determined using Table 3 provided in CSA A23.1. All samples were placed into laboratory-supplied containers, labeled and submitted under chain-of-custody protocol to AGAT and ALS. Analytical results received from the laboratory are provided in **Appendix D**.

The following table summarizes the laboratory test results for the eight (8) soil samples collected from the boreholes to assess soil potential for sulphate attack on concrete structures:

*Table 5.2 Soil Corrosivity Assessment as per the CSA A23.1 Standards*

| Borehole No. | Sample Depth (m) | Sulphate (%) | Class of Exposure (Ref. Table 3 of CSA A23.1) | Potential for Sulphate Attack (Ref. Table 3 of CSA A23.1) |
|---|---|---|---|---|
| BH4-21 SS2 | 0.7-1.0 | 0.0439 | Below S-3 | Negligible |
| MW6-21 SS2 | 0.7-1.0 | 0.0395 | Below S-3 | Negligible |
| BH7-21 SS2 | 0.7-1.0 | 0.0006 | Below S-3 | Negligible |
| MW8-21 SS2 | 1.1-1.3 | 0.0195 | Below S-3 | Negligible |
| BH11-22 SS2 | 0.6 – 0.9 | 0.0219 | Below S-3 | Negligible |
| BH16-22 SS2 | 0.6 – 1.2 | 0.0116 | Below S-3 | Negligible |
| BH17-22 SS2 | 0.7 – 1.1 | 0.0094 | Below S-3 | Negligible |
| MW09-22 SS2 | 0.3 – 0.9 | 0.65 | S-2 | Severe |

The results of sulphate ion content analysis indicate that the tested soil samples contain low levels of sulphate ion which are below the class of exposure levels outlined in CSA A23.1 with the exception of MW09-22 in which the collected sample had a class exposure of S-2 resulting in a severe potential for surface attack Additionally, the results of the corrosivity testing at the 1D4C site indicate that the majority of the tested soil/rock samples contain low levels of sulphate ion, which are below the class of exposure levels outlined in CSA A23.1 with the exception of one sample from the weathered shale bedrock. Based on the results from both sites, special cement mixtures such as moderate sulphate-resistant cement (MS) or high-sulphate cement (HS) will likely be required to provide protection against sulphate attack.

In regard to soil corrosivity potential against ductile iron pipes and fittings, it is noted that sulfide analysis presented in AWWA is a qualitative test where a positive, trace, or negative determination is based on the presence of bubbles as a result of a chemical reaction. Such testing has not been conducted as AGAT defines sulfides concentration that is unrelated to the scale provided by AWWA. As a result, it was assumed that the result was positive and a maximum score of 3.5 was selected (most conservative assumption). Also, for moisture content determination, the value obtained from the conducted laboratory tests were used for this analysis and soil poor drainage condition has been considered to obtain more conservative values. The table below summarizes the ANSI/AWWA rating of the tested soil/rock samples on their potential for corrosion towards buried ductile cast iron pipes/fittings. A score of ten (10) points or more indicates the soil is corrosive to ductile iron pipes and protection will be needed.

*Table 5.3 Soil Corrosivity Assessment as per the AWWA Standards*

| Borehole No. | | Parameters | | | | | Total Points | Corrosivity Potential |
|---|---|---|---|---|---|---|---|---|
| | Sample depth (m) | Resistivity (ohm/cm) | pH | Redox Potential (mV) | Moisture | Sulfides | | |
| BH4-21 SS2 | 0.7-1.0 | 826/10 | 6.35/0 | 435/0 | Wet/2 | Positive/3.5 | 15.5 | Yes |
| MW6-21 SS2 | 0.7-1.0 | 1070/10 | 7.4/0 | 393/0 | Wet/2 | Positive/3.5 | 15.5 | Yes |
| BH7-21 SS2 | 0.7-1.0 | 6130/0 | 7.23/0 | 420/0 | Wet/2 | Positive/3.5 | 5.5 | No |
| MW8-21 SS2 | 1.1-1.3 | 714/10 | 7.95/0 | 378/0 | Wet/2 | Positive/3.5 | 15.5 | Yes |
| BH11-22 SS2 | 0.6 – 0.9 | 390/10 | 7.28/0 | 393/0 | Wet/2 | Positive/3.5 | 15.5 | Yes |

| Borehole No. | | Parameters | | | | | Total Points | Corrosivity Potential |
|---|---|---|---|---|---|---|---|---|
| | Sample depth (m) | Resistivity (ohm/cm) | pH | Redox Potential (mV) | Moisture | Sulfides | | |
| BH16-22 SS2 | 0.6 – 1.2 | 2320/2 | 7.9/0 | 354/0 | Wet/2 | Positive/3.5 | 7.5 | No |
| BH17-22 SS2 | 0.7 – 1.1 | 1610/8 | 7.5/0 | 350/0 | Wet/2 | Positive/3.5 | 13.5 | Yes |
| MW09-22 SS2 | 0.3 – 0.9 | 180/10 | 6.8/0 | 371/0 | Wet/2 | Positive/3.5 | 15.5 | Yes |

Based on the results obtained for the samples submitted, the total points ranged between 5.5 and 15.5 and the results indicate that special provisions, such as polyethylene sheeting, will be required for corrosion protection of any metallic pipe components at this Site.

# 6. Limitations of the Investigation

This report is intended solely for Ontario Infrastructure and Lands Corporation and their designer and is prohibited for use by others without GHD's prior written consent. This report is considered GHD's professional work product and shall remain the sole property of GHD. Any unauthorized reuse, redistribution of or reliance on the report shall be at the Client and recipient's sole risk, without liability to GHD. No portion of this report may be used as a separate entity; it is to be read in its entirety and shall include all supporting drawings and appendices.

The recommendations made in this report are in accordance with our present understanding of the project, the current site use, ground surface elevation and conditions, and are based on the work scope approved by the Client and described in the report. The services were performed in a manner consistent with that level of care and skill ordinarily exercised by members of geotechnical engineering professions currently practicing under similar conditions in the same locality. No other representations, and no warranties or representations of any kind, either expressed or implied, are made. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties.

All details of design and construction are rarely known at the time of completion of a geotechnical study. The recommendations and comments made in the study report are based on our subsurface investigation and resulting understanding of the project, as defined at the time of the study. We should be retained to review our recommendations when the drawings and specifications are complete. Without this review, GHD will not be liable for any misunderstanding of our recommendations or their application and adaptation into the final design.

By issuing this report, GHD is the geotechnical engineer of record. It is recommended that GHD be retained during construction of all foundations and during earthwork operations to confirm the conditions of the subsoil are actually similar to those observed during our study. The intent of this requirement is to verify that conditions encountered during construction are consistent with the findings in the report and that inherent knowledge developed as part of our study is correctly carried forward to the construction phases.

It is important to emphasize that a soil investigation is, in fact, a random sampling of a site and the comments included in this report are based on the results obtained at the test locations only. The subsurface conditions confirmed at the test locations may vary at other locations. The subsurface conditions can also be significantly modified by the construction activities on site (e.g., excavation, dewatering and drainage, blasting, pile driving, etc.). These conditions can also be modified by exposure of soils or bedrock to humidity, dry periods or frost. Soil and groundwater conditions between and beyond the test locations may differ both horizontally and vertically from those encountered at the test locations and conditions may become apparent during construction which could not be detected or anticipated at the time of our investigation. Should any conditions at the site be encountered which differ from those found at the test

locations, we request that we be notified immediately in order to permit a reassessment of our recommendations. If changed conditions are identified during construction, no matter how minor, the recommendations in this report shall be considered invalid until sufficient review and written assessment of said conditions by GHD is completed.

All of Which is Respectfully Submitted,

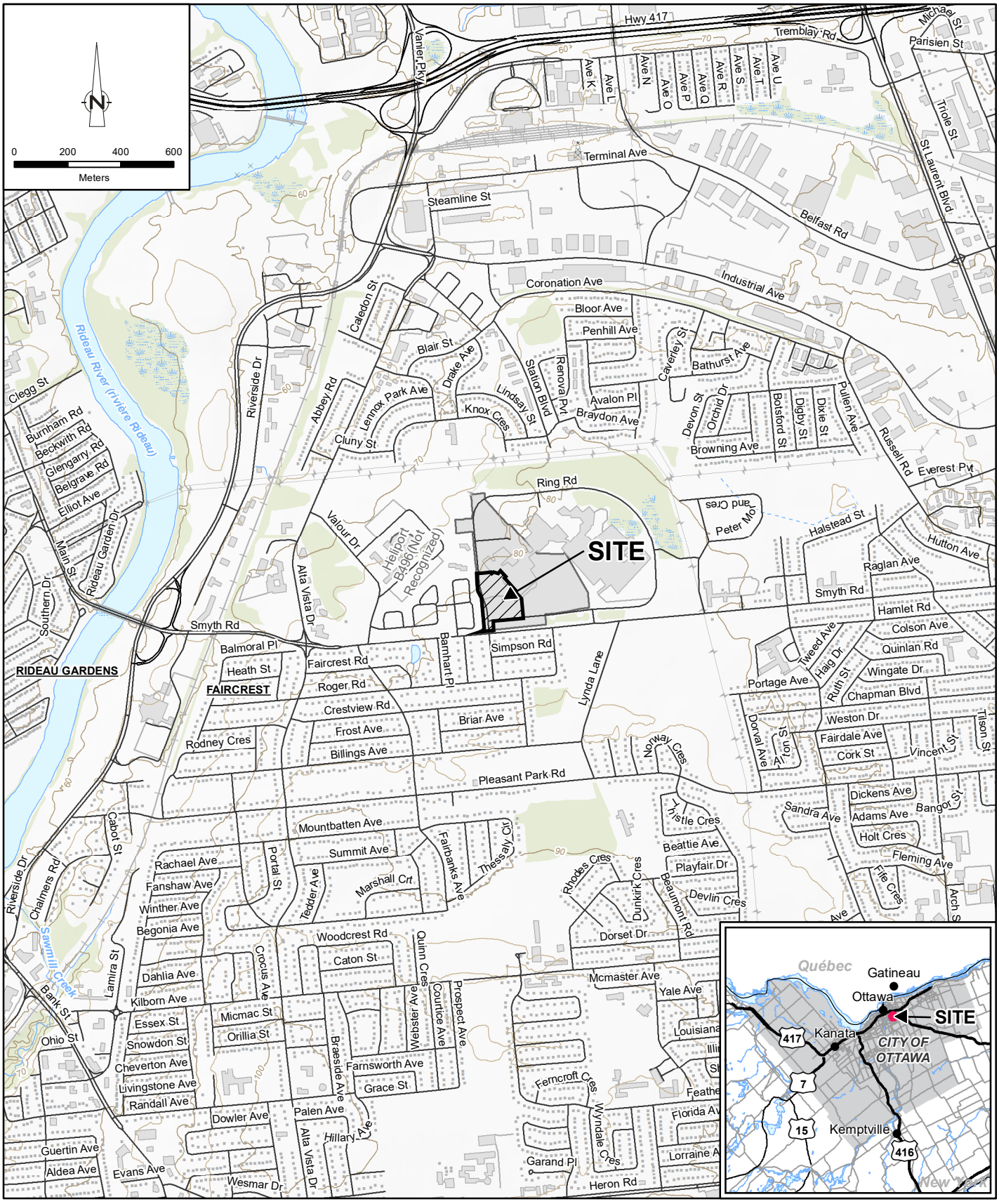
GHD

Brice Zanne, M.Eng., EIT
Geotechnical Engineer

Lewis Wong, M.Sc., P.Eng.
Senior Pavement Engineer


Nikol Kochmanová, PH.D., P. Eng., PMP
Senior Geotechnical Engineer

# Figures

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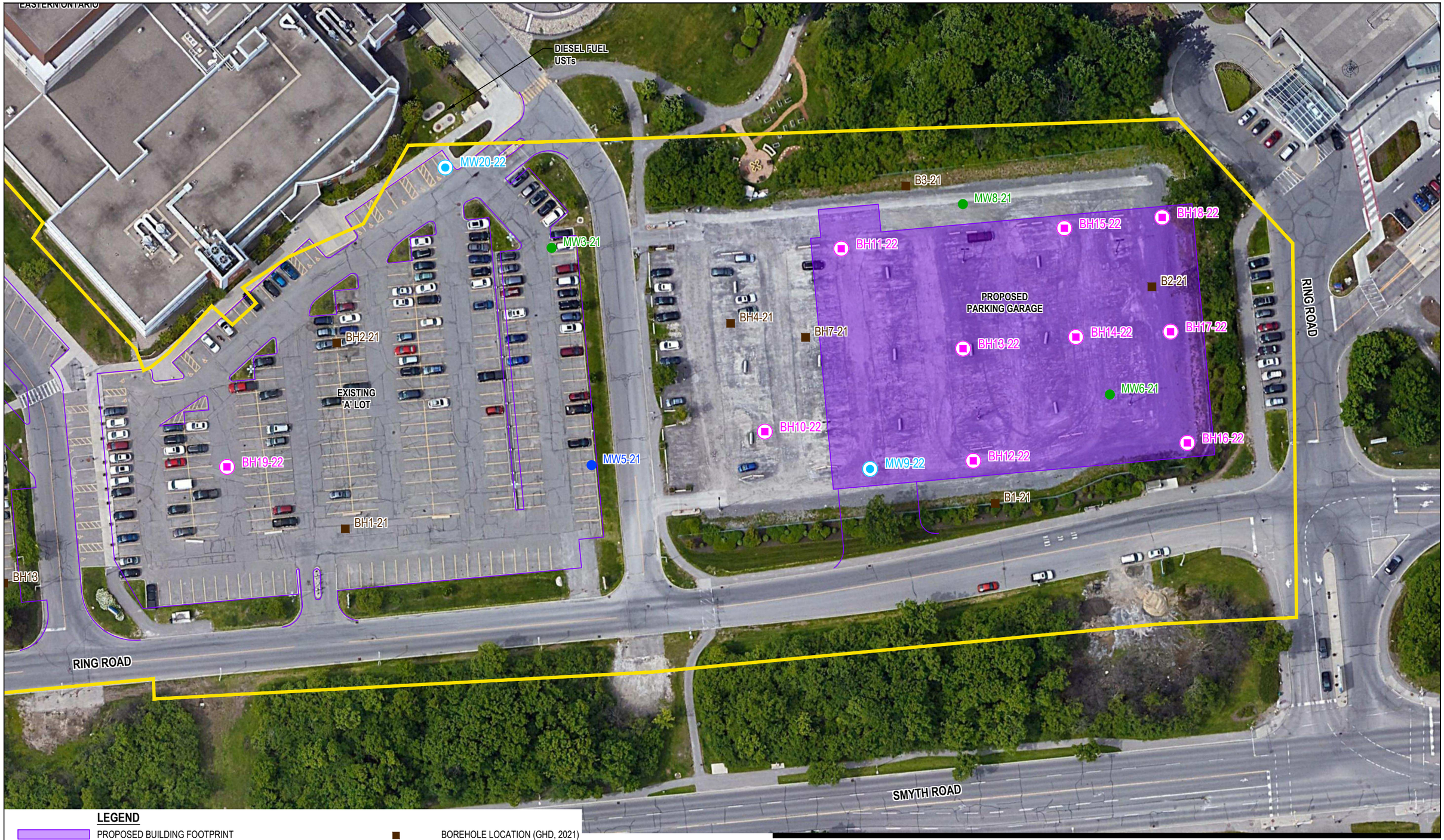
CHILDREN'S HOSPITAL OF EASTERN ONTARIO CAMPUS
401 & 407 SMYTH ROAD, OTTAWA, ONTARIO
PROPOSED 1DOOR4CARE FACILITY

11205379-15
Sept 2, 2022

# SITE LOCATION MAP

FIGURE 1

GIS File: Q:\GIS\PROJECTS\11205000s\11205379\Layouts\001\11205379-01(001)GIS-WA001.mxd




## LEGEND

- PROPOSED BUILDING FOOTPRINT
- PROPOSED PARKING AREA OR SITE FEATURE
- PROPOSED PROJECT AREA FOR SITE DUE DILIGENCE BOUNDARY
- BOREHOLE LOCATION (GHD, 2022)
- SHALLOW OVERBURDEN/BEDROCK MONITORING WELL LOCATION (GHD, 2022)
- BOREHOLE LOCATION (GHD, 2021)
- DEEP BEDROCK MONITORING WELL LOCATION (GHD, 2020-21)
- SHALLOW OVERBURDEN/BEDROCK MONITORING WELL LOCATION (GHD, 2020-21)

0 8 16 24m

1:800

Coordinate System:
NAD 83 UTM ZONE 18
METRES

N

GHD

**PROPOSED PARKING GARAGE**
**CHILDREN'S HOSPITAL OF EASTERN ONTARIO CAMPUS**
**401 & 407 SMYTH ROAD, OTTAWA, ONTARIO**

**INVESTIGATIVE LOCATION PLAN**

Project No. **11205379**
Date **September 2022**

# FIGURE 2

Filename: \\ghdnet\ghd\CA\Toronto\Projects\662\11205379\Digital_Design\ACAD 2018\Figures\RPT015\11205379-GHD-00-00-RPT-EN-D101_WA-015.dwg
Plot Date: 02 September 2022 8:28 AM

Data Sources: SURVEY BY J.D. BARNES LIMITED, DECEMBER 19, 2019. (UTM18-NAD83).
CHEO, 1DOORFOR4CARE (1D4C), SITE PLAN - PHASE 1A, Solic. No: 2111095, Date: 02/20/22.

# Tables

**Table 1a**

**Summary of Groundwater Levels (mBGS)**
**Preliminary Geotechnical Investigation**
**Proposed Parking Structure**
**Children's Hospital of Eastern Ontario Campus**
**401 Smyth Road, Ottawa, Ontario**

| | MW3-21 | MW5-21 | MW6-21 | MW8-21 |
|---|---|---|---|---|
| **Top of Riser (mAMSL)** | 81.227 | 81.737 | 82.072 | 82.095 |
| **Ground Surface (mAMSL)** | 81.369 | 81.825 | 82.17 | 82.2 |
| 28-Jan-21 | 2.69 | - | 2.97 | 2.03 |
| 2-Feb-21 | 2.69 | - | 2.98 | 2.03 |
| 10-Feb-21 | 2.49 | - | 3.09 | 2.09 |
| 23-Apr-21 | 2.62 | - | 2.96 | 1.67 |
| 24-Aug-21 | 2.69 | 1.79 | 3.09 | 1.71 |

Notes:

| | |
|---|---|
| - | Dry |
| mBGS | metres below ground surface |
| mAMSL | metres above mean sea level |

**Table 1b**

**Summary of Groundwater Elevation (mAMSL)**
**Preliminary Geotechnical Investigation**
**Proposed Parking Structure**
**Children's Hospital of Eastern Ontario Campus**
**401 Smyth Road, Ottawa, Ontario**

| | MW3-21 | MW5-21 | MW6-21 | MW8-21 |
|---|---|---|---|---|
| **Top of Riser (mAMSL)** | 81.227 | 81.737 | 82.072 | 82.095 |
| **Ground Surface (mAMSL)** | 81.369 | 81.825 | 82.17 | 82.2 |
| 28-Jan-21 | 78.68 | - | 79.20 | 80.18 |
| 2-Feb-21 | 78.68 | - | 79.19 | 80.18 |
| 10-Feb-21 | 78.88 | - | 79.08 | 80.11 |
| 23-Apr-21 | 78.75 | - | 79.21 | 80.53 |
| 24-Aug-21 | 78.68 | 80.04 | 79.08 | 80.50 |

Notes:

| | |
|---|---|
| - | Dry |
| mBGS | metres below ground surface |
| mAMSL | metres above mean sea level |

# Appendices

# Appendix A

## Record of Boreholes

# Notes on Borehole and Test Pit Reports

**Soil description :**

Each subsurface stratum is described using the following terminology. The relative density of granular soils is determined by the Standard Penetration Index ("N" value), while the consistency of clayey sols is measured by the value of undrained shear strength (Cu).

**Classification** (Unified system)

| | | | |
|---|---|---|---|
| Clay | < 0.002 mm | | |
| Silt | 0.002 to 0.075 mm | | |
| Sand | 0.075 to 4.75 mm | fine | 0.075 to 4.25 mm |
| | | medium | 0.425 to 2.0 mm |
| | | coarse | 2.0 to 4.75 mm |
| Gravel | 4.75 to 75 mm | fine | 4.75 to 19 mm |
| | | coarse | 19 to 75 mm |
| Cobbles | 75 to 300 mm | | |
| Boulders | >300 mm | | |

**Terminology**

| | |
|---|---|
| "trace" | 1-10% |
| "some" | 10-20% |
| adjective (silty, sandy) | 20-35% |
| "and" | 35-50% |

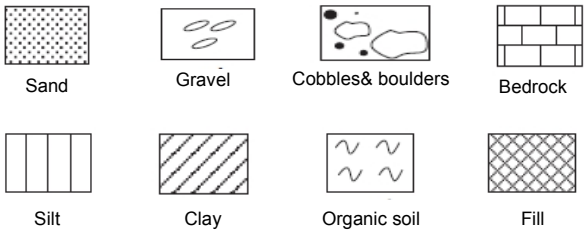
| Relative density of granular soils | Standard penetration index "N" value (BLOWS/ft – 300 mm) |
|---|---|
| Very loose | 0-4 |
| Loose | 4-10 |
| Compact | 10-30 |
| Dense | 30-50 |
| Very dense | >50 |

| Consistency of cohesive soils | Undrained shear strength (Cu) (P.S.F) | (kPa) |
|---|---|---|
| Very soft | <250 | <12 |
| Soft | 250-500 | 12-25 |
| Firm | 500-1000 | 25-50 |
| Stiff | 1000-2000 | 50-100 |
| Very stiff | 2000-4000 | 100-200 |
| Hard | >4000 | >200 |

**Rock quality designation**

| "RQD" (%) Value | Quality |
|---|---|
| <25 | Very poor |
| 25-50 | Poor |
| 50-75 | Fair |
| 75-90 | Good |
| >90 | Excellent |

**STRATIGRAPHIC LEGEND**




**Samples:**

**Type and Number**

The type of sample recovered is shown on the log by the abbreviation listed hereafter. The numbering of samples is sequential for each type of sample.

SS: Split spoon
ST: Shelby tube
AG: Auger
SSE, GSE, AGE: Environmental sampling
PS: Piston sample (Osterberg)
RC: Rock core
GS: Grab sample

**Recovery**

The recovery, shown as a percentage, is the ratio of length of the sample obtained to the distance the sampler was driven/pushed into the soil

**RQD**

The "Rock Quality Designation" or "RQD" value, expressed as percentage, is the ratio of the total length of all core fragments of 4 inches (10 cm) or more to the total length of the run.

**IN-SITU TESTS:**

N: Standard penetration index
R: Refusal to penetration
$N_c$: Dynamic cone penetration index
Cu: Undrained shear strength
Pr: Pressure meter
k: Permeability
ABS: Absorption (Packer test)

**LABORATORY TESTS:**

$I_p$: Plasticity index
$W_l$: Liquid limit
Wp: Plastic limit
H: Hydrometer analysis
GSA: Grain size analysis
A: Atterberg limits
w: Water content
γ: Unit weight
C: Consolidation
CS: Swedish fall cone
CHEM: Chemical analysis
O.V.: Organic vapor

## Explanation of Terms Used in the Bedrock Core Log

**Strength (ISRM)**

| Terms | Grade | Description | Unconfined Compressive Strength (MPa) | (psf) |
|---|---|---|---|---|
| Extremely Weak Rock | RQ | Indented by thumbnail | 0.25-1.0 | 36-145 |
| Very Weak | R1 | Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife. | 1.0-5.0 | 145-725 |
| Weak Rock | R2 | Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer. | 5.0-25 | 725-3625 |
| Medium Strong | R3 | Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer. | 25-50 | 3625-7250 |
| Strong Rock | R4 | Specimen requires more than one blow of geological hammer to fracture it. | 50-100 | 7250-14500 |
| Very strong Rock | R5 | Specimen requires many blows of geological hammer to fracture it. | 100-250 | 14500-36250 |
| Extremely Strong Rock | R6 | Specimen can only be chipped with geological hammer. | >250 | >36250 |

**Bedding (Geological Society Eng. Group Working Party, 1970, Q.J. of Eng. Geol. Vol 3)**

| Term | Bed Thickness | |
|---|---|---|
| Very thickly bedded | >2 m | >6.5 ft. |
| Thickly bedded | 600 mm-2 m | 2.00-6.50 ft. |
| Medium bedded | 200 mm-600 mm | 0.65-2.00 ft. |
| Thinly bedded | 60 mm-200 mm | 0.20-0.65 ft. |
| Very thinly bedded | 20 mm-60 mm | 0.06-0.20 ft. |
| Laminated | 6 mm-20 mm | 0.02-0.06 ft. |
| Thinly laminated | <6 mm | <0.02 ft. |

**TCR (Total Core Recovery)**

Sum of lengths of rock core recovered from a core run, divided by the length of the core rum and expressed as a percentage

**SCR (Solid Core Recover)**

Sum length of solid full diameter drill core recovered expressed as a percentage of the total length of the core run.

## Explanation of Terms Used in the Bedrock Core Log

**Weathering (ISRM)**

| Terms | Grade | Description |
|---|---|---|
| Fresh | W1 | No visible sign of rock material weathering. |
| Slightly | W2 | Discolouration indicates weathering of rock weathered material and discontinuity surfaces. All the rock material may be discoloured by weathering and may be somewhat weaker than in its fresh condition. |
| Moderately | W3 | Less than half of the rock material is weathered decomposed and/or disintegrated a soil. Fresh or discoloured rock is present either as a corestone. |
| Highly Weathered | W4 | More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a continuous framework or as corestones. |
| Completely Weathered | W5 | All rock material is decomposed and/or disintegrated to a soil. The original mass structure is still largely intact. |
| Residual Soil | W6 | All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has been significantly transported. |

**ROD (Rock Quality Designation, after Deere, 1968)**

Sum of lengths of pieces of rock core measured along centerline of core equal to or greater than 100 mm from a core run, divided by the length of the core run, divided by the length of the core run and expressed as a percentage.
Core fractured by drilling is considered intact. RQD normally quoted for N-Size core.

| RQD (%) | Rock Quality |
|---|---|
| 90-100 | Excellent |
| 75-90 | Good |
| 50-75 | Fair |
| 25-50 | Poor |
| 0-25 | Very Poor |

**(FI) Fracture Index**

Expressed as the number of discontinuities per 300 mm (1 ft.) Excluded drill-induced fractures and fragmented zones. Reported as “>25” if frequency exceeds 25 fractures/0.3 m.

**Broken Zone**

Zone where core diameter core of very low RQD which may include some drill-induced fractures.

**Fragmented Zone**

Zone where core is less than full diameter and RQD = 0.

**Discontinuity Spacing (ISRM)**

| Term | Average Spacing | |
|---|---|---|
| Extremely widely spaced | >6 m | >20.00 ft. |
| Very widely spaced | 2 m-6 m | 6.50-20.00 ft. |
| Widely spaced | 600 mm-2 m | 2.00-6.50 ft. |
| Moderately spaced | 200 mm-600 mm | 0.65-2.00 ft. |
| Closely spaced | 60 mm-200 mm | 0.20-0.65 ft. |
| Very closely spaced | 20 mm-60 mm | 0.06-0.20 ft. |
| Extremely closely spaced | <20 mm | >0.06 ft. |

Note: Excludes drill-induced fractures and fragmented rock.

**Discontinuity Orientation**

Discontinuity, fracture, and bedding plane orientations are cited as the acute angle measured with respect to the core axis. Fractures perpendicular to the core axis are at 90 degrees and those parallel to the core axis are at 0 degrees.

REFERENCE No.: 11205379-90 ENCLOSURE No.: 1

**BOREHOLE No.:** BH1-21
**ELEVATION:** 81.39 m

# BOREHOLE REPORT

Page: 1 of 1

CLIENT: Infrastructure Ontario (I.O.)

PROJECT: Preliminary Geotechnical Investigation - Proposed Parking Structure

LOCATION: Children's Hospital of Eastern Ontario Campus - 401 Smyth Road, Ottawa, Ontario

DESCRIBED BY: K. Schaller CHECKED BY: S. Shahangian

DATE (START): January 15, 2021 DATE (FINISH): January 15, 2021

**LEGEND**

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

NORTHING: 5027575.049 EASTING: 449073.301

| Depth (Feet) | Depth (Metres) | Elevation (m) BGS | Stratigraphy | DESCRIPTION OF SOIL AND BEDROCK | State | Type and Number | Recovery/ TCR(%) | Moisture Content | Blows per 15 cm/ RQD(%) | 'N' Value/ SCR(%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 81.39 | | GROUND SURFACE | | | % | | | N |
| | 0.13 | 81.26 | | ASPHALT : 125 mm | | GS1 | | 4 | -- | -- |
| | | | | FILL : SAND and GRAVEL, trace clay, brown, moist, loose to very dense Gravel : 48%, Sand : 41%, Clay : 3%, Silt : 8% | | SS1 | 25 | 5 | 10-5-4-6 | 9 |
| | 0.91 | 80.48 | | | | | | | | |
| | 1.0 | | | Gravel : 39%, Sand : 39%, Clay : 7%, Silt : 15% | | SS2 | 88 | 10 | 12-30-50/ 100mm | 50+ |
| | | | | BEDROCK (inferred), shale fragments, greyish brown, very dense | | SS3 | 100 | 4 | 50/ 100mm | 50+ |
| | 2.0 | | | | | SS4 | 100 | 4 | 50/ 75mm | 50+ |
| | 3.0 | | | | | SS5 | 100 | 4 | 50/ 75mm | 50+ |
| | 3.20 | 78.19 | | auger refusal | | | | | | |

**END OF BOREHOLE :**

**NOTE :**
- End of Borehole at 3.20 m bgs
- Borehole was backfilled with bentonite holeplug and sealed with cold patch
- bgs donates 'below ground surface'

Shear test (Cu) △ Field
Sensitivity (S) ☐ Lab
○ Water content (%)
$W_p$ $W_l$ Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

File: N:\CA\MISSISSAUGA - 111 BRUNEL\LEGACY\LOG DATABASE\8-CHAR\11-----\1120----\112053--\11205379\11205379 - 90.GPJ Library File: GHD_GEOTECH_V02.GLB Report: SOIL LOG WITH GRAPH+WELL Date: 2/26/21

REFERENCE No.: 11205379-90 ENCLOSURE No.: 2

**BOREHOLE No.:** BH2-21
**ELEVATION:** 81.36 m

# BOREHOLE REPORT

Page: 1 of 1

CLIENT: Infrastructure Ontario (I.O.)

PROJECT: Preliminary Geotechnical Investigation - Proposed Parking Structure

LOCATION: Children's Hospital of Eastern Ontario Campus - 401 Smyth Road, Ottawa, Ontario

DESCRIBED BY: K. Schaller CHECKED BY: S. Shahangian

DATE (START): January 18, 2021 DATE (FINISH): January 18, 2021

**LEGEND**

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

NORTHING: 5027616.781 EASTING: 449071.365

| Depth (Feet) | Depth (Metres) | Elevation (m) BGS | Stratigraphy | DESCRIPTION OF SOIL AND BEDROCK | State | Type and Number | Recovery/ TCR(%) | Moisture Content | Blows per 15 cm/ RQD(%) | 'N' Value/ SCR(%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 81.36 | | GROUND SURFACE | | | % | | | N |
| 0 | 0.10 | 81.26 | | ASPHALT : 100 mm | | GS1 | | 4 | -- | -- |
| 1 | | | | FILL : SAND and GRAVEL, trace silt, brown, moist, compact Gravel : 42%, Sand : 50%, Clay : 2%, Silt : 6% | | | | | | |
| 2 | 0.61 | 80.75 | | | | SS1 | 71 | 19 | 9-7-3-4 | 10 |
| 3 | 1.0 | | | | | | | | | |
| 4 | 1.14 | 80.22 | | SAND, some silt, trace clay and gravel, dark brown, moist, very dense Gravel : 15%, Sand : 61%, Clay : 6%, Silt : 18% | | SS2 | 87 | 7 | 10-22-42/ 100mm | 50+ |
| 5 | | | | | | SS3 | 83 | 4 | 50/ 125mm | 50+ |
| 6 | 2.0 | | | BEDROCK (inferred), shale fragments, grey, moist, very dense | | | | | | |
| 7 | | | | | | SS4 | 100 | 4 | 50/ 75mm | 50+ |
| 8 | | | | | | | | | | |
| 9 | 2.77 | 78.59 | | auger refusal | | SS5 | 100 | 9 | 50/ 25mm | 50+ |
| 10 | 3.0 | | | | | | | | | |
| 11 | | | | **END OF BOREHOLE :** | | | | | | |
| 12 | | | | **NOTE :** - End of Borehole at 2.77 m bgs - Borehole was backfilled with bentonite holeplug and sealed with cold patch - bgs donates 'below ground surface' | | | | | | |
| 13 | 4.0 | | | | | | | | | |
| 14 | | | | | | | | | | |
| 15 | | | | | | | | | | |
| 16 | 5.0 | | | | | | | | | |
| 17 | | | | | | | | | | |
| 18 | | | | | | | | | | |
| 19 | 6.0 | | | | | | | | | |
| 20 | | | | | | | | | | |
| 21 | | | | | | | | | | |
| 22 | | | | | | | | | | |
| 23 | 7.0 | | | | | | | | | |
| 24 | | | | | | | | | | |
| 25 | | | | | | | | | | |
| 26 | 8.0 | | | | | | | | | |
| 27 | | | | | | | | | | |
| 28 | | | | | | | | | | |
| 29 | 9.0 | | | | | | | | | |
| 30 | | | | | | | | | | |
| 31 | | | | | | | | | | |
| 32 | | | | | | | | | | |

Shear test (Cu) △ Field
Sensitivity (S) ☐ Lab
○ Water content (%)
$W_p$ $W_l$ Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

'N' Value/ SCR(%) scale: 10 20 30 40 50 60 70 80 90

File: N:\CA\MISSISSAUGA - 111 BRUNEL\LEGACY\LOG DATABASE\8-CHAR\11-----\1120----\112053--\11205379\11205379 - 90.GPJ Library File: GHD_GEOTECH_V02.GLB Report: SOIL LOG WITH GRAPH+WELL Date: 2/26/21

REFERENCE No.: 11205379-90 ENCLOSURE No.: 3

**BOREHOLE No.:** MW3-21
**ELEVATION:** 81.37 m

# BOREHOLE REPORT

Page: 1 of 2

CLIENT: Infrastructure Ontario (I.O.)

PROJECT: Preliminary Geotechnical Investigation - Proposed Parking Structure

LOCATION: Children's Hospital of Eastern Ontario Campus - 401 Smyth Road, Ottawa, Ontario

DESCRIBED BY: K. Schaller CHECKED BY: S. Shahangian

DATE (START): January 14, 2021 DATE (FINISH): January 15, 2021

**LEGEND**

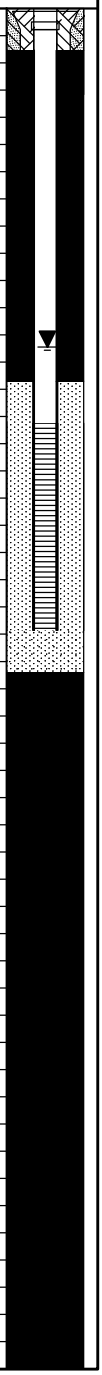
- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

NORTHING: 5027638.113 EASTING: 449119.449

| Depth (Feet) | Depth (Metres) | Elevation (m) BGS | Stratigraphy | DESCRIPTION OF SOIL AND BEDROCK | State | Type and Number | Recovery/ TCR(%) | Moisture Content | Blows per 15 cm/ RQD(%) | 'N' Value/ SCR(%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 81.37 | | GROUND SURFACE | | | % | | | N |
| 0 | | | | ASPHALT : 175 mm | | | | | | |
| 1 | 0.18 | 81.19 | | GRAVEL : 125 mm | | SS1 | 100 | 8 | 17-22-50/ 150mm | 72 |
| | 0.30 | 81.07 | | FILL : | | | | | | |
| 2 | 0.61 | 80.76 | | SAND/SILTY SAND, some gravel, trace organics, shale fragments, brown, damp/moist, very dense | | SS2 | 100 | 9 | 42-50/ 75mm | 50+ |
| 3 | 1.0 | | | BEDROCK (inferred), shale fragments, grey, wet, very dense | | SS3 | 100 | 4 | 50/ 125mm | 50+ |
| 4 | | | | | | SS4 | 100 | 4 | | 50+ |
| 5 | | | | Gravel : 19%, Sand : 50%, Clay : 14%, Silt : 17% | | SS5 | 100 | 4 | 50/ 100mm | 50+ |
| 6 | | | | | | | | | 50/ | |
| 7 | 2.0 | | | | | SS6 | 100 | 4 | 100mm | 50+ |
| 8 | | | | | | | | | 50/ 75mm | |
| 9 | | | | | | SS7 | 83 | 4 | 50/ 150mm | 50+ |
| 10 | 3.0 | | | | | | | | | |
| 11 | | | | | | SS8 | | 17 | -- | -- |
| 12 | | | | | | SS8A | 100 | 11 | 50/ 50mm | 50+ |
| 13 | 4.0 | | | | | SS9 | 100 | 5 | 50/ 50mm | 50+ |
| 14 | | | | | | | | | | |
| 15 | 4.57 | 76.80 | | auger refusal | | SS10 | 100 | 4 | 50/ 50mm | 50+ |
| 16 | | | | SHALE-BEDROCK, laminated, interbeds of limestone/siltstone (hard layers), highly weathered to fresh, weak to moderately strong, grey | | RC1 | 100 | -- | 100 | -- |
| 17 | 5.0 | | | | | | | | | |
| 18 | | | | | | | | | | |
| 19 | | | | | | RC2 | 100 | -- | 78 | -- |
| 20 | 6.0 | | | | | | | | | |
| 21 | | | | | | | | | | |
| 22 | | | | | | | | | | |
| 23 | 7.0 | | | | | | | | | |
| 24 | | | | | | RC3 | 98 | -- | 85 | -- |
| 25 | | | | | | | | | | |
| 26 | 8.0 | | | | | | | | | |
| 27 | | | | | | | | | | |
| 28 | | | | | | | | | | |
| 29 | | | | | | RC4 | 100 | -- | 93 | -- |
| 30 | 9.0 | | | | | | | | | |
| 31 | | | | | | | | | | |
| 32 | | | | | | RC5 | 83 | -- | 61 | -- |

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
$W_p$ $W_l$ Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

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REFERENCE No.: 11205379-90 ENCLOSURE No.: 3

**BOREHOLE No.:** MW3-21
**ELEVATION:** 81.37 m

# BOREHOLE REPORT

Page: 2 of 2

CLIENT: Infrastructure Ontario (I.O.)

PROJECT: Preliminary Geotechnical Investigation - Proposed Parking Structure

LOCATION: Children's Hospital of Eastern Ontario Campus - 401 Smyth Road, Ottawa, Ontario

DESCRIBED BY: K. Schaller CHECKED BY: S. Shahangian

DATE (START): January 14, 2021 DATE (FINISH): January 15, 2021

**LEGEND**

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

NORTHING: 5027638.113 EASTING: 449119.449

| Depth Feet | Depth Metres | Elevation (m) BGS | Stratigraphy | DESCRIPTION OF SOIL AND BEDROCK | State | Type and Number | Recovery/ TCR(%) | Moisture Content | Blows per 15 cm/ RQD(%) | 'N' Value/ SCR(%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 81.37 | | GROUND SURFACE | | | % | | | N |
| 33 | 10.06 | 71.31 | | **END OF BOREHOLE :** | | | | | | |
| 34 | | | | **NOTE :**<br>- End of Borehole at 10.06 m bgs<br>- Borehole was dry upon completion<br>- Rock coring from 4.57 m bgs<br>- 50 mm diameter monitoring well installed at 7.47 m bgs<br>- Groundwater found at 2.69 m bgs on January 28, 2021<br>- Groundwater found at 2.49 m bgs on February 10, 2021<br>- bgs donates 'below ground surface' | | | | | | |
| 35 | | | | | | | | | | |
| 36 | 11.0 | | | | | | | | | |
| 37 | | | | | | | | | | |
| 38 | | | | | | | | | | |
| 39 | 12.0 | | | | | | | | | |
| 40 | | | | | | | | | | |
| 41 | | | | | | | | | | |
| 42 | | | | | | | | | | |
| 43 | 13.0 | | | | | | | | | |
| 44 | | | | | | | | | | |
| 45 | | | | | | | | | | |
| 46 | 14.0 | | | | | | | | | |
| 47 | | | | | | | | | | |
| 48 | | | | | | | | | | |
| 49 | 15.0 | | | | | | | | | |
| 50 | | | | | | | | | | |
| 51 | | | | | | | | | | |
| 52 | 16.0 | | | | | | | | | |
| 53 | | | | | | | | | | |
| 54 | | | | | | | | | | |
| 55 | | | | | | | | | | |
| 56 | 17.0 | | | | | | | | | |
| 57 | | | | | | | | | | |
| 58 | | | | | | | | | | |
| 59 | 18.0 | | | | | | | | | |
| 60 | | | | | | | | | | |
| 61 | | | | | | | | | | |
| 62 | 19.0 | | | | | | | | | |
| 63 | | | | | | | | | | |
| 64 | | | | | | | | | | |
| 65 | | | | | | | | | | |

Shear test (Cu) △ Field
Sensitivity (S) ☐ Lab
○ Water content (%)
Atterberg limits (%) $w_p$ $w_l$
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

10.06 m

REFERENCE No.: 11205379-90 ENCLOSURE No.: 4

**BOREHOLE No.:** BH4-21
**ELEVATION:** 82.23 m

# BOREHOLE REPORT

Page: 1 of 1

CLIENT: Infrastructure Ontario (I.O.)

PROJECT: Preliminary Geotechnical Investigation - Proposed Parking Structure

LOCATION: Children's Hospital of Eastern Ontario Campus - 401 Smyth Road, Ottawa, Ontario

DESCRIBED BY: K. Schaller CHECKED BY: S. Shahangian

DATE (START): January 18, 2021 DATE (FINISH): January 18, 2021

**LEGEND**

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

NORTHING: 5027621.207 EASTING: 449159.803

| Depth (Feet) | Depth (Metres) | Elevation (m) BGS | Stratigraphy | DESCRIPTION OF SOIL AND BEDROCK | State | Type and Number | Recovery/ TCR(%) | Moisture Content | Blows per 15 cm/ RQD(%) | 'N' Value/ SCR(%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 82.23 | | GROUND SURFACE | | | % | | | N |
| 0 | | | | FILL : | | | | | | |
| 1 | | | | SAND and GRAVEL, trace clay and silt, brown, moist to wet, dense | | SS1 | 75 | -- | 15-27-21-10 | 48 |
| 2 | 0.76 | 81.47 | | Gravel : 46%, Sand : 41%, Clay : 3%, Silt : 10% | | | | | | |
| 3 | 1.0 | | | BEDROCK (inferred), shale fragments, grey, moist, very dense | | SS2 | 91 | 7 | 6-19-34-50/ 50mm | 53 |
| 4 | | | | | | SS3 | 90 | 8 | 21-50/ 100mm | 50+ |
| 5 | | | | | | | | | | |
| 6 | | | | | | SS4 | 100 | 4 | 50/ 75mm | 50+ |
| 7 | 2.0 | | | | | | | | | |
| 8 | | | | | | SS5 | 100 | 5 | 50/ 75mm | 50+ |
| 9 | 2.77 | 79.46 | | auger refusal | | | | | | |
| 10 | 3.0 | | | **END OF BOREHOLE :** | | | | | | |
| 11 | | | | **NOTE :** | | | | | | |
| 12 | | | | - End of Borehole at 2.77 m bgs | | | | | | |
| 13 | 4.0 | | | - Borehole was backfilled with bentonite holeplug and sealed with cold patch | | | | | | |
| 14 | | | | - bgs donates 'below ground surface' | | | | | | |
| 15 | | | | | | | | | | |
| 16 | 5.0 | | | | | | | | | |
| 17 | | | | | | | | | | |
| 18 | | | | | | | | | | |
| 19 | | | | | | | | | | |
| 20 | 6.0 | | | | | | | | | |
| 21 | | | | | | | | | | |
| 22 | | | | | | | | | | |
| 23 | 7.0 | | | | | | | | | |
| 24 | | | | | | | | | | |
| 25 | | | | | | | | | | |
| 26 | 8.0 | | | | | | | | | |
| 27 | | | | | | | | | | |
| 28 | | | | | | | | | | |
| 29 | 9.0 | | | | | | | | | |
| 30 | | | | | | | | | | |
| 31 | | | | | | | | | | |
| 32 | | | | | | | | | | |

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
$W_p$ $W_l$ Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

REFERENCE No.: 11205379-90 ENCLOSURE No.: 5

**BOREHOLE No.:** MW5-21
**ELEVATION:** 81.83 m

# BOREHOLE REPORT

Page: 1 of 1

CLIENT: Infrastructure Ontario (I.O.)

PROJECT: Preliminary Geotechnical Investigation - Proposed Parking Structure

LOCATION: Children's Hospital of Eastern Ontario Campus - 401 Smyth Road, Ottawa, Ontario

DESCRIBED BY: K. Schaller CHECKED BY: S. Shahangian

DATE (START): January 15, 2021 DATE (FINISH): January 15, 2021

NORTHING: 5027589.381 EASTING: 449128.777

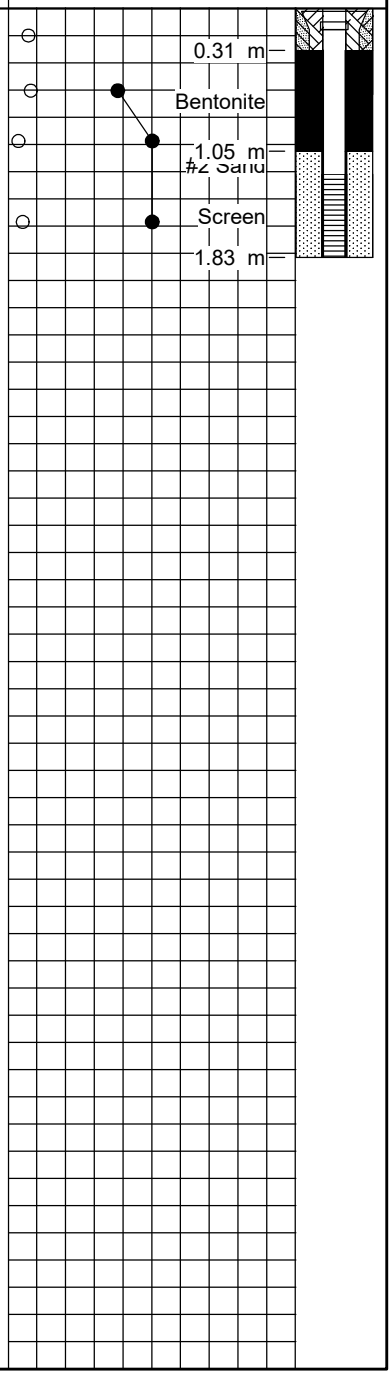
**LEGEND**

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- WATER LEVEL

| Depth Feet | Depth Metres | Elevation (m) BGS | Stratigraphy | DESCRIPTION OF SOIL AND BEDROCK | State | Type and Number | Recovery/ TCR(%) | Moisture Content | Blows per 15 cm/ RQD(%) | 'N' Value/ SCR(%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 81.83 | | GROUND SURFACE | | | % | | | N |
| 0 | 0.10 | 81.73 | | ASPHALT : 100 mm | | GS1 | | 7 | -- | -- |
| 1 | 0.30 | 81.53 | | SAND and GRAVEL, some silt, trace clay, brown, moist, dense | | | | | | |
| | 0.40 | 81.43 | | Gravel : 43%, Sand : 41%, Clay : 3%, Silt : 13% | | SS1 | 100 | 8 | 8-18-20-35 | 38 |
| 2 | | | | | | | | | | |
| 3 | 1.0 | | | FILL : GRAVELLY SAND, some silt, trace clay, brown, moist, dense | | SS2 | 100 | 3 | 50/ 125mm | 50+ |
| 4 | | | | | | | | | | |
| 5 | | | | Gravel : 23%, Sand : 49%, Clay : 8%, Silt : 20% | | SS3 | 100 | 5 | 50/ 100mm | 50+ |
| 6 | 1.83 | 80.00 | | | | | | | | |
| | 2.0 | | | BEDROCK (inferred), shale fragments, grey, damp, very dense | | | | | | |
| 7 | | | | | | | | | | |
| 8 | | | | **END OF BOREHOLE :** | | | | | | |
| 9 | | | | | | | | | | |
| 10 | 3.0 | | | **NOTE :** | | | | | | |
| 11 | | | | - End of Borehole at 1.83 m bgs | | | | | | |
| 12 | | | | - Borehole was dry upon completion | | | | | | |
| 13 | 4.0 | | | - Monitoring well installed at 1.837 m bgs | | | | | | |
| 14 | | | | - Borehole was dry on January 28, 2021 | | | | | | |
| 15 | | | | - Borehole was dry on February 10, 2021 | | | | | | |
| 16 | 5.0 | | | - bgs donates 'below ground surface' | | | | | | |
| 17 | | | | | | | | | | |
| 18 | | | | | | | | | | |
| 19 | | | | | | | | | | |
| 20 | 6.0 | | | | | | | | | |
| 21 | | | | | | | | | | |
| 22 | | | | | | | | | | |
| 23 | 7.0 | | | | | | | | | |
| 24 | | | | | | | | | | |
| 25 | | | | | | | | | | |
| 26 | 8.0 | | | | | | | | | |
| 27 | | | | | | | | | | |
| 28 | | | | | | | | | | |
| 29 | 9.0 | | | | | | | | | |
| 30 | | | | | | | | | | |
| 31 | | | | | | | | | | |
| 32 | | | | | | | | | | |

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
Atterberg limits (%) $w_p$ $w_l$
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

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REFERENCE No.: 11205379-90 ENCLOSURE No.: 6

**BOREHOLE No.:** MW6-21
**ELEVATION:** 82.17 m

# BOREHOLE REPORT

Page: 1 of 2

CLIENT: Infrastructure Ontario (I.O.)
PROJECT: Preliminary Geotechnical Investigation - Proposed Parking Structure
LOCATION: Children's Hospital of Eastern Ontario Campus - 401 Smyth Road, Ottawa, Ontario
DESCRIBED BY: K. Schaller CHECKED BY: S. Shahangian
DATE (START): January 12, 2021 DATE (FINISH): January 13, 2021

NORTHING: 5027605.404 EASTING: 449244.983

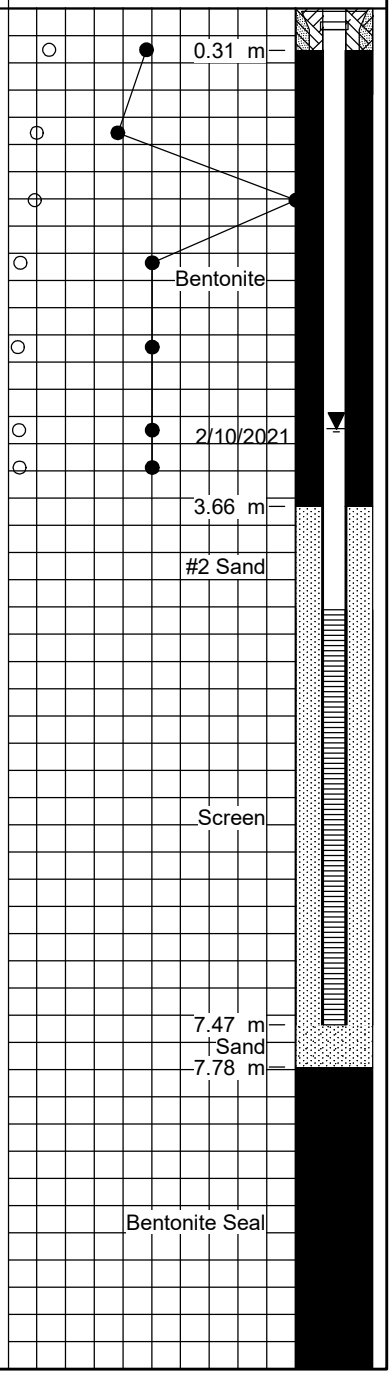
**LEGEND**

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- WATER LEVEL

| Depth Feet | Depth Metres | Elevation (m) BGS | Stratigraphy | DESCRIPTION OF SOIL AND BEDROCK | State | Type and Number | Recovery/ TCR(%) | Moisture Content | Blows per 15 cm/ RQD(%) | 'N' Value/ SCR(%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 82.17 | | GROUND SURFACE | | | % | | | N |
| 0 | | | | GRAVEL : 350 mm | | | | | | |
| 1 | 0.35 | 81.82 | | FILL : | | SS1 | 87 | 14 | 10-30-18-8 | 48 |
| 2 | 0.61 | 81.56 | | SILTY SAND, trace gravel, trace organics, grey/brown, moist, dense | | | | | | |
| 3 | 1.0 | | | NATIVE : | | SS2 | 100 | 10 | 4-11-27-45 | 38 |
| 4 | 1.22 | 80.95 | | ML-GRAVELLY SAND, trace clay, brown, moist, dense | | | | | | |
| 5 | | | | Gravel : 32%, Sand : 45%, Clay : 7%, Silt : 16% | | SS3 | 100 | 9 | 35-20-50/ 75mm | 100 |
| 6 | 2.0 | | | BEDROCK (inferred), shale fragments, grey, moist, very dense | | SS4 | 100 | 4 | 50/ 75mm | 50+ |
| 7 | | | | | | | | | | |
| 8 | | | | | | SS5 | 100 | 3 | 50/ 100mm | 50+ |
| 9 | | | | | | | | | | |
| 10 | 3.0 | | | | | SS6 | 100 | 4 | 50/ 100mm | 50+ |
| 11 | | | | | | SS7 | 100 | 4 | 50/ 50mm | 50+ |
| 12 | 3.51 | 78.66 | | SHALE-BEDROCK, laminated, interbeds of limestone/siltstone (hard layers), highly weathered to fresh, weak to moderately strong, grey | | RC1 | 58 | -- | 50 | -- |
| 13 | 4.0 | | | | | | | | | |
| 14 | | | | | | RC2 | 93 | -- | 24 | -- |
| 15 | | | | | | | | | | |
| 16 | 5.0 | | | | | | | | | |
| 17 | | | | | | | | | | |
| 18 | | | | | | RC3 | 95 | -- | 54 | -- |
| 19 | | | | | | | | | | |
| 20 | 6.0 | | | | | | | | | |
| 21 | | | | | | | | | | |
| 22 | | | | | | | | | | |
| 23 | 7.0 | | | | | RC4 | 97 | -- | 55 | -- |
| 24 | | | | | | | | | | |
| 25 | | | | | | | | | | |
| 26 | 8.0 | | | | | | | | | |
| 27 | | | | | | | | | | |
| 28 | | | | | | RC5 | 100 | -- | 52 | -- |
| 29 | | | | | | | | | | |
| 30 | 9.0 | | | | | | | | | |
| 31 | | | | | | | | | | |
| 32 | | | | | | RC6 | 100 | -- | 71 | -- |

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
$W_p$ $W_l$ Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

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REFERENCE No.: 11205379-90 ENCLOSURE No.: 6

**BOREHOLE No.:** MW6-21
**ELEVATION:** 82.17 m

# BOREHOLE REPORT

Page: 2 of 2

CLIENT: Infrastructure Ontario (I.O.)

PROJECT: Preliminary Geotechnical Investigation - Proposed Parking Structure

LOCATION: Children's Hospital of Eastern Ontario Campus - 401 Smyth Road, Ottawa, Ontario

DESCRIBED BY: K. Schaller CHECKED BY: S. Shahangian

DATE (START): January 12, 2021 DATE (FINISH): January 13, 2021

NORTHING: 5027605.404 EASTING: 449244.983

**LEGEND**

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

| Depth Feet | Depth Metres | Elevation (m) BGS | Stratigraphy | DESCRIPTION OF SOIL AND BEDROCK | State | Type and Number | Recovery/ TCR(%) | Moisture Content | Blows per 15 cm/ RQD(%) | 'N' Value/ SCR(%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 82.17 | | GROUND SURFACE | | | % | | | N |
| 33 | 10.06 | 72.11 | | **END OF BOREHOLE :** | | | | | | |
| 34 | | | | **NOTE :**<br>- End of Borehole at 10.06 m bgs<br>- Borehole was dry upon completion<br>- Rock coring from 3.51 m bgs<br>- Monitoring well installed at 7.47 m bgs<br>- Groundwater found at 2.97 m bgs on January 28, 2021<br>- Groundwater found at 3.09 m bgs on February 10, 2021<br>- bgs donates 'below ground surface' | | | | | | |
| 35 | | | | | | | | | | |
| 36 | 11.0 | | | | | | | | | |
| 37 | | | | | | | | | | |
| 38 | | | | | | | | | | |
| 39 | 12.0 | | | | | | | | | |
| 40 | | | | | | | | | | |
| 41 | | | | | | | | | | |
| 42 | | | | | | | | | | |
| 43 | 13.0 | | | | | | | | | |
| 44 | | | | | | | | | | |
| 45 | | | | | | | | | | |
| 46 | 14.0 | | | | | | | | | |
| 47 | | | | | | | | | | |
| 48 | | | | | | | | | | |
| 49 | 15.0 | | | | | | | | | |
| 50 | | | | | | | | | | |
| 51 | | | | | | | | | | |
| 52 | 16.0 | | | | | | | | | |
| 53 | | | | | | | | | | |
| 54 | | | | | | | | | | |
| 55 | | | | | | | | | | |
| 56 | 17.0 | | | | | | | | | |
| 57 | | | | | | | | | | |
| 58 | | | | | | | | | | |
| 59 | 18.0 | | | | | | | | | |
| 60 | | | | | | | | | | |
| 61 | | | | | | | | | | |
| 62 | 19.0 | | | | | | | | | |
| 63 | | | | | | | | | | |
| 64 | | | | | | | | | | |
| 65 | | | | | | | | | | |

Shear test (Cu) △ Field
Sensitivity (S) ☐ Lab
○ Water content (%)
$W_p$ $W_l$ Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

10.06 m

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REFERENCE No.: 11205379-90 ENCLOSURE No.: 7

**BOREHOLE No.:** BH7-21
**ELEVATION:** 82.22 m

# BOREHOLE REPORT

Page: 1 of 1

CLIENT: Infrastructure Ontario (I.O.)

PROJECT: Preliminary Geotechnical Investigation - Proposed Parking Structure

LOCATION: Children's Hospital of Eastern Ontario Campus - 401 Smyth Road, Ottawa, Ontario

DESCRIBED BY: K. Schaller CHECKED BY: S. Shahangian

DATE (START): January 19, 2021 DATE (FINISH): January 19, 2021

**LEGEND**

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

NORTHING: 5027618.043 EASTING: 449176.612

| Depth Feet | Depth Metres | Elevation (m) BGS | Stratigraphy | DESCRIPTION OF SOIL AND BEDROCK | State | Type and Number | Recovery/ TCR(%) | Moisture Content | Blows per 15 cm/ RQD(%) | 'N' Value/ SCR(%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 82.22 | | GROUND SURFACE | | | % | | | N |
| 0 | | | | FILL : SILTY SAND and GRAVEL, brown, moist, very dense | | SS1 | 54 | 6 | 28-35-17-10 | 52 |
| 1 | | | | | | | | | | |
| 2 | | | | | | | | | | |
| | 0.76 | 81.46 | | BEDROCK (inferred), shale fragments, grey, moist, very dense | | SS2 | 100 | 7 | 15-40-50/ 125mm | 50+ |
| 3 | 1.0 | | | | | | | | | |
| 4 | | | | | | SS3 | 100 | 4 | 45-50/ 75mm | 50+ |
| 5 | | | | | | | | | | |
| 6 | | | | | | SS4 | 100 | 4 | 50/ 125mm | 50+ |
| 7 | 2.0 | | | | | | | | | |
| 8 | 2.52 | 79.70 | | auger refusal | | SS5 | 100 | 3 | 50/ 75mm | 50+ |
| 9 | | | | | | | | | | |
| 10 | 3.0 | | | **END OF BOREHOLE :** | | | | | | |
| 11 | | | | | | | | | | |
| 12 | | | | **NOTE :** | | | | | | |
| 13 | 4.0 | | | - End of Borehole at 2.52 m bgs | | | | | | |
| 14 | | | | - Borehole was backfilled with bentonite holeplug and sealed with cold patch | | | | | | |
| 15 | | | | - bgs donates 'below ground surface' | | | | | | |
| 16 | | | | | | | | | | |
| 17 | 5.0 | | | | | | | | | |
| 18 | | | | | | | | | | |
| 19 | | | | | | | | | | |
| 20 | 6.0 | | | | | | | | | |
| 21 | | | | | | | | | | |
| 22 | | | | | | | | | | |
| 23 | 7.0 | | | | | | | | | |
| 24 | | | | | | | | | | |
| 25 | | | | | | | | | | |
| 26 | 8.0 | | | | | | | | | |
| 27 | | | | | | | | | | |
| 28 | | | | | | | | | | |
| 29 | 9.0 | | | | | | | | | |
| 30 | | | | | | | | | | |
| 31 | | | | | | | | | | |
| 32 | | | | | | | | | | |

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
$W_p$ $W_l$ Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

REFERENCE No.: 11205379-90 ENCLOSURE No.: 8

**BOREHOLE No.:** MW8-21
**ELEVATION:** 82.20 m

# BOREHOLE REPORT

Page: 1 of 1

CLIENT: Infrastructure Ontario (I.O.)

PROJECT: Preliminary Geotechnical Investigation - Proposed Parking Structure

LOCATION: Children's Hospital of Eastern Ontario Campus - 401 Smyth Road, Ottawa, Ontario

DESCRIBED BY: K. Schaller CHECKED BY: S. Shahangian

DATE (START): January 18, 2021 DATE (FINISH): January 18, 2021

**LEGEND**

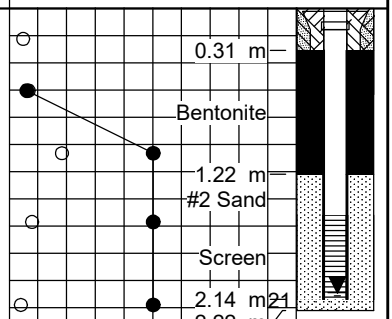
- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

NORTHING: 5027647.908 EASTING: 449211.832

| Depth (Feet) | Depth (Metres) | Elevation (m) BGS | Stratigraphy | DESCRIPTION OF SOIL AND BEDROCK | State | Type and Number | Recovery/ TCR(%) | Moisture Content | Blows per 15 cm/ RQD(%) | 'N' Value/ SCR(%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 82.20 | | GROUND SURFACE | | | % | | | N |
| 0 | 0.05 | 82.15 | | ASPHALT : 50 mm | | GS1 | | 5 | -- | -- |
| 1 | | | | FILL : SANDY GRAVEL, brown, moist, loose Gravel : 61%, Sand : 33%, Clay : 2%, Silt : 6% | | SS1 | 100 | 7 | 3-4-2-3 | 6 |
| 2 | | | | | | | | | | |
| 3 | 0.86 | 81.34 | | | | SS2 | 100 | 18 | 23-50/ 150mm | 50+ |
| 4 | 1.0 | | | BEDROCK (inferred), shale fragments, reddish brown/grey, wet, very dense | | | | | | |
| 5 | | | | | | SS3 | 100 | 8 | 50/ 100mm | 50+ |
| 6 | 2.0 | | | | | | | | | |
| 7 | 2.22 | 79.98 | | auger refusal | | SS4 | 100 | 4 | 50/ 75mm | 50+ |
| 8 | | | | | | | | | | |
| 9 | | | | **END OF BOREHOLE :** | | | | | | |
| 10 | 3.0 | | | **NOTE :** | | | | | | |
| 11 | | | | - End of Borehole at 2.22 m bgs | | | | | | |
| 12 | | | | - Borehole was dry upon completion | | | | | | |
| 13 | 4.0 | | | - Monitoring well installed at 2.14 m bgs | | | | | | |
| 14 | | | | - Groundwater found at 2.03 m bgs on January 28, 2021 | | | | | | |
| 15 | | | | - Groundwater found at 2.09 m bgs on February 10, 2021 | | | | | | |
| 16 | 5.0 | | | - bgs donates 'below ground surface' | | | | | | |
| 17 | | | | | | | | | | |
| 18 | | | | | | | | | | |
| 19 | | | | | | | | | | |
| 20 | 6.0 | | | | | | | | | |
| 21 | | | | | | | | | | |
| 22 | | | | | | | | | | |
| 23 | 7.0 | | | | | | | | | |
| 24 | | | | | | | | | | |
| 25 | | | | | | | | | | |
| 26 | 8.0 | | | | | | | | | |
| 27 | | | | | | | | | | |
| 28 | | | | | | | | | | |
| 29 | | | | | | | | | | |
| 30 | 9.0 | | | | | | | | | |
| 31 | | | | | | | | | | |
| 32 | | | | | | | | | | |

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
$W_p$ $W_l$ Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90




File: N:\CA\MISSISSAUGA - 111 BRUNEL\LEGACY\LOG DATABASE\8-CHAR\11-----\1120----\112053--\11205379\11205379 - 90.GPJ Library File: GHD_GEOTECH_V02.GLB Report: SOIL LOG WITH GRAPH+WELL Date: 2/26/21

REFERENCE No.: 11205379-90 ENCLOSURE No.: 9

**BOREHOLE No.:** B1-21
**ELEVATION:** 82.29 m

# BOREHOLE REPORT

Page: 1 of 1

CLIENT: Infrastructure Ontario (I.O.)

PROJECT: Preliminary Geotechnical Investigation - Proposed Parking Structure

LOCATION: Children's Hospital of Eastern Ontario Campus - 401 Smyth Road, Ottawa, Ontario

DESCRIBED BY: K. Schaller CHECKED BY: S. Shahangian

DATE (START): January 18, 2021 DATE (FINISH): January 18, 2021

**LEGEND**

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

NORTHING: 5027580.742 EASTING: 449219.213

| Depth (Feet) | Depth (Metres) | Elevation (m) BGS | Stratigraphy | DESCRIPTION OF SOIL AND BEDROCK | State | Type and Number | Recovery/ TCR(%) | Moisture Content | Blows per 15 cm/ RQD(%) | 'N' Value/ SCR(%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 82.29 | | GROUND SURFACE | | | % | | | N |
| 0 | | | | | | | | | | |
| 1 | 0.46 | 81.83 | | FILL : SILTY SAND and GRAVEL, greyish brown, moist, loose | | SS1 | 62 | 2 | 7-3-2-3 | 5 |
| 2 | | | | NATIVE : SAND and GRAVEL, some silt, trace clay, brown, moist, very dense Gravel : 39%, Sand : 39%, Clay : 7%, Silt : 15% | | SS2 | 89 | 10 | 9-24-50/ 125mm | 50+ |
| 3 | 0.91 | 81.38 | | | | | | | | |
| 4 | 1.04 | 81.25 | | BEDROCK, shale fragments, brownish red/grey, moist, very dense auger refusal | | | | | | |
| 5 | | | | | | | | | | |
| 6 | 2.0 | | | | | | | | | |
| 7 | | | | | | | | | | |
| 8 | | | | | | | | | | |
| 9 | | | | | | | | | | |
| 10 | 3.0 | | | | | | | | | |
| 11 | | | | | | | | | | |
| 12 | | | | | | | | | | |
| 13 | 4.0 | | | | | | | | | |
| 14 | | | | | | | | | | |
| 15 | | | | | | | | | | |
| 16 | 5.0 | | | | | | | | | |
| 17 | | | | | | | | | | |
| 18 | | | | | | | | | | |
| 19 | | | | | | | | | | |
| 20 | 6.0 | | | | | | | | | |
| 21 | | | | | | | | | | |
| 22 | | | | | | | | | | |
| 23 | 7.0 | | | | | | | | | |
| 24 | | | | | | | | | | |
| 25 | | | | | | | | | | |
| 26 | 8.0 | | | | | | | | | |
| 27 | | | | | | | | | | |
| 28 | | | | | | | | | | |
| 29 | 9.0 | | | | | | | | | |
| 30 | | | | | | | | | | |
| 31 | | | | | | | | | | |
| 32 | | | | | | | | | | |

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
Atterberg limits (%) $w_p$ $w_l$
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

**NOTE :**
- End of Borehole at 1.04 m bgs
- Borehole was dry upon completion
- bgs donates 'below ground surface'

**END OF BOREHOLE :**

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REFERENCE No.: 11205379-90 ENCLOSURE No.: 10

**BOREHOLE No.:** B2-21
**ELEVATION:** 82.18 m

# BOREHOLE REPORT

Page: 1 of 1

CLIENT: Infrastructure Ontario (I.O.)
PROJECT: Preliminary Geotechnical Investigation - Proposed Parking Structure
LOCATION: Children's Hospital of Eastern Ontario Campus - 401 Smyth Road, Ottawa, Ontario
DESCRIBED BY: K. Schaller CHECKED BY: S. Shahangian
DATE (START): January 18, 2021 DATE (FINISH): January 18, 2021

**LEGEND**

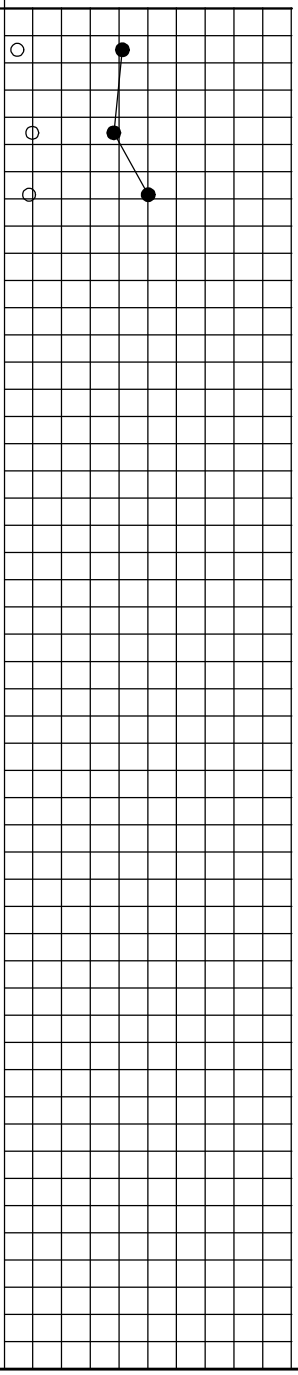
- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

NORTHING: 5027629.392 EASTING: 449254.399

| Depth (Feet) | Depth (Metres) | Elevation (m) BGS | Stratigraphy | DESCRIPTION OF SOIL AND BEDROCK | State | Type and Number | Recovery/ TCR(%) | Moisture Content | Blows per 15 cm/ RQD(%) | 'N' Value/ SCR(%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 82.18 | | GROUND SURFACE | | | % | | | N |
| 0 | | | | FILL : | | | | | | |
| 1 | | | | SILTY SAND and GRAVEL, brown, moist, dense | | SS1 | 71 | 4 | 13-17-24-9 | 41 |
| 2 | | | | | | | | | | |
| 3 | 1.0 | 81.27 | | BEDROCK, shale fragments, grey, very dense | | SS2 | 100 | 10 | 4-10-28-34 | 38 |
| 4 | | | | | | | | | | |
| 5 | 1.52 | 80.66 | | | | SS3 | | 9 | 22-50/ 150mm | 50+ |
| 6 | 2.0 | | | **END OF BOREHOLE :** | | | | | | |
| 7 | | | | **NOTE :** | | | | | | |
| 8 | | | | - End of Borehole at 1.52 m bgs | | | | | | |
| 9 | | | | - Borehole was dry upon completion | | | | | | |
| 10 | 3.0 | | | - bgs donates 'below ground surface' | | | | | | |
| 11 | | | | | | | | | | |
| 12 | | | | | | | | | | |
| 13 | 4.0 | | | | | | | | | |
| 14 | | | | | | | | | | |
| 15 | | | | | | | | | | |
| 16 | 5.0 | | | | | | | | | |
| 17 | | | | | | | | | | |
| 18 | | | | | | | | | | |
| 19 | | | | | | | | | | |
| 20 | 6.0 | | | | | | | | | |
| 21 | | | | | | | | | | |
| 22 | | | | | | | | | | |
| 23 | 7.0 | | | | | | | | | |
| 24 | | | | | | | | | | |
| 25 | | | | | | | | | | |
| 26 | 8.0 | | | | | | | | | |
| 27 | | | | | | | | | | |
| 28 | | | | | | | | | | |
| 29 | 9.0 | | | | | | | | | |
| 30 | | | | | | | | | | |
| 31 | | | | | | | | | | |
| 32 | | | | | | | | | | |

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
$W_p$ $W_l$ Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



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REFERENCE No.: 11205379-90 ENCLOSURE No.:

**BOREHOLE No.:** B3-21
**ELEVATION:** 82.27 m

# BOREHOLE REPORT

Page: 1 of 1

CLIENT: Infrastructure Ontario (I.O.)
PROJECT: Preliminary Geotechnical Investigation - Proposed Parking Structure
LOCATION: Children's Hospital of Eastern Ontario Campus - 401 Smyth Road, Ottawa, Ontario
DESCRIBED BY: K. Schaller CHECKED BY:
DATE (START): DATE (FINISH):

**LEGEND**

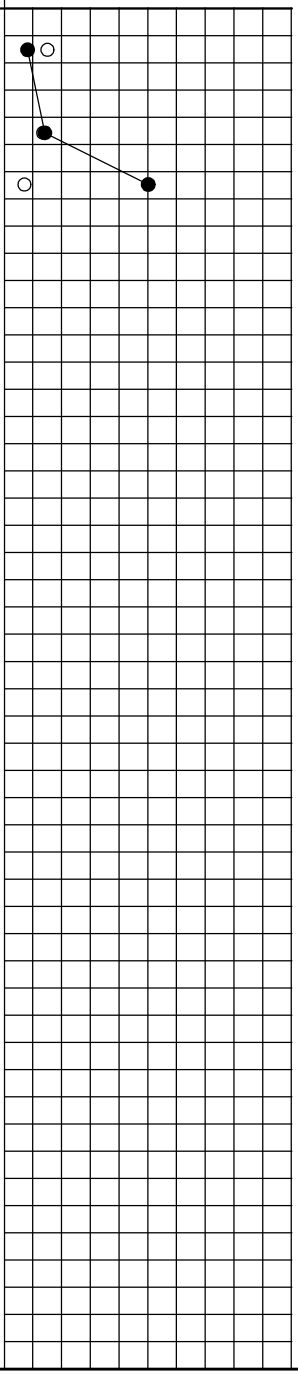
- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

NORTHING: 5027652.016 EASTING: 449199.133

| Depth (Feet) | Depth (Metres) | Elevation (m) BGS | Stratigraphy | DESCRIPTION OF SOIL AND BEDROCK | State | Type and Number | Recovery/ TCR(%) | Moisture Content | Blows per 15 cm/ RQD(%) | 'N' Value/ SCR(%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 82.27 | | GROUND SURFACE | | | % | | | N |
| 0 | | | | | | | | | | |
| 1 | | | | FILL : SILTY SAND with gravel, greyish brown, moist, loose | | SS1 | 62 | 15 | 6-6-2-2 | 8 |
| 2 | 0.61 | 81.66 | | trace to some clay | | | | | | |
| 3 | 1.0 | | | Sand, some gravel, silt and clay, reddish grey, moist, stiff | | SS2 | 100 | 13 | 4-5-9-25 | 14 |
| 4 | 1.22 | 81.05 | | | | | | | | |
| | 1.37 | 80.90 | | BEDROCK (inferred), shale fragments, greyish brown, very dense | | SS3 | 100 | 7 | 50/ 150mm | 50+ |
| 5 | | | | | | | | | | |
| 6 | | | | **END OF BOREHOLE :** | | | | | | |
| 7 | 2.0 | | | **NOTE :** | | | | | | |
| 8 | | | | - End of Borehole at 1.37 m bgs | | | | | | |
| 9 | | | | - Borehole was dry upon completion | | | | | | |
| 10 | 3.0 | | | - bgs donates 'below ground surface' | | | | | | |
| 11 | | | | | | | | | | |
| 12 | | | | | | | | | | |
| 13 | 4.0 | | | | | | | | | |
| 14 | | | | | | | | | | |
| 15 | | | | | | | | | | |
| 16 | 5.0 | | | | | | | | | |
| 17 | | | | | | | | | | |
| 18 | | | | | | | | | | |
| 19 | 6.0 | | | | | | | | | |
| 20 | | | | | | | | | | |
| 21 | | | | | | | | | | |
| 22 | | | | | | | | | | |
| 23 | 7.0 | | | | | | | | | |
| 24 | | | | | | | | | | |
| 25 | | | | | | | | | | |
| 26 | 8.0 | | | | | | | | | |
| 27 | | | | | | | | | | |
| 28 | | | | | | | | | | |
| 29 | 9.0 | | | | | | | | | |
| 30 | | | | | | | | | | |
| 31 | | | | | | | | | | |
| 32 | | | | | | | | | | |

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
$W_p$ $W_l$ Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



File: N:\CA\MISSISSAUGA - 111 BRUNEL\LEGACY\LOG DATABASE\8-CHAR\11-----\1120----\112053--\11205379\11205379 - 90.GPJ Library File: GHD_GEOTECH_V02.GLB Report: SOIL LOG WITH GRAPH+WELL Date: 2/26/21

REFERENCE No.: 11205379 ENCLOSURE No.: 9

**BOREHOLE No.:** MW9-22
**ELEVATION:** 82.0 m

# BOREHOLE REPORT

Page: 1 of 1

CLIENT: Infrastructure Ontario (I.O.) PROJECT: Preliminary Geotechnical Investigation
LOCATION: 401 Smyth Road, Ottawa, Ontario
DRILLING RIG: Track Drill Rig DRILLING METHOD: 203mm OD Hollow Stem Augers
DESCRIBED BY: D. Ash CHECKED BY: A. Khandekar
DATE (START): 19 July 2022 DATE (FINISH): 19 July 2022

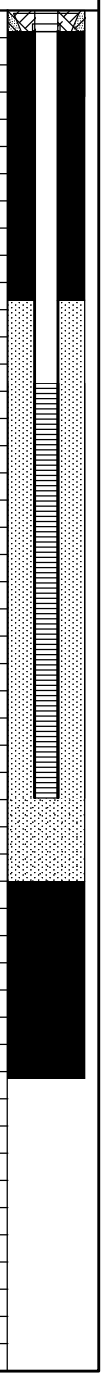
**LEGEND**
SS - SPLIT SPOON
ST - SHELBY TUBE
RC - ROCK CORE
▼ - WATER LEVEL

NORTHING: 5027588.5 m EASTING: 449191.1 m

| Depth Feet | Depth Metres | Elevation (m) | Stratigraphy | DESCRIPTION OF SOIL AND BEDROCK | State | Type and Number | Recovery/ TCR(%) | Moisture Content | Blows per 15cm/ RQD(%) | 'N' Value/ SCR(%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 82.0 | | GROUND SURFACE | | | | % | | |
| 0 | | | | FILL : | | | | | | |
| 1 | 0.3 | 81.8 | | GM-SAND and GRAVEL, grey/brown, moist, compact | | SS1 | 62 | 6 | 9-8-10-4 | 18 |
| 2 | | | | NATIVE : | | | | | | |
| 3 | 0.8 / 1.0 | 81.2 | | SM-SILTY SAND and GRAVEL, grey/brown, moist, compact to dense | | SS2 | 83 | 3 | 2-11-27-50 | 38 |
| 4 | | | | SHALE-BEDROCK, weathered, light brown | | | | | | |
| 5 | | | | | | | | | | |
| 6 | | | | | | | | | | |
| 7 | 2.0 | | | | | | | | | |
| 8 | | | | | | | | | | |
| 9 | 2.6 | 79.4 | | SHALE-BEDROCK, highly to moderately weathered, moderately bedded, weak to moderately strong, grey/black | | RC1 | 90 | -- | 13 | -- |
| 10 | 3.0 | | | | | | | | | |
| 11 | | | | | | | | | | |
| 12 | | | | | | | | | | |
| 13 | 4.0 | | | | | RC2 | 100 | -- | 40 | -- |
| 14 | | | | | | | | | | |
| 15 | | | | | | | | | | |
| 16 | | | | | | | | | | |
| 17 | 5.0 | | | | | | | | | |
| 18 | | | | | | | | | | |
| 19 | | | | | | RC3 | 97 | -- | 65 | -- |
| 20 | 6.0 | | | | | | | | | |
| 21 | | | | | | | | | | |
| 22 | | | | | | | | | | |
| 23 | 7.0 | | | | | RC4 | 93 | -- | 67 | -- |
| 24 | | | | | | | | | | |
| 25 | | | | | | | | | | |
| 26 | 7.9 / 8.0 | 74.2 | | **END OF BOREHOLE :** | | | | | | |
| 27 | | | | | | | | | | |
| 28 | | | | **NOTE :** | | | | | | |
| 29 | | | | - End of Borehole at 7.85 m bgs | | | | | | |
| 30 | 9.0 | | | - Rock coring from 2.59 m bgs | | | | | | |
| 31 | | | | - Monitoring well installed at 5.79 m bgs | | | | | | |
| 32 | | | | - bgs donates 'below ground surface' | | | | | | |

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
$W_p$ $W_l$ Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90




File: N:\CA\TORONTO\PROJECTS\66211205379\TECH\LOG DATABASE\11205379 - PARKING GARAGE ADDITION.GPJ Library File: 11205379 GHD_GEOTECH_V05.GLB Report: 11205379 SOIL LOG WITH GRAPH+WELL Date: 1/9/22

REFERENCE No.: 11205379 ENCLOSURE No.: 10

**BOREHOLE No.:** BH10-22
**ELEVATION:** 82.1 m

# BOREHOLE REPORT

Page: 1 of 1

CLIENT: Infrastructure Ontario (I.O.) PROJECT: Preliminary Geotechnical Investigation

LOCATION: 401 Smyth Road, Ottawa, Ontario

DRILLING RIG: Track Drill Rig DRILLING METHOD: 203mm OD Hollow Stem Augers

DESCRIBED BY: D. Ash CHECKED BY: A. Khandekar

DATE (START): 12 July 2022 DATE (FINISH): 12 July 2022

**LEGEND**

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

NORTHING: 5027596.9 m EASTING: 449167.5 m

| Depth Feet | Depth Metres | Elevation (m) | Stratigraphy | DESCRIPTION OF SOIL AND BEDROCK | State | Type and Number | Recovery/ TCR(%) | Moisture Content | Blows per 15cm/ RQD(%) | 'N' Value/ SCR(%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 82.1 | | GROUND SURFACE | | | | % | | |
| 0 | | | | FILL : GM-SAND and GRAVEL, some silt, trace clay, brown, moist, compact Gravel : 43%, Sand : 43%, Silt : 11%, Clay : 3% | | SS1 | 83 | 3 | 16-13-12-4 | 25 |
| 1 | 0.5 | | | | | | | | | |
| 2 | 0.6 | 81.5 | | NATIVE : SM-SILTY SAND and GRAVEL, trace clay, very dense | | SS2 | 87 | 6 | 7-38-50/ 75mm | 88/ 75mm |
| | 0.7 | 81.4 | | SHALE-BEDROCK, weathered, light brown | | | | | | |
| 3 | 1.0 | | | | | | | | | |
| 4 | 1.2 | 80.9 | | Borehole terminated due to spoon and auger refusal | | | | | | |
| 5 | 1.5 | | | **END OF BOREHOLE :** | | | | | | |
| 6 | | | | **NOTE :** - End of Borehole at 1.22 m bgs - Borehole was dry upon completion - bgs donates 'below ground surface' | | | | | | |
| 7 | 2.0 | | | | | | | | | |
| 8 | 2.5 | | | | | | | | | |
| 9 | | | | | | | | | | |
| 10 | 3.0 | | | | | | | | | |
| 11 | | | | | | | | | | |
| 12 | 3.5 | | | | | | | | | |
| 13 | 4.0 | | | | | | | | | |
| 14 | | | | | | | | | | |
| 15 | 4.5 | | | | | | | | | |
| 16 | | | | | | | | | | |

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
$W_p$ $W_l$ Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

REFERENCE No.: 11205379 ENCLOSURE No.: 11

**BOREHOLE No.:** BH11-22
**ELEVATION:** 82.1 m

# BOREHOLE REPORT

Page: 1 of 1

CLIENT: Infrastructure Ontario (I.O.) PROJECT: Preliminary Geotechnical Investigation

LOCATION: 401 Smyth Road, Ottawa, Ontario

DRILLING RIG: Track Drill Rig DRILLING METHOD: 203mm OD Hollow Stem Augers

DESCRIBED BY: D. Ash CHECKED BY: A. Khandekar

DATE (START): 18 July 2022 DATE (FINISH): 18 July 2022

**LEGEND**

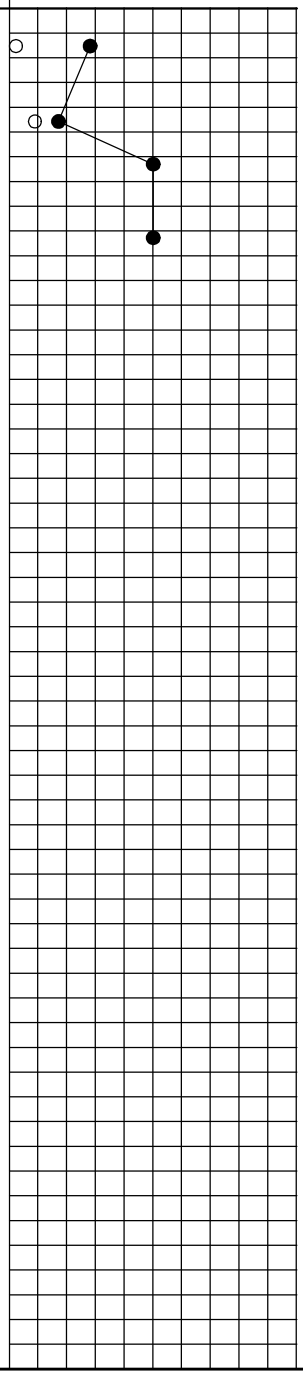
- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

NORTHING: 5027638.0 m EASTING: 449184.6 m

| Depth (Feet) | Depth (Metres) | Elevation (m) | Stratigraphy | DESCRIPTION OF SOIL AND BEDROCK | State | Type and Number | Recovery/ TCR(%) | Moisture Content | Blows per 15cm/ RQD(%) | 'N' Value/ SCR(%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 82.1 | | GROUND SURFACE | | | | % | | |
| 0 | | | | FILL : | | | | | | |
| 1 | | | | GW-GM-SANDY GRAVEL, trace silt, trace clay, brown, moist, compact | | SS1 | 67 | 2 | 19-17-11-3 | 28 |
| 2 | 0.6 | 81.5 | | Gravel : 52%, Sand : 37%, Silt : 8%, Clay : 3% | | | | | | |
| 3 | 0.9 | 81.3 | | | | SS2 | 62 | 9 | 3-6-11-14 | 17 |
| | 1.0 | | | NATIVE : | | | | | | |
| 4 | | | | SM-ML-SAND and SILT, trace clay, grey/brown, moist, compact | | SS3 | 100 | -- | 50/ 75mm | 50+ |
| 5 | | | | | | | | | | |
| 6 | | | | SHALE-BEDROCK, weathered, light brown | | SS4 | 100 | -- | 50/ 50mm | 50+ |
| 7 | 2.0 | | | | | | | | | |
| 8 | 2.5 | 79.6 | | auger refusal | | | | | | |
| 9 | | | | SHALE-BEDROCK, moderately bedded, moderately weathered, medium strong, grey/black | | | | | | |
| 10 | 3.0 | | | | | RC1 | 78 | -- | 36 | -- |
| 11 | | | | | | | | | | |
| 12 | | | | | | | | | | |
| 13 | 4.0 | | | | | RC2 | 100 | -- | 60 | -- |
| 14 | | | | | | | | | | |
| 15 | | | | | | | | | | |
| 16 | | | | | | | | | | |
| 17 | 5.0 | | | | | | | | | |
| 18 | | | | | | | | | | |
| 19 | | | | | | RC3 | 100 | -- | 50 | -- |
| 20 | 6.0 | | | | | | | | | |
| 21 | | | | | | | | | | |
| 22 | | | | | | | | | | |
| 23 | 7.0 | | | | | RC4 | 100 | -- | 55 | -- |
| 24 | | | | | | | | | | |
| 25 | | | | | | | | | | |
| 26 | 8.0 | 74.2 | | | | | | | | |
| 27 | 8.0 | | | **END OF BOREHOLE :** | | | | | | |
| 28 | | | | | | | | | | |
| 29 | | | | **NOTE :** | | | | | | |
| 30 | 9.0 | | | - End of Borehole at 7.98 m bgs | | | | | | |
| 31 | | | | - Borehole was dry upon completion | | | | | | |
| 32 | | | | - bgs donates 'below ground surface' | | | | | | |
| 33 | 10.0 | | | | | | | | | |
| 34 | | | | | | | | | | |
| 35 | | | | | | | | | | |

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
$W_p$ $W_l$ Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



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REFERENCE No.: 11205379 ENCLOSURE No.: 12

**BOREHOLE No.:** BH12-22
**ELEVATION:** 82.1 m

# BOREHOLE REPORT

Page: 1 of 1

CLIENT: Infrastructure Ontario (I.O.) PROJECT: Preliminary Geotechnical Investigation

LOCATION: 401 Smyth Road, Ottawa, Ontario

DRILLING RIG: Track Drill Rig DRILLING METHOD: 203mm OD Hollow Stem Augers

DESCRIBED BY: D. Ash CHECKED BY: A. Khandekar

DATE (START): 12 July 2022 DATE (FINISH): 12 July 2022

**LEGEND**

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

NORTHING: 5027590.3 m EASTING: 449214.3 m

| Depth Feet | Depth Metres | Elevation (m) | Stratigraphy | DESCRIPTION OF SOIL AND BEDROCK | State | Type and Number | Recovery/ TCR(%) | Moisture Content | Blows per 15cm/ RQD(%) | 'N' Value/ SCR(%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 82.1 | | GROUND SURFACE | | | | % | | |
| 0 | | | | FILL : GM-GRAVEL, some sand and silt, trace clay, brown, moist, compact Gravel : 66%, Sand : 14%, Clay & Silt : 20% | | SS1 | 46 | 3 | 13-25-5-5 | 30 |
| 1 | 0.5 | | | | | | | | | |
| 2 | 0.7 | 81.4 | | NATIVE : SM-ML-SAND and SILT, trace clay, brown, moist, very dense | | SS2 | 100 | 5 | 15-39-40-50/ 75mm | 79 |
| 3 | 1.0 | | | | | | | | | |
| | 1.1 | 81.0 | | SHALE-BEDROCK, weathered, light brown | | SS3 | 100 | -- | 50/ 0mm | 50/ 0mm |
| 4 | | | | | | | | | | |
| 5 | 1.5 | | | | | | | | | |
| 6 | 1.8 | 80.2 | | Borehole terminated due to spoon and auger refusal | | | | | | |
| | 2.0 | | | **END OF BOREHOLE :** | | | | | | |
| 7 | | | | **NOTE :** - End of Borehole at 1.83 m bgs - Borehole was dry upon completion - bgs donates 'below ground surface' | | | | | | |
| 8 | 2.5 | | | | | | | | | |
| 9 | | | | | | | | | | |
| 10 | 3.0 | | | | | | | | | |
| 11 | | | | | | | | | | |
| 12 | 3.5 | | | | | | | | | |
| 13 | 4.0 | | | | | | | | | |
| 14 | | | | | | | | | | |
| 15 | 4.5 | | | | | | | | | |
| 16 | | | | | | | | | | |

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
$W_p$ $W_l$ Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

REFERENCE No.: 11205379 ENCLOSURE No.: 13

GHD

**BOREHOLE No.:** BH13-22
**ELEVATION:** 82.2 m

# BOREHOLE REPORT

Page: 1 of 1

CLIENT: Infrastructure Ontario (I.O.) PROJECT: Preliminary Geotechnical Investigation
LOCATION: 401 Smyth Road, Ottawa, Ontario
DRILLING RIG: Track Drill Rig DRILLING METHOD: 203mm OD Hollow Stem Augers
DESCRIBED BY: L. McCann/S. Wallis CHECKED BY: A. Khandekar
DATE (START): 4 July 2022 DATE (FINISH): 4 July 2022

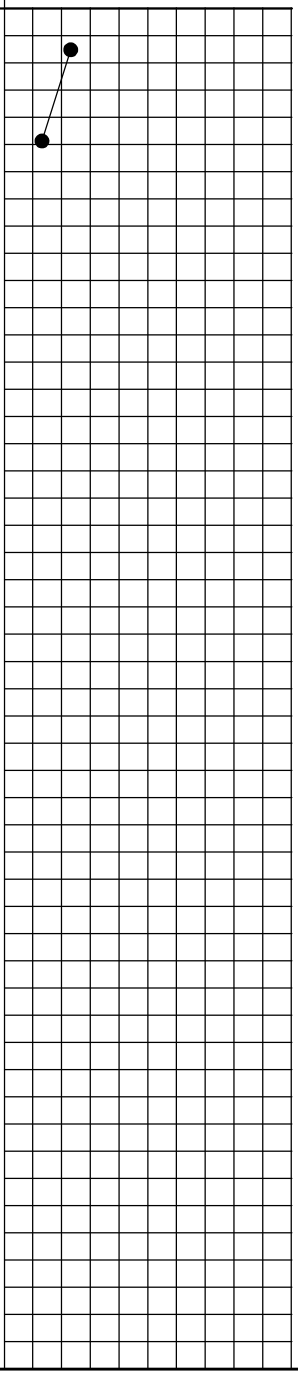
**LEGEND**
SS - SPLIT SPOON
ST - SHELBY TUBE
RC - ROCK CORE
▼ - WATER LEVEL

NORTHING: 5027615.5 m EASTING: 449212.0 m

| Depth (Feet) | Depth (Metres) | Elevation (m) | Stratigraphy | DESCRIPTION OF SOIL AND BEDROCK | State | Type and Number | Recovery/ TCR(%) | Moisture Content | Blows per 15cm/ RQD(%) | 'N' Value/ SCR(%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 82.2 | | GROUND SURFACE | | | | % | | |
| 0 | 0.1 | 82.1 | | ASPHALT : 75 mm | | | | | | |
| 1 | | | | FILL : GW-GM-SANDY GRAVEL, light brown/grey, dry, compact | | SS1 | 100 | -- | 10-13-10-5 | 23 |
| 2 | | | | | | | | | | |
| 3 | 0.9 | 81.3 | | | | | | | | |
| | 1.0 | 81.2 | | NATIVE : SP-GP-SAND and GRAVEL, trace clay, brown, moist, compact | | SS2 | 71 | -- | 2-2-11-15 | 13 |
| 4 | 1.0 | | | SHALE-BEDROCK, weathered, grey | | | | | | |
| 5 | | | | | | RC1 | 82 | -- | 0 | -- |
| 6 | 1.9 | 80.2 | | | | | | | | |
| | 2.0 | | | SHALE-BEDROCK, moderately to highly weathered, thinly bedded, highly to moderately fractured, grey, weak | | | | | | |
| 7 | | | | | | | | | | |
| 8 | | | | | | | | | | |
| 9 | | | | | | RC2 | 95 | -- | 10 | -- |
| 10 | 3.0 | | | | | | | | | |
| 11 | | | | occasional clay and shale layers | | | | | | |
| 12 | | | | | | | | | | |
| 13 | 4.0 | | | | | | | | | |
| 14 | | | | | | RC3 | 100 | -- | 37 | -- |
| 15 | | | | | | | | | | |
| 16 | 5.0 | | | | | | | | | |
| 17 | | | | occasional clay and shale layers | | | | | | |
| 18 | | | | | | | | | | |
| 19 | | | | | | RC4 | 100 | -- | 43 | -- |
| 20 | 6.0 | | | | | | | | | |
| 21 | | | | | | | | | | |
| 22 | 6.6 | 75.5 | | | | | | | | |
| 23 | 7.0 | | | **END OF BOREHOLE :** | | | | | | |
| 24 | | | | | | | | | | |
| 25 | | | | **NOTE :** | | | | | | |
| 26 | 8.0 | | | - End of Borehole at 2.37 m bgs | | | | | | |
| 27 | | | | - Borehole was dry upon completion | | | | | | |
| 28 | | | | - Rock coring from 1.32 m bgs | | | | | | |
| 29 | | | | - bgs donates 'below ground surface' | | | | | | |
| 30 | 9.0 | | | | | | | | | |
| 31 | | | | | | | | | | |
| 32 | | | | | | | | | | |

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
$W_p$ $W_l$ Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



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REFERENCE No.: 11205379 ENCLOSURE No.: 14

**BOREHOLE No.:** BH14-22
**ELEVATION:** 82.2 m

# BOREHOLE REPORT

Page: 1 of 1

CLIENT: Infrastructure Ontario (I.O.) PROJECT: Preliminary Geotechnical Investigation
LOCATION: 401 Smyth Road, Ottawa, Ontario
DRILLING RIG: Track Drill Rig DRILLING METHOD: 203mm OD Hollow Stem Augers
DESCRIBED BY: D. Ash CHECKED BY: A. Khandekar
DATE (START): 12 July 2022 DATE (FINISH): 12 July 2022

**LEGEND**
SS - SPLIT SPOON
ST - SHELBY TUBE
RC - ROCK CORE
▼ - WATER LEVEL

NORTHING: 5027618.1 m EASTING: 449237.3 m

| Depth Feet | Depth Metres | Elevation (m) | Stratigraphy | DESCRIPTION OF SOIL AND BEDROCK | State | Type and Number | Recovery/ TCR(%) | Moisture Content % | Blows per 15cm/ RQD(%) | 'N' Value/ SCR(%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 82.2 | | GROUND SURFACE | | | | | | |
| 0 | | | | FILL : GW-GM-SANDY GRAVEL, trace silt, trace clay, brown, moist, dense Gravel : 66%, Sand : 22%, Clay & Silt : 12% | | SS1 | 58 | 2 | 11-25-16-6 | 41 |
| 1 | 0.5 | | | | | | | | | |
| 2 | 0.6 | 81.6 | | NATIVE : SP-GP-SAND and GRAVEL, trace silt, trace clay, brown, moist, very dense | | | | | | |
| | 0.7 | 81.5 | | SHALE-BEDROCK, weathered, light brown | | SS2 | 100 | 5 | 7-35-48-42 | 83 |
| 3 | 1.0 | | | | | | | | | |
| 4 | 1.2 | 81.0 | | Borehole terminated due to spoon and auger refusal | | | | | | |
| 5 | 1.5 | | | **END OF BOREHOLE :** | | | | | | |
| 6 | | | | **NOTE :** - End of Borehole at 1.22 m bgs - Borehole was dry upon completion - bgs donates 'below ground surface' | | | | | | |
| 7 | 2.0 | | | | | | | | | |
| 8 | 2.5 | | | | | | | | | |
| 9 | | | | | | | | | | |
| 10 | 3.0 | | | | | | | | | |
| 11 | 3.5 | | | | | | | | | |
| 12 | | | | | | | | | | |
| 13 | 4.0 | | | | | | | | | |
| 14 | | | | | | | | | | |
| 15 | 4.5 | | | | | | | | | |
| 16 | | | | | | | | | | |

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
$W_p$ $W_l$ Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

REFERENCE No.: 11205379 ENCLOSURE No.: 15

**BOREHOLE No.:** BH15-22
**ELEVATION:** 82.1 m

# BOREHOLE REPORT

Page: 1 of 1

CLIENT: Infrastructure Ontario (I.O.) PROJECT: Preliminary Geotechnical Investigation

LOCATION: 401 Smyth Road, Ottawa, Ontario

DRILLING RIG: Track Drill Rig DRILLING METHOD: 203mm OD Hollow Stem Augers

DESCRIBED BY: D. Ash CHECKED BY: A. Khandekar

DATE (START): 12 July 2022 DATE (FINISH): 12 July 2022

**LEGEND**

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

NORTHING: 5027642.6 m EASTING: 449234.7 m

| Depth Feet | Depth Metres | Elevation (m) | Stratigraphy | DESCRIPTION OF SOIL AND BEDROCK | State | Type and Number | Recovery/ TCR(%) | Moisture Content | Blows per 15cm/ RQD(%) | 'N' Value/ SCR(%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 82.1 | | GROUND SURFACE | | | | % | | |
| 0 | | | | FILL : SM-SAND and GRAVEL, trace silt, trace clay, brown, moist, dense Gravel : 40%, Sand : 47%, Silt : 10%, Clay : 3% | | SS1 | 62 | 3 | 16-18-13-5 | 31 |
| 1 | 0.5 | | | | | | | | | |
| 2 | 0.6 | 81.5 | | SHALE-BEDROCK, weathered, light brown | | SS2 | 100 | 6 | 20-25-50/ 125mm | 75/ 125mm |
| 3 | 1.0 | | | | | | | | | |
| | 1.1 | 81.1 | | Borehole terminated due to spoon and auger refusal | | | | | | |
| 4 | | | | **END OF BOREHOLE :** | | | | | | |
| 5 | 1.5 | | | **NOTE :** - End of Borehole at 1.07 m bgs - Borehole was dry upon completion - bgs donates 'below ground surface' | | | | | | |
| 6 | | | | | | | | | | |
| 7 | 2.0 | | | | | | | | | |
| 8 | 2.5 | | | | | | | | | |
| 9 | | | | | | | | | | |
| 10 | 3.0 | | | | | | | | | |
| 11 | | | | | | | | | | |
| 12 | 3.5 | | | | | | | | | |
| 13 | 4.0 | | | | | | | | | |
| 14 | | | | | | | | | | |
| 15 | 4.5 | | | | | | | | | |
| 16 | | | | | | | | | | |

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
$W_p$ $W_l$ Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

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REFERENCE No.: 11205379 ENCLOSURE No.: 16

**BOREHOLE No.:** BH16-22
**ELEVATION:** 82.1 m

# BOREHOLE REPORT

Page: 1 of 1

CLIENT: Infrastructure Ontario (I.O.) PROJECT: Preliminary Geotechnical Investigation

LOCATION: 401 Smyth Road, Ottawa, Ontario

DRILLING RIG: Track Drill Rig DRILLING METHOD: 203mm OD Hollow Stem Augers

DESCRIBED BY: D. Ash CHECKED BY: A. Khandekar

DATE (START): 12 July 2022 DATE (FINISH): 17 December 2022

**LEGEND**

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

NORTHING: 5027594.4 m EASTING: 449262.3 m

| Depth Feet | Depth Metres | Elevation (m) | Stratigraphy | DESCRIPTION OF SOIL AND BEDROCK | State | Type and Number | Recovery/ TCR(%) | Moisture Content | Blows per 15cm/ RQD(%) | 'N' Value/ SCR(%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 82.1 | | GROUND SURFACE | | | | % | | |
| 0 | | | | FILL : SW-SM-SAND and GRAVEL, trace silt, trace clay, brown, moist, compact Gravel : 44%, Sand : 45%, Silt : 9%, Clay : 2% | | SS1 | 54 | 3 | 2-6-8-6 | 14 |
| 1 | 0.5 | | | | | | | | | |
| 2 | 0.7 | 81.4 | | NATIVE : SP-GP-SAND and GRAVEL, trace silt, trace clay, brown, moist, compact | | SS2 | 87 | 7 | 2-4-11-14 | 15 |
| 3 | 0.9 | 81.2 | | SHALE-BEDROCK, weathered, light brown | | | | | | |
| | 1.0 | | | | | | | | | |
| 4 | 1.2 | 80.9 | | Borehole terminated due to spoon and auger refusal | | SS3 | 100 | -- | 50/ 0mm | 50/ 0mm |
| 5 | 1.5 | | | **END OF BOREHOLE :** | | | | | | |
| 6 | | | | **NOTE :** - End of Borehole at 1.22 m bgs - Borehole was dry upon completion - bgs donates 'below ground surface' | | | | | | |
| 7 | 2.0 | | | | | | | | | |
| 8 | 2.5 | | | | | | | | | |
| 9 | | | | | | | | | | |
| 10 | 3.0 | | | | | | | | | |
| 11 | | | | | | | | | | |
| 12 | 3.5 | | | | | | | | | |
| 13 | 4.0 | | | | | | | | | |
| 14 | | | | | | | | | | |
| 15 | 4.5 | | | | | | | | | |
| 16 | | | | | | | | | | |

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
$W_p$ $W_l$ Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

REFERENCE No.: 11205379 ENCLOSURE No.: 17

**BOREHOLE No.:** BH17-22
**ELEVATION:** 82.1 m

# BOREHOLE REPORT

Page: 1 of 1

CLIENT: Infrastructure Ontario (I.O.) PROJECT: Preliminary Geotechnical Investigation

LOCATION: 401 Smyth Road, Ottawa, Ontario

DRILLING RIG: Track Drill Rig DRILLING METHOD: 203mm OD Hollow Stem Augers

DESCRIBED BY: D. Ash CHECKED BY: A. Khandekar

DATE (START): 12 July 2022 DATE (FINISH): 12 July 2022

**LEGEND**

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

NORTHING: 5027619.3 m EASTING: 449258.6 m

| Depth (Feet) | Depth (Metres) | Elevation (m) | Stratigraphy | DESCRIPTION OF SOIL AND BEDROCK | State | Type and Number | Recovery/ TCR(%) | Moisture Content | Blows per 15cm/ RQD(%) | 'N' Value/ SCR(%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 82.1 | | GROUND SURFACE | | | | % | | |
| 0 | | | | FILL : GW-GM-GRAVEL with SAND, trace silt, trace clay, brown, moist, compact Gravel : 52%, Sand : 39%, Silt : 7%, Clay : 2%, | | SS1 | 54 | -- | 4-10-17-11 | 27 |
| 1 | 0.5 | | | | | | | | | |
| 2 | 0.7 | 81.4 | | NATIVE : SP-GP-SAND and GRAVEL, trace silt, trace clay, brown, moist, compact | | SS2 | 100 | -- | 3-8-22-50/ 75mm | 30 |
| 3 | 1.0 | | | | | | | | | |
| | 1.1 | 81.0 | | SHALE-BEDROCK, weathered, light brown, | | | | | | |
| 4 | 1.1 | 81.0 | | Borehole terminated due to spoon and auger refusal | | | | | | |
| 5 | 1.5 | | | **END OF BOREHOLE :** | | | | | | |
| 6 | | | | **NOTE :** - End of Borehole at 1.14 m bgs - Borehole was dry upon completion - bgs donates 'below ground surface' | | | | | | |
| 7 | 2.0 | | | | | | | | | |
| 8 | 2.5 | | | | | | | | | |
| 9 | | | | | | | | | | |
| 10 | 3.0 | | | | | | | | | |
| 11 | | | | | | | | | | |
| 12 | 3.5 | | | | | | | | | |
| 13 | 4.0 | | | | | | | | | |
| 14 | | | | | | | | | | |
| 15 | 4.5 | | | | | | | | | |
| 16 | | | | | | | | | | |

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
$W_p$ $W_l$ Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

REFERENCE No.: 11205379 ENCLOSURE No.: 18

**BOREHOLE No.:** BH18-22
**ELEVATION:** 82.1 m

# BOREHOLE REPORT

Page: 1 of 1

CLIENT: Infrastructure Ontario (I.O.) PROJECT: Preliminary Geotechnical Investigation

LOCATION: 401 Smyth Road, Ottawa, Ontario

DRILLING RIG: Track Drill Rig DRILLING METHOD: 203mm OD Hollow Stem Augers

DESCRIBED BY: D. Ash CHECKED BY: A. Khandekar

DATE (START): 15 July 2022 DATE (FINISH): 15 July 2022

**LEGEND**

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

NORTHING: 5027645.0 m EASTING: 449256.7 m

| Depth (Feet) | Depth (Metres) | Elevation (m) | Stratigraphy | DESCRIPTION OF SOIL AND BEDROCK | State | Type and Number | Recovery/ TCR(%) | Moisture Content | Blows per 15cm/ RQD(%) | 'N' Value/ SCR(%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 82.1 | | GROUND SURFACE | | | | % | | |
| 0 | | | | FILL : | | | | | | |
| 1 | | | | GW-GM-SANDY GRAVEL with sand, trace silt, trace clay, grey/brown, moist, compact | | SS1 | 62 | -- | 9-8-10-4 | 18 |
| 2 | 0.6 | 81.5 | | Gravel : 73%, Sand : 21%, Silt : 5%, Clay : 1% | | | | | | |
| 3 | 0.8 1.0 | 81.3 | | NATIVE : | | SS2 | 83 | -- | 2-11-27-50 | 38 |
| 4 | | | | SP-GP-SAND and GRAVEL, trace silt, trace clay, moist, dense | | | | | | |
| 5 | 1.4 | 80.7 | | SHALE-BEDROCK | | RC1 | 100 | -- | 0 | -- |
| 6 | 2.0 | | | auger refusal | | | | | | |
| 7 | | | | SHALE-BEDROCK, moderately to highly weathered, thinly bedded, very weak to moderately strong, grey/black | | | | | | |
| 8 | | | | | | | | | | |
| 9 | | | | | | | | | | |
| 10 | 3.0 | | | | | RC2 | 100 | -- | 0 | -- |
| 11 | | | | | | | | | | |
| 12 | | | | | | | | | | |
| 13 | 4.0 | | | | | | | | | |
| 14 | | | | | | | | | | |
| 15 | | | | | | RC3 | 100 | -- | 36 | -- |
| 16 | 5.0 | | | | | | | | | |
| 17 | | | | | | | | | | |
| 18 | | | | | | | | | | |
| 19 | | | | | | | | | | |
| 20 | 6.0 | | | | | RC4 | 100 | -- | 51 | -- |
| 21 | | | | | | | | | | |
| 22 | | | | | | | | | | |
| 23 | 7.0 | | | | | | | | | |
| 24 | 7.1 | 75.0 | | **END OF BOREHOLE :** | | | | | | |
| 25 | | | | | | | | | | |
| 26 | 8.0 | | | **NOTE :** | | | | | | |
| 27 | | | | - End of Borehole at 7.13 m bgs | | | | | | |
| 28 | | | | - Rock coring from 1.40 m bgs | | | | | | |
| 29 | | | | - Borehole was dry upon completion | | | | | | |
| 30 | 9.0 | | | - bgs donates 'below ground surface' | | | | | | |
| 31 | | | | | | | | | | |
| 32 | | | | | | | | | | |

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
$W_p$ $W_l$ Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

REFERENCE No.: 11205379 ENCLOSURE No.: 19

**BOREHOLE No.:** BH19-22
**ELEVATION:** 81.1 m

# BOREHOLE REPORT

Page: 1 of 1

CLIENT: Infrastructure Ontario (I.O.) PROJECT: Preliminary Geotechnical Investigation
LOCATION: 401 Smyth Road, Ottawa, Ontario
DRILLING RIG: Track Drill Rig DRILLING METHOD: 203mm OD Hollow Stem Augers
DESCRIBED BY: D. Ash CHECKED BY: A. Khandekar
DATE (START): 14 July 2022 DATE (FINISH): 14 July 2022

**LEGEND**
SS - SPLIT SPOON
ST - SHELBY TUBE
RC - ROCK CORE
▼ - WATER LEVEL

NORTHING: 5027588.9 m EASTING: 449046.7 m

| Depth Feet | Depth Metres | Elevation (m) | Stratigraphy | DESCRIPTION OF SOIL AND BEDROCK | State | Type and Number | Recovery/ TCR(%) | Moisture Content % | Blows per 15cm/ RQD(%) | 'N' Value/ SCR(%) |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | 81.1 | | GROUND SURFACE | | | | | | |
| | 0.1 | 81.0 | | ASPHALT : 75 mm | | | | | | |
| 1 | | | | FILL : SM-GRAVELLY SAND, trace silt, trace clay, brown, loose | | SS1 | 79 | -- | 4-5-3-6 | 8 |
| | 0.5 | | | | | | | | | |
| 2 | 0.7 | 80.4 | | NATIVE : SP-GP-SAND and GRAVEL, some silt, trace clay, brown, moist, very dense Gravel : 31%, Sand : 46%, Silt : 16%, Clay : 7% | | | | | | |
| | 0.9 | 80.2 | | | | SS2 | 71 | -- | 17-33-50/ 125mm | 83/ 125mm |
| 3 | 1.0 | | | SHALE-BEDROCK, weathered, light brown to grey/black | | | | | | |
| 4 | 1.4 | 79.7 | | | | | | | | |
| 5 | 1.5 | | | **END OF BOREHOLE :** | | | | | | |
| 6 | | | | **NOTE :** - End of Borehole at 1.37 m bgs - Borehole was dry upon completion - bgs donates 'below ground surface' | | | | | | |
| 7 | 2.0 | | | | | | | | | |
| 8 | 2.5 | | | | | | | | | |
| 9 | | | | | | | | | | |
| 10 | 3.0 | | | | | | | | | |
| 11 | | | | | | | | | | |
| 12 | 3.5 | | | | | | | | | |
| 13 | 4.0 | | | | | | | | | |
| 14 | | | | | | | | | | |
| 15 | 4.5 | | | | | | | | | |
| 16 | | | | | | | | | | |

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
$W_p$ $W_l$ Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

File: N:\CA\TORONTO\PROJECTS\66211205379\TECH\LOG DATABASE\11205379 - PARKING GARAGE ADDITION.GPJ Library File: 11205379 GHD_GEOTECH_V05.GLB Report: 11205379 SOIL LOG WITH GRAPH+WELL Date: 1/9/22

REFERENCE No.: 11205379 ENCLOSURE No.: 20

GHD

**BOREHOLE No.:** MW20-22

**ELEVATION:** 81.2 m

# BOREHOLE REPORT

Page: 1 of 1

CLIENT: Infrastructure Ontario (I.O.) PROJECT: Preliminary Geotechnical Investigation

LOCATION: 401 Smyth Road, Ottawa, Ontario

DRILLING RIG: Track Drill Rig DRILLING METHOD: 203mm OD Hollow Stem Augers

DESCRIBED BY: D. Ash CHECKED BY: A. Khandekar

DATE (START): 14 July 2022 DATE (FINISH): 14 July 2022

**LEGEND**

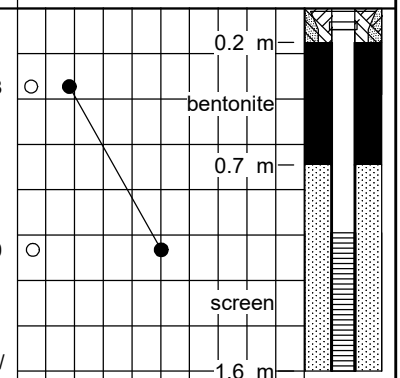
- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

NORTHING: 5027656.2 m EASTING: 449095.7 m

| Depth Feet | Depth Metres | Elevation (m) | Stratigraphy | DESCRIPTION OF SOIL AND BEDROCK | State | Type and Number | Recovery/ TCR(%) | Moisture Content | Blows per 15cm/ RQD(%) | 'N' Value/ SCR(%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 81.2 | | GROUND SURFACE | | | | % | | |
| 0 | 0.1 | 81.1 | | ASPHALT : 75 mm | | | | | | |
| 1 | 0.5 | | | FILL : SM-GRAVELLY SAND, some silt, trace clay, brown, moist, compact Gravel : 36%, Sand : 44%, Silt : 16%, Clay : 4% | | SS1 | 58 | 5 | 6-10-8-5 | 18 |
| 2 | 0.8 | 80.5 | | NATIVE : SP-GP-SAND and GRAVEL, trace silt, trace clay, brown, moist, dense Gravel : 46%, Sand : 41%, Silt : 9%, Clay : 4% | | | | | | |
| 3 | 1.0 | 80.2 | | | | SS2 | 87 | 5 | 8-21-29-27 | 50 |
| 4 | 1.0 | | | SHALE-BEDROCK, weathered, grey | | | | | | |
| 5 | 1.5 | | | | | SS3 | 100 | -- | 50/ 75mm | 50/ 75mm |
| 6 | 1.6 | 79.6 | | Borehole terminated due to spoon and auger refusal | | | | | | |
| 7 | 2.0 | | | **END OF BOREHOLE :** | | | | | | |
| 8 | 2.5 | | | **NOTE :** - End of Borehole at 1.60 m bgs - Monitoring well installed at 1.60 m bgs - bgs donates 'below ground surface' | | | | | | |
| 9 | | | | | | | | | | |
| 10 | 3.0 | | | | | | | | | |
| 11 | | | | | | | | | | |
| 12 | 3.5 | | | | | | | | | |
| 13 | 4.0 | | | | | | | | | |
| 14 | | | | | | | | | | |
| 15 | 4.5 | | | | | | | | | |
| 16 | | | | | | | | | | |
| 17 | 5.0 | | | | | | | | | |
| 18 | 5.5 | | | | | | | | | |
| 19 | | | | | | | | | | |

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
$W_p$ $W_l$ Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



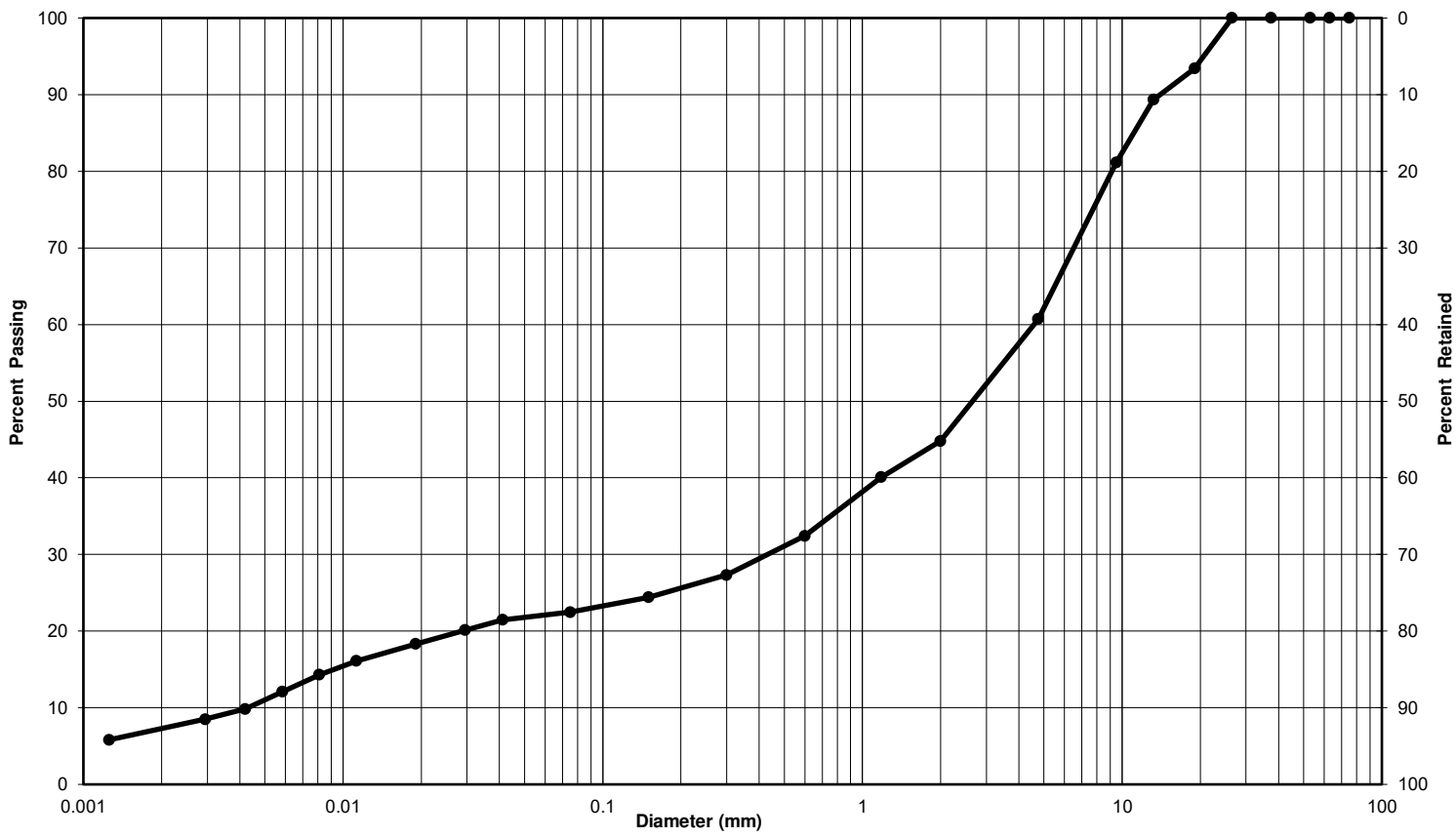

File: N:\CA\TORONTO\PROJECTS\66211205379\TECH\LOG DATABASE\11205379 - PARKING GARAGE ADDITION.GPJ Library File: 11205379 GHD_GEOTECH_V05.GLB Report: 11205379 SOIL LOG WITH GRAPH+WELL Date: 1/9/22

# Appendix B

## Geotechnical Laboratory Test Results

# Particle-Size Analysis of Soils
## MTO LS-702 (Geotechnical)

| | | | |
|---|---|---|---|
| **Client:** | Infrastructure Ontario | **Lab No.:** | G-21-01 |
| **Project, Site:** | Proposed Parking Structure<br>Children's Hospital of Eastern Ontario Campus<br>401 Smyth Road, Ottawa, Ontario | **Project No.:** | 11205379-80 |
| Borehole No.: | B1-21 | Sample No.: | SS2 |
| Depth: | 0.7-1.0m | Enclosure: | - |




| Clay & Silt | Sand | | | Gravel | |
|---|---|---|---|---|---|
| | Fine | Medium | Coarse | Fine | Coarse |
| Particle-Size Limits as per USCS (ASTM D-2487) | | | | | |

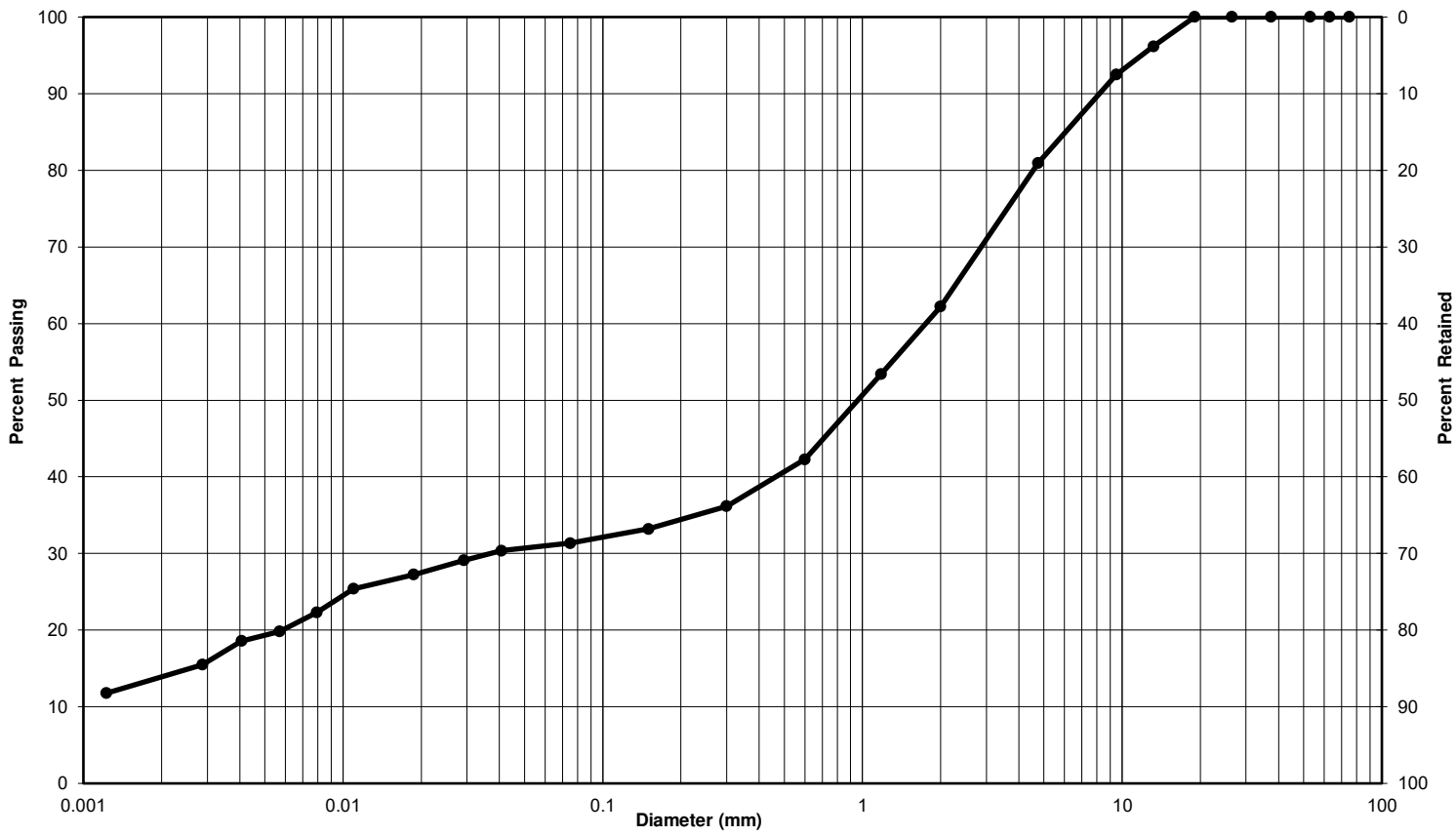
| Soil Description | Gravel (%) | Sand (%) | Clay & Silt (%) |
|---|---|---|---|
| Sand and Gravel, some Silt, trace Clay | 39 | 39 | 22 |
| Clay-size particles (<0.002 mm): | | | 7 % |

**Remarks:**

| | | | |
|---|---|---|---|
| **Performed by:** | Z. Mathurin | **Date:** | February 10, 2021 |
| **Verified by:** | E. Bennett | **Date:** | February 17, 2021 |

# Particle-Size Analysis of Soils
## MTO LS-702 (Geotechnical)

| | | | |
|---|---|---|---|
| **Client:** | Infrastructure Ontario | **Lab No.:** | G-21-01 |
| **Project, Site:** | Proposed Parking Structure<br>Children's Hospital of Eastern Ontario Campus<br>401 Smyth Road, Ottawa, Ontario | **Project No.:** | 11205379-80 |
| Borehole No.: | B3-21 | Sample No.: | SS2 |
| Depth: | 0.7-1.0 | Enclosure: | - |




| Clay & Silt | Sand | | | Gravel | |
|---|---|---|---|---|---|
| | Fine | Medium | Coarse | Fine | Coarse |
| Particle-Size Limits as per USCS (ASTM D-2487) | | | | | |

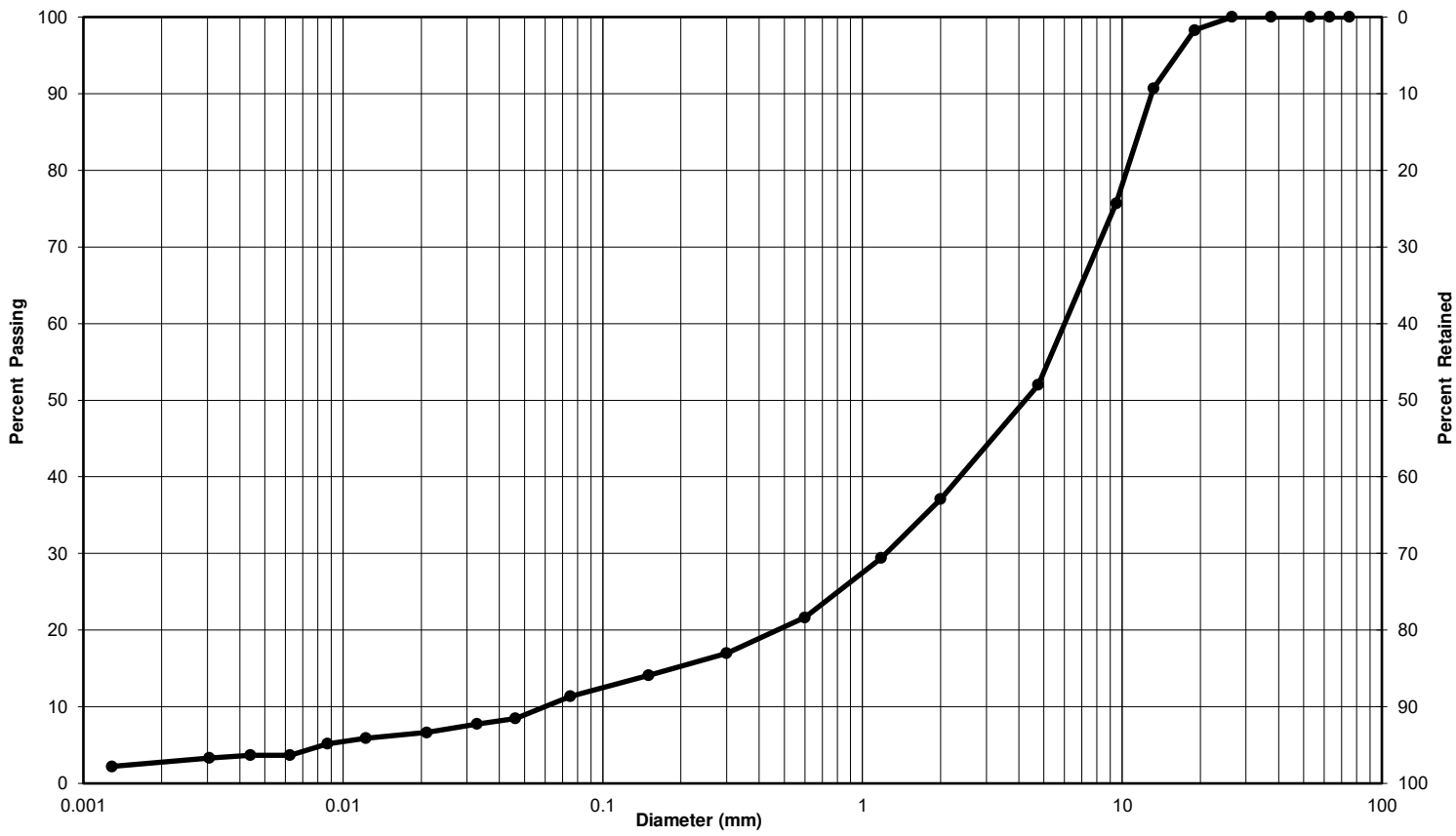
| Soil Description | Gravel (%) | Sand (%) | Clay & Silt (%) |
|---|---|---|---|
| Sand, some Gravel, some Silt, some Clay | 19 | 50 | 31 |
| Clay-size particles (<0.002 mm): | | | 14 % |

**Remarks:**

| | | | |
|---|---|---|---|
| **Performed by:** | Z. Mathurin | **Date:** | February 10, 2021 |
| **Verified by:** | E. Bennett | **Date:** | February 17, 2021 |

# Particle-Size Analysis of Soils
## MTO LS-702 (Geotechnical)

| | | | |
|---|---|---|---|
| **Client:** | Infrastructure Ontario | **Lab No.:** | G-21-01 |
| **Project, Site:** | Proposed Parking Structure<br>Children's Hospital of Eastern Ontario Campus<br>401 Smyth Road, Ottawa, Ontario | **Project No.:** | 11205379-80 |
| Borehole No.: | BH1-21 | Sample No.: | Grab |
| Depth: | 0.1-0.3m | Enclosure: | - |




| Clay & Silt | Sand | | | Gravel | |
|---|---|---|---|---|---|
| | Fine | Medium | Coarse | Fine | Coarse |
| Particle-Size Limits as per USCS (ASTM D-2487) | | | | | |

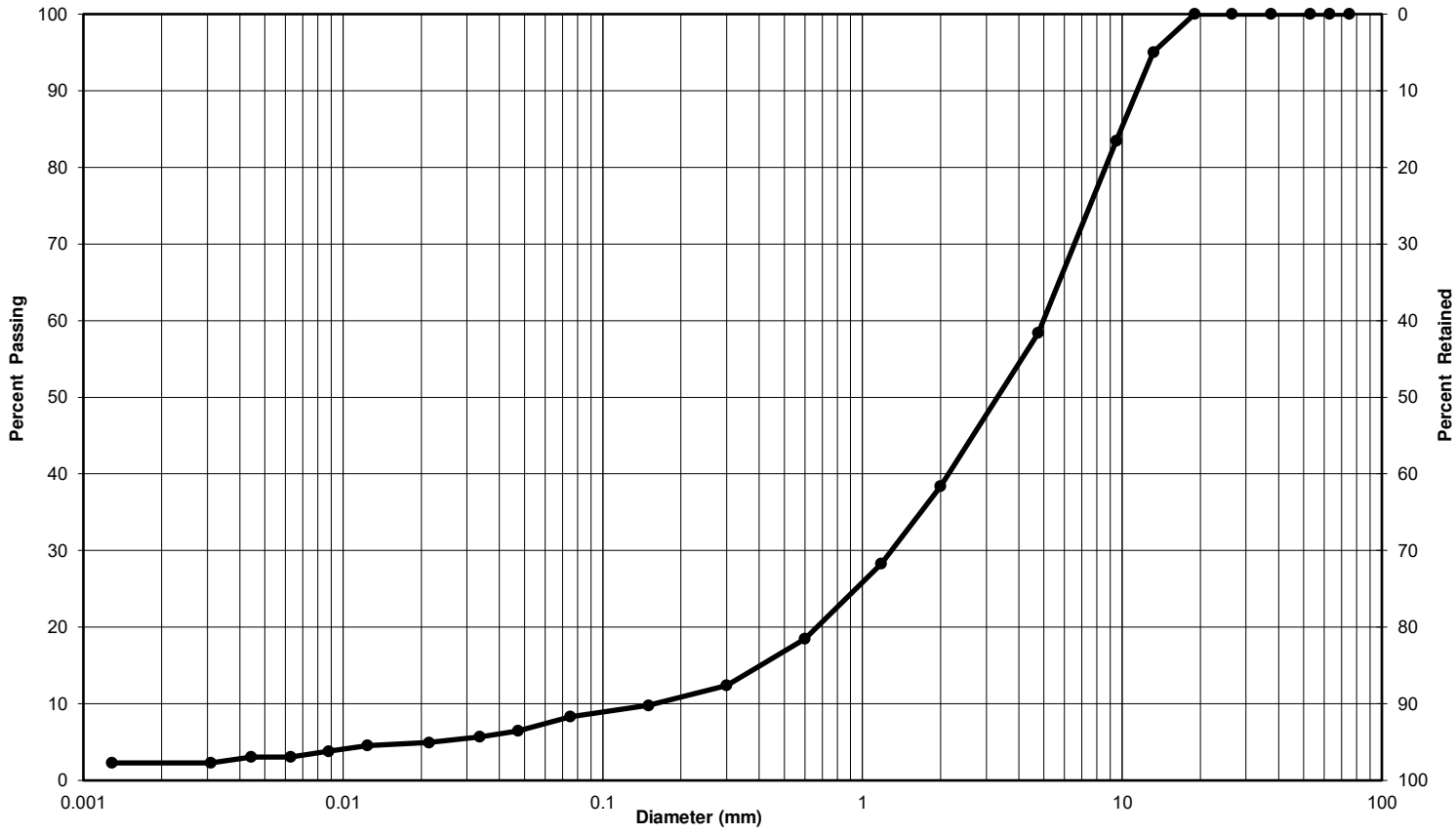
| Soil Description | Gravel (%) | Sand (%) | Clay & Silt (%) |
|---|---|---|---|
| Gravel and Sand, trace Silt, trace Clay | 48 | 41 | 11 |
| | | | 3 % |

**Remarks:**

| | | | |
|---|---|---|---|
| **Performed by:** | Z. Mathurin | **Date:** | February 10, 2021 |
| **Verified by:** | E. Bennett | **Date:** | February 17, 2021 |

# Particle-Size Analysis of Soils
## MTO LS-702 (Geotechnical)

| | | | |
|---|---|---|---|
| **Client:** | Infrastructure Ontario | **Lab No.:** | G-21-01 |
| **Project, Site:** | Proposed Parking Structure<br>Children's Hospital of Eastern Ontario Campus<br>401 Smyth Road, Ottawa, Ontario | **Project No.:** | 11205379-80 |
| Borehole No.: | BH2-21 | Sample No.: | Grab |
| Depth: | 0.1-0.3m | Enclosure: | - |




| Clay & Silt | Sand | | | Gravel | |
|---|---|---|---|---|---|
| | Fine | Medium | Coarse | Fine | Coarse |
| Particle-Size Limits as per USCS (ASTM D-2487) | | | | | |

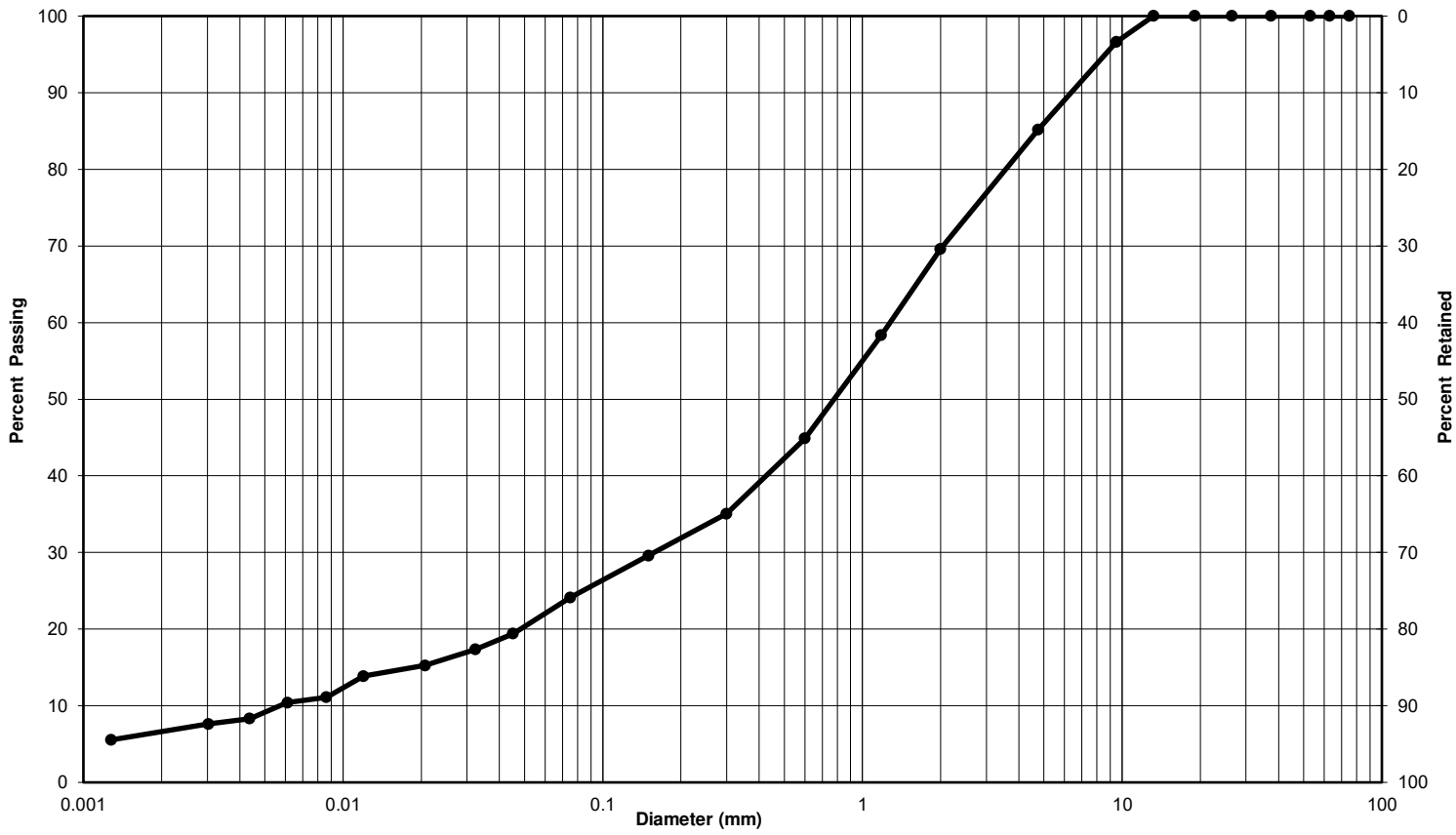
| Soil Description | Gravel (%) | Sand (%) | Clay & Silt (%) |
|---|---|---|---|
| Sand and Gravel, trace Silt, trace Clay | 42 | 50 | 8 |
| | | | 2 % |

**Remarks:**

| | | | |
|---|---|---|---|
| **Performed by:** | Z. Mathurin | **Date:** | February 10, 2021 |
| **Verified by:** | E. Bennett | **Date:** | February 17, 2021 |

# Particle-Size Analysis of Soils
## MTO LS-702 (Geotechnical)

| | | | |
|---|---|---|---|
| **Client:** | Infrastructure Ontario | **Lab No.:** | G-21-01 |
| **Project, Site:** | Proposed Parking Structure<br>Children's Hospital of Eastern Ontario Campus<br>401 Smyth Road, Ottawa, Ontario | **Project No.:** | 11205379-80 |
| Borehole No.: | BH2-21 | Sample No.: | SS1 |
| Depth: | 0.5-0.8m | Enclosure: | - |




| Clay & Silt | Sand | | | Gravel | |
|---|---|---|---|---|---|
| | Fine | Medium | Coarse | Fine | Coarse |
| Particle-Size Limits as per USCS (ASTM D-2487) | | | | | |

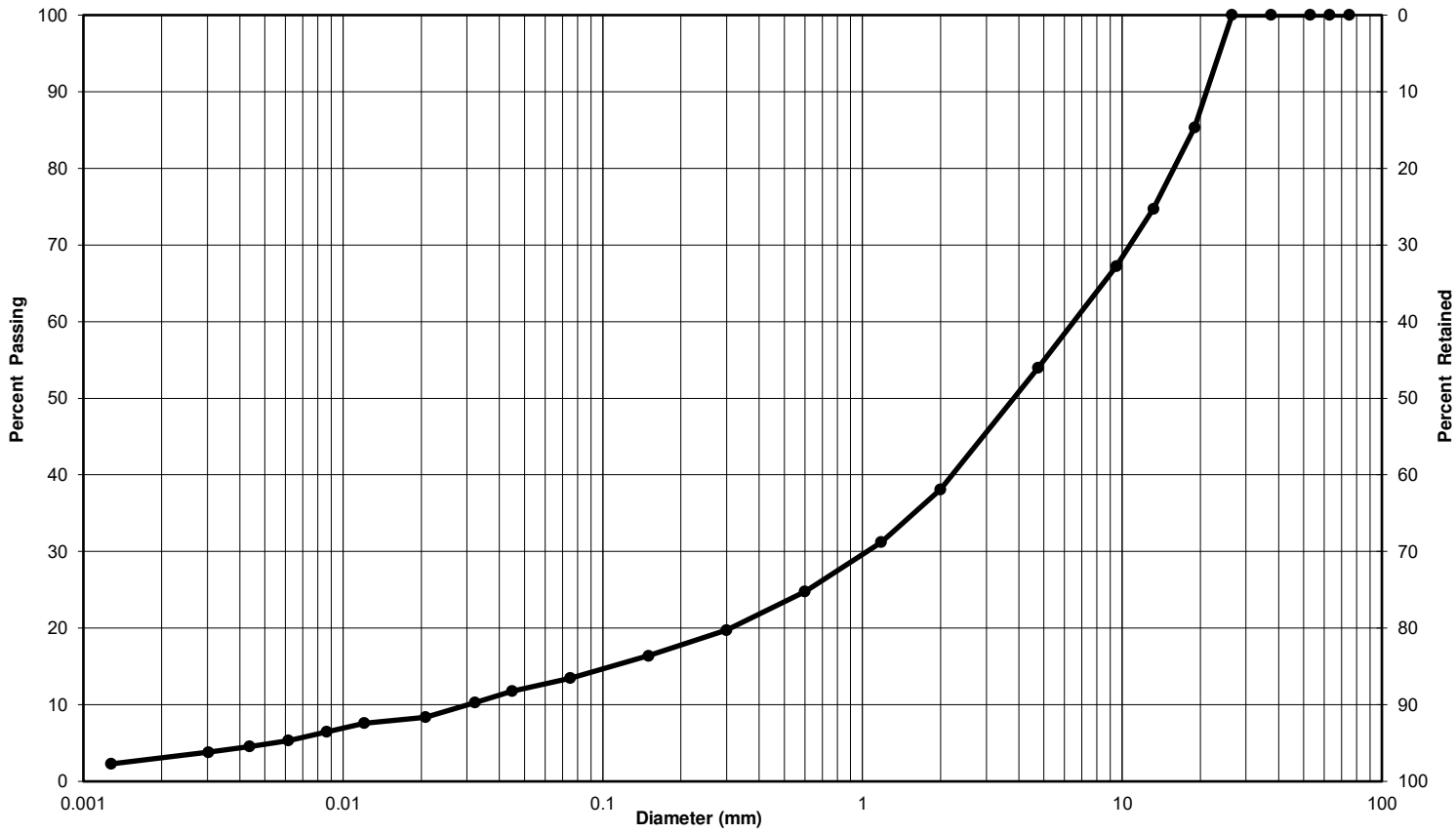
| Soil Description | Gravel (%) | Sand (%) | Clay & Silt (%) |
|---|---|---|---|
| Sand, some Silt, some Gravel, trace Clay | 15 | 61 | 24 |
| Clay-size particles (<0.002 mm): | | | 6 % |

**Remarks:**

| | | | |
|---|---|---|---|
| **Performed by:** | Z. Mathurin | **Date:** | February 10, 2021 |
| **Verified by:** | E. Bennett | **Date:** | February 17, 2021 |

# Particle-Size Analysis of Soils
## MTO LS-702 (Geotechnical)

| | | | |
|---|---|---|---|
| **Client:** | Infrastructure Ontario | **Lab No.:** | G-21-01 |
| **Project, Site:** | Proposed Parking Structure<br>Children's Hospital of Eastern Ontario Campus<br>401 Smyth Road, Ottawa, Ontario | **Project No.:** | 11205379-80 |
| Borehole No.: | BH4-21 | Sample No.: | SS1 |
| Depth: | 0.2-0.5m | Enclosure: | - |




| Clay & Silt | Sand | | | Gravel | |
|---|---|---|---|---|---|
| | Fine | Medium | Coarse | Fine | Coarse |
| Particle-Size Limits as per USCS (ASTM D-2487) | | | | | |

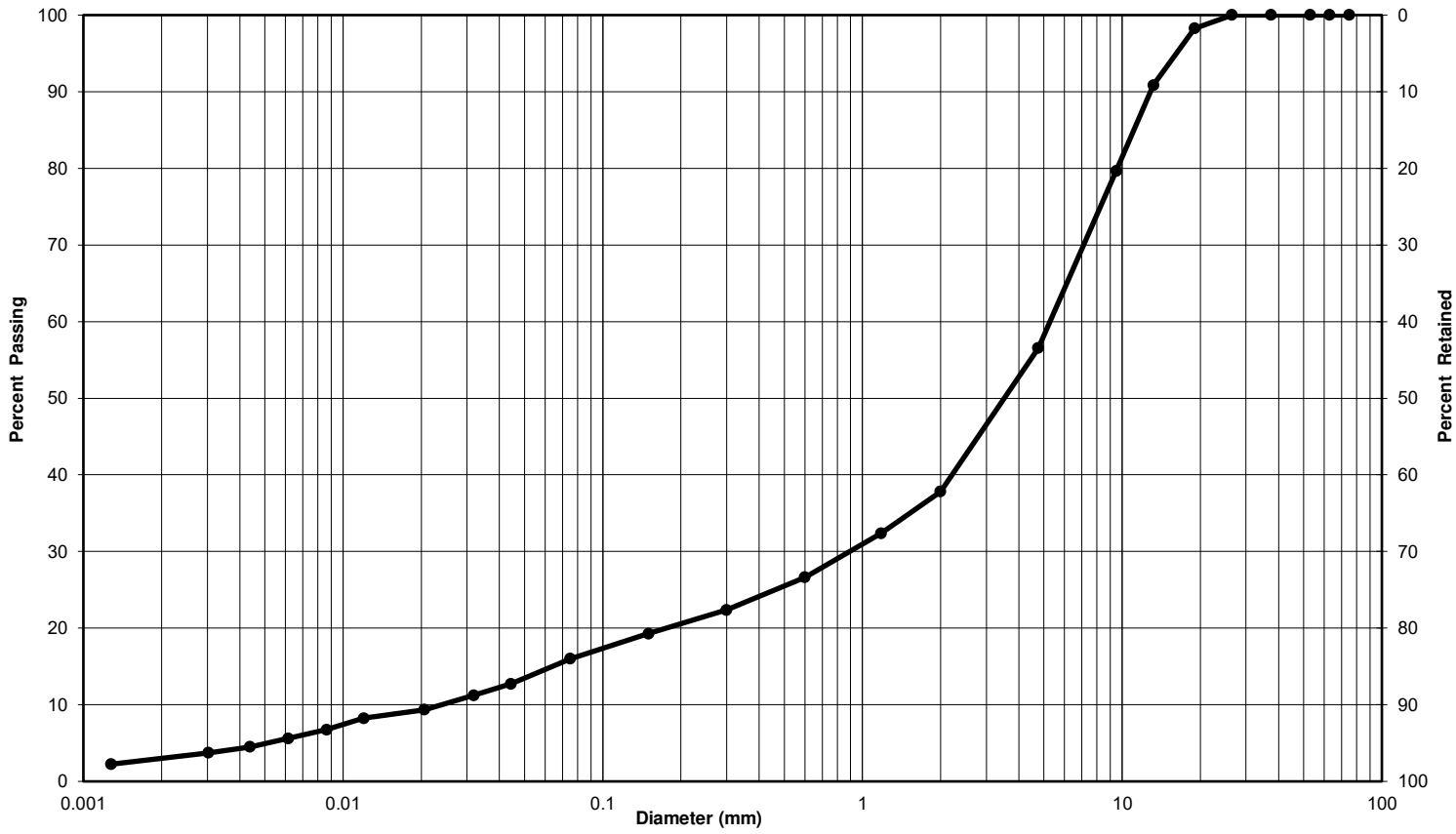
| Soil Description | Gravel (%) | Sand (%) | Clay & Silt (%) |
|---|---|---|---|
| Gravel and Sand, trace Silt, trace Clay | 46 | 41 | 13 |
| | | | 3 % |

**Remarks:**

| | | | |
|---|---|---|---|
| **Performed by:** | Z. Mathurin | **Date:** | February 10, 2021 |
| **Verified by:** | E. Bennett | **Date:** | February 17, 2021 |

# Particle-Size Analysis of Soils
## MTO LS-702 (Geotechnical)

| | | | |
|---|---|---|---|
| **Client:** | Infrastructure Ontario | **Lab No.:** | G-21-01 |
| **Project, Site:** | Proposed Parking Structure<br>Children's Hospital of Eastern Ontario Campus<br>401 Smyth Road, Ottawa, Ontario | **Project No.:** | 11205379-80 |
| Borehole No.: | MW5-21 | Sample No.: | Grab |
| Depth: | 0.1-0.3m | Enclosure: | - |




| Clay & Silt | Sand | | | Gravel | |
|---|---|---|---|---|---|
| | Fine | Medium | Coarse | Fine | Coarse |
| Particle-Size Limits as per USCS (ASTM D-2487) | | | | | |

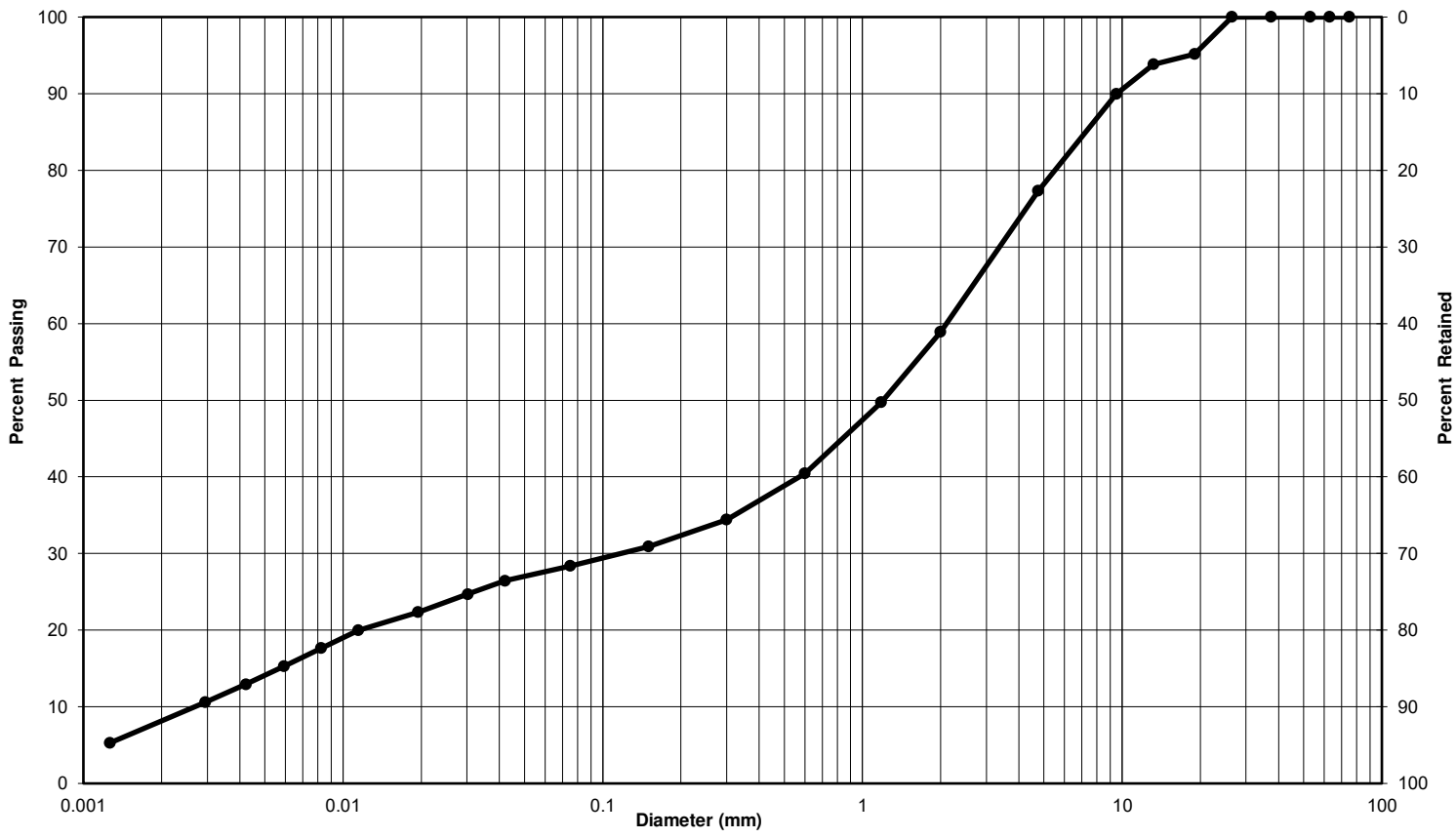
| Soil Description | Gravel (%) | Sand (%) | Clay & Silt (%) |
|---|---|---|---|
| Gravel and Sand, some Silt, trace Clay | 43 | 41 | 16 |
| Clay-size particles (<0.002 mm): | | | 3 % |

**Remarks:**

| | | | |
|---|---|---|---|
| **Performed by:** | Z. Mathurin | **Date:** | February 10, 2021 |
| **Verified by:** | E. Bennett | **Date:** | February 17, 2021 |

# Particle-Size Analysis of Soils
## MTO LS-702 (Geotechnical)

| | | | |
|---|---|---|---|
| **Client:** | Infrastructure Ontario | **Lab No.:** | G-21-01 |
| **Project, Site:** | Proposed Parking Structure<br>Children's Hospital of Eastern Ontario Campus<br>401 Smyth Road, Ottawa, Ontario | **Project No.:** | 11205379-80 |
| Borehole No.: | MW5-21 | Sample No.: | SS1 |
| Depth: | 0.5-0.8m | Enclosure: | - |




| Clay & Silt | Sand | | | Gravel | |
|---|---|---|---|---|---|
| | Fine | Medium | Coarse | Fine | Coarse |
| Particle-Size Limits as per USCS (ASTM D-2487) | | | | | |

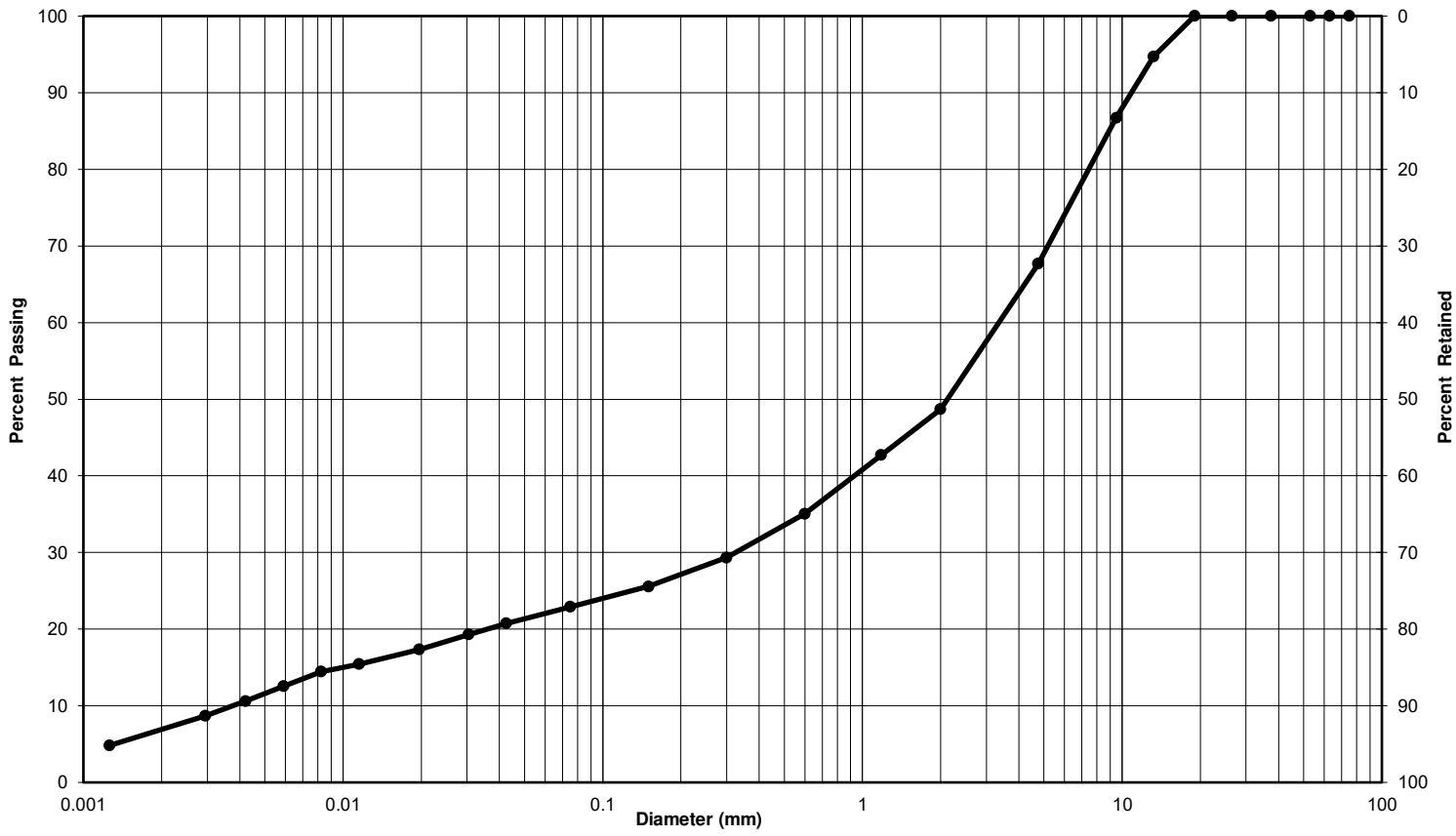
| Soil Description | Gravel (%) | Sand (%) | Clay & Silt (%) |
|---|---|---|---|
| Gravelly Sand, some Silt, trace Clay | 23 | 49 | 28 |
| Clay-size particles (<0.002 mm): | | | 8 % |

**Remarks:**

| | | | |
|---|---|---|---|
| **Performed by:** | Z. Mathurin | **Date:** | February 10, 2021 |
| **Verified by:** | E. Bennett | **Date:** | February 17, 2021 |

# Particle-Size Analysis of Soils
## MTO LS-702 (Geotechnical)

| | | | |
|---|---|---|---|
| **Client:** | Infrastructure Ontario | **Lab No.:** | G-21-01 |
| **Project, Site:** | Proposed Parking Structure<br>Children's Hospital of Eastern Ontario Campus<br>401 Smyth Road, Ottawa, Ontario | **Project No.:** | 11205379-80 |
| Borehole No.: | MW6-21 | Sample No.: | SS2 |
| Depth: | 0.8-1.1m | Enclosure: | - |




| Clay & Silt | Sand | | | Gravel | |
|---|---|---|---|---|---|
| | Fine | Medium | Coarse | Fine | Coarse |
| Particle-Size Limits as per USCS (ASTM D-2487) | | | | | |

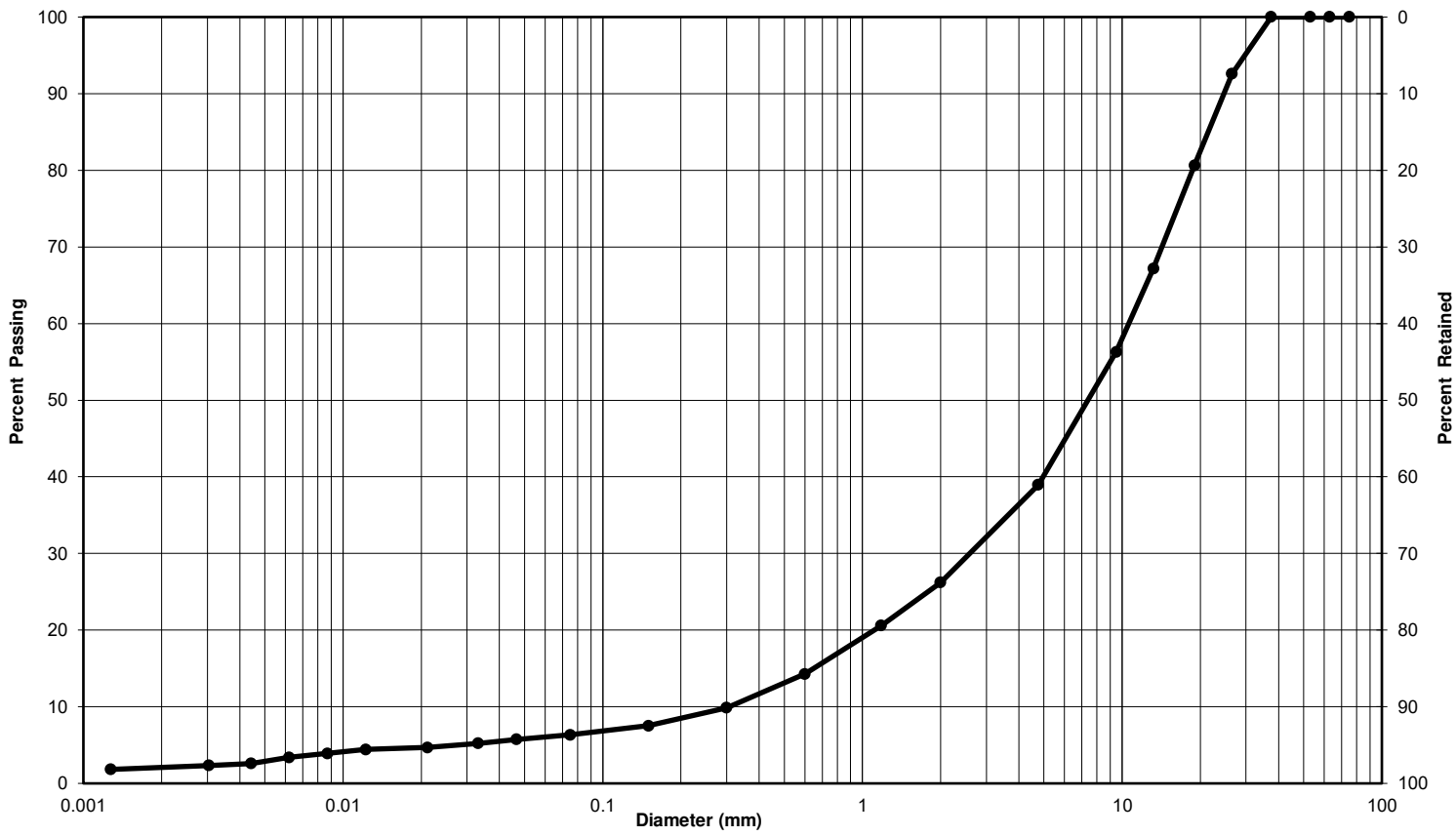
| Soil Description | Gravel (%) | Sand (%) | Clay & Silt (%) |
|---|---|---|---|
| Gravelly, Sand, some Silt, trace Clay | 32 | 45 | 23 |
| Clay-size particles (<0.002 mm): | | | 7 % |

**Remarks:**

| | | | |
|---|---|---|---|
| **Performed by:** | Z. Mathurin | **Date:** | February 10, 2021 |
| **Verified by:** | E. Bennett | **Date:** | February 17, 2021 |

# Particle-Size Analysis of Soils
## MTO LS-702 (Geotechnical)

| | | | |
|---|---|---|---|
| **Client:** | Infrastructure Ontario | **Lab No.:** | G-21-01 |
| **Project, Site:** | Proposed Parking Structure<br>Children's Hospital of Eastern Ontario Campus<br>401 Smyth Road, Ottawa, Ontario | **Project No.:** | 11205379-80 |
| Borehole No.: | MW8-21 | Sample No.: | Grab |
| Depth: | 0.0-0.3m | Enclosure: | - |




| Clay & Silt | Sand | | | Gravel | |
|---|---|---|---|---|---|
| | Fine | Medium | Coarse | Fine | Coarse |
| Particle-Size Limits as per USCS (ASTM D-2487) | | | | | |

| Soil Description | Gravel (%) | Sand (%) | Clay & Silt (%) |
|---|---|---|---|
| Sandy Gravel, trace Silt, trace Clay | 61 | 33 | 6 |
| | | | 2 % |

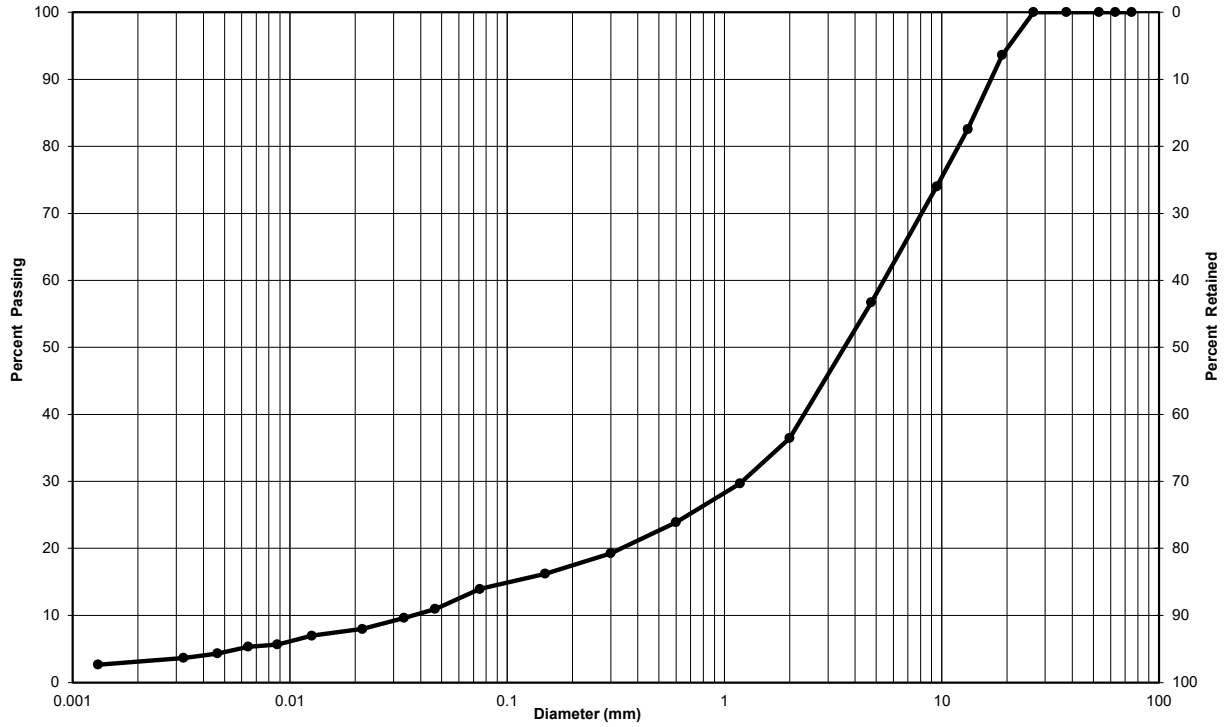
**Remarks:**

| | | | |
|---|---|---|---|
| **Performed by:** | Z. Mathurin | **Date:** | February 10, 2021 |
| **Verified by:** | E. Bennett | **Date:** | February 17, 2021 |

# Particle-Size Analysis of Soils
## MTO LS-702 (Geotechnical)

| | | | |
|---|---|---|---|
| **Client:** | Infrastructure Ontario | **Lab No.:** | G-22-03 |
| **Project, Site:** | Children Hospital | **Project No.:** | 11205379 |

| | | | |
|---|---|---|---|
| Borehole No.: | BH10-22 | Sample No.: | SS-1 |
| Depth: | 0 - 0,61 m | Enclosure: | - |




| Clay & Silt | Sand | | | Gravel | |
|---|---|---|---|---|---|
| | Fine | Medium | Coarse | Fine | Coarse |
| Particle-Size Limits as per USCS (ASTM D-2487) | | | | | |

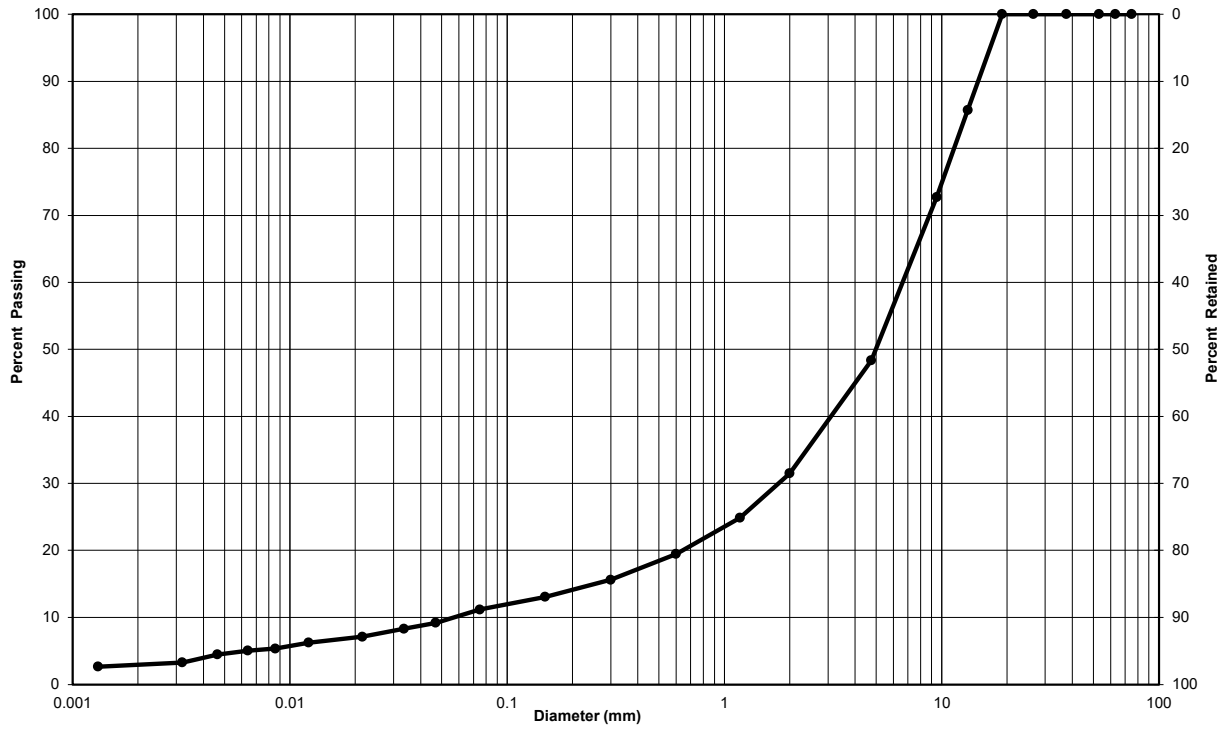
| Soil Description | Gravel (%) | Sand (%) | Clay & Silt (%) |
|---|---|---|---|
| Gravel and Sand, with Some Silt and Traces of Clay | 43 | 43 | 14 |
| **Silt-size particles (%) :** | 11 | | |
| **Clay-size particles (%) (<0.002 mm):** | 3 | | |

**Remarks:** More information is available upon request.

| | | | |
|---|---|---|---|
| **Performed by:** | J. Lalonde | **Date:** | August 15, 2022 |
| **Verified by:** | | **Date:** | August 24, 2022 |

# Particle-Size Analysis of Soils
## MTO LS-702 (Geotechnical)

| | | | |
|---|---|---|---|
| **Client:** | Infrastructure Ontario | **Lab No.:** | G-22-03 |
| **Project, Site:** | Children Hospital | **Project No.:** | 11205379 |
| Borehole No.: | BH11-22 | Sample No.: | SS-1 |
| Depth: | 0 - 0,61 m | Enclosure: | - |




| Clay & Silt | Sand | | | Gravel | |
|---|---|---|---|---|---|
| | Fine | Medium | Coarse | Fine | Coarse |
| Particle-Size Limits as per USCS (ASTM D-2487) | | | | | |

| Soil Description | Gravel (%) | Sand (%) | Clay & Silt (%) |
|---|---|---|---|
| Gravel and Sand, with Traces of Silt and Clay | 52 | 37 | 11 |
| **Silt-size particles (%) :** | 8 | | |
| **Clay-size particles (%) (<0.002 mm):** | 3 | | |

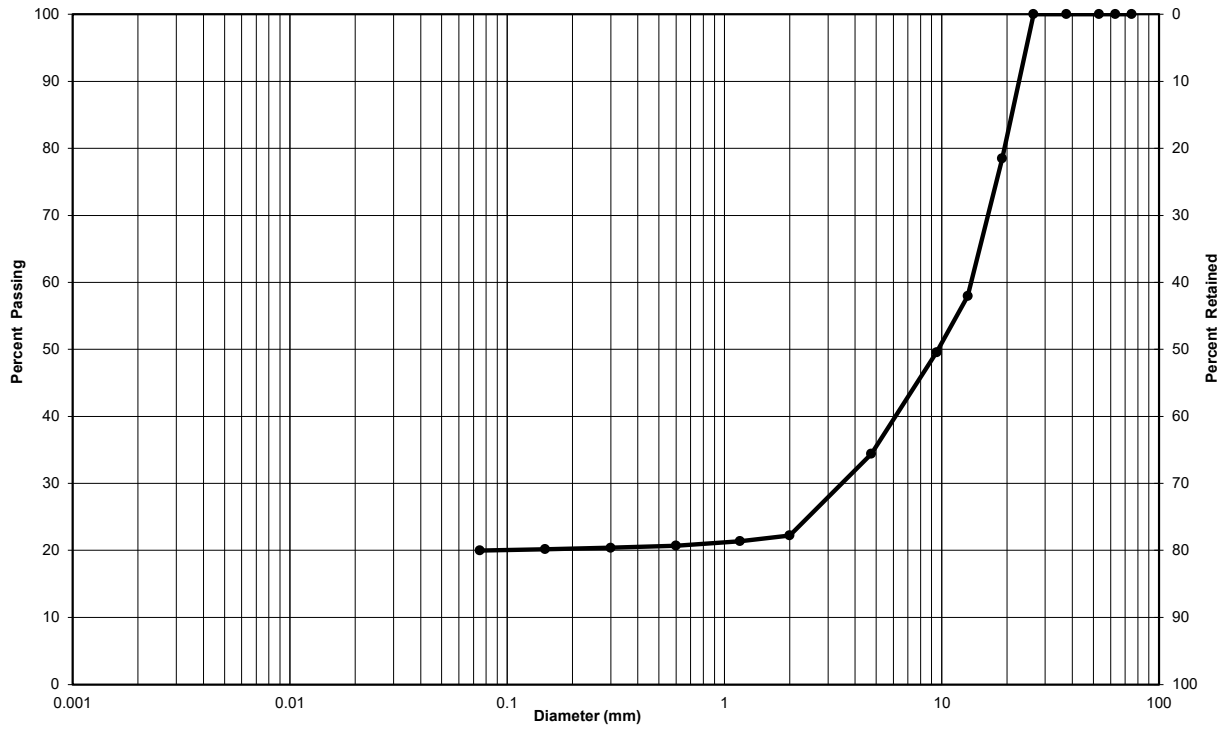
**Remarks:** More information is available upon request.

| | | | |
|---|---|---|---|
| **Performed by:** | J. Lalonde | **Date:** | August 11, 2022 |
| **Verified by:** | | **Date:** | August 24, 2022 |

# Particle-Size Analysis of Soils
## MTO LS-702 (Geotechnical)

| | | | |
|---|---|---|---|
| **Client:** | Infrastructure Ontario | **Lab No.:** | G-22-03 |
| **Project, Site:** | Children Hospital | **Project No.:** | 11205379 |

| | | | |
|---|---|---|---|
| Borehole No.: | BH12-22 | Sample No.: | SS-1 |
| Depth: | 0 - 0,61 m | Enclosure: | - |




| Clay & Silt | Sand | | | Gravel | |
|---|---|---|---|---|---|
| | Fine | Medium | Coarse | Fine | Coarse |
| Particle-Size Limits as per USCS (ASTM D-2487) | | | | | |

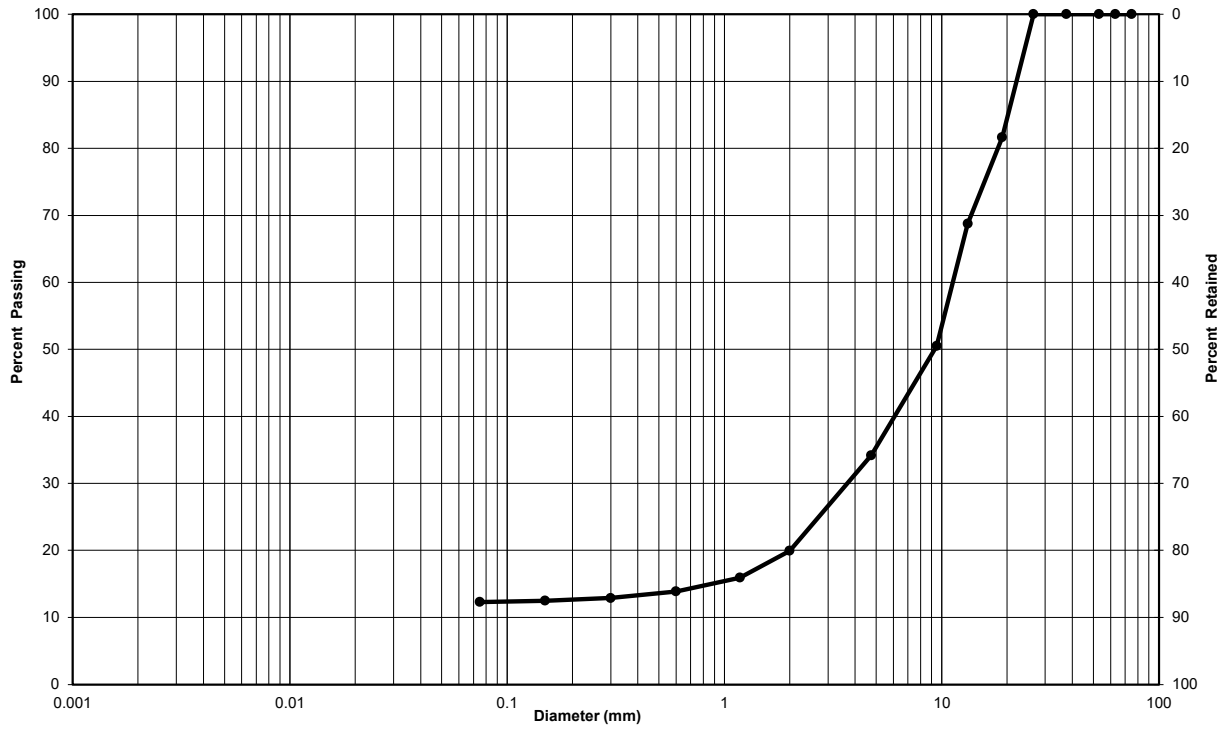
| Soil Description | Gravel (%) | Sand (%) | Clay & Silt (%) |
|---|---|---|---|
| Gravel, with Some Sand and Silt, Traces of Clay | 66 | 14 | 20 |
| **Silt-size particles (%) :** | | | |
| **Clay-size particles (%) (<0.002 mm):** | | | |

**Remarks:** More information is available upon request.

| | | | |
|---|---|---|---|
| **Performed by:** | J. Lalonde | **Date:** | August 11, 2022 |
| **Verified by:** | | **Date:** | August 24, 2022 |

# Particle-Size Analysis of Soils
## MTO LS-702 (Geotechnical)

| | | | |
|---|---|---|---|
| **Client:** | Infrastructure Ontario | **Lab No.:** | G-22-03 |
| **Project, Site:** | Children Hospital | **Project No.:** | 11205379 |
| Borehole No.: | BH14-22 | Sample No.: | SS-1 |
| Depth: | 0 - 0,61 m | Enclosure: | - |




| Clay & Silt | Sand | | | Gravel | |
|---|---|---|---|---|---|
| | Fine | Medium | Coarse | Fine | Coarse |
| Particle-Size Limits as per USCS (ASTM D-2487) | | | | | |

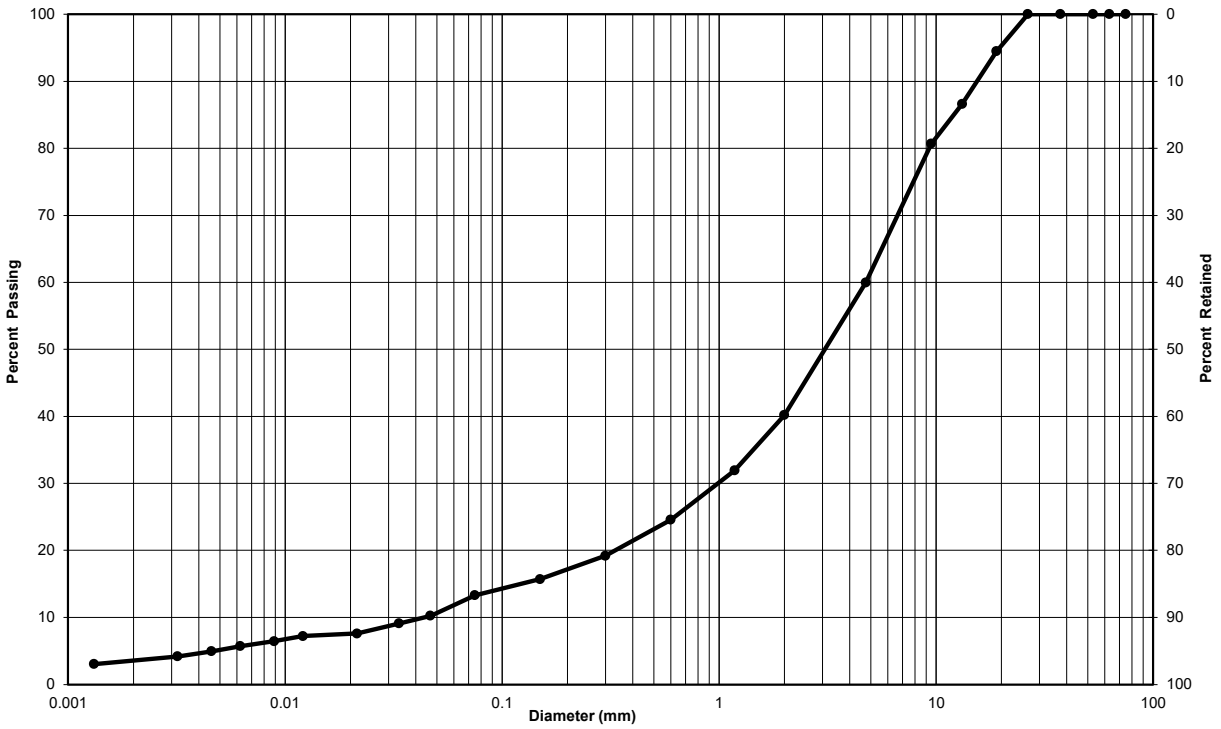
| Soil Description | Gravel (%) | Sand (%) | Clay & Silt (%) |
|---|---|---|---|
| Sandy Gravel, with Traces of Silt and Clay | 66 | 22 | 12 |
| **Silt-size particles (%) :** | | | |
| **Clay-size particles (%) (<0.002 mm):** | | | |

**Remarks:** More information is available upon request.

| | | | |
|---|---|---|---|
| **Performed by:** | J. Lalonde | **Date:** | August 11, 2022 |
| **Verified by:** | | **Date:** | August 24, 2022 |

# Particle-Size Analysis of Soils
## MTO LS-702 (Geotechnical)

| | | | |
|---|---|---|---|
| **Client:** | Infrastructure Ontario | **Lab No.:** | G-22-03 |
| **Project, Site:** | Children Hospital | **Project No.:** | 11205379 |
| Borehole No.: | BH15-22 | Sample No.: | SS-1 |
| Depth: | 0 - 0,61 m | Enclosure: | - |




| Clay & Silt | Sand | | | Gravel | |
|---|---|---|---|---|---|
| | Fine | Medium | Coarse | Fine | Coarse |
| Particle-Size Limits as per USCS (ASTM D-2487) | | | | | |

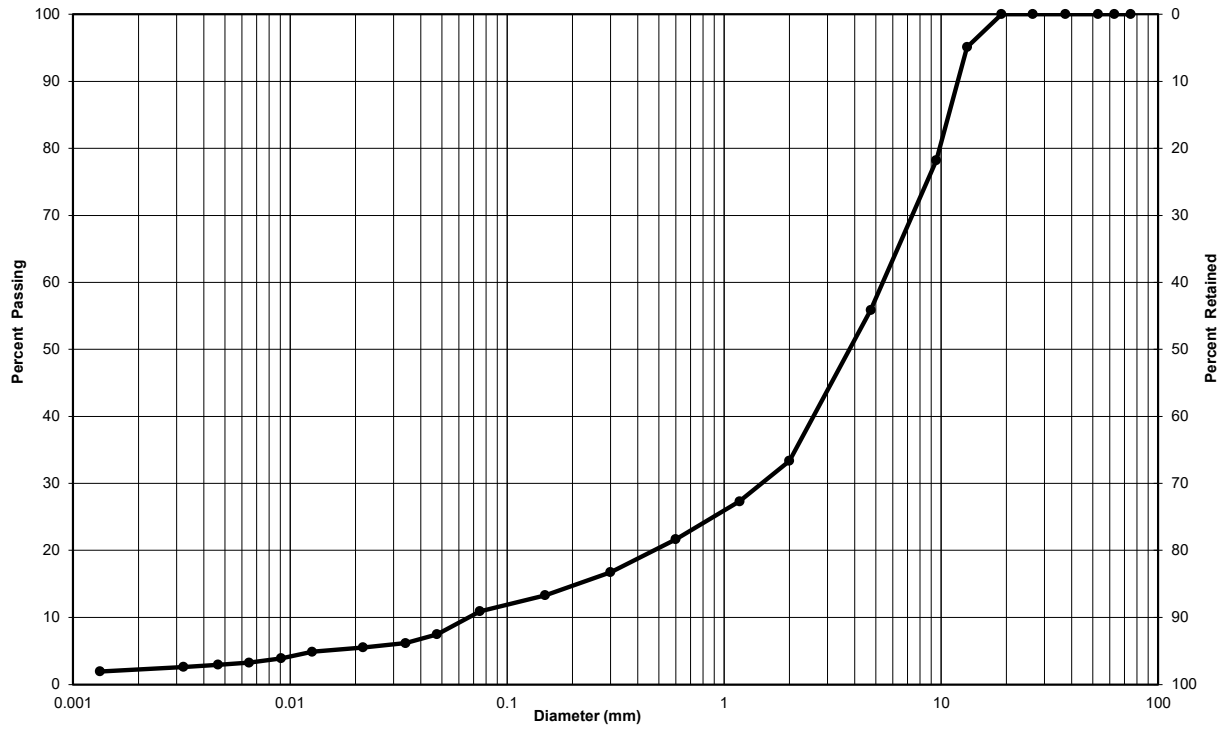
| Soil Description | Gravel (%) | Sand (%) | Clay & Silt (%) |
|---|---|---|---|
| Sand and Gravel, with Some Silt and Traces of Clay | 40 | 47 | 13 |
| **Silt-size particles (%) :** | 10 | | |
| **Clay-size particles (%) (<0.002 mm):** | 3 | | |

**Remarks:** More information is available upon request.

| | | | |
|---|---|---|---|
| **Performed by:** | J. Lalonde | **Date:** | August 11, 2022 |
| **Verified by:** | | **Date:** | August 24, 2022 |

# Particle-Size Analysis of Soils
## MTO LS-702 (Geotechnical)

| | | | |
|---|---|---|---|
| **Client:** | Infrastructure Ontario | **Lab No.:** | G-22-03 |
| **Project, Site:** | Children Hospital | **Project No.:** | 11205379 |
| Borehole No.: | BH16-22 | Sample No.: | SS-1 |
| Depth: | 0 - 0,61 m | Enclosure: | - |




| Clay & Silt | Sand | | | Gravel | |
|---|---|---|---|---|---|
| | Fine | Medium | Coarse | Fine | Coarse |
| Particle-Size Limits as per USCS (ASTM D-2487) | | | | | |

| Soil Description | Gravel (%) | Sand (%) | Clay & Silt (%) |
|---|---|---|---|
| Sand and Gravel, with Traces of Silt and Clay | 44 | 45 | 11 |
| **Silt-size particles (%) :** | 9 | | |
| **Clay-size particles (%) (<0.002 mm):** | 2 | | |

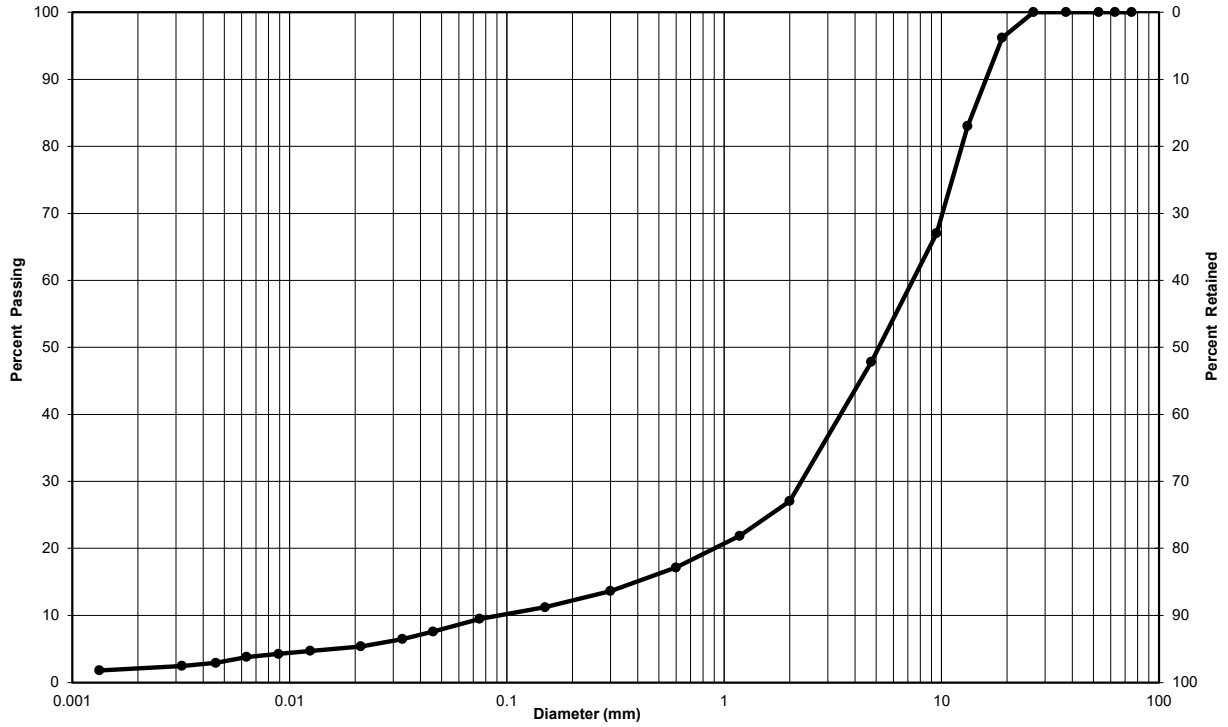
**Remarks:** More information is available upon request.

| | | | |
|---|---|---|---|
| **Performed by:** | J. Lalonde | **Date:** | August 11, 2022 |
| **Verified by:** | | **Date:** | August 24, 2022 |

# Particle-Size Analysis of Soils
## MTO LS-702 (Geotechnical)

| | | | |
|---|---|---|---|
| **Client:** | Infrastructure Ontario | **Lab No.:** | G-22-03 |
| **Project, Site:** | Children Hospital | **Project No.:** | 11205379 |

| | | | |
|---|---|---|---|
| Borehole No.: | BH17-22 | Sample No.: | SS-1 |
| Depth: | 0 - 0,61 m | Enclosure: | - |




| Clay & Silt | Sand | | | Gravel | |
|---|---|---|---|---|---|
| | Fine | Medium | Coarse | Fine | Coarse |
| Particle-Size Limits as per USCS (ASTM D-2487) | | | | | |

| Soil Description | Gravel (%) | Sand (%) | Clay & Silt (%) |
|---|---|---|---|
| Sandy Gravel, with Traces of Silt and Clay | 52 | 39 | 9 |
| **Silt-size particles (%) :** | 7 | | |
| **Clay-size particles (%) (<0.002 mm):** | 2 | | |

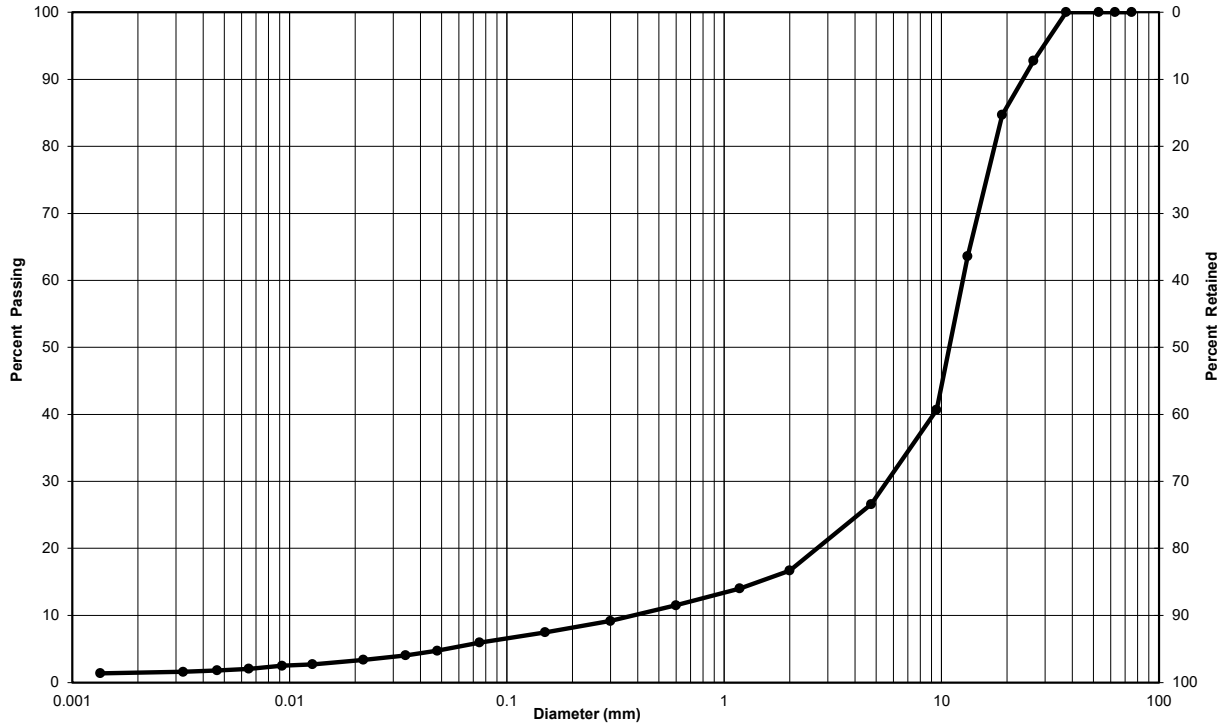
**Remarks:** More information is available upon request.

| | | | |
|---|---|---|---|
| **Performed by:** | J. Lalonde | **Date:** | August 9, 2022 |
| **Verified by:** | | **Date:** | August 24, 2022 |

# Particle-Size Analysis of Soils
## MTO LS-702 (Geotechnical)

| | | | |
|---|---|---|---|
| **Client:** | Infrastructure Ontario | **Lab No.:** | G-22-03 |
| **Project, Site:** | Children Hospital | **Project No.:** | 11205379 |

| | | | |
|---|---|---|---|
| Borehole No.: | BH18-22 | Sample No.: | SS-1 |
| Depth: | 0 - 0,61 m | Enclosure: | - |




| Clay & Silt | Sand | | | Gravel | |
|---|---|---|---|---|---|
| | Fine | Medium | Coarse | Fine | Coarse |
| Particle-Size Limits as per USCS (ASTM D-2487) | | | | | |

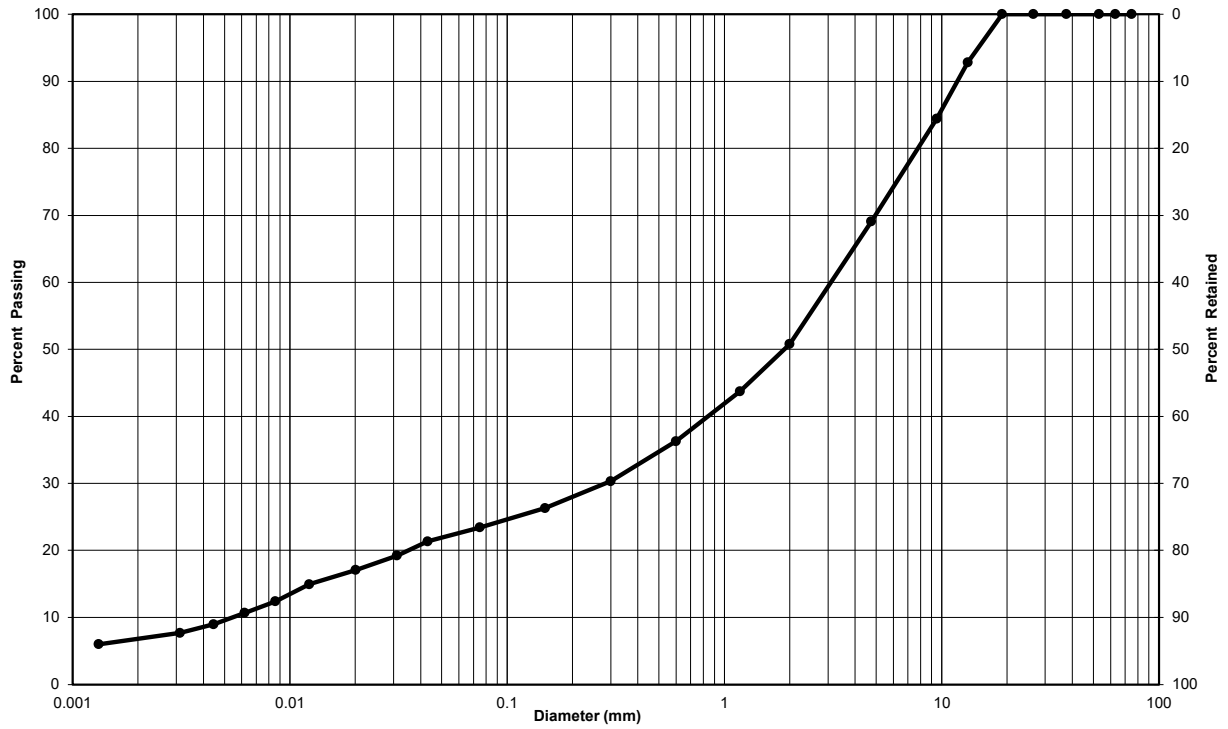
| Soil Description | Gravel (%) | Sand (%) | Clay & Silt (%) |
|---|---|---|---|
| Sandy Gravel, with Traces of Silt and Clay | 73 | 21 | 6 |
| **Silt-size particles (%) :** | 5 | | |
| **Clay-size particles (%) (<0.002 mm):** | 1 | | |

**Remarks:** More information is available upon request.

| | | | |
|---|---|---|---|
| **Performed by:** | J. Lalonde | **Date:** | August 9, 2022 |
| **Verified by:** | | **Date:** | August 24, 2022 |

# Particle-Size Analysis of Soils
## MTO LS-702 (Geotechnical)

| | | | |
|---|---|---|---|
| **Client:** | Infrastructure Ontario | **Lab No.:** | G-22-03 |
| **Project, Site:** | Children Hospital | **Project No.:** | 11205379 |
| Borehole No.: | BH19-22 | Sample No.: | SS-2 |
| Depth: | 0,76 - 1,37 m | Enclosure: | - |




| Clay & Silt | Sand | | | Gravel | |
|---|---|---|---|---|---|
| | Fine | Medium | Coarse | Fine | Coarse |
| Particle-Size Limits as per USCS (ASTM D-2487) | | | | | |

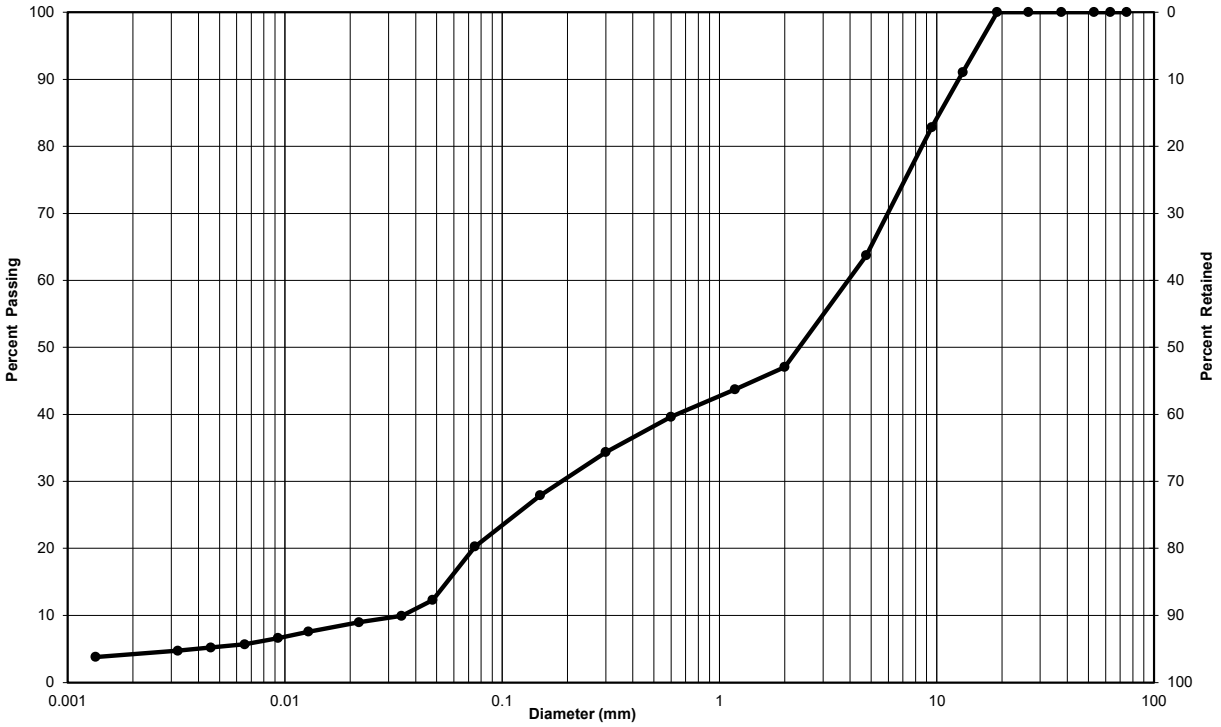
| Soil Description | Gravel (%) | Sand (%) | Clay & Silt (%) |
|---|---|---|---|
| Sand and Gravel, with Some Silt and Traces of Clay | 31 | 46 | 23 |
| **Silt-size particles (%) :** | 16 | | |
| **Clay-size particles (%) (<0.002 mm):** | 7 | | |

**Remarks:** More information is available upon request.

| | | | |
|---|---|---|---|
| **Performed by:** | J. Lalonde | **Date:** | August 17, 2022 |
| **Verified by:** | | **Date:** | August 24, 2022 |

# Particle-Size Analysis of Soils
## MTO LS-702 (Geotechnical)

| | | | |
|---|---|---|---|
| **Client:** | Infrastructure Ontario | **Lab No.:** | G-22-03 |
| **Project, Site:** | Children Hospital | **Project No.:** | 11205379 |
| Borehole No.: | MW20-22 | Sample No.: | SS-1 |
| Depth: | 0,00 - 0,61 m | Enclosure: | - |




| Clay & Silt | Sand | | | Gravel | |
|---|---|---|---|---|---|
| | Fine | Medium | Coarse | Fine | Coarse |
| Particle-Size Limits as per USCS (ASTM D-2487) | | | | | |

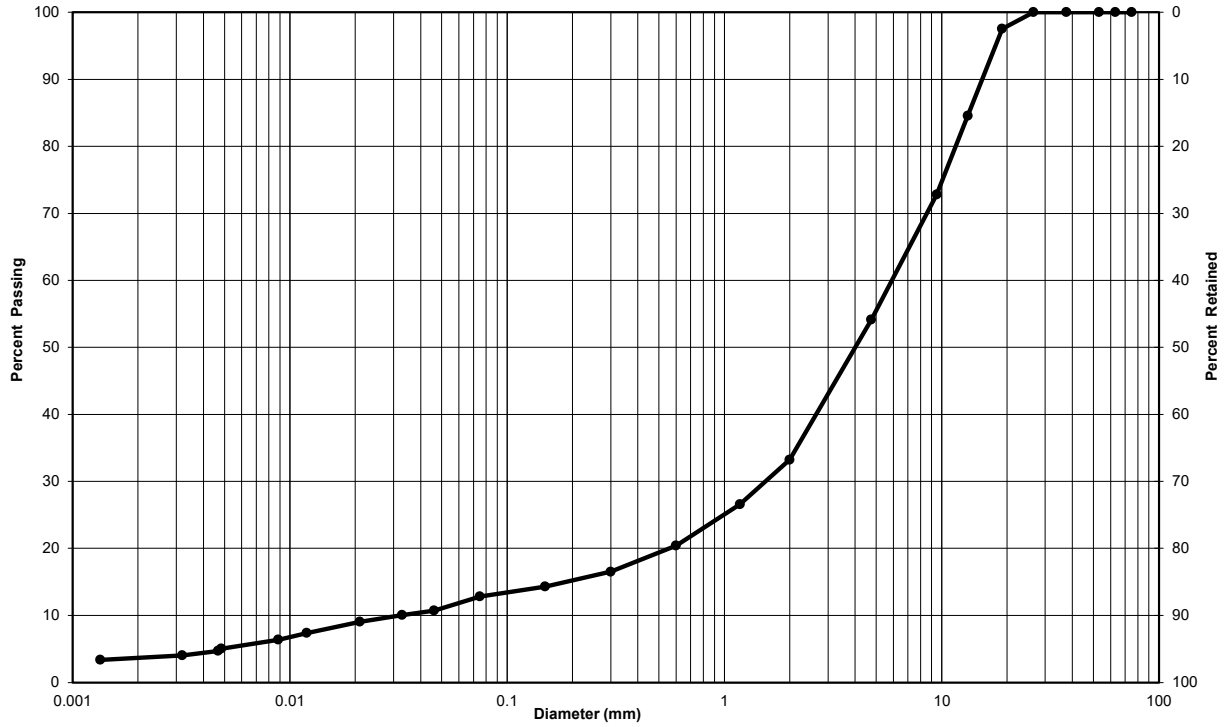
| Soil Description | Gravel (%) | Sand (%) | Clay & Silt (%) |
|---|---|---|---|
| Sand and Gravel, with Some Silt and Traces of Clay | 36 | 44 | 20 |
| **Silt-size particles (%) :** | 16 | | |
| **Clay-size particles (%) (<0.002 mm):** | 4 | | |

**Remarks:** More information is available upon request.

| | | | |
|---|---|---|---|
| **Performed by:** | J. Lalonde | **Date:** | August 9, 2022 |
| **Verified by:** | | **Date:** | August 24, 2022 |

# Particle-Size Analysis of Soils
## MTO LS-702 (Geotechnical)

| | | | |
|---|---|---|---|
| **Client:** | Infrastructure Ontario | **Lab No.:** | G-22-03 |
| **Project, Site:** | Children Hospital | **Project No.:** | 11205379 |
| Borehole No.: | MW20-22 | Sample No.: | SS-2 |
| Depth: | 0,61 - 1,22 m | Enclosure: | - |




| Clay & Silt | Sand | | | Gravel | |
|---|---|---|---|---|---|
| | Fine | Medium | Coarse | Fine | Coarse |
| Particle-Size Limits as per USCS (ASTM D-2487) | | | | | |

| Soil Description | Gravel (%) | Sand (%) | Clay & Silt (%) |
|---|---|---|---|
| Gravel and Sand, Traces of Silt and Clay | 46 | 41 | 13 |
| **Silt-size particles (%) :** | 9 | | |
| **Clay-size particles (%) (<0.002 mm):** | 4 | | |

**Remarks:** More information is available upon request.

| | | | |
|---|---|---|---|
| **Performed by:** | J. Lalonde | **Date:** | August 9, 2022 |
| **Verified by:** | | **Date:** | August 23, 2022 |

# Liquid Limit, Plastic Limit and Plasticity Index of Soils (ASTM D4318)

| | | | |
|---|---|---|---|
| **Client:** | Infrastructure Ontario | **Lab no.:** | G-20-01 |
| **Project/Site:** | CHEO Proposed New Parking Garage | **Project no.:** | 11205379-80 |

| | | | | | |
|---|---|---|---|---|---|
| Borehole no.: | BH3 | Sample no.: | SS2 | Depth: | 0.6-1.2m |
| Soil description: | | | | Date sampled: | 18-Jan-21 |

| | | | | | |
|---|---|---|---|---|---|
| Apparatus: | Hand Crank | Balance no.: | 1 | Porcelain bowl no.: | 1 |
| Liquid limit device no.: | 1 | Oven no.: | 1 | Spatula no.: | 1 |
| Sieve no.: | 1 | Glass plate no.: | 1 | | |

**Liquid Limit (LL):**

| | Test No. 1 | Test No. 2 | Test No. 3 |
|---|---|---|---|
| Number of blows | 30 | 25 | 20 |
| **Water Content:** | | | |
| Tare no. | S39 | S11 | S32 |
| Wet soil+tare, g | 32.39 | 33.80 | 32.26 |
| Dry soil+tare, g | 29.85 | 30.89 | 29.53 |
| Mass of water, g | 2.54 | 2.91 | 2.73 |
| Tare, g | 21.63 | 21.65 | 21.60 |
| Mass of soil, g | 8.22 | 9.24 | 7.93 |
| Water content % | 30.9% | 31.5% | 34.4% |

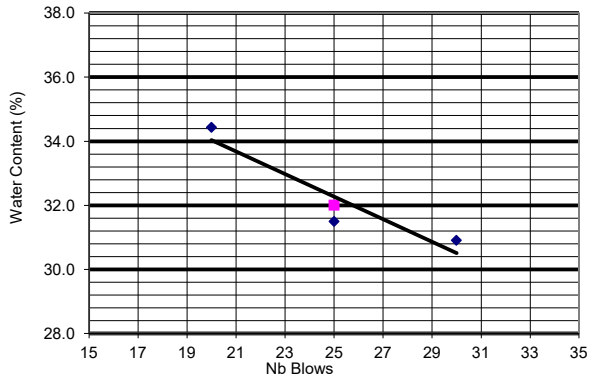
| **Plastic Limit (PL) - Water Content:** | | |
|---|---|---|
| Tare no. | S37 | S18 |
| Wet soil+tare, g | 28.17 | 28.51 |
| Dry soil+tare, g | 27.24 | 27.53 |
| Mass of water, g | 0.93 | 0.98 |
| Tare, g | 21.98 | 22.23 |
| Mass of soil, g | 5.26 | 5.30 |
| Water content % | 17.7% | 18.5% |
| Average water content % | 18.1% | |

| **Natural Water Content ( $W^n$ ):** | | |
|---|---|---|
| Tare no. | G | |
| Wet soil+tare, g | 445.80 | |
| Dry soil+tare, g | 393.10 | |
| Mass of water, g | 52.70 | |
| Tare, g | 0.00 | |
| Mass of soil, g | 393.10 | |
| Water content % | 13.4% | |

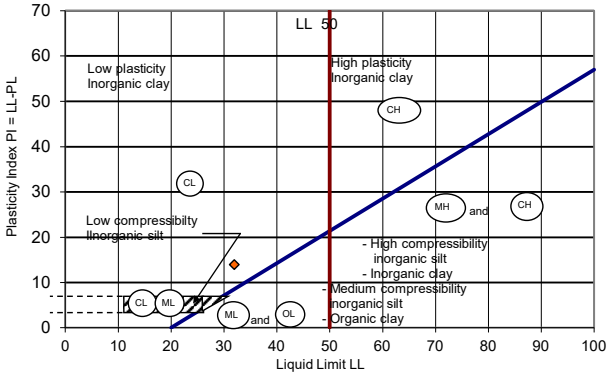
**Soil Preparation:**

- ☑ Cohesive <425 µm
- ☐ Cohesive >425 µm
- ☐ Non-cohesive
- ☐ Dry preparation
- ☑ Wet preparation

**Results**




**Soil Plasticity Chart**




| Liquid Limit (LL) | Plastic Limit (PL) | Plasticity Index (PI) | Natural Water Content $W^n$ |
|---|---|---|---|
| 32 | 18 | 14 | 13 |

**Remarks:**

| | | | |
|---|---|---|---|
| **Performed by:** | Ali Elhaddad | **Date:** | February 12, 2021 |
| **Verified by:** | E. Bennett | **Date:** | February 18, 2021 |

# Liquid Limit, Plastic Limit and Plasticity Index of Soils (ASTM D4318)

| | | | |
|---|---|---|---|
| **Client:** | Infrastructure Ontario | **Lab no.:** | G-22-03 |
| **Project/Site:** | Children Hospital | **Project no.:** | 11205379 |

| | | | | | |
|---|---|---|---|---|---|
| Borehole no.: | BH13-22 | Sample no.: | SS-2 | Depth: | 0,61 - 1,22 m |
| Soil Description: | | | | Date sampled: | |

| | | | | | |
|---|---|---|---|---|---|
| Apparatus: | Hand Crank | Balance no.: | 8033031049 | Porcelain bowl no.: | 1 |
| Liquid limit device no.: | 1 | Oven no.: | B23-04645 | Spatula no.: | 1 |
| Sieve no.: | 0155690 | Glass plate no.: | 1 | | |

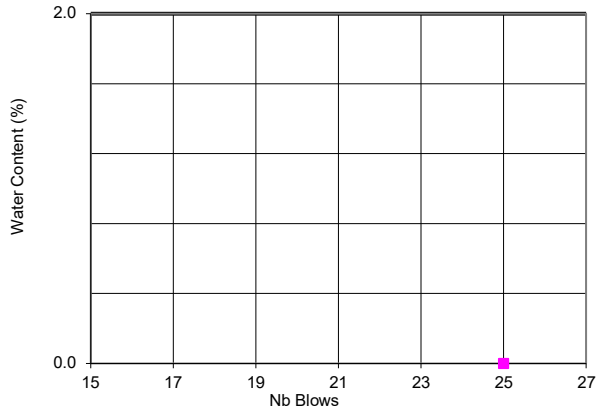
**Liquid Limit (LL):**

| | Test No. 1 | Test No. 2 | Test No. 3 |
|---|---|---|---|
| Number of blows | | | |
| **Water Content:** | | | |
| Tare no. | | | |
| Wet soil+tare, g | | | |
| Dry soil+tare, g | | | |
| Mass of water, g | | | |
| Tare, g | | | |
| Mass of soil, g | | | |
| Water content % | | | |
| **Plastic Limit (PL) - Water Content:** | | | |
| Tare no. | | | |
| Wet soil+tare, g | | | |
| Dry soil+tare, g | | | |
| Mass of water, g | | | |
| Tare, g | | | |
| Mass of soil, g | | | |
| Water content % | | | |
| Average water content % | | | |
| **Natural Water Content ( $W^n$ ):** | | | |
| Tare no. | | | |
| Wet soil+tare, g | | | |
| Dry soil+tare, g | | | |
| Mass of water, g | | | |
| Tare, g | | | |
| Mass of soil, g | | | |
| Water content % | | | |

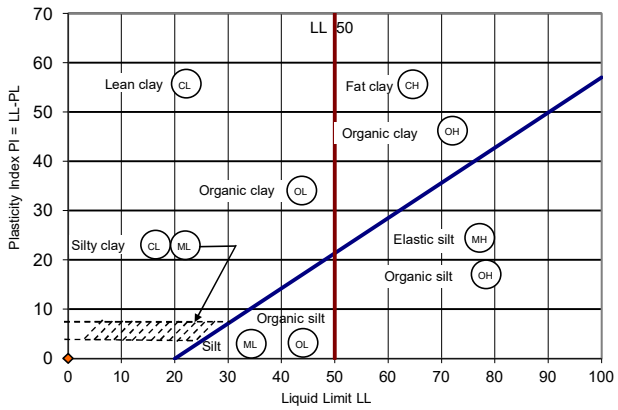
**Soil Preparation:**

- ☑ Cohesive <425 µm
- ☐ Cohesive >425 µm
- ☐ Non-cohesive
- ☑ Dry preparation
- ☐ Wet preparation

**Results**




**Soil Plasticity Chart ASTM D2487**




| Liquid Limit (LL) | Plastic Limit (PL) | Plasticity Index (PI) | Natural Water Content $W^n$ |
|---|---|---|---|
| | | | |

**Remarks:** Non-Plastic Sample

| | | | |
|---|---|---|---|
| **Performed by:** | J. Lalonde | **Date:** | September 13, 2022 |
| **Verified by:** | | **Date:** | September 13, 2022 |
| **Laboratory Location:** | 179 Colonnade Rd. Suite 400, Ottawa, Ontario | | |

# Liquid Limit, Plastic Limit and Plasticity Index of Soils (ASTM D4318)

| | | | |
|---|---|---|---|
| **Client:** | Infrastructure Ontario | **Lab no.:** | G-22-03 |
| **Project/Site:** | Children Hospital | **Project no.:** | 11205379 |

| | | | | | |
|---|---|---|---|---|---|
| Borehole no.: | BH19-22 | Sample no.: | SS-2 | Depth: | 0,76 - 1,37 m |
| Soil Description: | | | | Date sampled: | |

| | | | | | |
|---|---|---|---|---|---|
| Apparatus: | Hand Crank | Balance no.: | 8033031049 | Porcelain bowl no.: | 1 |
| Liquid limit device no.: | 1 | Oven no.: | B23-04645 | Spatula no.: | 1 |
| Sieve no.: | 0155690 | Glass plate no.: | 1 | | |

**Liquid Limit (LL):**

| | Test No. 1 | Test No. 2 | Test No. 3 |
|---|---|---|---|
| Number of blows | | | |
| **Water Content:** | | | |
| Tare no. | | | |
| Wet soil+tare, g | | | |
| Dry soil+tare, g | | | |
| Mass of water, g | | | |
| Tare, g | | | |
| Mass of soil, g | | | |
| Water content % | | | |

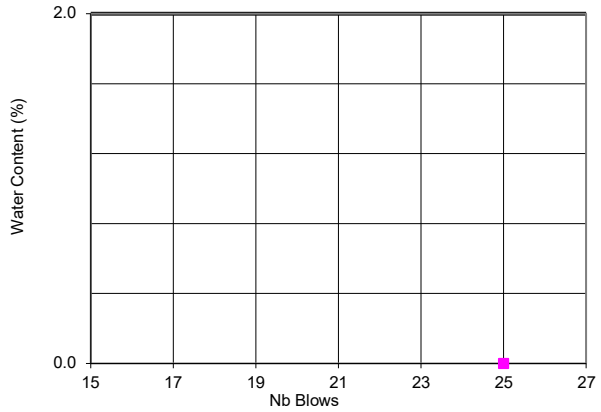
| **Plastic Limit (PL) - Water Content:** | | |
|---|---|---|
| Tare no. | | |
| Wet soil+tare, g | | |
| Dry soil+tare, g | | |
| Mass of water, g | | |
| Tare, g | | |
| Mass of soil, g | | |
| Water content % | | |
| Average water content % | | |

| **Natural Water Content ( $W^n$ ):** | | |
|---|---|---|
| Tare no. | | |
| Wet soil+tare, g | | |
| Dry soil+tare, g | | |
| Mass of water, g | | |
| Tare, g | | |
| Mass of soil, g | | |
| Water content % | | |

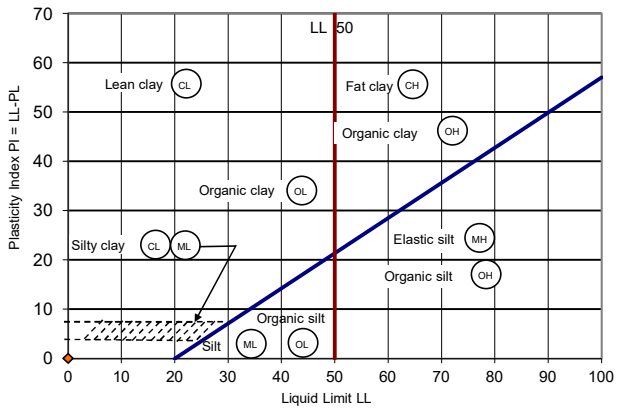
**Soil Preparation:**

- ☑ Cohesive <425 µm
- ☐ Cohesive >425 µm
- ☐ Non-cohesive
- ☑ Dry preparation
- ☐ Wet preparation

**Results**




**Soil Plasticity Chart ASTM D2487**




| Liquid Limit (LL) | Plastic Limit (PL) | Plasticity Index (PI) | Natural Water Content $W^n$ |
|---|---|---|---|
| | | | |

**Remarks:** Non-Plastic Sample

| | | | |
|---|---|---|---|
| **Performed by:** | J. Lalonde | **Date:** | September 13, 2022 |
| **Verified by:** | | **Date:** | September 13, 2022 |
| **Laboratory Location:** | 179 Colonnade Rd. Suite 400, Ottawa, Ontario | | |

# Liquid Limit, Plastic Limit and Plasticity Index of Soils (ASTM D4318)

| | | | |
|---|---|---|---|
| **Client:** | Infrastructure Ontario | **Lab no.:** | G-22-03 |
| **Project/Site:** | Children Hospital | **Project no.:** | 11205379 |

| | | | | | |
|---|---|---|---|---|---|
| Borehole no.: | MW20-22 | Sample no.: | SS-2 | Depth: | 0,61 - 1,22 m |
| Soil Description: | | | | Date sampled: | |

| | | | | | |
|---|---|---|---|---|---|
| Apparatus: | Hand Crank | Balance no.: | 8033031049 | Porcelain bowl no.: | 1 |
| Liquid limit device no.: | 1 | Oven no.: | B23-04645 | Spatula no.: | 1 |
| Sieve no.: | 0155690 | Glass plate no.: | 1 | | |

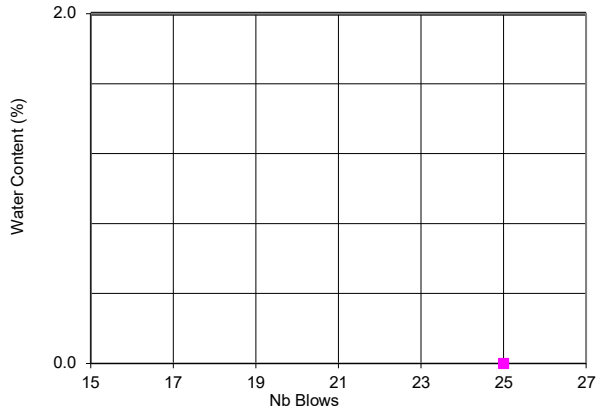
**Liquid Limit (LL):**

| | Test No. 1 | Test No. 2 | Test No. 3 |
|---|---|---|---|
| Number of blows | | | |
| **Water Content:** | | | |
| Tare no. | | | |
| Wet soil+tare, g | | | |
| Dry soil+tare, g | | | |
| Mass of water, g | | | |
| Tare, g | | | |
| Mass of soil, g | | | |
| Water content % | | | |
| **Plastic Limit (PL) - Water Content:** | | | |
| Tare no. | | | |
| Wet soil+tare, g | | | |
| Dry soil+tare, g | | | |
| Mass of water, g | | | |
| Tare, g | | | |
| Mass of soil, g | | | |
| Water content % | | | |
| Average water content % | | | |
| **Natural Water Content ( $W^n$ ):** | | | |
| Tare no. | | | |
| Wet soil+tare, g | | | |
| Dry soil+tare, g | | | |
| Mass of water, g | | | |
| Tare, g | | | |
| Mass of soil, g | | | |
| Water content % | | | |

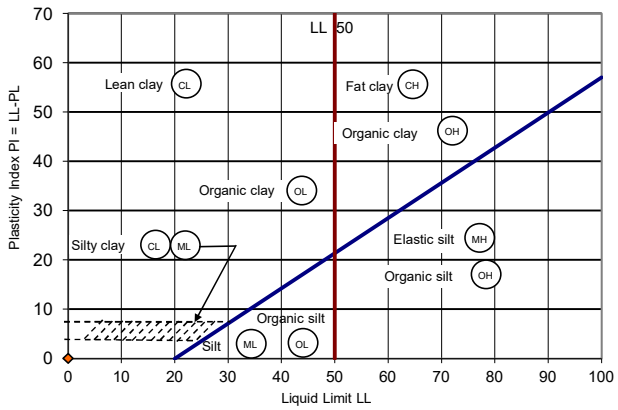
**Soil Preparation:**

- ☑ Cohesive <425 µm
- ☐ Cohesive >425 µm
- ☐ Non-cohesive
- ☑ Dry preparation
- ☐ Wet preparation

**Results**




**Soil Plasticity Chart ASTM D2487**




| Liquid Limit (LL) | Plastic Limit (PL) | Plasticity Index (PI) | Natural Water Content $W^n$ |
|---|---|---|---|
| | | | |

**Remarks:** Non-Plastic Sample

| | | | |
|---|---|---|---|
| **Performed by:** | J. Lalonde | **Date:** | September 13, 2022 |
| **Verified by:** | | **Date:** | September 13, 2022 |
| **Laboratory Location:** | 179 Colonnade Rd. Suite 400, Ottawa, Ontario | | |

# Moisture Content of Soils
# (ASTM D 2216)

| | | | |
|---|---|---|---|
| **Client:** | Infrastructure Ontario | **Lab No.:** | G-22-03 |
| **Project/Site:** | Children's Hospital | **Project No.:** | 11205379 |

**Apparatus Used for Testing**

**Oven No.:** B23-04645 **Scale No.:** 8033031049

| **BH No.:** | | | | | BH10-22 | BH10-22 | BH11-22 | BH11-22 |
|---|---|---|---|---|---|---|---|---|
| **Sample No.:** | | | | | SS1 | SS2 | SS1 | SS2 |
| **Depth:** | | | | | 0,0-2,0 | 2,0-3,3 | 0,0-2,0 | 2,0-4,0 |
| Container no. | | | | | 32 | 25 | 28 | 4 |
| Mass of container + wet soil (g) | | | | | 70.50 | 70.00 | 75.70 | 72.80 |
| Mass of container + dry soil (g) | | | | | 68.90 | 66.80 | 74.40 | 68.10 |
| Mass of container (g) | | | | | 14.80 | 14.60 | 14.70 | 14.80 |
| Mass of dry soil (g) | | | | | 54.1 | 52.2 | 59.7 | 53.3 |
| Mass of water (g) | | | | | 1.6 | 3.2 | 1.3 | 4.7 |
| Moisture content (%) | | | | | 3.0 | 6.1 | 2.2 | 8.8 |
| **BH No.:** | BH12-22 | BH12-22 | BH14-22 | BH14-22 | BH15-22 | BH15-22 | BH16-22 | BH16-22 |
| **Sample No.:** | SS1 | SS2 | SS1 | SS2 | SS1 | SS2 | SS1 | SS2 |
| **Depth:** | 0,0-2,0 | 2,0-4,0 | 0,0-2,0 | 2,0-4,0 | 0,0-2,0 | 2,0-3,5 | 0.0-2,0 | 2,0-4,0 |
| Container no. | 42 | 15 | 14 | 35 | 18 | 9 | 13 | 23 |
| Mass of container + wet soil (g) | 83.70 | 74.40 | 79.40 | 74.00 | 61.00 | 62.70 | 78.90 | 58.40 |
| Mass of container + dry soil (g) | 81.60 | 71.80 | 77.90 | 71.10 | 59.50 | 60.20 | 77.00 | 55.40 |
| Mass of container (g) | 14.60 | 14.80 | 14.80 | 15.10 | 15.00 | 14.70 | 14.80 | 15.10 |
| Mass of dry soil (g) | 67.0 | 57.0 | 63.1 | 56.0 | 44.5 | 45.5 | 62.2 | 40.3 |
| Mass of water (g) | 2.1 | 2.6 | 1.5 | 2.9 | 1.5 | 2.5 | 1.9 | 3.0 |
| Moisture content (%) | 3.1 | 4.6 | 2.4 | 5.2 | 3.4 | 5.5 | 3.1 | 7.4 |

**Remarks:**

| | | | |
|---|---|---|---|
| **Performed By:** | J A Baptiste | **Date:** | July 27, 2022 |
| **Verified by :** | | **Date:** | August 3, 2022 |

# Moisture Content of Soils
# (ASTM D 2216)

| | | | |
|---|---|---|---|
| **Client:** | Infrastructure Ontario | **Lab No.:** | G-22-03 |
| **Project/Site:** | Children's Hospital | **Project No.:** | 11205379 |

**Apparatus Used for Testing** **Oven No.:** B23-04645 **Scale No.:** 8033031049

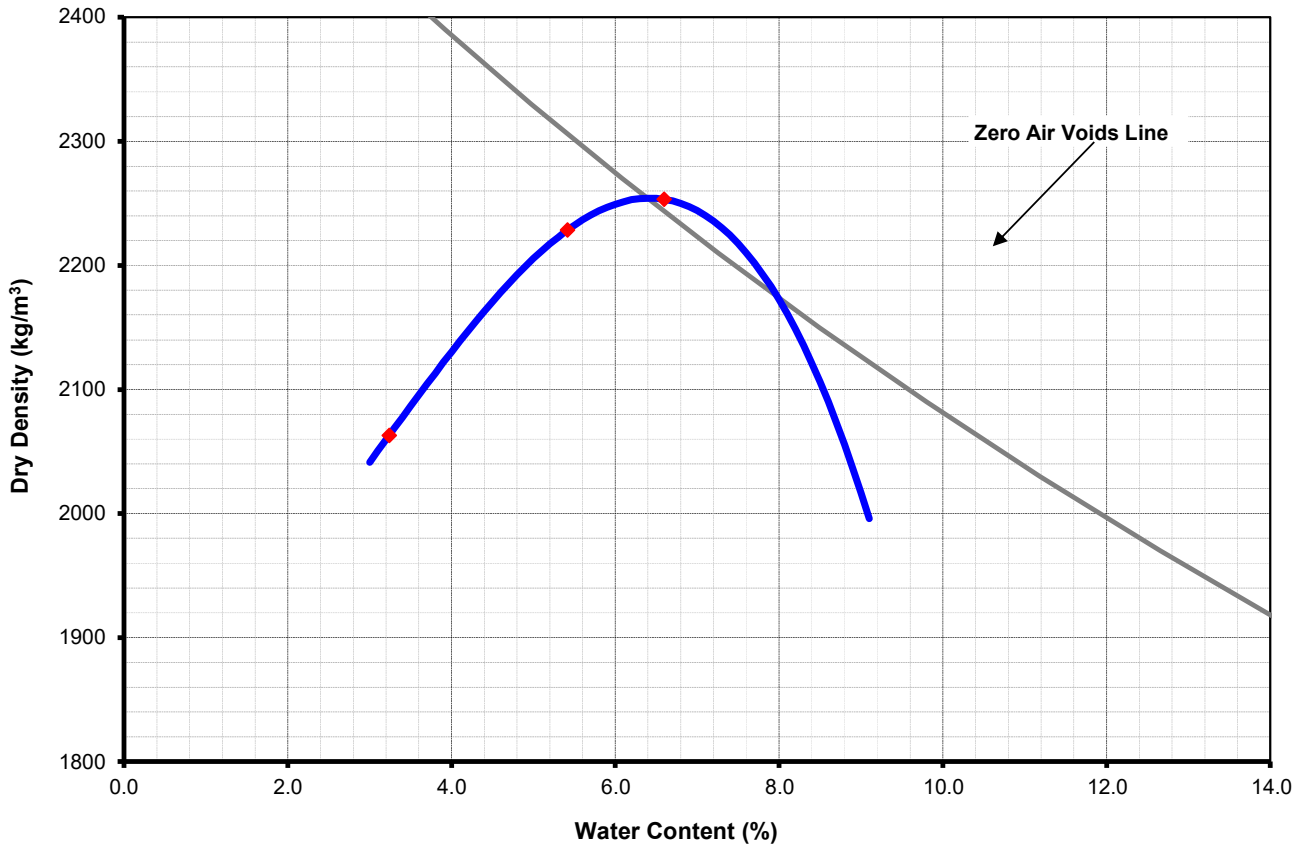
| **MW No.:** | BH9-22 | BH9-22 | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Sample No.:** | SS1 | SS2 | | | | | | |
| **Depth:** | 0,0-2,0 | 2,5-4,5 | | | | | | |
| Container no. | 9 | 32 | | | | | | |
| Mass of container + wet soil (g) | 59.30 | 55.60 | | | | | | |
| Mass of container + dry soil (g) | 56.90 | 54.30 | | | | | | |
| Mass of container (g) | 14.70 | 14.90 | | | | | | |
| Mass of dry soil (g) | 42.2 | 39.4 | | | | | | |
| Mass of water (g) | 2.4 | 1.3 | | | | | | |
| Moisture content (%) | 5.7 | 3.3 | | | | | | |
| **MW No.:** | BH14 | BH20-22 | BH20-22 | | | | | |
| **Sample No.:** | SS3B | SS1 | SS2 | | | | | |
| **Depth:** | 2,4-5,1 | 0,5-2,5 | 2,5-4,5 | | | | | |
| Container no. | 23 | 16 | 28 | | | | | |
| Mass of container + wet soil (g) | 54.30 | 48.50 | 58.60 | | | | | |
| Mass of container + dry soil (g) | 52.60 | 47.00 | 56.40 | | | | | |
| Mass of container (g) | 15.00 | 14.90 | 14.90 | | | | | |
| Mass of dry soil (g) | 37.6 | 32.1 | 41.5 | | | | | |
| Mass of water (g) | 1.7 | 1.5 | 2.2 | | | | | |
| Moisture content (%) | 4.5 | 4.7 | 5.3 | | | | | |

**Remarks:**

| | | | |
|---|---|---|---|
| **Performed By:** | J A Baptiste | **Date:** | July 27, 2022 |
| **Verified by :** | | **Date:** | August 3, 2022 |

# Standard Proctor Test (ASTM D698)

| | | | |
|---|---|---|---|
| **Client :** | Infrastructure Ontario | **Lab No :** | A-22-02 |
| **Project/Site :** | Children Hospital | **Project No :** | 11205379 |




| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Prepared Sample: | Dry | 0 | Moist | x | | | Assumed $G_s$: | 2.70 |
| ASTM D698 Test Method: | A | 0 | B | 0 | C | x | Type of Hammer: | Manual |
| | | 4.75 mm | | 9.50 mm | | 19.0 mm | | |

| | |
|---|---|
| Soil Type: | Crushed Stone |
| Material: | |
| Proposed Use: | |
| Sample Identification: | BH11-22 |
| Sample Location: | |
| Aggregate Supplier / Pit Name: | In Place |
| Sample Date: | |
| Sampled By: | D. Ash |

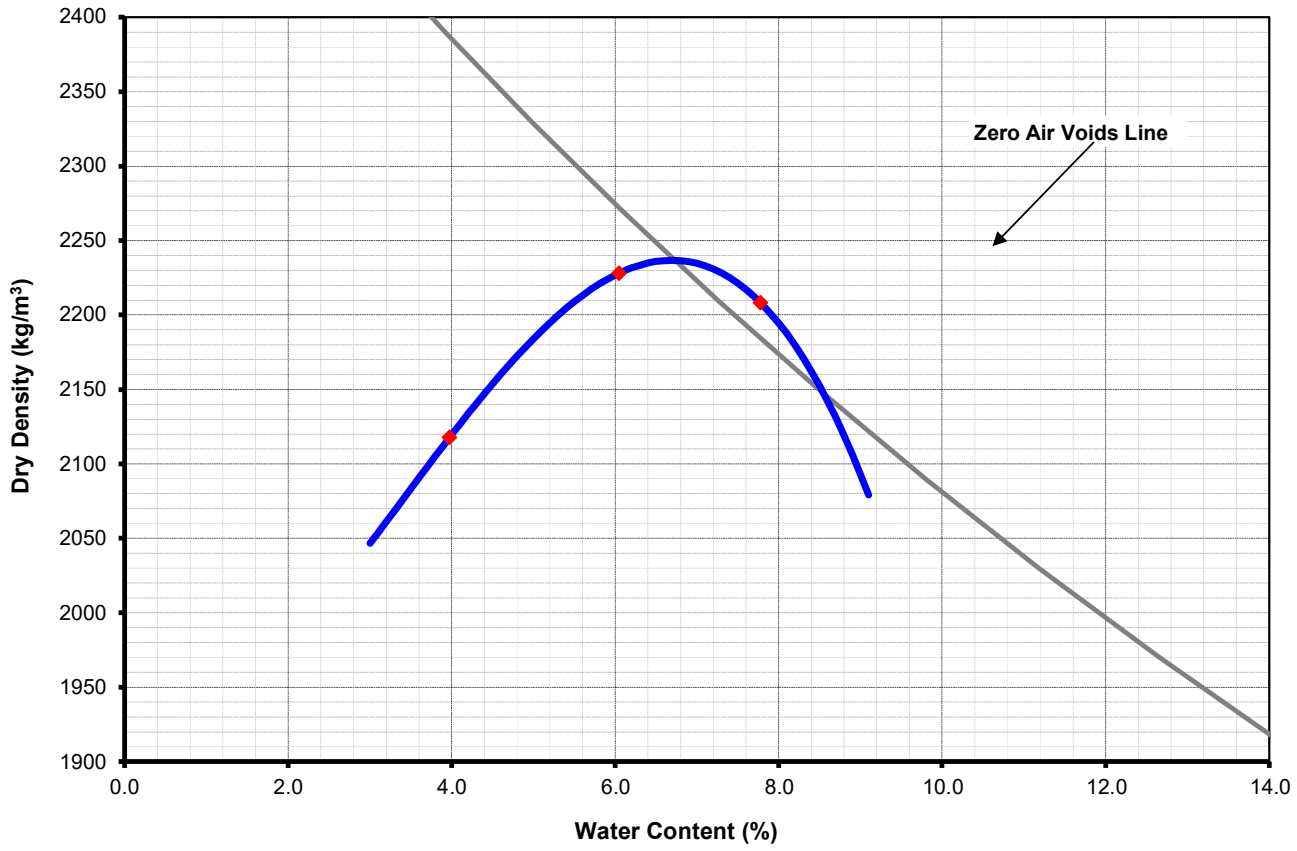
| | | |
|---|---|---|
| **Max. Dry Density:** | **2254** | **kg/m³** |
| **Optimum Moisture:** | **6.4** | **%** |
| **% Retained on 19.0 mm:** | **2.8** | **%** |
| **Corrected Dry Density:** | **2254** | **kg/m³** |
| **Corrected Opt. Moist.:** | **6.4** | **%** |

**Remarks :**

| | | | |
|---|---|---|---|
| **Performed by :** | J. Lalonde | **Date :** | September 2, 2022 |
| **Verified by :** | | **Date :** | September 6, 2022 |

# Standard Proctor Test (ASTM D698)

| | | | |
|---|---|---|---|
| **Client :** | Infrastructure Ontario | **Lab No :** | A-22-02 |
| **Project/Site :** | Children Hospital | **Project No :** | 11205379 |




| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Prepared Sample: | Dry | 0 | Moist | x | | | Assumed $G_s$: | 2.70 |
| ASTM D698 Test Method: | A | 0 | B | 0 | C | x | Type of Hammer: | Mechanical |
| | | 4.75 mm | | 9.50 mm | | 19.0 mm | | |

| | |
|---|---|
| Soil Type: | Crushed Stone |
| Material: | |
| Proposed Use: | |
| Sample Identification: | BH18-22 |
| Sample Location: | |
| Aggregate Supplier / Pit Name: | In Place |
| Sample Date: | |
| Sampled By: | D. Ash |

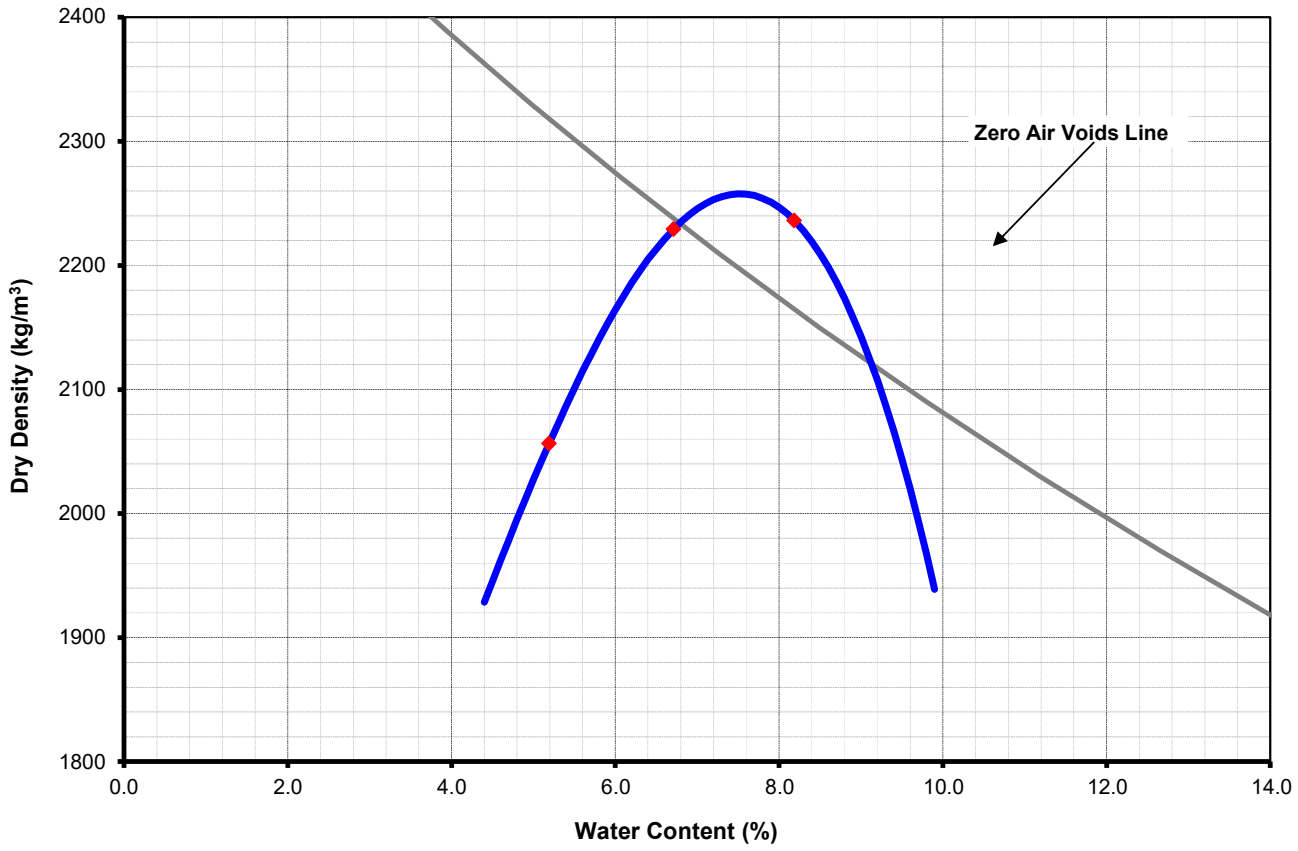
| | | |
|---|---|---|
| **Max. Dry Density:** | **2237** | **kg/m³** |
| **Optimum Moisture:** | **6.7** | **%** |
| **% Retained on 19.0 mm:** | **7.2** | **%** |
| **Corrected Dry Density:** | **2265** | **kg/m³** |
| **Corrected Opt. Moist.:** | **6.2** | **%** |

**Remarks :**

| | | | |
|---|---|---|---|
| **Performed by :** | J. Lalonde | **Date :** | September 9, 2022 |
| **Verified by :** | | **Date :** | September 13, 2022 |

# Standard Proctor Test (ASTM D698)

| | | | |
|---|---|---|---|
| **Client :** | Infrastructure Ontario | **Lab No :** | A-22-02 |
| **Project/Site :** | Children Hospital | **Project No :** | 11205379 |




| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Prepared Sample: | Dry | 0 | Moist | x | | | Assumed $G_s$: | 2.70 |
| ASTM D698 Test Method: | A | 0 | B | 0 | C | x | Type of Hammer: | Mechanical |
| | | 4.75 mm | | 9.50 mm | | 19.0 mm | | |

| | |
|---|---|
| Soil Type: | Crushed Stone |
| Material: | |
| Proposed Use: | |
| Sample Identification: | MW9-22 |
| Sample Location: | |
| Aggregate Supplier / Pit Name: | In Place |
| Sample Date: | |
| Sampled By: | D. Ash |

| | | |
|---|---|---|
| **Max. Dry Density:** | **2258** | **kg/m³** |
| **Optimum Moisture:** | **7.5** | **%** |
| **% Retained on 19.0 mm:** | **10.3** | **%** |
| **Corrected Dry Density:** | **2297** | **kg/m³** |
| **Corrected Opt. Moist.:** | **6.7** | **%** |

**Remarks :**

| | | | |
|---|---|---|---|
| **Performed by :** | J. Lalonde | **Date :** | September 7, 2022 |
| **Verified by :** | | **Date :** | September 13, 2022 |

# Unconfined Compressive Strength of Intact Rock Core Specimen
## ASTM D 7012, ASTM D 4543

**Client :** Infrastructure Ontario

**Project :** Proposed Parking Structure
Children's Hospital of Eastern Ontario Campus
401 Smyth Road, Ottawa, Ontario

**Project N° :** 11205379-80

**Sample N° :** MW3-21 RC1

**Depth :** 4.88-5.03m

**Sampling Date :** January 14-15 / 2021

**Testing Apparatus Used :** **Loading device N°** 1 **Caliper N°** 1

### Technical Data

| | | | | Average | |
|---|---|---|---|---|---|
| Diameter : | 63 | 63 | 63 | 63.0 | (mm) |
| Length : | 117 | 117 | 117 | 117.0 | (mm) |
| Straightness (0.5mm maximum) (S1) : | 0.3 | 0.2 | 0.3 | 0.3 | (mm) |
| Flatness (25µm maximum) (FP2) : | Ok | Ok | Ok | Ok | |
| Parallelism (0.25 ° maximum) (FP2) : | 0.15 | 0.15 | 0.15 | 0.15 | (°) |

Mass : 965.2 (g) Volume: 364718 ($mm^3$)

Density : 2646 ($kg/m^3$)

Moisture Conditions : Dry

Loading Rate (0.5 to 1.0 MPa / sec) : 0.6 (MPa/sec)

Type of Fracture : 3

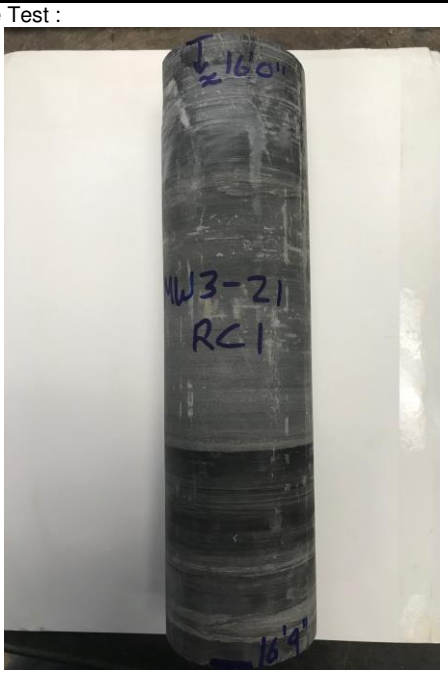
Test Duration (2-15 Minutes) : 3.5 (minutes)

Maximum Applied Load : 251.98 ☑ kN ☐ lbs

**Compressive Strength :** 80.8 (MPa)

### View of Specimen

Before Test :




After Test :

**Remarks :**

**Analysed by :** Ali Elhaddad **Date :** February 8, 2021

**Verified by :** E. Bennett **Date :** February 17, 2021

# Unconfined Compressive Strength of Intact Rock Core Specimen
## ASTM D 7012, ASTM D 4543

**Client :** Infrastructure Ontario

**Project :** Proposed Parking Structure
Children's Hospital of Eastern Ontario Campus
401 Smyth Road, Ottawa, Ontario

**Project N° :** 11205379-80

**Sample N° :** MW3-21 RC2

**Depth :** 6.4-6.55m

**Sampling Date :** January 14-15 / 2021

**Testing Apparatus Used :** **Loading device N°** 1 **Caliper N°** 1

### Technical Data

| | | | | Average | |
|---|---|---|---|---|---|
| Diameter : | 63 | 63 | 63 | 63.0 | (mm) |
| Length : | 74 | 74 | 74 | 74.0 | (mm) |
| Straightness (0.5mm maximum) (S1) : | 0.2 | 0.2 | 0.2 | 0.2 | (mm) |
| Flatness (25µm maximum) (FP2) : | Ok | Ok | Ok | Ok | |
| Parallelism (0.25 ° maximum) (FP2) : | 0.1 | 0.1 | 0.1 | 0.15 | (°) |

Mass : 612 (g) Volume: 230676 ($mm^3$)

Density : 2653 ($kg/m^3$)

Moisture Conditions : Dry

Loading Rate (0.5 to 1.0 MPa / sec) : 0.6 (MPa/sec)

Type of Fracture : 3

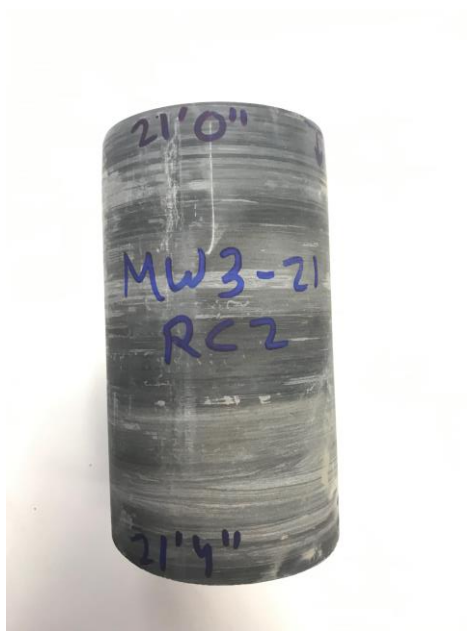
Test Duration (2-15 Minutes) : 4 (minutes)

Maximum Applied Load : 335.49 ☑ kN ☐ lbs

**Compressive Strength :** 107.6 (MPa)

### View of Specimen

Before Test :




After Test :

**Remarks :**

**Analysed by :** Ali Elhaddad **Date :** February 8, 2021

**Verified by :** E. Bennett **Date :** February 17, 2021

# Unconfined Compressive Strength of Intact Rock Core Specimen
## ASTM D 7012, ASTM D 4543

**Client :** Infrastructure Ontario

**Project :** Proposed Parking Structure
Children's Hospital of Eastern Ontario Campus
401 Smyth Road, Ottawa, Ontario

**Project N° :** 11205379-80

**Sample N° :** MW3-21 RC3

**Depth :** 7.92-8.07m

**Sampling Date :** January 14-15 / 2021

**Testing Apparatus Used :** **Loading device N°** 1 **Caliper N°** 1

### Technical Data

| | | | | Average | |
|---|---|---|---|---|---|
| Diameter : | 63 | 63 | 63 | 63.0 | (mm) |
| Length : | 78 | 78 | 78 | 78.0 | (mm) |
| Straightness (0.5mm maximum) (S1) : | 0.3 | 0.2 | 0.3 | 0.3 | (mm) |
| Flatness (25µm maximum) (FP2) : | Ok | Ok | Ok | Ok | |
| Parallelism (0.25 ° maximum) (FP2) : | 0.1 | 0.15 | 0.1 | 0.15 | (°) |

Mass : 656.6 (g) Volume: 243145 ($mm^3$)

Density : 2700 ($kg/m^3$)

Moisture Conditions : Dry

Loading Rate (0.5 to 1.0 MPa / sec) : 0.6 (MPa/sec)

Type of Fracture : 3

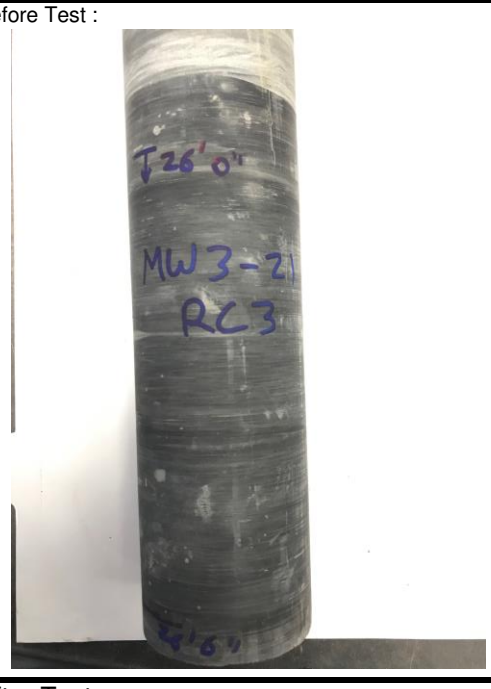
Test Duration (2-15 Minutes) : 3.5 (minutes)

Maximum Applied Load : 260.09 ☑ kN ☐ lbs

**Compressive Strength :** 83.4 (MPa)

### View of Specimen

Before Test :




After Test :

**Remarks :**

**Analysed by :** Ali Elhaddad **Date :** February 8, 2021

**Verified by :** E. Bennett **Date :** February 17, 2021

# Unconfined Compressive Strength of Intact Rock Core Specimen
## ASTM D 7012, ASTM D 4543

**Client :** Infrastructure Ontario

**Project :** Proposed Parking Structure
Children's Hospital of Eastern Ontario Campus
401 Smyth Road, Ottawa, Ontario

**Project N° :** 11205379-80

**Sample N° :** MW3-21 RC5

**Depth :** 9.63-9.75m

**Sampling Date :** January 14-15 / 2021

**Testing Apparatus Used :** **Loading device N°** 1 **Caliper N°** 1

### Technical Data

| | | | | Average | |
|---|---|---|---|---|---|
| Diameter : | 63 | 63 | 63 | 63.0 | (mm) |
| Length : | 91 | 91 | 91 | 91.0 | (mm) |
| Straightness (0.5mm maximum) (S1) : | 0.2 | 0.3 | 0.3 | 0.3 | (mm) |
| Flatness (25µm maximum) (FP2) : | Ok | Ok | Ok | Ok | |
| Parallelism (0.25 ° maximum) (FP2) : | 0.15 | 0.15 | 0.15 | 0.15 | (°) |

Mass : 736.3 (g) Volume: 283669 ($mm^3$)

Density : 2596 ($kg/m^3$)

Moisture Conditions : Dry

Loading Rate (0.5 to 1.0 MPa / sec) : 0.6 (MPa/sec)

Type of Fracture : 3

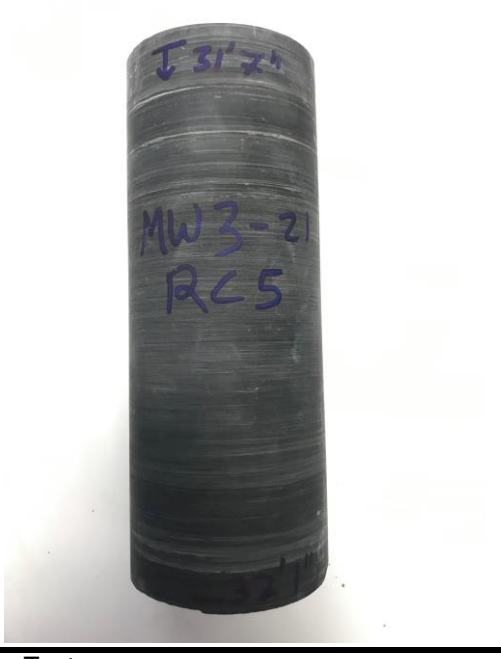
Test Duration (2-15 Minutes) : 4 (minutes)

Maximum Applied Load : 251.57 ☑ kN ☐ lbs

**Compressive Strength :** 80.7 (MPa)

### View of Specimen

Before Test :




After Test :

**Remarks :**

**Analysed by :** Ali Elhaddad **Date :** February 8, 2021

**Verified by :** E. Bennett **Date :** February 17, 2021

# Unconfined Compressive Strength of Intact Rock Core Specimen
## ASTM D 7012, ASTM D 4543

**Client :** Infrastructure Ontario

**Project N° :** 11205379-80

**Project :** Proposed Parking Structure
Children's Hospital of Eastern Ontario Campus
401 Smyth Road, Ottawa, Ontario

**Sample N° :** MW6-21 RC2

**Depth :** 4.75-4.88m

**Sampling Date :** January 14-15 / 2021

**Testing Apparatus Used :** **Loading device N°** 1 **Caliper N°** 1

### Technical Data

| | | | | Average | |
|---|---|---|---|---|---|
| Diameter : | 63 | 63 | 63 | 63.0 | (mm) |
| Length : | 86 | 86 | 86 | 86.0 | (mm) |
| Straightness (0.5mm maximum) (S1) : | 0.3 | 0.3 | 0.3 | 0.3 | (mm) |
| Flatness (25µm maximum) (FP2) : | Ok | Ok | Ok | Ok | |
| Parallelism (0.25 ° maximum) (FP2) : | 0.15 | 0.15 | 0.15 | 0.15 | (°) |

Mass : 702.4 (g) Volume: 268083 ($mm^3$)

Density : 2620 ($kg/m^3$)

Moisture Conditions : Dry

Loading Rate (0.5 to 1.0 MPa / sec) : 0.6 (MPa/sec)

Type of Fracture : 3

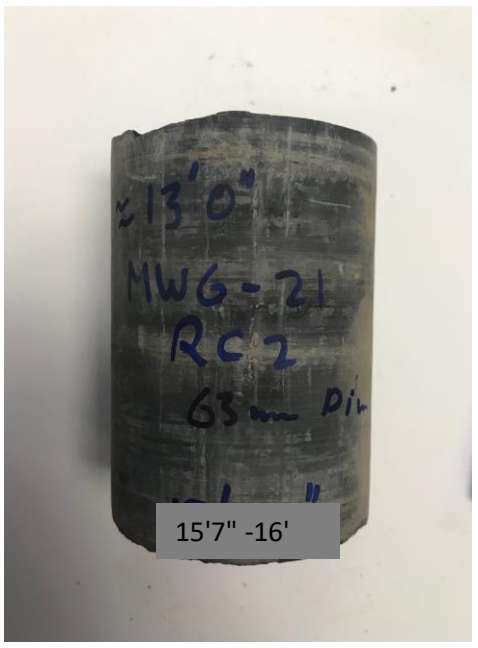
Test Duration (2-15 Minutes) : 4 (minutes)

Maximum Applied Load : 294.5 ☑ kN ☐ lbs

**Compressive Strength :** 94.5 (MPa)

### View of Specimen

Before Test :




After Test :

**Remarks :**

**Analysed by :** Ali Elhaddad **Date :** February 8, 2021

**Verified by :** E. Bennett **Date :** February 17, 2021

# Unconfined Compressive Strength of Intact Rock Core Specimen
## ASTM D 7012, ASTM D 4543

**Client :** Infrastructure Ontario

**Project N° :** 11205379-80

**Project :** Proposed Parking Structure
Children's Hospital of Eastern Ontario Campus
401 Smyth Road, Ottawa, Ontario

**Sample N° :** MW6-21 RC4

**Depth :** 6.65-6.81m

**Sampling Date :** January 14-15 / 2021

**Testing Apparatus Used :** **Loading device N°** 1 **Caliper N°** 1

### Technical Data

| | | | | Average | |
|---|---|---|---|---|---|
| Diameter : | 63 | 63 | 63 | 63.0 | (mm) |
| Length : | 82 | 82 | 82 | 82.0 | (mm) |
| Straightness (0.5mm maximum) (S1) : | 0.3 | 0.3 | 0.3 | 0.3 | (mm) |
| Flatness (25µm maximum) (FP2) : | Ok | Ok | Ok | Ok | |
| Parallelism (0.25 ° maximum) (FP2) : | 0.15 | 0.15 | 0.15 | 0.15 | (°) |

Mass : 676.1 (g) Volume: 255614 ($mm^3$)

Density : 2645 ($kg/m^3$)

Moisture Conditions : Dry

Loading Rate (0.5 to 1.0 MPa / sec) : 0.6 (MPa/sec)

Type of Fracture : 3

Test Duration (2-15 Minutes) : 4 (minutes)

Maximum Applied Load : 311.75 ☑ kN ☐ lbs

**Compressive Strength :** 100.0 (MPa)

### View of Specimen

Before Test :


After Test :

**Remarks :**

**Analysed by :** Ali Elhaddad **Date :** February 8, 2021

**Verified by :** E. Bennett **Date :** February 17, 2021

# Unconfined Compressive Strength of Intact Rock Core Specimen
## ASTM D 7012, ASTM D 4543

**Client :** Infrastructure Ontario

**Project N° :** 11205379-80

**Project :** Proposed Parking Structure
Children's Hospital of Eastern Ontario Campus
401 Smyth Road, Ottawa, Ontario

**Sample N° :** MW6-21 RC5

**Depth :** 7.98-8.10m

**Sampling Date :** January 14-15 / 2021

**Testing Apparatus Used :** **Loading device N°** 1 **Caliper N°** 1

### Technical Data

| | | | | Average | |
|---|---|---|---|---|---|
| Diameter : | 63 | 63 | 63 | 63.0 | (mm) |
| Length : | 93 | 93 | 93 | 93.0 | (mm) |
| Straightness (0.5mm maximum) (S1) : | 0.3 | 0.3 | 0.3 | 0.3 | (mm) |
| Flatness (25µm maximum) (FP2) : | Ok | Ok | Ok | Ok | |
| Parallelism (0.25 ° maximum) (FP2) : | 0.15 | 0.15 | 0.15 | 0.15 | (°) |

Mass : 776.4 (g) Volume: 289904 ($mm^3$)

Density : 2678 ($kg/m^3$)

Moisture Conditions : Dry

Loading Rate (0.5 to 1.0 MPa / sec) : 0.6 (MPa/sec)

Type of Fracture : 4

Test Duration (2-15 Minutes) : 5 (minutes)

Maximum Applied Load : 318.7 ☑ kN ☐ lbs

**Compressive Strength :** 102.2 (MPa)

### View of Specimen

Before Test :


After Test :

**Remarks :**

**Analysed by :** Ali Elhaddad **Date :** February 8, 2021

**Verified by :** E. Bennett **Date :** February 17, 2021

# Unconfined Compressive Strength of Intact Rock Core Specimen
## ASTM D 7012, ASTM D 4543

**Client :** Infrastructure Ontario

**Project :** Children's Hospital

**Project N° :** 11205379

**Sample N° :** MW9-22 r.1

**Depth :** 3,20 - 3,31 m

**Sampling Date :**

**Testing Apparatus Used :** **Loading device N°** _9130____ **Caliper N°** _1_____

### Technical Data

| | | | | Average | |
|---|---|---|---|---|---|
| Diameter : | 63.09 | 63.09 | 63.21 | **63.13** | (mm) |
| Length : | 109.59 | 108.25 | 109.84 | **109.23** | (mm) |
| Straightness (0.5mm maximum) (S1) : | 0.4 | 0.4 | 0.4 | **0.4** | (mm) |
| Flatness (25µm maximum) (FP2) : | Ok | Ok | Ok | **Ok** | (µm) |
| Parallelism (0.25 ° maximum) (FP2) : | 0.15 | 0.20 | 0.20 | **0.18** | (°) |

Mass : 913.8 (g) Volume: 341893 ($mm^3$)

Density : 2673 ($kg/m^3$)

Moisture Conditions : Dry

Loading Rate (0.5 to 1.0 MPa / sec) : 0.58 (MPa/sec)

Type of Fracture : Multiple Fracture

Test Duration (2-15 Minutes) : 123 (seconds)

Maximum Applied Load : 222.24 (kN)

**Compressive Strength :** 71.0 (MPa)

### View of Specimen

Before Test :

After Test :

**Remarks :**

**Analysed by :** J. Lalonde **Date :** 8/18/2022

**Verified by :** **Date :** 8/25/2022

# Unconfined Compressive Strength of Intact Rock Core Specimen
## ASTM D 7012, ASTM D 4543

**Client :** Infrastructure Ontario

**Project :** Children's Hospital

**Project N° :** 11205379

**Sample N° :** MW9-22 r.2

**Depth :** 4,04 - 4,14 m

**Sampling Date :**

**Testing Apparatus Used :**

**Loading device N°** _9130____

**Caliper N°** _1_____

### Technical Data

| | | | | Average | |
|---|---|---|---|---|---|
| Diameter : | 63.18 | 63.20 | 63.00 | **63.13** | (mm) |
| Length : | 96.49 | 95.36 | 95.29 | **95.71** | (mm) |
| Straightness (0.5mm maximum) (S1) : | 0.1 | 0.1 | 0.2 | **0.1** | (mm) |
| Flatness (25µm maximum) (FP2) : | Ok | Ok | Ok | **Ok** | (µm) |
| Parallelism (0.25 ° maximum) (FP2) : | 0.05 | 0.10 | 0.10 | **0.08** | (°) |

Mass : 798.9 (g) Volume: 299563 ($mm^3$)

Density : 2667 ($kg/m^3$)

Moisture Conditions : Dry

Loading Rate (0.5 to 1.0 MPa / sec) : 0.48 (MPa/sec)

Type of Fracture : Multiple Fracture

Test Duration (2-15 Minutes) : 118 (seconds)

Maximum Applied Load : 175.67 (kN)

**Compressive Strength :** 56.1 (MPa)

### View of Specimen

Before Test :

After Test :

**Remarks :**

**Analysed by :** J. Lalonde **Date :** 8/18/2022

**Verified by :** **Date :** 8/25/2022

# Unconfined Compressive Strength of Intact Rock Core Specimen
## ASTM D 7012, ASTM D 4543

**Client :** Infrastructure Ontario

**Project :** Children's Hospital

**Project N° :** 11205379

**Sample N° :** BH13-22 r.3

**Depth :** 3,61 - 3,71 m

**Sampling Date :**

**Testing Apparatus Used :**

**Loading device N°** _9130____

**Caliper N°** _1_____

### Technical Data

| | | | | Average | |
|---|---|---|---|---|---|
| Diameter : | 63.00 | 63.09 | 63.15 | **63.08** | (mm) |
| Length : | 100.38 | 100.26 | 100.38 | **100.34** | (mm) |
| Straightness (0.5mm maximum) (S1) : | 0.2 | 0.3 | 0.2 | **0.2** | (mm) |
| Flatness (25µm maximum) (FP2) : | Ok | Ok | Ok | **Ok** | (µm) |
| Parallelism (0.25 ° maximum) (FP2) : | 0.15 | 0.15 | 0.15 | **0.15** | (°) |

Mass : 831.5 (g) Volume: 313579 ($mm^3$)

Density : 2652 ($kg/m^3$)

Moisture Conditions : Dry

Loading Rate (0.5 to 1.0 MPa / sec) : 0.33 (MPa/sec)

Type of Fracture : Multiple Fracture

Test Duration (2-15 Minutes) : 108 (seconds)

Maximum Applied Load : 112.31 (kN)

**Compressive Strength :** 35.9 (MPa)

### View of Specimen

Before Test :

After Test :

**Remarks :**

**Analysed by :** J. Lalonde **Date :** 8/18/2022

**Verified by :** **Date :** 8/25/2022

# Unconfined Compressive Strength of Intact Rock Core Specimen
## ASTM D 7012, ASTM D 4543

**Client :** Infrastructure Ontario
**Project N° :** 11205379
**Project :** Children's Hospital
**Sample N° :** MW23-22 r.2
**Depth :** 6,93 - 7,03 m
**Sampling Date :**

**Testing Apparatus Used :** **Loading device N°_9130____** **Caliper N°_1_____**

### Technical Data

| | | | | Average | |
|---|---|---|---|---|---|
| Diameter : | 63.11 | 63.04 | 63.06 | **63.07** | (mm) |
| Length : | 100.32 | 100.27 | 100.42 | **100.34** | (mm) |
| Straightness (0.5mm maximum) (S1) : | 0.2 | 0.1 | 0.2 | **0.2** | (mm) |
| Flatness (25µm maximum) (FP2) : | Ok | Ok | Ok | **Ok** | (µm) |
| Parallelism (0.25 ° maximum) (FP2) : | 0.10 | 0.15 | 0.15 | **0.13** | (°) |

Mass : 845.1 (g) Volume: 313469 ($mm^3$)

Density : 2696 ($kg/m^3$)

Moisture Conditions : Dry

Loading Rate (0.5 to 1.0 MPa / sec) : 0.39 (MPa/sec)

Type of Fracture : Multiple Fracture

Test Duration (2-15 Minutes) : 121 (seconds)

Maximum Applied Load : 146.16 (kN)

**Compressive Strength :** 46.8 (MPa)

### View of Specimen

Before Test :

After Test :

**Remarks :**

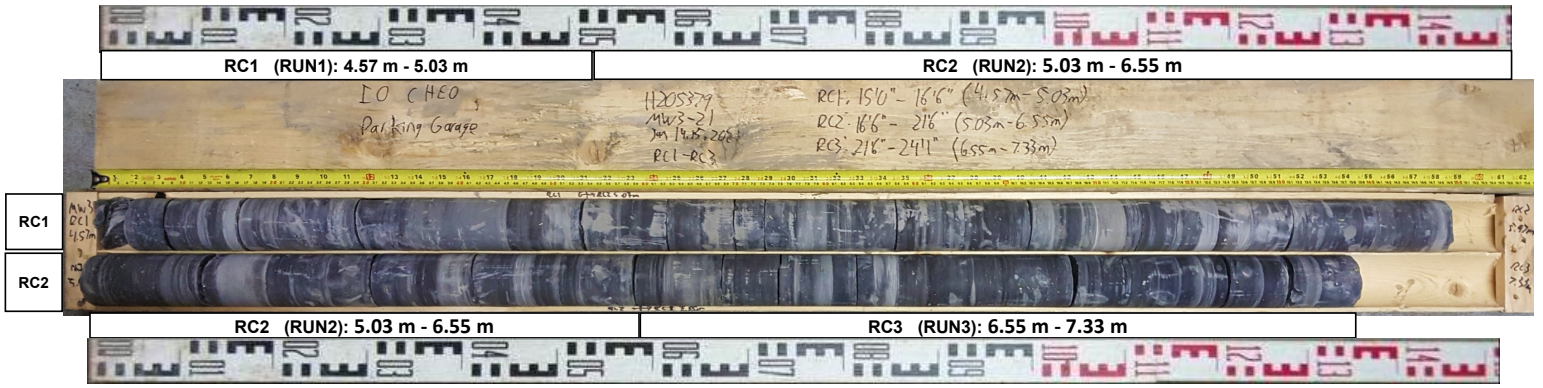
**Analysed by :** J. Lalonde **Date :** 8/18/2022

**Verified by :** **Date :** 8/25/2022

# Appendix C

## Rock Core Photographs

# HQ Rock Core Photo Log MW3-21 (RUN1,RUN2 & RUN3)




**RC1 (RUN1): 4.57 m - 5.03 m**
**RC2 (RUN2): 5.03 m - 6.55 m**
**RC3 (RUN3): 6.55 m - 7.33 m**

| | | | |
|---|---|---|---|
| **HQ ROCK CORE PHOTO LOG - MW3-21 (RUN1,RUN2 & RUN3)**<br>**Infrastructure Ontario**<br>**Preliminary Geotechnical Investigation,Proposed Parking Structure**<br>**Children's Hospital of Eastern Ontario Campus - 401 Smyth Road, Ottawa, Ontario** | **Prepared by:**<br>REZA BAY | **Scale:** As Shown<br>**Date:** 14/01/2021 | GHD |
| | **Checked by:**<br>S. Shahangian | **Referen No.: 11205379RPT-8** | |

# HQ Rock Core Photo Log  MW3-21 (RUN3,RUN4 & RUN5)


**RC3 (RUN3): 7.33 m - 8.08 m**
**RC4 (RUN4): 8.08 m - 9.60 m**
**RC5 (RUN5): 9.60 m - 10.06 m**

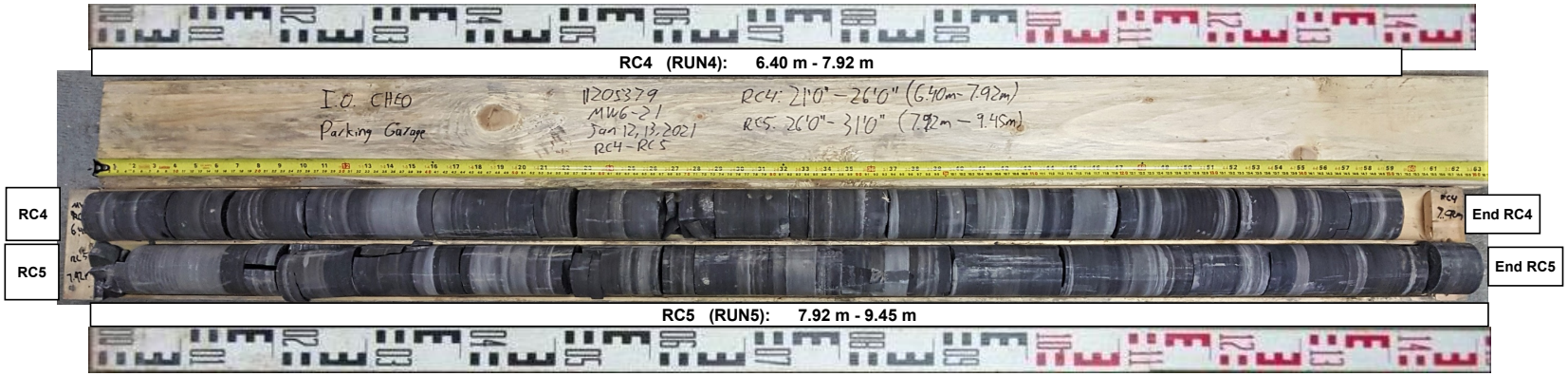
| | | | |
|---|---|---|---|
| **HQ ROCK CORE PHOTO LOG - MW3-21 (RUN3,RUN4 & RUN5)**<br>**Infrastructure Ontario**<br>**Preliminary Geotechnical Investigation,Proposed Parking Structure**<br>**Children's Hospital of Eastern Ontario Campus - 401 Smyth Road, Ottawa, Ontario** | **Prepared by:**<br>REZA BAY | **Scale:** As Shown<br>**Date:** 15/01/2021 | GHD |
| | **Checked by:**<br>S. Shahangian | **Referen No.:** 11205379RPT-8 | |

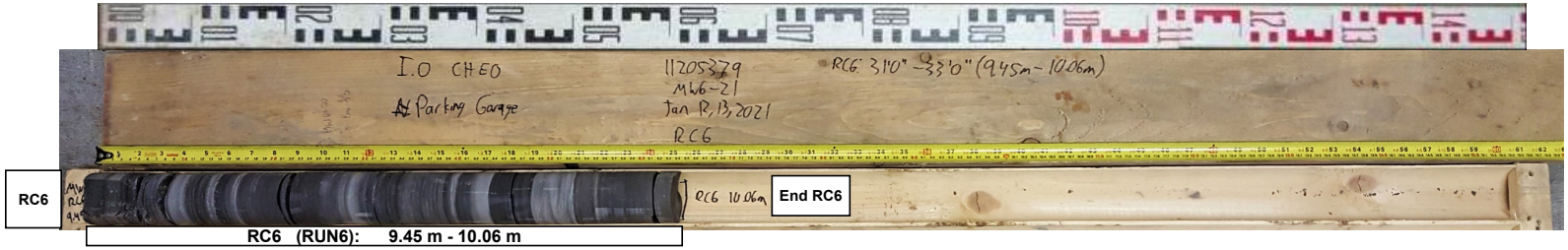
# HQ Rock Core Photo Log MW6-21 (RUN1,RUN2 & RUN3)


**RC1 (RUN1): 3.51 m - 3.81 m**
**RC2 (RUN2): 3.81 m - 4.88 m**
**RC3 (RUN3): 4.88 m - 6.40 m**

| | | | |
|---|---|---|---|
| **HQ ROCK CORE PHOTO LOG - MW6-21 (RUN1,RUN2 & RUN3)**<br>**Infrastructure Ontario**<br>**Preliminary Geotechnical Investigation,Proposed Parking Structure**<br>**Children's Hospital of Eastern Ontario Campus - 401 Smyth Road, Ottawa, Ontario** | **Prepared by:**<br>REZA BAY | **Scale:** As Shown<br>**Date:** 12/01/2021 | GHD |
| | **Checked by:**<br>S. Shahangian | **Referen No.:** 11205379RPT-8 | |

# HQ Rock Core Photo Log MW6-21 (RUN4,RUN5 & RUN6)

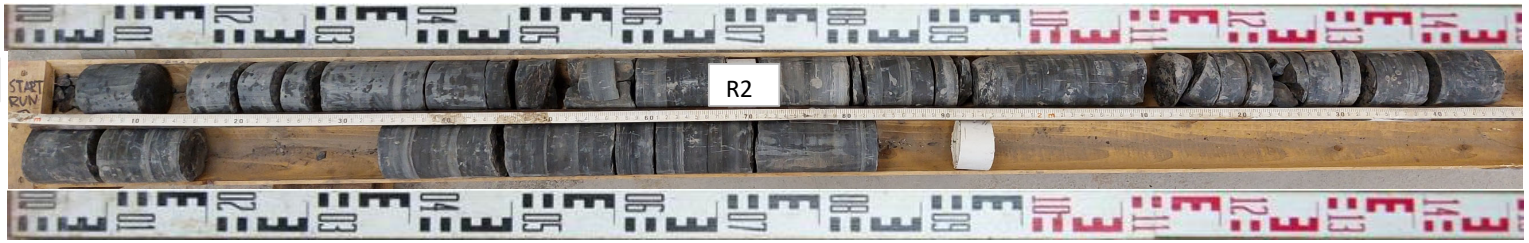



**RC4 (RUN4): 6.40 m - 7.92 m**
**RC5 (RUN5): 7.92 m - 9.45 m**
**RC6 (RUN6): 9.45 m - 10.06 m**

| | | | |
|---|---|---|---|
| **HQ ROCK CORE PHOTO LOG - MW6-21 (RUN4,RUN5 & RUN6)**<br>**Infrastructure Ontario**<br>**Preliminary Geotechnical Investigation,Proposed Parking Structure**<br>**Children's Hospital of Eastern Ontario Campus - 401 Smyth Road, Ottawa, Ontario** | **Prepared by:** | **Scale:** As Shown | GHD |
| | REZA BAY | **Date:** 13/01/2021 | |
| | **Checked by:** | **Referen No.:** 11205379RPT-8 | |
| | S. Shahangian | | |

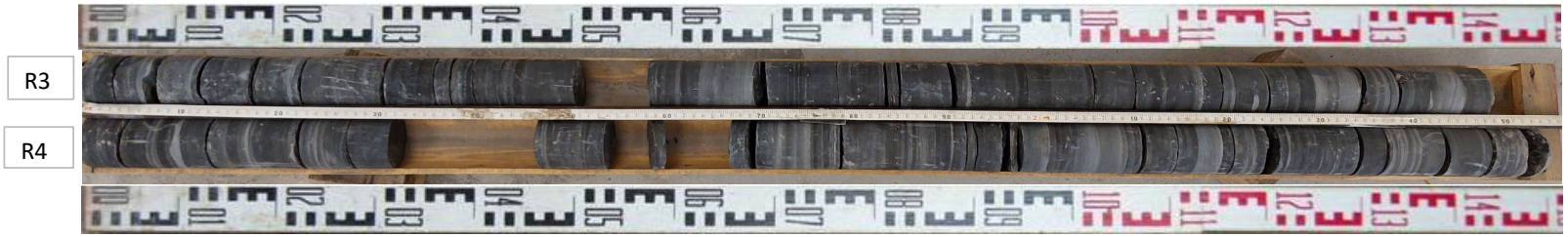
# Rock Core Photo Log BH11-22




**R1 (RUN 1): 2.5 m - 3.4 m**
**R2 (RUN 2): 3.4 m - 4.9 m**

| | | | | |
|---|---|---|---|---|
| **ROCK CORE PHOTO LOG BH11-22**<br>**Geotechnical Investigation - Infrastructure Ontario (I.O.)**<br>**Childrens Hospital of Eastern Ontario - 401 Smyth Road, Ottawa, Ontario** | **Note:**<br>**Missing cores were either retrieved for testing, not recovered or damage during sampling.** | **Prepared by:**<br>**Brice.Z**<br>**Checked by:**<br>**Nikol.K** | **Scale:** **As Shown**<br>**DATE:** **19/9/2022**<br>**Reference No.: 11205379** | GHD |

# Rock Core Photo Log BH11-22




**R3 (RUN 3): 4.9 m - 6.4 m**
**R4 (RUN 4): 6.4 m - 8.0 m**

| | | | | |
|---|---|---|---|---|
| **ROCK CORE PHOTO LOG BH11-22**<br>**Geotechnical Investigation - Infrastructure Ontario (I.O.)**<br>**Childrens Hospital of Eastern Ontario - 401 Smyth Road, Ottawa, Ontario** | **Note:**<br>**Missing cores were either retrieved for testing, not recovered or damage during sampling.** | **Prepared by:**<br>**Brice.Z**<br>**Checked by:**<br>**Nikol.K** | **Scale:** **As Shown**<br>**DATE:** **19/9/2022**<br>**Reference No.: 11205379** | GHD |

# Rock Core Photo Log BH13


**R1 (RUN 1): 1.2 m - 1.9 m**
**R2 (RUN 2): 1.9 m - 3.4 m**

| | | | |
|---|---|---|---|
| **ROCK CORE PHOTO LOG BH13**<br>**Geotechnical Investigation - Infrastructure Ontario (I.O.)**<br>**Childrens Hospital of Eastern Ontario - 401 Smyth Road, Ottawa, Ontario** | **Prepared by:** Brice. Z<br>**Checked by:** Nikol. M | **Scale:** As Shown<br>**DATE:** 02/09/2022<br>**Reference No.:** 11205379 | GHD |

# Rock Core Photo Log BH13

R3

R4

**R3 (RUN 3): 3.4 m - 5.0 m**
**R4 (RUN 4): 5.0 m - 6.6 m**

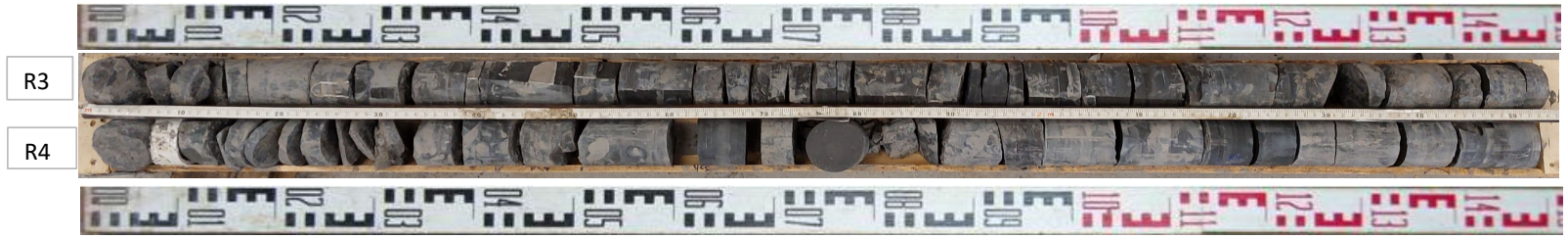
| | | | |
|---|---|---|---|
| **ROCK CORE PHOTO LOG BH13**<br>**Geotechnical Investigation - Infrastructure Ontario (I.O.)**<br>**Childrens Hospital of Eastern Ontario - 401 Smyth Road, Ottawa, Ontario** | **Prepared by:** Brice. Z | **Scale:** As Shown | GHD |
| | | **DATE:** 02/09/2022 | |
| | **Checked by:** Nikol. M | **Reference No.:** 11205379 | |

# Rock Core Photo Log BH18-22


**R1 (RUN 1): 1.4 m - 2.2 m**
**R2 (RUN 2): 2.2 m - 4.0 m**

| | | | | |
|---|---|---|---|---|
| **ROCK CORE PHOTO LOG BH18-22**<br>**Geotechnical Investigation - Infrastructure Ontario (I.O.)**<br>**Childrens Hospital of Eastern Ontario - 401 Smyth Road, Ottawa, Ontario** | **Note:**<br>**Missing cores were either retrieved for testing, not recovered or damage during sampling.** | **Prepared by:**<br>**Brice.Z**<br>**Checked by:**<br>**Nikol.K** | **Scale:** **As Shown**<br>**DATE:** **19/9/2022**<br>**Reference No.: 11205379** | GHD |

# Rock Core Photo Log BH18-22




**R3 (RUN 3): 4.0 m - 5.5 m**
**R4 (RUN 4): 5.5 m - 7.1 m**

| | | | | |
|---|---|---|---|---|
| **ROCK CORE PHOTO LOG BH18-22**<br>**Geotechnical Investigation - Infrastructure Ontario (I.O.)**<br>**Childrens Hospital of Eastern Ontario - 401 Smyth Road, Ottawa, Ontario** | **Note:**<br>**Missing cores were either retrieved for testing, not recovered or damage during sampling.** | **Prepared by:**<br>**Brice.Z**<br>**Checked by:**<br>**Nikol.K** | **Scale:** **As Shown**<br>**DATE:** **19/9/2022**<br>**Reference No.: 11205379** | GHD |

# Appendix D

## Soil Corrosivity Testing

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

**CLIENT NAME:** **GHD LIMITED**
**455 Phillip St**
**WATERLOO, ON N2V1C2**
**(519) 884-0510**
**ATTENTION TO:** **Jennifer Balkwill**
**PROJECT:** **11205379-RPT8**
**AGAT WORK ORDER:** **21Z712939**
**SOIL ANALYSIS REVIEWED BY:** **Nivine Basily, Inorganics Report Writer**
**DATE REPORTED:** **Mar 01, 2021**
**PAGES (INCLUDING COVER):** **5**
**VERSION*:** **1**

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*Notes
VERSION 1:Excluding Sulphide in Soil analysis

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

# Certificate of Analysis

**AGAT WORK ORDER: 21Z712939**

**PROJECT: 11205379-RPT8**

**CLIENT NAME: GHD LIMITED**

**ATTENTION TO: Jennifer Balkwill**

**SAMPLING SITE:**

**SAMPLED BY:**

## Corrosivity Package

**DATE RECEIVED: 2021-02-19** **DATE REPORTED: 2021-03-01**

| Parameter | Unit | G / S | RDL | Date Prepared | Date Analyzed | 11205379-BH4-21-SS2-0.7-1.0m Soil 2021-01-18 2122180 | RDL | 11205379-MW6-21-SS2-0.7-1.0m Soil 2021-01-13 2122181 | 11205379-BH7-21-SS2-0.7-1.0m Soil 2021-01-19 2122182 | RDL | 11205379-MW8-21-SS2-1.1-1.3m Soil 2021-01-18 2122183 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Chloride (2:1) | µg/g | | 4 | 2021-02-24 | 2021-02-24 | 440 | 2 | 253 | 69 | 4 | 562 |
| Sulphate (2:1) | µg/g | | 4 | 2021-02-24 | 2021-02-24 | 439 | 2 | 395 | 6 | 4 | 195 |
| pH (2:1) | pH Units | | NA | 2021-02-24 | 2021-02-24 | 6.35 | NA | 7.4 | 7.23 | NA | 7.95 |
| Electrical Conductivity (2:1) | mS/cm | | 0.005 | 2021-02-24 | 2021-02-24 | 1.21 | 0.005 | 0.936 | 0.163 | 0.005 | 1.40 |
| Resistivity (2:1) (Calculated) | ohm.cm | | 1 | 2021-02-24 | 2021-02-24 | 826 | 1 | 1070 | 6130 | 1 | 714 |
| Redox Potential 1 | mV | | NA | 2021-02-23 | 2021-02-23 | 428 | NA | 389 | 429 | NA | 377 |
| Redox Potential 2 | mV | | NA | 2021-02-23 | 2021-02-23 | 446 | NA | 394 | 416 | NA | 379 |
| Redox Potential 3 | mV | | NA | 2021-02-23 | 2021-02-23 | 432 | NA | 397 | 414 | NA | 377 |

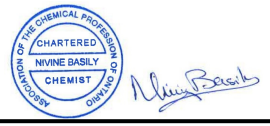
**Comments:** RDL - Reported Detection Limit; G / S - Guideline / Standard

**2122180-2122183** EC, pH, Chloride and Sulphate were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil). Resistivity is a calculated parameter.
Redox potential measured on as received sample. Due to the potential for rapid change in sample equilibrium chemistry with exposure to oxidative/reduction conditions laboratory results may differ from field measured results.
Redox potential measurement in soil is quite variable and non reproducible due in part, to the general heterogeneity of a given soil. It is also related to the introduction of increased oxygen into the sample after extraction. The interpretation of soil redox potential should be considered in terms of its general range rather than as an absolute measurement.

Dilution required, RDL has been increased accordingly.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:



AGAT Laboratories

5835 COOPERS AVENUE
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# Quality Assurance

**CLIENT NAME: GHD LIMITED**

**AGAT WORK ORDER: 21Z712939**

**PROJECT: 11205379-RPT8**

**ATTENTION TO: Jennifer Balkwill**

**SAMPLING SITE:**

**SAMPLED BY:**

## Soil Analysis

| RPT Date: Mar 01, 2021 | | | DUPLICATE | | | | REFERENCE MATERIAL | | | METHOD BLANK SPIKE | | | MATRIX SPIKE | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PARAMETER | Batch | Sample Id | Dup #1 | Dup #2 | RPD | Method Blank | Measured Value | Acceptable Limits | | Recovery | Acceptable Limits | | Recovery | Acceptable Limits | |
| | | | | | | | | Lower | Upper | | Lower | Upper | | Lower | Upper |
| **Corrosivity Package** | | | | | | | | | | | | | | | |
| Chloride (2:1) | 2129123 | | 42 | 42 | 0.0% | < 2 | 93% | 70% | 130% | 102% | 80% | 120% | 104% | 70% | 130% |
| Sulphate (2:1) | 2129123 | | 3 | 3 | NA | < 2 | 100% | 70% | 130% | 107% | 80% | 120% | 106% | 70% | 130% |
| pH (2:1) | 2122180 | 2122180 | 6.35 | 6.38 | 0.5% | NA | 100% | 90% | 110% | | | | | | |
| Electrical Conductivity (2:1) | 2122180 | 2122180 | 1.21 | 1.40 | 14.6% | < 0.005 | 105% | 80% | 120% | | | | | | |
| Redox Potential 1 | 1 | | | | | | 100% | 90% | 110% | | | | | | |

Comments: NA signifies Not Applicable.
pH duplicates QA acceptance criteria was met relative as stated in Table 5-15 of Analytical Protocol document.

Duplicate NA: results are under 5X the RDL and will not be calculated.

Certified By:

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
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TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

# Method Summary

**CLIENT NAME: GHD LIMITED**

**AGAT WORK ORDER: 21Z712939**

**PROJECT: 11205379-RPT8**

**ATTENTION TO: Jennifer Balkwill**

**SAMPLING SITE:**

**SAMPLED BY:**

| PARAMETER | AGAT S.O.P | LITERATURE REFERENCE | ANALYTICAL TECHNIQUE |
|---|---|---|---|
| **Soil Analysis** | | | |
| Chloride (2:1) | INOR-93-6004 | modified from SM 4110 B | ION CHROMATOGRAPH |
| Sulphate (2:1) | INOR-93-6004 | modified from SM 4110 B | ION CHROMATOGRAPH |
| pH (2:1) | INOR 93-6031 | MSA part 3 & SM 4500-H+ B | PH METER |
| Electrical Conductivity (2:1) | INOR-93-6036 | modified from MSA PART 3, CH 14 and SM 2510 B | EC METER |
| Resistivity (2:1) (Calculated) | INOR-93-6036 | McKeague 4.12, SM 2510 B,SSA #5 Part 3 | CALCULATION |
| Redox Potential 1 | INOR-93-6066 | modified G200-09, SM 2580 B | REDOX POTENTIAL ELECTRODE |
| Redox Potential 2 | INOR-93-6066 | modified G200-09, SM 2580 B | REDOX POTENTIAL ELECTRODE |
| Redox Potential 3 | INOR-93-6066 | modified G200-09, SM 2580 B | REDOX POTENTIAL ELECTRODE |

# AGAT Laboratories

1LG BTR

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

## Chain of Custody Record

**If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form** (potable water consumed by humans)

### Laboratory Use Only

Work Order #: 21Z712939

Cooler Quantity: 1 bag - none

Arrival Temperatures: 18.6 | 18.6 | 18.5

(TUCP pack) 4.0 | 4.6 | 4.8

Custody Seal Intact: ☐ Yes ☐ No ☐ N/A

Notes:

### Report Information:

Company: GHD Limited
Contact: Jennifer Balkwill
Address: 455 Phillip St Unit 100A, Waterloo, ON, N2L 3X2
Phone: 519-340-4286 Fax:
Reports to be sent to:
1. Email: jennifer.balkwill@ghd.com
2. Email:

### Regulatory Requirements:

(Please check all applicable boxes)

☐ Regulation 153/04
Table (Indicate One) ☐ Ind/Com ☐ Res/Park ☐ Agriculture
Soil Texture (Check One) ☐ Coarse ☐ Fine

☐ Excess Soils R406
Table (Indicate One)
☐ Regulation 558
☐ CCME

☐ Sewer Use ☐ Sanitary ☐ Storm
(Region)
☐ Prov. Water Quality Objectives (PWQO)
☐ Other
(Indicate One)

Is this submission for a **Record of Site Condition?** ☐ Yes ☐ No

**Report Guideline on *Certificate of Analysis*** ☐ Yes ☐ No

### Turnaround Time (TAT) Required:

**Regular TAT** (Most Analyses) ☐ 5 to 7 Business Days

**Rush TAT** (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day

**OR** Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

**For 'Same Day' analysis, please contact your AGAT CPM**

### Project Information:

Project: 11205379-RPT8
Site Location:
Sampled By:
AGAT ID #: PO: 73522893
*Please note: If quotation number is not provided, client will be billed full price for analysis.*

### Invoice Information:

Bill To Same: Yes ☑ No ☐

Company:
Contact:
Address:
Email:

### Sample Matrix Legend

| | |
|---|---|
| **B** | Biota |
| **GW** | Ground Water |
| **O** | Oil |
| **P** | Paint |
| **S** | Soil |
| **SD** | Sediment |
| **SW** | Surface Water |

| Sample Identification | Date Sampled | Time Sampled | # of Containers | Sample Matrix | Comments/ Special Instructions | Field Filtered - Metals, Hg, CrVI, DOC (Y/N) | O. Reg 153: Metals & Inorganics | O. Reg 153: Metals - ☐ CrVI, ☐ Hg, ☐ HWSB | O. Reg 153: BTEX, F1-F4 PHCs, Analyze F4G if required ☐ Yes ☐ No | O. Reg 153: PAHs | O. Reg 153: Total PCBs ☐ Aroclor | O. Reg 153: VOC | O. Reg 558: Landfill Disposal Characterization TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs | O. Reg 406: Excess Soils SPLP Rainwater Leach SPLP: ☐ Metals ☐ VOCs ☐ SVOCs | O. Reg 406: Excess Soils Characterization Package pH, ICPMS Metals, BTEX, F1-F4 | Salt - EC/SAR | Corrosivity | Potentially Hazardous or High Concentration (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | AM PM | | | | | | | | | | | | | | | | |
| 11205379- BH4-21 – SS2 - 0.7-1.0m | 2021-01-18 | AM PM | 1 | Soil | Corrosivity | | | | | | | | | | | | ☑ | |
| | | AM PM | | | | | | | | | | | | | | | | |
| 11205379- MW6-21 – SS2 - 0.7-1.0m | 2021-01-13 | AM PM | 1 | Soil | Corrosivity | | | | | | | | | | | | ☑ | |
| 11205379- BH7-21 – SS2 - 0.7-1.0m | 2021-01-19 | AM PM | 1 | Soil | Corrosivity | | | | | | | | | | | | ☑ | |
| 11205379- MW8-21 – SS2 - 1.1-1.3m | 2021-01-18 | AM PM | 1 | Soil | Corrosivity | | | | | | | | | | | | ☑ | |
| | | AM PM | | | | | | | | | | | | | | | | |
| | | AM PM | | | | | | | | | | | | | | | | |
| | | AM PM | | | | | | | | | | | | | | | | |
| | | AM PM | | | | | | | | | | | | | | | | |
| | | AM PM | | | | | | | | | | | | | | | | |

| Samples Relinquished By (Print Name and Sign) | Date | Time | Samples Received By (Print Name and Sign) | Date | Time |
|---|---|---|---|---|---|
| | | | (illegible) | 12/19 | 8h00 |
| Samples Relinquished By (Print Name and Sign) (illegible) | 21/2/19 | 10h00 | Samples Received By (Print Name and Sign) | Feb 20/21 | 11:24 am |
| Samples Relinquished By (Print Name and Sign) | Date | Time | Samples Received By (Print Name and Sign) | Date | Time |

Page ___ of ___

N°:

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **WT2214174** | Page | : 1 of 5 |
| Client | : **GHD Limited** | Laboratory | : Waterloo - Environmental |
| Contact | : Rick Hawthorne | Account Manager | : Rick Hawthorne |
| Address | : 455 Phillip Street<br>Waterloo ON Canada N2L 3X2 | Address | : 60 Northland Road, Unit 1<br>Waterloo ON Canada N2V 2B8 |
| Telephone | : ---- | Telephone | : +1 519 886 6910 |
| Project | : 11205379-100 | Date Samples Received | : 14-Sep-2022 10:30 |
| PO | : 735-004287 | Date Analysis Commenced | : 15-Sep-2022 |
| C-O-C number | : ---- | Issue Date | : 16-Sep-2022 16:35 |
| Sampler | : CLIENT | | |
| Site | : ---- | | |
| Quote number | : 11205379-100-SSOW 735-004287 | | |
| No. of samples received | : 8 | | |
| No. of samples analysed | : 8 | | |

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

## *Signatories*

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

| *Signatories* | *Position* | *Laboratory Department* |
|---|---|---|
| Greg Pokocky | Supervisor - Inorganic | Inorganics, Waterloo, Ontario |
| Joseph Scharbach | | Centralized Prep, Waterloo, Ontario |
| Walt Kippenhuck | Team Leader - Inorganics | Inorganics, Waterloo, Ontario |

## General Comments

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

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

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

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
LOR: Limit of Reporting (detection limit).

| *Unit* | *Description* |
|---|---|
| % | percent |
| µS/cm | Microsiemens per centimetre |
| mg/kg | milligrams per kilogram |
| mV | millivolts |
| ohm cm | ohm centimetre (resistivity) |
| pH units | pH units |

>: greater than.
<: less than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

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

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

## Qualifiers

| *Qualifier* | *Description* |
|---|---|
| *FR5* | *As per applicable reference method(s), soil:water ratio for Fixed Ratio Leach was modified to 1:5 due to high soil organic content* |

## Analytical Results

WT2214174-001

Sub-Matrix:**Soil** *Client sample ID:* 11205379- BH16-SS2

(Matrix: **Soil/Solid**) *Client sampling date / time:* 14-Sep-2022

| Analyte | CAS Number | Result | LOR | Unit | Method | Prep Date | Analysis Date | QCLot |
|---|---|---|---|---|---|---|---|---|
| **Physical Tests** | | | | | | | | |
| **conductivity (1:2 leachate)** | ---- | 2650 FR5, | 10.0 | µS/cm | E100-L | 16-Sep-2022 | 16-Sep-2022 | 648051 |
| **moisture** | ---- | 10.4 | 0.25 | % | E144 | - | 15-Sep-2022 | 648057 |
| **oxidation-reduction potential [ORP]** | ---- | 436 | 0.10 | mV | E125 | 15-Sep-2022 | 15-Sep-2022 | 648056 |
| **pH (1:2 soil:CaCl2-aq)** | ---- | 8.26 | 0.10 | pH units | E108A | 15-Sep-2022 | 15-Sep-2022 | 648054 |
| **resistivity** | ---- | 380 | 100 | ohm cm | EC100R | - | 16-Sep-2022 | - |
| **Leachable Anions & Nutrients** | | | | | | | | |
| **chloride, soluble ion content** | 16887-00-6 | 1300 | 5.0 | mg/kg | E236.Cl | 16-Sep-2022 | 16-Sep-2022 | 648053 |
| **sulfate, soluble ion content** | 14808-79-8 | 498 | 20 | mg/kg | E236.SO4 | 16-Sep-2022 | 16-Sep-2022 | 648052 |

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

## Analytical Results

WT2214174-002

Sub-Matrix:**Soil** *Client sample ID:* 11205379- BH20-SS2

(Matrix: **Soil/Solid**) *Client sampling date / time:* 14-Sep-2022

| Analyte | CAS Number | Result | LOR | Unit | Method | Prep Date | Analysis Date | QCLot |
|---|---|---|---|---|---|---|---|---|
| **Physical Tests** | | | | | | | | |
| **conductivity (1:2 leachate)** | ---- | 422 FR5, | 10.0 | µS/cm | E100-L | 16-Sep-2022 | 16-Sep-2022 | 648051 |
| **moisture** | ---- | 10.1 | 0.25 | % | E144 | - | 15-Sep-2022 | 648057 |
| **oxidation-reduction potential [ORP]** | ---- | 419 | 0.10 | mV | E125 | 15-Sep-2022 | 15-Sep-2022 | 648056 |
| **pH (1:2 soil:CaCl2-aq)** | ---- | 7.78 | 0.10 | pH units | E108A | 15-Sep-2022 | 15-Sep-2022 | 648054 |
| **resistivity** | ---- | 2370 | 100 | ohm cm | EC100R | - | 16-Sep-2022 | - |
| **Leachable Anions & Nutrients** | | | | | | | | |
| **chloride, soluble ion content** | 16887-00-6 | 19.6 | 5.0 | mg/kg | E236.Cl | 16-Sep-2022 | 16-Sep-2022 | 648053 |
| **sulfate, soluble ion content** | 14808-79-8 | 173 | 20 | mg/kg | E236.SO4 | 16-Sep-2022 | 16-Sep-2022 | 648052 |

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

## Analytical Results

WT2214174-003

Sub-Matrix:**Soil** *Client sample ID:* 11205379- MW17-SS1

(Matrix: **Soil/Solid**) *Client sampling date / time:* 14-Sep-2022

| Analyte | CAS Number | Result | LOR | Unit | Method | Prep Date | Analysis Date | QCLot |
|---|---|---|---|---|---|---|---|---|
| **Physical Tests** | | | | | | | | |
| **conductivity (1:2 leachate)** | ---- | 231 FR5, | 10.0 | µS/cm | E100-L | 16-Sep-2022 | 16-Sep-2022 | 648051 |
| **moisture** | ---- | <0.25 | 0.25 | % | E144 | - | 15-Sep-2022 | 648057 |
| **oxidation-reduction potential [ORP]** | ---- | 419 | 0.10 | mV | E125 | 15-Sep-2022 | 15-Sep-2022 | 648056 |
| **pH (1:2 soil:CaCl2-aq)** | ---- | 8.26 | 0.10 | pH units | E108A | 15-Sep-2022 | 15-Sep-2022 | 648054 |
| **resistivity** | ---- | 4330 | 100 | ohm cm | EC100R | - | 16-Sep-2022 | - |
| **Leachable Anions & Nutrients** | | | | | | | | |
| **chloride, soluble ion content** | 16887-00-6 | 8.6 | 5.0 | mg/kg | E236.Cl | 16-Sep-2022 | 16-Sep-2022 | 648053 |
| **sulfate, soluble ion content** | 14808-79-8 | 54 | 20 | mg/kg | E236.SO4 | 16-Sep-2022 | 16-Sep-2022 | 648052 |

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

## Analytical Results

WT2214174-004

Sub-Matrix:**Soil** *Client sample ID:* 11205379- MW18-SS3

(Matrix: **Soil/Solid**) *Client sampling date / time:* 14-Sep-2022

| Analyte | CAS Number | Result | LOR | Unit | Method | Prep Date | Analysis Date | QCLot |
|---|---|---|---|---|---|---|---|---|
| **Physical Tests** | | | | | | | | |
| **conductivity (1:2 leachate)** | ---- | 1310 FR5, | 10.0 | µS/cm | E100-L | 16-Sep-2022 | 16-Sep-2022 | 648051 |
| **moisture** | ---- | 8.45 | 0.25 | % | E144 | - | 15-Sep-2022 | 648057 |
| **oxidation-reduction potential [ORP]** | ---- | 398 | 0.10 | mV | E125 | 15-Sep-2022 | 15-Sep-2022 | 648056 |
| **pH (1:2 soil:CaCl2-aq)** | ---- | 8.16 | 0.10 | pH units | E108A | 15-Sep-2022 | 15-Sep-2022 | 648054 |
| **resistivity** | ---- | 760 | 100 | ohm cm | EC100R | - | 16-Sep-2022 | - |
| **Leachable Anions & Nutrients** | | | | | | | | |
| **chloride, soluble ion content** | 16887-00-6 | 734 | 5.0 | mg/kg | E236.Cl | 16-Sep-2022 | 16-Sep-2022 | 648053 |
| **sulfate, soluble ion content** | 14808-79-8 | 215 | 20 | mg/kg | E236.SO4 | 16-Sep-2022 | 16-Sep-2022 | 648052 |

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

## Analytical Results

WT2214174-005

Sub-Matrix:**Soil** *Client sample ID:* 11205379- BH11-22-SS2

(Matrix: **Soil/Solid**) *Client sampling date / time:* 14-Sep-2022

| Analyte | CAS Number | Result | LOR | Unit | Method | Prep Date | Analysis Date | QCLot |
|---|---|---|---|---|---|---|---|---|
| **Physical Tests** | | | | | | | | |
| **conductivity (1:2 leachate)** | ---- | 2540 FR5, | 10.0 | µS/cm | E100-L | 16-Sep-2022 | 16-Sep-2022 | 648051 |
| **moisture** | ---- | 6.72 | 0.25 | % | E144 | - | 15-Sep-2022 | 648057 |
| **oxidation-reduction potential [ORP]** | ---- | 393 | 0.10 | mV | E125 | 15-Sep-2022 | 15-Sep-2022 | 648056 |
| **pH (1:2 soil:CaCl2-aq)** | ---- | 7.28 | 0.10 | pH units | E108A | 15-Sep-2022 | 15-Sep-2022 | 648054 |
| **resistivity** | ---- | 390 | 100 | ohm cm | EC100R | - | 16-Sep-2022 | - |
| **Leachable Anions & Nutrients** | | | | | | | | |
| **chloride, soluble ion content** | 16887-00-6 | 1420 | 5.0 | mg/kg | E236.Cl | 16-Sep-2022 | 16-Sep-2022 | 648053 |
| **sulfate, soluble ion content** | 14808-79-8 | 219 | 20 | mg/kg | E236.SO4 | 16-Sep-2022 | 16-Sep-2022 | 648052 |

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

## Analytical Results

WT2214174-006

Sub-Matrix:**Soil** *Client sample ID:* 11205379- BH16-22-SS2

(Matrix: **Soil/Solid**) *Client sampling date / time:* 14-Sep-2022

| Analyte | CAS Number | Result | LOR | Unit | Method | Prep Date | Analysis Date | QCLot |
|---|---|---|---|---|---|---|---|---|
| **Physical Tests** | | | | | | | | |
| **conductivity (1:2 leachate)** | ---- | 430 FR5, | 10.0 | µS/cm | E100-L | 16-Sep-2022 | 16-Sep-2022 | 648051 |
| **moisture** | ---- | 6.03 | 0.25 | % | E144 | - | 15-Sep-2022 | 648057 |
| **oxidation-reduction potential [ORP]** | ---- | 354 | 0.10 | mV | E125 | 15-Sep-2022 | 15-Sep-2022 | 648056 |
| **pH (1:2 soil:CaCl2-aq)** | ---- | 7.85 | 0.10 | pH units | E108A | 15-Sep-2022 | 15-Sep-2022 | 648054 |
| **resistivity** | ---- | 2320 | 100 | ohm cm | EC100R | - | 16-Sep-2022 | - |
| **Leachable Anions & Nutrients** | | | | | | | | |
| **chloride, soluble ion content** | 16887-00-6 | 83.2 | 5.0 | mg/kg | E236.Cl | 16-Sep-2022 | 16-Sep-2022 | 648053 |
| **sulfate, soluble ion content** | 14808-79-8 | 116 | 20 | mg/kg | E236.SO4 | 16-Sep-2022 | 16-Sep-2022 | 648052 |

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

## Analytical Results

WT2214174-007

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

*Client sample ID:* 11205379- BH17-22-SS2
*Client sampling date / time:* 14-Sep-2022

| Analyte | CAS Number | Result | LOR | Unit | Method | Prep Date | Analysis Date | QCLot |
|---|---|---|---|---|---|---|---|---|
| **Physical Tests** | | | | | | | | |
| **conductivity (1:2 leachate)** | ---- | 622 FR5, | 10.0 | µS/cm | E100-L | 16-Sep-2022 | 16-Sep-2022 | 648051 |
| **moisture** | ---- | 7.97 | 0.25 | % | E144 | - | 15-Sep-2022 | 648057 |
| **oxidation-reduction potential [ORP]** | ---- | 350 | 0.10 | mV | E125 | 15-Sep-2022 | 15-Sep-2022 | 648056 |
| **pH (1:2 soil:CaCl2-aq)** | ---- | 7.47 | 0.10 | pH units | E108A | 15-Sep-2022 | 15-Sep-2022 | 648054 |
| **resistivity** | ---- | 1610 | 100 | ohm cm | EC100R | - | 16-Sep-2022 | - |
| **Leachable Anions & Nutrients** | | | | | | | | |
| **chloride, soluble ion content** | 16887-00-6 | 609 | 5.0 | mg/kg | E236.Cl | 16-Sep-2022 | 16-Sep-2022 | 648053 |
| **sulfate, soluble ion content** | 14808-79-8 | 94 | 20 | mg/kg | E236.SO4 | 16-Sep-2022 | 16-Sep-2022 | 648052 |

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

## Analytical Results

WT2214174-008

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

*Client sample ID:* 11205379- MW09-22
*Client sampling date / time:* 14-Sep-2022

| Analyte | CAS Number | Result | LOR | Unit | Method | Prep Date | Analysis Date | QCLot |
|---|---|---|---|---|---|---|---|---|
| **Physical Tests** | | | | | | | | |
| **conductivity (1:2 leachate)** | ---- | 5560 FR5, | 10.0 | µS/cm | E100-L | 16-Sep-2022 | 16-Sep-2022 | 648051 |
| **moisture** | ---- | 6.16 | 0.25 | % | E144 | - | 15-Sep-2022 | 648057 |
| **oxidation-reduction potential [ORP]** | ---- | 371 | 0.10 | mV | E125 | 15-Sep-2022 | 15-Sep-2022 | 648056 |
| **pH (1:2 soil:CaCl2-aq)** | ---- | 6.81 | 0.10 | pH units | E108A | 15-Sep-2022 | 15-Sep-2022 | 648054 |
| **resistivity** | ---- | 180 | 100 | ohm cm | EC100R | - | 16-Sep-2022 | - |
| **Leachable Anions & Nutrients** | | | | | | | | |
| **chloride, soluble ion content** | 16887-00-6 | 611 | 5.0 | mg/kg | E236.Cl | 16-Sep-2022 | 16-Sep-2022 | 648053 |
| **sulfate, soluble ion content** | 14808-79-8 | 6500 | 20 | mg/kg | E236.SO4 | 16-Sep-2022 | 16-Sep-2022 | 648052 |

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

# QUALITY CONTROL INTERPRETIVE REPORT

| | | | |
|---|---|---|---|
| **Work Order** | : **WT2214174** | Page | : 1 of 11 |
| Client | : **GHD Limited** | Laboratory | : Waterloo - Environmental |
| Contact | : Rick Hawthorne | Account Manager | : Rick Hawthorne |
| Address | : 455 Phillip Street<br>Waterloo ON Canada N2L 3X2 | Address | : 60 Northland Road, Unit 1<br>Waterloo, Ontario Canada N2V 2B8 |
| Telephone | : ---- | Telephone | : +1 519 886 6910 |
| Project | : 11205379-100 | Date Samples Received | : 14-Sep-2022 10:30 |
| PO | : 735-004287 | Issue Date | : 16-Sep-2022 16:35 |
| C-O-C number | : ---- | | |
| Sampler | : CLIENT | | |
| Site | : ---- | | |
| Quote number | : 11205379-100-SSOW 735-004287 | | |
| No. of samples received | : 8 | | |
| No. of samples analysed | : 8 | | |

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

**Key**

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

## *Workorder Comments*

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

## *Summary of Outliers*

### *Outliers : Quality Control Samples*

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Test sample Surrogate recovery outliers exist.

### *Outliers: Reference Material (RM) Samples*

- No Reference Material (RM) Sample outliers occur.

### *Outliers : Analysis Holding Time Compliance (Breaches)*

- No Analysis Holding Time Outliers exist.

### *Outliers : Frequency of Quality Control Samples*

- No Quality Control Sample Frequency Outliers occur.

# Analysis Holding Time Compliance

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

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

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

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

Matrix: **Soil/Solid**

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

| Analyte Group / Container / Client Sample ID(s) | Method | Sampling Date | Extraction / Preparation | | | | Analysis | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Preparation Date | Holding Times Rec | Holding Times Actual | Eval | Analysis Date | Holding Times Rec | Holding Times Actual | Eval |
| **Leachable Anions & Nutrients : Water Extractable Chloride by IC** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- BH11-22-SS2 | E236.Cl | 14-Sep-2022 | 16-Sep-2022 | 30 days | 3 days | ✓ | 16-Sep-2022 | 28 days | 0 days | ✓ |
| **Leachable Anions & Nutrients : Water Extractable Chloride by IC** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- BH16-22-SS2 | E236.Cl | 14-Sep-2022 | 16-Sep-2022 | 30 days | 3 days | ✓ | 16-Sep-2022 | 28 days | 0 days | ✓ |
| **Leachable Anions & Nutrients : Water Extractable Chloride by IC** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- BH16-SS2 | E236.Cl | 14-Sep-2022 | 16-Sep-2022 | 30 days | 3 days | ✓ | 16-Sep-2022 | 28 days | 0 days | ✓ |
| **Leachable Anions & Nutrients : Water Extractable Chloride by IC** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- BH17-22-SS2 | E236.Cl | 14-Sep-2022 | 16-Sep-2022 | 30 days | 3 days | ✓ | 16-Sep-2022 | 28 days | 0 days | ✓ |
| **Leachable Anions & Nutrients : Water Extractable Chloride by IC** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- BH20-SS2 | E236.Cl | 14-Sep-2022 | 16-Sep-2022 | 30 days | 3 days | ✓ | 16-Sep-2022 | 28 days | 0 days | ✓ |
| **Leachable Anions & Nutrients : Water Extractable Chloride by IC** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- MW09-22 | E236.Cl | 14-Sep-2022 | 16-Sep-2022 | 30 days | 3 days | ✓ | 16-Sep-2022 | 28 days | 0 days | ✓ |
| **Leachable Anions & Nutrients : Water Extractable Chloride by IC** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- MW17-SS1 | E236.Cl | 14-Sep-2022 | 16-Sep-2022 | 30 days | 3 days | ✓ | 16-Sep-2022 | 28 days | 0 days | ✓ |

Matrix: **Soil/Solid**

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

| Analyte Group / Container / Client Sample ID(s) | Method | Sampling Date | Extraction / Preparation | | | | Analysis | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Preparation Date | Holding Times Rec | Holding Times Actual | Eval | Analysis Date | Holding Times Rec | Holding Times Actual | Eval |
| **Leachable Anions & Nutrients : Water Extractable Chloride by IC** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- MW18-SS3 | E236.Cl | 14-Sep-2022 | 16-Sep-2022 | 30 days | 3 days | ✓ | 16-Sep-2022 | 28 days | 0 days | ✓ |
| **Leachable Anions & Nutrients : Water Extractable Sulfate by IC** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- BH11-22-SS2 | E236.SO4 | 14-Sep-2022 | 16-Sep-2022 | 30 days | 3 days | ✓ | 16-Sep-2022 | 28 days | 0 days | ✓ |
| **Leachable Anions & Nutrients : Water Extractable Sulfate by IC** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- BH16-22-SS2 | E236.SO4 | 14-Sep-2022 | 16-Sep-2022 | 30 days | 3 days | ✓ | 16-Sep-2022 | 28 days | 0 days | ✓ |
| **Leachable Anions & Nutrients : Water Extractable Sulfate by IC** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- BH16-SS2 | E236.SO4 | 14-Sep-2022 | 16-Sep-2022 | 30 days | 3 days | ✓ | 16-Sep-2022 | 28 days | 0 days | ✓ |
| **Leachable Anions & Nutrients : Water Extractable Sulfate by IC** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- BH17-22-SS2 | E236.SO4 | 14-Sep-2022 | 16-Sep-2022 | 30 days | 3 days | ✓ | 16-Sep-2022 | 28 days | 0 days | ✓ |
| **Leachable Anions & Nutrients : Water Extractable Sulfate by IC** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- BH20-SS2 | E236.SO4 | 14-Sep-2022 | 16-Sep-2022 | 30 days | 3 days | ✓ | 16-Sep-2022 | 28 days | 0 days | ✓ |
| **Leachable Anions & Nutrients : Water Extractable Sulfate by IC** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- MW09-22 | E236.SO4 | 14-Sep-2022 | 16-Sep-2022 | 30 days | 3 days | ✓ | 16-Sep-2022 | 28 days | 0 days | ✓ |
| **Leachable Anions & Nutrients : Water Extractable Sulfate by IC** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- MW17-SS1 | E236.SO4 | 14-Sep-2022 | 16-Sep-2022 | 30 days | 3 days | ✓ | 16-Sep-2022 | 28 days | 0 days | ✓ |
| **Leachable Anions & Nutrients : Water Extractable Sulfate by IC** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- MW18-SS3 | E236.SO4 | 14-Sep-2022 | 16-Sep-2022 | 30 days | 3 days | ✓ | 16-Sep-2022 | 28 days | 0 days | ✓ |

Matrix: **Soil/Solid**

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

| Analyte Group / Container / Client Sample ID(s) | Method | Sampling Date | Extraction / Preparation | | | | Analysis | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Preparation Date | Holding Times Rec | Holding Times Actual | Eval | Analysis Date | Holding Times Rec | Holding Times Actual | Eval |
| **Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- BH11-22-SS2 | E100-L | 14-Sep-2022 | 16-Sep-2022 | ---- | ---- | | 16-Sep-2022 | 30 days | 2 days | ✓ |
| **Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- BH16-22-SS2 | E100-L | 14-Sep-2022 | 16-Sep-2022 | ---- | ---- | | 16-Sep-2022 | 30 days | 2 days | ✓ |
| **Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- BH16-SS2 | E100-L | 14-Sep-2022 | 16-Sep-2022 | ---- | ---- | | 16-Sep-2022 | 30 days | 2 days | ✓ |
| **Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- BH17-22-SS2 | E100-L | 14-Sep-2022 | 16-Sep-2022 | ---- | ---- | | 16-Sep-2022 | 30 days | 2 days | ✓ |
| **Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- BH20-SS2 | E100-L | 14-Sep-2022 | 16-Sep-2022 | ---- | ---- | | 16-Sep-2022 | 30 days | 2 days | ✓ |
| **Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- MW09-22 | E100-L | 14-Sep-2022 | 16-Sep-2022 | ---- | ---- | | 16-Sep-2022 | 30 days | 2 days | ✓ |
| **Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- MW17-SS1 | E100-L | 14-Sep-2022 | 16-Sep-2022 | ---- | ---- | | 16-Sep-2022 | 30 days | 2 days | ✓ |
| **Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- MW18-SS3 | E100-L | 14-Sep-2022 | 16-Sep-2022 | ---- | ---- | | 16-Sep-2022 | 30 days | 2 days | ✓ |
| **Physical Tests : Moisture Content by Gravimetry** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- BH11-22-SS2 | E144 | 14-Sep-2022 | ---- | ---- | ---- | | 15-Sep-2022 | ---- | ---- | |

Matrix: **Soil/Solid**

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

| Analyte Group / Container / Client Sample ID(s) | Method | Sampling Date | Extraction / Preparation | | | | Analysis | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Preparation Date | Holding Times Rec | Holding Times Actual | Eval | Analysis Date | Holding Times Rec | Holding Times Actual | Eval |
| **Physical Tests : Moisture Content by Gravimetry** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- BH16-22-SS2 | E144 | 14-Sep-2022 | ---- | ---- | ---- | | 15-Sep-2022 | ---- | ---- | |
| **Physical Tests : Moisture Content by Gravimetry** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- BH16-SS2 | E144 | 14-Sep-2022 | ---- | ---- | ---- | | 15-Sep-2022 | ---- | ---- | |
| **Physical Tests : Moisture Content by Gravimetry** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- BH17-22-SS2 | E144 | 14-Sep-2022 | ---- | ---- | ---- | | 15-Sep-2022 | ---- | ---- | |
| **Physical Tests : Moisture Content by Gravimetry** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- BH20-SS2 | E144 | 14-Sep-2022 | ---- | ---- | ---- | | 15-Sep-2022 | ---- | ---- | |
| **Physical Tests : Moisture Content by Gravimetry** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- MW09-22 | E144 | 14-Sep-2022 | ---- | ---- | ---- | | 15-Sep-2022 | ---- | ---- | |
| **Physical Tests : Moisture Content by Gravimetry** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- MW17-SS1 | E144 | 14-Sep-2022 | ---- | ---- | ---- | | 15-Sep-2022 | ---- | ---- | |
| **Physical Tests : Moisture Content by Gravimetry** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- MW18-SS3 | E144 | 14-Sep-2022 | ---- | ---- | ---- | | 15-Sep-2022 | ---- | ---- | |
| **Physical Tests : ORP by Electrode** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- BH11-22-SS2 | E125 | 14-Sep-2022 | 15-Sep-2022 | ---- | ---- | | 15-Sep-2022 | 180 days | 1 days | ✓ |
| **Physical Tests : ORP by Electrode** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- BH16-22-SS2 | E125 | 14-Sep-2022 | 15-Sep-2022 | ---- | ---- | | 15-Sep-2022 | 180 days | 1 days | ✓ |

Matrix: **Soil/Solid**

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

| Analyte Group / Container / Client Sample ID(s) | Method | Sampling Date | Extraction / Preparation | | | | Analysis | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Preparation Date | Holding Times Rec | Holding Times Actual | Eval | Analysis Date | Holding Times Rec | Holding Times Actual | Eval |
| **Physical Tests : ORP by Electrode** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- BH16-SS2 | E125 | 14-Sep-2022 | 15-Sep-2022 | ---- | ---- | | 15-Sep-2022 | 180 days | 1 days | ✓ |
| **Physical Tests : ORP by Electrode** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- BH17-22-SS2 | E125 | 14-Sep-2022 | 15-Sep-2022 | ---- | ---- | | 15-Sep-2022 | 180 days | 1 days | ✓ |
| **Physical Tests : ORP by Electrode** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- BH20-SS2 | E125 | 14-Sep-2022 | 15-Sep-2022 | ---- | ---- | | 15-Sep-2022 | 180 days | 1 days | ✓ |
| **Physical Tests : ORP by Electrode** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- MW09-22 | E125 | 14-Sep-2022 | 15-Sep-2022 | ---- | ---- | | 15-Sep-2022 | 180 days | 1 days | ✓ |
| **Physical Tests : ORP by Electrode** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- MW17-SS1 | E125 | 14-Sep-2022 | 15-Sep-2022 | ---- | ---- | | 15-Sep-2022 | 180 days | 1 days | ✓ |
| **Physical Tests : ORP by Electrode** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- MW18-SS3 | E125 | 14-Sep-2022 | 15-Sep-2022 | ---- | ---- | | 15-Sep-2022 | 180 days | 1 days | ✓ |
| **Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- BH11-22-SS2 | E108A | 14-Sep-2022 | 15-Sep-2022 | ---- | ---- | | 15-Sep-2022 | 30 days | 1 days | ✓ |
| **Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- BH16-22-SS2 | E108A | 14-Sep-2022 | 15-Sep-2022 | ---- | ---- | | 15-Sep-2022 | 30 days | 1 days | ✓ |
| **Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- BH16-SS2 | E108A | 14-Sep-2022 | 15-Sep-2022 | ---- | ---- | | 15-Sep-2022 | 30 days | 1 days | ✓ |

Matrix: **Soil/Solid**

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

| Analyte Group / Container / Client Sample ID(s) | Method | Sampling Date | Extraction / Preparation | | | | Analysis | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Preparation Date | Holding Times Rec | Holding Times Actual | Eval | Analysis Date | Holding Times Rec | Holding Times Actual | Eval |
| **Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- BH17-22-SS2 | E108A | 14-Sep-2022 | 15-Sep-2022 | ---- | ---- | | 15-Sep-2022 | 30 days | 1 days | ✓ |
| **Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- BH20-SS2 | E108A | 14-Sep-2022 | 15-Sep-2022 | ---- | ---- | | 15-Sep-2022 | 30 days | 1 days | ✓ |
| **Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- MW09-22 | E108A | 14-Sep-2022 | 15-Sep-2022 | ---- | ---- | | 15-Sep-2022 | 30 days | 1 days | ✓ |
| **Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- MW17-SS1 | E108A | 14-Sep-2022 | 15-Sep-2022 | ---- | ---- | | 15-Sep-2022 | 30 days | 1 days | ✓ |
| **Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received** | | | | | | | | | | |
| **Glass soil jar/Teflon lined cap** | | | | | | | | | | |
| 11205379- MW18-SS3 | E108A | 14-Sep-2022 | 15-Sep-2022 | ---- | ---- | | 15-Sep-2022 | 30 days | 1 days | ✓ |

**Legend & Qualifier Definitions**

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

# Quality Control Parameter Frequency Compliance

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

Matrix: **Soil/Solid**

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

| Quality Control Sample Type | | | Count | | Frequency (%) | | |
|---|---|---|---|---|---|---|---|
| *Analytical Methods* | *Method* | *QC Lot #* | *QC* | *Regular* | *Actual* | *Expected* | *Evaluation* |
| **Laboratory Duplicates (DUP)** | | | | | | | |
| Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level) | E100-L | 648051 | 1 | 8 | 12.5 | 5.0 | ✓ |
| Moisture Content by Gravimetry | E144 | 648057 | 1 | 8 | 12.5 | 5.0 | ✓ |
| ORP by Electrode | E125 | 648056 | 1 | 8 | 12.5 | 5.0 | ✓ |
| pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received | E108A | 648054 | 1 | 8 | 12.5 | 5.0 | ✓ |
| Water Extractable Chloride by IC | E236.Cl | 648053 | 1 | 8 | 12.5 | 5.0 | ✓ |
| Water Extractable Sulfate by IC | E236.SO4 | 648052 | 1 | 8 | 12.5 | 5.0 | ✓ |
| **Laboratory Control Samples (LCS)** | | | | | | | |
| Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level) | E100-L | 648051 | 2 | 8 | 25.0 | 10.0 | ✓ |
| Moisture Content by Gravimetry | E144 | 648057 | 1 | 8 | 12.5 | 5.0 | ✓ |
| ORP by Electrode | E125 | 648056 | 1 | 8 | 12.5 | 5.0 | ✓ |
| pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received | E108A | 648054 | 1 | 8 | 12.5 | 5.0 | ✓ |
| Water Extractable Chloride by IC | E236.Cl | 648053 | 2 | 8 | 25.0 | 10.0 | ✓ |
| Water Extractable Sulfate by IC | E236.SO4 | 648052 | 2 | 8 | 25.0 | 10.0 | ✓ |
| **Method Blanks (MB)** | | | | | | | |
| Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level) | E100-L | 648051 | 1 | 8 | 12.5 | 5.0 | ✓ |
| Moisture Content by Gravimetry | E144 | 648057 | 1 | 8 | 12.5 | 5.0 | ✓ |
| Water Extractable Chloride by IC | E236.Cl | 648053 | 1 | 8 | 12.5 | 5.0 | ✓ |
| Water Extractable Sulfate by IC | E236.SO4 | 648052 | 1 | 8 | 12.5 | 5.0 | ✓ |

## Methodology References and Summaries

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

| Analytical Methods | Method / Lab | Matrix | Method Reference | Method Descriptions |
|---|---|---|---|---|
| Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level) | E100-L<br>Waterloo - Environmental | Soil/Solid | CSSS Ch. 15 (mod)/APHA 2510 (mod) | Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a soil sample that has been added in a defined ratio of soil to deionized water, then shaken well and allowed to settle. Conductance is measured in the fluid that is observed in the upper layer. |
| pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received | E108A<br>Waterloo - Environmental | Soil/Solid | MOEE E3137A | pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally 20 ± 5°C) and is carried out in accordance with procedures described in the Analytical Protocol (prescriptive method). A minimum 10g portion of the sample, as received, is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil by centrifuging, settling, or decanting and then analyzed using a pH meter and electrode. |
| ORP by Electrode | E125<br>Waterloo - Environmental | Soil/Solid | APHA 2580 (mod) | Oxidation Redution Potential (ORP) is reported as the oxidation-reduction potential of the platinum metal-reference electrode employed in the analysis, measured in mV. |
| Moisture Content by Gravimetry | E144<br>Waterloo - Environmental | Soil/Solid | CCME PHC in Soil - Tier 1 | Moisture is measured gravimetrically by drying the sample at 105°C. Moisture content is calculated as the weight loss (due to water) divided by the wet weight of the sample, expressed as a percentage. |
| Water Extractable Chloride by IC | E236.Cl<br>Waterloo - Environmental | Soil/Solid | EPA 300.1 | Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection using a soil sample that has been added in a defined ratio of soil to deionized water, then shaken well and allowed to settle. Anions are measured in the fluid that is observed in the upper layer. |
| Water Extractable Sulfate by IC | E236.SO4<br>Waterloo - Environmental | Soil/Solid | EPA 300.1 | Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection using a soil sample that has been added in a defined ratio of soil to deionized water, then shaken well and allowed to settle. Anions are measured in the fluid that is observed in the upper layer. |
| Resistivity Calculation for Soil Using E100-L | EC100R<br>Waterloo - Environmental | Soil/Solid | APHA 2510 B | Soil Resistivity (calculated) is determined as the inverse of the conductivity of a 2:1 water:soil leachate (dry weight). This method is intended as a rapid approximation for Soil Resistivity. Where high accuracy results are required, direct measurement of Soil Resistivity by the Wenner Four-Electrode Method (ASTM G57) is recommended. |

| Preparation Methods | Method / Lab | Matrix | Method Reference | Method Descriptions |
|---|---|---|---|---|
| Leach 1:2 Soil:Water for pH/EC | EP108<br>Waterloo - Environmental | Soil/Solid | BC WLAP METHOD: PH, ELECTROMETRIC, SOIL | The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water. |

| Preparation Methods | Method / Lab | Matrix | Method Reference | Method Descriptions |
|---|---|---|---|---|
| Leach 1:2 Soil : 0.01CaCl2 - As Received for pH | EP108A<br><br>Waterloo - Environmental | Soil/Solid | MOEE E3137A | A minimum 10g portion of the sample, as received, is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil by centrifuging, settling or decanting and then analyzed using a pH meter and electrode. |
| Preparation of ORP by Electrode | EP125<br><br>Waterloo - Environmental | Soil/Solid | APHA 2580 (mod) | Field-moist sample is extracted in a 1:2 ratio with DI water and then analyzed by ORP meter. |
| Anions Leach 1:10 Soil:Water (Dry) | EP236<br><br>Waterloo - Environmental | Soil/Solid | EPA 300.1 | 5 grams of dried soil is mixed with 50 grams of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography. |
| Distillation for Acid Volatile Sulfide in Soil | EP396-L<br><br>Waterloo - Environmental | Soil/Solid | APHA 4500S2J | Acid Volatile Sulfide is determined by colourimetric measurement on a sediment sample that has been treated with hydrochloric acid within a purge and trap system, where the evolved hydrogen sulfide gas is carried into a basic solution by argon gas for analysis. |

# QUALITY CONTROL REPORT

| | | | |
|---|---|---|---|
| **Work Order** | : **WT2214174** | Page | : 1 of 4 |
| Client | : GHD Limited | Laboratory | : Waterloo - Environmental |
| Contact | : Rick Hawthorne | Account Manager | : Rick Hawthorne |
| Address | : 455 Phillip Street<br>Waterloo ON Canada N2L 3X2 | Address | : 60 Northland Road, Unit 1<br>Waterloo, Ontario Canada N2V 2B8 |
| Telephone | : ---- | Telephone | : +1 519 886 6910 |
| Project | : 11205379-100 | Date Samples Received | : 14-Sep-2022 10:30 |
| PO | : 735-004287 | Date Analysis Commenced | : 15-Sep-2022 |
| C-O-C number | : ---- | Issue Date | : 16-Sep-2022 16:35 |
| Sampler | : CLIENT | | |
| Site | : ---- | | |
| Quote number | : 11205379-100-SSOW 735-004287 | | |
| No. of samples received | : 8 | | |
| No. of samples analysed | : 8 | | |

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

This Quality Control Report contains the following information:

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

## *Signatories*

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

| *Signatories* | *Position* | *Laboratory Department* |
|---|---|---|
| Greg Pokocky | Supervisor - Inorganic | Waterloo Inorganics, Waterloo, Ontario |
| Joseph Scharbach | | Waterloo Centralized Prep, Waterloo, Ontario |
| Walt Kippenhuck | Team Leader - Inorganics | Waterloo Inorganics, Waterloo, Ontario |

## General Comments

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

Key :

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

## Workorder Comments

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

## Laboratory Duplicate (DUP) Report

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

Sub-Matrix: **Soil/Solid**

| | | | | | Laboratory Duplicate (DUP) Report | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Laboratory sample ID* | *Client sample ID* | *Analyte* | *CAS Number* | *Method* | *LOR* | *Unit* | *Original Result* | *Duplicate Result* | *RPD(%) or Difference* | *Duplicate Limits* | *Qualifier* |
| **Physical Tests (QC Lot: 648051)** | | | | | | | | | | | |
| WT2214174-006 | 11205379- BH16-22-SS2 | conductivity (1:2 leachate) | ---- | E100-L | 10.0 | µS/cm | 430 | 438 | 1.84% | 20% | ---- |
| **Physical Tests (QC Lot: 648054)** | | | | | | | | | | | |
| WT2214174-008 | 11205379- MW09-22 | pH (1:2 soil:CaCl2-aq) | ---- | E108A | 0.10 | pH units | 6.81 | 6.82 | 0.147% | 5% | ---- |
| **Physical Tests (QC Lot: 648056)** | | | | | | | | | | | |
| WT2214174-007 | 11205379- BH17-22-SS2 | oxidation-reduction potential [ORP] | ---- | E125 | 0.10 | mV | 350 | 430 | 20.5% | 25% | ---- |
| **Physical Tests (QC Lot: 648057)** | | | | | | | | | | | |
| WT2214174-008 | 11205379- MW09-22 | moisture | ---- | E144 | 0.25 | % | 6.16 | 6.68 | 8.05% | 20% | ---- |
| **Leachable Anions & Nutrients (QC Lot: 648052)** | | | | | | | | | | | |
| WT2214174-006 | 11205379- BH16-22-SS2 | sulfate, soluble ion content | 14808-79-8 | E236.SO4 | 20 | mg/kg | 116 | 118 | 1 | Diff <2x LOR | ---- |
| **Leachable Anions & Nutrients (QC Lot: 648053)** | | | | | | | | | | | |
| WT2214174-006 | 11205379- BH16-22-SS2 | chloride, soluble ion content | 16887-00-6 | E236.Cl | 5.0 | mg/kg | 83.2 | 83.3 | 0.136% | 30% | ---- |

## Method Blank (MB) Report

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

Sub-Matrix: **Soil/Solid**

| Analyte | CAS Number | Method | LOR | Unit | Result | Qualifier |
|---|---|---|---|---|---|---|
| **Physical Tests (QCLot: 648051)** | | | | | | |
| conductivity (1:2 leachate) | ---- | E100-L | 5 | µS/cm | <5.00 | ---- |
| **Physical Tests (QCLot: 648057)** | | | | | | |
| moisture | ---- | E144 | 0.25 | % | <0.25 | ---- |
| **Leachable Anions & Nutrients (QCLot: 648052)** | | | | | | |
| sulfate, soluble ion content | 14808-79-8 | E236.SO4 | 20 | mg/kg | <20 | ---- |
| **Leachable Anions & Nutrients (QCLot: 648053)** | | | | | | |
| chloride, soluble ion content | 16887-00-6 | E236.Cl | 5 | mg/kg | <5.0 | ---- |

## Laboratory Control Sample (LCS) Report

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

Sub-Matrix: **Soil/Solid**

| | | | | | Laboratory Control Sample (LCS) Report | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Spike | Recovery (%) | Recovery Limits (%) | | |
| Analyte | CAS Number | Method | LOR | Unit | Concentration | LCS | Low | High | Qualifier |
| **Physical Tests (QCLot: 648051)** | | | | | | | | | |
| conductivity (1:2 leachate) | ---- | E100-L | 5 | µS/cm | 1409 µS/cm | 98.8 | 90.0 | 110 | ---- |
| **Physical Tests (QCLot: 648054)** | | | | | | | | | |
| pH (1:2 soil:CaCl2-aq) | ---- | E108A | ---- | pH units | 7 pH units | 100 | 98.0 | 102 | ---- |
| **Physical Tests (QCLot: 648057)** | | | | | | | | | |
| moisture | ---- | E144 | 0.25 | % | 50 % | 101 | 90.0 | 110 | ---- |
| **Leachable Anions & Nutrients (QCLot: 648052)** | | | | | | | | | |
| sulfate, soluble ion content | 14808-79-8 | E236.SO4 | 20 | mg/kg | 5000 mg/kg | 100 | 70.0 | 130 | ---- |
| **Leachable Anions & Nutrients (QCLot: 648053)** | | | | | | | | | |
| chloride, soluble ion content | 16887-00-6 | E236.Cl | 5 | mg/kg | 5000 mg/kg | 101 | 80.0 | 120 | ---- |

## Reference Material (RM) Report

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

Sub-Matrix:

| | | | | | Reference Material (RM) Report | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | RM Target | Recovery (%) | Recovery Limits (%) | | |
| Laboratory sample ID | Reference Material ID | Analyte | CAS Number | Method | Concentration | RM | Low | High | Qualifier |
| **Physical Tests (QCLot: 648051)** | | | | | | | | | |
| | RM | conductivity (1:2 leachate) | ---- | E100-L | 3239 µS/cm | 100 | 70.0 | 130 | ---- |
| **Physical Tests (QCLot: 648056)** | | | | | | | | | |
| | RM | oxidation-reduction potential [ORP] | ---- | E125 | 475 mV | 102 | 80.0 | 120 | ---- |
| **Leachable Anions & Nutrients (QCLot: 648052)** | | | | | | | | | |
| | RM | sulfate, soluble ion content | 14808-79-8 | E236.SO4 | 217 mg/kg | 98.5 | 60.0 | 140 | ---- |
| **Leachable Anions & Nutrients (QCLot: 648053)** | | | | | | | | | |
| | RM | chloride, soluble ion content | 16887-00-6 | E236.Cl | 673 mg/kg | 94.1 | 70.0 | 130 | ---- |

# Chain of Custody (COC) / Analytical Request Form

COC Number: 22 -

Page of

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

Environmental Division
Waterloo
Work Order Reference
WT2214174

Telephone : +1 519 886 6910

| Report To | Contact and company name below will appear on the final report | Reports / Recipients | Turnaround Time (TAT) Requeste |
|---|---|---|---|
| Company: | GHD Limited | Select Report Format: ☑ PDF ☐ EXCEL ☐ EDD (DIGITAL) | ☐ Routine [R] if received by 3pm M-F - no surcharges ap |
| Contact: | Jennifer Balkwill | Merge QC/QCI Reports with COA ☑ YES ☐ NO ☐ N/A | ☐ 4 day [P4] if received by 3pm M-F - 20% rush surchar |
| Phone: | 519-340-4286 | ☐ Compare Results to Criteria on Report - provide details below if box checked | ☐ 3 day [P3] if received by 3pm M-F - 25% rush surchan |
| | Company address below will appear on the final report | Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX | ☑ 2 day [P2] if received by 3pm M-F - 50% rush surcharg |
| Street: | 455 Phillip Street, Unit 100A | Email 1 or Fax jennifer.balkwill@ghd.com | ☐ 1 day [E] if received by 3pm M-F - 100% rush surcharg |
| City/Province: | Waterloo, Ontario | Email 2 | ☐ Same day [E2] if received by 10am M-S - 200% rush su |
| Postal Code: | N2L 3X2 | Email 3 | Additional fees may apply to rush requests on we |
| Invoice To | Same as Report To ☑ YES ☐ NO | Invoice Recipients | Date and Time Required for all E&P TATs: |
| | Copy of Invoice with Report ☐ YES ☐ NO | Select Invoice Distribution: ☐ EMAIL ☐ MAIL ☐ FAX | For all tests with rush TATs requested, ple |
| Company: | | Email 1 or Fax | Analysis |
| Contact: | | Email 2 | |

| Project Information | | Oil and Gas Required Fields (client use) | |
|---|---|---|---|
| ALS Account # / Quote #: | | AFE/Cost Center: | PO# |
| Job #: | 11205379-100 | Major/Minor Code: | Routing Code: |
| PO / AFE: | 735-003472-1 | Requisitioner: | |
| LSD: | | Location: | |
| ALS Lab Work Order # (ALS use only): | JD | ALS Contact: | Sampler: |

| ALS Sample # (ALS use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | NUMBER OF CONTAINER | Indicate Filtered (F), Preserved (P) or Filtere... (F/P) below | SAMPLES ON HOLD | EXTENDED STORAGE REQUIRED | SUSPECTED HAZARD (see notes |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Corrosivity | | | |
| | 11205379 - BH10-SS2 | | | | | X | | | |
| | 11205379 - BH20-SS2 | | | | | | | | |
| | 11205379 - MW17-SS1 | | | | | | | | |
| | 11205379 - MW18-SS3 | | | | | | | | |
| | 11205379 - BH11-22-SS2 | | | | | | | | |
| | 11205379 - BH16-22-SS2 | | | | | | | | |
| | 11205379 - BH17-22-SS2 | | | | | | | | |
| | 11205379 - MW09-22 | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

| Drinking Water (DW) Samples[1] (client use) | Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only) |
|---|---|
| Are samples taken from a Regulated DW System? ☐ YES ☐ NO | |
| Are samples for human consumption/ use? ☐ YES ☐ NO | |

**SAMPLE RECEIPT DETAILS (ALS use only)**

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

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

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

| INITIAL COOLER TEMPERATURES °C | | | | FINAL COOLER TEMPERATURES °C | | | |
|---|---|---|---|---|---|---|---|
| | | | | 20.4 | | | |

| SHIPMENT RELEASE (client use) | | | INITIAL SHIPMENT RECEPTION (ALS use only) | | | FINAL SHIPMENT RECEPTION (ALS use only) | | |
|---|---|---|---|---|---|---|---|---|
| Released by: | Date: 2022-09-13 | Time: | Received by: | Date: | Time: | Received by: | Date: 14-Sep-22 | Time: 10:30 |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION WHITE - LABORATORY COPY YELLOW - CLIENT COPY

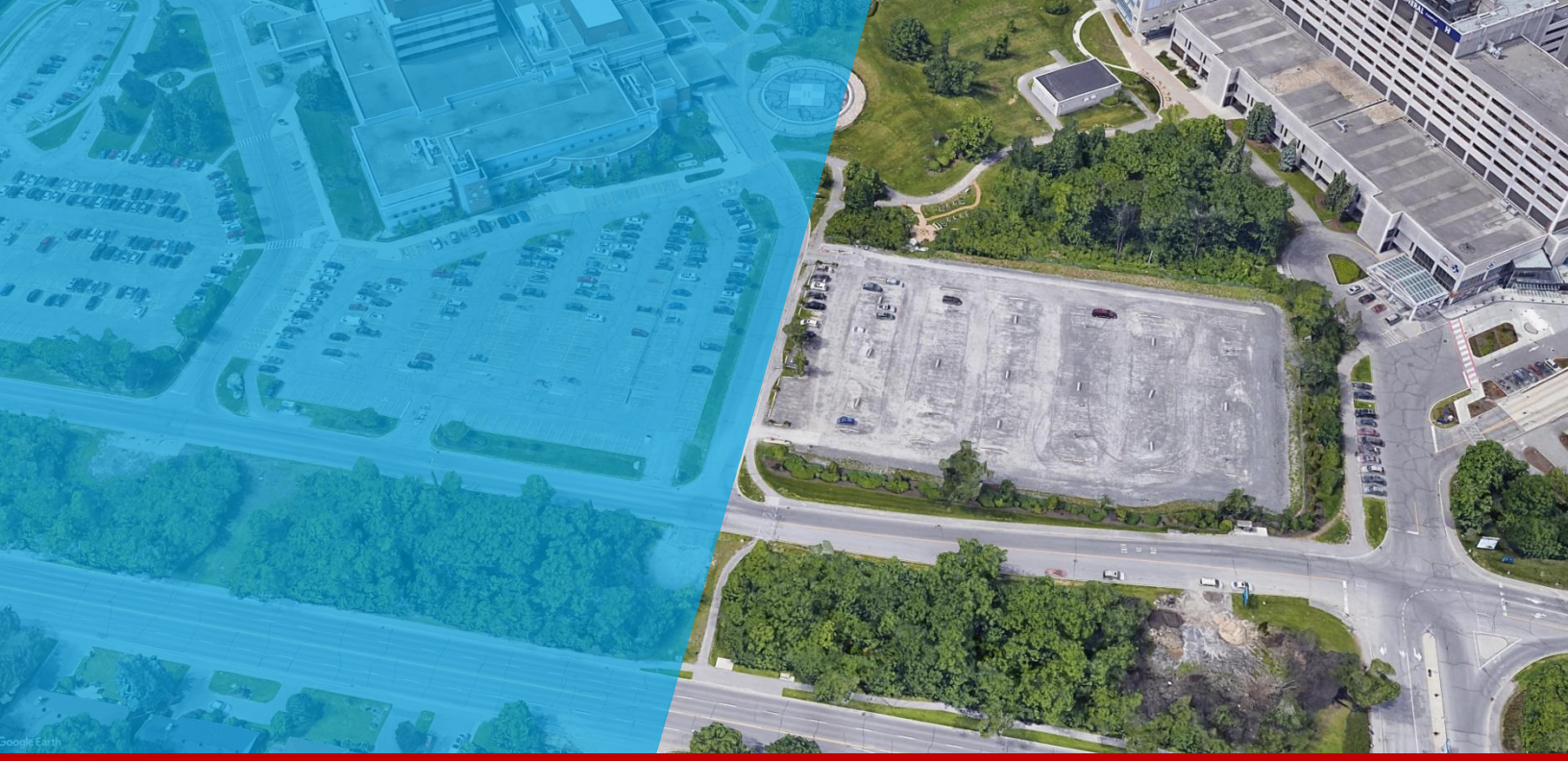
FEB 2022 FRONT

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

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

# Appendix E

## Geophysical Survey



# GEOPHYSICAL INTERPRETATION REPORT

REGARDING GEOPHYSICAL SURVEY FOR
DETECTION OF UNDERGROUND ANOMALIES

401 SMYTH ROAD, OTTAWA, ON, CANADA


Prepared For:
Adita Khandekar
PE, Project Manager
GHD
184 Front Street East, Suite 302, Toronto,Ontario, Canada, M5A 4N3

Submitted By:
Joel Halverson
Geophysical Technologist
MULTIVIEW LOCATES INC.
325 Matheson Blvd East, Mississauga ON, L4Z 1X8


August 29, 2022

# TABLE OF CONTENTS

# LIST OF FIGURES



# LIST OF TABLES

# DIGITAL ARCHIVE CONTENT

*Table 1: Digital Archive Content*

| Folder | Content |
|---|---|
| …//Deliverables/ | Digital copy of the survey results, final documents and maps |
| …//Maps/ | Grid and interpretation maps |
| …//Reports/ | Geophysical survey report |
| | |

# PROJECT SPECIFICATION LIST

*Table 2: Project Specification List*

| | |
|---|---|
| **Contract** | |
| MLI Reference Number | 52070 |
| Report Date | August 29, 2022 |
| **Client** | |
| Legal Name | GHD |
| Address | 184 Front Street East, Suite 302, Toronto,Ontario, Canada, M5A 4N3 |
| Phone | 416-360-1600 |
| **Contact** | |
| Client Representative: | Adita Khandekar |
| Qualifications: | PE, Project Manager |
| Email | aditya.khandekar@ghd.com |
| **Survey** | |
| Survey Description | Detection of Underground Anomalies |
| Methodology | Geophysical Survey |
| Location | 401 Smyth Road, Ottawa, ON, Canada |
| Execution Date | 02/08/2022 |
| **Contractor** | |
| Survey by: | multiVIEW Locates Inc. |
| Responsible | Joel Halverson |
| Qualifications | Geophysical Technologist |
| Phone | 800-363-3116 |
| Email | jhalverson@multiview.ca |

# CONTRACT RELEASE LETTER: 52070

August 29, 2022

GHD

184 Front Street East, Suite 302, Toronto,Ontario, Canada, M5A 4N3
Phone: 416-360-1600

Attention to: Mr. Adita Khandekar, PE, Project Manager

**Re: Geophysical Interpretation Report regarding Detection of Underground Anomalies at 401 Smyth Road, Ottawa, ON, Canada.**

Dear Mrs. Adita Khandekar:

GHD retained multiVIEW Locates Inc. to carry out Geophysical Survey for Detection of Underground Anomalies for the site located at 401 Smyth Road, Ottawa, ON, Canada. The geophysical survey was undertaken on 04/07/2022 and was completed on 02/08/2022.

Included, you will find a geophysical survey report describing the data acquisition, methodology, data quality, processing, interpretation results, conclusion and recommendations relevant to survey objectives, including appendices, tables and figures. A digital archive containing the acquired raw data and final processed results, digital maps, presentations and documents is also provided.

This represents the end of our contractual agreement regarding the aforementioned geophysical survey. Contact us if you need any additional material or information.

Thank you,

Signed by: _____

Joel Halverson, Geophysical Technologist
multiVIEW Locates Inc.

# 1 INTRODUCTION

GHD retained multiVIEW Locates Inc. (multiVIEW) to carry out a Geophysical Survey for Detection of Underground Anomalies for the site located at the Children's Hospital of Eastern Ontario (CHEO), 401 Smyth Road, Ottawa, ON, Canada.

This geophysical interpretation report summarizes the data collection logistics and methodology, processing results and data interpretation associated with the geophysical investigation.

The acquisition, processing and analysis of the data were performed according to professionally regulated industry standards. The geophysical data are presented in screen captured figures and plan maps throughout the sections of the report.

The geophysical interpretation contained in this report is based on the analysis of the Geophysical Survey responses recorded during the field acquisition stage. The images and figures presented in the body of the report are scaled to fit the report page size and should be used for illustration purposes only. Detailed maps and images of the data and results are available in the digital archive supplied along with the interpretation report.

The interpretation of the geophysical data obtained during this investigation is intended to provide guidance for any potential intrusive subsurface investigation work. Interpretation of the data used during any subsequent programs is subject to the Law of Physics and Technical limitations of the geophysical techniques used. The criteria and models used for the interpretation of the acquired data are not unique and may not represent the actual objects present on site.

## 1.1 SURVEY OBJECTIVES

The primary objective of the investigation was to detect and map the presence of underground anomalies in the survey area.

The inferred location of interpreted geophysical signatures was documented and transferred to digital drawings for referencing and assessment.

# 2 PROJECT OVERVIEW

The geophysical study was completed using Geophysical Survey techniques. The exploration and acquisition phase of the survey was completed on 02/08/2022. The raw data and survey results presented as digital plan maps and sections are:

- Integrated Interpretation Plan Maps depicting the spatial location of interpreted geophysical signatures and subsurface features;
- Time Domain Electromagnetics (TDEM) EM61 Channel 3 contour grid map;
- 250mHz GPR reflected signal amplitude contour grid map;
- Sample GPR raw data used for interpretation results.

## 2.1 SITE LOCATION AND ACCESS

The geophysical project is located at 401 Smyth Road, Ottawa, ON, Canada, depicted in Figure 2-1. The site is occupied by two active parking lots divided by an access road to the CHEO Emergency Entrance. The survey area spanned from the western curb of Parking Lot A to the Eastern edge of gravel in Parking Lot E and from the northern limits of both Parking lots A and E to the southern limits of the parking lots. An accurate outline of the survey area is displayed in Figure 3-1.

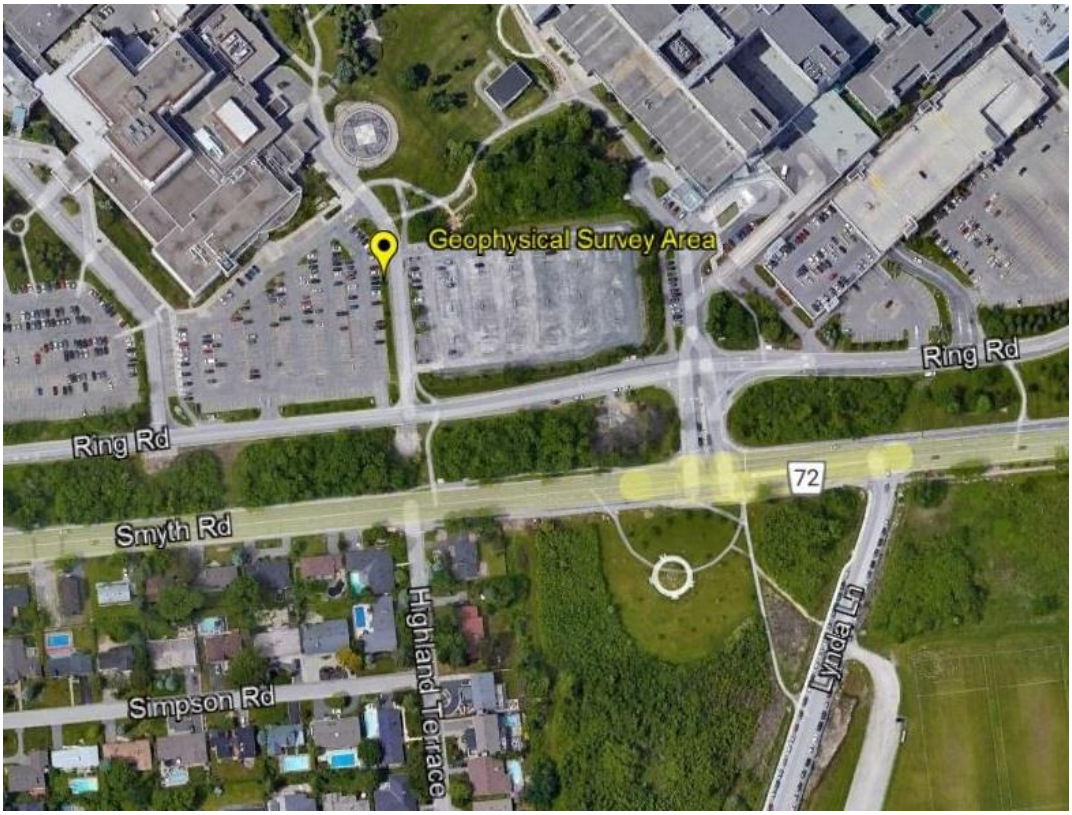



*Figure 2-1: Geophysical Survey General Location Map*

## 2.2 WEATHER AND TERRAIN CONDITIONS

The geophysical data acquisition was performed at night to avoid traffic and vehicles in the parking lot. Average temperatures fluctuated from ~16 degrees Celsius ~25 degrees Celsius.

The parking lots, roads and pathways were, however some parked cars were present during the survey data collection. Photos taken during the survey are displayed in Figure 2-2 to Figure 2-5.

*Figure 2 -2: Photo of the south west side of Parking Lot A during survey acquisition.*

*Figure 2 -3: Photo of the north west side of Parking Lot A during survey acquisition.*

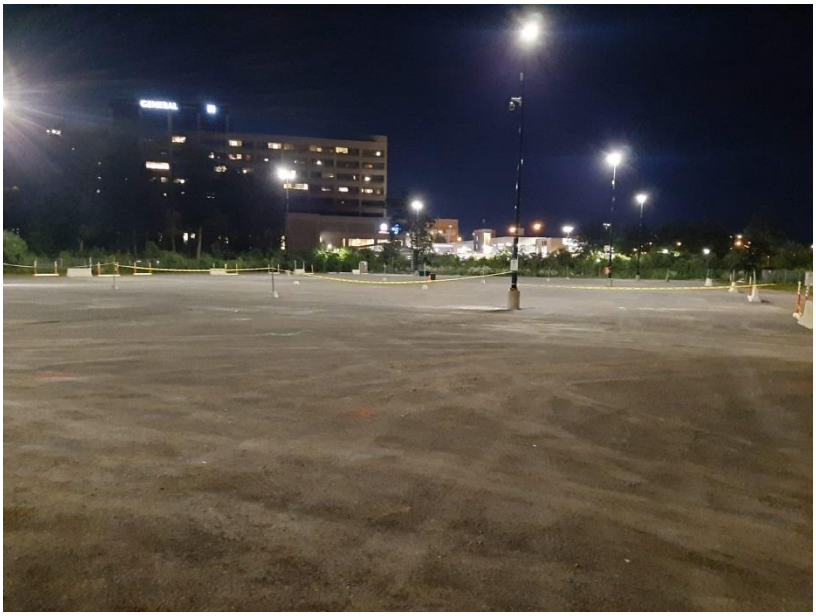


*Figure 2 -4: Photo of Parking Lot E during survey acquisition.*

*Figure 2 -5: Photo of east side of Parking Lot E and driveway to CHEO Emergency during survey acquisition.*

# 3 METHODOLOGY

A subsurface investigation was performed using Geophysical Survey techniques. The TDEM data acquisition was performed using a EM61 from Geonics Limited. The acquisition phase of the survey was completed on 02/08/2022.

Field labor included the following activities:

- Grid Instalment;
- GPS Control Survey;
- TDEM profile imaging (EM61);
- GPR profile imaging;
- Site Documentation;
- Data Interpretation and Results Presentation;

## 3.1 SURVEY GRID INSTALLMENT

The grid layout was done using commercial measuring tapes and line-of-site positioning. Data referenced to grid coordinates were acquired for the purpose of grid establishment, geophysical data collection, interpretation and map creation. The data collection grid is displayed on Figure 3-1.

A GPS receiver was utilized for to acquire the UTM (WGS84/Zone 18N) coordinates of the Site Survey Grid. The subsequent data presentation and interpretation are displayed in UTM coordinates.

The project area measured approximately 17700 square metres. The extent of the total survey coverage is displayed by the yellow line in Figure 3-1. This map is presented digitally in “DWG-1 Site Survey Grid”.

TDEM data was acquired at a station spacing of 2 meters along survey lines spaced at 2 metres. The GPR data was acquired along bidirectional line orientation at station spacing 0.02m along survey lines spaced at 2 metres. Survey lines and data collection were partially restricted by large surface objects including gates, barriers, planters and vehicles.


*Figure 3-1: Geophysical Survey Area*

## 3.2 TIME DOMAIN EM DATA ACQUISITION (EM61)

A Time Domain Electromagnetic survey was conducted across the survey area using Geonics EM61 instrumentation with coincident receiver-transmitter loop configuration. The system is equipped with a secondary receiver loop for target depth estimation and noise rejection. The instrumentation provides high resolution data for indirect detection of buried metal objects to depth of approximately 2 meters. The measurement units of the time decaying induced secondary electromagnetic field are millivolts (mV). The data was acquired by pushing the cart at normal walking speed. These raw data were collected at a rate 0.2 meter station intervals at slow walking speed along lines spaced at roughly 2 meter intervals.

*Figure 3-2: Typical TDEM Acquisition System Setup*

## 3.3 GPR DATA ACQUISITION

Ground Penetrating Radar (GPR) transmits electromagnetic signal into the subsurface and is reflected by the structures, geological features and buried objects, are recorded by GPR instrumentation permitting real-time interpretation of subsurface features to a depth. The GPR data were acquired with station spacing of 0.05m along the grid profiles. Over the scanned area, the GPR profiling was run in multiple orientations with perpendicular cross lines spaced at 2 meter intervals. The GPR survey was completed using a Noggin GPR Smart Cart system manufactured by Sensors & Software Inc., with the 250MHz GPR Antenna sensor.

*Figure 3-3: Typical GPR 250MHz Smart Cart System Setup*

## 3.4 GEOPHYSICAL DATA INTERPRETATION AND PRESENTATION

The TDEM (EM61) anomaly identification was accomplished by examining the data provided by the Channel 3 data output created by the difference of the two EM coils on the EM61. The interpretation was accomplished by examining the subsurface electromagnetic response of the channel 3 data compared to surface object responses and data analysis completed by comparing the characteristics of the acquired data to examples and results available at multiVIEW from historic field surveys. The Channel 3 TDEM data map is presented in a plan map containing contoured responses.

All TDEM elevated readings were evaluated based on the proximity to known surface objects that could have produced the elevated readings. The readings deemed likely to be caused by surface features were discounted as subsurface responses and were not included in the interpretation figures and not listed as buried anomalies for further investigation.

The GPR anomaly identification was accomplished by examining the subsurface electromagnetic reflection characteristics such as continuous anomalous trending and high amplitude hyperbolic reflection identification. Results of the ground penetrating radar survey (GPR) are presented plan maps containing contoured signal reflection amplitude and in sectional views (distance versus depth profiles) extracted from the line raw data as required for the interpretation.

The inferred location of all GPR features and interpreted anomalous zones was documented and transferred to digital drawings. Detailed plan maps illustrating the interpreted GPR anomalies associated with underground features are presented in the report. All distance units used throughout this report are in meters unless otherwise noted. GPR interpretation and compilation was completed by comparing the characteristics of the acquired profiles to examples and results available at multiVIEW from in-house tests and historic field surveys. GPR data processing and interpretation included the following tasks:

- Hyperbola Velocity Calibration for correcting depth estimates;
- Background Average Subtraction for removing direct wave reflections;
- De-wowing;
- Gain equalization and enhancement;
- Visual interpretation;
- Event picking;
- Maps and sections creation;

GRP data analysis was completed by comparing the characteristics of the acquired profiles to examples and results available at multiVIEW from historic field surveys.

Only data sets, figures and drawings relevant to the task of identifying the buried anomalies were included in this report. The interpretation of both equipment data sets are merged into an inclusive and comparative interpretation data set and figure. Interpretation results are presented in UTM 18N grid coordinates. Third party aerial photos were placed on the grid files at a best fit attempt and may not be accurate. Please use the UTM coordinates for accurate reference positions.

# 4 RESULTS

## 4.1 GEOPHYSICAL INTERPRETATION

A Geophysical Survey was performed at 401 Smyth Road, Ottawa, ON, Canada using Time Domain Electromagnetics (TDEM) and Ground Penetrating Radar (GPR) to map out Detection of Underground Anomalies.

The resulting data and interpretation of that data is outlined as follows.

- Fourteen (14) TDEM linear anomalies were detected and were only detected by the TDEM Equipment. These anomalies are designated “L”.
- Four (4) GPR linear anomalies were detected and were only detected by the GPR Equipment. These anomalies are designated “R”.
- Seven (7) linear anomalies were detected by both the TDEM and GPR Equipment. These anomalies are designated “LR”
- Two (2) TDEM zones of elevated Channel 3 data were detected but not detected by the GPR equipment. These anomalous zones are designated “Z”

Interpretation notes and UTM coordinates for each anomaly detected are listed on Table 3. As seen on Figure 4-1: Geophysical Data Interpretation, the anomalies are displayed on the map containing the UTM grid and aerial photo of the site. Each anomaly is numbered and labeled by the equipment that detected the anomaly.

As displayed on Figure 4-2 the TDEM Channel 3 data map presented. Surface objects including vehicles, gates, concrete barriers, planters and light posts prevented the entire area from being surveyed. Elevated TDEM responses occurred in the immediate vicinity of metal surface objects and are not considered anomalous.

As displayed on Figures 4-3 to 4-6, GPR reflections contour maps are presented in 0.5m depth increment slice images. The depth limits of the each depth slice reflection map were selected to best show the anomalous reflections.

GPR data for the survey grids were of good quality for providing a comprehensive interpretation of reflective responses and anomalous zones. For the scanned area, the main source of the GPR electromagnetic reflections, diffractions and edge-type responses observed in the acquired raw data are possibly related to previous excavations, utilities, roots and underground structures. GPR reflected data is classified as anomalous when compared to the surrounding reflections and reflection signature. GPR signal penetration appeared to be limited to 0.75 to 1.5 meters on average. Limited GPR signal penetration, or higher signal attenuation, increases the probability that the GPR equipment is unable to detect subsurface anomalies at greater depths. The signal penetration likely was restricted by increased attenuation caused by increase of soil conductivity near surface. The common use of road salt in winter conditions is likely the cause of the increase of soil conductivity in parking lots and road ways.

GPR line data sample analysis is displayed in section 4.3. These raw GPR data lines display sample analysis of the GPR lines and anomalies detected in the data.

| Anomaly | Location of Observation | | | | Interpreation Notes |
|---|---|---|---|---|---|
| | From | | To | | |
| | UTM Easting | UTM Northing | UTM Easting | UTM Northing | |
| **L** | **TDEM Detected Linear Anomalies** | | | | |
| L1 | 449022.1131 | 5027590.886 | 449036.6597 | 5027573.915 | Possible utility |
| L2 | 449037.8719 | 5027573.511 | 449131.2123 | 5027659.376 | Possible Water line. Travels to water valve |
| L3 | 449051.6103 | 5027592.503 | 449082.9258 | 5027595.331 | Possible Sewer Line, Travels to manhole |
| L4 | 449060.4999 | 5027630.889 | 449065.5508 | 5027576.946 | Unkown Linear Anomaly |
| L5 | 449098.4826 | 5027632.708 | 449102.9273 | 5027585.229 | Unkown Linear Anomaly |
| L6 | 449106.564 | 5027644.426 | 449112.221 | 5027654.527 | Unkown Linear Anomaly |
| L7 | 449127.9797 | 5027647.052 | 449133.4347 | 5027655.336 | Unkown Linear Anomaly |
| L8 | 449147.7792 | 5027641.799 | 449150.4057 | 5027608.867 | Possible Electric Line, Travels to Electric Manhole and Electic Box |
| L9 | 449151.8199 | 5027605.029 | 449157.679 | 5027578.158 | Possible Electric Line, Travels to Electric Manhole and Electic Box |
| L10 | 449151.4159 | 5027608.059 | 449180.509 | 5027595.331 | Possible Electric Line, Travels to Electric Manhole and Light |
| L11 | 449152.8301 | 5027644.426 | 449175.6601 | 5027629.879 | Possible Electric Line, Travels to Lights |
| L12 | 449178.4886 | 5027629.475 | 449209.8041 | 5027632.91 | Possible Electric Line, Travels to Lights |
| L13 | 449181.5191 | 5027595.129 | 449249.4031 | 5027601.392 | Possible Electric Line, Travels to Lights |
| L14 | 449213.0367 | 5027634.122 | 449245.9685 | 5027636.748 | Possible Electric Line, Travels to Lights |
| | | | | | |
| **R** | **GPR Detected Linear Anomalies** | | | | |
| R1 | 449023.5274 | 5027593.311 | 449049.3879 | 5027585.229 | Possible Electric Line |
| R2 | 449097.6744 | 5027566.844 | 449123.1309 | 5027569.066 | Unkown Linear Anomaly |
| R3 | 449170.8113 | 5027578.36 | 449257.4845 | 5027590.28 | Unkown Linear Anomaly |
| R4 | 449173.2357 | 5027645.84 | 449252.8377 | 5027652.911 | Unkown Linear Anomaly |
| | | | | | |
| **LR** | **TDEM Detected Anomalous Zones** | | | | |
| LR1 | 449024.3355 | 5027569.673 | 449030.8007 | 5027563.409 | Unkown Linear Anomaly |
| LR2 | 449033.2251 | 5027564.622 | 449130.8082 | 5027572.299 | Unkown Linear Anomaly |
| LR3 | 449053.2266 | 5027624.02 | 449053.6307 | 5027616.949 | Unkown Linear Anomaly |
| LR4 | 449054.0348 | 5027611.696 | 449056.2571 | 5027587.25 | Unkown Linear Anomaly |
| LR5 | 449057.0653 | 5027582.199 | 449057.6714 | 5027575.33 | Unkown Linear Anomaly |
| LR6 | 449116.4637 | 5027622.202 | 449126.1614 | 5027623.414 | Possible Sewer line, Travels to Catch Basin |
| LR7 | 449121.9187 | 5027649.679 | 449135.6571 | 5027561.995 | Possible Bell Duct, Travels to Bell Manhole |
| | | | | | |
| **Z** | **TDEM Anomalous Zones** | | | | |
| Z1 | Centred on UTM Grid Possition | | 449031.8822 | 5027581.388 | Unknown Anomaly |
| Z2 | Centred on UTM Grid Possition | | 449040.5807 | 5027606.136 | Unknown Anomaly |

*Table 3: Geophysical Interpretation Summary Table*

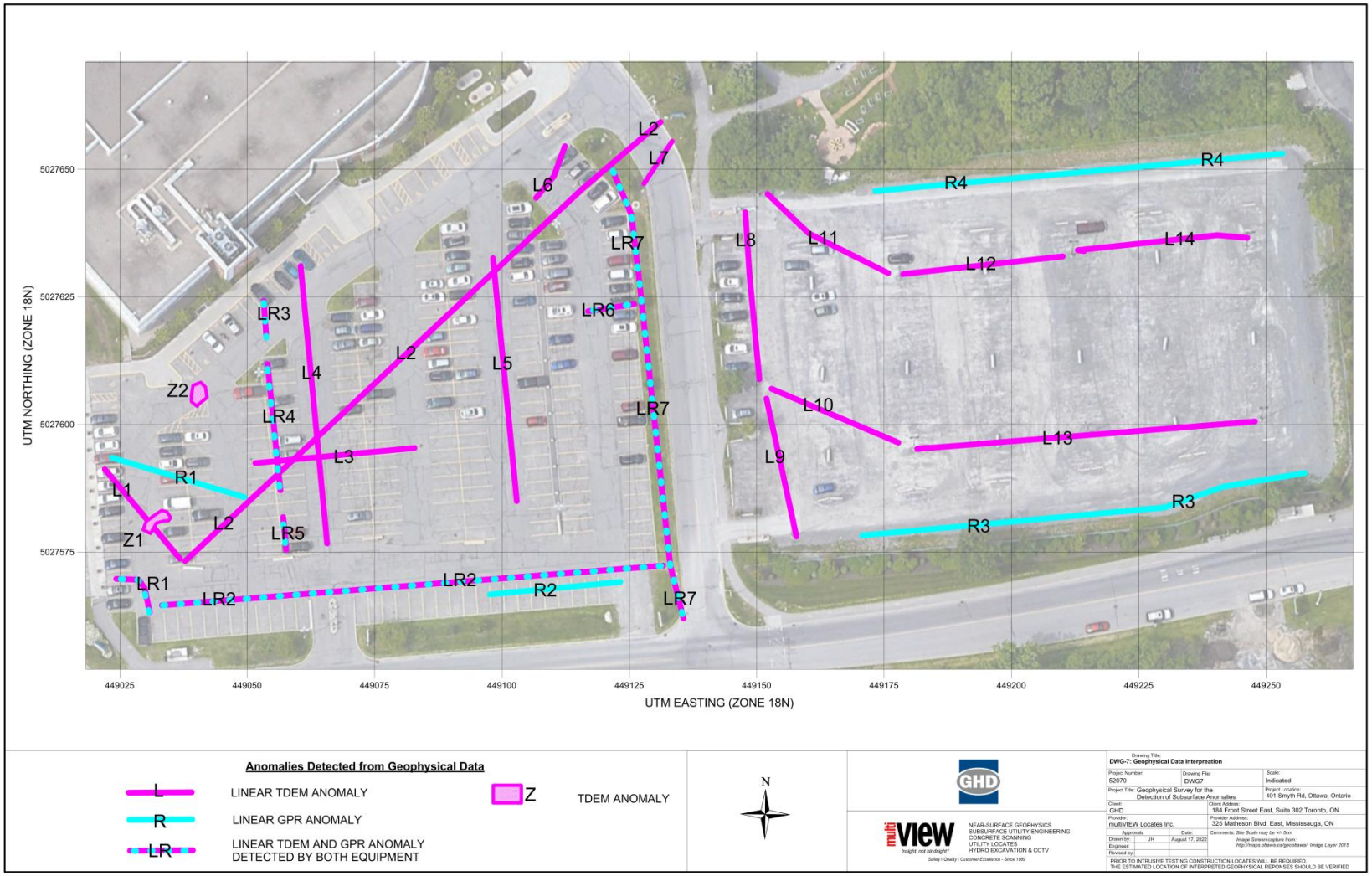



*Figure 4-1: Geophysical Data Interpretation*

## 4.2 GEOPHYSICAL DATA MAPS

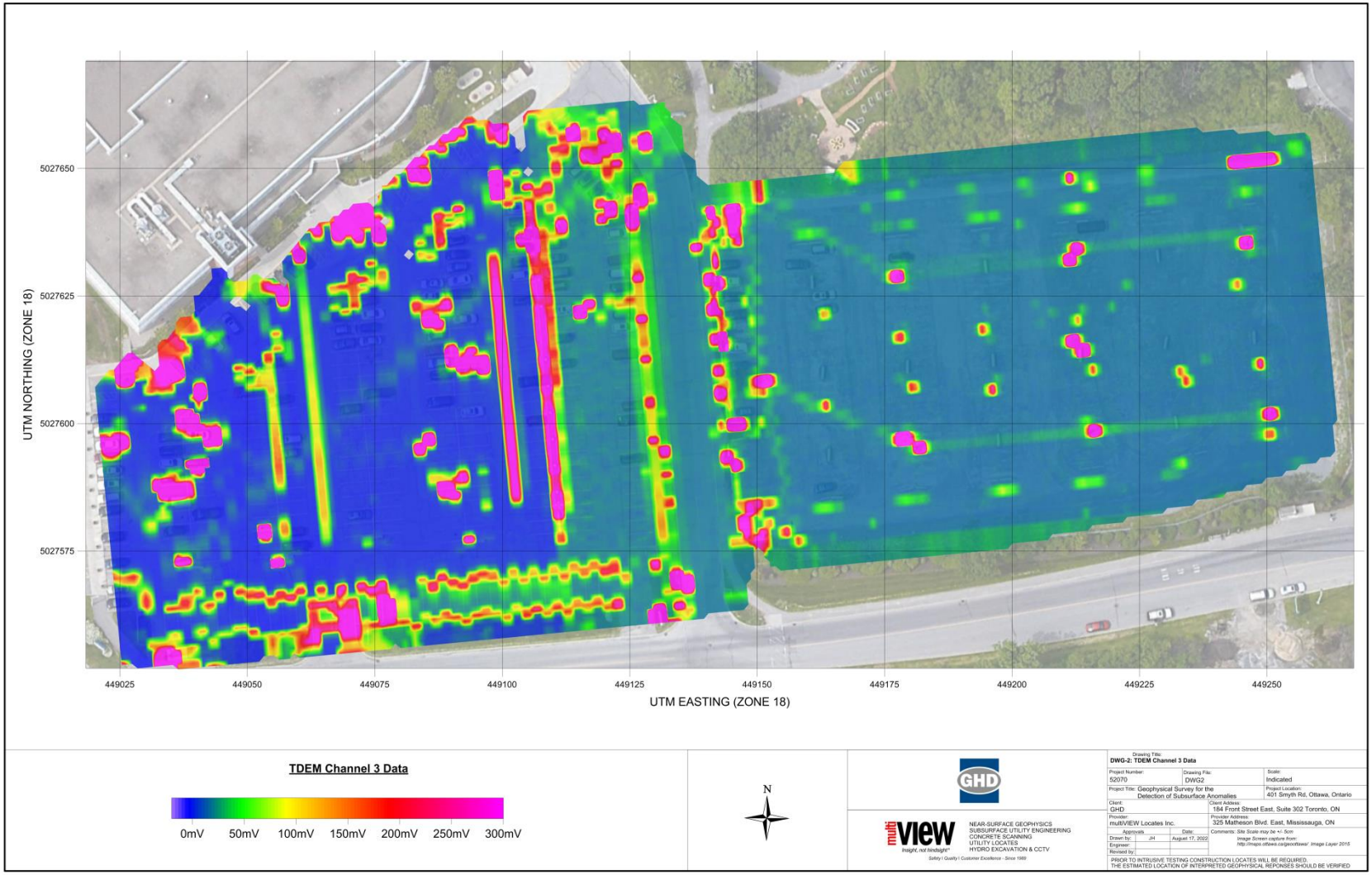



*Figure 4-2: TDEM Channel 3 Data*

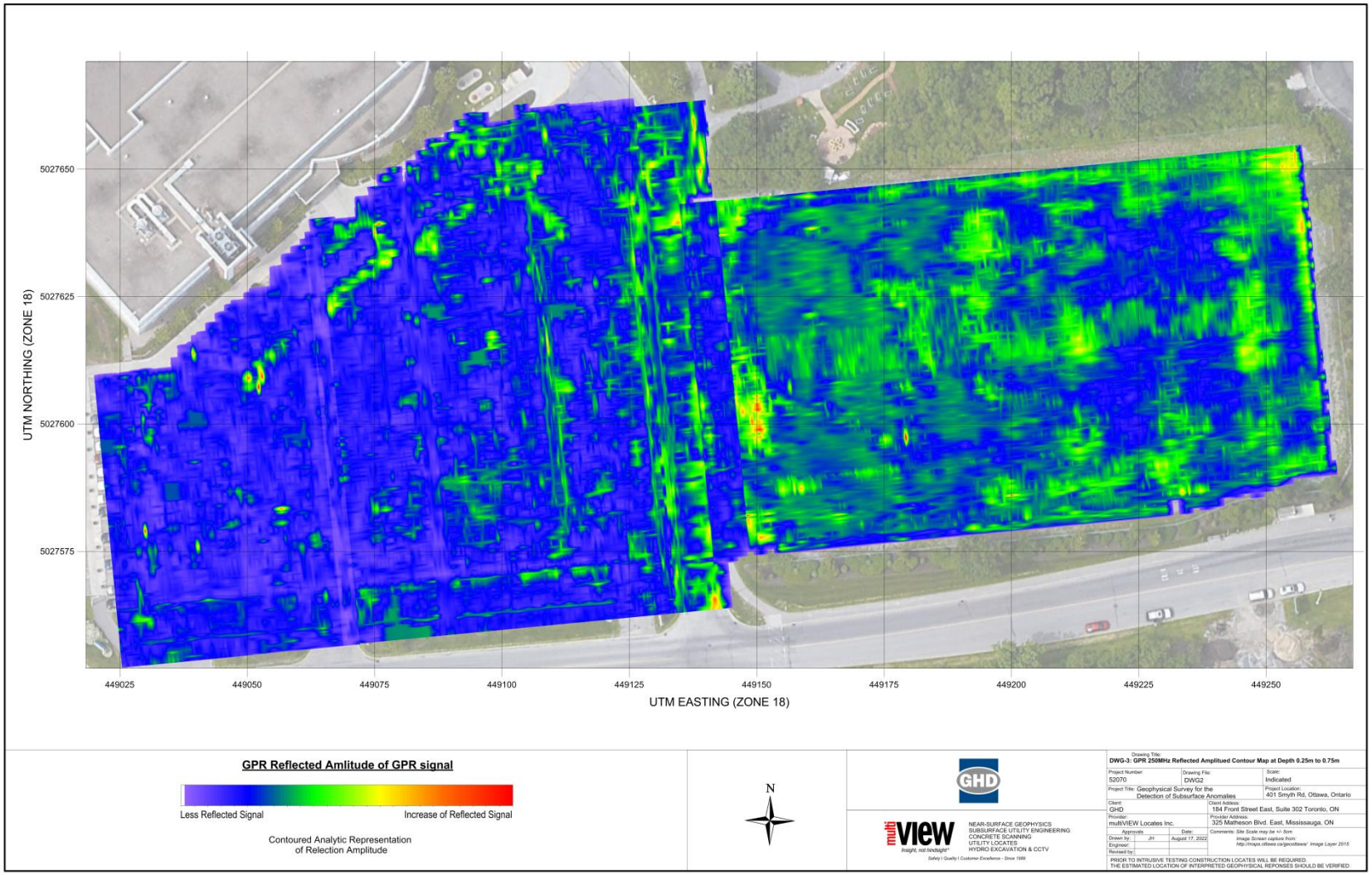



*Figure 4-3: GPR Reflected Signal, Depth 0.25m to 0.75m*

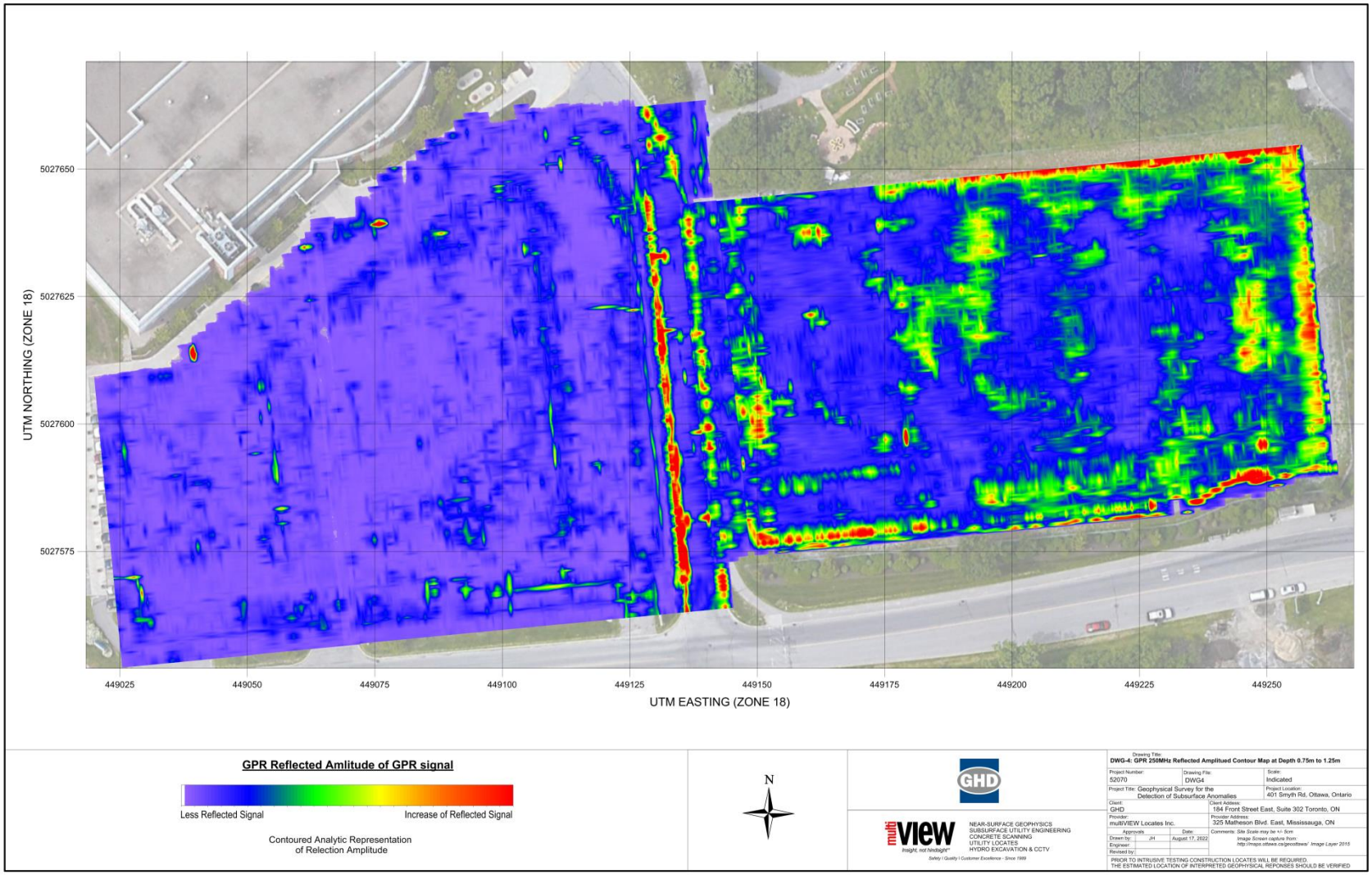



*Figure 4-4: GPR Reflected Signal, Depth 0.75m to 1.25m*


*Figure 4-5: GPR Reflected Signal, Depth 1.25m to 1.75m*

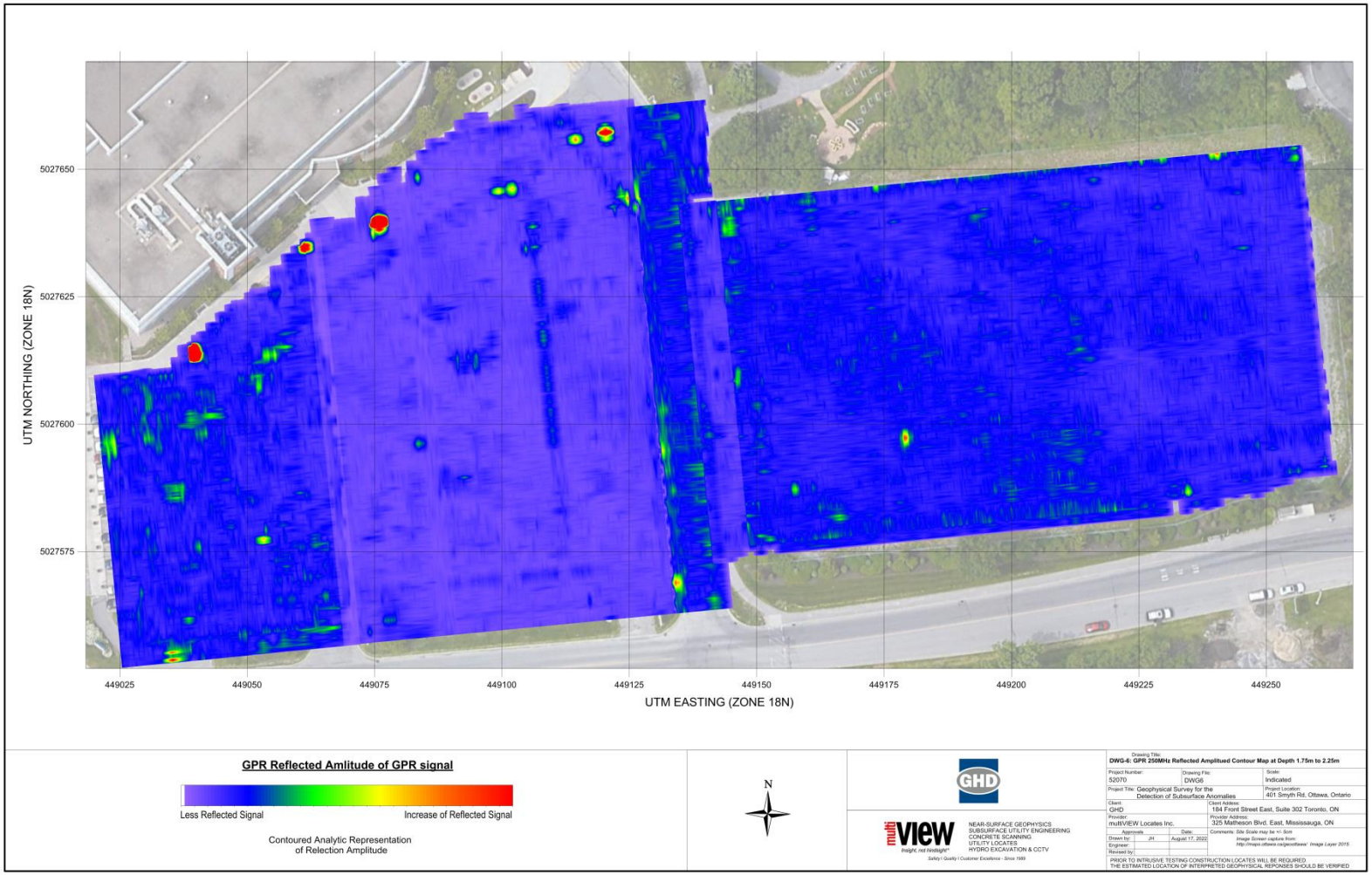



*Figure 4-6: GPR Reflected Signal, Depth 1.75m to 2.25m*

## 4.3 GPR Line Data Sample Analysis

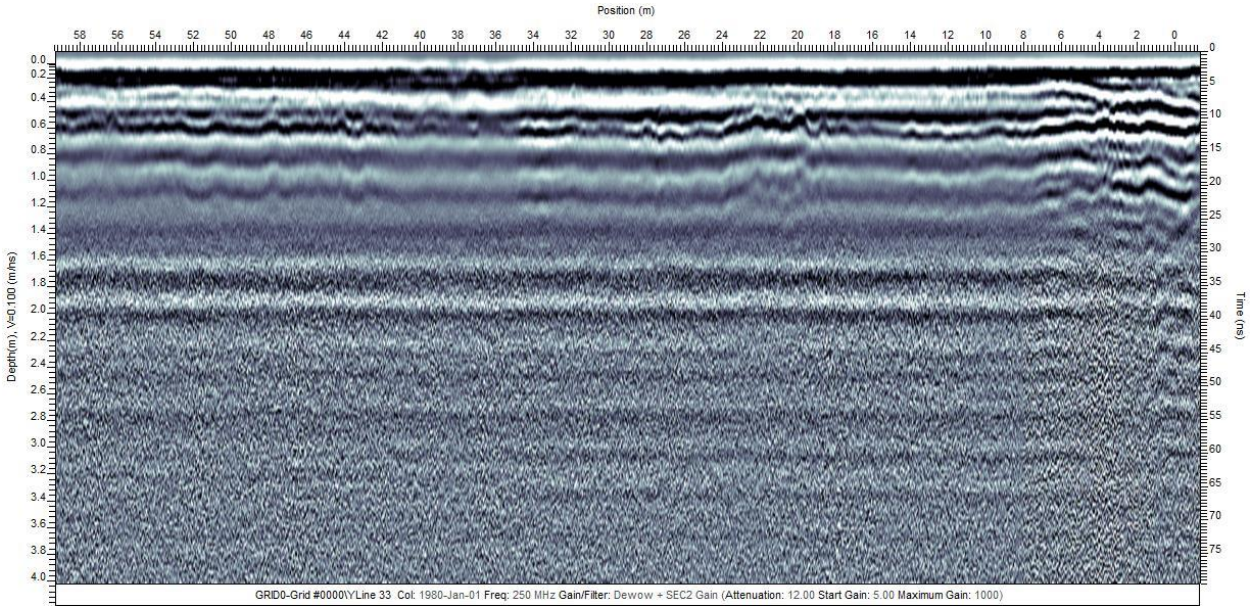



*Figure 4-7: Typical GPR Line Data*

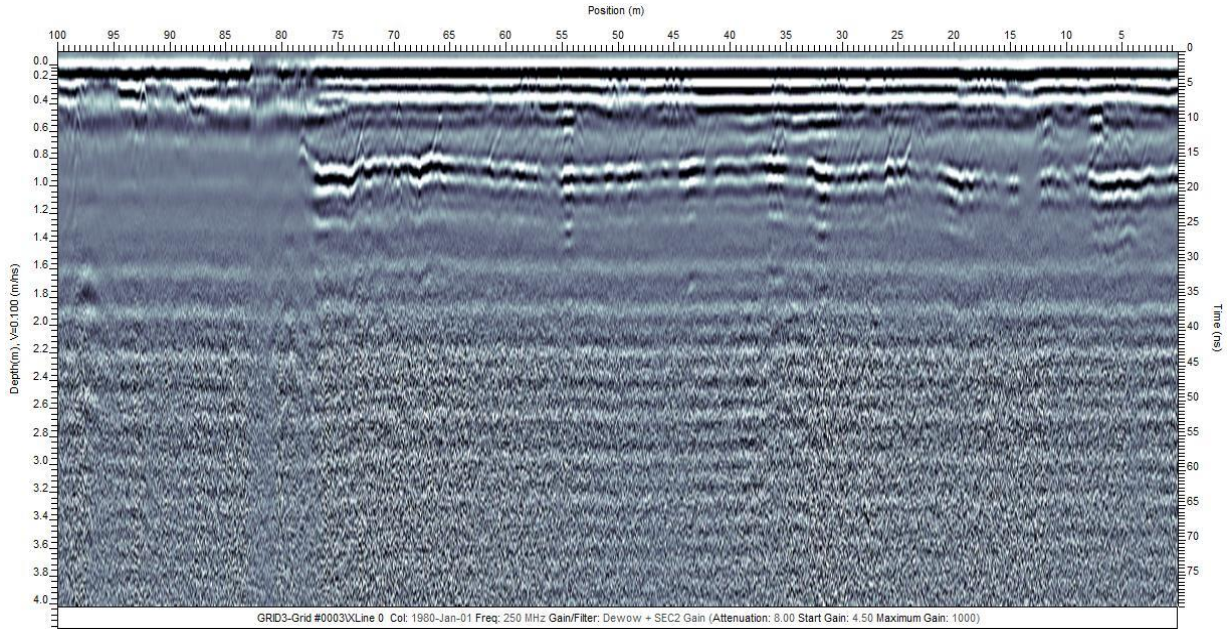



*Figure 4-8: GPR Line Data, Along Road to CHEO Emergency*

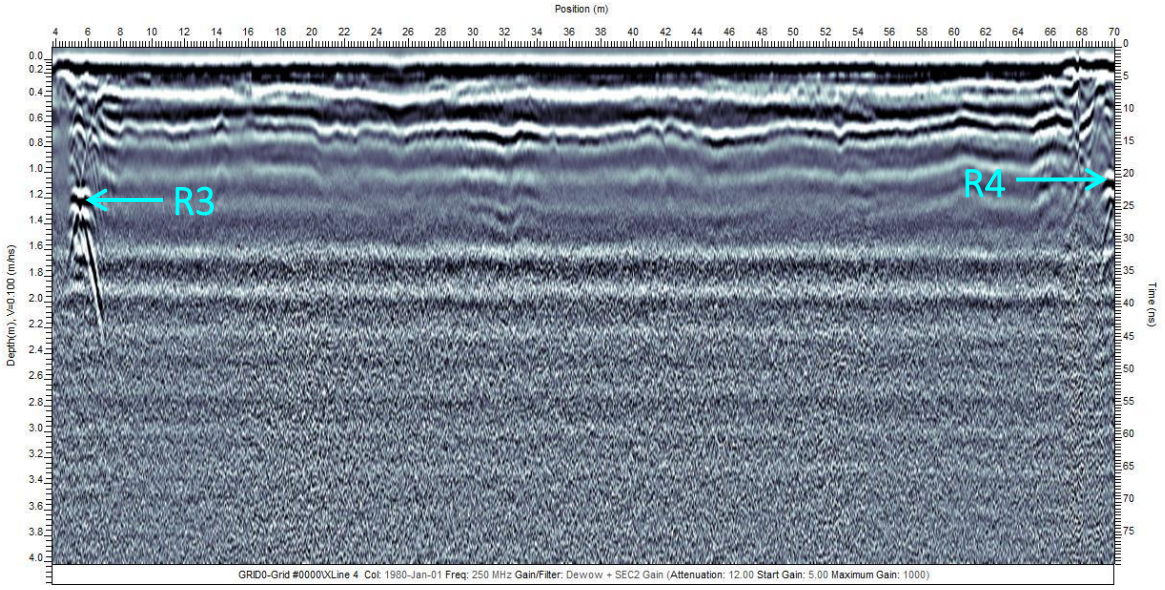



*Figure 4-9: GPR Line Data, Parking Lot E*

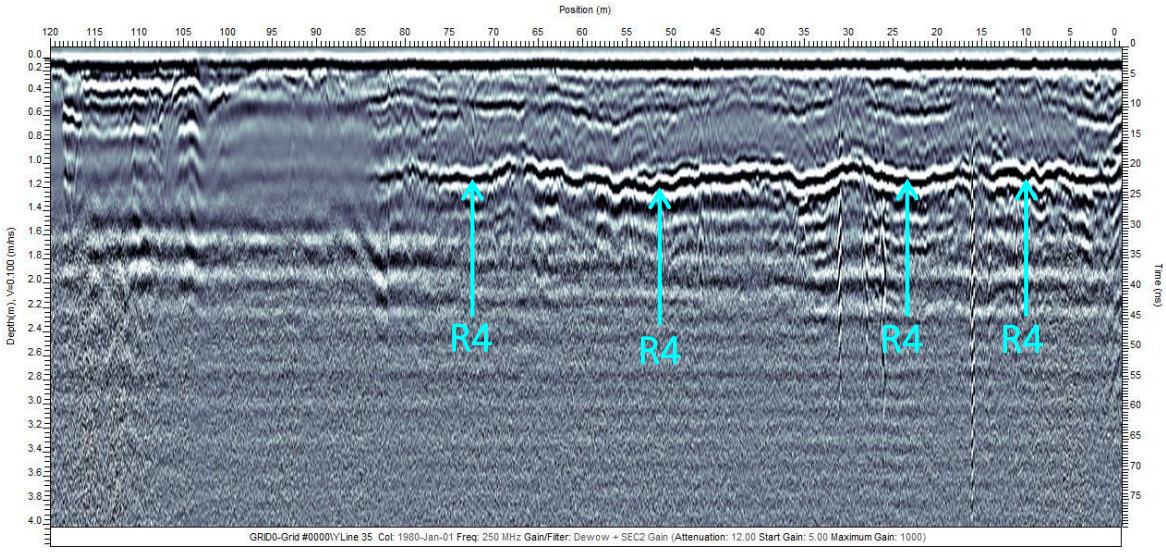



*Figure 4-10: GPR Line Data, North side of Parking Lot E*

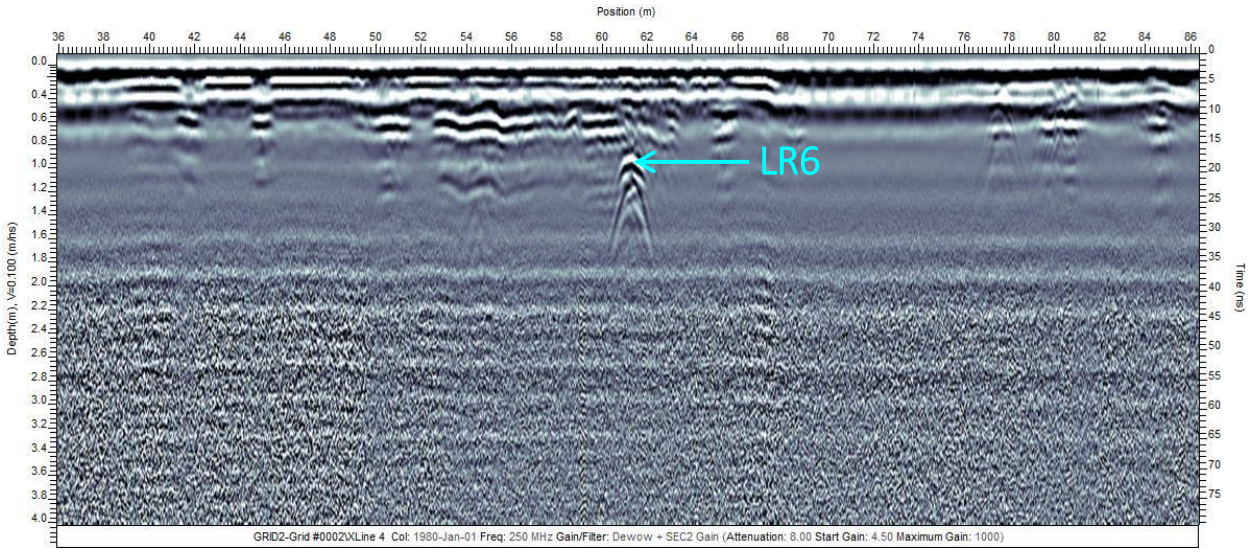



*Figure 4-11: GPR Line Data, Eastern side of Parking Lot A.*

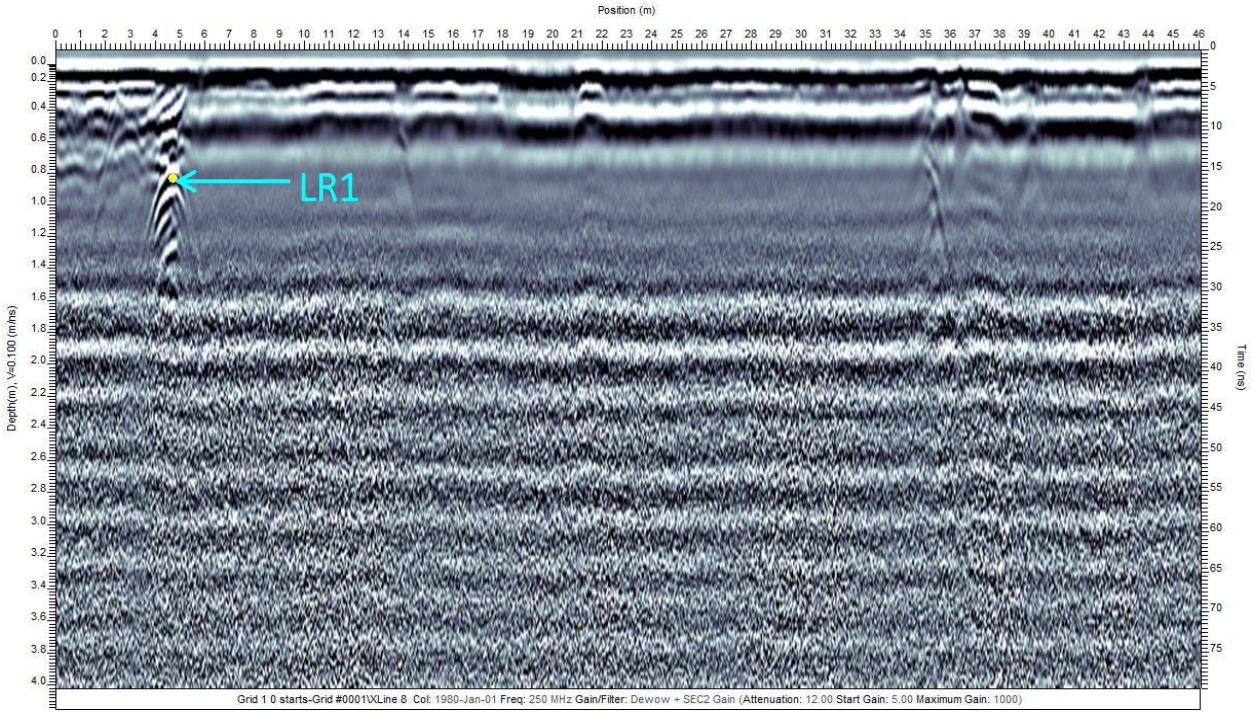



*Figure 4-12: GPR Line Data, South-Western Side of Parking Lot A*

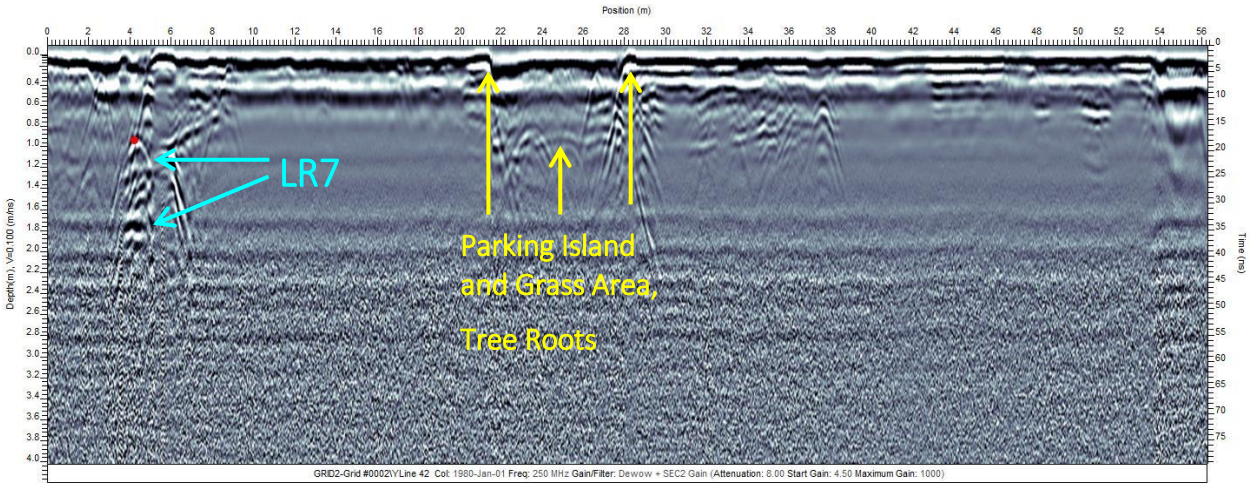



*Figure 4-13: GPR Line Data, North-Eastern Side of Parking Lot A*

# 5 CONCLUSION

Geophysical Survey was carried out in the property located at 401 Smyth Road, Ottawa, ON, Canada. The primary objective of the investigation was to map the presence of underground anomalies.

The results of the geophysical survey detected various anomalies in the Geophysical Survey data and outlined potential subsurface variance within project area. A summary depicting the interpretation of the geophysical responses is provided in the following list:

- Fourteen (14) TDEM linear anomalies were detected and were only detected by the TDEM Equipment.
- Four (4) GPR linear anomalies were detected and were only detected by the GPR Equipment.
- Seven (7) linear anomalies were detected by both the TDEM and GPR Equipment.
- Two (2) TDEM zones of elevated Channel 3 data were detected but not detected by the GPR equipment.

The geophysical data obtained during this investigation is intended for the guidance of the geotechnical engineering and excavation activities only. Interpretation of the data used during any subsequent programs is subject to the Law of Physics and Technical limitations. Additional information regarding advantages and limitations of this geophysical data is provided in the report appendices.

MultiVIEW services and geophysical technical limitations can be found at http://www.multiview.ca/Services/Terms-and-Conditions.

When physically locating the interpreted geophysical responses over the terrain for intrusive testing, excavation or site rehabilitation, it is recommended to properly correlate the reference grid stations with the stations presented on the digital maps.

Respectfully Submitted,

August 29, 2022

*[signature and date]*
Joel Halverson
Geophysical Technologist
multiVIEW Locates Inc.

# 6 REFERENCES


- Geonics Limited. 2002. Geophysical instrumentation for exploration & the environment. Geonics Limited.
- Misac N. Nabighian. 2008. Electromagnetic Methods in Applied Geophysics: Volume 2, Application, Parts A and B. (Society of Exploration Geophysicists). Newmont Exploration Limited, Denver, Colorado, US.
- Lisa Dojack. 2012. Ground Penetrating Radar Theory, Data Collection, Processing, and Interpretation: A Guide for Archaeologists.
- Reynolds, J.M. 2011. An Introduction to Applied and Environmental Geophysics. John Wiley & Sons Ltd, Chichester, 712 pp.

# APPENDICES

# APPENDIX A

*Terms and Conditions for Electromagnetic Investigations*

*Data Presentation*

1. The electromagnetic point data were acquired at the station spacing and on the date as defined in the survey objectives.
2. Colour-contoured maps were created from the collected electromagnetic data and referenced to the survey grid coordinates
3. The images of the colour contoured maps presented in the body of the report are for display and review purposes only. The images are scaled to fit page sizes. Data acquired for QC/QA purposes (base station, background or auxiliary data) are available in the digital archive. The raw data and maps in the digital archive are properly referenced to the survey area, using either grid or UTM coordinates. The maps are presented at a scale to facilitate the accompanying interpretation.

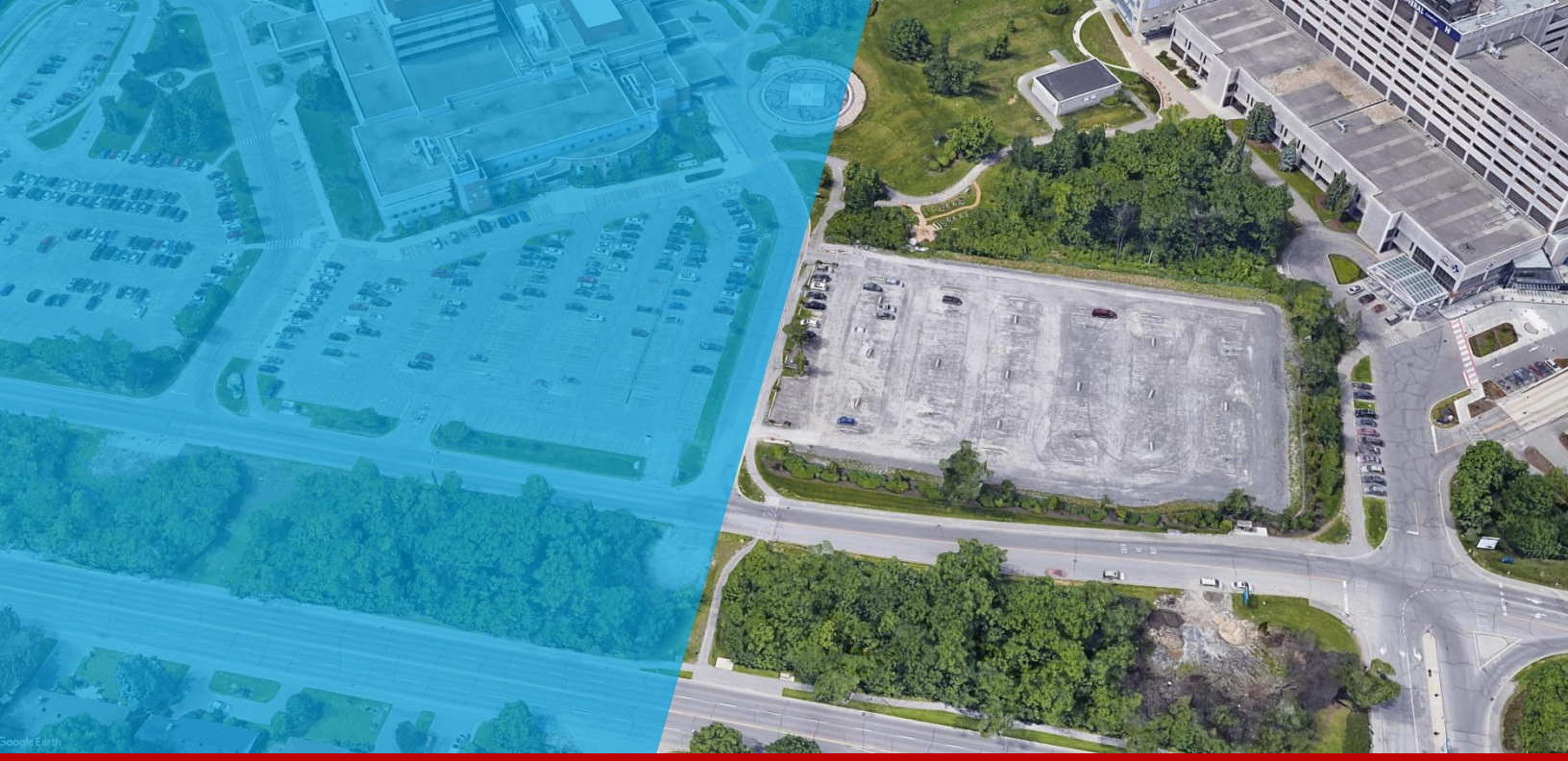
*Data Interpretation*

Interpretation of the electromagnetic data is intended for guidance on environmental engineering and excavation purposes only. The user must be aware of the following interpretive restrictions:

4. Features shown on the interpretation map are related to the expression of subsurface man-made objects and other geological features and structures underground. The projection and location of these features on the surface is referenced to the grid coordinate system established at the time of the survey. All detected features are not necessarily shown due to the weak and non-relevance of the observed responses.
5. Interpretation of buried features or change in soil conditions cannot be made in areas where data were not collected.
6. The electromagnetic data were reviewed with respect to the position of the cultural features (i.e. man-made metallic objects) identified on site. The electromagnetic response observed in proximity to a known cultural feature is attributed to that feature.
7. Where known surface or subsurface metallic objects exist within 2 metres of the electromagnetic data observation station, it is possible that other metallic objects or a change in soil conditions may be present but not identified in the interpretation because the electromagnetic response is attributed to, or masked by, the known feature.
8. The spatial position of all interpreted electromagnetic anomalies (zones where electromagnetic fields are different than background) inferred to represent buried metallic objects are indicated in red on this figure.
9. If red anomalies are not present on this figure, no electromagnetic signatures were identified which could not reasonably be ascribed to known metallic objects and/or no isolated electromagnetic anomalies could be identified.
10. The spatial position of all interpreted electromagnetic anomalies inferred to represent unusual soil conditions is indicated in blue on this figure. These anomalies may represent local changes in soil type or geology, changes in soil moisture conditions; fill versus natural soils or contaminated areas.
11. If blue anomalies are not present on this figure, no electromagnetic signatures were identified which could not reasonably be ascribed to known changes in soil type or geology, changes in soil moisture conditions, fill versus natural soils or contaminated areas.

*Comments for Subsequent Investigations*

12. The electromagnetic anomalies identified within the survey area and as potential buried objects relevant to the survey objectives should be excavated to confirm the source of the electromagnetic response. The excavation point and/or area must be referenced to the site survey grid and located in the center of the anomaly.
13. The survey grid coordinates were established using survey tapes. The stations and lines were picketed and marked over the ground and left in-place upon completion of the survey. After survey completion, if markings are unclear, the survey grid should be reconstructed prior to excavation activities, using all the information provided in this report and in the digital archive (e.g. GPS locations, photographs and additional location maps).
14. In all cases, excavation should be extended to a minimum depth of 2 metres to allow confident identification of the anomaly source.
15. It is recommended that this document be retained on site during any excavation activities. Excavation may reveal features not identified in the interpretation process due to the limitations of the technique.



# GEOPHYSICAL INTERPRETATION REPORT

REGARDING GEOPHYSICAL SURVEY FOR
DETECTION OF UNDERGROUND ANOMALIES

401 SMYTH ROAD, OTTAWA, ON, CANADA


Prepared For:
Adita Khandekar
PE, Project Manager
GHD
184 Front Street East, Suite 302, Toronto,Ontario, Canada, M5A 4N3

Submitted By:
Joel Halverson
Geophysical Technologist
MULTIVIEW LOCATES INC.
325 Matheson Blvd East, Mississauga ON, L4Z 1X8


October 17, 2022

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# LIST OF FIGURES



# LIST OF TABLES

# DIGITAL ARCHIVE CONTENT

*Table 1: Digital Archive Content*

| Folder | Content |
|---|---|
| …//Deliverables/ | Digital copy of the survey results, final documents and maps |
| …//Maps/ | Grid and interpretation maps |
| …//Reports/ | Geophysical survey report |
| | |

# PROJECT SPECIFICATION LIST

*Table 2: Project Specification List*

| Contract | |
|---|---|
| MLI Reference Number | 52070 |
| Report Date | October 17, 2022 |
| **Client** | |
| Legal Name | GHD |
| Address | 184 Front Street East, Suite 302, Toronto,Ontario, Canada, M5A 4N3 |
| Phone | 416-360-1600 |
| **Contact** | |
| Client Representative: | Adita Khandekar |
| Qualifications: | PE, Project Manager |
| Email | aditya.khandekar@ghd.com |
| **Survey** | |
| Survey Description | Detection of Underground Anomalies |
| Methodology | Geophysical Survey |
| Location | 401 Smyth Road, Ottawa, ON, Canada |
| Execution Date | 02/08/2022 |
| **Contractor** | |
| Survey by: | multiVIEW Locates Inc. |
| Responsible | Joel Halverson |
| Qualifications | Geophysical Technologist |
| Phone | 800-363-3116 |
| Email | jhalverson@multiview.ca |

# CONTRACT RELEASE LETTER: 52070

October 17, 2022

GHD

184 Front Street East, Suite 302, Toronto,Ontario, Canada, M5A 4N3
Phone: 416-360-1600

Attention to: Mr. Adita Khandekar, PE, Project Manager

**Re: Geophysical Interpretation Report regarding Detection of Underground Anomalies at 401 Smyth Road, Ottawa, ON, Canada.**

Dear Mrs. Adita Khandekar:

GHD retained multiVIEW Locates Inc. to carry out Geophysical Survey for Detection of Underground Anomalies for the site located at 401 Smyth Road, Ottawa, ON, Canada. The geophysical survey was undertaken on 04/07/2022 and was completed on 02/08/2022.

Included, you will find a geophysical survey report describing the data acquisition, methodology, data quality, processing, interpretation results, conclusion and recommendations relevant to survey objectives, including appendices, tables and figures. A digital archive containing the acquired raw data and final processed results, digital maps, presentations and documents is also provided.

This represents the end of our contractual agreement regarding the aforementioned geophysical survey. Contact us if you need any additional material or information.

Thank you,

Signed by: _____

Joel Halverson, Geophysical Technologist
multiVIEW Locates Inc.

Reviewed by Alex Brkljac, P.Geo, PMP
multiVIEW Locates Inc.

PROFESSIONAL GEOSCIENTIST
ALEXANDER BRKLJAC
PRACTISING MEMBER
3035
ONTARIO

# 1 INTRODUCTION

GHD retained multiVIEW Locates Inc. (multiVIEW) to carry out a Geophysical Survey for Detection of Underground Anomalies for the site located at the Children's Hospital of Eastern Ontario (CHEO), 401 Smyth Road, Ottawa, ON, Canada.

This geophysical interpretation report summarizes the data collection logistics and methodology, processing results and data interpretation associated with the geophysical investigation.

The acquisition, processing and analysis of the data were performed according to professionally regulated industry standards. The geophysical data are presented in screen captured figures and plan maps throughout the sections of the report.

The geophysical interpretation contained in this report is based on the analysis of the Geophysical Survey responses recorded during the field acquisition stage. The images and figures presented in the body of the report are scaled to fit the report page size and should be used for illustration purposes only. Detailed maps and images of the data and results are available in the digital archive supplied along with the interpretation report.

The interpretation of the geophysical data obtained during this investigation is intended to provide guidance for any potential intrusive subsurface investigation work. Interpretation of the data used during any subsequent programs is subject to the Law of Physics and Technical limitations of the geophysical techniques used. The criteria and models used for the interpretation of the acquired data are not unique and may not represent the actual objects present on site.

## 1.1 SURVEY OBJECTIVES

The primary objective of the investigation was to detect and map the presence of underground anomalies in the survey area.

The inferred location of interpreted geophysical signatures was documented and transferred to digital drawings for referencing and assessment.

# 2 PROJECT OVERVIEW

The geophysical study was completed using Geophysical Survey techniques. The exploration and acquisition phase of the survey was completed on 02/08/2022. The raw data and survey results presented as digital plan maps and sections are:

- Integrated Interpretation Plan Maps depicting the spatial location of interpreted geophysical signatures and subsurface features;
- Time Domain Electromagnetics (TDEM) EM61 Channel 3 contour grid map;
- 250mHz GPR reflected signal amplitude contour grid map;
- Sample GPR raw data used for interpretation results.

## 2.1 SITE LOCATION AND ACCESS

The geophysical project is located at 401 Smyth Road, Ottawa, ON, Canada, depicted in Figure 2-1. The site is occupied by two active parking lots divided by an access road to the CHEO Emergency Entrance. The survey area spanned from the western curb of Parking Lot A to the Eastern edge of gravel in Parking Lot E and from the northern limits of both Parking lots A and E to the southern limits of the parking lots. An accurate outline of the survey area is displayed in Figure 3-1.

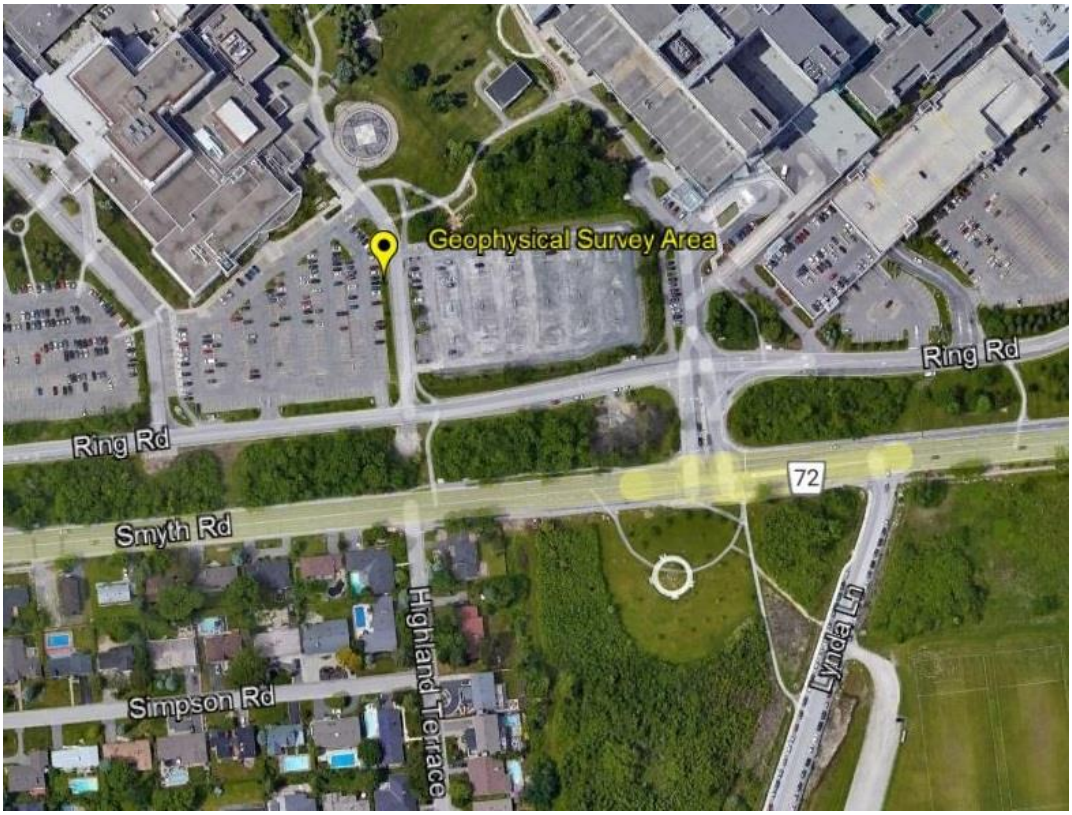


*Figure 2-1: Geophysical Survey General Location Map*

## 2.2 Weather and Terrain Conditions

The geophysical data acquisition was performed at night to avoid traffic and vehicles in the parking lot. Average temperatures fluctuated from ~16 degrees Celsius ~25 degrees Celsius.

The parking lots, roads and pathways were, however some parked cars were present during the survey data collection. Photos taken during the survey are displayed in Figure 2-2 to Figure 2-5.

*Figure 2 -2: Photo of the south west side of Parking Lot A during survey acquisition.*

*Figure 2 -3: Photo of the north west side of Parking Lot A during survey acquisition.*

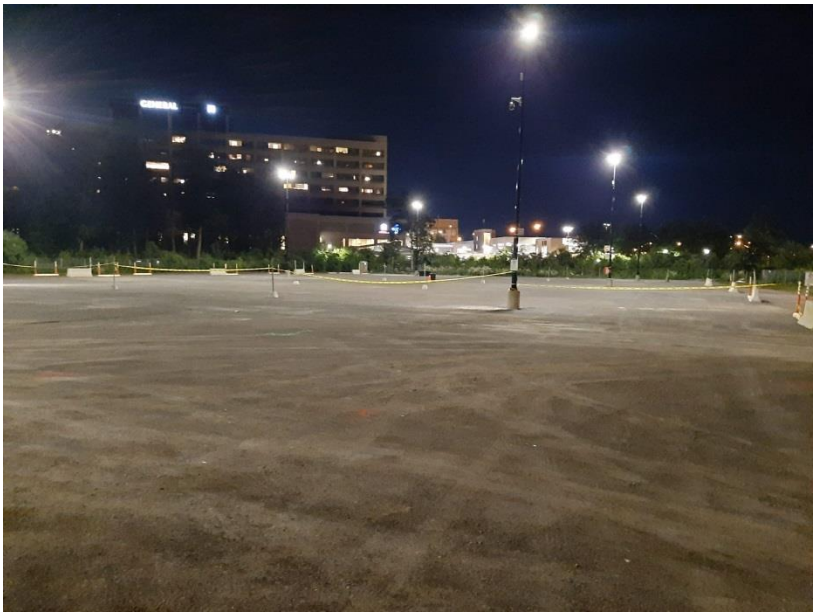

*Figure 2 -4: Photo of Parking Lot E during survey acquisition.*

*Figure 2 -5: Photo of east side of Parking Lot E and driveway to CHEO Emergency during survey acquisition.*

# 3 METHODOLOGY

A subsurface investigation was performed using Geophysical Survey techniques. The TDEM data acquisition was performed using a EM61 from Geonics Limited. The acquisition phase of the survey was completed on 02/08/2022.

Field labor included the following activities:

- Grid Instalment;
- GPS Control Survey;
- TDEM profile imaging (EM61);
- GPR profile imaging;
- Site Documentation;
- Data Interpretation and Results Presentation;

## 3.1 SURVEY GRID INSTALLMENT

The grid layout was done using commercial measuring tapes and line-of-site positioning. Data referenced to grid coordinates were acquired for the purpose of grid establishment, geophysical data collection, interpretation and map creation. The data collection grid is displayed on Figure 3-1.

A GPS receiver was utilized for to acquire the UTM (WGS84/Zone 18N) coordinates of the Site Survey Grid. The subsequent data presentation and interpretation are displayed in UTM coordinates.

The project area measured approximately 17700 square metres. The extent of the total survey coverage is displayed by the yellow line in Figure 3-1. This map is presented digitally in “DWG-1 Site Survey Grid”.

TDEM data was acquired at a station spacing of 2 meters along survey lines spaced at 2 metres. The GPR data was acquired along bidirectional line orientation at station spacing 0.02m along survey lines spaced at 2 metres. Survey lines and data collection were partially restricted by large surface objects including gates, barriers, planters and vehicles.


*Figure 3-1: Geophysical Survey Area*

## 3.2 TIME DOMAIN EM DATA ACQUISITION (EM61)

A Time Domain Electromagnetic survey was conducted across the survey area using Geonics EM61 instrumentation with coincident receiver-transmitter loop configuration. The system is equipped with a secondary receiver loop for target depth estimation and noise rejection. The instrumentation provides high resolution data for indirect detection of buried metal objects to depth of approximately 2 meters. The measurement units of the time decaying induced secondary electromagnetic field are millivolts (mV). The data was acquired by pushing the cart at normal walking speed. These raw data were collected at a rate 0.2 meter station intervals at slow walking speed along lines spaced at roughly 2 meter intervals.

*Figure 3-2: Typical TDEM Acquisition System Setup*

## 3.3 GPR DATA ACQUISITION

Ground Penetrating Radar (GPR) transmits electromagnetic signal into the subsurface and is reflected by the structures, geological features and buried objects, are recorded by GPR instrumentation permitting real-time interpretation of subsurface features to a depth. The GPR data were acquired with station spacing of 0.05m along the grid profiles. Over the scanned area, the GPR profiling was run in multiple orientations with perpendicular cross lines spaced at 2 meter intervals. The GPR survey was completed using a Noggin GPR Smart Cart system manufactured by Sensors & Software Inc., with the 250MHz GPR Antenna sensor.

*Figure 3-3: Typical GPR 250MHz Smart Cart System Setup*

## 3.4 Geophysical Data Interpretation and Presentation

The TDEM (EM61) anomaly identification was accomplished by examining the data provided by the Channel 3 data output created by the difference of the two EM coils on the EM61. The interpretation was accomplished by examining the subsurface electromagnetic response of the channel 3 data compared to surface object responses and data analysis completed by comparing the characteristics of the acquired data to examples and results available at multiVIEW from historic field surveys. The Channel 3 TDEM data map is presented in a plan map containing contoured responses.

All TDEM elevated readings were evaluated based on the proximity to known surface objects that could have produced the elevated readings. The readings deemed likely to be caused by surface features were discounted as subsurface responses and were not included in the interpretation figures and not listed as buried anomalies for further investigation.

The GPR anomaly identification was accomplished by examining the subsurface electromagnetic reflection characteristics such as continuous anomalous trending and high amplitude hyperbolic reflection identification. Results of the ground penetrating radar survey (GPR) are presented plan maps containing contoured signal reflection amplitude and in sectional views (distance versus depth profiles) extracted from the line raw data as required for the interpretation.

The inferred location of all GPR features and interpreted anomalous zones was documented and transferred to digital drawings. Detailed plan maps illustrating the interpreted GPR anomalies associated with underground features are presented in the report. All distance units used throughout this report are in meters unless otherwise noted. GPR interpretation and compilation was completed by comparing the characteristics of the acquired profiles to examples and results available at multiVIEW from in-house tests and historic field surveys. GPR data processing and interpretation included the following tasks:

- Hyperbola Velocity Calibration for correcting depth estimates;
- Background Average Subtraction for removing direct wave reflections;
- De-wowing;
- Gain equalization and enhancement;
- Visual interpretation;
- Event picking;
- Maps and sections creation;

GRP data analysis was completed by comparing the characteristics of the acquired profiles to examples and results available at multiVIEW from historic field surveys.

Only data sets, figures and drawings relevant to the task of identifying the buried anomalies were included in this report. The interpretation of both equipment data sets are merged into an inclusive and comparative interpretation data set and figure. Interpretation results are presented in UTM 18N grid coordinates. Third party aerial photos were placed on the grid files at a best fit attempt and may not be accurate. Please use the UTM coordinates for accurate reference positions.

# 4 RESULTS

## 4.1 GEOPHYSICAL INTERPRETATION

A Geophysical Survey was performed at 401 Smyth Road, Ottawa, ON, Canada using Time Domain Electromagnetics (TDEM) and Ground Penetrating Radar (GPR) to map out Detection of Underground Anomalies.

The resulting data and interpretation of that data is outlined as follows.

- Fourteen (14) TDEM linear anomalies were detected and were only detected by the TDEM Equipment. These anomalies are designated "L".
- Four (4) GPR linear anomalies were detected and were only detected by the GPR Equipment. These anomalies are designated "R".
- Seven (7) linear anomalies were detected by both the TDEM and GPR Equipment. These anomalies are designated "LR"
- Two (2) TDEM zones of elevated Channel 3 data were detected but not detected by the GPR equipment. These anomalous zones are designated "Z"

Interpretation notes and UTM coordinates for each anomaly detected are listed on Table 3. As seen on Figure 4-1: Geophysical Data Interpretation, the anomalies are displayed on the map containing the UTM grid and aerial photo of the site. Each anomaly is numbered and labeled by the equipment that detected the anomaly.

As displayed on Figure 4-2 the TDEM Channel 3 data map presented. Surface objects including vehicles, gates, concrete barriers, planters and light posts prevented the entire area from being surveyed. Elevated TDEM responses occurred in the immediate vicinity of metal surface objects and are not considered anomalous.

As displayed on Figures 4-3 to 4-6, GPR reflections contour maps are presented in 0.5m depth increment slice images. The depth limits of the each depth slice reflection map were selected to best show the anomalous reflections.

GPR data for the survey grids were of good quality for providing a comprehensive interpretation of reflective responses and anomalous zones. For the scanned area, the main source of the GPR electromagnetic reflections, diffractions and edge-type responses observed in the acquired raw data are possibly related to previous excavations, utilities, roots and underground structures. GPR reflected data is classified as anomalous when compared to the surrounding reflections and reflection signature. GPR signal penetration appeared to be limited to 0.75 to 1.5 meters on average. Limited GPR signal penetration, or higher signal attenuation, increases the probability that the GPR equipment is unable to detect subsurface anomalies at greater depths. The signal penetration likely was restricted by increased attenuation caused by increase of soil conductivity near surface. The common use of road salt in winter conditions is likely the cause of the increase of soil conductivity in parking lots and road ways.

GPR line data sample analysis is displayed in section 4.3. These raw GPR data lines display sample analysis of the GPR lines and anomalies detected in the data.

| Anomaly | Location of Observation | | | | Interpreation Notes |
|---|---|---|---|---|---|
| | From | | To | | |
| | UTM Easting | UTM Northing | UTM Easting | UTM Northing | |
| **L** | **TDEM Detected Linear Anomalies** | | | | |
| L1 | 449022.1131 | 5027590.886 | 449036.6597 | 5027573.915 | Possible utility |
| L2 | 449037.8719 | 5027573.511 | 449131.2123 | 5027659.376 | Possible Water line. Travels to water valve |
| L3 | 449051.6103 | 5027592.503 | 449082.9258 | 5027595.331 | Possible Sewer Line, Travels to manhole |
| L4 | 449060.4999 | 5027630.889 | 449065.5508 | 5027576.946 | Unkown Linear Anomaly |
| L5 | 449098.4826 | 5027632.708 | 449102.9273 | 5027585.229 | Unkown Linear Anomaly |
| L6 | 449106.564 | 5027644.426 | 449112.221 | 5027654.527 | Unkown Linear Anomaly |
| L7 | 449127.9797 | 5027647.052 | 449133.4347 | 5027655.336 | Unkown Linear Anomaly |
| L8 | 449147.7792 | 5027641.799 | 449150.4057 | 5027608.867 | Possible Electric Line, Travels to Electric Manhole and Electic Box |
| L9 | 449151.8199 | 5027605.029 | 449157.679 | 5027578.158 | Possible Electric Line, Travels to Electric Manhole and Electic Box |
| L10 | 449151.4159 | 5027608.059 | 449180.509 | 5027595.331 | Possible Electric Line, Travels to Electric Manhole and Light |
| L11 | 449152.8301 | 5027644.426 | 449175.6601 | 5027629.879 | Possible Electric Line, Travels to Lights |
| L12 | 449178.4886 | 5027629.475 | 449209.8041 | 5027632.91 | Possible Electric Line, Travels to Lights |
| L13 | 449181.5191 | 5027595.129 | 449249.4031 | 5027601.392 | Possible Electric Line, Travels to Lights |
| L14 | 449213.0367 | 5027634.122 | 449245.9685 | 5027636.748 | Possible Electric Line, Travels to Lights |
| | | | | | |
| **R** | **GPR Detected Linear Anomalies** | | | | |
| R1 | 449023.5274 | 5027593.311 | 449049.3879 | 5027585.229 | Possible Electric Line |
| R2 | 449097.6744 | 5027566.844 | 449123.1309 | 5027569.066 | Unkown Linear Anomaly |
| R3 | 449170.8113 | 5027578.36 | 449257.4845 | 5027590.28 | Unkown Linear Anomaly |
| R4 | 449173.2357 | 5027645.84 | 449252.8377 | 5027652.911 | Unkown Linear Anomaly |
| | | | | | |
| **LR** | **TDEM Detected Anomalous Zones** | | | | |
| LR1 | 449024.3355 | 5027569.673 | 449030.8007 | 5027563.409 | Unkown Linear Anomaly |
| LR2 | 449033.2251 | 5027564.622 | 449130.8082 | 5027572.299 | Unkown Linear Anomaly |
| LR3 | 449053.2266 | 5027624.02 | 449053.6307 | 5027616.949 | Unkown Linear Anomaly |
| LR4 | 449054.0348 | 5027611.696 | 449056.2571 | 5027587.25 | Unkown Linear Anomaly |
| LR5 | 449057.0653 | 5027582.199 | 449057.6714 | 5027575.33 | Unkown Linear Anomaly |
| LR6 | 449116.4637 | 5027622.202 | 449126.1614 | 5027623.414 | Possible Sewer line, Travels to Catch Basin |
| LR7 | 449121.9187 | 5027649.679 | 449135.6571 | 5027561.995 | Possible Bell Duct, Travels to Bell Manhole |
| | | | | | |
| **Z** | **TDEM Anomalous Zones** | | | | |
| Z1 | Centred on UTM Grid Possition | | 449031.8822 | 5027581.388 | Unknown Anomaly |
| Z2 | Centred on UTM Grid Possition | | 449040.5807 | 5027606.136 | Unknown Anomaly |

*Table 3: Geophysical Interpretation Summary Table*

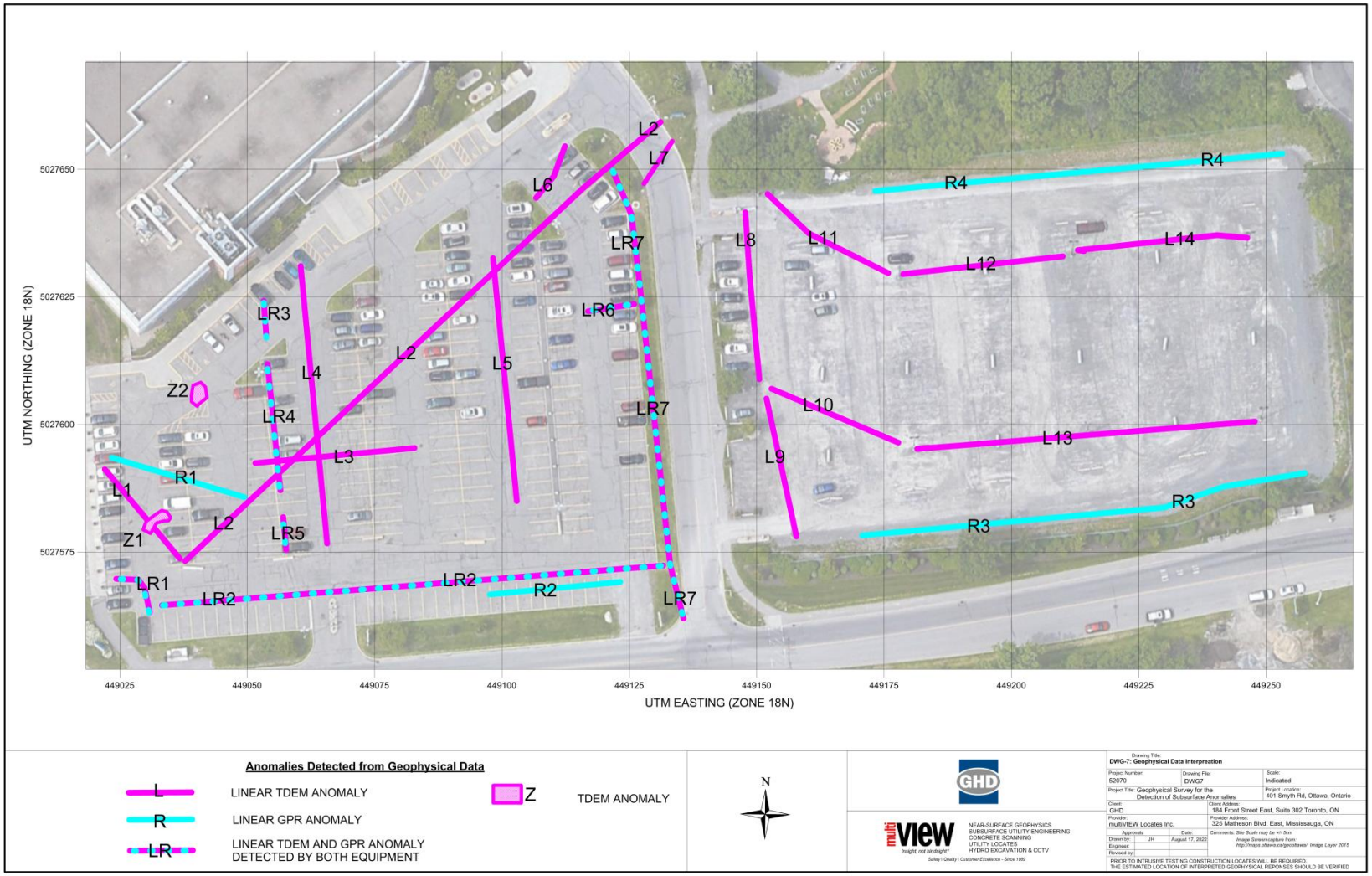


*Figure 4-1: Geophysical Data Interpretation*

## 4.2 GEOPHYSICAL DATA MAPS

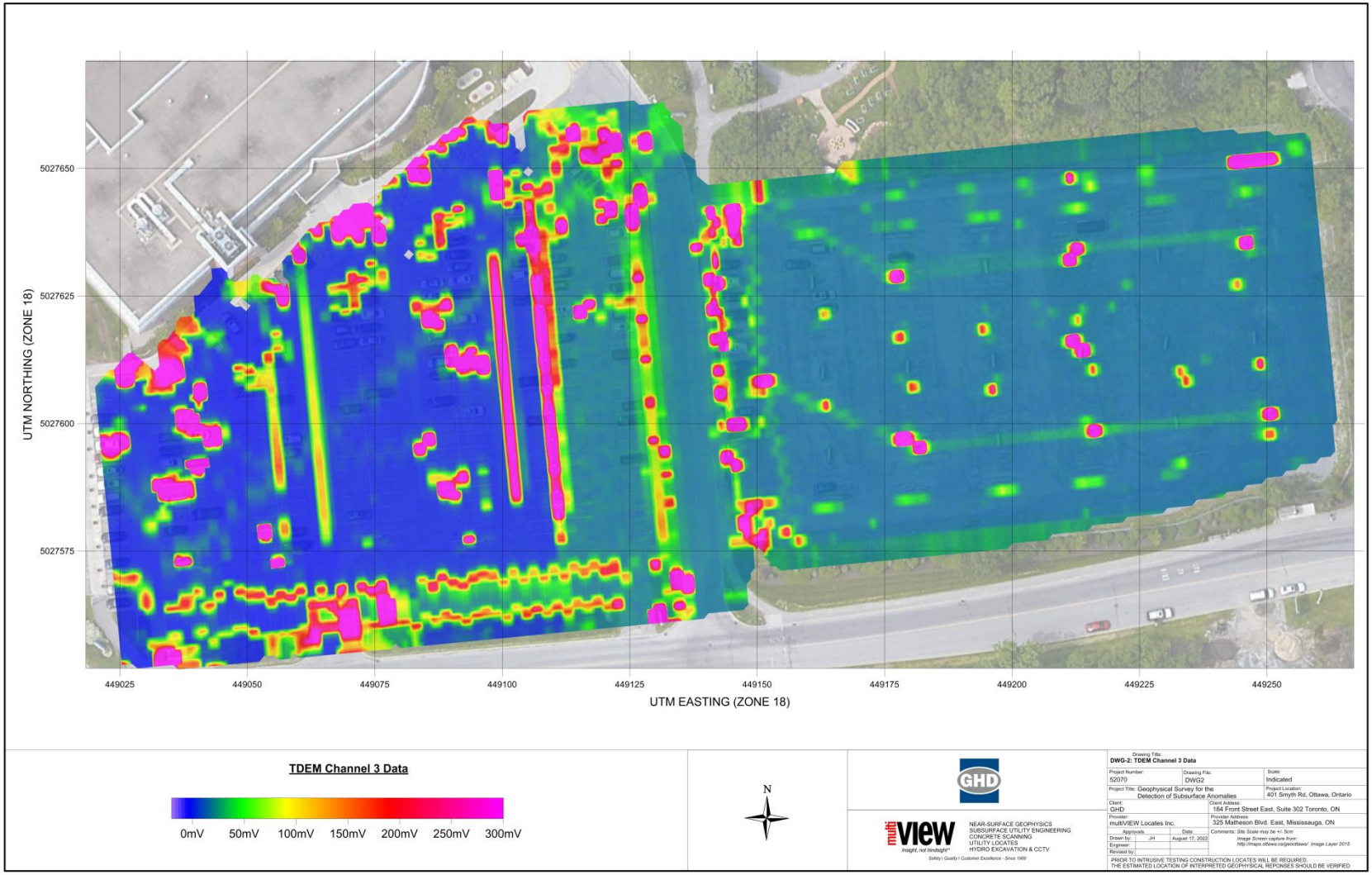


*Figure 4-2: TDEM Channel 3 Data*

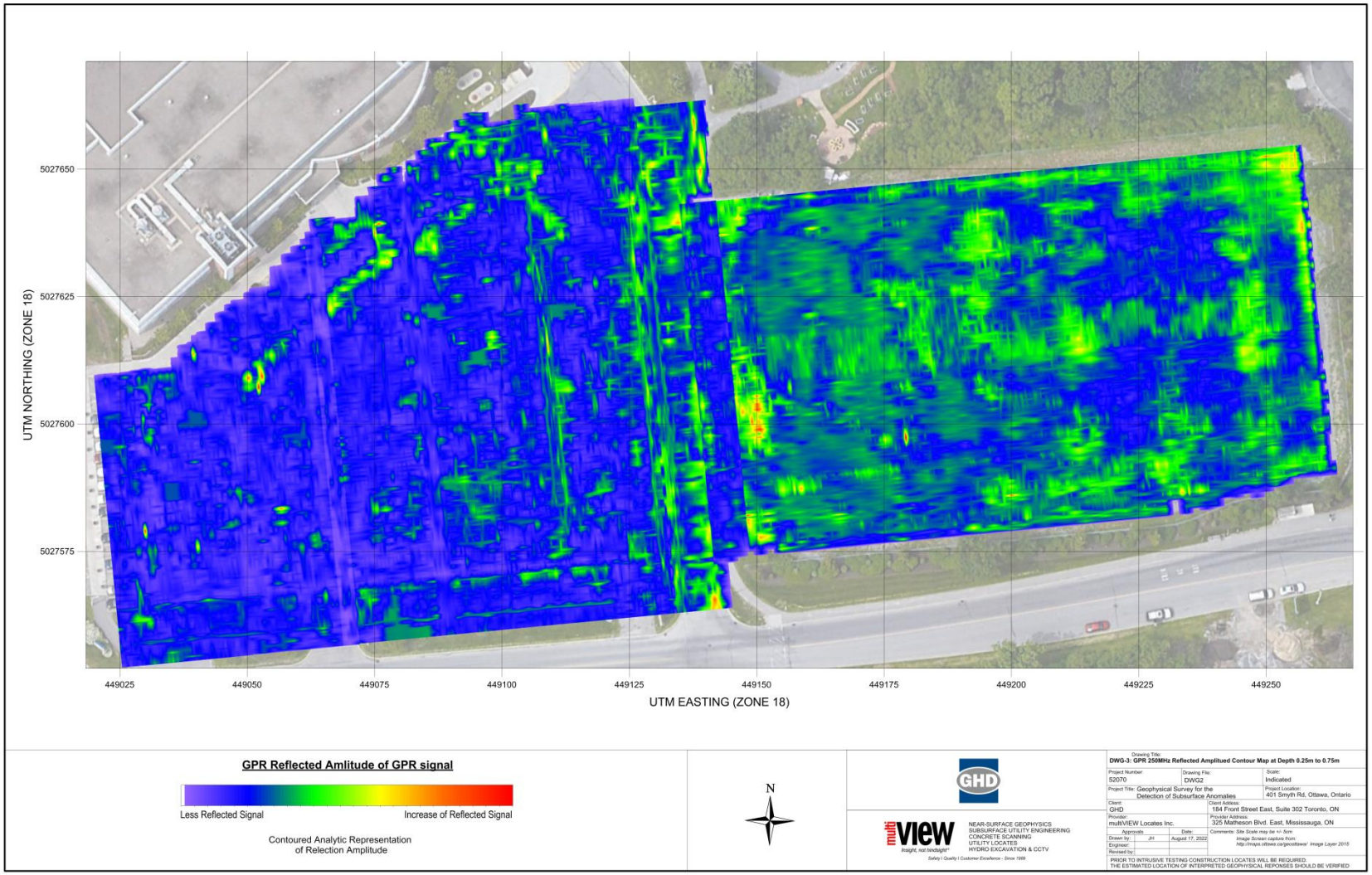


*Figure 4-3: GPR Reflected Signal, Depth 0.25m to 0.75m*

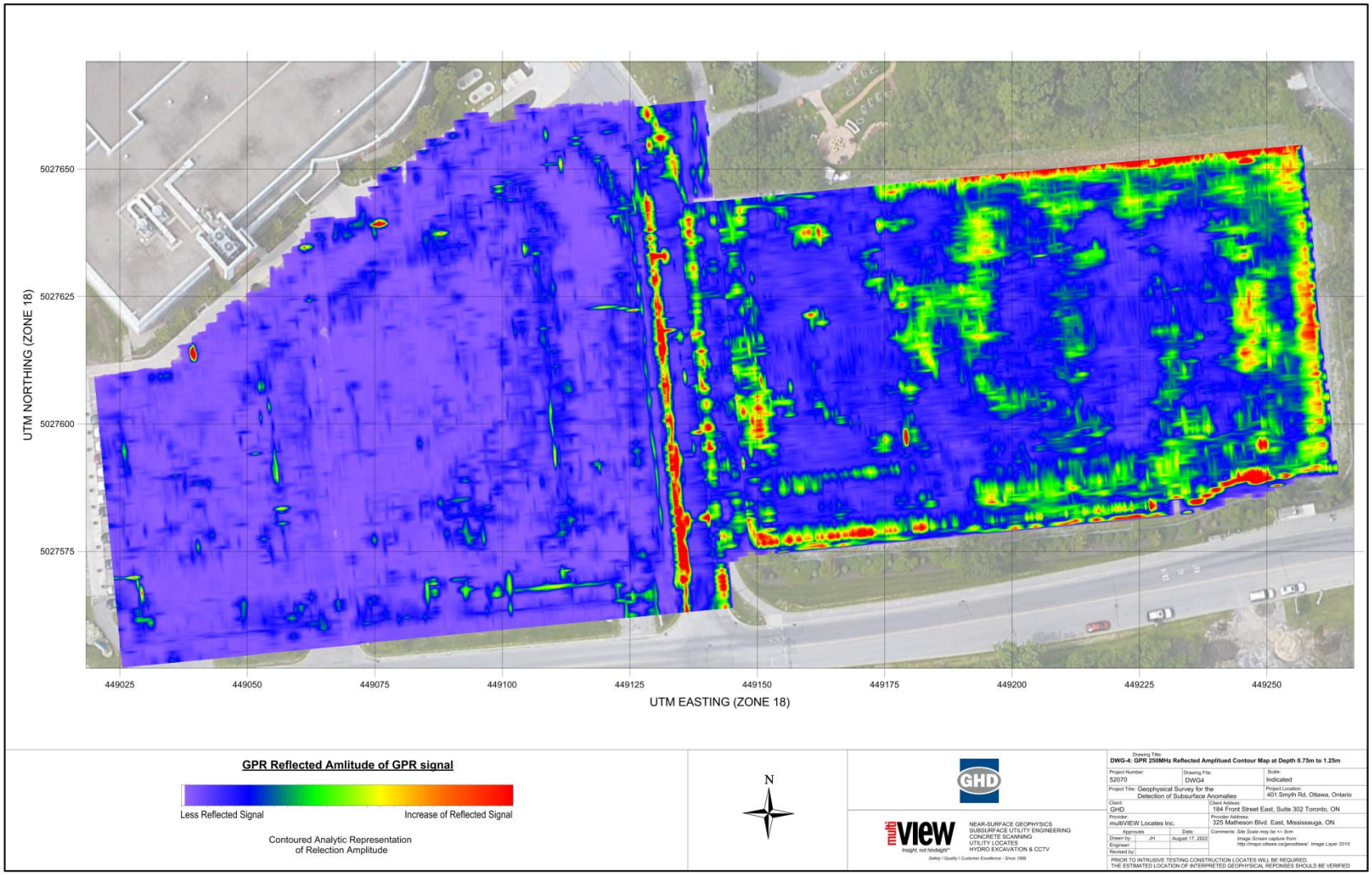


*Figure 4-4: GPR Reflected Signal, Depth 0.75m to 1.25m*


*Figure 4-5: GPR Reflected Signal, Depth 1.25m to 1.75m*

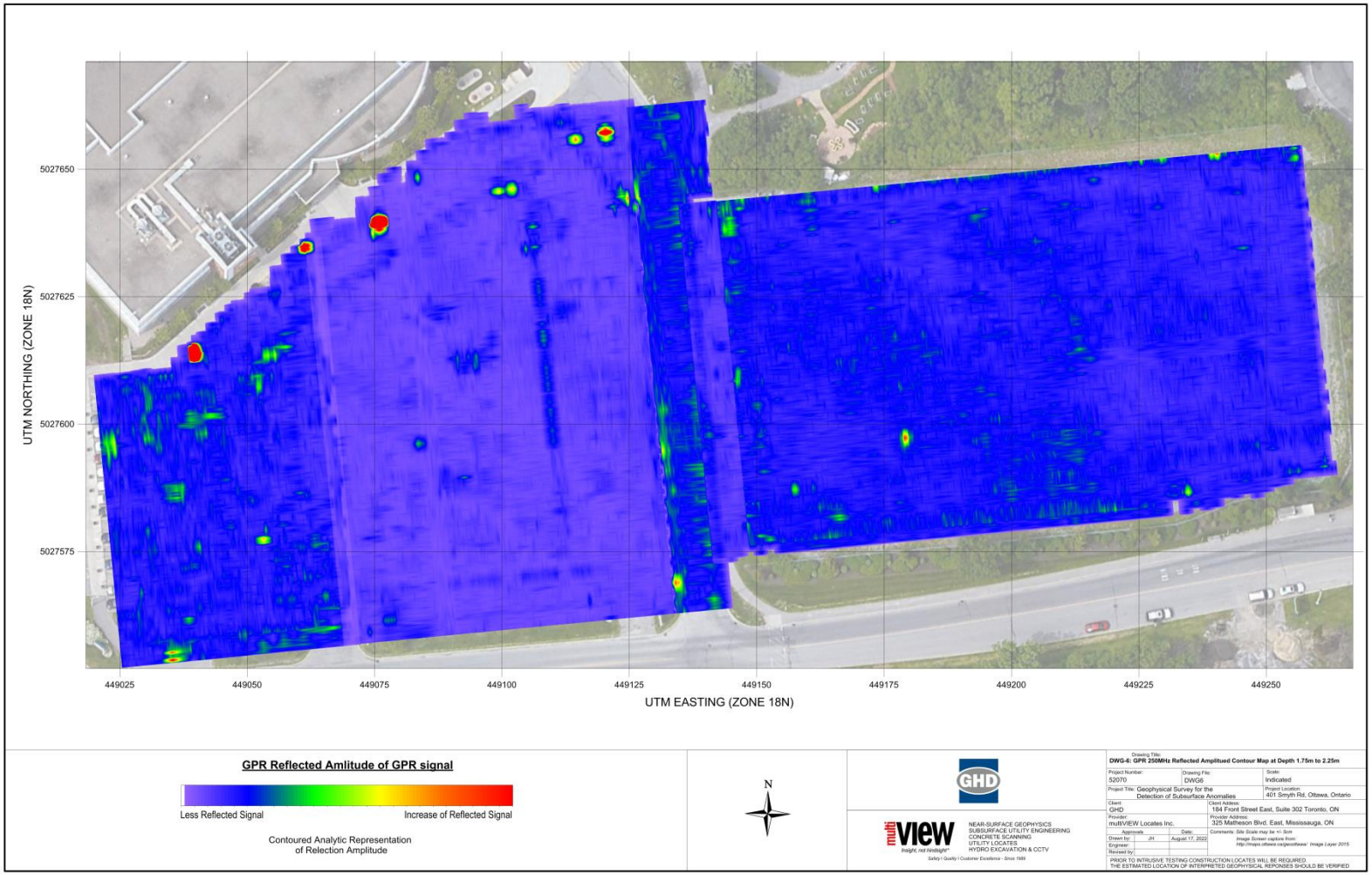


*Figure 4-6: GPR Reflected Signal, Depth 1.75m to 2.25m*

## 4.3 GPR Line Data Sample Analysis

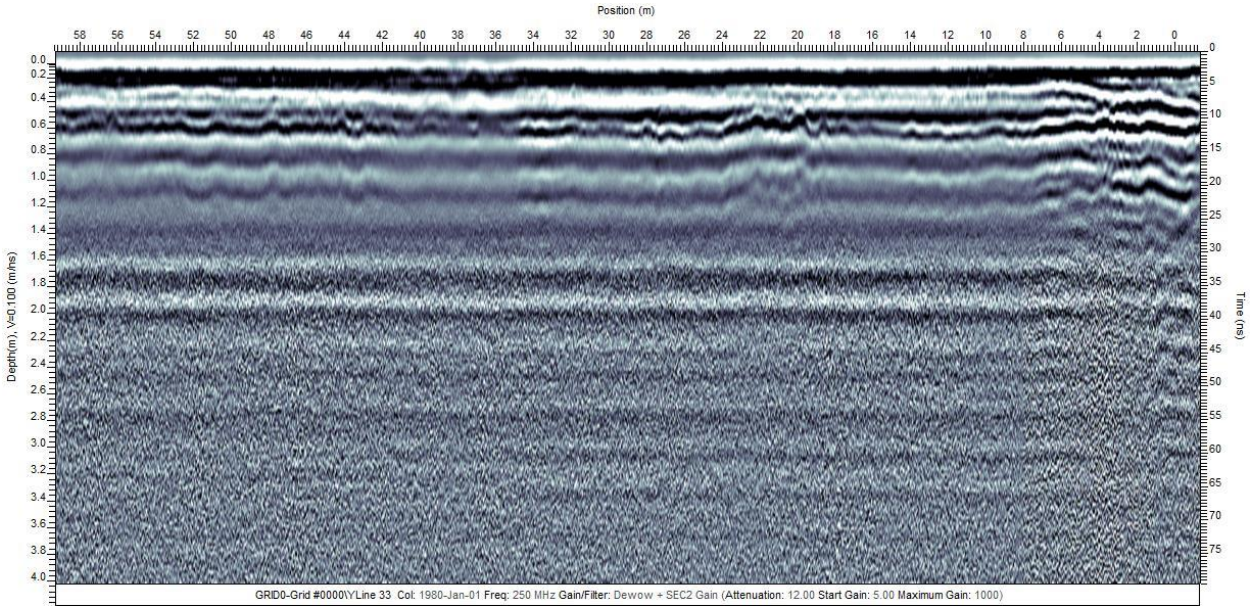


*Figure 4-7: Typical GPR Line Data*

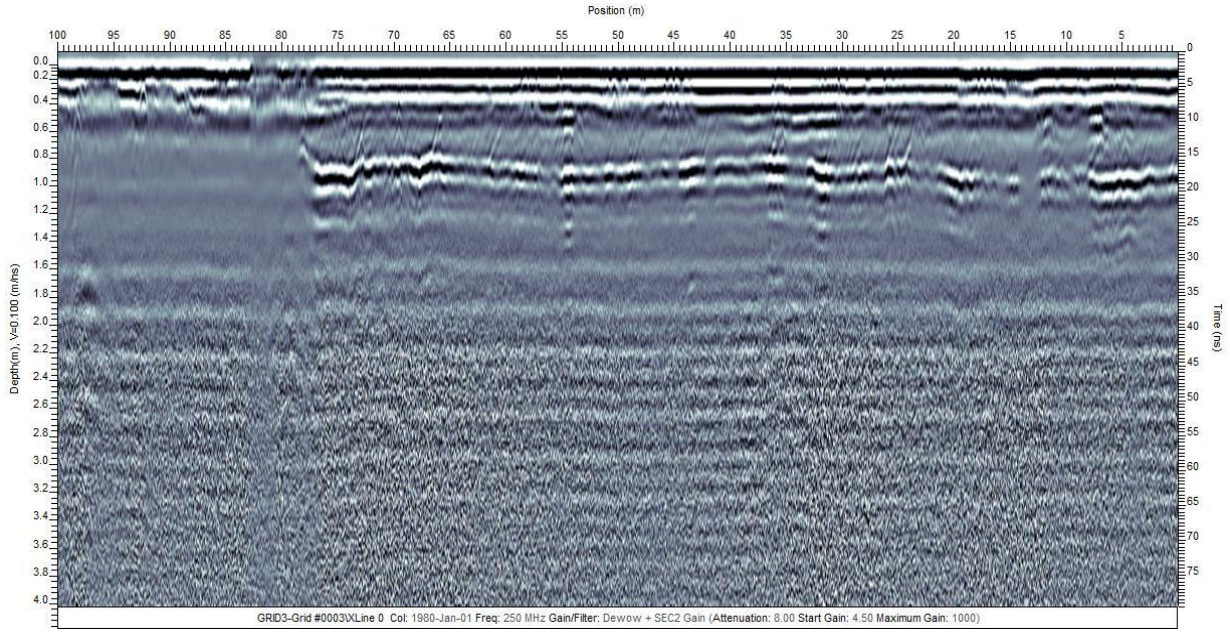


*Figure 4-8: GPR Line Data, Along Road to CHEO Emergency*

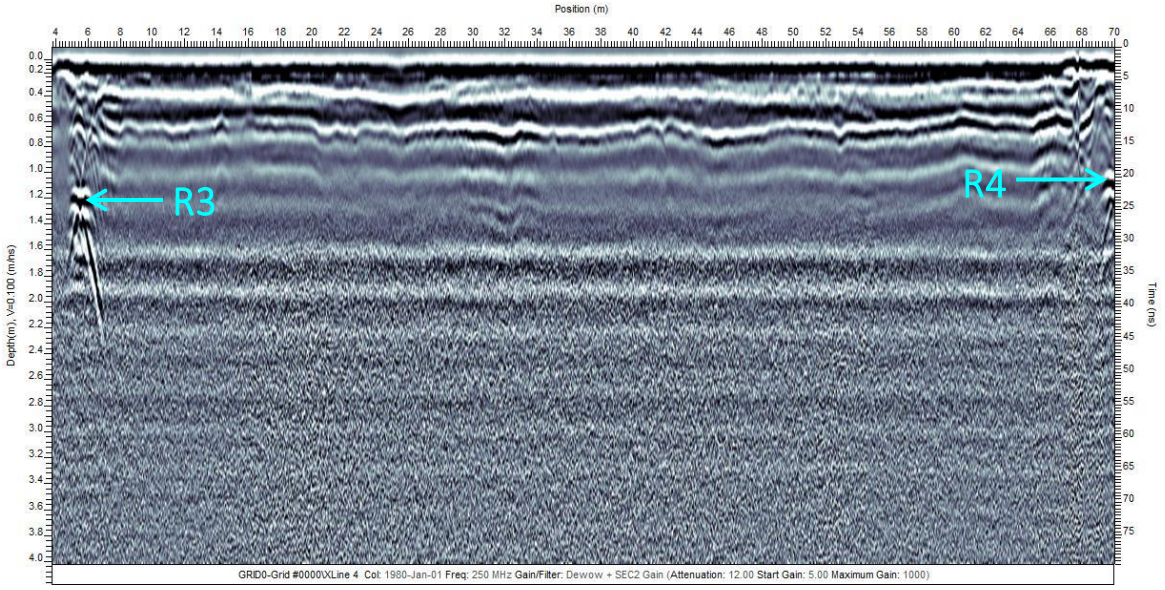


*Figure 4-9: GPR Line Data, Parking Lot E*

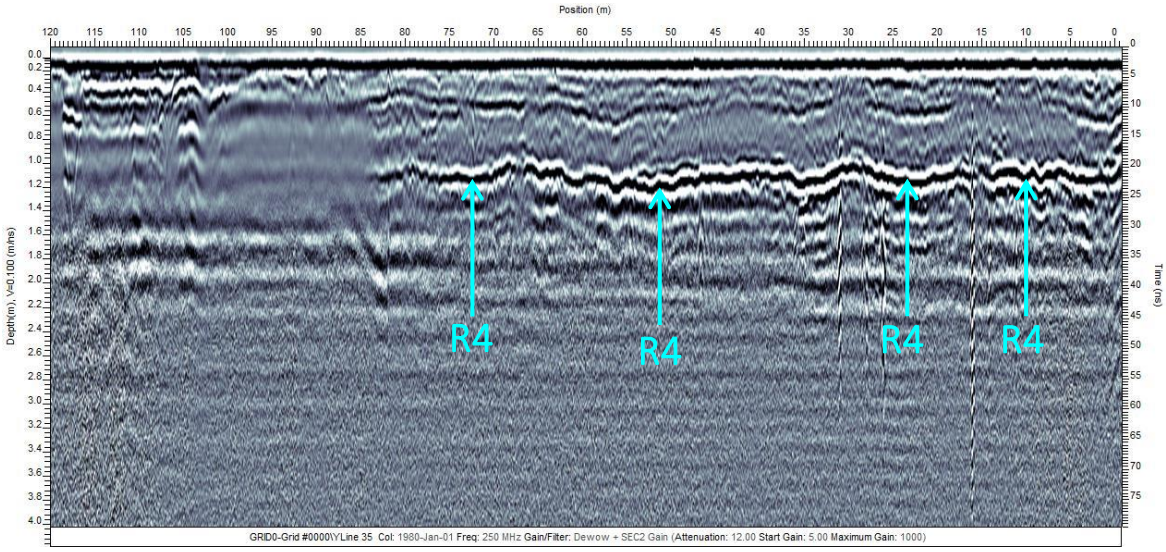


*Figure 4-10: GPR Line Data, North side of Parking Lot E*

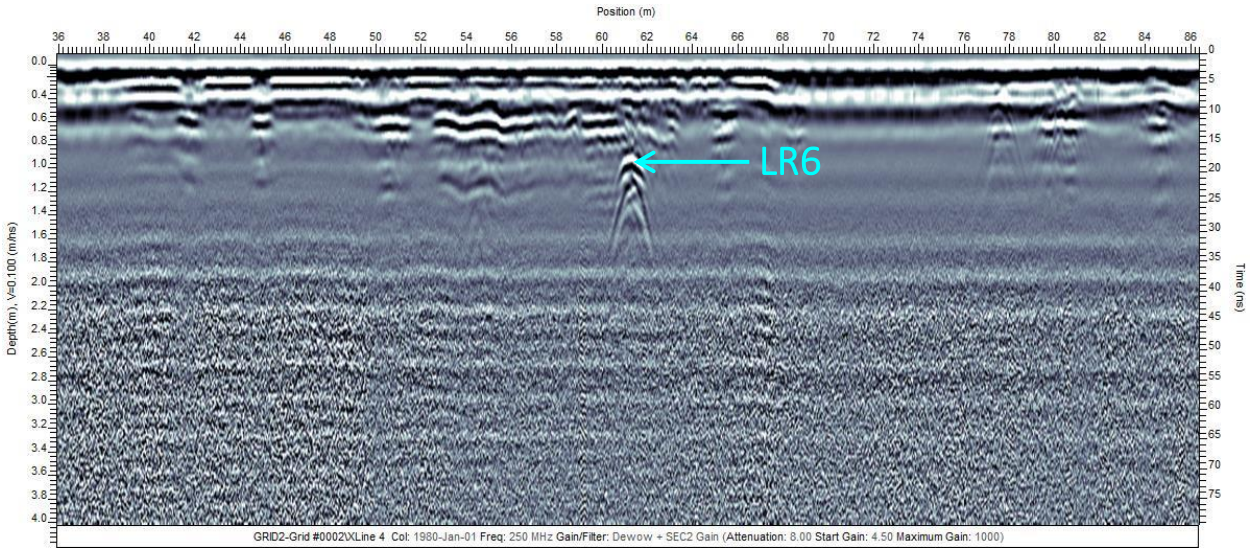


*Figure 4-11: GPR Line Data, Eastern side of Parking Lot A.*

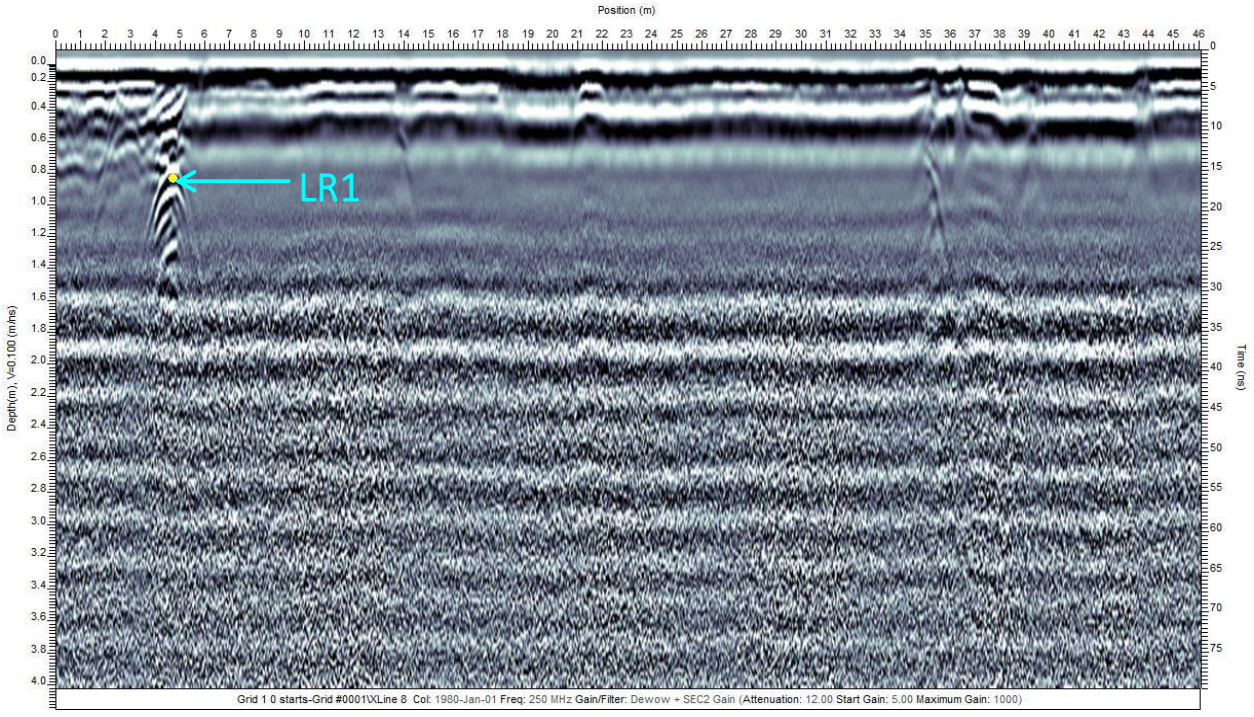


*Figure 4-12: GPR Line Data, South-Western Side of Parking Lot A*

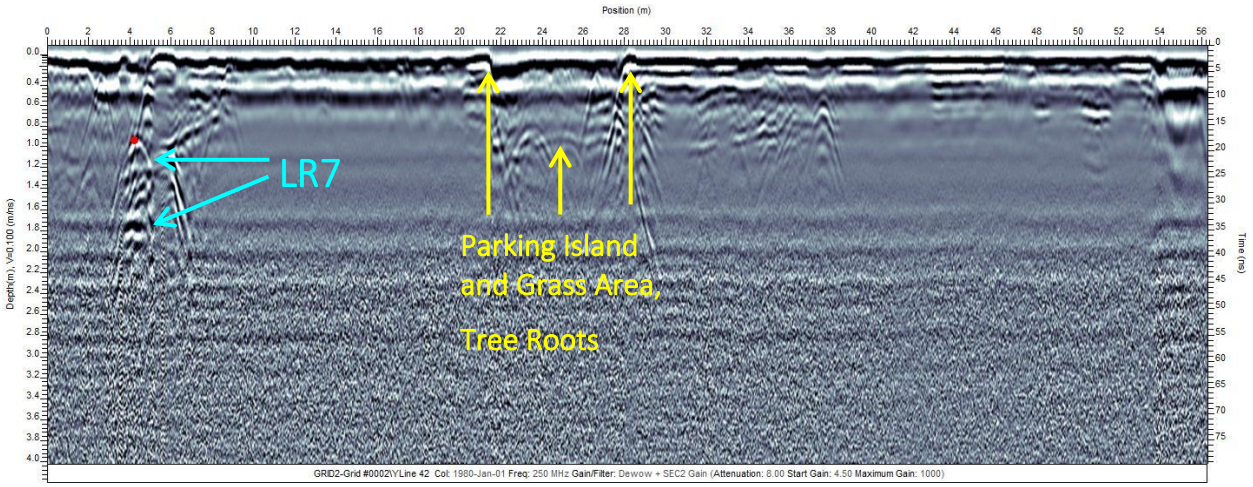


*Figure 4-13: GPR Line Data, North-Eastern Side of Parking Lot A*

# 5 CONCLUSION

Geophysical Survey was carried out in the property located at 401 Smyth Road, Ottawa, ON, Canada. The primary objective of the investigation was to map the presence of underground anomalies.

The results of the geophysical survey detected various anomalies in the Geophysical Survey data and outlined potential subsurface variance within project area. A summary depicting the interpretation of the geophysical responses is provided in the following list:

- Fourteen (14) TDEM linear anomalies were detected and were only detected by the TDEM Equipment.
- Four (4) GPR linear anomalies were detected and were only detected by the GPR Equipment.
- Seven (7) linear anomalies were detected by both the TDEM and GPR Equipment.
- Two (2) TDEM zones of elevated Channel 3 data were detected but not detected by the GPR equipment.

The geophysical data obtained during this investigation is intended for the guidance of the geotechnical engineering and excavation activities only. Interpretation of the data used during any subsequent programs is subject to the Law of Physics and Technical limitations. Additional information regarding advantages and limitations of this geophysical data is provided in the report appendices.

MultiVIEW services and geophysical technical limitations can be found at http://www.multiview.ca/Services/Terms-and-Conditions.

When physically locating the interpreted geophysical responses over the terrain for intrusive testing, excavation or site rehabilitation, it is recommended to properly correlate the reference grid stations with the stations presented on the digital maps.

Respectfully Submitted,

October 17, 2022

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# APPENDICES

# APPENDIX A

*Terms and Conditions for Electromagnetic Investigations*

*Data Presentation*

1. The electromagnetic point data were acquired at the station spacing and on the date as defined in the survey objectives.
2. Colour-contoured maps were created from the collected electromagnetic data and referenced to the survey grid coordinates
3. The images of the colour contoured maps presented in the body of the report are for display and review purposes only. The images are scaled to fit page sizes. Data acquired for QC/QA purposes (base station, background or auxiliary data) are available in the digital archive. The raw data and maps in the digital archive are properly referenced to the survey area, using either grid or UTM coordinates. The maps are presented at a scale to facilitate the accompanying interpretation.

*Data Interpretation*

Interpretation of the electromagnetic data is intended for guidance on environmental engineering and excavation purposes only. The user must be aware of the following interpretive restrictions:

4. Features shown on the interpretation map are related to the expression of subsurface man-made objects and other geological features and structures underground. The projection and location of these features on the surface is referenced to the grid coordinate system established at the time of the survey. All detected features are not necessarily shown due to the weak and non-relevance of the observed responses.
5. Interpretation of buried features or change in soil conditions cannot be made in areas where data were not collected.
6. The electromagnetic data were reviewed with respect to the position of the cultural features (i.e. man-made metallic objects) identified on site. The electromagnetic response observed in proximity to a known cultural feature is attributed to that feature.
7. Where known surface or subsurface metallic objects exist within 2 metres of the electromagnetic data observation station, it is possible that other metallic objects or a change in soil conditions may be present but not identified in the interpretation because the electromagnetic response is attributed to, or masked by, the known feature.
8. The spatial position of all interpreted electromagnetic anomalies (zones where electromagnetic fields are different than background) inferred to represent buried metallic objects are indicated in red on this figure.
9. If red anomalies are not present on this figure, no electromagnetic signatures were identified which could not reasonably be ascribed to known metallic objects and/or no isolated electromagnetic anomalies could be identified.
10. The spatial position of all interpreted electromagnetic anomalies inferred to represent unusual soil conditions is indicated in blue on this figure. These anomalies may represent local changes in soil type or geology, changes in soil moisture conditions; fill versus natural soils or contaminated areas.
11. If blue anomalies are not present on this figure, no electromagnetic signatures were identified which could not reasonably be ascribed to known changes in soil type or geology, changes in soil moisture conditions, fill versus natural soils or contaminated areas.

*Comments for Subsequent Investigations*

12. The electromagnetic anomalies identified within the survey area and as potential buried objects relevant to the survey objectives should be excavated to confirm the source of the electromagnetic response. The excavation point and/or area must be referenced to the site survey grid and located in the center of the anomaly.
13. The survey grid coordinates were established using survey tapes. The stations and lines were picketed and marked over the ground and left in-place upon completion of the survey. After survey completion, if markings are unclear, the survey grid should be reconstructed prior to excavation activities, using all the information provided in this report and in the digital archive (e.g. GPS locations, photographs and additional location maps).
14. In all cases, excavation should be extended to a minimum depth of 2 metres to allow confident identification of the anomaly source.
15. It is recommended that this document be retained on site during any excavation activities. Excavation may reveal features not identified in the interpretation process due to the limitations of the technique