



FINAL REPORT

FOUNDATION INVESTIGATION AND DESIGN REPORT New Material Storage Facility at Parry Sound Patrol Yard, ON

**Agreement No. 5015-E-0007
Assignment No. 10
Geocres No.31E-405**

Prepared for:
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Foundation Investigation and Design Report

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1 FOUNDATION INVESTIGATION REPORT

1.1 Introduction

This report presents the results of a geotechnical investigation carried out by EXP Services Inc. (EXP) for the proposed new winter sand/salt storage facility on the existing dome at the Parry Sound Patrol Yard, located in Parry Sound, Northeastern Ontario. The work was undertaken under Agreement # 5015-E-0007, Assignment No. 10. The terms of reference (TOR) were as presented in the Ministry of Transportation (MTO) email received on March 12, 2019.

The purpose of this investigation is to establish existing subsurface conditions at the proposed location of the patrol yard structure within construction limits defined by MTO. The site-specific geotechnical investigation consisted of field investigation including visual inspection, drilling, soil sampling, and laboratory testing. Factual results of the investigation and laboratory testing are included in this report. The report has been prepared specifically and solely for the project described in the report.

1.2 Site Description and Geological Setting

1.2.1 Site Description

The Parry Sound Patrol Yard is located on Quebec Drive, approximately 3 km west of the Trans-Canada Hwy 400 and Oastler Park Drive junction in Parry Sound, Northeastern Ontario (see Key Map on Drawing 1, Appendix B). The site is bound by Quebec Drive to the southeast, Oastler Park Drive to the southwest, farm land to the northeast, and by bush and mature trees to the northwest.

A paved roadway and parking area lead from the site entrance on Quebec Drive to a storage shed, located approximately 70 m northwest and seven-bay garages/office, located approximately 70 m northeast of entrance gate. The proposed new storage facility will be located approximately 40 m north from the storage shed and approximately 130 m northwest from the site entrance.

The topography of the site is considered flat lying with borehole elevations ranging from 210.1 to 210.2 m. The ground surface of Parry Sound patrol yard is paved around the existing buildings and has gravel in the other areas. Photographs of the site are included in Appendix A.

1.2.2 Geological Setting

According to the Ministry of Northern Development and Mines Map 2556, Quarternary Geology of Ontario, Southern Sheet, the site is generally undifferentiated igneous and metamorphic rock, exposed at surface or covered by a discontinuous, thin layer of drift. According to the Ministry of Northern Development and Mines Map 2544, Bedrock Geology of Ontario, Southern Sheet, the bedrock at the site consists of Mafic rocks: amphibolite, gabbro, diorite and mafic gneisses.

1.3 Available Documents of Previous Investigations

The available report of the previous investigation for Parry Sound Patrol Yard in the MTO GEOCREs library is:

Geocres No. 31E-278: "MTO Agreement No. 5007-E-0052 Foundation Investigation and Design Report, Proposed Dome Structure, Parry Sound Patrol Yard, 2 Quebec Street, Parry Sound, Ontario" prepared by Jagger Hims Ltd., July 2008.

The details of five boreholes completed by Jagger Hims Ltd. (Jagger Hims) for Parry Sound Patrol Yard are outlined in Table 1.1 and the borehole locations are shown on Drawings in Appendix B. For the ground elevations mentioned in Table 1.1 the BM with elevation 207.727 m was used as noted in the Jagger Hims's report. The borehole logs are included in Appendix H. As can be seen, the previous boreholes were drilled approximately 100 m southeast of the proposed location for the new storage building.

Table 1.1. Summary of boreholes completed by Jagger Hims Ltd.

BH #	MTM NAD83 Northing	MTM NAD83 Easting	Ground Elevation (m)	Borehole Depth (m)
BH-1	5018290	580069	210.54	4.9
BH-2	5018321	580103	209.95	10.2
BH-3	5018310	580084	210.06	6.1
BH-4	5018329	580078	210.01	5.5
BH-5	5018298	580099	209.76	6.7

1.4 Investigation Procedures

1.4.1 Fieldwork

The field investigation was performed between April 30 and May 2, 2019. The field program consisted of drilling four (4) sampled boreholes (BH19-PS-1 to BH19-PS-4). The boreholes were strategically located at the patrol yard to provide the subsurface information for the design of the proposed material storage facility. The borehole locations are shown on Drawing 1 in Appendix B.

The borehole locations (referenced to the MTM NAD83 coordinate system) and their ground surface elevations were surveyed by EXP personnel, with reference to the temporary benchmark (TBM)

established on the northwest corner of concrete pad below AST located at the facility. The elevation of the TBM was considered 210.40 m based on the drawing provided with TOR. The TBM location is shown on Drawing 1, in Appendix B.

The boreholes were advanced using a truck mounted CME-55 drill rig, equipped with a hollow stem augers and diamond bit NW casing. All borehole drilling and sampling operations were performed by a specialist drilling contractor, Landcore Drilling Services. The locations, elevations and depths of boreholes are shown below in Table 1.2.

Table 1.2. Locations, elevations and depths of boreholes completed by EXP Services Inc.

BH #	Location	MTM NAD83 Northing	MTM NAD83 Easting	Ground Elevation (m)	Borehole Depth (m)
BH19-PS-1	West corner of existing dome	5019448.0	267165.3	210.1	6.8
BH19-PS-2	North corner of existing dome	5019472.7	267183.7	210.2	6.8
BH19-PS-3	South corner of existing dome	5019428.7	267182.9	210.1	7.7
BH19-PS-4	East corner of existing dome	5019458.0	267206.4	210.2	9.8

During the drilling of the boreholes, soil samples were obtained using a 51 mm outside diameter (O.D.) split-spoon sampler in accordance with Standard Penetration Test (SPT) procedures (ASTM D 1586), at intervals shown on the attached borehole logs (Appendix C). The original field (uncorrected) SPT “N” values were recorded on the borehole logs as recommended in the Canadian Foundation Engineering Manual (CFEM pg. 40) and used to provide an assessment of in-situ consistency of cohesive soils or relative density of non-cohesive soils. Field vane testing was conducted in cohesive soil to measure the in-situ undrained shear strength of this soil. Field vane test was conducted with the standard MTO vane (6” tampered vane, 2.5” diameter) in accordance with ASTM D2573-08. When a hard stratum was reached sampling of hard material was performed by diamond core drilling, using a 1.5 m long NQ double tube wireline core barrel. The water supply from the site, Parry Sound Patrol Yard was used for soil sampling and rock coring.

Upon completion of the drilling operations, groundwater level measurements were carried out in the open holes. The groundwater levels encountered in the boreholes are shown on the borehole logs and presented below in Table 1.7. The boreholes were decommissioned by bentonite/cement mixtures in accordance with the Ministry of the Environment Regulation 903, as amended by Regulation 128/03 (the well regulation under the Ontario Water Resources Act).

The fieldwork was supervised by a member of EXP's engineering staff who directed the drilling and sampling operation, logged borehole data in accordance with MTO and/or ASTM standards for soils classification, and retrieved soil samples for subsequent laboratory testing and identification.

All the recovered soil samples were placed in labelled moisture-proof bags and returned to EXP's Sudbury and Brampton laboratory for additional visual, textual and olfactory examination, and sampling for laboratory testing.

1.4.2

1.4.2 Laboratory Testing

All samples recovered from boreholes undertaken by EXP during this investigation were returned to the laboratory and subjected to visual examination and classification. The laboratory testing program included the determination of natural moisture content, particle size distribution and Atterberg Limits tests for approximately 25% of the collected soil samples. Soil chemical (Corrosivity and Contamination) package tests were performed on two soil samples. All the laboratory tests were carried out in accordance with MTO and/or ASTM standards as appropriate.

The laboratory test results are provided on the attached borehole log sheets in Appendix C. The results of the grain size analyses are presented graphically in Appendix D.

1.5 Subsurface Conditions

The detailed subsurface soil and groundwater conditions encountered in the boreholes advanced during this investigation, together with the results of the laboratory tests carried out on selected soil samples, are presented on the borehole log sheets in Appendix C. Laboratory test results are provided in Appendix D. The "Explanation of Terms Used in Report" preceding the borehole logs in Appendix C forms an integral part of and should be read in conjunction with this report.

A borehole location plan and stratigraphic section along the proposed material storage facility are provided in Appendix B. It should be noted that the stratigraphic boundaries indicated on the borehole logs and stratigraphic section are inferred from non-continuous sampling, observations of drilling progress and results of Standard Penetration Tests. These boundaries typically represent transitions from one soil type to another and should not be regarded as exact planes of geological change. Further, subsurface conditions may vary between and beyond the borehole locations.

In general, the stratigraphic sequence at the proposed structure site consists of top pavement structure/sand fill, underlain by native fine-grained sand and silty clay deposits followed by bedrock. The findings are generally consistent with those reported in the previous investigation report, even though the locations of investigations are different. A summary of the soil and groundwater conditions encountered in the boreholes is provided below.

1.5.1 Pavement Structure

Asphaltic concrete was encountered at the surface of boreholes BH19-PS-1 and BH19-PS-3, and ranged in thickness from approximately 100 mm to 125 mm. Asphalt thicknesses may further vary beyond the borehole locations.

Sand fill with trace silt and some gravel was encountered below the Asphaltic concrete on boreholes BH19-PS-1 and BH19-PS-3, and ranged in thickness from approximately 485 mm to 530 mm. The total thickness of pavement structure in these boreholes is 0.6 m. Based on laboratory testing conducted, the sand fill has a moisture content between 3% to 22%.

1.5.2 Sand (Fill)

A sand fill layer was encountered at the surface of boreholes BH19-PS-2 and BH19-PS-4. The approximate elevations of the surface and base of the fill and the thickness of fill as encountered in boreholes are summarized in Table 1.3 below:

Table 1.3. Summary of sand fill layer

Borehole	Elevation (m)		Layer Surface Depth (m)	Layer Thickness (m)
	Top	Bottom		
BH19-PS-2	210.2	209.6	0.0	0.6
BH19-PS-4	210.2	208.7	0.0	1.5

This layer consists of sand with trace to some gravel, trace to some silt. The material is brown in color, and moist. The SPT "N" values within this layer is about 25 blows per 300 mm penetration.

Laboratory testing performed on selected samples consisted of moisture content tests. The test results are as follows:

Moisture Content:

- 18% to 31%

1.5.3 Sand

A layer of native sand was encountered in all boreholes, below pavement structure in boreholes BH19-PS-1 and BH19-PS-3 and below sand fill in boreholes BH19-PS-2 and BH19-PS-4. Another layer of sand was encountered below clayey silt and silty clay layers in boreholes BH19-PS-2 and BH19-PS-3, respectively. The approximate elevations of the surface and base of the deposit and the thickness of deposit as encountered in boreholes are summarized in Table 1.4 below:

Table 1.4. Summary of sand layer

Borehole	Elevation (m)		Layer Surface Depth (m)	Layer Thickness (m)
	Top	Bottom		
BH19-PS-1	209.5	206.4	0.6	3.1
BH19-PS-2	209.6	208.6	0.6	0.9
	208.0	206.5	2.2	1.5
BH19-PS-3	209.5	208.6	0.6	0.9
	207.1	205.5	1.5	1.5
BH19-PS-4	208.7	203.9	1.5	4.8

The composition of this layer is fine grained sand, with trace to some gravel, trace to some silt, trace clay and trace organics. The material is brown to brown/grey and brown/black in color with orange molting, and moist to wet. The SPT "N" values within this layer were between 2 and 38 blows per 300 mm penetration, suggesting very loose to dense, but generally compact compactness condition.

Laboratory testing performed on selected sample consisted of moisture content and grain size distribution tests. The test results are as follow:

Moisture Content:

- 2% to 27%

Grain Size Distribution:

- 5% to 20% gravel;
- 57% to 84% sand;
- 8% to 22% silt; and
- 1% to 2% clay

The results of the moisture content and grain size distribution tests are provided on the record of borehole sheets in Appendix C. The result of grain size distribution tests performed is also provided on Figure 1, in Appendix D.

1.5.4 Silty Clay

A layer of native silty clay was encountered between the two sand layers in boreholes BH19-PS-2 and BH19-PS-3. The approximate elevations of the surface and base of the deposit and the thickness of deposit as encountered in boreholes are summarized in Table 1.5 below:

Table 1.5. Summary of silty clay

Borehole	Elevation (m)		Layer Surface Depth (m)	Layer Thickness (m)
	Top	Bottom		
BH19-PS-2	208.6	208.0	1.5	0.6
BH19-PS-3	208.6	207.1	1.5	1.5

The composition of this layer is silt and clay, trace sand. The material is brown/grey in color and moist to wet. The SPT "N" values within this layer ranged from 4 to 10 blows per 300 mm penetration, suggesting soft to stiff consistency.

Laboratory testing performed on selected sample consisted of moisture content, grain size distribution and Atterberg Limit tests. The test results are as follow:

Moisture Content:

- 17% to 18%

Grain Size Distribution:

- 0% gravel;
- 3% sand;
- 46% silt; and
- 51% clay

Atterberg limits:

- Liquid Limit: 19%
- Plastic Limit: 23%
- Plasticity Index: 42%

The results of the moisture content grain size distribution and Atterberg Limit tests are provided on the record of borehole sheets in Appendix C. The results of the grain size distribution test and Atterberg Limit tests are also provided on Figures 2 and 3, respectively, in Appendix D.

1.5.5 Bedrock

The bedrock was encountered below the sand deposit in all boreholes BH19-PS-1 to BH19-PS-4 at depths ranging from 3.7 to 6.3 m below the ground surface with elevation ranging from 206.5 m to 203.9 m. The bedrock was confirmed using coring with lengths of about 1.5 m. All the boreholes are terminated within bedrock. The bedrock surface depth and elevation are summarized in Table 1.6 below:

Table 1.6. Depth and elevation of bedrock surface

Borehole	Depth Below Ground Surface (m)	Elevation (m)	Description
BH19-PS-1	3.7	206.4	Bedrock Cored
BH19-PS-2	3.7	206.5	Bedrock Cored
BH19-PS-3	4.5	205.5	Bedrock Cored
BH19-PS-4	6.3	203.9	Bedrock Cored

Based on the bedrock cores recovered, the bedrock is identified as Dioritic to Granitoid Gneiss. In general, the bedrock sample is described as dark to pinkish grey groundmass with coarse to medium grained with very weak foliation. The Rock Quality Designation (RQD) measured on the core samples ranges from 48% to 100%, indicating a rock mass of fair to very good quality. Based on the International Society for Rock Mechanics and Rock Engineering classification (ISRM 1980) the rock can be described as medium (R3 grade) to very strong strength (R5 grade) with an estimated Uniaxial Compressive Strength (UCS) of between 25 and 250 MPa. Photographs of rock cores are included in Appendix E.

1.6 Groundwater Conditions

Information regarding groundwater levels at the site was obtained by measuring water levels in the open holes of all the boreholes after completion of drilling. The groundwater levels measured in the boreholes are shown on Table 1.7 and on the borehole logs. Water levels measured in open boreholes might not be stabilized due to the relatively short period of observation.

Table 1.7 Groundwater data

Borehole	Date of Drilling	Ground surface Elevation (m)	Groundwater Elevation (m)	Groundwater Depth (m)
BH19-PS-1	5/1/2019	210.1	208.6	1.5

Borehole	Date of Drilling	Ground surface Elevation (m)	Groundwater Elevation (m)	Groundwater Depth (m)
BH19-PS-2	4/30/2019	210.2	208.7	1.5
BH19-PS-3	5/1/2019	210.1	208.6	1.5
BH19-PS-4	4/30/2019	210.2	208.7	1.5

During investigation, few hours after borehole drilling, the unstabilized groundwater level was measured within the sand/silty clay/ clayey silt deposit approximately 1.5 m below ground surface (Elev. 208.6 m). Seasonal variations in the water tables should be expected, with higher levels occurring during wetter periods of the year and lower levels during drier periods.

1.7 Chemical Analyses

One (1) soil sample was selected for chemical analyses, and were sent via courier, in a secure cooler under chain of custody, to AGAT Laboratories., a CALA-certified and accredited laboratory in Mississauga, Ontario.

The sample SS3 from borehole BH19-PS-2 was analyzed for corrosivity chemical analysis. The analytical results are summarized in Table 1.8 below and are presented in Appendix D.

Table 1.8. Corrosivity chemical analysis

Sample Identification	pH (unitless)	Soluble Chloride (ppm)	Soluble Sulphate (ppm)	Resistivity (ohm-cm)	Conductivity (mS/cm)	Redox Potential (mV)
BH19-PS-2-SS3 Silty Clay	6.26	160	15	2720	0.368	142 to 181

1.8 Environmental Analyses

In addition to corrosivity testing, one (1) sample of native sand materials from BH 19-PS-1 (SS2) was analyzed for metals and general inorganics parameters and BTEX/ Petroleum Hydrocarbons (PHCs) – (F1-F4). The analytical results (Certificate of Analysis) are compiled in Appendix D.

2 DISCUSSIONS AND ENGINEERING RECOMMENATIONS

2.1 General

This section of the report provides geotechnical design recommendations for the proposed Patrol Yard sand/salt storage structure at the Parry Sound Patrol Yard, located in Parry Sound, Northeastern Ontario. The recommendations are based on interpretation of the factual data obtained from the boreholes advanced during the current investigation at the site and presented in **Part I-Foundation Investigation Report**. The interpretation and recommendations provided are intended solely to permit designers to assess foundation alternatives and design the proposed structure. Comments on construction are only provided to highlight issues that could affect the design. Contractors bidding on the works should make their own assessments of the factual data and how it might affect construction means and methods, scheduling and the like.

Based on information included in the TOR and correspondence with MTO it is understood that the new sand/salt storage building will be constructed at the MTO Parry Sound Patrol Yard at the location defined by MTO. Based on information provided in the MTO email from June 19 2019, it is understood that the existing 31 m diameter dome will be replaced by the building having the footprint about 18.3 m x 24.4 m. At the time of writing this report the design of the building was not finalized. However, based on the provided similar design by MTO, it is assumed that a building will have a maximum height of about 11.0 m to the bottom of the trusses (underside of roof truss) and it will be encompassed with a 2.5 m high, cast-in-place concrete foundation walls around the perimeter. The building can then be erected with either steel or timber framing, at a height to accommodate indoor loading and delivery of road sand/salt. The existing ground surface at the structure location is approximately at Elev. 210.1 m and it is assumed that finished top of floor will be at that current ground level to tie-in to the adjacent exterior paved areas.

This report addresses the geotechnical design of the foundation for the proposed structure by providing geotechnical design parameters at the Ultimate Limit State (ULS) and Serviceability Limit States (SLS) as well as other geotechnical parameters that may be required in accordance with the latest edition of the *Canadian Highway Bridge Design Code (CHBDC)* (CAN/CSA-S6-14), the *Guideline for Professional Engineers Providing Geotechnical Engineering Service* (1992), the *Canadian Foundation Engineering Manual (CFEM)* (2006), the *provisions in the TOR* and good practice. It also provides discussion about the structure foundation type, stability and settlement analyses, frost protection, construction considerations and dewatering during construction, as requested in the TOR from the MTO email dated March 18, 2019.

As further requested in the TOR, the settlement and stability analyses were completed for a scenario in which the new structure would be loaded to its full allowable capacity. This scenario consists of sand/salt stacked to the maximum allowable height of the concrete walls with a stockpile area covering the entire footprint of the building. The angle of repose for sand/salt was assumed to be 33°.

2.2 Geotechnical Design Considerations for Foundations

The subsurface conditions at the site below the pavement structure or superficial fill consist of layers of compact to dense sand sandwiching a layer of soft silty clay. The bedrock was encountered at depths ranging from 3.7 to 6.3 m below the ground surface with elevation ranging from 206.5 m to 203.9 m. The groundwater level was measured at about 1.5 m below the ground surface (Elev. 208.7 m).

2.2.1 Structure Foundation Alternatives

Based on the results of this investigation as well as the previous investigation, several foundation alternatives for the structure are evaluated in this report. Advantages, disadvantages relative cost and risk/consequences of shallow foundations such as strip/spread footings and deep foundations such as driven steel H-piles and drilled caissons are presented in Table 2.1.

2.2.2 Evaluation of Foundation Alternatives

Considering the findings during the geotechnical investigations, as well as the high cost of pile foundations and the structure's operating life it is unlikely that deep foundations can be considered practical for this patrol yard structure. Shallow foundations are assessed as more practicable. Therefore, as noted in Table 2.1, the shallow foundation using strip/spread footings on the native compact sand and/or soft silty clay is ranked as the preferred foundation design option if the geotechnical resistance is adequate. However, if higher geotechnical resistance is required, shallow foundation using strip footings on 1.3 m thick engineered fill over the native compact sand layer will be the recommended option, as discussed in the following sections. The latter option requires full excavation of the soft silty clay encountered at the site.

Given the subsurface conditions at the site the impact of settlement at the foundations of the structure will be influenced by the operating/stockpiling practices. It is our understanding that the structure will accommodate stockpiles of sand/salt at strategic locations within the structure. Based on the information mentioned in Section 2.1, the maximum loading condition is likely to be salt stockpiled to at least the level of the concrete wall over the full footprint. Mounding in the center at the angle of repose material of 33% beyond the height of the concrete wall is also a possibility.

These types of structures generally have service lives of about 20 years. Typically, in settings of poor soil conditions, the approach would be to mitigate potential distress for a shallow foundation supported on it rather than employ expensive deep foundations for building support. Mitigation to create stable foundation soils can include preloading of the footprint area before construction, structure support on engineered fill and/or stockpiling constrains in order to enhance serviceability. However, since the new building is going to be placed at the location of the existing building it is reasonable to expect that the post construction settlement within the existing stockpile area will be less reflecting the pre load effects from previous operations.

Table 2.1 Evaluation of foundation alternatives

Options		Rank	Advantages	Disadvantages	Relative Costs	Risks/Consequences
Shallow Foundation	Strip/Spread Footings on Native Compact Sand and/or Soft Silty Clay	1*	<ul style="list-style-type: none"> • Straightforward construction 	<ul style="list-style-type: none"> • Fairly low geotechnical resistance available • Preloading the footprint of structure area might be required if new structure is outside the previous footprint • Require dewatering for the construction of footing 	<ul style="list-style-type: none"> • Significantly lower relative cost compared to piles and other shallow foundation option 	<ul style="list-style-type: none"> • Risk of differential settlements due to loading patterns in the past and during operations • Risk of high groundwater and subgrade disturbance • Possible constraints on storage volume
	Strip/Spread Footings on Engineered Fill	2	<ul style="list-style-type: none"> • Straightforward construction • Higher geotechnical resistance than footing on native soil layer • Compaction control 	<ul style="list-style-type: none"> • Require greater effort for dewatering to allow the construction of footing in dry and prevention of subgrade disturbance 	<ul style="list-style-type: none"> • Significantly lower relative cost compared to deep foundation but higher cost compared to shallow foundation on native soil 	<ul style="list-style-type: none"> • Risk of high groundwater and subgrade disturbance

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Deep Foundation	Driven Steel H-Piles	3	<ul style="list-style-type: none"> • Higher geotechnical resistance • Do not require preloading • Do not require dewatering • Negligible settlement • No subgrade disturbance 	<ul style="list-style-type: none"> • Not typical for this type of structure • Relatively short piles 	<ul style="list-style-type: none"> • Higher relative costs compared with shallow foundations 	<ul style="list-style-type: none"> • Not viable due to cost • Sloping bedrock
	Drilled Caissons	4	<ul style="list-style-type: none"> • High geotechnical resistance available • Reduced number of deep elements compared to steel-H-piles • Do not require preloading • Negligible settlement • No subgrade disturbance 	<ul style="list-style-type: none"> • Not typical for this type of structure • Temporary liners would be required for groundwater control and support through overburden • Concrete for caissons would have to be placed by tremie methods below the water level 	<ul style="list-style-type: none"> • Higher relative costs compared with other deep foundation option and shallow foundations 	<ul style="list-style-type: none"> • Not viable due to cost

* If geotechnical resistance is adequate, otherwise preloading and/or founding on engineered fill and/or stockpiling constraints may be necessary.

Based on the provided typical design for the sand/salt storage structure, it is assumed that the strip/spread footings for the structure will be about 2.1 m. As mentioned, the footings could be founded on/within the native firm to stiff silty clay/clayey silt deposit, or on free draining engineered fill, such as Granular 'A' or Granular 'B', Type I or Type II (OPSS.PROV 1010).

The feasibility of shallow foundations depends on whether the structure can be accommodated in ground conditions with the axial resistance and settlement conditions described below. If the geotechnical resistances provided below for strip/spread footings are not sufficient for the design of the structure driven steel piles or caissons can be also considered.

2.2.3 Shallow Foundation

2.2.3.1 Footing Elevation

Based on the results of the geotechnical investigation and a requirement for adequate protection against frost penetration in the project area (i.e. a minimum 1.7 m below the lowest surrounding area, see Section 2.2.5), the following founding elevations of strip/spread footings are recommended:

Table 2.2 Recommendations for footing elevation

Soil at Founding Level	Foundation Elevation (m)	Depth Below Existing Grade
Native compact sand and/or soft silty clay	208.4	~1.7 m
1.3 m thick engineered fill over native compact sand	208.4	~1.7 m (requires excavation up to Elev. 207.1 m)

2.2.3.2 Geotechnical Resistances

In the context of the CHBDC, a satisfactory foundation design would require, in terms of Limit States Design, the factored geotechnical resistance of its foundation to withstand and not exceed the imposed Ultimate Limit State loads - (ULS) Design Approach, and its ability to deform acceptably under the Service Limit State loads - (SLS) Design Approach. These associated loads are typically known as unfactored and factored loads, respectively. Therefore, strip/spread footings placed on the properly prepared subgrade at the design elevation given in Table 2.2, should be designed based on the factored resistances at ULS and geotechnical reactions at SLS for 25 mm of settlement given in Table 2.3 below. The footing width of 2.1 m is assumed. Settlement of the footings under the loading from the stockpile inside the structure which will occur after its construction is considered and discussed in Section 2.6.2. In determining the settlement characteristics of the proposed building (tolerable total and differential settlement), the unfactored loads are required to be provided by the Structural or Design Engineer. The

ULS and SLS consequence factor of 1.0 and degree of site understanding of 0.9 were applied in accordance with Tables 6.1 and 6.2 in the CHBDC S6-14, respectively.

Table 2.3 Factored geotechnical resistances for a 2.1 m wide footing

Soil at Founding Level	Width of Footing (m)	Factored Ultimate Geotechnical Resistance (kPa)	Factored Serviceability Geotechnical Resistance* (kPa) (for 25 mm settlement)
Native compact sand and/or soft silty clay	2.1	225	150
1.3 m thick engineered fill over native compact sand	2.1	450	300

*Note: * Factored serviceability geotechnical resistance values can be reviewed, if higher settlement is tolerable*

Since the ULS resistance and the settlement depend on the footing size and depth of embedment, the geotechnical resistances given in Table 2.3 should be reviewed if the selected footing width or founding elevations differ from those given in the table. Similarly, if an inclined load is applied instead of a vertical load, which is used in these calculations, the values given in Table 2.3 should be reviewed to consider those inclinations.

Prior to placing footings, the exposed native subgrade should be inspected according with OPSS 902 and SP 109S12. A Qualified Geotechnical Engineer should check that the design foundation elevation is achieved and all unsuitable soils including fill and organics should be removed.

2.2.3.3 Resistance to Lateral Loads

Resistance to lateral forces/sliding resistance between the subgrade and concrete should be calculated in accordance with Section 6.7.5 of the CHBDC. The unfactored values of the coefficient of friction, $\tan \delta$, between the base of cast-in-place concrete footing and the native silty clay/ clayey silt subgrade soils below the frost level are presented in Table 2.4.

Table 2.4 Recommendations for coefficient of friction

Interface	Coefficient of Friction, $\tan \delta$
Cast-in- place concrete and native compact sand/soft silty clay	0.45

Cast-in-place concrete and engineered fill	0.60
--	------

A factor of 0.8 should be applied in calculation of the horizontal resistance in accordance with CHBDC.

In a case of the unbalanced lateral earth pressures caused by sand/salt stockpiles being piled against the perimeter walls, these walls should be designed based on the following geotechnical parameters assuming a triangular lateral earth pressure distribution:

- Unit weight of sand/salt stockpile material = 20 kN/m³
- Friction angle of sand/salt stockpile material= 33°
- Lateral earth pressure coefficient (K_o) = 0.5

2.2.3.4 Frost Protection

According to Ontario Provincial Standard Drawing (OPSD – 3090.100), the frost depth in Parry Sound area is about 1.7 m. Consequently, all footings exposed to seasonal freezing conditions should be protected from frost action by at least 1.7 m of soil cover or equivalent insulation.

2.2.4 Deep Foundation

2.2.4.1 Driven Steel Piles

Deep foundations are not considered the most practical option for this patrol yard structure; however, steel H-piles (HP 310 x 110) driven to the bedrock can be used to support the patrol yard structure and the information provided to support design is presented for completeness. The piles will be installed through the sand and silty clay layers and terminated on the bedrock. For design purpose, tip elevations for the piles discussed in this report are estimated and given in Table 2.5.

Geotechnical Axial Resistances of Piles

The factored ultimate geotechnical axial resistances and factored serviceability geotechnical axial reactions for 25 mm of displacement for recommended driven piles are presented in Table 2.5. It is anticipated that for H-piles driven and seated on the underlying unyielding bedrock, the factored serviceability geotechnical axial resistance for 25 mm of settlement will be greater than the factored ultimate geotechnical axial resistance; as such, ULS conditions will govern for this foundation type.

Table 2.5 Factored geotechnical resistances for considered HP 310 x 110 piles

Pile Founding Stratum	Estimated Tip Elevation (m)	Approx. Design Pile Length ¹ (m)	Factored Ultimate Geotechnical Axial Resistance (kN/pile)	Factored Serviceability Geotechnical Axial Resistance (kN/pile) ²
Bedrock	Varies (206.4 to 203.9)	Varies (~2 m to 4.5 m)	2,000	NA

Notes:

- (1) below frost depth of 1.7 m; ground elevation 208.4 m
- (2) Structural capacity of pile per MTO note

Resistance of Piles to Lateral Loads

The resistance of a vertical pile to lateral loads may be calculated using subgrade reaction theory, Broms' Method where the coefficient of lateral subgrade reaction, K_h (MPa/m) for granular soils is based on the following equations:

For cohesionless soils:

$$K_h = n_h(z/d)$$

For cohesive soils:

$$K_h = 67C_u/d$$

where,

- K_h =coefficient of horizontal subgrade reactions (MPa/m)
- d =pile diameter/ width (m)
- n_h =constant of horizontal subgrade reaction (MPa/m)
- C_u =undrained shear strength (kPa)
- z =depth below ground surface (m)

Pile Installation

The piles could be fitted with a driving shoe section (Titus pile point due to sloping bedrock, APF Hard Bite bearing points or similar) offering some protection against buckling at the toe or the piles should be stiffened as per OPSD 3000.100, Type I to minimize damage to the piles in anticipation of heavy driving conditions. Care must be taken to avoid overdriving and damaging the pile tip (i.e., the structural capacity of the piles should not be exceeded).

In addition, all piles should be visually monitored by experienced personnel during installation to check for plumbness, set, internal damage, etc. All damaged piles should be rejected, or if the damage is considered to be minor, the pile can be dynamically tested to determine the available pile capacity.

2.2.4.2 Drilled Caissons

Alternatively, the patrol yard structure may also be supported on caissons socketed into the bedrock. The high axial capacity of caissons would result in fewer units being required to support the structure than that required for the H-piles. Temporary liners and tremie concrete will be required to install caissons at this site.

Table 2.6 below provides the factored ultimate geotechnical axial resistances for 1.2 m diameter caissons socketed a minimum of 1.5 m into the bedrock. The given value for caissons includes the shaft resistance of the bedrock socket and its end bearing.

Table 2.6. Geotechnical resistance for a 1.2 m diameter caisson

Relevant Borehole	Foundation Elevation (m)	Factored Ultimate Geotechnical Axial Resistance (kN/pile)	Factored Serviceability Geotechnical Axial Resistance (kN/pile)
BH19-PS-1	204.9	17,000	N/A
BH19-PS-4	202.4		

Note:

NA-not applicable since for caissons socketed into the bedrock, the factored serviceability geotechnical axial resistance for 25 mm of settlement will be greater than the factored ultimate geotechnical axial resistance and, therefore, ULS conditions will govern

To verify the soundness/structural integrity of the caissons, one of the following non-destructive evaluation tests may be performed:

- Cross-hole acoustic testing and backscatter gamma ray (gamma-gamma) tests through access tubes installed within the caissons during the placement of the concrete; or
- Sonic echo tests. The advantage of these tests is that they do not require preparation during construction of the caissons. The disadvantage is that these tests do not identify all imperfections in a caisson, but provides information about continuity, defects, such as cracks, necking, soil incursions, changes in cross section and approximate pile lengths, unless the pile is very long or the skin friction is too high.

Cross-hole Sonic Logging should be in general accordance with the latest version of ASTM D6760 - Standard Test Method for Integrity Testing of Concrete Deep Foundations by Ultrasonic Cross-Hole Testing. Static load tests to confirm the bearing capacity of the caissons may also be completed as described in ASTM D1143-81 (Compression Test Quick Method) and ASTM D3966-90 (Lateral Test) or as per designer's specification.

2.3 Earthquake Considerations

Recommendations for the geotechnical aspects to determine the earthquake loading are presented below.

Subsoil Conditions:

The subsoil and groundwater information at this site have been examined in relation to Section 4.1.8.4 A of the Ontario Building Code (OBC, 2012). The subsoil generally consists of compact sand and soft silty clay underlain by bedrock approximately at a 3.7 m to 6.3 m depth below the ground surface. It is expected that the foundations will be founded in the sand and/or silty clay layer. The reported N-values for the soil below 3 m of the founding level ranged from 4 to 30 blows for 300 mm of penetration, with an average value being around 12 blows per 300 mm of penetration.

Corrected N-Values N_{60} :

The Average Standard Penetration Resistance shown in Table 4.1.8.4.A. Site Classification for Seismic Site Response in OBC 2012 refers to N_{60} which is defined as "Average Standard Penetration Resistance for the top 30 m, corrected to a rod energy efficiency of 60% of the theoretical maximum". It should be noted that the drillers in the Parry Sound area do not have their rod energy efficiencies measured and therefore, computed N_{60} values are not available for this site. In our opinion, the reported N-values could be considered as an approximate equivalent to the normalized N_{60} values as noted in the OBC 2012 for establishing the site classification.

Depth of Boreholes:

Table 4.1.8.4.A. Site Classification for Seismic Site Response in OBC 2012 indicated that the average properties in the top 30 m are to be used to determine the site classification. The four (4) boreholes advanced for building construction at this site were between 6.8 m and 9.8 m deep. The total overburden thickness was between 3.7 m and 6.3 m at the tested locations. The overburden soils are typically underlain by bedrock of excellent quality.

Site Classification:

Based on the above assumptions and interpretations, and the soil conditions, the Site Class for this site is estimated to be Class "C" as per Table 4.1.8.4.A, Site Classification for Seismic Site Response, OBC 2012.

These parameters should be reviewed by a Structural Engineer.

2.4 Liquefaction Considerations

Based on soils and groundwater condition encountered at the site, no liquefaction is expected due to the ground motion from an earthquake having 10% probability of exceedance in a 50-year period.

2.5 Perimeter Wall and Floor Construction

The perimeter wall of the proposed structures may be constructed as a cantilever retaining wall with an extended heel toward the inside of the structure and founded on native soils or engineered fill. Structural steel bars should be provided in the footings and in the walls.

The concrete and/or asphalt floor slabs supported on the existing granular fill or on engineered fill could be designed inside the structure. Based on available information, the floor slab/ asphalt surface elevation

will be around 210.1 m. Below the floor, a sub-floor drainage system should be placed and compacted as described later in this section. The asphalt pavement structure will need to be designed by a pavement engineer. The concrete floor slab has to be design by a structural engineer specialist as well. However, it is recommended that for the concrete floor slab the final lift of granular fill beneath the floor slabs should consist of a minimum thickness of 200 mm of OPSS Granular A material, uniformly compacted to 100% of SPMDD. For this condition, a modulus of subgrade reaction k_v of 50 MPa/m may be assumed for preliminary assessment purposes. For design purposes, the value provided above needs to be modified to account for size effects as per standard design methods as outlined in CFEM 2006. The concrete floor slabs should be structurally separate from the foundation walls and columns and saw-cut control joints should be provided at regular intervals along column lines to minimize shrinkage cracking and allow for normal differential settlement of the floor slabs. Considering that the floor will be covered by sand/salt stockpile during cold weather, a frost protection is not considered necessary.

The construction of spread footing and subgrade for the floor may be carried out in accordance with the following recommendations:

Prior to construction, all obviously unsuitable material should be fully removed from the entire underfooting and underfloor area (see Section 2.7). Following rough grading, the exposed subgrade should be proof-rolled with a roller under the full-time supervision of a qualified geotechnical personnel. Any soft spots detected during proof-rolling should be sub-excavated and replaced with Granular A or Granular B, Type I or Type II materials compacted to at least 98 % of the Standard Proctor Maximum Dry Density (SPMDD). The prepared subgrade should be covered with at least 200 mm thick layer of Granular A compacted to not less than 100% of the material's SPMDD, crowned slightly in the central area.

Around the perimeter of the building the ground surface should be sloped on a positive grade away from the structure to promote surface water run-off and reduce groundwater infiltration adjacent to the foundations. Permanent perimeter drains are not required if the interior base is set at least 200 mm above the exterior grade and the grade is sloped away from the structure. However, a permanent subfloor drainage system may be required to collect salt-bearing water. To minimize contamination into the native soils and subsequently into the groundwater, a barrier such as a compacted low-permeability clay liner or geomembrane usually should be installed below a salt storage area. In practice, the use of geomembrane shows advantage over the compacted clay liner in terms of improved performance of the barrier. The geomembrane should be installed on a minimum 75 mm thick sand layer (OPSS PROV 1004 or OPSS PROV 1002) and covered with a 300 mm thick layer of sand fill on top of the geomembrane to protect it from the overlying pavement structure. At this particular site, the presence of layer of natural stiff silty clay could be considered as a natural barrier system for contaminant transport.

2.6 Stability and Settlement Analyses

2.6.1 Stability

To assess the global stability of the material storage facilities and to check that a minimum Factor of Safety of 1.3 will be achieved for the maximum height winter sand/salt stockpiles, a series of slope stability analyses were performed. The static slope stability analyses were performed using the Morgenstern-Price method developed based on limit equilibrium. The SLOPE/W computer program developed by GeoSlope International was employed for computation.

Stability assessments were performed for the proposed new structure of 18.3 m x 24.4 m dimensions assuming that the maximum sand/salt stockpile height could be 8.5 m having side slopes of 1.5H:1V as shown on in Appendix F. The stratigraphy and groundwater condition at the site were developed based on the results of the geotechnical investigation presented in Part I - Foundation Investigation Report.

Given the above, effective stress analyses for a long-term stability assessment and total stress analysis for a short-term stability assessment was performed taking into consideration the subsoil conditions encountered directly beneath and adjacent the proposed structures.

Tabulated below in Table 2.7 are the soil parameters used for the slope stability analyses. The soil parameters were generally estimated based on the results of field and laboratory investigation.

Table 2.7 Soil properties used in slope stability analyses

Material Type	Effective Stress Parameters			Total Stress Parameters		
	ϕ (degrees)	c (kPa)	γ (kN/m ³)	ϕ (degrees)	c (kPa)	γ (kN/m ³)
Engineered Fill	32	0	21	32	0	21
Sand Fill	30	0	20	30	0	20
Compact Sand	30	0	19	30	0	19
Soft Silty Clay	24	0	18	0	25	18
Stockpile Material (Winter sand/salt)	33	0	20	33	0	20

The graphical results of these analyses can be seen in Appendix F. As shown on Figures in Appendix F, the results of stability analyses for an approximately 8.5 m high winter sand/salt stockpile (in the center, with the side slopes of 1.5H:1V) restrained with concrete walls on both sides in the building suggest that the factor of safety greater of 1.3 can be obtained for a deep-seated failure surface.

2.6.2 Settlement

To evaluate the maximum settlement and differential settlement values below the winter sand/salt stockpile loadings in the proposed storage building, a 3D computer program; Settle3D (Rocscience) was

employed. The properties for the encountered soil layers used in the settlement model are evaluated based on the results of the SPT as per CHBDC. The parameters are listed in Table 2.8.

Table 2.8 Soil properties used in settlement analyses

Material Type	γ (kN/m ³)	E (MPa)	C _c	C _r	P _c (kPa)	e ₀
Engineered Fill	20	50	-	-	-	-
Soft Silty Clay	18	-	0.18	0.02	150	0.5
Compact Sand	19	30	-	-	-	-

The geometry of the stockpiles was assumed based on its maximum allowable capacity which is a maximum height of approximately 8.5 m at the center and 2.5 m along the sides at the wall. The model is illustrated on Figures G1 included in Appendix G.

The results of the settlement analyses are plotted on Figures G1 and G2 (Appendix G). The estimated settlements under the stockpile at the center and at the edges of the stockpile (i.e. location of footings) are presented in Table 2.9.

Table 2.9 Results of settlement analyses

Foundation Soil Type	Estimated Settlement (mm)			
	Elastic		Consolidation	
	Edge	Centre	Edge	Centre
Soft Silty Clay/Compact Sand	2	13	9	29

The calculated settlements are anticipated to occur immediately after the stockpile loadings are applied or within a period of one month. However, the loadings and consequent consolidation settlement would occur after the footings have been constructed. Therefore, the footings for these structures should be designed under the full allowable stockpile loadings. The geometries of stockpiles under the full allowable loadings including their possible maximum heights are recommended above. Since, the proposed storage building lies within the footprint of existing building, the post construction settlement within the existing stockpile area would be less than estimated above. Assuming preconsolidated condition, the consolidation settlement is expected to be less than 29mm as outline above. The inferred increase in strength in clay layer between the period of the previous investigation in 2008 and the current investigation is noted.

Assuming that the virgin footprint area is preloaded by a gravel/sand stockpile prior of construction, the post-construction settlement would be significantly reduced. For example, the settlement analysis for a 4 m high stockpile preloading was performed and the result is presented in Table 2.10 and attached Figure G3, Appendix G. The result shows that the total settlement of approximately 17 mm at the center could be expected by placing the 4 m high preloading. A total settlement of about 5 mm can be expected at the proposed location of the footings. Therefore, these analyses demonstrate that preloading can significantly reduce the post construction settlement if the compressible clayey soil exists below. It is anticipated that these predicted total settlements will take place as the load is applied or within a time period of about 30 days.

Table 2.10 Results of settlement analyses for preloading the virgin footprint area

Height of Stockpile Preloading (m)	Estimated Settlement at Centre (mm)	Estimated Settlement at Location of Proposed Footing (mm)
4	17	5

Assuming preloading of the virgin areas for a period of one month is undertaken there should be no significant settlement issues at this site. Some monitoring of the preloading and perimeter walls after construction is indicated to confirm expectation.

2.7 Site Preparation and Engineered Fill Construction

As mentioned previously, the areas within the limits of the buildings should be stripped and cleared of asphalt, surface vegetation, topsoil and debris prior to construction. Any soils containing excessive organics or loose/disturbed materials are not suitable for the subgrade of building foundations, floor slabs or engineered fill. Therefore, areas with those soils should be excavated and replaced with engineered fill comprised of Granular A or Granular B, Type II (below the groundwater table).

Engineered fill could be placed after stripping all topsoil, organic matter, fill and other compressible, weak and deleterious materials within an area extending at least 1.0 meters beyond the outside edge of the founding level of any footings. After stripping, the entire area should be heavily proof-rolled inspected and approved by a Geotechnical Engineer. Engineered fill should be placed in accordance with OPSS 501 and SP105S22. The fill material should be placed in thin layers not exceeding approximately 300 mm when loose. Oversize particles larger than 120 mm should be discarded, and each fill layer should be uniformly compacted with heavy compactors, suitable for the type of fill used. The engineered fill below the footing and floor slab should be compacted to 100% of its SPMDD, while within outside/exterior paved areas, the fill should be compacted to 98% of its SPMDD.

Full-time geotechnical inspection and quality control (by means of frequent field density and laboratory testing) should be provided by the Geotechnical Engineer. Every lift should be evaluated by a sufficient number of tests to ensure that the level of compaction is constantly achieved, and the compaction

procedure is applied.

2.8 Excavation and Groundwater Control

The groundwater level at the site was encountered at Elev. 208.7, while the excavation to the foundation level has to be carried out to Elev. 208.4 m or 207.1 m for the footing founded on native soil or footing founded on engineered fill, respectively. Therefore, it is possible that the groundwater table is about 1.6 m above the bottom of excavation. Considering that the soils encountered below the groundwater table and within potential excavation depths consist of native silty clay, it is assessed that these soils are susceptible to disturbance from groundwater and mobilized equipment. Therefore, the groundwater level needs to be controlled to at least 0.5 m below the excavation level to avoid disturbance, and any surface or groundwater seepage should be removed from the excavation prior to placement of granular backfill in dry. In general, where the excavation base is within 0.5 m of the prevailing groundwater level at the time of construction, it is anticipated that control of seepage can be accomplished by using properly filtered sumps, and/or filtered drains placed along the base the excavation. However, given the conditions at the site, it is expected that positive dewatering systems will be required to control the groundwater seepage.

Dewatering shall be carried out in accordance with OPSS.PROV 517, SP 517F01 and SP FOUN0003. It is responsibility of the Contractor to propose a suitable dewatering system based on the time of construction, water levels and flow conditions for prior approval of the MTO. As noted in the SP FOUN0003 working drawings, discharge of water, monitoring and removal of the dewatering system should be according to OPSS 517. The method used should not undermine the adjacent existing footings and utilities. Alternatively, and in accordance with SP 5017F01, the dewatering systems may be completed by a design Engineer and design-checking Engineer with a minimum of 5 year experience.

All excavations should be carried out in accordance with the latest version of the Occupational Health and Safety Act. For the act, the existing materials are considered as Type 3 soils above the groundwater table and Type 4 soils below the groundwater table. Temporary excavations (i.e. those that are open only for a short period) above the groundwater table may be made with side slopes not steeper than about 1H:1V, while the temporary slopes below the groundwater table must be formed at 3H:1V unless a suitable dewatering system is installed to lower the water level below the base of the excavation.

Qualified geotechnical personnel should be on-site during the foundation installation and for fill material placement, to verify the design assumptions, and to verify the design recommendations.

2.9 Corrosion Protection

As stated above, one soil sample was selected for analyses of pH, water soluble sulphate, chloride concentrations, resistivity, conductivity and oxidation-reduction potential. The testing was completed to determine the potential for degradation of the concrete in the presence of soluble sulphate and the potential for corrosion of exposed steel used in foundations and buried infrastructure. The analysis

results are summarized in summarized in Section 1.6 of this report and detailed results are included in Appendix D.

The chemical data presented in Section 1.6 indicates resistivity of the tested soil of 2,720 ohm-cm, which suggests a moderate potential for corrosion of buried metallic elements (MTO Gravity Pipe Design Guidelines, Page 25). The maximum chloride content reported is 160 ppm ($\mu\text{g/g}$) which also indicates some potential for additional corrosion. The soil pH was about 6.26 which is within what is considered the normal range for soil pH of 5.0 to 9.0. The test results in Table 1.10 may be used to aid in the selection of coatings and corrosion protection systems for buried steel objects.

The maximum water-soluble sulphate content of the soils tested is 15 ppm ($\mu\text{g/g}$), i.e. 0.0015% which is less than 0.10%. It indicates low potential to corrode normal Portland cement concrete. Therefore, no particular precautions are required to provide protection against sulphate attack such as special cements or mixtures.

2.10 Environmental Consideration

One (1) sample of sand soil from BH 19-PS-1 (SS2) was analyzed for metals and general inorganics parameters and for BTEX/ Petroleum Hydrocarbons (PHCs) – (F1-F4) in accordance with land use criteria listed in the Ministry of the Environment standards (Ontario Regulation 153). The results were compared with soil criteria in Table 2 (Potable Groundwater Condition) and Table 3 (Non-Potable Groundwater Condition). The analytical results (Certificate of Analysis) are compiled in Appendix D and summarized below.

The soil sample meets all property use standards in Table 2 and Table 3 of Ontario Regulation 153.

July 26, 2019

3 CLOSURE

The recommendations made in this report are in accordance with our present understanding of the project and are provided solely for the team responsible for the design of the works described herein.

We recommend that we be retained to review our recommendations as the design nears completion to ensure that the final design is in agreement with the assumptions on which our recommendations are based and that our recommendations have been interpreted as intended. If not accorded this review, EXP will assume no responsibility for the interpretation and use of the recommendations in this report.

A subsurface investigation is a limited sampling of a site; the subsurface conditions have been established only at the test hole locations. Should conditions at the site be encountered which differ from those reported at the test locations, we require that we be notified immediately in order to assess this additional information and our recommendations, as appropriate. It may then be necessary to perform additional investigation and analysis.

Contractors bidding on or undertaking any proposed work at this site should, relative to the subsurface conditions, decide on their own investigations, if deemed necessary, as well as their own interpretations of the factual results provided herein, so they may draw their own conclusions as to how the subsurface conditions may affect them.

This Foundation Investigation and Design Report has been prepared by Sugitha Anandakumar, M.Eng., EIT and Silvana Micic, Ph.D., P.Eng., and reviewed by TaeChul Kim, M.E.Sc., P.Eng. and Stan E. Gonsalves, M.Eng., P.Eng., MTO Designated Foundation Contact. The field investigation was conducted by Phillips Laframboise.

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Encl.

4 LIMITATIONS AND USE OF REPORT

BASIS OF REPORT

This report ("Report") is based on site conditions known or inferred by the geotechnical investigation undertaken as of the date of the Report. Should changes occur which potentially impact the geotechnical condition of the site, or if construction is implemented more than one year following the date of the Report, the recommendations of EXP may require re-evaluation.

The Report is provided solely for the guidance of design engineers and on the assumption that the design will be in accordance with applicable codes and standards. Any changes in the design features which potentially impact the geotechnical analyses or issues concerning the geotechnical aspects of applicable codes and standards will necessitate a review of the design by EXP. Additional field work and reporting may also be required.

Where applicable, recommended field services are the minimum necessary to ascertain that construction is being carried out in general conformity with building code guidelines, generally accepted practices and EXP's recommendations. Any reduction in the level of services recommended will result in EXP providing qualified opinions regarding the adequacy of the work. EXP can assist design professionals or contractors retained by the Client to review applicable plans, drawings, and specifications as they relate to the Report or to conduct field reviews during construction.

Contractors contemplating work on the site are responsible for conducting an independent investigation and interpretation of the borehole results contained in the Report. The number of boreholes necessary to determine the localized underground conditions as they impact construction costs, techniques, sequencing, equipment and scheduling may be greater than those carried out for the purpose of the Report.

Classification and identification of soils, rocks, geological units, contaminant materials, building envelopment assessments, and engineering estimates are based on investigations performed in accordance with the standard of care set out below and require the exercise of judgment. As a result, even comprehensive sampling and testing programs implemented with the appropriate equipment by EXPerienced personnel may fail to locate some conditions. All investigations or building envelope descriptions involve an inherent risk that some conditions will not be detected. All documents or records summarizing investigations are based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated. Some conditions are subject to change over time. The Report presents the conditions at the sampled points at the time of sampling. Where special concerns exist, or the Client has special considerations or requirements, these should be disclosed to EXP to allow for additional or special investigations to be undertaken not otherwise within the scope of investigation conducted for the purpose of the Report.

RELIANCE ON INFORMATION PROVIDED

The evaluation and conclusions contained in the Report are based on conditions in evidence at the time of site inspections and information provided to EXP by the Client and others. The Report has been prepared for the specific site, development, building, design or building assessment objectives and purpose as communicated by the Client. EXP has relied in good faith upon such representations,

information and instructions and accepts no responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of any misstatements, omissions, misrepresentation or fraudulent acts of persons providing information. Unless specifically stated otherwise, the applicability and reliability of the findings, recommendations, suggestions or opinions EXPressed in the Report are only valid to the extent that there has been no material alteration to or variation from any of the information provided to EXP.

STANDARD OF CARE

The Report has been prepared in a manner consistent with the degree of care and skill exercised by engineering consultants currently practicing under similar circumstances and locale. No other warranty, EXPressed or implied, is made. Unless specifically stated otherwise, the Report does not contain environmental consulting advice.

COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment form part of the Report. This material includes, but is not limited to, the terms of reference given to EXP by its client ("Client"), communications between EXP and the Client, other reports, proposals or documents prepared by EXP for the Client in connection with the site described in the Report. In order to properly understand the suggestions, recommendations and opinions EXPressed in the Report, reference must be made to the Report in its entirety. EXP is not responsible for use by any party of portions of the Report.

USE OF REPORT

The information and opinions EXPressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. No other party may use or rely upon the Report in whole or in part without the written consent of EXP. Any use of the Report, or any portion of the Report, by a third party are the sole responsibility of such third party. EXP is not responsible for damages suffered by any third party resulting from unauthorised use of the Report.

REPORT FORMAT

Where EXP has submitted both electronic file and a hard copy of the Report, or any document forming part of the Report, only the signed and sealed hard copy shall be the original documents for record and working purposes. In the event of a dispute or discrepancy, the hard copy shall govern. Electronic files transmitted by EXP have utilize specific software and hardware systems. EXP makes no representation about the compatibility of these files with the Client's current or future software and hardware systems. Regardless of format, the documents described herein are EXP's instruments of professional service and shall not be altered without the written consent of EXP.

Appendix A – Photographs



Photo 1. Parry Sound Patrol Yard - Drilling borehole BH19-PS-2, facing northeast



Photo 2. Parry Sound Patrol Yard - Entrance from Quebec Dr., facing north

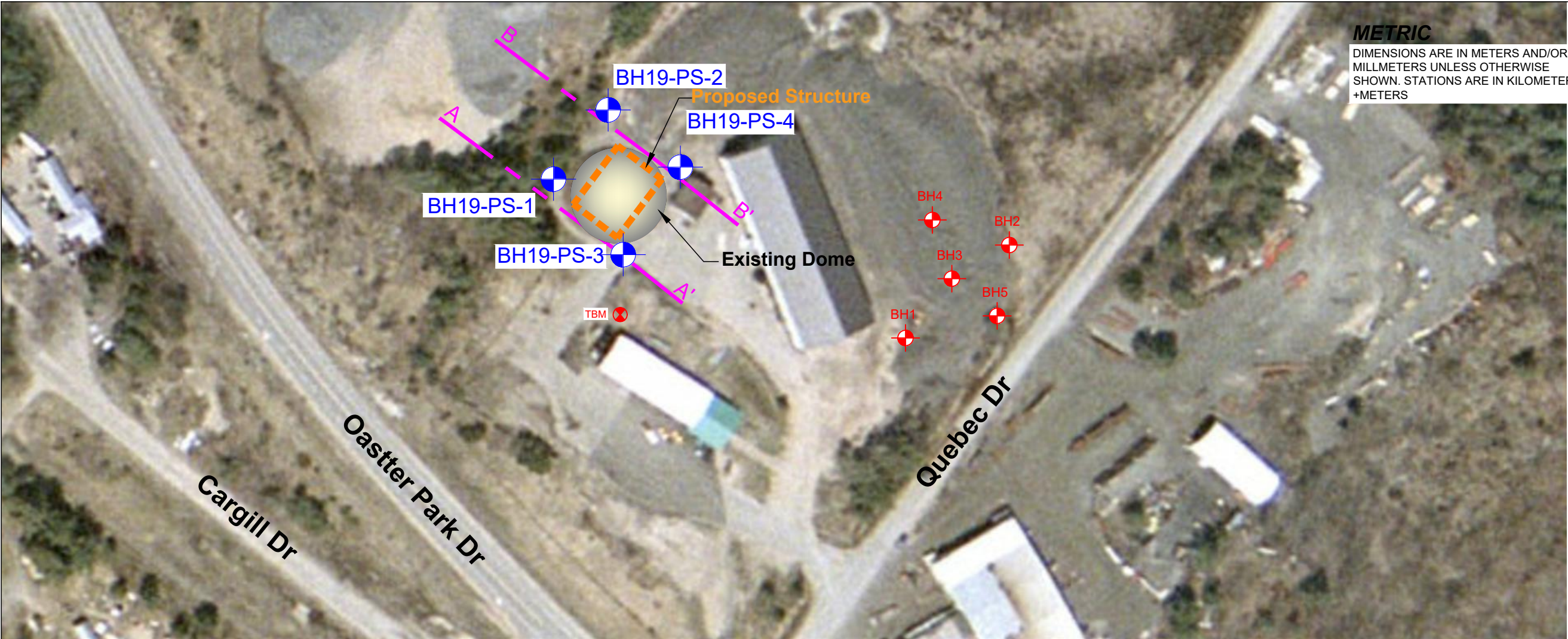


Photo 3. Parry Sound Patrol Yard - Existing garages/office, facing southeast




Photo 4. Parry Sound Patrol Yard - Existing sand dome, facing east

Appendix B – Drawings



CONT. No. 5015-E-0007
GWP No. -
Assignment No. 10


SHEET
1






Various Patrol Yards, Sudbury and North Bay Areas
PATROL YARD AT PARRY SOUND
ON QUEBEC DR
BOREHOLE LOCATION PLAN AND SOIL STRATA

exp Services Inc.







KEY PLAN



LEGEND

-  Borehole Location
-  Existing Borehole Location
-  N
-  Groundwater level measured in open hole
-  Temporary Bench Mark (Elev. 210.4 m)

SOIL STRATA SYMBOLS

 PAVEMENT STRUCTURE	 FILL
 SAND AND GRAVEL	 SAND
 BEDROCK	 SILTY CLAY

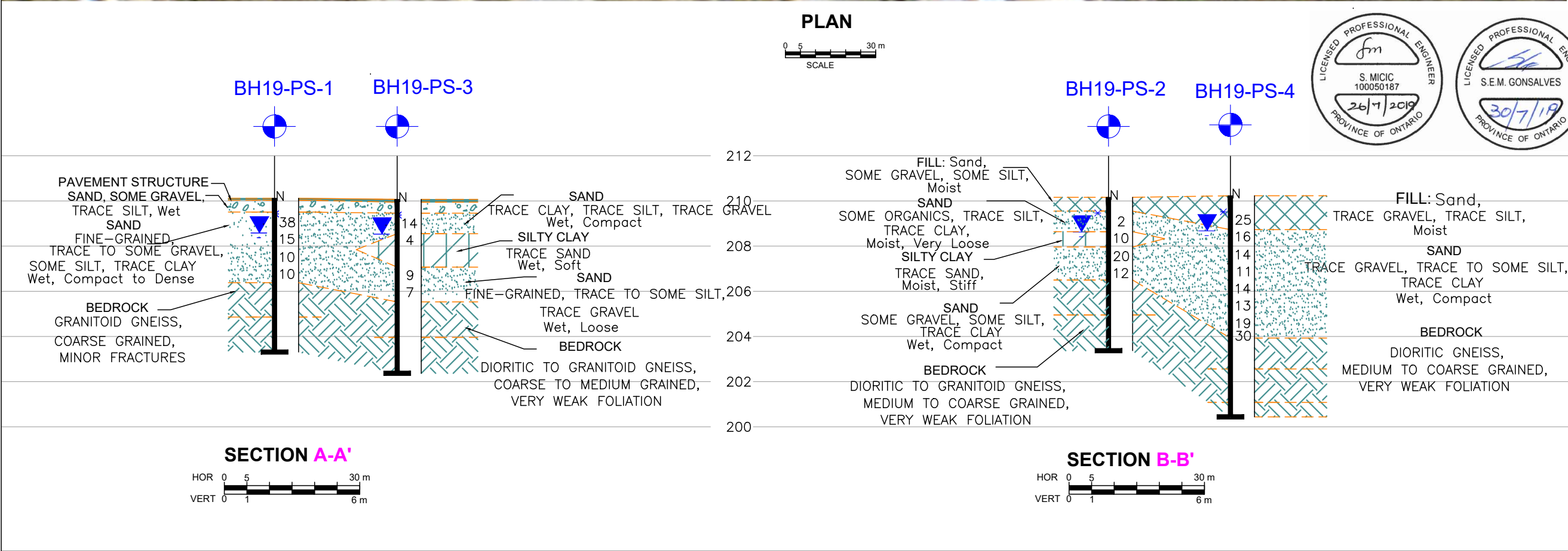
BH No.	ELEV.	MTM CO-ORDINATES (ZONE ON-10)	
		NORTHING	EASTING
BH19-PS-1	210.1	5019448.0	267165.3
BH19-PS-2	210.2	5019472.7	267183.7
BH19-PS-3	210.1	5019428.7	267182.9
BH19-PS-4	210.2	5019458.0	267206.4

NOTES

This drawing is for subsurface information only. The proposed structure details/ works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents

The complete foundation investigation and design report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in the report and related documents are specifically excluded in accordance with the conditions of Section GC 2.01 of OPS Gen. Cond.

	SM	SUBMISSION FOR MTO REVIEW	
DATE	BY	DESCRIPTION	
		GEOCRES NO. 31E-405	
		PROJECT NO. ADM-00233185-K0	
SUBM'D SH	CHECKED SM	DATE	Jul. 26, 19
DRAWN SH	CHECKED SM	APPROVED SG	DWG. 1



Appendix C – Borehole Logs

Explanation of Terms Used on Borehole Records

SOIL DESCRIPTION

Terminology describing common soil genesis:

Topsoil: mixture of soil and humus capable of supporting good vegetative growth.

Peat: fibrous fragments of visible and invisible decayed organic matter.

Fill: where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc.; none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.

Till: the term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

Terminology describing soil structure:

Desiccated: having visible signs of weathering by oxidization of clay minerals, shrinkage cracks, etc.

Stratified: alternating layers of varying material or color with the layers greater than 6 mm thick.

Laminated: alternating layers of varying material or color with the layers less than 6 mm thick.

Fissured: material breaks along plane of fracture.

Varved: composed of regular alternating layers of silt and clay.

Slickensided: fracture planes appear polished or glossy, sometimes striated.

Blocky: cohesive soil that can be broken down into small angular lumps which resist further breakdown.

Lensed: inclusion of small pockets of different soil, such as small lenses of sand scattered through a mass of clay; not thickness.

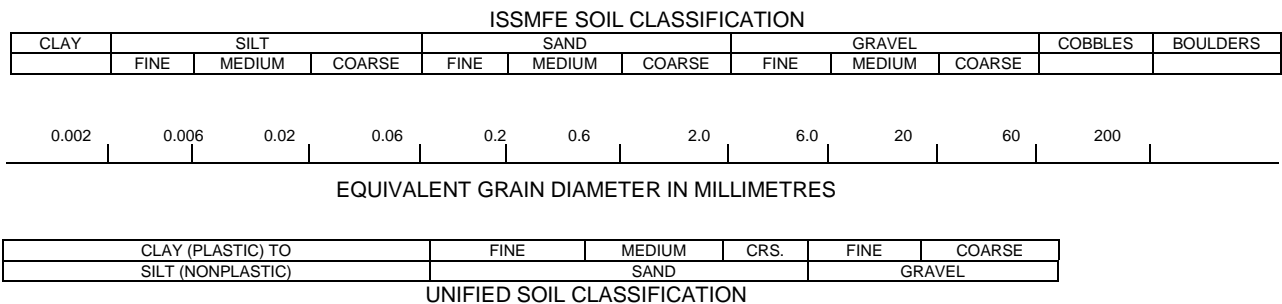
Seam: a thin, confined layer of soil having different particle size, texture, or color from materials above and below.

Homogeneous: same color and appearance throughout.

Well Graded: having wide range in grain sized and substantial amounts of all predominantly on grain size.

Uniformly Graded: predominantly on grain size.

All soil sample descriptions included in this report follow generally the ASTM D2487-11 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) with some modification to reflect current MTO practices. The system divides soils into three major categories: (1) coarse grained, (2) fine-grained, and (3) highly organic. The soil is then subdivided based on either gradation or plasticity characteristics. The system provides a group symbol (e.g. SM) and group name (e.g. silty sand) for identification. The classification excludes particles larger than 76 mm. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually in accordance with ASTM D2488-09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems. Others may use different classification systems; one such system is the ISSMFE Soil Classification.



Terminology describing materials outside the USCS, (e.g. particles larger than 76 mm, visible organic matter, construction debris) is based upon the proportion of these materials present and as described below in accordance with Canadian Foundation Engineering Manual (CFEM):

Table a: Percent or Proportion of Soil

	Criteria
Trace	1% - 10%
Some	10% - 20%
Little	20% - 35%
Some	>35% and main fraction

The standard terminology to describe cohesionless soils includes the compactness as determined by the Standard Penetration Test 'N' value:

Table b: Apparent Density of Cohesionless Soil

	'N' Value (blows/0.3 m)
Very Loose	N<5
Loose	5≤N<10
Compact	10≤N<30
Dense	30≤N<50
Very Dense	50≤N

The standard terminology to describe cohesive soils includes consistency, which is based on undrained shear strength as measured by insitu vane tests, penetrometer tests, unconfined compression tests or similar field and laboratory analysis, Standard Penetration Test 'N' values can also be used to provide an approximate indication of the consistency and shear strength of fine grained, cohesive soils:

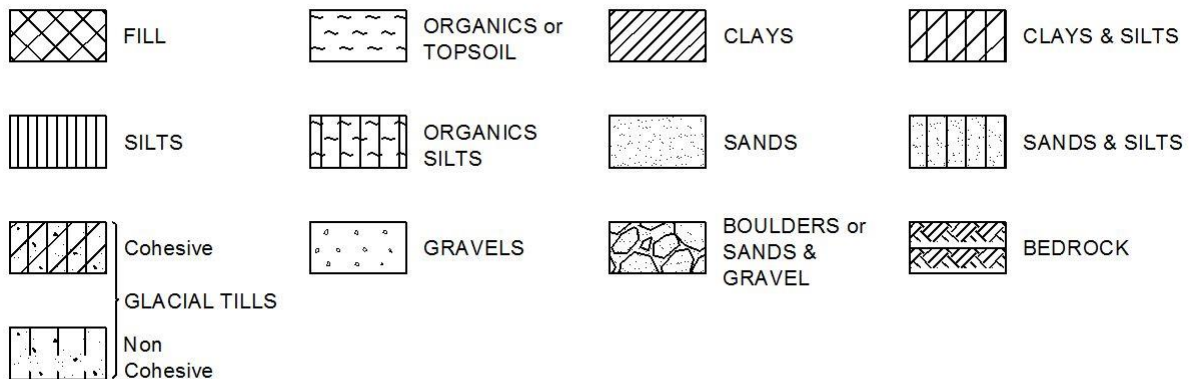
Table c: Consistency of Cohesive Soil

Consistency	Vane Shear Measurement (kPa)	'N' Value
Very Soft	<12.5	<2
Soft	12.5-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

Note: 'N' Value - The Standard Penetration Test records the number of blows of a 140 pound (64kg) hammer falling 30 inches (760mm), required to drive a 2 inch (50.8mm) O.D. split spoon sampler 1 foot (305mm). For split spoon samples where full penetration is not achieved, the number of blows is reported over the sampler penetration in meters (e.g. 50/0.15).

STRATA PLOT

Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols:



WATER LEVEL MEASUREMENT



Open Borehole or Test Pit



Monitoring Well, Piezometer or Standpipe

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

SS	Split spoon sample (obtained from the Standard Penetration Test)
WS	Wash sample
BS	Bulk sample
TW	Thin wall sample or Shelby tube
PS	Piston sample
AS	Auger sample
VT	Vane test
GS	Grab sample
HQ, NQ, etc.	Rock core samples obtained with the use of standard size diamond drilling bits

STRESS AND STRAIN

u_w	kPa	Pore water pressure
r_u	1	Pore pressure ratio
σ	kPa	Total normal stress
σ'	kPa	Effective normal stress
τ	kPa	Shear stress
$\sigma_1, \sigma_2, \sigma_3$	kPa	Principal stresses
ε	%	Linear strain
$\varepsilon_1, \varepsilon_2, \varepsilon_3$	%	Principal strains
E	kPa	Modulus of linear deformation
G	kPa	Modulus of shear deformation
μ	1	Coefficient of friction

MECHANICAL PROPERTIES OF SOIL

m_v	kPa ⁻¹	Coefficient of volume change
c_c	1	Compression index
c_s	1	Swelling index
c_r	1	Recompression index
c_v	m ² /s	Coefficient of consolidation
H	m	Drainage path
T_v	1	Time factor
U	%	Degree of consolidation
σ'_{v0}	kPa	Effective overburden pressure
σ'_p	kPa	Preconsolidation pressure
τ_f	kPa	Shear strength
c'	kPa	Effective cohesion intercept
ϕ'	—°	Effective angle of internal friction
c_u	kPa	Apparent cohesion intercept
ϕ_u	—°	Apparent angle of internal friction
τ_R	kPa	Residual shear strength
τ_r	kPa	Remoulded shear strength
S_t	1	Sensitivity = c_u/τ_r

PHYSICAL PROPERTIES OF SOIL

P_s	kg/m ³	Density of solid particles
γ_s	kN/m ³	Unit weight of solid particles
ρ_w	kg/m ³	Density of water
γ_w	kN/m ³	Unit weight of water
ρ	kg/m ³	Density of soil
γ	kN/m ³	Unit weight of soil
ρ_d	kg/m ³	Density of dry soil
γ_d	kN/m ³	Unit weight of dry soil
ρ_{sat}	kg/m ³	Density of saturated soil
γ_{sat}	kN/m ³	Unit weight of saturated soil
ρ'	kg/m ³	Density of submerged soil
γ'	kN/m ³	Unit weight of submerged soil
e	1, %	Void ratio
n	1, %	Porosity
w	1, %	Water content
S_r	%	Degree of saturation
W_L	%	Liquid limit
W_P	%	Plastic limit
W_s	%	Shrinkage limit
I_p	%	Plasticity index = $(W_L - W_P)$
I_L	%	Liquidity index = $(W - W_P)/I_p$
I_C	%	Consistency index = $(W_L - W)/I_p$
e_{max}	1, %	Void ratio in loosest state
e_{min}	1, %	Void ratio in densest state
I_D	1	Density index = $(e_{max} - e)/(e_{max} - e_{min})$
D	mm	Grain diameter
D_n	mm	N percent - diameter
C_u	1	Uniformity coefficient
h	m	Hydraulic head or potential
q	m ³ /s	Rate of discharge
v	m/s	Discharge velocity
i	1	Hydraulic gradient
k	m/s	Hydraulic conductivity
j	kN/m ³	Seepage force

Brampton, Ontario

RECORD OF BOREHOLE No 19-PS-1

1 OF 1

METRIC

W.P. _____ LOCATION Parry Sound Patrol Yard, Highway 11, Parry Sound ON, MTM ON10 ORIGINATED BY PL
 DIST Parry Sound HWY Quebec Dr BOREHOLE TYPE CME 55, Hollow stem auger drill, NW Coring COMPILED BY LC/SA
 DATUM Geodetic DATE 2019.05.01 - 2019.05.01 LATITUDE 45.313974 LONGITUDE 79.97999 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X P. PENETROMETER												
210.1	Ground Surface					▽														
210.0	PAVEMENT STRUCTURE 100 mm asphaltic concrete		1	AS																
209.5	- over 530 mm sand, some gravel, trace silt, brown, wet																			
209.0	SAND fine-grained, trace to some gravel, some silt, trace clay, orange mottling, brown, wet, compact to dense		2	SS	38															
			3	SS	15													20 57 22 1		
			4	SS	10															
			5	SS	10															
206.4	BEDROCK: granitoid gneiss, grey to pinkish grey, coarse grained, minor fractures NQ Coring Run 1 Length 1.52 m Recovery = 98% RQD = 95% Run 2 Length 1.55 m Recovery = 100% RQD = 95%		6	NQ																
				7	NQ															
203.3	End of borehole at 6.81 m depth.																			
6.8	Notes: 1. Groundwater level measured at 1.52 m below ground surface.																			

ONTARIO MTO, PARRY SOUND BH LOGS V2.GPJ, ONTARIO MTO, GDT 7/23/19

+ 3, X 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

Brampton, Ontario

RECORD OF BOREHOLE No 19-PS-2

1 OF 1

METRIC

W.P. _____ LOCATION Parry Sound Patrol Yard, Highway 11, Parry Sound ON, MTM ON10 ORIGINATED BY PL
 DIST Parry Sound HWY Quebec Dr BOREHOLE TYPE CME 55, Hollow stem auger drill, NW Coring COMPILED BY LC/SA
 DATUM Geodetic DATE 2019.04.30 - 2019.04.30 LATITUDE 45.314197 LONGITUDE 79.979757 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X P. PENETROMETER										
210.2	Ground Surface							20 40 60 80 100		20 40 60								
0.0	FILL sand, some gravel, some silt, brown, moist		1	AS		▽	210					○			17 62 19 2			
209.6												○						
0.6	SAND some organics, trace silt, trace clay, brown/black, moist, very loose		2	SS	2		209						○					
208.6													○					
1.5	SILT CLAY trace sand, brown/grey, moist, stiff		3	SS	10		208							○				
208.0														○				
2.2	SAND some gravel, some silt, trace clay, brown/grey, wet, compact		4	SS	20		207							○				
			5	SS	12								○					
206.5															- Coring commenced upon refusal to auger			
3.7	BEDROCK: dioritic gneiss, medium to dark grey, medium to coarse grained, very weak foliation NQ Coring Run 1 Length 1.55 m Recovery = 100% RQD = 100% Run 2 Length 1.58 m Recovery = 100% RQD = 95%		6	NQ		206												
			7	NQ		205												
203.4							204											
6.8	End of borehole at 6.79 m depth. Notes: 1. Groundwater level measured at 1.52 m below ground surface.																	

ONTARIO MTO, PARRY SOUND BH LOGS V2.GPJ, ONTARIO MTO, GDT 7/23/19

+ 3, X 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

Brampton, Ontario

RECORD OF BOREHOLE No 19-PS-3

1 OF 1

METRIC

W.P. _____ LOCATION Parry Sound Patrol Yard, Highway 11, Parry Sound ON, MTM ON10 ORIGINATED BY PL
 DIST Parry Sound HWY Quebec Dr BOREHOLE TYPE CME 55, Hollow stem auger drill, NW Coring COMPILED BY LC/SA
 DATUM Geodetic DATE 2019.05.01 - 2019.05.01 LATITUDE 45.313801 LONGITUDE 79.979764 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIALX P. PENETROMETER		W _P W W _L WATER CONTENT (%)					
210.1	Ground Surface						20	40	60	80	100	20	40	60	GR SA SI CL
209.9	PAVEMENT STRUCTURE 125 mm asphaltic concrete		1	AS											
0.1	- over 485 mm sand, some gravel, trace silt, brown, moist														
209.5	SAND trace clay, trace silt, trace gravel, brown/grey, wet, compact		2	SS	14										
0.6															
208.6	SILTY CLAY trace sand, brown/grey, wet, soft		3	SS	4										
1.5															
207.1															
3.0	SAND fine-grained, trace gravel, trace to some silt, brown to brown/grey, wet, loose		4	SS	9										
			5	SS	7										
205.5															
4.5	BEDROCK: dioritic to granitoid gneiss, grey with pinkish sections, coarse to medium grained, very weak foliation NQ Coring Run 1 Length 1.57 m Recovery = 100% RQD = 55% Run 2 Length 1.59 m Recovery = 98% RQD = 48%		6	NQ											
			7	NQ											
202.4															
7.7	End of borehole at 7.7 m depth. Notes: 1. Groundwater level measured at 1.52 m below ground surface.														

ONTARIO MTO, PARRY SOUND BH LOGS V2.GPJ, ONTARIO MTO, GDT, 7/23/19

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

Brampton, Ontario

RECORD OF BOREHOLE No 19-PS-4

1 OF 1

METRIC

W.P. _____ LOCATION Parry Sound Patrol Yard, Highway 11, Parry Sound ON, MTM ON10 ORIGINATED BY PL
 DIST Parry Sound HWY Quebec Dr BOREHOLE TYPE CME 55, Hollow stem auger drill, NW Coring COMPILED BY LC/SA
 DATUM Geodetic DATE 2019.04.30 - 2019.04.30 LATITUDE 45.314066 LONGITUDE 79.979467 CHECKED BY SM

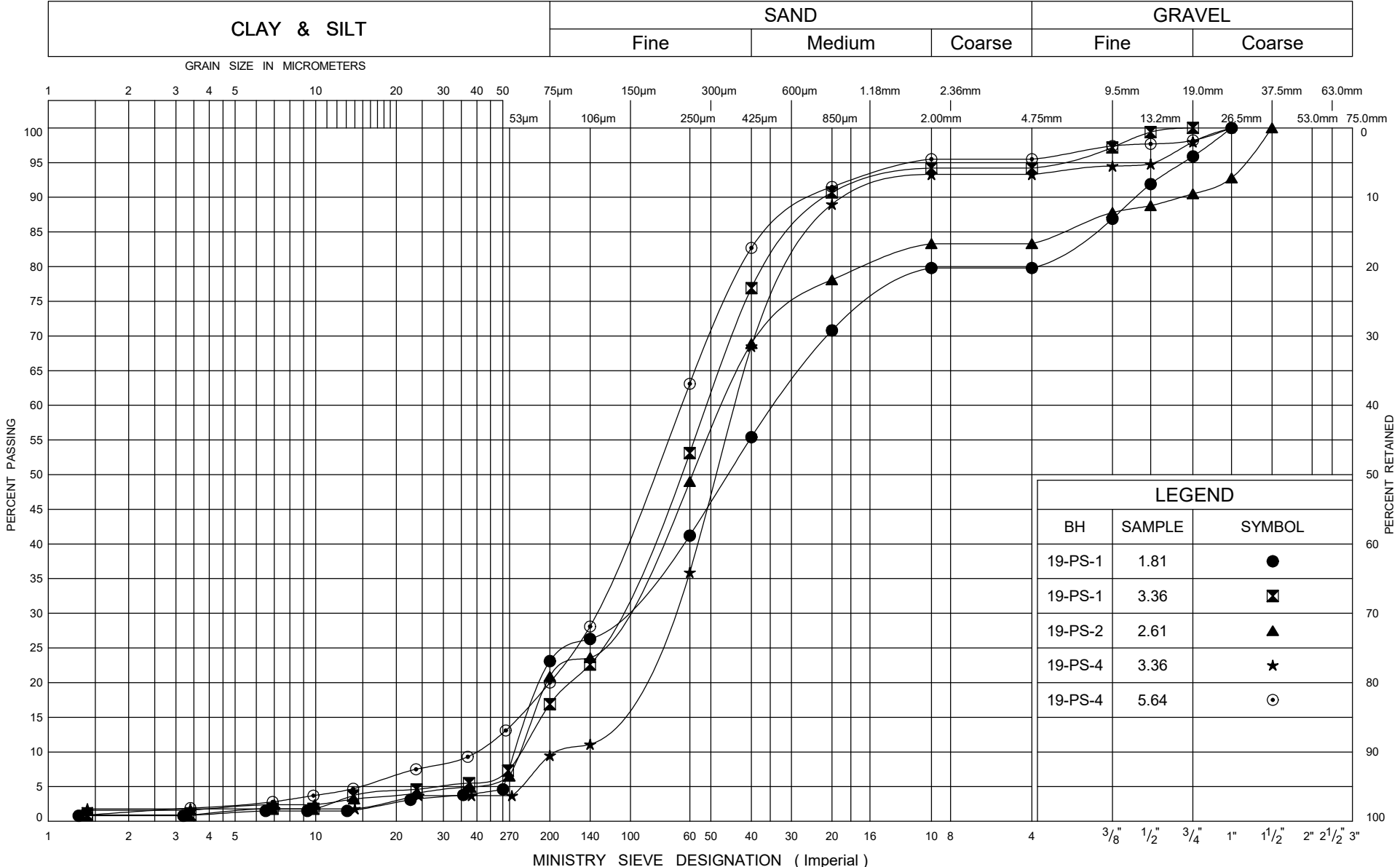
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								20 40 60 80 100								20 40 60		
210.2	Ground Surface																	
0.0	FILL sand, trace gravel, trace silt, brown, moist		1	AS		▽	210											
			2	SS	25		209											
208.7	SAND trace gravel, trace to some silt, trace clay, orange mottling, brown to brown/grey, wet, compact		3	SS	16		208											
1.5			4	SS	14		207											
			5	SS	11		206											
			6	SS	14		205											
			7	SS	13		204											
			8	SS	19													
			9	SS	30													
203.9		BEDROCK: dioritic gneiss, medium to dark grey, medium to coarse grained, very weak foliation NQ Coring Run 1 Length 1.37 m Recovery = 100% RQD = 73% Run 2 Length 1.48 m Recovery = 97% RQD = 72% Run 3 Length 0.64 m Recovery = 100% RQD = 68%		10	NQ													
6.3			11	NQ														
			12	NQ														
200.4																		
9.8	End of borehole at 9.79 m depth. Notes: 1. Groundwater level measured at 1.52 m below ground surface.																	

ONTARIO MTO, PARRY SOUND BH LOGS V2.GPJ, ONTARIO MTO, GDT 7/23/19

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

Appendix D – Laboratory Data

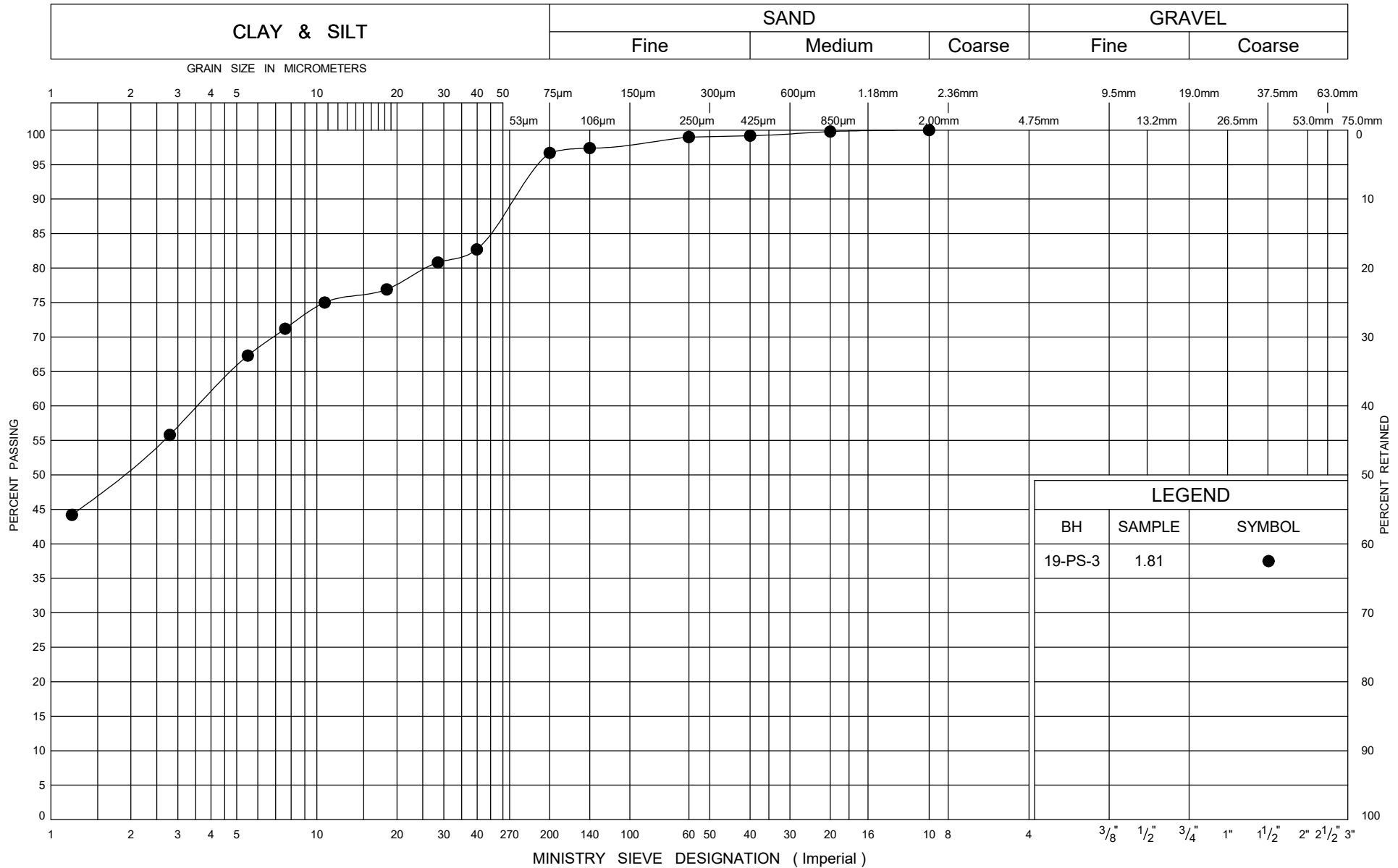
UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION

Sand

UNIFIED SOIL CLASSIFICATION SYSTEM

Ministry of
Transportation

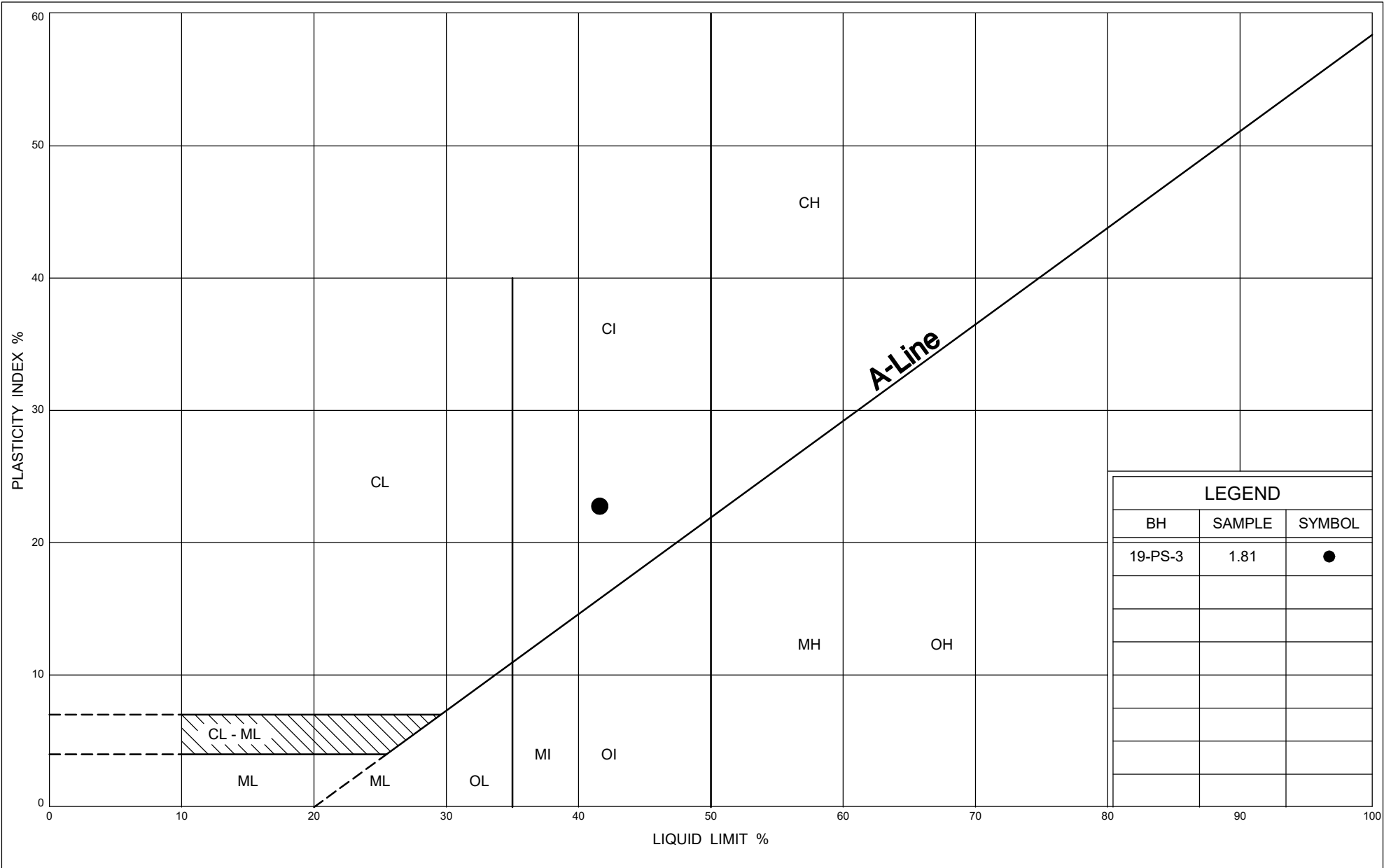
GRAIN SIZE DISTRIBUTION

Silty Clay

FIG No 2

W P

5015-E-0007, Assignment 10



CLIENT NAME: EXP. SERVICES INC.
885 REGENT ST
SUDBURY, ON P3E5M4
(705) 674-9681

ATTENTION TO: Ian MacMillan

PROJECT: ADM-00233185-K0

AGAT WORK ORDER: 19U464857

SOIL ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Supervisor

TRACE ORGANICS REVIEWED BY: Pinkal Patel, Report Reviewer

DATE REPORTED: May 15, 2019

PAGES (INCLUDING COVER): 10

VERSION*: 2

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

***NOTES**

VERSION 2: Partial report for sample "19-H-1-SS2" issued May 14, 2019.

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.



Certificate of Analysis

AGAT WORK ORDER: 19U464857

PROJECT: ADM-00233185-K0

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

CLIENT NAME: EXP. SERVICES INC.

SAMPLING SITE:

ATTENTION TO: Ian MacMillan

SAMPLED BY:

Corrosivity Package

DATE RECEIVED: 2019-05-08

DATE REPORTED: 2019-06-15

		SAMPLE DESCRIPTION:		19-D-2-SS4	19-PS-2-SS3	19-G-1-SS3	19-P-2-SS3	
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	
		DATE SAMPLED:		2019-05-08	2019-05-08	2019-05-08	2019-05-08	
Parameter	Unit	G / S	RDL	182124	182125	182126	RDL	182127
Sulfide (S2-)	%		0.05	<0.05	<0.05	<0.05	0.05	<0.05
Chloride (2:1)	µg/g		2	8	160	6	40	7470
Sulphate (2:1)	µg/g		2	26	15	14	40	157
pH (2:1)	pH Units		NA	6.04	6.26	6.83	NA	6.86
Electrical Conductivity (2:1)	mS/cm		0.005	0.040	0.368	0.053	0.005	13.4
Redox Potential 1	mV		5	204	142	233	5	255
Redox Potential 2	mV		5	228	179	245	5	247
Redox Potential 3	mV		5	214	181	249	5	259
Resistivity (2:1)	ohm.cm		1	25000	2720	18900	1	75

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

182124-182126 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.

*Sulphide analyzed at AGAT 5623 McAdam

PI note: Redox Potential is not an accredited 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.

182127 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.

*Sulphide analyzed at AGAT 5623 McAdam

PI note: Redox Potential is not an accredited parameter.

Elevated RDL indicates the degree of sample dilution prior to the analysis in order to keep analytes within the calibration range of the instrument and to reduce matrix interference.

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.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:

Anamjot Bhela




AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 19U464857

PROJECT: ADM-00233185-K0

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

CLIENT NAME: EXP. SERVICES INC.

ATTENTION TO: Ian MacMillan

SAMPLING SITE:

SAMPLED BY:

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2019-05-08

DATE REPORTED: 2019-05-13

		SAMPLE DESCRIPTION:		19-G-1-SS2	19-PS-1-SS2	19-P-1-SS2	19-D-2-SS2
		SAMPLE TYPE:		Soil	Soil	Soil	Soil
		DATE SAMPLED:		2019-05-08	2019-05-08	2019-05-08	2019-05-08
Parameter	Unit	G / S	RDL	182119	182121	182122	182123
Antimony	µg/g		0.8	<0.8	<0.8	<0.8	<0.8
Arsenic	µg/g		1	<1	1	<1	<1
Barium	µg/g		2	35	32	40	27
Beryllium	µg/g		0.5	<0.5	<0.5	<0.5	<0.5
Boron	µg/g		5	<5	<5	<5	<5
Boron (Hot Water Soluble)	µg/g		0.10	<0.10	<0.10	<0.10	<0.10
Cadmium	µg/g		0.5	<0.5	<0.5	<0.5	<0.5
Chromium	µg/g		2	8	14	8	9
Cobalt	µg/g		0.5	3.2	4.9	1.9	4.5
Copper	µg/g		1	12	28	4	10
Lead	µg/g		1	4	2	1	1
Molybdenum	µg/g		0.5	<0.5	<0.5	<0.5	<0.5
Nickel	µg/g		1	6	10	4	6
Selenium	µg/g		0.4	0.6	<0.4	0.7	<0.4
Silver	µg/g		0.2	<0.2	<0.2	<0.2	<0.2
Thallium	µg/g		0.4	<0.4	<0.4	<0.4	<0.4
Uranium	µg/g		0.5	<0.5	<0.5	0.6	<0.5
Vanadium	µg/g		1	19	36	10	26
Zinc	µg/g		5	22	21	11	16
Chromium VI	µg/g		0.2	<0.2	<0.2	<0.2	<0.2
Cyanide	µg/g		0.040	<0.040	<0.040	<0.040	<0.040
Mercury	µg/g		0.10	<0.10	<0.10	<0.10	<0.10
Electrical Conductivity	mS/cm		0.005	0.099	5.02	0.137	0.052
Sodium Adsorption Ratio	NA		NA	1.30	50.5	5.73	0.438
pH, 2:1 CaCl2 Extraction	pH Units		NA	5.59	5.81	7.18	5.12

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

182119-182123 EC was determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl2 extract prepared at 2:1 ratio. SAR is a calculated parameter.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:





Certificate of Analysis

AGAT WORK ORDER: 19U464857

PROJECT: ADM-00233185-K0

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
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<http://www.agatlabs.com>

CLIENT NAME: EXP. SERVICES INC.

ATTENTION TO: Ian MacMillan

SAMPLING SITE:

SAMPLED BY:

O. Reg. 153(511) - PHCs F1 - F4 (Soil)

DATE RECEIVED: 2019-05-08

DATE REPORTED: 2019-05-13

		SAMPLE DESCRIPTION:		19-G-1-SS2	19-H-1-SS2	19-PS-1-SS2	19-P-1-SS2	19-D-2-SS2
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		2019-05-08	2019-05-08	2019-05-08	2019-05-08	2019-05-08
Parameter	Unit	G / S	RDL	182119	182120	182121	182122	182123
Benzene	µg/g		0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Toluene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ethylbenzene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Xylene Mixture	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
F1 (C6 to C10)	µg/g		5	<5	<5	<5	<5	<5
F1 (C6 to C10) minus BTEX	µg/g		5	<5	<5	<5	<5	<5
F2 (C10 to C16)	µg/g		10	<10	<10	<10	<10	<10
F3 (C16 to C34)	µg/g		50	<50	<50	<50	<50	<50
F4 (C34 to C50)	µg/g		50	<50	<50	<50	<50	<50
Gravimetric Heavy Hydrocarbons	µg/g		50	NA	NA	NA	NA	NA
Moisture Content	%		0.1	12.7	25.6	12.2	11.7	12.8
Surrogate	Unit	Acceptable Limits						
Terphenyl	%		60-140	112	96	87	120	100

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

182119-182123

Results are based on sample dry weight.
The C6-C10 fraction is calculated using Toluene response factor.
Xylenes is a calculated parameter. The calculated value is the sum of m&p-Xylene and o-Xylene.
C6-C10 (F1 minus BTEX) is a calculated parameter. The calculated value is F1 minus BTEX.
The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons are not included in the Total C16-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
The chromatogram has returned to baseline by the retention time of nC50.
Total C6 - C50 results are corrected for BTEX contribution.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
Extraction and holding times were met for this sample.
Fractions 1-4 are quantified with the contribution of PAHs. Under Ontario Regulation 153, results are considered valid without determining the PAH contribution if not requested by the client.
Quality Control Data is available upon request.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:

Jinkal Patel

Quality Assurance

CLIENT NAME: EXP. SERVICES INC.

AGAT WORK ORDER: 19U464857

PROJECT: ADM-00233185-K0

ATTENTION TO: Ian MacMillan

SAMPLING SITE:

SAMPLED BY:

Soil Analysis															
RPT Date:			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

O. Reg. 153(511) - Metals & Inorganics (Soil)

Antimony	182264		<0.8	<0.8	NA	< 0.8	91%	70%	130%	95%	80%	120%	94%	70%	130%
Arsenic	182264		3	3	NA	< 1	101%	70%	130%	94%	80%	120%	98%	70%	130%
Barium	182264		109	110	0.9%	< 2	105%	70%	130%	100%	80%	120%	116%	70%	130%
Beryllium	182264		<0.5	<0.5	NA	< 0.5	99%	70%	130%	98%	80%	120%	76%	70%	130%
Boron	182264		7	7	NA	< 5	101%	70%	130%	104%	80%	120%	76%	70%	130%
Boron (Hot Water Soluble)	182264		0.31	0.33	NA	< 0.10	113%	60%	140%	100%	70%	130%	102%	60%	140%
Cadmium	182264		<0.5	<0.5	NA	< 0.5	99%	70%	130%	101%	80%	120%	99%	70%	130%
Chromium	182264		30	31	3.3%	< 2	103%	70%	130%	102%	80%	120%	112%	70%	130%
Cobalt	182264		10.0	10.3	3.0%	< 0.5	105%	70%	130%	105%	80%	120%	103%	70%	130%
Copper	182264		20	20	0.0%	< 1	95%	70%	130%	101%	80%	120%	97%	70%	130%
Lead	182264		9	9	0.0%	< 1	105%	70%	130%	104%	80%	120%	100%	70%	130%
Molybdenum	182264		<0.5	<0.5	NA	< 0.5	108%	70%	130%	100%	80%	120%	98%	70%	130%
Nickel	182264		25	25	0.0%	< 1	103%	70%	130%	108%	80%	120%	110%	70%	130%
Selenium	182264		0.5	0.5	NA	< 0.4	103%	70%	130%	92%	80%	120%	96%	70%	130%
Silver	182264		<0.2	<0.2	NA	< 0.2	99%	70%	130%	99%	80%	120%	95%	70%	130%
Thallium	182264		<0.4	<0.4	NA	< 0.4	101%	70%	130%	113%	80%	120%	107%	70%	130%
Uranium	182264		0.5	0.5	NA	< 0.5	112%	70%	130%	116%	80%	120%	121%	70%	130%
Vanadium	182264		41	43	4.8%	< 1	103%	70%	130%	112%	80%	120%	111%	70%	130%
Zinc	182264		52	52	0.0%	< 5	93%	70%	130%	102%	80%	120%	103%	70%	130%
Chromium VI	182119	182119	<0.2	<0.2	NA	< 0.2	108%	70%	130%	100%	80%	120%	102%	70%	130%
Cyanide	182122	182122	<0.040	<0.040	NA	< 0.040	98%	70%	130%	99%	80%	120%	104%	70%	130%
Mercury	182264		<0.10	<0.10	NA	< 0.10	127%	70%	130%	109%	80%	120%	110%	70%	130%
Electrical Conductivity	182119	182119	0.099	0.108	8.7%	< 0.005	109%	90%	110%	NA			NA		
Sodium Adsorption Ratio	182119	182119	1.30	1.38	6.0%	NA	NA			NA			NA		
pH, 2:1 CaCl2 Extraction	182119	182119	5.59	5.61	0.4%	NA	100%	80%	120%	NA			NA		

Comments: NA signifies Not Applicable.

Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL

pH duplicates QA acceptance criteria was met relative as stated in Table 5-15 of Analytical Protocol document.

Corrosivity Package

Sulfide (S2-)	182124	182124	< 0.05	< 0.05	NA	< 0.05	100%	80%	120%						
Chloride (2:1)	178497		10	9	NA	< 2	93%	80%	120%	89%	80%	120%	89%	70%	130%
Sulphate (2:1)	178497		10	9	NA	< 2	92%	80%	120%	93%	80%	120%	97%	70%	130%
pH (2:1)	182124	182124	6.04	6.01	0.5%	NA	99%	90%	110%	NA			NA		
Electrical Conductivity (2:1)	182119	182119	0.099	0.108	8.7%	< 0.005	109%	90%	110%	NA			NA		
Redox Potential 1		1				< 5	100%	70%	130%		70%	130%		70%	130%

Quality Assurance

CLIENT NAME: EXP. SERVICES INC.

PROJECT: ADM-00233185-K0

SAMPLING SITE:

AGAT WORK ORDER: 19U464857

ATTENTION TO: Ian MacMillan

SAMPLED BY:

Soil Analysis (Continued)

RPT Date:			DUPLICATE			Method Blank	REFERENCE MATERIAL		METHOD BLANK SPIKE			MATRIX SPIKE			
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

Comments: NA signifies Not Applicable.

Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL

Certified By:






Quality Assurance

CLIENT NAME: EXP. SERVICES INC.

AGAT WORK ORDER: 19U464857

PROJECT: ADM-00233185-K0

ATTENTION TO: Ian MacMillan

SAMPLING SITE:

SAMPLED BY:

Trace Organics Analysis

RPT Date:			DUPLICATE			Method Blank	REFERENCE MATERIAL		METHOD BLANK SPIKE		MATRIX SPIKE	
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper

O. Reg. 153(511) - PHCs F1 - F4 (Soil)

Benzene	174969		< 0.02	< 0.02	NA	< 0.02	90%	60%	130%	85%	60%	130%	89%	60%	130%
Toluene	174969		< 0.05	< 0.05	NA	< 0.05	88%	60%	130%	89%	60%	130%	86%	60%	130%
Ethylbenzene	174969		< 0.05	< 0.05	NA	< 0.05	101%	60%	130%	87%	60%	130%	79%	60%	130%
Xylene Mixture	174969		< 0.05	< 0.05	NA	< 0.05	97%	60%	130%	81%	60%	130%	82%	60%	130%
F1 (C6 to C10)	174969		< 5	< 5	NA	< 5	96%	60%	130%	86%	85%	115%	80%	70%	130%
F2 (C10 to C16)	173534		< 10	< 10	NA	< 10	100%	60%	130%	95%	80%	120%	70%	70%	130%
F3 (C16 to C34)	173534		< 50	< 50	NA	< 50	104%	60%	130%	98%	80%	120%	76%	70%	130%
F4 (C34 to C50)	173534		< 50	< 50	NA	< 50	95%	60%	130%	87%	80%	120%	116%	70%	130%

Comments: When the average of the sample and duplicate results is less than 5x the RDL, the Relative Percent Difference (RPD) will be indicated as Not Applicable (NA).

Certified By:

Jinkal Patel



Method Summary

CLIENT NAME: EXP. SERVICES INC.

PROJECT: ADM-00233185-K0

SAMPLING SITE:

AGAT WORK ORDER: 19U464857

ATTENTION TO: Ian MacMillan

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Sulfide (S2-)	MIN-200-12025	ASTM E1915-09	GRAVIMETRIC
Chloride (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	McKeague 4.12 & 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	McKeague 4.12, SM 2510 B	EC METER
Redox Potential 1	INOR-93-6066	G200-09, SM 2580 B	REDOX POTENTIAL ELECTRODE
Redox Potential 2	INOR-93-6066	G200-09, SM 2580 B	REDOX POTENTIAL ELECTRODE
Redox Potential 3	INOR-93-6066	G200-09, SM 2580 B	REDOX POTENTIAL ELECTRODE
Resistivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B,SSA #5 Part 3	CALCULATION
Antimony	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Arsenic	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Barium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Beryllium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Boron	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Boron (Hot Water Soluble)	MET-93-6104	EPA SW 846 6010C; MSA, Part 3, Ch.21	ICP/OES
Cadmium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Chromium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Cobalt	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Copper	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Lead	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Molybdenum	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Nickel	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Selenium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Silver	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Thallium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Uranium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Vanadium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Zinc	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Chromium VI	INOR-93-6029	SM 3500 B; MSA Part 3, Ch. 25	SPECTROPHOTOMETER
Cyanide	INOR-93-6052	MOE CN-3015 & E 3009 A;SM 4500 CN	TECHNICON AUTO ANALYZER
Mercury	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Electrical Conductivity	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Sodium Adsorption Ratio	INOR-93-6007	McKeague 4.12 & 3.26 & EPA SW-846 6010C	ICP/OES
pH, 2:1 CaCl2 Extraction	INOR-93-6031	MSA part 3 & SM 4500-H+ B	PH METER

Method Summary

CLIENT NAME: EXP. SERVICES INC.

AGAT WORK ORDER: 19U464857

PROJECT: ADM-00233185-K0

ATTENTION TO: Ian MacMillan

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Benzene	VOL-91-5009	EPA SW-846 5035 & 8260D	P&T GC/MS
Toluene	VOL-91-5009	EPA SW-846 5035 & 8260D	P&T GC/MS
Ethylbenzene	VOL-91-5009	EPA SW-846 5035 & 8260D	P&T GC/MS
Xylene Mixture	VOL-91-5009	EPA SW-846 5035 & 8260D	P&T GC/MS
F1 (C6 to C10)	VOL-91-5009	CCME Tier 1 Method	P&T GC/FID
F1 (C6 to C10) minus BTEX	VOL-91-5009	CCME Tier 1 Method	P&T GC/FID
F2 (C10 to C16)	VOL-91-5009	CCME Tier 1 Method	GC/FID
F3 (C16 to C34)	VOL-91-5009	CCME Tier 1 Method	GC/FID
F4 (C34 to C50)	VOL-91-5009	CCME Tier 1 Method	GC/FID
Gravimetric Heavy Hydrocarbons	VOL-91-5009	CCME Tier 1 Method	BALANCE
Moisture Content	VOL-91-5009	CCME Tier 1 Method	BALANCE
Terphenyl	VOL-91-5009		GC/FID



AGAT Laboratories

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Chain of Custody Record

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

Report Information:

Company: exp
Contact: Ian Macmillan @ exp.com
Address: Sudbury
Phone: _____ Fax: _____
Reports to be sent to: Ian Macmillan @ exp.com
1. Email: _____
2. Email: _____

Project Information:

Project: ADM-00233185-KO
Site Location: MTO
Sampled By: PL
AGAT Quote #: SOA PO: _____
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Company: _____
Contact: _____
Address: _____
Email: _____
Bill To Same: Yes ☒ No ☐

Regulatory Requirements:

(Please check all applicable boxes)

☐ Regulation 153/04

Table Indicate One

☐ Ind/Corn
☐ Res/Park
☐ Agriculture

Soil Texture (Check One)

☐ Coarse
☐ Fine

☐ Sewer Use

☐ Sanitary

☐ Storm

Region Indicate One

☐ MISA

☐ Regulation 558

☐ CCME

☐ 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

Sample Matrix Legend

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

Field Filtered - Metals, Hg, CrVI

0. Reg 153

☐ All Metals ☐ 153 Metals (excl. Hydrides)
☐ Hydride Metals ☐ 153 Metals (incl. Hydrides)

ORPs: ☐ B-HWS ☐ Cl- ☐ CN
☐ C* ☐ EC ☐ FOC ☐ Hg
☐ pH ☐ SAR

Full Metals Scan

Regulation/Custom Metals

Nutrients: ☐ TP ☐ NH₃ ☐ TKN
☐ NO₃ ☐ NO₂ ☐ NO₂+NO₃

Volatiles: ☐ VOC ☒ BTEX ☐ THM

PHCs F1 - F4

ABNs

PAHs

PCBs: ☐ Total ☐ Aroclors

Organochlorine Pesticides

TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs

Sewer Use

Corrosivity

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Y / N	Metals and Inorganics	0. Reg 153	Full Metals Scan	Regulation/Custom Metals	Nutrients	Volatiles	PHCs F1 - F4	ABNs	PAHs	PCBs	Organochlorine Pesticides	TCLP	Sewer Use	Corrosivity
19-G-1-SS2	May 8/19		5	S	No rush		<input checked="" type="checkbox"/>	<input type="checkbox"/>				<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>							
19-H-1-SS2			2		Rush 2 day - no M&I		<input checked="" type="checkbox"/>	<input type="checkbox"/>				<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>							
19-PS-1-SS2			5		No rush		<input checked="" type="checkbox"/>	<input type="checkbox"/>				<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>							
19-P-1-SS2							<input checked="" type="checkbox"/>	<input type="checkbox"/>				<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>							
19-D-2-SS2							<input checked="" type="checkbox"/>	<input type="checkbox"/>				<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>							
19-D-2-SS4							<input checked="" type="checkbox"/>	<input type="checkbox"/>				<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>							
19-PS-2-SS3							<input checked="" type="checkbox"/>	<input type="checkbox"/>				<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>							
19-G-1-SS3							<input checked="" type="checkbox"/>	<input type="checkbox"/>				<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>							
19-P-2-SS3							<input checked="" type="checkbox"/>	<input type="checkbox"/>				<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>							

Samples Relinquished By (Print Name and Sign):

Samples Relinquished By (Print Name and Sign):

Samples Relinquished By (Print Name and Sign):

Date

Date

Date

Time

Time

Time

Samples Received By (Print Name and Sign):

Samples Received By (Print Name and Sign):

Samples Received By (Print Name and Sign):

Date

Date

Date

Time

Time

Time

Page 1 of 1

No: T 087566

Appendix E – Rock Core Photographs

Project No: ADM 00233185-K0
BH No: 19-PS-1
Sample Depth: 3.7 m to 6.8 m
Elevation: 206.4 m to 203.3 m
Description: Granitoid Gneiss
Date: May 1, 2019



Figure E1. Rock core from BH19-PS-1

Project No: ADM 00233185-K0
BH No: 19-PS-2
Sample Depth: 3.7 m to 6.8 m
Elevation: 206.5 m to 203.4 m
Description: Dioritic Gneiss
Date: April 30, 2019



Figure E2. Rock core from BH19-PS-2

Project No: ADM 00233185-K0
BH No: 19-PS-3
Sample Depth: 4.5 m to 7.7 m
Elevation: 205.5 m to 202.4 m
Description: Dioritic to Granitoid Gneiss
Date: May 1, 2019



Figure E3. Rock core from BH19-PS-3

Project No: ADM 00233185-K0
BH No: 19-PS-4
Sample Depth: 7.7 m to 9.8 m
Elevation: 202.6 m to 200.4 m
Description: Dioritic Gneiss
Date: April 30, 2019



Figure E4. Rock core from BH19-PS-4

Appendix F – Results of Stability Analyses

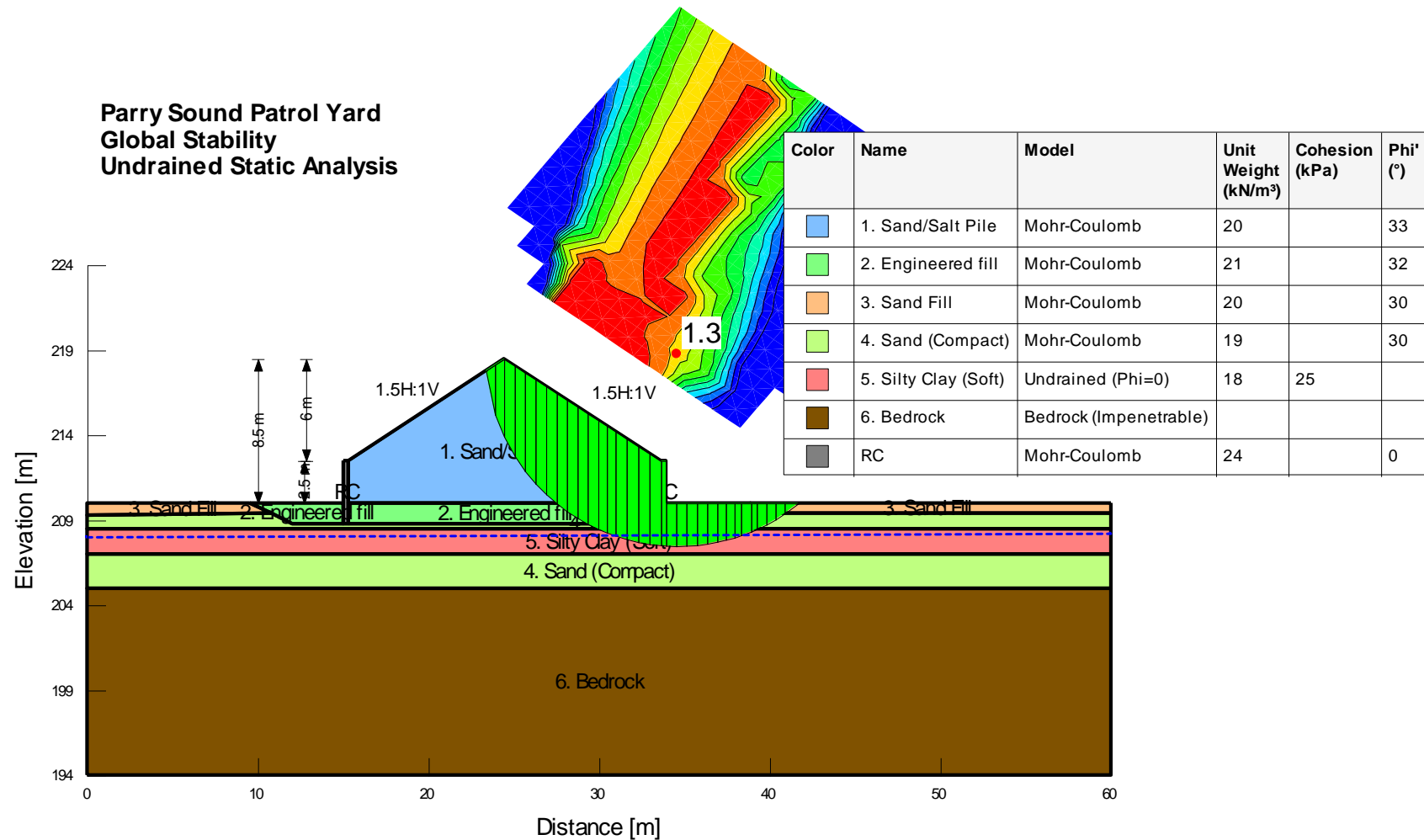


Figure 1. Global stability for Parry Sound Patrol Yard – Undrained static analysis

**Parry Sound Patrol Yard
 Global Stability
 Drained Static Analysis**

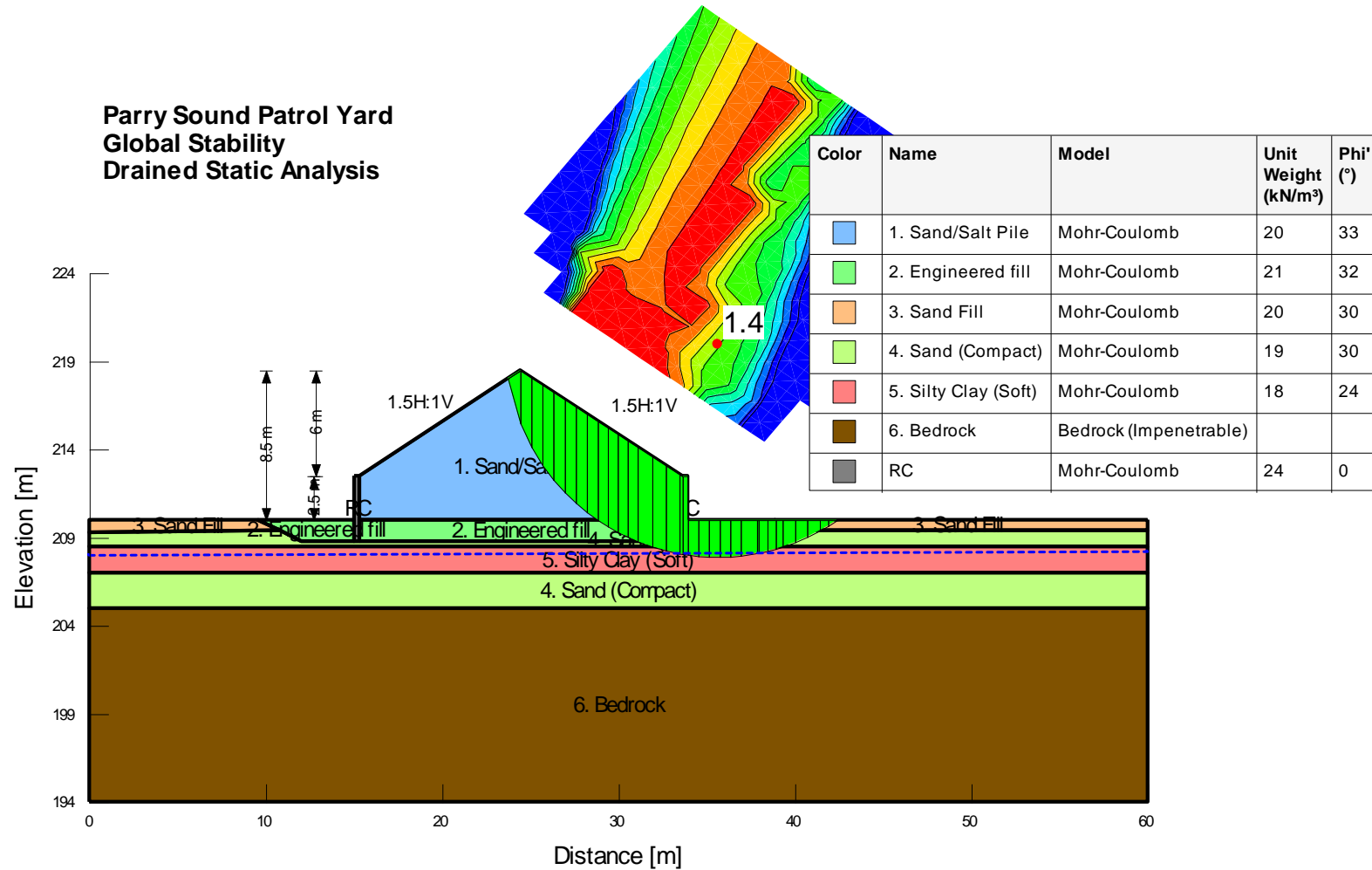


Figure 2. Global stability for Parry Sound Patrol Yard – Drained static analysis

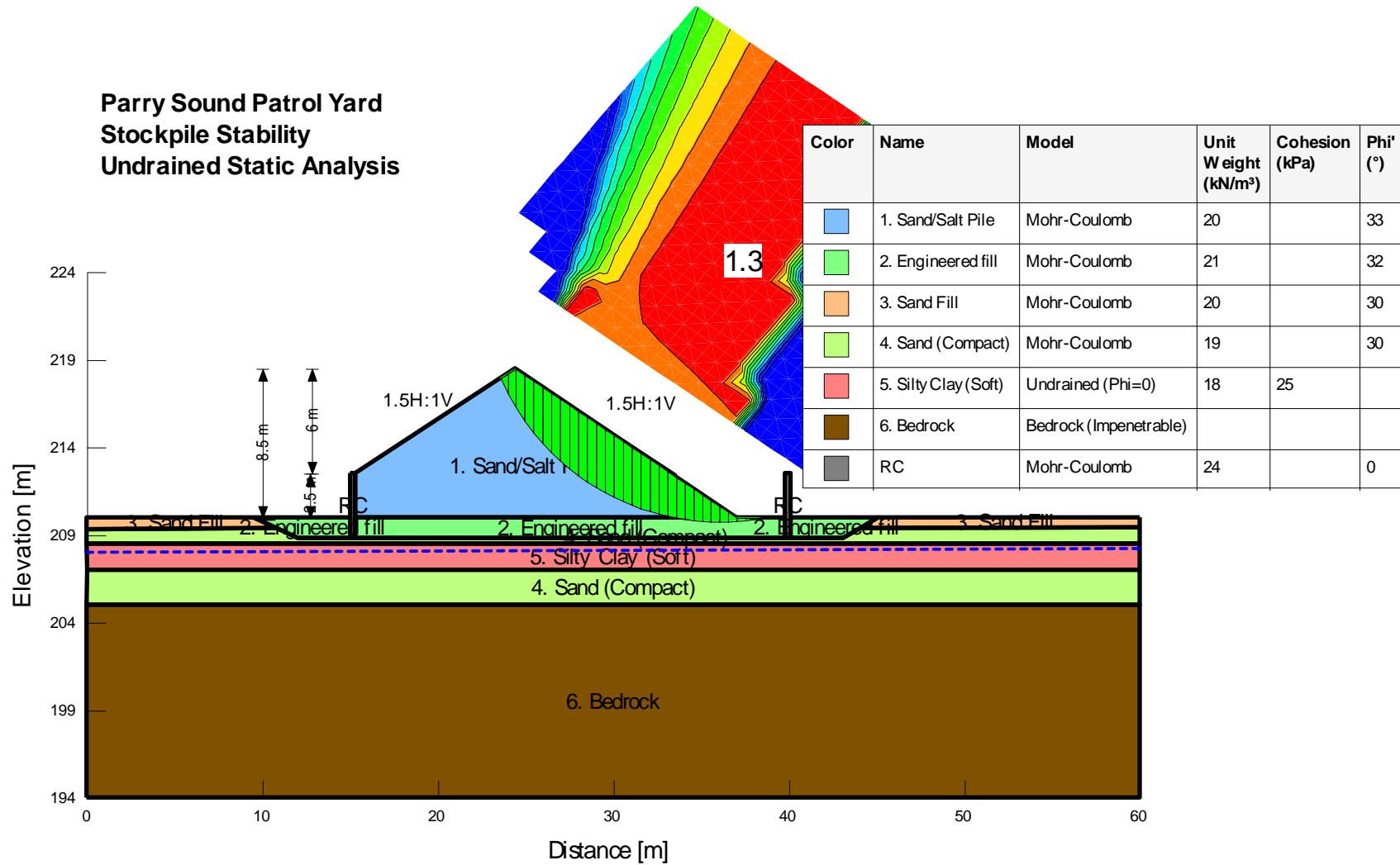


Figure 3. Stockpile stability for Parry Sound Patrol Yard – Undrained static analysis

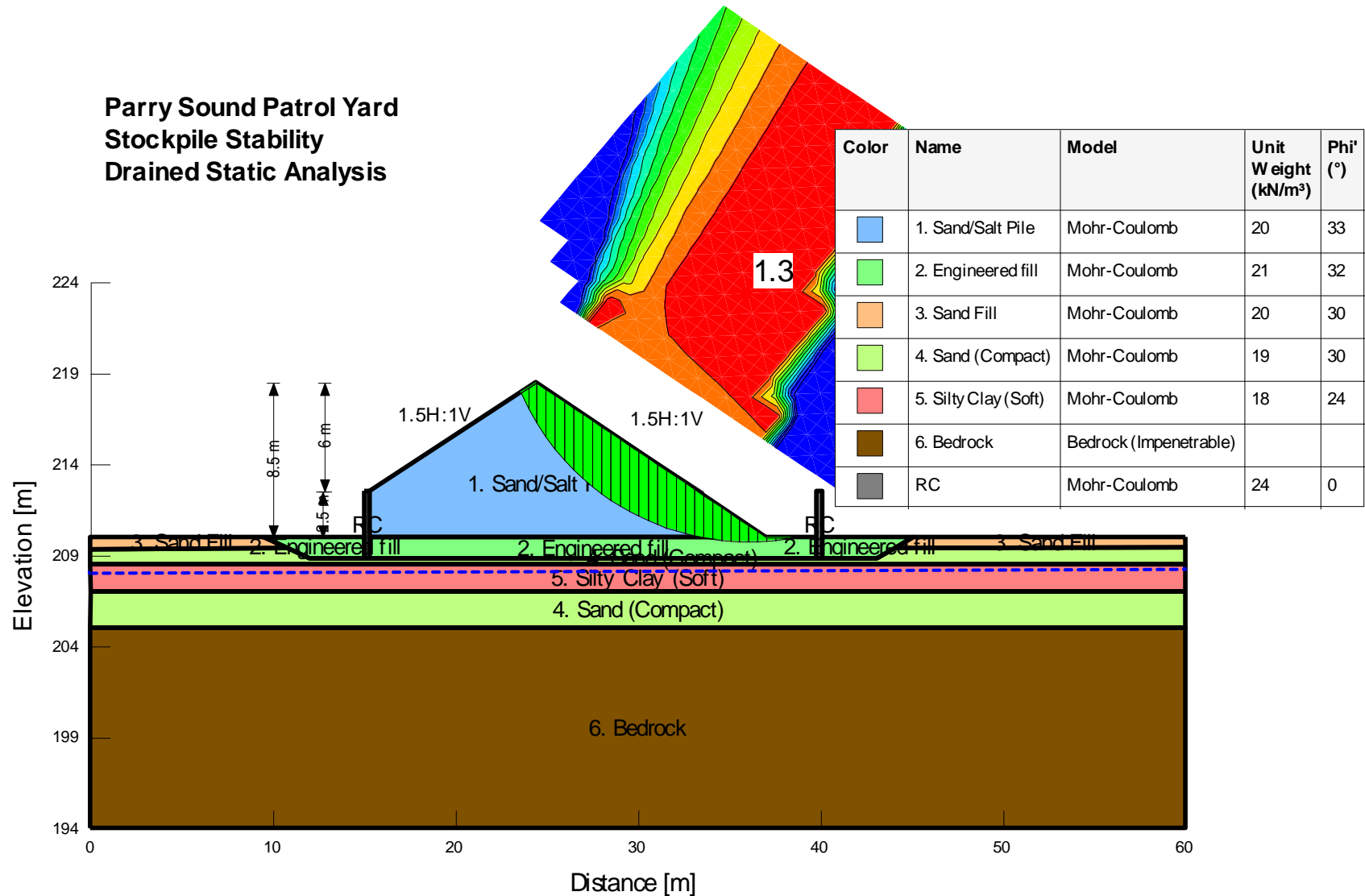
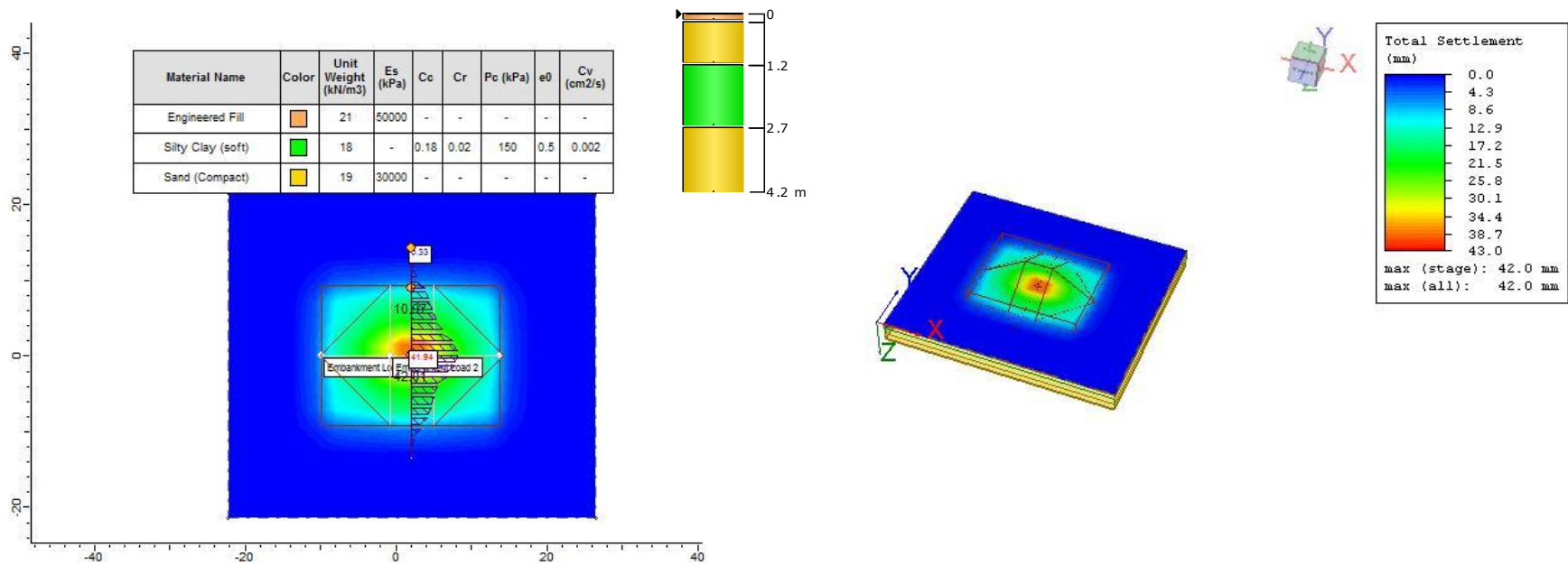


Figure 4. Stockpile stability for Parry Sound Patrol Yard – Drained static analysis

Appendix G – Results of Settlement Analyses



Project: FIDR for Parry Sound Patrol Yard

Analysis Description: Full loading – Total Settlement

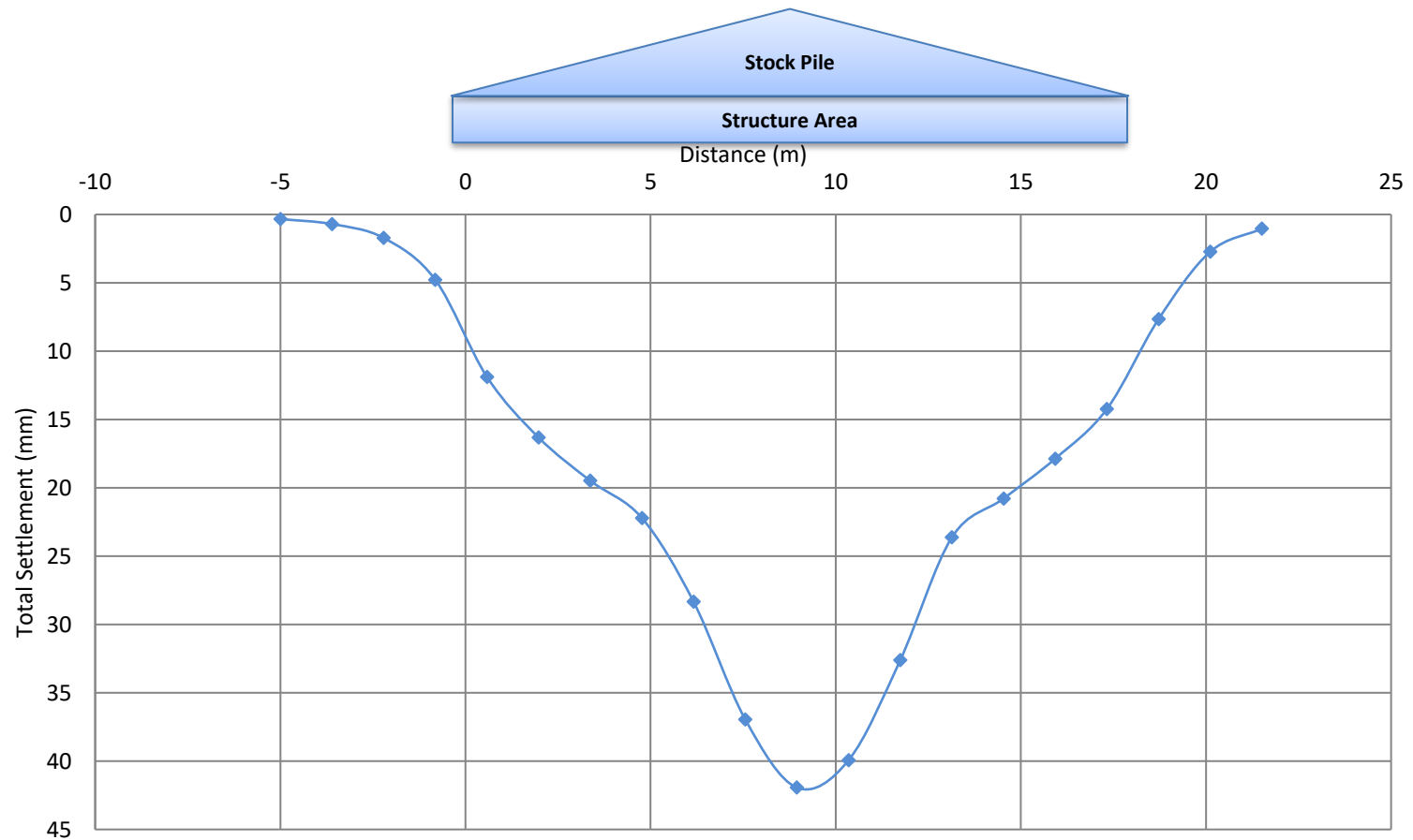
Figure No: G1

Company: EXP Services Inc.

Date: June, 2019

File Name: Settlement Analysis – Assignment 10

Distance vs. Total Settlement



Project: FIDR for Parry Sound Patrol Yard

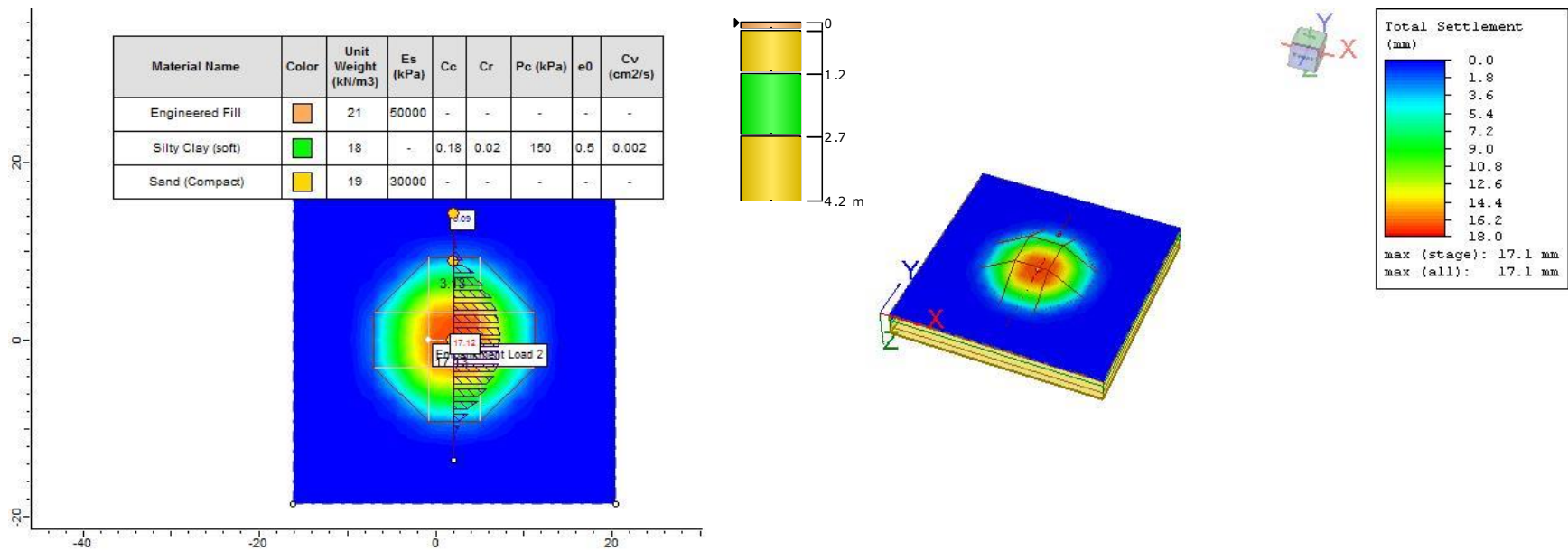
Analysis Description: Full loading – **Total Settlement**

Figure No: G2

Company: EXP Services Inc.

Date: June, 2019

File Name: Settlement Analysis – Assignment 10



Project: FIDR for Parry Sound Patrol Yard

Analysis Description: Preloading 4 m – **Total Settlement**

Figure No: G3

Company: EXP Services Inc.

Date: June, 2019

File Name: Settlement Analysis – Assignment 10

Appendix H – Records of Borehole from Previous Investigation

BOREHOLE LOG EXPLANATION FORM

This explanatory section provides the background to assist in the use of the borehole logs. Each of the headings used on the borehole log, is briefly explained.

DEPTH

This column gives the depth of interpreted geologic contacts in metres below ground surface.

STRATIGRAPHIC DESCRIPTION

This column gives a description of the soil based on a tactile examination of the samples and/or laboratory test results. Each stratum is described according to the following classification and terminology.

<u>Soil Classification *</u>		<u>Terminology</u>	<u>Proportion</u>
Clay	<0.002 mm		
Silt	0.002 to 0.06 mm	"trace" (eg. trace sand)	<10%
Sand	0.06 to 2 mm	"some" (eg. some sand)	10% - 20%
Gravel	2 to 60 mm	adjective (eg. sandy)	20% - 35%
Cobbles	60 to 200 mm	"and" (eg. and sand)	35% - 50%
Boulders	>200 mm	noun (eg. sand)	>50%

* Extension of MIT Classification system unless otherwise noted.

The use of the geologic term "till" implies that both disseminated coarser grained (sand, gravel, cobbles or boulders) particles and finer grained (silt and clay) particles may occur within the described matrix.

The compactness of cohesionless soils and the consistency of cohesive soils are defined by the following:

<u>COHESIONLESS SOIL</u>		<u>COHESIVE SOIL</u>	
Compactness	Standard Penetration Resistance "N", Blows / 0.3 m	Consistency	Standard Penetration Resistance "N", Blows / 0.3 m
Very Loose	0 to 4	Very Soft	0 to 2
Loose	4 to 10	Soft	2 to 4
Compact	10 to 30	Firm	4 to 8
Dense	30 to 50	Stiff	8 to 15
Very Dense	Over 50	Very Stiff	15 to 30
		Hard	Over 30

The moisture conditions of cohesionless and cohesive soils are defined as follows.









<u>COHESIONLESS SOILS</u>		<u>COHESIVE SOILS</u>	
Dry		DTPL	- Drier Than Plastic Limit
Moist		APL	- About Plastic Limit
Wet		WTPL	- Wetter Than Plastic Limit
Saturated		MWTPL	- Much Wetter Than Plastic Limit

STRATIGRAPHY

Symbols may be used to pictorially identify the interpreted stratigraphy of the soil and rock strata.

MONITOR DETAILS

This column shows the position and designation of standpipe and/or piezometer ground water monitors installed in the borehole. Also the water level may be shown for the date indicated.

	Standpipe and Designation		Cement Seal
	Piezometer and Designation		Granular Pack
	Gas Monitor and Designation		Granular Backfill
	Borehole Seal (Peltonite, Bentonite or Hole Plug)		Native Soil Backfill/Cave

Where monitors are placed in separate boreholes, these are shown individually in the "Monitor Details" column. Otherwise, monitors are in the same borehole. For further data regarding seals, screens, etc., the reader is referred to the summary of monitor details table.

SAMPLE

These columns describe the sample type and number, the "N" value, the water content, the percentage recovery, and Rock Quality Designation (RQD), of each sample obtained from the borehole where applicable. The information is recorded at the approximate depth at which the sample was obtained. The legend for sample type is explained below.

SS = Split Spoon	GS = Grab Sample
ST = Thin Walled Shelby Tube	CS = Channel Sample
AS = Auger Flight Sample	WS = Wash Sample
CC = Continuous Core	RC = Rock Core

$$\% \text{ Recovery} = \frac{\text{Length of Core Recovered Per Run}}{\text{Total Length of Run}} \times 100$$

Where rock drilling was carried out, the term RQD (Rock Quality Designation) is used. The RQD is an indirect measure of the number of fractures and soundness of the rock mass. It is obtained from the rock cores by summing the length of core recovered, counting only those pieces of sound core that are 100 mm or more in length. The RQD value is expressed as a percentage and is the ratio of the summed core lengths to the total length of core run. The classification based on the RQD value is given below.

<u>RQD Classification</u>	<u>RQD (%)</u>
Very poor quality	< 25
Poor quality	25 - 50
Fair quality	50 - 75
Good quality	75 - 90
Excellent quality	90 - 100

TEST DATA

The central section of the log provides graphs which are used to plot selected field and laboratory test results at the depth at which they were carried out. The plotting scales are shown at the head of the column.

Dynamic Penetration Resistance - The number of blows required to advance a 51 mm diameter, 60° steel cone fitted to the end of 45 mm OD drill rods, 0.3 m into the subsoil. The cone is driven with a 63.5 kg hammer over a fall of 750 mm.

Standard Penetration Resistance - Standard Penetration Test (SPT) "N" Value - The number of blows required to advance a 51 mm diameter standard split-spoon sampler 300 mm into the subsoil, driven by means of a 63.5 kg hammer falling freely a distance of 750 mm. In cases where the split spoon does not penetrate 300 mm, the number of blows over the distance of actual penetration in millimetres is shown as $\frac{x \text{ Blows}}{\text{mm}}$

Water Content - The ratio of the mass of water to the mass of oven-dry solids in the soil expressed as a percentage.

W_P - Plastic Limit of a fine-grained soil expressed as a percentage as determined from the Atterberg Limit Test.

W_L - Liquid Limit of a fine-grained soil expressed as a percentage as determined from the Atterberg Limit Test.

REMARKS

The last column describes pertinent drilling details, field observations and/or provides an indication of other field or laboratory tests that were performed.

BOREHOLE NO. 1

PAGE 1 of 1

PROJECT NAME: PARRY SOUND PATROL YARD

PROJECT NO.: 3080770.04

CLIENT: MINISTRY OF TRANSPORTATION

DATE COMPLETED: Apr. 23, 2008

BOREHOLE TYPE: 110 mm I.D HSA / 51 mm O.D SPLIT SPOON

SUPERVISOR: DCL

GROUND ELEVATION: 210.54 m (Relative datum)

REVIEWER: JSA

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE					CONE PENETRATION "N" VALUE		WATER CONTENT %		REMARKS		
				TYPE	N VALUE	% WATER	% RECOVERY	ROD (%)	10	20	30	10		20	30
									SHEAR STRENGTH			W _p W _L			
0.0	<u>SANDY GRAVEL:</u> MOTTLED GREY AND BROWN SANDY GRAVEL, TRACE SILT, TRACE ASPHALT, MOIST, DENSE TO VERY DENSE												ELEVATIONS ARE RELATIVE TO THE FINISHED FLOOR ELEVATION OF THE EXISTING MTO GARAGE (210.54 m) N45.3136 W79.9785 SS1 GSA 64% GRAVEL 31% SAND 5% SILT LSFH GROUNDWATER AT 1.9 m DEPTH ON COMPLETION SS4 GSA 8% GRAVEL 74% SAND 15% SILT 3% CLAY LSFH		
1.0	<u>SILTY SAND:</u> BROWN SILTY SAND TO SAND SOME SILT, TRACE GRAVEL, TRACE CLAY, WET, SATURATED BELOW 2 m, LOOSE TO COMPACT		SS1	49	3	92				49					
2.0			SS2	63	18	92				63					
3.0		SS3	9		83										
4.0		SS4	21	17	75										
5.0	<u>SAND:</u> BROWN FINE TO MEDIUM SAND, TRACE SILT, SATURATED, LOOSE	SS5	9		54										
4.9	REFUSAL AT 4.9 m ON INFERRED BEDROCK		SS6	7		96									
6.0															
7.0															
8.0															
9.0															
10.0															
11.0															
12.0															
13.0															

JHL GEOLOGIC B/W (METRIC) WITH DYNAMIC CONE PENETRATION 3080770.04.GPJ JAGGER HIMES BASIC.GDT 7/14/08

BOREHOLE NO. 2

PAGE 1 of 1

PROJECT NAME: PARRY SOUND PATROL YARD

PROJECT NO.: 3080770.04

CLIENT: MINISTRY OF TRANSPORTATION

DATE COMPLETED: Apr. 23, 2008

BOREHOLE TYPE: 110 mm I.D HSA / 51 mm O.D SPLIT SPOON

SUPERVISOR: DCL

GROUND ELEVATION: 209.95 m (Relative datum)

REVIEWER: JSA

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE					CONE PENETRATION "N" VALUE 10 20 30 SHEAR STRENGTH	WATER CONTENT % 10 20 30 W _p W _L	REMARKS
				TYPE	N VALUE	% WATER	% RECOVERY	RQD (%)			
0.0	GRAVELLY SAND: DARK GREY GRAVELLY SAND, SOME WASTE ASPHALT, MOIST, VERY DENSE			SS1	81		42			81	ELEVATIONS ARE RELATIVE TO THE FINISHED FLOOR ELEVATION OF THE EXISTING MTO GARAGE (210.54 m) N45.3137 W79.9782 GROUNDWATER AT 1.9 m DEPTH ON COMPLETION SS3 GSA 43% GRAVEL 46% SAND 9% SILT 2% CLAY LSFH
0.7	SAND AND GRAVEL: DARK GREY SAND AND GRAVEL, SOME TO TRACE SILT, TRACE CLAY, WET TO SATURATED, VERY DENSE TO LOOSE			SS2	65		63			65	
1.0	-COBBLES AT 1.0 m			SS3	18	14	67				
2.0				SS4	3		21				
2.9	CLAYEY SILT: GREY CLAYEY SILT, TRACE FINE SAND, WTPL, VERY SOFT TO SOFT			SS5	2	37	21				
4.0				SS6	4		88				
4.2	SAND: GREY FINE SAND, SATURATED, VERY LOOSE TO COMPACT			SS7	2		29				
5.0				SS8	13	20	54				
6.0											
7.0											
7.2	DIORITIC GNEISS: GREY WITH BLACK SPECKLES, MEDIUM TO COARSE GRAINED, FOLIATION AT 45 DEGREES TO CORE AXIS, DIABASE INTRUSIONS PARALLEL TO FOLIATION			RC9				93			
8.0											
9.0											
10.0											
10.2	BOREHOLE TERMINATED AT 10.2 m IN BEDROCK										
11.0											
12.0											
13.0											

BOREHOLE NO. 3

PAGE 1 of 1

PROJECT NAME: PARRY SOUND PATROL YARD

PROJECT NO.: 3080770.04

CLIENT: MINISTRY OF TRANSPORTATION

DATE COMPLETED: Apr. 24, 2008

BOREHOLE TYPE: 110 mm I.D HSA / 51 mm O.D SPLIT SPOON

SUPERVISOR: DCL

GROUND ELEVATION: 210.06 m (Relative datum)

REVIEWER: JSA

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE					CONE PENETRATION N		WATER CONTENT %		REMARKS
				TYPE	N VALUE	% WATER	% RECOVERY	ROD (%)	"N" VALUE				
									10	20	30	10	
0.0													
0.7	GRAVELLY SAND: GREY GRAVELLY SAND, WOOD, MOIST, VERY DENSE			SS1	96		42				96		ELEVATIONS ARE RELATIVE TO THE FINISHED FLOOR ELEVATION OF THE EXISTING MTO GARAGE (210.54 m) N45.3136 W79.9784 SS2 GSA 7% GRAVEL 80% SAND 11% SILT 2% CLAY LSFH GROUNDWATER AT 1.8 m DEPTH ON COMPLETION SS5 GSA 5% SAND 38% SILT 57% CLAY HSFH SS6 GSA 23% GRAVEL 77% SAND LSFH
1.0	SAND: GREY TO BROWN SAND, SOME SILT, TRACE GRAVEL, TRACE CLAY, MOIST, VERY DENSE, TO DENSE			SS2	72	6.1	92				520		
1.8	SILTY SAND: DARK BROWN SILTY SAND, TRACE CLAY, TRACE ROOTS, WET TO SATURATED, COMPACT			SS3	33		88				720		
2.0				SS4	13		58				510		
2.9	SILT AND CLAY: GREY SILT AND CLAY, TRACE SAND, WTPL, VERY SOFT			SS5	0	54	100					540	
4.0	GRAVELLY SAND: BROWNISH GREY GRAVELLY SAND, TRACE SILT, SATURATED, VERY LOOSE TO LOOSE			SS6	4	20	83					440	
6.1	BOREHOLE TERMINATED AT 6.1 m ON PRESUMED BEDROCK			SS7	100							1000	
7.0													
8.0													
9.0													
10.0													
11.0													
12.0													
13.0													

BOREHOLE NO. 4

PAGE 1 of 1

PROJECT NAME: PARRY SOUND PATROL YARD

PROJECT NO.: 3080770.04

CLIENT: MINISTRY OF TRANSPORTATION

DATE COMPLETED: Apr. 24, 2008

BOREHOLE TYPE: 110 mm I.D HSA / 51 mm O.D SPLIT SPOON

SUPERVISOR: DCL

GROUND ELEVATION: 210.01 m (Relative datum)

REVIEWER: JSA

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE					CONE PENETRATION "N" VALUE 10 20 30 SHEAR STRENGTH	WATER CONTENT % 10 20 30 W _p W _L	REMARKS
				TYPE	N VALUE	% WATER	% RECOVERY	ROD (%)			
0.0	GRAVELLY SAND: DARK GREY GRAVELLY SAND, SOME SILT, MOIST, VERY DENSE			SS1	101		50		101		ELEVATIONS ARE RELATIVE TO THE FINISHED FLOOR ELEVATION OF THE EXISTING MTO GARAGE (210.54 m) N45.3138 W79.9785 SS2 GSA 46% GRAVEL 42% SAND 10% SILT 2% CLAY LSFH GROUNDWATER AT 1.1 m DEPTH ON COMPLETION SS4 GSA 60% SAND 32% SILT 8% CLAY MSFH
0.7	SAND AND GRAVEL: BROWN SAND AND GRAVEL, TRACE TO SOME SILT, TRACE CLAY, OCCASIONAL COBBLES, MOIST TO WET, DENSE TO COMPACT			SS2	49	7	58		520		
1.0									49		
2.0				SS3	16	18	75		510		
2.2	SILT: DARK BROWN ORGANIC SILT, ROOTS, WET, COMPACT			SS4	11		63				
2.4											
2.9	SILTY SAND: GREY SILTY SAND, TRACE CLAY, SATURATED, COMPACT			SS5	1	34	100				
3.0	CLAYEY SILT: MOTTLED GREY AND BROWN TO GREY CLAYEY SILT, WTPL, VERY SOFT			SS6	0		100				BOREHOLE TERMINATED AT 5.5 m ON PRESUMED BEDROCK
4.0											
4.3	SAND: MOTTLED GREY AND BROWN FINE SAND, SATURATED			SS7	0		54				
5.0											
5.5											
6.0											
7.0											
8.0											
9.0											
10.0											
11.0											
12.0											
13.0											

BOREHOLE NO. 5

PAGE 1 of 1

PROJECT NAME: PARRY SOUND PATROL YARD

PROJECT NO.: 3080770.04

CLIENT: MINISTRY OF TRANSPORTATION

DATE COMPLETED: Apr. 24, 2008

BOREHOLE TYPE: 110 mm I.D HSA / 51 mm O.D SPLIT SPOON

SUPERVISOR: DCL

GROUND ELEVATION: 209.76 m (Relative datum)

REVIEWER: JSA

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE					CONE PENETRATION "N" VALUE 10 20 30 SHEAR STRENGTH	WATER CONTENT % 10 20 30 W _p W _L	REMARKS
				TYPE	N VALUE	% WATER	% RECOVERY	ROD (%)			
0.0	GRAVELLY SAND: DARK GREY TO BROWN GRAVELLY SAND TO SAND AND GRAVEL, SOME SILT, TRACE CLAY, MOIST, COMPACT			SS1	24		54				ELEVATIONS ARE RELATIVE TO THE FINISHED FLOOR ELEVATION OF THE EXISTING MTO GARAGE (210.54 m) N45.3135 W79.9782 SS1 GSA 42% GRAVEL 42% SAND 14% SILT 2% CLAY LSFH GROUNDWATER AT 1.8 m DEPTH ON COMPLETION SS5 GSA 1% GRAVEL 82% SAND 15% SILT 2% CLAY LSFH
1.0				SS2	24	13	46				
1.4	SILTY SAND: DARK BROWN SILTY SAND, WET, COMPACT			SS3	14		42				
1.6	CLAYEY SILT: MOTTLED GREYISH BROWN CLAYEY SILT, DTPL			SS4	14	19	0				
1.8	SAND: DARK GREY SAND, TRACE TO SOME SILT, TRACE CLAY, WET TO SATURATED, LOOSE TO COMPACT			SS5	14		58				
2.0				SS6	6		38				
3.0				SS7	12		42				
4.0				SS8	100		13				
5.0											
6.0											
6.7	BOREHOLE TERMINATED AT 6.7 m ON PRESUMED BEDROCK										
7.0											
8.0											
9.0											
10.0											
11.0											
12.0											
13.0											