



FINAL REPORT

FOUNDATION INVESTIGATION REPORT

**Roadway Protection Systems for Rehabilitation of CPR Overhead Bridge,
Highway 144, Site No. 46-226, Sudbury, Ontario**

Agreement No. 5013-E-0008

Assignment No. 12

GWP 5223-14-00

Geocres No. 41I-341

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Foundation Investigation Report

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Foundation Investigation and Design for Roadway Protection Systems for rehabilitation of CPR Overhead Bridge, Site No. 46-226, HWY 144, Chelmsford, District of Sudbury

Project Number:

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1 FOUNDATION INVESTIGATION REPORT

1.1 Introduction

This foundation investigation report presents the results of a geotechnical investigation completed by **exp** Services Inc. for the roadway protection systems for rehabilitation of CPR overhead bridge at Hwy 144, Chelmsford, east of Township of Dowling near Sudbury, District of Sudbury, the Ministry of Transportation (MTO) Northeastern Region (Site No. 46-226). The work was undertaken under Agreement # 5013-E-0008, Assignment No. 12 (GWP 5294-11-00). The terms of reference (TOR) were as presented in the MTO letter dated November 26, 2015. The General Arrangement (GA) drawing for the underpass bridge prepared by Aecom was provided to **exp** by MTO.

The purpose of the investigation is to determine the subsurface conditions within the vicinity of proposed roadway protection for the CPR overhead bridge rehabilitation. The site specific geotechnical investigation consisted of borings, soil sampling, borehole logging, and laboratory testing.

This foundation investigation report has been prepared specifically and solely for the project described herein. It contains the factual results of the investigation and the laboratory testing completed for this project.

1.2 Site Description and Geological Setting

1.2.1 Site Description

The CPR overhead bridge is located on Hwy 144, east of the Township of Dowling near Sudbury, Chelmsford, District of Sudbury. The site plan and cross-section profile for the CPR overhead bridge are shown in Drawing 1 in Appendix B. Photographs of the existing site/bridge are included in Appendix A.

At the site location, Hwy 144 is two lanes. The roadway and shoulders are paved on both side of road. The existing structure is a three span precast concrete girders concrete deck bridge constructed in late 1960s, and is about 64 m in length and about 12.8 m wide. The approaches are provided with guardrails on both sides of roadway. The CPR track is located in the middle span within the railway right of way.

The general site conditions were assessed during the drilling operations conducted on December 14 and 15, 2015. The surrounding terrain in the immediate area is relatively flat, grass covered, treed areas with mostly coniferous trees and well-drained. Bedrock outcrops were observed about 100 m north of the north abutment. Selected photographs showing the surrounding area are provided in Appendix A.

1.2.2 Geological Setting

In accordance with the Ministry of Northern Development and Mines Map 2556, Quaternary Geology of Ontario, Southern Sheet, the site is glaciolacustrine deposits consisting of silt and clay, minor sand to undifferentiated igneous and metamorphic rock.

In accordance with the Ministry of Northern Development and Mines Map 2544, Bedrock Geology of Ontario, Southern Sheet, the bedrock at the site consists of Whitewater GP, Chelmsford formation consisting of fragmental rocks, mudstone and wacke.

1.3 Site Investigation Procedures

1.3.1 Field Work

The field work for this project was carried out on December 14 and 15, 2015. Prior to the field work commencement the presence of utilities/services was checked out. The investigation consisted of a total of three (3) sampled boreholes (BH1, BH2 and BH3) and one (1) non-sampled borehole (BH3A). The boreholes were strategically located within abutments and the south pier to provide subsurface information for the design of temporary roadway protection systems. Boreholes BH1 and BH2 were advanced from the embankment crest within the existing roadway close to abutment locations. BH1 was drilled through roadway close to the north abutment whereas BH2 drilled close to the south abutment. Both boreholes were advanced to a depth of 9.8 m below the ground surface. BH3 and BH3A were advanced close to the south pier through the south berm under the CPR overhead bridge. Following the CPR safety requirements, these boreholes were located minimum 15 m of the railway track. BH3 advanced to a depth of 8.8 m and BH3A to a depth of 2.7 m below ground surface. A dynamic cone penetration test (DCPT) was performed in BH3 below the depth of 3.1 m, and in BH3A from the ground surface to determine the penetration resistance of soil/subgrade at those locations (i.e. presence of obstacles such as large rock fragments). The borehole locations are shown on Drawing 1 in Appendix B.

Boreholes BH1 and BH2 were advanced using a Mobile CME-55 truck mounted drill rig, equipped with a hollow stem auger and standard soil sampling equipment operated by a specialist drilling contractor, Marathon Drilling Co. Ltd. Because of the difficulty in accessibility at the berm location under the bridge, the boreholes BH3 and BH3A were advanced using a hand drilling/sampling equipment (a portable hammer) operated also by Marathon Drilling Co. Ltd.

The borehole locations (referenced to the MTM NAD83 coordinate system) and their ground surface elevations were surveyed by **exp** personnel using a handheld GPS. These temporary collected data were compared and found consistence with the data in the GA drawing.

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 D1586) at intervals ranging from 0.75 m to 1.5 m in depth as 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 or relative density of non-cohesive soils. However in

the case of sampling done by a manually lifting portable hammer (31.7 kg), half the weight of conventional hammer weight, the corresponding blow counts was factored by 0.5.

Upon completion of the boreholes, ground water level measurements were carried out from the boreholes in accordance with the Ministry of Transportation guidelines. The measured ground water levels after completion of drilling boreholes were recorded on borehole log sheets in Appendix C. The boreholes were decommissioned by backfilling with 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 members 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 of the recovered soil samples were placed in labelled moisture-proof bags, and returned to **exp**'s Brampton laboratory for additional visual, textual and olfactory examination.

1.3.2 Laboratory Testing

All samples returned to the laboratory were subjected to visual examination and classification. The laboratory testing program included the determination of natural moisture content, particle size distribution test for approximately 25% of the collected soil samples. All of the laboratory tests were carried out according 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.

1.3.3 Previous Investigation

One foundation report is available in the MTO GEOCRES library for this particular site.

- 1 Foundation Investigation Report for Proposed Overhead at the Crossing of Hwy # 144, Line 'F' and CPR, District 17, W.J. 67-F-59; WP # 183-63; Sudbury, Geocres No. 411-059; Department of Highways Ontario, September 1967.

1.4 Subsurface Conditions

The detailed subsurface conditions encountered in the boreholes advanced during this investigation 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 cross sections of subsurface profiles are provided in Appendix B (Drawings 1). It should be noted that the stratigraphic boundaries indicated on the borehole logs, and the cross section stratigraphic profiles are inferred from non-continuous sampling in boreholes,

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. Furthermore, subsurface conditions may vary between and beyond the borehole locations.

In general, the subsurface conditions within the existing abutments consist of gravel and sand fill followed by sand fill. At the site adjacent to the south pier, silty sand fill underlain by silty clay fill is encountered. A more detailed description of the subsurface conditions encountered in the boreholes is provided in the following sections.

1.4.1 Asphalt

Asphalt was encountered at the surface of boreholes drilled through the road surface (BH1 and BH2). The thickness of the asphalt layer is about 130 mm. Asphalt thicknesses may vary beyond the borehole location.

1.4.2 Fill: Gravel and Sand

Gravel and sand fill was encountered below the asphalt layer in boreholes BH1 and BH2. The fill layer was encountered at depth of 0.1 m below ground surface (Elev. 278.0 m) and extended to a depth of 1.5 m below the ground surface (Elev. 277.5 m) in BH1 and to 3.1 m below the ground surface (Elev. 276.0 m) in BH2. The explored thickness of this fill layer was between 1.4 m to 3.0 m.

The composition of the fill layer is mostly gravel and sand, trace to few silt and clay size particles. The material is brown and moist. The SPT "N" values within this fill layer ranged from 60 to 100 blows per 300 mm penetration, suggesting a very dense compactness condition. Auger grinding from a depth of 2.4 m to 3.1 m was recorded.

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

Moisture Contents:

- 1.6% to 5.3%

Grain Size Distribution:

- 36% to 58% gravel;
- 40% to 55% sand;
- 2% to 9% silt and clay

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

1.4.3 Fill: Sand

Sand fill layer was encountered below the gravel and sand fill layer in boreholes (BH1 and BH2) and at ground surface (Elev. 274.0 m) in borehole BH3. The sand fill layer was encountered at a depth of 1.5 m below the ground surface (Elev. 277.5 m) in BH1 and at the depth of 3.1 m below the ground surface (Elev. 276.0 m) in BH2, and extended to depth explored of 9.8 m below the ground surface (Elev. 269.3 m). In BH3 this layer extended to depth of 1.8 m (Elev. 272.2 m) below the ground surface. The explored thickness of this deposit was between 6.7 m to 8.3 m in boreholes (BH1 and BH2) and about 1.8 m in borehole BH3. Boreholes BH1 and BH2 were terminated within this layer.

The composition of this layer is mostly sand trace gravel, trace to some silt and trace organics. The material is brown and moist. The SPT "N" values within this layer ranged from 0 to 41 blows per 300 mm penetration, suggesting a very loose to dense compactness condition. One SPT "N" value of 68 blows per 300 mm penetration was recorded in BH1.

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

Moisture Contents:

- 4.2 % 9%

Grain Size Distribution:

- 0% to 3% gravel;
- 86% to 92% sand; and
- 8% to 14% silt and clay

The results of the moisture content and grain size distribution tests are provided on the record of borehole sheet in Appendix C. The results of the grain size distribution tests are also provided on Figure 2 in Appendix D.

1.4.4 Fill: Clayey Silt

Clayey silt fill layer was encountered below the sand fill layer in borehole BH3. The clayey silt fill layer was encountered at a depth of 1.8 m below ground surface (Elev. 272.2 m) and extended to a depth of 3.1 m below ground surface (Elev. 271.0 m). The explored thickness of this deposit was 1.3 m. Sampling of BH3 is terminated within this layer. A dynamic cone penetration test (DCPT) commenced further below.

The composition of this layer is mostly silt and clay trace sand and trace gravel. The material is brown to grey and moist. The SPT "N" values within this layer ranged from 7 to 9 blows per 300 mm penetration, suggesting a firm to stiff consistency. The results of DCPT suggested presence of stiffer/dancer soils below Elev. 269.0 m, corresponding to about 5 m below the ground surface.

1.5 Ground Water Conditions

Information of groundwater levels at the site was obtained by measuring the water levels in the open boreholes after completion of drilling. However, all boreholes were found dry at the time of investigation (December 2015).

Water levels measured in open boreholes might not be stabilized due to short term observation. However, based on moisture content of the soil samples observed during drilling and measured subsequently in the lab, the ground water level should be below investigation depth (below Elev. 269.3 m). Seasonal variations in the water table should be expected, with higher levels occurring during wetter periods of the year and lower levels during drier periods.

February 04, 2016

1.6 Closure

The comments given in this report are intended only for the guidance of design engineers. The number of boreholes required to determine the localized underground conditions between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc. could be greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

This Foundation Investigation Report has been prepared by Mr. Nimesh Tamrakar, M.Eng, EIT., and Mrs. S. Micic, Ph.D., P. Eng. and reviewed by Mr. T.C. Kim, M.E.Sc., P.Eng. and Mr. S.E. Gonsalves, M.Eng., P.Eng. designated MTO foundation contact. The field investigation was conducted by Ms. Nicole Wyld.

We trust that these comments provide you with sufficient information to for your present requirements. Should you have any questions, please do not hesitate to contact this office

Yours truly,


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Encl.



Appendix A Photographs



Photograph 1. North approach looking south



Photograph 2. East side of overhead bridge looking west



Photograph 3. Under overhead bridge looking to south piers and south abutment



Photograph 4. South approach looking northwest

Appendix B Drawings

METRIC
DIMENSIONS ARE IN METERS AND/OR
MILLIMETERS UNLESS OTHERWISE SHOWN.
STATIONS ARE IN KILOMETERS + METERS

DIST. No. 54
CONT. No.
WP. No. 5223-14-00



ROADWAY PROTECTION SYSTEMS, HWY 144
CPR OVERHEAD BRIDGE
(EAST PF DOWLING TOWNSHIP)
BOREHOLE LOCATIONS & CROSS SECTION

SHEET

exp Services Inc.

KEY PLAN



LEGEND

- Location of Drilled Boreholes
- Standard Penetration Test (Blows/0.3 m)

SOIL STRATA SYMBOLS

- FILL
- ASPHALT

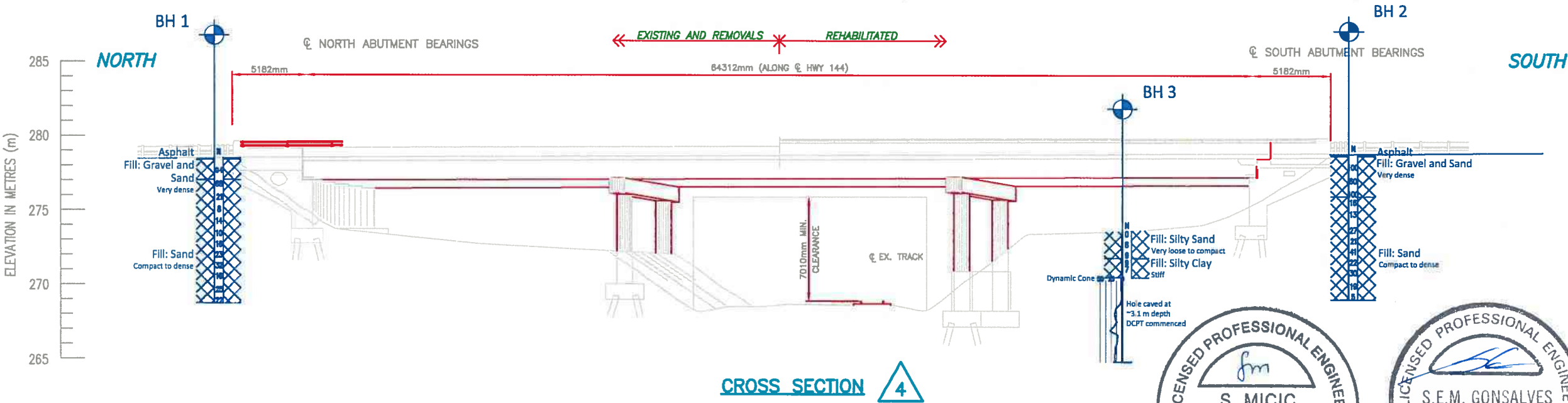
| BH No. | APPROX. ELEV. (m) | MTM CO-ORDINATES | |
|--------|-------------------|------------------|---------|
| | | NORTHING | EASTING |
| BH 1 | 279.000 | 5159277 | 282730 |
| BH 2 | 279.000 | 5159207 | 282780 |
| BH 3 | 274.000 | 5159253 | 282733 |
| BH 3A | 274.000 | 5159253 | 282728 |

NOTE

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.

| | | | |
|---------------------|------------|-----------------------------|------------|
| | | | |
| | | | |
| 2016.01.15 | SM | SUBMISSION FOR MTO REVIEW | |
| DATE | BY | DESCRIPTION | |
| GEOCRES NO. 411-341 | | SITE NO. 46-226 | |
| | | PROJECT NO. ADM-00028245-N0 | |
| SUBM'D SM | CHECKED SM | DATE | 2016.01.15 |
| DRAWN JH | CHECKED SG | APPROVED | DWG. |



Note: The plan and cross section were provided by MTO.



Appendix C – Record of Boreholes

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.

| ISSMFE SOIL CLASSIFICATION | | | | | | | | | | | |
|---|------|--------|--------|------|--------|--------|--------|--------|--------|-------------|----------|
| CLAY | SILT | | | SAND | | | GRAVEL | | | COBBLES | BOULDERS |
| | FINE | MEDIUM | COARSE | FINE | MEDIUM | COARSE | FINE | MEDIUM | COARSE | | |
| <div><div>0.002</div><div>0.006</div><div>0.02</div><div>0.06</div><div>0.2</div><div>0.6</div><div>2.0</div><div>6.0</div><div>20</div><div>60</div><div>200</div></div> | | | | | | | | | | | |
| EQUIVALENT GRAIN DIAMETER IN MILLIMETRES | | | | | | | | | | | |
| | | | | | | | | | | | |
| CLAY (PLASTIC) TO | | | | FINE | | MEDIUM | | CRS. | | FINE COARSE | |
| SILT (NONPLASTIC) | | | | SAND | | | | GRAVEL | | | |
| UNIFIED 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 Note 16 in ASTM D2488-09a:

Table a: Percent or Proportion of Soil, Pp

| | Criteria |
|--------|--|
| Trace | Particles are present but estimated to be less than 5% |
| Few | $5 \leq Pp \leq 10\%$ |
| Little | $15 \leq Pp \leq 25\%$ |
| Some | $30 \leq Pp \leq 45\%$ |
| Mostly | $50 \leq Pp \leq 100\%$ |

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 | $5 \leq N < 10$ |
| Compact | $10 \leq N < 30$ |
| Dense | $30 \leq N < 50$ |
| Very Dense | $50 \leq N$ |

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:

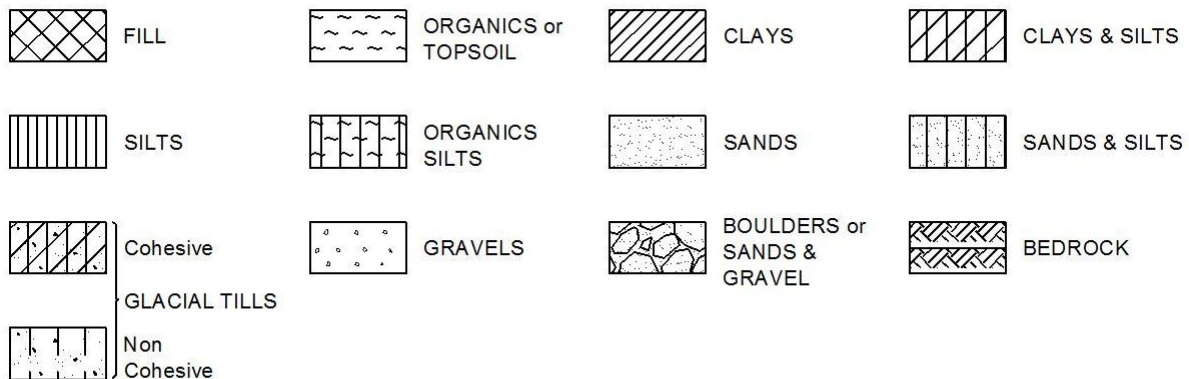
Table c: Consistency of Cohesive Soil

| 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 BH-1

1 OF 1

METRIC

W. P. 5223-14-00 LOCATION CPR Overhead Bridge (Site 46-226), (N 5159277 E 282730) ORIGINATED BY NW
 DIST Hwy 144 Sudbury BOREHOLE TYPE CME 550, 200mm Dia. Hollow Stem Auger COMPILED BY KR
 DATUM Geodetic (Hand-held GPS) DATE 2015/12/15 - 2015/12/15 CHECKED BY IM

| 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 (%) |
|---------------|--|------------|---------|------|------------|----------------------------|--------------------|---|----|----|----|-----|------------------------------------|-------------------------------------|-----------------------------------|---|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | 20 | 40 | 60 | 80 | 100 | | | | | |
| 279.0 | ASPHALT (~ 130 mm thick) | | AS | AS | | | | | | | | | | | | | |
| 278.9 0.1 | FILL: GRAVEL AND SAND trace silt, brown, moist, very dense. | | 1 | SS | 94 | | 278 | | | | | | | | | | 53 44 (3) |
| 277.5 1.5 | FILL: SAND trace gravel, trace silt, brown, moist, dense to compact. | | 2 | SS | 68 | | 277 | | | | | | | | | | |
| | | | 3 | SS | 21 | | 276 | | | | | | | | | | 0 92 (8) |
| | no gravel below ~ 3.1 m depth. | | 4 | SS | 8 | | 275 | | | | | | | | | | |
| | | | 5 | SS | 14 | | 274 | | | | | | | | | | |
| | | | 6 | SS | 10 | | 273 | | | | | | | | | | |
| | trace organics below ~ 5.3 m depth. | | 7 | SS | 16 | | 272 | | | | | | | | | | |
| | | | 8 | SS | 23 | | 271 | | | | | | | | | | |
| | no organics, some silt below ~ 6.1 m depth. | | 9 | SS | 32 | | 270 | | | | | | | | | | 0 86 (14) |
| | | | 10 | SS | 16 | | | | | | | | | | | | |
| | | | 11 | SS | 25 | | | | | | | | | | | | |
| | | | 12 | SS | 22 | | | | | | | | | | | | |
| 269.3 9.8 | END OF BOREHOLE | | | | | | | | | | | | | | | | |
| | NOTES: 1. This drawing is to be read with the subject report and project numbers as presented above. 2. Interpretation assistance by exp is required before used by others. 3. Groundwater level dry upon completion of borehole. | | | | | | | | | | | | | | | | |

OPG_EXP RECORD OF BOREHOLE ADM-00028245-NO - BOREHOLE LOGS.GPJ ONTARIO MOT.GDT 2/3/16

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

Brampton, Ontario

RECORD OF BOREHOLE No BH-2

1 OF 1

METRIC

W. P. 5223-14-00 LOCATION CPR Overhead Bridge (Site 46-226), (N 5159207 E 282780) ORIGINATED BY NW
 DIST Hwy 144 Sudbury BOREHOLE TYPE CME 550, 200mm Dia. Hollow Stem Auger COMPILED BY KR
 DATUM Geodetic (Hand-held GPS) DATE 2015/12/15 - 2015/12/15 CHECKED BY IM

| 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 (%) | | | |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|---|----|----|----|--|------------------------------------|-------------------------------------|-----------------------------------|--|---|--------|--|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH: Cu, KPa | | | | | | | | | | | | |
| | | | | | | | | ○ UNCONFINED + FIELD VANE | | | | | | | | | | | | |
| | | | | | | | | × QUICK TRIAXIAL LAB VANE | | | | | | | | | WATER CONTENT (%) | | | |
| 20 | 40 | 60 | 80 | 100 | 10 | 20 | 30 | GR | SA | SI | CL | | | | | | | | | |
| 279.0 | | | | | | | | | | | | | | | | 58 | 40 | (2) | | |
| 278.9 | ASPHALT (~ 130 mm thick) | | AS | AS | | | | | | | | | | | | | | | | |
| 0.1 | FILL: GRAVEL AND SAND trace silt, brown, moist, very dense | | 1 | SS | 100 | | | | | | | | | | | | | | | |
| | auger grinding, gravel coming up from auger below ~ 1.2 m depth. | | 2 | SS | 60 | | | | | | | | | | | | 36 | 55 (9) | | |
| | Auger grinding from ~ 2.4 m to 3.1 m depth. | | 3 | SS | 100 | | | | | | | | | | | | | | | |
| 276.0 | | | 4 | SS | 16 | | | | | | | | | | | | 3 | 90 (8) | | |
| 3.1 | FILL: SAND trace gravel, trace silt, brown, moist, compact to dense. | | 5 | SS | 13 | | | | | | | | | | | | | | | |
| | | | 6 | SS | 27 | | | | | | | | | | | | | | | |
| | | | 7 | SS | 21 | | | | | | | | | | | | | | | |
| | | | 8 | SS | 41 | | | | | | | | | | | | | | | |
| | | | 9 | SS | 22 | | | | | | | | | | | | 0 | 91 (9) | | |
| | | | 10 | SS | 30 | | | | | | | | | | | | | | | |
| | | | 11 | SS | 19 | | | | | | | | | | | | | | | |
| | | | 12 | SS | 5 | | | | | | | | | | | | | | | |
| 269.3 | END OF BOREHOLE | | | | | | | | | | | | | | | | | | | |
| 9.8 | NOTES: 1. This drawing is to be read with the subject report and project numbers as presented above. 2. Interpretation assistance by exp is required before used by others. 3. Groundwater level dry upon completion of borehole. | | | | | | | | | | | | | | | | | | | |

OPG_EXP RECORD OF BOREHOLE ADM-00028245-NO - BOREHOLE LOGS.GPJ ONTARIO MOT.GDT 2/3/16

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

Brampton, Ontario

RECORD OF BOREHOLE No BH-3

1 OF 1

METRIC

W. P. 5223-14-00 LOCATION CPR Overhead Bridge (Site 46-226), (N 5159253 E 282733) ORIGINATED BY NW
 DIST Hwy 144 Sudbury BOREHOLE TYPE Hand Equipment COMPILED BY KR
 DATUM Geodetic (Hand-held GPS) DATE 2015/12/14 - 2015/12/15 CHECKED BY IM

| 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 (%) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---------------|-------------|------------|---------|------|------------|----------------------------|-----------------|---|--------------|----|----------------|----------|------------------------------------|-------------------------------------|-----------------------------------|--|---|--|--|--|-------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH: Cu, KPa | | | | | | | | | | | | | WATER CONTENT (%) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | ○ UNCONFINED | + FIELD VANE | × | QUICK TRIAXIAL | LAB VANE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 274.0 | | | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

OPG_EXP_RECORD OF BOREHOLE ADM-00028245-NO - BOREHOLE LOGS.GPJ ONTARIO MOT.GDT 2/3/16

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

Brampton, Ontario

RECORD OF BOREHOLE No BH-3A

1 OF 1

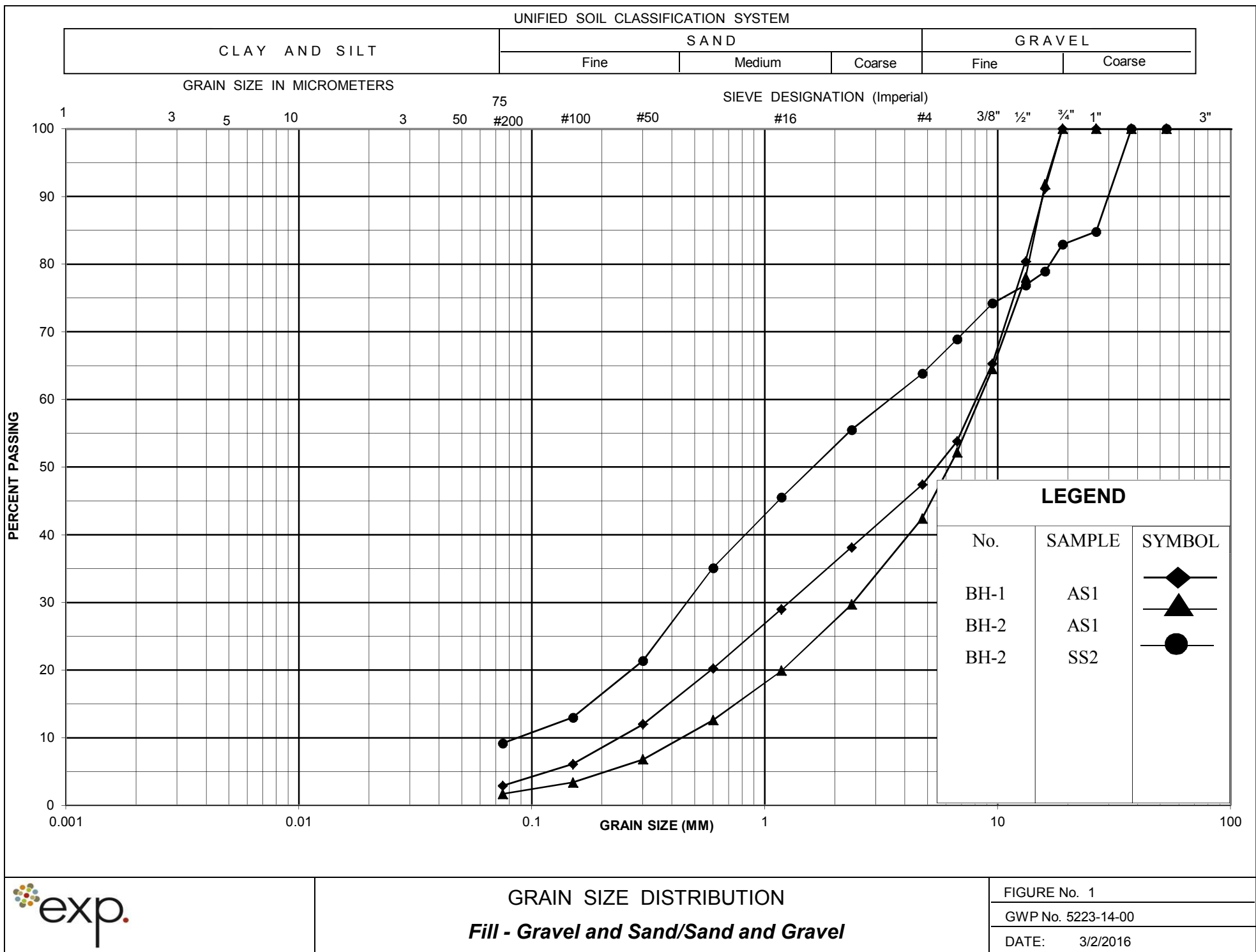
METRIC

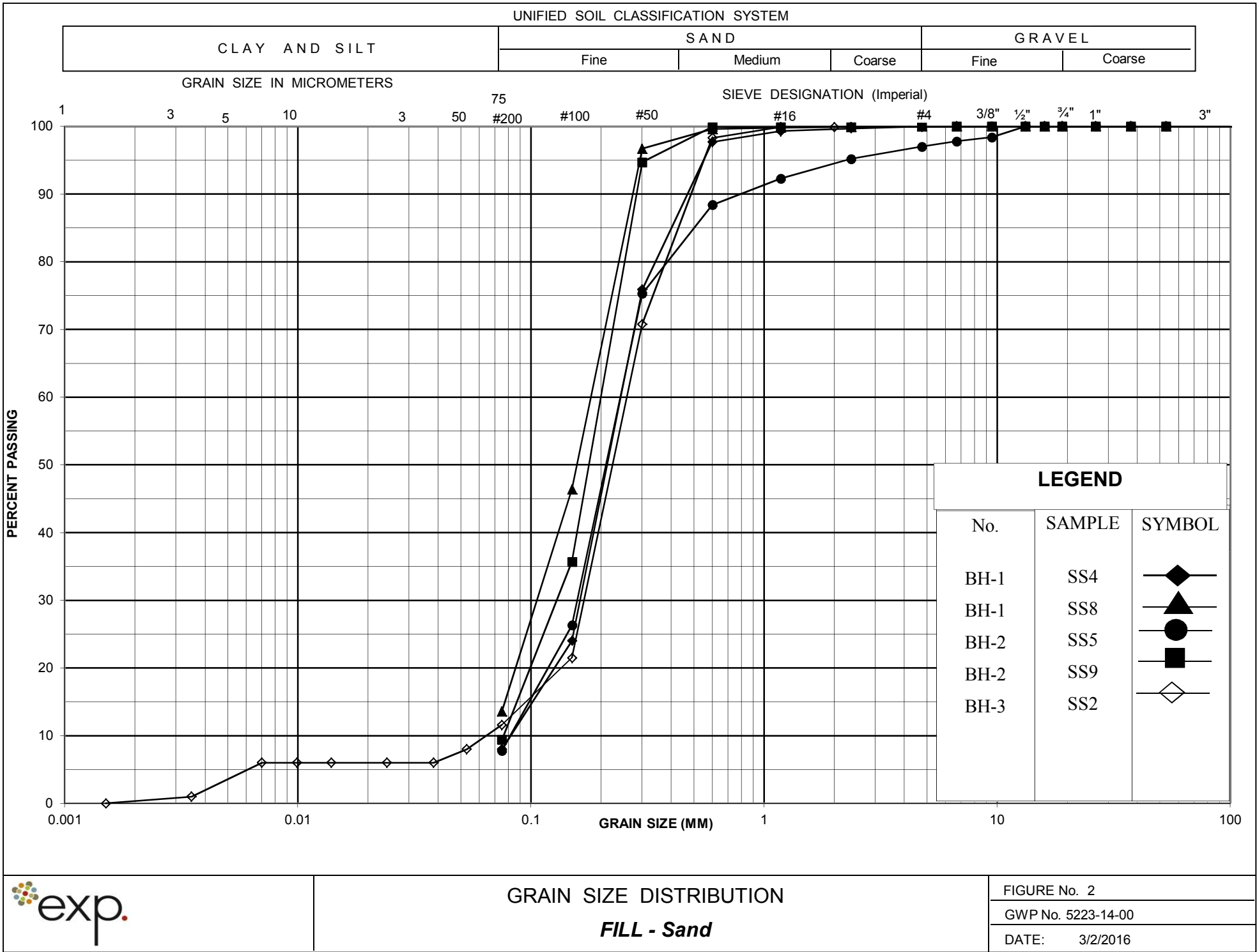
W. P. 5223-14-00 LOCATION CPR Overhead Bridge (Site 46-226), (N 5159253 E 282728) ORIGINATED BY NW
 DIST Hwy 144 Sudbury BOREHOLE TYPE Hand Equipment COMPILED BY KR
 DATUM Geodetic (Hand-held GPS) DATE 2015/12/14 - 2015/12/15 CHECKED BY IM

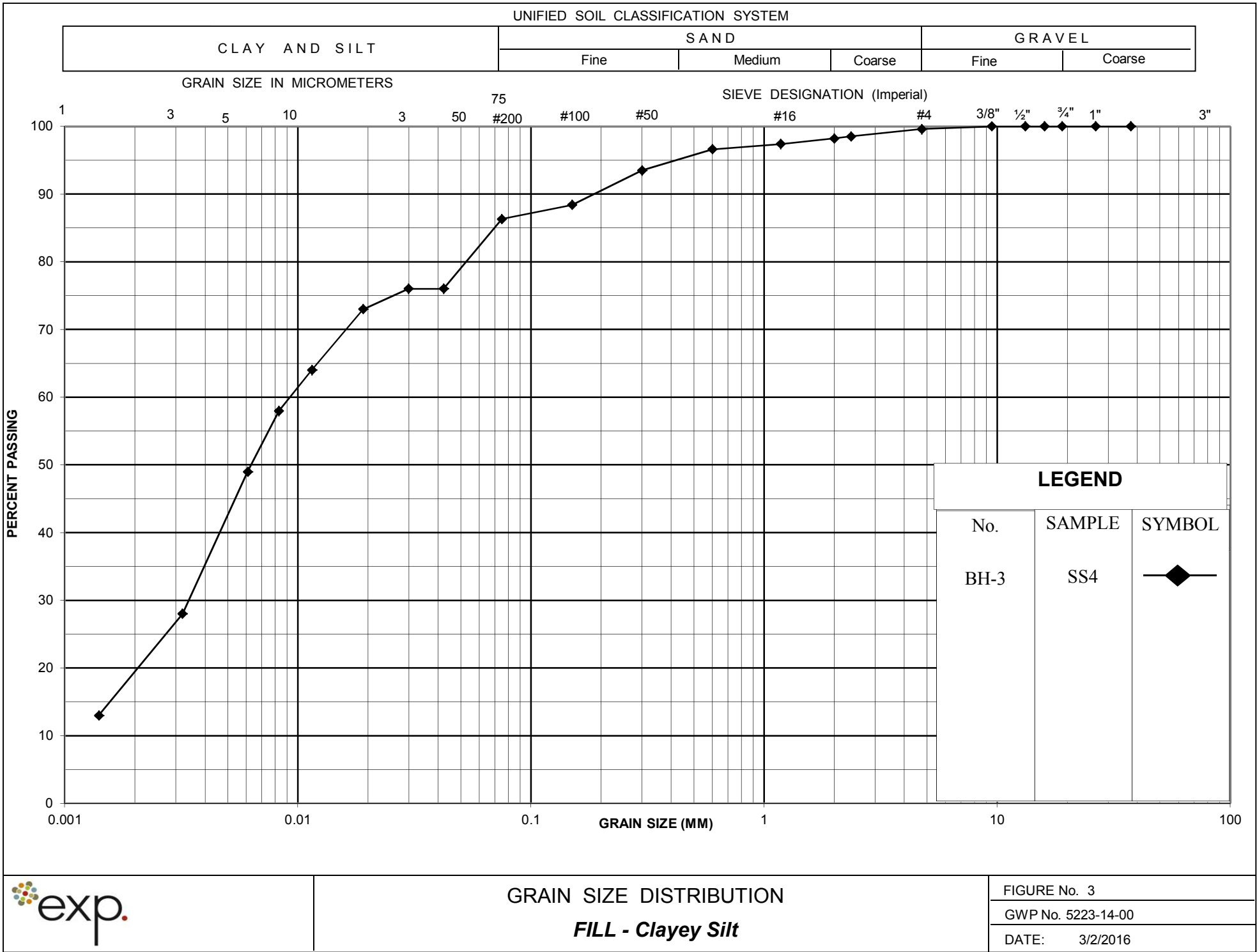
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|---|------------|---------|------|------------|----------------------------|-----------------|---|----|----|----|-----|---|---|----------------|---|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | 20 | 40 | 60 | 80 | 100 | W _p | W | W _L | | |
| 274.0 | DCPT commenced from surface. | X | | | | | | | | | | | | | | | |
| | | X | | | | | | | | | | | | | | | |
| | | X | | | | | | | | | | | | | | | |
| | | X | | | | | | | | | | | | | | | |
| 271.3 | | X | | | | | | | | | | | | | | | |
| 2.7 | END OF BOREHOLE | | | | | | | | | | | | | | | | |
| | NOTES: 1. This drawing is to be read with the subject report and project numbers as presented above. 2. Interpretation assistance by exp is required before used by others. | | | | | | | | | | | | | | | | |

OPG_EXP RECORD OF BOREHOLE ADM-00028245-NO - BOREHOLE LOGS.GPJ ONTARIO MOT.GDT 2/3/16

Appendix D – Results of Laboratory Tests







GRAIN SIZE DISTRIBUTION

FILL - Clayey Silt

FIGURE No. 3

GWP No. 5223-14-00

DATE: 3/2/2016

Rehabilitation of CPR Overhead Bridge, Hwy 144, Sudbury

