FINAL REPORT

FOUNDATION INVESTIGATION REPORT

Deception Lake Culvert Replacement, Highway 516, Site No. 41S-147/C, District of Kenora

Agreement No. 6014-E-0017
Assignment No. 7
GWP 6364-14-01
Geocres No. 52J-014

Prepared for:

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exp Services Inc.
December 16, 2015

Ministry of Transportation

Foundation Investigation Report
Agreement No. 6014-E-0017
Assignment No. 7
GWP 6364-14-01
Geocres No. 52J-014

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Project Name:
Foundation Investigation Report for Deception Lake Culvert Replacement
Highway 516, Site No. 41S-147/C, District of Kenora, Ontario

Project Number:
ADM-00223648-F0

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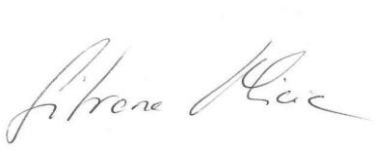

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December 16, 2015

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Appendices

Part I: FOUNDATION INVESTIGATION REPORT

1.1 Introduction

This foundation investigation report presents the results of a geotechnical investigation completed by **exp** Services Inc. for the replacement of the Deception Lake Culvert, located on Highway 516, about 15.2 km east of the junction of Hwy 516 and Hwy 642, in the District of Kenora, the Ministry of Transportation (MTO) Northwestern Region. The work was undertaken under Agreement # 6014-E-0017, Assignment No. 7 (GWP 6364-14-01). The terms of reference (TOR) were as presented in the MTO letter dated July 7, 2015.

Based on the information provided and our observations, the existing culvert is a corrugated steel pipe with a diameter of about 3.2 m and a length of about 29.22 m. It is understood that the existing culvert was constructed at an unknown date, and is intended to be replaced with a new culvert along the same alignment.

The purpose of the investigation was to evaluate the subsurface conditions along the alignment, to permit detailed design for the culvert replacement. The site specific geotechnical investigation consisted of borings, soil sampling, borehole logging, and field 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.

1.1 Site Description and Geological Setting

1.1.1 Site Description

As shown on Drawing 1 (Appendix B), the Deception Lake Culvert is located on Highway 516, about 15.2 km east of the junction of Hwy 516 and Hwy 642, in the District of Kenora, northeast of Sioux Lookout, Ontario. At the site, Hwy 516 is a two lane roadway, with a speed limit of 80 km/h and is about 8.2 m wide from edge of pavement to edge of pavement, with sand and gravel shoulders. Based on drawings provided, the roadway embankment is about 4.0 m high with shelfed side slopes on both sides of the highway. The north side has a shelf slope of about 3.6H:1V from the edge of pavement to the top of culvert and a secondary slope of about 1H:1V from the top of culvert to the base. The south side has a shelf slope of about 6H:1V from the edge of pavement to the top of culvert and a secondary slope of about 1H:2V from the top of culvert to the toe.

During the fieldwork on August 12 to 14, 2015, the general site conditions were assessed. Hwy 516 runs in a generally east and west direction and the water flows from south (Deception Lake) to north (Deception Bay) beneath the highway. At the time of this investigation, the approximate lake elevations at the inlet and outlet were both about 356.58 m. The elevation of highway pavement centerline at the culvert centerline is about 359.67 m. Guard rails were present on both sides of the roadway at the culvert location.

The vicinities of the inlet and outlet of the culvert are free from vegetation. The surrounding area of the culvert (i.e. the shoreline) contained some tall grasses. The inlet and outlet appeared to be generally clear of debris and as such the flow does not appear to be restricted.

Select photographs are provided in Appendix A.

1.1.2 Geological Setting

According to the MNR Northern Ontario Engineering Geology Terrain Data Base Map, Ontario Geological Survey Map 5114, Scale 1:100,000, dated 1979, the underlying native soil at the site consists of silt till ground moraine with bedrock below a drift veneer and a subordinate landform consisting of bedrock knob and peat organic terrain; mainly moderate local relief, undulating to rolling, washed, reworked and mixed wet and dry surface conditions.

According the Ministry of Northern Development and Mines (MNDM) Bedrock Geology of Ontario, West-Central Sheet Map No. 2542, Scale 1:1,000,000, dated 1991, the bedrock geology of the site is intrusive Tonalite Suites of the Neo to Mesoarchean Era (2.5 to 3.4 Ga), and generally consists of tonalite to granodiorite rock in massive, foliated or gneissic formations.

1.2 Investigation Procedures

1.2.1 Site Investigation and Field Testing

The field investigation was performed on August 12 to 14, 2015. The field program consisted of drilling four (4) sampled boreholes (BH101 to BH104). Two (2) boreholes were located within the highway, BH101, and BH102. BH101 was located about 6.0 m west of the culvert centerline and about 3.0 m south of the highway centerline. BH102 was located about 6.6 m east of the culvert centerline and about 1.4 m north of the highway centerline. An additional two (2) boreholes (BH103 and BH104) were advanced off of the highway. BH103 was located about 23 m east of the culvert centerline and about 12 m south of the highway centerline (inlet/upstream side). BH104 was located about 15 m west of the culvert centerline and about 15 m north of the highway centerline (outlet/downstream side). The borehole locations are shown on Drawing 1 in Appendix B.

All the boreholes (BH101 to BH104) were advanced using a CME 850 track mounted drill rig. The drill rig was equipped with hollow stem continuous flight augers and standard soil sampling equipment (includes 51 mm outside diameter split spoon samplers and *in situ* shear vane testing equipment). In addition, the CME 850 drill rig was equipped with rock coring equipment (HQ size). The roadway boreholes BH101 and BH102 were advanced to depths of about 11.3 m, 9.5 m below ground surface, respectively. The off-road boreholes BH103 and BH104 were advanced to auger and SPT refusal, at depths of about 5.6 m and 3.7 m below ground surface, respectively. The off-road boreholes were terminated at the refusal depths.

At BH101 and BH102, rock coring techniques were initiated at about 8.2 m and 6.7 m depth, respectively, to advance the borehole into the bedrock. BH101 and BH102 were advanced to about 3.1 m and 2.8 m into bedrock, respectively, and rock core samples were collected at both borehole locations. No rock coring techniques were conducted at the remaining borehole locations.

It is noted that at both roadway borehole locations, BH101 and BH102, refusal to auger was encountered within the fill at about 1.0 m and 3.1 m below ground surface, respectively. At original borehole BH101, rock coring casing (HW size) was used to advance the borehole beyond auger refusal; however, at a depth of 4.6 m, a field decision was made to relocate the borehole about 1.4 m west of the original location. Upon refusal at BH102, the borehole was relocated about 1 m east, rather than continuing with rock coring casing. The final borehole locations of BH101 and BH102 are shown on drawings in Appendix B.

The borehole locations were referenced to the MTM ON-16 NAD83 coordinate system and their ground surface elevations were surveyed by **exp** personnel. The ground surface elevations, including top of water at the lake, were referenced to a geodetic benchmark (BM) provided (tablet in rock) west of the site and south of the highway. The BM elevation is 359.956 m. The location of the BM is shown on Drawing 1, in Appendix B.

During the drilling of the boreholes (BH101 to BH104), 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), and were generally performed at intervals of about 0.75 m. The original field (uncorrected) SPT "N" values were recorded on the borehole logs as recommended in the Canadian Foundation Engineering Manual and used to provide an assessment of *in-situ* compactness (cohesionless) or consistency (cohesive) soils. In addition, samples were collected directly from the auger flighting in the upper 0.8 m at BH104.

Upon completion of the boreholes, groundwater level measurements were carried out in boreholes in accordance with the Ministry of Transportation guidelines. The measured groundwater levels after completion of drilling boreholes were recorded on borehole log sheets in Appendix C. The boreholes were backfilled with a mixture of bentonite and auger cuttings. The borehole decommissioning was in general 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. All of the recovered soil samples were placed in labelled moisture-proof bags which, along with the rock cores, were brought to **exp**'s Thunder Bay laboratory for additional visual, textual and olfactory examination, and for subsequent examination by a geotechnical engineer and laboratory testing.

1.2.2 Laboratory Testing

All samples brought to the laboratory were subjected to visual examination and classification. The laboratory testing program included the determination of natural moisture content and particle size distribution for approximately 25% of the collected soil samples. Atterberg Limits tests were carried out on select cohesive soil samples. All of the laboratory tests were carried out in accordance with MTO and/or ASTM Standards, as appropriate, at the **exp** laboratory in Thunder Bay, Ontario.

The laboratory test results are provided on the attached borehole log sheets in Appendix C as well as graphically in Appendix D.

In addition, chemical testing of two select soil samples were conducted. The soil samples was sent via courier, in a secure cooler under chain of custody, to Maxxam Analytics Inc., a CALA-certified and accredited laboratory in Mississauga, Ontario. Details of the chemical testing are discussed below and the lab results are included in Appendix E.

1.3 Subsurface Conditions

The detailed subsurface conditions encountered in the boreholes advanced during this investigation are presented on the Borehole Records in Appendix C. Laboratory test results are provided in Appendix D. The "Explanation of Terms Used on Borehole Records" preceding the borehole logs in Appendix C forms an integral part of and should be read in conjunction with this report. In addition, photographs of the bedrock core obtained are included in Appendix C.

A borehole location plan and stratigraphic sections are provided in Appendix B. It should be noted that the stratigraphic boundaries indicated on the borehole log and stratigraphic sections are inferred from semi-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 interpreted as exact planes of geological change. Furthermore, subsurface conditions may vary between and beyond the borehole locations.

In general, the subsurface conditions along the proposed culvert alignment consist of a layer of fill material composed of silty sand with gravel, and poorly graded sand. In general, the fill was overlying silty sand till and overlying bedrock. A more detailed summary of the subsurface conditions encountered in the boreholes is provided in the following sections.

1.3.1 Silty Sand with Gravel Fill

Silty sand with gravel fill was encountered beneath the asphalt at BH101 and BH102. The asphalt thickness was about 65 mm. The silty sand with gravel fill was generally described as very dense, brown, damp and containing occasional cobbles at depth. The SPT "N" values ranged between 63 and 80 blows per 300 mm penetration, with an average "N" value of about 70. The silty sand with gravel fill extended to a depth of about 1.5 m below ground surface at both of the borehole locations with elevations of about 358.2 m and 358.3 m at BH101 and BH102, respectively.

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

Moisture content:

- 4.9% to 5.1%

Grain size distribution:

- 16% gravel;
- 72% sand; and
- 12% silt and clay size.

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

1.3.2 Poorly Graded Sand Fill

Poorly graded sand fill was encountered underlying the silty sand with gravel fill and at BH103. The poorly graded sand fill was generally described as dense to very loose at depth, brown and damp to wet at depth. Occasional cobbles were encountered at BH102 and BH103. At BH101 about 300 mm of sand blow up were noted at about 4.6 m, 5.3 m and 6.1 m depth. The SPT "N" values ranged between 2 and 74 blows per 300 mm penetration, with an average "N" value of about 17. The poorly graded sand fill extended to depths of 6.1 m (353.6 m elevation), 5.6 m (354.2 m elevation), and 2.3 m (356.0 m elevation) at BH101, BH102 and BH103, respectively.

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

Moisture content:

- 0.9% to 17.3%

Grain size distribution:

- 10% gravel;
- 88% sand; and
- 2% silt and clay size.

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

1.3.3 Peat / Rootmat

Peat was encountered beneath the fill at BH102 and rootmat was encountered surfacing BH103 and BH104. The peat was described as soft, dark brown, wet and containing trace gravel and some sand. One (1) SPT was performed in the peat, the SPT "N" value was 2 blows per 300 mm penetration. The rootmat was described as soft, dark brown and wet. One (1) SPT was performed in the rootmat and the SPT "N" value was 4 blows per 300 mm penetration. The peat was about 500 mm in thickness and extended to a depth of about 6.1 m (353.7 m elevation) below ground surface. The rootmat extended to depths of about 0.1 m (358.1 m elevation) and 0.2 m (356.9 m elevation) below ground surface.

Laboratory testing performed on selected samples of the peat and rootmat consisted of moisture content. The test results are as follows:

Moisture content:

- 20.5% to 33.8%

The results of the moisture content tests are provided on the record of borehole sheets in Appendix C.

1.3.4 Silty Clay to Clayey Silt

Silty clay to clayey silt was encountered underlying the poorly graded sand fill at BH103 and beneath the rootmat at BH104. The silty clay to clayey silt was generally described as firm to very soft, brown to grey, wet, and containing trace rootlets or organics. The SPT "N" values ranged between 1 and 6 blows per 300 mm penetration, with an average "N" value of about 4. Due to the gravel and sand content, *in situ* vane shear tests were not performed. The silty clay to clayey silt extended to depths ranging between about 3.1 m and about 3.4 m below ground surface, and elevations ranging between 354.0 m and 354.9 m.

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

Moisture content:

- 14.7% to 27.6%

Grain size distribution:

- 1% to 8% gravel;
- 1% to 29% sand;
- 39% to 53% silt; and
- 28% to 45% clay size.

Total saturated unit weights have been calculated based on the moisture contents and are estimated to range from about 19.4 to 21.7 kN/m^3. Three (3) Atterberg Limits tests were performed on representative samples of the silty clay to clayey silt (BH103-S4, BH104-S3 and BH104-S5B). The results indicated that the soil is of medium plasticity. The data is shown on the plasticity chart, Figure 5. The liquid limit, plastic limit and plasticity index ranged between about 31 and 37, 13 and 17, and 15 and 23, respectively.

The results of the moisture content, grain size distribution and Atterberg Limits tests are provided on the record of borehole sheets in Appendix C. The results of the grain size distribution are also provided on Figure 3 in Appendix D, and Atterberg Limits tests are provided on Figure 5 in Appendix D.

1.3.5 Silty Sand

Silty sand was encountered underlying the silty clay at BH103 and within the silty clay to clayey silt at BH104. The silty sand was generally described as very loose to loose, brown, and wet. The SPT "N" values ranged between 1 and 8 blows per 300 mm penetration, with an average "N" value of about 3. The silty sand extended to depths ranging between about 2.4 m and about 3.8 m below ground surface, and elevations ranging between 354.4 m and 354.7 m.

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

Moisture content:

- 12.3% to 17.4%

Grain size distribution:

- 7% gravel;
- 66% sand; and
- 27% silt and clay size.

Total saturated unit weights have been calculated based on the moisture contents and are estimated to range from about 21.1 to 22.3 kN/m^3.

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

1.3.6 Silty Sand Till to Silty Sand with Gravel Till

Silty sand till to silty sand with gravel till was encountered underlying the fill at BH101, the peat at BH102, the silty sand at BH103 and the clayey silt at BH104. The till was generally described as compact to very dense, grey, and moist. Occasional cobbles were encountered at BH104. Sand blow up of about 460 mm and 410 mm was noted at 4.6 m and 5.3 m depth, respectively, at BH103. The SPT "N" values ranged between 19 and 100 (i.e. SPT refusal) blows per 300 mm penetration, with an average "N" value of about 38. The till extended to depths ranging between about 3.7 m and about 8.2 m below ground surface, and elevations ranging between 351.5 m and 353.4 m.

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

Moisture content:

- 7.4% to 10.2%

Grain size distribution:

- 13% to 25% gravel;
- 52% to 66% sand;
- <13% to 25% silt; and
- 3% to <23% clay sizes.

Total saturated unit weights have been calculated based on the moisture contents and are estimated to range from about 22.9 to 23.7 kN/m^3.

The results of the moisture content and grain size distribution tests are provided on the record of borehole sheets in Appendix C. The results of the grain size distribution are also provided on Figure 4 in Appendix D.

1.3.7 Bedrock

Bedrock was encountered underlying the till at BH101 and BH102 at depths of about 8.2 m (351.5 m elevation) and 6.7 m (353.1 m elevation), respectively. The bedrock at BH101 was described as weak to medium strong (5 MPa to 50 MPa compressive strength), white, grey, black and green in colour, severely fractured to fractured and medium to fine grained, diorite. The bedrock at BH102 was described as medium strong (25 MPa to 50 MPa), pink, white and black in colour, fractured and coarse grained (pegmatitic), granite. The boreholes were extended by rock coring about 2.8 m to 3.1 m into bedrock, and to depths ranging between about 9.5 m and 11.3 m below ground surface. The boreholes were terminated at elevations ranging between about 348.4 m and 350.3 m. Photographs of the bedrock core samples are presented in Appendix C, after the Borehole Logs.

Gross recoveries ranged between about 93% and 100%. The Rock Quality Designation (RQD), which is a modified core recovery, ranged between 36% and 69% (severely fractured to fractured).

1.4 Groundwater and Surface Water Conditions

Information on groundwater levels at the site was obtained by measuring the water levels in the open boreholes after completion of drilling. The groundwater levels encountered in the boreholes are shown on the borehole logs and presented below in Table 1.1.

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.

Table 1.1. Groundwater data

Borehole	Date Completed	Date Measured	Ground Surface Elevation[2]	Depth to Water[3]	Groundwater Elevation
BH101	Aug. 13/15	Aug. 13/15	359.71	2.90	356.81
BH102	Aug. 14/15	Aug. 14/15	359.78	2.77	357.01
BH103	Aug. 14/15	Aug. 14/15	358.25	1.22	357.03
BH104	Aug. 14/15	Aug. 14/15	357.07	0.61	356.46
Deception Lake WL Upstream (South) Side	--	Aug. 17/15	--	--	356.58[4]
Deception Bay WL Downstream (North) Side	--	Aug. 17/15	--	--	356.58[4]

Borehole	Date Completed	Date Measured	Ground Surface Elevation[2]	Depth to Water[3]	Groundwater Elevation

Notes:
1) All units in metres.
2) Elevations surveyed are referenced to a geodetic benchmark (BM) provided (tablet in rock) west of the site and south of the highway. The BM elevation is 359.956 m.
3) Depths are relative to ground surface.
4) Indicates top of surface water elevation at Deception Lake and Deception Bay.

1.5 Chemical Analyses

Two soil samples were selected for chemical analyses and were sent via courier, in a secure cooler under chain of custody, to Maxxam Analytics Inc., a CALA-certified and accredited laboratory in Mississauga, Ontario. The analytical laboratory results are presented in Appendix E, and are summarized in Table 1.2, below.

Table 1.2. Corrosivity Chemical Analysis

Sample Identification	pH (unitless)	Soluble Chloride (ppm)	Soluble Sulphate (ppm)	Resistivity (ohm-cm)	Conductivity (µS/cm)
BH101-S10	7.93	41	<20	7,400	135
BH104-S2	7.56	45	<20	5,700	176

1.2 Closure

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 Ahileas Mitsopoulos, P.Eng., Nimesh Tamrakar, M.Eng, EIT., Demetri N. Georgiou, MASc. P.Eng., and Silvana Micic, Ph.D., P.Eng. It was reviewed by TaeChul Kim, P.Eng. and by Stan E. Gonsalves, M.Eng., P.Eng., Designated MTO Foundation Contact. The field investigation was supervised by Elwin Farkas.

Yours truly,

exp Services Inc.

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Encl.

Appendix A –
Site Photographs

Photo 1. Existing culvert inlet on south side of highway

Photo 2. Existing culvert outlet on north side of highway

Photo 3. Facing west on Highway 516 before the existing culvert

Photo 4. Facing east on Highway 516 before the existing culvert

Photo 5. Embankment slope on north side facing east

Photo 6. Embankment slope on south side facing east

Appendix B – Drawings

Agreement No. 6014-E-0017
Assignment No. 7
GWP 6364-14-01

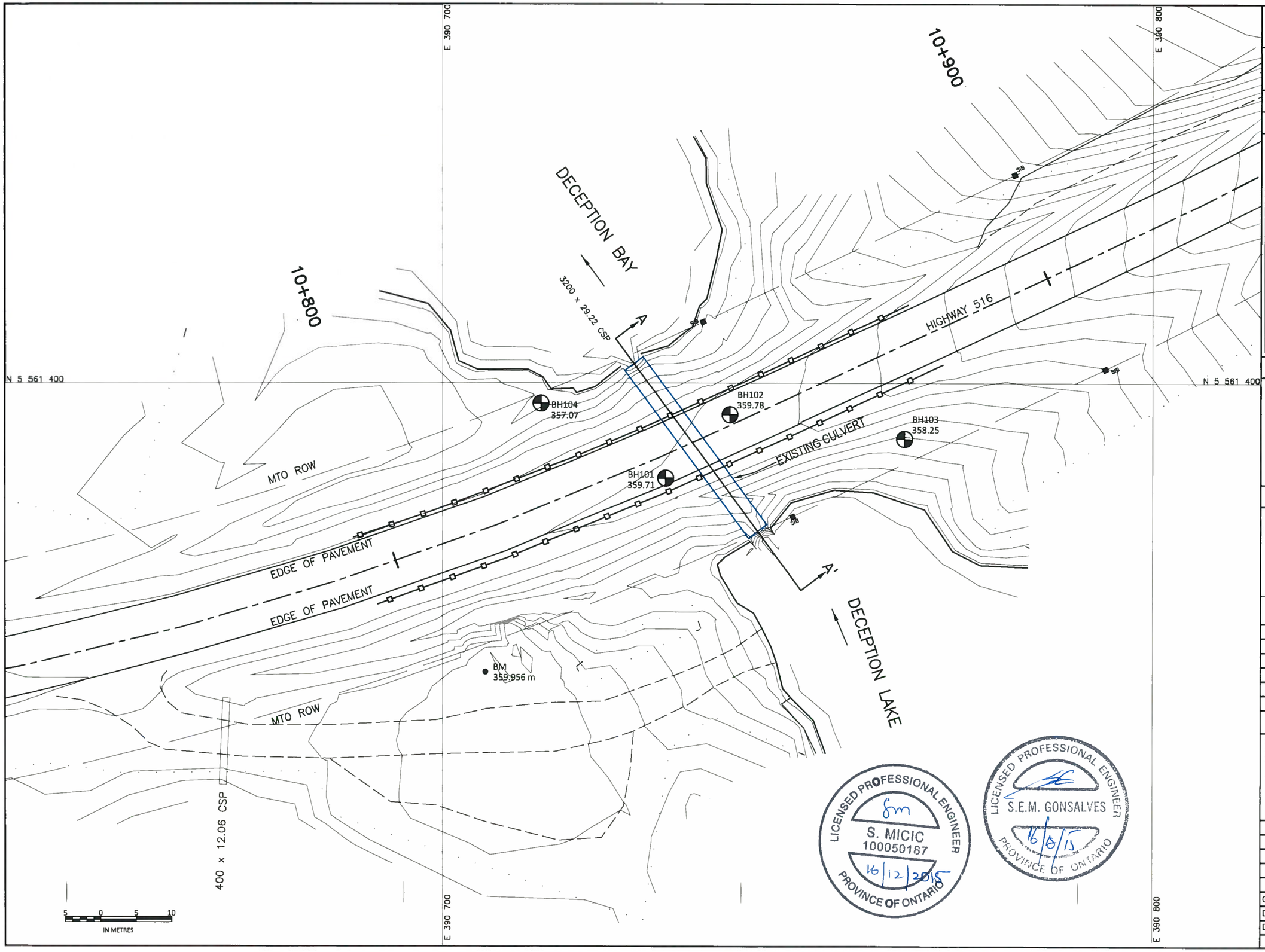
DECEPTION LAKE CULVERT

(Highway 516, District of Kenora, ON)

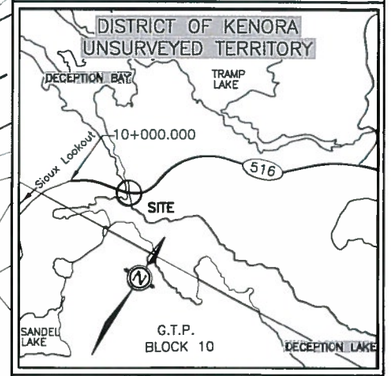
PLAN

DWG 1

exp. **exp** Services Inc.



KEY PLAN



LEGEND

BH101 359.71	BOREHOLE LOCATION GROUND SURFACE ELEVATION IN METRES
BM 359.956 m	BENCHMARK LOCATION GEODETIC ELEVATION IN METRES

BH No.	APPROX. ELEV. (m)	MTM COORDINATES	
		NORTH	EAST
BH101	359.71	5,561,387	390,731
BH102	359.78	5,561,400	390,740
BH103	358.25	5,561,392	390,765
BH104	357.07	5,561,398	390,715

NOTES

1. ALL DIMENSIONS ARE IN METRES.
2. BASE MAP PROVIDED BY CLIENT.
3. MTM COORDINATES BASE ON MTM ZONE ON-16 PROJECTION, AS PER PROVIDED FIGURE.
4. THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. THE PROPOSED STRUCTURE DETAILS/WORKS ARE SHOWN FOR ILLUSTRATION PURPOSES ONLY.

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REVISIONS		
DATE	BY	DESCRIPTION

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Date: December 11, 2015	Scale : 1:500
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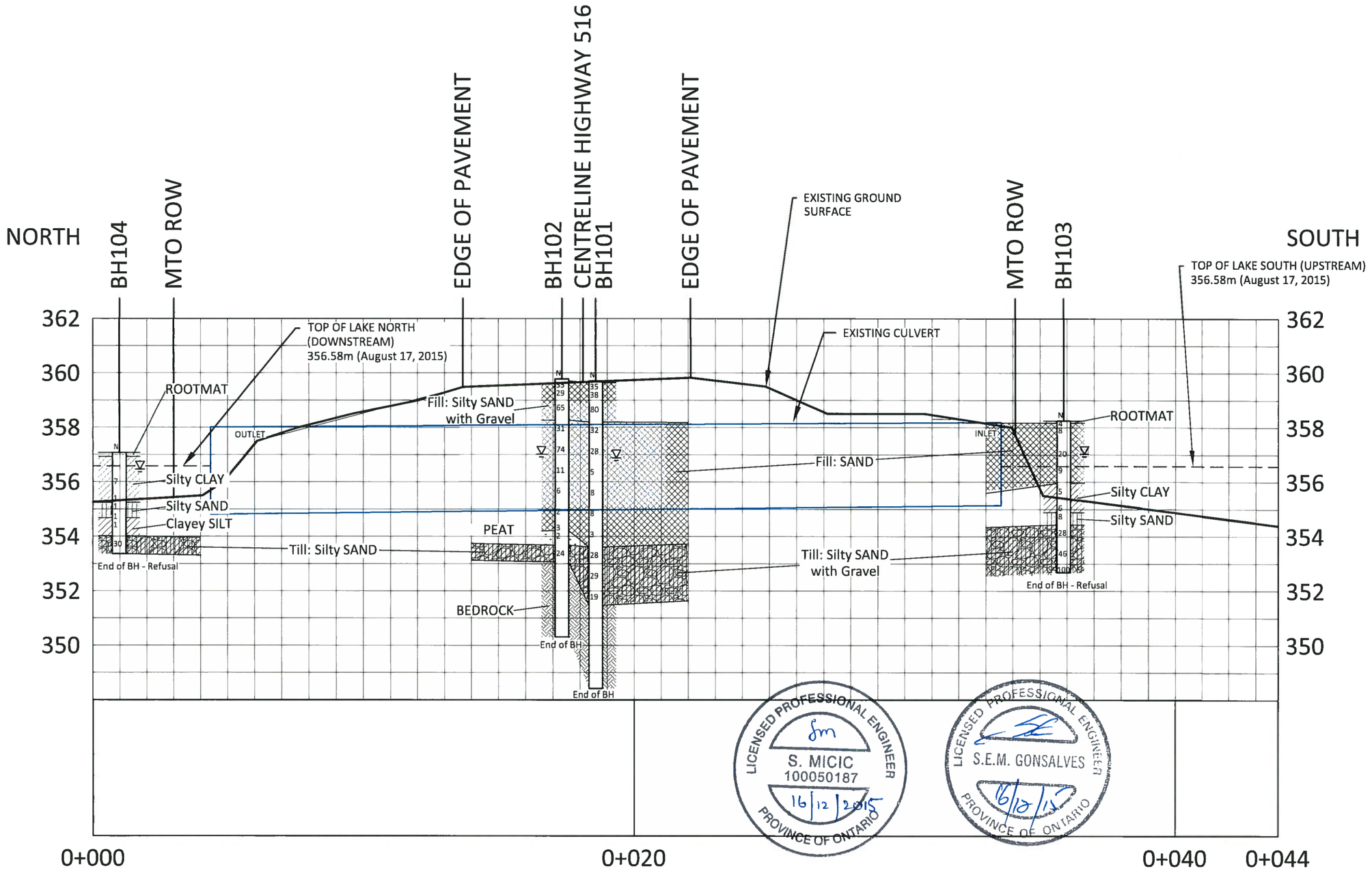
	Checked By: DG



A - A'

PROFILE OF DECEPTION LAKE CULVERT

3 0 3 6

IN METRES

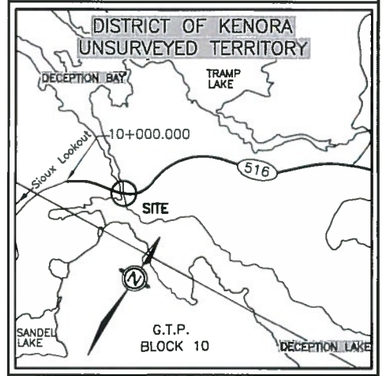
Agreement No. 6014-E-0017
Assignment No. 7
GWP 6364-14-01

DECEPTION LAKE CULVERT
(Highway 516, District of Kenora, ON)
Section A-A'

DWG 2

exp. **exp** Services Inc.

KEY PLAN



LEGEND

N STANDARD PENETRATION TEST (BLOWS/0.3 m)

MEASURED WATER LEVEL

BH No.	APPROX. ELEV. (m)	MTM COORDINATES	
		NORTH	EAST
BH101	359.71	5,561,387	390,731
BH102	359.78	5,561,400	390,740
BH103	358.25	5,561,392	390,765
BH104	357.07	5,561,398	390,715

NOTES

1. ALL DIMENSIONS ARE IN METRES.
2. BASE MAP PROVIDED BY CLIENT.
3. MTM COORDINATES BASED ON MTM ZONE ON-16 PROJECTION, AS PER PROVIDED FIGURE.
4. BOREHOLE LOCATIONS ARE PROJECTED PERPENDICULAR TO THE SECTION LINE A-A'.
5. THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. THE PROPOSED STRUCTURE DETAILS/WORKS ARE SHOWN FOR ILLUSTRATION PURPOSES ONLY.

REVISIONS

DATE	BY	DESCRIPTION

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GEOCRES No. 52J-014	Project No. ADM-00223648-F0
Date: December 11, 2015	Horizontal Scale : 1:150
Drawn By: RM	Vertical Scale : 1:150
Checked By: DG	Checked By: AM

Appendix C –
Borehole Logs and Bedrock Core Photos

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		

0.002	0.006	0.02	0.06	0.2	0.6	2.0	6.0	20	60	200

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≤Pp≤10%
Little	15≤Pp≤25%
Some	30≤Pp≤45%
Mostly	50≤Pp≤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≤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:

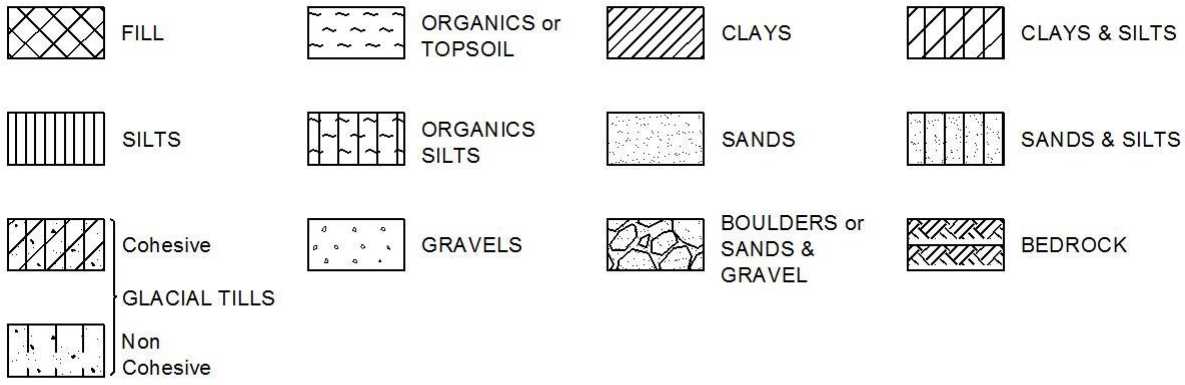
Table c: Consistency of Cohesive Soil

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

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

MECHANICALL PROPERIES 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'	$-^\circ$	Effective angle of internal friction
c_u	kPa	Apparent cohesion intercept
ϕ_u	$-^\circ$	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

RECORD OF BOREHOLE No BH101 1 OF 1 METRIC

W.P. GWP No. 6364-14-01 LOCATION **Deception Lake Culvert (Site No. 41S-147/C) MTM ON-16 5,561,387N 390,731E** ORIGINATED BY EF

DIST 61 HWY Hwy 516 BOREHOLE TYPE CME 850 Track Carrier / HSA / HQ COMPILED BY AM

DATUM **Geodetic** DATE 8.13.15 - 8.13.15 CHECKED BY DG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
359.7	Asphalt										
359.6 / 0.1	**ASPHALT** - about 65 mm										
	Silty SAND with Gravel (FILL) - very dense, brown, damp		S1A	SS	35				○		
			S1B	SS	38		359		○		16 72 (12)
	- occasional cobbles noted during augering at about 0.8 m depth		S2	SS	80						
358.2											
1.5	**Poorly Graded SAND (FILL)** - dense to compact, brown, damp		S3	SS	32		358		○		
			S4	SS	28	▽			○		
	- becoming loose to very loose, wet at about 3.0 m depth		S5	SS	5		357		○		
			S6	SS	8		356		○		
	- about 300 mm sand blowup at about 4.6 m depth		S7	SS	8		355		○		10 88 (2)
	- about 300 mm sand blowup at about 5.3 m depth		S8	SS	3		354		○		
353.6											
6.1	- about 300 mm sand blowup at about 6.1 m depth		S9	SS	28				○		25 52 (23)
	Silty SAND with Gravel (TILL) - compact, grey, moist						353				
			S10	SS	29						
			S11	SS	19		352		○		21 66 (13)
351.5											
8.2	**BEDROCK** - weak to medium strong, white, grey, black and green, severely fractured to fractured, medium to fine grained, diorite		S12	CORE			351				Recovery=100%, RQD=36%
							350				
			S13	CORE							Recovery=93%, RQD=66%
							349				
348.4											
11.3	**End of Borehole**										

$+^3$, $\times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No BH102 1 OF 1 METRIC

W.P. GWP No. 6364-14-01 LOCATION **Deception Lake Culvert (Site No. 41S-147/C) MTM ON-16 5,561,400N 390,740E** ORIGINATED BY EF

DIST 61 HWY Hwy 516 BOREHOLE TYPE CME 850 Track Carrier / HSA / HQ COMPILED BY AM

DATUM **Geodetic** DATE 8.14.15 - 8.14.15 CHECKED BY DG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
359.8	Asphalt										
359.7 / 0.1	**ASPHALT** - about 65 mm										
	Silty SAND with Gravel (FILL) - very dense, brown, damp		S1A	SS	35						
			S1B	SS	29						
	- occasional cobbles noted during augering at about 0.8 m depth		S2	SS	65		359				
358.3											
1.5	**Poorly Graded SAND (FILL)** - dense to very dense, brown, damp, occasional cobbles		S3	SS	31		358				
			S4	SS	74	▽	357				
	- becomimg compact to very loose, wet at about 3.0 m depth		S5	SS	11						
			S6	SS	6		356				
			S7	SS	2		355				
354.2			S8A	SS	3						
5.6	**PEAT** - soft, dark brown, wet, trace gravel, some sand		S8B	SS	2		354				
353.7											
6.1	**Silty SAND (TILL)** - compact, grey, moist		S9	SS	24						13 59 25 3
353.1							353				
6.7	**BEDROCK** - medium strong, pink, white and black, fractured, coarse grained (pegmatitic), granite		S10	CORE							Recovery=100%, RQD=69%
							352				
			S11	CORE			351				Recovery=99%, RQD=68%
350.3											
9.5	**End of Borehole**										

$+^3$, $\times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No BH103 1 OF 1 METRIC

W.P. GWP No. 6364-14-01 LOCATION **Deception Lake Culvert (Site No. 41S-147/C) MTM ON-16 5,561,392N 390,765E** ORIGINATED BY EF

DIST 61 HWY Hwy 516 BOREHOLE TYPE CME 850 Track Carrier / HSA COMPILED BY AM

DATUM **Geodetic** DATE 8.13.15 - 8.14.15 CHECKED BY DG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
358.2	Rootmat										
358.0 / 0.1	**ROOTMAT** - soft, dark brown, wet		S1A	SS	4		358				
	Poorly Graded SAND (FILL) - loose to compact, brown, damp, occasional cobbles		S1B	SS	8						
			S2	SS	20	▽	357				
	- becoming wet at about 1.5 m depth		S3	SS	9						
356.0							356				
2.3	**Silty CLAY** - firm, grey, wet to moist, trace rootlets		S4	SS	5						1 1 53 45
354.9			S5A	SS	6		355				
3.4	**Silty SAND** - loose, brown, wet		S5B	SS	8						7 66 (27)
354.4											
3.8	**Silty SAND with Gravel (TILL)** - compact to very dense, brown to grey, moist to wet		S6	SS	28		354				
	- about 460 mm sand blowup at about 4.6 m depth		S7	SS	46						19 63 (18)
352.7	- about 410 mm sand blowup at about 5.3 m depth		S8	SS	100		353				
5.6	**End of Borehole** - refusal to auger and SPT										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No BH104 1 OF 1 METRIC

W.P. GWP No. 6364-14-01 LOCATION **Deception Lake Culvert (Site No. 41S-147/C) MTM ON-16 5,561,398N 390,715E** ORIGINATED BY EF

DIST 61 HWY Hwy 516 BOREHOLE TYPE CME 850 Track Carrier / HSA COMPILED BY AM

DATUM **Geodetic** DATE 8.14.15 - 8.14.15 CHECKED BY DG

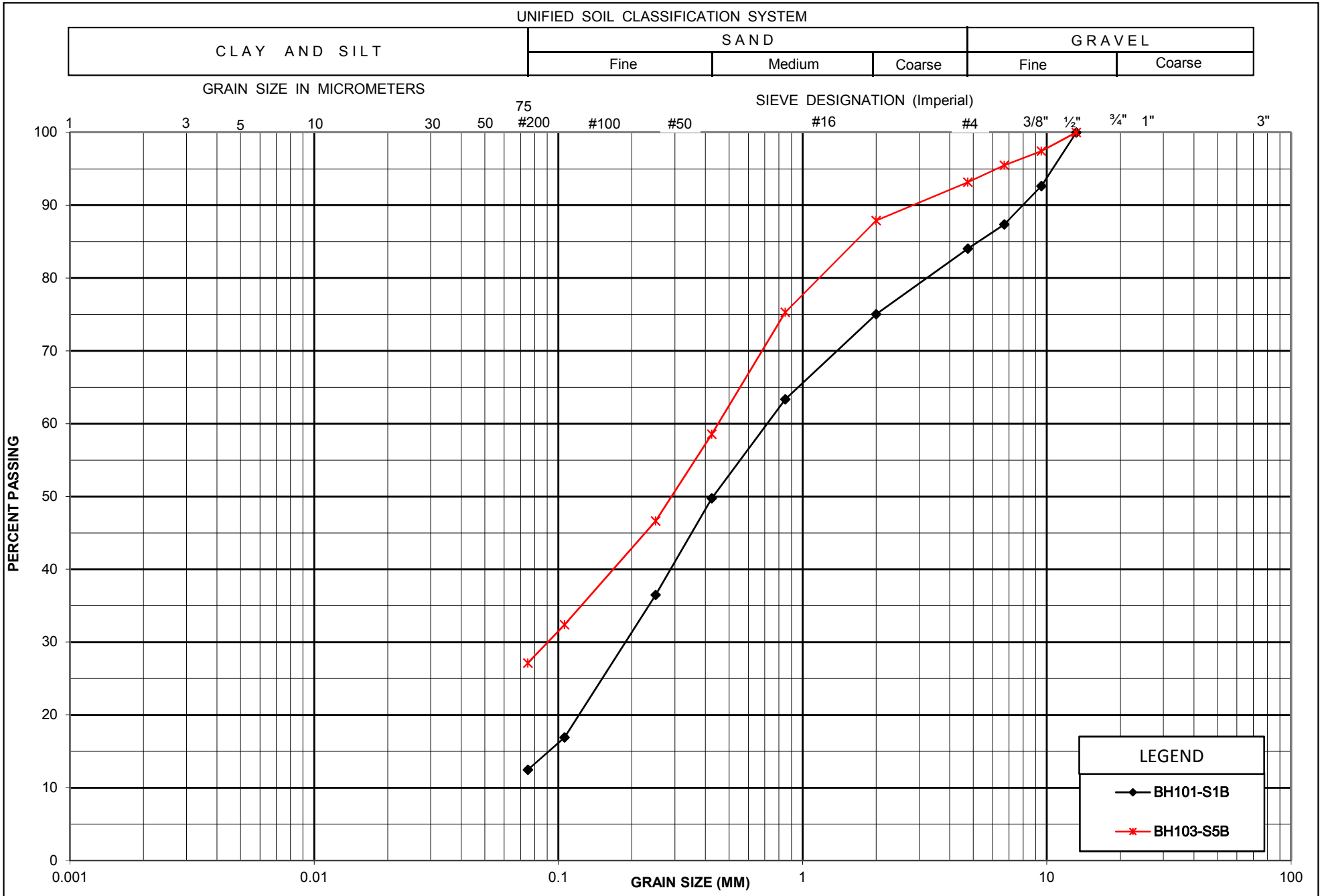
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
357.1	Rootmat										
356.9	**ROOTMAT** - soft, dark brown, wet		S1	AUGER			357				
0.2	**Silty CLAY** - stiff, brown, wet		S2	AUGER		▽					
			S3	SS	7		356				8 20 39 33
355.2			S4A	SS	1						
1.8	**Silty SAND** - very loose, brown, wet		S4B	SS	1		355				
354.7			S5A	SS	1						
2.4	**Clayey SILT** - very soft to soft, grey, wet, trace organics		S5B	SS	1						3 29 40 28
354.0							354				
3.1	**Silty SAND (TILL)** - compact to very dense, grey, moist, occasional cobbles		S6	SS	30						
353.4											
3.7	**End of Borehole** - refusal to SPT and auger										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

BH101 - Bedrock Core Samples with Depths and Elevations

BH102 - Bedrock Core Samples with Depths and Elevations

Appendix D – Laboratory Data



exp.

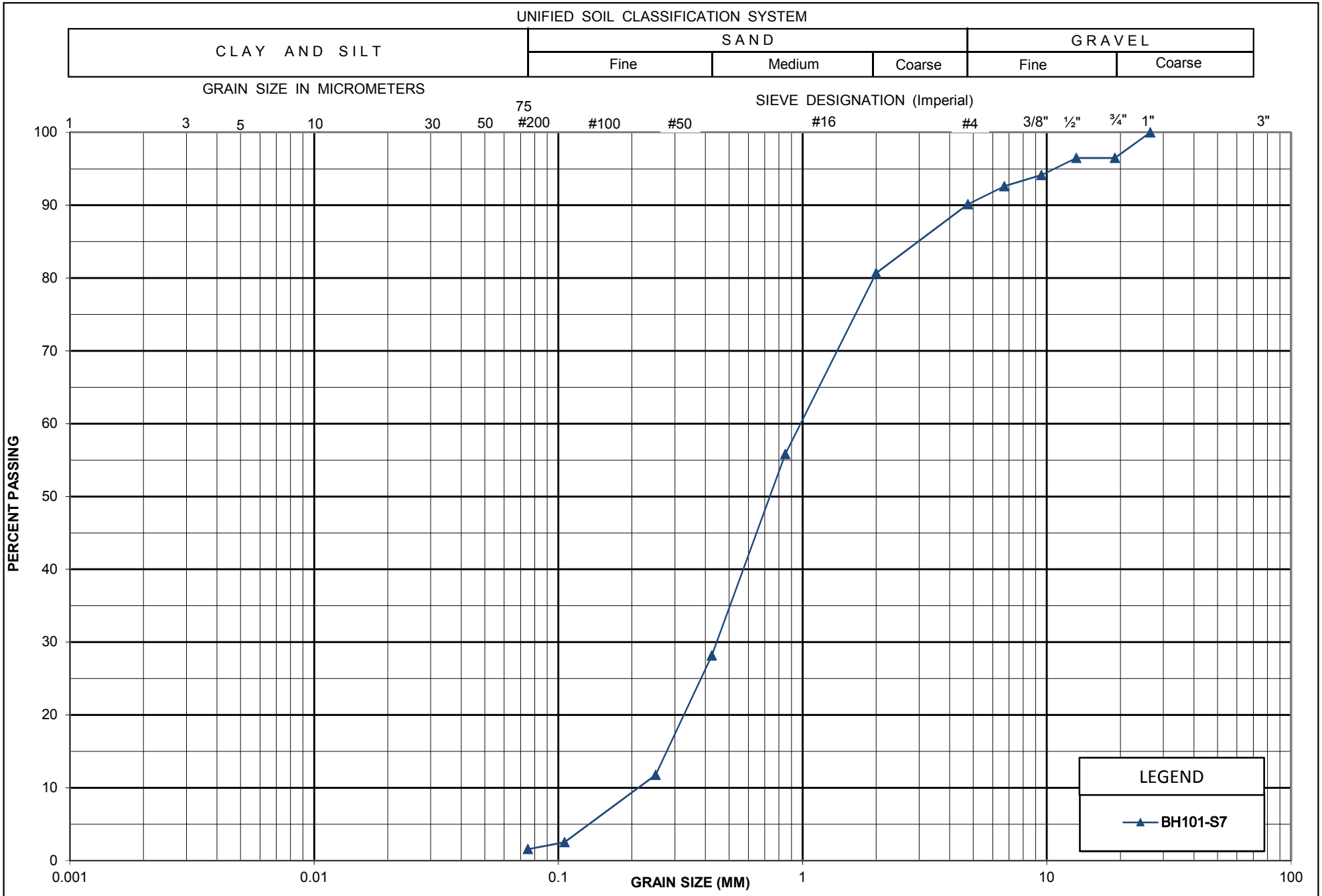
GRAIN SIZE DISTRIBUTION

Silty SAND

FIGURE: No. 1

GWP: 6364-14-01

DATE : September 18, 2015



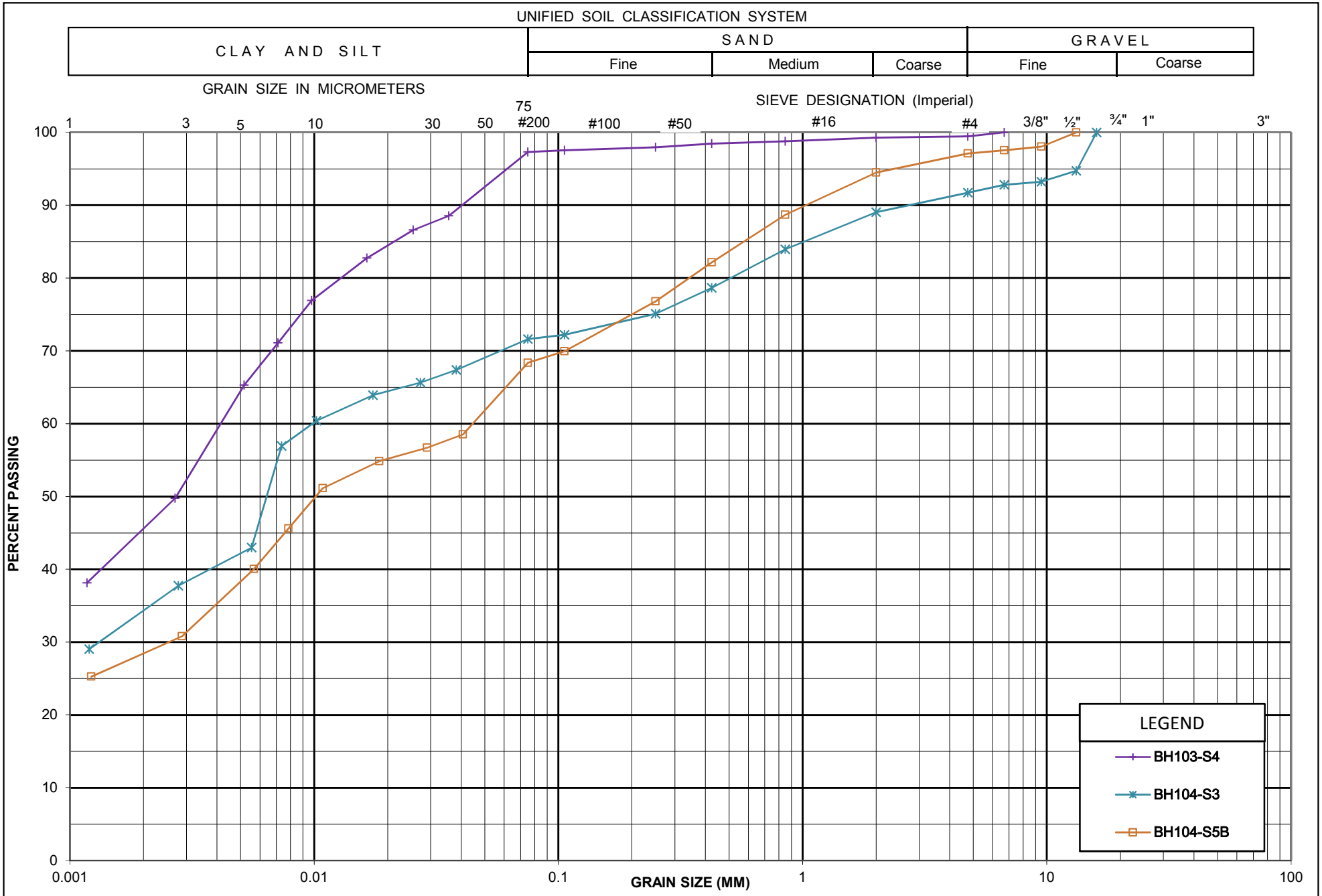
GRAIN SIZE DISTRIBUTION

Poorly Graded SAND

FIGURE: No. 2

GWP: 6364-14-01

DATE : September 18, 2015



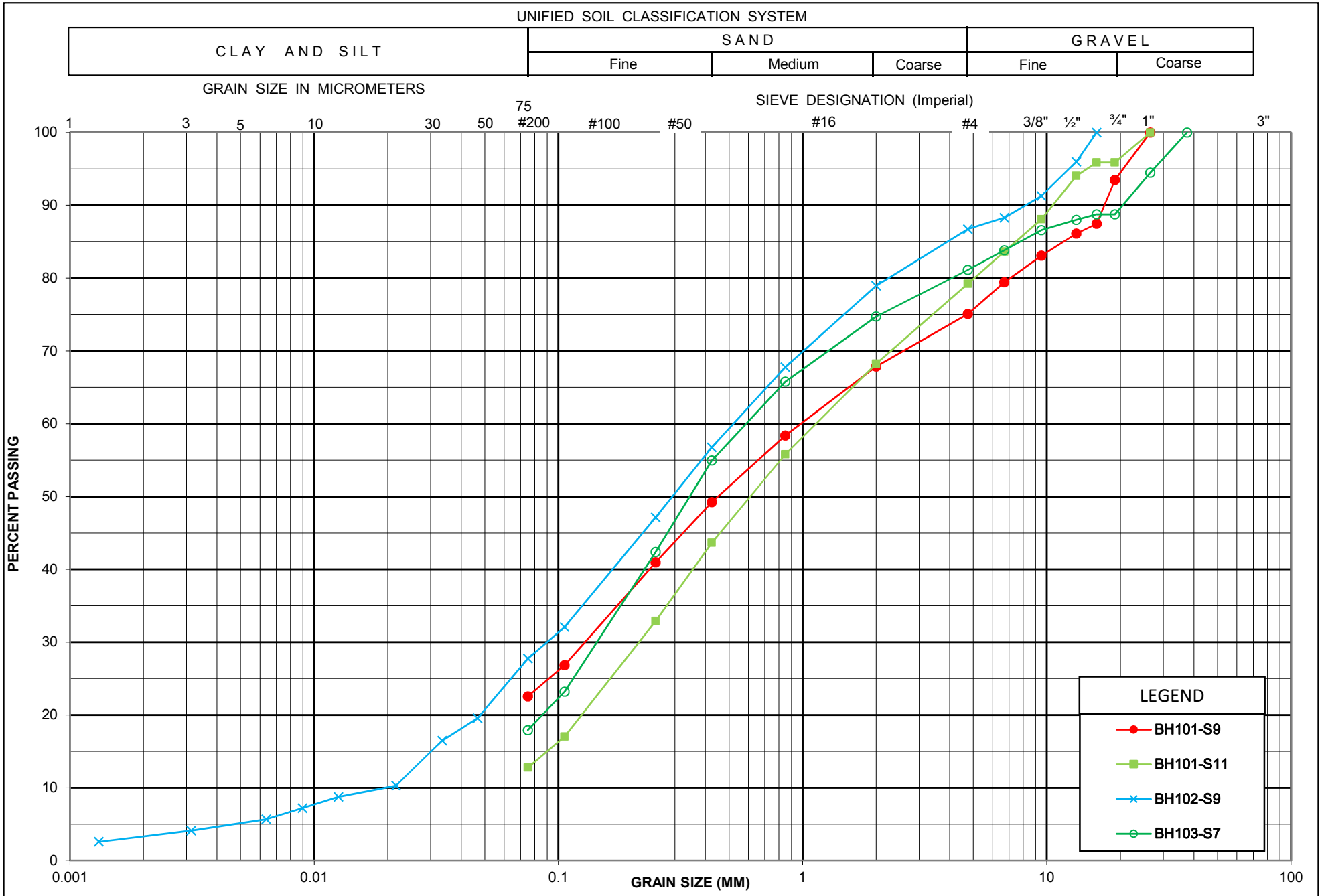
GRAIN SIZE DISTRIBUTION

Clayey SILT to Silty CLAY

FIGURE: No. 3

GWP: 6364-14-01

DATE : September 22, 2015



exp.

GRAIN SIZE DISTRIBUTION

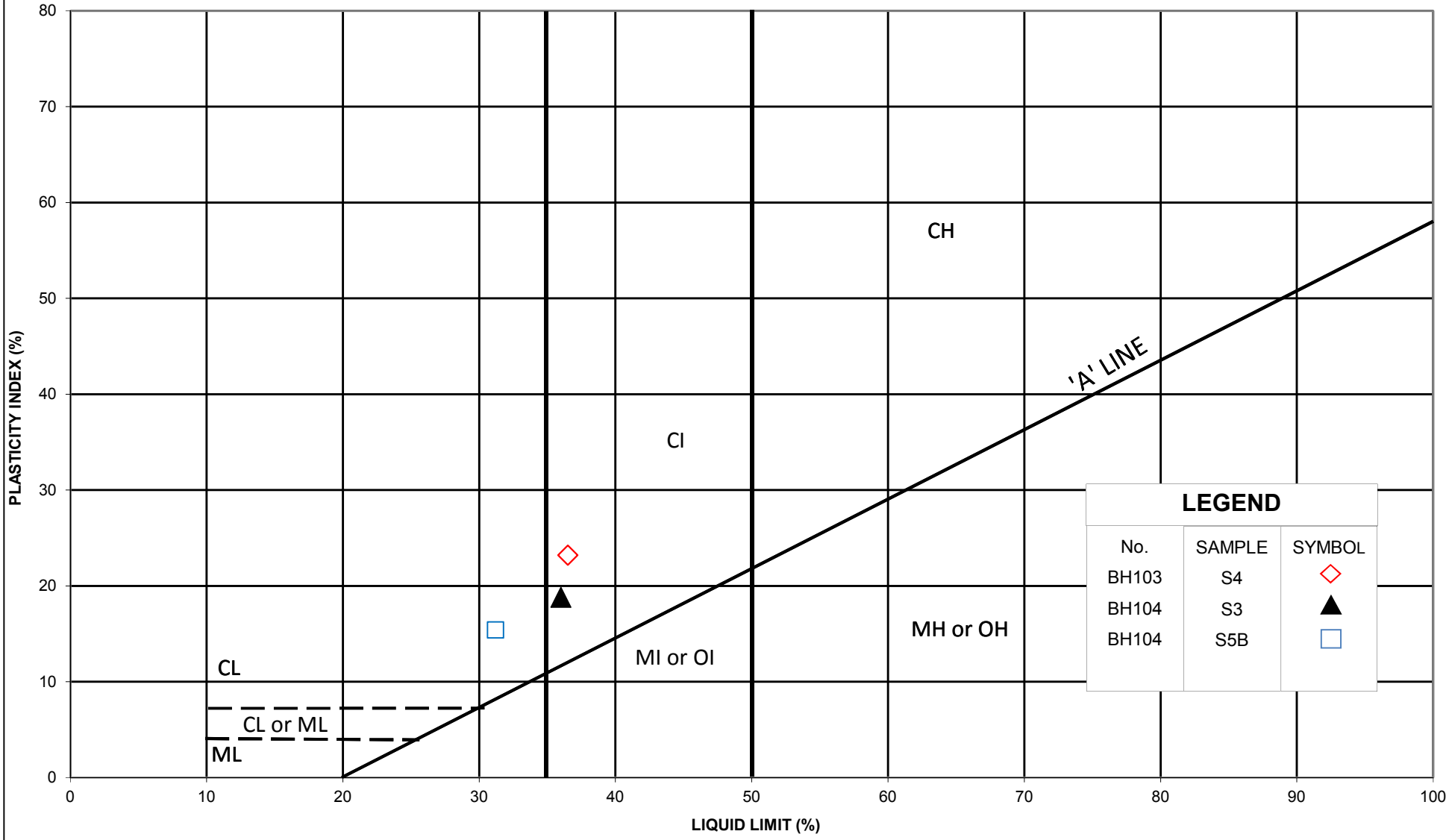
Silty SAND (TILL)

FIGURE: No. 4

GWP: 6364-14-01

DATE : September 22, 2015

Deception Lake Culvert (Site No. 41S-147/C)
GWP No. 6364-14-01, Highway 516, District of Kenora, Ontario



PLASTICITY CHART

Clayey SILT to Silty CLAY

FIGURE No. 5

ADM-00223648-F0

October 6, 2015

Appendix E – Chemical Analyses

Your Project #: ADM-00223648-F0
Site Location: SIOUX LOOKOUT, ONTARIO
Your C.O.C. #: NA

Attention:Ahileas Mitsopoulos/Michael S

exp Services Inc
Thunder Bay Branch
1142 Roland St
Thunder Bay, ON
P7B 5M4

Report Date: 2015/09/15
Report #: R3661790
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B5I2028
Received: 2015/09/09, 09:30

Sample Matrix: Soil
Samples Received: 6

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Chloride (20:1 extract)	6	N/A	2015/09/15	CAM SOP-00463	EPA 325.2 m
Conductivity	6	N/A	2015/09/14	CAM SOP-00414	OMOE E3138 v2 m
pH CaCl2 EXTRACT	6	2015/09/14	2015/09/14	CAM SOP-00413	EPA 9045 D m
Resistivity of Soil	6	2015/09/11	2015/09/14	CAM SOP-00414	SM 22 2510 m
Sulphate (20:1 Extract)	6	N/A	2015/09/14	CAM SOP-00464	EPA 375.4 m

Remarks:

Maxxam Analytics has performed all analytical testing herein in accordance with ISO 17025 and the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act. All methodologies comply with this document and are validated for use in the laboratory. The methods and techniques employed in this analysis conform to the performance criteria (detection limits, accuracy and precision) as outlined in the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act.

Maxxam Analytics is accredited for all specific parameters as required by Ontario Regulation 153/04. Maxxam Analytics is limited in liability to the actual cost of analysis unless otherwise agreed in writing. There is no other warranty expressed or implied. Samples will be retained at Maxxam Analytics for three weeks from receipt of data or as per contract.

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Hina Siddiqui, Project Manager –Environmental Customer Service
Email: HSiddiqui@maxxam.ca
Phone# (905) 817-5700

==========

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Job #: B5I2028
Report Date: 2015/09/15

exp Services Inc
Client Project #: ADM-00223648-F0
Site Location: SIOUX LOOKOUT, ONTARIO
Sampler Initials: EF

RESULTS OF ANALYSES OF SOIL

Maxxam ID			AYK667	AYK668	AYK669	AYK670	AYK670	AYK671		
Sampling Date			2015/08/12 14:00	2015/08/14 17:00	2015/08/17 10:00	2015/08/20 01:15	2015/08/20 01:15	2015/08/11 12:00		
COC Number			NA	NA	NA	NA	NA	NA		
	UNITS	**Criteria**	**BH101-S10**	**BH104-S2**	**BH201-S9**	**BH204-S4**	**BH204-S4 Lab-Dup**	**BH302-S5**	**RDL**	**QC Batch**
Calculated Parameters										
Resistivity	ohm-cm	-	7400	5700	15000	4800		27000		4186431
Inorganics										
Soluble (20:1) Chloride (Cl)	ug/g	-	41	45	<20	57	45	<20	20	4188251
Conductivity	umho/cm	**470**	135	176	65	208	208	38	2	4188121
Available (CaCl2) pH	pH	**-**	7.93	7.56	7.50	6.98		5.99	N/A	4188358
Soluble (20:1) Sulphate (SO4)	ug/g	**-**	<20	<20	<20	<20	<20	<20	20	4188113

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
Criteria: Ontario Reg. 153/04 (Amended April 15, 2011)
Table 1: Full Depth Background Site Condition Standards
Soil - Agricultural or Other Property Use
N/A = Not Applicable

Maxxam ID			AYK672		
Sampling Date			2015/08/12 13:00		
COC Number			NA		
	UNITS	**Criteria**	**BH303-S4B**	**RDL**	**QC Batch**
Calculated Parameters					
Resistivity	ohm-cm	-	5600		4186431
Inorganics					
Soluble (20:1) Chloride (Cl)	ug/g	-	<20	20	4188251
Conductivity	umho/cm	**470**	178	2	4188121
Available (CaCl2) pH	pH	**-**	7.34	N/A	4188358
Soluble (20:1) Sulphate (SO4)	ug/g	**-**	<20	20	4188113

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Criteria: Ontario Reg. 153/04 (Amended April 15, 2011)
Table 1: Full Depth Background Site Condition Standards
Soil - Agricultural or Other Property Use
N/A = Not Applicable

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Maxxam Job #: B5I2028
Report Date: 2015/09/15

exp Services Inc
Client Project #: ADM-00223648-F0
Site Location: SIOUX LOOKOUT, ONTARIO
Sampler Initials: EF

TEST SUMMARY

Maxxam ID: AYK667 **Collected:** 2015/08/12
Sample ID: BH101-S10 **Shipped:**
Matrix: Soil **Received:** 2015/09/09

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	4188251	N/A	2015/09/15	Deonarine Ramnarine
Conductivity	AT	4188121	N/A	2015/09/14	Neil Dassanayake
pH CaCl2 EXTRACT	AT	4188358	2015/09/14	2015/09/14	Neil Dassanayake
Resistivity of Soil		4186431	2015/09/14	2015/09/14	Cristina Carriere
Sulphate (20:1 Extract)	KONE/EC	4188113	N/A	2015/09/14	Alina Dobreanu

Maxxam ID: AYK668 **Collected:** 2015/08/14
Sample ID: BH104-S2 **Shipped:**
Matrix: Soil **Received:** 2015/09/09

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	4188251	N/A	2015/09/15	Deonarine Ramnarine
Conductivity	AT	4188121	N/A	2015/09/14	Neil Dassanayake
pH CaCl2 EXTRACT	AT	4188358	2015/09/14	2015/09/14	Neil Dassanayake
Resistivity of Soil		4186431	2015/09/14	2015/09/14	Cristina Carriere
Sulphate (20:1 Extract)	KONE/EC	4188113	N/A	2015/09/14	Alina Dobreanu

Maxxam ID: AYK669 **Collected:** 2015/08/17
Sample ID: BH201-S9 **Shipped:**
Matrix: Soil **Received:** 2015/09/09

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	4188251	N/A	2015/09/15	Deonarine Ramnarine
Conductivity	AT	4188121	N/A	2015/09/14	Neil Dassanayake
pH CaCl2 EXTRACT	AT	4188358	2015/09/14	2015/09/14	Neil Dassanayake
Resistivity of Soil		4186431	2015/09/14	2015/09/14	Cristina Carriere
Sulphate (20:1 Extract)	KONE/EC	4188113	N/A	2015/09/14	Alina Dobreanu

Maxxam ID: AYK670 **Collected:** 2015/08/20
Sample ID: BH204-S4 **Shipped:**
Matrix: Soil **Received:** 2015/09/09

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	4188251	N/A	2015/09/15	Deonarine Ramnarine
Conductivity	AT	4188121	N/A	2015/09/14	Neil Dassanayake
pH CaCl2 EXTRACT	AT	4188358	2015/09/14	2015/09/14	Neil Dassanayake
Resistivity of Soil		4186431	2015/09/14	2015/09/14	Cristina Carriere
Sulphate (20:1 Extract)	KONE/EC	4188113	N/A	2015/09/14	Alina Dobreanu

Maxxam ID: AYK670 Dup **Collected:** 2015/08/20
Sample ID: BH204-S4 **Shipped:**
Matrix: Soil **Received:** 2015/09/09

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	4188251	N/A	2015/09/15	Deonarine Ramnarine

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Maxxam Job #: B5I2028
Report Date: 2015/09/15

exp Services Inc
Client Project #: ADM-00223648-F0
Site Location: SIOUX LOOKOUT, ONTARIO
Sampler Initials: EF

TEST SUMMARY

Maxxam ID: AYK670 Dup
Sample ID: BH204-S4
Matrix: Soil

Collected: 2015/08/20
Shipped:
Received: 2015/09/09

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Conductivity	AT	4188121	N/A	2015/09/14	Neil Dassanayake
Sulphate (20:1 Extract)	KONE/EC	4188113	N/A	2015/09/14	Alina Dobreanu

Maxxam ID: AYK671
Sample ID: BH302-S5
Matrix: Soil

Collected: 2015/08/11
Shipped:
Received: 2015/09/09

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	4188251	N/A	2015/09/15	Deonarine Ramnarine
Conductivity	AT	4188121	N/A	2015/09/14	Neil Dassanayake
pH CaCl2 EXTRACT	AT	4188358	2015/09/14	2015/09/14	Neil Dassanayake
Resistivity of Soil		4186431	2015/09/14	2015/09/14	Cristina Carriere
Sulphate (20:1 Extract)	KONE/EC	4188113	N/A	2015/09/14	Alina Dobreanu

Maxxam ID: AYK672
Sample ID: BH303-S4B
Matrix: Soil

Collected: 2015/08/12
Shipped:
Received: 2015/09/09

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	4188251	N/A	2015/09/15	Deonarine Ramnarine
Conductivity	AT	4188121	N/A	2015/09/14	Neil Dassanayake
pH CaCl2 EXTRACT	AT	4188358	2015/09/14	2015/09/14	Neil Dassanayake
Resistivity of Soil		4186431	2015/09/14	2015/09/14	Cristina Carriere
Sulphate (20:1 Extract)	KONE/EC	4188113	N/A	2015/09/14	Alina Dobreanu

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GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	3.3°C

Results relate only to the items tested.

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QUALITY ASSURANCE REPORT

exp Services Inc
Client Project #: ADM-00223648-F0
Site Location: SIOUX LOOKOUT, ONTARIO
Sampler Initials: EF

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
4188113	Soluble (20:1) Sulphate (SO4)	2015/09/14	113	70 - 130	102	70 - 130	<20	ug/g	NC	35		
4188121	Conductivity	2015/09/14			99	90 - 110	<2	umho/cm	0	10	117	75 - 125
4188251	Soluble (20:1) Chloride (Cl)	2015/09/15	NC	70 - 130	101	70 - 130	<20	ug/g	NC	35		
4188358	Available (CaCl2) pH	2015/09/14			99	97 - 103			1.9	N/A		

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than 2x that of the native sample concentration).

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (one or both samples < 5x RDL).

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exp Services Inc
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Site Location: SIOUX LOOKOUT, ONTARIO
Sampler Initials: EF

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Cristina Carriere

Cristina Carriere, Scientific Services

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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IMMEDIATE TEST

CHAIN OF CUSTODY RECORD

Page 1 of 1

INVOICE INFORMATION	REPORT INFORMATION (if differs from invoice)	PROJECT INFORMATION	TURNAROUND TIME (TAT) REQUIRED
Company Name: exp Services Inc.	Company Name:	Quotation #:	[x] Regular TAT (5-7 days)
Contact Name: Michael Suslyk, Ahileas Mitsopoulos	Contact Name:	P.O. #:	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address: 1142 Roland Street	Address:	Project #: ADM-00223648-F0	Rush TAT (Applicable Surcharge)
Thunder Bay, ON P7B 5M4		Site Location: Sioux Lookout, Ontario	[ ] 1 Day (100%)
Phone: 807.623.9495 Fax: 807.623.8070	Phone: Fax:	Site #:	[ ] 2 Days (50%)
Email: michael.suslyk@exp.com, ahileas.mitsopoulos@exp.com	Email:	Sampled By: Elwin Farkas	[ ] 3-4 Days (25%)

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY

REGULATION 153 (2011)

[x] Table 1 [ ] Res/Park [ ] Med/Fine
[ ] Table 2 [ ] Ind/Comm [ ] Coarse
[ ] Table 3 [ ] Agri/Other
[ ] Table ___

FOR RSC (PLEASE CIRCLE) Yes / [No]

OTHER REGULATIONS

[ ] CCME [ ] Sanitary Sewer Bylaw
[ ] MISA [ ] Storm Sewer Bylaw
[ ] PWQO Municipality:
[ ] Other (Specify):

[ ] REG 558 (MINIMUM 3 DAY TAT REQUIRED)

Include Criteria on Certificate of Analysis (Y/N)? Y

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	MATRIX	# OF CONT.	FIELD FILTERED (PLEASE CIRCLE) Metals / Hg / CrVI	pH	Water Soluble Sulphate	Resistivity	Conductivity	Chloride	PHC F1 to F4 (including BTEX)	TCLP							
1	BH101-S10	12-Aug-15	14:00	Soil	2		x	x	x	x	x									
2	BH104-S2	14-Aug-15	17:00	Soil	2		x	x	x	x	x									
3	BH201-S9	17-Aug-15	10:00	Soil	2		x	x	x	x	x									
4	BH204-S4	20-Aug-15	1:15	Soil	2		x	x	x	x	x									
5	BH302-S5	11-Aug-15	12:00	Soil	2		x	x	x	x	x									
6	BH303-S4B	12-Aug-15	13:00	Soil	2		x	x	x	x	x									
7	BH203-S2	20-Aug-15	13:00	Soil	3							x								
8	BH203-S3	20-Aug-15	13:03	Soil	4							x	x							
9	BH203-S4	20-Aug-15	13:05	Soil	3							x								
10																				

ANALYSIS REQUESTED

Rush Confirmation #:

Date Required:

LABORATORY USE ONLY

CUSTODY SEAL (Y/N)		Temperature (°C) on Receipt
Present	Y	3/4/3
Intact	Y	
COOLING MEDIA PRESENT (Y / N)	Y	

COMMENTS / TAT COMMENTS

Hold testing until confirmation from exp Services
Hold teseting until confirmation from exp Services
Hold testing until confirmation from exp Services

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME:	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME:	# JARS AND SUBM
Michael Suslyk	08-Sep-15	15:30	ASAD BHATTI	2015/09/09	09:30	

09-Sep-15 09:30
Hina Siddiqui
B5I2028
FSD ENV-746

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