



**FOUNDATION INVESTIGATION REPORT
LITTLE GRASSY TRIBUTARY CULVERT, OLSON ROAD
75 M NORTH-WEST OF HIGHWAY 621
PRATT TOWNSHIP
AGREEMENT NO.: 5014-E-0049
SITE NO.: 45-282/C
GEOCRES NO. 52D-22
GWP 6065-13-00**

**MARCH 22, 2016
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FACTUAL INFORMATION

1. INTRODUCTION

DST Consulting Engineers Inc. (DST) has been retained by the prime consultant, Ainley Group, to conduct a foundation investigation report for the proposed culvert replacement on Olson Road 75 m North-West of Highway 621. This work was carried out under Agreement No.: 5014-E-0049. This report addresses the field investigation, laboratory test program, factual report on conditions for construction for the proposed culvert replacement.

2. SITE DESCRIPTION

The site is located on Olson Road, approximately 75 m North-West of Highway 621 (Latitude 48.912234, Longitude -94.409477), in the Township of Pratt.

It is understood that the existing structure is a triple cell timber box culvert with an overall span of 14 m, width of 4.8 m, minimum clearance of 1.51 m, and 2° skew. This culvert currently carries one lane of rural northwest-southeast traffic. The existing box culvert deck is in a fair to poor condition with the timber spans sagging and separating. The timber barrel soffit walls are in a fair to poor condition exhibiting checking, splitting, leaning towards the west, and the timbers separating. The inlet and outlets of the culvert are also in a fair to poor condition with the northwest and northeast wing walls rotated and separated respectively. The existing timber bridge can be seen in (Figure 2-1 to 2-2). Inspection of the triple cell timber culvert was conducted by others.

Geological information is available from published *Ontario Geological Survey Map #52DNE* by the *Ontario Ministry of Natural Resources* for the Stratton area. The map indicates that the local area landform is identified as glaciolacustrine plains. Sediments in glaciolacustrine plains consist of varved and massive, fine grained materials deposited in glacial lake basins of varying size and depth. The proportions of clay, silt, and sand deposited at any particular location in these basins

varies with depth of water in the former lake, distance from former shorelines, and the size of particles washed into the lake. Most clay, silt, and sand lacustrine deposits contain minor inclusions of till and scattered dropstones which were drafted into the lake on pieces of ice. In places, wave and current action in former glacial lakes eroded the surface of till deposits, producing thin patches of washed sand, gravel and boulders that rest on till or bedrock. In other areas, bedrock knobs and ridges are surrounded by pockets of glaciolacustrine sediment. Glacial lake deposits usually consist of clay and silt which accumulated in deep offshore waters at a depth where the bottom was no longer affected by wave action (generally below 10 m). Closer to shore, and at points where rivers discharged sandy materials into the lake, the deposits usually consist of fine and medium sand with minor silt. Most of these sandy lacustrine deposits accumulated in deltaic environments.



Figure 2-1 Location of existing culvert Olson Road (downstream)



Figure 2-2 Location of existing culvert Olson Road (looking North-West)

3. INVESTIGATION PROCEDURES AND LABORATORY TESTING

Site work was carried out on August 29th to September 9th, 2015 utilizing a CME 750 drill rig equipped for geotechnical drilling. A total of six boreholes were advanced to depths ranging from 10.7 m to 18.3 m. The minimum number and depth of the boreholes was specified by the Ministry of Transportation (MTO).

The borehole locations and stratigraphic sections are shown on the Borehole Location Plan and Drawings 1 and 2 in Appendix C. Borehole 1 was advanced 2.6 m North of the existing bridge and 2.0 m West of outlet to a depth of 17.7 m below the existing surface. Borehole 2 was advanced 5.0 m North of the bridge and 2.2 m East of the bridge to a depth of 12.5 m below the existing surface. Borehole 3 was advanced 15 m North of the bridge and 3.0 m West of outlet to a depth of 11.9 m below the existing surface. Borehole 4 was advanced 2.0 m South of the bridge and 2.0 m East of inlet to a depth of 18.3 m below the existing surface. Borehole 5 was advanced 5.0 m South of the bridge and 0.6 m East of outlet to a depth of 12.2 m below the existing surface. Borehole 6 was advanced 15 m South of the bridge and 2.0 m East of inlet to a depth of 10.7 m below the existing surface.

The ground surface elevations at the borehole locations were surveyed by DST personnel and referenced to benchmark 328.565 m (N = 5420262.7, E = 201491.8) as indicated on the

drawings provided by the Ministry. Table 3-1 summarizes the detail of borehole locations and depths.

All boreholes were abandoned using suitable abandonment barrier as described in Ontario Regulation 903 and its amendments. Boreholes were decommissioned by backfilling to the bottom of the road base with cuttings and bentonite chips. From the bottom of the road base, granular materials were replaced to the bottom of the asphalt and the asphalt was sealed with a cold patch.

The fieldwork was supervised on a full-time basis by DST personnel. Soil samples were obtained from the auger flights and from the split spoon sampler used for the standard penetration test (SPT). The SPT involves driving a 51 mm diameter thick-walled sampler into the soil under the energy of a 63.5 kg weight falling through 760 mm. The number of blows required to drive the sampler 305 mm is known as the standard penetration blow count (N) which provides an indication of the condition or consistency of the soil. In addition, in-situ vane shear testing were performed in cohesive soils at selected depths using M.T.O vane (65 mm x 150 mm). The soil samples collected during drilling were identified in the field, placed in labelled containers and transported to DST's laboratory in Thunder Bay for further analyses.

Classification and index tests were subsequently performed in the laboratory on samples collected from the boreholes to aid in the selection of engineering properties. Laboratory tests included moisture contents, particle size analyses, Atterberg limits including plastic limit and liquid limit, unconfined compression tests and chemical tests. A total of forty four (44) moisture contents, five (5) particle size analyses, twelve (12) Atterberg limits, five (5) point load tests, and a set of chemical tests have been carried out for this assignment. Laboratory test results are presented in the Boreholes Logs and graphical plots attached Appendix D (Enclosures).

Table 3-1 Detail of Borehole Location

| Borehole ID | Station | Elevation (m) | Depth (m) |
|-------------|----------|---------------|-----------|
| BH1 | 10 + 090 | 328.6 | 17.7 |
| BH2 | 10 + 093 | 328.6 | 12.5 |
| BH3 | 10 + 102 | 328.4 | 11.9 |
| BH4 | 10 + 078 | 328.6 | 18.3 |
| BH5 | 10 + 076 | 329.1 | 12.2 |
| BH6 | 10 + 064 | 328.7 | 10.7 |

4. DESCRIPTION OF SUBSURFACE CONDITIONS

The subsurface conditions are presented based on the information obtained during power auger drilling.

The generalized stratigraphy of the existing embankment and approaches at the existing culvert, based on the conditions encountered in the boreholes consists of sand and gravel fill at surface underlain by silty clay which further overlies various deposits of sand, silty clay, clayey sand, sand and gravel, and cobbles and boulders. Topsoil was encountered in Borehole 5. Bedrock was encountered in Boreholes 1 and 4. Summary of the soil strata is provided in Table 4-1.

Table 4-1 Summary of soil strata at the existing bridge

| Layer | Depth (m) | Elevation (m) | Comments |
|------------------------|--------------|----------------|----------|
| Topsoil | 0.0 to 0.2 | 329.1 to 328.9 | BH5 |
| Fill - Sand and Gravel | 0.0 to 1.0 | 328.6 to 327.6 | BH1 |
| | 0.0 to 0.8 | 328.6 to 327.8 | BH2 |
| | 0.0 to 0.8 | 328.4 to 327.6 | BH3 |
| | 0.0 to 0.6 | 328.7 to 328.1 | BH6 |
| Fill – Silty Sand | 0.0 to 0.8 | 328.6 to 327.8 | BH4 |
| Sandy Silty Clay | 0.2 to 10.7 | 328.9 to 318.4 | BH5 |
| Silty Clay | 1.0 to 9.1 | 327.6 to 319.5 | BH1 |
| | 0.8 to 6.1 | 327.8 to 322.5 | BH2 |
| | 0.8 to 11.9 | 327.6 to 316.5 | BH3 |
| | 0.8 to 9.7 | 327.8 to 318.9 | BH4 |
| | 0.6 to 9.8 | 328.1 to 318.9 | BH6 |
| Sand | 6.1 to 12.5 | 322.5 to 316.1 | BH2 |
| Silt and Sand | 9.1 to 13.1 | 319.5 to 315.5 | BH1 |
| Silty Sand | 9.8 to 10.7 | 318.9 to 318.0 | BH6 |
| Clayey Sand | 9.7 to 12.2 | 318.9 to 316.4 | BH4 |
| Sand and Gravel | 10.7 to 12.2 | 318.4 to 316.9 | BH5 |
| Cobbles and Boulders | 12.2 to 13.7 | 316.4 to 314.9 | BH4 |
| Bedrock | 13.1 to 17.7 | 315.5 to 310.9 | BH1 |
| | 13.7 to 18.3 | 314.9 to 310.3 | BH4 |

4.1 Topsoil

Topsoil was encountered in Borehole 5 (Elev. 329.1 to 328.9 m) with a thickness of 0.2 m.

4.2 Fill – Sand and Gravel

Sand and gravel fill with trace silt was encountered in Boreholes 1, 2, 3, and 6 at surface at depths 0.0 to 1.0 m (Elev. 328.6 to 327.6 m), 0.0 to 0.8 m (Elev. 328.6 to 327.8 m), 0.0 to 0.8 m (Elev. 328.4 to 327.6 m), and 0.0 to 0.6 m (Elev. 328.7 to 328.1m) with thicknesses of 1.0 m, 0.8 m, 0.8 m, and 0.6 m respectively.

The SPT 'N' values vary from 10 to 25, indicating a compact condition. The moisture contents of the sand and gravel fill vary from 3 to 8 %.

4.3 Fill – Silty Sand

Silty sand with some gravel fill was encountered at the surface of Borehole 4 at the depth from 0.0 to 0.8 m (Elev. 328.6 to 327.8 m) with a thickness of 0.8 m.

The SPT 'N' value was 17, indicating a compact condition. The moisture contents of a selected sample tested was 9 %. The laboratory test results are summarized in Table 4-2.

Table 4-2: Summary of Sieve Analysis- Fill – Sand

| Laboratory Results – Sieve Analysis | |
|-------------------------------------|----|
| Gravel % | 13 |
| Sand % | 54 |
| Fines % | 33 |

4.4 Sandy Silty Clay

Various portions of sand, silt and clay with some to trace gravel was encountered below the topsoil in Borehole 5 at the depth from 0.2 to 10.7 m (Elev. 328.9 to 318.4 m) with a thickness of 10.5 m.

Atterberg limits tests carried out on samples from Boreholes indicate that the sandy silty clay has medium to high plasticity. Field vane test completed in the borehole show shear strength of 42 kPa indicating a firm consistency. The SPT 'N' values vary from 2 to 15. The moisture content of the clay ranges from 16 to 53 %. The laboratory test results are summarized in the following Tables 4-3 and 4-4.

Table 4-3 Summary of Atterberg Limits- Sandy Silty Clay

| Laboratory Results – Atterberg Limits | |
|---------------------------------------|----------|
| Liquid Limit % | 49 to 55 |
| Plastic Limit % | 18 to 29 |
| Plastic Index % | 26 to 31 |

Table 4-4: Summary of Sieve Analysis- Sandy silty clay

| Laboratory Results – Sieve Analysis | |
|-------------------------------------|----------|
| Gravel % | 8 to 11 |
| Sand % | 38 to 41 |
| Fines % | 48 to 54 |

4.5 Silty Clay

Silty clay was encountered below the sand and gravel fill in Borehole 1,2,3,4, and 6 at the depths from 1.0 to 9.1 m (Elev. 327.6 to 319.5 m), 0.8 to 6.1 m (Elev. 327.8 to 322.5 m), 0.8 to 11.9 m (Elev. 327.6 to 316.5 m), 0.8 to 12.2 m (Elev. 327.8 to 316.4 m), and 0.6 to 9.8 m (Elev. 328.1 to 318.9 m) with a thicknesses of 8.1m, 5.3 m, 11.1 m, 11.4 m, and 9.2 m respectively.

Atterberg limits tests carried out on samples from Boreholes indicate that the clay has medium to high plasticity. Field vane tests completed in Boreholes show shear strength between 48 and 132 kPa indicating a firm to very stiff consistency. The SPT 'N' values vary from 1 to 16. The moisture content of the clay ranges from 13 to 64 %. The laboratory test results are summarized in following Tables 4-5.

Table 4-5: Summary of Atterberg Limits- Silty Clay

| Laboratory Results – Atterberg Limits | |
|---------------------------------------|----------|
| Liquid Limit % | 41 to 78 |
| Plastic Limit % | 17 to 27 |
| Plastic Index % | 20 to 57 |

4.6 Sand

Sand with to some gravel and some fines was encountered below the silty clay in Boreholes 2, and below the sandy silty clay in Borehole 5 at the depth from 6.1 to 12.5 m (Elev. 322.5 to 316.1 m) and 10.7 to 12.2 m (Elev. 318.4 to 316.9 m) with thicknesses of 6.4 m and 1.5 m respectively.

The SPT 'N' values vary from 7 to 100+, indicating a loose to very dense condition. The moisture contents of a selected samples tested range from 17 to 18 %. The laboratory test results are summarized in Table 4-6.

Table 4-6 Summary of Sieve Analysis- Sand

| Laboratory Results – Sieve Analysis | |
|-------------------------------------|----------|
| Gravel % | 10 to 27 |
| Sand % | 62 to 90 |
| Fines % | 4 to 11 |

4.7 Silt and Sand

Silt and sand with trace gravel was encountered below the silty clay in Borehole 1 at the depth from 9.1 to 13.1 m (Elev. 319.5 to 315.5 m) with a thickness of 4.0 m.

The SPT 'N' values vary from 6 to 100+, indicating a loose to very dense condition. The moisture contents of a selected sample tested was 34 %. The laboratory test results are summarized in Table 4-7.

Table 4-7: Summary of Sieve Analysis- Silt and Sand

| Laboratory Results – Sieve Analysis | |
|-------------------------------------|----|
| Gravel % | 3 |
| Sand % | 46 |
| Fines % | 51 |

4.8 Silty Sand

Silty sand was encountered below the silty clay in Boreholes 6 at the depth 9.8 to 10.7 m (Elev. 318.9 to 318.0 m) with a thickness of 0.9 m.

The SPT 'N' value 100+, indicating a very dense condition. The moisture contents of a selected sample tested was 21 %.

4.9 Clayey Sand

Clayey sand with some gravel was encountered below the silty clay in Borehole 4 at the depth from 9.7 to 12.2 m (Elev. 318.9 to 316.4 m) with a thickness of 2.5 m.

The SPT 'N' values was 20, indicating a compact condition. The moisture contents of a selected sample tested was 19 %.

4.10 Sand and Gravel

Sand and gravel with trace silt was encountered below the sandy silty clay in Borehole 5 at the depth from 10.7 to 12.2 m (Elev. 318.4 to 316.9 m) with a thickness of 1.5 m.

The SPT 'N' values vary from 18 to 50+, indicating a compact to very dense condition. The moisture content of a selected sample tested was 15 %.

4.11 Cobbles and Boulders

Cobbles and boulders was encountered in Borehole 4 at the depth from 12.2 to 13.7 m (Elev. 316.4 to 314.9 m) with a thickness of 1.5 m.

4.12 Bedrock

Bedrock was encountered in two (2) Boreholes, Borehole 1 and 4 at depth below 13.1 m (Elev. 315.5 m) and 13.7 m (Elev. 314.9 m) respectively.

The type of Bedrock is a metamorphic rock Gneiss diorite based on our visual classification of rock cores and this is also consistent with our review of surficial bedrock geology of the area. This is a rock composed mainly of translucent white plagioclase and dark hornblende with a little biotite giving it a grey colour. The appearance of the stone varies from dark (hornblende and biotite make up almost 50 %) to very light (5 % hornblende). The cores recovered had no signs of physical, chemical or biological weathering. The rock cores can be seen in Figures 4-1 and 4-2.



Figure 4-1 Little Grassy River rock core Borehole 1



Figure 4-2 Little Grassy River rock core Borehole 4

In Borehole 1, Total Core Recovery (TCR) and Solid Core Recovery (SCR) were 85 % to 100%. Rock Quality Designation (RQD) was found between 41% and 73% indicating Poor to Fair

Rock. In Borehole 4, Total Core Recovery (TCR) and Solid Core Recovery (SCR) were 92% to 98%. Rock Quality Designation (RQD) was found between 0% and 66% indicating a Very Poor to Fair Rock. The unconfined compressive strength of rock, derived from the Point Load Test, varies between 53 to 67 MPa at Borehole 1 and 30 to 136 MPa at Borehole 4 indicating an Average to Very strong rock.

4.13 Groundwater

At the time of the field investigation groundwater was observed in Boreholes 1 and 6. The groundwater levels can be expected to vary with the season and precipitation events.

Table 4-8: Groundwater depth

| Borehole | Groundwater Depth (m) | Groundwater Elev. (m) |
|------------|-----------------------|-----------------------|
| Borehole 1 | 0.9 | 327.7 |
| Borehole 6 | 1.5 | 327.2 |

4.14 Chemical Test Results

Selected soil samples were submitted to ALS Laboratories Thunder Bay for chemical analyses (pH, sulphate, conductivity, resistivity and Chloride) to assess the potential for corrosion and sulphate attack on buried structures. The conductivity and resistivity of samples are determined in the lab by tumbling soil samples in de-ionized (DI) water at the ratio of 2:1 water to soil. After tumbling the sample is analysed by conductivity meter to determine the conductivity. The inverse of the conductivity is taken and calculated for resistivity.

The results are presented below in Table 4-9 and a copy of the Laboratory Certificate of Analysis is provided in **Appendix D**.

Table 4-9: Chemical Test Results

| Sample ID | Moisture (%) | Sulphate (mg/kg) | Chloride (mg/kg) | pH | Conductivity (umhos/cm) | Resistivity (ohm - cm) |
|-------------------|--------------|------------------|------------------|------|-------------------------|------------------------|
| BH1 @ 2.7 m depth | 27.3 | 84 | <20 | 7.19 | 215 | 4200 |

The analytical results of the soil samples were compared with applicable Canadian Standards Association (CSA) standards as shown in **Table 4-10** below

The chemical sulphate content analyses for representative soil sample tested indicate a sulphate concentration of 84 mg/kg or 0.0084 % in soil. The results were compared with Canadian

Standards Association (CSA) Standards A23.1 for sulphate attack potential on concrete structures and possess a “negligible” risk for sulphate attack on concrete material and accordingly, conventional GU or MS Portland cement may be used in the construction of the proposed concrete elements.

The pH value for the soil samples was reported to be 7.19, indicating a durable condition against corrosion. These results were evaluated using Table 2 of Building Research Establishment (BRE) Digest 363 (July 1991). The pH is greater than 5.5 indicating the concrete will not be exposed to attack from acids. The chloride content of the selected soil sample was also compared with the threshold level and present negligible concrete corrosion potential. Soil resistivity and conductivity was found to be 4200 ohm-cm and 215 umhos / cm respectively for the sample analysed from BH1.

Table 4-10 Additional requirements for concrete subjected to sulphate attack

| Class of Exposer | Degree of Exposer | Water soluble Sulphate in soil sample (%) | Cementing Material to be used |
|------------------|-------------------|-------------------------------------------|-------------------------------|
| S-1 | Very Severe | > 2.0 | HS or HSb |
| S-2 | Severe | 0.20 – 2.0 | HS or HSb |
| S-3 | Moderate | 0.10 – 0.20 | MS, MSb, LH, HS, or HSb |

* Information from Table 3 of CSA Standards A23.1-04

5. MISCELLANEOUS

Site work was carried out during the week of August 29th to September 9th, 2015 utilizing a CME 750 all-terrain drill rig operated by DST. Fieldwork was supervised on a full time basis by DST personnel. Soil samples collected during drilling were identified in the field, placed in labelled containers and transported to DST’s laboratory in Thunder Bay for further analysis. Interpretation of the data and preparation of the report was completed by Selorm Danku, P.Eng and reviewed by Dr. Masud Karim, P.Eng who is the designated principal contact for MTO projects.

9. LIMITATIONS OF REPORT

A description of limitations which are inherent in carrying out site investigation studies is given in Appendix 'A', and this forms an integral part of this report.

For DST CONSULTING ENGINEERS INC.

Prepared by:



Selorm Danku P. Eng
Geotechnical Engineer

Reviewed by:



Dr. ASM Masud Karim, P.Eng.
Senior Associate – Regional Manager
Infrastructure Client Group

APPENDIX 'A'
LIMITATIONS OF REPORT

LIMITATIONS OF REPORT

GEOTECHNICAL STUDIES

The data, conclusions and recommendations which are presented in this report, and the quality thereof, are based on a scope of work authorized by the Client. Note that no scope of work, no matter how exhaustive, can identify all conditions below ground. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the specific locations tested, and conditions may become apparent during construction which were not detected and could not be anticipated at the time of the site investigation. Conditions can also change with time. It is recommended practice that DST Consulting Engineers be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered in the testholes. The benchmark and elevations used in this report are primarily to establish relative elevation differences between the testhole locations and should not be used for other purposes, such as grading, excavation, planning, development, etc.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with details stated in this report. Since all details of the design may not be known, we recommend that we be retained during the final stage to verify that the design is consistent with our recommendations, and that assumptions made in our analysis are valid.

Unless otherwise noted, the information contained herein in no way reflects on environmental aspects of either the site or the subsurface conditions.

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

Any results from an analytical laboratory or other subcontractor reported herein have been carried out by others, and DST Consulting Engineers Inc. cannot warranty their accuracy. Similarly, DST cannot warranty the accuracy of information supplied by the client.

Appendix B

DESCRIPTION OF TERMS

EXPLANATION OF TERMS USED IN REPORT

SPT 'N' VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE OF THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51 mm O.D. SPLIT BARREL SAMPLES TO PENETRATE 0.3 m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5 kg, FALLING FREELY A DISTANCE OF 0.76 m. FOR PENETRATION OF LESS THAN 0.3 m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST (DCPT): CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51 mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3 m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS

TEXTURAL CLASSIFICATION OF SOILS

| BOULDERS | COBBLES | GRAVEL | SAND | SILT | CLAY |
|---------------------|--------------|---------------|------------------|-------------------|--------------------|
| GREATER THAN 200 mm | 75 TO 200 mm | 4.75 TO 75 mm | 0.075 TO 4.75 mm | 0.002 TO 0.075 mm | LESS THAN 0.002 mm |

COARSE GRAIN SOIL DESCRIPTION (50% GREATER THAN 0.075 mm)

| TERMINOLOGY | TRACE OR OCCASIONAL | SOME | WITH | ADJECTIVE (e.g. SILTY OR SANDY) | AND (e.g. SAND AND SILT) |
|-------------|---------------------|-----------|-----------|---------------------------------|--------------------------|
| | LESS THAN 10% | 10 TO 20% | 20 TO 30% | 30 TO 40% | 40 TO 60% |

CONSISTENCY*: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (C_u) AND SPT 'N' VALUES AS FOLLOWS

| | | | | | | |
|-------------------|-----------|---------|---------|----------|------------|-------|
| C_u (kPa) | 0 – 12 | 12 – 25 | 25 – 50 | 50 - 100 | 100 - 200 | > 200 |
| N (BLOWS / 0.3 m) | <2 | 2 - 4 | 4 - 8 | 8 - 15 | 15 - 30 | >30 |
| | VERY SOFT | SOFT | FIRM | STIFF | VERY STIFF | HARD |

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS ON DENSENESS AS INDICATED BY SPT 'N' VALUES AS FOLLOWS

| | | | | | |
|-------------------|------------|--------|---------|---------|------------|
| N (BLOWS / 0.3 m) | 0 – 5 | 5 – 10 | 10 – 30 | 30 – 50 | > 50 |
| | VERY LOOSE | LOOSE | COMPACT | DENSE | VERY DENSE |

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND/OR STRENGTH

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100 mm+ IN LENGTH EXPRESSED AS A PERCENTAGE OF THE LENGTH OF THE CORING RUN.

THE **ROCK QUALITY DESIGNATION (R.Q.D)** FOR MODIFIED RECOVERY IS:

| | | | | | |
|-----------|-----------|---------|---------|---------|-----------|
| R.Q.D (%) | 0 – 25 | 25 – 50 | 50 – 75 | 75 – 90 | 90 – 100 |
| | VERY POOR | POOR | FAIR | GOOD | EXCELLENT |

LEGEND OF RECORDS FOR BOREHOLES: SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE

| | | | |
|-------------------------------------------------------------------------------------|----------------------------------------|--------------------------------------------------------------------------------|-------------------------------------|
| SS | SPLIT SPOON SAMPLE | WS | WASH SAMPLE |
| TW | THIN WALL SHELBY TUBE SAMPLE | AS | AUGER (GRAB) SAMPLE |
| PH | SAMPLER ADVANCED BY HYDRAULIC PRESSURE | TP | THIN WALL PISTON SAMPLE |
| WH | SAMPLER ADVANCED BY SELF STATIC WEIGHT | PM | SAMPLER ADVANCED BY MANUAL PRESSURE |
| SC | SOIL CORE | RC | ROCK CORE |
|  | WATER LEVEL | $SENSITIVITY = \frac{UNDISTURBED\ SHEAR\ STRENGTH}{REMOLDED\ SHEAR\ STRENGTH}$ | |

*HIERARCHY OF SOIL STRENGTH PREDICTION: **1)** LABORATORY TRIAXIAL TESTING. **2)** FIELD INSITU VANE TESTING. **3)** LABORATORY VANE TESTING. **4)** SPT VALUES. **5)** POCKET PENETROMETER.

Appendix C

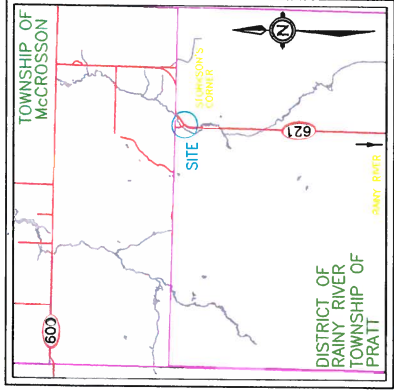
DRAWINGS

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

AG No 5014-E-0049
WP No 6065-13-00
SITE No 45-282C
GEOCRES No 52D-22

REPLACEMENT OF
LITTLE GRASSY TIMBER BRIDGE
SITE PLAN
STA 10+060 TO STA 10+120
Survey _____ Revised _____

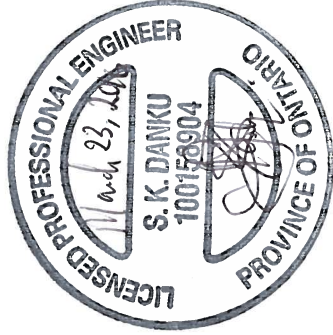
SHEET
1



KEY PLAN
0 2.5 km

LEGEND

Borehole



TIMBER BRIDGE 7m SPAN
SPRUCE

10+080

BM 328.565
N&W IN ROOT OF
201491.8

W/L 326.95
OCT. 28/2014

W/L 326.89
OCT. 28/2014

WOOD TIE RETAINING WALL

CREEK

EC

P&W FENCE

PLAN



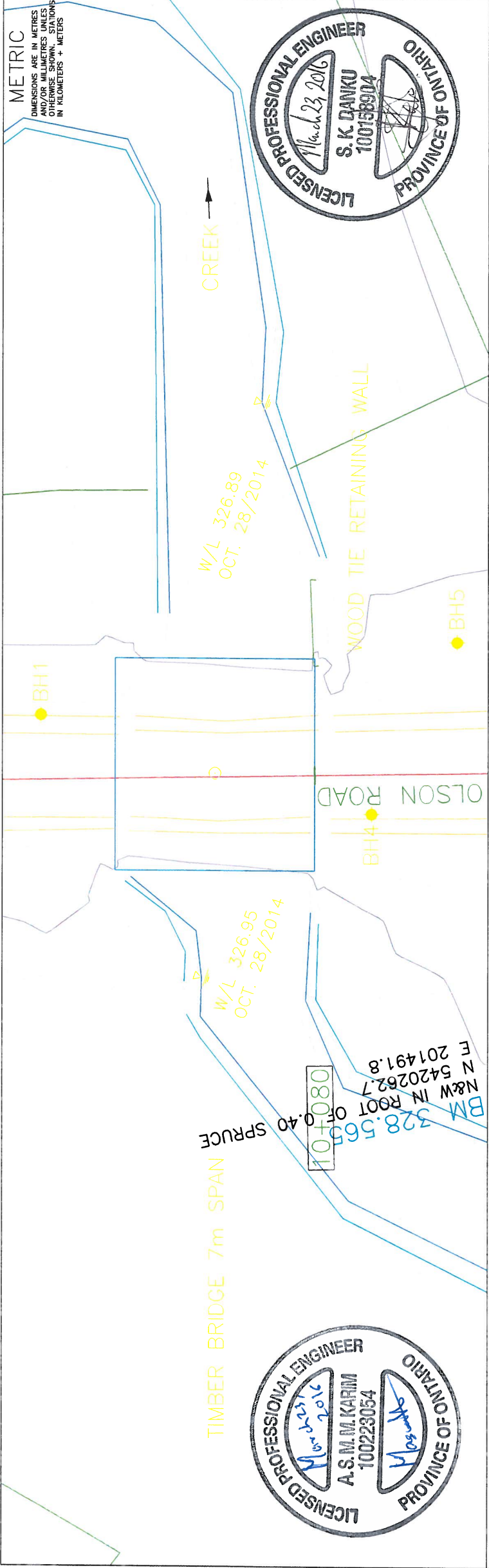
| No. | Elev. (m) | MTM Zone 16 | | Survey | |
|-----|--------------|-------------|----------|---------|-----------|
| | | North (m) | East (m) | Station | Offset |
| BH1 | 328.6 | 5420290 | 201494 | 10+089 | 2.26 m RT |
| BH2 | 328.6 | 5420290 | 201491 | 10+092 | 0.92 m LT |
| BH3 | 328.4 | 5420299 | 201490 | 10+102 | 1.49 m RT |
| BH4 | 328.6 | 5420276 | 201495 | 10+078 | 1.38 m LT |
| BH5 | 329.1 | 5420265 | 201501 | 10+075 | 4.59 m RT |
| BH6 | 328.7 | 5420265 | 201501 | 10+065 | 1.62 m LT |

| REV | DATE | ISSUE | APPROVAL |
|-----|----------|-------|----------|
| 1 | 11/03/16 | FINAL | MK |
| | | | |
| | | | |
| | | | |

NOTE:
The boundaries between soil areas have been established only at borehole
locations. All other boundaries are assumed by interpolation
and may not represent actual conditions.

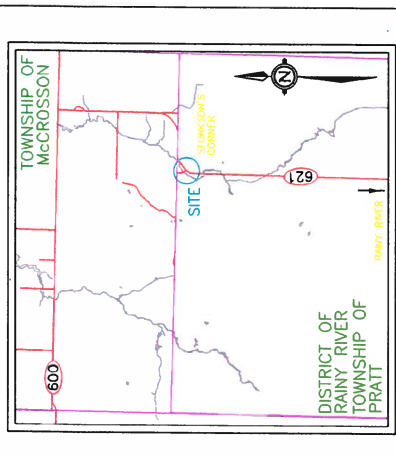
DST
DST Consulting Engineers Inc.
605 Hewitson Street
Thunder Bay, ON P7B 5V5
Ph: (807) 623-2929
Fx: (807) 623-1792
Email: thunderbay@dsggroup.com

DRAWING 1



AG No 5014-E-0049
WP No 6065-13-00
SITE No 45-282C
GEOCRES No 52D-22

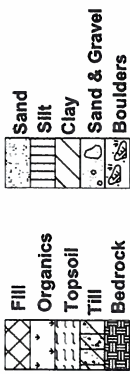
REPLACEMENT OF
LITTLE GRASSY TIMBER BRIDGE
STRATIGRAPHIC PROFILE AND
CROSS SECTION
STA 10+060 TO STA 10+120
Survey _____ Revised _____



KEY PLAN
2.5 km
0 2.5 km

LEGEND

Borehole
'N' Blows/0.3m (Std. Pen Test, 475 J/Blow)



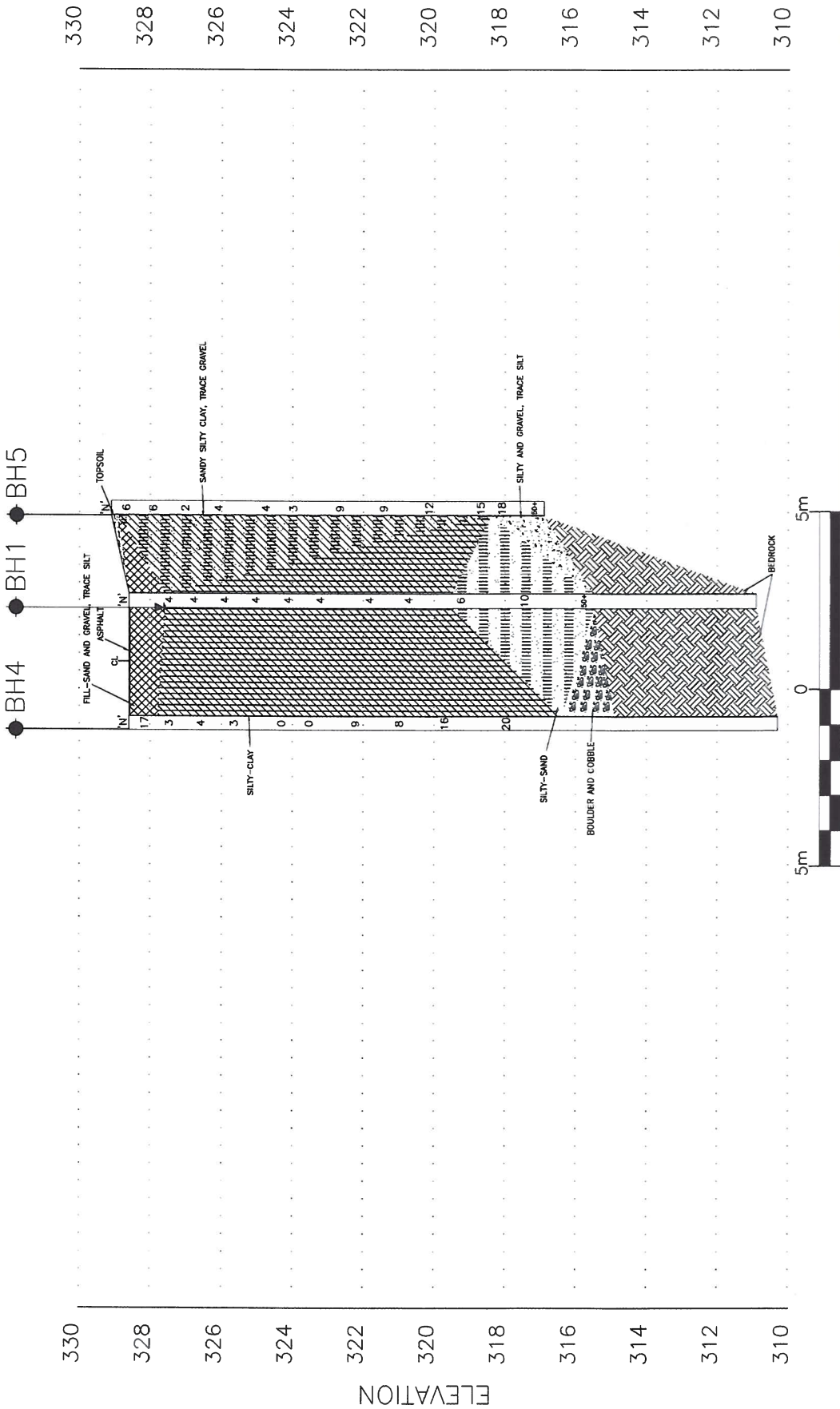
| No. | Elev. (m) | MTM Zone16 | | | Survey | | |
|-----|--------------|------------|----------|---------|---------|--------|--|
| | | North (m) | East (m) | Station | Station | Offset | |
| BH1 | 328.6 | 5420290 | 201494 | 10+089 | 2.26 m | RT | |
| BH2 | 328.6 | 5420290 | 201491 | 10+092 | 0.92 m | LT | |
| BH3 | 328.4 | 5420299 | 201490 | 10+102 | 1.49 m | RT | |
| BH4 | 328.6 | 5420276 | 201495 | 10+078 | 1.38 m | LT | |
| BH5 | 329.1 | 5420265 | 201501 | 10+075 | 4.59 m | RT | |
| BH6 | 328.7 | 5420265 | 201501 | 10+065 | 1.62 m | LT | |

| REV | DATE | ISSUE | APPROVAL |
|-----|----------|-------|----------|
| 1 | 11/03/16 | FINAL | HK |
| | | | |
| | | | |

NOTE:
The boundaries between soil areas have been established only at borehole
locations. Intermediate boundaries are assumed by interpolation
and may not represent actual conditions.

DST
DST Consulting Engineers Inc.
605 Hewitson Street
Thunder Bay, ON P7B 5V5
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Email: thunderbay@dstgroup.com

DRAWING 2



Appendix D
ENCLOSURES

RECORD OF BOREHOLE No BH1

1 OF 2

METRIC

W.P. G.W.P. 6065-13-00 LOCATION LITTLE GRASSY RIVER TRIB. CULVERT ORIGINATED BY RW
 DIST MTO HWY OLSON ROAD BOREHOLE TYPE HOLLOW STEM AUGER - 80 mm ID COMPILED BY SA
 DATUM Geodetic DATE 2015 09 09 CHECKED BY BV

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT w _p | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | |
|---------------|---------------------------------------------------------------|------------|---------|------|------------|----------------------------------|-----------------|---------------------------------------------|--|------------------------------------|-------------------------------------|-----------------------------------|---------------------|---------------------------------------------------|-------------------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | WATER CONTENT (%) |
| | | | | | | | | ○ UNCONFINED + FIELD VANE | | | | | | | |
| | | | | | | □ QUICK TRIAXIAL × LAB VANE | | | | | | | | | |
| 328.6 | GROUND SURFACE | | | | | | | 20 40 60 80 100 | | | | | | | |
| | FILL - SAND AND GRAVEL, TRACE SILT VERY LOOSE BROWN | | AS1 | AS | | | 328 | | | | | | | | |
| 327.6 | SILTY CLAY | | SS2 | SS | 4 | | 327 | | | | | | | | |
| 1.0 | | | SS3 | SS | 2 | | 326 | | | | | | | | |
| | VERY SOFT TO FIRM GREY | | SS4 | SS | 4 | | 325 | | | | | | | | |
| | | | SS5 | SS | 4 | | 324 | | | | | | | | |
| | | | SS6 | SS | 2 | | 323 | | | | | | | | |
| | | | SS7 | SS | 1 | | 322 | | | | | | | | |
| | | | SS8 | SS | 7 | | 321 | | | | | | | | |
| | | | SS9 | SS | 7 | | 320 | | | | | | | | |
| 319.5 | SILTY AND SAND TRACE GRAVEL LOOSE TO VERY DENSE GREY | | SS10 | SS | 6 | | 319 | | | | | | | | |
| 9.1 | | | SS11 | SS | 10 | | 318 | | | | | | | | |
| | | | SS12 | SS | 100+ | | 317 | | | | | | | | |
| | | | | | | | 316 | | | | | | | | |

Continued Next Page

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

ENCLOSURE 1

RECORD OF BOREHOLE No BH1

2 OF 2

METRIC

W.P. G.W.P. 6065-13-00 LOCATION LITTLE GRASSY RIVER TRIB. CULVERT ORIGINATED BY RW
 DIST MTO HWY OLSON ROAD BOREHOLE TYPE HOLLOW STEM AUGER - 80 mm ID COMPILED BY SA
 DATUM Geodetic DATE 2015 09 09 CHECKED BY BV

| 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 | | | SHEAR STRENGTH kPa | | | | | WATER CONTENT (%) | | | | |
| | | | | | | | 20 | 40 | 60 | 80 | 100 | W _p | W | W _L | | | |
| 315.5 13.1 | GROUND SURFACE | | | | | | | | | | | | | | | | |
| | BEDROCK GNEISS DIORITE | | | | | | | | | | | | | | | | |
| | RQD = 41% | | | | | | | | | | | | | | | | |
| | RQD = 47% | | | | | | | | | | | | | | | | |
| | RQD = 73% | | | | | | | | | | | | | | | | |
| 310.9 17.7 | END OF BOREHOLE AT 17.7 m | | | | | | | | | | | | | | | | |

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

ENCLOSURE 2

ONL_MOT-HIGH VANES LITTLE GRASSY CREEK.GPJ DST_MIN.GDT 18/3/16

RECORD OF BOREHOLE No BH2

1 OF 1

METRIC

W.P. G.W.P. 6065-13-00 LOCATION LITTLE GRASSY RIVER TRIB. CULVERT ORIGINATED BY RW
DIST MTO HWY OLSON ROAD BOREHOLE TYPE HOLLOW STEM AUGER - 80 mm ID COMPILED BY SA
DATUM Geodetic DATE 2015 09 01 CHECKED BY BV

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | |
|---------------|-----------------------------------------------------|------------|---------|------|------------|----------------------------|-----------------|---------------------------------------------|----|----|---------------------------------------------------------|-----|-------------------|-------------------------------------------------|---------------------------------------------------|--|--|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | WATER CONTENT (%) | | | | | |
| | | | | | | | | | | | | | | | | | | |
| 328.6 | GROUND SURFACE | | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | | |
| | FILL - SAND AND GRAVEL, TRACE SILT COMPACT BROWN | | | SS1 | SS | 25 | | | | | | | | | | | | |
| 327.8 | SILTY CLAY VERY SOFT TO STIFF GREY | | | SS2 | SS | 6 | | | | | | | | | | | | |
| 0.8 | | | | SS3 | SS | 5 | | | | | | | | | | | | |
| | | | | SS4 | SS | 4 | | | | | | | | | | | | |
| | | | | SS5 | SS | 2 | | | | | | | | | | | | |
| | | | | SS6 | SS | 2 | | | | | | | | | | | | |
| | | | | SS7 | SS | 1 | | | | | | | | | | | | |
| 322.5 | SAND WITH GRAVEL, SOME SILT | | | SS8 | SS | 9 | | | | | | | | | | | | |
| 6.1 | | | | SS9 | SS | 8 | | | | | | | | | | | | |
| | | | | SS10 | SS | 7 | | | | | | | | | | | | |
| | | | | SS11 | SS | 12 | | | | | | | | | | | | |
| | LOOSE TO VERY DENSE GREY | | | SS12 | SS | 100+ | | | | | | | | | | | | |
| 316.1 | END OF BOREHOLE AT 12.5 m | | | | | | | | | | | | | | | | | |
| 12.5 | | | | | | | | | | | | | | | | | | |

ON_MOT-HIGH VANES LITTLE GRASSY CREEK.GPJ DST_MIN.GDT 18/3/16

+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ENCLOSURE 3

RECORD OF BOREHOLE No BH3

1 OF 1

METRIC

W.P. G.W.P. 6065-13-00 LOCATION LITTLE GRASSY RIVER TRIB. CULVERT ORIGINATED BY RW
 DIST MTO HWY OLSON ROAD BOREHOLE TYPE HOLLOW STEM AUGER - 80 mm ID COMPILED BY SA
 DATUM Geodetic DATE 2015 08 31 CHECKED BY BV

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | PLASTIC LIMIT w _p | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w _L | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL | |
|---------------|---------------------------------------------------|------------|---------|------|------------|----------------------------|--------------------|---------------------------------------------|--|--|------------------------------------|-------------------------------------|-----------------------------------|------------------------------------------|------------------------------------------------------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | |
| | | | | | | | | ○ UNCONFINED + FIELD VANE | | | | | | | | |
| 328.4 | GROUND SURFACE | | | | | | 50 100 150 200 250 | | | | | | | | | |
| | FILL - SAND AND GRAVEL | | SS1 | SS | 22 | | | | | | | | | | | |
| 327.6 | COMPACT BROWN | | | | | | | | | | | | | | | |
| 0.8 | SILTY CLAY VERY SOFT TO STIFF BROWN TO GREY | | SS2 | SS | 3 | | | | | | | | | | | |
| | | | SS3 | SS | 2 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | SS4 | SS | 3 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | SS5 | SS | 5 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | SS6 | SS | 2 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | SS7 | SS | 1 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | SS8 | SS | 7 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | SS9 | SS | 7 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | SS10 | SS | 10 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | SS11 | SS | 2 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| 316.5 | END OF BOREHOLE AT 11.9 m | | | | | | | | | | | | | | | |
| 11.9 | | | | | | | | | | | | | | | | |

ON MOT-HIGH VANES LITTLE GRASSY CREEK.GPJ DST_MIN.GDT 18/3/16

+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ENCLOSURE 4

RECORD OF BOREHOLE No BH4

1 OF 2

METRIC

W.P. G.W.P. 6065-13-00 LOCATION LITTLE GRASSY RIVER TRIB. CULVERT ORIGINATED BY RW
 DIST MTO HWY OLSON ROAD BOREHOLE TYPE HOLLOW STEM AUGER - 80 mm ID COMPILED BY SA
 DATUM Geodetic DATE 2015 08 29 CHECKED BY BV

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | PLASTIC LIMIT W _P | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|--------------------------------------------------------|--------------------|---------|------|------------|----------------------------|-----------------|------------------------------------------------------------------|--|--|----------------------------------------|-----------------------------------------|---------------------------------------|--------------------------------------------------|----------------------------------------------------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | |
| | | | | | | | | ○ UNCONFINED + FIELD VANE □ QUICK TRIAXIAL × LAB VANE | | | | | | | |
| 328.6 | GROUND SURFACE | | | | | | 20 40 60 80 100 | | | | | | | | |
| 327.8 0.8 | FILL - SAND, WITH SILT, SOME GRAVEL COMPACT GREY | | SS1 | SS | 17 | | | | | | | | | | 13 54 (33) |
| | SILTY CLAY SOFT TO STIFF GREY | | SS2 | SS | 3 | | | | | | | | | | |
| | | | SS3 | SS | 4 | | | | | | | | | | |
| | | | SS4 | SS | 3 | | | | | | | | | | |
| | | | ST1 | SH | | | | | | | | | | | |
| | | | SS5 | SS | 0 | | | | | | | | | | |
| | | | SS6 | SS | 0 | | | | | | | | | | |
| | | | SS7 | SS | 9 | | | | | | | | | | |
| | | | SS8 | SS | 8 | | | | | | | | | | |
| | | | SS9 | SS | 16 | | | | | | | | | | |
| 318.9 9.7 | CLAYEY SAND, SOME GRAVEL | | | | | | | | | | | | | | |
| | SANDY CLAY, SOME GRAVEL | | SS10 | SS | 20 | | | | | | | | | | 11 55 (34) |
| 316.4 12.2 | | BOULDER AND COBBLE | | | | | | | | | | | | | |

Continued Next Page

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

ENCLOSURE 5

RECORD OF BOREHOLE No BH4

2 OF 2

METRIC

W.P. G.W.P. 6065-13-00 LOCATION LITTLE GRASSY RIVER TRIB. CULVERT ORIGINATED BY RW
 DIST MTO HWY OLSON ROAD BOREHOLE TYPE HOLLOW STEM AUGER - 80 mm ID COMPILED BY SA
 DATUM Geodetic DATE 2015 08 29 CHECKED BY BV

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|---------------------------|------------|---------|------|------------|----------------------------|-----------------|----------------------------------------------------------|-----|-----|-----|-----|-------------------------------------------------|---------------------------------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | 20 | 40 | 60 | 80 | 100 | | |
| | GROUND SURFACE | | | | | | | SHEAR STRENGTH kPa | | | | | | |
| | | | | | | | | ○ UNCONFINED + FIELD VANE □ QUICK TRIAXIAL × LAB VANE | | | | | | |
| | | | | | | | | 50 | 100 | 150 | 200 | 250 | | |
| | | | | | | | | WATER CONTENT (%) | | | | | | |
| | | | | | | | | 20 | 40 | 60 | | | | |
| | | | | | | | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | | | | |
| | | | | | | | | W _p W W _L | | | | | | |
| 314.9 | | | | | | | 315 | | | | | | | |
| 13.7 | BEDROCK GNEISS DIORITE | | | | | | | | | | | | | |
| | RQD = 0% | | | | | | 314 | | | | | | | |
| | RQD = 66% | | | | | | 313 | | | | | | | |
| | RQD = 55% | | | | | | 312 | | | | | | | |
| | | | | | | | 311 | | | | | | | |
| 310.3 | END OF BOREHOLE AT 18.3 m | | | | | | | | | | | | | |
| 18.3 | | | | | | | | | | | | | | |

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

RECORD OF BOREHOLE No BH5

1 OF 1

METRIC

W.P. G.W.P. 6065-13-00 LOCATION LITTLE GRASSY RIVER TRIB. CULVERT ORIGINATED BY RW
 DIST MTO HWY OLSON ROAD BOREHOLE TYPE HOLLOW STEM AUGER - 80 mm ID COMPILED BY SA
 DATUM Geodetic DATE 2015 08 31 CHECKED BY BV

| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|------------------------------------------------------------------------|------------|--------|------|----------------------------|-----------------|---------------------------------------------|----|----|----|-----|-------------------------------------------------|---------------------------------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | 20 | 40 | 60 | 80 | 100 | | |
| 329.1 | GROUND SURFACE | | | | | | | | | | | | |
| 328.9 | TOPSOIL | | | | | | | | | | | | |
| 0.2 | SANDY SILTY CLAY, TRACE GRAVEL SOFT TO FIRM BROWN TO GREY | | SS1 | SS | 6 | | | | | | | | 8 38 (54) |
| | | | SS2 | SS | 6 | | | | | | | | 11 41 27 21 |
| | | | SS3 | SS | 2 | | | | | | | | |
| | | | SS4 | SS | 4 | | | | | | | | |
| | | | SS5 | SS | 4 | | | | | | | | |
| | | | SS6 | SS | 3 | | | | | | | | |
| | | | SS7 | SS | 9 | | | | | | | | Saturated |
| | | | SS8 | SS | 9 | | | | | | | | |
| | | | SS9 | SS | 12 | | | | | | | | |
| | | | SS10 | SS | 15 | | | | | | | | |
| 318.4 | SAND SOME SILT | | SS11 | SS | 18 | | | | | | | | 0 90 (10) |
| 10.7 | COMPACT TO VERY DENSE GREY | | SS12 | SS | 100+ | | | | | | | | |
| 316.9 | END OF BOREHOLE AT 12.2 m | | | | | | | | | | | | |
| 12.2 | | | | | | | | | | | | | |

ON MOT-HIGH VANES LITTLE GRASSY CREEK.GPJ DST_MIN.GDT 18/3/16

+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ENCLOSURE 7

RECORD OF BOREHOLE No BH6

1 OF 1

METRIC

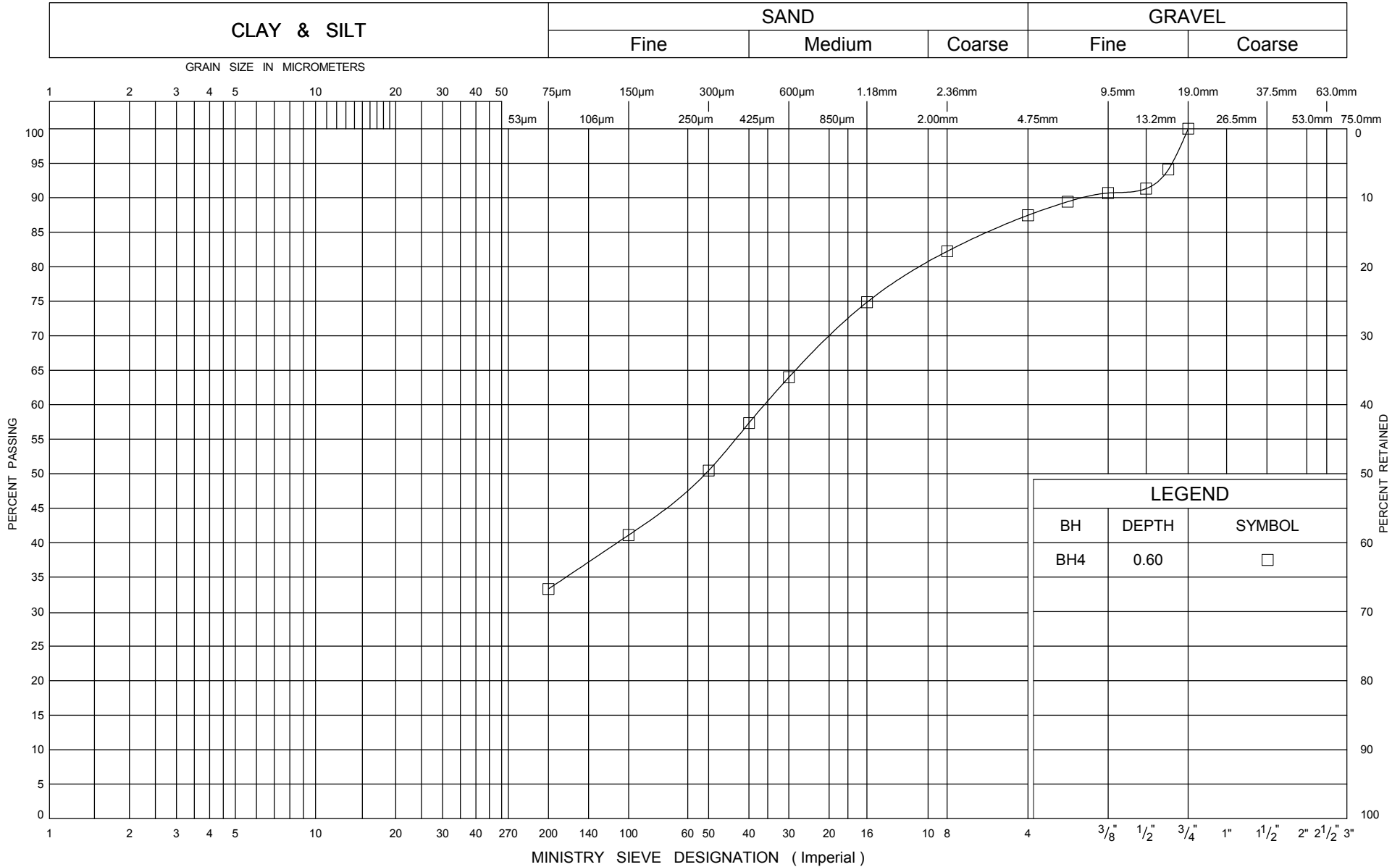
W.P. G.W.P. 6065-13-00 LOCATION LITTLE GRASSY RIVER TRIB. CULVERT ORIGINATED BY RW
 DIST MTO HWY OLSON ROAD BOREHOLE TYPE HOLLOW STEM AUGER - 80 mm ID COMPILED BY SA
 DATUM Geodetic DATE 2015 08 30 CHECKED BY BV

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|------------------------------------------|------------|---------|------|------------|----------------------------|-------------------------------------------------------------------------------------------------------------------|---------------------------------------------|--|---------------------------------------------------------|---|-------------------|-------------------------------------------------|---------------------------------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | W _p | W | W _L | | |
| 328.7 | GROUND SURFACE | | | | | ▽ | 328 327 326 325 324 323 322 321 320 319 318 | 20 40 60 80 100 | | | | GR SA SI CL | | |
| 328.1 | FILL - SAND AND GRAVEL | | SS1 | SS | 10 | | | ○ UNCONFINED + FIELD VANE | | | | | | |
| 0.6 | COMPACT BROWN SILTY CLAY | | | | | | | □ QUICK TRIAXIAL × LAB VANE | | | | | | |
| | VERY SOFT TO VERY STIFF BROWN TO GREY | | SS2 | SS | 6 | | | | | | | | | |
| | | | SS3 | SS | 10 | | | | | | | | | |
| | | | SS4 | SS | 7 | | | | | | | | | |
| | | | SS5 | SS | 6 | | | | | | | | | |
| | | | SS6 | SS | 1 | | | | | | | | | |
| | | | SS7 | SS | 8 | | | | | | | | | |
| | | | SS8 | SS | 7 | | | | | | | | | |
| | | | SS9 | SS | 10 | | | | | | | | | |
| | | | SS10 | SS | 11 | | | | | | | | | |
| 318.9 | SILTY SAND | | | | | | | | | | | | | |
| 9.8 | VERY DENSE GREY | | | | | | | | | | | | | |
| 318.0 | | | SS11 | SS | 100+ | | | | | | | | | |
| 10.7 | END OF BOREHOLE AT 10.7 m | | | | | | | | | | | | | |

ON MOT-HIGH VANES LITTLE GRASSY CREEK GPJ DST_MIN.GDT 18/3/16

+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation
Ontario

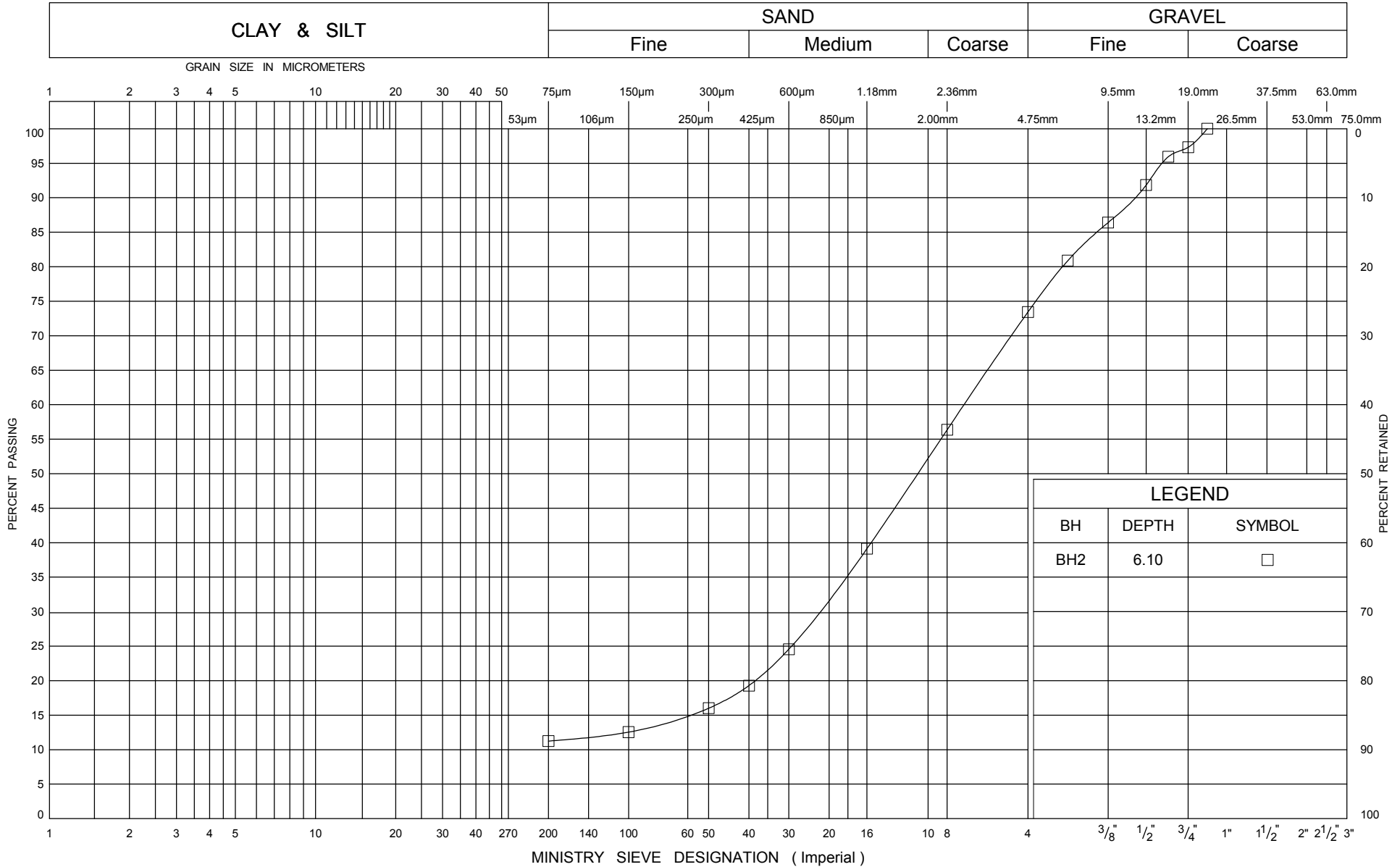
GRAIN SIZE DISTRIBUTION
SOIL DESCRIPTION
FILL - SILTY SAND

ENCLOSURE 9

DST REF. # GS-TB-021102

LITTLE GRASSY TRIB. CULVERT

UNIFIED SOIL CLASSIFICATION SYSTEM



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Transportation
Ontario

GRAIN SIZE DISTRIBUTION
SOIL DESCRIPTION
SAND

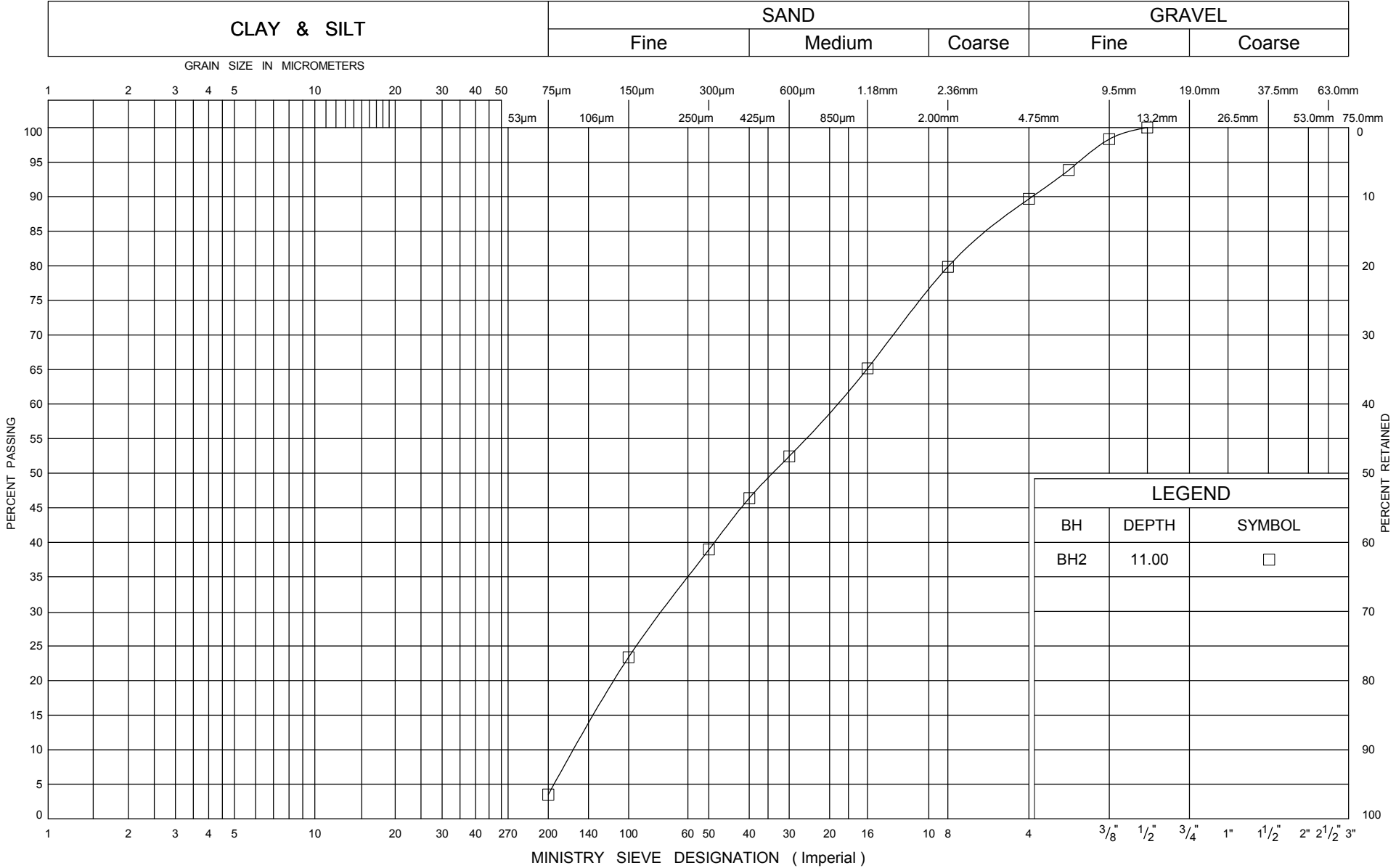
ENCLOSURE 10

DST REF. # GS-TB-021102

LITTLE GRASSY TRIB. CULVERT

ONTARIO MOT GRAIN SIZE LITTLE GRASSY CREEK.GPJ DST_MIN.GDT 19/11/15

UNIFIED SOIL CLASSIFICATION SYSTEM



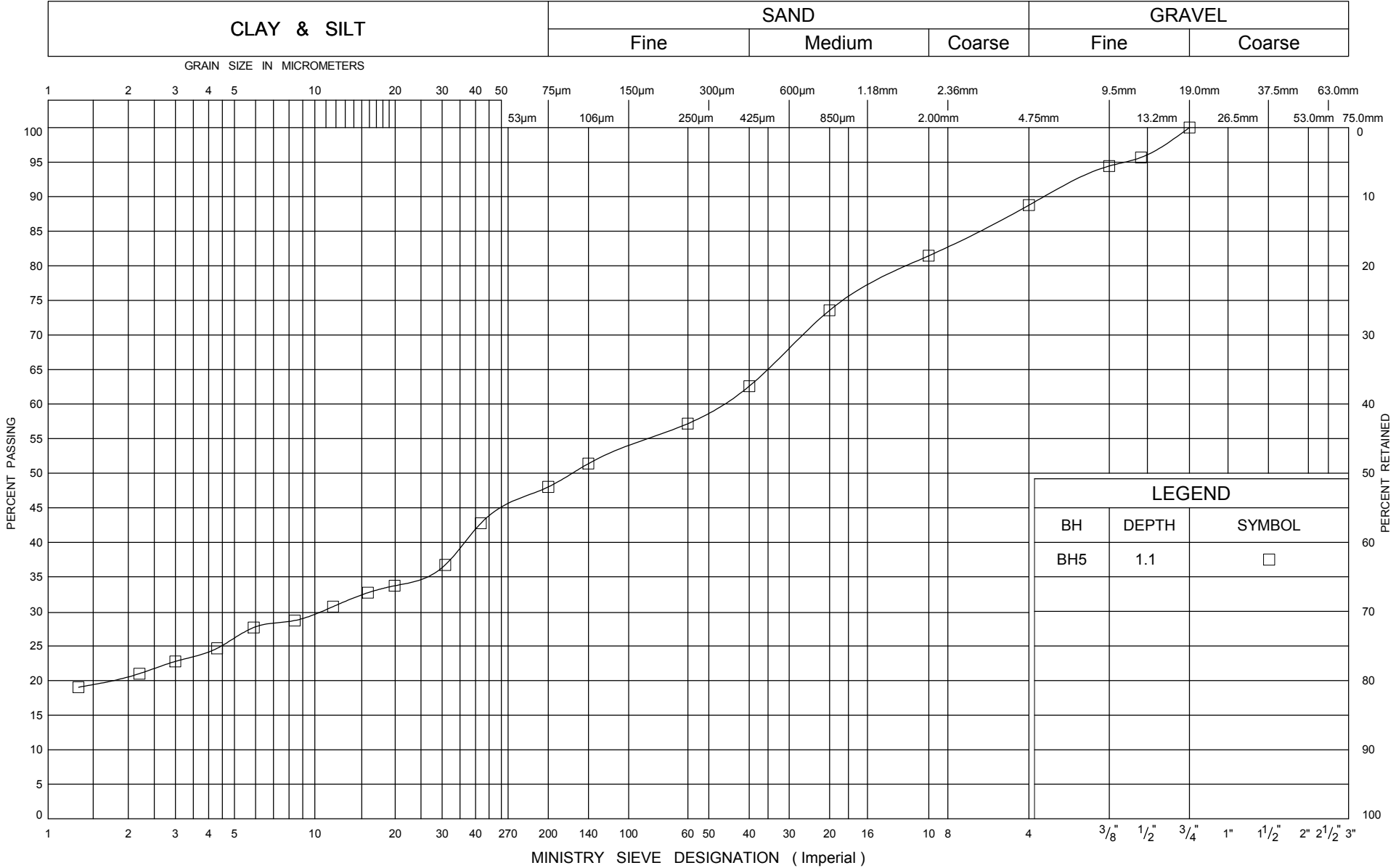
Ministry of
Transportation
Ontario

GRAIN SIZE DISTRIBUTION
SOIL DESCRIPTION
SAND

ENCLOSURE 11
DST REF. # GS-TB-021102
LITTLE GRASSY TRIB. CULVERT

ONTARIO MOT GRAIN SIZE LITTLE GRASSY CREEK.GPJ DST_MIN.GDT 20/11/15

UNIFIED SOIL CLASSIFICATION SYSTEM

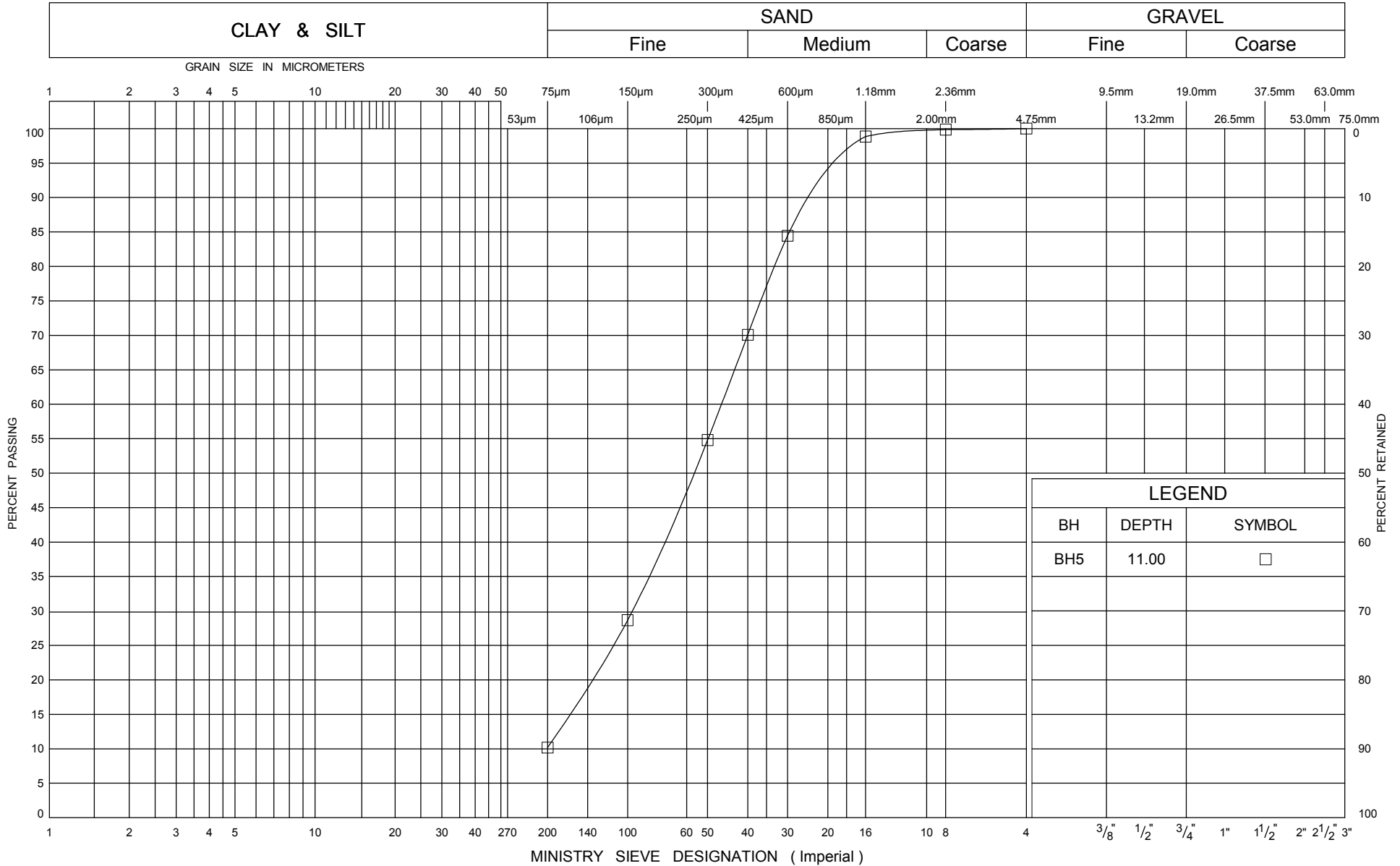


Ministry of
Transportation
Ontario

GRAIN SIZE DISTRIBUTION
SOIL DESCRIPTION
SAND

ENCLOSURE 12
DST REF. # GS-TB-021102
LITTLE GRASSY TRIB. CULVERT

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation
Ontario

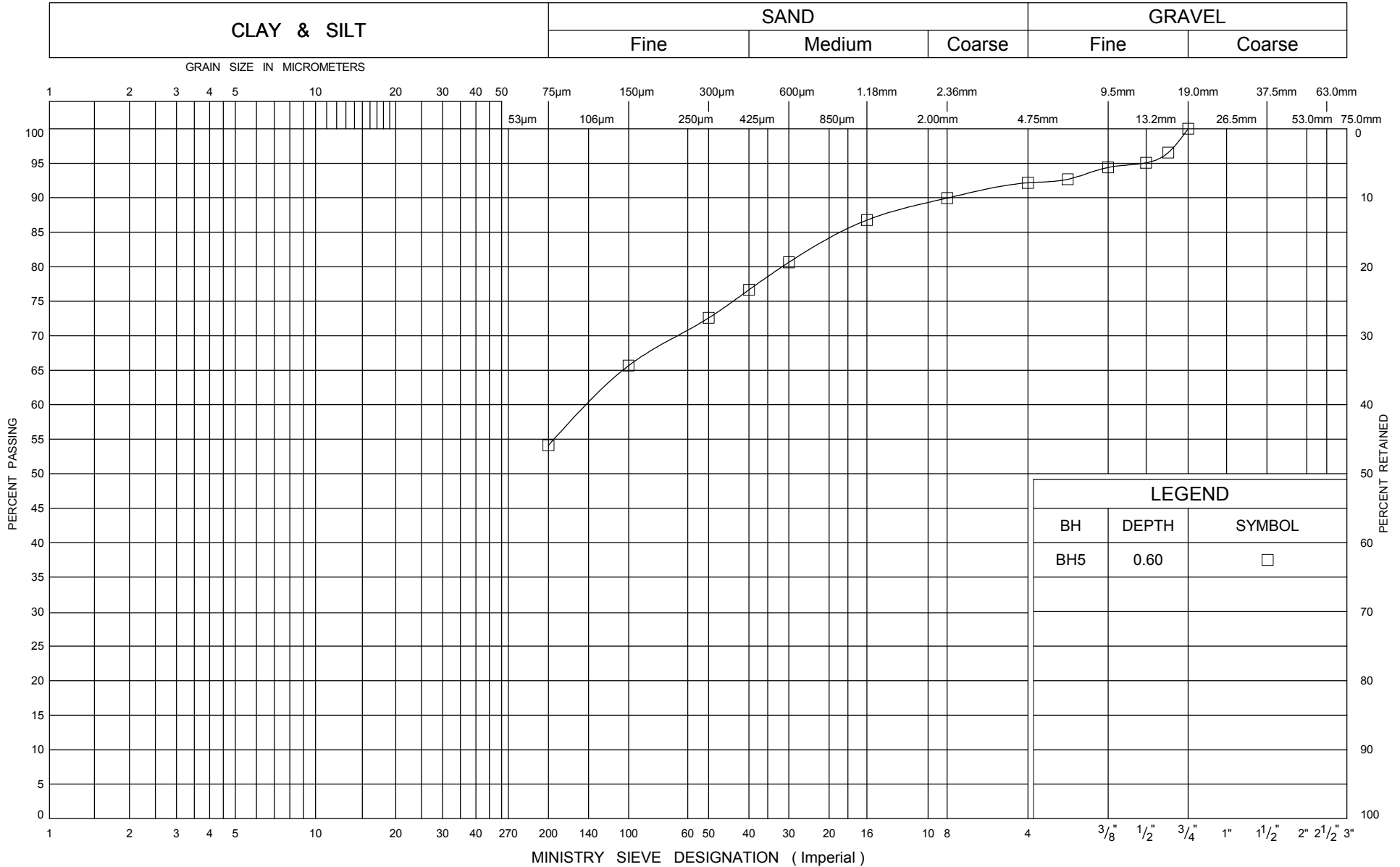
GRAIN SIZE DISTRIBUTION
SOIL DESCRIPTION
SAND

ENCLOSURE 13

DST REF. # GS-TB-021102

LITTLE GRASSY TRIB. CULVERT

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation
Ontario

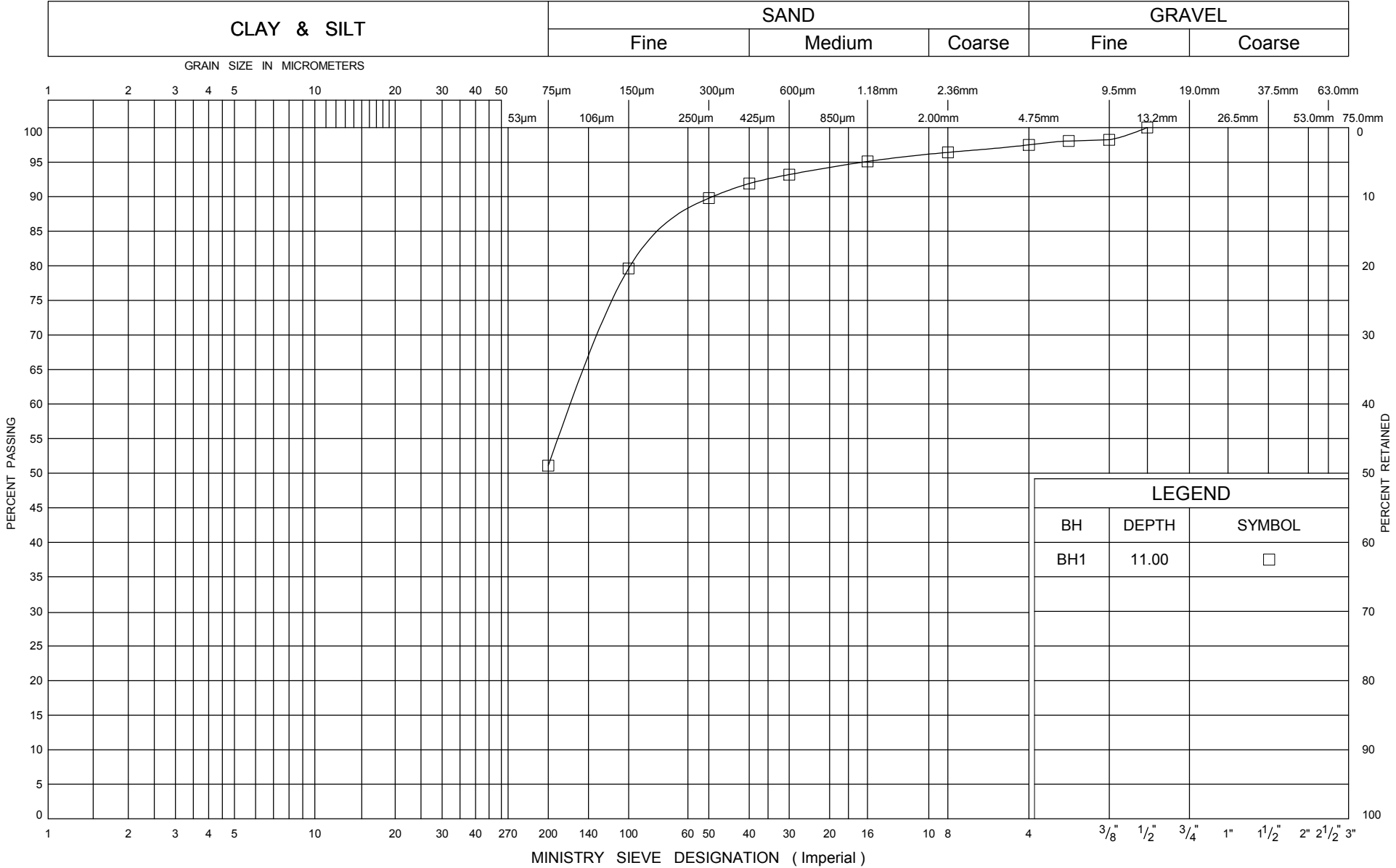
GRAIN SIZE DISTRIBUTION
SOIL DESCRIPTION
SANDY SILTY CLAY

ENCLOSURE 14

DST REF. # GS-TB-021102

LITTLE GRASSY TRIB. CULVERT

UNIFIED SOIL CLASSIFICATION SYSTEM

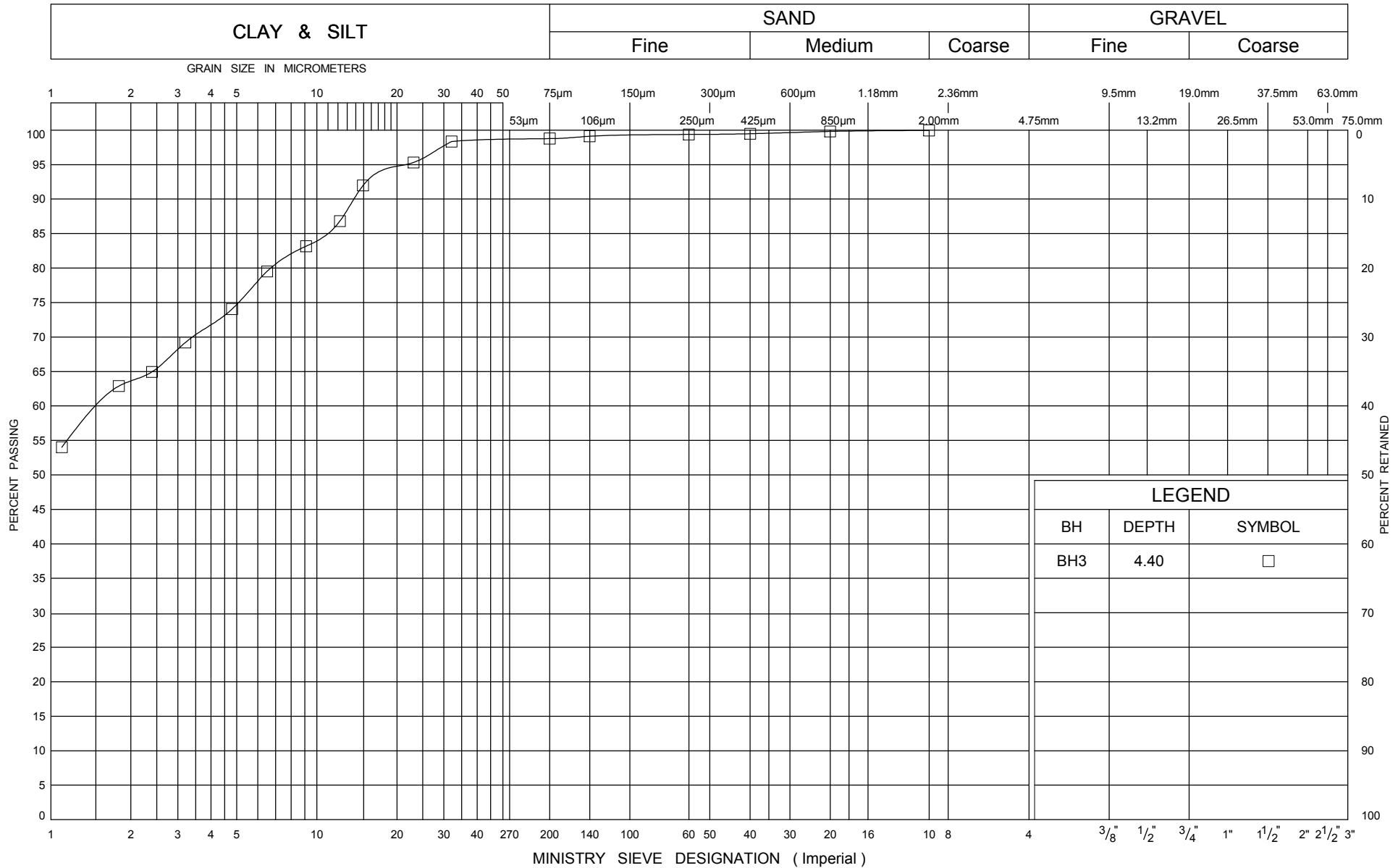


Ministry of
Transportation
Ontario

GRAIN SIZE DISTRIBUTION
SOIL DESCRIPTION
SILT

ENCLOSURE 15
DST REF. # GS-TB-021102
LITTLE GRASSY TRIB. CULVERT

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation
Ontario

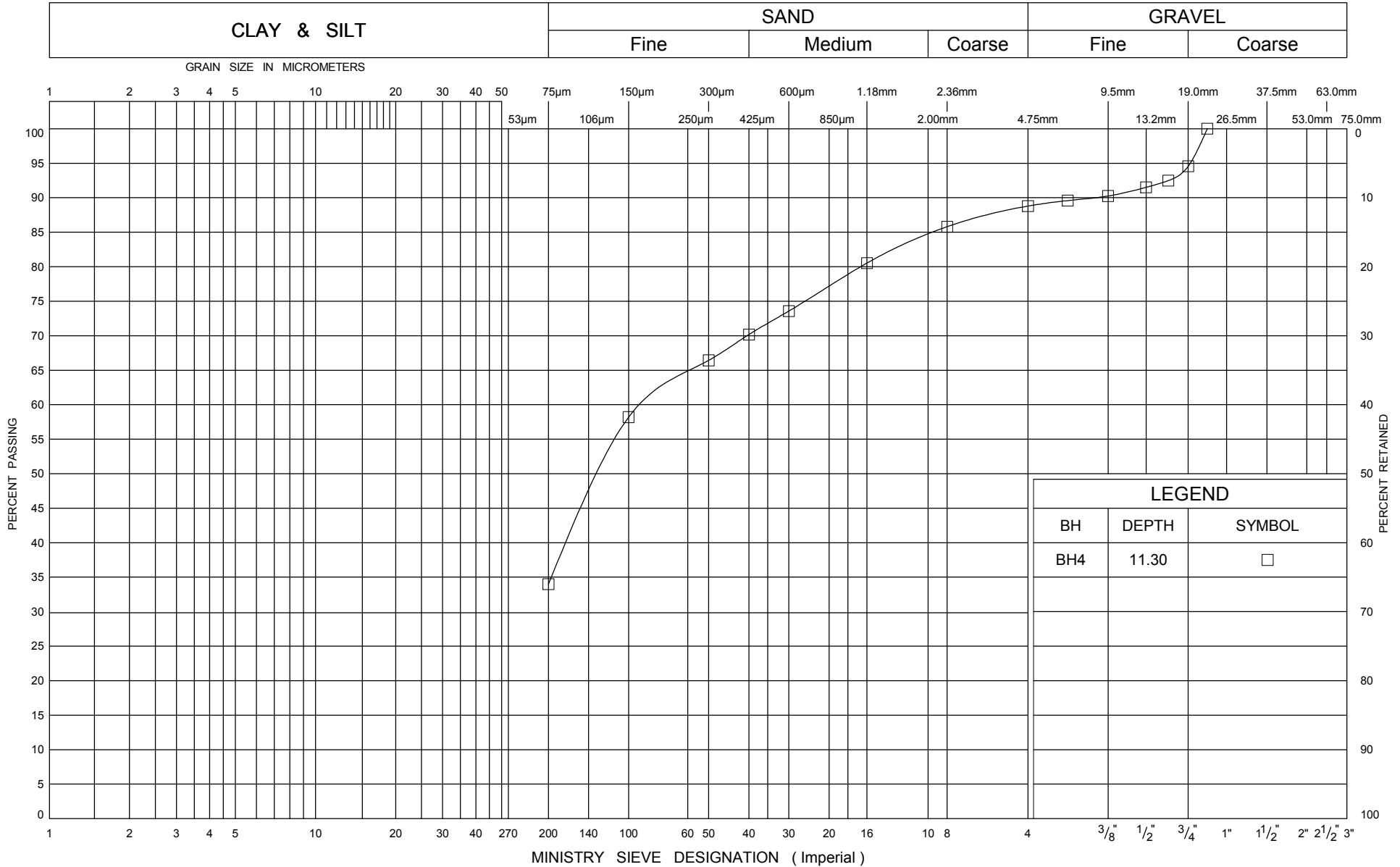
GRAIN SIZE DISTRIBUTION
SOIL DESCRIPTION
SILTY CLAY

ENCLOSURE 16

DST REF. # GS-TB-021102

LITTLE GRASSY TRIB. CULVERT

UNIFIED SOIL CLASSIFICATION SYSTEM



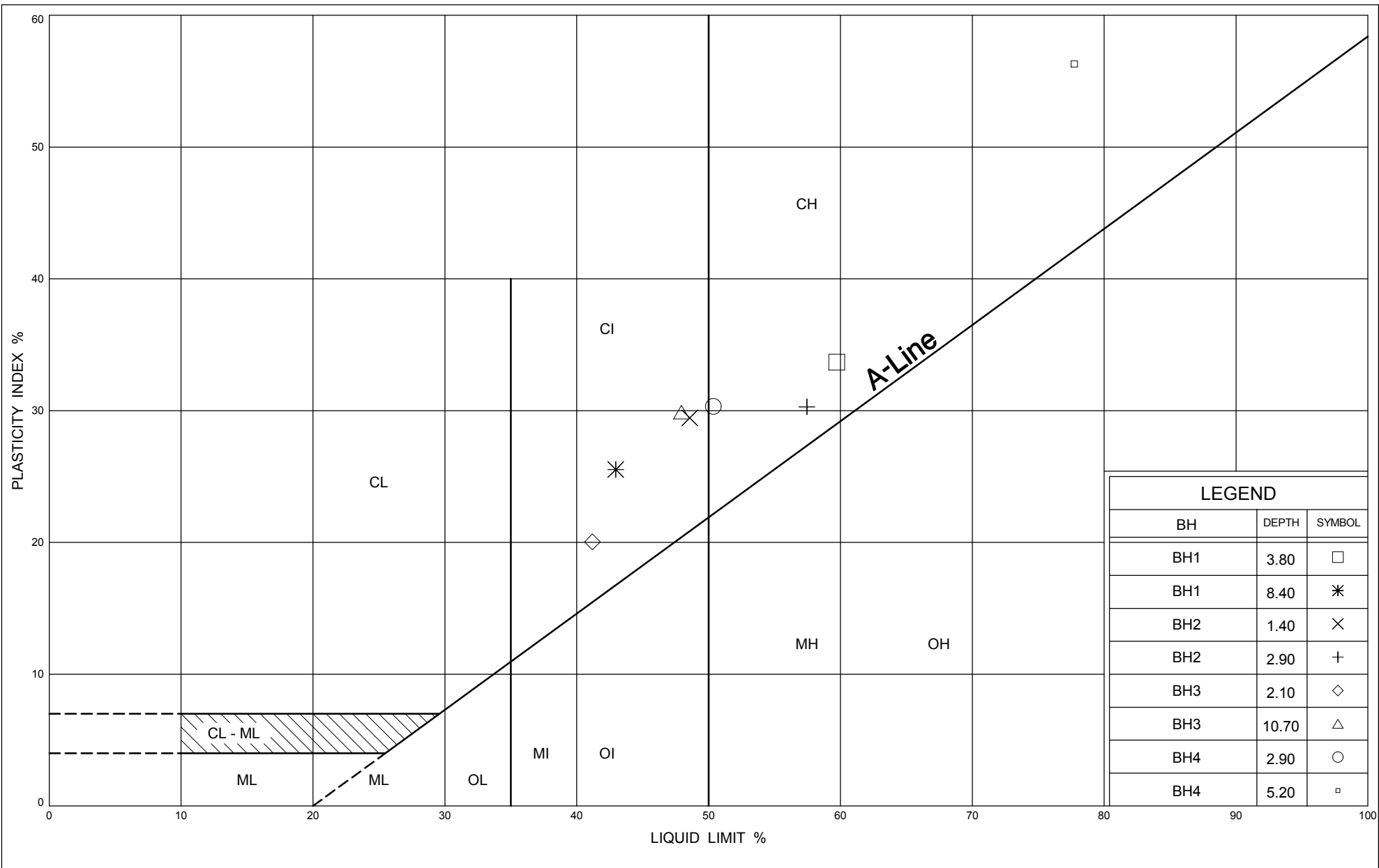
Ministry of
Transportation
Ontario

GRAIN SIZE DISTRIBUTION
SOIL DESCRIPTION
CLAYEY SAND

ENCLOSURE 17

DST REF. # GS-TB-021102

LITTLE GRASSY TRIB. CULVERT



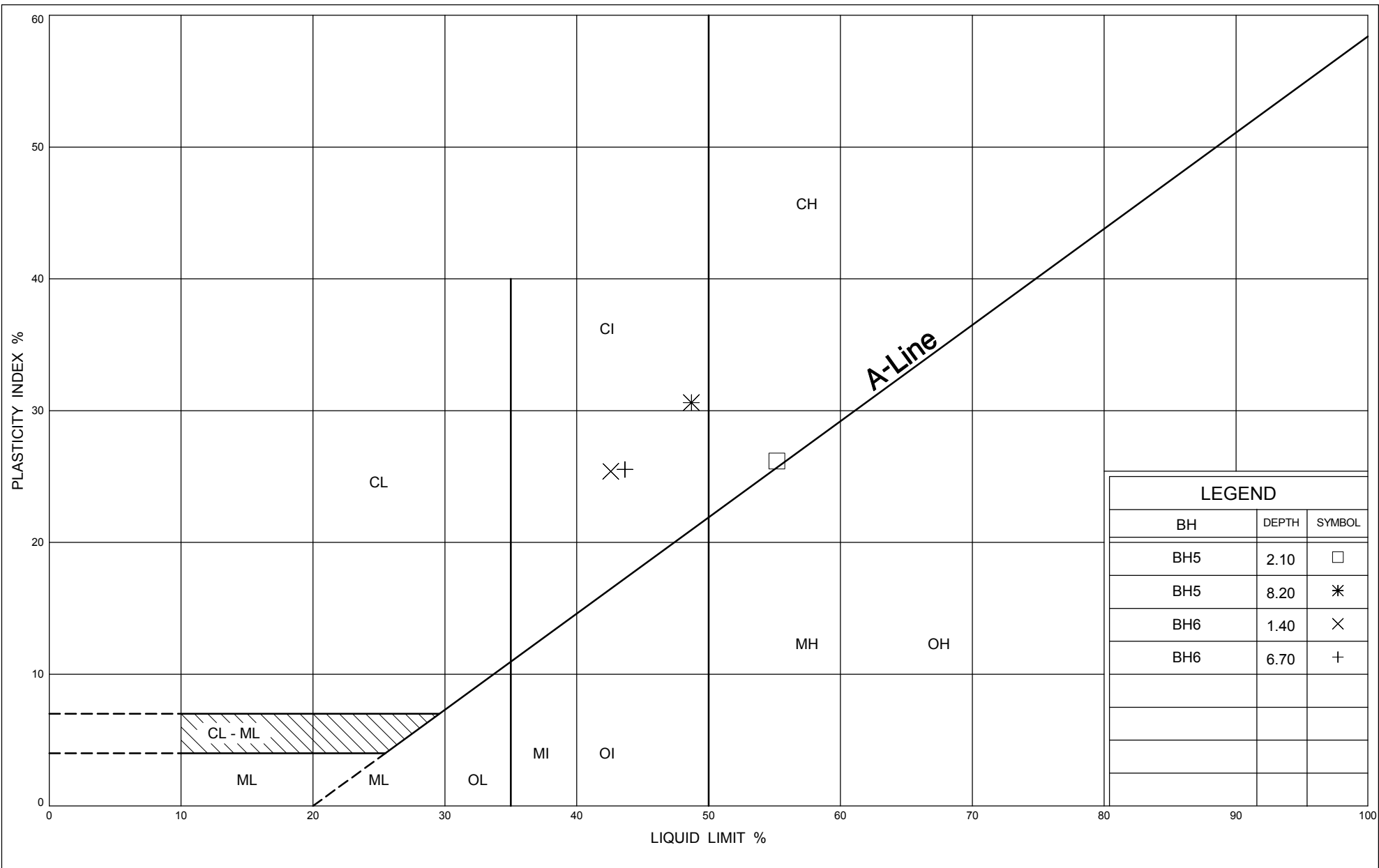
Ministry of
Transportation
Ontario

PLASTICITY CHART INTERMEDIATE TO HIGH PLASTIC CLAY

ENCLOSURE 18

DST REF. # GS-TB-021102

LITTLE GRASSY TRIB. CULVERT



Ministry of
Transportation
Ontario

PLASTICITY CHART INTERMEDIATE TO HIGH PLASTIC CLAY

ENCLOSURE 19

DST REF. # GS-TB-021102

LITTLE GRASSY TRIB. CULVERT

POINT LOAD TEST RESULTS (diametric and axial)

PROJECT: 5014-E-0049, Replacement of Little Grassy Trib. Culvert **JOB NO.:** GS-TB-021102

This spreadsheet is based on information from 'Suggested Method for Determining Point Load Strength', International Society for Rock Mechanics Commission on Testing Methods, 1985.

* Valid or Invalid based on description of break according to Fig 4 from 'Suggested Method for Determining Point Load Strength'

| | | |
|------------------------------------------------------------|-----------------------------------|------------------------------------------------------------------------------------------------------|
| I_s = uncorrected point load strength | $D_e^2 = D^2$ for diametral tests | F = size correction factor |
| P = load | $D_e^2 = 4A/\pi$ for axial tests | $F = (D_e/50)^{0.45}$ or Fig. 7 from ' <i>Suggested Method for Determining Point Load Strength</i> ' |
| D_e = equivalent core diameter | where $A = WD$ | $F = \text{SQRT}(D_e/50)$ for tests near the standard (50 mm) size |
| | $I_s = P/D_e^2$ | Size Correction $I_{s(50)} = F \times I_s$ |
| Uniaxial Compressive Strength = $C_o = 21 \times I_s$ (50) | | |

21 is from: "*Using the Point Load Test to Determine the Uniaxial Compressive Strength of Coal Measure Rock*", Peng SS, Mark C, eds. Proceedings of the 19th International Conference on Ground Control in Mining. Morgantown, WV: West Virginia University.

[illegible]



DST Thunder Bay
ATTN: Selorm Danku
DST Consulting Engineers Inc.
605 Hewitson Street
Thunder Bay ON P7B 5V5

Date Received: 16-NOV-15
Report Date: 18-NOV-15 09:55 (MT)
Version: FINAL

Client Phone: 807-626-1310

Certificate of Analysis

Lab Work Order #: L1702558
Project P.O. #: NOT SUBMITTED
Job Reference:
C of C Numbers:
Legal Site Desc:

Rikki Thomson
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 1081 Barton Street, Thunder Bay, ON P7B 5N3 Canada | Phone: +1 807 623 6463 | Fax: +1 807 623 7598
ALS CANADA LTD Part of the ALS Group A Campbell Brothers Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|---------------------------------------------------------------------------------------------------|--|--------|------------|------|----------|-----------|-----------|----------|
| L1702558-1 STRAWBERRY CREEK BRIDGE Sampled By: CLIENT on 16-NOV-15 @ 00:01 Matrix: SOIL | | | | | | | | |
| Physical Tests | | | | | | | | |
| Conductivity | | 88.9 | | 4.0 | umhos/cm | | 17-NOV-15 | R3312712 |
| % Moisture | | 2.69 | | 0.10 | % | 17-NOV-15 | 18-NOV-15 | R3312766 |
| pH | | 7.31 | | 0.10 | pH units | | 17-NOV-15 | R3312709 |
| Resistivity | | 8330 | | 100 | ohm cm | 17-NOV-15 | 17-NOV-15 | R3312722 |
| Leachable Anions & Nutrients | | | | | | | | |
| Chloride | | <20 | | 20 | mg/kg | 17-NOV-15 | 17-NOV-15 | R3313157 |
| Anions and Nutrients | | | | | | | | |
| Sulphate | | 74 | | 20 | mg/kg | 17-NOV-15 | 17-NOV-15 | R3313157 |
| L1702558-2 KASH KAKOESIS RIVER BRIDGE Sampled By: CLIENT on 16-NOV-15 @ 00:01 Matrix: SOIL | | | | | | | | |
| Physical Tests | | | | | | | | |
| Conductivity | | 254 | | 4.0 | umhos/cm | | 17-NOV-15 | R3312712 |
| % Moisture | | 43.7 | | 0.10 | % | 17-NOV-15 | 18-NOV-15 | R3312766 |
| pH | | 7.64 | | 0.10 | pH units | | 17-NOV-15 | R3312709 |
| Resistivity | | 4030 | | 100 | ohm cm | 17-NOV-15 | 17-NOV-15 | R3312722 |
| Leachable Anions & Nutrients | | | | | | | | |
| Chloride | | <20 | | 20 | mg/kg | 17-NOV-15 | 17-NOV-15 | R3313157 |
| Anions and Nutrients | | | | | | | | |
| Sulphate | | 258 | | 20 | mg/kg | 17-NOV-15 | 17-NOV-15 | R3313157 |
| L1702558-3 LITTLE GRASSY TIMBER BRIDGE Sampled By: CLIENT on 16-NOV-15 @ 00:01 Matrix: SOIL | | | | | | | | |
| Physical Tests | | | | | | | | |
| Conductivity | | 215 | | 4.0 | umhos/cm | | 17-NOV-15 | R3312712 |
| % Moisture | | 27.3 | | 0.10 | % | 17-NOV-15 | 18-NOV-15 | R3312766 |
| pH | | 7.19 | | 0.10 | pH units | | 17-NOV-15 | R3312709 |
| Resistivity | | 4200 | | 100 | ohm cm | 17-NOV-15 | 17-NOV-15 | R3312722 |
| Leachable Anions & Nutrients | | | | | | | | |
| Chloride | | <20 | | 20 | mg/kg | 17-NOV-15 | 17-NOV-15 | R3313157 |
| Anions and Nutrients | | | | | | | | |
| Sulphate | | 84 | | 20 | mg/kg | 17-NOV-15 | 17-NOV-15 | R3313157 |
| | | | | | | | | |

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-------------------|-------------------------|
| CL-WT | Soil | Chloride in Soil | EPA 300.0 |
| EC-WT | Soil | Conductivity (EC) | EPA 9050A |
| A representative subsample is tumbled with de-ionized (DI) water. The ratio of water to soil is 2:1 v/w. After tumbling the sample is then analyzed by a conductivity meter. | | | |
| MOISTURE-WT | Soil | % Moisture | Gravimetric: Oven Dried |
| PH-WT | Soil | pH | MOEE E3137A |
| Soil samples are mixed in the deionized water and the supernatant is analyzed directly by the pH meter. | | | |
| RESISTIVITY-WT | Soil | Resistivity | MOECC E3138 |
| Resistivity on a soil is a 2:1 extraction of DI water to soil. Sample is tumbled for 30 min. Conductivity of the extraction is taken and the inverse is calculated for resistivity. | | | |
| SO4-WT | Soil | Sulphate | EPA 300.0 |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|-----------------------------------------------|
| WT | ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA |

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.

mg/kg - milligrams per kilogram based on dry weight of sample

mg/kg wwwt - milligrams per kilogram based on wet weight of sample

mg/kg lwt - milligrams per kilogram based on lipid weight of sample

mg/L - unit of concentration based on volume, parts per million.

< - Less than.

D.L. - The reporting limit.

N/A - Result not available. Refer to qualifier code and definition for explanation.

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

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L1702558

Report Date: 18-NOV-15

Page 1 of 3

Client: DST Thunder Bay
DST Consulting Engineers Inc. 605 Hewitson Street
Thunder Bay ON P7B 5V5

Contact: Selorm Danku

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|----------------------------|----------|------------|--------|-----------|----------|------|---------|-----------|
| CL-WT Soil | | | | | | | | |
| Batch | R3313157 | | | | | | | |
| WG2215497-4 CRM | | AN-CRM-WT | | | | | | |
| Chloride | | | 99.8 | | % | | 70-130 | 17-NOV-15 |
| WG2215497-3 DUP | | L1702558-1 | | | | | | |
| Chloride | | <20 | <20 | RPD-NA | mg/kg | N/A | 30 | 17-NOV-15 |
| WG2215497-2 LCS | | | | | | | | |
| Chloride | | | 97.5 | | % | | 70-130 | 17-NOV-15 |
| WG2215497-1 MB | | | | | | | | |
| Chloride | | | <20 | | mg/kg | | 20 | 17-NOV-15 |
| EC-WT Soil | | | | | | | | |
| Batch | R3312712 | | | | | | | |
| WG2215454-1 DUP | | L1702558-3 | | | | | | |
| Conductivity | | 215 | 197 | | umhos/cm | 8.7 | 20 | 17-NOV-15 |
| WG2215743-1 MB | | | | | | | | |
| Conductivity | | | <4.0 | | umhos/cm | | 4 | 17-NOV-15 |
| MOISTURE-WT Soil | | | | | | | | |
| Batch | R3312766 | | | | | | | |
| WG2215461-2 LCS | | | | | | | | |
| % Moisture | | | 98.6 | | % | | 90-110 | 18-NOV-15 |
| WG2215461-1 MB | | | | | | | | |
| % Moisture | | | <0.10 | | % | | 0.1 | 18-NOV-15 |
| PH-WT Soil | | | | | | | | |
| Batch | R3312709 | | | | | | | |
| WG2215439-1 DUP | | L1702558-2 | | | | | | |
| pH | | 7.64 | 7.48 | J | pH units | 0.16 | 0.3 | 17-NOV-15 |
| WG2215740-1 LCS | | | | | | | | |
| pH | | | 6.96 | | pH units | | 6.7-7.3 | 17-NOV-15 |
| RESISTIVITY-WT Soil | | | | | | | | |
| Batch | R3312722 | | | | | | | |
| WG2215421-1 DUP | | L1702558-1 | | | | | | |
| Resistivity | | 8330 | 8260 | | ohm cm | 0.8 | 25 | 17-NOV-15 |
| SO4-WT Soil | | | | | | | | |
| Batch | R3313157 | | | | | | | |
| WG2215497-4 CRM | | AN-CRM-WT | | | | | | |
| Sulphate | | | 111.9 | | % | | 70-130 | 17-NOV-15 |
| WG2215497-3 DUP | | L1702558-1 | | | | | | |
| Sulphate | | 74 | 97 | | mg/kg | 27 | 30 | 17-NOV-15 |

Quality Control Report

Workorder: L1702558

Report Date: 18-NOV-15

Page 2 of 3

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|-------------|----------|-----------|--------|-----------|-------|-----|--------|-----------|
| SO4-WT | Soil | | | | | | | |
| Batch | R3313157 | | | | | | | |
| WG2215497-2 | LCS | | | | | | | |
| Sulphate | | | 97.2 | | % | | 70-130 | 17-NOV-15 |
| WG2215497-1 | MB | | | | | | | |
| Sulphate | | | <20 | | mg/kg | | 20 | 17-NOV-15 |

Quality Control Report

Workorder: L1702558

Report Date: 18-NOV-15

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Legend:

| | |
|-------|---------------------------------------------|
| Limit | ALS Control Limit (Data Quality Objectives) |
| DUP | Duplicate |
| RPD | Relative Percent Difference |
| N/A | Not Available |
| LCS | Laboratory Control Sample |
| SRM | Standard Reference Material |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| ADE | Average Desorption Efficiency |
| MB | Method Blank |
| IRM | Internal Reference Material |
| CRM | Certified Reference Material |
| CCV | Continuing Calibration Verification |
| CVS | Calibration Verification Standard |
| LCSD | Laboratory Control Sample Duplicate |

Sample Parameter Qualifier Definitions:

| Qualifier | Description |
|-----------|---------------------------------------------------------------------------------------------|
| J | Duplicate results and limits are expressed in terms of absolute difference. |
| RPD-NA | Relative Percent Difference Not Available due to result(s) being less than detection limit. |

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

2010 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

Requested by: , DST Consulting Engineers Inc.
Site Coordinates: 48.5451 North 89.5664 West
User File Reference: 48.545187,-89.566437

September 16, 2015

National Building Code ground motions:

2% probability of exceedance in 50 years (0.000404 per annum)

| Sa(0.2) | Sa(0.5) | Sa(1.0) | Sa(2.0) | PGA (g) |
|---------|---------|---------|---------|---------|
| 0.095 | 0.057 | 0.026 | 0.008 | 0.036 |

Notes. Spectral and peak hazard values are determined for firm ground (NBCC 2010 soil class C - average shear wave velocity 360-750 m/s). Median (50th percentile) values are given in units of g. 5% damped spectral acceleration (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are tabulated. Only 2 significant figures are to be used. ***These values have been interpolated from a 10 km spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the calculated values.***

Ground motions for other probabilities:

| | | | |
|---------------------------------------|-------|--------|-------|
| Probability of exceedance per annum | 0.010 | 0.0021 | 0.001 |
| Probability of exceedance in 50 years | 40% | 10% | 5% |
| Sa(0.2) | 0.011 | 0.035 | 0.055 |
| Sa(0.5) | 0.007 | 0.022 | 0.034 |
| Sa(1.0) | 0.003 | 0.011 | 0.016 |
| Sa(2.0) | 0.001 | 0.003 | 0.005 |
| PGA | 0.003 | 0.011 | 0.019 |

References

National Building Code of Canada 2010 NRCC no. 53301; sections 4.1.8, 9.20.1.2, 9.23.10.2, 9.31.6.2, and 6.2.1.3

Appendix C: Climatic Information for Building Design in Canada - table in Appendix C starting on page C-11 of Division B, volume 2

User's Guide - NBC 2010, Structural Commentaries NRCC no. 53543 (in preparation)
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File xxxx
Fourth generation seismic hazard maps of Canada: Maps and grid values to be used with the 2010 National Building Code of Canada (in preparation)

See the websites www.EarthquakesCanada.ca and www.nationalcodes.ca for more information

Aussi disponible en français

