



Foundation Investigation Report

Bass Creek Bridge Replacement

GWP 476-00-00

Highway 585
14 km north of the 585 and 11/17 Highway Intersection

Prepared for
Ministry of Transportation, Northwestern Region

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Part A - **FOUNDATION INVESTIGATION REPORT**

1 Introduction

TBT Engineering has been retained by the Ministry of Transportation to provide foundation investigation services for the bridge replacement at Bass Creek.

The site is located on Highway 585, approximately 14 km north of the Highway 11/17 intersection, within Booth Township, Ontario.

The foundation investigation was carried out to investigate subsurface conditions at the site. This investigation consisted of five boreholes drilled in the vicinity of the proposed bridge replacement, and laboratory testing. This report provides a summary of that work and of the conditions encountered.

2 Site Description

The site is located on Highway 585, approximately 14 km north of the Highway 11/17 intersection. At this location Highway 585 runs generally in a north-south direction.

The existing bridge is a single lane “Bailey” type structure supported on timber cribs and is approximately 40 m long. The side embankments along the approaches have side slopes of approximately 1.5 horizontal to 1 vertical or flatter as the Highway approaches the Bass Creek ravine. The existing bridge abutment and approaches have been built up from the original ground in order to cross the creek.

The site is within Ontario’s boreal forest region. Highway 585 at the bridge location is generally level with the surrounding area. Bass Creek flows easterly in a ravine below the bridge, with approximately 7 m from the bridge deck to the top of water.



Bass Creek - Existing Bridge

3 Investigation Procedures

A site investigation was undertaken on July 24, 25, 28 and August 25, 2008. Five boreholes were drilled for this project, two along the approach, two near the existing abutments (one of each for either side of the creek), and the remaining one on the north end approximately 10 m east of the centerline.

The investigation was carried out using a CME drill rig equipped for geotechnical testing. The boreholes were drilled to depths ranging between 8.3 and 21.5 m below existing ground surface. Borehole locations and depths were determined through consultation with the client during an onsite meeting. Borehole BC08-02 was located in a potential detour route away from the road and bridge alignment. The remaining proposed detour boreholes were deleted upon cancellation of the detour. Refer to the Record of Borehole drawings (Appendix C) for specific depths and comments concerning each borehole.

Soil samples were obtained at the boreholes with a split spoon sampler as a part of the Standard Penetration Testing (SPT). The SPT involves driving a thick walled sampler into the soils under a standardized energy (63.5 kg, falling 760 mm). The number of blows required to drive the sampler 0.3 m, known as the SPT blow count (N), was recorded. In addition to SPTs, field shear vane testing was conducted within cohesive soils. Thin walled tube samples were taken within cohesive materials to obtain relatively undisturbed samples. Bedrock was sampled utilizing diamond core techniques.

Borehole location and elevations were surveyed in the field by Cook Engineering and referenced to the benchmark Number 302, located on the RR spike in a 0.45 m diameter poplar, at station 10+334.988 23.16 Left. A reference elevation of 100.000 m was assigned to the benchmark.

A summary of the borehole location data is provided on the enclosed Borehole Location Plan and Soil Strata Drawing 1 (Appendix C).

The borehole characteristics and drill techniques utilized are summarized for the various borehole locations in the following table.

Table 1 - Drill Summary
Bass Creek
Booth Township

| Location | Borehole Elevations m | | | Comments |
|----------|-----------------------|------------------------------|-------------|------------------------------------|
| | Surface | 1 st SPT Refusal* | Termination | |
| BC08-01 | 97.9 | 80.6 | 76.4 | Hollow Stem Augers, BW Casing |
| BC08-02 | 96.4 | 80.2 | 80.2 | Hollow Stem Augers |
| BC08-03 | 98.5 | 80 | 77.1 | Hollow Stem Augers, Diamond Coring |
| BC08-04 | 97.9 | - | 88.1 | Hollow Stem Augers |
| BC08-05 | 97.8 | - | 89.5 | Hollow Stem Augers |

*Refusal has been defined as a SPT test with an "N" value which exceeds 100 blows per 0.3 m

The boreholes were backfilled to ensure the environmental integrity of the site, utilizing appropriate bentonite mixtures for the soils encountered (at individual locations) and complying with the amended Ontario Regulation 903.

Soil samples were transported to TBT Engineering's laboratory in Thunder Bay for testing. Routine testing included moisture content and grain size analysis. In addition, consolidation testing was conducted on select samples. The results of this testing are shown on the Borehole Logs (Appendix A) and on the laboratory data reports (Appendix B).

4 General Site Geology and Sub-Surface Conditions

4.1 Site Geology

The Bass Creek flows easterly through an area of high land to the north west of the bridge site, reporting to the Nipigon River just downstream of the bridge. The Nipigon River flows generally south and reports to Lake Superior near the town site of Red Rock.

Bedrock in the area of Bass Creek is of the Archean-aged Quetico geological subprovince. Available mapping (OGS Map 2232 – Nipigon-Schreiber Compilation) shows paragneiss and metasedimentary-derived migmatite underlying the area of the bridge. Associated granitic units may also be present nearby. Regional deformation is generally aligned east-west; however, faulting is locally aligned approximately north-south. A Proterozoic-aged Nipigon diabase sill is exposed approximately 500 m to the west and northwest of the bridge site.

Available surficial geology mapping (OGS NOEGTS Map 5052 – Frazer Lake) shows generally low and wet local relief with coarse-sand lacustrine plain and delta deposits fringing the Nipigon River, associated with the former Nipigon spillway.

4.2 Subsurface Conditions

Details of the subsurface conditions are provided on the Borehole Logs, Appendix A, and on the Borehole Location Plan and Strata Drawing 1.

4.2.1 General

In general, the subsurface stratigraphy consists of various mixtures of fill, overlying layered lacustrine deposits which are further underlain by a glacial till. At all boreholes the upper strata consist of sands and/or silts followed by a thick clay deposit and a second silt stratum. A deposit of sand and gravel till exists below the silt stratum (overlying bedrock).

The subsurface stratigraphy has been interpreted based on the results of the boreholes and has been illustrated on the Borehole Location Plan and Soil Strata Drawing 1.

4.2.1.1 Topsoil

Topsoil was encountered off of the driving surface, at Borehole BC08-02. The topsoil extended to a depth of 0.1 m (elevation 96.3 m).

4.2.1.2 Roadway Fill

Fill consisting of various mixtures of sand, gravel and silt were encountered below the road surface at Boreholes BC08-01, 03, 04, and 05. Based on four grain size tests samples the fill can consist of 0 - 6 % gravel, 23 - 91% sand, and 9 - 77 % silt/clay sized particles. There is no record of fill placement and differing conditions may be present in the fill. This material does not meet Granular "B" Type 1 specifications. The fill varies in thickness from 2.1 to 2.9 and extended to a depth ranging from 2.1 to 2.9 m (elevation 95.8 to 95.0 m). The material is very loose to compact as indicated by "N" values ranging from 1 to 15 blows per 0.3 m. The fill material is considered to be frost susceptible.

4.2.1.3 Discontinuous Upper Sand

A discontinuous sand layer is present beneath the roadway fill at Borehole BC08-01. The sand layer can consist of 0 % gravel, 98 % sand, and 2 % silt/clay sized particles. The sand is 1.5 m thick and extends to a depth of 3.6 m (elevation 94.3 m). The material is loose as indicated by "N" values ranging from 4 to 9 blows per 0.3 m. This stratum is not considered to be frost susceptible.

4.2.1.4 Silt and Sand

Silt and sand was encountered beneath the fill at Boreholes BC-08-03 and 04, and beneath the topsoil at Borehole BC08-02. Based on a sample from Borehole BC08-04 the silt can consist of 0 % gravel, 39 % sand, and 61 % silt/clay sized particles. The silt and sand varies in thickness from 0.9 to 2.1 m in thickness and extends to a depth

ranging from 2.2 to 4.6 m (elevation 94.7 to 93.3 m). The deposit is very loose to loose as indicated by "N" values ranging from 3 to 8 blows per 0.3 m. This material is considered to be frost susceptible.

4.2.1.5 Clay

Silty clay is found beneath the silt and sand at all borehole locations. This stratum varies in thickness from 4.0 to 10.0 m in thickness and extends to depths ranging from 8.3 to 12.2 m (elevation 89.5 to 84.3 m). The silty clay varies from CL-ML to low and medium plastic (CL to CI) with natural moisture contents at or above the liquid limit. (Atterberg Limit Testing Appendix B).

The clay is soft to very stiff as indicated by field vane tests ranging from 22 to 110 kPa, although generally the clay has a firm consistency.

A consolidation test carried out on a low plastic silty clay sample from Borehole BR08-01 at a depth of 6.1 m indicates the clay is slightly over consolidated with an estimated over consolidation ratio (OCR) of 1.8. The calculated compression index is 0.15 and the coefficient of consolidation varies from 0.2 to 1.4 mm²/min. The hydraulic conductivity within the design stress range as interpreted from the consolidation testing varies from 10⁻⁹ to 10⁻⁸ cm/sec.

A consolidation test carried out on a medium plastic clay sample from Borehole BR08-03 at a depth of 7.6 m indicates the clay is normally consolidated to slightly over consolidated with an estimated over consolidation ratio (OCR) of 1.5. The calculated compression index is 0.15 and the coefficient of consolidation varies from 2.5 to 5.4 mm²/min. The hydraulic conductivity within the design stress range as interpreted from the consolidation testing varies from 10⁻⁸ to 10⁻⁷ cm/sec.

A discontinuous one metre thick layer of non plastic silt is bedded within the clay at Borehole BC08-04, 7 .0 m below grade (Elev. 91.9)

4.2.1.6 Lower Silt

A layer of silt with trace to some sand was encountered below the clay at all boreholes with the exception of BC08-05 in which the borehole was terminated within the silty clay above. Based on samples from Boreholes BC08-02, and 03 the silt can consist of 0 - 15 % gravel, 5 -13 % sand, and 72 - 95 % silt/clay sized particles. The silt varies in thickness from 3.0 to 9.2 m in thickness and extends to a depth ranging from 15.2 to 18.2 m (elevation 81.4 to 80.3 m). The material is loose to compact as indicated by “N” values ranging from 4 to 26 blows per 0.3 m.

4.2.1.7 Sand and Gravel (Till)

Heterogeneous mixtures of sand, gravel and silt were encountered below the lower silt at Boreholes BC08-01, 02, and 03, Borehole BC08-04 was terminated above this within the lower silt stratum. Based on two samples, the sand and gravel can consist of 7 - 89 % gravel, 9 – 73 % sand, and 3 - 20 % silt/clay sized particles. This stratum is likely of glacial till origin. This material varies in thickness from 0.6 to 5.0 and extended to a depth ranging from 16.2 to 21.5 m (elevation 80.3 to 76.4 m). The till is dense to very dense as indicated by “N” values ranging from 46 blows to blows greater than 100 per 0.3 m.

4.2.1.8 Bedrock

Bedrock was sampled at Borehole BC08-03 from 18.8 to 21.4 m below grade (elevation 79.7 to 77.1 m). The bedrock can be described as a migmatite, with zones of gneiss and fine and medium-grained granitic material. The granitic zones are mostly massive, grey to pink. The gneissic zones have a strong foliation/schistosity.

The rock quality designation (RQD) is an indirect measure of the number of fractures and the amount of jointing in the rock mass. The RQD is expressed as a percentage of the ratio of summed core lengths (greater than 100 mm) to the total length cored. The RQD index is used to provide a classification for the rock quality according to the following limits.

Table 2 – RQD Index

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

The RQD for the two core lengths at Borehole BC08-03 were 47 % and 58 %, indicating poor to fair quality.

The bedrock surface grades are known to vary considerably in this region. Significant rock surface elevation changes and steeply sloping bedrock surfaces are common within short distances.

4.2.1.9 Ground Water

The water level of the creek at the time of the investigation was at elevation 90.9 m. The ground water table was measured in the boreholes at depths ranging from 2.2 to 4.4 m from ground surface (elevation 95.8 to 93.5). Ground water levels will be highly dependant on the water level within the creek, and will generally rise in elevation away from the creek. Ground water levels will also fluctuate with precipitation events.

5 Miscellaneous

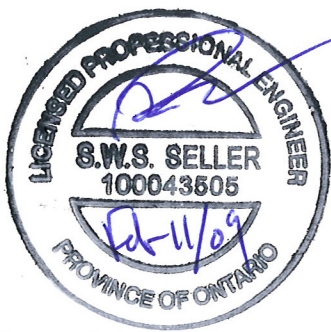
The field drilling services for this project were provided by TBT Engineering. Laboratory testing was carried out at the TBT Engineering laboratory in Thunder Bay. The field operations were supervised by H. Finke. This report was prepared by S. Seller, P.Eng. and G. Maki, P.Eng., and reviewed by W. Hurley, P.Eng.

6 Closure

We trust the above addresses your project requirements at this time. Should you have any questions or comments, please do not hesitate to contact us at your convenience.

Yours truly,

For TBT ENGINEERING



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Manager of Foundation Engineering

References

1. Carter, M.W., McIlwaine, W.H, and Wisely, P.A, 1970-1, Ontario Division of Mines, Nipigon – Schreiber, Geological Compilation Series, Map 2232
2. Mollard, D.G., 1979, Northern Ontario Engineering Geology Terrain Study, Data Base Map, Frazer Lake. Ontario Geological Survey, Map 5052
3. Ontario Ministry of Transportation, Surveys and Design Office, Pavement Design and Rehabilitation Manual, The Queens Printer for Ontario, 1990, ISBN 0-7729-6379-7
4. Canadian Geotechnical Society, Canadian Foundation Engineering Manual, Fourth Edition, BiTech Publishers Ltd., 1992, ISBN 0-920505-28-7
5. Hunt, Roy E., Geotechnical Engineering Analysis and Evaluation, McGraw Hill Inc, 1986, ISBN 0-07-031310-5

APPENDIX A

BOREHOLE LOGS

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m 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: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm 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 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

| | | | | | | |
|-------------|-----------|---------|---------|----------|------------|-------|
| c_u (kPa) | 0 - 12 | 12 - 25 | 25 - 50 | 50 - 100 | 100 - 200 | > 200 |
| | VERY SOFT | SOFT | FIRM | STIFF | VERY STIFF | HARD |

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF 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 DENS. |

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, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN.
THE ROCK QUALITY DESIGNATION { R Q D }, FOR MODIFIED RECOVERY, IS :

| | | | | | |
|---------|-----------|---------|---------|---------|-----------|
| RQD (%) | 0 - 25 | 25 - 50 | 50 - 75 | 75 - 90 | 90 - 100 |
| | VERY POOR | POOR | FAIR | GOOD | EXCELLENT |

JOINTING AND BEDDING:

| | | | | | |
|----------|------------|------------|------------|---------|------------|
| SPACING | 50mm | 50 - 300mm | 0.3 m - 1m | 1m - 3m | >3m |
| JOINTING | VERY CLOSE | CLOSE | MOD. CLOSE | WIDE | VERY WIDE |
| BEDDING | VERY THIN | THIN | MEDIUM | THICK | VERY THICK |

FIELD SAMPLING

| | | | |
|-----|---------------------|-----|----------------------------|
| S S | SPLIT SPOON | T P | THINWALL PISTON |
| W S | WASH SAMPLE | O S | OSTERBERG SAMPLE |
| S T | SLOTTED TUBE SAMPLE | R C | ROCK CORE |
| B S | BLOCK SAMPLE | P H | T W ADVANCED HYDRAULICALLY |
| C S | CHUNK SAMPLE | P M | T W ADVANCED MANUALLY |
| T W | THINWALL OPEN | F S | FOIL SAMPLE |

STRESS AND STRAIN

| | | |
|--------------------------------------|-----|-------------------------------|
| u_w | kPa | PORE WATER PRESSURE |
| r_u | 1 | PORE PRESSURE RATIO |
| σ_p | kPa | TOTAL NORMAL STRESS |
| σ' | kPa | EFFECTIVE NORMAL STRESS |
| τ | kPa | SHEAR STRESS |
| $\sigma_1, \sigma_2, \sigma_3$ | kPa | PRINCIPAL STRESSES |
| ϵ_1 | % | LINEAR STRAIN |
| $\epsilon_1, \epsilon_2, \epsilon_3$ | % | PRINCIPAL STRAINS |
| E | kPa | MODULUS OF LINEAR DEFORMATION |
| G | kPa | MODULUS OF SHEAR DEFORMATION |
| μ | 1 | COEFFICIENT OF FRICTION |

MECHANICAL PROPERTIES OF SOIL

| | | |
|----------------|------------|--------------------------------------|
| m_v | kPa^{-1} | COEFFICIENT OF VOLUME CHANGE |
| C_c | 1 | COMPRESSION INDEX |
| C_s | 1 | SWELLING INDEX |
| C_a | 1 | RATE OF SECONDARY CONSOLIDATION |
| C_v | m^2/s | COEFFICIENT OF CONSOLIDATION |
| U | m | DRAINAGE PATH |
| T_v | 1 | TIME FACTOR |
| U_c | % | DEGREE OF CONSOLIDATION |
| σ'_{vo} | kPa | EFFECTIVE OVERBURDEN PRESSURE |
| σ'_p | kPa | PRECONSOLIDATION PRESSURE |
| T_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 |
| T_R | kPa | RESIDUAL SHEAR STRENGTH |
| T_r | kPa | REMOULDED SHEAR STRENGTH |
| S_t | 1 | SENSITIVITY : $\frac{C_u}{T_r}$ |

PHYSICAL PROPERTIES OF SOIL

| | | | | | | | | |
|----------------|-------------------|--------------------------------|------------|------|---|------------|-------------------|--|
| ρ_s | kg/m ³ | DENSITY OF SOLID PARTICLES | e | 1, % | VOID RATIO | e_{\min} | 1, % | VOID RATIO IN DENSEST STATE |
| γ_s | kN/m ³ | UNIT WEIGHT OF SOLID PARTICLES | n | 1, % | POROSITY | I_D | 1 | DENSITY INDEX = $\frac{e_{\max} - e}{e_{\max} - e_{\min}}$ |
| ρ_w | kg/m ³ | DENSITY OF WATER | w | 1, % | WATER CONTENT | D | mm | GRAIN DIAMETER |
| ρ_w | kN/m ³ | UNIT WEIGHT OF WATER | S_r | % | DEGREE OF SATURATION | D_n | mm | n PERCENT - DIAMETER |
| ρ | kg/m ³ | DENSITY OF SOIL | w_L | % | LIQUID LIMIT | C_U | 1 | UNIFORMITY COEFFICIENT |
| γ | kN/m ³ | UNIT WEIGHT OF SOIL | w_p | % | PLASTIC LIMIT | h | m | HYDRAULIC HEAD OR POTENTIAL |
| ρ_d | kg/m ³ | DENSITY OF DRY SOIL | w_s | % | SHRINKAGE LIMIT | q | m ³ /s | RATE OF DISCHARGE |
| γ_d | kN/m ³ | UNIT WEIGHT OF DRY SOIL | I_p | % | PLASTICITY INDEX = $w_L - w_p$ | v | m/s | DISCHARGE VELOCITY |
| γ_{sat} | kg/m ³ | DENSITY OF SATURATED SOIL | I_L | 1 | LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$ | i | 1 | HYDRAULIC GRADIENT |
| γ_{sat} | kN/m ³ | UNIT WEIGHT OF SATURATED SOIL | I_C | 1 | CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$ | k | m/s | HYDRAULIC CONDUCTIVITY |
| ρ' | kg/m ³ | DENSITY OF SUBMERGED SOIL | e_{\max} | 1, % | VOID RATIO IN LOOSEST STATE | j | kn/m ² | SEEPAGE FORCE |
| ρ' | kN/m ³ | UNIT WEIGHT OF SUBMERGED SOIL | | | | | | |

| TBT Engineering Consulting Group | | | RECORD OF Borehole No BC08-01 | | | 1 OF 2 | | METRIC | | | | | |
|----------------------------------|--|------------|---|------|------------|-----------------------------|--|--|--|--|--|--|--|
| W.P. 476 00 00 | | | PROJECT Bass Creek Bridge | | | SITE NO. 48C-043 | | ORIGINATED BY HF | | | | | |
| DIST 61 HWY 585 | | | LOCATION 10+325.2 o/s 4.0 m Lt Booth Twp | | | TBTE JOB# 08-085 | | COMPILED BY TB | | | | | |
| DATE July 23, 2008 | | | BOREHOLE TYPE Hollow Stem Auger | | | DATUM Local | | CHECKED BY SS | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | | | | | | |
| 97.9 0.0 | FILL - SAND - Silty, trace gravel, brown, loose | | 1 | AS | | GROUND WATER CONDITIONS | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT WATER CONTENT (%) | UNIT WEIGHT γ kN/m ³ | | | | |
| | | | 2 | SS | 7 | | | | | | | | |
| | | | 3 | SS | 9 | | | | | | | | |
| 95.8 2.1 | SAND - trace silt, brown, loose | | 4 | SS | 9 | | | | | | | | |
| | | | 5 | SS | 4 | | | | | | | | |
| | | | 6 | SS | 1 | | | | | | | | |
| 94.3 3.6 | CLAY - Silty, grey, firm | | 7 | SS | 1 | | | | | | | | |
| | | | 8 | TW | | | | | | | | | |
| | | | 9 | SS | 1 | | | | | | | | |
| | | | 10 | SS | 4 | | | | | | | | |
| | | | 11 | SS | 5 | | | | | | | | |
| | | | 12 | SS | 4 | | | | | | | | |
| 86.1 11.8 | SILT - trace sand, occasional cobbles, grey, loose | | 13 | SS | 9 | | | | | | | | |
| | | | | | | | | | | | | | |

Continued Next Page

x³, *³: Numbers refer to Sensitivity
 NP Non Plastic
 O 3% STRAIN AT FAILURE

ON_MOT_BH-10 08-085 BASS CREEK BRIDGE.GPJ ON_MOT.GDT 1/22/09

| TBT Engineering Consulting Group | | | RECORD OF Borehole No BC08-01 | | | 2 OF 2 | | METRIC | |
|----------------------------------|---|------------|---|------|------------|-------------------------|--|-------------------------|--|
| W.P. 476 00 00 | | | PROJECT Bass Creek Bridge | | | SITE NO. 48C-043 | | ORIGINATED BY HF | |
| DIST 61 HWY 585 | | | LOCATION 10+325.2 o/s 4.0 m Lt Booth Twp | | | TBTE JOB# 08-085 | | COMPILED BY TB | |
| DATE July 23, 2008 | | | BOREHOLE TYPE Hollow Stem Auger | | | DATUM Local | | CHECKED BY SS | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | | ELEVATION SCALE | |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | | |
| 81.4 | GRAVEL - trace sand, trace silt, numerous cobbles, brown, dense to very dense | | 14 | SS | 4 | | | | |
| 16.5 | | | 15 | SS | 46 | | | | |
| | | | 16 | SS | 100+ | | | | |
| | | | 17 | SS | 100+ | | | | |
| | | | 18 | SS | 100+ | | | | |
| 76.4 | End of Borehole @ 21.5 m. | | | | | | | | |
| 21.5 | | | | | | | | | |

DYNAMIC CONE PENETRATION RESISTANCE PLOT

SHEAR STRENGTH kPa

○ UNCONFINED ✕ FIELD VANE
 ■ SPT (N) ★ LAB VANE

WATER CONTENT (%)

W_p W W_L

PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT

UNIT WEIGHT

γ

kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

88 9 (3)

Auger refusal @ 17.3 m. BH advanced with casing.

| TBT Engineering Consulting Group | | | RECORD OF Borehole No BC08-02 | | 1 OF 2 METRIC | | | |
|----------------------------------|---|--|--------------------------------------|----------------------------|---|---|--|--|
| W.P. 476 00 00 | | PROJECT Bass Creek Bridge | | SITE NO. 48C-043 | | ORIGINATED BY HF | | |
| DIST 61 HWY 585 | | LOCATION 10+319.7 o/s 9.0m Rt Booth Twp | | TBTE JOB# 08-085 | | COMPILED BY TB | | |
| DATE July 24, 2008 | | BOREHOLE TYPE Hollow Stem Auger | | DATUM Local | | CHECKED BY SS | | |
| SOIL PROFILE | | SAMPLES | | GROUND WATER CONDITIONS | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | | TYPE | "N" VALUES | | |
| | | | | | | 20 40 60 80 100 O UNCONFINED X FIELD VANE SPT (N) * LAB VANE 20 40 60 80 100 | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W _p W W _L WATER CONTENT (%) | |
| 96.4 | TOPSOIL - 75 mm | | 1 | AS | | | | |
| 96.1 | SILT & SAND - brown, loose to very loose | | 2 | SS | 8 | | | |
| | | | 3 | SS | 3 | | | |
| 94.2 | CLAY - brown, soft to firm | | 4 | SS | 2 | | | |
| 2.2 | - grey | | 5 | TW | | | | |
| | | | 6 | SS | 1 | | | |
| | | | 7 | TW | | | | |
| | | | 8 | SS | 2 | | | |
| | - Silty | | 9 | SS | 4 | | | |
| | | | 10 | SS | 1 | | | |
| | - stiff | | 11 | SS | 4 | | | |
| 84.6 | SILT - some gravel, some sand, trace clay, occasional cobbles, loose to compact | | 12 | SS | 8 | | | |
| 11.8 | | | 13 | SS | 26 | | | |
| 81.4 | | | | | | | | 15 13 (72) |

Continued Next Page

X³, *³: Numbers refer to Sensitivity O 3% STRAIN AT FAILURE
 NP Non Plastic

ON_MOT_BH-10 08-085 BASS CREEK BRIDGE.GPJ ON_MOT.GDT 1/22/09

| TBT Engineering Consulting Group | | | RECORD OF Borehole No BC08-02 | | | 2 OF 2 | | METRIC | | | | | | |
|----------------------------------|---|------------|--|------|----------------------------|-------------------------|--|-------------------------|------------------------------------|-------------------------------------|-----------------------------------|--|--|--|
| W.P. 476 00 00 | | | PROJECT Bass Creek Bridge | | | SITE NO. 48C-043 | | ORIGINATED BY HF | | | | | | |
| DIST 61 HWY 585 | | | LOCATION 10+319.7 o/s 9.0m Rt Booth Twp | | | TBTE JOB# 08-085 | | COMPILED BY TB | | | | | | |
| DATE July 24, 2008 | | | BOREHOLE TYPE Hollow Stem Auger | | | DATUM Local | | CHECKED BY SS | | | | | | |
| 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 | | | | | | |
| | | | | | | | 20 40 60 80 100 ○ UNCONFINED ✕ FIELD VANE ■ SPT (N) ★ LAB VANE | | | | | | | |
| 15.0 | SAND - some silt, trace gravel, grey, very dense | | 14 | SS | 63 | 81 | | | | | | | 7 73 (20) | |
| 80.2 | | | | | | | | | | | | | | |
| 16.2 | End of Borehole @ 16.2 m. Auger Refusal. | | 15 | SS | 100+ | | | >>■ | | | | | | |

ON_MOT_BH-10 08-085 BASS CREEK BRIDGE.GPJ ON_MOT.GDT 1/22/09

| TBT Engineering Consulting Group | | | RECORD OF Borehole No BC08-03 | | 1 OF 2 METRIC | | | | |
|----------------------------------|--|--|--------------------------------------|----------------------------|---|-------------------------|---|---|--------------------|
| W.P. 476 00 00 | | PROJECT Bass Creek Bridge | | SITE NO. 48C-043 | | ORIGINATED BY HF | | | |
| DIST 61 HWY 585 | | LOCATION 10+272.0 o/s 3.0m Lt Booth Twp | | TBTE JOB# 08-085 | | COMPILED BY TB | | | |
| DATE July 28, 2008 | | BOREHOLE TYPE Hollow Stem Auger | | DATUM Local | | CHECKED BY SS | | | |
| SOIL PROFILE | | SAMPLES | | GROUND WATER CONDITIONS | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa |
| 98.5 0.0 | FILL - SAND - Silty, trace gravel, brown, very loose to compact | | 1 | AS | | | | Water level @ 2.7 m 1 hr after completion. Cave @ 15.0 m on completion. | |
| | | | 2 | SS | 1 | | | | |
| | | | 3 | SS | 10 | | | | |
| | | | 4 | SS | 9 | | | | |
| 95.6 2.9 | SILT & SAND - brown, very loose | | 5 | SS | 4 | | | 3 76 (21) | |
| 94.7 3.8 | CLAY - brown, firm | | 6 | SS | 5 | | | | |
| | - 150 mm sand layer | 7 | SS | 1 | | | | | |
| | ----- | 8 | SS | 1 | | | | | |
| | - grey | 9 | TW | | | | | | |
| 89.8 8.7 | SILT - trace sand, grey, loose to compact | | 10 | SS | 10 | | | | 0 7 (94) |
| | | | 11 | SS | 9 | | | | |
| | | | 12 | SS | 10 | | | | |
| | | | 13 | SS | 11 | | | | |
| | | | | | | | | | |

Continued Next Page

x³, *³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE
 NP Non Plastic

ON_MOT_BH-10 08-085 BASS CREEK BRIDGE.GPJ ON_MOT.GDT 1/22/09

| TBT Engineering Consulting Group | | | RECORD OF Borehole No BC08-03 | | | 2 OF 2 | | METRIC | |
|----------------------------------|--|------------|--|------|------------|-------------------------|--|-------------------------|--|
| W.P. 476 00 00 | | | PROJECT Bass Creek Bridge | | | SITE NO. 48C-043 | | ORIGINATED BY HF | |
| DIST 61 HWY 585 | | | LOCATION 10+272.0 o/s 3.0m Lt Booth Twp | | | TBTE JOB# 08-085 | | COMPILED BY TB | |
| DATE July 28, 2008 | | | BOREHOLE TYPE Hollow Stem Auger | | | DATUM Local | | CHECKED BY SS | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | | ELEVATION SCALE | |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | | |
| | - 10 mm clay layer | | 14 | SS | 15 | | | | |
| | | | 15 | SS | 10 | | | | |
| 80.8 | | | | | | | | | |
| 17.7 | SAND & GRAVEL - some silt, grey, very dense | | 16 | SS | 100+ | | | | |
| 79.7 | | | | | | | | | |
| 18.8 | BEDROCK - Meta Sedimentary from a migmatite-gneiss suite of the Quetico Sub-province | | 1 | RC | | | | | |
| | | | 2 | RC | | | | | |
| 77.1 | | | | | | | | | |
| 21.4 | End of Borehole @ 21.4 m. | | | | | | | | |

DYNAMIC CONE PENETRATION RESISTANCE PLOT

SHEAR STRENGTH kPa

○ UNCONFINED ✕ FIELD VANE
 ■ SPT (N) ★ LAB VANE

WATER CONTENT (%)

PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT

W_p W W_L

UNIT WEIGHT γ

REMARKS & GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

| TBT Engineering Consulting Group | | RECORD OF Borehole No BC08-04 | | | | 1 OF 1 | | METRIC | | | | | | | | |
|----------------------------------|--|--|---------|------|------------|----------------------------|--------------------|---|--|------------------------------------|-------------------------------------|-----------------------------------|--|--|-------------|--|
| W.P. 476 00 00 | | PROJECT Bass Creek Bridge | | | | SITE NO. 48C-043 | | ORIGINATED BY HF | | | | | | | | |
| DIST 61 HWY 585 | | LOCATION 10+278.4 o/s 2.0m Rt Booth Twp | | | | TBTE JOB# 08-085 | | COMPILED BY TB | | | | | | | | |
| DATE August 25, 2008 | | BOREHOLE TYPE Hollow Stem Auger | | | | DATUM Local | | CHECKED BY SS | | | | | | | | |
| 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 ■ SPT (N) ★ LAB VANE | | | | | | | | |
| 97.9 0.0 | FILL - SAND - Gravelly, trace silt, occasional cobbles, brown, loose | | 1 | AS | | | | | | | | | | Water level @ 4.4 m on completion. 29 64 (7) | | |
| | | | 2 | SS | 6 | | | | | | | | | | | |
| | | | 3 | SS | 6 | | | | | | | | | | | |
| | | | 4 | SS | 4 | | | | | | | | | | | |
| 95.0 2.9 | SILT & SAND - brown, loose | | 5 | SS | 5 | | | | | | | | 0 39 (61) | | | |
| | | | 6 | SS | 8 | | | | | | | | | | | |
| 93.3 4.6 | CLAY - Silty, very stiff | | 7 | SS | 2 | | | | | | | | | | | |
| 91.9 6.0 | SILT - trace organics, brown, loose | | 8 | SS | 7 | | | | | | | | | | Non Plastic | |
| 90.9 7.0 | CLAY - Silty, brown, stiff | | 9 | SS | 3 | | | | | | | | | | | |
| 89.3 8.6 | SILT - trace sand, grey, loose | | 10 | SS | 7 | | | | | | | | | | | |
| 88.1 9.8 | End of Borehole @ 9.8 m. | | | | | | | | | | | | | | | |

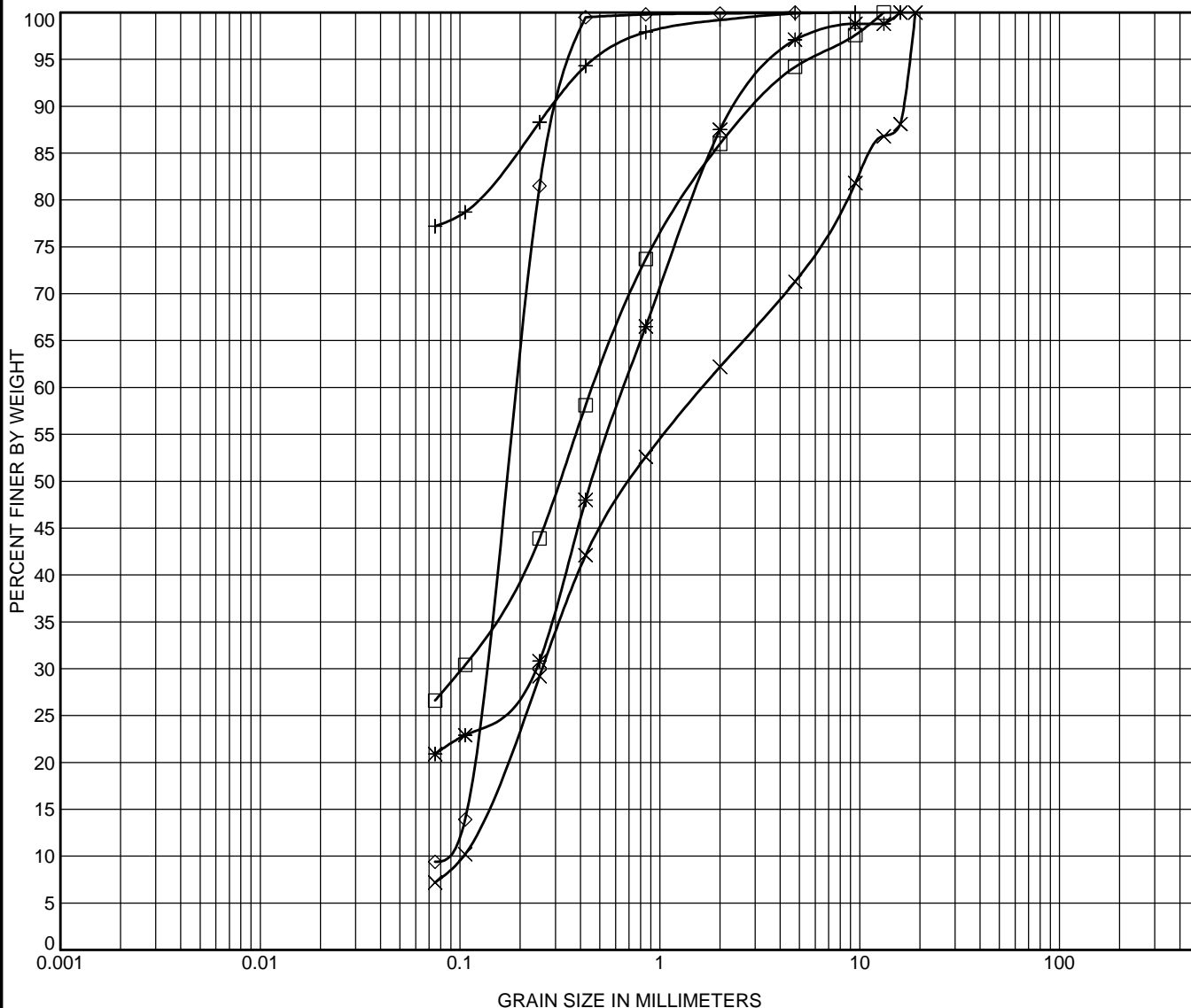
✕³, ★³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE
NP Non Plastic

ON_MOT_BH-10 08-085 BASS CREEK BRIDGE.GPJ ON_MOT.GDT 1/22/09

| TBT Engineering Consulting Group | | RECORD OF Borehole No BC08-05 | | | | 1 OF 1 | | METRIC | | | | | | |
|----------------------------------|--|--|---------|------|------------|----------------------------|--------------------|---|--|------------------------------------|-------------------------------------|-----------------------------------|---|--|
| W.P. 476 00 00 | | PROJECT Bass Creek Bridge | | | | SITE NO. 48C-043 | | ORIGINATED BY HF | | | | | | |
| DIST 61 HWY 585 | | LOCATION 10+321.9 o/s 2.0m Rt Booth Twp | | | | TBTE JOB# 08-085 | | COMPILED BY TB | | | | | | |
| DATE August 25, 2008 | | BOREHOLE TYPE Hollow Stem Auger | | | | DATUM Local | | CHECKED BY SS | | | | | | |
| 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 | | | | | | |
| 97.8 0.0 | FILL - SILT- Sandy, brown, compact | | 1 | AS | | | | | | | | | No water observed. 0 23 (77) 0 91 (9) | |
| | | | 2 | SS | 15 | | | | | | | | | |
| | | | 3 | SS | 10 | | | | | | | | | |
| | ----- - SAND - trace silt, compact, brown | | 4 | SS | 11 | | | | | | | | | |
| 95.0 2.8 | CLAY - Silty, grey, soft to firm | 5 | SS | 1 | | | | | | | | | | |
| | | 6 | SS | 1 | | | | | | | | | | |
| | | 7 | SS | 1 | | | | | | | | | | |
| | | 8 | SS | 1 | | | | | | | | | | |
| | | 9 | SS | 2 | | | | | | | | | | |
| 89.5 8.3 | End of Borehole @ 8.3 m. | | | | | | | | | | | | | |

APPENDIX B

Laboratory Test Data



| SILT OR CLAY | SAND | | | GRAVEL | | COBBLES |
|--------------|------|--------|--------|--------|--------|---------|
| | fine | medium | coarse | fine | coarse | |

Remarks:
FILL

| Test Hole | Depth | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|-----------|-------|------|-------|-------|-------|---------|-------|-------|-------|
| □ BC08-01 | 0.75 | 13.2 | 0.462 | 0.102 | | 5.8 | 67.6 | 26.6 | |
| * BC08-03 | 1.50 | 16 | 0.666 | 0.229 | | 2.9 | 76.2 | 20.9 | |
| × BC08-04 | 0.70 | 19 | 1.644 | 0.258 | 0.104 | 28.7 | 64.1 | 7.2 | |
| + BC08-05 | 1.50 | 9.5 | | | | 0.1 | 22.7 | 77.2 | |
| ◇ BC08-05 | 2.30 | 4.75 | 0.19 | 0.13 | 0.079 | 0.0 | 90.6 | 9.4 | |



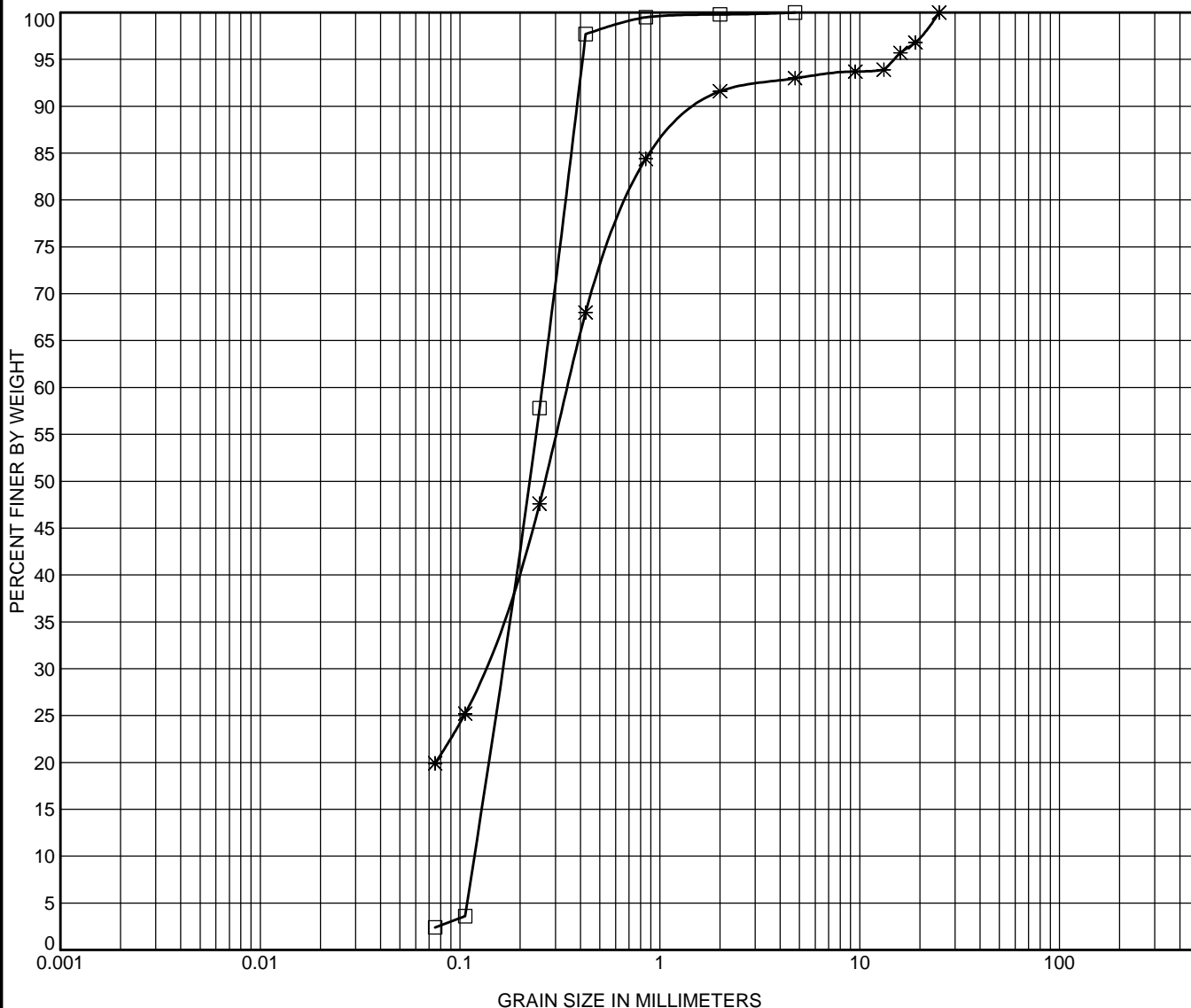
TBT Engineering Consulting Group
101 Syndicate Avenue North
Thunder Bay, Ontario P7C 3V4
PH: 807-624-5160
FX: 807-624-5161
Email: tbte@tbte.ca
Web: www.tbte.ca

GRAIN SIZE DISTRIBUTION

Project: Bass Creek Bridge

W P: 476 00 00

DIST: 61 HWY: 585



| SILT OR CLAY | SAND | | | GRAVEL | | COBBLES |
|--------------|------|--------|--------|--------|--------|---------|
| | fine | medium | coarse | fine | coarse | |

Remarks:
SAND

| Test Hole | Depth | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|-----------|-------|------|-------|-------|-------|---------|-------|-------|-------|
| □ BC08-01 | 3.00 | 4.75 | 0.257 | 0.161 | 0.117 | 0.0 | 97.6 | 2.4 | |
| * BC08-02 | 15.20 | 25 | 0.345 | 0.127 | | 7.0 | 73.1 | 19.9 | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |



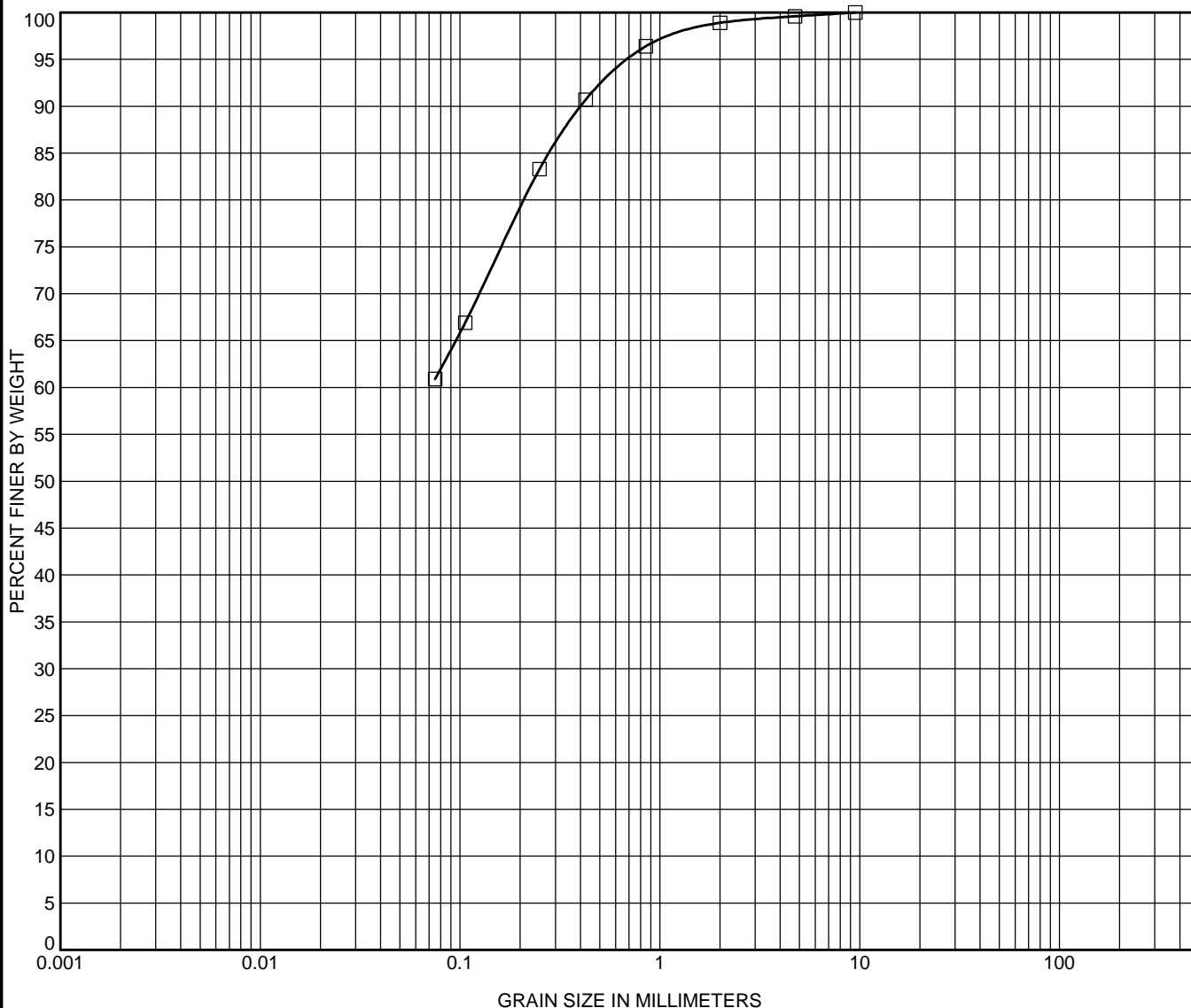
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Web: www.tbte.ca

GRAIN SIZE DISTRIBUTION

Project: Bass Creek Bridge

W P: 476 00 00

DIST: 61 HWY: 585



| SILT OR CLAY | SAND | | | GRAVEL | | COBBLES |
|--------------|------|--------|--------|--------|--------|---------|
| | fine | medium | coarse | fine | coarse | |

Remarks:
SILT & SAND

| Test Hole | Depth | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|----------------------------------|-------|------|-----|-----|-----|---------|-------|-------|-------|
| <input type="checkbox"/> BC08-04 | 3.00 | 9.5 | | | | 0.4 | 38.7 | 60.9 | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |



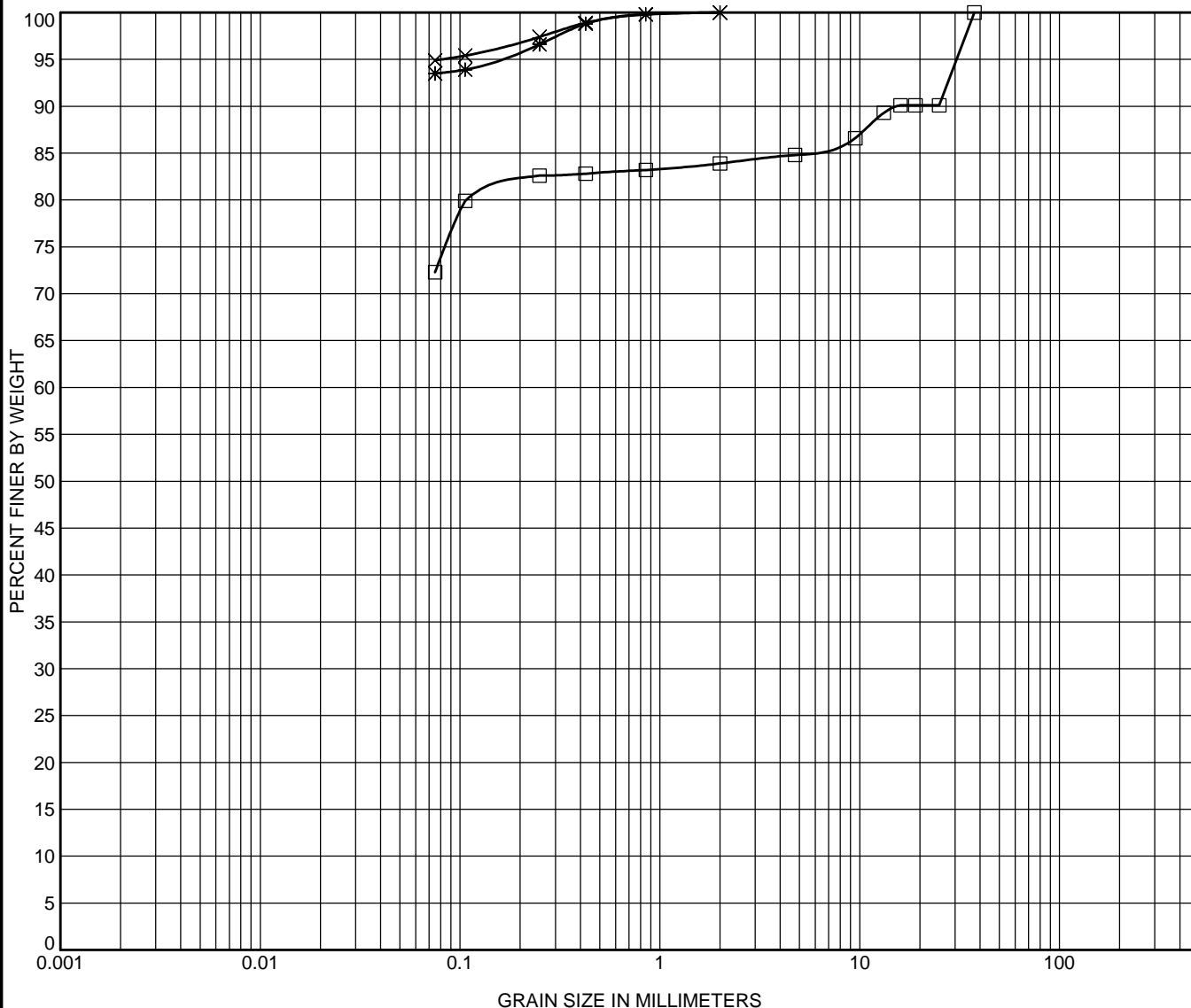
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FX: 807-624-5161
Email: tbte@tbte.ca
Web: www.tbte.ca

GRAIN SIZE DISTRIBUTION

Project: Bass Creek Bridge

W P: 476 00 00

DIST: 61 HWY: 585



| SILT OR CLAY | SAND | | | GRAVEL | | COBBLES |
|--------------|------|--------|--------|--------|--------|---------|
| | fine | medium | coarse | fine | coarse | |

Remarks:
SILT

| Test Hole | Depth | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|-----------|-------|------|-----|-----|-----|---------|-------|-------|-------|
| □ BC08-02 | 13.70 | 37.5 | | | | 15.2 | 12.5 | 72.3 | |
| * BC08-03 | 10.70 | 2 | | | | 0.0 | 6.5 | 93.5 | |
| × BC08-03 | 16.70 | 2 | | | | 0.0 | 5.1 | 94.9 | |
| | | | | | | | | | |
| | | | | | | | | | |



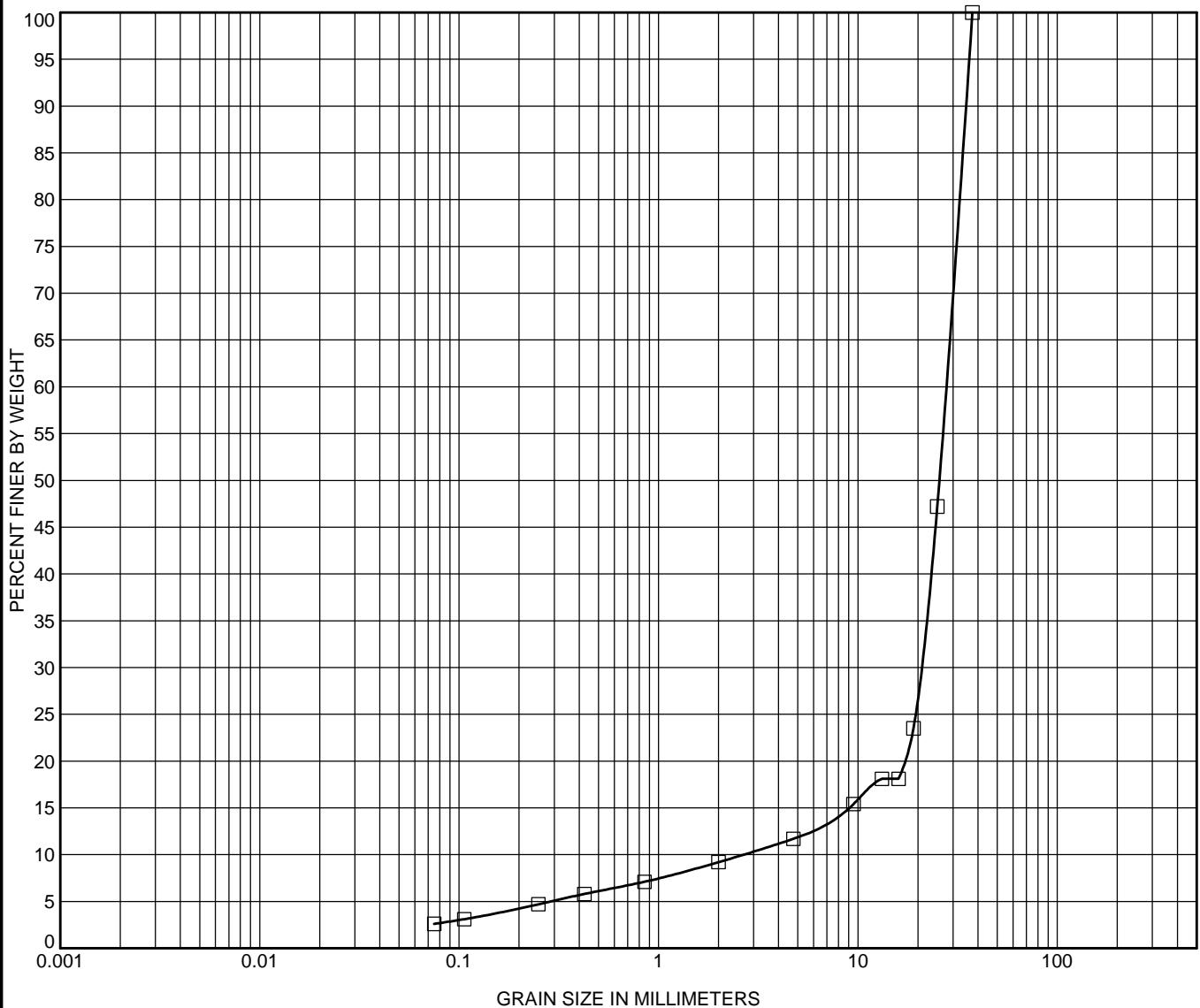
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FX: 807-624-5161
Email: tbte@tbte.ca
Web: www.tbte.ca

GRAIN SIZE DISTRIBUTION

Project: Bass Creek Bridge

W P: 476 00 00

DIST: 61 HWY: 585



| SILT OR CLAY | SAND | | | GRAVEL | | COBBLES |
|--------------|------|--------|--------|--------|--------|---------|
| | fine | medium | coarse | fine | coarse | |

Remarks:
GRAVEL

| Test Hole | Depth | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|----------------------------------|-------|------|--------|--------|-------|---------|-------|-------|-------|
| <input type="checkbox"/> BC08-01 | 16.70 | 37.5 | 27.582 | 20.485 | 2.638 | 88.3 | 9.1 | 2.6 | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |



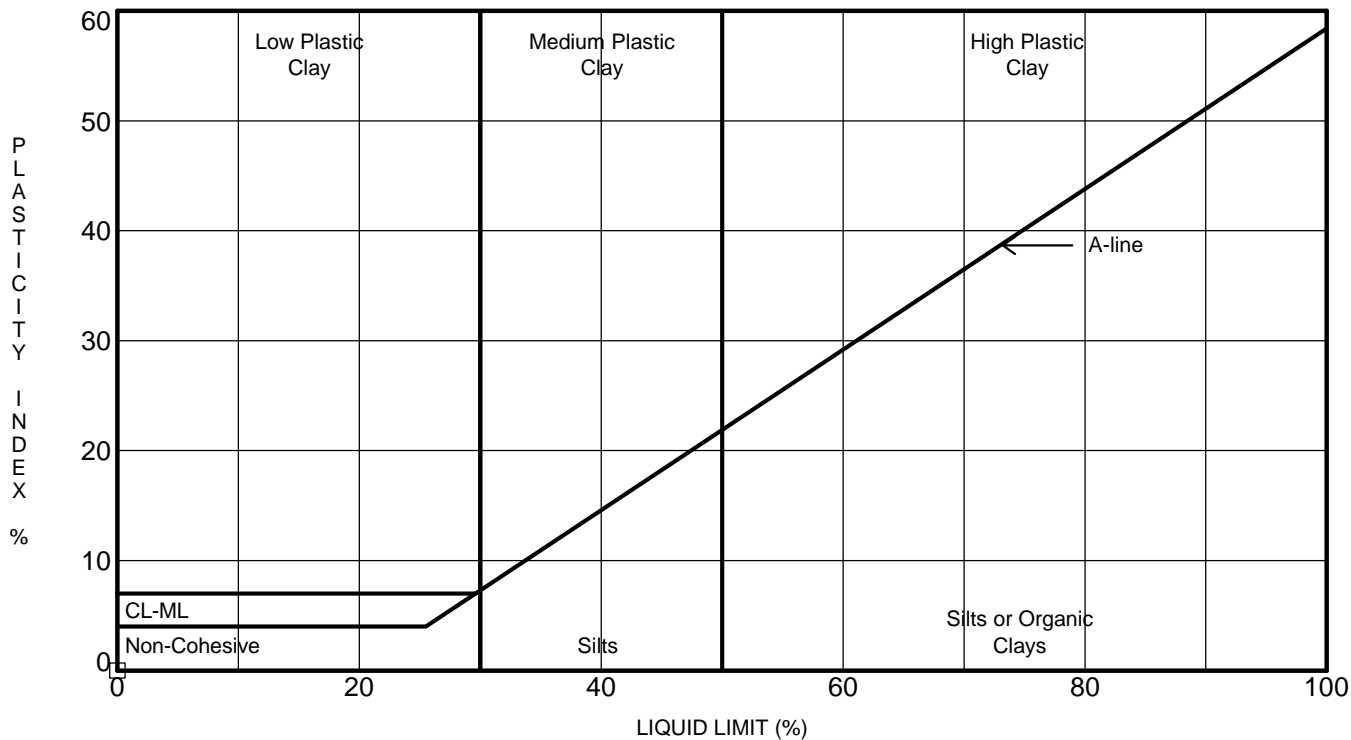
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FX: 807-624-5161
Email: tbte@tbte.ca
Web: www.tbte.ca

GRAIN SIZE DISTRIBUTION

Project: Bass Creek Bridge

W P: 476 00 00

DIST: 61 HWY: 585



Remarks:
NON-PLASTIC

| | Borehole No. | Sample No. | Depth (m) | LL% | PL% | PI% | M/C% | |
|--------------------------|--------------|------------|-----------|-----|-----|-----|------|--|
| <input type="checkbox"/> | BC08-04 | | 6.10 | NP | NP | NP | 41 | |
| <input type="checkbox"/> | | | | | | | | |
| <input type="checkbox"/> | | | | | | | | |
| <input type="checkbox"/> | | | | | | | | |
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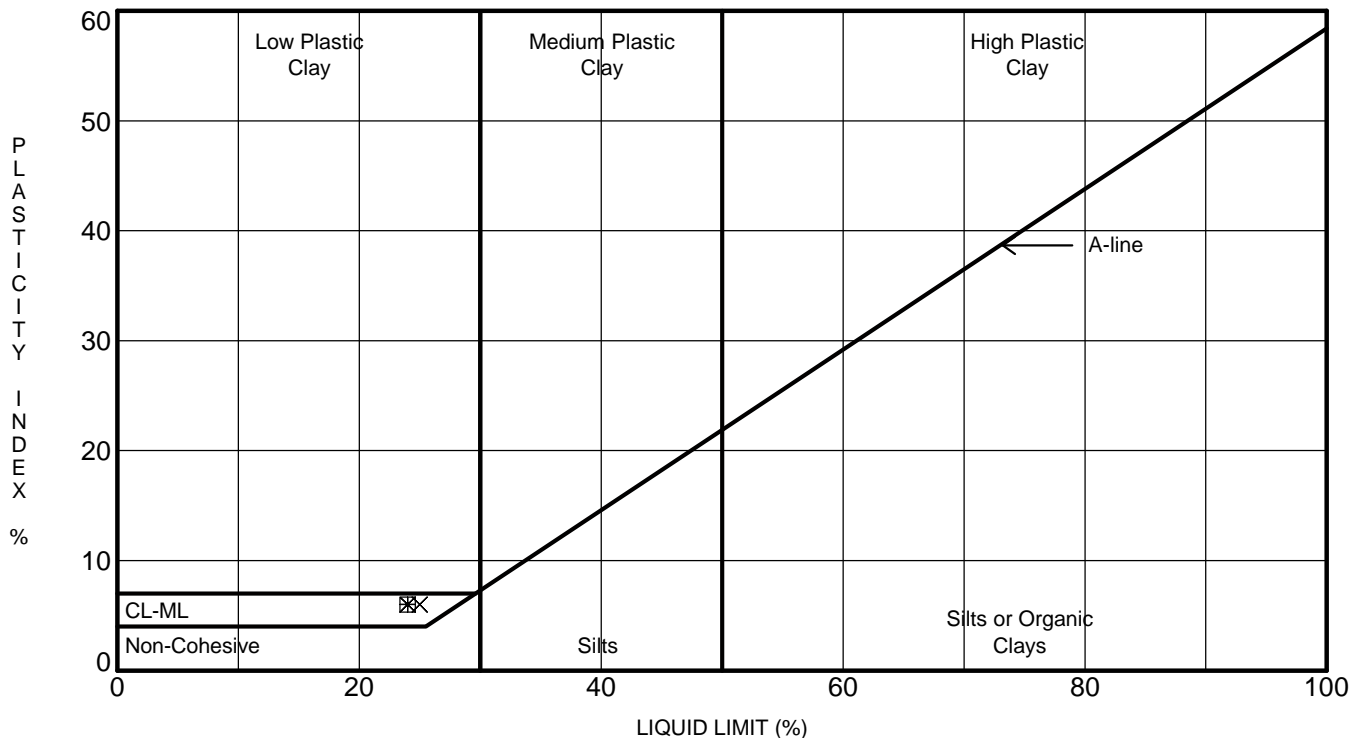
TBT Engineering Consulting Group
101 Syndicate Avenue North
Thunder Bay, Ontario P7C 3V4
Telephone: 807-624-5160
Fax: 807-624-5161

ATTERBERG LIMIT RESULTS

W P: 476 00 00

District: 61

Highway: 585



Remarks:
Silty CLAY

| | Borehole No. | Sample No. | Depth (m) | LL% | PL% | PI% | M/C% | |
|-------------------------------------|--------------|------------|-----------|-----|-----|-----|------|--|
| <input type="checkbox"/> | BC08-02 | | 7.60 | 24 | 18 | 6 | 30 | |
| <input checked="" type="checkbox"/> | BC08-04 | | 4.60 | 24 | 18 | 6 | 29 | |
| <input checked="" type="checkbox"/> | BC08-05 | | 6.10 | 25 | 19 | 6 | 32 | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
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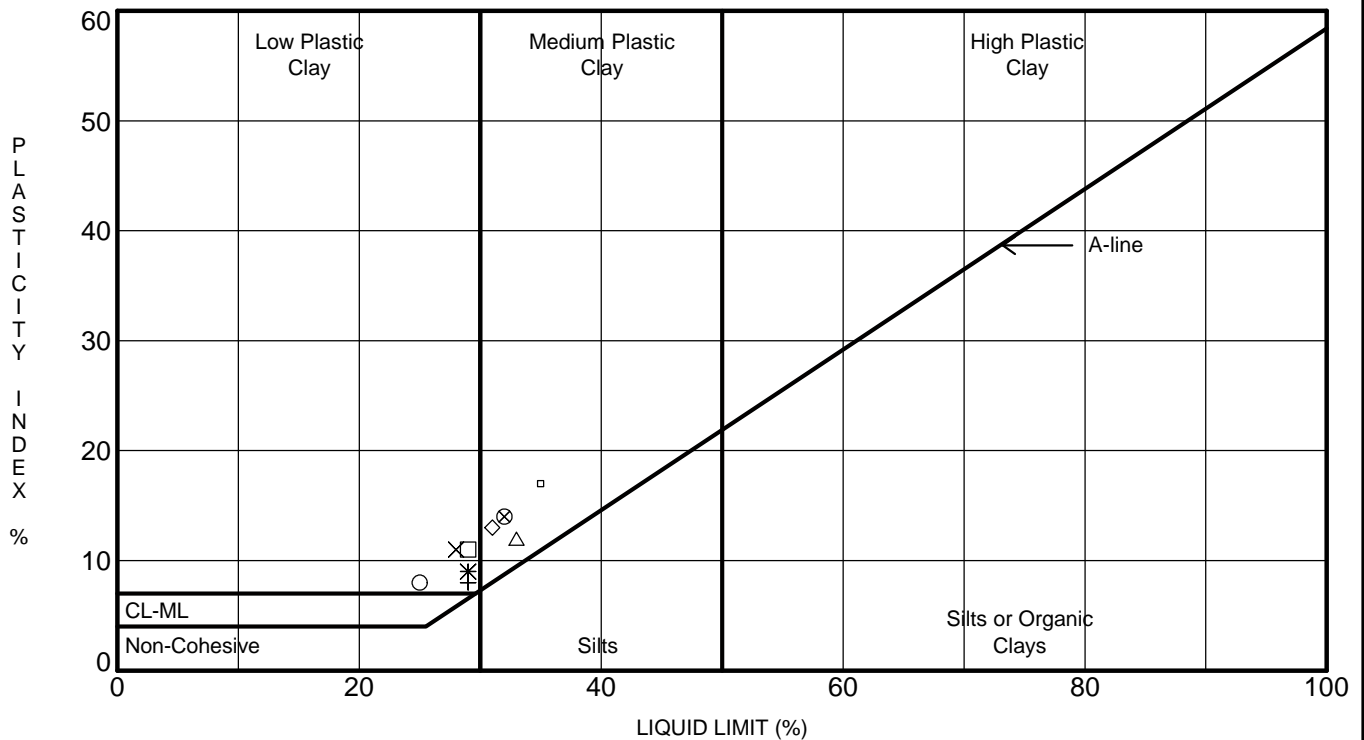
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 101 Syndicate Avenue North
 Thunder Bay, Ontario P7C 3V4
 Telephone: 807-624-5160
 Fax: 807-624-5161

ATTERBERG LIMIT RESULTS

W P: 476 00 00

District: 61

Highway: 585



Remarks:
CLAY

| | Borehole No. | Sample No. | Depth (m) | LL% | PL% | PI% | M/C% | |
|---|--------------|------------|-----------|-----|-----|-----|------|--|
| □ | BC08-01 | | 4.50 | 29 | 18 | 11 | 37 | |
| * | BC08-01 | | 6.10 | 29 | 20 | 9 | 47 | |
| X | BC08-01 | | 10.70 | 28 | 17 | 11 | 34 | |
| + | BC08-02 | | 2.30 | 29 | 21 | 8 | 32 | |
| ◇ | BC08-03 | | 6.10 | 31 | 18 | 13 | 38 | |
| △ | BC08-03 | | 7.60 | 33 | 21 | 12 | 42 | |
| ○ | BC08-04 | | 7.60 | 25 | 17 | 8 | 24 | |
| □ | BC08-05 | | 3.00 | 35 | 18 | 17 | 40 | |
| ⊗ | BC08-05 | | 7.60 | 32 | 18 | 14 | 30 | |
| | | | | | | | | |



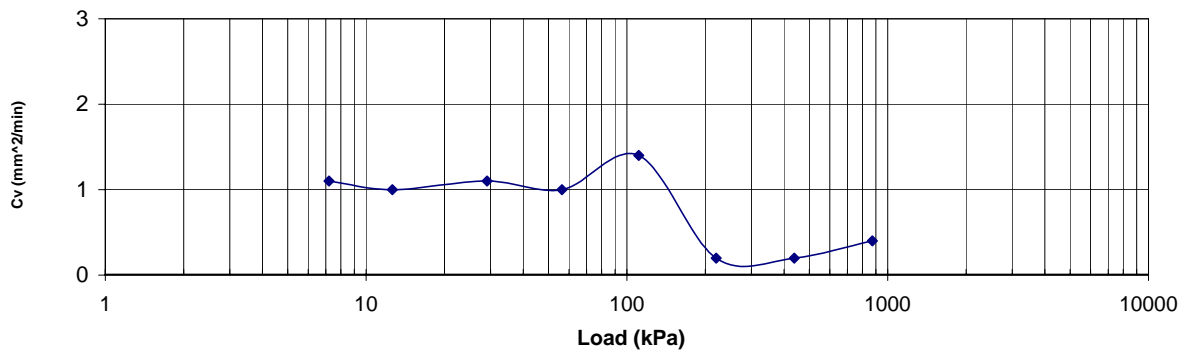
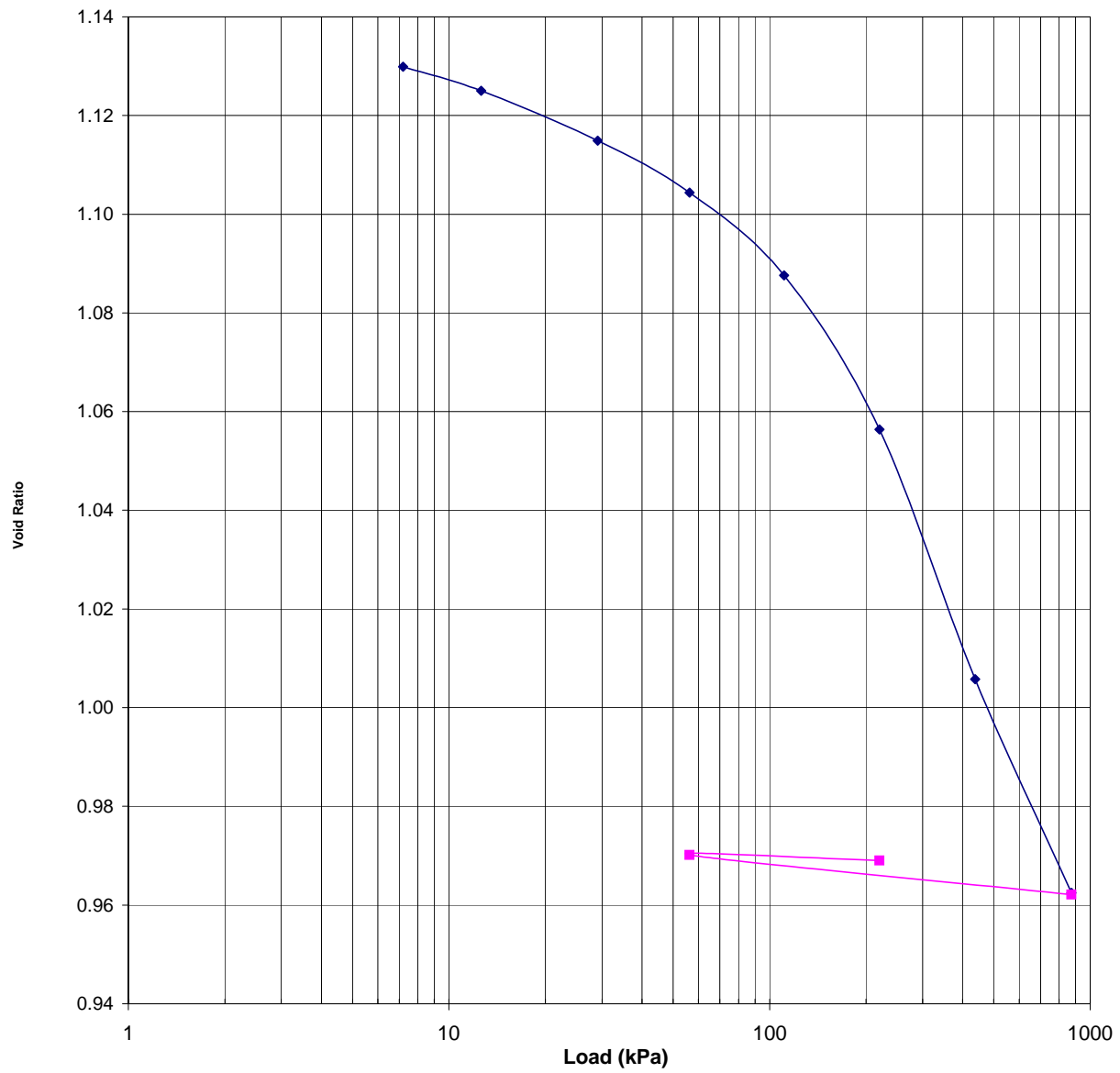
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Fax: 807-624-5161

ATTERBERG LIMIT RESULTS

W P: 476 00 00

District: 61

Highway: 585



CONSOLIDATION TEST
MTO - Bass Creek Highway 585

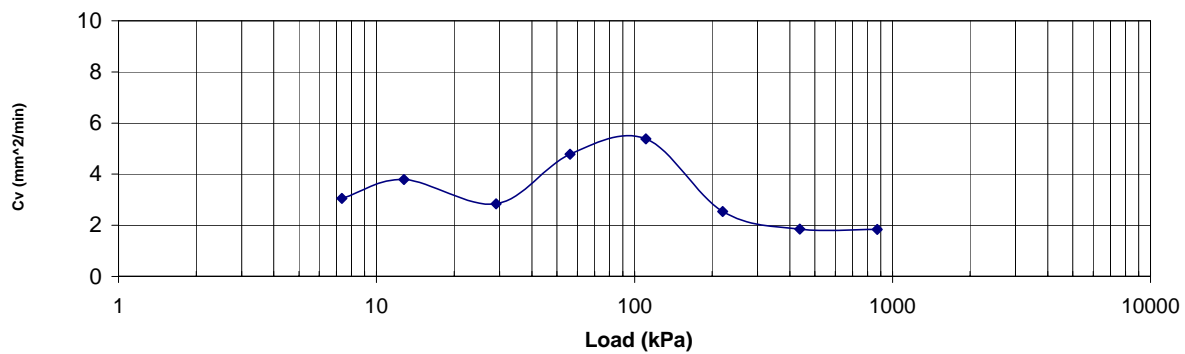
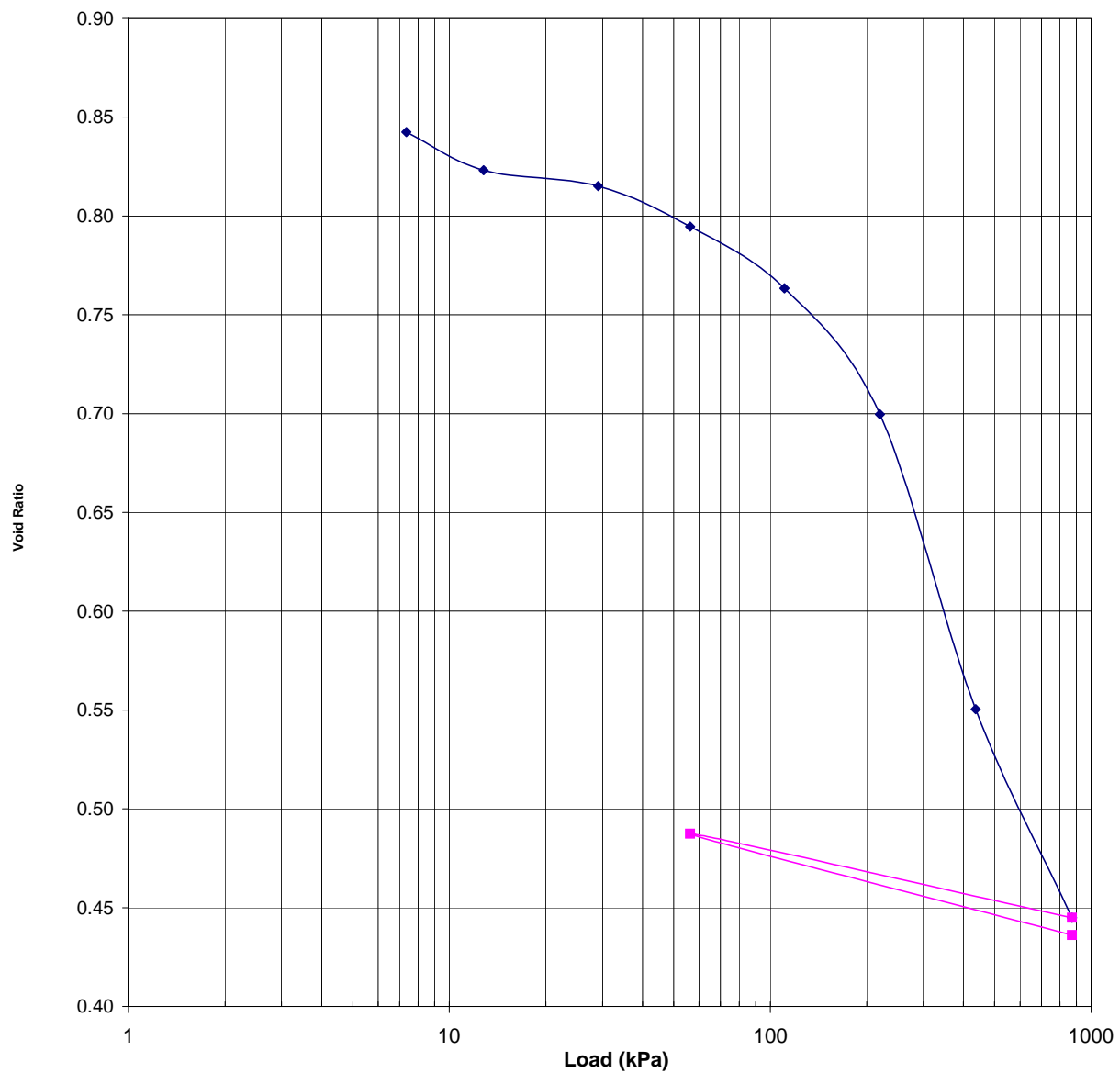
Borehole: BC08-01 TW8

Depth: 6.1

Lab No. 08-594

Project No.: 08-085

GWP 476-00-00



CONSOLIDATION TEST
MTO - Bass Creek Highway 585

Borehole: BC08-03 TW 9

Depth: 7.6 m

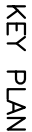
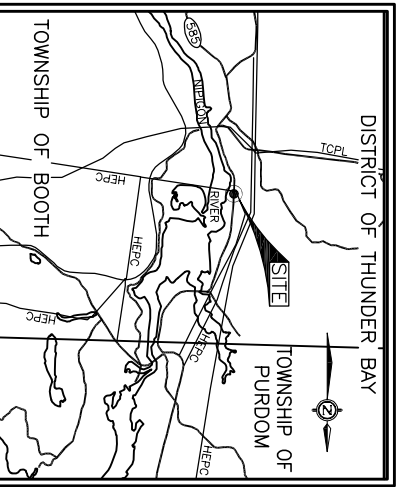
Lab No. 08-640

Project No.: 08-085


GWP 476-00-00

APPENDIX C

Borehole Locations and Soil Strata Drawings



A vertical scale bar labeled "SCALE" with markings at 0, 5, and 10 m.

 **Ontario**
Ministry of Transportation
Northwestern Region
Structural Section



TBT ENGINEERING
CONSULTING GROUP

| SOIL STRATA SYMBOLS | | | |
|---------------------|---------|--|---------------|
| | TOPSOIL | | SAND |
| | FILL | | SAND & GRAVEL |
| | GRAVEL | | BEDROCK |
| | SILT | | |

| LEGEND | | | |
|---------|---------------------------|----------|--------|
| | Borehole | | |
| N' | Std Pen Test (Blows/0.3m) | | |
| | Water Level | | |
| NFP | No Further Progress | | |
| EOH | End of Hole | | |
| No | ELEVATION | STATION | OFFSET |
| BC08-01 | 97.9 | 10+325.2 | 4.0 LT |
| BC08-02 | 96.4 | 10+319.7 | 9.0 RT |
| BC08-03 | 98.5 | 10+272.0 | 3.0 LT |
| BC08-04 | 97.9 | 10+278.4 | 2.0 RT |
| BC08-05 | 97.8 | 10+321.9 | 2.0 RT |

—NOTE—

| REVISIONS | | | | | |
|-------------|--------|----------|-----------|--------------------|----------|
| | | 11/02/09 | SS | ISSUED FOR REPORT | |
| | | 22/01/09 | TB | REVIEW | |
| DESCRIPTION | | | | | |
| DESIGN | CHK | CODE | XXXXX--XX | LOADXX--XM--XMDATE | XXXXXXXX |
| PAYN | TB CHK | SS SITE | 48C--04B | DWG. | X |