



**FOUNDATION INVESTIGATION REPORT  
RAMSDALE CREEK CULVERT REPLACEMENT  
HIGHWAY 11  
TOWNSHIP OF LASH, RAINY RIVER DISTRICT  
AGREEMENT NO.: 6013-E-0023  
ASSIGNMENT NO.: 2  
SITE NO.: 45-139/C  
W.P. NO.: 6903-12-01  
GEOCRES NO.: 52C-35**

**AUGUST 6, 2014  
GS-TB-018737**

**PREPARED FOR:**  
Ministry of Transportation  
Geotechnical Section  
Northwestern Region Office  
615 South James Street  
Thunder Bay, ON P7E 6P6

3 Copies - Ministry of Transportation, Thunder Bay, ON  
1 Copy - DST Consulting Engineers

DST CONSULTING ENGINEERS INC.  
605 Hewitson Street, Thunder Bay, Ontario P7B 5V5  
Phone: 1-807-623-2929 Fax: 1-807-623-1792

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**PART 1: FACTUAL INFORMATION**

**1. INTRODUCTION**

DST Consulting Engineers Inc. (DST) has been retained by the Ministry of Transportation (MTO), Geotechnical Section, Northwestern Region to conduct a foundation investigation for the proposed culvert replacement on Highway 11. This work was carried out under Agreement No.: 6013-E-0023 - Geotechnical Retainer - Assignment No. 2.

This report addresses the field investigation, laboratory test program, factual report on soils conditions at the culvert location.

## **2. SITE DESCRIPTION**

The site is located on Highway 11, approximately 12.5 km West of Highway 613, LHR 18370, offset 12.54 km (latitude 48.6334 and longitude -93.8312), Station 11+499, in the Township of Lash, in the Emo area, Rainy River District.

It is understood that the existing 32.0 m long centerline culvert is a Reinforced Box Culvert (RFB) approximately 6.1 m wide and approximately 2.4 m in height. The existing culvert (Figure 2.3 and 2.4) was originally built in 1899 and inspection by others indicates there is a cracking, reinforcement corrosion, delamination and scaling. The fill thickness above the culvert is approximately 5.0 m and the side slope of the embankment is approximately 2H:1V. The surrounding area is moderately vegetated and wooded (Figure 2.1 and 2.2). Photographs were taken by others (Figures 2.1 to 2.4).

Geological information is available from published *Ontario Geological Survey Map #52CNW* by the *Ontario Ministry of Natural Resources* for the Rainy River area. The map indicates that the local area landform is identified as clay, silt glaciolacustrine plain. The topography in the area is mainly low local relief; rolling to undulating with dry drainage conditions.



Figure 2.1 Location of existing culvert at Highway 11 (looking West)



Figure 2.2 Location of existing culvert at Highway 11 (looking East)





Figure 2.3 Culvert inlet (North)



Figure 2.4 Culvert outlet (South)

### **3. INVESTIGATION PROCEDURES AND LABORATORY TESTING**

Site work was carried out on May 5<sup>th</sup> and 14<sup>th</sup>, 2014 utilizing a CME 55 drill rig equipped for geotechnical drilling and operated by DST. A total of four boreholes were advanced to depths ranging from 3.0 m to 15.2 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 2 to 3. Borehole 1 was advanced East of the existing culvert, 5.0 m left of centreline, and advanced to a depth of 15.2 m below surface. Borehole 2 was advanced West of the existing culvert, 5.2 m right of centreline, and advanced to a depth of 15.2 m below surface. The remaining two boreholes were advanced with portable hand equipment at the inlet and outlet of the existing culvert. Borehole 3 was advanced at the inlet, 23.0 m left of centreline, and advanced to a depth of 3.0 m below surface. Borehole 4 was advanced at the outlet, 23.0 m right of centreline, and advanced to a depth of 3.0 m below surface.

The borehole locations are referenced to the MTO Station numbering system as indicated on the drawings provided by the Ministry. The ground surface elevations at the borehole locations were surveyed by DST personnel and referenced to the existing culvert at Station 11+499. A telephone pole on the north side of the culvert was assigned as temporary benchmark with elevation of 100.0 m (Drawing 1). 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 who located the boreholes in the field, performed sampling, in-situ testing and logged the boreholes. 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. 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 analysis.

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 and Atterberg limits including plastic limit and liquid limit. A total of thirty four (34) moisture contents, two (2) sieve analyses, one (1) particle size analyses and six (6) Atterberg limits have been done 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 locations

Borehole ID	Station	Elevation (m)	Depth (m)	Offset (m)
BH1	11+504	100.8	15.2	5.0 Lt
BH2	11+493	101.0	15.2	5.2 Rt
BH3 (HA)	11+496	94.0	3.0	23.0 Lt
BH4 (HA)	11+498	97.4	3.0	23.0 Rt

#### **4. DESCRIPTION OF SUBSURFACE CONDITIONS**

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

The generalized stratigraphy of the existing embankment, based on the conditions encountered in Boreholes 1 and 2, consists of asphalt overlying a fill (sand and gravel materials) that is underlain by clays.

Table 4.1 Summary of soil strata at the culvert location

Layer	Depth (m)	Elevation (m)	Comments
Asphalt			120 to 130 mm measured
Fill- Sand and Crushed Gravel	0.0 to 0.8	100.8 to 100.0 101.0 to 100.2	
Fill- Sand	0.8 to 2.3	100 to 98.5 100.2 to 98.7	
Clay	2.3 to 15.2	98.5 to 85.6 98.7 to 85.8	

##### **4.1 Asphalt**

Asphaltic concrete was encountered at surface in Boreholes 1 and 2 with thickness of 120 to 130 mm.

##### **4.2 Topsoil**

Topsoil was encountered in Borehole 4 with a thickness of approximately 0.1 m at a depth of 0.0 to 0.1 m (Elev. 97.4 to 97.3 m).

##### **4.3 Fill – Sand and Crushed Gravel**

Sand fill and crushed gravel, trace to some silt was encountered in Boreholes 1 and 2 below the asphalt with a thickness of 0.7 m at depths between 0.1 to 0.8 m (Elev. 100.7 to 100.0m) and depths between 0.1 to 0.8 m ( Elev. 101.1 to 100.2 m) respectively. The moisture contents of samples tested range from 3 to 8 %. The results of laboratory tests are summarized in Table 4.2.

Table 4.2 Summary of sand and crushed gravel fill sieve analyses

Laboratory Results - Sieve Analyses	
Gravel %	40 to 61
Sand %	34 to 44
Fines %	5 to 16

#### 4.4 Fill – Sand and Gravel

Sand fill with trace to some gravel, trace silt and organics was encountered in the Boreholes 1 and 2 with a thickness of approximately 1.5 m at depths 0.8 to 2.3 m (Elev. 100.0 to 98.5 m) and 0.8 to 2.3 m (Elev. 100.2 to 98.7 m) respectively.

SPT 'N' values vary from 14 to 17, indicating a compact condition. The moisture contents of the sand material vary from 20 to 30 %.

#### 4.5 Clay

A clay material was encountered in Boreholes 3 and 4 at a depths of 0.0 m (Elev. 94.0 m) and 0.1 m (Elev. 94.0 m) respectively. In Boreholes 1 and 2, clay was encountered at depths of 2.3 m (Elev. 98.5 and 98.7 m). The thickness of this stratum is not defined as borehole terminus was reached within this stratum.

Atterberg limits tests carried out on samples from Boreholes 1, 2, and 4 indicate that the clay has intermediate to high plasticity with liquid limits ranging from 46 to 58 % and plasticity indexes ranging from 27 to 41 %. The moisture content of the clay ranges from 17 to 36 %. Field vane tests completed in Boreholes 3 and 4 showing 35 kPa to 130 kPa and Cone Penetration resistance showing 793 kPa to 1378 kPa, indicating a stiff to very stiff consistency. The laboratory test results are summarized in following Tables 4.3

Table 4.3 Summary of Atterberg limits- clay

Laboratory Results – Atterberg Limits	
Liquid Limit %	46 to 58
Plastic Limit %	16 to 21
Plastic Index %	27 to 41

#### **4.6     Groundwater**

At the time of the field investigation groundwater was not observed in any Boreholes. The groundwater levels can be expected to vary with the season and precipitation events. During the time of investigation, water levels in creek were at 97.48 m and 97.01 m at the inlet and outlet respectively.

## **5. MISCELLANEOUS**

Site work was carried out during the week of May 5th, 2014 utilizing a CME 750 all-terrain drill rig operated by DST personnel. Fieldwork was supervised on a full time basis by Joe Forgues who located the boreholes in the field, performed sampling, in-situ testing and logged the boreholes. 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 Deep Bansal, P.Eng and reviewed by Prof. Myint Win Bo, P.Eng a designated principal contact for MTO projects.



## 6. 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:

Reviewed by:



Deep Bansal, P. Eng  
Project Manager

A handwritten signature in black ink that reads "Bernardo Villegas".

For Bernardo Villegas, M.Sc  
Manager

Reviewed By:



Dr. M W Bo, PhD., P. Eng, P.Geo, Int PE,  
C.Geol, C. Eng, Eur Geol, Eur Eng  
Senior Vice President / Senior Principal



**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	$SENSITIVITY = \frac{UNDISTURBED\ SHEAR\ STRENGTH}{REMOLDED\ SHEAR\ STRENGTH}$	

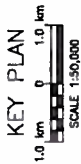
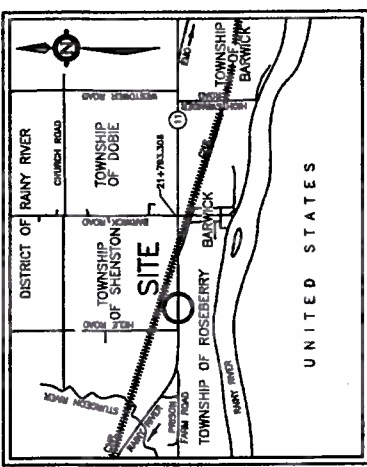
\*HIERARCHY OF SOIL STRENGTH PREDICTION: **1)** LABORATORY TRIAXIAL TESTING. **2)** FIELD INSITU VANE TESTING. **3)** LABORATORY VANE TESTING. **4)** SPT VALUES. **5)** POCKET PENETROMETER.














# **APPENDIX 'C'**

## **DRAWINGS**

METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SPECIFIED  
IN NUMBERS + METERS

CONT No	6013-E-0023	
WP No	6944-10-01	
SITE No	45-137/C	
GEORES No	52C-34	
WESTOVER CREEK		SHEET
CULVERT REPLACEMENT HWY 11		
STA 20+400 TO STA 20+600		
Survey 00-00 Revised		

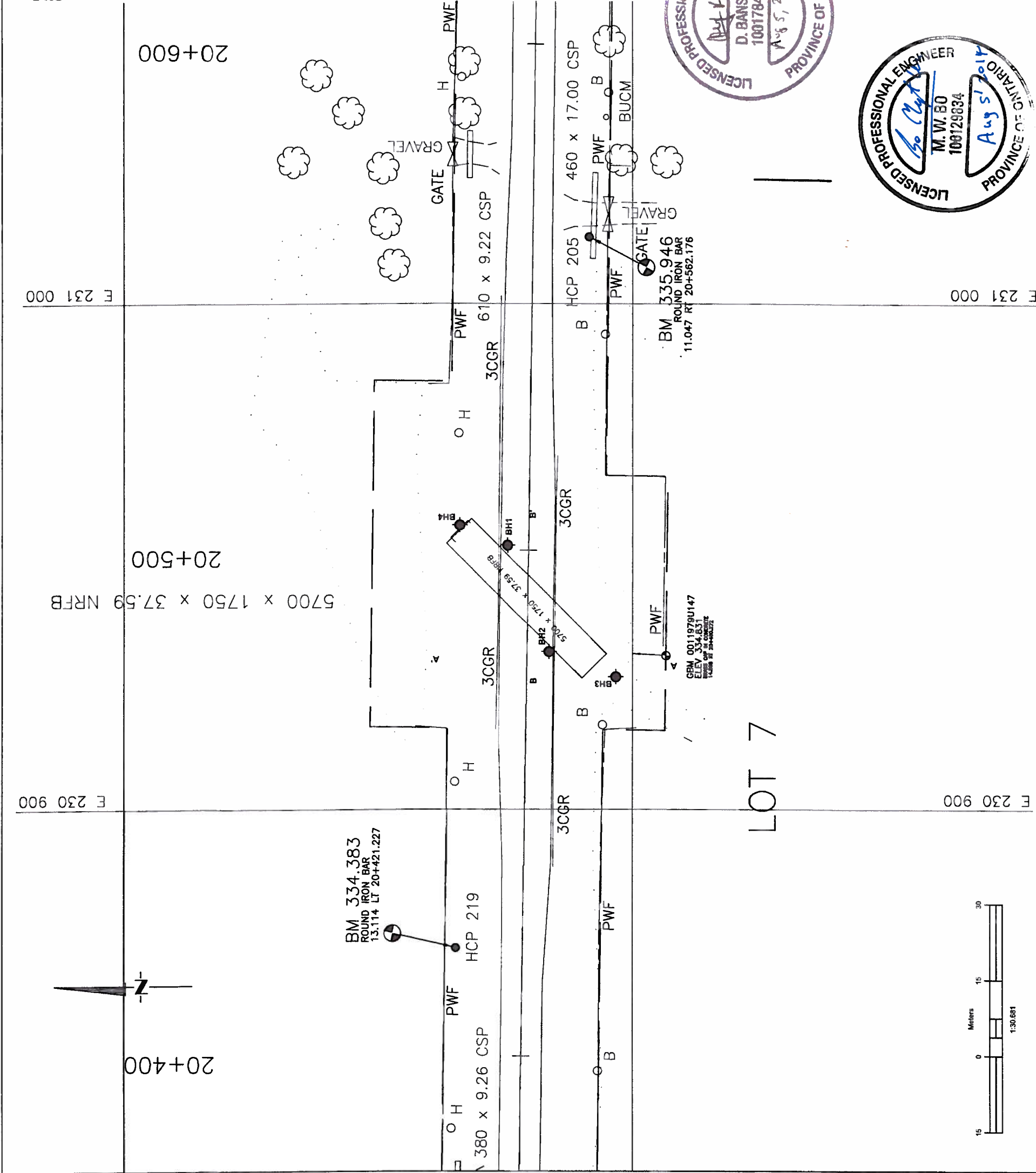


LEGEND					
	Borehole		Borehole with DCPT		Pavement Hole
	Rock Probe		Blows (0.3m (Std. Pen Test, 475 J/Blow)		Water level at time of investigation.
	Fill		Organics		Topsoil
	Till		Sand & Gravel		Boulders
	Bedrock				
No.	Elevation	Northing	Eastings	Station	Offset
BH1	101.481	5390524	230952	20+501	4.0 m LT
BH2	101.414	5390516	230951	20+480	4.0 m RT
BH3	97.379	5390503	230928	20+475	17.5 m RT
BH4	98.089	5390533	230956	20+505	13.5 m LT

NOTE:  
The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed by interpolation and may not represent actual conditions.  
Borehole coordinate system reference: UTM NAD83 Zone 17T

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

DRAWING 1



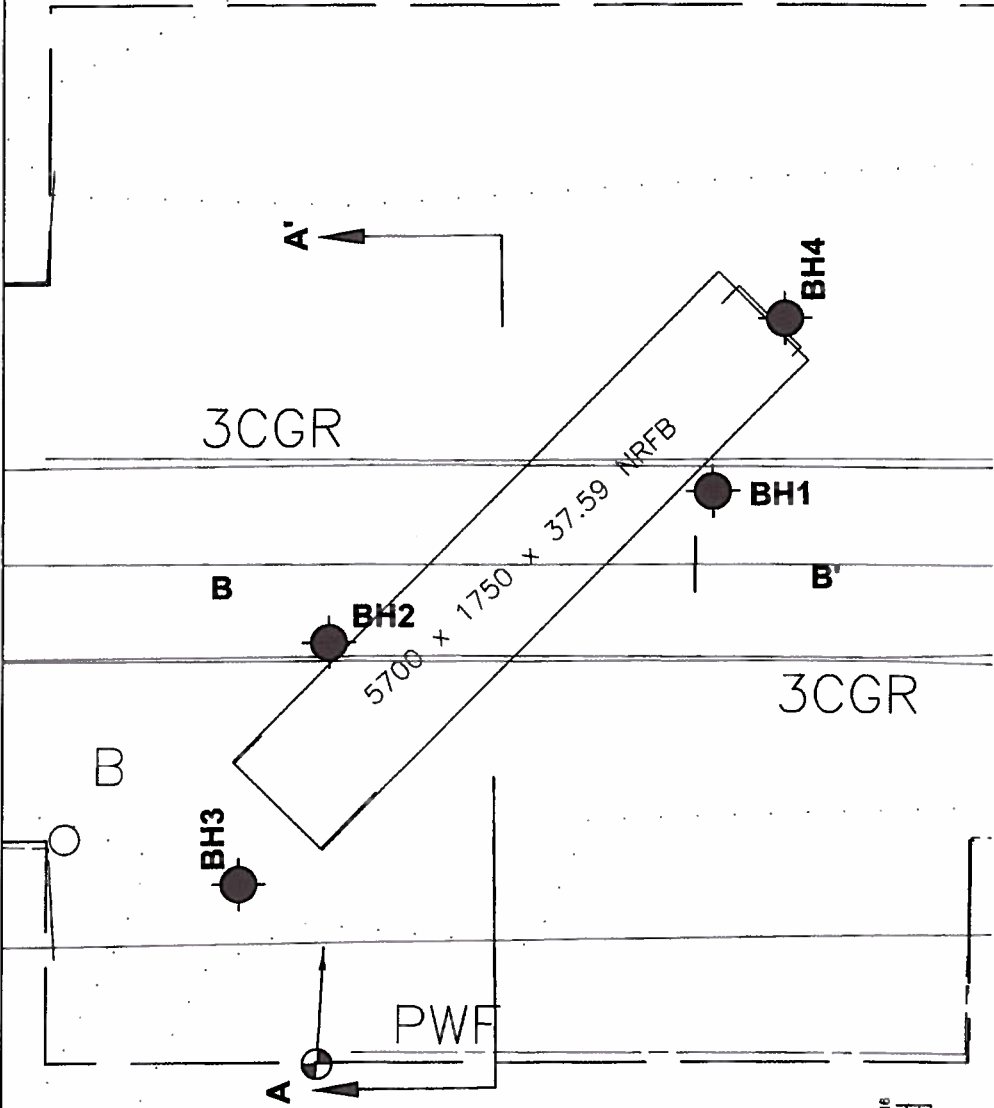
**PROFESSIONAL ENGINEER**  
D. BANSAL  
100179485  
Aug 5, 2014  
PROVINCE OF ONTARIO

**PROFESSIONAL ENGINEER**  
M.W. BO  
100129834  
Aug 5, 2014  
PROVINCE OF ONTARIO

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

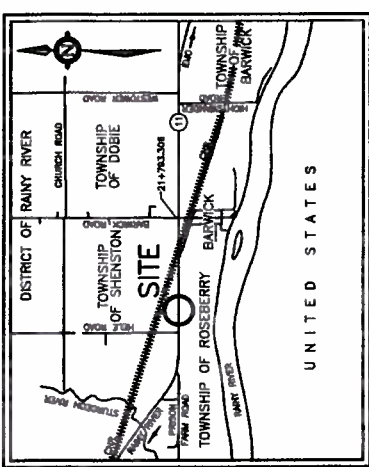
CONT No	6013-E-0023	
WP No	6944-10-01	
SITE No	45-137/C	
GEORES No	52C-34	
WESTOVER CREEK		SHEET
CULVERT REPLACEMENT HWY 11		
STA 20+400 TO STA 20+600		
Survey 00-00		Revised

GBM 0011979U147  
ELEV 334.831  
BRASS CAP IN CONCRETE  
14.598 RT 20+480.272



5700 x 175

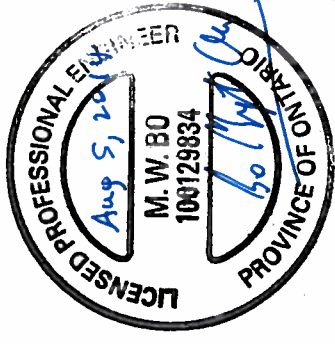
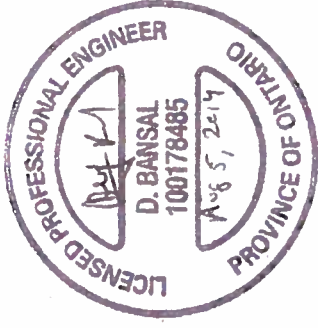
C Z



KEY PLAN  
1.0 km 0 1.0 km  
SCALE 1:50,000

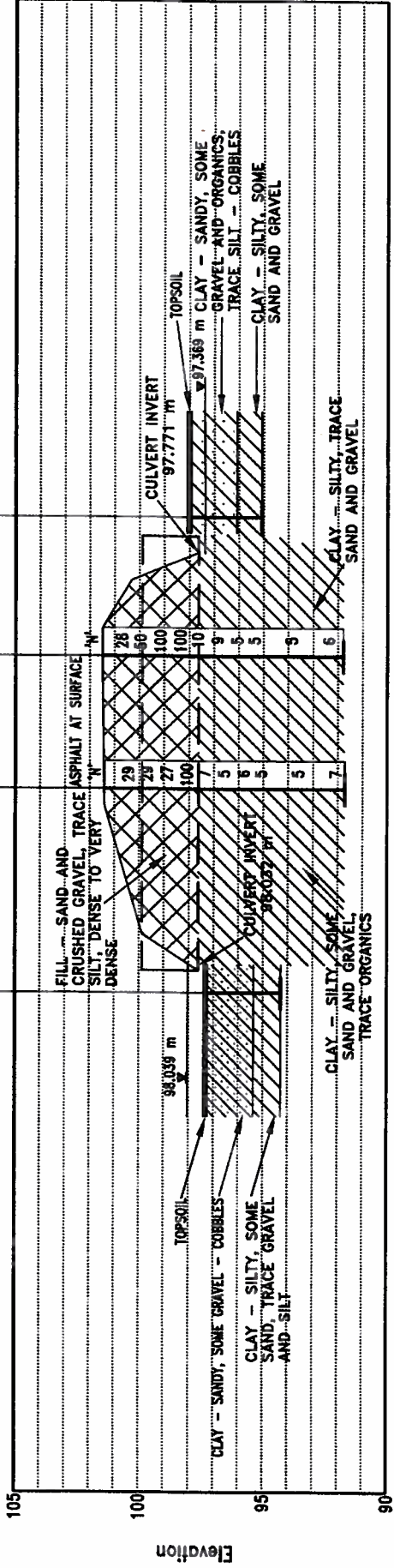
LEGEND			
	Borehole		Sand
	Borehole with DCPT		Silt
	Pavement Hole		Clay
	Rock Probe		Sand & Gravel
	Blows/0.3m (Std. Pen Test, 475 J/Blow)		Boulders
	Water level at time of investigation		
	Fill		
	Organics		
	Topsoil		
	Till		
	Bedrock		
No.	Elevation	Station	Offset
BH1	101.481	230852	20+581
BH2	101.414	230851	20+480
BH3	97.278	230826	20+475
BH4	98.089	230956	20+595

NOTE:  
The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed by interpolation and may not represent actual conditions.  
Borehole coordinate system reference: UTM NAD83 Zone 17T



PROFILE ALONG SECTION A-A'

BH3 BH2 BH1 BH4



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

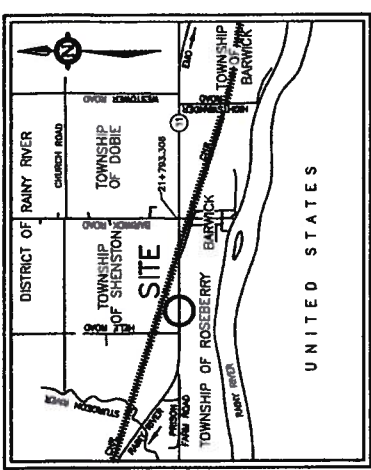


CULVERT

METRIC

DIMENSIONS ARE IN METRES  
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GEORES No	52C-34	
WESTOVER CREEK		SHEET
CULVERT REPLACEMENT HWY 11		
STA 20+400 TO STA 20+600		
Survey 00-00 Revised		



LEGEND			
	Borehole		Station
	Borehole with DCPT		Easting
	Pavement Hole		Northing
	Rock Probe		Offset
	Blows/0.3m (Std. Pen Test, 475 J/Blow)		
	Water level at time of investigation		
	Fill		
	Organics		
	Topsoil		
	Till		
	Bedrock		
	Sand		
	Silt		
	Clay		
	Sand & Gravel		
	Boulders		

No.	Elevation	Northling	Eastling	Station	Offset
BH1	101.481	530524	230952	20+501	4.9 m LT
BH2	101.414	530516	230921	20+480	4.9 m RT
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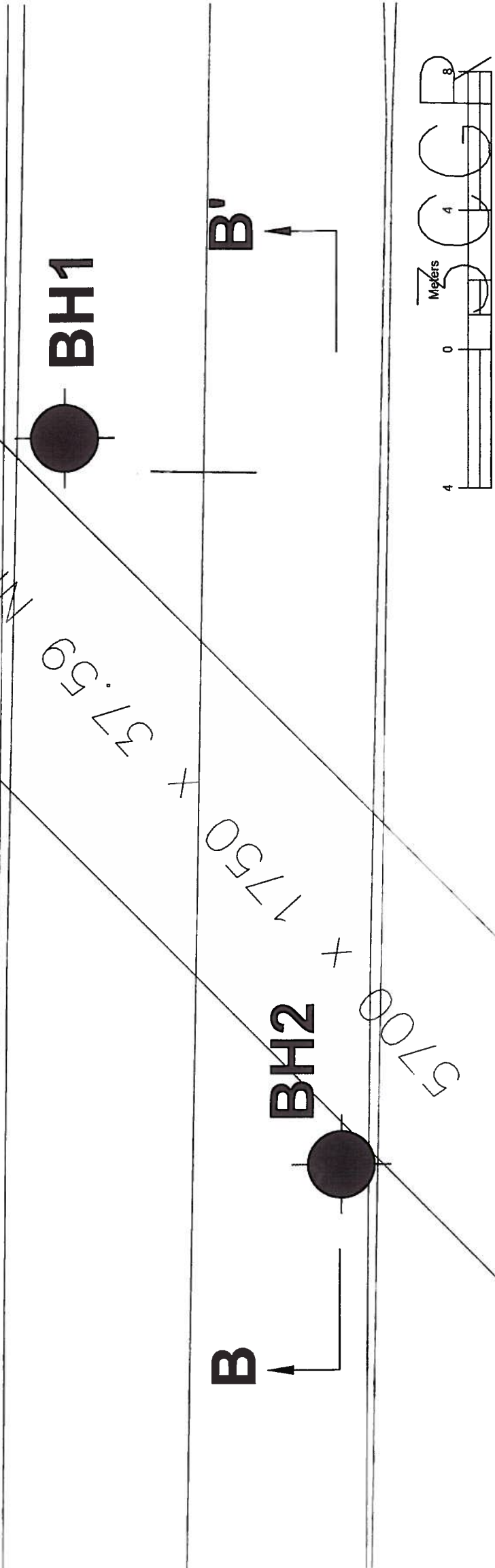
NOTE:

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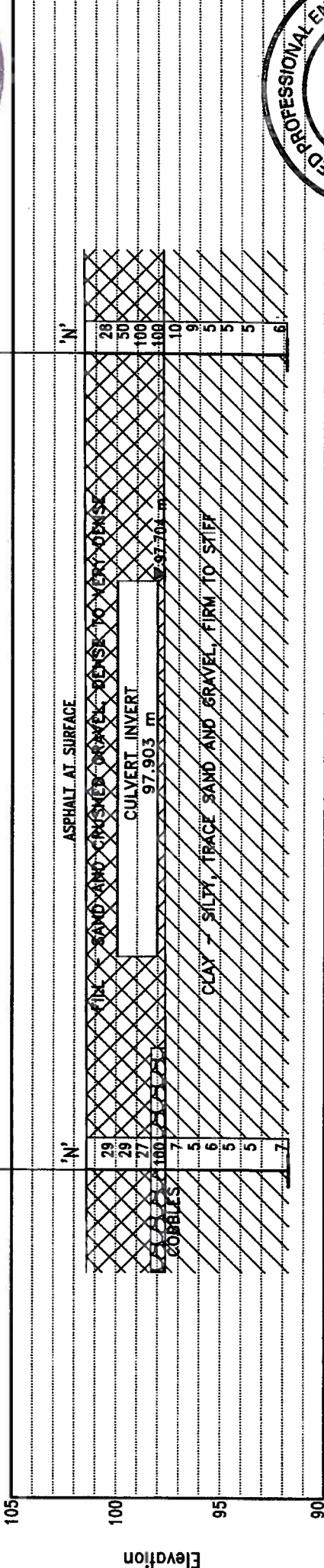
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605 Hewitson Street  
Thunder Bay, ON P7B 5V5  
Ph: (807) 623-2929  
Fax: (807) 623-1792  
Email: thunderbay@dstgroup.com

DRAWING 3



LICENSED PROFESSIONAL ENGINEER  
D. BANSAL  
100178485  
Aug 5, 2014  
PROVINCE OF ONTARIO



LICENSED PROFESSIONAL ENGINEER  
M. W. BO  
100129834  
Aug 5, 2014  
PROVINCE OF ONTARIO



# **APPENDIX 'D'**

## **ENCLOSURES**

# RECORD OF BOREHOLE No BH1

1 OF 1

METRIC

W.P. 6013-E-0023 LOCATION Westover Creek Culvert: STA. 20+501 - 4.0 m LT ORIGINATED BY JF  
 DIST            HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY ML  
 DATUM LOCAL DATE 2014 05 02 CHECKED BY DB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT  W <sub>P</sub>	NATURAL MOISTURE CONTENT  W	LIQUID LIMIT  W <sub>L</sub>	UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	50 100 150 200 250	20 40 60					
101.5	GROUND SURFACE														
100.4	ASPHALT - 75 mm		AS1	AS											Water level at 3.5 m on completion
100.7	FILL - SAND & CRUSHED GRAVEL - trace silt, brown														
0.8	FILL - SAND - some gravel and silt, brown, dense to very dense		SS2	SS	28										
			SS3	SS	50+										19 62 (19)
			SS4	SS	100+										
	- COBBLES		SS5	SS	100+										
97.7															
3.8	CLAY - Silty, trace sand and gravel, grey, firm to stiff		SS6	SS	10										
			SS7	SS	9										
			SS8	SS	5										
			SS9	SS	5										
			SS10	SS	5										
			SS11	SS	6										
91.8															
9.7	End of Borehole at 9.7 m														

ON\_MOT-HIGH VANES GS-TB-018738 - WESTOVER CREEK CULVERT.GPJ DST\_MIN.GDT 6/11/14

+ <sup>3</sup>, X <sup>3</sup>: Numbers refer to Sensitivity      ○ <sup>3</sup>% STRAIN AT FAILURE

ENCLOSURE 1

# RECORD OF BOREHOLE No BH2

1 OF 1

METRIC

W.P. 6013-E-0023 LOCATION Westover Creek Culvert: STA. 20+480 - 4.0 m RT ORIGINATED BY JF  
DIST HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY ML  
DATUM LOCAL DATE 2014 05 02 CHECKED BY DB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
								20	40	60	80	100				
								50	100	150	200	250				
101.4	GROUND SURFACE															
101.3	ASPHALT - 75 mm		AS1	AS												
100.7	FILL - SAND & CRUSHED GRAVEL - trace silt, brown															
0.8	FILL - SAND - with silt, some gravel, brown, dense to very dense		SS2	SS	29											
			SS3	SS	29											
			SS4	SS	27											
	- COBBLES		SS5	SS	100+											
97.6																
3.8	CLAY - Silty, some sand and gravel, trace organics, grey, firm to stiff		SS6	SS	7											
			SS7	SS	5											
			SS8	SS	6											
			SS9	SS	5											
			SS10	SS	5											
			SS11	SS	7											
91.7																
9.7	End of Borehole at 9.7 m															

ON\_MOT-HIGH VANES GS-TB-018738 - WESTOVER CREEK CULVERT.GPJ DST\_MIN.GDT 6/11/14

+ <sup>3</sup>, X <sup>3</sup>: Numbers refer to Sensitivity ○ <sup>3</sup>% STRAIN AT FAILURE

## METRIC

DATUM	LOCAL	DATE	2014 05 02	CHECKED BY	DB
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+<sup>3</sup>, X<sup>3</sup>: Numbers refer to Sensitivity      ○<sup>3%</sup> STRAIN AT FAILURE

ON MOT-HIGH VANES GS-TB-018738 - WESTOVER CREEK CULVERT.GPJ DST\_MIN.GDT 6/11/14

# RECORD OF BOREHOLE No BH4

1 OF 1

METRIC

W.P. 6013-E-0023 LOCATION Westover Creek Culvert: STA. 20+505 - 13.5 m LT ORIGINATED BY JF  
 DIST            HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY ML  
 DATUM LOCAL DATE 2014 05 02 CHECKED BY DB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT   NATURAL LIMIT   MOISTURE   CONTENT   LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR   SA   SI   CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
98.1	GROUND SURFACE							20   40   60   80   100						
97.9 0.2	TOPSOIL CLAY - Sandy, some gravel and organics, trace silt, grey, very stiff - COBBLES						98	50   100   150   200   250	○ UNCONFINED   + FIELD VANE		W <sub>P</sub> W   W <sub>L</sub>			
							97		□ QUICK TRIAXIAL   × LAB VANE					
96.1 2.0	CLAY - Silty, some sand and gravel, grey, very stiff						96							
95.1 3.0	End of Borehole at 3.0 m													

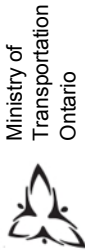
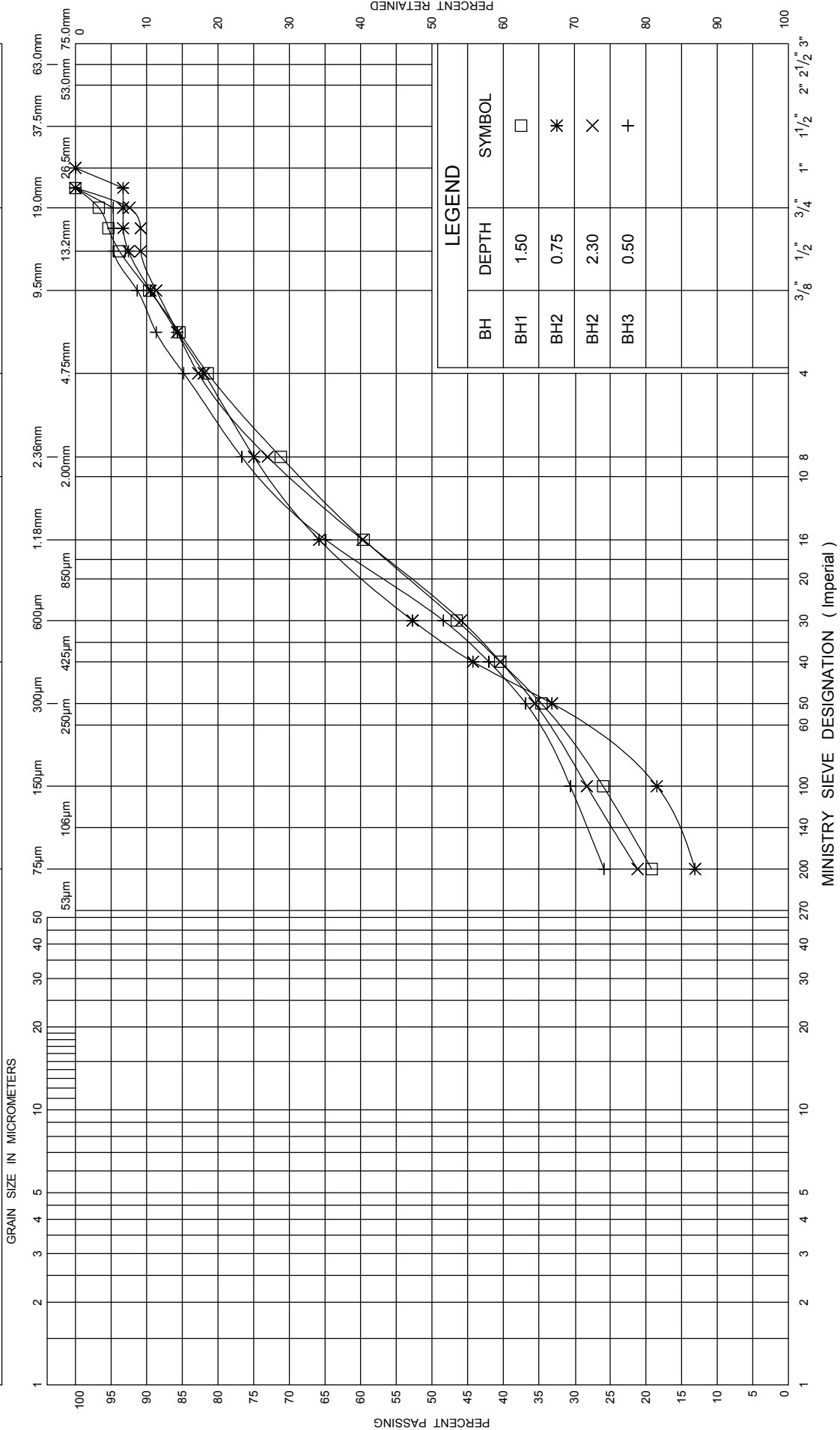
ON\_MOT-HIGH VANES GS-TB-018738 - WESTOVER CREEK CULVERT.GPJ DST\_MIN.GDT 6/11/14

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○<sup>3</sup>% STRAIN AT FAILURE

ENCLOSURE 4

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT		SAND			GRAVEL	
		Fine	Medium	Coarse	Fine	Coarse



GRAIN SIZE DISTRIBUTION

ENCLOSURE 5

W P 6013-E-0023

Highway 11, Roseberry Twsp

