



**FOUNDATION INVESTIGATION  
REPORT  
ABITIBI RIVER TRIBUTARY  
CULVERT REPLACEMENT  
HIGHWAY 634  
TOWNSHIP OF PINARD  
AGREEMENT No.: 5010-E-0006  
GWP: 5145-07-00  
WP: 5125-05-01  
GEOCRES NO.: 42H-47**

**March 2012**

**DST Reference No. GS-TB-012144**

**Prepared for:**

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**DST CONSULTING ENGINEERS INC.**

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**PART 1: FACTUAL INFORMATION**

**1. INTRODUCTION**

DST Consulting Engineers Inc. has been subcontracted by Genivar who was retained by the Ministry of Transportation (MTO), NorthEastern Region, to conduct a geotechnical investigation for the replacement of a culvert on Highway 634. This work was carried out under Agreement No.: 5010-E-0006, Detailed Design for the Replacement/Rehabilitation of Various Culverts.

This report addresses the field investigation, laboratory test program, factual report on field findings (Part 1) and recommendations for design and construction for the proposed culvert replacement (Part 2).

Geological information is available from *Northern Ontario Geology Terrain Study* published by the Ontario Ministry of Natural Resources for the Island Falls Area, District of Cochrane. This indicates that the local terrain for the area has been identified as a glaciolacustrine plain and primarily contains sands. The area is typically of low local relief with dry conditions and a high water table.

## 2. SITE DESCRIPTION

The site is located on Highway 634, approximately 73.2 km north of Highway 11, Township of Pinard, Cochrane Area. The structural site number is 39E-250.

Existing culvert at this location is a 3.2 m x 35 m Structural Plate Corrugated Steel Pipe (SPCSP). The culvert was identified to be in poor condition and significant deterioration of barrels and coating of invert and soil cover of approximately 3.0 m. The barrel has been structurally supported with wooden column internally approximately at centre line due to excessive deformation. (Figures 2.4)

The embankment slopes at this location are approximately 2H:1V. Both sides of the embankment are vegetated (Figures 2.1 and 2.2). The photographs shown in Figures 2.3 to 2.5 were taken by MTO and photograph shown in Figure 2.1, 2.2 were captured during DST's site visit.



Figure 2.1 Culvert inlet (looking west)





Figure 2.2 Culvert outlet (looking east)



Figure 2.3 Culvert inlet (looking East)





Figure 2.4 Culvert internal condition



Figure 2.5 Highway 634, Unknown Creek (looking south)

### 3. INVESTIGATION PROCEDURES AND LABORATORY TESTING

Site work was carried out in a period between March 19, 2011 and March 31, 2011 utilizing a CME 55 drill rig and hand auger those were operated by DST personnel. A total of four (4) drilled boreholes using hollow stem auger and hand auger were put down for the purpose of foundation design at this site.

Two boreholes were advanced at either end of the existing culvert (inlet and outlet), 22.7 m left and 14.3 m right from the centerline, using hand auger. HA 2 was placed 22.7 m left of the centerline due to refusal on frozen materials at lesser distances. The remaining two boreholes were drilled through the road structure at station 10+005 offset 3.2 m right and station 10+001 offset 3.1 m left respectively. The minimum number of boreholes, and depths & locations of boreholes were chosen according to the given specification in Request for Quotation (RFQ) by MTO. Borehole locations and stratigraphic sections are shown on the Borehole Location Plans, (Drawings 1 to 4).

The borehole locations are referenced to the MTO Station numbering system as indicated in the RFQ. The centreline of the existing culvert was assumed as Station 10+000. The ground surface elevations at the borehole locations were surveyed by DST personnel. At approximately Station 9+984 offset 12 m left a benchmark with an elevation of 92.9 m was placed in a poplar tree and flagged. Elevations are correlated to surveyed elevations provided by Genivar. Borehole locations, stationing and benchmark location are shown on the Borehole Location Plan, Drawings 1. Table 3.1 summarizes the detail of borehole locations and depths.

Table 3.1 Detail of borehole locations

Borehole ID	Station	Elevation (m)	Depth (m)	Offset (m)
BH1	10+005	94.8	20.9	3.2 Rt
BH2	10+001	95.0	16.2	3.1 Lt
HA1	9+982	88.8	3.1	14.3 Rt
HA2	10+020	90.4	3.1	22.7 Lt

The fieldwork was supervised on a full-time basis by DST personnel who located the boreholes in the field, performed sampling and in-situ testing and logged the boreholes. Standard Penetration Testing (SPT) and Filed Vane Shear tests were performed in each borehole. 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 and Atterberg limits including plastic limit and liquid limit. A total of thirty seven (37) moisture contents, six (6) sieve analyses, six (6) particle size analyses and six (6) Atterberg limit tests have been carried out for this assignment. Laboratory test results are presented in the Boreholes Logs (Enclosures 1 to 4), and Plots (Enclosures 5 to 8).

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

The subsurface conditions are presented based on the information obtained during field and laboratory testing.

The generalized stratigraphy of the existing embankment, based on the conditions encountered in boreholes, consists of surfacing (surface treatment) overlying a mixed fill that is underlain by silty clay which in some places (Borehole 1) is underlain by sand and then silty clay again. The fill varies from sand to silty clay with cobbles noted during the drilling process.

##### **4.1 Surface Treatment**

Surface treatment was encountered in Borehole 1 and 2 with thickness of approximately 20 to 25 mm.

##### **4.2 Embankment Fill**

The embankment fill was encountered below the surface treatment in Borehole 1 and 2 up to depths of 6.8 and 6.9 m, with corresponding elevations between 94.78 and 94.98 m to 88.0 and 88.1 m respectively. Materials encountered in the embankment fill varied from sand and gravel to silty clay. Grain size distributions of the fill materials are reported in borehole logs (Enclosures 1 to 4) and plots (Enclosures 5 and 7).

A road structure of sand fill was encountered in Borehole 1 and 2 at depths between 0.02 and 1.5 m below surface; this corresponds to maximum and minimum upper and lower boundary elevations of approximately 94.8 and 93.5 m respectively. Gradation analyses conducted on sample from Borehole 2 indicate gravel, sand and fine contents of approximately 33%, 59% and 8% respectively. This material does not classify as Granular A or Granular B, Type II, meeting SSP 110S13 requirements, however this material does classify as Granular B, Type I and III meeting SSP 110S13 requirements. Moisture contents of samples ranged from 2% to 4%.

Silty clay fill was encountered in Borehole 1 and 2 at depths between 0.9 and 6.0 m below surface; this corresponds to maximum and minimum upper and lower boundary elevations of approximately 93.9 and 89.0 m respectively. The thickness of this stratum was found to be 3.6 and 4.5 m for Borehole 1 and 2 respectively. Gradation analysis conducted on the samples from Borehole 1 indicates gravel, sand and fine contents of 8 to 34%, 29 to 38% and 37 to 54%

respectively. Gradation analyses conducted on samples from Borehole 2 indicate gravel, sand, silt and clay contents of 0 to 4%, 26 to 33%, 50 to 51% and 16 to 19% respectively. Moisture contents of samples ranged from 7% to 18%.

Sand to sand and gravel fill was encountered in Borehole 1 and 2 at depths between 4.5 and 6.9 m below surface; this corresponds to maximum and minimum upper and lower boundary elevations of approximately 90.3 and 88.0 m respectively. The thickness of this layer was 2.3 and 0.9 m for Boreholes 1 and 2 respectively. Gradation analyses conducted on the samples from Boreholes 1 and 2 indicate gravel, sand and fine contents of approximately 18 to 42%, 52 to 75% and 6 to 7% respectively. Moisture contents of samples ranged from 7% to 13%. This material does not classify as Granular A or Granular B, Type II meeting SSP 110S13 requirements, however, the material tested does classify as Granular B, Type I and III meeting SSP 110S13 requirements.

#### **4.3     Silty Clay**

Soft to very stiff silty clay was encountered in Boreholes 1 and 2 at depths between 6.8 and 20.9 m below surface; this corresponds to maximum and minimum upper and lower boundary elevations of approximately 88.1 and 73.9 m respectively. The thickness of this stratum is not determined in Borehole 2 as borehole terminus was reached within this stratum. Gradation analyses conducted on the samples from Boreholes 1 and 2 indicate gravel, sand, silt and clay contents of 0 to 1%, 0 to 13%, 69 to 85% and 12 to 23% respectively with cobbles noted during the drilling process. Atterberg limit tests carried out on samples from Boreholes 1 and 2 indicate low plasticity silty clay with liquid limits and plasticity index of 21 to 25 and 5 to 8% respectively. In-situ field vane tests taken in Boreholes 1 indicate undrained shear strengths between 25 and 130 kPa with sensitivities ranging from 1 to 8. Moisture contents of samples ranged from 14% to 31%.

#### **4.4     Silt**

Silt with organic material was encountered in Auger Hole 2 at depths between 0.75 and 1.0 m below surface; this corresponds to maximum and minimum upper and lower boundary elevations of approximately 89.7 and 89.4 m respectively. The thickness of this layer was approximately 0.25 m.

#### **4.5     Sand**

Dense sand was encountered in Borehole 2 at depths between 12.5 and 13.3 m below surface; this corresponds to maximum and minimum upper and lower boundary elevations of approximately 82.5

and 81.7 m respectively. Gradation analyses conducted on the samples from Borehole 2 indicate gravel, sand, and fine contents of 31%, 61%, and 8% respectively. A moisture content of sample was found to be 22%.

Sand was encountered in Auger Hole 1 at depths between 0.4 and 1.0 m below surface; this corresponds to maximum and minimum upper and lower boundary elevations of approximately 88.5 and 87.9 m respectively. The thickness of this layer was approximately 0.25 m.

#### 4.6 Groundwater

The groundwater table was identified below the ground surface during the field investigation and visual identification of soil samples. The estimated depth of groundwater level below the ground surface elevation is given in Table 4.2. The groundwater level at the culvert was between elevations of 89.2 and 89.5 m at the measured borehole locations during the field investigation. The groundwater levels and water level at the culvert can be expected to vary with season and precipitation events.

Table 4.1 Depth of water table at boreholes

Borehole ID	Borehole elevation (m)	Water table elevation (m)	Depth of water table below the ground surface (m)
BH1	94.8	89.2	5.6
BH2	95.0	89.5	5.5



## 5. REFERENCES

*Canadian Highway Bridge Design Code* (2006), CAN/CSA-S6-06, A National Standard of Canada, Canadian standards Association.

Municipal and Provincial Common, Volume 1 - General & Construction Specifications, "*Ontario Provincial Standard for Roads & Public Works*" Spec No. OPSS 422, 501, 510, 511, 517, 518, 539, 805, 902.

Municipal and Provincial Common, Volume 3 - Drawings for Roads, Barriers, Drainage, Sanitary Sewers, Watermains and Structures, "*Ontario Provincial Standard for Roads & Public Works*" Spec No. OPSD 203.040, 803.010, 810.010, 810.020, 3090.100.

Municipal and Provincial Common, Volume 2 - Material Specifications, "*Ontario Provincial Standard for Roads & Public Works*" Spec No. OPSS 1010, 1860.

Special Provisions, Ontario Provincial Standards, SP110S13.

## 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:



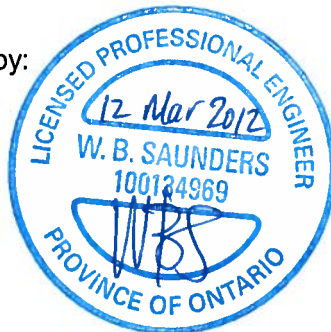
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C.Geol, C. Eng, Eur Geol, Eur Eng  
Senior Principal / Director (GeoServices)

Reviewed by:



Wesley Saunders, P.Eng  
Project Manager

## **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 a Quality Verification Engineer 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'**  
**DESCRIPTIVE TERMS**  
**FOR SOIL CLASSIFICATION**

**Descriptive Terms for soil classification:**

As per the soil classification manual by MTO, the descriptive terms based on percent by mass of the whole sample, are described as per following table

<b>Descriptive Term</b>	<b>Example</b>	<b>Percent by Mass of Sample</b>
And (with two major soil types)	Sand and gravel	40-60
Adjective (silty)	Silty	30-40
With	Silt with fine sand	20-30
Some	Silt, some fine sand	10-20
Trace	Sand, trace of gravel	0-10



## EXPLANATION OF TERMS USED IN REPORT

**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.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

**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/0.3m)	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, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), 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	0.3m - 1m	1m - 3m	> 3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

## ABBREVIATIONS AND SYMBOLS

### 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

### MECHANICAL PROPERTIES OF SOIL

$m_v$	$\text{kPa}^{-1}$	COEFFICIENT OF VOLUME CHANGE
$C_c$	1	COMPRESSION INDEX
$C_s$	1	SWELLING INDEX
$C_\alpha$	1	RATE OF SECONDARY CONSOLIDATION
$c_v$	$\text{m}^2/\text{s}$	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
$T_v$	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
$\sigma'_{vo}$	kPa	EFFECTIVE OVERBURDEN PRESSURE
$\sigma'_p$	kPa	PRECONSOLIDATION PRESSURE
$\tau_f$	kPa	SHEAR STRENGTH
$c'$	kPa	EFFECTIVE COHESION INTERCEPT
$\phi'$	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
$c_u$	kPa	APPARENT COHESION INTERCEPT
$\phi_u$	-°	APPARENT ANGLE OF INTERNAL FRICTION
$\tau_R$	kPa	RESIDUAL SHEAR STRENGTH
$\tau_r$	kPa	REMOULDED SHEAR STRENGTH
$S_t$	1	SENSITIVITY = $\frac{c_u}{\tau_r}$


### STRESS AND STRAIN

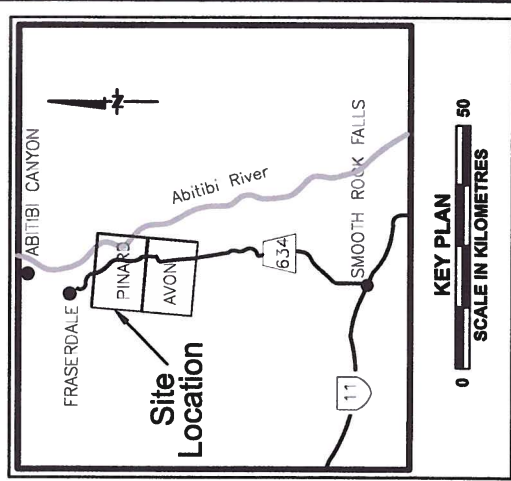
$u_w$	kPa	PORE WATER PRESSURE
$r_u$	1	PORE PRESSURE RATIO
$\sigma$	kPa	TOTAL NORMAL STRESS
$\sigma'$	kPa	EFFECTIVE NORMAL STRESS
$\tau$	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
$\epsilon$	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
$\mu$	1	COEFFICIENT OF FRICTION

### PHYSICAL PROPERTIES OF SOIL

$\rho_s$	$\text{kg}/\text{m}^3$	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	$e_{\min}$	1, %	VOID RATIO IN DENSEST STATE
$\gamma_s$	$\text{KN}/\text{m}^3$	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	$I_D$	1	DENSITY INDEX = $\frac{e_{\max} - e}{e_{\max} - e_{\min}}$
$\rho_w$	$\text{kg}/\text{m}^3$	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
$\gamma_w$	$\text{KN}/\text{m}^3$	UNIT WEIGHT OF WATER	$S_r$	%	DEGREE OF SATURATION	$D_n$	mm	n PERCENT - DIAMETER
$\rho$	$\text{kg}/\text{m}^3$	DENSITY OF SOIL	$w_L$	%	LIQUID LIMIT	$C_u$	1	UNIFORMITY COEFFICIENT
$\gamma$	$\text{KN}/\text{m}^3$	UNIT WEIGHT OF SOIL	$w_p$	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
$\rho_d$	$\text{kg}/\text{m}^3$	DENSITY OF DRY SOIL	$w_{s.}$	%	SHRINKAGE LIMIT	q	$\text{m}^3/\text{s}$	RATE OF DISCHARGE
$\gamma_d$	$\text{KN}/\text{m}^3$	UNIT WEIGHT OF DRY SOIL	$I_p$	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
$\rho_{\text{sat}}$	$\text{kg}/\text{m}^3$	DENSITY OF SATURATED SOIL	$I_L$	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
$\gamma_{\text{sat}}$	$\text{KN}/\text{m}^3$	UNIT WEIGHT OF SATURATED SOIL	$I_C$	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
$\rho'$	$\text{kg}/\text{m}^3$	DENSITY OF SUBMERGED SOIL	$e_{\max}$	1, %	VOID RATIO IN LOOSEST STATE	j	$\text{KN}/\text{m}^2$	SEEPAGE FORCE
$\gamma'$	$\text{KN}/\text{m}^3$	UNIT WEIGHT OF SUBMERGED SOIL						

## **D R A W I N G S**

CONT	No 1012-5129		SHEET
GWP	No 5145-07-00		
WP	No 5125-05-01		
Site	No 39E-250		
Geores	No 42H-47		
CULVERT REPLACEMENT 73.2 Km North of Hwy 11 Highway 634 - Pinard Twp. Geotechnical Investigation			

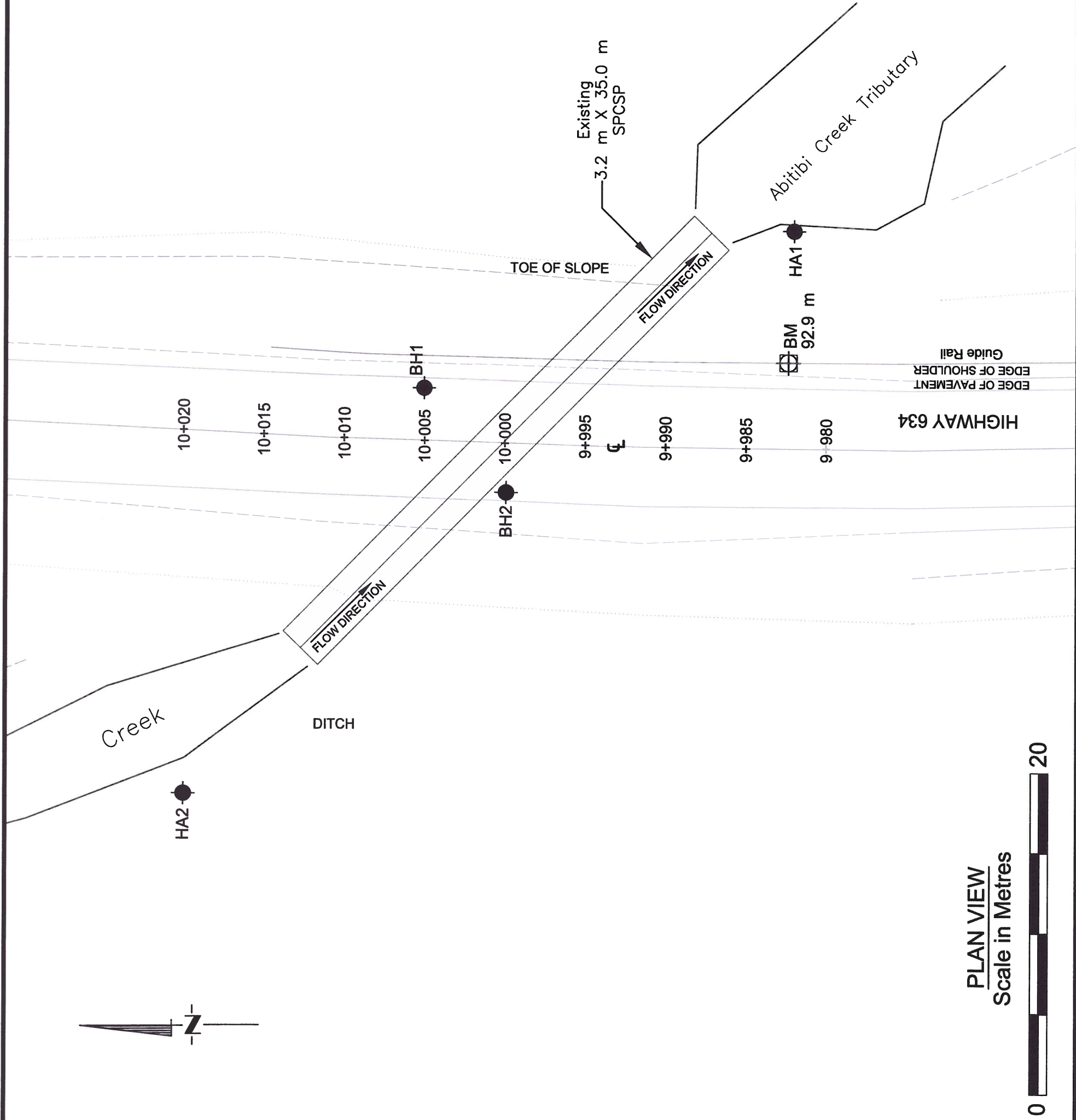


LEGEND						
◆	Borehole/Hand Auger					
●	Borehole with DCPT					
⊕	Dynamic Cone Penetration Test (DCPT)					
●	Rock Probe					
'N'	Blows/0.3m' (Std. Pen Test, 475 J/Blow)					
W	Water level at time of investigation.					
⊕	Benchmark					
		Fill	Sand	Silt	Clay	Sand & Gravel
		Organics				Boulders
		Topsoil				
		Till				
		Bedrock				
No.	Elevation	Northing	Easting	Station	Offset	
BH1	94.80	5521162	456972	10+005	3.2 m LT	
BH2	95.00	5521164	456964	10+000	3.1 m RT	
HA1	98.55	5521149	456938	9+932	14.25 m RT	
HA2	90.42	5521167	456987	10+020	22.75 m LT	

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## DRAWING 1



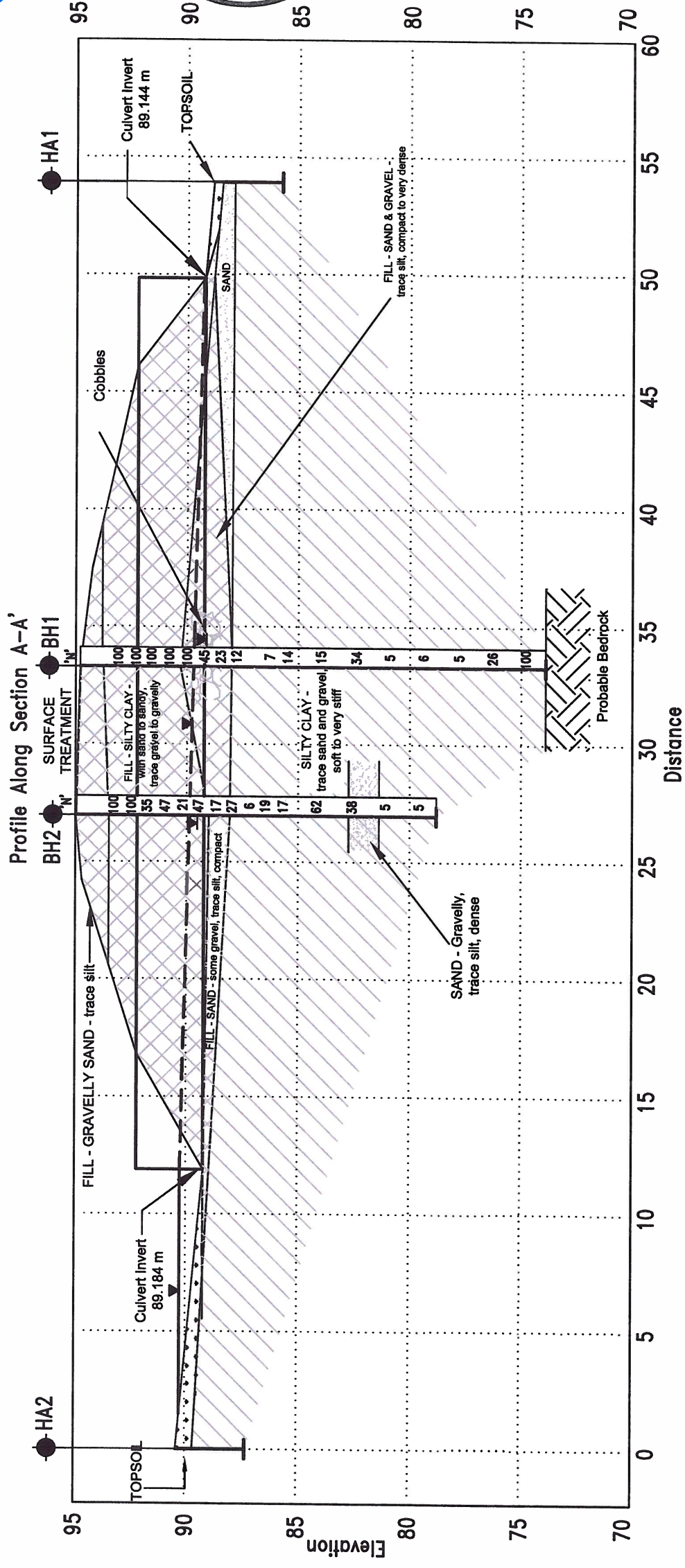
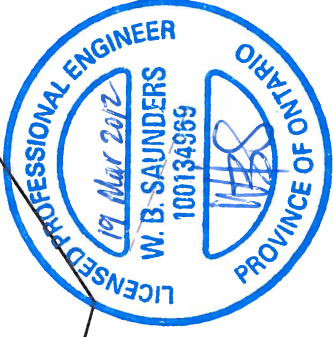
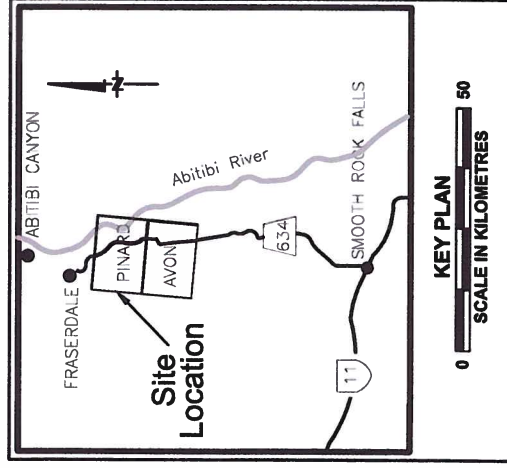
**PLAN VIEW**  
**Scale in Metres**





CONT No 2012-5129  
GWP No 5145-07-00  
WP No 5125-05-01  
Site No 39E-250  
Geocres No 42H-47

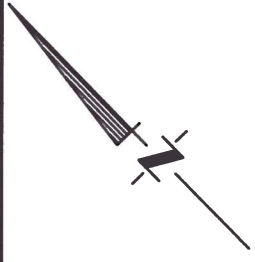
CULVERT REPLACEMENT  
73.2 Km North of Hwy 11  
Highway 634 – Pinard Twp.  
Geotechnical Investigation



**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.

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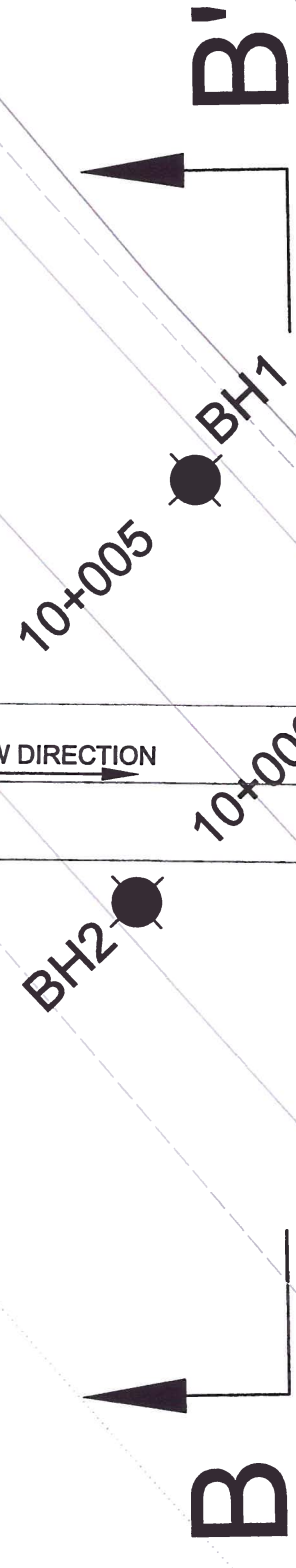


METRIC  
DIMENSIONS ARE IN METRES  
AND ARE SHOWN IN ALL  
DIMENSIONS UNLESS  
OTHERWISE SHOWN. STATIONS  
IN KILOMETERS + METERS

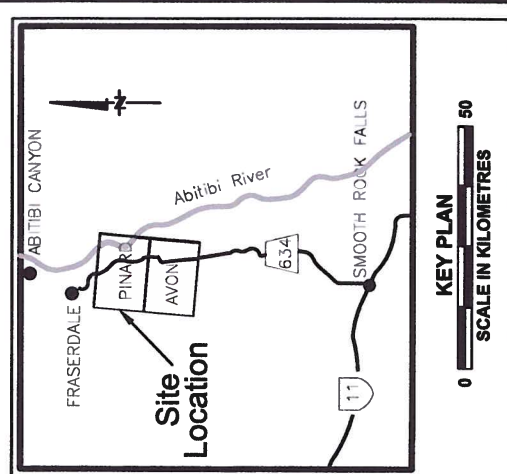
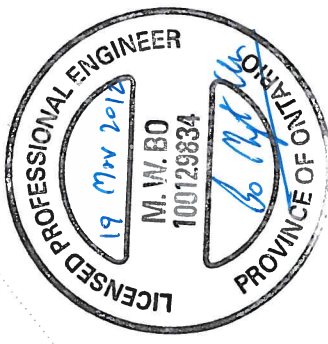
CONT	No 2012-5129
GWP	No 5145-07-00
WP	No 5125-05-01
Site	No 39E-250
Geocres	No 42H-47

CULVERT REPLACEMENT 73.2 Km North of Hwy 11 Highway 634 – Pinard Twp. Geotechnical Investigation	SHEET 32
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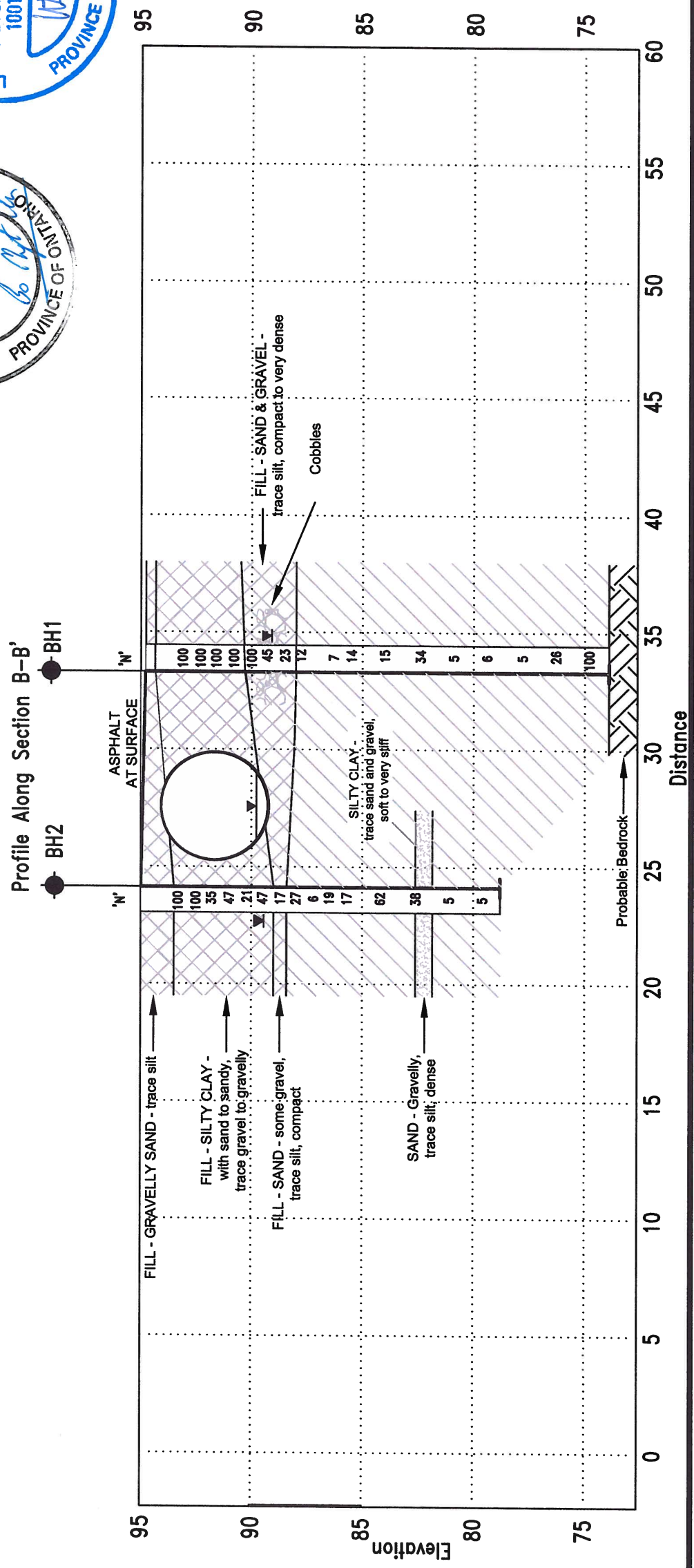
FLOW DIRECTION



PLAN VIEW  
Scale in Metres



LEGEND				
	Borehole/Hand Auger		Dynamic Cone Penetration Test (DCPT)	
	Rock Probe		Blows/0.3m (Std. Pen Test, 475 J/Blow)	
	Water level at time of investigation.		Benchmark	
	Fill		Organics	
	Topsoil		Till	
	Bedrock		Sand	
	Silt		Clay	
	Sand & Gravel		Boulders	
No.	Elevation	Northing	Easting	Station
BH1	94.80	5521182	459972	10+005
BH2	95.00	5521184	459984	10+000
HA1	88.85	5521149	459889	9+982
HA2	90.42	5521187	459887	10+020
				22.75 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.

**DST**  
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Email: thunderbay@dstgroup.com

## **E N C L O S U R E S**



# RECORD OF BOREHOLE No BH1

1 OF 1

METRIC

W.P. 5125-05-01 LOCATION STA. 10+005, 3.2 m RT (5521162 m N, 456972 m E) ORIGINATED BY KS/JF  
DIST HWY 634 BOREHOLE TYPE Hollow Stem Auger (80 mm ID) COMPILED BY ML  
DATUM Local DATE 2011 03 19 CHECKED BY WS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
94.8	GROUND SURFACE													
90.8	SURFACE TREATMENT - 20 mm		AS1	AS										Water level at 89.2 m on 03/19/11 Frozen to 5.0 m
93.9	FILL - SAND - Gravelly, trace silt, cobbles, brown		AS2	AS			94							
0.9	FILL - CLAY - Silty, with gravel to gravelly, with sand to sandy, brown - cobbles		SS3	SS	100+		93							34 29 (37)
			SS4	SS	100+		92							
			SS5	SS	100+		91							8 38 (54) SPT 80 blows/76 mm
			SS6	SS	100+		90							
90.3	FILL - SAND & GRAVEL - trace silt, brown, compact to very dense - cobbles		SS7	SS	100+		89							42 52 (6)
4.5			SS8	SS	45		88							
			SS9	SS	23		87							1 7 69 23
88.0	CLAY - Silty, trace sand and gravel, grey, soft to very stiff		SS10	SS	12		86							
6.8	- cobbles		TW11	TW			85							0 0 84 16
			SS12	SS	7		84							
			SS13	SS	14		83							1 13 71 15
			SS14	SS	15		82							
			SS15	SS	34		81							
			SS16	SS	5		80							
			SS17	SS	6		79							
			SS18	SS	5		78							
			SS19	SS	26		77							
			SS20	SS	100+		76							
73.9	End of Borehole at 20.9 m Auger Refusal on Bedrock						75							
20.9							74							

Numbers refer to Sensitivity 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No BH2

1 OF 1

METRIC

W.P. 5125-05-01 LOCATION STA. 10+000, 3.1 m LT (5521164 m N, 456964 m E) ORIGINATED BY KS/JF  
 DIST HWY 634 BOREHOLE TYPE Hollow Stem Auger (80 mm ID) COMPILED BY ML  
 DATUM Local DATE 2011 03 21 CHECKED BY WS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)										
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20   40   60   80   100	20   40   60   80   100	W <sub>P</sub> W   W <sub>L</sub>	WATER CONTENT (%)													
95.0	GROUND SURFACE						94							Water level at 89.5 m on 03/21/11 33 59 (8) Frozen to 2.8 m										
96.0	SURFACE TREATMENT - 25 mm FILL - SAND - Gravelly, trace silt, cobbles, brown		AS1	AS																				
			AS2	AS																				
93.5																								
1.5	FILL - CLAY - Silty, with sand to sandy, trace gravel, brown, compact to very dense - cobbles		SS3	SS	100+																		0 33 51 16	
			SS4	SS	100+																			
			SS5	SS	35																			
			SS6	SS	47																			
			SS7	SS	21																		4 26 51 19	
			SS8	SS	47																			
89.0																								
6.0	FILL - SAND - some gravel, trace silt, brown, compact			SS9	SS										17									18 75 (7)
88.1																								
6.9	CLAY - Silty, trace sand, grey, very stiff		SS10	SS	27																			
			SS11	SS	6																			
			SS12	SS	19																			
			SS13	SS	17																			
			SS14	SS	62																			
82.5																								
12.5	SAND - Gravelly, trace silt, grey, dense		SS15	SS	38									0 3 85 12 31 61 (8)										
81.7																								
13.3	CLAY - Silty, trace sand and gravel, grey, firm		SS16	SS	5																			
			SS17	SS	5																			
78.8																								
16.2	End of Borehole at 16.2 m																							

ON\_MOT\_CS-TB-012144 - ABITIBI RIVER TRIBUTARY - 73.4 KM - HWY 634.CPJ DST\_MIN.GDT 5/3/12

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

ENCLOSURE 2

# RECORD OF BOREHOLE No HA1

1 OF 1

METRIC

W.P. 5125-05-01 LOCATION STA. 9+982, 14.25 m RT (5521149 m N, 456989 m E) ORIGINATED BY KS/JF  
 DIST HWY 634 BOREHOLE TYPE Hollow Stem Auger (80 mm ID) COMPILED BY ML  
 DATUM Local DATE 2011 03 31 CHECKED BY WS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
88.9	GROUND SURFACE													
88.5	TOPSOIL		AS1	AS										
0.4	SAND - trace gravel and silt, grey		AS2	AS										
87.9														
1.0	CLAY - Silty, trace sand and gravel, grey/brown		AS3	AS										
85.8			AS4	AS										
3.1	End of Borehole at 3.1 m													

ON\_MOT\_CS-TB-012144 - ABITIBI RIVER TRIBUTARY - 73.4 KM - HWY 634.GPJ DST\_MIN.GDT 5/3/12

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

ENCLOSURE 3

# RECORD OF BOREHOLE No HA2

1 OF 1

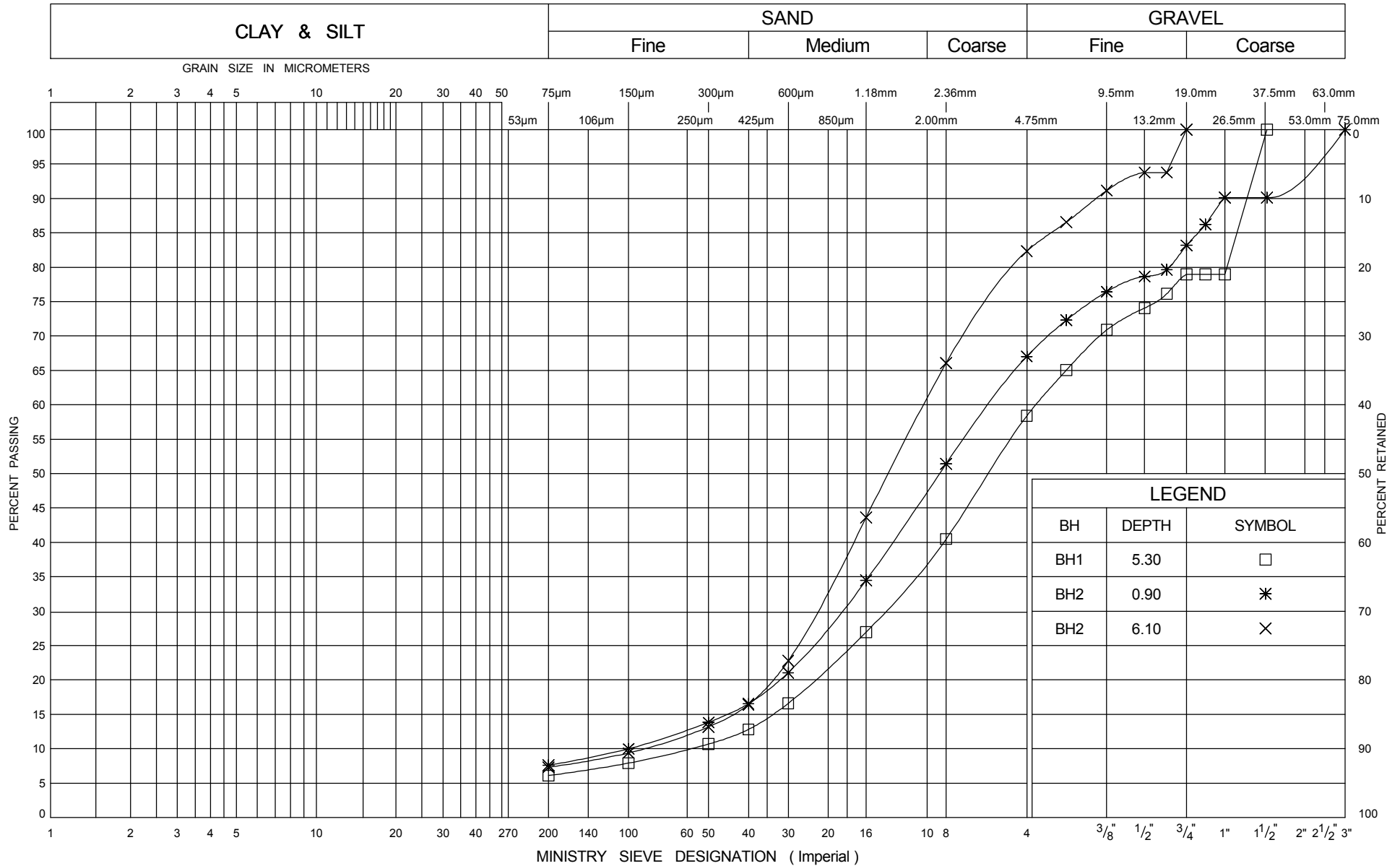
METRIC

W.P. 5125-05-01 LOCATION STA. 10+020, 22.73 m LT (5521167 m N, 456987 m E) ORIGINATED BY KS/JF  
 DIST HWY 634 BOREHOLE TYPE Hollow Stem Auger (80 mm ID) COMPILED BY ML  
 DATUM Local DATE 2011 03 31 CHECKED BY WS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL 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 20 40 60 80 100 ○ UNCONFINED + FIELD VANE □ QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%) 20 40 60 W <sub>p</sub> W W <sub>L</sub>				
90.4	GROUND SURFACE																
89.7	TOPSOIL		AS1	AS			90										
89.6	SILT - with fibrous black organics, brown CLAY - Silty, trace sand, grey/brown		AS2	AS			89										
1.0			AS3	AS													
87.3			AS4	AS													
3.1	End of Borehole at 3.1 m																

ON\_MOT\_CS-TB-012144 - ABITIBI RIVER TRIBUTARY - 73.4 KM - HWY 634.GPJ DST\_MIN.GDT 5/3/12

# UNIFIED SOIL CLASSIFICATION SYSTEM

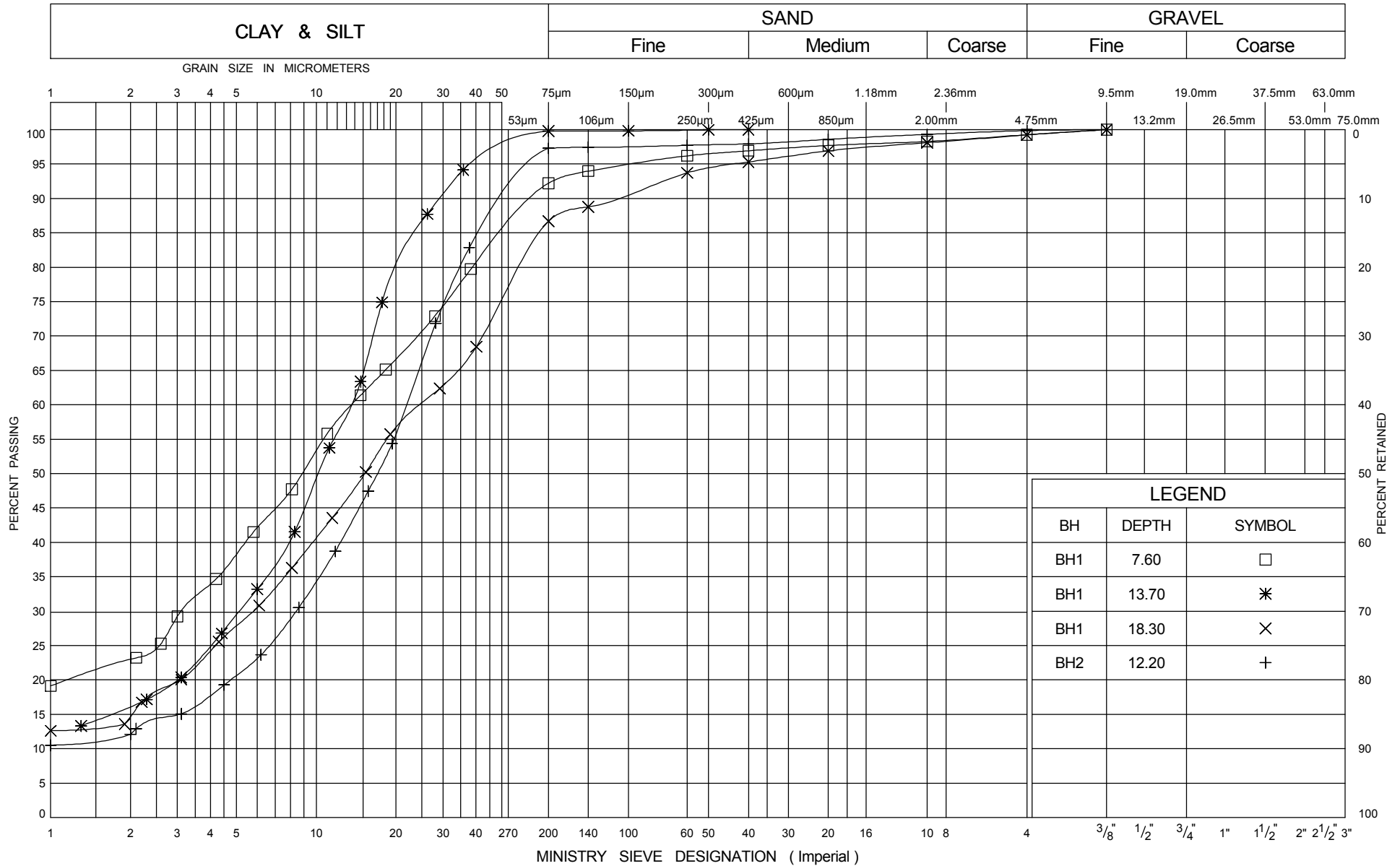


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## GRAIN SIZE DISTRIBUTION SAND

ENCLOSURE 5  
W P 5125-05-01  
HIGHWAY 634

# UNIFIED SOIL CLASSIFICATION SYSTEM

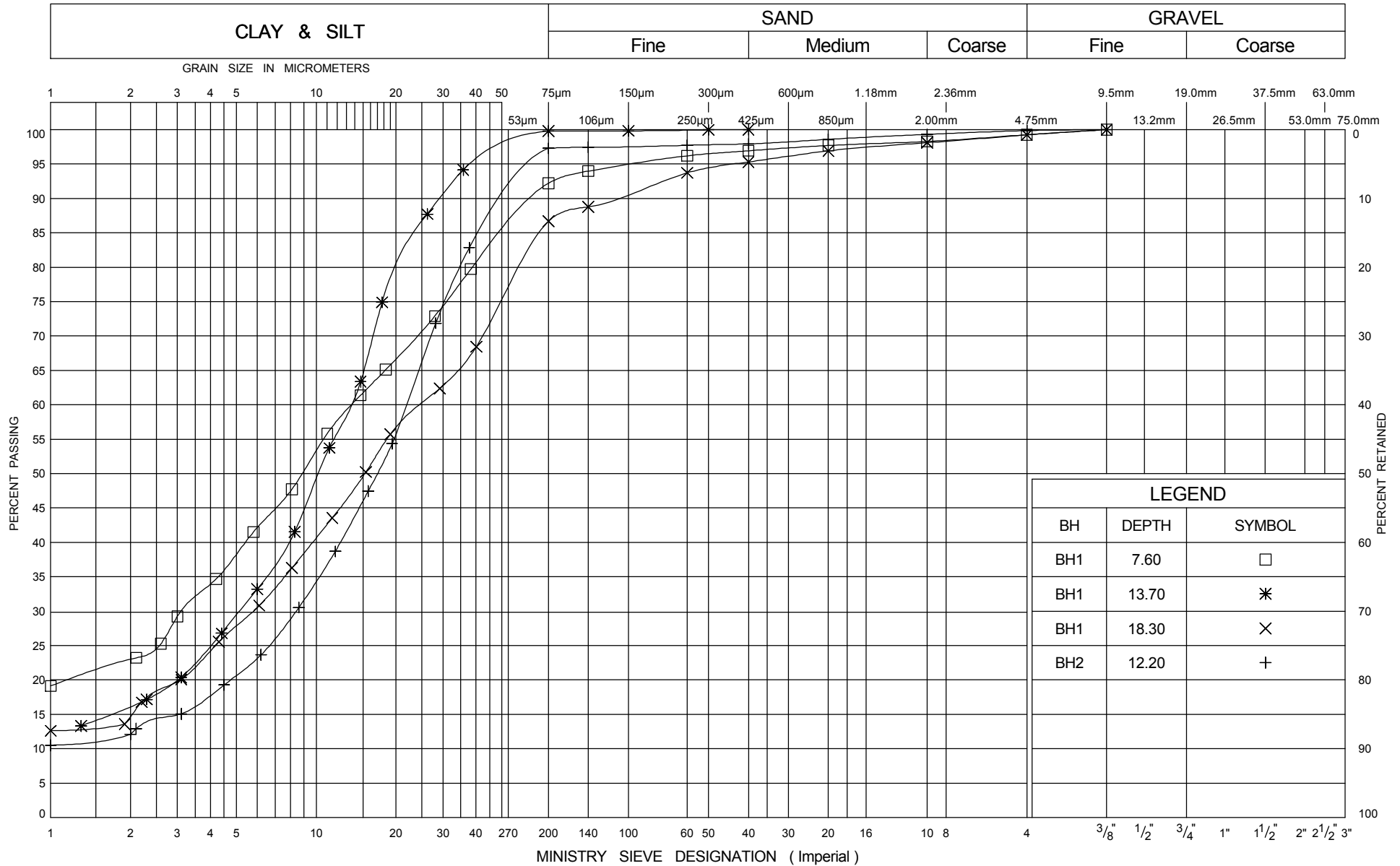


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GRAIN SIZE DISTRIBUTION  
FILL - CLAY

ENCLOSURE 6  
W P 5125-05-01  
HIGHWAY 634

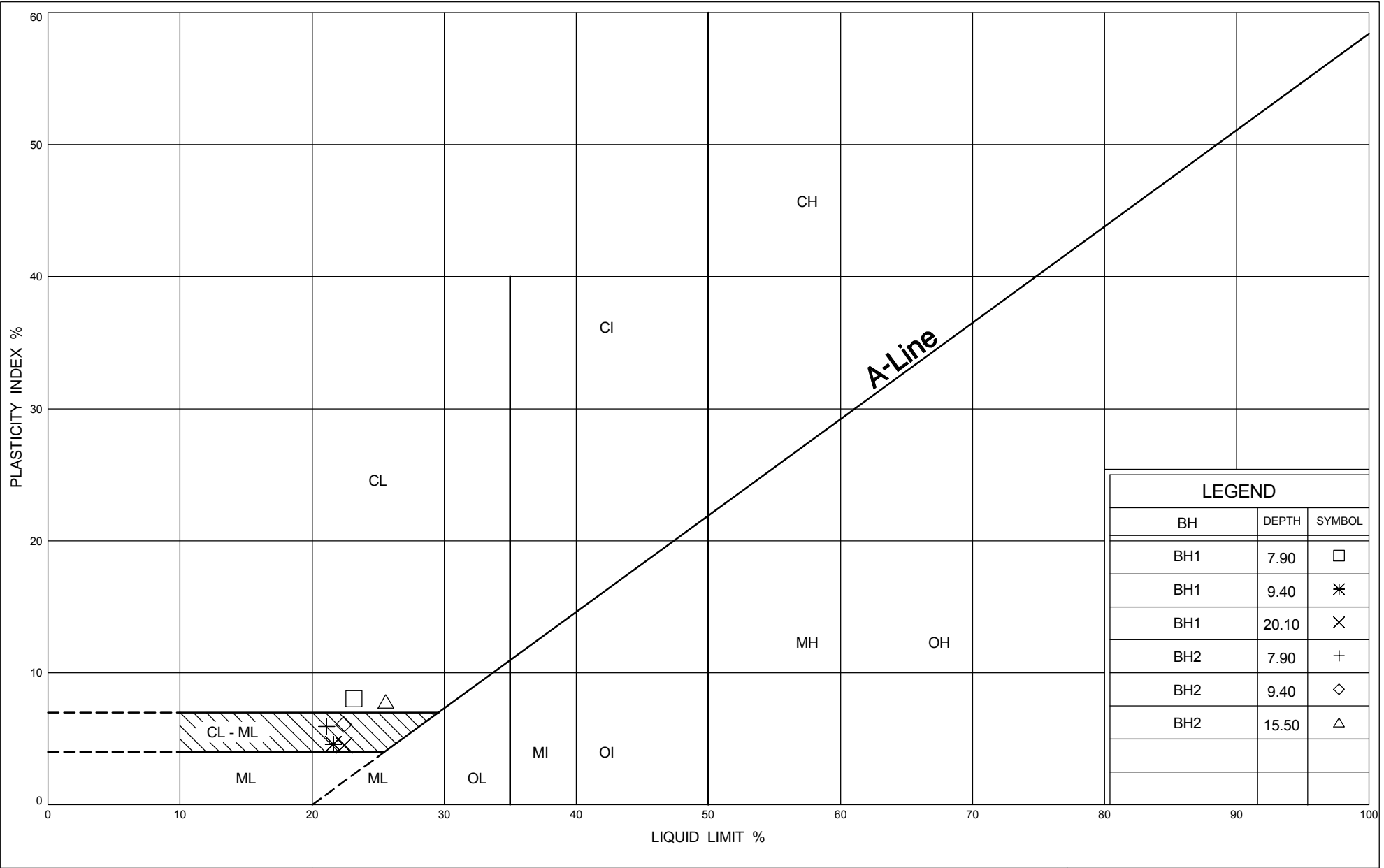
# UNIFIED SOIL CLASSIFICATION SYSTEM



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## GRAIN SIZE DISTRIBUTION NATIVE CLAY

ENCLOSURE 7  
W P 5125-05-01  
HIGHWAY 634



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## PLASTICITY CHART CLAY

ENCLOSURE 8  
W P 5125-05-01  
HIGHWAY 634