



**FOUNDATION INVESTIGATION REPORT
for
OVERHEAD SIGNS REPLACEMENT
HIGHWAY 17
GREATER SUDBURY AREA, ONTARIO
AGREEMENT NO. 5010-E-0027
G.W.P. 5146-09-00**

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FOUNDATION INVESTIGATION REPORT
for
Overhead Signs Replacement
Highway 17
East and West of Highway 17/Regional Road 55 Interchange Bridge
Greater Sudbury Area, Ontario
GWP 5146-09-00

1. INTRODUCTION

This report summarizes the results of a foundation investigation carried out for the proposed replacement of two (2) overhead signs located on Highway 17, approximately 53 m east and 49 m west of the Regional Road 55 Interchange Bridge (Centerline) in the Township of Waters. This project is part of the detail design for a resurfacing project which extends from 0.8 km east of the Highway 17 / Regional Road 55 interchange at Sudbury westerly 21.8 km.

The investigation was carried out by Peto MacCallum Ltd. (PML) for AECOM Canada Ltd. (AECOM) on behalf of the Ministry of Transportation of Ontario (MTO). The terms of reference and scope of work for the foundation engineering services are outlined in MTO's Change Order Request No. 6 under Agreement No. 5010-E-0027 dated February 2015.

The General Arrangement (GA) drawing was not available during the preparation of this report. Approximate borehole locations are shown in Drawing OHS-1.

The elevations in this report are expressed in meters, unless otherwise noted.

1.1 Sources of Information

The following report, including drawings, was available for the Highway 17 and Regional Road 55 Interchange.

Foundation Investigation and Design Report: Highway 17 and Sudbury Bypass Interchange, W.P. 62-74-10 and 11, Highway 17 West, Sudbury, Ontario, by William Trow and Associates Ltd. (Sudbury), dated February 1975, GEOCRE 41I-90.



2. SITE DESCRIPTION AND GEOLOGY

The Highway 17 corridor within the project limits is generally flanked by open water bodies, marsh areas and rock outcrops. The proposed overhead signs are located south-west of Sudbury on the Highway 17 eastbound and westbound lane shoulders at the locations illustrated in attached Image 1. Industrial areas are established north of the Highway 17 / Regional Road 55 interchange with residential areas at the south of the interchange.

The project site is located within the geological region categorized as the Huronian Supergroup of the Canadian Shield. The typical rock types in this geological region are argillite, siltstone and greywacke of the McKim Formation. The soil/bedrock interface is encountered at variable depths at this site. The overall surface topography along this section of Highway 17 is gently sloping towards west, transitioning to a gently flat area at the southern and northern portions of the project.

Photographs P1 and P2 (Appendix A) illustrate the site and surface conditions at the time of the investigation.

3. INVESTIGATION PROCEDURES

Six (6) boreholes and dynamic cone penetration tests were advanced at/near this site for the Highway 17 and Regional Road 55 Interchange in 1975 and are presented in the referenced GECRES report No.: 411-90. The locations of boreholes and associated stratigraphical sections are presented on Drawing OHS-1.

The field work for the current foundation investigation consisted of 3 boreholes (numbered EBL-1, EBL-1A and WBL-1) advanced on May 11 and 12, 2015. The boreholes were drilled to depths of 1.2 and 2.6 m on the eastbound lane and 9.8 m on the westbound lane. The approximate borehole locations are shown on Drawing OHS-1.

An auger probe was advanced at approximately 7 m south-west of the EBL overhead sign near borehole EBL-1 in view of the shallow refusal in borehole EBL-1. The probe penetrated through silty/sandy soils and met refusal on probable bedrock at an approximate depth of 0.4 m.



A bedrock outcrop was observed to the south-west of existing EBL overhead sign base (Refer to Record of Borehole No. EBL-1 for more information).

The following table summarizes the subsurface investigation program at the culvert location.

Table Section 3: Summary of the Subsurface Investigation

Borehole No.	Location	Drilling Method	Depth (m)
EBL-1	Highway 17 Eastbound Lane Shoulder	Semi-Continuous Sampling	2.6 (Probable Bedrock)
EBL-1A		Semi-Continuous Sampling	1.2 (Probable Bedrock)
AP-1		Power Augering	0.4 (Probable Bedrock)
WBL-2	Highway 17 Westbound Lane Shoulder	Semi-Continuous Sampling	9.8

The boreholes were advanced using continuous flight hollow and solid stem augers, powered by truck-mounted CME-75 drill rig, supplied and operated by a specialist drilling contractor, working under the full-time supervision of a PML field supervisor.

Soil samples were recovered from the boreholes at regular 0.75 and 1.5 m intervals with standard penetration testing that was conducted to assess the strength characteristics of the substrata. The recovered soils were identified in accordance with the MTO soil classification manual procedures. The results of the field tests and observations are reported on the Record of Borehole sheets. The ground surface elevations at the borehole locations were provided by exp Geomatics Inc.

The groundwater conditions at the borehole locations were assessed during drilling by visual examination of the soil and the sampler as the samples were retrieved. The groundwater levels in the boreholes were also obtained during and upon completion of drilling.

The boreholes were backfilled with a bentonite/cement mixture where required in accordance with the MTO guidelines and MOE Reg. 903 for borehole abandonment procedures.



The soil samples were returned to our laboratory for detailed visual examination, classification and routine moisture content determination. The laboratory testing program comprised the following tests:

- Natural moisture content determinations (12)
- Grain size analyses (3)
- Atterberg Limits tests (2)

The results of the laboratory natural moisture content determinations, grain size analyses and Atterberg limits testing are shown on the Record of Borehole sheets. The grain size distribution charts are presented in Figures OHS-GS-1 to OHS-GS-3. The Atterberg limit results are presented in Figure OHS-PC-1.

4. SUMMARIZED SUBSURFACE CONDITIONS

4.1 General

Refer to the attached Record of Borehole sheets for the details of the subsurface conditions including soil classifications, inferred stratigraphy, standard penetration test results, pocket penetrometer test results and groundwater observations.

The borehole locations, stratigraphic profile and cross-sections prepared from the borehole data are shown on Drawing OHS-1. The boundaries between soil strata are transitional and have been established at the borehole locations only. Between and beyond the boreholes, the boundaries are assumed and may vary.

In summary, the subsurface stratigraphy revealed at the eastbound lane boreholes (BHs EBL-1 and EBL-1A) comprised 0.7 and 0.9 m thick pavement fill overlying 0.5 and 1.7 m thick cohesionless sand and gravel. Probable bedrock was inferred at depths of 1.2 and 2.6 m (Elevation 264.0 and 262.8) at this location and is consistent with the observation of a bedrock outcrop near this location. The overburden at the westbound lane borehole (BH WBL-1) is at least 9.8 m thick and generally consists of a 3.7 m thick fill overlying a 2.3 m thick cohesive deposit of clayey silt



underlain by a minimum 3.8 m thick non-plastic silt in which the borehole was terminated. The water levels measured in the open boreholes were found to be at a depth of 0.8 m (Elevation 264.6) at borehole EBL-1 and at a depth of 4.6 m (Elevation 258.1) at borehole WBL-1.

The strata encountered are summarised below:

4.1.1 Pavement Structure

A 100 mm layer of asphaltic concrete over approximately 600 and 800 mm of sand and gravel base course was encountered surficially in boreholes EBL-1 and EBL-1A (located on Highway 17 eastbound lane shoulder). The pavement structure extended to depths of 0.7 and 0.9 m (Elevation 264.0 and 264.5) in boreholes EBL-1 and EBL-1A, respectively.

4.1.2 Fill

A 3.7 m thick fill was encountered surficially in borehole WBL-1 (on Highway 17, westbound lane shoulder) and extended to Elevation 259.0. The fill was composed of gravelly sand with cobbles and boulders and clayey silt with organic inclusions. This unit was very dense becoming compact in relative density (SPT-'N' values of 18 and 55) and firm (SPT-'N' values of 7 and 8) in consistency.

The condition of the fill placement should be considered variable and uncontrolled.

4.1.3 Sand and Gravel

On the eastbound lane shoulder, 0.5 and 1.7 m thick deposit of cohesionless sand and gravel containing cobbles was contacted below the pavement structure at 0.7 and 0.9 m (Elevation 264.5 and 264.5) in boreholes EBL-1A and EBL-1, respectively and extended to probable bedrock at depths of 1.2 and 2.6 m (Elevation 264.0 and 262.8). This stratum was compact to very dense (SPT-'N' values of 11 to over 82).

The results of grain size distribution analyses for a cohesionless sample are included in Figure OHS-GS-1. The moisture content of the sand and gravel ranged from 10 to 13%.



4.1.4 Clayey Silt

A 2.3 m thick cohesive deposit of clayey silt was encountered below the fill at a depth of 3.7 m (Elevation 259.0) in borehole WBL-1 (on the westbound lane) and penetrated to a depth of 6.0 m (Elevation 256.7). The clayey silt was stiff to hard in consistency (SPT-'N' values of 8 and 32). Two penetrometer tests indicated undisturbed shear strengths in the order of 100 kPa.

The results of Atterberg Limits testing and grain size distribution analyses conducted on a cohesive sample are presented in Figures OHS-PC-1 and OHS-GS-2, respectively. The liquid limit and plastic limits of the clayey silt were 34 and 22, thus giving a plasticity index of 12. The moisture content of the deposit was about 29%.

4.1.5 Silt

A minimum 3.8 m thickness of non-plastic silt was contacted below the clayey silt at 6.0 m (Elevation 256.7) in borehole WBL-1 (on the westbound lane) and extended to the borehole termination depth of 9.8 m (Elevation 252.9). The silt was compact to dense (SPT-'N' values of 10 to 31).

The results of grain size distribution analysis performed on a cohesionless sample are included in Figure OHS-GS-3. The moisture content of the silt varied between 21 and 28%.

4.1.6 Bedrock

Based on the previous GEOCRETS report (identified in Section 1), the bedrock encountered at the location of boreholes 9 and 14 comprised a slightly weathered to weathered quartz diorite and was typically classified as fair to excellent quality (RQD of 46 to 100%) with a core recovery of 71 to 100%.

Probable bedrock was inferred by refusal at 1.2 and 2.6 m (Elevation 264.0 and 262.8) in boreholes EBL-1A and EBL-1 (on the eastbound lane). Probable bedrock was also inferred by refusal at 0.4 m (Elevation 265.1) at the location of auger probe AP-1. A bedrock outcrop was observed at



approximately 7 m south-west of the existing eastbound lane sign base, providing further evidence of the proximity of the bedrock surface.

4.1.7 Groundwater

In the process of augering, water was detected at 0.9 and 7.6 m (Elevation 264.5 and 255.1) in boreholes EBL-1 and WBL-1, respectively. Upon completion of drilling, groundwater was at 0.8 and 4.6 m (Elevation 264.6 and 258.1) in boreholes EBL-1 and WBL-1, respectively.

The groundwater level is subject to seasonal fluctuations and rainfall patterns.



5. CLOSURE

Mr. S. Aziz carried out the field investigation under the supervision of Ms. M. Kamranzadeh, MSc, Project Supervisor, EIT and Mr. C. M. P. Nascimento, P. Eng., Project Manager. LandCore Drilling Ltd. supplied the drill equipment for the subsurface exploration. The laboratory testing of the selected samples was carried out in the PML laboratory in Toronto.

This report was prepared by Ms. Marzieh Kamranzadeh, MSc, Project Supervisor, EIT and reviewed by Mr. D. Dundas, P.Eng., Senior Engineer, Geotechnical Services. Mr. C. M. P. Nascimento, P. Eng., Project Manager and MTO Designated Principal Contact, conducted an independent review of the report.

Yours very truly

Peto MacCallum Ltd.

Marzieh Kamranzadeh, MSc, EIT
Project Supervisor, Geotechnical Services



David Dundas, P.Eng.
Senior Engineer, Geotechnical Services



Carlos M.P. Nascimento, P.Eng.
Project Manager and
MTO Designated Principal Contact

MK/DD/CN:mk-mi-jk

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.

COMPOSITION: SECONDARY SOIL COMPONENTS ARE DESCRIBED ON THE BASIS OF PERCENTAGE BY MASS OF THE WHOLE SAMPLE AS FOLLOWS:

PERCENT BY MASS	0 - 10	10 - 20	20 - 30	30 - 40	> 40
	TRACE	SOME	WITH	ADJECTIVE (SILTY)	AND (AND SILT)

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 (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

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
F V FIELD VANE	

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	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_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m ² /s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_i	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

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

RECORD OF BOREHOLE No EBL-1
1 of 1
METRIC

G.W.P. 5146-09-00 **LOCATION** Coords: 5 143 114.9 N; 295 432.1 E **ORIGINATED BY** S.A.
DIST Sudbury **HWY** 17 **BOREHOLE TYPE** Continuous Flight Solid Stem Augers **COMPILED BY** M.K.
DATUM Geodetic **DATE** May 11, 2015 **CHECKED BY** C.N.

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/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE									
								● QUICK TRIAXIAL × LAB VANE									
							WATER CONTENT (%)										
							20	40	60	80	100	20	40	60			
265.4	Ground Surface																
0.0	100mm asphalt over sand and gravel																
264.5	(PAVEMENT FILL)																
0.9	Sand and gravel some silt, trace clay organic inclusions		1	SS	11												
	Compact to Dark Wet very dense brown/grey		2	SS	55												
	cobbles		3	SS	82/18cm												
262.8	End of borehole																
2.6	Refusal on probable bedrock																
	Sample 3: Sampler bouncing																
	* 2015 05 11																
	▽ Water level observed during drilling																
	▼ Water level measured after drilling																
	NOTE: Borehole caved in at 2.0m																
	Bedrock outcrop was found 8.0m west and 3.5 south of existing sign base																

RECORD OF BOREHOLE No EBL-1(A) 1 of 1
METRIC

G.W.P. 5146-09-00 **LOCATION** Coords: 5 143 112.5 N; 295 437.2 E **ORIGINATED BY** S.A.
DIST Sudbury **HWY** 17 **BOREHOLE TYPE** Continuous Flight Solid Stem Augers **COMPILED BY** M.K.
DATUM Geodetic **DATE** May 11, 2015 **CHECKED BY** C.N.

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										WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE												
265.2	Ground Surface						20	40	60	80	100									
0.0	100mm asphalt over sand and gravel		1	AS	-		265													
264.5	(PAVEMENT FILL)																			
0.7	Sand and gravel		2	SS	54															
264.0	Very dense Brown Wet						264													
1.2	End of borehole																			
	Refusal on probable bedrock																			

RECORD OF BOREHOLE No WBL-1

1 of 1

METRIC

G.W.P.	5146-09-00	LOCATION	Coords: 5 143 110.6 N; 295 587.0 E	ORIGINATED BY	S.A.
DIST	Sudbury	HWY	17	BOREHOLE TYPE	Continuous Flight Hollow Stem Augers
DATUM	Geodetic	DATE	May 11 and 12, 2015	COMPILED BY	M.K.
				CHECKED BY	C.N.

SOIL PROFILE				SAMPLES			GROUND WATER CONDITIONS	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)								
262.7	Ground Surface						20	40	60	80	100								
0.0	Gravelly sand cobbles and boulders		1	AS	--														
	Very dense Brown/ to compact grey		2	SS	55														
			3	SS	18														
	Clayey silt, trace gravel organic inclusions, rootlets		4	SS	8														
	Firm Grey/ dark brown (FILL)		5	SS	7														
259.0	Clayey silt, trace sand cobbles		6	SS	8														
3.7	Stiff to hard Grey/ light brown		7	SS	32														
256.7	Silt trace sand, trace clay		8	SS	10														
6.0	Compact Brown/ to dense grey																		
			9	SS	17														
			10	SS	31														
252.9	End of borehole																		
9.8																			
	* 2015 05 11&12																		
	▽ Water level observed during drilling																		
	▼ Water level measured after drilling																		
	■ Penetrometer test																		
	NOTE: Borehole caved in at 4.7m																		

RECORD OF AUGER PROBE No AP-1

1 of 1

METRIC

G.W.P.	5146-09-00	LOCATION	Coords: 5 143 114.0 N; 295 427.9 E	ORIGINATED BY	S.A.
DIST	Sudbury HWY 17	BOREHOLE TYPE	Power Auger	COMPILED BY	M.K.
DATUM	Geodetic	DATE	May 11, 2015	CHECKED BY	C.N.

[illegible]

BOREHOLE LOG

JOB No. S-2506

BOREHOLE No. 9

DRAWING No. 2

PROJECT Highway 17 and Sudbury

LOCATION Bypass Interchange

W.P. 62-74-10 & 11

HOLE LOCATION AND DATUM SEE DRAWING No. 1

AUGER SAMPLE

2" O.D. SPLIT TUBE

2" I.D. SHELBY TUBE

2" DIA. CONE

PUSHED

VANE TEST AND SENSITIVITY (S)

LAB. VANE TEST

NATURAL MOISTURE

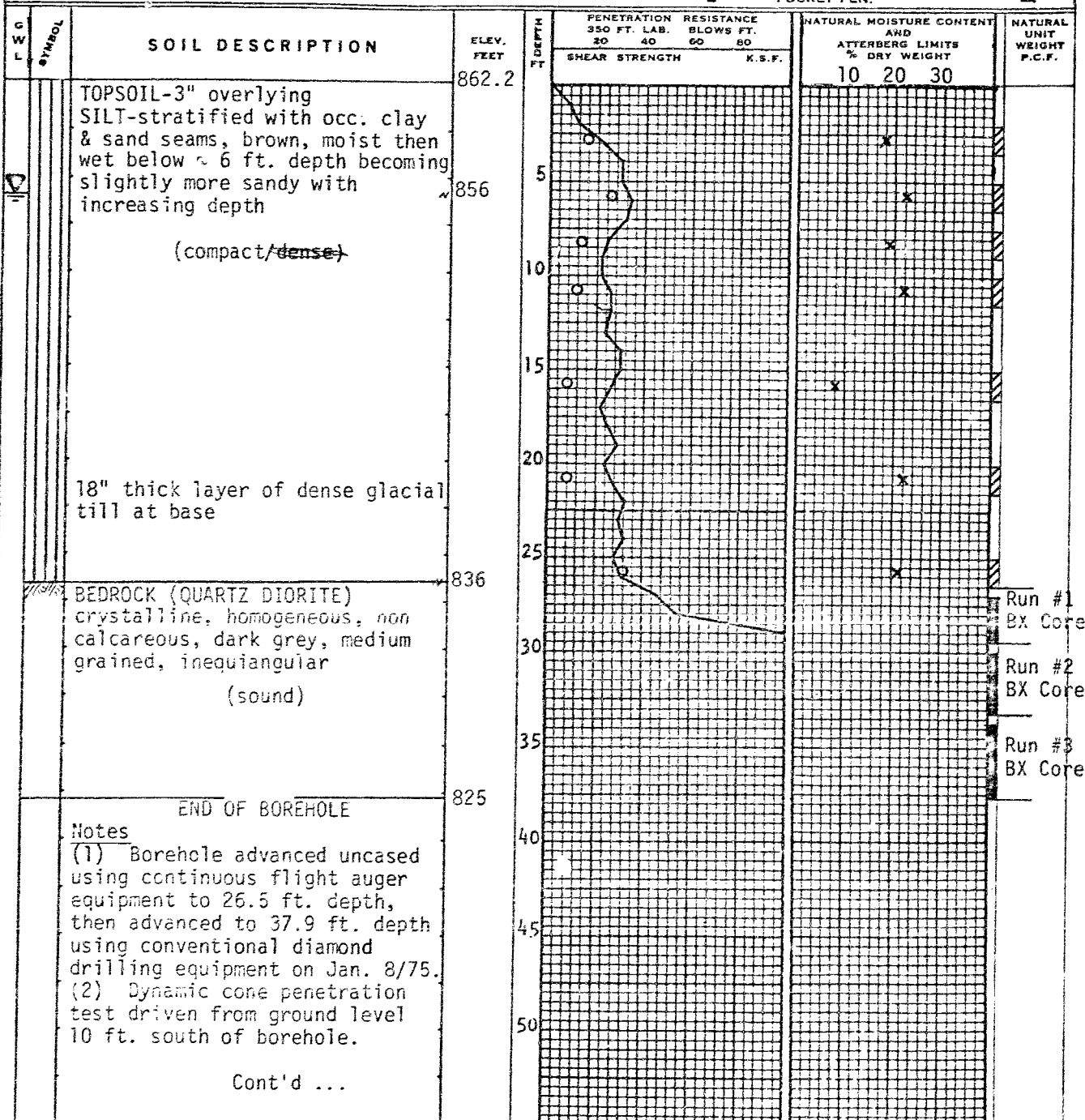
PLASTIC AND LIQUID LIMIT

UNDRAINED TRIAXIAL AT

OVERBURDENED PRESSURE

% STRAIN AT FAILURE

POCKET PEN.



William Trow Associates Ltd.

BOREHOLE NO. 9 (Cont'd)

(3) Water Levels:

Elapsed Time	Water Level At(ft.)	Hole Open To (ft.)
On Completion	17.6	22.0
After 36½ hrs.	7.0	7.8
After 48 hrs.	6.0	7.0






(4) Core Drilling Record:





Run No.	Depth (ft.)	Recovery %	R.Q.D. %	Remarks
1	26.5 - 29.1	71	46	sound, weathered, quartz diorite, 100% water return 80-90% pressure
2	29.1 - 33.2	100	92	sound, intact quartz diorite 100% water return & full pressure
3	33.2 - 37.9	100	100	sound, intact quartz diorite 100% water return, full pressure

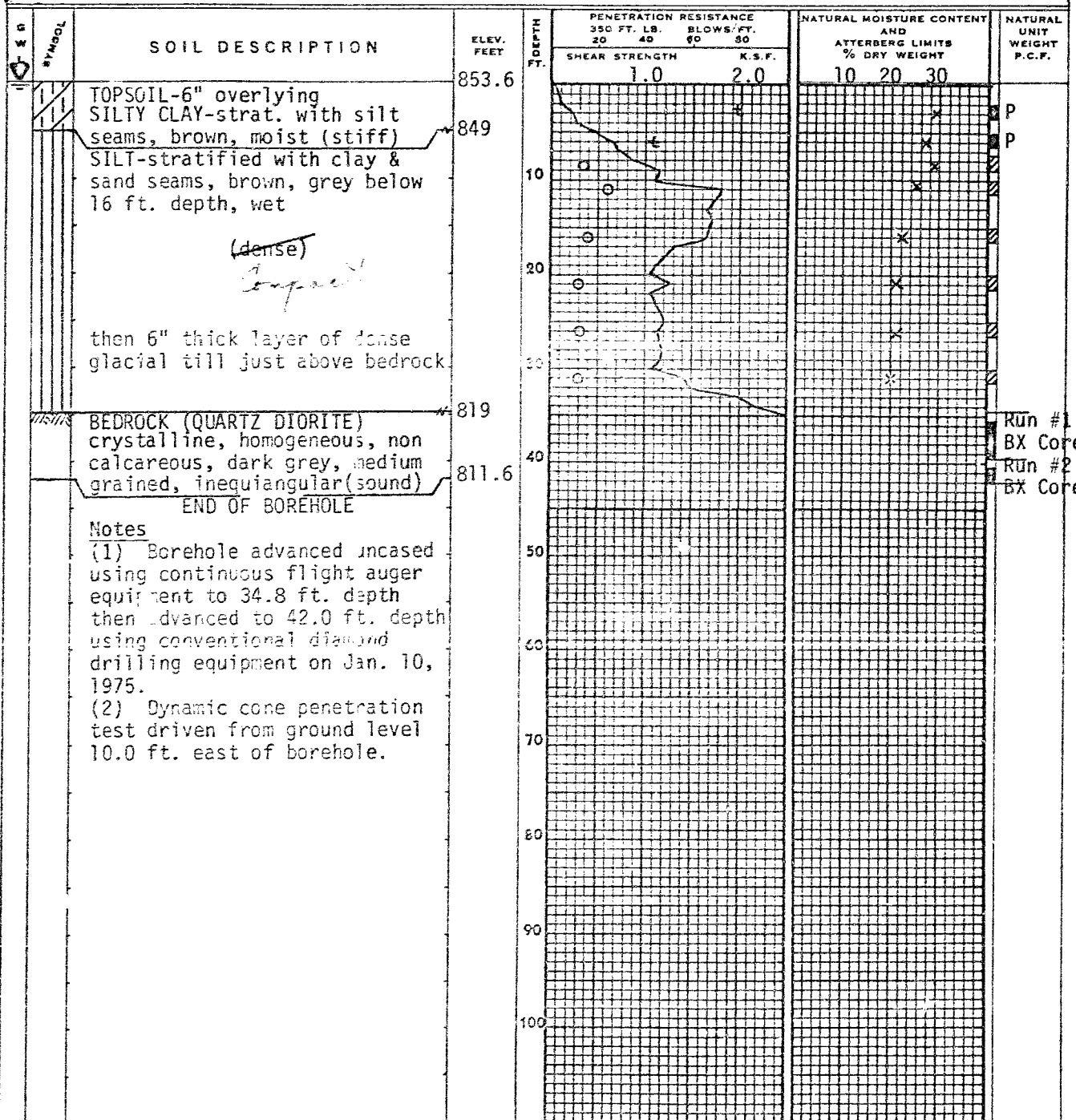
BOREHOLE LOG

JOB No. S-2506BOREHOLE No. 14DRAWING No. 7PROJECT Highway 17 and SudburyLOCATION Bypass InterchangeW.P. 62-74-10 & 11

HOLE LOCATION AND DATUM SEE DRAWING No. 1

2" O.D. SPLIT TUBE 
 2" I.D. SHELBY TUBE 
 2" DIA. CONE 
 PUSHED 
 VANE TEST AND SENSITIVITY (S) 

NATURAL MOISTURE 
 PLASTIC AND LIQUID LIMIT 
 UNDRAINED TRIAXIAL AT OVERBURDEN PRESSURE 
 % STRAIN AT FAILURE 





BOREHOLE NO. 14 (Cont'd)

(3) Water Levels:

Elapsed Time	Water Level At(ft.)	Hole Open To (ft.)
On completion	7.0	15.0
After ½ hr.	surface	2.0
After 24 hrs.	surface	---- could be some surface run-off

(4) Core Drilling Records:

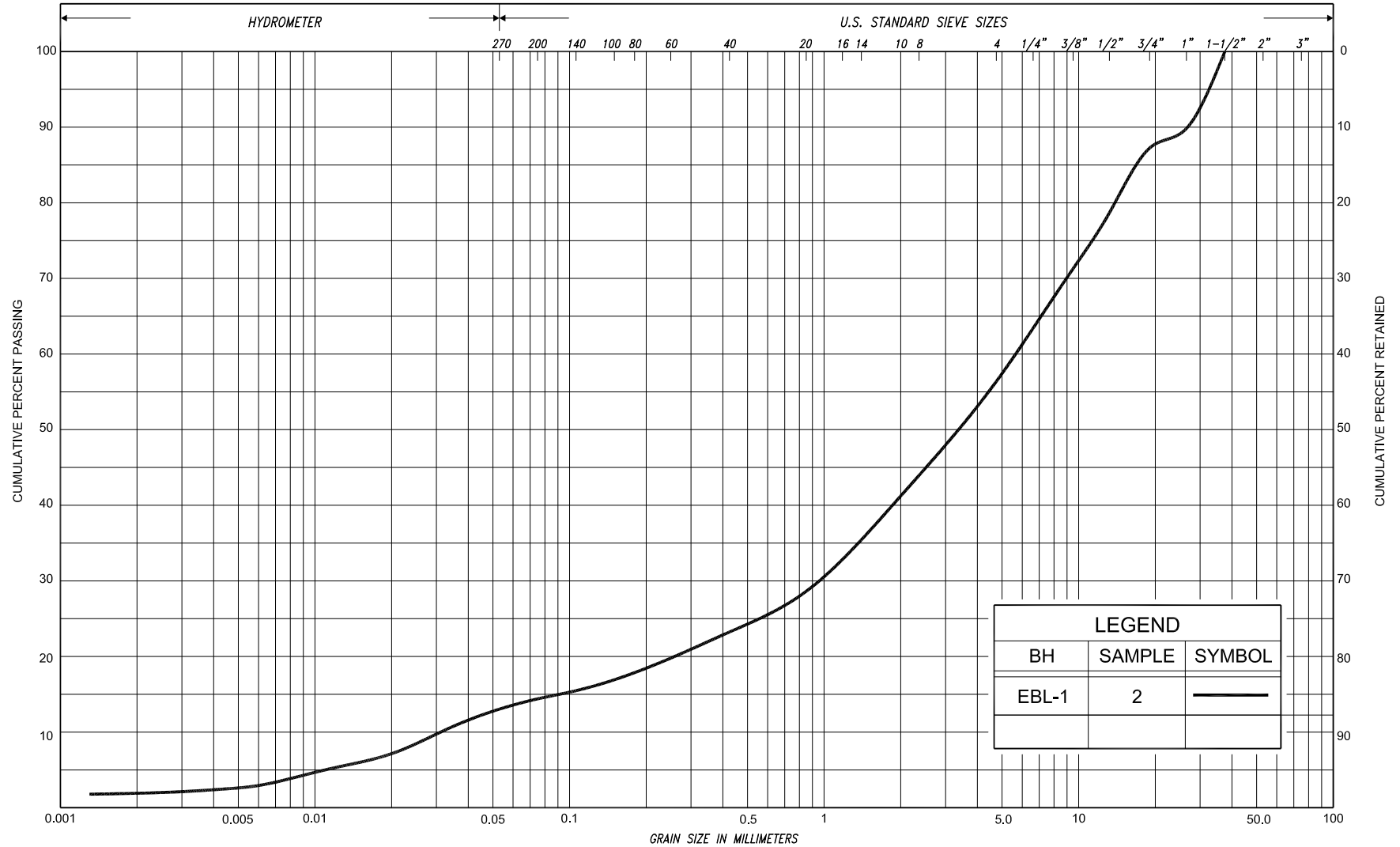
RUN NO.	DEPTH (ft.)	RECOVERY %	R.Q.D. %	REMARKS
1	34.8 - 39.5	100	62	sound, slightly fractured quartz diorite, 100% water return, full pressure
2	39.5 - 42.0	90	66	sound, slightly fractured quartz diorite, 100% water return, full pressure, lost part of core in hole

(5) Chemical Tests on Groundwater:

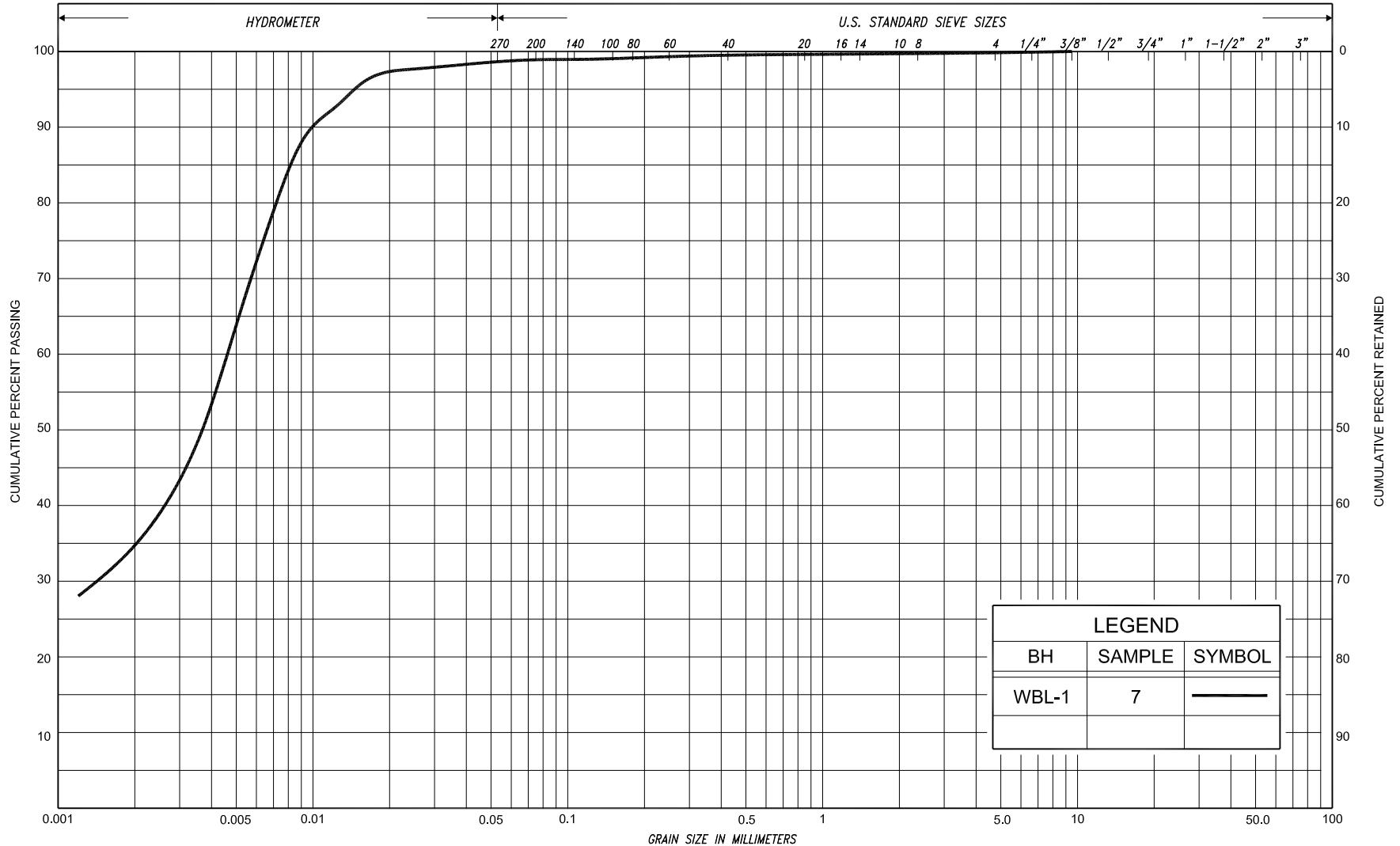
PH: 7.0

Sulphate Concentration:

SO₄ (p.p.m.) = traces



SILT & CLAY				FINE		MEDIUM		COARSE		GRAVEL				COBBLES	UNIFIED		
				SAND													
CLAY	FINE		MEDIUM		COARSE		FINE		MEDIUM		COARSE		GRAVEL			COBBLES	M.I.T.
	SILT																
CLAY			SILT			V. FINE		FINE	MED.	COARSE		GRAVEL				U.S. BUREAU	
						SAND											



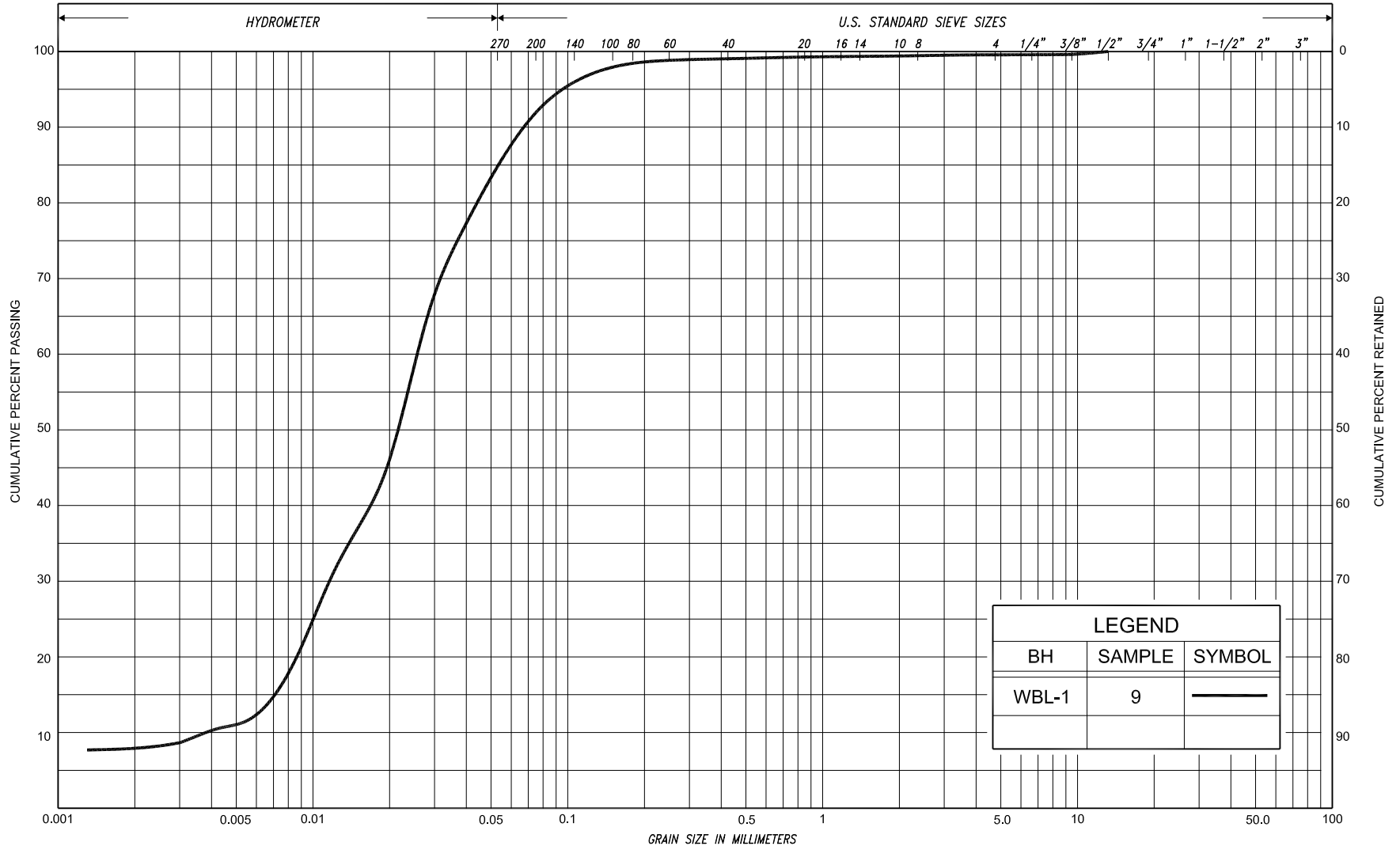
SILT & CLAY				FINE		MEDIUM		COARSE	GRAVEL			COBBLES	UNIFIED
				SAND									
CLAY	FINE	MEDIUM	COARSE	FINE		MEDIUM	COARSE		GRAVEL			COBBLES	M.I.T.
	SILT			SAND									
CLAY		SILT		V. FINE	FINE	MED.	COARSE	GRAVEL					U.S. BUREAU
				SAND									



GRAIN SIZE DISTRIBUTION

CLAYEY SILT, trace sand (CL)

FIG No.	OHS-GS-2
HWY:	17
G.W.P. No.	5146-09-00



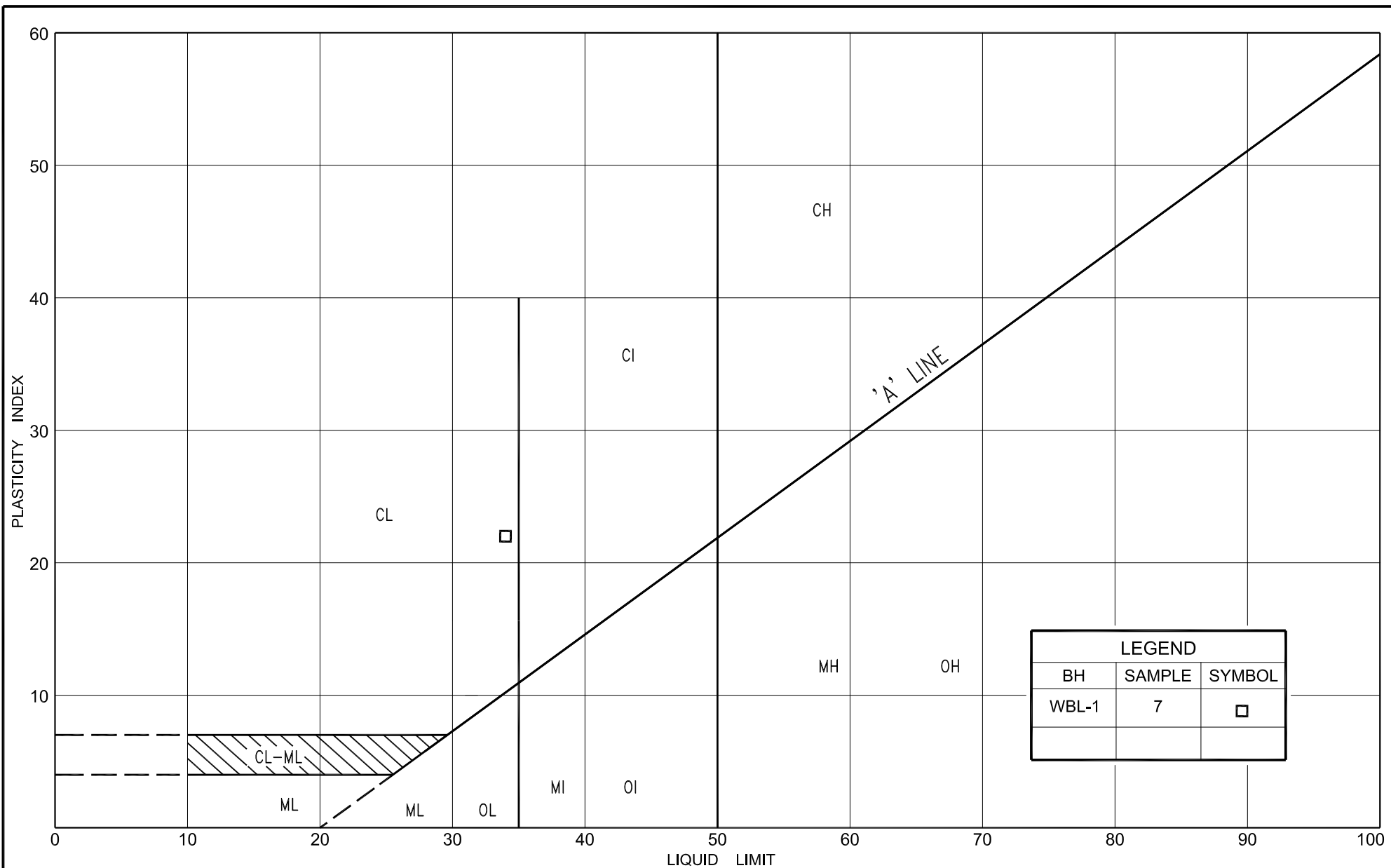
SILT & CLAY				FINE		MEDIUM		COARSE	GRAVEL			COBBLES	UNIFIED
				SAND									
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	GRAVEL				COBBLES	M.I.T.	
	SILT												
CLAY		SILT		V. FINE	FINE	MED.	COARSE	GRAVEL					U.S. BUREAU
				SAND									



GRAIN SIZE DISTRIBUTION

SILT, trace sand, trace clay

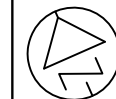
FIG No.	OHS-GS-3
HWY:	17
G.W.P. No.	5146-09-00



PLASTICITY CHART
CLAYEY SILT, trace sand (CL)

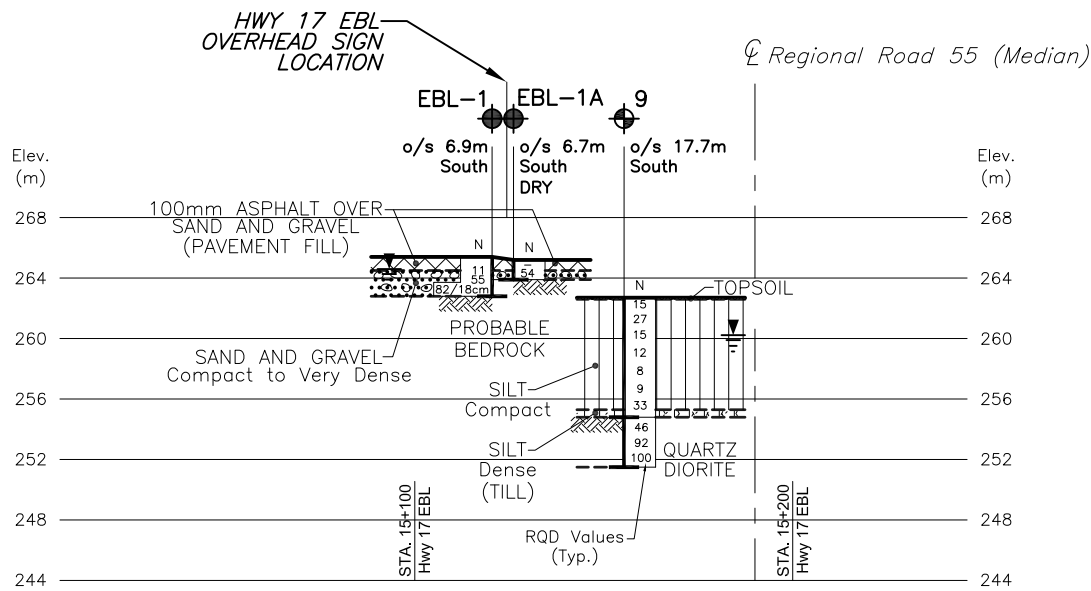
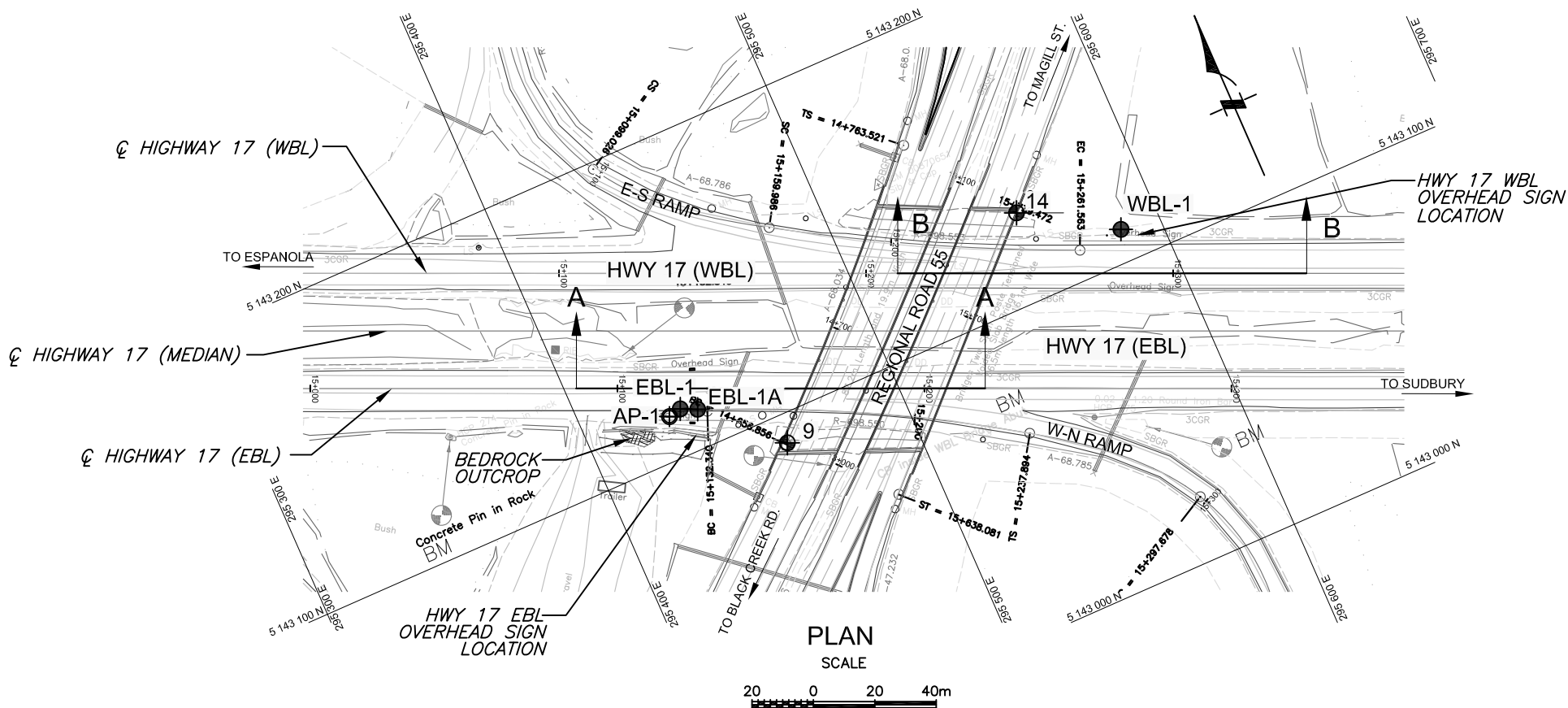
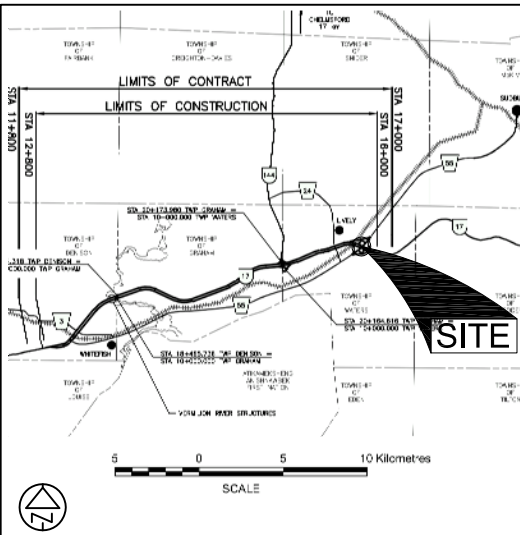
FIG No.	OHS-PC-1
HWY:	17
G.W.P. No.	5146-09-00

CONT No
GWP No 5146-09-00
WP No

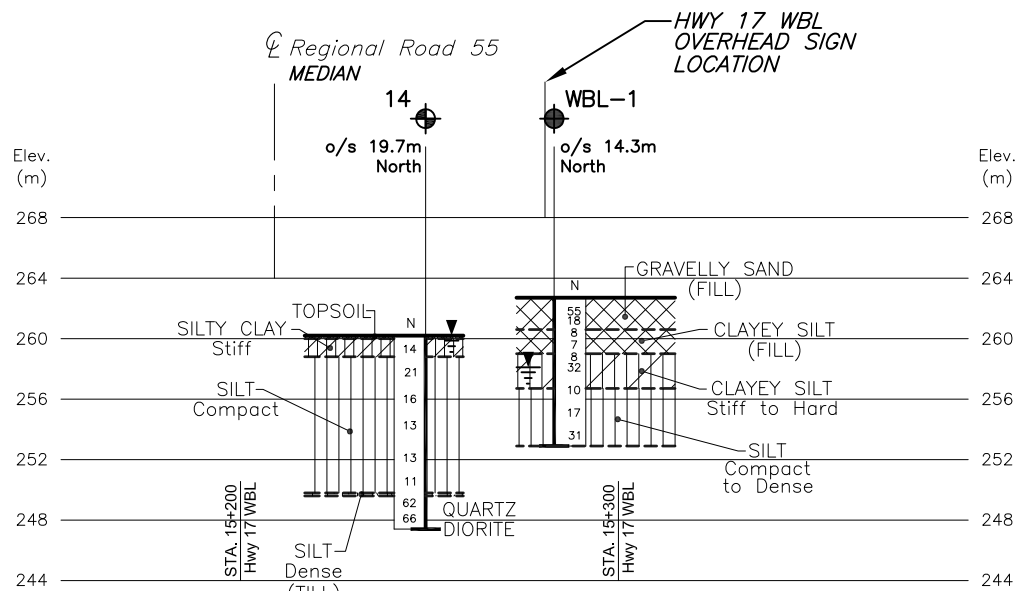


OVERHEAD SIGNS REPLACEMENT
HIGHWAY 17
BOREHOLE LOCATIONS & SOIL STRATA

SHEET



PROFILE A - A ALONG \varnothing HIGHWAY 17 (EBL)



PROFILE B - B ALONG \varnothing HIGHWAY 17 (WBL)

LEGEND

- Borehole
- Geocres Borehole (Geocres 411-90)
- Auger Probe
- N Blows/0.3m (Std. Pen Test, 475 J/blow)
- CONE Blows/0.3m (60 Cone, 475 J/blow)
- WL at time of investigation (May 2015)

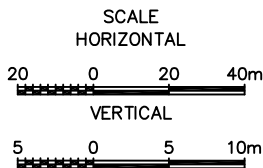
BH No	ELEVATION	NORTHINGS	EASTINGS
EBL-1	265.4	5 143 114.9	295 432.1
EBL-1A	265.4	5 143 112.5	295 437.2
WBL-1	262.7	5 143 110.6	295 587.0
AP-1	265.2	5 143 114.0	295 427.9
ESTIMATED			
9	262.8	5 143 090.7	295 459.6
14	262.2	5 143 129.2	295 558.1

NOTE

The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

NOTES:

- THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE TEXT OF REPORT AND RECORD OF BOREHOLE LOGS.
- THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
- DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.



REF AECOM Drawings: wp 51460900_PML.dwg undated

REVISIONS	DATE	BY	DESCRIPTION

Geocres No. 411-339

HWY No	17	DIST	SUDBURY
SUBM'D	NA	CHECKED MK	DATE JANUARY 13, 2016
DRAWN	NA	CHECKED DD	APPROVED CN

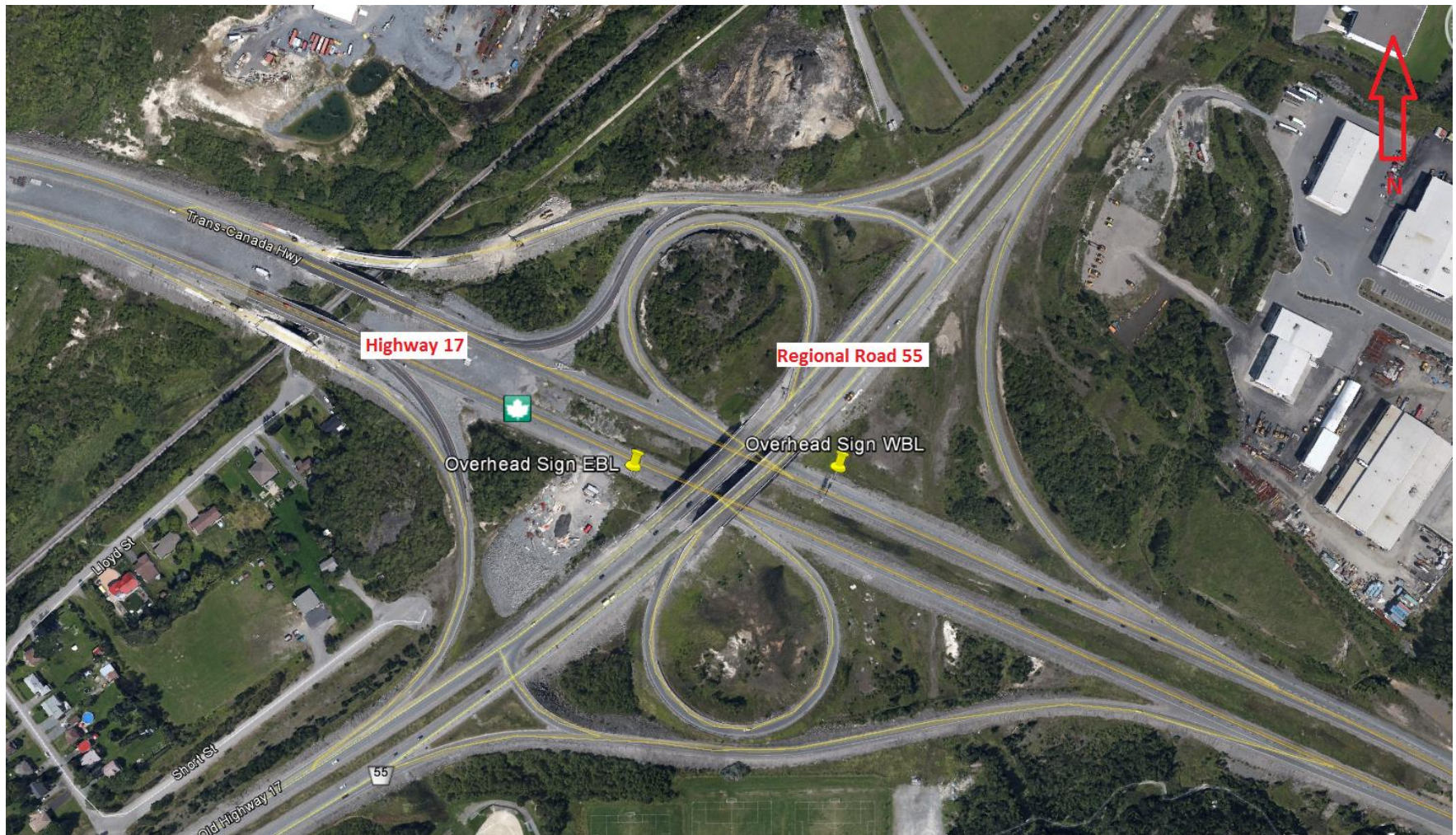
DWG OHS-1



APPENDIX A

Image 1 – Aerial View of the Site
Site Photographs

IMAGE 1- AERIAL VIEW OF THE SITE



Note: The Image 1 is for illustration purposes only and it is not to scale.



Photograph P1: Looking east from the Highway 17 EBL shoulder at the location of Borehole EBL-1. A bedrock outcrop is visible in the foreground. (May 11, 2015)



Photograph P2: Looking west from the Highway 17 WBL shoulder at the location of Borehole WBL-1. The existing overhead sign base is visible in the foreground. (May 12, 2015)