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FOUNDATION INVESTIGATION REPORT

W.P. 545-93-00
HIGHWAY 60 –
KEARNEY CREEK
BRIDGE REPLACEMENT

McCormick Rankin Corporation

PROJECT NO. 1023332
GEOCRE NO. 31F-273

PROJECT NO. 1023332

FOUNDATION INVESTIGATION REPORT

TO **McCormick Rankin Corporation**
2655 North Sheridan Way
Mississauga, Ontario
L5K 2P8

ON **W.P. 545-93-00**
Highway 60 – Kearney Creek
Bridge Replacement
County of Nipissing
District 43, Bancroft
Ministry of Transportation
Ontario
Geocres No. 31F-273

October 2007

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FOUNDATION INVESTIGATION REPORT

for

W.P. 545-93-00
Highway 60 – Kearney Creek Bridge
County of Nipissing
District 43, Bancroft

1.0 INTRODUCTION

This report was prepared as part of the Total Project Management (TPM) assignment for the Detailed Design of the Clarke Creek and Kearney Creek Bridge Replacements, Highway 60, G.W.P. 545-93-00.

This report presents the results of a foundation investigation carried out for the proposed replacement of the existing Kearney Creek Bridge on Highway 60 in Algonquin Park (Site No. 43-145).

The foundation investigation was carried out in general accordance with our proposal number 1019534 dated December 5, 2006. Authorization to proceed was provided by the Ministry of Transportation of Ontario (MTO) under Agreement Number 4006-E-0018 with McCormick Rankin Corporation (MRC), the Detailed Design Consultant for this project.

This report has been prepared specifically and solely for the project described herein. It contains factual information pertaining to the subsurface conditions which was obtained as part of this investigation.

It is noted that a Preliminary Foundation Investigation of this site was carried out by Jacques Whitford Limited. The relevant results from Report No. ONO11685 dated June 2006 have been included in the present report.

2.0 SITE DESCRIPTION AND GEOLOGY

The subject site is within the limits of MTO project W.P. 545-93-00 (Highway 60). The site location is shown on the Key Plan inset to Drawing No. 1 provided in Appendix A. It is noted that for project orientation purposes, Highway 60 will be assumed to run east-west at the Kearney Creek Bridge, with chainage increasing from west to east.

Physiographically, the Kearney Creek Crossing is located within the Algonquin Highlands. This region is characterized by rough rounded knobs and ridges with frequent outcrops of bare rock. The bedrock is generally shallow, however, the depth to bedrock varies greatly over short distances.

Many of the valleys are floored with outwash sand and gravel. There are frequent swamps and bogs.

Kearney Creek flows from north to south and is approximately 9 m in width at the centreline of the proposed realignment. Water depths were estimated to be less than 1 m at the time of the investigation. The observed water level at the time of the 2007 field investigation was approximately 392.0 m Geodetic. The high water level (100-year storm) is identified in the Structural Planning Report as being elevation 393.20 m.

The existing roadway embankments are approximately 3 m high at both the east and west abutments. The water level in Kearney Creek was approximately 3.5 m below the top of pavement on the existing bridge deck at the time of the 2007 investigation. The banks of the creek are steeply sloped for approximately 1 m above water level and then very gradually sloped upwards away from the creek. No indications of significant erosion were noted at the time of the site inspection. The ground surface within the highway right-of-way was vegetated with grass. Mature trees are present beyond the edges of the cleared right-of-way. Drainage in the area consisted of overland flow directed towards the creek.

A plan view and profile are shown on Drawing No. 1, provided in Appendix A.

3.0 PROCEDURE

3.1 Field Investigation

The preliminary investigation consisted of eight (8) boreholes designated as 05-1 through 05-8. The details concerning the field procedures for those boreholes is documented in the June 2006 Preliminary Foundation Investigation Report.

The site soil conditions were further investigated in 2007 with a borehole drilling investigation, piezocone (CPTu) investigation and laboratory testing program. The borehole drilling and CPTu testing was carried out using a track-mounted CME-55 drill rig between April 30 and May 10, 2007.

A total of two (2) boreholes, designated as 07-7 and 07-9 were put down during the field investigation. Boreholes 07-7 and 07-9 were advanced at the proposed west and east abutment locations, respectively, of the replacement bridge structure along the proposed permanent re-alignment.

The 2007 boreholes were advanced through the overburden using casing and drilling mud in order to balance the pressure within the borehole and minimize sand coming up the augers. Despite the use of casing and thick drilling mud, frequent problems were encountered with sand/silt coming up inside the casing.

The subsurface conditions were identified in the field by Jacques Whitford Limited (JW) personnel from samples obtained while carrying out Standard Penetration Tests (SPT) (ASTM D1586) at regular intervals. The boreholes were advanced through boulders and into bedrock by coring a minimum of 4.9 m using NQ-size coring equipment.

The recovered soil samples were stored in moisture proof containers and returned to our laboratory. The subsurface conditions encountered are described in detail in the Borehole Records presented in Appendix B.

Groundwater levels were measured in the open boreholes prior to backfilling.

Two CPTu test holes, designated as CPT 07-8 and CPT 07-10, were put down approximately 5 to 10 m behind the proposed west and east abutments, respectively. The piezocone was pushed through the native silt and sand materials using the hydraulic system on the drill rig until refusal. The testing technique is described in further detail in ASTM D3441. In this case, refusal was reached when the piezocone tip resistance was sufficient to cause the drill rig to start to lift up from the ground.

Prior to completing the investigation, the boreholes were grouted with a cement/bentonite mix.

3.2 Survey

Borehole locations were established in the field by measurement by JW personnel relative to existing site features such as the existing bridge structure. The ground surface elevations at the borehole locations were surveyed relative to the top of asphalt on the deck of the existing Kearney Creek bridge structure adjacent to the west abutment. The top of pavement at this location has been identified as having a geodetic elevation of 395.3 m.

3.3 Laboratory Testing

All samples returned to the laboratory were subjected to detailed visual classification by a geotechnical engineer. Routine testing, consisting of moisture content testing and grain size distribution analysis, was carried out on representative samples. Two soil samples were submitted for pH, sulphate and resistivity testing to assess the potential for corrosion of buried steel and the potential for sulphate attack on buried concrete. Four samples had previously been analyzed as part of the preliminary investigation.

No complex testing was deemed to be necessary based on the soil conditions.

All soil samples will be stored for a period of one year after issuance of the final version of the preliminary foundation investigation report. Unless otherwise directed, the stored samples will be disposed of after this period.

4.0 SUBSURFACE CONDITIONS

4.1 Subsurface Profile

The subsurface conditions observed in the boreholes are presented in detail on the Borehole Records provided in Appendix B. An explanation of the symbols and terms used to describe the Borehole Records is also provided. The results of the CPTu testing are also presented in Appendix B along with an explanation of terminology used on CPTu/SCPTu Records.

Borehole Records from the preliminary foundation investigation report for this project have been included in this report for completeness.

In general, the subsurface profile beneath the proposed re-alignment (Boreholes 05-1 to 05-4, 07-7 and 07-9 and CPT 07-8 and 07-10) consists of a deep deposit of poorly-graded silt with sand, silty sand, silt and sandy silt over a thin layer of bouldery till over bedrock.

A Borehole Location Plan and Stratigraphic Section of the soils encountered within the boreholes are provided on Drawing No. 1 in Appendix A.

4.1.1 Fill: Silty Sand to Gravelly Sand with Silt

Granular fill was encountered beneath the asphalt in all of the boreholes located along the existing Highway 60 alignment (05-5 to 05-8). The composition of the fill ranged from gravelly sand, trace to some silt, to sand, some silt, trace gravel. Woody organic matter was observed in the fill deposit in Boreholes 05-4 and 05-6. The thickness of the fill, where present, varied from 3.6 m to 4.4 m. The underside of the fill was observed to range from elevation 390.9 m to 391.8 m. The upper portion of the fill was frozen to a depth of approximately 1.4 m at the time of the 2005 preliminary investigation. The moisture content of the 8 samples of fill tested ranged from 5% to 34% and averaged 18%. The results of three grain size analyses indicated that the samples contained 1% to 8% gravel, 83% to 85% sand and 8% to 16% fines. The gradation results are provided on Figure 1 in Appendix B.

The SPT 'N' values ranged from 2 to 55 (excluding the results within the upper frozen zone) with an average value of 12 indicating that the fill was generally compact. The asphalt surface overlying the fill was observed to be 75 mm to 120 mm thick at the borehole locations.

A 100 mm thick organic layer was observed beneath the fill in Borehole 05-8.

A 300 mm thick layer of loose sand with cobbles was observed beneath the toposil in Borehole 07-9 which was located along the drainage ditch at the toe of the existing highway embankment.

4.1.2 Poorly-Graded Sand with Silt (SP-SM)

A layer of poorly-graded sand with silt was observed in Boreholes 07-7, 05-1, 05-2 and 05-3. The thickness of this layer ranged from 0.8 m to 4.5 m. Where encountered, this material was observed within the upper 13 m below ground surface (above elevation 381.5 m). SPT 'N' values ranged from 5 to 95 and averaged 34, indicating that the deposit varies from a loose to very dense state but is on average, dense. The results of three grain size analyses indicate that the deposit contained 0 % gravel and between 91 % and 94 % sand and 6 to 9% fines. The gradation results are provided on Figure 2 in Appendix B. This material ranges is classified as an SP-SM soil using the MTO Soil Classification System.

4.1.3 Silty Sand (SM)

A layer of silty sand was observed beneath the vegetation, fill or poorly-graded sand with silt deposits in all boreholes. In some cases, the silty sand deposit was interrupted by layers of silt (ML) or poorly-graded sand with silt (SP-SM). Where fully penetrated, the silty sand deposit ranged from 4.0 m thick to 31.0 m thick. The base of the unit varied from elevation 350.5 m to 380.1 m (geodetic). SPT 'N' values ranged from 1 to 107 and averaged 19, suggesting a generally compact state. The moisture content of the 26 samples tested ranged from 14% to 34% with an average of 23%. Grain size analysis of 18 samples indicated that this deposit contained 0% to 6% gravel, 47% to 87% sand and 13% to 50% silt and clay sized particles. The results of the grain size distribution testing are shown on Figure 3 in Appendix B. This material corresponds to SM soil using the MTO Soil Classification System.

4.1.4 Silt / Silt with Sand / Sandy Silt (ML)

A layer of silt, silt with sand or sandy silt was encountered within five of the ten boreholes at this site.

The thickness of the silty layers ranged from 3 m to 27.6 m. Where fully penetrated the base of the unit varied from elevation 349.8 m to 363.0 m (geodetic). SPT 'N' values ranged from 3 to 124 and averaged 28, suggesting a generally compact state. The moisture content of the 17 samples tested ranged from 16% to 22% with an average of 21%. Grain size analysis of the six samples tested indicated that they contained 0% gravel, 10% to 41% sand and 59% to 90% silt and clay sized particles. The results of the grain size distribution testing are shown on Figure 4 in Appendix B. These materials correspond to an ML soil using the MTO Soil Classification System.

4.1.5 Silty Sand with Gravel, Cobbles and Boulders (TILL)

A thin layer of bouldery glacial till was encountered just above the bedrock in Boreholes 07-7 and 07-9. The upper surface of the till deposit ranged from 41.3 m to 42.1 m below ground surface (elev. 350.5 m to 351.7 m). The thickness of the till ranged from 2.3 m to 3.8 m

Rock coring techniques were used to advance the holes through boulders within the till. The limited sample recovered from the only split spoon sample successfully driven within the till deposit consisted of silty sand with gravel. Based on the above, it is inferred that the till deposit likely consists of silty sand with gravel and frequent cobbles and boulders.

4.1.6 Bedrock

Bedrock was encountered in Borehole 07-7 and 07-9 at depths of 45.9 m and 43.6 m below ground surface respectively. These depths correspond to elevations 346.7 m and 349.4 m geodetic, respectively. The bedrock was penetrated 1.8 m and 2.6 m by coring with NQ-size coring equipment. The core recovery ranged from 88 to 100 %. The rock quality designation (RQD) ranged from 50 % to 95 %, indicating fair to excellent rock mass quality. The recovered rock core consisted of black, white and pink biotite gneiss. The rock generally had a fair to excellent rock mass quality and was moderately to slightly weathered with close to moderately spaced fractures with dip angles ranging from 30 to 45 degrees from horizontal. The unconfined compressive strength of four samples of the recovered rock core ranged from 94 MPa to 145 MPa, indicating strong to very strong rock.

A detailed description of the rock cores is provided in the Rock Core Summary Table in Appendix B.

4.2 Groundwater

Groundwater levels were measured in the standpipes installed during the preliminary investigation on February 10, 2005. The water levels at that time ranged from 1.2 m to 6.0 m below ground surface (elevation 392.1 m to 392.8 m). Groundwater levels were observed in the open boreholes at the time of drilling during the 2007 investigation. The water levels were approximately 0.6 m to 0.8 m below ground surface (elevation 392.0 to 392.2 m).

The water level in Kearney Creek on January 20, 2005, was surveyed to be at elevation 392.4 m. The groundwater levels measured in the boreholes are very close to the water level in the creek, as would be expected considering the permeable nature of the upper sandy deposits.

Fluctuations in the groundwater level due to seasonal variations or in response to a particular precipitation event should be anticipated.

5.0 CLOSURE

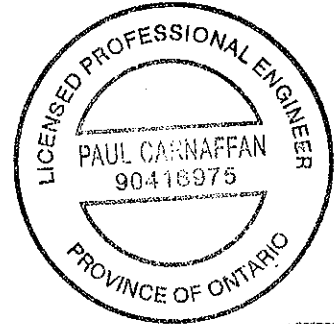
A subsurface investigation is a limited sampling of a site. The subsurface conditions given herein are based on information gathered at the specific borehole locations. Should any conditions at the site be encountered which differ from those at the borehole locations, we request that we be notified immediately in order to assess the additional information.

Yours very truly,

JACQUES WHITFORD LIMITED



Paul Carnaffan, M.Eng., P.Eng.



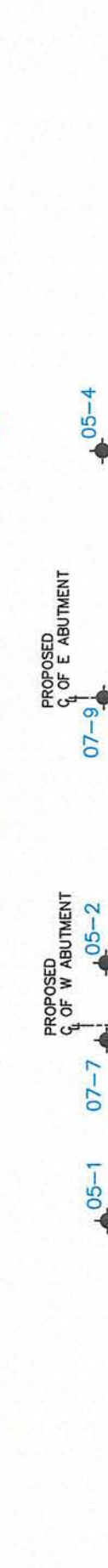
Fred J. Griffiths, Ph.D., P.Eng.
Designated Principal MTO Foundation Contact



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APPENDIX A

Borehole Location Plan and Profile Plot



REVISIONS		DATE	BY	DESCRIPTION
		--	--	

GEODES NO. 31F-147

HWY NO 60	CHECKED	DATE 2007-10-25	DIST 43
SUBWD PC	CHECKED		SITE --
DRAWN GBB	CHECKED	Approved <i>AC</i>	DWG 1

NOTE=

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

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineer's Materials Office, 10401-10th Avenue, North, Centennial, Colorado 80112. All information furnished is confidential and is to be used only for the conditions of Section 102-2 of Form 100.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

APPENDIX B

Symbols and Terms Used on Borehole Records

Borehole Records

Terminology Used on SCPTu Records

SCPTu Records

Grain Size Distribution Test Results

Rock Core Summary Table

SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

SOIL DESCRIPTION

Terminology describing common soil genesis:

<i>Topsoil</i>	- mixture of soil and humus capable of supporting vegetative growth
<i>Peat</i>	- mixture of visible and invisible fragments of decayed organic matter
<i>Till</i>	- unstratified glacial deposit which may range from clay to boulders
<i>Fill</i>	- material below the surface identified as placed by humans (excluding buried services)

Terminology describing soil structure:

<i>Desiccated</i>	- having visible signs of weathering by oxidization of clay minerals, shrinkage cracks, etc.
<i>Fissured</i>	- having cracks, and hence a blocky structure
<i>Varved</i>	- composed of regular alternating layers of silt and clay
<i>Stratified</i>	- composed of alternating successions of different soil types, e.g. silt and sand
<i>Layer</i>	- > 75 mm in thickness
<i>Seam</i>	- 2 mm to 75 mm in thickness
<i>Parting</i>	- < 2 mm in thickness

Terminology describing soil types:

The classification of soil types are made on the basis of grain size and plasticity in accordance with the Unified Soil Classification System (USCS) (ASTM D 2487 or D 2488). The classification excludes particles larger than 76 mm (3 inches). The USCS provides a group symbol (e.g. SM) and group name (e.g. silty sand) for identification.

Terminology describing cobbles, boulders, and non-matrix materials (organic matter or debris):

Terminology describing materials outside the USCS, (e.g. particles larger than 76 mm, visible organic matter, construction debris) is based upon the proportion of these materials present:

<i>Trace, or occasional</i>	Less than 10%
<i>Some</i>	10-20%
<i>Frequent</i>	> 20%

Terminology describing compactness of cohesionless soils:

The standard terminology to describe cohesionless soils includes compactness (formerly "relative density"), as determined by the Standard Penetration Test N-Value (also known as N-Index). A relationship between compactness condition and N-Value is shown in the following table.

Compactness Condition	SPT N-Value
<i>Very Loose</i>	<4
<i>Loose</i>	4-10
<i>Compact</i>	10-30
<i>Dense</i>	30-50
<i>Very Dense</i>	>50

Terminology describing consistency of cohesive soils:

The standard terminology to describe cohesive soils includes the consistency, which is based on undrained shear strength as measured by *in situ* vane tests, penetrometer tests, or unconfined compression tests.

Consistency	Undrained Shear Strength	
	kips/sq.ft.	kPa
<i>Very Soft</i>	<0.25	<12.5
<i>Soft</i>	0.25 - 0.5	12.5 - 25
<i>Firm</i>	0.5 - 1.0	25 - 50
<i>Stiff</i>	1.0 - 2.0	50 - 100
<i>Very Stiff</i>	2.0 - 4.0	100 - 200
<i>Hard</i>	>4.0	>200



ROCK DESCRIPTION

Terminology describing rock quality:

RQD	Rock Mass Quality
0-25	<i>Very Poor</i>
25-50	<i>Poor</i>
50-75	<i>Fair</i>
75-90	<i>Good</i>
90-100	<i>Excellent</i>

Rock quality classification is based on a modified core recovery percentage (RQD) in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be due to close shearing, jointing, faulting, or weathering in the rock mass and are not counted. RQD was originally intended to be done on NW core; however, it can be used on different core sizes if the bulk of the fractures caused by drilling stresses are easily distinguishable from *in situ* fractures. The terminology describing rock mass quality based on RQD is subjective and is underlain by the presumption that sound strong rock is of higher engineering value than fractured weak rock.

Terminology describing rock mass:

Spacing (mm)	Joint Classification	Bedding, Laminations, Bands
> 6000	<i>Extremely Wide</i>	-
2000-6000	<i>Very Wide</i>	<i>Very Thick</i>
600-2000	<i>Wide</i>	<i>Thick</i>
200-600	<i>Moderate</i>	<i>Medium</i>
60-200	<i>Close</i>	<i>Thin</i>
20-60	<i>Very Close</i>	<i>Very Thin</i>
<20	<i>Extremely Close</i>	<i>Laminated</i>
<6	-	<i>Thinly Laminated</i>

Terminology describing rock strength:

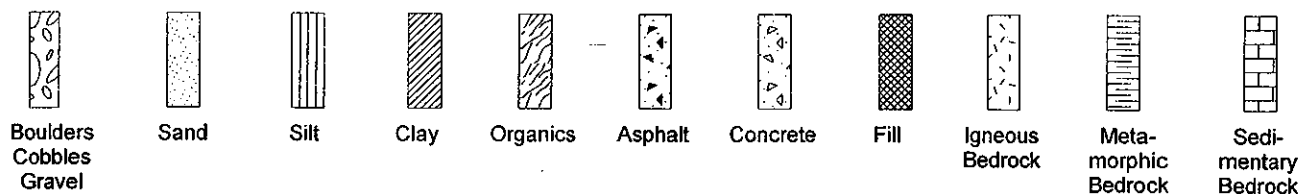
Strength Classification	Unconfined Compressive Strength (MPa)
<i>Extremely Weak</i>	< 1
<i>Very Weak</i>	1 – 5
<i>Weak</i>	5 – 25
<i>Medium Strong</i>	25 – 50
<i>Strong</i>	50 – 100
<i>Very Strong</i>	100 – 250
<i>Extremely Strong</i>	> 250

Terminology describing rock weathering:

Term	Description
<i>Fresh</i>	No visible signs of rock weathering. Slight discolouration along major discontinuities
<i>Slightly Weathered</i>	Discolouration indicates weathering of rock on discontinuity surfaces. All the rock material may be discoloured.
<i>Moderately Weathered</i>	Less than half the rock is decomposed and/or disintegrated into soil.
<i>Highly Weathered</i>	More than half the rock is decomposed and/or disintegrated into soil.
<i>Completely Weathered</i>	All the rock material is decomposed and/or disintegrated into soil. The original mass structure is still largely intact.

STRATA PLOT

Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.



SAMPLE TYPE

SS	Split spoon sample (obtained by performing the Standard Penetration Test)
ST	Shelby tube or thin wall tube
PS	Piston sample
BS	Bulk sample
WS	Wash sample
HQ, NQ, BQ, etc.	Rock core samples obtained with the use of standard size diamond coring bits.

WATER LEVEL MEASUREMENT



RECOVERY

For soil samples, the recovery is recorded as the length of the soil sample recovered. For rock core, recovery is defined as the total cumulative length of all core recovered in the core barrel divided by the length drilled and is recorded as a percentage on a per run basis.

N-VALUE / RQD

Numbers in this column are the field results of the Standard Penetration Test: the number of blows of a 140 pound (64 kg) hammer falling 30 inches (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler one foot (305 mm) into the soil. For split spoon samples where insufficient penetration was achieved and N-values cannot be presented, the number of blows are reported over sampler penetration in millimetres (e.g. 50/75). Some design methods make use of N value corrected for various factors such as overburden pressure, energy ratio, borehole diameter, etc. No corrections have been applied to the N-values presented on the log. RQD is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery.

DYNAMIC CONE PENETRATION TEST (DCPT)

Dynamic cone penetration tests are performed using a standard 60 degree apex cone connected to A size drill rods with the same standard fall height and weight as the Standard Penetration Test. The DCPT value is the number of blows of the hammer required to drive the cone one foot (305 mm) into the soil. The DCPT is used as a probe to assess soil variability. Soil type may be inferred from adjacent boreholes and test pits.

OTHER TESTS

S	Sieve analysis
H	Hydrometer analysis
k	Laboratory permeability
γ	Unit weight
G_s	Specific gravity of soil particles
CD	Consolidated drained triaxial
CU	Consolidated undrained triaxial with pore pressure measurements
UU	Unconsolidated undrained triaxial
DS	Direct Shear
C	Consolidation
Q_u	Unconfined compression
I_p	Point Load Index (I_p on Borehole Record equals $I_p(50)$ in which the index is corrected to a reference diameter of 50 mm)

	Single packer permeability test; test interval from depth shown to bottom of borehole
	Double packer permeability test; test interval as indicated
	Falling head permeability test using casing
	Falling head permeability test using well point or piezometer



RECORD OF BOREHOLE No 05-1

1 OF 1

METRIC

W.P. 545-93-00 LOCATION Highway 60, Kearney Bridge, N5048288.3 E387496.4
DIST Bancroft HWY 60 BOREHOLE TYPE Hollow Stem Augers with Split Spoons
DATUM Geodetic DATE 05.01.27 - 05.01.27
ORIGINATED BY AB
COMPILED BY JF
CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
392.6 0.0	Silty SAND, trace organics, very loose, brown (SM)		1	SS	3		392							
391.1 1.5	Silty SAND, loose to compact, brown (SM)		2	SS	7									
			3	SS	12		390							80 (20)
			4	SS	7									
			5	SS	28		388							
	- becomes grey		6	SS	11		386							
385.2 7.4	Poorly-graded SAND with silt, loose, grey (SP-SM)		7	SS	6									
383.6 9.0	Silty SAND, loose to compact, grey (SM)		8	SS	11		384							
			9	SS	7		382							78 (22)
379.8 12.8	End of Borehole		10	SS	21		380							

x³, x³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 05-2

1 OF 2

METRIC

W.P. 545-93-00 LOCATION Highway 60, Kearney Creek Bridge, N5048279.0 E387510.6 ORIGINATED BY AB
DIST Bancroft HWY 60 BOREHOLE TYPE Hollow Stem Augers/Casing with SplitSpoons COMPILED BY JF
DATUM Geodetic DATE 05.01.24 - 05.01.25 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)		
								20	40	60	80	100			W _p	W	W _L
392.4	Grass																
0.0	Organic Matter						392										
391.6																	
0.8	Poorly-graded SAND with silt, loose to very dense, grey to brown (SP-SM)		1	SS	5												
			2	SS	17												
			3	SS	68		390										
			4	SS	95									0 93 (7)			
			5	SS	49												
			6	SS	45		388										
387.1																	
5.3	Silty SAND, compact to dense, grey (SM)		7	SS	10		386							0 69 (31)			
	- gravelly sand seam		8	SS	32		384										
			9	SS	11												
			10	SS	12		382										
380.6																	
11.8	Poorly-graded SAND with silt, very dense, grey (SP-SM)		11	SS	64		380							0 94 (6)			
379.1																	
13.3	Sandy SILT to SILT with sand, loose to dense, grey (ML)		12	SS	22		378										
			13	SS	8												
			14	SS	23		376										
			15	SS	30		374										
			16	SS	25		372										
			17	SS	27		370										
			18	SS	41												
			19	SS	44		368										

Continued Next Page

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

ONTARIO MTO UPDATE 1985.GPJ ONTARIO MOT.GDT 07/10/25

RECORD OF BOREHOLE No 05-2

2 OF 2

METRIC

W.P. 545-93-00 LOCATION Highway 60, Kearney Creek Bridge, N5048279.0 E387510.6 ORIGINATED BY AB
 DIST Bancroft HWY 60 BOREHOLE TYPE Hollow Stem Augers/Casing with Split Spoons COMPILED BY JF
 DATUM Geodetic DATE 05.01.24 - 05.01.25 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT Y kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
								○ UNCONFINED × FIELD VANE							
								● QUICK TRIAXIAL × LAB VANE							
					20	40	60	80	100	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	WATER CONTENT (%)		
					20	40	60	80	100		10	20	30		
	Sandy SILT to SILT with sand, loose to dense, grey (ML.) (continued)														
			20	SS	36		366								
			21	SS	23		364								
			22	SS	19		362								
			23	SS	31		360								
			24	SS	22		358								
			25	SS	18		356								
			26	SS	30		354								
			27	SS	20										
			28	SS	54										
352.2			29	SS	124										
40.2	End of Borehole Standpipe Installed (25 mm diameter flexible poly-tube)														

ONTARIO MTO UPDATE 11685.GPJ ONTARIO MOT.GDT 07/10/25

METRIC

ORIGINATED BY AB

COMPILED BY JF

CHECKED BY _____ **PC** _____

Continued Next Page

\times^3, \times^3 : Numbers refer to Sensitivity

 $\bigcirc^{3\%}$ STRAIN AT FAILURE

RECORD OF BOREHOLE No 05-3

2 OF 2

METRIC

W.P. 545-93-00 LOCATION Highway 60, Kearney Creek Bridge, N5048271.8 E387526.0
DIST Bancroft HWY 60 BOREHOLE TYPE Hollow Stem Augers/Casing with Split Spoons
DATUM Geodetic DATE 05.01.28 - 05.02.01
ORIGINATED BY AB
COMPILED BY JF
CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
	Sandy SILT to SILT, compact to dense, grey (ML) (continued)		20	SS	12		366							
			21	SS	24		364							
			22	SS	15		362							
			23	SS	24		360							
			24	SS	36		358							
			25	SS	26		356							
			26	SS	39		354							
			27	SS	31		352							
			28	SS	82		350							
349.8 42.8	End of Borehole		29	SS	100 75 mm									

ONTARIO MTO UPDATE 11685 GPJ ONTARIO MOT.GDT 07/10/25

x³, x³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

METRIC

ONTARIO MTO UPDATE 16885.GPJ ONTARIO MOT.GDT 07/10/25

✕³, ✕³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE

RECORD OF BOREHOLE No 05-5

1 OF 1

METRIC

W.P. 545-93-00 LOCATION Highway 60, Kearney Creek Bridge, N5048271.5 E387488.7 ORIGINATED BY AB
DIST Bancroft HWY 60 BOREHOLE TYPE Hollow Stem Augers with SplitSpoons COMPILED BY JF
DATUM Geodetic DATE 05.01.22 - 05.01.22 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
395.5	Asphalt							20	40	60	80	100					
394.9	120 mm Asphalt		1	GS													
394.4	Sand and gravel, some silt, very dense, brown (FILL)		2	SS	50/80mm												
1.1	Silty sand, very loose to compact, brown (FILL)		3	SS	7												
			4	SS	3												
391.8			5	SS	2												
3.7	Silty SAND, loose, brown (SM)		6	SS	4												
389.4			7	SS	6												
6.1	End of Borehole																

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

RECORD OF BOREHOLE No 05-6

1 OF 1

METRIC

W.P. 545-93-00 LOCATION Highway 60, Kearney Creek Bridge, N5048265.8 E387498.1 ORIGINATED BY AB
 DIST Bancroft HWY 60 BOREHOLE TYPE Hollow Stem Augers/Casing with Split Spoons COMPILED BY JF
 DATUM Geodetic DATE 05.02.02 - 05.02.02 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
395.3	Asphalt													
394.7	75 mm ASPHALT													
	Gravelly sand, trace to some silt, brown (FILL)		1	SS	100/ 125 mm		394							
	- frozen to 1.5 m		2	SS	16									
	- occasional wood		3	SS	13									
			4	SS	18		392							
			5	SS	55									
390.9			6	SS	40									
4.4	Silty SAND, compact to dense, brown (SM)		7	SS	29		390							
			8	SS	32									
			9	SS	25		386							
386.2			10	SS	24									
9.1	Silty SAND, compact to dense, grey (SM)		11	SS	45		384							
			12	SS	15									
			13	SS	26		380							
			14	SS	107		378							
376.4	- becomes very dense													
18.9	End of Borehole													

ONTARIO MTO UPDATE 11685.GPJ ONTARIO MOT.GDT 07/10/25

METRIC

SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W _p ——— W ——— W _L WATER CONTENT (%) 10 20 30	UNIT WEIGHT Y KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20 40 60 80 100			
395.4	Asphalt						SHEAR STRENGTH kPa ○ UNCONFINED × FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100				

Continued Next Page

\times^3, \times^3 : Numbers refer to Sensitivity $\bigcirc^{3\%}$ STRAIN AT FAILURE

METRIC

\times^3, \times^3 : Numbers refer to Sensitivity

 $\bigcirc^{3\%}$ STRAIN AT FAILURE

RECORD OF BOREHOLE No 05-8

1 OF 1

METRIC

W.P. 545-93-00 LOCATION Highway 60, Kearney Creek Bridge, N5048251.5 E387534.6
 DIST Bancroft HWY 60 BOREHOLE TYPE Hollow Stem Augers with SplitSpoons
 DATUM Geodetic DATE 05.01.22 - 05.01.22
 ORIGINATED BY AB
 COMPILED BY JF
 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED		× FIELD VANE		● QUICK TRIAXIAL						× LAB VANE		
395.5	Asphalt						20	40	60	80	100									
394.9	110 mm Asphalt		1	GS																
394.2	Gravelly sand, some silt, very dense, brown (FILL)		2	SS	50/100mm															
1.3	- frozen to 1.3 m																			
	Sand, trace silt, trace gravel, very loose to compact, brown (FILL)		3	SS	11							○				8 84 (8)				
			4	SS	3															
392.4																				
3.1	Silty sand, loose, brown to dark brown (FILL)		5	SS	2									○						
391.2			6	SS	6										○					
391.9	Organic layer																			
4.4	Silty SAND, loose, brown (SM)		7	SS	8									○						
389.4			8	SS	5									○		66 (34)				
6.1	End of Borehole																			

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

RECORD OF BOREHOLE No 07-7

1 OF 5

METRIC

W.P. 545-93-00 LOCATION Highway 60, Kearney Creek Bridge, N5048280.0 E387505.8 ORIGINATED BY JF
DIST 43 HWY 60 BOREHOLE TYPE HW casing, NW casing, Split Spoons, NQ Core COMPILED BY JF
DATUM Geodetic DATE 07.05.04 - 07.05.10 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								20	40	60							80	100
392.8	Grass							20	40	60	80	100						
392.4	150 mm TOPSOIL																	
0.2	Silty SAND, very loose to compact, brown to orangy brown (SM)		1	SS	1	▽	392											
			2	SS	2		391											0 69 (31)
			3	SS	14		390											
			4	SS	18		389											
			5	SS	10		388											
			6	SS	12		387											
			7	SS	7		386											
			8	SS	11		385											
			9	SS	9		384											
			10	SS	14		383											
387.3	Silty SAND, loose to compact, brownish grey (SM)																	
5.3																		
					</													

Continued Next Page

×³, ×³: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

ONTARIO MTO 1023332.GPJ ONTARIO MOT.GDT 07/10/25

RECORD OF BOREHOLE No 07-7

2 OF 5

METRIC

W.P. 545-83-00

LOCATION

Highway 60, Kearney Creek Bridge, N5048280.0 E387505.8

ORIGINATED BY JF

DIST 43 HWY 60

BOREHOLE TYPE

HW casing, NW casing, Split Spoons, NQ Core

COMPILED BY JF

DATUM Geodetic

DATE _____

07.05.04_07.05.10

CHECKED BY **PC**

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			20	40	60						80	100
								SHEAR STRENGTH kPa								WATER CONTENT (%)	
	Poorly-graded SAND with silt, compact, grey (SP-SM) (continued)		12	SS	13												
381.5							382										
11.1	Silty SAND, loose to dense, grey (SM)		13	SS	23		381										
							380										
			14	SS	32		379							0 65 (35)			
							378										
			15	SS	22		377										
							376										
							375										
							374										
			16	SS	37		373							0 79 (21)			

Continued Next Page

 $x^3, x^3;$

Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

ONTARIO MTO 1023332.GPJ ONTARIO MOT.GDT 07/10/25

RECORD OF BOREHOLE No 07-7

3 OF 5

METRIC

W.P. 545-93-00 LOCATION Highway 80, Kearney Creek Bridge, N5048280.0 E387505.8 ORIGINATED BY JF
 DIST 43 HWY 80 BOREHOLE TYPE HW casing, NW casing, Split Spoons, NQ Core COMPILED BY JF
 DATUM Geodetic DATE 07.05.04 - 07.05.10 CHECKED BY PC

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								
	Silty SAND, loose to dense, grey (SM) (continued)												
			17	SS	23		372						
							371						
							370						
							369						
							368						
							367						
							366						
							365						
			18	SS	24		364						
							363						

Continued Next Page

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

ONTARIO MTO 1023332.GPJ ONTARIO MOT.GDT 07/10/25

RECORD OF BOREHOLE No 07-7

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METRIC



W.P. 545-93-00 LOCATION Highway 60, Kearney Creek Bridge, N5046280.0 E387505.8 ORIGINATED BY JF
 DIST 43 HWY 60 BOREHOLE TYPE HW casing, NW casing, Split Spoons, NQ Core COMPILED BY JF
 DATUM Geodetic DATE 07.05.04 - 07.05.10 CHECKED BY PC

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 ● QUICK TRIAXIAL × LAB VANE								
	Silty SAND, loose to dense, grey (SM) (continued)																		
			19	SS	9													0 58 42 0	
			20	SS	16														
			21	SS	22													0 50 49 1	

Continued Next Page

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

METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100				Wp			W	Wl
								SHEAR STRENGTH kPa								
								<input type="radio"/> UNCONFINED <input checked="" type="radio"/> QUICK TRIAXIAL	<input checked="" type="radio"/> FIELD VANE <input type="radio"/> LAB VANE							
								20 40 60 80 100								
										WATER CONTENT (%)						
										10	20	30				

	Interval	Description	Core Number	SS	NQ	Other	TCR (%)	RQD (%)
350.5 42.1	Silty SAND, loose to dense, grey (SM) (continued)							
346.7 45.9	Silty sand, some gravel, frequent cobbles and boulders, dense, grey: TILL.		22	SS	24			
			23	NQ				
			24	NQ				
			25	NQ				
344.9 47.7	Biotite GNEISS, black, white and pink, fair, moderate to slightly weathered, close to moderately spaced fractures, thin bedding, 30 to 45 degree dip		26	NQ				
			27	NQ				
344.9 47.7	End of Borehole							

ONTARIO MTO 1023332.GPJ ONTARIO MOT.GDT 07/10/25

\times^3, \times^3 : Numbers refer to Sensitivity

 $\bigcirc^{3\%}$ STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-9

1 OF 5

METRIC

W.P. 545-93-00 LOCATION Highway 60, Kearney Creek Bridge, N5048287.1 E387523.4
 DIST 43 HWY 80 BOREHOLE TYPE HW casing, NW casing, Split Spoons, NQ Core
 DATUM Geodetic DATE 07.04.30 - 07.05.03
 ORIGINATED BY AB
 COMPILED BY JF
 CHECKED BY PC

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 (%)			
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N° VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								○ UNCONFINED		× FIELD VANE							● QUICK TRIAXIAL	
393.0	Grass						20	40	60	80	100							
392.8	150 mm TOPSOIL																	
0.2	Sand, with cobbles, loose, brown. FILL																	
392.5																		
0.5	Silty SAND, loose to compact, brown (SM)																	
			1	SS	15													
			2	SS	6													
			3	SS	12													
			4	SS	23													
			5	SS	9													
			6	SS	15													
			7	SS	6													
			8	SS	6													
			9	SS	16													
387.8																		
5.2	Silty SAND, loose to compact, grey (SM)																	

Continued Next Page

*³ X³: Numbers refer to Sensitivity
 O 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-9

2 OF 5

METRIC

W.P. 545-93-00 LOCATION Highway 60, Kearney Creek Bridge, N5048267.1 E387523.4 ORIGINATED BY AB
DIST 43 HWY 60 BOREHOLE TYPE HW casing, NW casing, Split Spoons, NQ Core COMPILED BY JF
DATUM Geodetic DATE 07.04.30 - 07.05.03 CHECKED BY PC

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						
	Silty SAND, loose to compact, grey (SM) (continued)		10	SS	4		382							0 70 (30)
			11	SS	5		381							
			12	SS	7		379							
378.5														
14.5	SILT, loose, grey (ML)		13	SS	8		378							
			14	SS	6		376							0 12 83 5
375.5														
17.5	Silty SAND, loose to compact, grey (SM)		15	SS	12		375							
							374							

ONTARIO MTO 1023332.GPJ ONTARIO MOT.GDT 07/10/25

Continued Next Page

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

RECORD OF BOREHOLE No 07-9

3 OF 5

METRIC

W.P. 545-93-00 LOCATION Highway 60, Kearney Creek Bridge, N5048267.1 E387523.4 ORIGINATED BY AB
DIST 43 HWY 60 BOREHOLE TYPE HW casing, NW casing, Split Spoons, NQ Core COMPILED BY JF
DATUM Geodetic DATE 07.04.30 - 07.05.03 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa 20 40 60 80 100 ○ UNCONFINED * FIELD VANE ● QUICK TRIAXIAL x LAB VANE					WATER CONTENT (%) 10 20 30 W _p W W _L				
	Silty SAND, loose to compact, grey (SM) (continued)																
			16	SS	8		372										
							371										
							370										
							369										
			17	SS	15		368									0 80 20 0	
							367										
368.5 26.5	SILT with sand, loose to dense, grey (ML)						366										
			18	SS	15		365										
							364										

Continued Next Page

x³, x³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ONTARIO MTO 1023332.GPJ ONTARIO MOT.GDT 07/10/25

RECORD OF BOREHOLE No 07-9

4 OF 5

METRIC

W.P. 545-93-00 LOCATION Highway 60, Kearney Creek Bridge, N5048267.1 E387523.4
DIST 43 HWY 60 BOREHOLE TYPE HW casing, NW casing, Split Spoons, NQ Core
DATUM Geodetic DATE 07.04.30 - 07.05.03
ORIGINATED BY AB
COMPILED BY JF
CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _p W W _L	20 40 60 80 100	10 20 30		
	SILT with sand, loose to dense, grey (ML) (continued)		19	SS	22		362							
							361							
							360							
			20	SS	5		359							0 25 74 1
							358							
							357							
			21	SS	34		356							
							355							
							354							
			22	SS	13									

Continued Next Page

\times^3, \times^3 : Numbers refer to Sensitivity \circ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-9

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METRIC

W.P. 545-93-00 LOCATION Highway 60, Kearney Creek Bridge, N5048267.1 E387523.4 ORIGINATED BY AB
 DIST 43 HWY 60 BOREHOLE TYPE HW casing, NW casing, Split Spoons, NQ Core COMPILED BY JF
 DATUM Geodetic DATE 07.04.30 - 07.05.03 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
	SILT with sand, loose to dense, grey (ML) (continued)													
351.7 41.3	Silty sand, some gravel, frequent cobbles and boulders, dense, grey; TILL		23	NQ										
349.4 43.6	Biotite GNEISS, black, white and pink, fair to excellent, moderate to slightly weathered, close to moderately spaced fractures, thin bedding, 30 to 40 degree dip		24	NQ										TCR = 88% RQD = 87%
			25	NQ										TCR = 96% RQD = 92%
														TCR = 100% RQD = 95%
346.8 46.2	End of Borehole		26	NQ										

ONTARIO MTO 1023332.GPJ ONTARIO MOT.GDT 07/10/25

✕³, ✕³. Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

Terminology Used on SCPTu Records

Key Terminology and Principles

SCPTu:

- Seismic Piezocone (SCPTu);
- A piezocone (CPTu) is an enhanced cone penetration test (CPT) probe that is able to measure porewater pressure (u);
- A seismic piezocone (SCPTu) is further enhanced to measure surface generated compression and shear waves at depth; used to define the shear wave velocity of soils.

Equipment Type and Governing Standard:

- 10 cm² seismic piezocone;
- 150 cm² friction sleeve;
- manufactured by Applied Research Associates, Inc.;
- ASTM Specification D3441.

PCPT Investigation Objectives:

- evaluate soil type and soil stratigraphy;
- estimate the relative density of granular soils and in situ undrained shear strength of cohesive soils.

Soil Behaviour Type (SBT):

- The SBT is selected based on a soil's response to cone penetration, which is different from an explicit soil type defined by specified laboratory testing procedures, but is normally what the geotechnical engineer requires for design purposes.
- The SBT can be classified on the basis of the soil friction ratio, f_s ; ratio between the side shear on the friction sleeve and cone tip resistance.
- The SBT can also be classified on the basis of the normalized pore pressure, B_q ; a function of the pore water response and the cone tip resistance.
- The "CPT Soil Behaviour Type Legend" used for this project is attached.

Canadian Foundation Engineering Manual (3rd Edition) Statement on the CPT

- "The most significant advantage that the electric cone penetrometers offer is their repeatability and accuracy."
- "One of the most important applications of the cone penetration test is to accurately determine the soil profile."

Key References:

T. Lunne, P.K. Robertson, and J.J.M. Powell (1997). "Cone Penetration Testing in Geotechnical Practice"; Spon Press.

P.W. Mayne (1986). "CPT indexing of in situ OCR in Clays"; Proceedings of the ASCE Specialty Conference In Situ '86: Use of In Situ Tests in Geotechnical Engineering, Blacksburg, 780-93, ASCE.

P.K. Robertson and R.G. Campanella (1988). "Guidelines for geotechnical design using CPT and CPTU"; University of British Columbia, Vancouver, Department of Civil Engineering, Soil Mechanics Series 120.



Terminology and Key Engineering Relationships

Parameter	Description	Symbol/Equation	Reference
Depth	Depth of the centroid of the sensor		
Elevation	Elevation of centroid of the sensor	Ground Surface – Depth	
Sleeve Stress	Sleeve Stress – interpolated to the depth of the tip	f_s	
Tip Stress, Uncorrected	Measured Tip Stress	q_c	
Tip Stress COR	Tip Stress, corrected for probe geometry	$q_t = q_c + u_2 x(1 - a)$	
Ratio COR	Friction Ratio	$R_f = \frac{f_s}{q_t} \times 100\%$	
Pore Pressure	Measured Pore Pressure	u_2	
Soil Behaviour Type	Soil Behaviour Type	SBT	Lunne, Robertson and Powell, 1997
Overburden Stress		$\sigma_{vo} = \sum_{i=1}^n \gamma_i x h_i$	
Effective Overburden Stress		$\sigma'_{vo} = \sigma_{vo} - u_o$	
Normalized Tip Stress		$Q_t = \frac{q_t - \sigma_{vo}}{\sigma'_{vo}}$	Lunne, Robertson and Powell, 1997
Normalized Friction Ratio		$F_r = \frac{f_s}{q_t - \sigma_{vo}}$	Lunne, Robertson and Powell, 1997
Normalized Pore Pressure		$B_q = \frac{\Delta u}{q_t - \sigma_{vo}}$ where $\Delta u = u_2 - u_o$	Lunne, Robertson and Powell, 1997

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Tools\Terminology

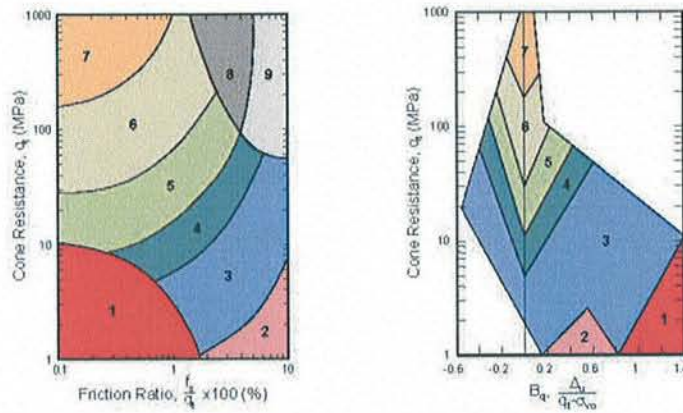
Used

on

SCPTu

Records.doc

CPT Soil Behavior Type Legend (Robertson et al. 1990)



Zone	Soil Behavior Type
1	Sensitive, Fine Grained
2	Organic Soils-Peats
3	Clays; Clay to Silty Clay
4	Silt Mixtures; Clayey Silt to Silty Clay
5	Sand Mixtures; Silty Sand to Sandy Silt
6	Sands; Clean Sands to Silty Sands
7	Gravelly Sand to Sand
8	Very Stiff Sand to Clayey Sand*
9	Very Stiff Fine Grained*

*Overconsolidated or Cemented

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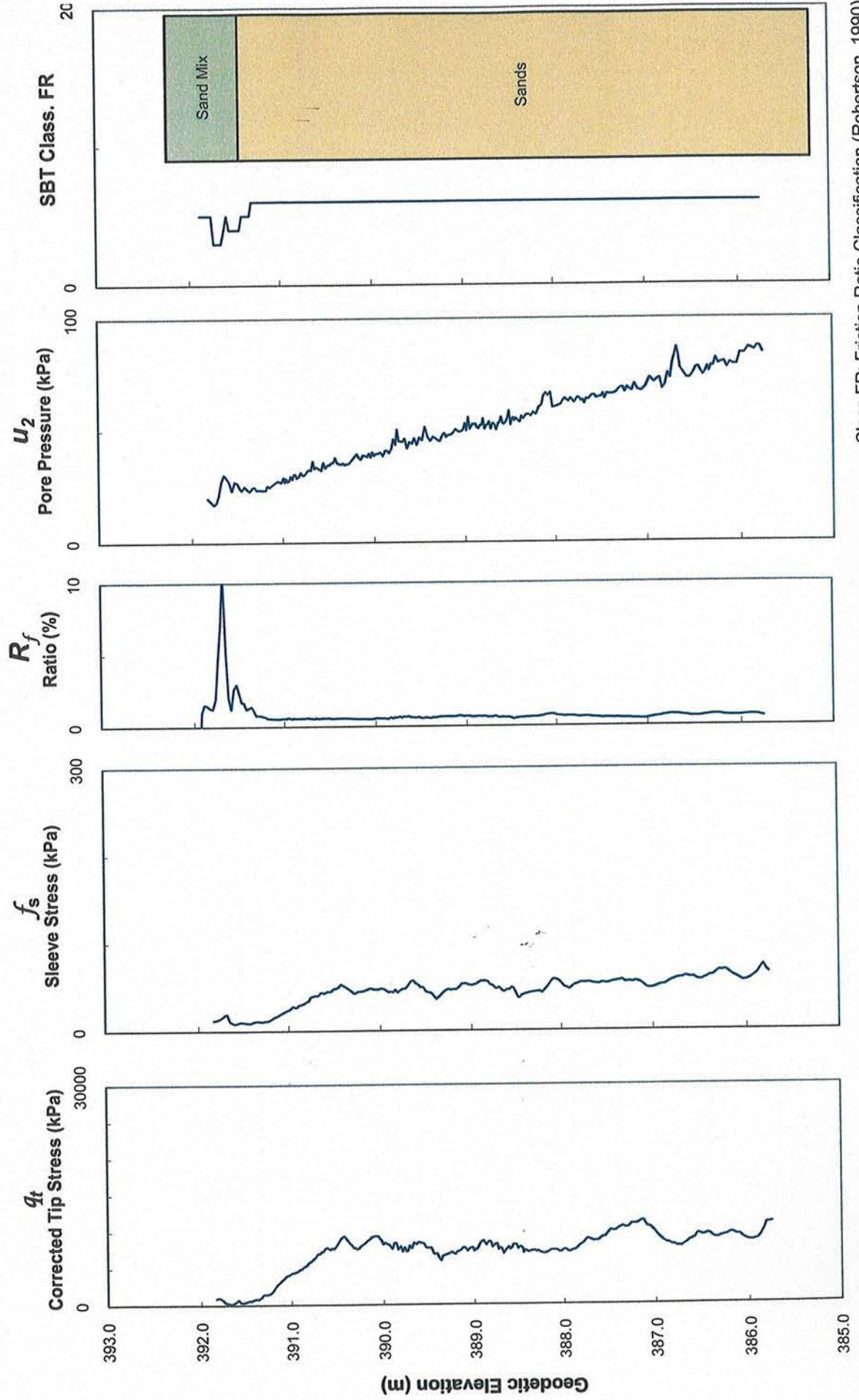
Ground Surface Elevation: 392.6 m
SCPTu Start Elevation: 392.0 m
Groundwater Elevation: 392.0 m

Client: McCormick Rankin Corporation

Project: MTO WP 545-93-00, Kearney Creek Bridge Replacement

Test Date: April 26, 2006
Project No. 1023332
N5048281.0 E387501.8

CPT 07-8





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Elevation: 393.0 m

SCPTu Start Elevation: 391.5 m

Groundwater Elevation: 392.0 m

Client: McCormick Rankin Corporation

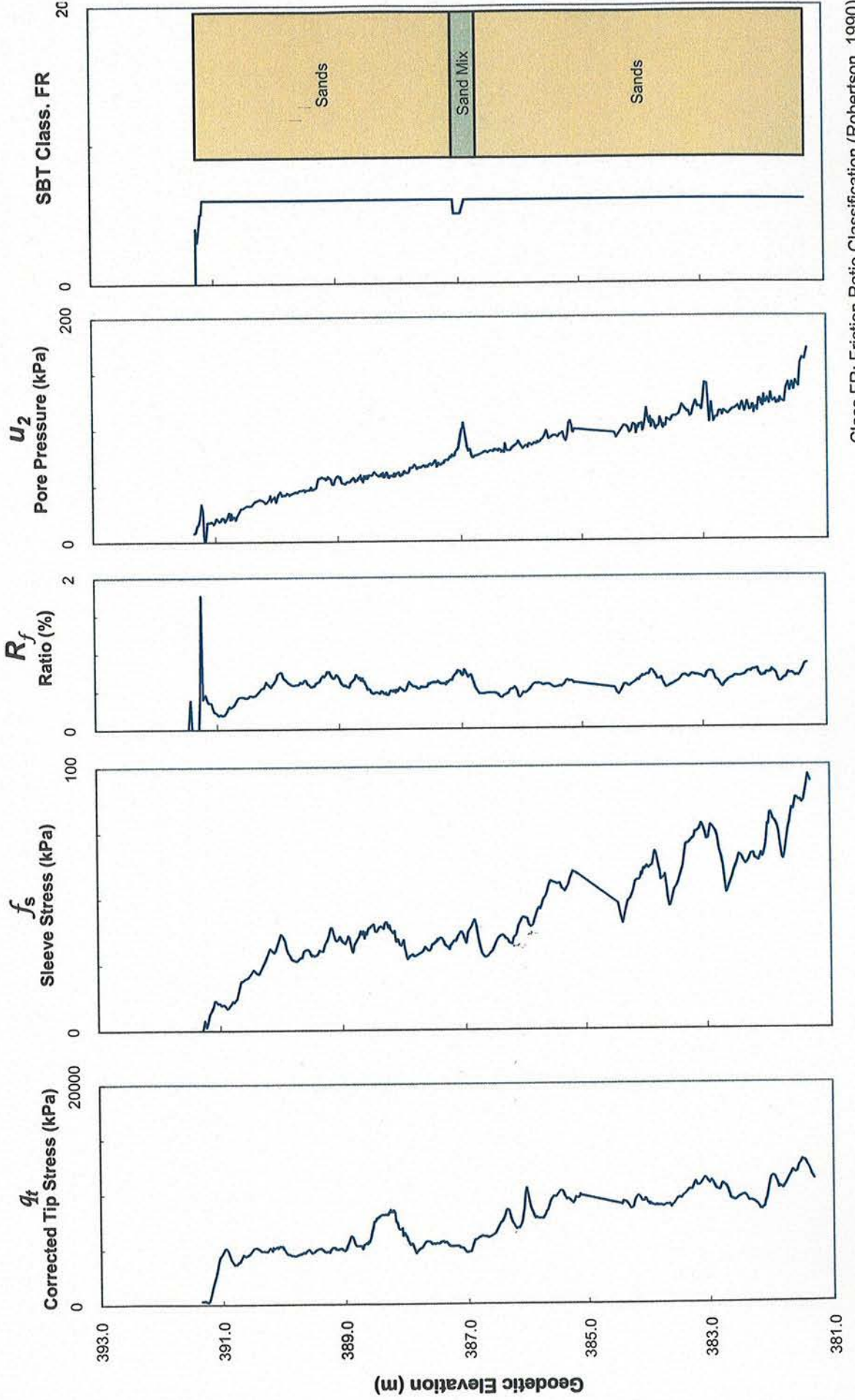
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Test Date: April 26, 2006

Project No. 1023332

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CPT 07-10



UNIFIED SOIL CLASSIFICATION SYSTEM

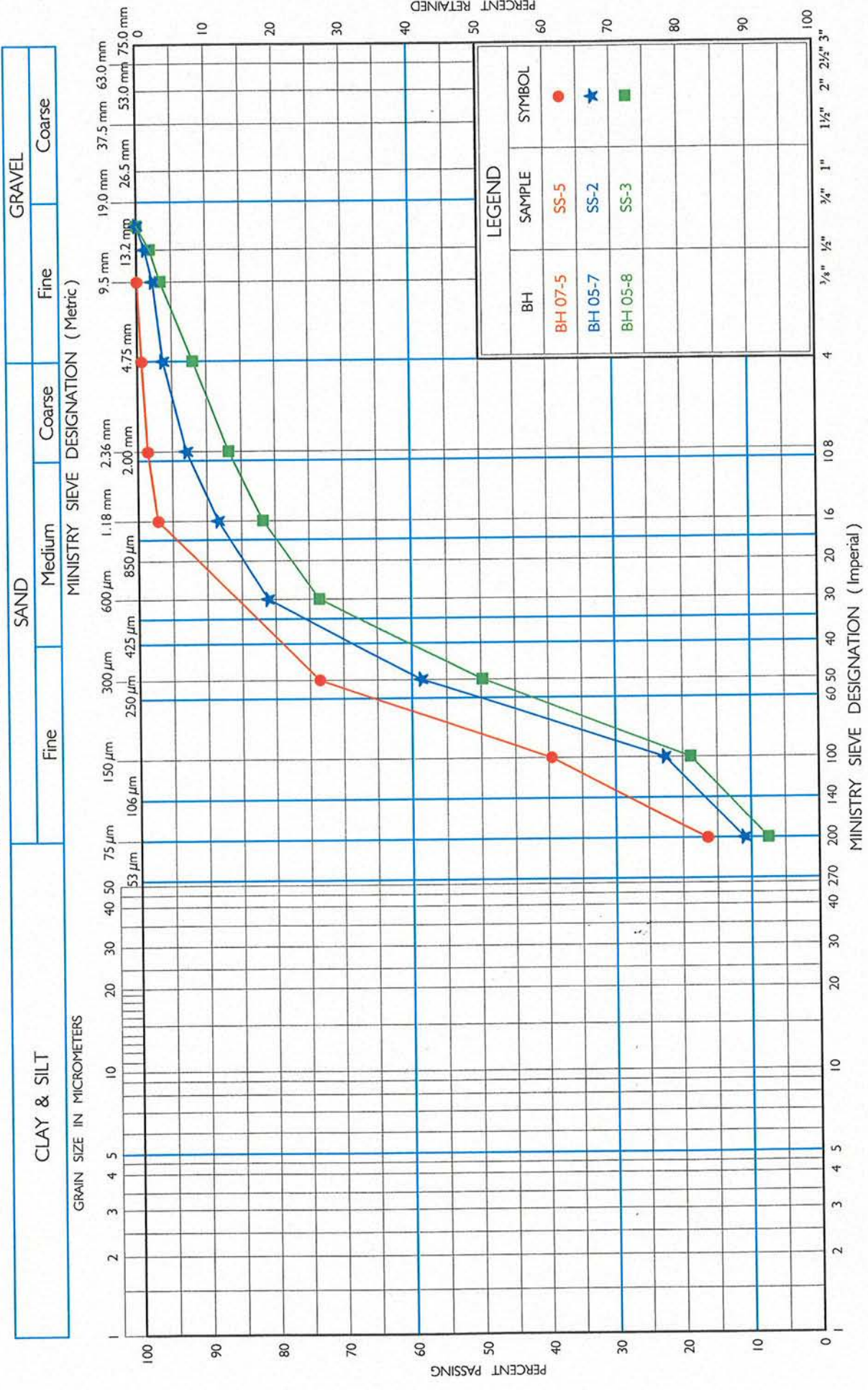


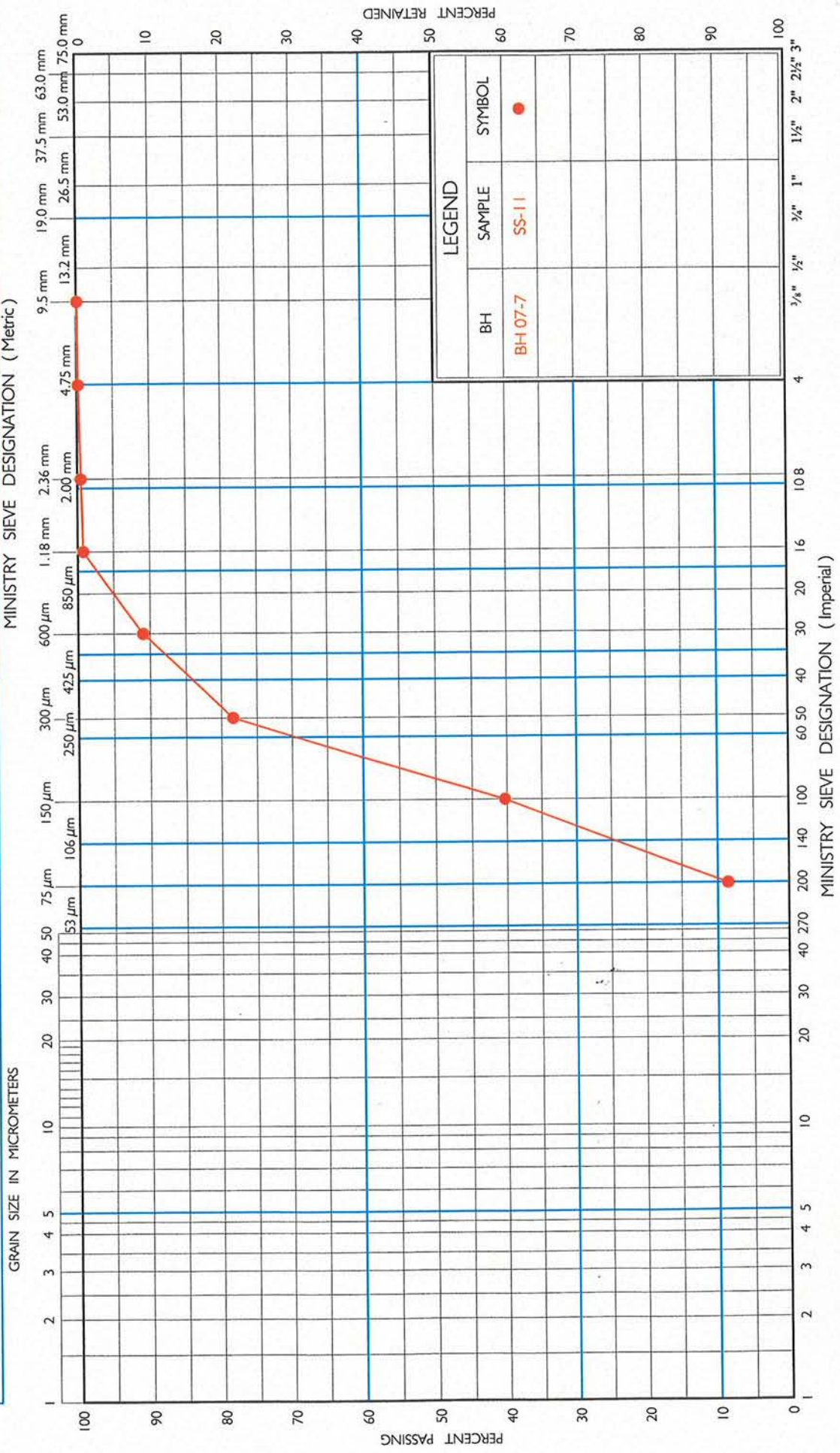
FIG No 1

GRAIN SIZE DISTRIBUTION

POORLY-GRADED SAND WITH SILT TO SILTY SAND

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT			SAND			GRAVEL		
			Fine	Medium	Coarse	Fine	Coarse	
MINISTRY SIEVE DESIGNATION (Metric)								



UNIFIED SOIL CLASSIFICATION SYSTEM

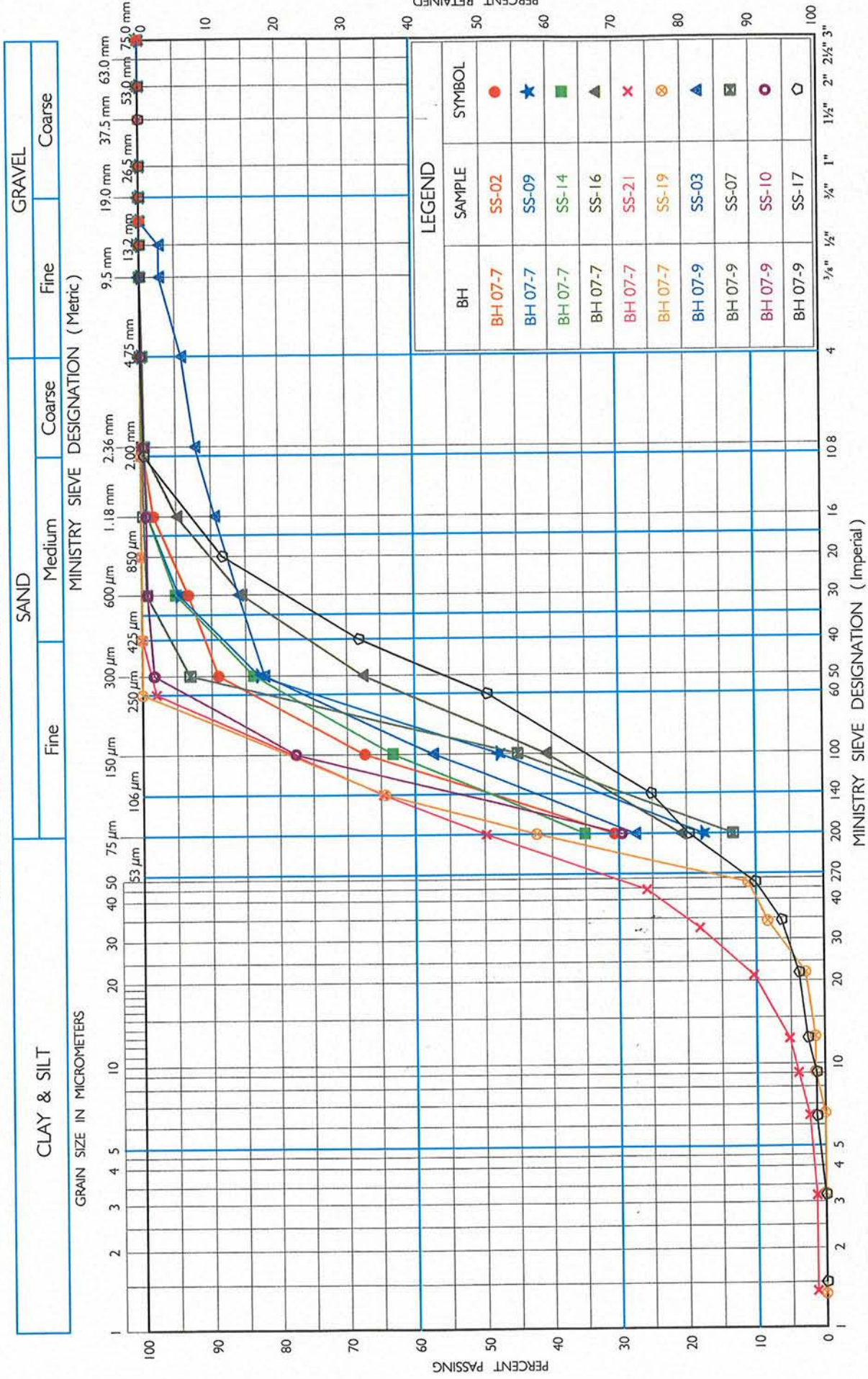
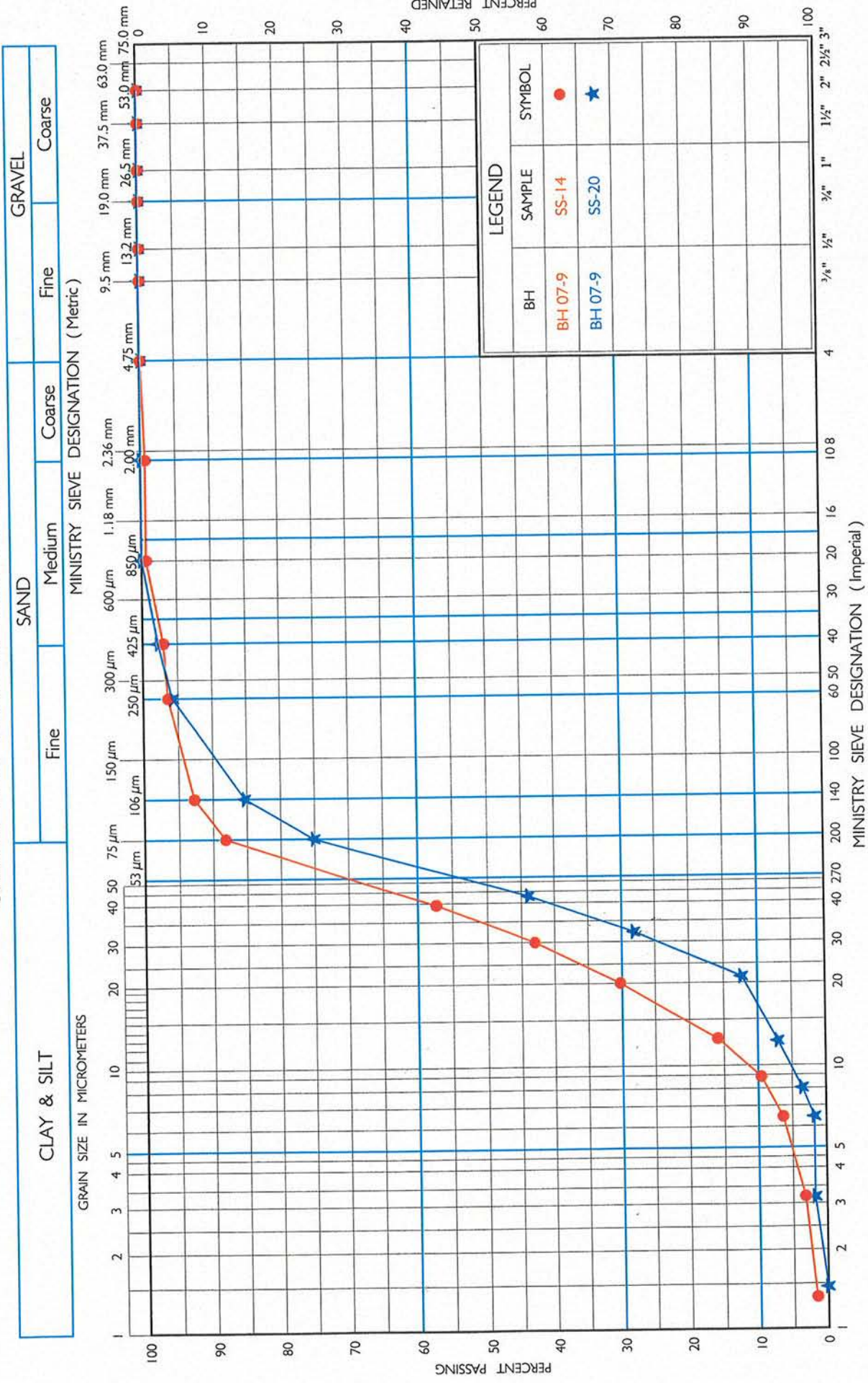


FIG No 3
GRAIN SIZE DISTRIBUTION
SILTY SAND (SM)

GWP 545-93-00

UNIFIED SOIL CLASSIFICATION SYSTEM



Rock Core Summary Table
W.P. 302-89-00

Borehole #	Sample #	Recovery (%)	R.Q.D. (%)	Unconfined Compressive Strength (MPa)	Description
07-7	26	100	64	-	Biotite GNEISS, black, white and pink, fair, moderate to slightly weathered, close to moderately spaced fractures, 30 to 45 degree dip
	27	90	50	103, 107	
07-9	24	88	87	145	Biotite GNEISS, black, white and pink, fair to excellent, moderate to slightly weathered, close to moderately spaced fractures, 30 to 40 degree dip
	25	96	92	94	
	26	92	95	-	

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