

**FOUNDATION INVESTIGATION REPORT  
PROPOSED HIGHWAY 17 (NEW)  
FROM ECHO RIVER TO BAR RIVER ROAD  
DISTRICT 62, SAULT STE. MARIE, ONTARIO  
G.W.P. 354 AND 352-94-00**

**(Volume 2)**

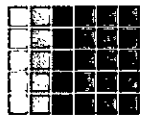
**Prepared For:**

**MARSHALL MACKLIN MONAGHAN LTD.**

**Prepared by:**

**SHAHEEN & PEAKER LIMITED**

**Project: SPT1055  
August 2003**



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#### **4.6 SITE NO. 6 : HIGHWAY 17 (NEW) FILL SECTION BETWEEN STATIONS 15+470 AND 15+670 WESTBOUND LANES, AND BETWEEN STATIONS 15+470 AND 15+690 EASTBOUND LANES**

Site No. 6 is a low-lying area adjacent to and north of a high ground area (Site No. 7). The grade from this low-lying area rises southerly from an elevation of 187 m near Station 15+400 to about Elevation 190 to 192 m at Station 15+650. In this section, from Station 15+460 to 15+640, a total of ten boreholes was drilled, some along the proposed east and west bound lanes, others at or near the median centerline. In general, the grade also falls gradually from east to west or from westbound towards eastbound lanes between Stations 15+560 and 15+640.

The location plan of the boreholes in this section and the stratigraphic profiles for eastbound lanes (EBL) and westbound lanes (WBL) are presented in Drawing Nos. 6A and 6B.

The boreholes showed the presence of 0.1 to 0.25 m thick topsoil or peat followed in some of the boreholes by a surficial layer of sand or silty sand to a maximum depth of 2.0 m below the ground surface. These surficial soils are underlain by an extensive clay deposit. In some of the boreholes, the clay is underlain by sand and gravel or silty sand till deposits at depths generally ranging from 2.3 to 7.8 m below the ground surface while others were terminated at depths of up to 12 m within the clay deposit, where these sand or silty sand till deposits were encountered.

Details of the subsurface conditions encountered in the boreholes and test pits are presented on the Record of Borehole Sheets and Test Pit Logs in Appendix A6. The individual soil strata are briefly described in the following paragraphs.

##### **4.6.1 TOPSOIL AND PEAT**

In Borehole 15+531 CL, a 0.1 m thick peat layer was contacted. The remaining boreholes, except for Borehole 15+621 Lt, encountered a 0.1 to 0.25 m thick layer of topsoil.

##### **4.6.2 SURFICIAL SAND**

Underlying the topsoil and peat, surficial granular soils ranging in composition from sand to silty sand were contacted in Boreholes 15+561 Rt, 15+621 Lt and 15+630 Rt. These deposits extended to depths ranging from 0.7 to 2.0 m below the ground surface.

The grain-size distribution of two samples from these surficial granular deposits is given in Figure B6-1 in Appendix B6. These results indicate 14-15% gravel, 57-76% sand, 8-24% silt and 2-4% clay-size particles.

With the exception of Borehole 15+621 Lt, in which a value of 106 blows/0.3 m was recorded, the Standard Penetration tests performed in these surficial granular deposits yielded N-values ranging from 2 to 8 blows/0.3 m, indicating a generally very loose to loose condition.

#### 4.6.3 CLAY

Underlying the surficial deposits described in the preceding paragraphs, all the boreholes contacted a major deposit of clay at depths ranging from 0.1 to 2.0 m below the ground surface or below elevations ranging from 189.1 and 187.1 m. Boreholes 15+469 CL and 15+501 Lt were terminated in this deposit at depths ranging from 3.8 to 12.0 m below the ground surface while in the remaining eight boreholes, the presence of sand and gravel or silty sand till was found at depths ranging from 2.3 to 7.8 m or below Elevations 186.5 and 179.6 m.

At most locations the clay is a layered material with highly plastic (fat) to medium plasticity clay with some low plasticity (lean) clay seams/lenses. It is generally irregularly layered with occasional thin clayey silt to silt interlayers, some zones being more layered than others. In general, the soil has a reddish to reddish grey colour. The results of grain-size analyses carried out on four samples from the deposit are presented in Figure B6-2 of Appendix B6. These indicate 2% gravel, 2-7% sand, 28-55% silt and 43-68% clay-size particles.

This deposit is described as a cohesive soil and Atterberg Limits tests performed on eight samples from the material gave the following index values (Figure B6-3, Appendix B6):

Liquid Limit:	49-72%
Plastic Limit:	21-29%
Plasticity Index:	27-46%

As shown in Figure B6-3, these values are characteristic of clays of medium to high but generally of high plasticity.

Natural moisture contents measured on samples from the deposit generally range from about 21 to 97% but are generally in excess of 50%. The measured natural moisture contents are generally near or in excess of the measured liquid limit values, with Liquidity Index values of between 0.8 and 1.9, but generally 1.2 to 1.3. These results are characteristic of weak and compressible (generally normally consolidated) clays. The

measured bulk unit weights range from 16.4 to 19.5 kN/m<sup>3</sup> within the upper desiccated zone, and is about 17.3 kN/m<sup>3</sup> within the weaker clay below. The results of a consolidation (oedometer) test are given in Figure B6-4 of Appendix B6. These test results show a probable pre-consolidation pressure of about 200 to 210 kPa, which is about 160 to 170 kPa in excess of the existing overburden pressure. The measured specific gravity of this sample is 2.70.

Standard Penetration tests in this cohesive deposit gave N-values ranging from 1 to 30 blows/0.3 m (except for a higher value of in excess of 100 in Borehole 15+501 Lt), but generally 1 to 3 blows/0.3 m. Field Vane tests yielded in-situ undrained shear strengths ranging from 20 to 80 kPa (except for the higher values in the desiccated crust). These values indicate that the consistency of the material can be described as soft to stiff, but generally soft to firm. A combined plot of all the vane test results from all the boreholes is presented in Figure C6-1 of Appendix C6. In many of the boreholes, an approximately linear increase of undrained shear strength with depth was observed. This usually indicates normally consolidated clay. Figure C6-2 show typical plot of undrained shear strength versus elevation at the location of Borehole 15+469 CL.

#### 4.6.4 SAND AND GRAVEL

Sand and gravel to silty sand and gravel was contacted in Boreholes 15+499 Rt and 15+469 CL, immediately underlying the clay deposit, at a depth of 7.8 m (Elevation 179.6 m) and about 11.5 m (Elevation 175.9 m), respectively.

A grain-size distribution analysis was performed on a sample from these granular deposits. The results are presented in Figure B6-5 in Appendix B6. These results indicate 49% gravel, 47% sand, and 4% silt and clay-size particles.

From a recorded N-value of 26 blows/0.3 m, the relative density of the material is described as compact. The recorded N-value of 56 blows/0.2 m of penetration at Borehole 15+469 CL is considered not reliable due to refusal encountered at the bottom of this borehole.

#### 4.6.5 SILTY SAND TILL

Below the clay deposits (except for Boreholes 15+469 CL, 15+499 Rt and 15+501 Lt), a glacial till deposit was contacted at depths ranging from 2.3 m to 7.2 m or below Elevations 185.5 and 180.6 m. The till was penetrated for a vertical distance of 0.6 to 4.0 m where the boreholes were terminated.



The grain-size distribution of two samples from the deposit is given in Figure B6-6 of Appendix B4. These indicate 10-25% gravel, 44-54% sand, 25-32% silt and 4-6% clay-size particles. The measured natural moisture contents of the recovered samples from this deposit range from 10 to 16% but generally 10 to 12%.

Based on this and visual and tactile examination of the soil samples, the deposit is described as silty sand till, which consists of a heterogeneous, unsorted mixture of sand and silt with some gravel and clay. It is described as a granular material.

Standard Penetration tests performed in this deposit yielded N-values ranging from 2 to in excess of 50 blows/0.3 m, but generally 30 to 45 blows/0.3 m. Based on these results, the state of compactness of this deposit is described as very loose to very dense but generally compact to dense.

A DCPT was conducted in Borehole 15+531 CL from a depth of 8.1 m to 9.2 m and the test results are presented on the corresponding Record of Borehole Sheet.

#### 4.6.6 GROUNDWATER CONDITIONS

Upon their completion, water levels in the open boreholes were measured at depths ranging from 3.7 to 5.5 m below the ground surface. These levels are, however, not considered to be stabilized.

To enable us to monitor the groundwater level over a prolonged period of time without interference from surface water, a piezometer was installed in Borehole 15+531 CL within the clay deposit at a depth of 5.8 m below the ground surface. Water level in this piezometer was measured at 0.3 m below the ground surface or at Elevation 187.3 m, about two weeks after its installation. Based on the above observation and the colour of the soils encountered in the boreholes, it is our opinion that the groundwater level at the site was at or very close to the ground surface.

It should be pointed out that the groundwater table would be subject to seasonal fluctuations and a perched water condition can occur in the more pervious surficial deposits overlying the practically impervious clay deposit.

# Drawings

# METRIC

DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN. STATIONS  
ARE IN KILOMETRES + METRES.

NOTE:  
BOREHOLES 95-10,95-11,95-12,95-13  
BY GOLDER ASSOCIATES LTD  
LOCATIONS ARE VERY APPROXIMATE.  
FOR DETAILED SUBSURFACE CONDITIONS OF ALL  
BOREHOLES & TEST PITS REFER TO RECORD OF BOREHOLE  
SHEETS & TEST PITS LOGS.

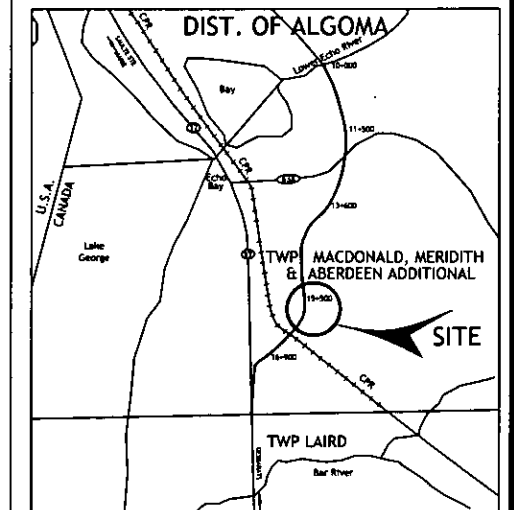
CONT No.

GWP: 354-94-00

HIGHWAY 17 (NEW) EBL  
ECHO RIVER TO BAR RIVER ROAD  
SITE No. 6  
BORE HOLE LOCATIONS & SOIL STRATA



## SHAHEEN & PEAKER LIMITED



KEY PLAN  
N.T.S

### LEGEND

- Bore Hole
- Bore Hole Done By MTO, Golder Associates Ltd.
- N Blows/0.3m (Std. Pen. Test, 475 J/blow)
- Cu Undrained Shear Strength measured by Field Vane Test
- Water Level at Time of Investigation Apr. 2002
- Test Pit

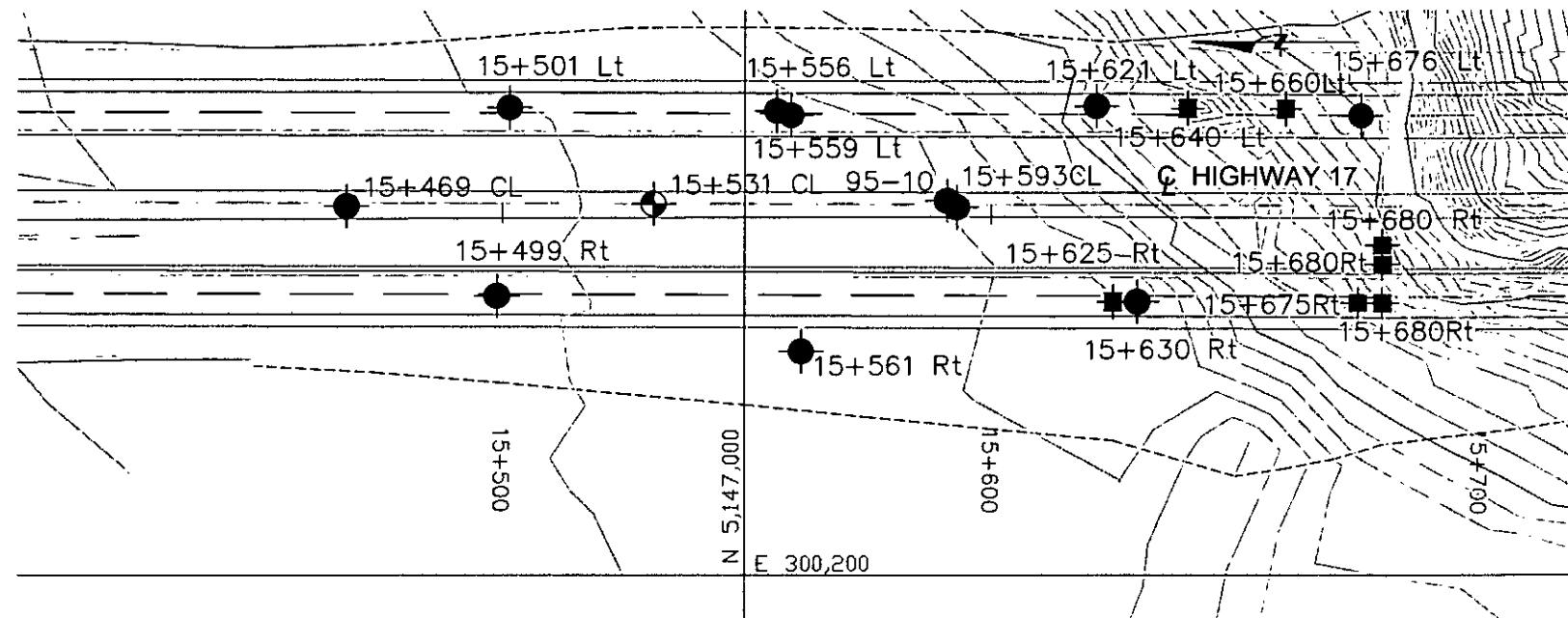
No.	ELEV.	CO-ORDINATES	
		NORTH	EAST
15+499 Rt	187.4	5 147 050.5	300 257.7
15+561 Rt	187.8	5 146 988.4	300 246.2
15+630 Rt	187.9	5 146 919.6	300 256.4
15+680 20m Rt	192.5	5 146 869.6	300 256.2

### NOTE

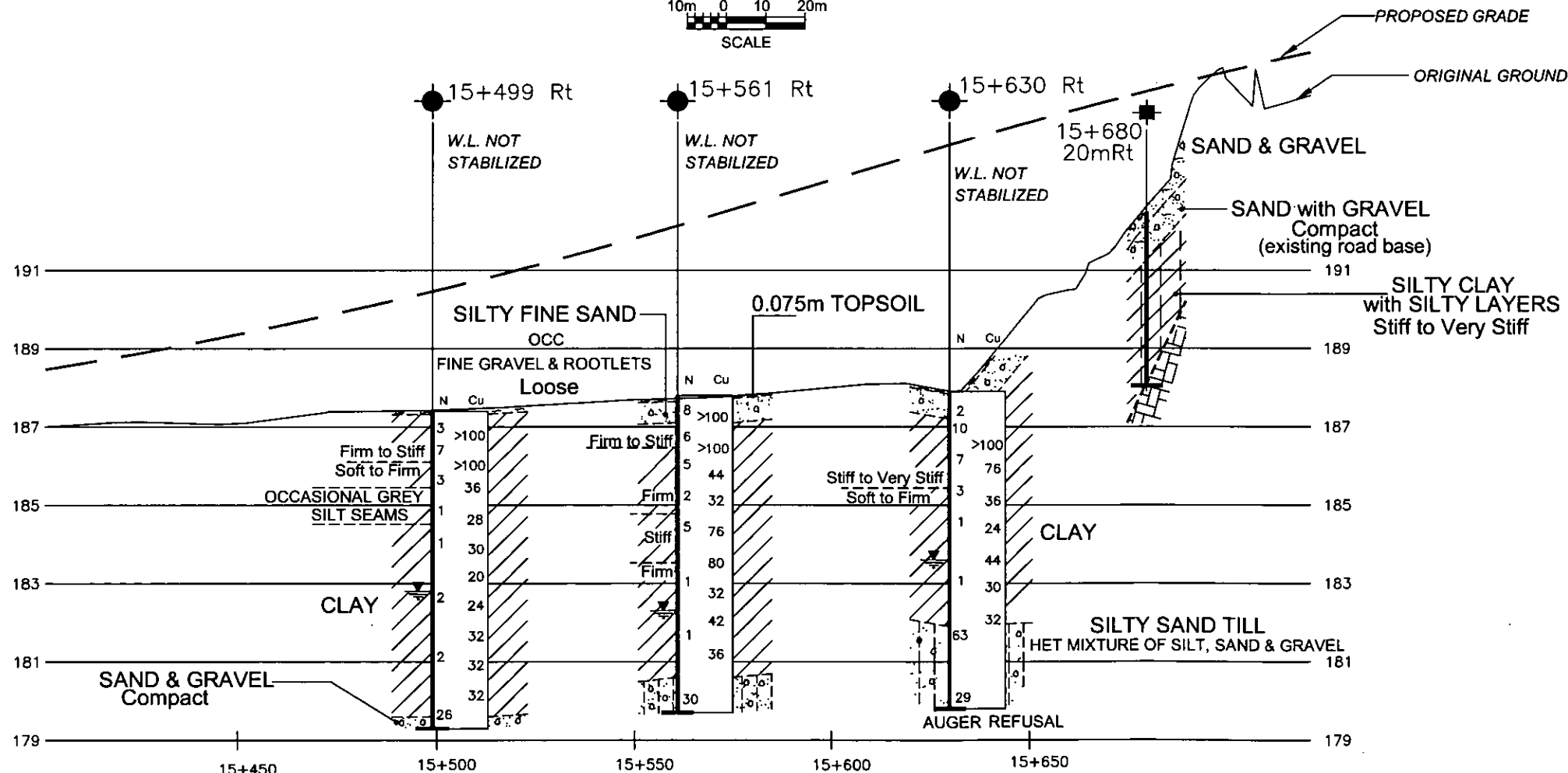
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents are specifically excluded in accordance with the conditions of Section GC 2.01 of OPS Gen. Cond.

REV.	DATE	BY	DESCRIPTION
Geocres No.			
HWY No. 17 (New)			DIST 62
SUBM'D ZO	CHECKED ZO	DATE Mar, 2003	SITE
DRAWN JZ	CHECKED	APPROVED	DWG 6A

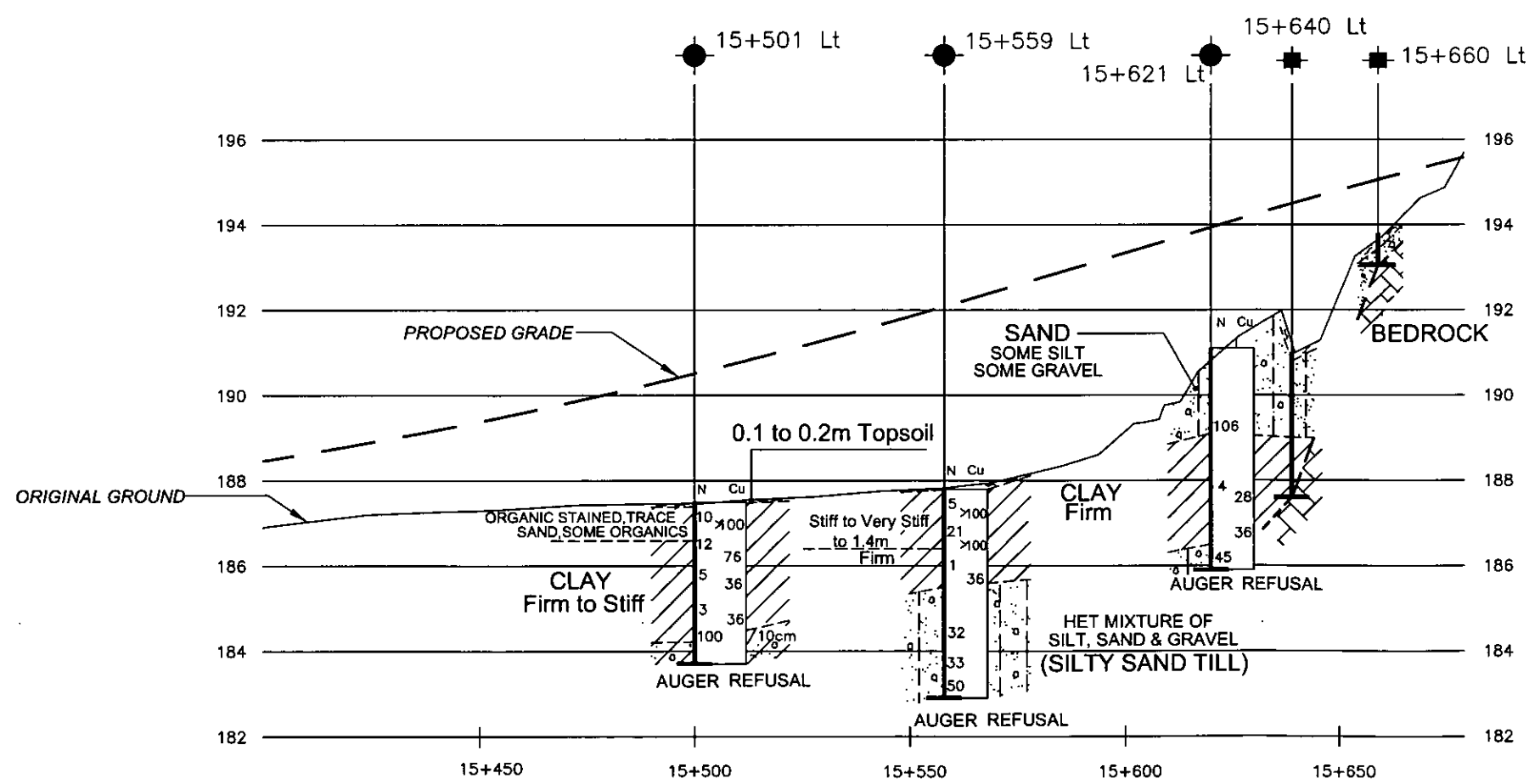
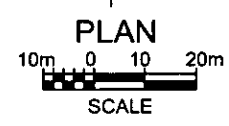
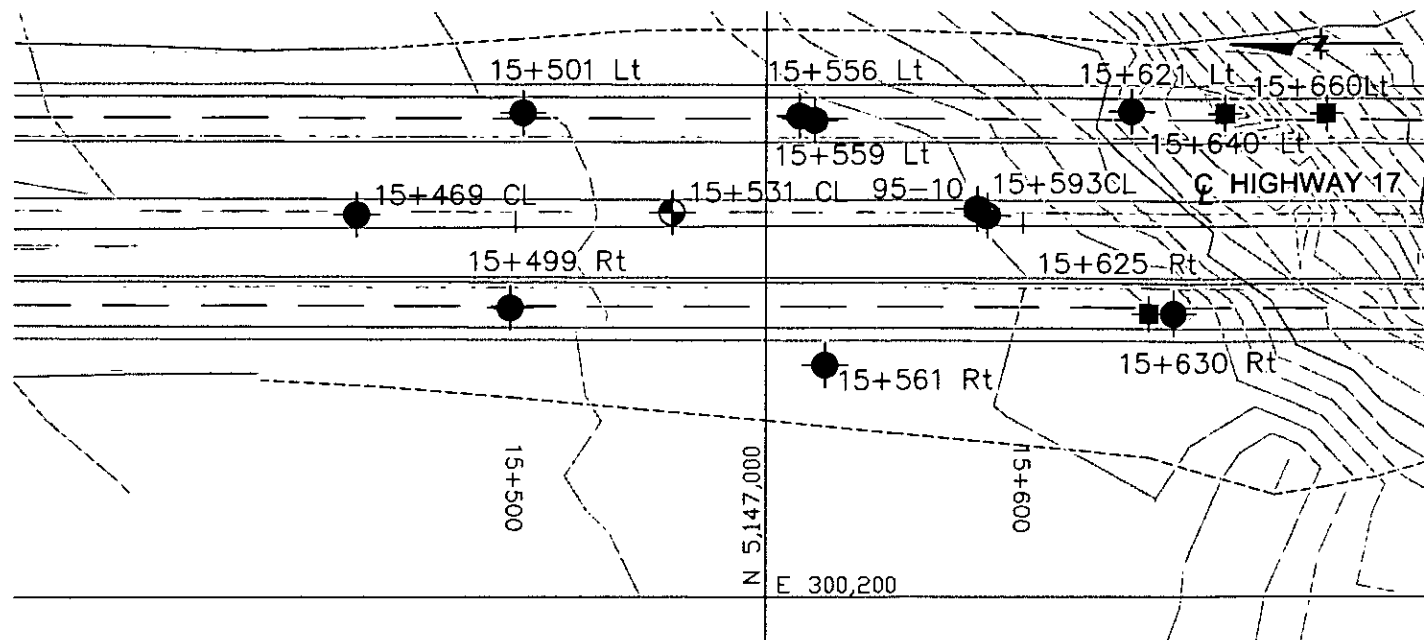


PLAN  
10m 0 10 20m  
SCALE

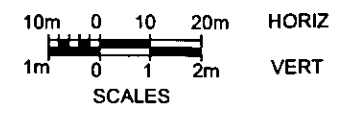


PROFILE EASTBOUND LANES

10m 0 10 20m HORIZ  
1m 0 1 2m VERT  
SCALES



PROFILE WESTBOUND LANES



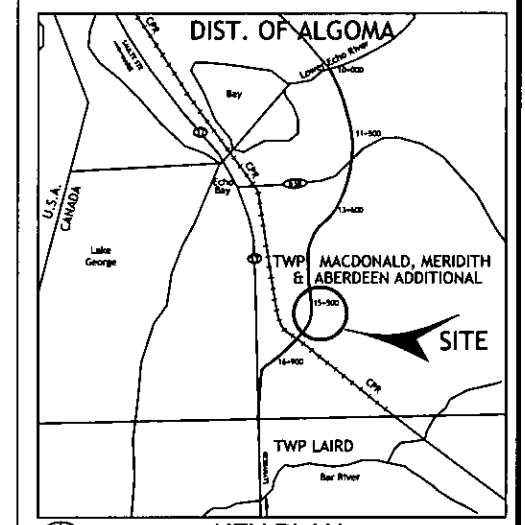
# METRIC

DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN. STATIONS  
ARE IN KILOMETRES + METRES.

NOTE:  
BOREHOLES 95-10,95-11,95-12,95-13  
BY GOLDER ASSOCIATES LTD  
LOCATIONS ARE VERY APPROXIMATE.  
FOR DETAILED SUBSURFACE CONDITIONS OF ALL  
BOREHOLES & TEST PITS REFER TO RECORD OF BOREHOLE  
SHEETS & TEST PITS LOGS.

CONT No.	
GWP: 354-94-00	
HIGHWAY 17 (NEW) WBL ECHO RIVER TO BAR RIVER ROAD SITE No. 6	
BORE HOLE LOCATIONS & SOIL STRATA	

## SHAHEEN & PEAKER LIMITED



KEY PLAN  
N.T.S.

LEGEND			
	Bore Hole		
	Bore Hole Done By MTO, Golder Associates Ltd.		
N	Blows/0.3m (Std. Pen. Test, 475 J/blow)		
Cu	Undrained Shear Strength measured by Field Vane Test		
	Water Level at Time of Investigation		
	Test Pit		

No.	ELEV.	CO-ORDINATES	
		NORTH	EAST
15+501 Lt	187.5	5 147 048.0	300 296.6
15+559 Lt	187.8	5 146 990.4	300 295.0
15+621 Lt	191.1	5 146 928.0	300 296.8
15+640 Lt	191.0	5 146 909.4	300 296.3
15+660 Lt	193.8	5 146 889.4	300 296.3

**NOTE**  
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes 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 Materials Engineering and Research Office, Downsview. Information contained in this report and related documents are specifically excluded in accordance with the conditions of Section GC 2.01 of OPS Gen. Cond.

REV.	DATE	BY	DESCRIPTION

Geocres No.			
HWY No. 17 (New)	DIST 62		
SUBMD ZO	CHECKED ZO	DATE Mar, 2003	SITE
DRAWN JZ	CHECKED	APPROVED	DWG 6B

## Appendix A6

# Record of Boreholes and Test Pit Logs

# RECORD OF BOREHOLE No 15+469 CL

1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 147 080.8; E 300 276.3 ORIGINATED BY Y.L.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.L.  
DATUM Geodetic DATE 4/22/2002 CHECKED BY Z.O.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT  γ  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 ○ UNCONFINED    + FIELD VANE ● POCKET PENETR.    × LAB VANE				
187.4	Ground Surface											
0.0	0.25 m Topsoil, trace fine sand to 0.7 m		1	SS	5							
			2	SS	30							
	very stiff		3	SS	5							
	firm to stiff		4	SS	3							
			5	SS	2							
			6	SS	4							
	CLAY reddish grey to grey											
			7	TW	PH							
			8	SS	2							
			9	SS	3							
			10	SS	1							
			11	SS	56/20							
175.4	with silty sand and fine gravel											
12.0	End of borehole. Auger refusal probably on a boulder or bedrock.  * Water level at 3.7 m (not stabilized) and hole open to 10.4 m on completion  ** Dynamic Cone Penetration Test attempted at 12.0 m. No penetration. Rods and cone bouncing probably on a boulder or bedrock  Borehole advanced 0.5 m right of center line.											

RECORD OF BOREHOLE No 15+499; 19 m Rt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 147 050.5; E 300 257.7 ORIGINATED BY Y.L.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.L.  
DATUM Geodetic DATE 4/22/2002 CHECKED BY Z.O.

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			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● POCKET PENETR. × LAB VANE				
187.4	Ground Surface											
0.0	0.1 m Topsoil		1	SS	3						18.0	
		firm to stiff	2	SS	7						18.1	
		soft to firm	3	SS	3						16.4	
	occasional grey silt seams		4	SS	1							
			5	SS	1							
	CLAY reddish grey to grey trace rootlets to 0.7 m		6	SS	2							
			7	SS	2							
179.6			8	SS	26							
7.8	SAND and GRAVEL grey, saturated, compact											
179.9	End of borehole											
8.1	* Water level at 4.6 m (not stabilized) and hole open to 7.2 m on completion											

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 (% STRAIN AT FAILURE

# RECORD OF BOREHOLE No 15+501; 20 m Lt 1 OF 1 METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 147 048.0; E 300 296.6 ORIGINATED BY Y.L.  
 DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.L.  
 DATUM Geodetic DATE 4/23/2002 CHECKED BY Z.O.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ 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 ○ UNCONFINED    + FIELD VANE ● POCKET PENETR.    × LAB VANE							
187.5 0.0	Ground Surface 0.1 m Topsoil  organic stained, trace of sand, some organics -----  CLAY trace rootlets to 2.1 m reddish grey firm to stiff		1	SS	10										
			2	SS	12										
			3	SS	5										
			4	SS	3										
184.3 3.2			5	SS	100/10										
183.7 3.8			6	AS	-										
	CLAY some sand and gravel occasional fragmented sandstone pieces reddish grey													** Fragmented sandstone in spoon tip	
	End of borehole. Auger refusal at 3.8 m, probably on a boulder or bedrock.  Borehole moved to N 5147045.9, E 300296.6, refusal at 3.0 m.  Borehole moved again to N 5147050.9, E 300296.6, refusal at 4.6 m.  Borehole finally moved to N 5147037.9, E 300296.6, refusal again at 2.3 m.  * Wet cave at 3.0 m.														



# RECORD OF BOREHOLE No 15+531 CL

1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 147 018.3; E 300 268.0 ORIGINATED BY Y.L.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers & DCPT COMPILED BY M.L.  
DATUM Geodetic DATE 4/21/2002 CHECKED BY Z.O.

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			SHEAR STRENGTH kPa				
								○ UNCONFINED + FIELD VANE ● POCKET PENETR. x LAB VANE				
187.6	Ground Surface						20 40 60 80 100	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>		GR SA SI CL
0.0	0.1 m Peat, dark brown to black.		1	SS	2							
			2	SS	5						17.6	
			3	SS	2						17.2	
			4	SS	3							
	CLAY trace rootlets to 2.1 m reddish grey firm to stiff		5	SS	3							
			6	TW	PH						17.3	Consolidation Test
			7	SS	1							
			8	SS	1							
180.7	Heterogenous mixture of silt, sand and gravel (SILTY SAND TILL) reddish grey, wet, dense		9	SS	45							** Unable to push vane below 6.9 m
179.5	End of borehole											
178.4	End of Dynamic Cone Penetration Test											
9.2	** Dynamic Cone Penetration Test performed from 8.1 m to 9.2 m.  Piezometer installed to 5.8 m. Water level on April 21, 2002 - 3.0 m below ground surface; May 6, 2002 - 0.3 m below ground surface.  Borehole advanced 8.7 m right of center line											

+ 3, X 3: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 15+556; 19 m Lt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 146 993.4; E 300 295.9 ORIGINATED BY Y.L.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.L.  
DATUM Geodetic DATE 4/21/2002 CHECKED BY Z.O.

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 (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				
187.8 0.0	Ground Surface							<div><div>20406080100</div><div>○ UNCONFINED + FIELD VANE</div><div>● POCKET PENETR. X LAB VANE</div><div>20406080100</div></div>				
186.3 1.5	Augered from 0.0 m to 1.5 m. Refer to Borehole 15+559 Lt for soil stratigraphy.							<div><div>20406080100</div><div>○ UNCONFINED + FIELD VANE</div><div>● POCKET PENETR. X LAB VANE</div><div>20406080100</div></div>				
185.6 2.2	CLAY reddish grey, firm	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></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# RECORD OF BOREHOLE No 15+559; 18 m Lt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 146 990.4; E 300 295.0 ORIGINATED BY Y.L.  
 DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.L.  
 DATUM Geodetic DATE 4/20/2002 CHECKED BY Z.O.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT  γ  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 ○ UNCONFINED + FIELD VANE ● POCKET PENETR. × LAB VANE					PLASTIC LIMIT w <sub>p</sub> NATURAL MOISTURE CONTENT w LIQUID LIMIT w <sub>L</sub> WATER CONTENT (%)			
187.8 0.0	Ground Surface 0.1 m Topsoil  trace sand, rootlets  -----  CLAY reddish grey stiff to very stiff to 1.4 m firm below		1	SS	5		187						18.7			
			2	SS	21											18.3
			3	SS	1											
185.5 2.3	Heterogenous mixture of silt, sand and gravel (SILTY SAND TILL) grey, wet compact to very dense		4	TW	PH		185							10 54 32 4		
			5	SS	32											
			6	SS	33											
			7	SS	50											
182.9 4.9	End of borehole. Auger refusal probably on a boulder. Borehole moved to N 5146992.5, E 300295.9, see Record of Borehole Log 15+556 Lt.  * Wet cave at 3.0 m.  ** Sampler met refusal at 2.3 m. No recovery.															

RECORD OF BOREHOLE No 15+561; 30 m Rt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 146 988.4, E 300 246.2 ORIGINATED BY Y.L.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.L.  
DATUM Geodetic DATE 4/21/2002 CHECKED BY Z.O.

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 (%) GR SA SI CL			
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● POCKET PENETR. x LAB VANE					w <sub>p</sub> w      w <sub>L</sub>		
187.8	Ground Surface						20	40	60	80	100	20	40	60	
0.0	0.1 m Topsoil		1	SS	8										
187.1	<b>SILTY FINE SAND</b> occasional fine gravel and rootlets grey brown, wet, loose														
0.7	occasional silt inclusions firm to stiff		2	SS	6										
			3	SS	5										
	<b>CLAY</b> reddish grey		4	SS	2										
	firm		5	SS	5										
	stiff														
	firm		6	SS	1										
			7	SS	1										
180.6	Heterogenous mixture of silt, sand and gravel <b>(SILTY SAND TILL)</b> brown, moist, compact to dense		8	SS	30										
179.7	End of borehole														
8.1	* Water level at 5.5 m (not stabilized) and hole open to 6.7 m on completion														

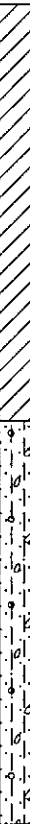
+<sup>3</sup> x<sup>3</sup>: Numbers refer to  
Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 15+593 CL

1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 146 956.5; E 300 276.0 ORIGINATED BY Y.L.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.L.  
DATUM Geodetic DATE 4/20/2002 CHECKED BY Z.O.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT  γ  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 ○ UNCONFINED    + FIELD VANE ● POCKET PENETR.    × LAB VANE					WATER CONTENT (%) w <sub>p</sub> w                      w <sub>L</sub>			
188.0 0.0	Ground Surface 0.1 m Topsoil		1	SS	8		188						19.5			
	CLAY trace sand to 0.7 m trace organics to 1.4 m reddish grey		2	SS	9		187								18.2	
			stiff to very stiff	3	SS		12	186								17.2
			firm	4	SS		1	185								
				5	SS		1	184								
183.9 4.1	Heterogenous mixture of silt, sand and gravel (SILTY SAND TILL) reddish grey to grey wet	6	SS	24	183											
		7	SS	41	182											
		dense	8	SS	33		181									
		very loose	9	SS	2		180									
179.9 8.1	End of borehole  * Wet cave at 4.7 m.  Borehole advanced 0.5 m right of center line.															

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 15+621; 20 m Lt 1 OF 1 METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 146 928.0; E 300 296.8 ORIGINATED BY Y.L.  
 DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.L.  
 DATUM Geodetic DATE 4/24/2002 CHECKED BY Z.O.

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 (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● POCKET PENETR. x LAB VANE				
191.1 0.0	Ground Surface						20 40 60 80 100	20 40 60				
189.1 2.0	SAND some silt, some gravel brown, moist		1	AS	-							
			2	AS	-							
			3	SS	106							
186.5 4.6	CLAY trace organics reddish grey firm		4	SS	4							
185.9 5.2	Heterogenous mixture of silt, sand and gravel (SILTY SAND TILL) grey, dense		5	SS	45							
	End of borehole. Auger refusal on possible bedrock.  * Wet cave at 0.3 m on completion											

+<sup>3</sup>, x<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 15+630; 20 m Rt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 146 919.6; E 300 256.4 ORIGINATED BY Y.L.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.L.  
DATUM Geodetic DATE 4/23/2002 CHECKED BY Z.O.

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			SHEAR STRENGTH kPa ○ UNCONFINED    + FIELD VANE ● POCKET PENETR.    × LAB VANE					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT					
187.9 0.0	Ground Surface						20	40	60	80	100	20	40	60	GR	SA	SI	CL
187.2 0.7	0.1 m Topsoil  <b>SAND</b> some gravel, trace silt brown, wet, very loose		1	SS	2										14	76	8	2
			2	SS	10													
			3	SS	7													
			4	SS	3													
			5	SS	1													
			6	SS	1													
			7	SS	63													
			8	SS	29													
181.9 6.0	Heterogenous mixture of silt, sand and gravel <b>(SILTY SAND TILL)</b> grey, brown, moist compact to very dense														25	44	25	6
179.8 8.1	End of borehole. Auger refusal probably on a boulder or bedrock.  * Water level at 4.3 m (not stabilized) and hole open to 6.4 m on completion.																	

# RECORD OF BOREHOLE No 15+676; 19 m Lt 1 OF 1 METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 146 873.9; E 300 295.0 ORIGINATED BY Y.L.  
 DIST 62 HWY 17 (New) BOREHOLE TYPE Solid Stem Augers & Casing & Wash Boring & BQ Coring COMPILED BY M.L.  
 DATUM Geodetic DATE 5/6/2002 CHECKED BY Z.O.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
194.9	Ground Surface							20 40 60 80 100					
0.0	0.1 m Topsoil							20 40 60 80 100					
	SILTY SAND (trace clay, trace gravel) occasional cobbles and boulders, damp to moist reddish grey		1	AS	-		194	20 40 60 80 100					8 54 25 13
			2	AS	-			20 40 60 80 100					
			3	RC	-			20 40 60 80 100					*casing and was boring
183.4	SANDSTONE BEDROCK reddish brown		4	BQ	Rec		193	20 40 60 80 100					RQD=25%
1.5				RC	83%			20 40 60 80 100					
			5	BQ	Rec		192	20 40 60 80 100					RQD=65%
				RC	100%			20 40 60 80 100					
			6	BQ	Rec		191	20 40 60 80 100					RQD=80%
				RC	100%			20 40 60 80 100					
			7	BQ	Rec			20 40 60 80 100					RQD=90%
				RC	100%			20 40 60 80 100					
190.0	End of borehole.							20 40 60 80 100					
4.9	Piezometer installed to 4.9 m. Water level on May 6, 2002 - 0.6 m (El. 194.3 m); Oct. 19, 2002 - 2.1 m (El. 192.8 m)							20 40 60 80 100					



# TEST PIT LOGS

**FILL AREA #3  
(15+470 to 15+690)  
GWP 354-94-00, HIGHWAY 17 (New)  
From Echo River to Bar River Road  
Sault Ste. Marie**

15+625 20m Rt Median C/L

0	-	300	Si Sa W Org, Wet
300	-	5.2	Cl Tr Si layers, Firm to soft, Moist
		5.2	NFP BR

15+640 20m Lt Median C/L

0	-	200	Peat W Org
200	-	600	Si Sa some Gr Occ Blds, Comp, Wet
600	-	2.0	Si Sa some Gr, Comp, Wet
2.0	-	3.4	Cl W Si seams, Varved, Soft to firm, Moist to wet
		3.4	NFP BR

15+660 20m Lt Median C/L

0	-	150	Tps with Sa
150	-	750	Sa and Gr with Blds Wet Comp
		750	NFP BR

15+680 20m Rt Median C/L

0	-	300	Sa and Gr with Org
300	-	900	Sa with Gr Moist Comp (existing road base)
900	-	4.6	Si Cl with Si layers Moist Stiff to very stiff

15+680 8m Rt Median C/L

0	-	100	Tps with Gr Sa
100	-	1.0	Sa and Gr Tr Si Tr Org
1.0	-	3.5	Si Cl Damp to moist Stiff to very stiff
		3.5	NFP (Poss BR)

15+680 12m Rt Median C/L

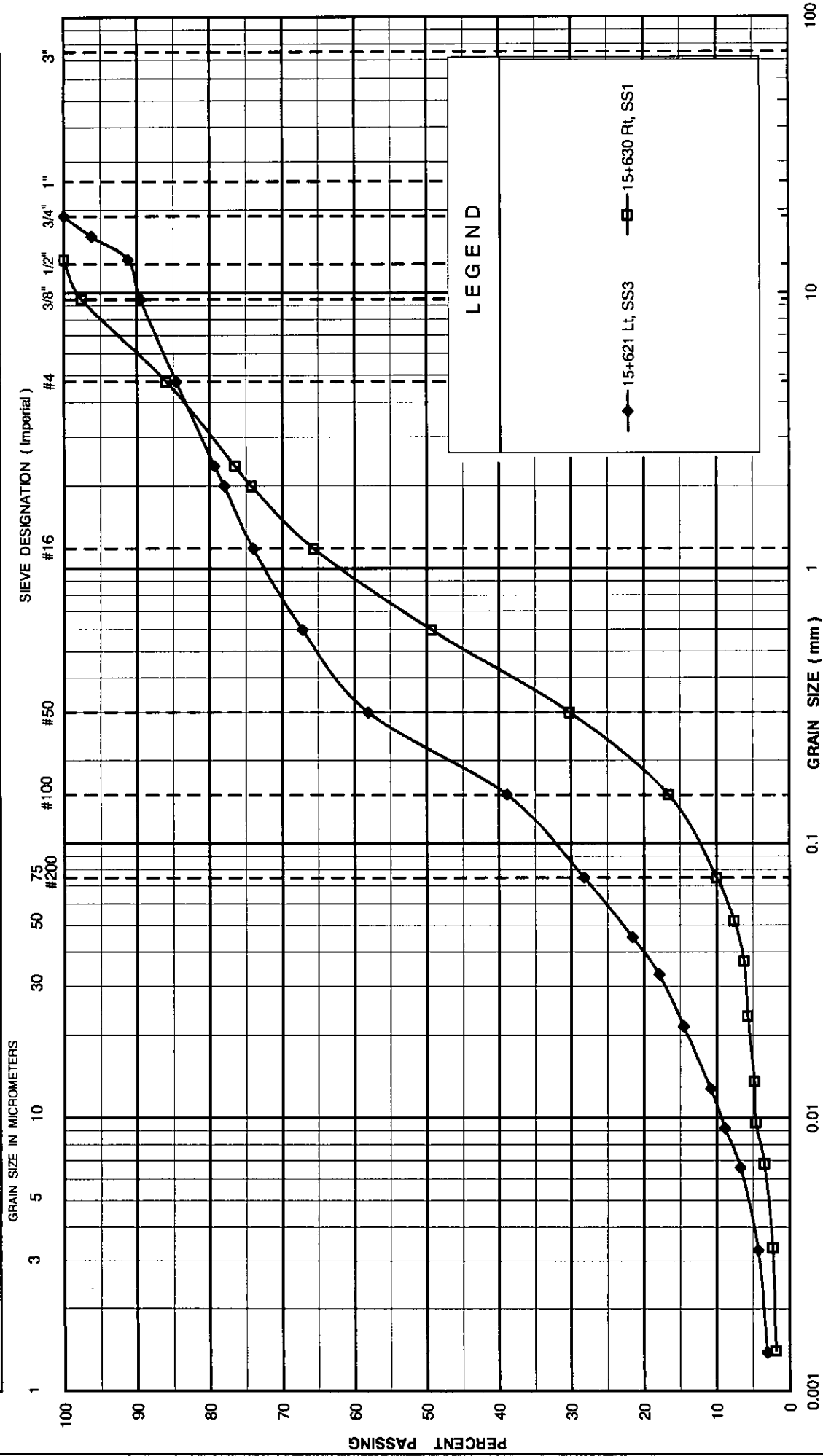
0	-	300	Tps with Gr Sa
300	-	1.0	Sa and Gr Damp
1.0	-	3.0	Si Cl Damp to moist Very stiff
3.0	-	3.8	Si Cl Occ Gr Stiff
		3.8	NFP (Poss BR)

# Appendix B6

## Laboratory Test Results

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT		SAND			GRAVEL		
		Fine	Medium	Coarse	Fine	Coarse	Coarse



## GRAIN SIZE DISTRIBUTION SAND

SHAHEEN & PEAKER LIMITED

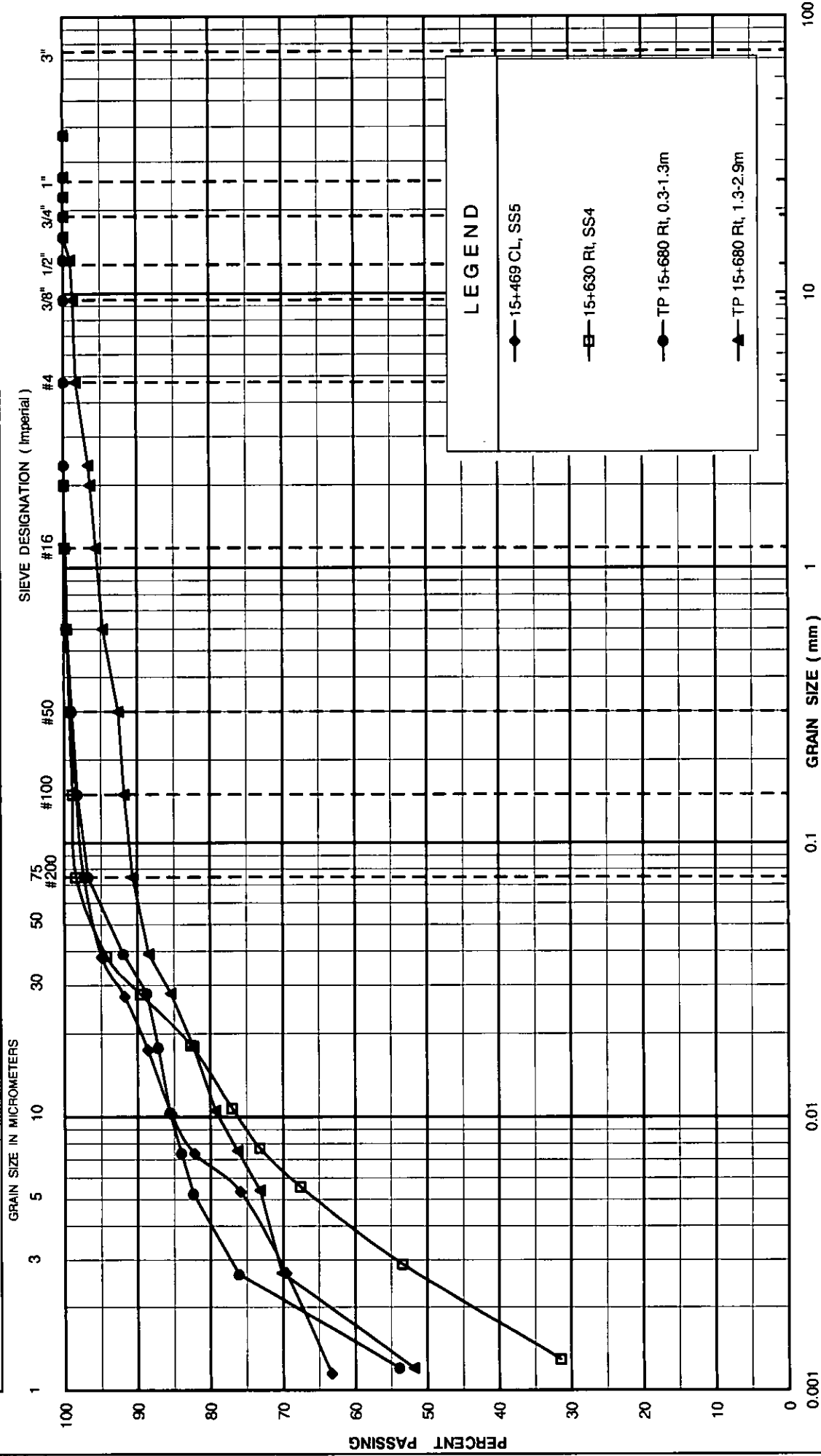
FIG. No. B6-1

REF. No. SPT 1055

G.W.P. 354-94-00

# UNIFIED SOIL CLASSIFICATION SYSTEM

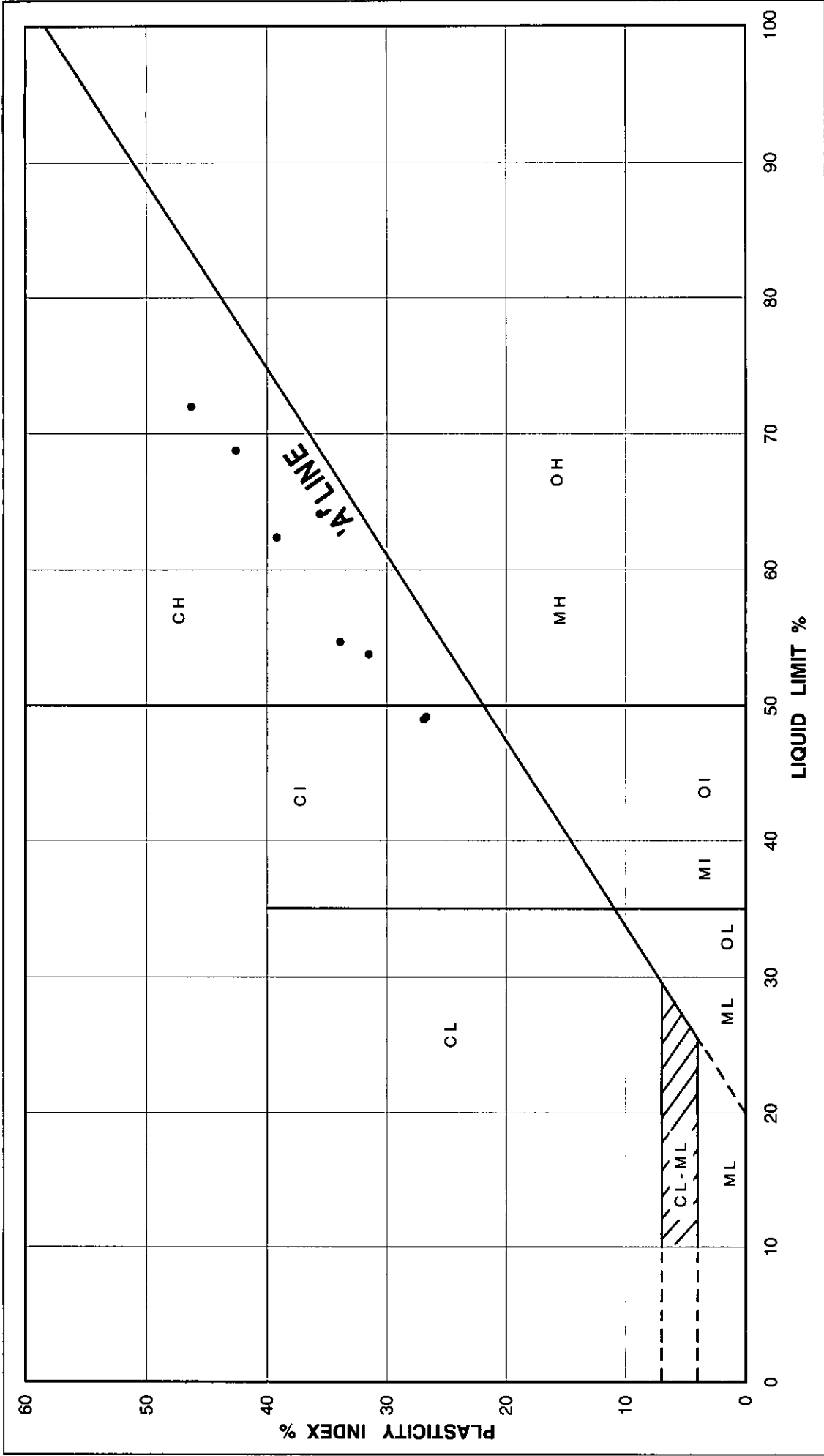
CLAY AND SILT		SAND			GRAVEL		
		Fine	Medium	Coarse	Fine	Coarse	



## GRAIN SIZE DISTRIBUTION CLAY

SHAHEEN & PEAKER LIMITED

FIG. No. B6-2  
REF. No. SPT 1055  
G.W.P. 354-94-00



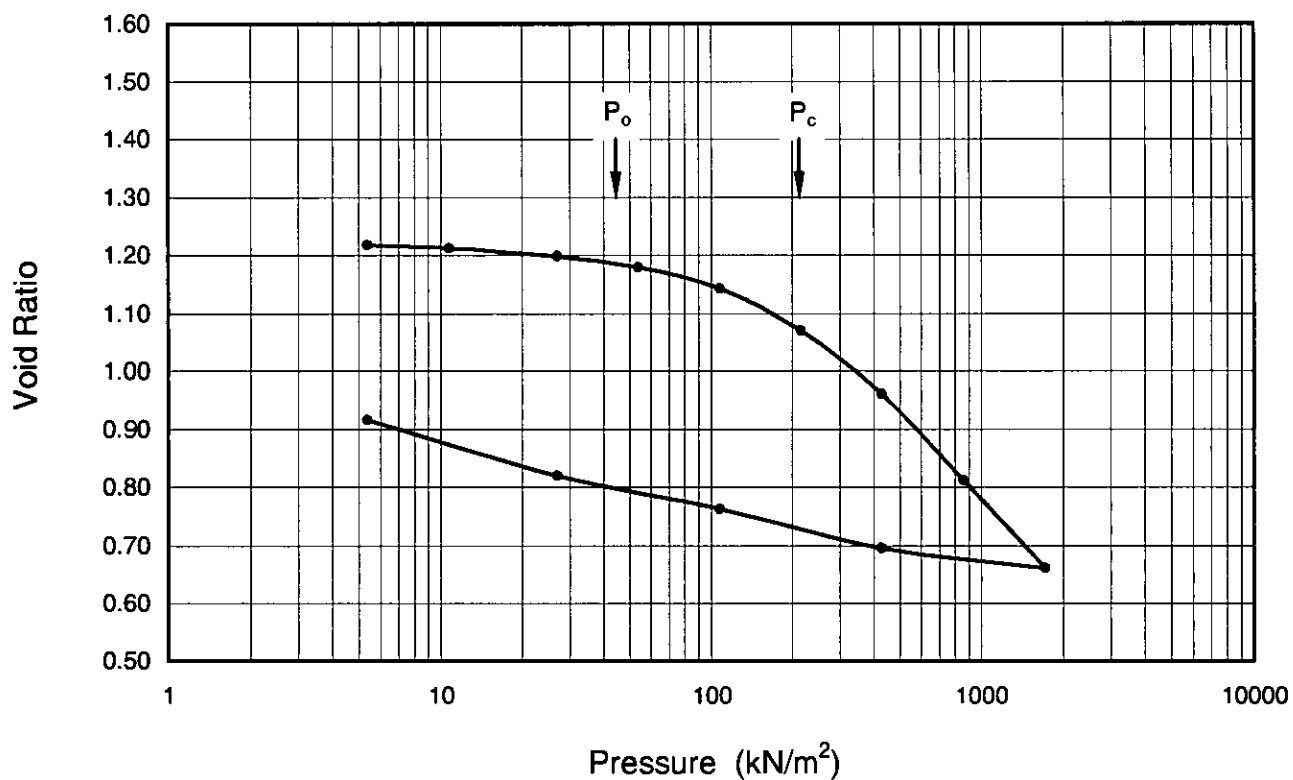
SHAHEEN & PEAKER LIMITED	PLASTICITY CHART		FIG No B6-3
			G.W.P. 354-94-00
			SPT 1055

15+530 CL

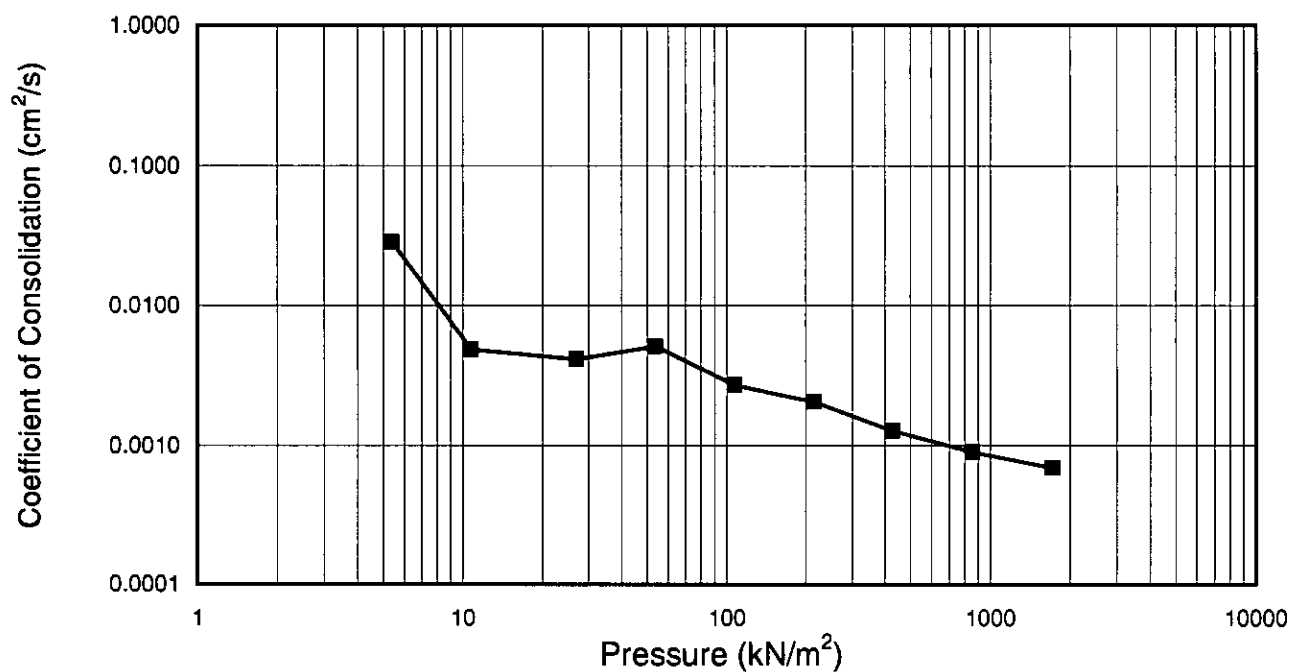
TW 6 Depth 3.8-4.2 m

Fig. B6-4

Void Ratio versus Pressure

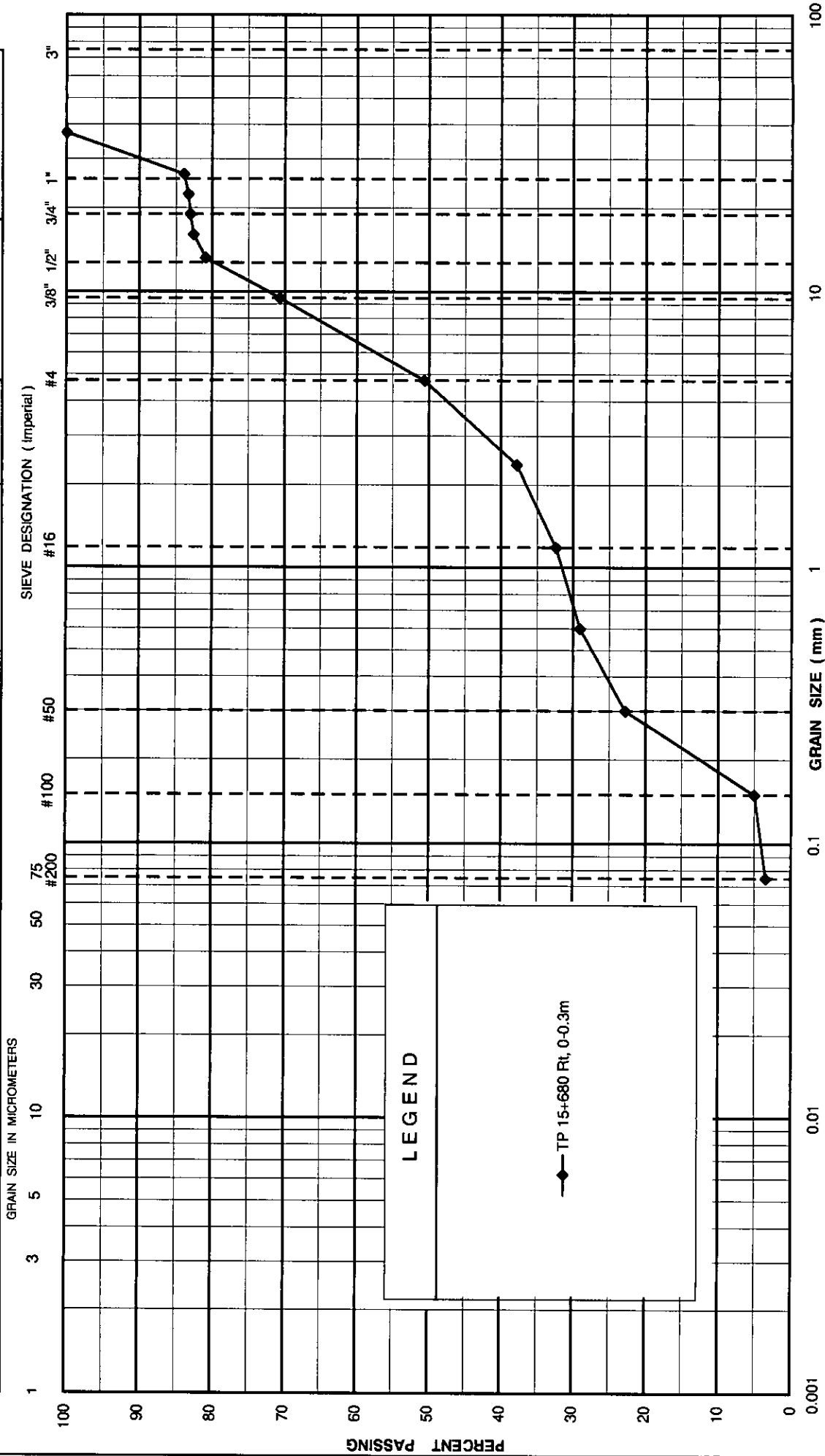


Coefficient of Consolidation vs Pressure



# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT			SAND			GRAVEL		
GRAIN SIZE IN MICROMETERS			Fine	Medium	Coarse	Fine	Coarse	
1	3	5	10	30	50	75	#200	

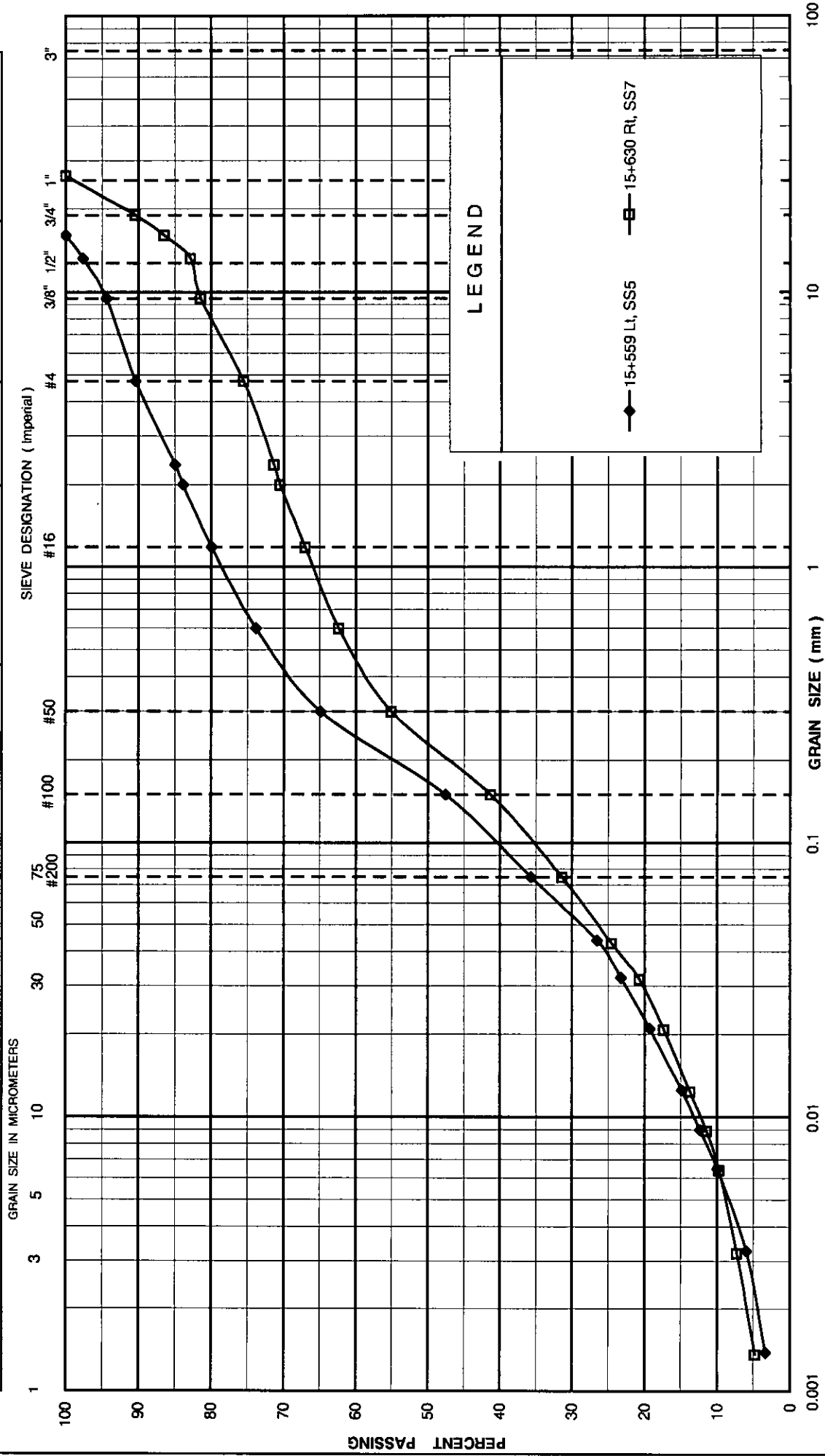


GRAIN SIZE DISTRIBUTION  
SAND AND GRAVEL

FIG. No. B6-5  
REF. No. SPT 1055  
G.W.P. 354-94-00

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT			SAND			GRAVEL		
GRAIN SIZE IN MICROMETERS			Fine	Medium	Coarse	Fine	Coarse	Coarse



GRAIN SIZE DISTRIBUTION  
SILTY SAND TILL

SHAHEEN & PEAKER LIMITED

FIG. No. B6-6

REF. No. SPT 1055

G.W.P. 354-94-00



## Appendix C6

# Measured Undrained Shear Strength Results

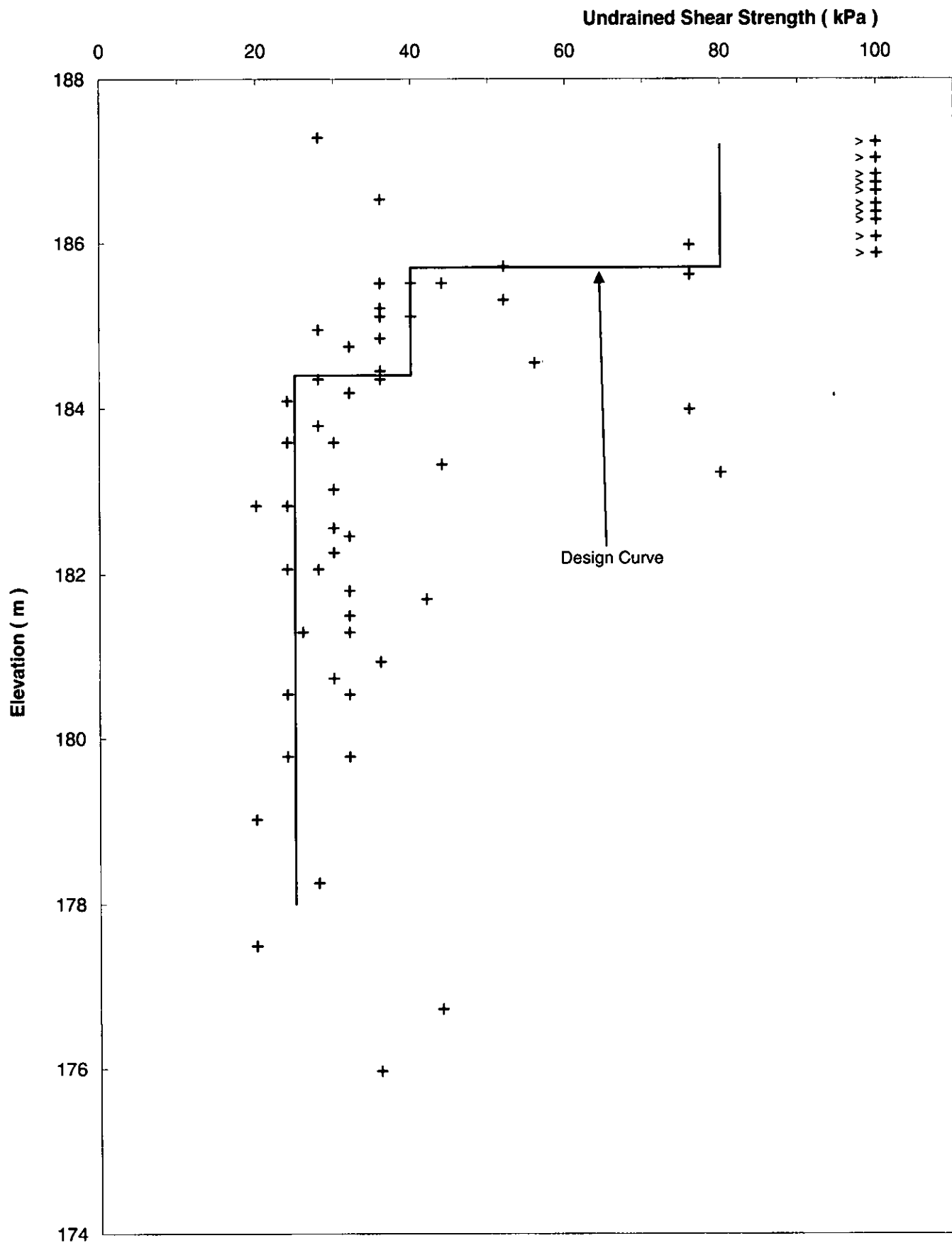


Fig. C6-1: Variation of Undrained Shear Strength (as measured by field vane tests) with Elevation

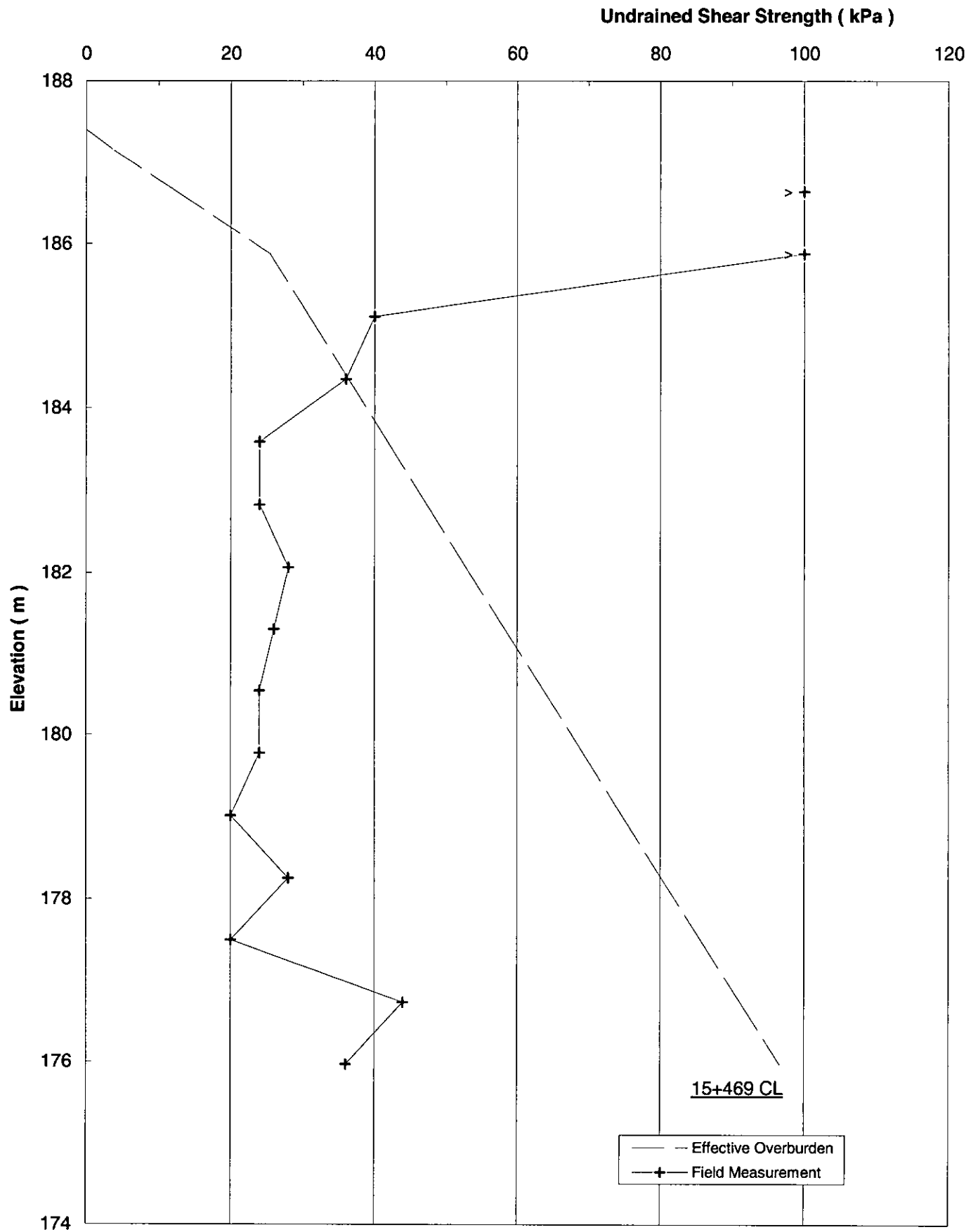


Fig. C6-2: Variation of Undrained Shear Strength (as measured by field vane tests) with Elevation  
(Borehole 15+469 CL)

**4.7 SITE NO. 7 : HIGHWAY 17 (NEW) CUT SECTION BETWEEN STATIONS 15+670 AND 15+850 WESTBOUND LANES, AND FILL AND CUT SECTION BETWEEN STATIONS 15+690 AND 15+850 EASTBOUND LANES**

Site No. 7 is located between Stations 15+670 and 15+850, north of the CPR Crossing and adjacent to Government Road re-alignment.

The site is located in a hilly and wooded area where exposed bedrock knobs and steep rock face were observed. The existing Government Road also intersects the proposed Highway 17 alignment at the following locations: at Stations 15+660 and 15+860 along the EBL, and at Stations 15+600 and 15+910 along the WBL.

The existing grade along the WBL centerline varies from a high Elevation 211.8 m at about Station 15+730, where the grade slopes down towards the north and towards the south (towards increasing station) beyond this station, to a low Elevation 194.7 m. The existing grade along the EBL varies from a high Elevation 196.1 m (at Station 15+700) to a low Elevation 192.9 m within the limits of this section. The existing grades in this section are also sloping down towards the right (west) at a rate of about 10H:1V within the EBL and about 2H:1V within the WBL, with very steep exposed rock face at some locations. The proposed grades along the road centerlines range from about Elevation 195.5 at Station 15+670 to 198.6 m at Station 15+850.

The location plans of the boreholes and test pits along this section of Highway 17 (New) alignment are shown on Drawing Nos. 7A and 7B. The stratigraphic profiles are presented in Drawing Nos. 7A and 7B, respectively. The cross-sections through Stations 15+730 and 15+760 are shown on Drawing Nos. 7C and 7D.

Four boreholes were drilled and twelve test pits were dug in this site. The boreholes and test pits in the area along WBL show, below a generally thin overburden consisting of surficial topsoil and sand and gravel with occasional cobbles and boulders, the presence of bedrock. The bedrock in this area was proven by diamond drilling at Boreholes 15+676 20m Lt, 15+700 20m Rt, 15+730 20m Lt and 15+755 20m Rt (see borehole logs for details). The bedrock is classified as quartzite and sandstone.

The boreholes in the area along EBL show that below variable depths of silty sand, sand and gravel with cobbles and boulders, silty sand till and thin silty clay layer at the south end of this section, this area is underlain by bedrock described above.

Details of the subsurface conditions encountered in the boreholes and test pits are presented on the Record of Borehole Sheets and Test Pit Logs in Appendix A7. The

individual strata are briefly described in the following paragraphs. The logs of Borehole 15+850 22m Rt and Borehole 15+910 20 & 22m Lt, from the adjacent Site 8 to the south, are also included in Appendix A7.

#### 4.7.1 CUT SECTION BETWEEN STATIONS 15+670 AND 15+850 WBL

##### 4.7.1.1 TOPSOIL

In this section, some of the test pits encountered 0.1 to 0.3 m layer of topsoil with sand and gravel.

##### 4.7.1.2 SANDS

Below the topsoil or from the ground surface, most of the test pits contacted thin overburden consisting of silty sand to sand and gravel with occasional cobbles and boulders and traces of silt. This surficial layer extends to a maximum depth of 1.2 m, at the test pit locations.

A grain-size distribution analysis was performed on a sample from this deposit and the results are presented in Figure B7-1, Appendix B7. They indicate the following particle size distribution:

Gravel	=	8%
Sand	=	54%
Silt	=	25%
Clay	=	13%

##### 4.7.1.3 BEDROCK

Underneath the surficial sand and gravel and from the ground surface, the boreholes and test pits from this investigation indicate the presence of bedrock.

The bedrock in this area was proven by diamond drilling along the WBL alignment at the location of Boreholes 15+676 Lt and 15+730 Lt (see Record of Borehole Sheets for details). The bedrock is classified as quartzite between about Stations 15+700 and 15+750. The bedrock to the north of Station 15+700 and to the south of Station 15+750 is described as sandstone. The Rock Quality Designation (RQD) of the quartzite ranged from 71 to 100% indicating good to excellent quality, while the RQD of the sandstone varied between 25 and 65% within the top 1.5 m of the rock indicating poor to fair quality, and 80 to 90% below this depth indicating good rock quality. Quartzites are generally 'very strong' to 'extremely

strong' with unconfined compressive strength (UCS) between 100 to greater than 250 MPa; while the sandstones are considered 'strong' rock with UCS of about 50 to 100 MPa.

#### 4.7.1.4 GROUNDWATER CONDITIONS

Water level observations in the boreholes and test pits were made during excavation and at completion of the test pits and boreholes. A piezometer was also installed in one of the boreholes to measure the groundwater level over a prolonged period of time without interference from surface water.

No groundwater was observed in the boreholes and test pits during and at completion of the excavation, except for Borehole 15+676 Lt, where the measured water level in the piezometer was at a depth of 2.1 m, five months after completion of the borehole. Perched water condition could, however, exist from the accumulation of surface water in the granular soil overlying the bedrock.

#### 4.7.2 FILL AND CUT AREA BETWEEN STATIONS 15+690 AND 15+850 EBL

##### 4.7.2.1 TOPSOIL

In this section, a 0.2 to 0.3 m layer of topsoil with sand and gravel was encountered in majority of the test pits.

##### 4.7.2.2 SAND AND GRAVEL

Below the topsoil or from the ground surface, the boreholes (except Borehole 15+700 20m Rt) and the test pits contacted a surficial layer of silty sand to sand and gravel with traces of gravel and silt and occasional cobbles and boulders.

A grain-size distribution analysis was carried out on a sample from this deposit and the results are presented in Figure B7-2, Appendix B7. They indicate the following particle size distribution:

Gravel	=	63%
Sand	=	35%
Silt	=	2%

#### 4.7.2.3 SILTY SAND TILL

In general, below the sand and gravel layer, a silty sand till deposit was encountered in some of the boreholes and test pits. The glacial till is a heterogeneous mixture of clay, silt, sand and gravel size particles and contains occasional cobbles and boulders. In Borehole 15+755 20m Rt, the sand and gravel deposit contains frequent cobbles and boulders and this deposit extended to a dept of 7.2 m below existing grade. This deposit is described as 'possible till'. Based on the findings of Borehole 15+850 22m Rt (with N-values between 15 and greater than 50 blows/0.3m), the relative density of this coarse deposit was inferred to be generally compact.

A grain-size distribution analysis was performed on a sample from this deposit and the results are presented in Figure B7-3 in Appendix B7. They indicate the following particle size distribution:

Gravel	=	12%
Sand	=	68%
Silt & Clay	=	20%

#### 4.7.2.4 BEDROCK

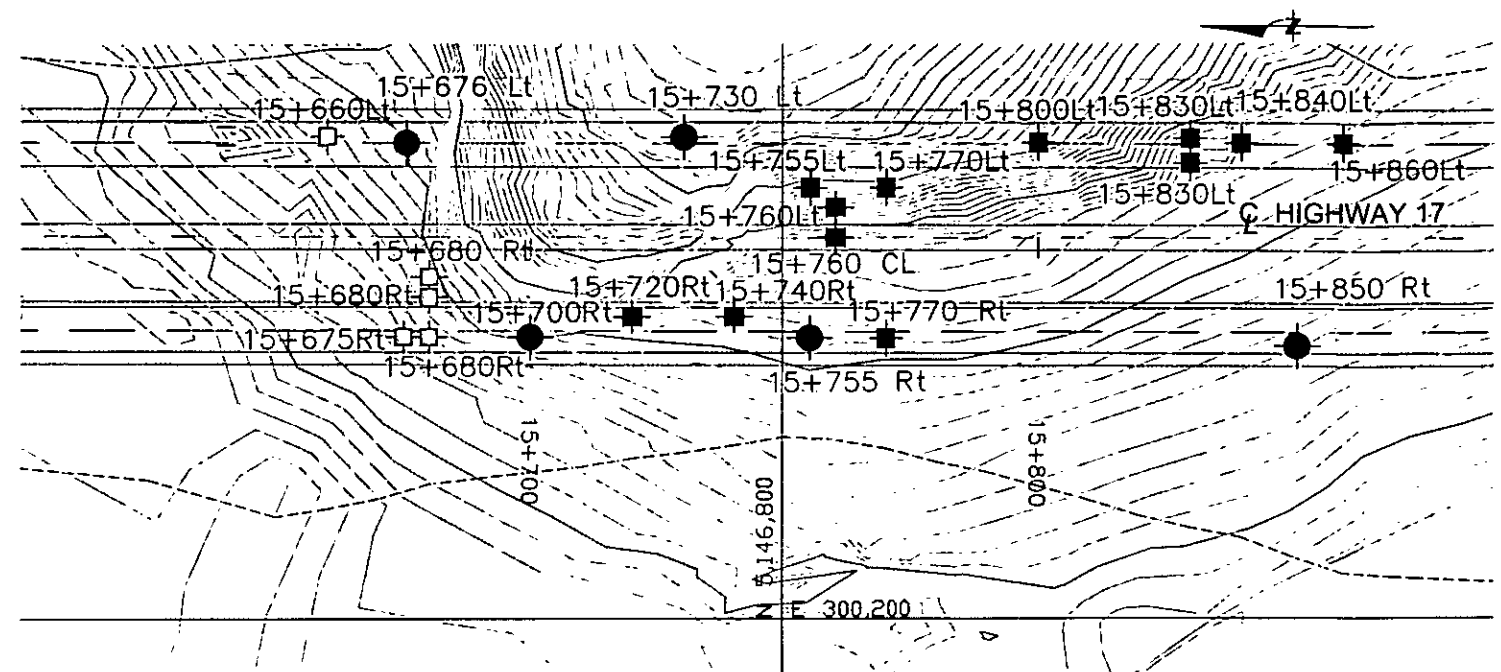
Underneath the sand and gravel and silty sand till, or from the ground surface, the boreholes and test pits from this investigation indicate the presence of bedrock. The description and properties of the bedrock is described in Section 4.7.1.3 of this report.

#### 4.7.2.5 GROUNDWATER CONDITIONS

Water level observations in the boreholes and test pits were made during excavation and at completion of the test pits and boreholes. No groundwater was observed in the boreholes and test pits during or at completion of the excavation, except at the locations of Test Pits 15+720 16m Rt and 15+740 16m Rt. Perched water condition could, however, exist from the accumulation of surface water in the granular soil overlying the bedrock.

# Drawings



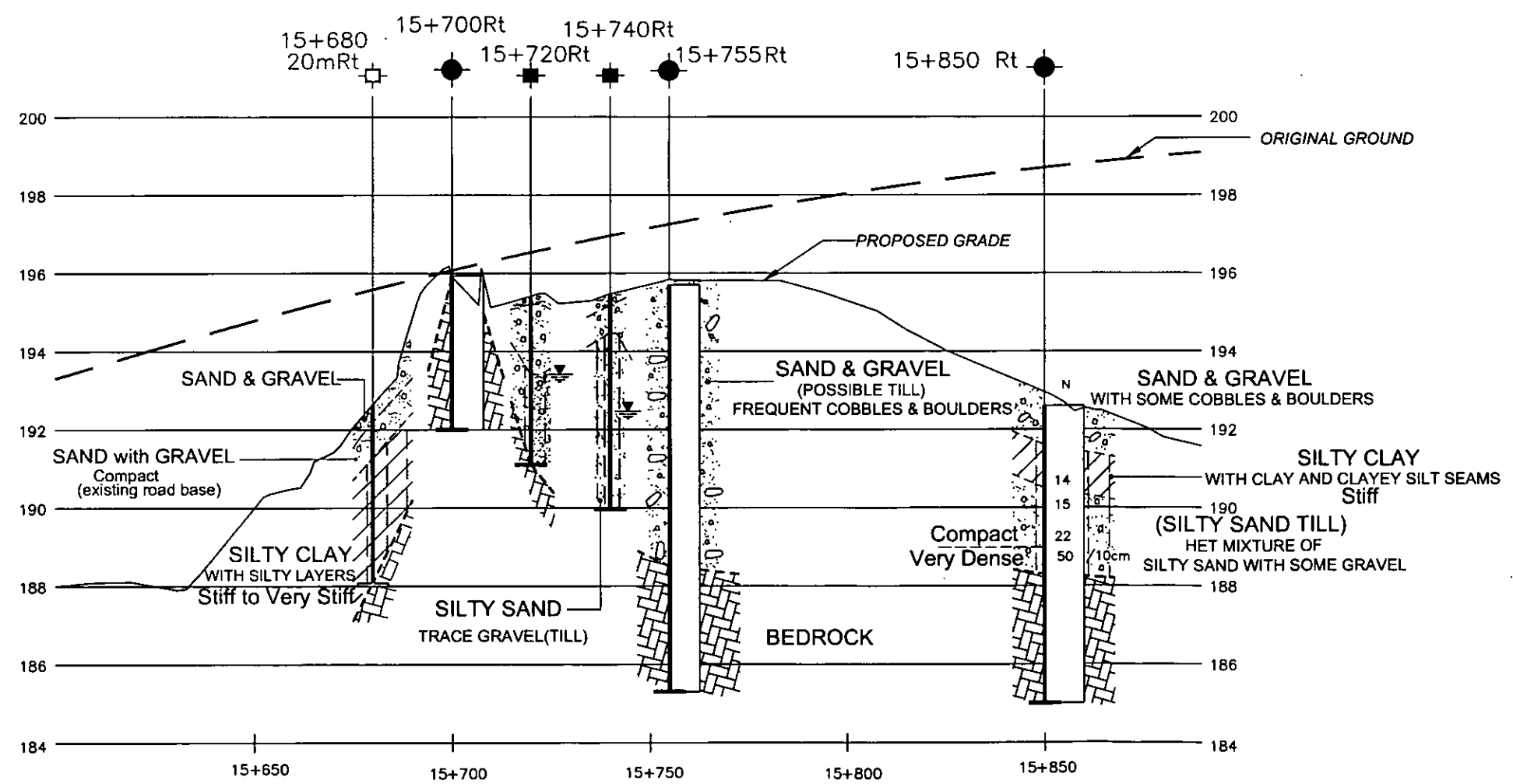


PLAN  
10m 0 10 20m  
SCALE

# METRIC

DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN. STATIONS  
ARE IN KILOMETRES + METRES.

NOTE:  
FOR DETAILED SUBSURFACE CONDITIONS OF ALL  
BOREHOLES & TEST PITS REFER TO RECORD OF BOREHOLE  
SHEETS & TEST PITS LOGS.

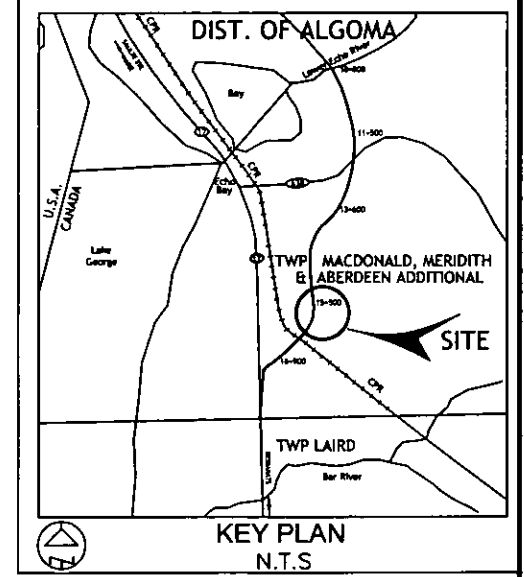


PROFILE EASTBOUND LANES

10m 0 10 20m HORIZ  
1m 0 1 2m VERT  
SCALES

CONT No.	
GWP: 354-94-00	
HIGHWAY 17 (NEW) EBL ECHO RIVER TO BAR RIVER ROAD SITE No. 7	
BORE HOLE LOCATIONS & SOIL STRATA	

## SHAHEEN & PEAKER LIMITED



LEGEND			
	Bore Hole		
N	Blows/0.3m (Std. Pen. Test, 475 J/blow)		
	Water Level at Time of Investigation		
	Water Level in Piezometer		
	Piezometer		
	Test Pit		
	Test Pit Of Site No.6		

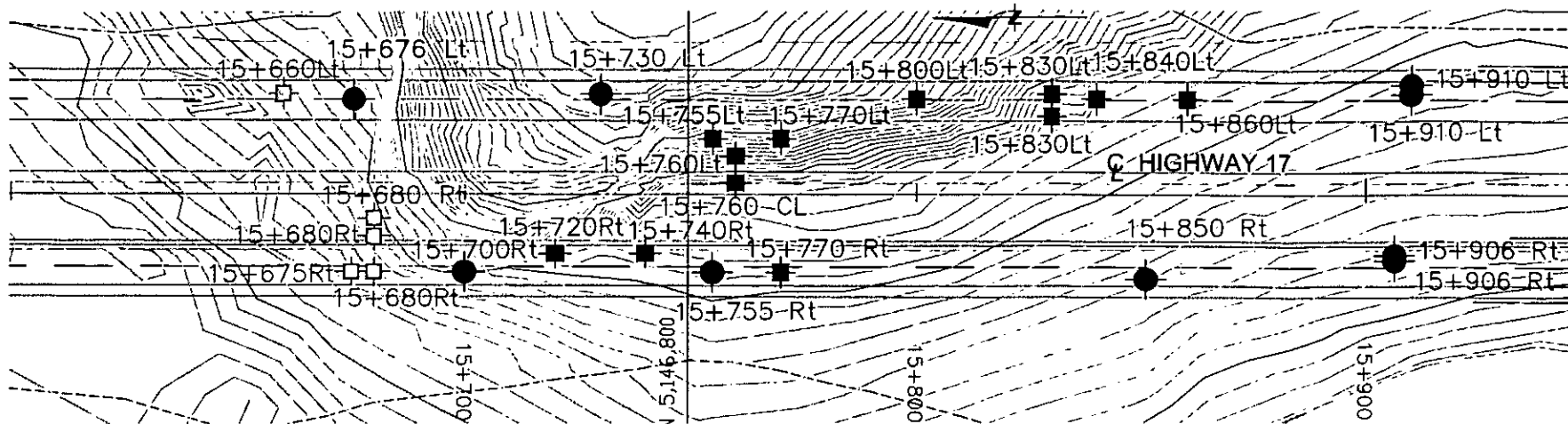
No.	ELEV.	CO-ORDINATES	
		NORTH	EAST
15+700 Rt	195.9	5 146 849.6	300 256.2
15+755 Rt	195.7	5 146 794.6	300 256.0
15+720 Rt	196.1	5 146 829.5	300 260.1
15+740 Rt	195.8	5 146 809.5	300 260.0
15+850 Rt	192.6	5 146 698.5	300 254.3

NOTE:  
The boundaries between soil strata have been established only  
at Bore Hole locations. Between Bore Holes the boundaries  
are assumed from geological evidence.

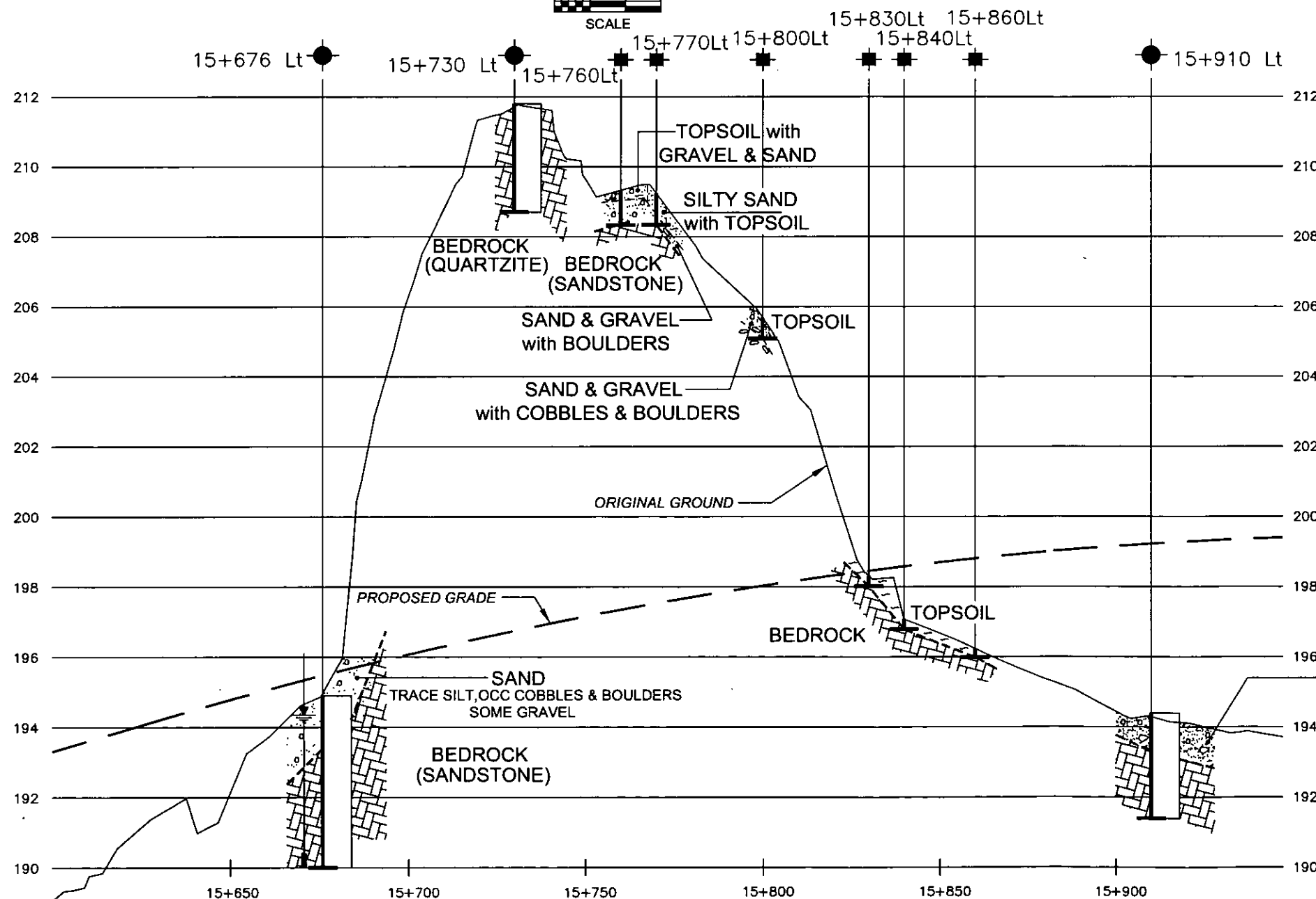
NOTE: The complete foundation investigation and design report  
for this project and other related documents may be examined at  
the Materials Engineering and Research Office, Downsview.  
Information contained in this report and related documents are  
specifically excluded in accordance with the conditions of Section  
GC 2.01 of OPS Gen. Cond.

REV.	DATE	BY	DESCRIPTION
------	------	----	-------------

Geocres No.			
HWY No. 17 (New)			DIST 62
SUBM'D ZO	CHECKED ZO	DATE Jun, 2003	SITE
DRAWN JZ	CHECKED	APPROVED	DWG 7A



PLAN  
10m 0 10 20m  
SCALE



PROFILE WESTBOUND LANES

10m 0 10 20m HORIZ  
1m 0 1 2m VERT  
SCALES

## METRIC

DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN. STATIONS  
ARE IN KILOMETRES + METRES.

### NOTE:

FOR DETAILED SUBSURFACE CONDITIONS OF ALL  
BOREHOLES & TEST PITS REFER TO RECORD OF BOREHOLE  
SHEETS & TEST PITS LOGS.

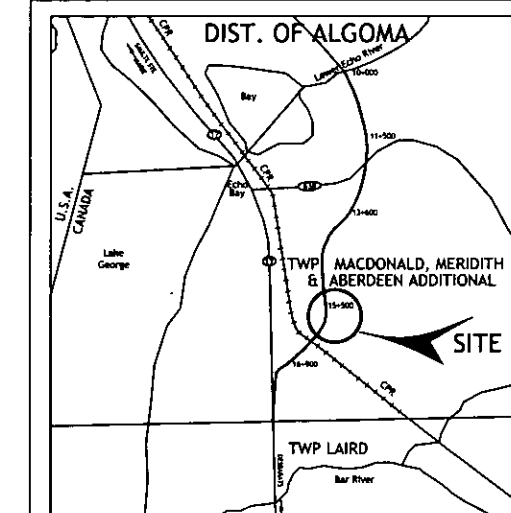
CONT No.

GWP: 354-94-00

HIGHWAY 17 (NEW) WBL  
ECHO RIVER TO BAR RIVER ROAD  
SITE No. 7  
BORE HOLE LOCATIONS & SOIL STRATA



## SHAHEEN & PEAKER LIMITED



KEY PLAN  
N.T.S

### LEGEND

- Bore Hole
- N Blows/0.3m (Std. Pen. Test, 475 J/blow)
- Water Level at Time of Investigation
- Water Level in Piezometer
- Piezometer
- Test Pit
- Test Pit Of Site No.6

No.	ELEV.	CO-ORDINATES	
		NORTH	EAST
15+676 Lt	194.9	5 146 873.9	300 295.0
15+730 Lt	211.8	5 146 819.4	300 296.1
15+760 Lt	201.8	5 146 789.5	300 282.0
15+770 Lt	204.3	5 146 779.5	300 285.9
15+800 Lt	205.7	5 146 749.4	300 294.8
15+830 Lt	197.4	5 146 719.4	300 290.8
15+830 Lt	198.8	5 146 719.4	300 295.8
15+840 Lt	197.1	5 146 709.4	300 294.7
15+860 Lt	196.3	5 146 689.4	300 294.7
15+910 Lt	194.4	5 146 639.4	300 297.5

**NOTE:**  
The boundaries between soil strata have been established only  
at Bore Hole locations. Between Bore Holes 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 Materials Engineering and Research Office, Downsview.  
Information contained in this report and related documents are  
specifically excluded in accordance with the conditions of Section  
GC 2.01 of OPS Gen. Cond.

REV.	DATE	BY	DESCRIPTION

Geocres No.

HWY No. 17 (New)			DIST 62
SUBM'D ZO	CHECKED ZO	DATE Jun, 2003	SITE
DRAWN JZ	CHECKED	APPROVED	DWG 7B

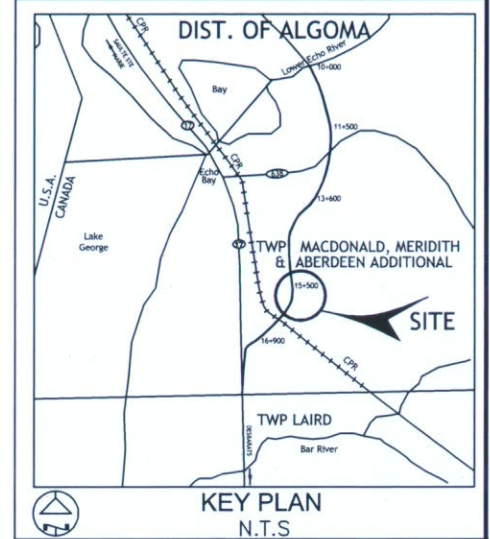


# METRIC

DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN. STATIONS  
ARE IN KILOMETRES + METRES.

CONT No.  
GWP: 354-94-00  
HIGHWAY 17 (NEW)  
ECHO RIVER TO BAR RIVER ROAD  
SITE No. 7  
CROSS SECTION

## SHAHEEN & PEAKER LIMITED



### LEGEND

- Test Pit
- Bore Hole

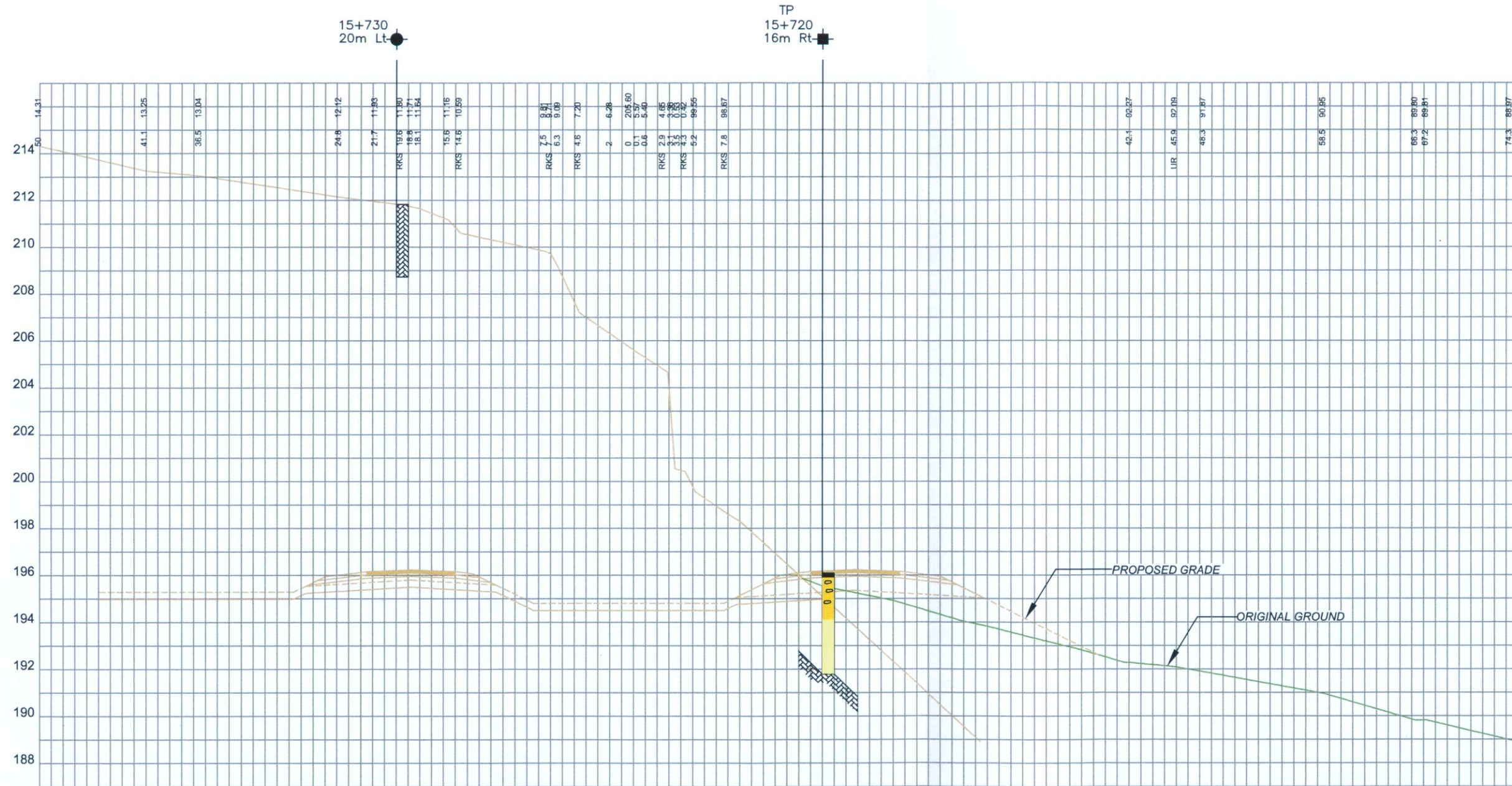
No.	ELEV.	CO-ORDINATES	
		NORTH	EAST
15+730 20mLt	211.8	5 146 819.4	300 296.1
15+720 16mRt	196.1	5 146 829.5	300 260.1

### =NOTE=

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

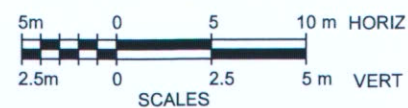
NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents are specifically excluded in accordance with the conditions of Section GC 2.01 of OPS Gen. Cond.

REV.	DATE	BY	DESCRIPTION
Geocres No.			
HWY No. 17 (New)			DIST 62
SUBM'D ZO	CHECKED ZO	DATE Mar, 2003	SITE
DRAWN JZ	CHECKED	APPROVED	DWG 7C



- Colour Soil Type
- PEAT, TOPSOIL, ORGANIC SOIL
  - SAND AND GRAVEL WITH COBBLES AND BOULDERS
  - SAND
  - BEDROCK

### CROSS SECTION (SITE 7)





METRIC

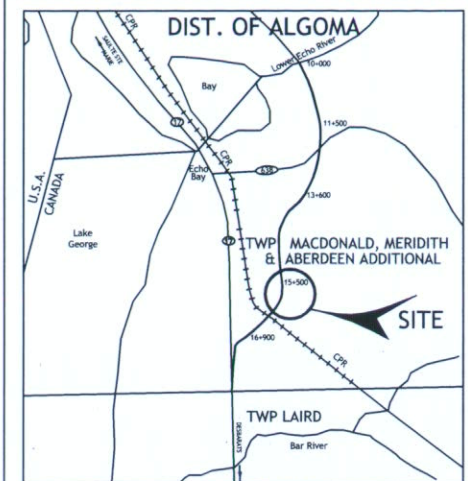
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN. STATIONS  
ARE IN KILOMETRES + METRES.

CONT No.

GWP: 354-94-00

HIGHWAY 17 (NEW)  
ECHO RIVER TO BAR RIVER ROAD  
SITE No. 7  
CROSS SECTION

SHAHEEN & PEAKER LIMITED



KEY PLAN  
N.T.S

LEGEND

- Test Pit
- Bore Hole

No.	ELEV.	CO-ORDINATES	
		NORTH	EAST
15+755 20mRt	195.7	5 146 794.6	300 256.0
15+760 CL	198.7	5 146 789.5	300 276.0
15+760 6mLt	201.8	5 146 789.5	300 282.0

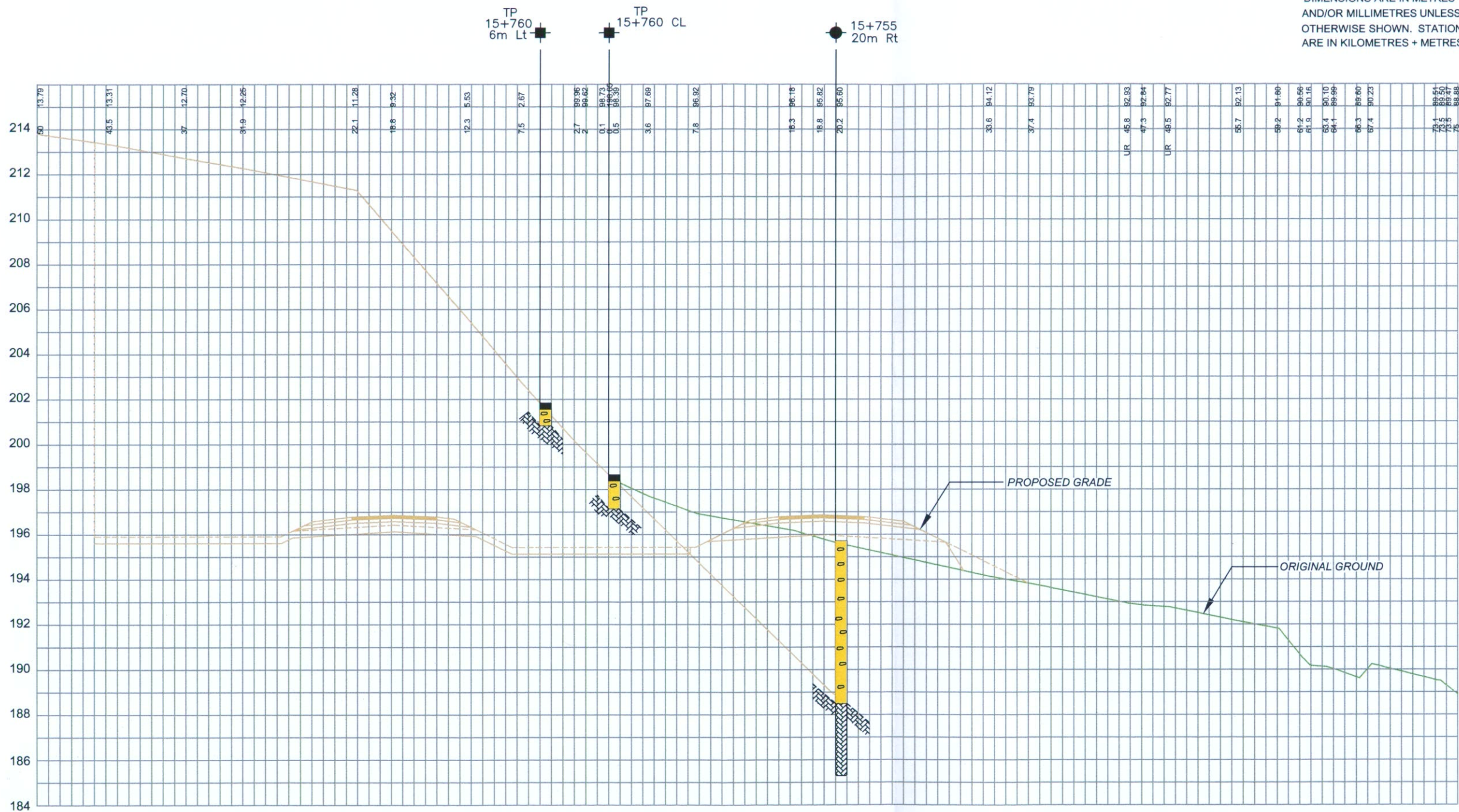
NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes 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 Materials Engineering and Research Office, Downsview. Information contained in this report and related documents are specifically excluded in accordance with the conditions of Section GC 2.01 of OPS Gen. Cond.

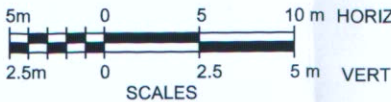
REV.	DATE	BY	DESCRIPTION
------	------	----	-------------

Geocres No.			
HWY No. 17 (New)			DIST 62
SUBMD ZO	CHECKED ZO	DATE Mar, 2003	SITE
DRAWN JZ	CHECKED	APPROVED	DWG 7D



15+760.00

CROSS SECTION (SITE 7)



- Colour Soil Type
- PEAT, TOPSOIL, ORGANIC SOIL
  - SAND AND GRAVEL WITH COBBLES AND BOULDERS
  - BEDROCK



## Appendix A7-1

# Record of Boreholes and Test Pit Logs



# RECORD OF BOREHOLE No 15+676; 19 m Lt 1 OF 1 METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 146 873.9; E 300 295.0 ORIGINATED BY Y.L.  
 DIST 62 HWY 17 (New) BOREHOLE TYPE Solid Stem Augers & Casing & Wash Boring & BQ Coring COMPILED BY M.L.  
 DATUM Geodetic DATE 5/6/2002 CHECKED BY Z.O.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)
								○ UNCONFINED    + FIELD VANE ● POCKET PENETR.    × LAB VANE										
194.9 0.0	Ground Surface 0.1 m Topsoil						20	40	60	80	100						GR SA SI CL	
193.4 1.5      190.0 4.9	SILTY SAND trace clay, trace gravel occasional cobbles and boulders, damp to moist reddish grey		1	AS	-												8 54 25 13	
			2	AS	-													
			3	RC	-													*casing and wash boring
	SANDSTONE BEDROCK reddish brown		4	BQ	Rec												RQD=25%	
				RC	83%													
			5	BQ	Rec													RQD=65%
				RC	100%													
6	BQ	Rec														RQD=80%		
	RC	100%																
7	BQ	Rec														RQD=90%		
	RC	100%																
	End of borehole.  Piezometer installed to 4.9 m. Water level on May 6, 2002 - 0.6 m (El. 194.3 m); Oct. 19, 2002 - 2.1 m (El. 192.8 m)																	

# RECORD OF BOREHOLE No 15+700; 20 m Rt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 146 849.6; E 300 256.2.0 ORIGINATED BY Y.L.  
 DIST 62 HWY 17 (New) BOREHOLE TYPE Portable Electrical Core Drill COMPILED BY M.L.  
 DATUM Geodetic DATE 4/24/2002 CHECKED BY Z.O.


SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL			
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● POCKET PENETR. × LAB VANE												
195.9 0.0	Ground Surface		1	NQ RC	Rec 100%		195									RQD=71%				
	QUARTZITE BEDROCK		2	NQ RC	Rec 74%		194									RQD=91%				
192.9 3.0			End of borehole					193												

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15 10 5  
(%) STRAIN AT FAILURE

**RECORD OF BOREHOLE No 15+730; 20 m Lt 1 OF 1 METRIC**

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 146 819.4; E 300 296.1 ORIGINATED BY Y.L.  
 DIST 62 HWY 17 (New) BOREHOLE TYPE Portable Electrical Core Drill COMPILED BY M.L.  
 DATUM Geodetic DATE 5/5/2002 CHECKED BY Z.O.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT  γ  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 ○ UNCONFINED + FIELD VANE ● POCKET PENETR. × LAB VANE					WATER CONTENT (%) W P W W L				
211.8 0.0	Ground Surface																
	QUARTZITE BEDROCK		1	NQ RC	Rec 100%		211										RQD=25%
			2	NQ RC	Rec 100%		210										RQD=100%
208.8 3.0	End of borehole						209										



RECORD OF BOREHOLE No 15+755; 20 m Rt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 146 794.6; E 300 256.0 ORIGINATED BY Y.L.  
DIST 82 HWY 17 (New) BOREHOLE TYPE Solid Stem Augers & Casing & Wash Boring & BQ Coring COMPILED BY M.L.  
DATUM Geodetic DATE 5/4/2002 CHECKED BY Z.O.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL	
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE	● POCKET PENETR. × LAB VANE			
195.7 0.0	Ground Surface						20 40 60 80 100	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>			
194.8 0.9	0.2 m Topsoil		1	AS	-								** casing and wash boring
	SAND and GRAVEL (Possible Till) frequent cobbles and boulders damp to moist brown to 1.7 m reddish grey below		2	RC	-								*** frequent cobbles and boulders
			3	RC	-								
			4	RC	-								
			5	RC	-								
			6	RC	-								
			7	RC	-								
			8	RC	-								
			9	RC	-								
188.5 7.2	SANDSTONE BEDROCK reddish brown		10	BQ RC	Rec 85%								RQD=85%
			11	BQ RC	Rec 100%								RQD=80%
			12	BQ RC	Rec 100%								RQD=82%
185.3 10.4	End of borehole * Wet cave at 0.3 m on completion												

SPT 1055

RECORD OF BOREHOLE No 15+850; 22 m Rt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, ON - Coords: N 5 146 698.5; E 300 254.3 ORIGINATED BY Y.L.  
DIST 82 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers & BQ Rock Coring COMPILED BY M.L.  
DATUM Geodetic DATE 5/7/2002 CHECKED BY Z.O.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)		
								20 40 60 80 100							
192.6 0.0	Ground Surface														
191.6 1.0	SAND and GRAVEL with some cobbles and boulders, brown, moist														
190.5 2.1	SILTY CLAY with clay and clayey silt seams, brown, stiff		1	SS	14							18.2			
			2	SS	15								Sampler wet at 2.2 m		
	Heterogeneous mixture of Silty Sand with some Gravel (SILTY SAND TILL) greyish to 2.8 m, reddish below, wet		3	SS	22										
188.3 4.3	compact very dense		4	SS	50/10										
			5	BQ RC	Rec. 100%								RQD=70%		
	SANDSTONE BEDROCK reddish brown		6	BQ RC	Rec. 100%								RQD=90%		
			7	BQ RC	Rec. 100%								RQD=80%		
185.0 7.6	End of borehole														
	* Water used to facilitate rock coring; water level not stabilized on completion														

+ 3, x 3; Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

SPT 1055

RECORD OF BOREHOLE No 15+910; 20 m Lt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, ON - Coords: N 5 148 639.4; E 300 295.5 ORIGINATED BY Y.L.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.L.  
DATUM Geodetic DATE 4/25/2002 CHECKED BY Z.O.

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 <sup>3</sup>	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 <sub>p</sub>	W	W <sub>L</sub>					
194.4	Ground Surface																
0.0																	
193.3	SAND with Gravel, Cobbles and Boulders		1	AS	-												
1.1	End of borehole Sampler bouncing and refusal to further augering at 1.1 m. Borehole dry and caved at ground surface. Borehole relocated and re-drilled at Station 15+912; (21 m) Lt, refusal to augering at 0.9 m below ground surface. Borehole relocated and re-drilled at Station 15+908; (19 m) Lt. Refusal again at 0.3 m below ground surface.																

+ 3, x 3: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

SPT 1055

RECORD OF BOREHOLE No 15+910; 22 m Lt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, ON - Coords: N 5 146 639.4; E 300 297.5 ORIGINATED BY Y.L.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Rock Coring COMPILED BY M.L.  
DATUM Geodetic DATE 5/7/2002 CHECKED BY Z.O.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL			
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED    + FIELD VANE ● POCKET PENETR.    × LAB VANE												
194.4 0.0	Ground Surface						20	40	60	80	100	20	40	60						
	SANDSTONE BEDROCK reddish brown		1	BQ RC	Rec. 100%		194									RQD=40%				
			2	BQ RC	Rec. 100%		193									RQD=95%				
191.4 3.0	End of borehole																			

+ 3, x 3: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

# TEST PIT LOGS

## CUT AREA #4

### GWP 354-94-00, HIGHWAY 17 (NEW)

From Echo River to Bar River Road, Sault Ste. Marie

#### Highway 17 (new)

##### 15+720 16m Rt Median C/L

0	-	200	Tps with Gr Sa Occ Blds
200	-	2.0	Sa Gr with Blds Damp to wet
			Water seepage at 2.0 m depth
2.0	-	4.3	Si Sa Tr Gr Occ Blds (Till), Damp to moist
		4.3	NFP (Poss BR)

##### 15+740 16m Rt Median C/L

0	-	300	Tps with Gr Sa
300	-	1.0	Sa and Gr with Cob and Blds, Damp to moist
1.0	-	5.5	Si Sa Tr Gr (Till) Damp
			Water seepage at 3.0 m depth

##### 15+755 10m Lt Median C/L

0	-	600	Sa and Gr with Org
600	-	1.2	Sa and Gr with Blds Tr Si
		1.2	NFP BR

##### 15+760 Median C/L

0	-	300	Tps with Gr Sa
300	-	1.5	Sa and Gr Occ Blds, Damp to moist
1.5	-	1.6	Fractured BR with Cl seams
		1.6	NFP BR

##### 15+760 6m Lt Median C/L

0	-	300	Tps with Gr Sa
300	-	1.0	Sa and Gr with Blds, Moist
1.0	-	2.2	Fractured BR with Cl seams
		2.2	NFP BR

##### 15+770 10m Lt Median C/L

0	-	600	Si Sa with Tps
600	-	900	Sa and Gr with Blds
		900	NFP BR

15+770 20m Rt Median C/L

0            -            450  
                             450

Sa and Gr with Tps  
NFP BR

15+800 19m Lt Median C/L

0            -            150  
150          -            600  
                             600

Tps  
Sa and Gr with Cob and Blds  
NFP Bld (hand-digging)

15+830 15m Lt Median C/L

0            -            300  
                             300

Tps  
NFP BR

15+830 20m Lt Median C/L

0            -            300  
                             300

Tps  
NFP BR

15+840 19m Lt Median C/L

0            -            300  
                             300

Tps  
NFP BR

15+860 19m Lt Median C/L

0            -            250  
                             250

Tps  
NFP BR

# Appendix A7-2

## Photograph





PHOTOGRAPH OF BEDROCK CORE  
Borehole 15+730, 20m Lt, Quartzite Bedrock

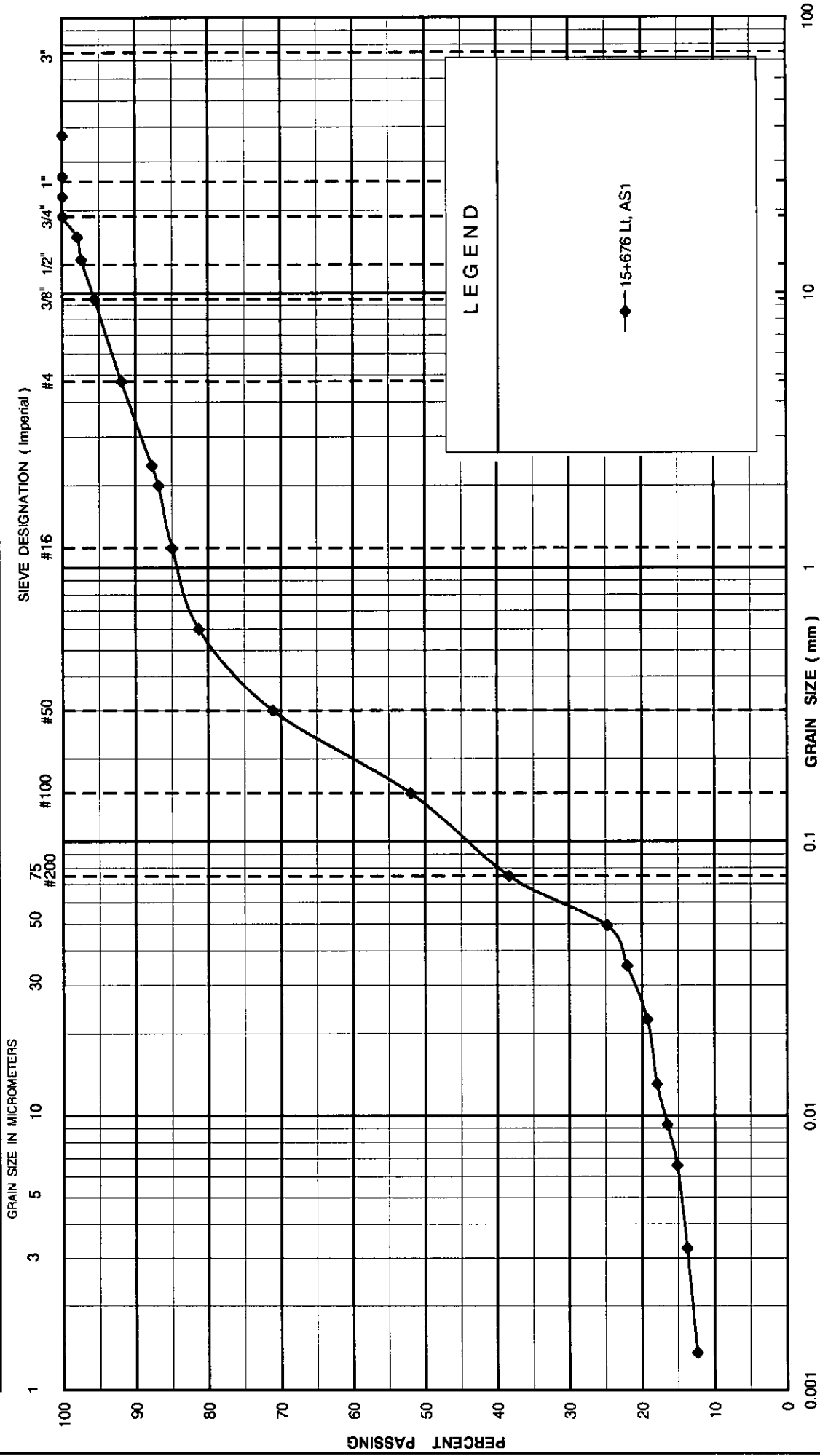


# Appendix B7

## Laboratory Test Results

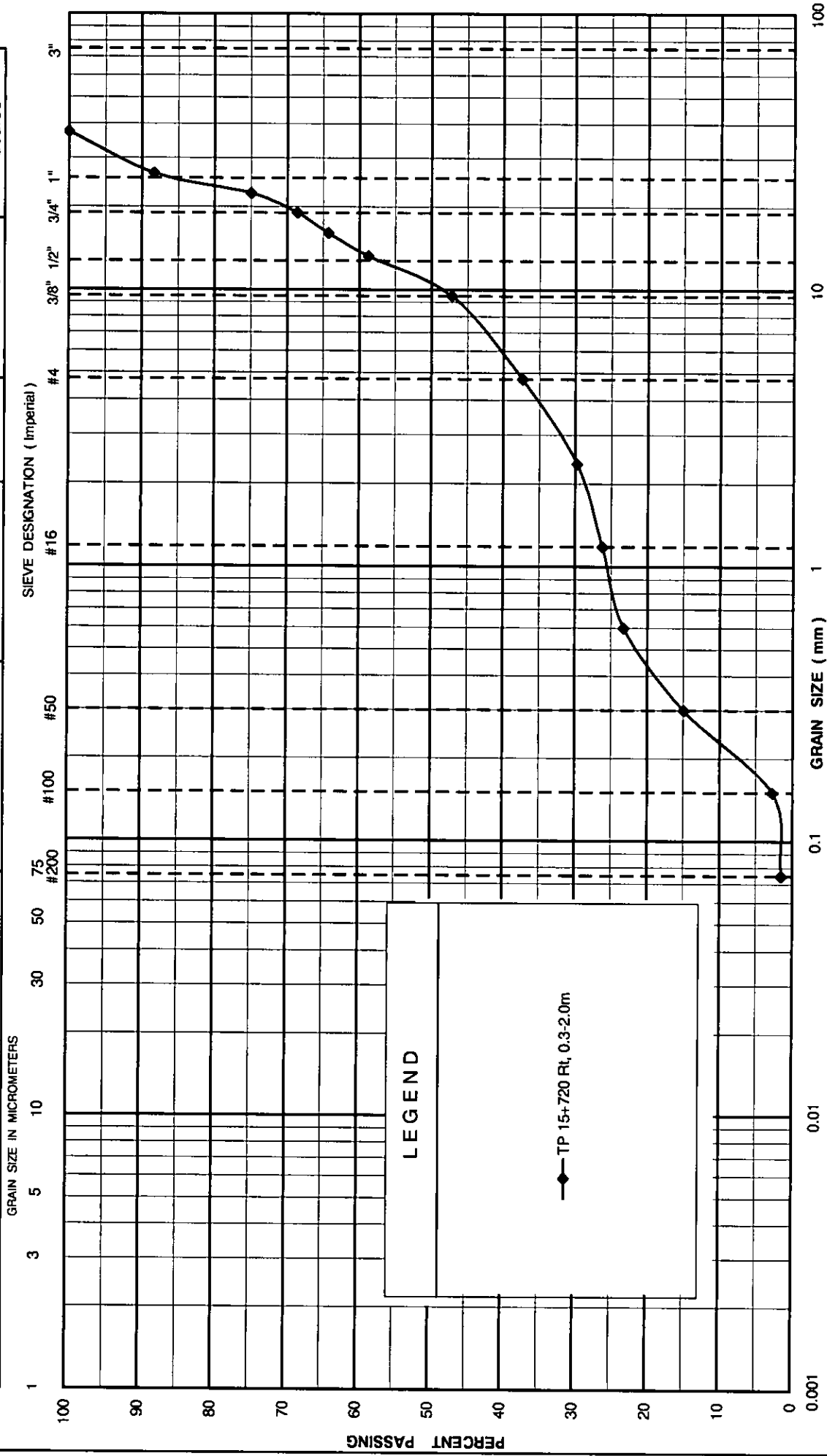
# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT			SAND			GRAVEL		
			Fine	Medium	Coarse	Fine	Coarse	



# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT			SAND			GRAVEL		
GRAIN SIZE IN MICROMETERS			Fine	Medium	Coarse	Fine	Coarse	
1	3	5	10	30	50	75	100	200



## GRAIN SIZE DISTRIBUTION SANDY GRAVEL

SHAHEEN & PEAKER LIMITED

FIG. No. B7-2

REF. No. SPT 1055

G.W.P. 354-94-00

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT			SAND			GRAVEL		
GRAIN SIZE IN MICROMETERS			Fine	Medium	Coarse	Fine	Coarse	Coarse

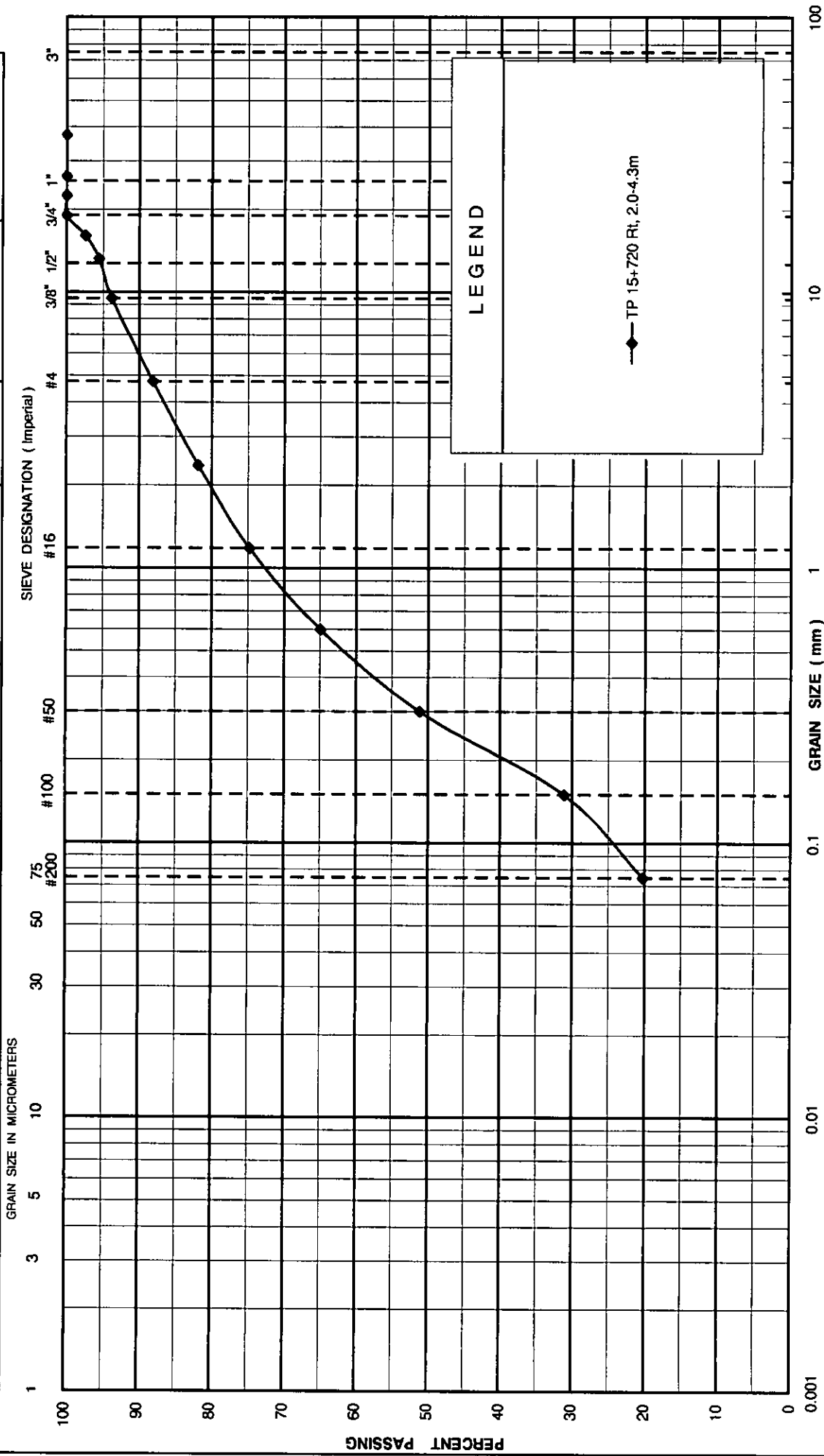


FIG. No. B7-3  
REF. No. SPT 1055  
G.W.P. 354-94-00

GRAIN SIZE DISTRIBUTION  
SILTY SAND, trace gravel (Till)

SHAHEEN & PEAKER LIMITED

#### **4.8 SITE NO. 8 : HIGHWAY 17 (NEW) FILL SECTION BETWEEN STATIONS 15 + 850 AND 16 + 600\***

The grade north of this approximately 0.7 km section falls sharply from north to south along a massive rock outcrop, along the westbound lane (WBL) alignment from a high elevation of 212 m at about Station 15 + 730 to about 195 m at Station 15 + 890 (a drop of about 17 m within a horizontal distance of about 160 m), where the bedrock is still visible. From thereon no bedrock outcrop is visible and the grade drops more gradually to about El.189 m at the CPR crossing at about Station 16 + 130. Further south, the grade is relatively level and drops to an elevation of about 188 m near Maple Leaf Road at about Station 16 + 280. From thereon southerly, the grade is level with a low point at about El.186 m near Station 16 + 500. Further to the south, the grade gradually rises to about El.187.5 m within a distance of about 150 m. Along the eastbound lane (EBL) alignment the grade follows a similar pattern although rock is not visible to about Station 15 + 800.

Originally, it was planned to drill a total of 32 boreholes along this section but the number of the boreholes was increased to 41 in order to obtain a better understanding of the subsurface conditions, including the dip of the bedrock. In addition, the bedrock was cored in 17 of the boreholes, while in some of the others the presence of frequent cobbles and boulders rendered drilling difficult and arduous, requiring diamond drilling and washboring methods in order to advance the boreholes to the desirable depths. Dynamic Cone Penetration tests (DCPT) were also performed at 12 of the boreholes.

The locations of the boreholes are shown in Drawing No. 4 while stratigraphic profiles along the EBL and WBL are presented in Drawings No. 8A-1 to 8A-3 and 8B-1 to 8B-3.

In general, the boreholes show the presence of bedrock starting at the ground surface at Station 15 + 910 along the WBL and from thereon southerly the depth of overburden (i.e. the depth to the surface of the bedrock) increases to about 12 m at the south side of the CPR crossing. Along the EBL the most northerly borehole drilled (i.e. Borehole 15 + 850 (22 m) Rt) showed the presence of about 4 m overburden above the bedrock, the depth to the surface of the bedrock increasing to about 12 m at the south side of the CPR tracks. Bedrock is below the depths explored to the south, beyond about Station 16 + 150.

\* For a list of boreholes put down in-between these stations, reference can be made to Appendix A8.

From the north end of the alignment in this section of the project, southerly to about Maple Leaf Road crossing, the overburden generally consists of granular soils, ranging from gravelly sand to silty fine sands, underlain at many locations by silty sand till and/or a zone of cobbles and boulders in a sand and gravel matrix with some silt. Near Maple Leaf Road, the boreholes contacted a weak and compressible clay deposit, the depth of which gradually increased southerly to more than 10 m near the south limits of the site.

The observations made in the open boreholes and in the installed piezometers indicate a high groundwater table near the ground surface.

Details of the subsurface conditions encountered in the boreholes are given on the Record of Borehole Sheets in Appendix A8. The individual strata are briefly described in the following paragraphs.

The Records of Boreholes previously drilled at the site by MTO and Golder Associates Ltd. are also included in Appendix A8.

#### 4.8.1 TOPSOIL AND PEAT

The boreholes generally contacted topsoil, which ranged in thickness from 0.1 to 0.3 m from Station 15 + 850 to Station 16 + 385 along the EBL and from Station 15 + 910 to Station 16 + 300 along the WBL. Southerly from Borehole 16 + 350 (20 m) Lt along the WBL and Borehole 16 + 450 (25 m) Rt along the EBL, peat was encountered. The thickness of the peat/peaty topsoil ranges from 0.4 to 0.6 m.

It should however be pointed out that many of the boreholes were drilled when the ground was frozen or inundated, which rendered an accurate identification of the topsoil and especially peat layers rather difficult.

#### 4.8.2 SILTY CLAY

A 1.1 m thick silty clay layer with clay and clayey silt seams was contacted in Borehole 15 + 850 (22 m) Rt (i.e. the most northerly borehole drilled). The deposit was encountered at 1.0 m depth or at Elevation 191.6 m and extended to 2.1 m (Elevation 190.5 m).

A Standard Penetration test yielded, in this cohesive deposit, an N-value of 14 blows/0.3 m and a pocket penetrometer test indicated an undrained shear strength of 100 kPa. Based on these results, the consistency of this cohesive material is described as stiff.

#### 4.8.3 SAND

In the majority of the boreholes, a granular sand deposit was contacted. In general, towards the northern limits of the site, the sand was found to be relatively coarser (i.e. gravelly sand to well-graded sand) while in the majority of the boreholes to the south of Station 16 + 050, it consists of silty fine sand to fine sand with silt. Where fully penetrated, the sand generally extends to a silty sand till layer or on to a zone of cobbles and boulders within a sand and gravel matrix over the bedrock. At about Maple Leaf Road, the sand is overlain by clay.

The sand is a granular soil and the deposit exhibits a wide range of grain-size distribution that ranges from gravelly sand to fine sand with silt. In many of the boreholes, however, it consists of fine sand with traces to some silt. The grain-size distribution of 21 samples from the material is shown in an envelope form in Figure B8-1 of Appendix B8, while the grain-size distribution of more silty zones is presented in Figure B8-2.

The grain-size distribution of the soil at some locations ranges from fine to medium and coarse sand sizes (i.e. relatively well-graded) and curves for these materials are shown in Figures B8-3, 4 and 5 of Appendix B8. Figure B8-6 shows the grain-size distribution of even coarser zones (i.e. gravelly sand).

Standard Penetration tests performed in the deposit yielded N-values which mostly range from 1 to 60 blows/0.3 m, indicating a very loose to very dense relative density but the results are generally in the 2 to 16 blows/0.3 m range. Based on these values, together with the results of the DCPT, the deposit is considered to be in a generally loose or loose to compact condition.

#### 4.8.4 SILTY SAND TILL

Layers and pockets/lenses of silty sand to sandy silt till were contacted in many of the boreholes drilled between Stations 15 + 906 and 16 + 330.

In Boreholes 16 + 140 (13 m)Rt, 16 + 160 CL, 16 + 210 (20 m)Lt, 16 + 225 (20 m)Rt, 16 + 235 CL, 16 + 255 (20 m)Rt, 16 + 275 (20 m)Rt and 16 + 330 (20 m)Rt, this deposit was contacted at depths ranging from 182.4 and 179.8 m. In these boreholes the deposit was penetrated for a vertical distance of 0.4 to 6.1 m, where the exploration was terminated between elevations ranging from 181.5 and 176.3 m.

In Borehole 15 + 906 (17 m)Rt, the till deposit was contacted at 1.5 m depth/Elevation 189.8 m and was penetrated by 3.1 m where the borehole was terminated, probably on bedrock at Elevation 186.7 m.

In Boreholes 15 + 850 (22 m)Rt, 16 + 018 (17 m)Lt, 16 + 020 (23 m)Rt, 16 + 050 CL and 16 + 070 (19 m)Lt, the till deposit was encountered at depths ranging between 1.7 and 5.2 m below the ground surface (Elevation 190.8 – 183.8 m). In these boreholes, the deposit was fully penetrated to the surface of the bedrock or to a zone of cobbles and boulders at Elevation 188.8 – 180.5 m and at these locations the thickness of the deposit ranged from 1.4 to 3.7 m.

The deposit consists of a heterogeneous mixture of sand and silt with traces to some gravel and trace to clay. The grain-size distribution of eight samples from the deposit is given in Figures B8-7 and one (i.e. sandy silt till) in B8-8.

These indicate:

Gravel	=	2 – 16 %
Sand	=	36 – 61 %
Silt	=	19 – 58 %
Clay	=	1 – 3 %

The presence of cobbles and boulders should always be anticipated in glacial till deposits, due to the mode of their deposition.

The recorded N-values in the deposit range from 6 to in excess of 100 blows/0.3 m, indicating a loose to very dense, but generally compact to very dense material.

#### 4.8.5 COBBLES AND BOULDERS IN A SAND AND GRAVEL MATRIX

In many of the boreholes drilled north of Station 16 + 200, the sand deposit is underlain by a zone of cobbles and boulders in a matrix of sand and gravel and some silt. In most cases, it is a transition zone to the underlying bedrock.

This deposit was contacted in Boreholes 1-4, 6-8, 15 + 975 (17 m)Lt, 16 + 018 (17 m)Lt, 16 + 020 (20 m)Lt, 16 + 070 (19 m)Lt and 16 + 180 (20 m)Rt, where its thickness ranged from about 1 to 8 m. It was contacted between depths ranging from 1.9 m/EI. 191.2 m on the north side in Borehole 15 + 975 (17 m)Lt and extended to a maximum depth of 15.6 m/EI. 173.2 m in Borehole 16 + 180 (20 m)Rt. In addition to these boreholes, the presence of cobbles and boulders was inferred at several other borehole locations. Furthermore, the presence of cobbles and boulders can be anticipated in the glacial till deposit.



In most cases, these materials had to be penetrated by coring and where Standard Penetration testing was attempted, very little penetration was possible despite high number of blows of the hammer. This is likely due to the very coarse nature of these soils. In any event, in several attempts where some penetration was possible, N-values of 7, 29, 29, 38 and 43 blows/0.3 m were recorded. Based on these observations, the relative density of the deposit is inferred to be loose to very dense but generally compact to very dense.

#### 4.8.6 CLAY

The boreholes revealed the presence of a major clay deposit starting towards the south end of the site, in the vicinity of Maple Leaf Road and increasing in thickness in the southerly direction.

The clay deposit was contacted either immediately below the topsoil/peat (below depths ranging from 0.2 to 0.6 m below the ground surface) or underlying a thin surficial silty sand layer, below a depth of 0.7 m.

As mentioned before, the thickness of the deposit increases gradually from north to south. Along the WBL, the deposit was contacted at Borehole 16 + 255 (20 m) Lt (to the north of Maple Leaf Road) at a depth 0.7 m/EI. 187.9 m and extended to 2.3 m depth/EI. 186.3 m. Further south, it was found to extend to 5.2 m depth/EI. 182.4 m at Station 16 + 350, increasing to 11.0 m/EI. 176.1 m at Station 16 + 560. Its thickness beyond this station was not explored.

Along the EBL, the clay deposit was encountered at Station 16 + 330 where it extended to 0.7 m/EI. 187.3 m, increasing to 2.9 m/EI. 184.9 m at Station 16 + 385. At Station 16 + 480, it was found to extend to 8.7 m depth/EI. 178.5 m and probably deeper. Its full depth beyond this station was not explored.

The clay is mostly a layered soil, incorporating some medium and low plastic (lean) clay interbeds and occasional silt seams/lenses within a highly plastic (fat) clay structure.

The layering is irregular, some zones incorporating more layering than others. It is generally reddish grey, with some reddish brown and grey zones/layers.

The grain-size distribution of seven samples from various boreholes drilled along this stretch is given in an envelope format in Figure B8-10 of Appendix B8. The following grain-size distribution is indicated.

Sand = 0 – 2 %

Silt	=	34 – 51 %
Clay	=	49 – 65 %

When examining the laboratory and field test results, the layered nature of the soil should be taken into consideration. It is noted that while there is a high percentage of clay-size particles, the percentage of clay is not as much as was measured at several other locations along other areas within the project area (e.g. between Stations 11 + 440 and 11 + 665 where the percentage of clay-size particles ranged from 64 to 90 %).

From the grain-size distribution curves the deposit can be expected to be practically impervious. Because of its interbedded nature, the mass permeability of the deposit can be expected to be somewhat variable, particularly in the horizontal direction.

The deposit is classified as a cohesive soil. Index properties of 22 samples were determined in the laboratory and the tests performed gave the following results, as shown in Figure B8-11, Appendix B8).

Liquid Limit :	42 – 70 %
Plastic Limit :	21 – 26 %
Plasticity Index :	19 – 45 %

As shown in Figure B8-11, these results are characteristic of medium to high plasticity clay. The measured natural moisture contents of samples from the deposit ranges from 35 to 95 %. The Liquidity Indices range from 0.7 to 2.1 but are generally in excess of 1.0. Generally such results are characteristic of normally consolidated, highly compressible weak clays, while other criteria indicate some pre-consolidation, as discussed below.

The results of a consolidation (oedometer) test are presented in Figure B8-12, Appendix B8. The test results show a probable pre-consolidation pressure ( $P_c$ ) of about 120 kPa, which is about 90 kPa, in excess of the existing effective overburden pressure. As mentioned in previous sections of this report, this is probably attributable to a phenomenon referred to as 'aging' rather than erosion of previously existed overburden or desiccation.

N-values generally ranging from 0 to 5 blows/0.3 m were recorded in this deposit. In most cases, however, the recorded values were 1 to 2 blows/0.3 m. Undrained in-situ shear strengths as measured by Field Vane tests ranged from 10 to 64 kPa. A combined plot of all the in-situ vane test results from all the boreholes is presented in Figure C8-1 of Appendix C8. These values show a large scatter in the undrained shear strength values, which can to a certain extent be attributed to the layered nature of the soil. The plot also shows that there is no distinct trend of increase in strength with increasing depth, except below about El.180 m. Figure C8-2 in Appendix C8 shows the results of a typical borehole with regards to undrained shear strength versus depth (Borehole 16 + 410 (20 m) Lt). On

the same figure, the plot of the approximate overburden pressure ( $p'$  or  $\sigma_v'$ ) is shown. This plot indicates a high ratio of  $p'/c$  value, when compared with typical values for normally consolidated clays in Northern Ontario. This points out to a possible pre-consolidation, in agreement with the consolidation test results presented in Figure B8-12, Appendix B8. On the other hand, it is difficult to reconcile this with high Liquidity Index values obtained.

Field Vane tests indicate sensitivity values (i.e. ratio of peak/remolded shear strengths), which range between 6 and 32. These values indicate medium to extra sensitive clays. It should also be indicated that these sensitivity values are higher than some of the results obtained in other parts of the project. In addition, the sensitivity values recorded in Borehole 16 + 540 (20 m)Lt, put down at the south end of the project, along the WBL alignment) were generally higher than elsewhere at the site.

#### 4.8.7 BEDROCK

To the north, north-east of the site a massive rock outcrop can be seen. The surface of the bedrock can therefore be expected to dip south, south-west. Along the west bound lanes, the most northerly borehole drilled at 15 + 910 (22 m)Lt, contacted bedrock at surface, at Elevation 194.4 m, while in another borehole drilled 2 m to the west, the surface of the bedrock was inferred 1.1 m below this elevation, indicating a sharp dip from east to west. In boreholes drilled along the WBL alignment, the surface of the bedrock appeared to dip relatively steeply to Elevation 183.3 m at Station 16 + 020 (i.e. a drop of about 10 m over a horizontal distance of 110 m. From thereon, the dip is more gradual, from Elevation 183.3 m at Station 16 + 020 to Elevation 176.1 m at Station 16 + 167 (i.e. a drop of about 7 m over a horizontal distance of about 150 m).

Along the EBL alignment, the surface of the bedrock in the boreholes drilled was contacted at Elevation 188.3 m at Station 15 + 850, dropping to 183.3 m at Station 16 + 020 (i.e. a drop of about 5 m over a horizontal distance of 170 m). From thereon the drop in the surface of the bedrock elevation is about 5 m over a distance of about 110 m.

In Borehole 15 + 910 (20 m) Lt drilled along the WBL alignment, the surface of the bedrock was inferred at Elevation 193.3 m, while in Borehole 15 + 906 (19 m) Rt, drilled along the EBL, 39 m to the west, the surface of the bedrock was contacted at Elevation 186.9 m, giving an elevation difference of 6.4 m over a distance of 39 m in the east-west direction between the two alignments.

Bedrock was cored by diamond drilling in 17 of the boreholes. From the recovered core samples, the bedrock was identified as a reddish brown sandstone, the upper zones of which appeared to be weathered. Core recoveries range from 75 % - 100 % but are

generally in the 90 to 100% range, while the recorded R.Q.D. values ranged from 33 to 100 %, but are generally 60 to 98 % range. The recorded R.Q.D. values indicate a poor to excellent but generally fair to excellent rock quality. The rock is described as weathered near its surface (i.e. within the upper 1 m) and sound below.

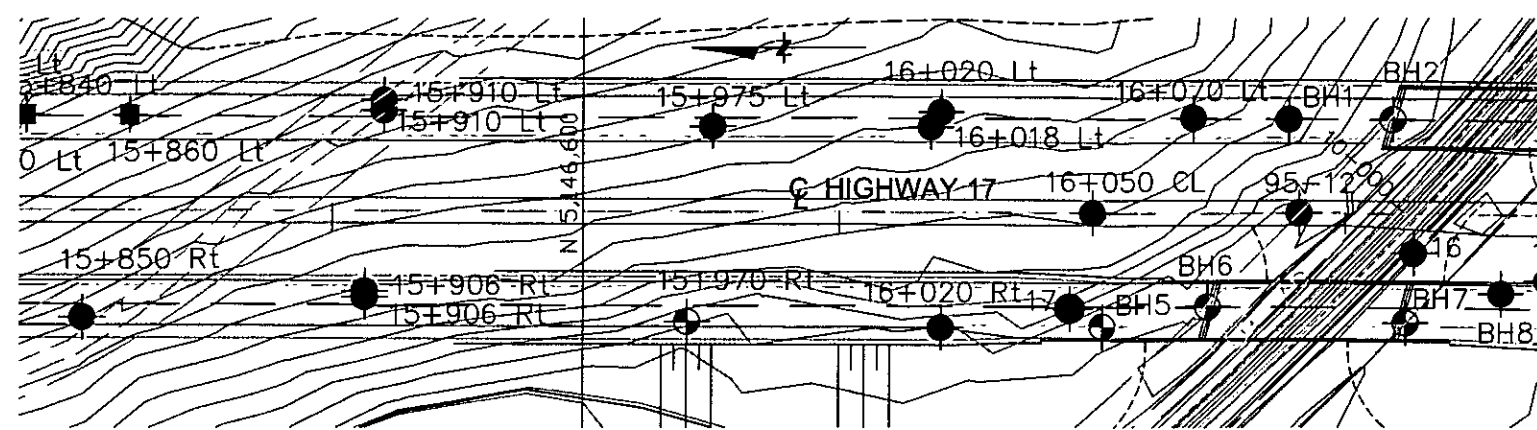
#### 4.8.8 GROUNDWATER CONDITIONS

Groundwater levels in five piezometers, installed across the site, were measured at depths ranging from 0.5 to 1.4 m below the ground surface or between Elevations 188.2 and 187.1 m.

Based on these values, observations were made in the boreholes while drilling, water contents of the samples and the site conditions during our field work, it is our opinion that the groundwater level at the site is generally about 1 m below the ground surface to the north of Maple Leaf Road and within 0.5 m of the ground surface to the south. In fact at several borehole locations south of Maple Leaf Road, drilling had to be completed working under water (i.e. the surface water had ponded to above knee height at the spring time, and the drilling had to be done when the ponding level had dropped to about 0.2 m above the ground surface).

It should be pointed out that both surface and groundwater levels can be expected to fluctuate seasonally and in response to major weather events.

# Drawings



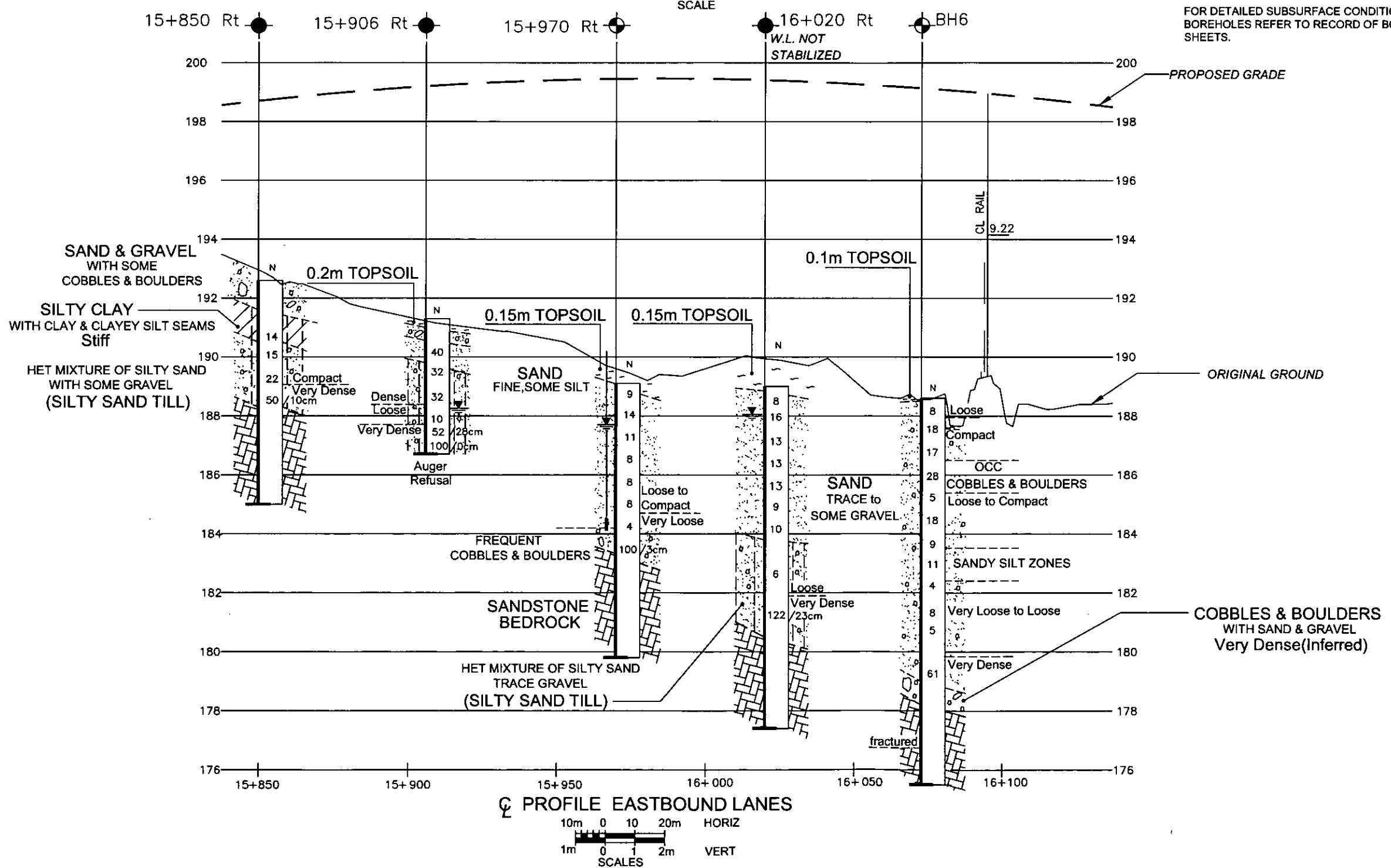
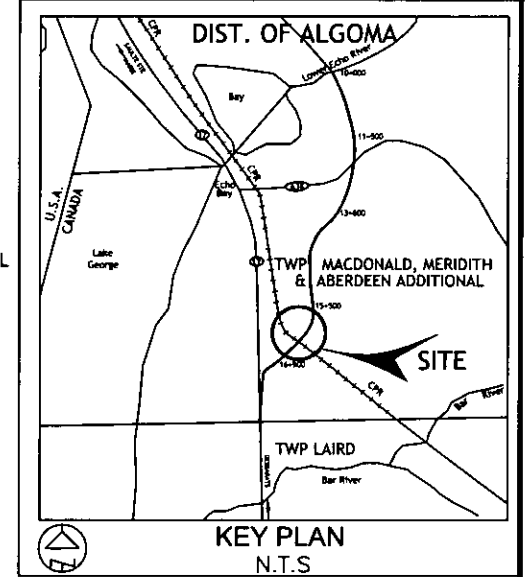
PLAN  
10m 0 10 20m  
SCALE

**METRIC**  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN. STATIONS  
ARE IN KILOMETRES + METRES.

NOTE:  
BOREHOLES 1, 2, 12, 13, 14, 15, 16, 17, 18 & 19  
BY MTO, JULY 1975.  
BOREHOLES 95-10, 95-11, 95-12, 95-13  
BY GOLDER ASSOCIATES LTD  
LOCATIONS ARE VERY APPROXIMATE.  
FOR DETAILED SUBSURFACE CONDITIONS OF ALL  
BOREHOLES REFER TO RECORD OF BOREHOLE  
SHEETS.

CONT No.  
GWP: 354-94-00  
HIGHWAY 17 (NEW) EBL  
ECHO RIVER TO BAR RIVER ROAD  
SITE No. 8  
BORE HOLE LOCATIONS & SOIL STRATA

**SHAHEEN & PEAKER LIMITED**



**LEGEND**

- Bore Hole
- Bore Hole & Cone
- N Blows/0.3m (Std. Pen. Test, 475 J/blow)
- Water Level at Time of Investigation Apr. and Nov., 2002
- Water Level in Piezometer
- Piezometer
- Bore Hole Done By MTO, Golder Associates Ltd.

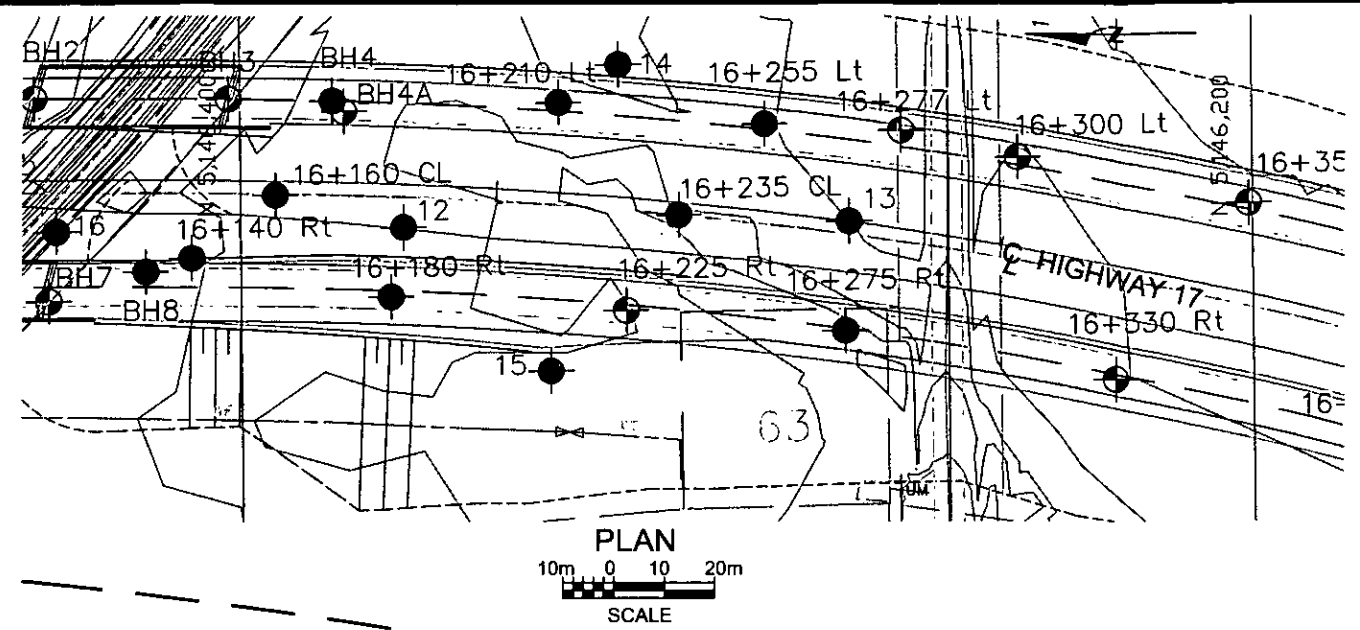
No.	ELEV.	CO-ORDINATES	
		NORTH	EAST
15+850 Rt	192.6	5 146 698.5	300 254.3
15+906 Rt	191.3	5 146 643.1	300 258.3
15+970 Rt	189.1	5 146 579.6	300 253.3
16+020 Rt	189.0	5 146 529.6	300 252.2
BH6	188.6	5 146 476.6	300 256.3

**=NOTE=**  
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REV.	DATE	BY	DESCRIPTION
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Geocres No.			
HWY No. 17 (New)	DIST 62		
SUBM'D ZO	CHECKED ZO	DATE Mar, 2003	SITE
DRAWN JZ	CHECKED	APPROVED	DWG 8A-1

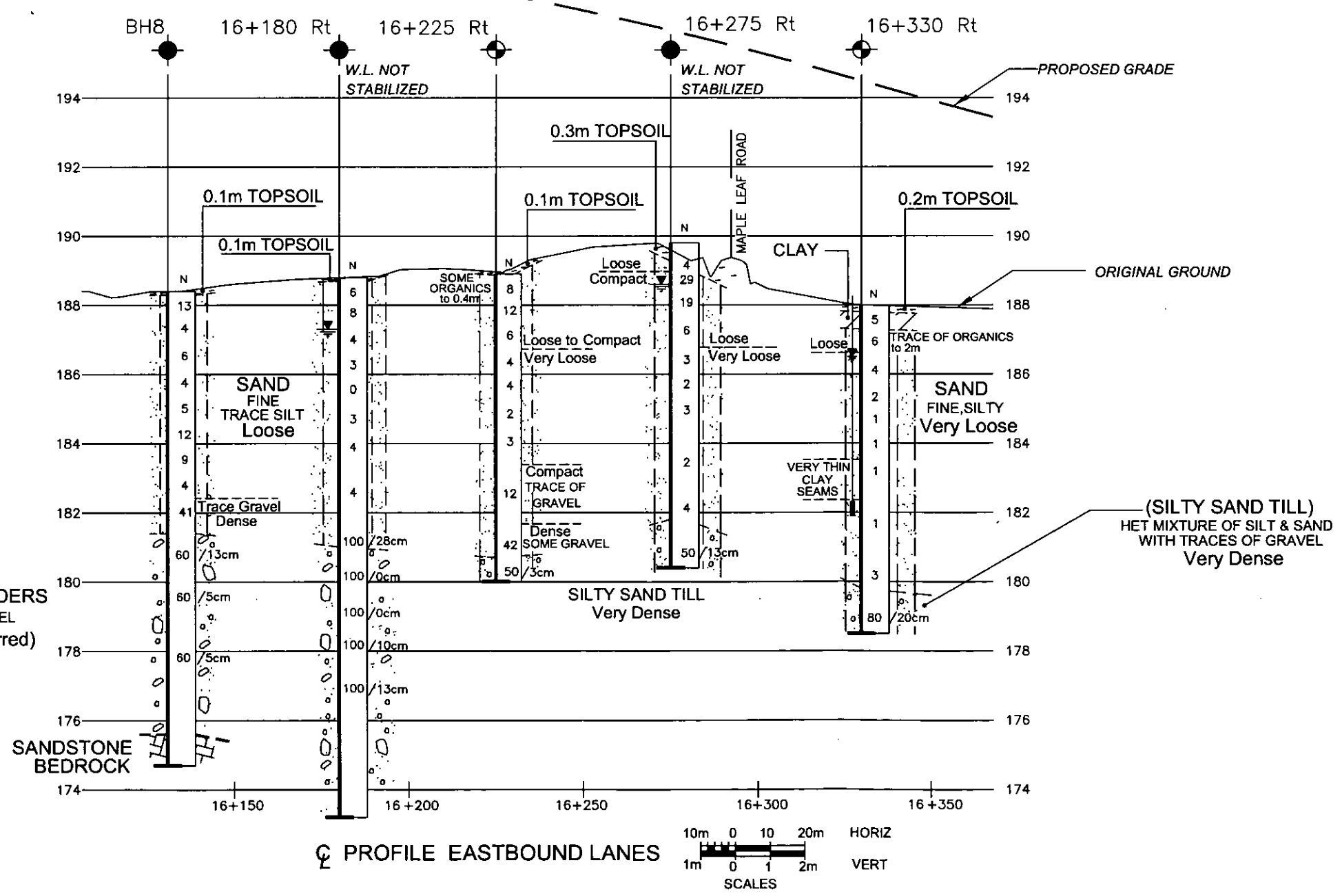
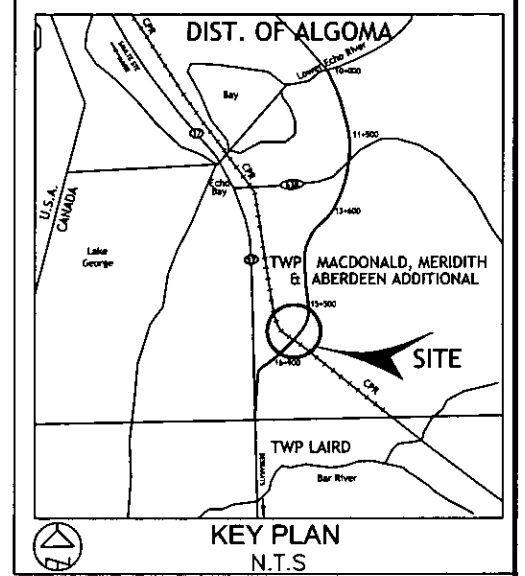


**METRIC**  
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 SHEETS.

CONT No.  
 GWP: 354-94-00  
 HIGHWAY 17 (NEW) EBL  
 ECHO RIVER TO BAR RIVER ROAD  
 SITE No. 8  
 BORE HOLE LOCATIONS & SOIL STRATA

**SHAHEEN & PEAKER LIMITED**



- LEGEND**
- Bore Hole
  - Bore Hole & Cone
  - N Blows/0.3m (Std. Pen. Test, 475 J/blow)
  - Water Level at Time of Investigation Apr. and Oct., 2002
  - Water Level in Piezometer
  - Piezometer
  - Bore Hole Done By MTO, Golder Associates Ltd.

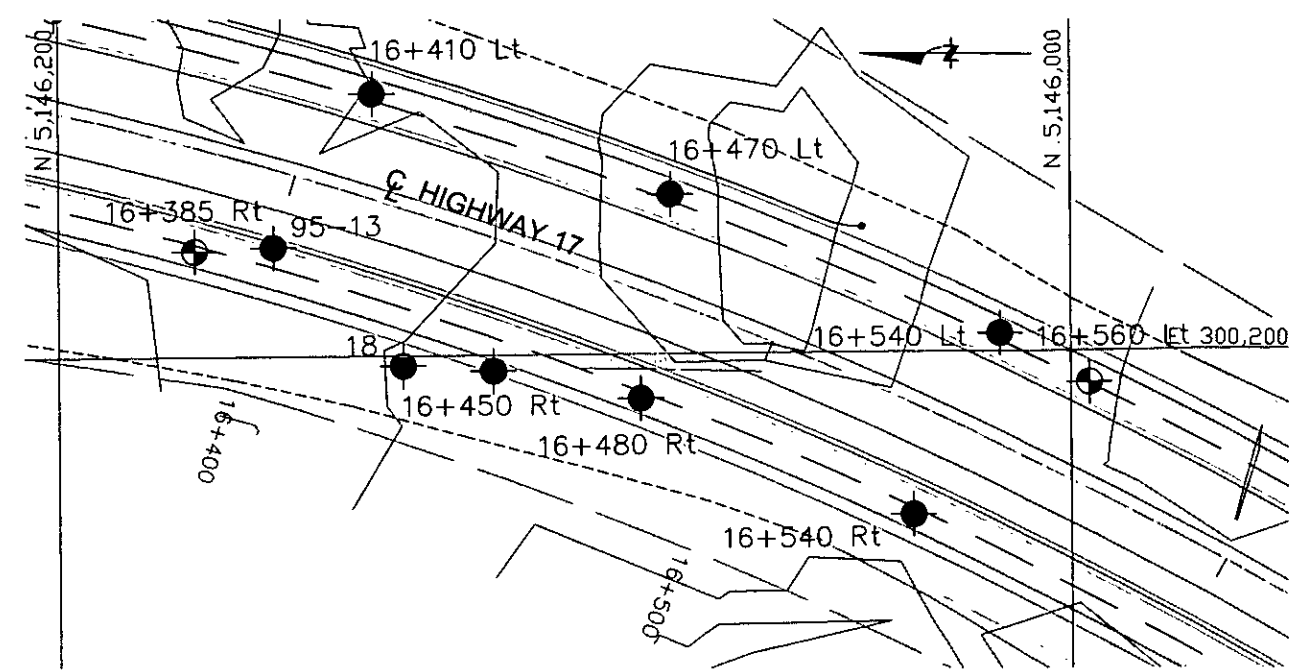
No.	ELEV.	CO-ORDINATES	
		NORTH	EAST
BH8	188.4	5 146 418.7	300 258.9
16+180 Rt	188.8	5 146 370.5	300 253.2
16+225 Rt	188.9	5 146 324.0	300 249.9
16+275 Rt	189.8	5 146 280.9	300 245.2
16+330 Rt	188.0	5 146 227.5	300 234.9

**NOTE**  
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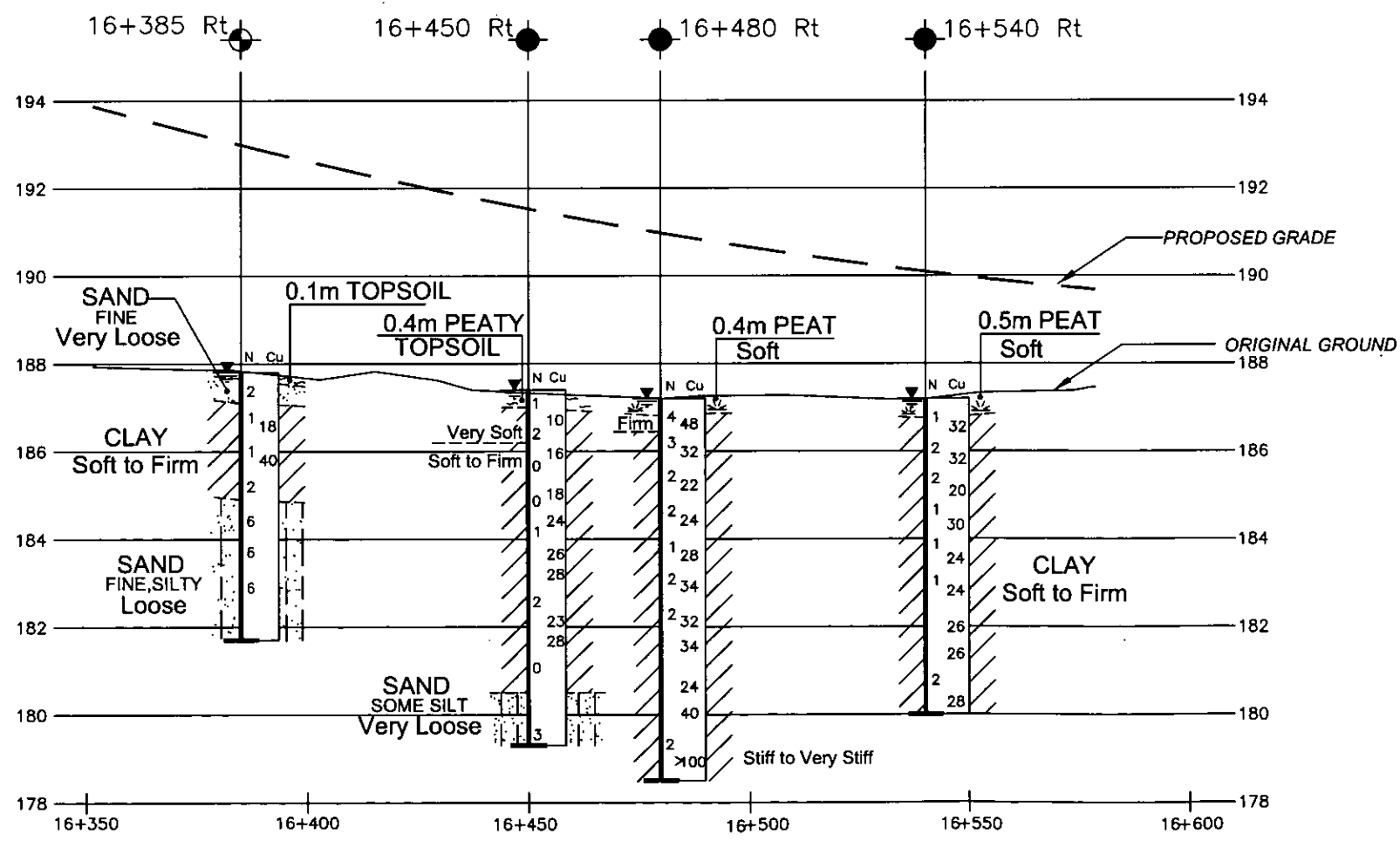
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REV.	DATE	BY	DESCRIPTION

Geocres No.			
HWY No. 17 (New)			DIST 62
SUBMD ZO	CHECKED ZO	DATE Mar, 2003	SITE
DRAWN JZ	CHECKED	APPROVED	DWG 8A-2



PLAN  
10m 0 10 20m  
SCALE



PROFILE EASTBOUND LANES

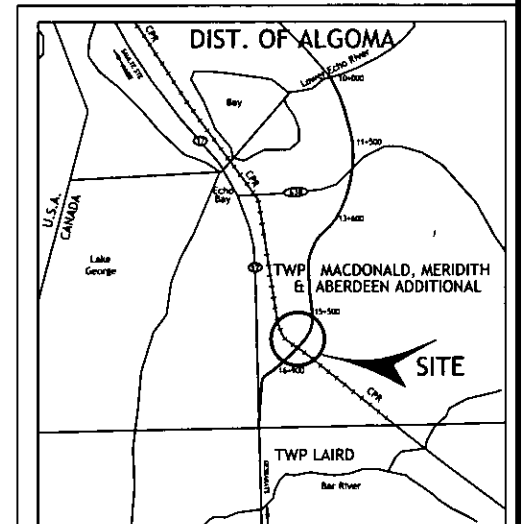
10m 0 10 20m HORIZ  
1m 0 1 2m VERT  
SCALES

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SHEETS.

CONT No.  
GWP: 354-94-00  
HIGHWAY 17 (NEW) EBL  
ECHO RIVER TO BAR RIVER ROAD  
SITE No. 8  
BORE HOLE LOCATIONS & SOIL STRATA

**SHAHEEN & PEAKER LIMITED**



KEY PLAN  
N.T.S.

**LEGEND**

- Bore Hole
- Bore Hole & Cone
- N Blows/0.3m (Std. Pen. Test, 475 J/blow)
- Cu Undrained Shear Strength measured by Field Vane Test
- Water Level at Time of Investigation Apr. ,2002 and May. ,2003
- Water Level in Piezometer
- Piezometer
- Bore Hole Done By MTO, Golder Associates Ltd.

No.	ELEV.	CO-ORDINATES	
		NORTH	EAST
16+385 Rt	187.8	5 146 173.1	300 221.1
16+450 Rt	187.4	5 146 114.3	300 196.9
16+480 Rt	187.2	5 146 085.2	300 191.2
16+540 Rt	187.2	5 146 031.5	300 167.6

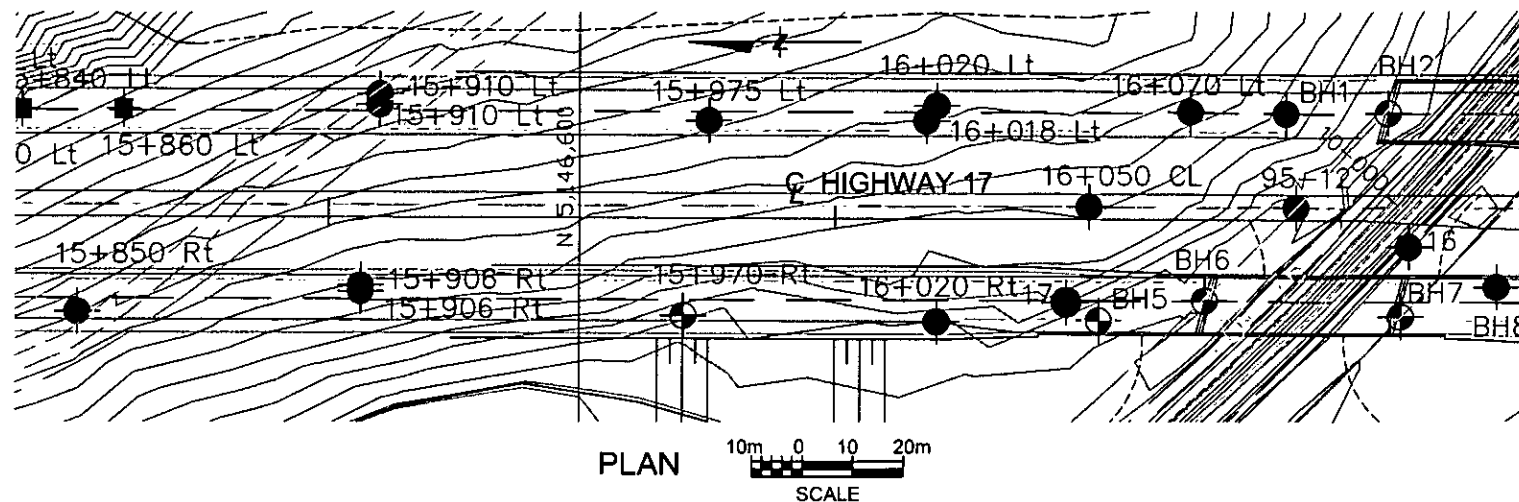
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REV.	DATE	BY	DESCRIPTION

Geocres No.			
HWY No. 17 (New)			DIST 62
SUBM'D ZO	CHECKED ZO	DATE Jul, 2003	SITE
DRAWN JZ	CHECKED	APPROVED	DWG 8A-3





# METRIC

DIMENSIONS ARE IN METRES  
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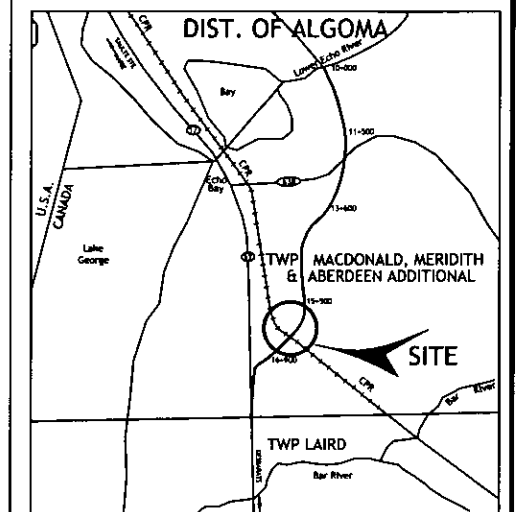
NOTE:  
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BY MTO, JULY 1975.  
BOREHOLES 95-10, 95-11, 95-12, 95-13  
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SHEETS.

CONT No.  
GWP: 354-94-00

HIGHWAY 17 (NEW) WBL  
ECHO RIVER TO  
BAR RIVER ROAD  
BORE HOLE LOCATIONS & SOIL STRATA



## SHAHEEN & PEAKER LIMITED



KEY PLAN  
N.T.S.

### LEGEND

- Bore Hole
- Bore Hole & Cone
- N Blows/0.3m (Std. Pen. Test, 475 J/blow)
- Water Level at Time of Investigation  
Nov. ,2002
- Water Level in Piezometer
- Piezometer
- Bore Hole Done By MTO, Golder Associates Ltd.

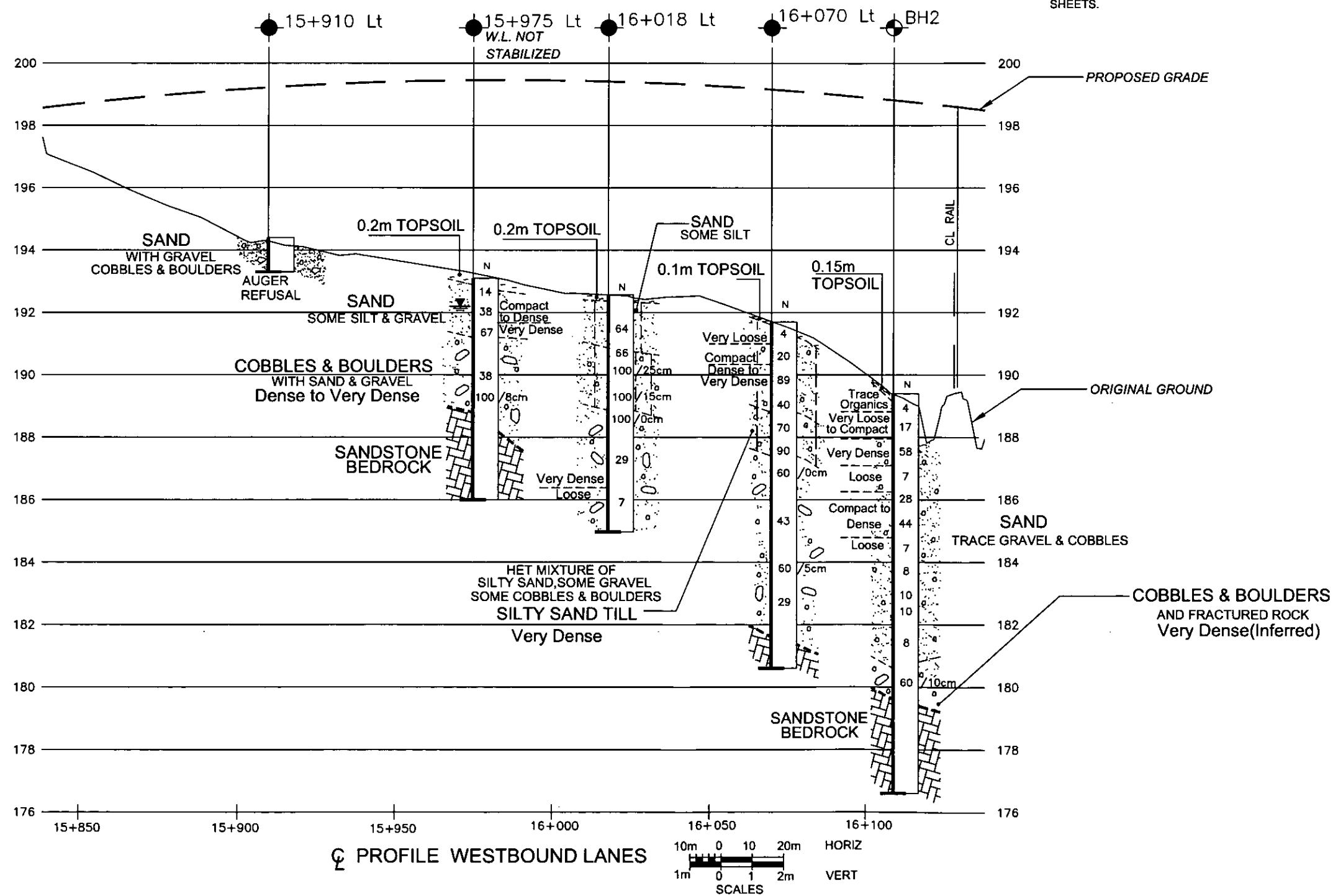
No.	ELEV.	CO-ORDINATES	
		NORTH	EAST
15+910 Lt	194.4	5 146 639.4	300 295.5
15+975 Lt	193.1	5 146 574.4	300 292.3
16+018 Lt	192.5	5 146 531.4	300 292.2
16+070 Lt	191.7	5 146 479.4	300 294.0
BH2	189.4	5 146 440.4	300 293.6

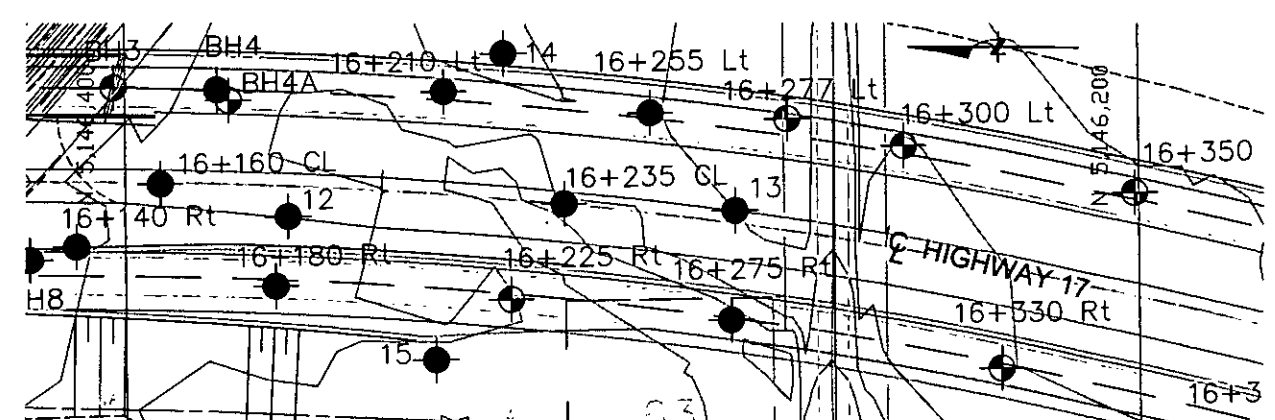
### =NOTE=

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Information contained in this report and related documents are  
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GC 2.01 of OPS Gen. Cond.

REV.	DATE	BY	DESCRIPTION
Geocres No.			
HWY No. 17 (New)			DIST 62
SUBMD ZO	CHECKED ZO	DATE Mar, 2003	SITE
DRAWN JZ	CHECKED	APPROVED	DWG 8B-1



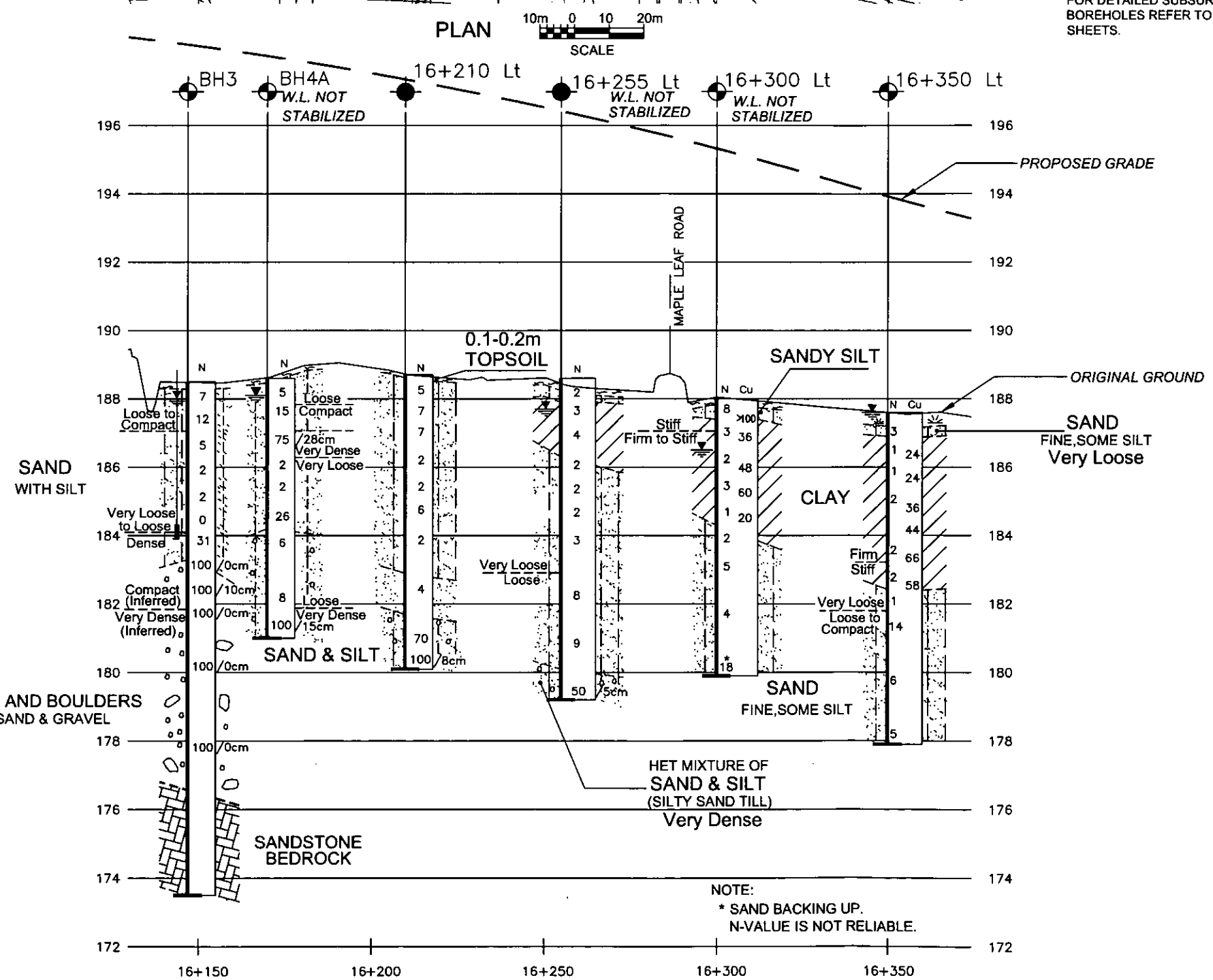
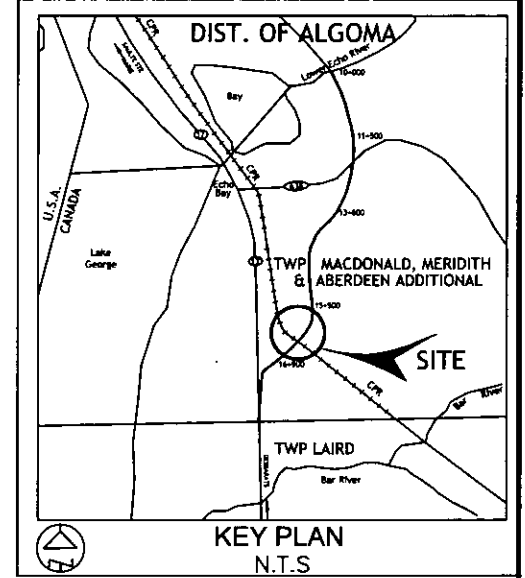


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SHEETS.

CONT No.  
GWP: 354-94-00  
HIGHWAY 17 (NEW) WBL  
ECHO RIVER TO  
BAR RIVER ROAD  
BORE HOLE LOCATIONS & SOIL STRATA

**SHAHEEN & PEAKER LIMITED**



**LEGEND**

- Bore Hole
- Bore Hole & Cone
- N Blows/0.3m (Std. Pen. Test, 475 J/blow)
- Cu Undrained Shear Strength measured by Field Vane Test
- Water Level at Time of Investigation Apr. ,2002
- Water Level in Piezometer
- Piezometer
- Bore Hole Done By MTO, Golder Associates Ltd.

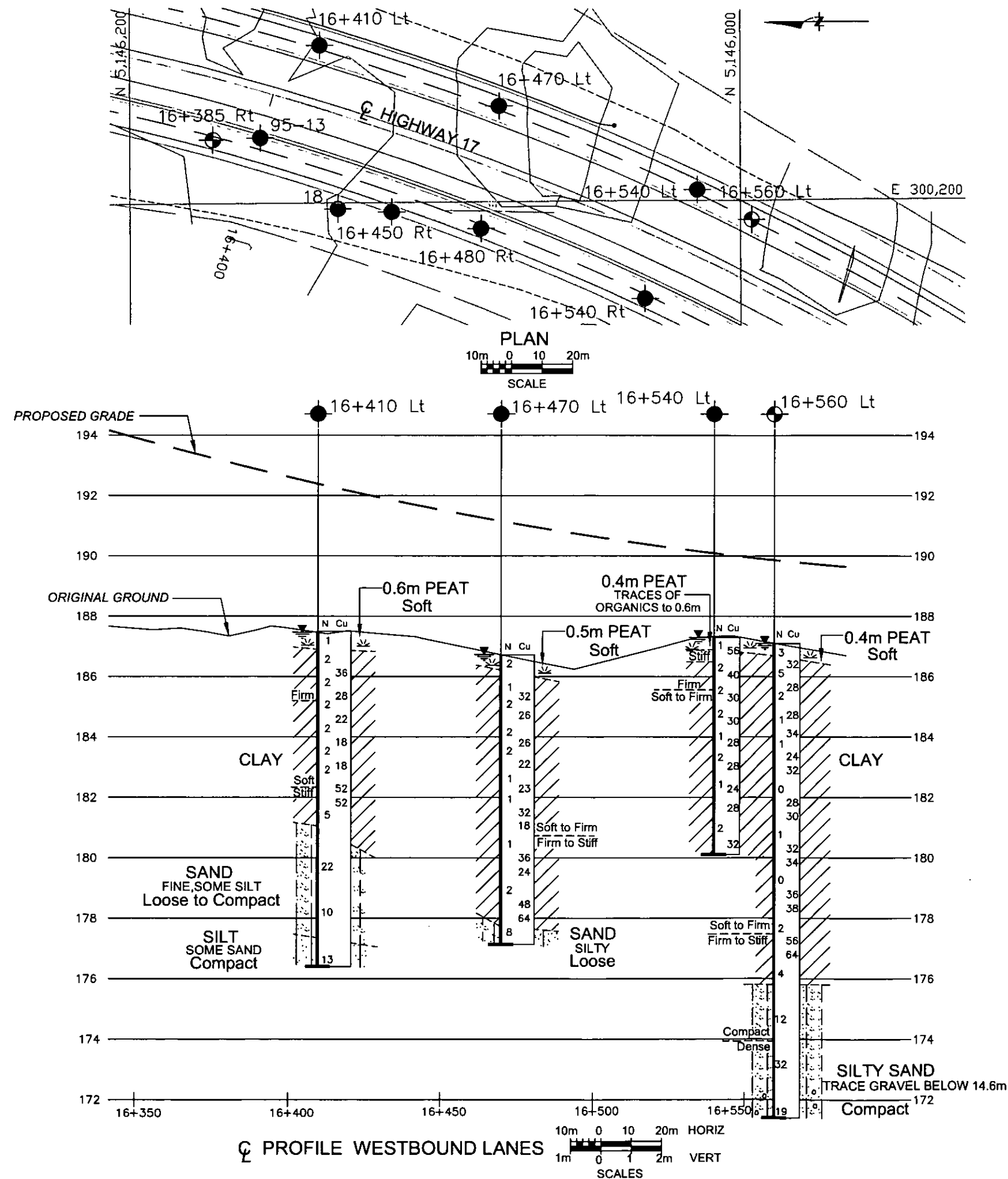
No.	ELEV.	CO-ORDINATES	
		NORTH	EAST
BH3	188.5	5 146 402.1	300 293.1
BH4A	188.6	5 146 379.6	300 290.3
16+210 Lt	188.7	5 146 337.1	300 291.5
16+255 Lt	188.6	5 146 296.5	300 286.7
16+300 Lt	188.0	5 146 246.7	300 279.5
16+350 Lt	187.6	5 146 200.7	300 269.6

**=NOTE=**  
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REV.	DATE	BY	DESCRIPTION

Geocres No.			
HWY No. 17 (New)	DIST 62		
SUBMD ZO	CHECKED ZO	DATE Mar, 2003	SITE
DRAWN JZ	CHECKED	APPROVED	DWG 8B-2



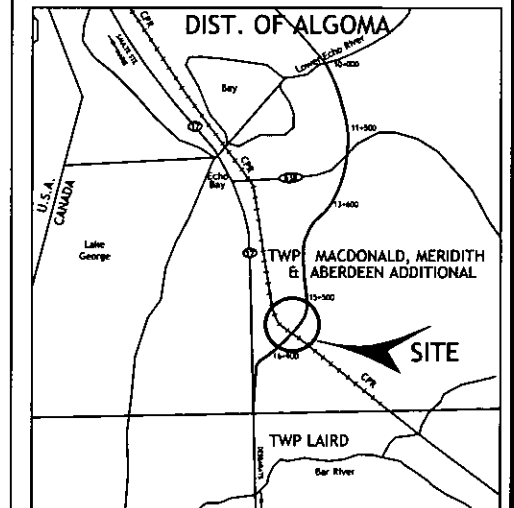
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BOREHOLES 95-10, 95-11, 95-12, 95-13  
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FOR DETAILED SUBSURFACE CONDITIONS OF ALL  
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SHEETS.

CONT No.  
GWP: 354-94-00

HIGHWAY 17 (NEW) WBL  
ECHO RIVER TO BAR RIVER ROAD  
SITE No. 8  
BORE HOLE LOCATIONS & SOIL STRATA

**SHAHEEN & PEAKER LIMITED**



KEY PLAN  
N.T.S.

**LEGEND**

- Bore Hole
- Bore Hole & Cone
- N Blows/0.3m (Std. Pen. Test, 475 J/blow)
- Cu Undrained Shear Strength measured by Field Vane Test
- Water Level at Time of Investigation Apr. ,2002 and May. ,2003
- Water Level in Piezometer
- Piezometer
- Bore Hole Done By MTO, Golder Associates Ltd.

No.	ELEV.	CO-ORDINATES	
		NORTH	EAST
16+410 Lt	187.5	5 146 137.6	300 294.1
16+470 Lt	186.7	5 146 081.9	300 228.6
16+540 Lt	187.3	5 146 014.2	300 203.6
16+560 Lt	187.1	5 145 996.3	300 193.7

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REV.	DATE	BY	DESCRIPTION
------	------	----	-------------

Geocres No.			
HWY No. 17 (New)			DIST 62
SUBM'D ZO	CHECKED ZO	DATE Jul, 2003	SITE
DRAWN JZ	CHECKED	APPROVED	DWG 88-3

# Appendix A8-1

## Record of Boreholes

**List of boreholes put down in-between  
Stations 15+850 and 16+600**

15+850 (22m) Rt	16+160 CL
15+906 (16m) Rt	BH 4
15+906 (17m) Rt	BH 4A
15+910 (20m) Lt	16+180 (20m) Rt
15+910 (22m) Lt	16+210 (20m) Lt
15+970 (22m) Rt	16+225 (20m) Rt
15+975 (17m) Lt	16+235 CL
16+018 (17m) Lt	16+255 (20m) Lt
16+020 (20m) Lt	16+275 (20m) Rt
16+020 (23m) Rt	16+277 (22m) Lt
16+050 CL	16+300 (20m) Lt
BH 5	16+330 (20m) Rt
16+070 (19m) Lt	16+350 (20m) Lt
BH 6	16+385 (20m) Rt
BH 1	16+410 (20m) Lt
BH 2	16+450 (25m) Rt
BH 7	16+470 (20m) Lt
BH 8	16+480 (20m) Rt
16+140 (13m) Rt	16+540 (20m) Lt
BH 3	16+540 (20m) Rt
	16+560 (19m) Lt

RECORD OF BOREHOLE No 15+850; 22 m Rt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, ON - Coords: N 5 146 698.5; E 300 254.3 ORIGINATED BY Y.L.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers & BQ Rock Coring COMPILED BY M.L.  
DATUM Geodetic DATE 5/7/2002 CHECKED BY Z.O.

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 (%)  GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED    + FIELD VANE ● POCKET PENETR.    × LAB VANE						PLASTIC LIMIT w <sub>p</sub> NATURAL MOISTURE CONTENT w LIQUID LIMIT w <sub>L</sub> WATER CONTENT (%)			
192.6 0.0	Ground Surface						20	40	60	80	100						
191.6 1.0	<b>SAND and GRAVEL</b> with some cobbles and boulders, brown, moist																
190.5 2.1	<b>SILTY CLAY</b> with clay and clayey silt seams, brown, stiff		1	SS	14												
			2	SS	15												
	Heterogeneous mixture of Silty Sand with some Gravel <b>(SILTY SAND TILL)</b> grayish to 2.6 m, reddish below, wet		3	SS	22												
			4	SS	50/10												
188.3 4.3			5	BQ RC	Rec. 100%												
	<b>SANDSTONE BEDROCK</b> reddish brown		6	BQ RC	Rec. 100%												
			7	BQ RC	Rec. 100%												
185.0 7.6	End of borehole  * Water used to facilitate rock coring; water level not stabilized on completion																

SPT 1055

RECORD OF BOREHOLE No 15+906; 16 m Rt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, ON - Coords: N 5 146 643.1; E 300 259.5 ORIGINATED BY Y.L.  
DIST 82 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers & BQ Rock Coring COMPILED BY M.L.  
DATUM Geodetic DATE 5/8/2002 CHECKED BY Z.O.

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			20 40 60 80 100	PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	
191.3 0.0	Ground Surface										GR SA SI CL
187.2 4.1	See Record of Borehole No 15+906 (17 m) Rt					191					
186.9 4.4						190					
						189					
	BOULDER		1	RC	-	188					
			2	BQ RC	Rec. 100%	187					RQD=95%
			3	BQ RC	Rec. 100%	186					RQD=95%
183.8 7.5	End of borehole					185					
	Refusal to further augering at 4.1 m on a boulder. Borehole extended by diamond drilling and rock coring.					184					
	* Water used to facilitate rock coring; water level not stabilized.										

+ 3, x 3: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

SPT 1055

RECORD OF BOREHOLE No 15+906; 17 m Rt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, ON - Coords: N 5 148 643.1; E 300 258.3 ORIGINATED BY Y.L.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.L.  
DATUM Geodetic DATE 4/24/2002 CHECKED BY Z.O.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
191.3	Ground Surface							20	40	60	80	100				
0.0	0.2 m Topsoil						191									
190.6	<b>SAND and GRAVEL</b> , frequent cobbles brown, wet															
0.7	<b>SAND</b> Fine, some silt reddish brown, dense, wet		1	SS	40		190									4 81 13 2
189.8																
1.5	Heterogeneous mixture of Sand and Silt, some Gravel <b>(SILTY SAND TILL)</b> increasing gravel content with depth, some cobbles, reddish brown to grey, wet		2	SS	32		189									
	dense		3	SS	32											2 46 40 2
	loose		4	SS	10		188									
	very dense		5	SS	52/28											
186.7	very gravelly		6	SS	100/0		187									
4.6	End of borehole. Refusal to further augering at 4.6 m and sampler bouncing probably on bedrock.  * Wet Cave at 3.0 m on completion.  Relocate Borehole by 2.0 m to Station 15+904; (17 m) Rt and re-drill. Refusal to augering at 4.5 m.  Relocate Borehole by 2.0 m to Station 15+908; (17 m) Rt and re-drill. Refusal to augering at 4.7 m.  Borehole moved by 1.0 m to Station 15+906; (16 m) Rt. See Record of Borehole 15+906 (16 m) Rt.															

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10  
(%) STRAIN AT FAILURE



SPT 1055

RECORD OF BOREHOLE No 15+910; 20 m Lt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, ON - Coords: N 5 146 639.4; E 300 295.5 ORIGINATED BY Y.L.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.L.  
DATUM Geodetic DATE 4/25/2002 CHECKED BY Z.O.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
194.4 0.0	Ground Surface					194	20	40	60	80	100						GR SA SI CL
193.3 1.1	<p>SAND with Gravel, Cobbles and Boulders</p> <p>End of borehole</p> <p>Sampler bouncing and refusal to further augering at 1.1 m.</p> <p>Borehole dry and caved at ground surface.</p> <p>Borehole relocated and re-drilled at Station 15+912; (21 m) Lt, refusal to augering at 0.9 m below ground surface.</p> <p>Borehole relocated and re-drilled at Station 15+908; (19 m) Lt. Refusal again at 0.3 m below ground surface.</p>		1	AS	-												

+ 3, × 3; Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

SPT 1055

# RECORD OF BOREHOLE No 15+910; 22 m Lt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, ON - Coords: N 5 146 639.4; E 300 297.5 ORIGINATED BY Y.L.  
 DIST 62 HWY 17 (New) BOREHOLE TYPE Rock Coring COMPILED BY M.L.  
 DATUM Geodetic DATE 5/7/2002 CHECKED BY Z.O.

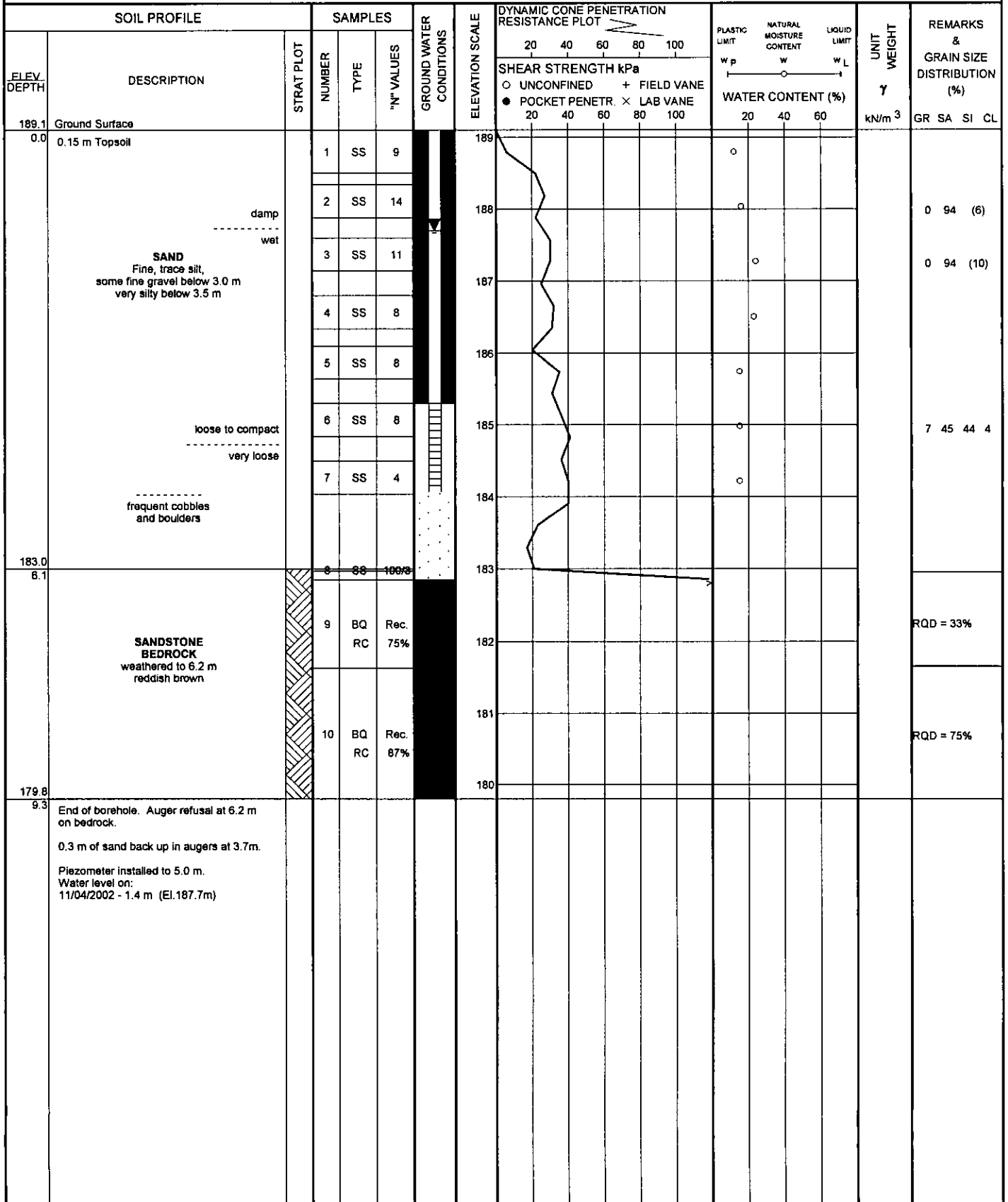
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
194.4	Ground Surface													
0.0			1	BQ RC	Rec. 100%		194							RQD=40%
			2	BQ RC	Rec. 100%		193							RQD=95%
191.4							192							
3.0	End of borehole													

SPT 1055

RECORD OF BOREHOLE No 15+970; 22 m Rt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, ON - Coords: N 5 146 579.6; E 300 253.3 ORIGINATED BY Y.L.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers, Wash Boring & BQ Rock Coring COMPILED BY R.A.  
DATUM Geodetic DATE 11/3/2002 CHECKED BY R.A.



+ 3, × 3: Numbers refer to  
Sensitivity



20  
15  
10  
(%) STRAIN AT FAILURE

SPT 1055

RECORD OF BOREHOLE No 15+975; 17 m Lt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, ON - Coords: N 5 146 574.4; E 300 292.3 ORIGINATED BY Y.L.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers, Wash Boring & BQ Rock Coring COMPILED BY R.A.  
DATUM Geodetic DATE 11/4/2002 CHECKED BY R.A.


SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  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 ○ UNCONFINED      + FIELD VANE ● POCKET PENETR.    × LAB VANE								WATER CONTENT (%)
193.1	Ground Surface						20	40	60	80	100					
0.0	0.2 m Topsoil		1	SS	14										21 49 28 2	
	SAND some silt and gravel, brown, damp compact to dense ----- very dense		2	SS	38											
191.2			3	SS	67											
1.9	COBBLES and BOULDERS with sand and gravel brown, wet dense to very dense		4	RC	-											
			5	SS	38											
			6	SS	100/2											
188.8	SANDSTONE BEDROCK reddish brown		7	BQ RC	Rec. 94 %										RQD = 78 %	
4.3				8	BQ RC	Rec. 97 %										RQD = 93 %
186.0	End of borehole.															
7.1	* Water level at 0.9 m (not stabilized) and hole open to 1.7 m on completion.															

SPT 1055

# RECORD OF BOREHOLE No 16+018; 17 m Lt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, ON - Coords: N 5 146 531.4; E 300 292.2 ORIGINATED BY Y.L.  
 DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers, Wash Boring & BQ Rock Coring COMPILED BY R.A.  
 DATUM Geodetic DATE 11/7/2002 CHECKED BY R.A.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT  γ  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 ○ UNCONFINED    + FIELD VANE ● POCKET PENETR.    × LAB VANE					WATER CONTENT (%) PLASTIC LIMIT    NATURAL MOISTURE CONTENT    LIQUID LIMIT w <sub>p</sub> w                      w <sub>L</sub>	
192.5 0.0	Ground Surface  0.2 m Topsoil		1	AS	-	.	192							9 61 28 2  ** commence casing and washboring
	<b>SAND</b> Fine, some silt brown, damp very dense		2	SS	64		191							
190.8 1.7	Heterogeneous mixture of silty sand, trace gravel ( <b>SILTY SAND TILL</b> ) reddish brown, damp very dense		3	SS	66		190							
			4	SS	100/25		189							
			5	SS	100/15		188							
188.8 3.7	<b>COBBLES AND BOULDERS</b> with sand and gravel  very dense  loose		6	SS	100/0		187							
			7	RC	-		186							
			8	SS	29		185							
			9	RC	-									
			10	SS	7									
184.9 7.6	Borehole terminated. Refer to Borehole 16+020 (20 m) Lt. for stratigraphy below 7.6 m.  * Water used to facilitate casing and washboring; water level not stabilized.													

+ 3, x 3: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

SPT 1055

RECORD OF BOREHOLE No 16+020; 20 m Lt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, ON - Coords: N 5 146 529.4; E 300 295.2 ORIGINATED BY G.I.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Casing and Wash Boring & BQ Rock Coring COMPILED BY R.A.  
DATUM Geodetic DATE 12/11/2002 CHECKED BY R.A.

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 (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
192.6 0.0	Ground Surface													
	Casing and Washboring to 8.2 m Refer to Record of Borehole 16+018 (17 m) Lt. for soil stratigraphy.													
184.4 8.2	COBBLES and BOULDERS		1	RC	-									
			2	RC	-									
183.3 9.3			3	RC	-									
	SANDSTONE BEDROCK reddish brown		1	BQ RC	Rec. 100%									RQD = 100%
			2	BQ RC	Rec. 100%									RQD = 100%
180.1 12.5	End of borehole.  * Water used to facilitate casing and washboring; water level not stabilized.													

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

SPT 1055

RECORD OF BOREHOLE No 16+020; 23 m Rt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, ON - Coords: N 5 146 529.6; E 300 252.2 ORIGINATED BY Y.L.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers, Casing and Wash Boring & BQ Rock Coring COMPILED BY R.A.  
DATUM Geodetic DATE 11/5/2002 CHECKED BY R.A.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)		
								○ UNCONFINED	+ FIELD VANE	● POCKET PENETR.	× LAB VANE						20	40	60
189.0 0.0	Ground Surface 0.15 m Topsoil		1	SS	8														
			2	SS	16														
			3	SS	13														
			4	SS	13														
			5	SS	13														
			6	SS	9														
			7	SS	10														
183.8 5.2	Heterogeneous mixture of silty sand, trace gravel (SILTY SAND TILL) reddish grey, wet		8	SS	6														
			9	SS	122/23														
180.5 8.5	SANDSTONE BEDROCK reddish brown		10	BQ RC	Rec. 95%														
			11	BQ RC	Rec. 95%														
177.4 11.6	End of borehole. * Water level at 0.9 m (not stabilized) and hole open to 4.6 m on completion. ** 0.3 m of sand back up in augers. *** Commence casing and washboring.																		

RECORD OF BOREHOLE No 16+050 CL

1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, ON - Coords: N 5 146 499.5; E 300 275.1 ORIGINATED BY Y.L.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers, Casing and Wash Boring & BQ Rock Coring COMPILED BY R.A.  
DATUM Geodetic DATE 11/6/2002 CHECKED BY R.A.

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			SHEAR STRENGTH kPa					
								20 40 60 80 100					
191.1	Ground Surface												
0.0	0.15 m Topsoil		1	SS	5								
	<b>SAND</b> trace silt, brown, damp loose compact to dense		2	SS	46								
189.2			3	SS	28								
1.9	Heterogeneous mixture of silty sand, some gravel. (SILTY SAND TILL) reddish brown, damp to moist, wet below 3.7 m dense to very dense compact silty sand seams compact frequent cobbles		4	SS	56								
			5	SS	39								
			6	SS	18								
			7	SS	26								
185.5			8	SS	9								
5.6	<b>SAND</b> trace silt with gravel below 7.1 m reddish/gray, wet loose to compact		9	SS	26								
			10	SS	8								
180.6													
10.5	<b>SANDSTONE BEDROCK</b> reddish brown		11	BQ RC	Rec. 100%								
179.0	End of borehole.												
12.1	* Water level at 3.4 m (not stabilized) and hole open to 6.4 m on completion.												



SPT1055

# RECORD OF BOREHOLE No 5

1 OF 2

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sta. 16+052, 23m Rt. - Coords: N 5 148 497.6; E: 300 252.3 ORIGINATED BY Y.L.  
DIST 82 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers, D.C.P.T., Casing & Washboring & BQ Rock Coring COMPILED BY M.L.  
DATUM Geodetic DATE 11/8/2002 CHECKED BY R.A.

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			SHEAR STRENGTH kPa				
188.6 0.0	Ground Surface						20 40 60 80 100	PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>		
	0.2 m Topsoil		1	SS	4			WATER CONTENT (%)				
	very loose, moist											
	wet compact		2	SS	14							
			3	SS	18							10 85 (5)
	SAND											
	trace gravel and silt		4	SS	10							
	brownish grey											
			5	SS	9							
	loose to compact											
			6	SS	8							
			7	SS	4							1 88 (11)
			8	SS	14							
	some gravel		9	SS	9							Possible cobble at 6.8 m
	loose											20 75 (5)
	dense		10	SS	36							
178.2 10.4												
	SANDSTONE BEDROCK reddish brown		11	BQ RC	Rec. 89%							RQD=83%
			12	BQ RC	Rec. 100%							RQD=99%
175.2 13.4	End of borehole.											
	* Water used to facilitate washboring and rock coring, water level at 1.5 m (not stabilized) hole open to 5.2 m on completion.											

Continued Next Page

+ 3 . x 3 : Numbers refer to  
Sensitivity

20  
15  
10  
(%) STRAIN AT FAILURE

**SPT1055**

## 2 OF 2

METRIC

GWP	354-94-00	LOCATION	Echo River to Bar River Road, Sta. 16+052, 23m Rt. - Coords: N 5 146 497.6; E: 300 252.3	ORIGINATED BY	Y.L.
DIST	62	HWY	17 (New)	BOREHOLE TYPE	Hollow Stem Augers, D.C.P.T., Casing & Washboring & BQ Rock Coring
DATUM	Geodetic	DATE	11/6/2002	CHECKED BY	R.A.

[illegible]

+ 3, × 3: Numbers refer to Sensitivity

SP1055

RECORD OF BOREHOLE No 16+ 070; 19 m Lt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie, ON - Coords: N 5 146 479.4; E 300 294.0 ORIGINATED BY G.I.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers, casing & washboring & NQ Rock Coring COMPILED BY G.T.  
DATUM Geodetic DATE 11/13/2002 CHECKED BY R.A.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ 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 ○ UNCONFINED    + FIELD VANE ● POCKET PENETR.    × LAB VANE								
191.7 0.0	Ground Surface						20	40	60	80	100					
	0.1 m Topsoil		1	SS	4											
	very loose															
	compact		2	SS	20											24 57 17 2
	dense to very dense		3	SS	89											
	<b>SAND</b> Silty, trace to some gravel brown, damp		4	SS	40											
188.8 2.9	Heterogeneous mixture of silty sand, some gravel some cobbles and boulders <b>SILTY SAND TILL</b> reddish grey, moist, very dense		5	SS	70											
			6	RC	-											
			7	SS	90											
187.4 4.3			8	RC	-											
			9	SS	60/0											
			10	RC	-											
			11	RC	-											
	<b>COBBLES and BOULDERS</b> with sand and gravel brown, wet compact to very dense inferred		12	SS	43											
			13	RC	-											
			14	SS	88/6											
			15	RC	-											
			16	SS	29											
			17	RC	-											
181.6 10.1	<b>SANDSTONE BEDROCK</b> reddish brown		18	RC	-											
			19	NQ RC	Rec. 100%											RQD = 89%
180.6 11.1	End of borehole.  * Water used to facilitate coring and wash boring, water level not stabilized.															

+ 3, x 3: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

SPT1055

# RECORD OF BOREHOLE No 6

1 OF 2

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sta. 16+073, 19m Rt. - Coords: N 5 146 476.6; E: 300 256.3 ORIGINATED BY G.I.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers, D.C.P.T., Casing & Washboring & NQ Rock Coring COMPILED BY G.T.  
DATUM Geodetic DATE 11/17/2002 CHECKED BY R.A.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● POCKET PENETR. × LAB VANE				
188.6 0.1	Ground Surface  0.1 m Topsoil  loose, moist wet compact  occasional cobbles or boulders  loose to compact  SAND trace to some gravel, trace silt, brown, wet  sandy silt zones  very loose to loose  very dense		1	SS	8							20 74 (6)   <

Continued Next Page

+ 3, x 3: Numbers refer to Sensitivity

20  
15  
10  
(%) STRAIN AT FAILURE



SPT1055

# RECORD OF BOREHOLE No 1

1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sta. 16+089, 19m LL - Coords: N 5 146 460.4; E: 300 293.7 ORIGINATED BY G.I.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers, Casing & Washboring & NQ Rock Coring COMPILED BY G.T.  
DATUM Geodetic DATE 11/16/2002 CHECKED BY R.A.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ 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	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
190.8 0.0	Ground Surface													
	0.1 m Topsoil		1	SS	84/20	*								
			2	SS	20		180							
	damp wet		3	SS	49		189							
			4	SS	27									
	SAND some silt and gravel occasional cobbles and boulders brown, compact to dense		5	SS	24		188							
			6	SS	15		187							
			7	SS	27		186							
			8	SS	44		185							
			9	SS	51									
	numerous boulder cobbles and boulders	boulder	10	RC	-	**	184							**Commenced casing and washboring
		boulder	11	RC	-									
			12	SS	23		183							
							182							
		boulder	13	RC	-		181							
180.6 10.0	SANDSTONE BEDROCK reddish brown		14	NQ RC	Rec. 87%		180							RQD 67%
179.5 11.3	End of borehole													
	* Water used to facilitate washboring and rock coring, water level not stabilized and hole open to 7.3 m on completion.													

+ 3, x 3: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

SPT1055

RECORD OF BOREHOLE No 2

1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sta. 16+109, 19m Lt. - Coords: N 5 146 440.4; E: 300 293.6 ORIGINATED BY G.I.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Solid Stem Augers, D.C.P.T., Casing & Washboring & NQ Rock Coring COMPILED BY G.T.  
DATUM Geodetic DATE 11/15/2002 CHECKED BY R.A.

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	20 40 60 80 100	20 40 60 80 100		
189.4 0.0	Ground Surface											
	0.15 m Topsoil		1	SS	4	*	189					1 94 (5)
	trace organics											
	moist		2	SS	17		188					
	wet											
	very loose to compact		3	SS	58		187					
	very dense											
	loose, wet		4	SS	7		186					
	compact to dense		5	SS	28		185					
	loose		6	SS	44		184					
	SAND some silt and gravel occasional cobbles brown		7	SS	7		183					
			8	SS	8		182					16 72 (10)
			9	SS	10		181					
			10	SS	10		180					
			11	SS	8		179					
180.6 8.8	COBBLES AND BOULDERS and fractured rock very dense (inferred)		12	SS	60/111		178					RQD=58%
179.6 9.8	SANDSTONE BEDROCK fractured reddish brown		13	NQ RC	Rec. 94%		177					
			14	NQ RC	Rec. 98%							
178.6 12.8	End of borehole		15	NQ RC	Rec. 96%							RQD=85%
	* Water used to facilitate washboring and rock coring, water level not stabilized and hole open to 3.4 m on completion.  Dynamic Cone Penetration Test (DCPT) performed from 0 to 9 m.											RQD=96%

SPT1055

# RECORD OF BOREHOLE No 7

1 OF 2

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sta. 16+112, 22m Rt. - Coords: N: 5 146 437.7; E: 300253.1 ORIGINATED BY Y.L.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers, D.C.P.T., Casing & Washboring & NQ Rock Coring COMPILED BY M.L.  
DATUM Geodetic DATE 11/25/2002 CHECKED BY R.A.

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	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	
188.2 0.0	Ground Surface											
	0.1 m Topsoil	moist wet	1	SS	6		188					
			2	SS	3		187					
	<b>SAND</b> Fine, trace to some silt brownish grey loose to very loose		3	SS	3		186					0 95 (5)
			4	SS	1		185					
			5	SS	2		184					
	occasional Cobbles		6	SS	2		183					
			7	SS	4		182					0 80 (20)
			8	SS	8		181					Possible cobble at 7.1 m.
		with silt, occasional cobbles, compact	9	SS	5		180					5 57 25 13
			10	SS	22		179					
			11	SS	25		178					
179.9 8.3		boulders	12	RC	-		177					
			13	SS	100/10		176					
	<b>COBBLES and BOULDERS</b> with sand and gravel very dense (inferred)		14	RC	-		175					
		boulders	15	RC	-		174					
			16	SS	100/10							
			17	RC	-							
		boulder	18	RC	-							
176.2 12.0			19	SS	100/10							
	<b>SANDSTONE BEDROCK</b> reddish brown		20	NQ RC	Rec. 86%							RQD=93%
			21	NQ RC	Rec. 100%							RQD=92%

Continued Next Page

+ 3, x 3: Numbers refer to  
Sensitivity

20  
15 10 5  
10 (%) STRAIN AT FAILURE



SPT1055

RECORD OF BOREHOLE No 7

2 OF 2

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sta. 16+112, 22m Rt. - Coords: N: 5 148 437.7; E: 300253.1 ORIGINATED BY Y.L.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers, D.C.P.T., Casing & Washboring & NQ Rock Coring COMPILED BY M.L.  
DATUM Geodetic DATE 11/25/2002 CHECKED BY R.A.

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 (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20	40	60	80	100		
173.1		///											
15.1	End of borehole  * Water used to facilitate washboring and rock coring, water level at 0.6 m (not stabilized) and hole open to 15.1 m on completion.  **No recovery, 1.2 m sand back-up inside auger. Commence casing and washboring.  Dynamic Cone Penetration Test (DCPT) performed from 0 to 7.1 m. Refusal at 7.1 m probably on a cobble or boulder					173							

+<sup>3</sup>, x<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

SPT1055

# RECORD OF BOREHOLE No 8

1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sta. 16+131, 16m Rt. - Coords: N 5 146 418.7; E: 300 258.9 ORIGINATED BY G.I.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers, Casing & Washboring & BQ Rock Coring COMPILED BY G.T.  
DATUM Geodetic DATE 11/19/2002 CHECKED BY R.A.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT  Y  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL			
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)		
								○ UNCONFINED    + FIELD VANE ● POCKET PENETR.    × LAB VANE					W <sub>p</sub> W    W <sub>L</sub>		
188.4 0.0	Ground Surface					20 40 60 80 100	20 40 60 80 100	20 40 60							
0.1 m Topsoil	moist wet  <b>SAND</b> Fine, trace silt, brownish grey loose  reddish brown		1	SS	13	*	188						0 92 (8)		
			2	SS	4		187								
			3	SS	6		186								
			4	SS	4		185								
			5	SS	5		184								
			6	SS	12		183								
			7	SS	9		182								
			8	SS	4		181								
			9	SS	41		180								
181.4 7.0	<b>COBBLES AND BOULDERS</b> with Sand and Gravel with Sandy Silt till layers reddish brown very dense (inferred)		10	RC	-	**	181						**Commence casing and washboring.		
11			SS	60/13		180									
12			RC	-		179									
13			RC	-		178									
14			SS	60/8		177									
15			RC	-		176									
16			RC	-		175									
17			SS	60/8											
18			RC	-											
19			RC	-											
20			RC	-											
175.6 12.8	<b>SANDSTONE BEDROCK</b> reddish brown		21	RC	-							RQD=69%			
174.7 13.7			22	BQ	REC. 97%										
174.7 13.7	End of borehole.														
* Water used to facilitate washboring and rock coring, water level not stabilized and hole open to 6.4 m on completion.															

+ 3, x 3: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

SPT 1055

# RECORD OF BOREHOLE No 16+140 (13 m) Rt 1 of 1 METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, ON - Coords: N5 146 409.8; E 300 261.5 ORIGINATED BY Y.L.  
 DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers, Casing and Wash Boring & BQ Rock Coring COMPILED BY R.A.  
 DATUM Geodetic DATE 11/2/2002 CHECKED BY R.A.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT  γ  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				
								○ UNCONFINED + FIELD VANE				
								● POCKET PENETR. × LAB VANE				
						WATER CONTENT (%)						
						PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT						
						w <sub>p</sub> w w <sub>L</sub>						
						20 40 60 80 100						
						20 40 60 80 100						
						20 40 60						
188.5	Ground Surface											
0.0	0.2 m Topsoil		1	SS	10		188					
			2	SS	14							
			3	SS	6		187					
			4	SS	9		186					0 88 11 1
			5	SS	8		185					
			6	SS	6		184					1 86 12 1
			7	SS	12		183					
182.4			8	SS	25		182					
6.1			9	SS	130/13		181					16 48 33 3
			10	SS	120/13		180					
			11	RC	-		179					
			12	SS	120/13		178					
			13	RC	-		177					
176.3			14	SS	100/6							
12.2	End of Borehole.											
	* Water level at 0.5 m (not stabilized) and hole open to 4.6 m on completion.											

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 (% STRAIN AT FAILURE)

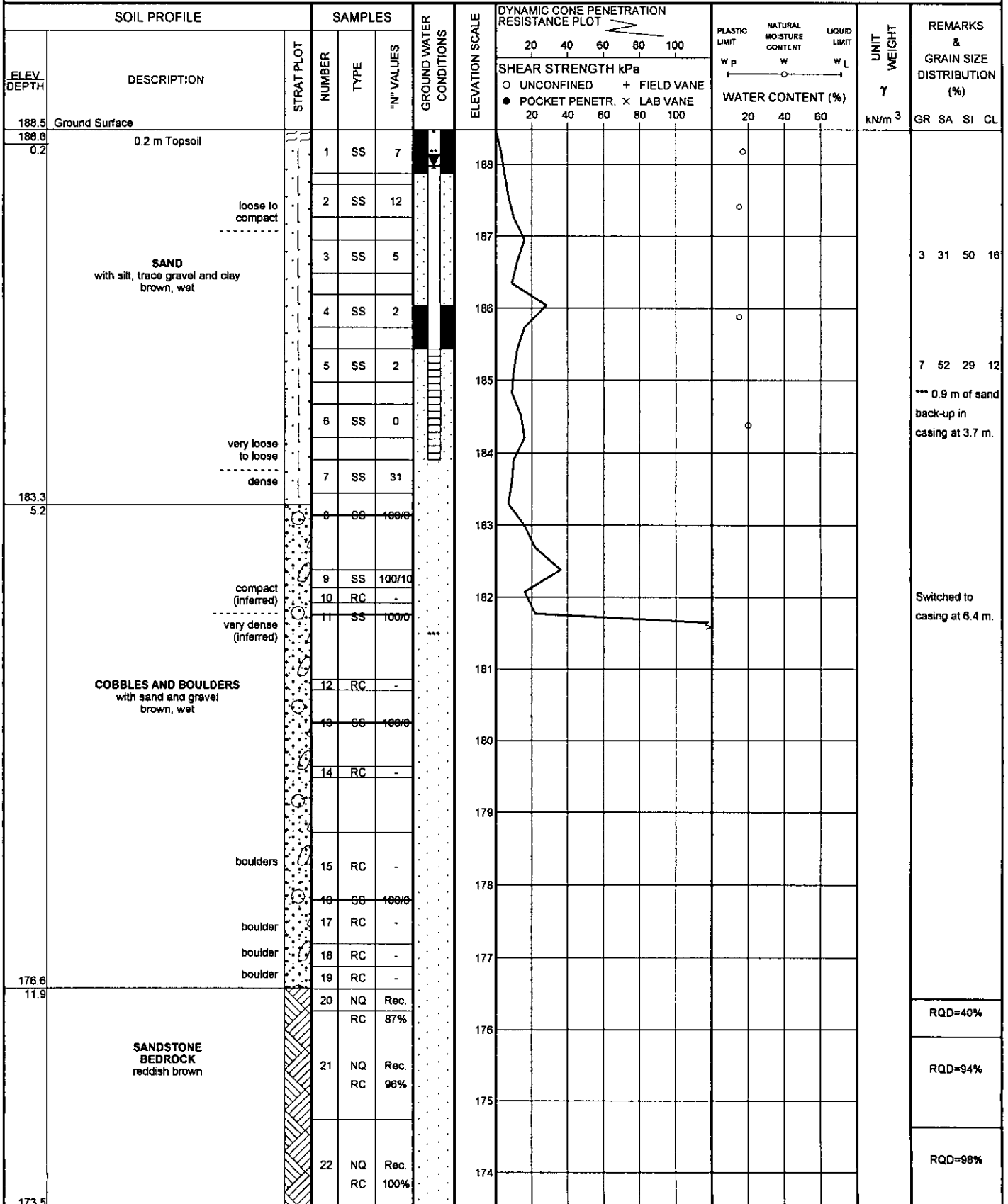
SPT1055

# RECORD OF BOREHOLE No 3

1 OF 2

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sta. 16+147, 19m Lt. - Coords: N 5 146 402.1; E: 300 293.1 ORIGINATED BY Y.L.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers, D.C.P.T., Casing & Washboring & NQ Rock Coring COMPILED BY M.L.  
DATUM Geodetic DATE 11/27/2002 CHECKED BY R.A.



Continued Next Page

+ 3. × 3: Numbers refer to  
Sensitivity 20 15 10 5  
(%) STRAIN AT FAILURE

SPT1055

RECORD OF BOREHOLE No 3

2 OF 2

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sta. 16+147, 19m Lt. - Coords: N 5 146 402.1; E: 300 293.1 ORIGINATED BY Y.L.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers, D.C.P.T., Casing & Washboring & NQ Rock Coring COMPILED BY M.L.  
DATUM Geodetic DATE 11/27/2002 CHECKED BY R.A.

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			20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
15.0	End of borehole  * Water used to facilitate washboring and rock coring, water level at 0.2 m (not stabilized) and hole open to 4.6 m upon completion.  ** Piezometer installed to 4.6 m Water Level on: December 01, 2002 0.6 m (El. 187.9) December 05, 2002 0.5 m (El. 188.0)  Dynamic Cone Penetration Test (DCPT) performed from 0 to 6.8 m.						173										

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10  
(%) STRAIN AT FAILURE

SPT 1055

# RECORD OF BOREHOLE No 16+160 CL

1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, ON - Coords: N 5 146 393.1; E 300 273.8 ORIGINATED BY Y.L.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.L.  
DATUM Geodetic DATE 4/19/2002 CHECKED BY Z.O.

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 (%)
FLEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20	40	60	80	100		
188.6 0.0	Ground Surface												
	0.1 m Topsoil some organics to 0.5 m		1	SS	6								
	<b>SAND</b> Fine, silty, loose to compact, wet		2	SS	11								
	brown		3	SS	12**								
	reddish		4	SS	10								
	grey		5	SS	7**								
185.0 3.6	<b>GRAVELLY SAND</b> reddish grey, wet		6	SS	16								
	compact		7	SS	18								
	very loose		8	SS	3								
181.9 6.7	<b>SANDY SILT TILL</b> reddish grey, very dense, wet		9	SS	100/13								
181.5 7.1	End of borehole												
	* Water level at 0.05 m upon completion. Piezometer installed to 5.2 m. Water level on: 04/21/2002 - 1.4 m (El. 188.2m)  **Slight hydrocarbon odour.												

**SPT1055**

## 1 OF 1

METRIC

GWP	354-94-00	LOCATION	Echo River to Bar River Road, Sta. 16+167, 19m Lt. - Coords: N 5 146 381.8; E: 300 292.5	ORIGINATED BY	Y.L.
DIST	62	HWY	17 (New)	BOREHOLE TYPE	Hollow Stem Augers, Casing & Washboring & NQ Rock Coring
DATUM	Geodetic	DATE	11/30/2002	COMPILED BY	M.L.
				CHECKED BY	R.A.

[illegible]

+ 3, x 3: Numbers refer to Sensitivity

SPT1055

# RECORD OF BOREHOLE No 4A

1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sta. 16+170, 17m LL - Coords: N 5 146 379.6; E: 300 290.3 ORIGINATED BY Y.L.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers & D.C.P.T. COMPILED BY G.T.  
DATUM Geodetic DATE 4/19/2002 CHECKED BY R.A.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● POCKET PENETR. × LAB VANE							
188.6 0.0	Ground Surface							20 40 60 80 100							
	0.15 m Topsoil							20 40 60 80 100							
	brown loose		1	SS	5										
	reddish brown compact		2	SS	15										
	reddish SAND														
	grey Fine, trace to some silt, wet		3	SS	75/28										
	very dense gravelly														
	very loose		4	SS	2										
			5	SS	2										
	gravelly sand layer, loose to compact		6	SS	26										
184.2 4.4			7	SS	6										
	SAND AND SILT trace to some gravel and clay reddish grey, wet		8	SS	8										
	loose														
	very dense		9	SS	100/15										
181.0 7.6	End of borehole														
	* Water level at 0.5 m (not stabilized) and hole open to 0.8 m on completion.														
	Dynamic Cone Penetration Test (DCPT) performed from 0 to 7.4 m.														

+<sup>3</sup> ×<sup>3</sup>: Numbers refer to Sensitivity

20  
15  
10  
(%) STRAIN AT FAILURE



SPT 1055

RECORD OF BOREHOLE No 16+180 (20 m) Rt 1 OF 2

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, ON - Coords: N 5 146 370.5; E 300 253.2 ORIGINATED BY Y.L.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers, Wash Boring & BQ Rock Coring COMPILED BY R.A.  
DATUM Geodetic DATE 10/30/2002 CHECKED BY R.A.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ 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	20 40 60 80 100	20 40 60					
188.8	Ground Surface													
0.0	0.1 m Topsoil		1	SS	6									
			2	SS	8									
			3	SS	4									
			4	SS	3									
			5	SS	0									
			6	SS	3									
			7	SS	4									
			8	SS	4									
181.0			9	SS	100/28									
7.8			10	SS	100/6									
			11	SS	100/0									
			12	SS	100/10									
			13	SS	100/13									
			14	WS	-									
			15	RC	-									

Continued Next Page

+ 3, x 3: Numbers refer to 20  
Sensitivity 15 10 5 (%) STRAIN AT FAILURE

SPT 1055

RECORD OF BOREHOLE No 16+180 (20 m) Rt 2 of 2

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, ON - Coords: N 5 146 370.5; E 300 253.2 ORIGINATED BY Y.L.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers, Wash Boring & BQ Rock Coring COMPILED BY R.A.  
DATUM Geodetic DATE 10/30/2002 CHECKED BY R.A.

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					W <sub>p</sub>	W	W <sub>L</sub>		
							20	40	60	80	100					
173.2			16	RC	-											
15.6	End of borehole. * Water level at 1.5 m (not stabilized) and hole open to 10.7 m on completion. ** Spoon sinking under weight of hammer and rods. *** 1.5 m of sand back up in augers.															

SPT 1055

RECORD OF BOREHOLE No 16+210 (20 m) Lt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, ON - Coords: N 5 146 337.1; E 300 291.5 ORIGINATED BY Y.L.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.L.  
DATUM Geodetic DATE 4/18/2002 CHECKED BY Z.O.

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		
189.7	Ground Surface													
0.0	0.1 m Topsoil some organics to 0.4 m		1	SS	5	*	188							
			2	SS	7									
			3	SS	7		187							
			4	SS	2		186							
			5	SS	2		185							
			6	SS	6									
			7	SS	2		184							
182.9							183							
5.8			8	SS	4		182							
181.7							181							
7.0			9	SS	70									
180.1			10	SS	100/8									
8.6	End of borehole													
	* Wet cave at 1.5 m on completion. **Slight hydrocarbon odour.													

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10  
(%) STRAIN AT FAILURE

SPT 1055

RECORD OF BOREHOLE No 16+225 (20 m) Rt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, ON - Coords: N 5 146 324.0; E 300 249.9 ORIGINATED BY Y.L.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers & DCPT COMPILED BY M.L.  
DATUM Geodetic DATE 4/18/2002 CHECKED BY Z.O.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
								○ UNCONFINED	+ FIELD VANE	● POCKET PENETR.			x LAB VANE	W <sub>p</sub>	W	W <sub>L</sub>																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
188.9	Ground Surface						20	40	60	80	100	20	40	60																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
0.0	0.1 m Topsoil some organics to 0.4 m		1	SS	8																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 10 (%) STRAIN AT FAILURE

SPT 1055

RECORD OF BOREHOLE No 16+235 CL

1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, ON - Coords: N 5 146 313.6; E 300 268.8 ORIGINATED BY Y.L.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.L.  
DATUM Geodetic DATE 4/17/2002 CHECKED BY Z.O.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL					
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)				
								○ UNCONFINED		+ FIELD VANE						● POCKET PENETR.		× LAB VANE		
189.0	Ground Surface						20	40	60	80	100	20	40	60						
0.0	0.1 m Topsoil		1	SS	9															
	some organics to 0.3 m																			
	sandy silt seams to 0.7 m		2	SS	20										0 88 (12)					
	brown, moist																			
	grey, wet		3	SS	13															
			4	SS	6															
	loose to compact																			
	very loose		5	SS	2										0 81 (19)					
			6	SS	2															
	SAND																			
	Fine, some silt		7	SS	3															

SPT 1055

# RECORD OF BOREHOLE No 16+255 (20 m) Lt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, ON - Coords: N 5 146 296.5; E 300 286.7 ORIGINATED BY Y.L.  
DIST 82 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.L.  
DATUM Geodetic DATE 4/17/2002 CHECKED BY Z.O.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE	● POCKET PENETR.						
188.6 0.0	Ground Surface 0.2 m Topsoil		1	SS	2											
187.9 0.7	<b>SAND</b> Fine, some silt, some thin clay seams brown, very loose, wet		2	SS	3											
	<b>CLAY</b> reddish brown, firm		3	SS	4											
186.3 2.3	silty fine sand seams		4	SS	2											
			5	SS	2											
			6	SS	2											
	occasional thin clay seams		7	SS	3											
	<b>SAND</b> Fine, some silt wet		8	SS	8											
	grey, very loose															
	loose, reddish grey		9	SS	9											
180.1 8.5	Heterogeneous mixture of Sand and Silt with traces of gravel ( <b>SILTY SAND TILL</b> )															
179.2 9.4	reddish grey, very dense, wet		10	SS	50/5											
	End of borehole															
	* Water level at 0.9 m (not stabilized) and hole open to 1.2 m on completion.															
	** faint hydrocarbon odour.															

SPT 1055

RECORD OF BOREHOLE No 16+275 (20 m) Rt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, ON - Coords: N 5 146 280.9; E 300 245.2 ORIGINATED BY Y.L.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.L.  
DATUM Geodetic DATE 4/17/2002 CHECKED BY Z.O.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)			
								○ UNCONFINED    + FIELD VANE ● POCKET PENETR.    × LAB VANE										
189.8	Ground Surface						20	40	60	80	100	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	GR	SA	SI	CL
0.0 189.5 0.3	TOPSOIL		1	SS	4													
		loose																
		compact	2	SS	29													
	moist		3	SS	19													
		loose, brown	4	SS	6													
		very loose grey	5	SS	3													
	SAND Fine, silty wet		6	SS	2													
			7	SS	3													
			8	SS	2													

+ 3. x 3. Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

**SPT 1055**

**METRIC**

ORIGINATED BY Y.L.

COMPILED BY     M.L.    

CHECKED BY            Z.O.

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity

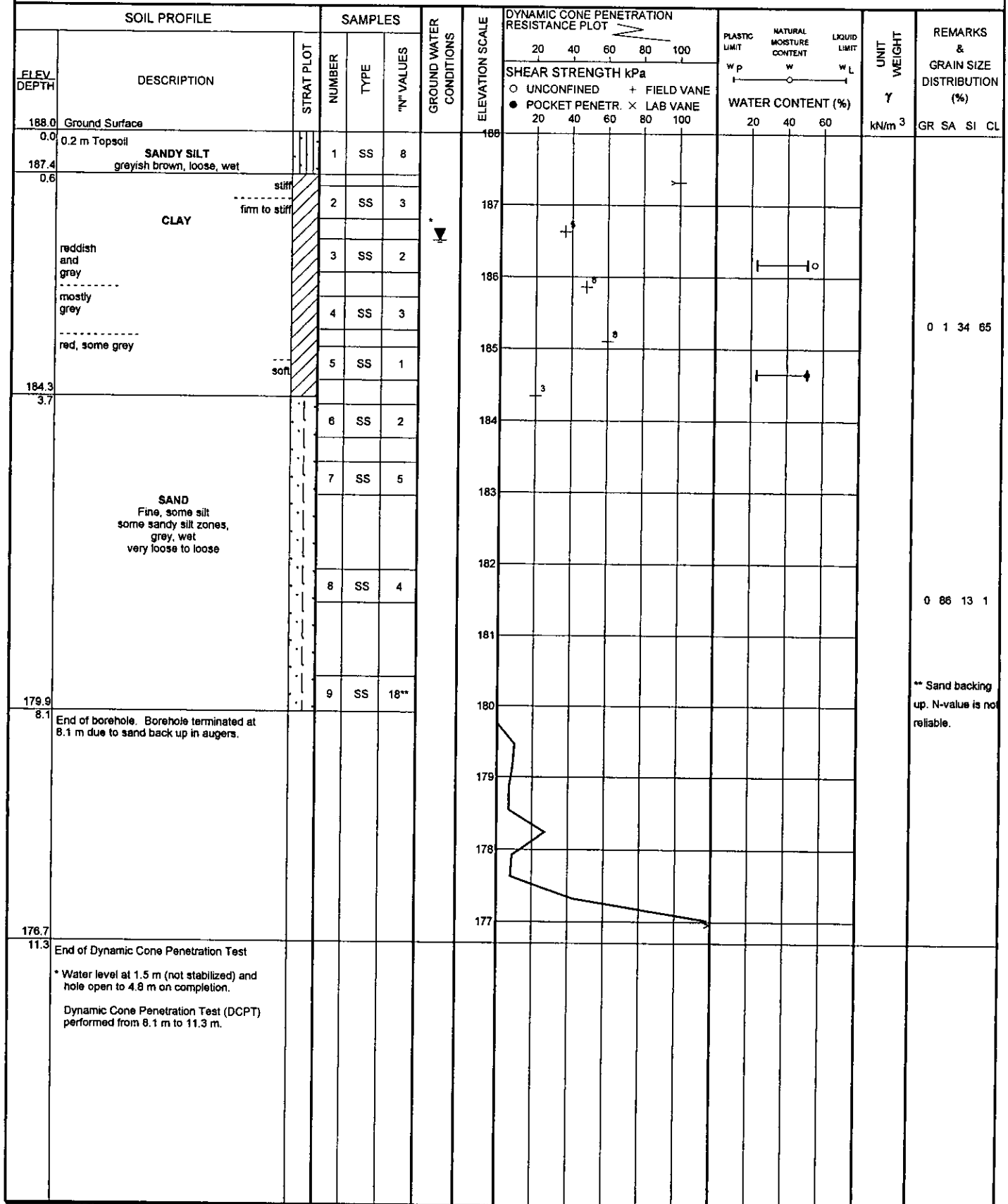


SPT 1055

RECORD OF BOREHOLE No 16+300 (20 m) Lt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, ON - Coords: N 5 148 246.7; E 300 279.5 ORIGINATED BY G.I.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers & DCPT COMPILED BY M.L.  
DATUM Geodetic DATE 4/8/2002 CHECKED BY Z.O.

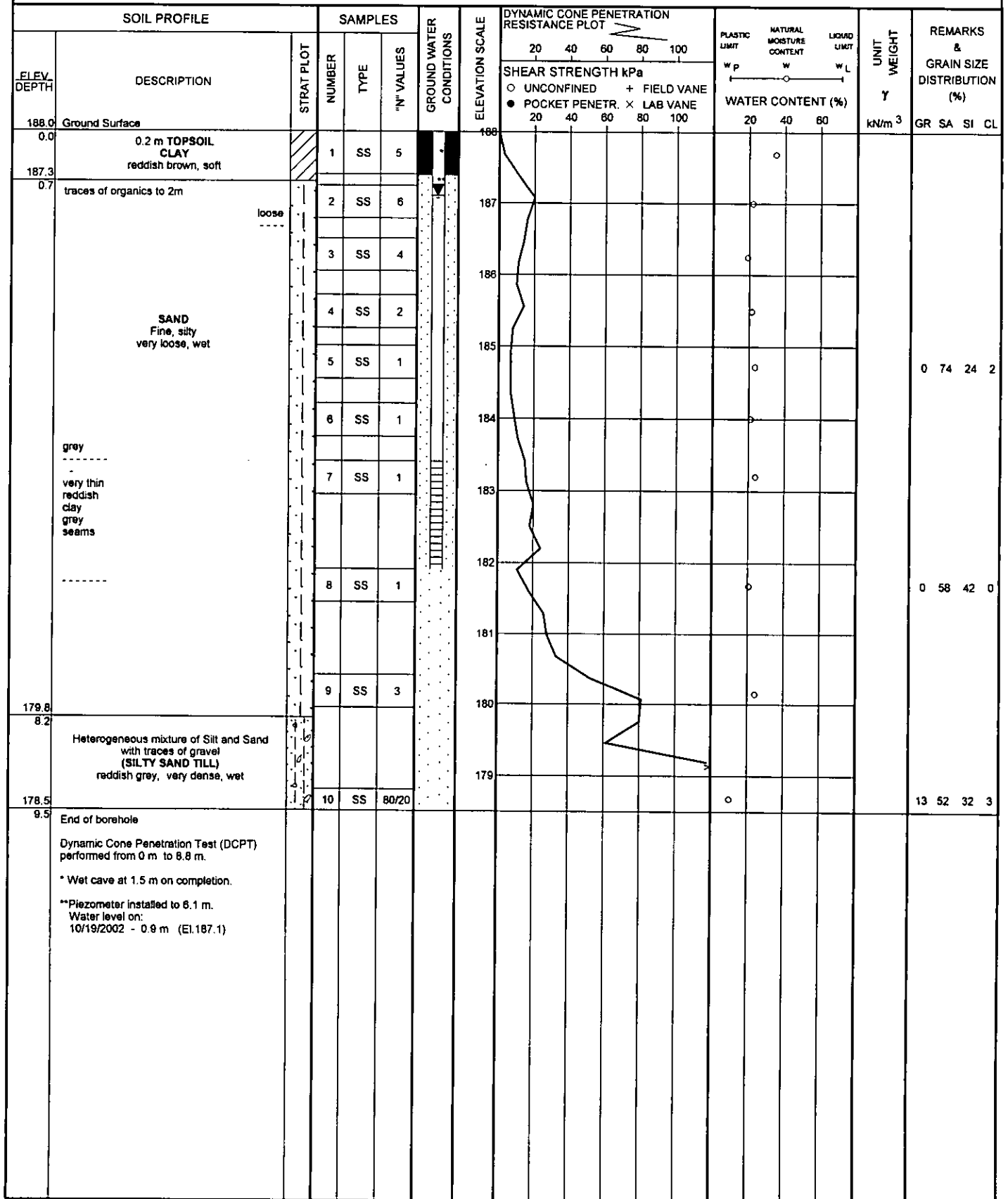


SPT 1055

RECORD OF BOREHOLE No 16+330; 20 m Rt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, ON - Coords: N 5 146 227.5; E 300 234.9 ORIGINATED BY Y.L.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers & DCPT COMPILED BY M.L.  
DATUM Geodetic DATE 4/16/2002 CHECKED BY Z.O.



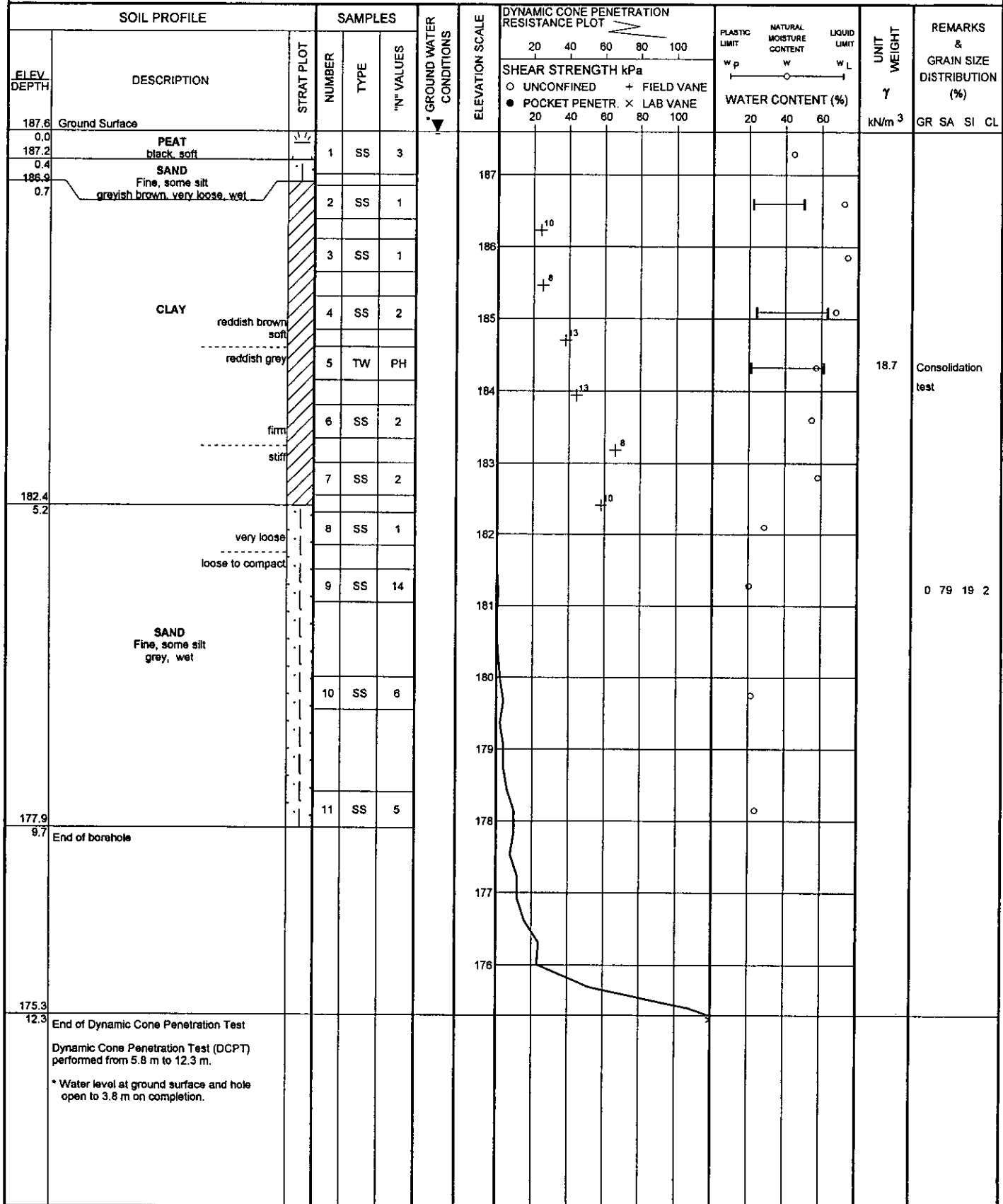
+ 3. x 3. Numbers refer to  
Sensitivity 20  
15 10 5 (%) STRAIN AT FAILURE

SPT 1055

RECORD OF BOREHOLE No 16+350 (20 m) Lt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, ON - Coords: N 5 146 200.7; E 300 269.6 ORIGINATED BY G.I.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers & DCPT COMPILED BY M.L.  
DATUM Geodetic DATE 4/8/2002 CHECKED BY Z.O.



+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 (%) STRAIN AT FAILURE

SPT 1055

# RECORD OF BOREHOLE No 16+385 (20 m) Rt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, ON - Coords: N 5 146 173.1; E 300 221.1 ORIGINATED BY G.I.  
 DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers & DCPT COMPILED BY M.L.  
 DATUM Geodetic DATE 4/8/2002 CHECKED BY Z.O.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT		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 (%)		
187.8 0.0	Ground Surface 0.1 m Topsoil		1	SS	2								
187.1 0.7	SAND Fine, brown, very loose, wet		2	SS	1								
			3	SS	1								
	CLAY red and reddish grey soft to firm		4	SS	2								
184.9 2.9			5	SS	6								
			6	SS	6								
	SAND Fine, silty some sandy silt seams, grey, loose, wet		7	SS	6								
181.7 6.1	End of borehole					**							**Sand backing up in the hole.
177.3 10.5	End of Dynamic Cone Penetration Test.  * Water level at ground surface and hole open to 2.4 m on completion.  Dynamic Cone Penetration Test (DCPT) performed from 6.1 m to 10.5 m.												

+ 3, x 3: Numbers refer to Sensitivity 20 15 10 5 10 (%) STRAIN AT FAILURE

**SPT 1055**

## METRIC

GWP	354-94-00	LOCATION	Echo River to Bar River Road, ON - Coords: N 5 146 137.6; E 300 294.1	ORIGINATED BY	G.I.
DIST	62	HWY	17 (New)	BOREHOLE TYPE	Hollow Stem Augers
DATUM	Geodetic	DATE	12/11/2002	COMPILED BY	R.A.
				CHECKED BY	R.A.

+ 3, x 3: Numbers refer to Sensitivity

SPT 1055

RECORD OF BOREHOLE No 16+450; 25 m Rt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 146 114.3; E 300 196.9 ORIGINATED BY G.I.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY Y.L.  
DATUM Geodetic DATE 5/31/2003 CHECKED BY R.M.

SOIL PROFILE			SAMPLES			GROUND WATER • CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  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							
187.4 0.0	Ground Surface							20 40 60 80 100							
	0.4 m Peaty Topsoil		1	SS	1		187								
	very soft		2	SS	2		186								
	soft to firm		3	SS	0		185								
			4	SS	0		184								
	CLAY reddish grey, wet		5	SS	1		183								
			6	SS	2		182								
			7	SS	0		181								
180.4 6.9	SAND Fine, trace to some silt grey, wet, very loose		8	SS	3		180								
179.3 8.1	End of Borehole.  * Water level at ground surface and hole open to 5.2 m on completion.  ** Field vane test attempted, unable to push vane beyond 6.9 m														

SPT 1055

# RECORD OF BOREHOLE No 16+470 20 m Lt 1 OF 1 METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, ON - Coords: N 5 146 081.9; E 300 228.6 ORIGINATED BY G.I.  
 DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY R.A.  
 DATUM Geodetic DATE 12/11/2002 CHECKED BY R.A.

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			SHEAR STRENGTH kPa		WATER CONTENT (%)			
								○ UNCONFINED ● POCKET PENETR.	+ FIELD VANE x LAB VANE	W <sub>p</sub> W W <sub>L</sub>			
186.7	Ground Surface						20 40 60 80 100		20 40 60				
0.0	PEAT		1	SS	2								
186.2	black, wet, soft		2	SS	1								
0.5			3	SS	2								
			4	SS	2								
			5	SS	2								
			6	SS	1								
			7	SS	1								
			8	SS	1								
			9	SS	2								
177.7			10	SS	8								
9.0	SAND												
177.1	silty, grey, wet, loose												
9.6	End of borehole												
	* Water level at ground surface and hole open to 6.1 m on completion.												

SPT 1055

# RECORD OF BOREHOLE No 16+480 (20 m) Rt 1 OF 1 METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, ON - Coords: N 5 146 085.2; E 300 191.2 ORIGINATED BY G.I.  
 DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.L.  
 DATUM Geodetic DATE 4/7/2002 CHECKED BY Z.O.

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		
187.2	Ground Surface													
0.0	PEAT		1	SS	4		187							
186.8	black, soft		2	SS	3		186							
0.4			3	SS	2		185							
			4	SS	2		184							
	CLAY		5	SS	1		183							
	reddish and grey		6	SS	2		182							
	soft to firm		7	SS	2		181							
			8	TW	PH		180							
			9	SS	2		179							
178.5	stiff to very stiff													
8.7	End of borehole													
	* Water level at ground surface and hole caved at 5.5 m on completion													

+ 3, x 3: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE



SPT 1055

RECORD OF BOREHOLE No 16+540 (20 m) Lt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, ON - Coords: N 5 146 014.2; E 300 203.6 ORIGINATED BY G.I.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.L.  
DATUM Geodetic DATE 4/8/2002 CHECKED BY Z.O.

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	20 40 60 80 100	20 40 60 80 100		
187.3	Ground Surface											
0.0	PEAT		1	SS	1		187				17.5	
186.9	black, soft		2	SS	2		186					
0.4	traces of organics to 0.6 m	stiff	3	SS	2		185					
		firm	4	SS	2		184					
		soft to firm	5	SS	1		183					
	CLAY		6	SS	2		182					
	reddish gray to grey		7	SS	1		181					
180.1			8	SS	2							
7.2	End of borehole											
	* Water level at ground surface and hole open to 4.6 m on completion.											

SPT 1055

RECORD OF BOREHOLE No 16+540 (20 m) Rt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 146 031.5; E 300 167.6 ORIGINATED BY G.I.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.L.  
DATUM Geodetic DATE 4/8/2002 CHECKED BY Z.O.

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	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
187.2	Ground Surface												
0.0	PEAT		1	SS	1		187						
186.8	black, soft												
0.5			2	SS	2		186					17.4	
			3	SS	2		185						
	CLAY		4	SS	1		184						0 0 38 62
	soft to firm		5	SS	1		183						
	red with occasional grey seams		6	SS	1		182						
			7	TW	PH		181						
			8	SS	2		180						
180.0	End of borehole												
7.2													
	* Water level at ground surface and hole open to 5.5 m on completion.												

SPT 1055

RECORD OF BOREHOLE No 16+560; 19 m Lt 1 OF 2

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 145 996.3; E 300 193.7 ORIGINATED BY G.I.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers & D.C.P.T. COMPILED BY Y.L.  
DATUM Geodetic DATE 5/31/2003 CHECKED BY R.M.

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 (%)
FLEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● POCKET PENETR. X LAB VANE				
187.1	Ground Surface						20 40 60 80 100					
0.0	PEAT		1	SS	3							0.2 m water above ground surface
186.7	dark brown to black, wet, soft		2	SS	5							
0.4	CLAY reddish grey, wet		3	SS	2							
			4	SS	1							
			5	SS	1							
			6	SS	0							
			7	SS	1							
			8	SS	0							
			9	SS	2							
			10	SS	4							
			11	SS	12							
			12	SS	32							
176.1	SAND											
11.0	Fine, some silt trace gravel below 14.6 m. grey, wet											

Continued Next Page

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 (% STRAIN AT FAILURE

SPT 1055

RECORD OF BOREHOLE No 16+560; 19 m Lt 2 OF 2

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 145 996.3; E 300 193.7 ORIGINATED BY G.I.  
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers & D.C.P.T. COMPILED BY Y.L.  
DATUM Geodetic DATE 5/31/2003 CHECKED BY R.M.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT  γ  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 ○ UNCONFINED    + FIELD VANE ● POCKET PENETR.    × LAB VANE				
							20 40 60 80 100					
171.4	<b>SAND</b> some silt trace gravel, gray, wet, compact		13	SS	19							
15.7	End of Borehole.											
169.8												
17.3	End of D.C.P.T.  Dynamic Cone Penetration Test (D.C.P.T.) performed from 15.5 m to 17.3 m.  * Water level at ground surface and hole open to 10.7 m on completion.  ** Field vane test attempted, unable to push vane beyond 11.4 m.											

W.P. 903-72-01

LOCATION CO-ORDS. 884,600N 984,530 E

ORIGINATED BY HS

DIST. 18 HWY. 17

BORING DATE Feb. 24 -26, 1975

COMPILED BY MM

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & Cone Test

CHECKED BY                     

15  $\frac{20}{10}$  5 % STRAIN AT FAILURE

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 2

W.P. 903-72-01

LOCATION CO-ORDS. 884,770N 984,680E

ORIGINATED BY HS

DIST. 18 HWY. 17

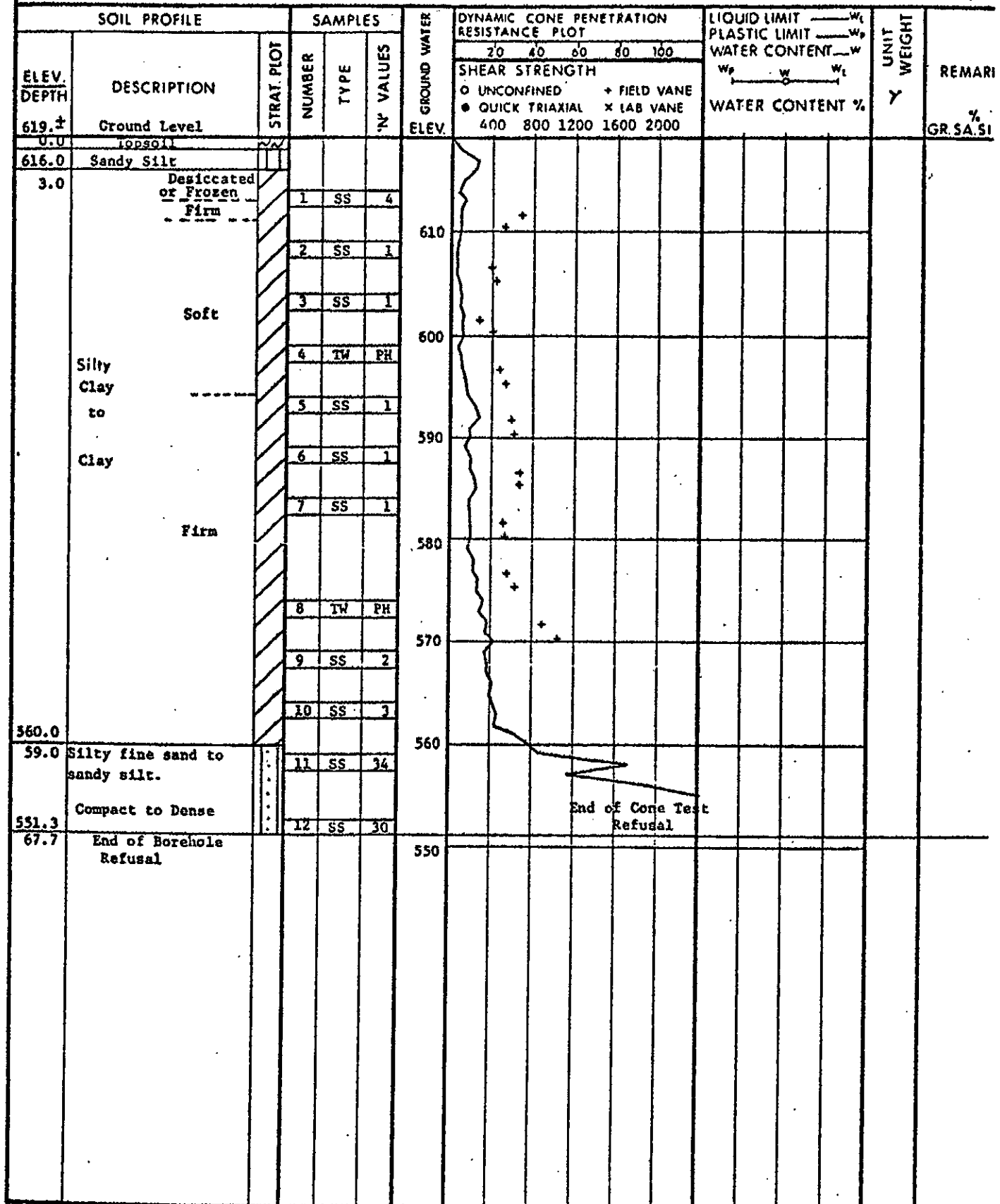
BORING DATE February 26-28, 1975

COMPILED BY MM

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger and Cone Test

CHECKED BY



20  
15  $\diamond$  5 % STRAIN AT FAILURE  
10

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 12

W.P. 903-72-01

LOCATION CO-ORDS. 883,640 N 985,145 E

ORIGINATED BY R.S.

DIST 18 HWY. 17

BORING DATE APRIL 26, 1975

COMPILED BY R.S.

DATUM GEODETIC

BOREHOLE TYPE HOLLOW STEM - 2 3/4"

CHECKED BY M.C.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$			UNIT WEIGHT $\gamma$	REMARKS % GR. SA. SI
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	VALUES		20	40	60	80	100	$W_P$	$W$	$W_L$		
617.0	GROUND LEVEL															
0.0	Topsoil															
	Silty Sand to Sand		1	SS	10											
			2	SS	4	610										
	Very loose to loose		3	SS	2											
			4	SS	4											
			5	SS	2											
			6	SS	6	600										
596.0																
21.0	Sand & Gravel compact v. dense		7	SS	11											
	with cobbles		8	SS	71	590										
			9	SS	100/6"											
	and few boulders		10	SS	76/3"	580										
			11	SS	200/3"											
570.0																
47.0	End of Borehole Refusal to Augering probable boulder					570										
						560										

MINISTRY OF TRANSPORT, ON AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 13

W.P. 903-72-01 LOCATION CO-ORDS. 883,400N 985,135 E ORIGINATED BY RB  
DIST. 18 HWY. 17 BORING DATE APRIL 28, 1975 COMPILED BY H.S.  
DATUM GEODETIC BOREHOLE TYPE HOLLOW STEM AUGERS - 2 3/4" CHECKED BY HL

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT Y	REMARKS % GR. S.A.S
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N° VALUES		20	40	60	80	100	$w_p$	$w$	$w_L$		
615.0	GROUND LEVEL															
0.0	TOPSOIL		1	SS	10											
	Silty Sand to Sand		2	SS	2/18	610										
	Very Loose to loose		3	SS	4											
			4	SS	4	600										
			5	SS	4											
590.5																
24.5	Sand & Gravel		6	SS	12	590										
	Compact with V. Dense cobbles		7	SS	96											
579.5																
35.5	End of Borehole Refusal to Augering Probable Boulder					580										
						570										



ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 14

W.P. 903-72-01 LOCATION CO-ORDS. 883,520N 985,240 E ORIGINATED BY H.S.  
 DIST. 18 HWY. 17 BORING DATE APRIL 28, 1975 COMPILED BY H.S.  
 DATUM GEODETIC BOREHOLE TYPE HOLLOW STEM AUGERS - 2 3/4" CHECKED BY H.S.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	$w_p$	$w$	$w_L$		
616.0	GROUND LEVEL															
0.0	Topsoil															
613.0																
3.0	Clay, Trace of Sand		1	SS	7											
	Firm		2	SS	2	610										
607.0																
9.0	Silty Sand to Sand		3	SS	2											
	Very Loose		4	SS	4	600										
592.0																
24.0	Sand and Gravel		5	SS	2	590										
	with V. Loose cobbles V. Dense		6	SS	69											
583.5																
32.5	End of Borehole Refusal to Augering Probable Boulder					580										

RECORD OF BOREHOLE NO 15

W.P. 903-72-01

LOCATION CO-ORDS. 883,565 N 985,040 E

ORIGINATED BY H.S.

DIST. 18 HWY. 17

BORING DATE APRIL 28, 1975

COMPILED BY H.S.

DATUM GEODETIC

BOREHOLE TYPE HOLLOW STEM AUGERS - 2 3/4"

CHECKED BY M.L.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMAI % GR.SA.S
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20 40 60 80 100					SHEAR STRENGTH P.S.F.				
												○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE				
							WATER CONTENT %					$w_p$ $w$ $w_L$				
617.0	GROUND LEVEL															
0.0	<del>TOP SOIL</del> Silty Sand to Sand  V. Loose to Compact															
			1	SS	12											
			2	SS	4											
			3	SS	3											
			4	SS	3											
591.0			5	SS	100											
26.0	Sand and Gravel					590										
588.5	with cobbles V. Dense															
28.5	End of Borehole															
	Refusal to Augering Probable Boulder					580										

W.P. 903-72-01

LOCATION CO-ORDS. 883,860N 985,145 E

ORIGINATED BY H.S

DIST. 18 HWY. 17

BORING DATE APRIL 28-29, 1975

COMPILED BY H.S.

DATUM GEODETIC

**BOREHOLE TYPE HOLLOW STEM AUGERS - 2-3/4"**

CHECKED BY 22

[illegible]

## ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

## RECORD OF BOREHOLE NO 17

W.P. 903-72-01

LOCATION CO-ORDS. 884,095N 985,120E

ORIGINATED BY \_\_\_\_\_

DIST. 18 HWY. 17

BORING DATE APRIL 29, 1975

COMPILED BY HS

DATUM GEODETIC

BOREHOLE TYPE HOLLOW STEM AUGERS - 2 3/4"

CHECKED BY ML

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			UNIT WEIGHT $\gamma$	REMAI % GR. S.A.S
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N° VALUES		20 40 60 80 100					$w_p$ — $w$ — $w_L$				
							SHEAR STRENGTH P.S.F.					WATER CONTENT %				
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE									
623.0	GROUND LEVEL															
0.0	Sand, Some gravel		1	SS	31	620										
			2	SS	17											
613.5	Compact to Dense		3	SS	34											
9.5	Silty Sand to Sand,  Some Gravel  Loose to Compact		4	SS	15	610										
			5	SS	10											
			6	SS	12	600										
			7	SS	6											
			8	SS	10	590										
593.0	Cobbles															
40.0	End of Borehole Refusal to Auger probable boulder					580										

MINISTRY OF TRANSPORT ON AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 18

W.P. 903-72-01 LOCATION CO-ORDS. 882.915N 984.910 E  
DIST. 18 HWY. 17 BORING DATE APRIL 29, 1975  
DATUM GEODETIC BOREHOLE TYPE HOLLOW STEM AUGERS - 2 3/4" ORIGINATED BY H.S.  
COMPILED BY H.S.  
CHECKED BY H.S.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	$w_p$	$w$	$w_L$		
615.0	GROUND LEVEL															
0.0	Topsoil															
612.0																
3.0	Silty Clay to Clay Soft Firm		1	SS	2	610	+S=3.5									
			2	SS	1		+S=2.4									
			3	TW	PM		+S=2.6									
			4	SS	2	600	+S=7.5									
							+S=6.2									
596.0							+S=5.7									
19.0	Silty Sand to Sand Very Loose		5	SS	4	590										
			6	SS	4											
			7	SS	2											
581.8			8	SS	100%											
33.2	End of Borehole Refusal to Augering Probable Boulder					580										



PROJECT: 941-1364

## RECORD OF BOREHOLE 95-10

SHEET 1 OF 2

LOCATION: SEE FIGURE 2H

BORING DATE: SEPT.21-22/95

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm



J3840010.B15

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER TYPE	BLOWS/0.3m	SHEAR STRENGTH				WATER CONTENT, PERCENT					
							Cu, kPa	nat V - rem V -	+	Q - ● U - ○	Wp	W	Wi			
							20	40	60	80		20	40	60	80	
-2																
-1		GROUND SURFACE														PIEZO. 95-10B
0		Organic silt, trace sand, some grey silty clay Soft Dark brown and black		187.80 0.00 187.30 0.50	1 50 DO	3										PIEZO. 95-10A
1					2 50 DO	3										CUTTINGS BENTONITE SEAL
2		Irregularly layered silty clay and clayey silt, occ. rootlets, some grey silt laminations and inclusions, some sand, occ. gravel. Soft Greyish/reddish brown to grey.			3 50 DO	5										CUTTINGS
3					4 50 DO	WH										BENTONITE SEAL
4	TRACK MOUNTED CME SS POWER AUGER 106mm ID HOLLOW STEM AUGERS			183.80 4.00	5 50 DO	21										SAND PIEZO. 95-10A
5					6 50 DO	16										BENTONITE SEAL
6		Silty sand and gravel, trace clay. (TILL) Compact, becoming very loose from 7.2m to 8.7m depth. Grey			7 50 DO	14										
7					8 50 DO	13										
8					9 50 DO	2										
		CONTINUED ON NEXT PAGE														

DATA INPUT: P6 JAN.22/98

JLM6

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: GEB

CHECKED: ASP

DATA INPUT: PB JAN 22/96

PROJECT: 841-1364

# RECORD OF BOREHOLE 95-10

**SHEET 2 OF 2**

LOCATION: SEE FIGURE 2H

**BORING DATE: SEPT.21-22/95**

**DATUM: GEODETIC**

**SAMPLER HAMMER, 63.5kg; DROP, 760mm**

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

[illegible]

LOGGED: GEB

CHLORAMPHENICOL ACID

**DEPTH SCALE**



DATA INPUT: P8 JAN 22/86

**CHECKED: ASP**



PROJECT: 941-1384

## RECORD OF BOREHOLE 95-12

SHEET 1 OF 1

LOCATION: SEE FIGURE 2H

BORING DATE: SEPT.25/95

DATUM: GEODETIC

SAMPLER: HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST: HAMMER, 63.5kg; DROP, 760mm



DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE; BLOWS/0.3m		HYDRAULIC CONDUCTIVITY, k, cm/s		ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		DESCRIPTION	STRATA PLOT	ELEV.	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH Cu, kPa	nat V - + rem V - ⊗	O - ● U - ○	WATER CONTENT, PERCENT Wp — W — Wl		
				DEPTH (m)									
0	TRACK MOUNTED CHIEF 88 POWER AUGER 106mm ID HOLLOW STEM AUGERS	GROUND SURFACE		188.80									
		TOPSOIL		0.00									
				0.15	1	50 DO	5						FILL
1		Sand, trace to some gravel; trace silt, occ. organic Loose to compact Brown			2	50 DO	8						BENTONITE SEAL
													CUTTINGS
2				188.60	3	50 DO	17						
				2.00									
3		Silty sand, some gravel, trace clay (TILL) Compact Reddish to greyish brown			4	50 DO	27						MH
					5	50 DO	17						
4				185.10									
			3.70										
5		Silty sand, some gravel, trace clay, slightly layered. Loose Reddish to greyish brown.		6	50 DO	8						CAVED	
				7	50 DO	9							
6			183.50										
			5.30	8	50 DO	15						MH	
7			182.80										
			6.00	9	50 DO	8							
8													
			181.60										
			7.20										
9													
			180.88	10	50 DO	105							
			7.92										
10		END OF BOREHOLE Refusal to Auger and Sampler Penetration (possible boulder) Note: Gravel stuck in sampler and possible boulder likely cause of higher blows recorded in sample 10										Water level in auger at about 0.5m depth below ground surface upon completion of drilling. Water level in piezometer at Elev. 188.0 on October 6, 1995.	

DEPTH SCALE

7 to 50

Golder Associates

LOGGED: GEB

CHECKED: ASP

PROJECT: 941-1364

## RECORD OF BOREHOLE 95-13

SHEET 1 OF 2

LOCATION: SEE FIGURE 2H

BORING DATE: SEPT.30/95

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP: 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP: 760mm



DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m		HYDRAULIC CONDUCTIVITY, k, cm/s		ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH		WATER CONTENT, PERCENT			
								Cu, kPa	nat V - + Q - ● rem V - ⊗ U - ○	Wp			W
-1	TRACK MOUNTED CME 55 POWER AUGER 100mm ID HOLLOW STEM AUGERS												
0		GROUND SURFACE		187.20									
		Sandy organic silt Very loose Dark brown		0.00 186.80 0.30	1	50 DO	4						
1		Sand, some silt Very loose Grayish brown			2	50 DO	WH						
2		Irregularly layered silty clay and clayey silt, occ. gravel, trace organics. Firm Reddish to greyish brown with grey interlayers, becoming grey with reddish to greyish brown interlayers below 2.7m depth.		185.80 1.40	3	50 DO	1						
					4	50 DO	WH						
3				183.50 3.70	5	50 DO	WR						
4					6	50 DO	WH						
5		Fine sand, trace to some silt Very loose Grey			7	50 DO	WR						
6					8	50 DO	1						
7					9	50 DO	7						
8		Sandy silt, some coarse sand Loose Grey		179.40 7.80 178.20 8.00									
		Silty sand, some gravel, trace clay (TILL) Loose Grey		178.50 8.70									
9													

FILL

CUTTINGS

BENTONITE  
SEAL

MH

FILTER SAND  
& CAVED

MH

DEPTH SCALE

LOGGED: GEB

Golden Associates

CHECKED: ASP

J2840013 BH3

PROJECT: 941-1384

## RECORD OF BOREHOLE 95-13

SHEET 2 OF 2

LOCATION: SEE FIGURE 2H


BORING DATE: SEPT.30/95

DATUM: GEODETIC

SAMPLER HAMMER: 63.5kg; DROP: 760mm

PENETRATION TEST HAMMER: 63.5kg; DROP: 760mm



DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, K, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT	ELEV.	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH				WATER CONTENT, PERCENT						
				DEPTH (m)				Cu, kPa	nat V - rem V -	+ ●	Q - ● U - O	Wp	W	Wi				
9	TRACK MOUNTED CME 55 POWER AUGER 100mm ID HOLLOW STEM AUGERS	CONTINUED FROM PREVIOUS PAGE Sand, trace gravel to sand and fine gravel Graded/layered appearance Loose Grey		177.40	10	DO	9											
10		Sand, trace gravel to sand and gravel inferred by augering		9.80														
11																		
12				175.00														
13		END OF BOREHOLE  Note: Sand "blowback" of 4m inside augers when sampling at 10.7m depth (therefore no sample taken)		12.20														
14																		
15																		
16																		
17																		
18																		
19																		

FILTER SAND  
& CAVEDWater level at  
top of piezometer  
pipe (0.15m above  
ground surface)  
on October 6, 1995.

DATA INPUT: PG JAN 22/96

LMS

DEPTH SCALE

Golder Associates

LOGGED: GEB

CHECKED: ASP

# Appendix A8-2

## Photograph



SPT 1055  
GWP 354-94-00

Highway 17 (New)  
Sault Ste. Marie, Ontario



PHOTOGRAPH OF BEDROCK CORE  
Borehole 15+975, 17m Lt, Quartzite Bedrock



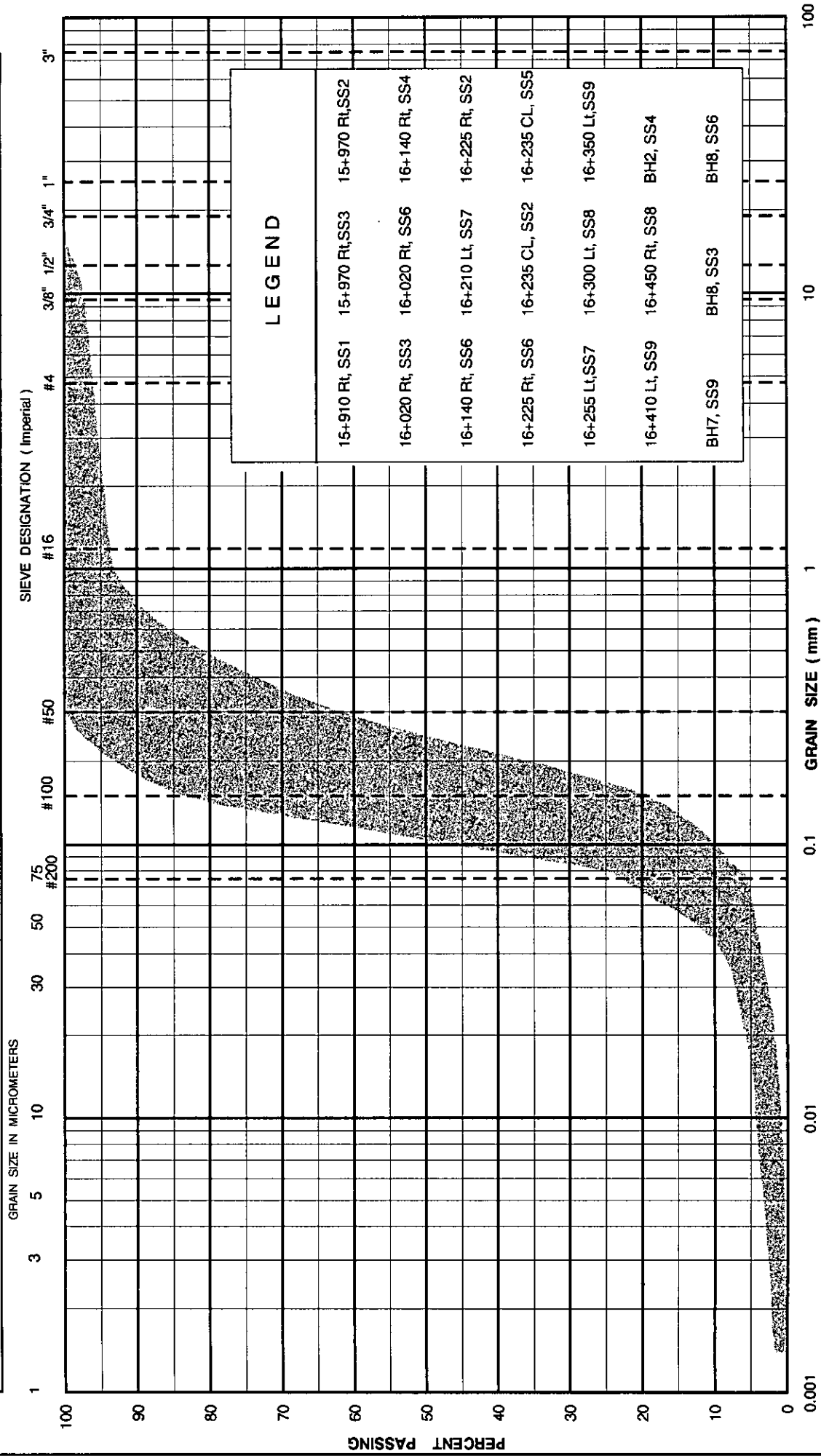
# Appendix B8

## Laboratory Test Results



# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT		SAND			GRAVEL		
		Fine	Medium	Coarse	Fine	Coarse	



## GRAIN SIZE DISTRIBUTION

SAND, fine, trace to some silt

SHAHEEN & PEAKER LIMITED

FIG. No. B8-1

REF. No. SPT 1055

G.W.P. 354-94-00

CLAY AND SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



### GRAIN SIZE DISTRIBUTION

SAND, fine, silty

FIG. No. B8-2

REF. No. SPT 1055

G.W.P.	354-94-00
--------	-----------

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT		SAND			GRAVEL		
		Fine	Medium	Coarse	Fine	Coarse	Coarse

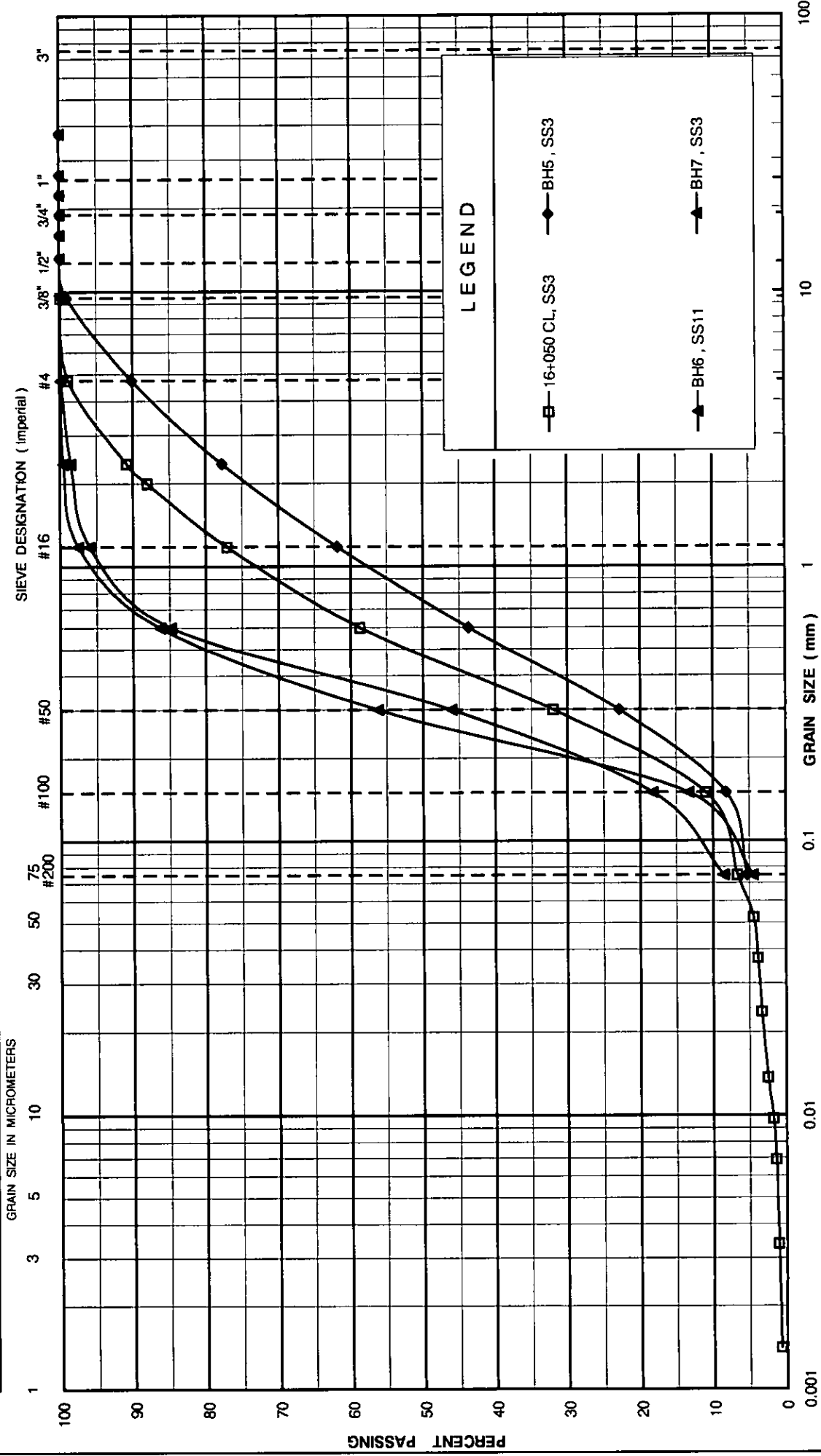


FIG. No. B8-3

REF. No. SPT 1055

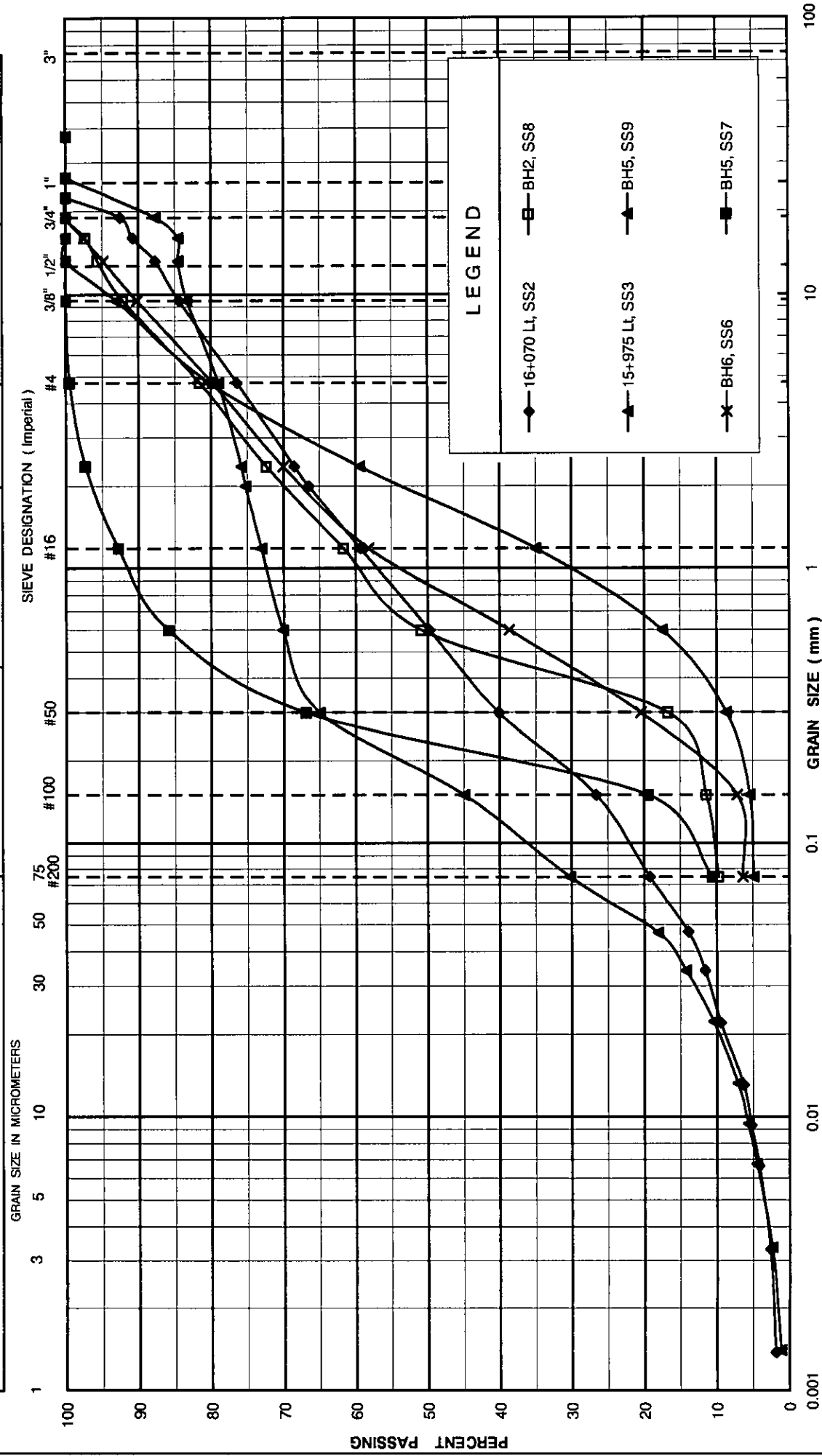
G.W.P. 354-94-00

GRAIN SIZE DISTRIBUTION  
SAND

SHAHEEN & PEAKER LIMITED

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT			SAND			GRAVEL		
			Fine	Medium	Coarse	Fine	Coarse	



# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT		SAND			GRAVEL		
		Fine	Medium	Coarse	Fine	Coarse	

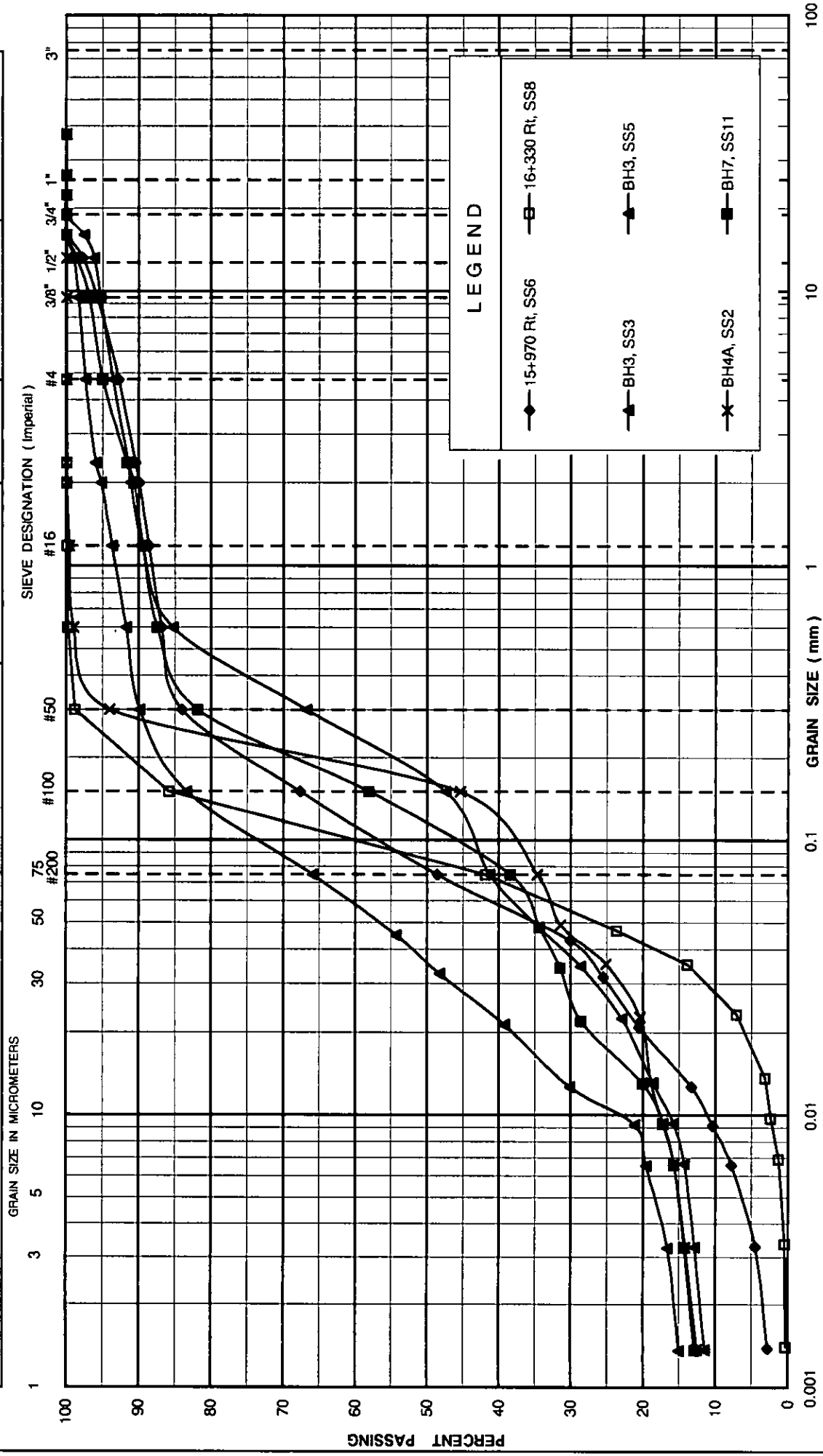


FIG. No. B8-5

REF. No. SPT 1055

G.W.P. 354-94-00

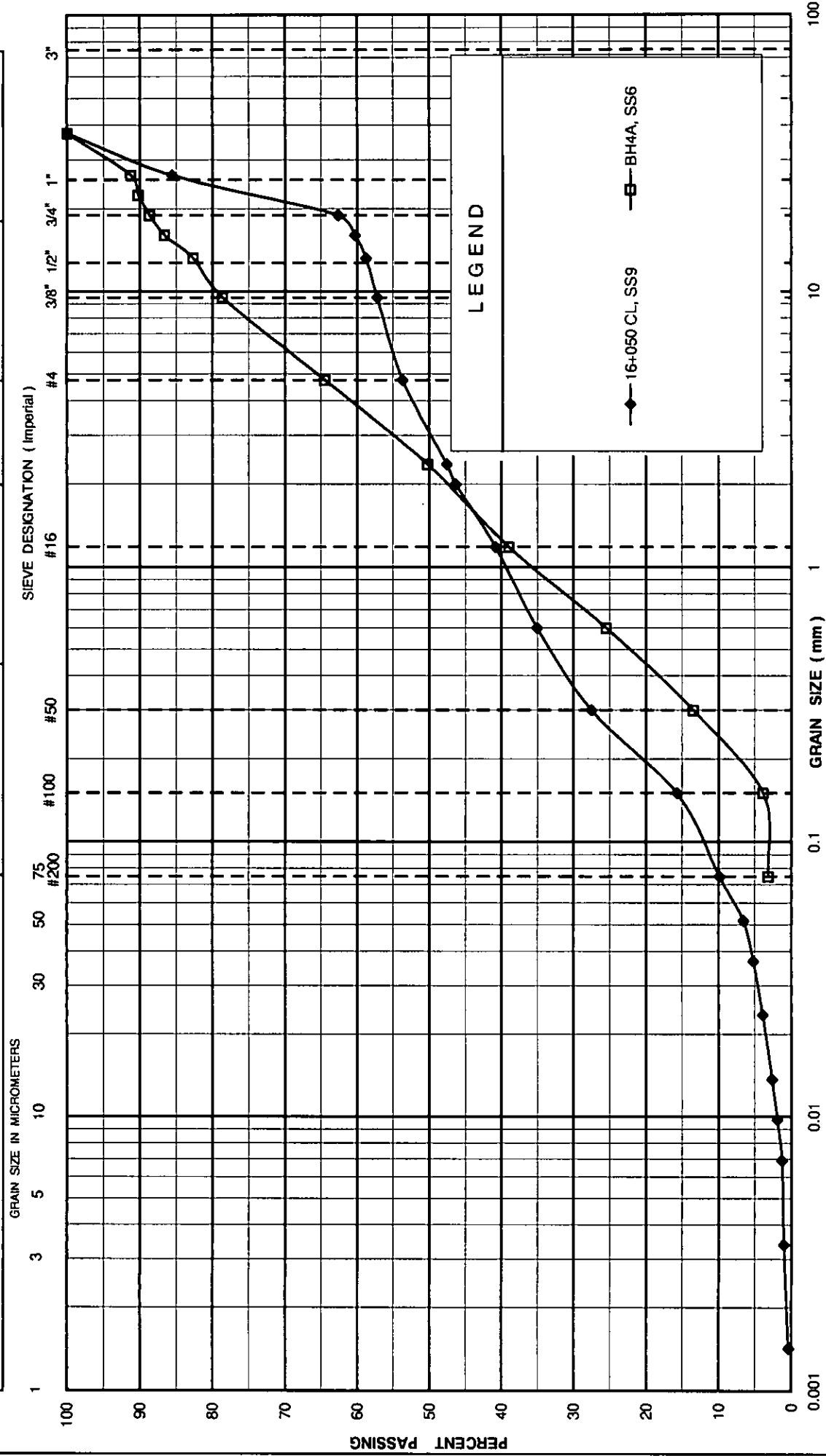
## GRAIN SIZE DISTRIBUTION

SAND, with silt

SHAHEEN & PEAKER LIMITED

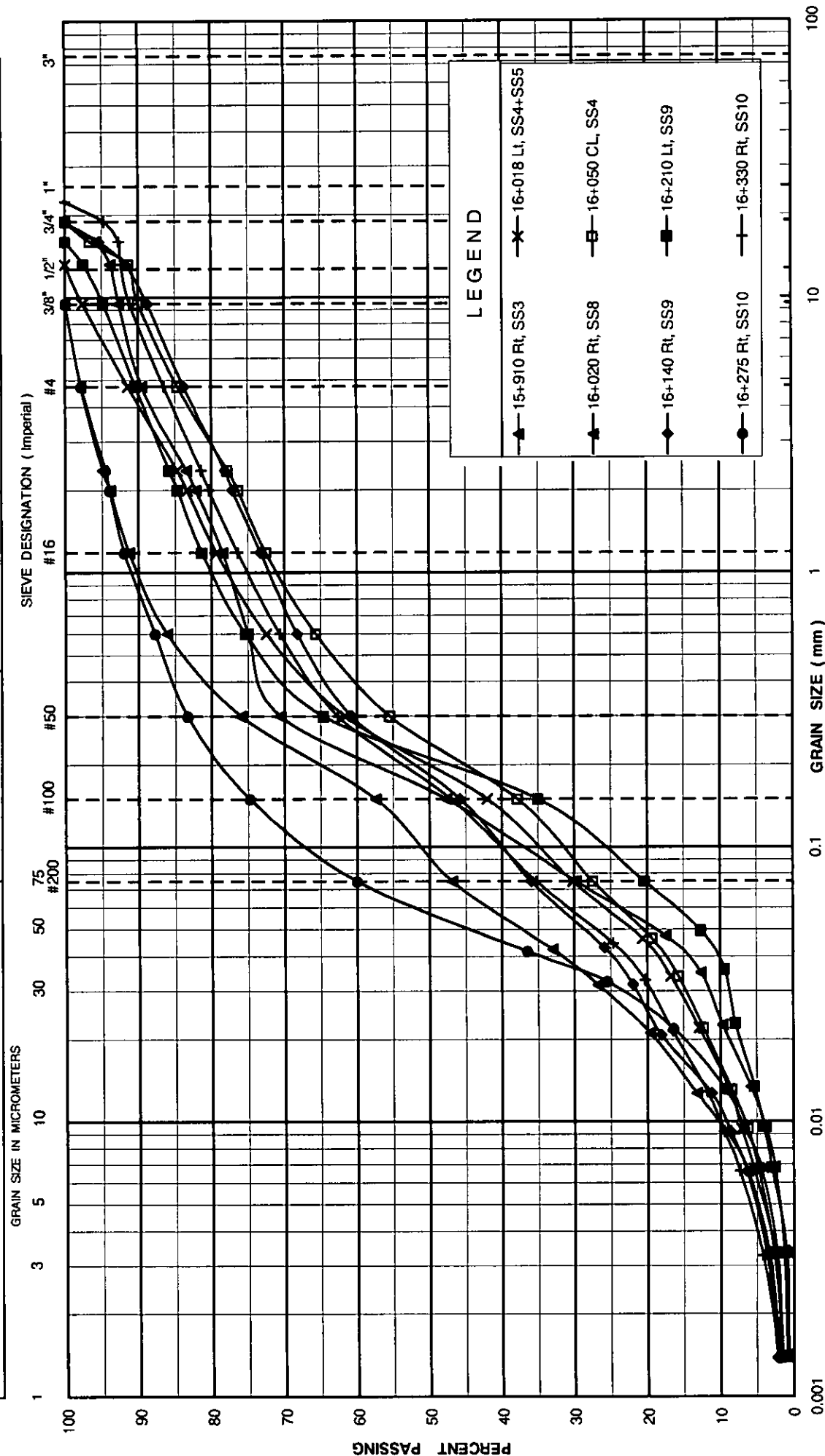
# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT		SAND			GRAVEL		
		Fine	Medium	Coarse	Fine	Coarse	



# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT		SAND			GRAVEL		
		Fine	Medium	Coarse	Fine	Coarse	Coarse



GRAIN SIZE DISTRIBUTION  
SILTY SAND TILL

SHAHEEN & PEAKER LIMITED

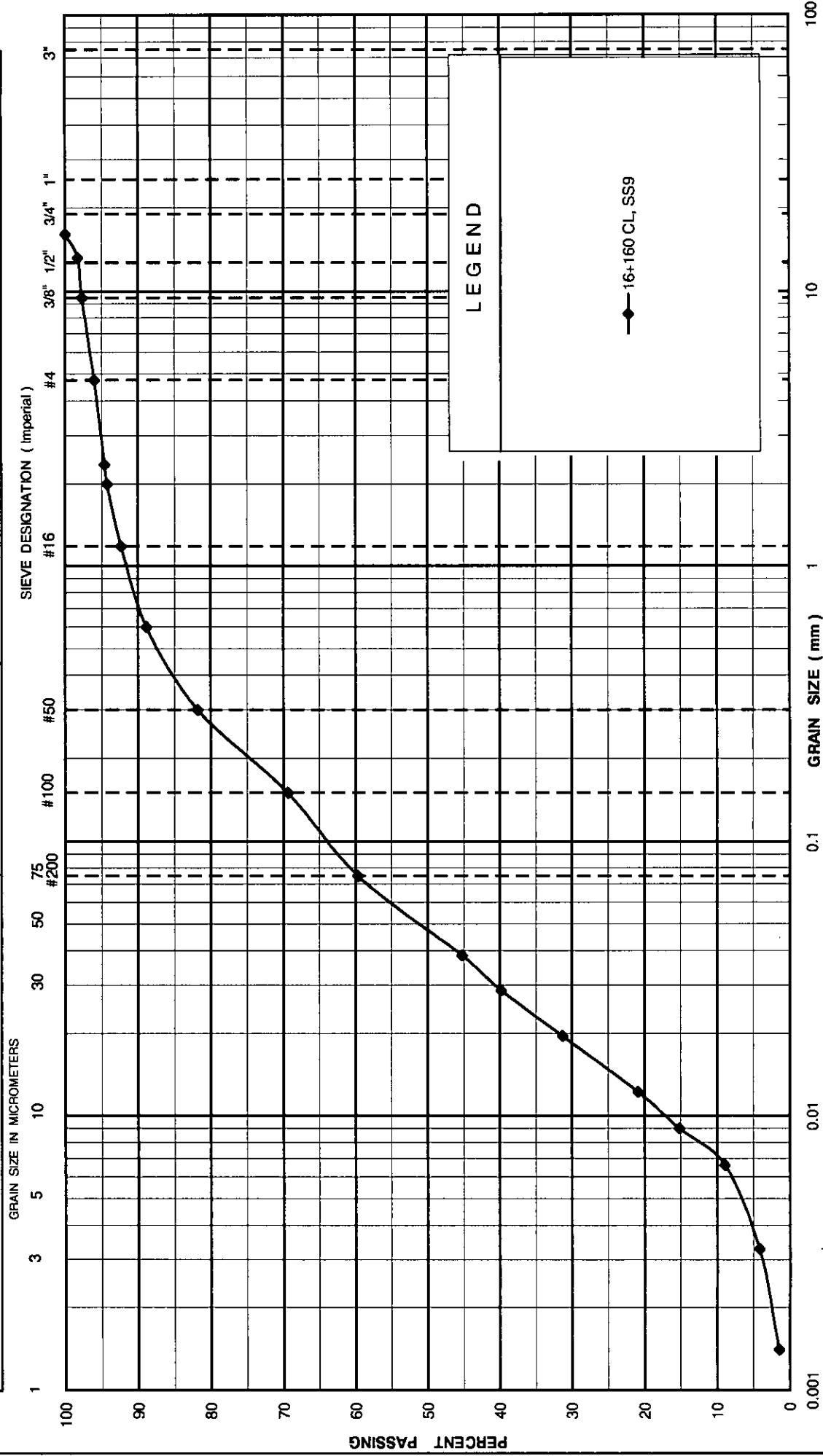
FIG. No. B8-7

REF. No. SPT 1055

G.W.P. 354-94-00

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT		SAND			GRAVEL		
		Fine	Medium	Coarse	Fine	Coarse	



## GRAIN SIZE DISTRIBUTION SANDY SILT TILL

SHAHEEN & PEAKER LIMITED

FIG. No. B8-8

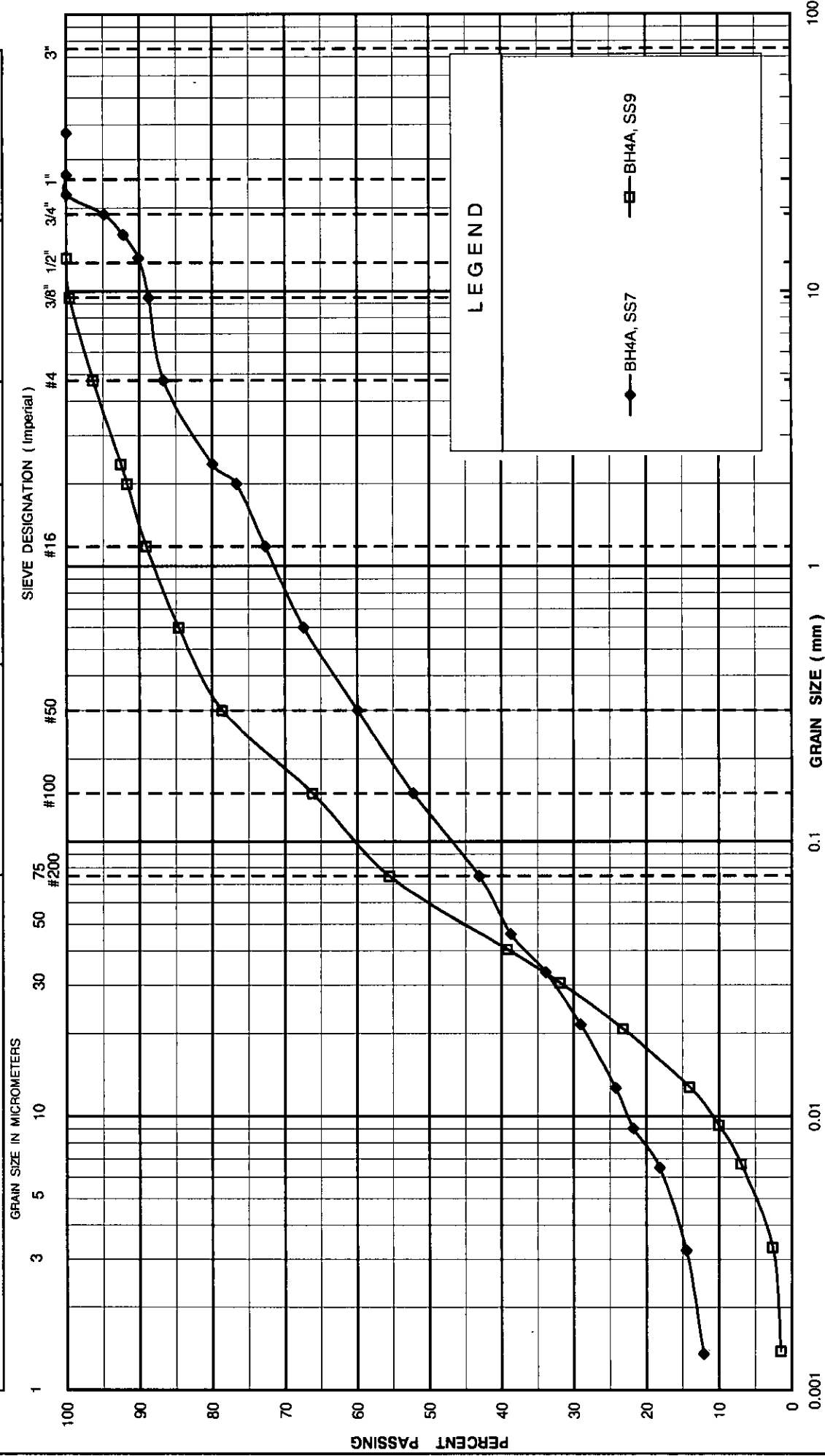
REF. No. SPT 1055

G.W.P. 354-94-00



# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT		SAND			GRAVEL		
		Fine	Medium	Coarse	Fine	Coarse	



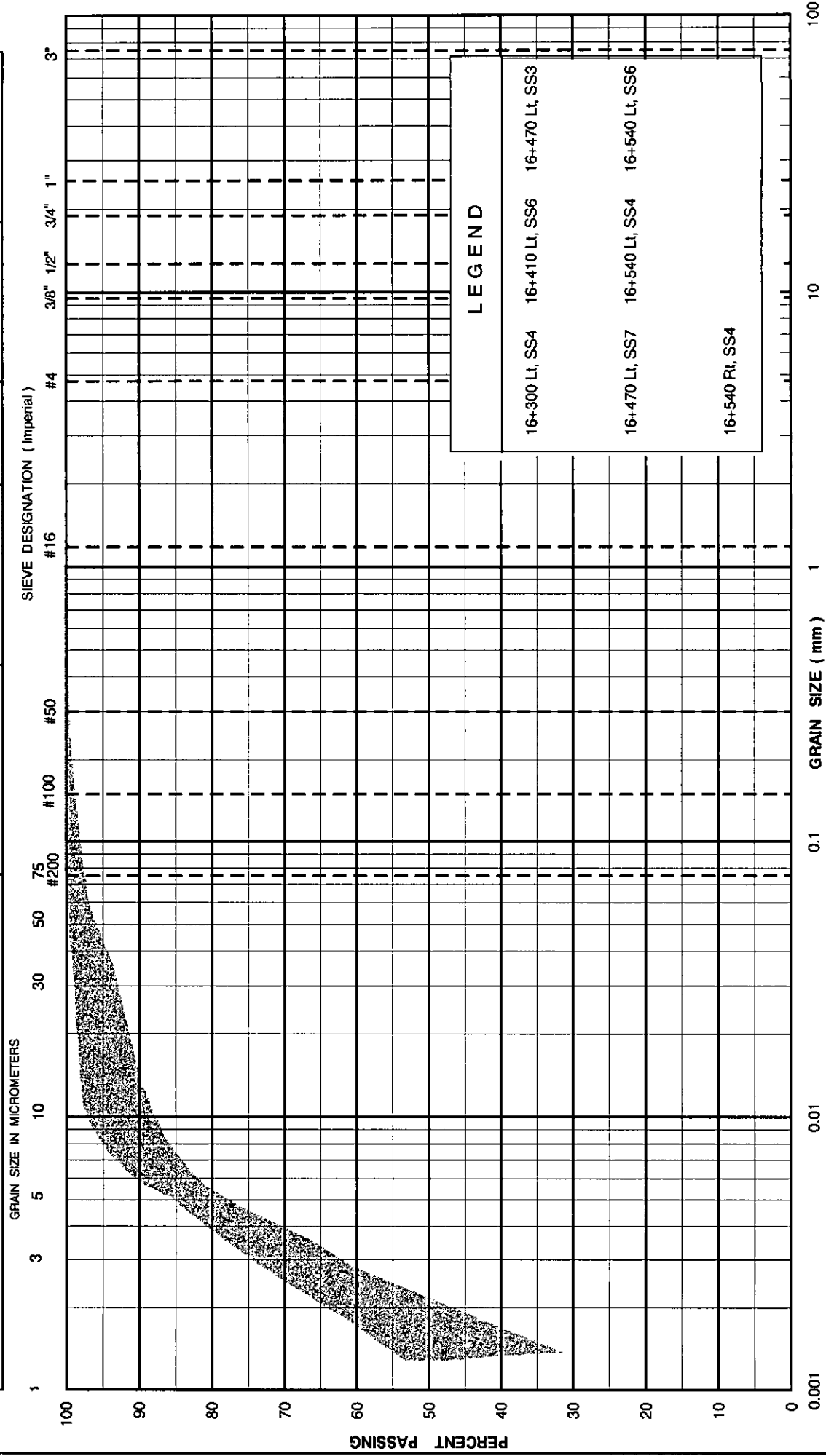
GRAIN SIZE DISTRIBUTION  
SAND AND SILT, some gravel, with clay

SHAHEEN & PEAKER LIMITED

FIG. No. B8-9  
REF. No. SPT 1055  
G.W.P. 354-94-00

# UNIFIED SOIL CLASSIFICATION SYSTEM

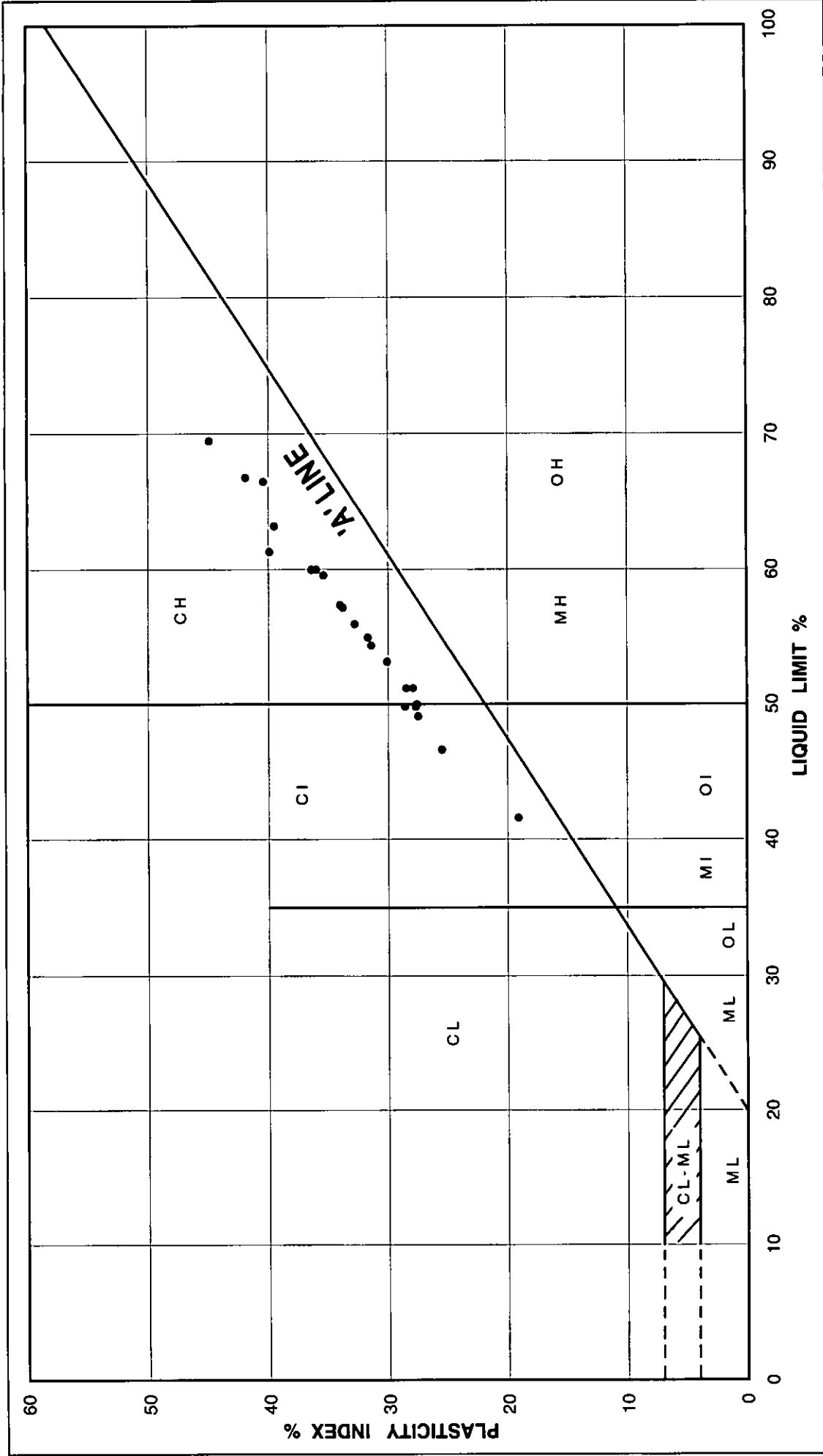
CLAY AND SILT		SAND			GRAVEL		
		Fine	Medium	Coarse	Fine	Coarse	



## GRAIN SIZE DISTRIBUTION CLAY

SHAHEEN & PEAKER LIMITED

FIG. No. B8-10  
REF. No. SPT 1055  
G.W.P. 354-94-00



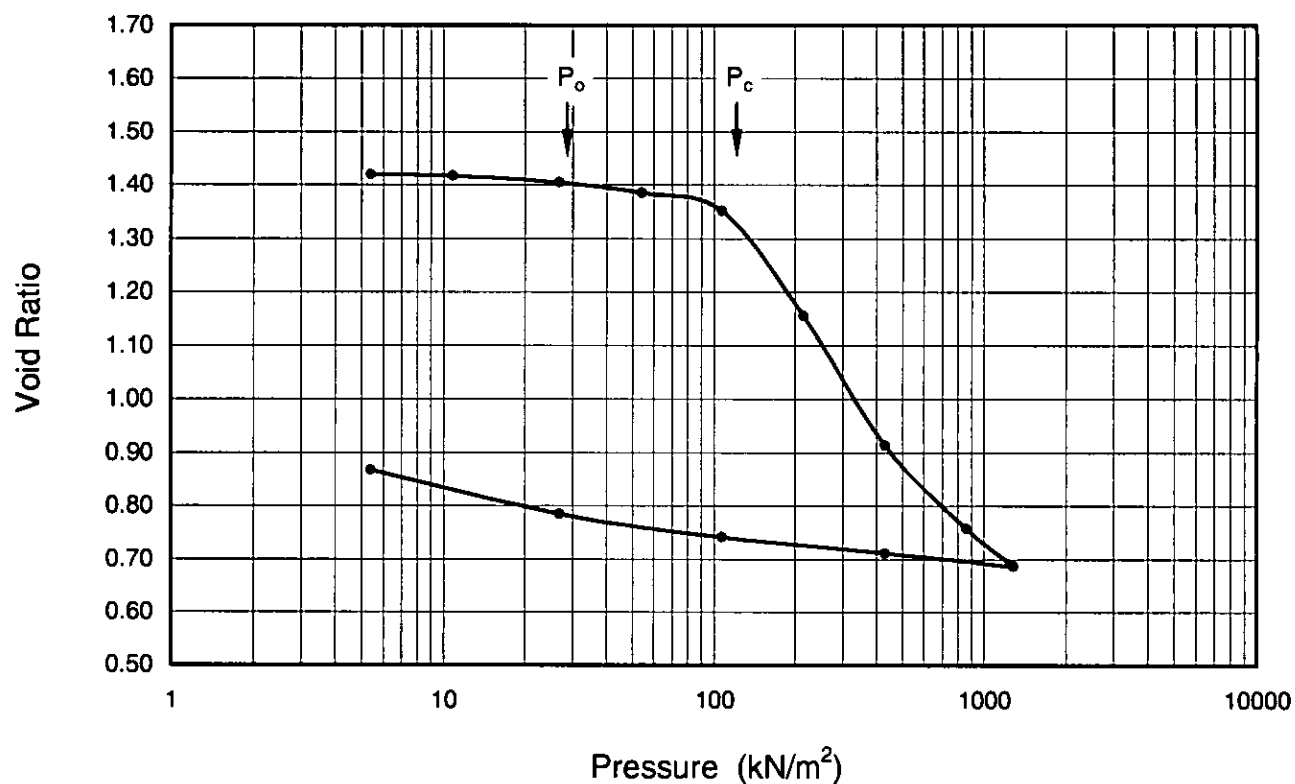
SHAHEEN & PEAKER LIMITED	PLASTICITY CHART CLAY	FIG No B8-11
		G.W.P. 354-94-00
		SPT 1055

16+350 Lt

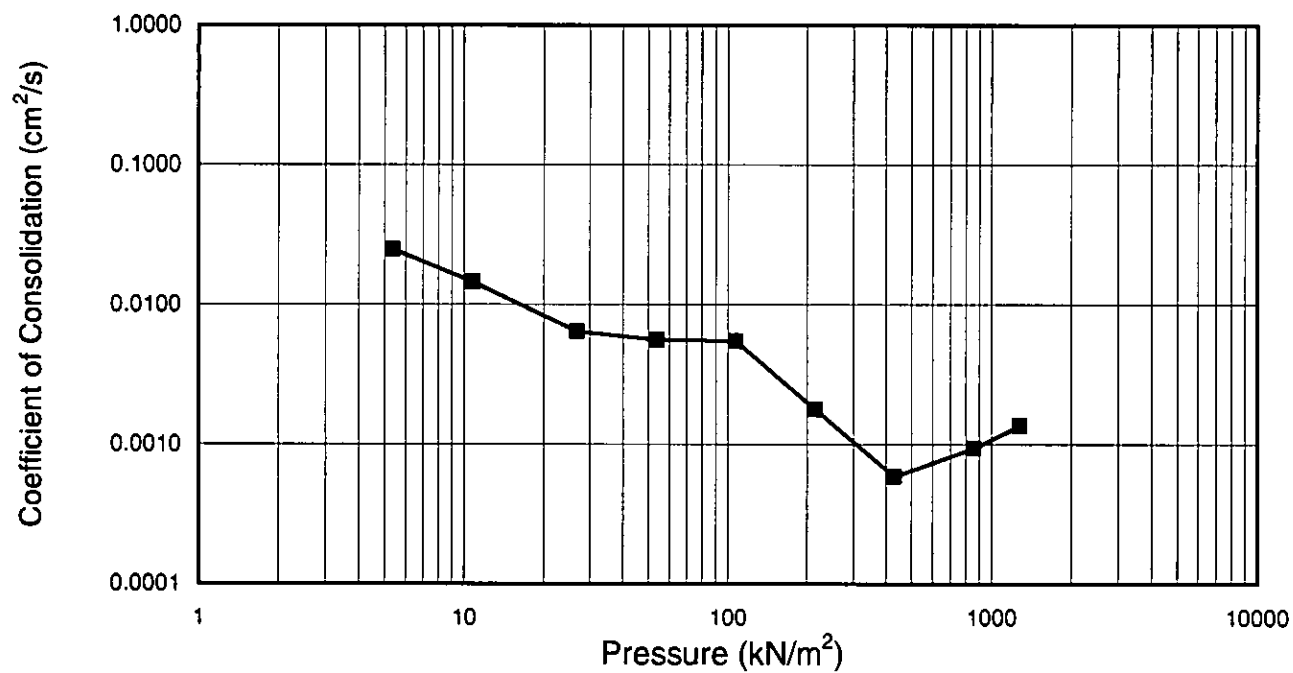
TW 5 Depth 3.0-3.5 m

Fig. B8-12

Void Ratio versus Pressure



Coefficient of Consolidation vs Pressure



## Appendix C8

# Measured Undrained Shear Strength Results

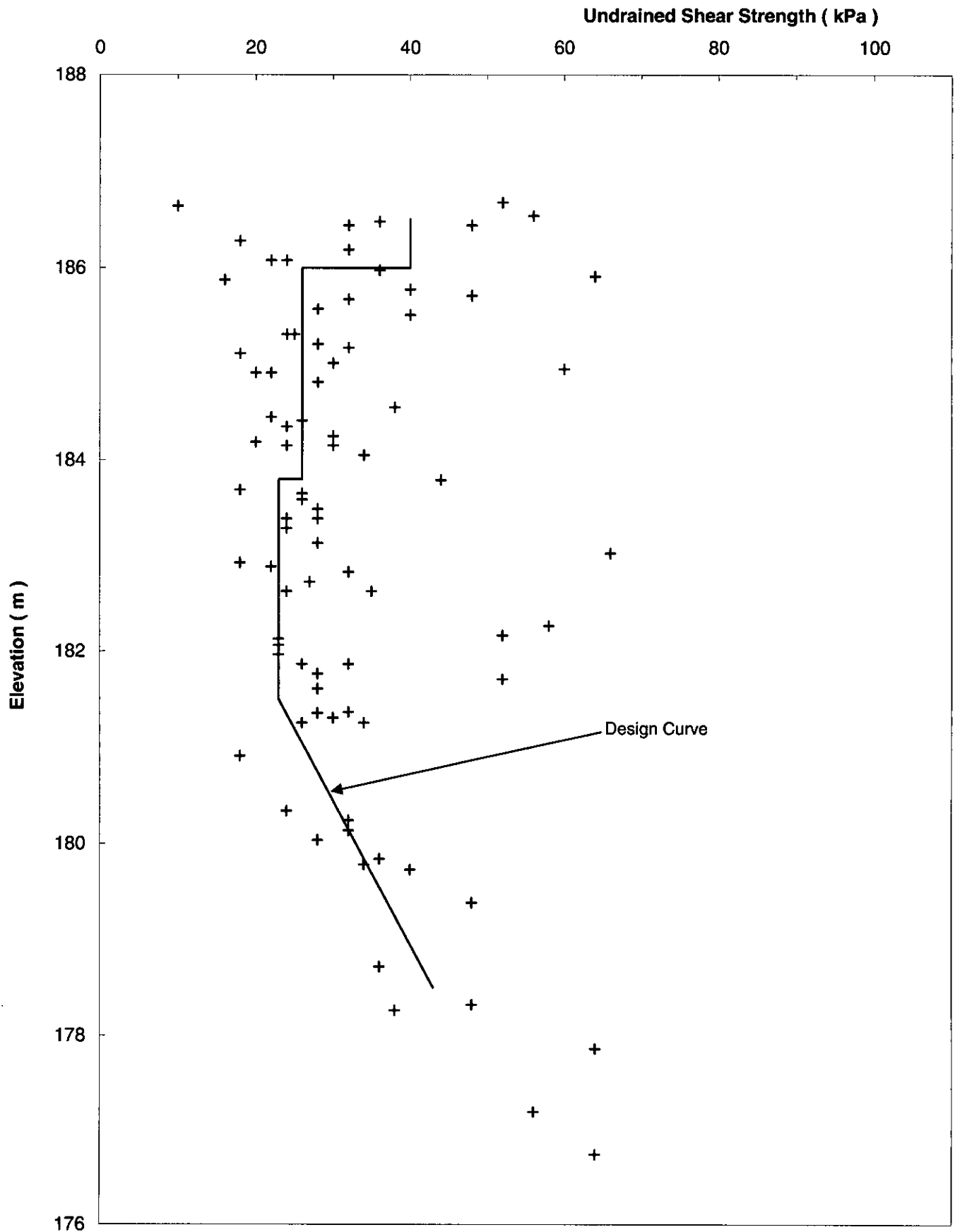


Fig. C8-1: Variation of Undrained Shear Strength (as measured by field vane tests) with Elevation

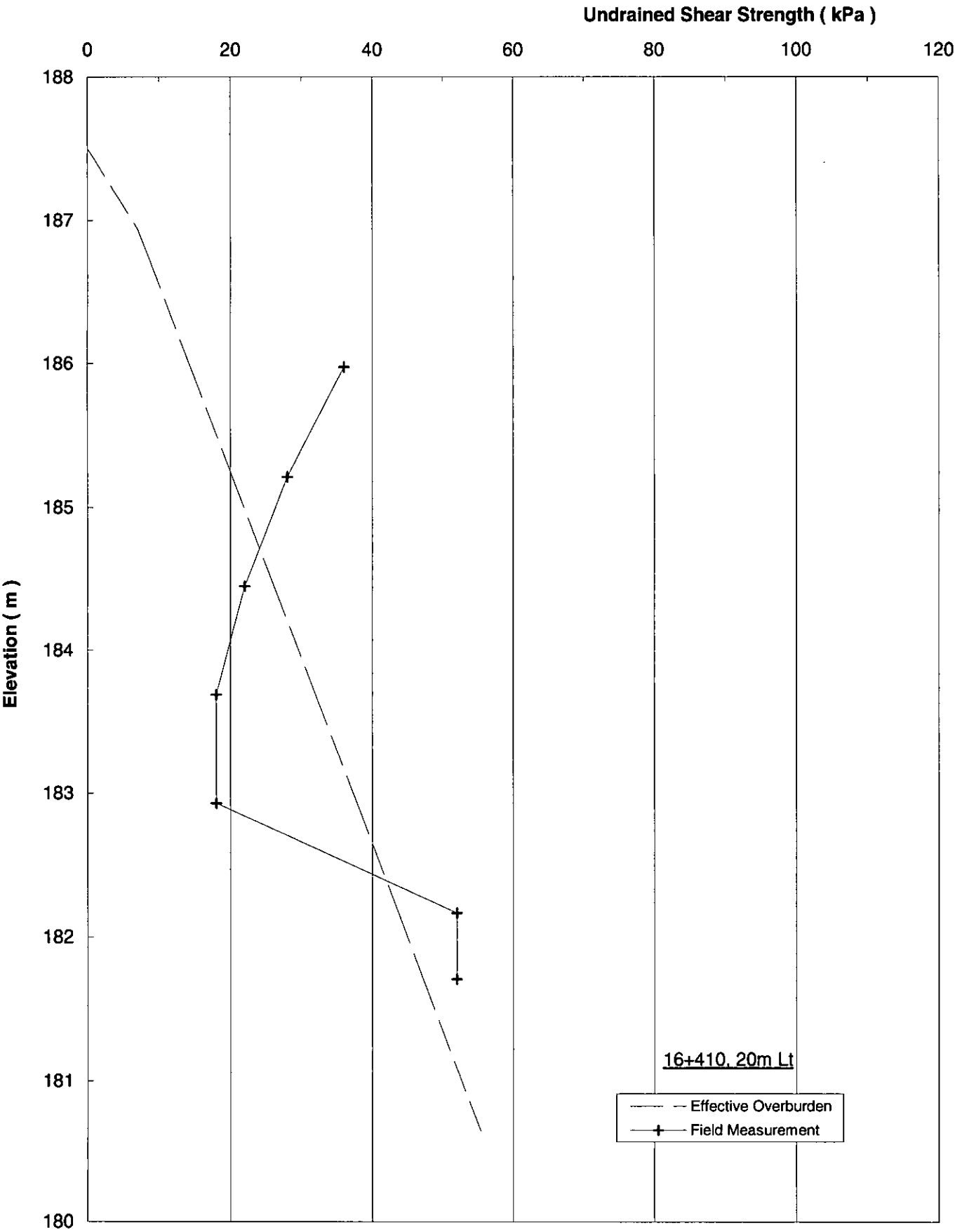


Fig. C8-2: Variation of Undrained Shear Strength (as measured by field vane tests) with Elevation  
(Borehole 16+410 Lt)

#### **4.9 SITE NO. 9 : GOVERNMENT ROAD CUT SECTION BETWEEN STATIONS 11+000 AND 11+220**

Site No. 9 is the re-alignment of Government Road between Stations 11+000 and 11+220. This road re-alignment is located in a hilly and wooded area where exposed bedrock knobs were observed. The existing grade is at its highest elevation at about Station 11+067 and the grade slopes down towards the north and towards the south (towards increasing station) beyond this station. The existing grade in this area varies from a high Elevation 215.3 m (at Station 11+067) to a low Elevation 197 m. The existing grades in this second section are also sloping down towards the right (west) at a rate of about 10% (i.e., about 2 m drop over 20 m horizontal distance).

The location plans of the boreholes and test pits along the Government Road re-alignment are shown on Drawing 9A. The stratigraphic profile for this section is also presented in Drawing 9A. The cross-sections through Stations 11+040, 11+120 and 11+220 are shown on Drawing Nos. 9B and 9C.

Twenty six test pits were dug in the area of the Government Road re-alignment. The test pits show below some surficial topsoil, silty sand till, clayey silt, and sand and gravel, the presence of bedrock. The bedrock in this area was proven by diamond drilling at the adjacent Highway 17 westbound lanes (WBL) alignment at the location of Boreholes 15+676 Lt and 15+730 Lt (see Record of Borehole Sheets for details).

Details of the subsurface conditions encountered in the test pits are presented on the Test Pit Logs in Appendix A9. The individual strata are briefly described in the following paragraphs.

##### **4.9.1 TOPSOIL**

In this section, the test pits encountered 0.05 to 0.3 m layer of topsoil with sand and gravel with occasional cobbles and boulders.

##### **4.9.2 SAND AND GRAVEL**

Below the topsoil or from the ground surface, the test pits contacted a surficial deposit of gravelly sand to sand and gravel. This sand and gravel layer contains occasional cobbles and boulders and traces of silt.



A grain-size distribution analysis was performed on a sample from this layer and the results are presented in Figure B9-1, Appendix B9. They indicate the following particle-size distribution:

Gravel	=	28%
Sand	=	58 %
Silt & Clay	=	14%

Probing in this deposit indicated that this material has a generally compact relative density.

#### 4.9.3 SILTY SAND TILL

Below the topsoil and surficial clayey silt, silty sand till was also contacted in the test pits between Stations 11+040 and 11+220. This glacial till is a heterogeneous mixture of clay, silt, sand and gravel-size particles and contains occasional cobbles and boulders.

Probing in this deposit indicated that this material has a generally compact to dense relative density.

#### 4.9.4 CLAYEY SILT

Between Stations 11+180 and 11+220, below the topsoil or from the ground surface, a surficial clayey silt was encountered. This material contains traces of gravel and is described as possible till.

#### 4.9.5 BEDROCK

Test pits from this investigation indicate that bedrock was encountered along the Government Road re-alignment between Stations 11+000 and 11+240. Beyond or north of Station 11+000 to Station 10+939 (about the north limit of this section), borehole logs by DST Consulting Engineers Inc. were utilized to be able to plot the rock line and this is shown in Drawing 9A.

The bedrock in this area was proven by diamond drilling at the adjacent Highway 17 westbound lanes (WBL) alignment at the location of Boreholes 15+676 Lt and 15+730 Lt (see Record of Borehole Sheets for details). Along the Government Road alignment, and based on visual inspection of the rock cores and exposed rock at the bottom of the test pits, the bedrock in this area is described as quartzite between about Stations 11+010 and 11+100. The bedrock to the north of Station 11+010 and to the south of Station 11+100 is

identified as sandstone. Quartzites are generally 'very strong' to 'extremely strong' with unconfined compressive strength (UCS) between 100 to greater than 250 MPa; while the sandstones are considered 'strong' rock with UCS of about 50 to 100 MPa.

#### 4.9.6 GROUNDWATER CONDITIONS

Water level observations in the test pits were made during excavation and at completion of the test pits. No groundwater was observed in the test pits during or at completion of the excavation, however, wet soil was encountered at Station 11+180 (7m) Lt, at a depth of 2.2 m below existing grade. Perched water condition could exist from the accumulation of surface water in the granular soil overlying the bedrock. The groundwater level can be expected to fluctuate seasonally and in response to weather events.

#### SHAHEEN & PEAKER LIMITED



Z.S. Ozden, P.Eng.



Ramon Miranda, P.Eng.

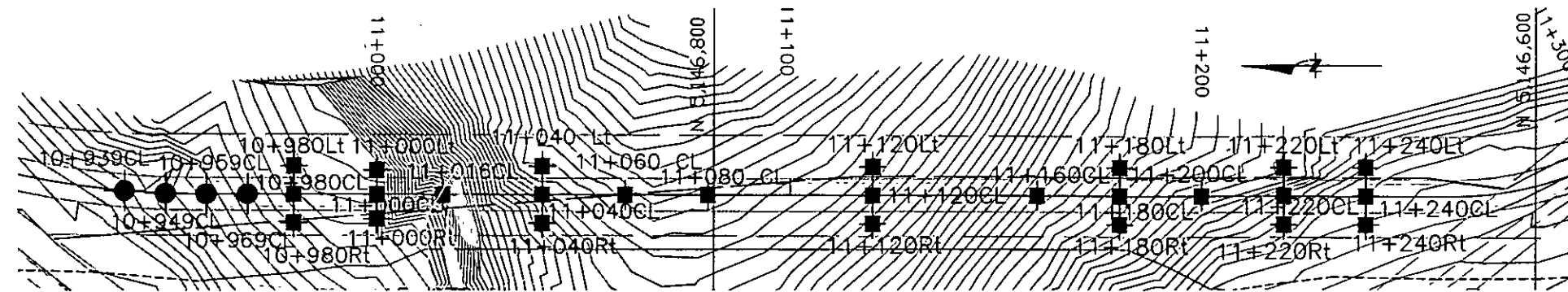


K. R. Peaker, Ph.D., P.Eng.



ZO:tr/hd

# Drawings



## METRIC

DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN. STATIONS  
ARE IN KILOMETRES + METRES.

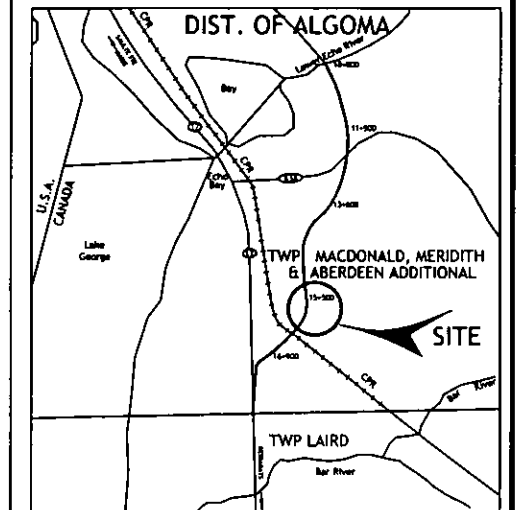
NOTE:  
FOR DETAILED SUBSURFACE CONDITIONS OF ALL  
TEST PITS REFER TO RECORD OF TEST PIT  
LOGS.

CONT No.  
GWP: 354-94-00

HIGHWAY 17 (NEW)  
GOVERNMENT ROAD  
BORE HOLE LOCATIONS & SOIL STRATA



## SHAHEEN & PEAKER LIMITED



KEY PLAN  
N.T.S.

### LEGEND

- Test Pit
- Bore Hole Done by  
DST Consulting Engineers Inc

No.	ELEV.	CO-ORDINATES	
		NORTH	EAST
10+980 CL	196.3	5 146 901.4	300 331.3
10+980 7m Lt	196.8	5 146 901.4	300 338.3
10+980 7m Rt	195.6	5 146 901.5	300 324.3
11+000 CL	197.2	5 146 881.4	300 331.3
11+000 6m Rt	196.8	5 146 881.5	300 325.3
11+000 6m Lt	197.7	5 146 881.4	300 337.3
11+016 CL	201.7	5 146 865.4	300 331.2
11+040 CL	212.6	5 146 841.4	300 331.1
11+040 7m Rt	211.4	5 146 841.5	300 324.1
11+040 7m Lt	213.9	5 146 841.4	300 338.1
11+060 CL	214.7	5 146 821.4	300 331.1
11+080 CL	214.8	5 146 801.4	300 331.0
11+120 CL	212.1	5 146 761.4	300 330.9
11+120 7m Rt	211.3	5 146 761.5	300 323.9
11+120 7m Lt	212.9	5 146 761.4	300 337.9
11+160 CL	205.9	5 146 721.4	300 330.8
11+180 CL	203.5	5 146 701.4	300 330.7
11+180 7m Lt	204.3	5 146 701.4	300 337.7
11+180 7m Rt	202.8	5 146 701.5	300 323.7
11+200 CL	201.4	5 146 681.4	300 330.6
11+220 CL	199.4	5 146 661.4	300 330.6
11+220 7m Lt	201.4	5 146 661.4	300 337.6
11+220 7m Rt	198.4	5 146 661.5	300 323.6
11+240 CL	197.5	5 146 641.4	300 330.5
11+240 7m Lt	198.4	5 146 641.4	300 337.5
11+240 7m Rt	196.9	5 146 641.5	300 323.5

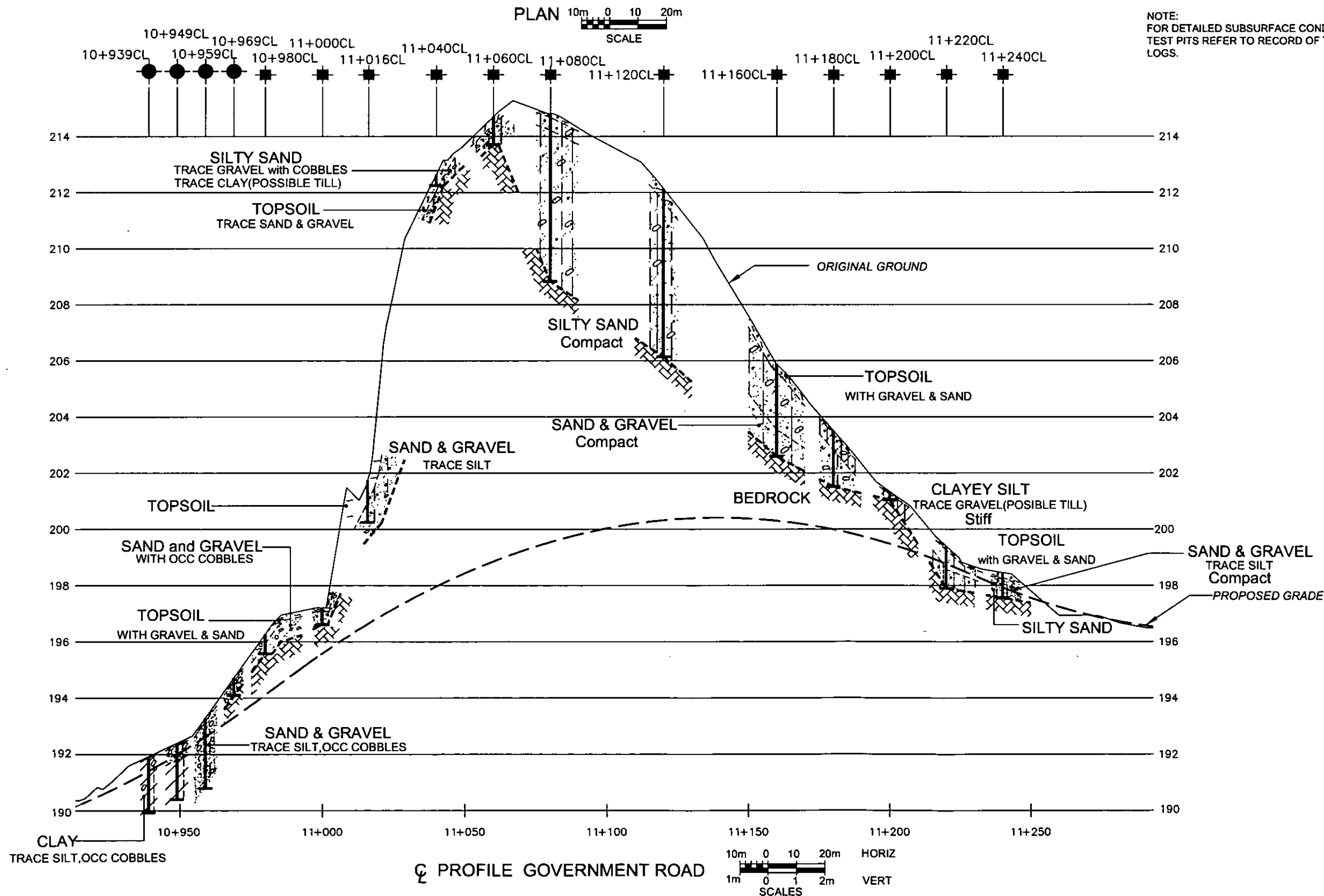
### NOTE

The boundaries between soil strata have been established only  
at Bore Hole locations. Between Bore Holes 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 Materials Engineering and Research Office, Downsview.  
Information contained in this report and related documents are  
specifically excluded in accordance with the conditions of Section  
GC 2.01 of OPS Gen. Cond.

DATE	BY	DESCRIPTION
------	----	-------------

Geocres No.		DIST 62	
Hwy No. 17 (New)	CHECKED ZO	DATE Mar, 2003	SITE
DRAWN JZ	CHECKED	APPROVED	DWG 9A



# METRIC

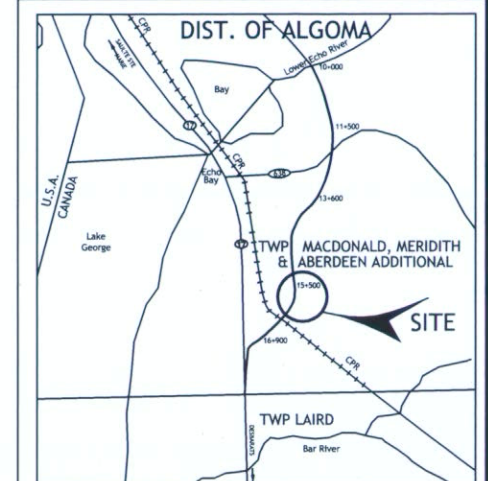
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN. STATIONS  
ARE IN KILOMETRES + METRES.

CONT No.

GWP: 354-94-00

HIGHWAY 17 (NEW)  
ECHO RIVER TO BAR RIVER ROAD  
SITE No. 9  
CROSS SECTION

## SHAHEEN & PEAKER LIMITED



KEY PLAN  
N.T.S.

### LEGEND

Test Pit

No.	ELEV.	CO-ORDINATES	
		NORTH	EAST
11+040 7mRt	211.4	5 146 841.5	300 324.1
11+040 CL	212.6	5 146 841.4	300 331.1
11+040 7mLt	213.9	5 146 841.4	300 338.1

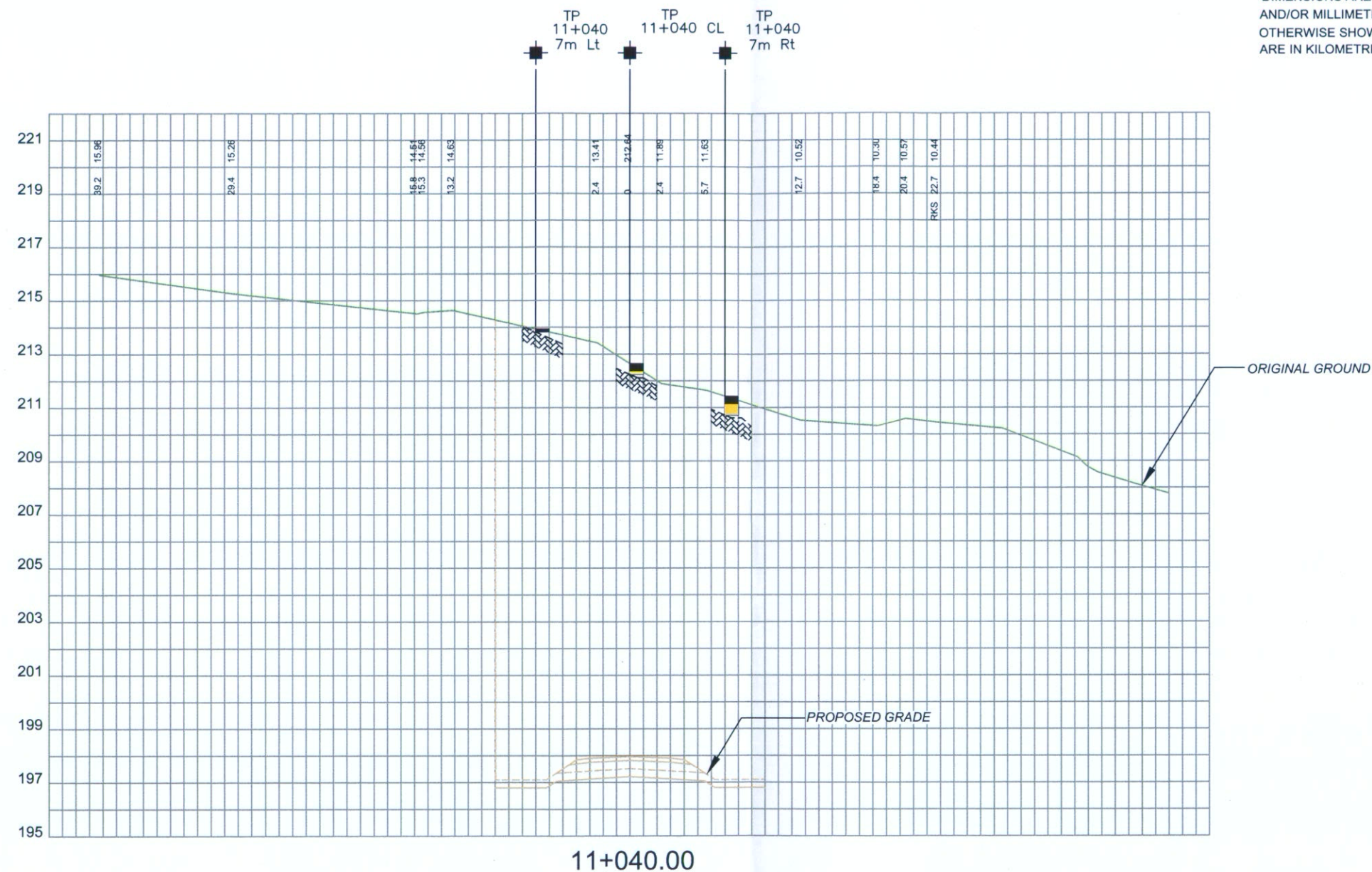
### NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

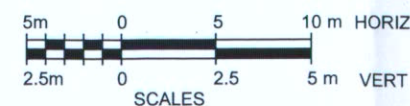
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REV.	DATE	BY	DESCRIPTION

Geocres No.			
HWY No. 17 (New)	DIST 62		
SUBM'D ZO	CHECKED ZO	DATE Mar, 2003	SITE
DRAWN JZ	CHECKED	APPROVED	DWG 9B



## CROSS SECTION (Government Road)



Colour	Soil Type
Black	PEAT, TOPSOIL, ORGANIC SOIL
Yellow	SAND AND GRAVEL
Light Yellow	SAND
Hatched	BEDROCK



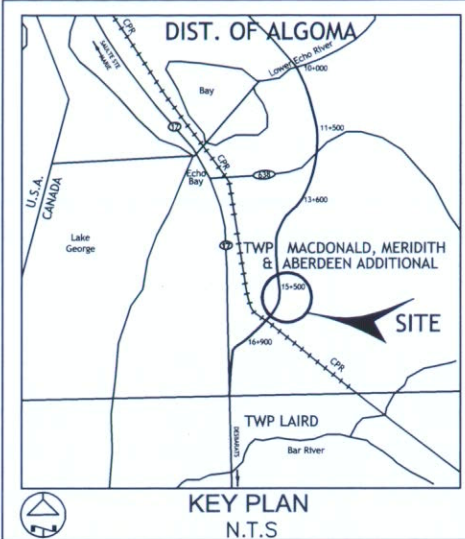
METRIC

DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN. STATIONS  
ARE IN KILOMETRES + METRES.

CONT No.  
GWP: 354-94-00

HIGHWAY 17 (NEW)  
ECHO RIVER TO BAR RIVER ROAD  
SITE No. 9  
CROSS SECTION

SHAHEEN & PEAKER LIMITED



LEGEND

Test Pit

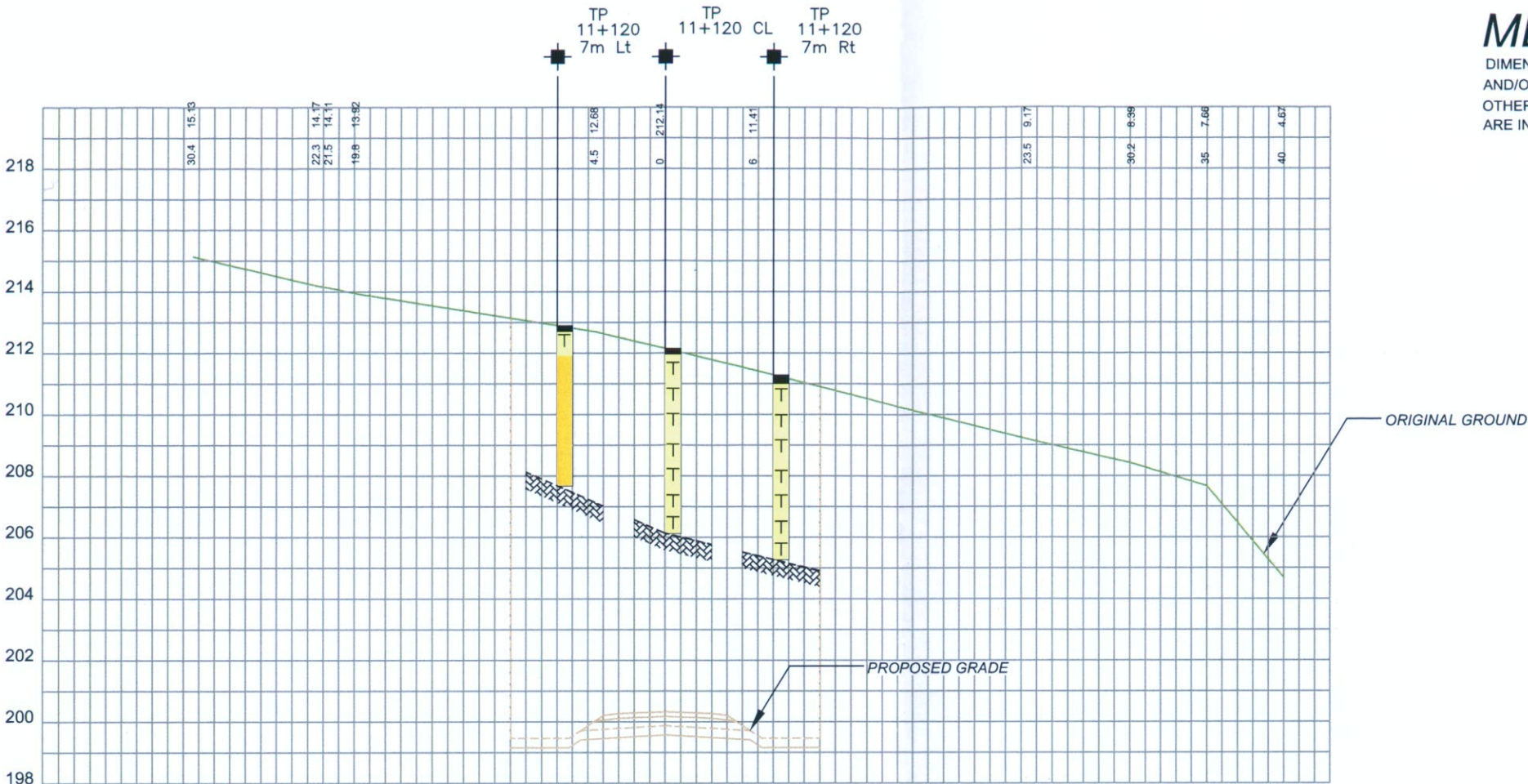
No.	ELEV.	CO-ORDINATES	
		NORTH	EAST
11+120 7mRt	211.3	5 146 761.5	300 323.9
11+120 CL	212.1	5 146 761.4	300 330.9
11+120 7mLt	212.9	5 146 761.4	300 337.9
11+220 7mRt	198.4	5 146 661.5	300 323.6
11+220 CL	199.4	5 146 661.4	300 330.6
11+220 7mLt	201.4	5 146 661.4	300 337.6

**NOTE**  
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

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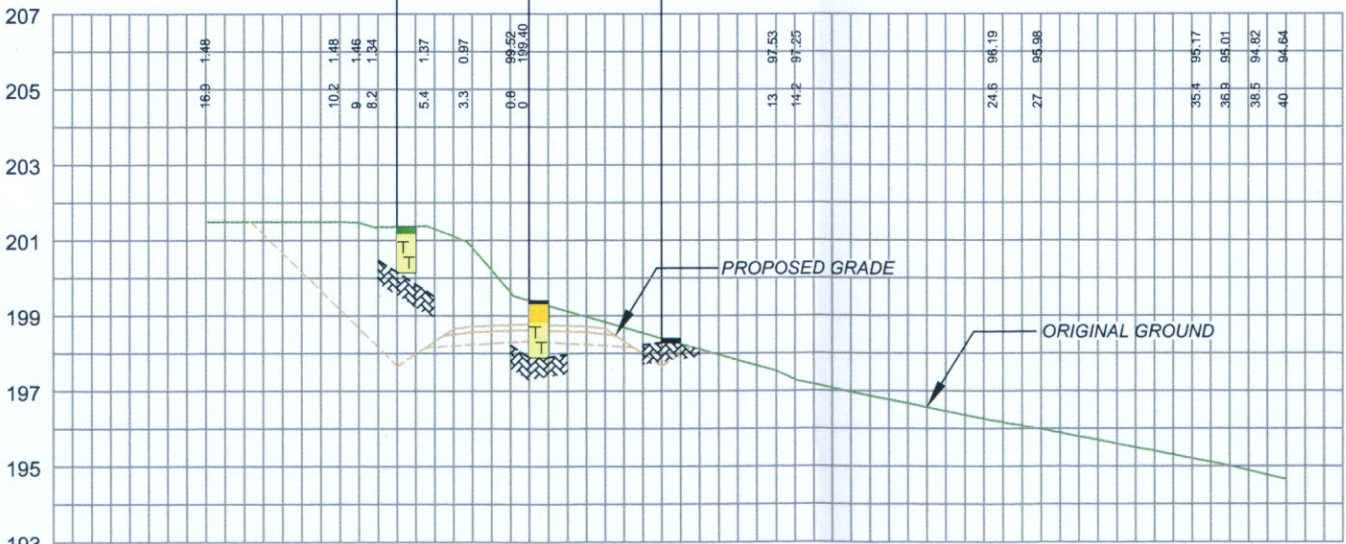
REV.	DATE	BY	DESCRIPTION
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Geocres No.			DIST 62
HWY No. 17 (New)			SITE
SUBM'D ZO	CHECKED ZO	DATE Mar, 2003	DWG 9C
DRAWN JZ	CHECKED	APPROVED	



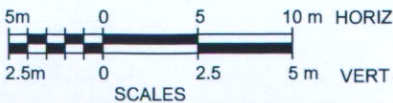
11+120.00

TP 11+220 7m Lt TP 11+220 CL TP 11+220 7m Rt



11+220.00

CROSS SECTION (Government Road)



Colour	Soil Type
Black	PEAT, TOPSOIL, ORGANIC SOIL
Yellow	SAND AND GRAVEL
Green	SILT
Hatched	SILTY SAND TILL
Hatched	BEDROCK

# Appendix A9

## Test Pit Logs

# TEST PIT LOGS

**GWP 354-94-00, HIGHWAY 17 (New)  
From Echo River to Bar River Road  
Sault Ste. Marie**

## **Government Road**

### 10+980 C/L

0	-	200	Tps with Gr Sa
200	-	700	Sa and Gr with Cob Occ Bld Damp to moist
			w@400=5%
		700	NFP BR

### 10+980 7m Lt C/L D+400

0	-	300	Gr Sa with Org, Cob and Bld
300	-	600	Sa and Gr with Cob Occ Blds Damp
			w@400=6%
		600	NFP BR

### 10+980 7m Rt C/L D-400

0	-	200	Tps with Gr Sa
200	-	500	Sa and Gr with Cob and Bld Tr Si
			w@400=6%
500	-	700	Sa and Gr Damp
			w@600=5%
		700	NFP BR

### 11+000 C/L

0	-	130	Tps with Gr Sa
130	-	600	Sa Gr Occ Cob and Bld Damp to Moist
600	-	700	Fractured BR
		700	NFP BR

### 11+000 6m Rt C/L D+300

0	-	100	Tps with Gr Sa
100	-	500	Sa Gr with Cob and Bld Damp
		500	NFP BR

### 11+000 6m Lt D-400

0	-	120	Tps with Gr Sa Occ Bld
120	-	500	Gr Tr Sa Damp to Moist
500	-	600	Fractured BR
		600	NFP BR



<u>11+016 C/L</u>			
0	-	300	Tps
300	-	1.5	Sa and Gr with Bld Tr Si Damp
		1.5	NFP BR
<u>11+040 C/L</u>			
0	-	300	Tps Tr Sa and Gr
300	-	400	Si Sa Tr Gr with Cob Tr Cl (Poss Till)
		400	NFP BR
<u>11+040 7m Rt C/L D-1.1</u>			
0	-	300	Tps with Gr Sa
300	-	700	Si Sa and Gr with Cob and Blds Tr Cl
			(Poss. Till)
		700	NFP BR
<u>11+040 7m Lt C/L D+1.5</u>			
0	-	100	Tps
		100	NFP BR
<u>11+060 C/L</u>			
0	-	200	Tps
200	-	600	Si Sa Tr Gr with Cob and Bld Tr Cl (Poss Till)
600	-	1.0	Si Sa Tr Gr (Till), Damp, Comp
		1.0	NFP Br
<u>11+080 C/L</u>			
0	-	100	Tps with Gr Sa Occ Cob
100	-	600	Si Sa Tr Gr with Cob and Blds Tr Cl
			(Poss Till) Damp to moist Comp
600	-	6.0	Si Sa Tr Gr (Till) numerous Blds
			Damp to Moist Comp
		6.0	NFP (Poss BR)
<u>11+120 C/L</u>			
0	-	200	Tps with Gr Sa
200	-	6.0	Si Sa with Gr and Blds (Poss Till)
			Damp Comp
		6.0	NFP (Poss BR)
<u>11+120 7m Rt D-500</u>			
0	-	300	Tps with Gr Sa
300	-	6.0	Si Sa with Gr and Blds (Poss Till)
			Damp Comp

11+120 7m Lt C/L D+500

0	-	200
200	-	1.0
1.0	-	5.2
		5.2

Tps with Gr Sa  
Si Sa Tr Gr (Till) Damp to moist  
Sa and Gr numerous Blds Tr Si  
(Poss Till) Comp  
NFP BR

11+160 C/L

0	-	200
200	-	1.5
1.5	-	3.3
		3.3

Tps with Gr Sa  
Si Sa Tr Gr with Cob and Blds Damp Comp  
Sa and Gr with Blds Tr Si (Poss Till)  
Moist Comp  
NFP BR

11+180 C/L

0	-	80
80	-	450
450	-	2.0
		2.0

Tps  
Cl Si some Gr Tr Blds Damp to moist Comp  
Sa and Gr with Blds Tr Si Damp Comp  
NFP BR

11+180 7m Lt C/L D+500

0	-	150
150	-	500
500	-	3.5
		3.4

Tps  
Cl Si some Gr and Blds (Poss till) Damp  
Gr Sa with Blds with Si Damp Wet@ 2.2 m  
Comp w@2.5=11%  
NFP BR

11+180 7m Rt D-500

0	-	150
150	-	1.6
		1.6

Tps  
Si Sa with Gr and Blds Damp to Moist Comp  
NFP BR

11+200 C/L

0	-	50
50	-	300
		300

Tps  
Cl Si Tr Gr (Till) Damp Stiff  
w@300=26%  
NFP BR

11+220 C/L

0	-	100
100	-	600
600	-	1.5
1.5	-	1.7
		1.7

Tps  
Gr Tr Sa and Cl Si  
Si Sa Tr Gr (Till) Damp Comp  
Fractured BR  
NFP Br

11+220 7m Lt C/L D+100

0	-	200
200	-	1.2
1.2	-	1.4
1.4	-	1.6

Cl Si Tr Gr Damp  
 Si Sa Tr Gr (Till) Damp to moist Comp  
 Fractured BR  
 NFP BR

11+220 7m Rt C/L D-400

0	-	100
		100

Tps  
 NFP BR

11+240 C/L

0	-	200
200	-	400
400	-	900
		900

Tps with Gr Sa and Cob and Blds  
 Sa and Gr Tr Si Damp  
 Si Sa Tr Gr (Till) Damp Comp  
 NFP BR

11+240 7m Lt C/L D+300

0	-	300
300	-	600
600	-	1.0
		1.0

Tps with Sa and Gr Cob and Blds  
 w@200=33%  
 Sa Gr Tr Si Damp  
 w@400=9%  
 Si Sa Tr Gr (Till) Damp Comp  
 w@600=11%  
 NFP BR

11+240 7m Rt C/L D-300

0	-	250
		250

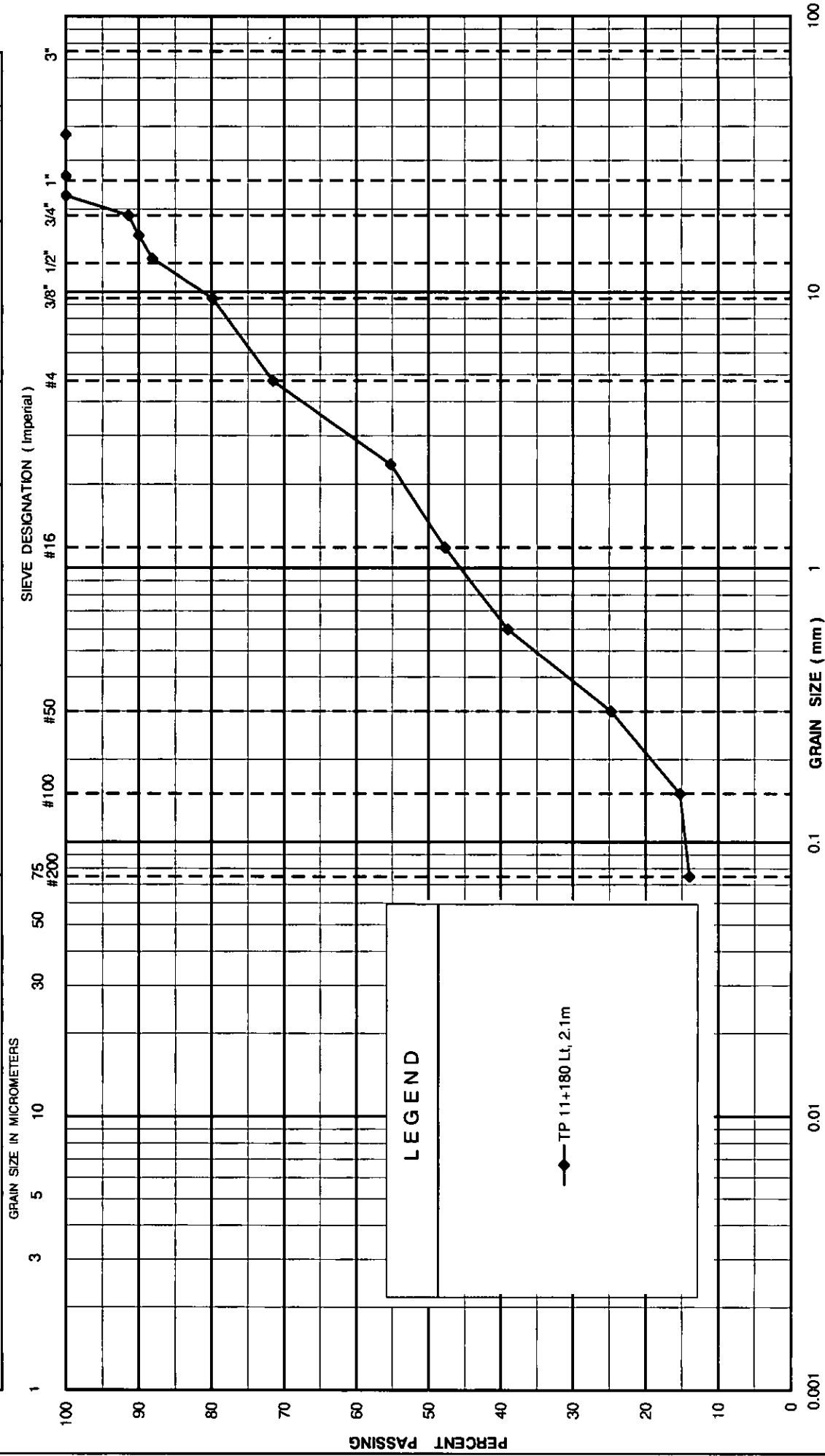
Tps with Sa and Gr  
 NFP BR

# Appendix B9

## Laboratory Test Results

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT		SAND			GRAVEL		
		Fine	Medium	Coarse	Fine	Coarse	Coarse



GRAIN SIZE DISTRIBUTION  
SILTY SAND, some gravel

SHAHEEN & PEAKER LIMITED

FIG. No. B9-1

REF. No. SPT 1055

G.W.P. 354-94-00

# Appendix D

## Explanation of Terms Used in Report

## 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 N.

**DYNAMIC CONE PENETRATION TEST:** CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475J 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

SS	SPLIT SPOON	TP	THINWALL PISTON
WS	WASH SAMPLE	OS	OSTERBERG SAMPLE
ST	SLOTTED TUBE SAMPLE	RC	ROCK CORE
BS	BLOCK SAMPLE	PH	TW ADVANCED HYDRAULICALLY
CS	CHUNK SAMPLE	PM	TW ADVANCED MANUALLY
TW	THINWALL OPEN	FS	FOIL SAMPLE

### 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

### MECHANICAL PROPERTIES OF SOIL

$m_v$	kPa <sup>-1</sup>	COEFFICIENT OF VOLUME CHANGE
$C_c$	1	COMPRESSION INDEX
$C_s$	1	SWELLING INDEX
$C_{\alpha}$	1	RATE OF SECONDARY CONSOLIDATION
$C_{\alpha}$	m <sup>2</sup> /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 = $c_u / \tau_r$

## PHYSICAL PROPERTIES OF SOIL

$\rho_s$	kg/m <sup>3</sup>	DENSITY OF SOLID PARTICLES	e	1.0	VOID RATIO	$e_{min}$	1.0	VOID RATIO IN DENSEST STATE
$\gamma_s$	kN/m <sup>3</sup>	UNIT WEIGHT OF SOLID PARTICLES	n	1.0	POROSITY	$I_D$	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
$\rho_w$	kg/m <sup>3</sup>	DENSITY OF WATER	w	1.0	WATER CONTENT	D	mm	GRAIN DIAMETER
$\gamma_w$	kN/m <sup>3</sup>	UNIT WEIGHT OF WATER	$S_r$	%	DEGREE OF SATURATION	$D_n$	mm	n PERCENT - DIAMETER
$\rho$	kg/m <sup>3</sup>	DENSITY OF SOIL	$w_L$	%	LIQUID LIMIT	$C_u$	1	UNIFORMITY COEFFICIENT
$\gamma$	kN/m <sup>3</sup>	UNIT WEIGHT OF SOIL	$w_p$	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
$\rho_d$	kg/m <sup>3</sup>	DENSITY OF DRY SOIL	$w_s$	%	SHRINKAGE LIMIT	q	m <sup>3</sup> /s	RATE OF DISCHARGE
$\gamma_d$	kN/m <sup>3</sup>	UNIT WEIGHT OF DRY SOIL	$I_p$	%	PLASTICITY INDEX = $(w_L - w_p)$	v	m/s	DISCHARGE VELOCITY
$\rho_{sat}$	kg/m <sup>3</sup>	DENSITY OF SATURATED SOIL	$I_L$	1	LIQUIDITY INDEX = $(w - w_p) / I_p$	l	1	HYDRAULIC GRADIENT
$\gamma_{sat}$	kN/m <sup>3</sup>	UNIT WEIGHT OF SATURATED SOIL	$I_c$	1	CONSISTENCY INDEX = $(w_L - w) / I_p$	k	m/s	HYDRAULIC CONDUCTIVITY
$\rho'$	kg/m <sup>3</sup>	DENSITY OF SUBMERGED SOIL	$e_{max}$	1.0	VOID RATIO IN LOOSEST STATE	j	kN/m <sup>3</sup>	SEEPAGE FORCE
$\gamma'$	kN/m <sup>3</sup>	UNIT WEIGHT OF SUBMERGED SOIL						