

GEOCRES No:

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DS-LEA ASSOCIATES LTD.

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GEOTECHNICAL INVESTIGATION
ATHERLEY NARROWS BRIDGE
HIGHWAY 12
ORILLIA, ONTARIO

Prepared for
DS-LEA ASSOCIATES LTD.

Prepared by
SHAHEEN & PEAKER LIMITED

Project: SP2106
January 27, 1998

250 Galaxy Boulevard
Etobicoke, Ontario
M9W 5R8
Tel: (416) 213-1255
Fax: (416) 213-1260

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DRAWINGS

DRAWING No.

PLAN SHOWING BOREHOLE LOCATION

1

BOREHOLE LOGS

2 TO 13

1. INTRODUCTION

Shaheen & Peaker Limited was retained by the DS-Lea Associates Limited to carry out a geotechnical investigation at the Atherley Narrows bridge construction site located on Highway 12 east of Orillia, Ontario. The site location is shown on Drawing 1. Mr. Peter Ojala, P.Eng. of DS-Lea Associates Ltd. authorized the investigation.

It is understood that the new bridge piers are supported by caissons that were to be founded on the limestone bedrock at this site.

The purpose of this investigation was to determine the subsurface conditions and bedrock levels at 5 borehole locations.

2. PROCEDURE

In total eight boreholes were drilled at five pier locations at this site. The boreholes were drilled to depths ranging from 13.4 to 15.4 m. Hollow stem continuous flight auger equipment was used to drill through the upper softer sediments and the till and bedrock in some cases. In Borehole 1, the upper levels of the bedrock were penetrated to a depth about 3 m with hollow stem augers. MTO personnel on site indicated from previous experience that the till was very bouldery and was expected at about 9 m depth. The drilling of the so called bouldery till was very difficult and slow. The augers were grinding all the way and drilling was rough. The heat generated during drilling was intensive enough to fuse the teeth of the augers into the auger head. The drilling was stopped where the drilling became smoother and on an apparent flat harder layer at about 12.3 m depth. This was assumed to be the bedrock level. The material above was assumed to be boulders but after review of the subsequent cores was found to be fractured bedrock. In order to speed up the work in Borehole 2, the possible till was drilled with a tricone bit to a depth of 11.7 m. Again in this borehole the drilling was rough through the fractured bedrock (assumed to be boulders) and became smooth on a harder layer at about 11.7 m. After review of the split spoon samples from Borehole 1 in the laboratory it was not possible to confirm that till was encountered and therefore the same hard layer was drilled with an NQ core barrel. Diamond drilling with an

NQ core barrel was undertaken in the bedrock in all boreholes and in the possible till in Borehole 3.

The drilling was undertaken by a drilling sub-contractor under the direction and supervision of Shaheen & Peaker Limited personnel. In Boreholes 1, 4 and 5 soil, samples were retrieved at regular intervals with a 50 mm O.D. split-barrel sampler driven with a hammer weighing 624 N and dropping 760 mm. Soil samples were not obtained in Boreholes 2 and 3 and instead these boreholes were drilled to the till or bedrock level without sampling. The samples and rock core were logged in the field and returned to the Shaheen & Peaker Limited laboratory for detailed examination by the project engineer and for laboratory testing.

The surveying of the borehole locations was undertaken by Shaheen & Peaker Limited personnel. The ground surface elevations were surveyed by DS Lea Associates Limited.

As well as visual examination in the laboratory, all of the soil samples were tested for moisture content and selected samples for natural unit weight.

3. SUBSURFACE CONDITIONS

The borehole locations are shown on Drawing 1 and detailed subsurface conditions are presented on the borehole and core logs, Drawings 2 to 13. These are summarized as follows.

The soil in the boreholes consisted of varying depths of loose to dense fill overlying very loose peat, marl and organic silt and, soft silty clay. Rock fill was present at the location of Boreholes 1 and 2. In Boreholes 1 and 2 the weak soils were found to overlie limestone bedrock. In Boreholes 3 and 4, a thin layer of sandy silt till was found over the bedrock and in Borehole 5, stiff layered silty clay to sandy silt was found to overlie compact to very dense granular deposits of fine to coarse sand and, sand and gravel. A thin layer of till may be present over the bedrock at Borehole 5, but the sample was of poor quality.

Limestone bedrock was found at depths of 9.4 to 10.9 m across the site. The actual bedrock elevations are summarized below on Table 1.

Table 1: Bedrock Elevations

Borehole	Elevation (m)
1 and 1A	210.8
2A and 2B	211.1
3	208.7
4	209.4
5	208.5

The limestone was fine grained and contained stylolites. It was grey, unweathered and the strength was estimated to be medium (15 to 50 MPa). Bedding joints were in general at close (<5 cm) to very close (5 to 30 cm) intervals with occasional moderately (30 to 100 cm) spaced joints. Vertical cross joints were common and occasional diagonal cross joints were noted. Where the vertical joints were encountered the core was broken up and this probably accounted for some of the poor recovery. All joint surfaces were rough planar. Random clay seams were noted in some boreholes. These appeared to be very thin (< 1 to 3 mm).

4. GENERAL COMMENTS

The comments given in this report are intended only for the guidance of design engineers. The number of boreholes required to determine the localized underground conditions between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc., would be much greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

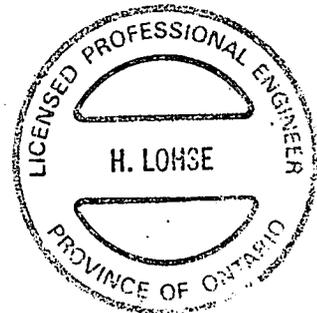
The information in this report in no way reflects on the environmental aspects of the soil and has not been addressed in this report, since this aspect is beyond the scope and terms of reference. Should specific information be required, additional testing may be required.

We trust that the information contained in this report is satisfactory. Should you have any questions, please do not hesitate to contact this office.

Shaheen & Peaker Limited.



Holger Lohse, P.Eng



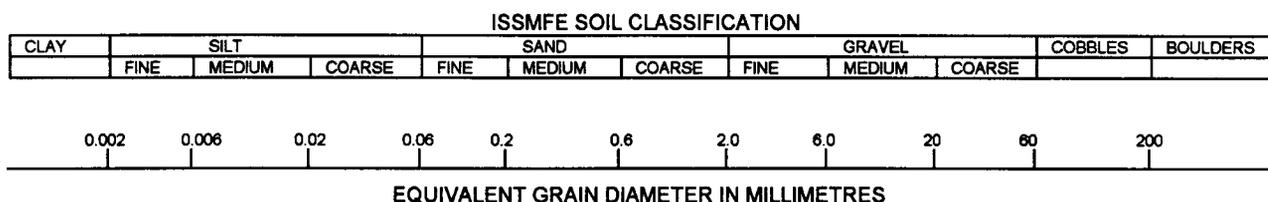
Shaheen A. Ahmad, M.A.Sc., P.Eng.



Drawings

Notes On Sample Descriptions

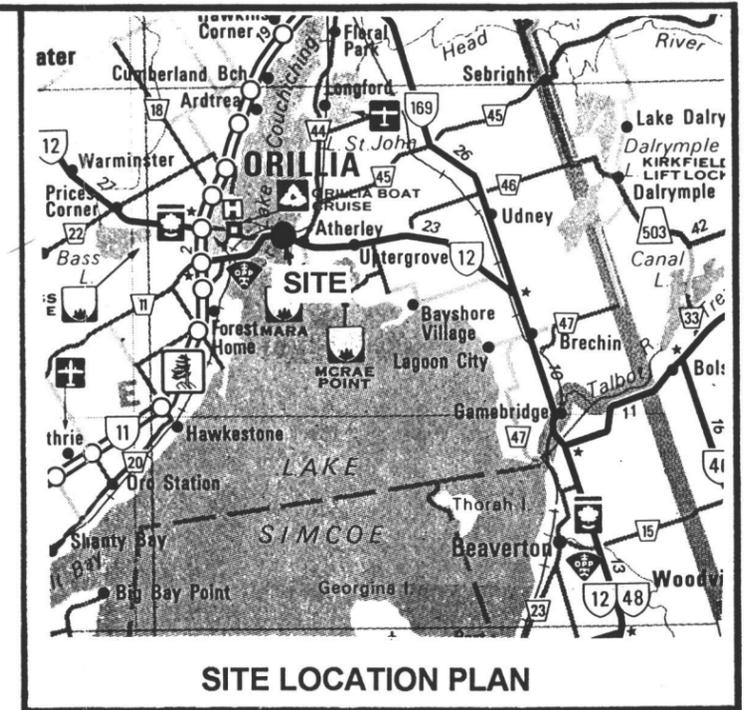
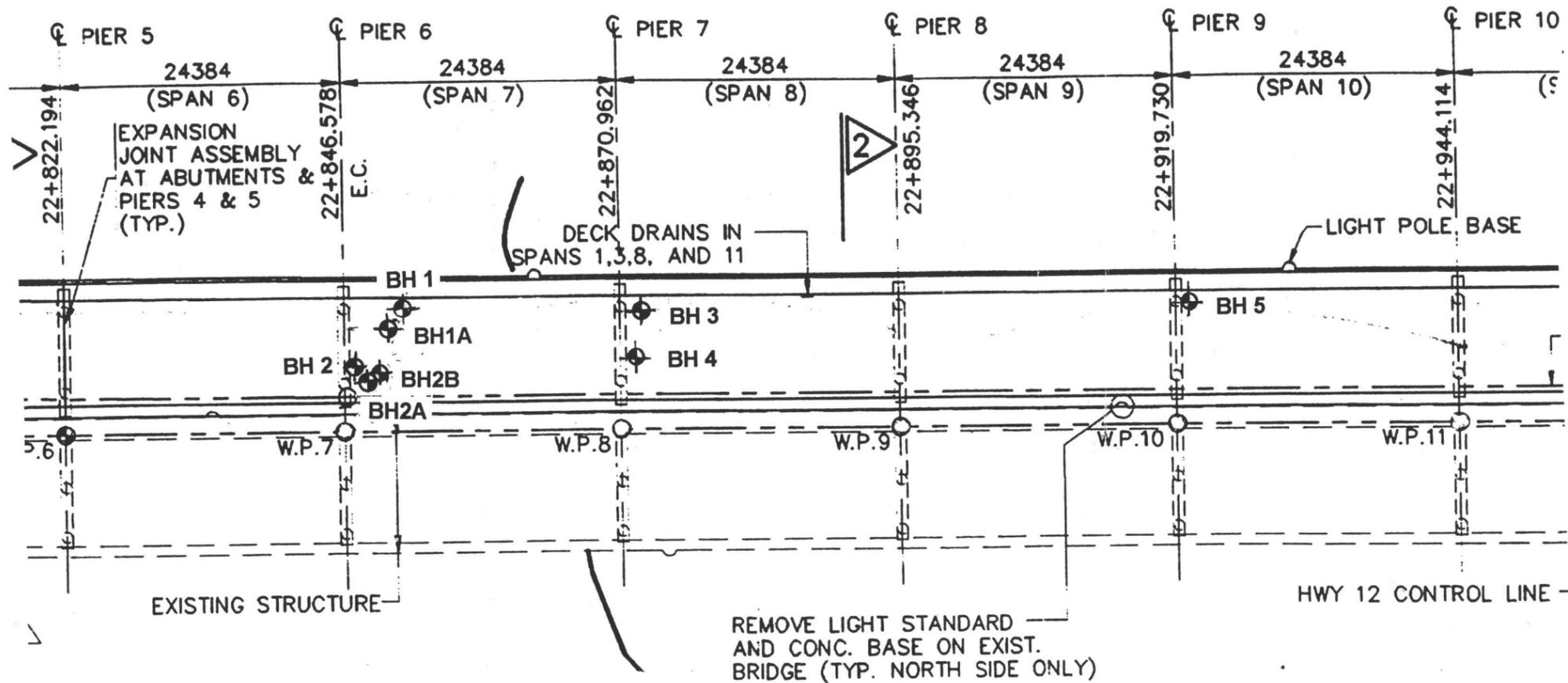
- All sample descriptions included in this report follow the Canadian Foundations Engineering Manual soil classification system. This system follows the standard proposed by the International Society for Soil Mechanics and Foundation Engineering. Laboratory grain size analyses provided by Shaheen & Peaker Limited also follow the same system. Different classification systems may be used by others; one such system is the Unified Soil Classification. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.



CLAY (PLASTIC) TO SILT (NONPLASTIC)	FINE	MEDIUM	CRS.	FINE	COARSE
	SAND			GRAVEL	

UNIFIED SOIL CLASSIFICATION

- Fill:** Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.
- Till:** The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.



NOTES

1. The boundaries and soil types have been established only at borehole locations. Between boreholes they are assumed and may be subject to considerable error.
2. Soil samples will be retained in storage for 3 months and then destroyed unless the client advises an extended time period is required.
3. Topsoil quantities should not be established from the information provided at the borehole locations.
4. Borehole elevations should not be used to design building(s) or floor slab(s) or parking lot(s) grades.
5. This drawing forms part of the report (project number as referenced) and should only be used in conjunction with this report.

SHAHEEN & PEAKER LIMITED		
PLAN SHOWING BOREHOLE LOCATIONS		
GEOTECHNICAL INVESTIGATION ATHERLY NARROWS BRIDGE HIGHWAY 12 ORILLIA, ONTARIO		
PROJECT: SP2106	SCALE: ~1:500	DRAWING NO. 1

Project No. SP2106

Log of Borehole 1

Dwg No. 2

Project: Atherley Narrows Bridge

Sheet No. 1 of 1

Location: Highway 12, Orillia, Ontario

Date Drilled: January 6, 1998

Drill Type: Hollow Stem Augers

Datum: Geodetic

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Sensitivity
- Piezometric Water Level
- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer

SYMBOL	Soil Description	ELEV. (m)	DEPTH (m)	N Value				Combustible Vapour Reading (ppm)			Natural Unit Weight kN/m ³
				Shear Strength				Natural Moisture Content %			
				20	40	60	80	250	500	750	
	ROCK FILL: augered to 3.0 m without sampling	220.2	0	0.1	0.2	10	20	30			
	MARL: sandy, trace of organics and shells, grey, wet, very loose	217.6	3						63.32		
	ORGANIC CLAYEY SILT: trace of organics, brownish grey, very moist to wet, soft	216.2	4						64.87	15.5	
	SILTY CLAY: grey, very moist to wet, soft	213.9	6							16.4	
	Limestone Bedrock: see attached core logs of Borehole 1 and 1A for rock description	210.8	9						63.79	15.5	
	This hole was augered to about 12.2 m on January 6, 1998 and sampled with a split-barrel sampler. According to MTO personnel on site this material was bouldery till. However, augering was very difficult and slow and sample recovery was negligible and an accurate assessment of the material could not be made. The same layer was subsequently cored and found to consist of limestone.	204.8	15								
	End of Borehole										

WATER LEVEL RECORD:

Time	Water Level (m)	Depth to Cave (m)

S & P Shaheen and Peaker Limited
Consulting Geo-Environmental Engineers

CORE LOG

BH NO. 1

PROJECT Atherley Narrows Bridge	ORIENTATION Vertical	ELEVATION (m) 220.2	DATUM Geodetic	PROJECT NO. SP2106
LOCATION Highway 12, Orillia, Ontario	DATE STARTED 01/06/98	COMPLETED 01/06/98	LOGGED BY H. Lohse	DRAWING NO. 3
CLIENT DS-Lea Associates Ltd.	DRILLER Malone	DRILL TYPE CME75	CORE BARREL NQ	SHEET 1 of 1

ELEV. (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	JOINT CHARACTERISTICS							WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No.	RECOVERY %	RQD	WATER RECOVERY %	WATER COLOUR	
				No. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERATURE (mm)									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
220.2																			
	1		Refer to Borehole Log for soil description																
	2																		
	3																		
	4																		
	5																		
	6																		
	7																		
	8																		
	9																		
210.8			See Borehole 1A for core log from Elevation 210.8 to 208.7 m.																
	10																		
	11																		
207.9			LIMESTONE: fine grained, occasional stylolites, unweathered, medium strength																
	12																		
	13														1	75	43	96	grey
	14		Top 0.15 m of Run 1 was broken up. Probable core loss occurred at this depth.	1	B	F	C	RP	T	O									
	15							VC							2	100	53	100	grey
204.8			End of Borehole																
	16																		
	17																		
	18																		
	19																		

CORE LOG

BH NO. 1A

PROJECT Atherley Narrows Bridge	ORIENTATION Vertical	ELEVATION (m) 220.0	DATUM Geodetic	PROJECT NO. SP2106
LOCATION Highway 12, Orillia, Ontario	DATE STARTED 01/14/98	COMPLETED 01/14/98	LOGGED BY H. Lohse	DRAWING NO. 4
CLIENT DS-Lea Associates Ltd.	DRILLER Malone	DRILL TYPE CME75	CORE BARREL NQ	SHEET 1 of 1

1 ELEV. (m)	2 DEPTH (m)	3 SYMBOL	4 GENERAL DESCRIPTION	JOINT CHARACTERISTICS							12 WEATHERING	13 STRENGTH	14 FRACTURE FREQUENCY	15 RUN No.	16 RECOVERY %	17 RQD	18 WATER RECOVERY %	19 WATER COLOUR	
				5 No. OF SETS	6 JOINT TYPE	7 ORIENTATION	8 SPACING	9 ROUGHNESS	10 FILLING	11 APERATURE (mm)									
220.0	1		Refer to Borehole Log for soil description																
	2																		
	3																		
	4																		
	5																		
	6																		
	7																		
	8																		
210.8	9		LIMESTONE: fine grained, occasional stylolites, unweathered, medium strength																
	10				2	B C	F V	C VC	RP	T	O				1A	77	21	var.	grey
208.7	11																		
	12		End of Borehole Note: Core at top and bottom of Run 1 was broken up.																
	13																		
	14																		
	15																		
	16																		
	17																		
	18																		
	19																		

Project No. SP2106

Log of Borehole 2A

Dwg No. 6

Project: Atherley Narrows Bridge

Sheet No. 1 of 1

Location: Highway 12, Orillia, Ontario

Date Drilled: January 7, 1998

Drill Type: Hollow Stem Augers

Datum: Geodetic

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Sensitivity
- Piezometric Water Level
- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer

G W L	S Y M B O L	Soil Description	ELEV. (m)	D I P T H	N Value				Combustible Vapour Reading (ppm)			Natural Unit Weight kN/m ³
					Shear Strength				Natural Moisture Content %			
					MPa				Atterberg Limits (% Dry Weight)			
		ROCK FILL: not sampled	220.0	0	20	40	60	80	250	500	750	
		MARL AND SILT CLAY: not sampled	217.6	1								
				2								
				3								
				4								
				5								
				6								
				7								
				8								
				9								
		LIMESTONE: triconed without sampling This material was formerly thought to be bouldery till based on information from MTO personnel and was triconed without sampling. It was subsequently cored and found to be limestone. Refer to the core logs for Boreholes 2A and 2B for rock description. Continued on Core Log 2A	210.9	10								
			208.4	11								
				12								
				13								
				14								
		End of Borehole	205.2									

WATER LEVEL RECORD:

Time	Water Level (m)	Depth to Cave (m)

CORE LOG

BH NO. 2A

PROJECT Atherley Narrows Bridge	ORIENTATION Vertical	ELEVATION (m) 220.0	DATUM Geodetic	PROJECT NO. SP2106
LOCATION Highway 12, Orillia, Ontario	DATE STARTED 01/12/98	COMPLETED 01/12/98	LOGGED BY H. Lohse	DRAWING NO. 7
CLIENT DS-Lea Associates Ltd.	DRILLER Malone	DRILL TYPE CME75	CORE BARREL NQ	SHEET 1 of 1

ELEV. (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	JOINT CHARACTERISTICS							WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No.	RECOVERY %	ROD	WATER RECOVERY %	WATER COLOUR		
				No. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERATURE (mm)										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19		
220.0		1	Not sampled																	
	1																			
	2																			
	3																			
	4																			
	5																			
	6																			
	7																			
	8																			
	9																			
	10																			
	11																			
208.3		12	LIMESTONE: fine grained, occasional stylolites, grey, unweathered, medium strength Broken and rounded core at 12 m probably accounts for core loss in Run 1. Much of core in Run 2 was broken up.	1	B	F	C	RP	T	O				1	91	58	var.	lt bwn		
	12							VC												
	13																			
	14													2	77	25	var.	lt bwn		
205.2		15	End of Borehole																	
	16																			
	17																			
	18																			
	19																			



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CORE LOG

BH NO. 2B

PROJECT Atherley Narrows Bridge	ORIENTATION Vertical	ELEVATION (m) 219.9	DATUM Geodetic	PROJECT NO. SP2106
LOCATION Highway 12, Orillia, Ontario	DATE STARTED 01/19/98	COMPLETED 01/19/98	LOGGED BY H. Lohse	DRAWING NO. 8
CLIENT DS-Lea Associates Ltd.	DRILLER Malone	DRILL TYPE CME75	CORE BARREL NQ	SHEET 1 of 1

1 ELEV. (m)	2 DEPTH (m)	3 SYMBOL	4 GENERAL DESCRIPTION	JOINT CHARACTERISTICS							12 WEATHERING	13 STRENGTH	14 FRACTURE FREQUENCY	15 RUN No.	16 RECOVERY %	17 RQD	18 WATER RECOVERY %	19 WATER COLOUR	
				5 No. OF SETS	6 JOINT TYPE	7 ORIENTATION	8 SPACING	9 ROUGHNESS	10 FILLING	11 APERATURE (mm)									
219.9	1		Not sampled																
	2																		
	3																		
	4																		
	5																		
	6																		
	7																		
	8																		
211.1	9		LIMESTONE: fine grained, occasional stylolites, grey, unweathered, medium strength. Broken and rounded core at 12 m probably accounts for core loss in Run 1.	1	B	F	C	RP	T	0				1A	100	0	100	51	
	10				2	B C	F V	VC							2A	83	01	00	grey
	11									SO					3A	90	10	grey	
208.3	12		End of Borehole																
	13																		
	14																		
	15																		
	16																		
	17																		
	18																		
	19																		

CORE LOG

BH NO. 3

PROJECT Atherley Narrows Bridge	ORIENTATION Vertical	ELEVATION (m) 219.9	DATUM Geodetic	PROJECT NO. SP2106
LOCATION Highway 12, Orillia, Ontario	DATE STARTED 01/13/98	COMPLETED 01/14/98	LOGGED BY H.Lohse	DRAWING NO. 9
CLIENT DS-Lea Associates Ltd.	DRILLER Malone's	DRILL TYPE CME75	CORE BARREL NQ	SHEET 1 of 1

1 ELEV. (m)	2 DEPTH (m)	3 SYMBOL	4 GENERAL DESCRIPTION	JOINT CHARACTERISTICS							12 WEATHERING	13 STRENGTH	14 FRACTURE FREQUENCY	15 RUN No.	16 RECOVERY %	17 RQD	18 WATER RECOVERY %	19 WATER COLOUR	
				5 No. OF SETS	6 JOINT TYPE	7 ORIENTATION	8 SPACING	9 ROUGHNESS	10 FILLING	11 APERATURE (mm)									
219.9			Augered to approximate level of till or bedrock without sampling.																
	1																		
	2																		
	3																		
	4																		
	5																		
	6																		
	7																		
	8																		
	9																		
209.9	10		TILL: coring recovered rounded gravel and a trace of clayey sandy silt. Wash water was brown and contained a high concentration of sand and silt.											A	5	0	100	bwn.	
208.7	11		LIMESTONE: fine grained, grey, unweathered, medium strength Core partly broken and rounded by drill in Runs 1 and 2 Probable thin clay seam at 12.7 m	1	B	F	C	RP	T	O				B	50	0	100	gr.p.	
	12														1	58	0	var	gr.p.
	13										SO				2	69	46	var	gr.p.
	14														3	90	49	var	grey
205.6	14		Core in run 4 broken and redrilled.											4	30	0	var	grey	
	15		End of Borehole																
	16																		
	17																		
	18																		
	19																		



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Consulting Geo-Environmental Engineers

Project No. SP2106

Log of Borehole 4

Dwg No. 10

Project: Atherley Narrows Bridge

Sheet No. 1 of 1

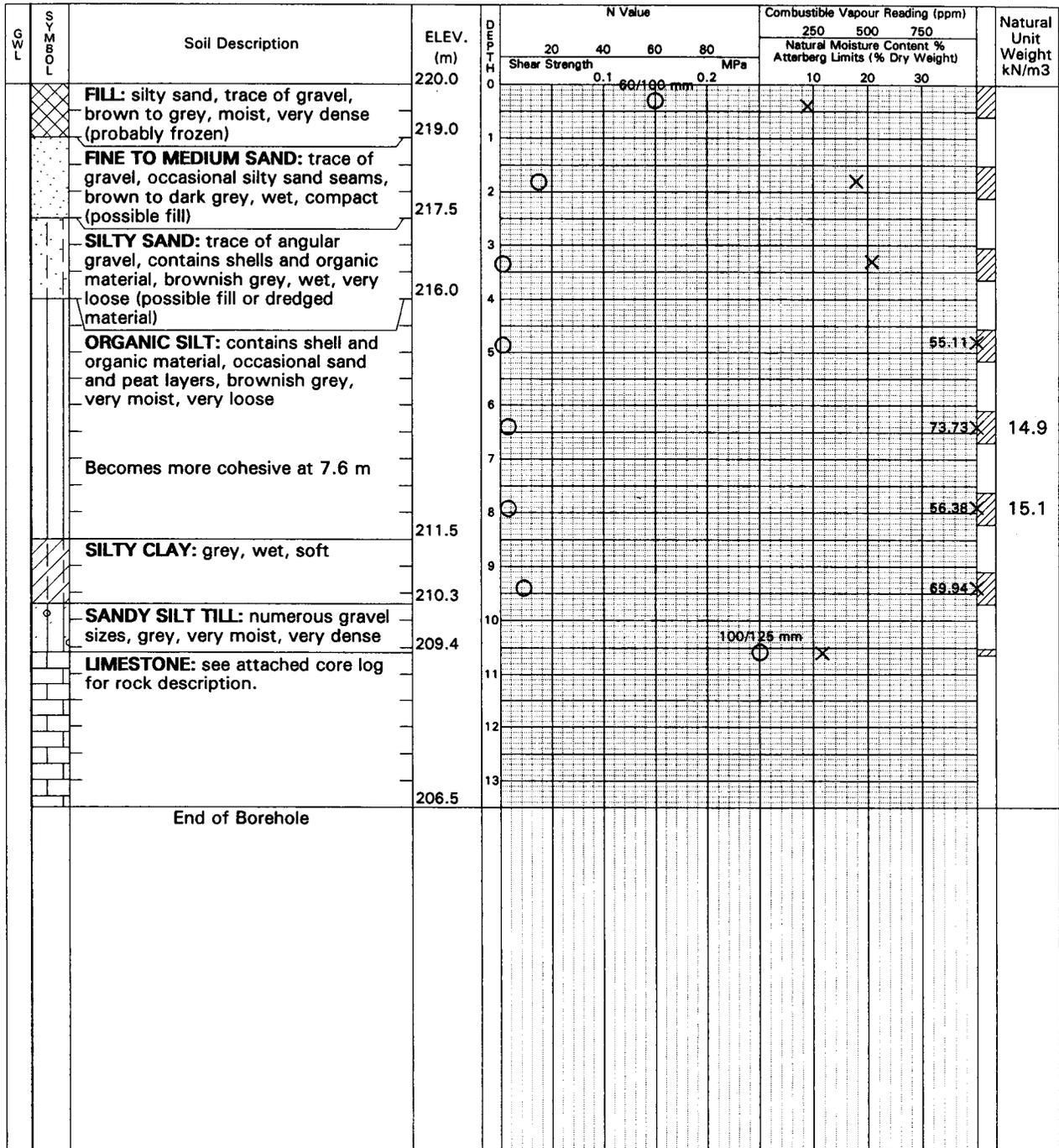
Location: Highway 12, Orillia, Ontario

Date Drilled: January 16, 1998

Drill Type: Hollow Stem

Datum: Geodetic

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Sensitivity
- Piezometric Water Level
- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer



WATER LEVEL RECORD:

Time	Water Level (m)	Depth to Cave (m)



Shaheen and Peaker Limited
Consulting Geo-Environmental Engineers

CORE LOG

BH NO. 4

PROJECT Atherley Narrows Bridge	ORIENTATION Vertical	ELEVATION (m) 220.0	DATUM Geodetic	PROJECT NO. SP2106
LOCATION Highway 12, Orillia, Ontario	DATE STARTED 01/15/98	COMPLETED 01/15/98	LOGGED BY H.Lohse	DRAWING NO. 11
CLIENT DS-Lea Associates Ltd.	DRILLER Malone's	DRILL TYPE CME75	CORE BARREL NQ	SHEET 1 of 1

ELEV. (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	JOINT CHARACTERISTICS								WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No.	RECOVERY %	RQD	WATER RECOVERY %	WATER COLOUR	
				No. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERATURE (mm)										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19		
220.0			See Borehole log for soil description																	
	1																			
	2																			
	3																			
	4																			
	5																			
	6																			
	7																			
	8																			
	9																			
209.4	10																			
	11		LIMESTONE: fine grained, grey, unweathered, medium strength. Core above 11 m was broken and rounded by drilling. Thin clay seams at 11.6 and 11.8 m. Core barrel dropped about 75 mm at 11.9 m.	1	B	F	C	RP	T	O				1	63	28	100	grey		
	12				C	V				SO	SO				2	90	65	100	grey	
206.6	13																			
	14		End of Borehole																	
	15																			
	16																			
	17																			
	18																			
	19																			



Shaheen & Peaker Limited
 Consulting Geo-Environmental Engineers

Project: Atherley Narrows Bridge

Sheet No. 1 of 1

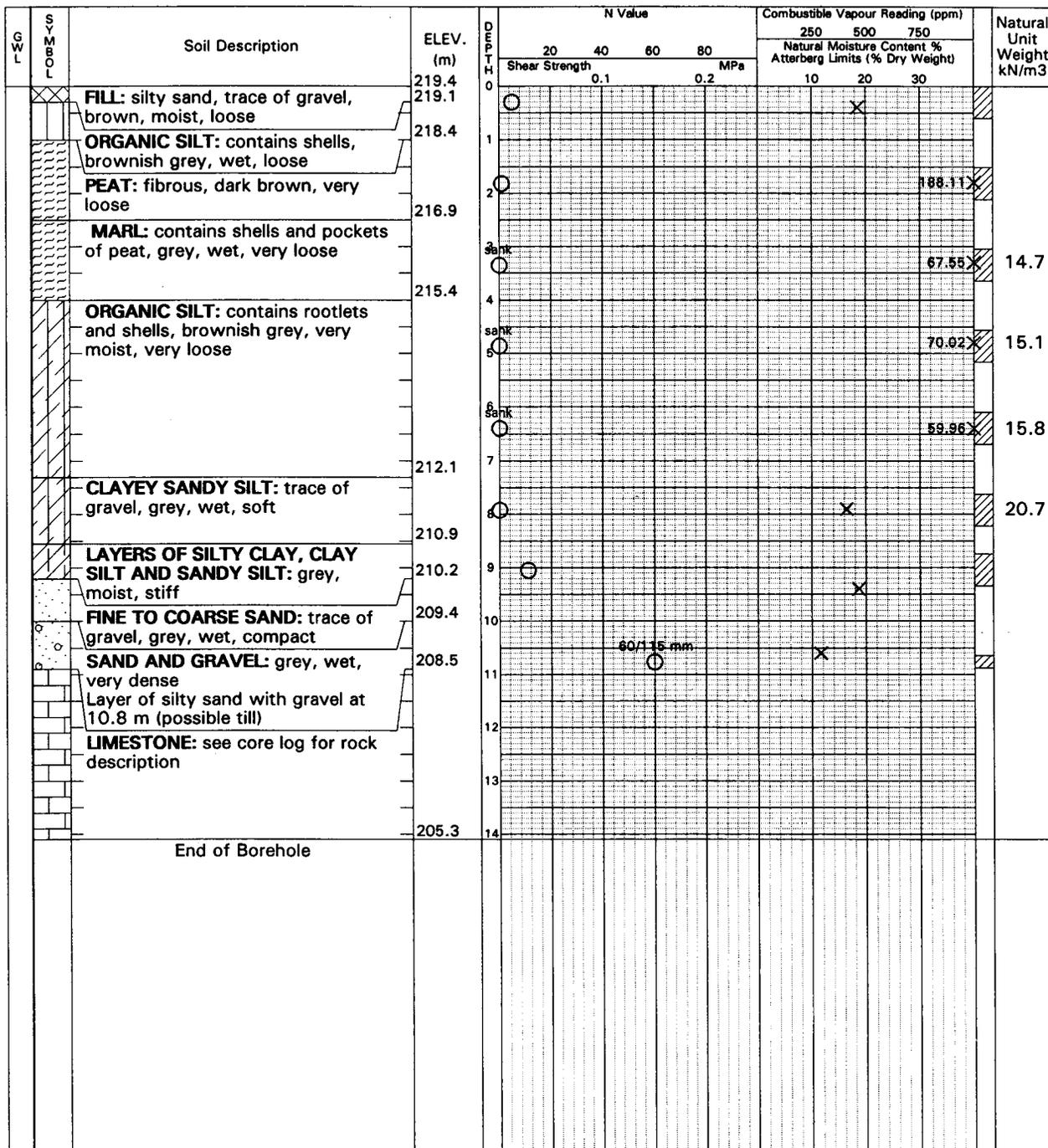
Location: Highway 12, Orillia, Ontario

Date Drilled: January 20, 1998

Drill Type: Hollow Stem Augers

Datum: Geodetic

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Sensitivity
- Piezometric Water Level
- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer



WATER LEVEL RECORD:

Time	Water Level (m)	Depth to Cave (m)



Shaheen and Peaker Limited
Consulting Geo-Environmental Engineers

CORE LOG

BH NO. 5

PROJECT Atherley Narrows Bridge	ORIENTATION Vertical	ELEVATION (m) 219.4	DATUM Geodetic	PROJECT NO. SP2106
LOCATION Highway 12, Orillia, Ontario	DATE STARTED 01/20/98	COMPLETED 01/20/98	LOGGED BY H.Lohse	DRAWING NO. 13
CLIENT DS-Lea Associates Ltd.	DRILLER Malone's	DRILL TYPE CME75	CORE BARREL NQ	SHEET 1 of 1

ELEV. (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	JOINT CHARACTERISTICS							WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No.	RECOVERY %	RQD	WATER RECOVERY %	WATER COLOUR	
				No. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERATURE (mm)									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
219.4	1		Refer to Borehole Log for soil Description																
	2																		
	3																		
	4																		
	5																		
	6																		
	7																		
	8																		
	9																		
	10			Rounded and polished limestone gravel from 10.8 to 10.9 m (probable till)															
208.5	11		LIMESTONE: fine grained, occasional stylolites, grey, unweathered, medium strength. Thin clay seam at 11.7 m	1	B	F	C	RP	T	O				1	74	32	100	gr.	
	12							VC			SO			2	81	77	100	gr.	
	13								RP	T	O			3	100	0	100	gr.	
	14				2	B	F	C	RP	T	O			4	98	33	100	gr.	
	15				C	V	VC							5	98	68	100	gr.	
205.3	14		End of Borehole																
	15																		
	16																		
	17																		
	18																		
	19																		



Shaheen & Peaker Limited
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Project No. SP2106

Log of Borehole 6-1

Dwg No. 14

Project: Atherley Narrows Bridge

Sheet No. 1 of 1

Location: Highway 12, Orillia, Ontario

Date Drilled: February 9, 1998

Drill Type: Hollow Stem Augers

Datum: Geodetic

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Sensitivity
- Piezometric Water Level
- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer

G W L	S O I L	Soil Description	ELEV. (m)	D E P T H	N Value				Combustible Vapour Reading (ppm)			Natural Unit Weight kN/m ³
					20	40	60	80	250	500	750	
					Shear Strength 0.1 0.2 MPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)			
		ROCK FILL: not sampled	220.1	0								
		SOFT MATERIAL: marl, organic silt, silty clay (not sampled)	217.8	1								
				2								
				3								
				4								
				5								
				6								
				7								
				8								
		Some wet sandy silt till on auger tip at 9.25 m	210.8	9								
		TILL-BEDROCK COMPLEX: Sandy silt till and shattered limestone at 9.3 m		10								
		Shattered limestone at 9.9 m										
		Sandy silt till and shattered limestone at 10.7 m	208.8	11								
		Auger refusal at 11.4 m										
		End of Augered Borehole See core log for continuation										

WATER LEVEL RECORD:

Time	Water Level (m)	Depth to Cave (m)

CORE LOG

BH NO. 6-1

PROJECT Atherley Narrows Bridge	ORIENTATION Vertical	ELEVATION (m) 220.1	DATUM Geodetic	PROJECT NO. SP2106
LOCATION Highway 12, Orillia, Ontario	DATE STARTED 02/09/98	COMPLETED 02/09/98	LOGGED BY H. Lohse	DRAWING NO. 15
CLIENT DS-Lea Associates Ltd.	DRILLER Malone	DRILL TYPE CME 75	CORE BARREL NQ	SHEET 1 of 1

1 ELEV. (m)	2 DEPTH (m)	3 SYMBOL	4 GENERAL DESCRIPTION	JOINT CHARACTERISTICS							12 WEATHERING	13 STRENGTH	14 FRACTURE FREQUENCY	15 RUN No.	16 RECOVERY %	17 ROD	18 WATER RECOVERY %	19 WATER COLOUR
				5 No. OF SETS	6 JOINT TYPE	7 ORIENTATION	8 SPACING	9 ROUGHNESS	10 FILLING	11 APERATURE (mm)								
220.1	1		See Borehole log for soil description															
	2																	
	3																	
	4																	
	5																	
	6																	
	7																	
	8																	
	9																	
	10			Piece of lithographic limestone in top 1 cm of core, probable transported material														
208.8	11		LIMESTONE: fine grained, unweathered, medium strength ~25 mm void at 12.4 m	2	C	V	C	RP	T	0			1	100	39			
207.5	12				1	B	F	VC										
	13																	
	14																	
	15																	
	16																	
	17																	
	18																	
	19																	

Project No. SP2106

Log of Borehole 6-1-A

Dwg No. 16

Project: Atherley Narrows Bridge

Sheet No. 1 of 1

Location: Highway 12, Orillia, Ontario

Date Drilled: February 10, 1998

Drill Type: Hollow Stem Augers

Datum: Geodetic

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Sensitivity
- Piezometric Water Level
- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer

G W L	S Y M B O L	Soil Description	ELEV. (m)	D E P T H	N Value				Combustible Vapour Reading (ppm)			Natural Unit Weight kN/m ³			
									250	500	750				
									Natural Moisture Content % Atterberg Limits (% Dry Weight)						
		ROCK FILL: not sampled	220.1	0	20	40	60	80	0.1	0.2	MPa	10	20	30	
		SOFT MATERIAL: marl, organic silt, silty clay (not sampled)	217.7	1											
				2											
				3											
				4											
				5											
				6											
				7											
				8											
				9											
		Recovered medium to coarse sand and fine to medium sand This material contained pieces of root or wood and is most likely cave material	211.0 210.6												
		End of Augered Borehole See core log for continuation													

WATER LEVEL RECORD:

Time	Water Level (m)	Depth to Cave (m)



Shaheen and Peaker Limited
Consulting Geo-Environmental Engineers

CORE LOG

BH NO.6-1-A

PROJECT Atherley Narrows Bridge	ORIENTATION Vertical	ELEVATION (m) 220.1	DATUM Geodetic	PROJECT NO. SP2106
LOCATION Highway 12, Orillia, Ontario	DATE STARTED 02/10/98	COMPLETED 02/10/98	LOGGED BY H. Lohse	DRAWING NO. 17
CLIENT DS-Lea Associates Ltd.	DRILLER Malone	DRILL TYPE CME 75	CORE BARREL NQ	SHEET 1 of 1

1	2	3	4	JOINT CHARACTERISTICS							12	13	14	15	16	17	18	19	
				5	6	7	8	9	10	11									
ELEV. (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	No. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERATURE (mm)	WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No.	RECOVERY %	RQD	WATER RECOVERY %	WATER COLOUR	
220.1	1		See Borehole log for soil description																
	2																		
	3																		
	4																		
	5																		
	6																		
	7																		
	8																		
	9																		
210.5	10		LIMESTONE: fine grained, generally unweathered, medium strength Limestone fragments in Run 1 were angular to rounded by drill, there were no obvious till polished fragments Clay and silt sized material in joints at about 11 m and 11.5 m																
	11				2	B C	F V	C VC	SU RP	SC T SC	0				1	19	0		
	12														2	100	47		
	13														3	90	71		
206.8	14		End of Borehole Note: Water recovery low to nil from 12.7 to 13.2 m											4	98	95			
	15																		
	16																		
	17																		
	18																		
	19																		

Project No. SP2106

Log of Borehole 6-2-A

Dwg No. 19

Project: Atherley Narrows Bridge

Sheet No. 1 of 1

Location: Highway 12, Orillia, Ontario

Date Drilled: February 11, 1998

Drill Type: Hollow Stem Augers

Datum: Geodetic

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Sensitivity
- Piezometric Water Level
- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer

DEPTH (m)	Soil Description	ELEV. (m)	N Value				Combustible Vapour Reading (ppm)			Natural Unit Weight kN/m ³
			20	40	60	80	250	500	750	
			Shear Strength 0.1 0.2 MPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)			
0	ROCK FILL: not sampled	219.9								
1										
2										
3	SOFT MATERIAL:	217.5								
4										
5										
6										
7										
8										
	SANDY SILT TILL: contains shattered rock, traces of wood or root	211.1								
	End of Augered Borehole	211.0								

WATER LEVEL RECORD:

Time	Water Level (m)	Depth to Cave (m)



Shaheen and Peaker Limited
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CORE LOG

BH NO.6-2-A

PROJECT Atherley Narrows Bridge	ORIENTATION Vertical	ELEVATION (m) 219.9	DATUM Geodetic	PROJECT NO. SP2106
LOCATION Highway 12, Orillia, Ontario	DATE STARTED 02/11/98	COMPLETED 02/12/98	LOGGED BY H. Lohse	DRAWING NO. 20
CLIENT DS-Lea Associates Ltd.	DRILLER Malone	DRILL TYPE CME 75	CORE BARREL NQ	SHEET 1 of 1

ELEV. (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	JOINT CHARACTERISTICS							WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No.	RECOVERY %	ROD	WATER RECOVERY %	WATER COLOUR	
				No. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERATURE (mm)									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
219.9	1		See Borehole log for soil description																
	2																		
	3																		
	4																		
	5																		
	6																		
	7																		
	8																		
211.0	9		Broken rock, piece of filter cloth, probable till Core loss in Run 1 assumed to be in this area											1	55	0			
210.5	10		LIMESTONE: fine grained, generally unweathered, medium strength Core at 10.4 m was re-drilled											2	71	0			
	11		Mud coating on joints at about 11 m Some of the core at 11.1 and 11.5 m was re-drilled											3/4	79	0			
	12													5	100	66			
207.6	13		End of Borehole Note: There was very poor recovery from Runs 3 and 4. The inner core barrel casing was removed and the combined recovery from Runs 3 and 4 was 79%.																
	14																		
	15																		
	16																		
	17																		
	18																		
	19																		

Project: Atherley Narrows Bridge

Sheet No. 1 of 1

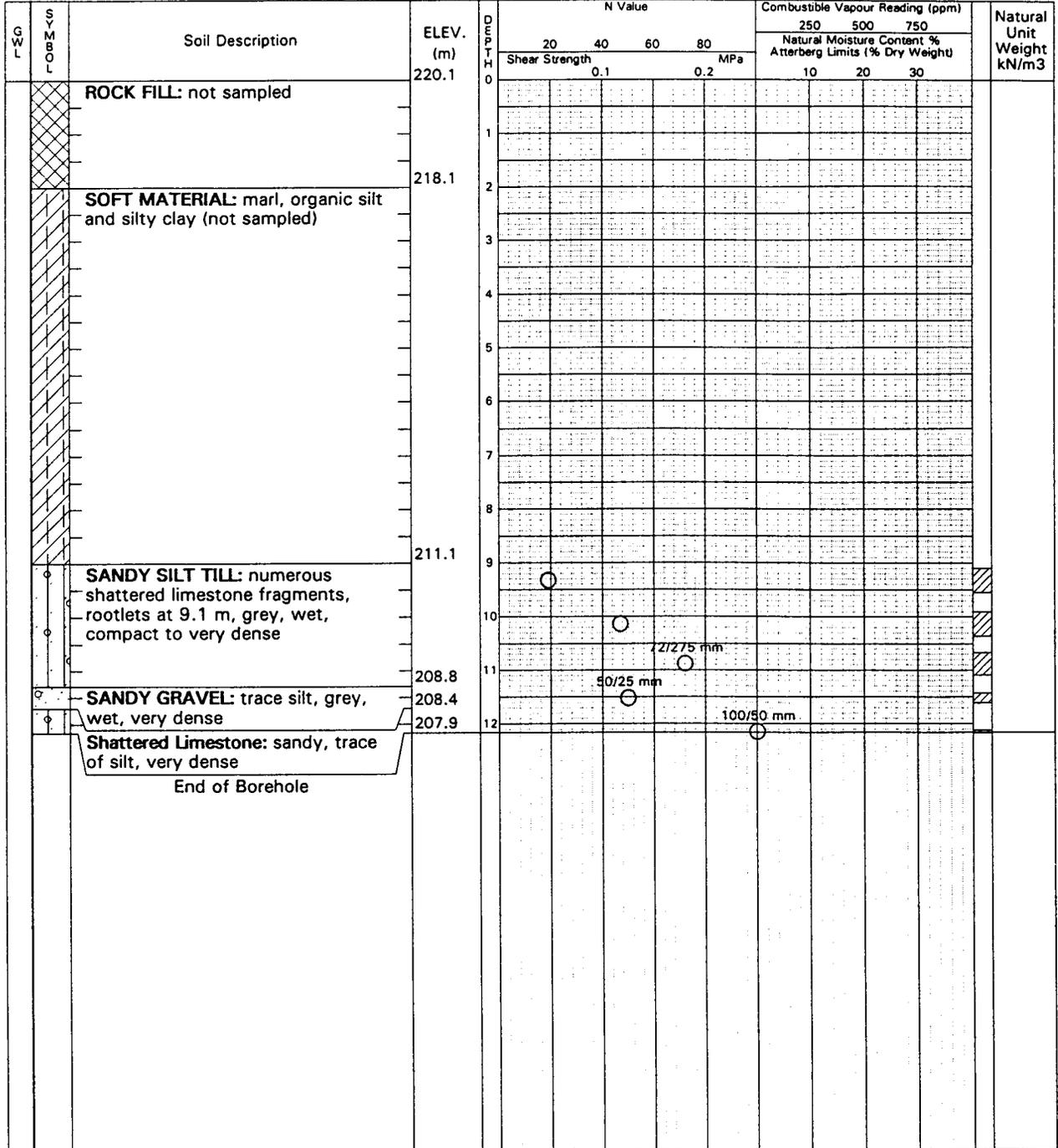
Location: Highway 12, Orillia, Ontario

Date Drilled: February 12, 1998

Drill Type: Hollow Stem Augers

Datum: Geodetic

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Sensitivity
- Piezometric Water Level
- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer



WATER LEVEL RECORD:

Time	Water Level (m)	Depth to Cave (m)

CORE LOG

BH NO. 7A

PROJECT Atherley Narrows Bridge	ORIENTATION Vertical	ELEVATION (m) 220.0	DATUM Geodetic	PROJECT NO. SP2106
LOCATION Highway 12, Orillia, Ontario	DATE STARTED 02/12/98	COMPLETED 02/13/98	LOGGED BY H. Lohse	DRAWING NO. 22
CLIENT DS-Lea Associates Ltd.	DRILLER Malone	DRILL TYPE CME 75	CORE BARREL NQ	SHEET 1 of 1

1 ELEV. (m)	2 DEPTH (m)	3 SYMBOL	4 GENERAL DESCRIPTION	JOINT CHARACTERISTICS							12 WEATHERING	13 STRENGTH	14 FRACTURE FREQUENCY	15 RUN No.	16 RECOVERY %	17 ROD	18 WATER RECOVERY %	19 WATER COLOUR	
				5 No. OF SETS	6 JOINT TYPE	7 ORIENTATION	8 SPACING	9 ROUGHNESS	10 FILLING	11 APERATURE (mm)									
220.0	1		See Borehole log for soil description																
	2																		
	3																		
	4																		
	5																		
	6																		
	7																		
	8																		
	9																		
	10																		
208.7	11																		
	12		LIMESTONE: fine grained, generally unweathered, medium strength Clay on joint surface at about 11.8 m											1	87	40			
207.1	13		End of Borehole											2	92	59			
	14																		
	15																		
	16																		
	17																		
	18																		
	19																		



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Project: Atherley Narrows Bridge

Sheet No. 1 of 1

Location: Highway 12, Orillia, Ontario

Date Drilled: February 16, 1998

Drill Type: Hollow Stem Augers

Datum: Geodetic

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Sensitivity
- Piezometric Water Level
- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer

G W L	SYMBOL	Soil Description	ELEV. (m)	D E P T H (m)	N Value				Combustible Vapour Reading (ppm)			Natural Unit Weight kN/m ³
					20	40	60	80	250	500	750	
					Shear Strength MPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)			
		ROCK FILL: not sampled	219.5	0								
		SOFTER MATERIAL: marl, organic silt and silty clay (not sampled)	218.3	1								
				2								
				3								
				4								
				5								
				6								
				7								
				8								
		SANDY SILT: some gravel, partly rounded	210.5	9								
		Fine to coarse sand layer at 9.9 m (possible cave)	209.0	10								
		BEDROCK-TILL COMPLEX: shattered limestone over silty sand to sandy silt, trace of gravel angular limestone, seam of sandy silt, trace of rounded fine gravel angular limestone and sandy silt till, trace clay	206.5	11								
		angular limestone and sandy silt till(?)		12								
		End of borehole										

WATER LEVEL RECORD:

Time	Water Level (m)	Depth to Cave (m)



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CORE LOG

BH NO. 8A

PROJECT Atherley Narrows Bridge	ORIENTATION Vertical	ELEVATION (m) 219.5	DATUM Geodetic	PROJECT NO. SP2106
LOCATION Highway 12, Orillia, Ontario	DATE STARTED 02/16/98	COMPLETED 02/16/98	LOGGED BY H. Lohse	DRAWING NO. 24
CLIENT DS-Lea Associates Ltd.	DRILLER Malone	DRILL TYPE CME 75	CORE BARREL NQ	SHEET 1 of 1

ELEV. (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	JOINT CHARACTERISTICS							WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No.	RECOVERY %	ROD	WATER RECOVERY %	WATER COLOUR	
				No. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERATURE (mm)									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
219.5	1		See Borehole log for soil description																
	2																		
	3																		
	4																		
	5																		
	6																		
	7																		
	8																		
	9																		
208.6	11			LIMESTONE: fine grained, generally unweathered, medium strength Re-drilled rock fragments at top of Run 1 Core barrel dropped ~25 mm at 12.8 m, possible void		C B	V F	C VC	RP	T	O				1	85	37		
	12														2	90	41		
	13														3	85	37		
206.3	13		End of Borehole Note: No water return below 12.9 m																
	14																		
	15																		
	16																		
	17																		
	18																		
	19																		



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Project No. SP2106

Log of Borehole 9

Dwg No. 25

Project: Atherley Narrows Bridge

Sheet No. 1 of 1

Location: Highway 12, Orillia, Ontario

Date Drilled: February 17, 1998

Drill Type: Hollow Stem Augers

Datum: Geodetic

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Sensitivity
- Piezometric Water Level
- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer

G W L	S Y M B O L	Soil Description	ELEV. (m)	D E P T H	N Value				Combustible Vapour Reading (ppm)			Natural Unit Weight kN/m ³
					20	40	60	80	250	500	750	
					Shear Strength MPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)			
		ROCK FILL: not sampled	219.4	0								
		SOFTER MATERIAL: marl, organic silt, silty clay (not sampled)	218.4	1								
				2								
				3								
				4								
				5								
				6								
				7								
				8								
				9								
			209.4	10								
		SANDY SILT: trace of clay and gravel, grey, wet (possible till)	208.8	11								
		SANDY SILT TILL: grey, wet, dense bottom of sample consisted of shattered limestone Coring started at this depth	208.3									

WATER LEVEL RECORD:

Time	Water Level (m)	Depth to Cave (m)



Shaheen and Peaker Limited
Consulting Geo-Environmental Engineers

CORE LOG

BH NO. 9

PROJECT Atherley Narrows Bridge	ORIENTATION Vertical	ELEVATION (m) 219.4	DATUM Geodetic	PROJECT NO. SP2106
LOCATION Highway 12, Orillia, Ontario	DATE STARTED 02/17/98	COMPLETED 02/17/98	LOGGED BY H. Lohse	DRAWING NO. 26
CLIENT DS-Lea Associates Ltd.	DRILLER Malone	DRILL TYPE CME 75	CORE BARREL NQ	SHEET 1 of 1

ELEV. (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	JOINT CHARACTERISTICS								WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No.	RECOVERY %	RQD	WATER RECOVERY %	WATER COLOUR
				No. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERATURE (mm)									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
219.4	0																		
	1		See Borehole logs for soil description																
	2																		
	3																		
	4																		
	5																		
	6																		
	7																		
	8																		
	9																		
	10																		
208.4	11		Possible Till																
207.9	12		LIMESTONE: fine grained, generally unweathered, medium strength											1	31	0			
	13		Core barrel dropped about 25 mm at 12.1 m, possible void											2	86	56			
	14													3	99	81			
205.3	14		End of Borehole																
	15																		
	16																		
	17																		
	18																		
	19																		

Project No. SP2106

Log of Borehole 9A

Dwg No. 27

Project: Atherley Narrows Bridge

Sheet No. 1 of 1

Location: Highway 12, Orillia, Ontario

Date Drilled: February 17, 1998

Drill Type: Hollow Stem Augers

Datum: Geodetic

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Sensitivity
- Piezometric Water Level
- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer

GWL	SYMBOL	Soil Description	ELEV. (m)	DEPTH	N Value				Combustible Vapour Reading (ppm)			Natural Unit Weight kN/m ³
					20	40	60	80	250	500	750	
					Shear Strength 0.1 0.2 MPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)			
		Augered to 10.7 m without sampling	219.4	0								
				1								
				2								
				3								
				4								
				5								
				6								
				7								
				8								
				9								
				10								
			208.8	11								
		SANDY SILT TILL: contains shattered limestone, grey, very moist to wet, very dense Sample refusal at 11.7 m Auger refusal at about 12 m	207.5									
		End of Borehole Note: split-barrel sampler had to be pushed through cave material above 11.43 m to reach sampling depth										

WATER LEVEL RECORD:

Time	Water Level (m)	Depth to Cave (m)



Shaheen and Peaker Limited
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Project No. SP2106

Log of Borehole 10

Dwg No. 28

Project: Atherley Narrows Bridge

Sheet No. 1 of 1

Location: Highway 12, Orillia, Ontario

Date Drilled: February 18, 1998

Drill Type: Solid Stem Augers

Datum: Geodetic

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Sensitivity
- Piezometric Water Level
- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer

GWL	SYMBOL	Soil Description	ELEV. (m)	DEPTH	N Value				Combustible Vapour Reading (ppm)			Natural Unit Weight kN/m ³
					20	40	60	80	250	500	750	
					Shear Strength MPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)			
		FILL: fine to coarse sand, some gravel, brown, moist	220.3	0	0.1	0.2						
		PEAT: contains roots and wood fibers, dark brown, moist	218.8	1								
		MARL: brownish grey sandy silt, contains shells and rootlets, very moist to wet	217.9	2								
		SILTY CLAY: some gravel, grey, very moist to wet	216.8	3								
		SILTY CLAY: some gravel, grey, very moist to wet	215.8	4								
		End of Borehole Note: Borehole was not sampled.										

WATER LEVEL RECORD:

Time	Water Level (m)	Depth to Cave (m)



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Consulting Geo-Environmental Engineers

Project No. SP2106

Log of Borehole 11

Dwg No. 29

Project: Atherley Narrows Bridge

Sheet No. 1 of 1

Location: Highway 12, Orillia, Ontario

Date Drilled: February 18, 1998

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Sensitivity
- Piezometric Water Level
- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer

Drill Type: Solid Stem Augers

Datum: Geodetic

G W L	S Y M B O L	Soil Description	ELEV. (m)	D I P T I N G	N Value				Combustible Vapour Reading (ppm)			Natural Unit Weight kN/m ³
					20	40	60	80	250	500	750	
					Shear Strength MPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)			
		FILL: mixture of peat and fine to coarse sand with some gravel, brown to grey, wet	220.4	0	0.1	0.2						
		PEAT: contains roots and wood fibers, dark brown, moist	218.9	1								
		SILTY CLAY: some gravel, grey, very moist	217.9	2								
		Slightly harder augering at about 4.5 m	215.9	3								
		End of Borehole Note: borehole was not sampled.		4								

WATER LEVEL RECORD:

Time	Water Level (m)	Depth to Cave (m)



Shaheen and Peaker Limited
Consulting Geo-Environmental Engineers

CORE LOG

BH NO. 12

PROJECT Atherley Narrows Bridge	ORIENTATION Vertical	ELEVATION (m) 220.3	DATUM Geodetic	PROJECT NO. SP2106
LOCATION Highway 12, Orillia, Ontario	DATE STARTED 02/19/98	COMPLETED 02/19/98	LOGGED BY H. Lohse	DRAWING NO. 31
CLIENT DS-Lea Associates Ltd.	DRILLER Malone	DRILL TYPE CME 75	CORE BARREL NQ	SHEET 1 of 1

ELEV. (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	JOINT CHARACTERISTICS							WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No.	RECOVERY %	RQD	WATER RECOVERY %	WATER COLOUR
				No. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERATURE (mm)								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
220.3			See Borehole log for soil description															
	1																	
	2																	
	3																	
	4																	
	5																	
	6																	
	7																	
	8																	
	9																	
210.5	10		LIMESTONE: fine grained, generally unweathered, medium strength Core in all runs showed signs of re-drilling and was in part broken up.	1	C B	D F	C M	RP	T	O				1	55	16		
	11													2	82	56		
	12		Vertical joint in Run 3 was coated with mud (till-like material) Core barrel dropped slightly a few times in Run 3		C	V				SC				3	31	0		
206.8	13													4	14	0		
	14		End of Borehole															
	15																	
	16																	
	17																	
	18																	
	19																	

CORE LOG

BH NO. 12A

PROJECT Atherley Narrows Bridge	ORIENTATION Vertical	ELEVATION (m) 220.3	DATUM Geodetic	PROJECT NO. SP2106
LOCATION Highway 12, Orillia, Ontario	DATE STARTED 02/25/98	COMPLETED 02/26/98	LOGGED BY H. Lohse	DRAWING NO. 32
CLIENT DS-Lea Associates Ltd.	DRILLER Malone	DRILL TYPE CME75	CORE BARREL NQ	SHEET 1 of 1

ELEV. (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	JOINT CHARACTERISTICS							WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No.	RECOVERY %	ROD	WATER RECOVERY %	WATER COLOUR	
				No. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERATURE (mm)									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
220.3	1		Augered without sampling																
	2		At 2.1 m pulled up cable with augers and drilled through about 450 mm timber																
	3																		
	4																		
	5																		
	6																		
	7																		
	8		Auger refusal at 9.9 m																
	9																		
210.3	10		LIMESTONE: fine grained, medium grey, generally unweathered											1	83	36	100	grey	
	11		Core barrel dropped 50 mm at 10.8 m, possible void											2	80	21	100	grey	
	12		Drilling was faster at about 12 m depth. Mud coated fractures at about 12 to 12.4 m.						NC					3	63	13	100	grey	
	13			1	B	F	C	RP	T	O				4	57	17	100	grey	
	14		Fractures filled with fine to medium sand at about 14.3 to 14.8 m				VC				S	10			5	50	13	100	grey
205.2	15		VOID: filled with fine to medium sand											6	25	21	100	grey	
	16		Split-barrel sample at 15.2 m, N = 8 (top 1.1 m of Run 6 penetrated easily)											7	94	48	100	grey	
203.1	17		LIMESTONE: fine to medium grained, medium grey, generally unweathered											7A	100	0	100	grey	
	18		Small 50 mm thick void at about 18 m Sandy along fractures	1	B	F	C	RP	T	O									
201.4	19		LITHOGRAPHIC LIMESTONE: very fine grained, light grey, unweathered	1	B	F	M	RP	T	O				9	94	82	100	grey	
200.2	20		End of Borehole																



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CORE LOG

BH NO. 13

PROJECT Atherley Narrows Bridge	ORIENTATION Vertical	ELEVATION (m) 220.2	DATUM Geodetic	PROJECT NO. SP2106
LOCATION Highway 12, Orillia, Ontario	DATE STARTED 02/27/98	COMPLETED 03/02/98	LOGGED BY H. Lohse	DRAWING NO. 33
CLIENT DS-Lea Associates Ltd.	DRILLER Malone	DRILL TYPE CME75	CORE BARREL NQ	SHEET 1 of 1

ELEV. (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	JOINT CHARACTERISTICS							WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No.	RECOVERY %	ROD	WATER RECOVERY %	WATER COLOUR
				No. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERATURE (mm)								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
220.2			Augered to 10.36 m without sampling															
	1																	
	2																	
	3																	
	4																	
	5																	
	6																	
	7		Casing advanced to 10.6 m															
	8																	
	9																	
	10																	
209.7	11		LIMESTONE: fine grained, generally unweathered, medium grey, moderate strength							NC				1	81	41	100	grey
	12		Mud noted on fractures from 11 to 12 m	2	B	F	C	RP	T	O				2	90	57	100	grey
	13		Oxidized fractures and a trace of mud in Run 3 (probable void)		C	D	VC							3	40	20	100	grey
	14			1	B	F	C	RP	T	O				4	82	20	100	grey
	15		Oxidized fracture in Run 5				VC							5	69	39	100	grey
	16				C	V								6	78	25	100	grey
	17		Sand noted along fractures from 15.8 to 16.1 m						S					7	72	0	100	pr. grey
	18		Trace of mud at 17.3 m Limestone fragments and clay seam at 17.5 m		C	V								8	90	31	100	grey
201.9	18								NC					9	53	17	100	grey
	19		End of Borehole															



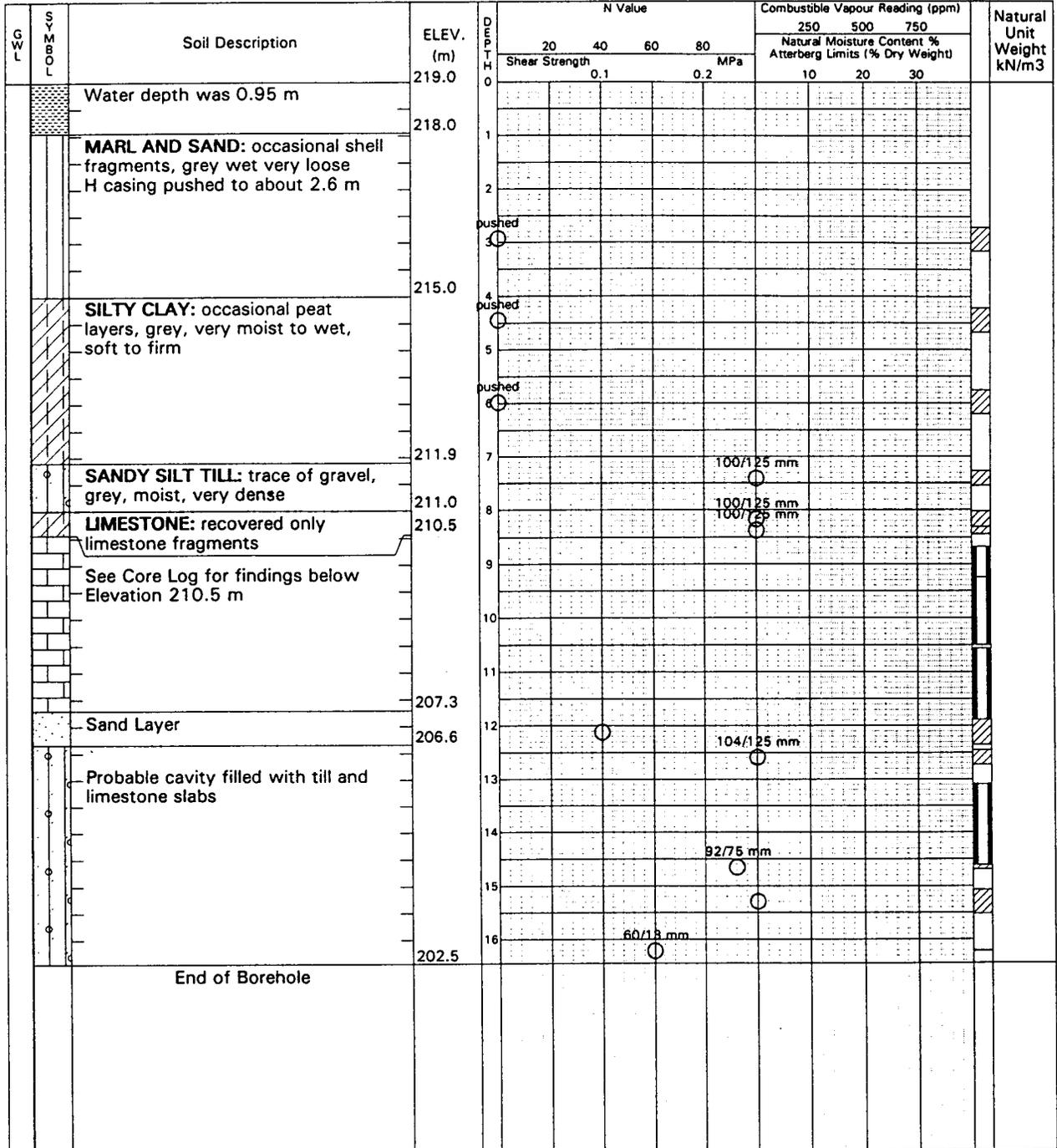
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Date Drilled: March 23, 1998

Drill Type: Wash Boring

Datum: Geodetic

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Sensitivity
- Piezometric Water Level
- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer



WATER LEVEL RECORD:

Time	Water Level (m)	Depth to Cave (m)



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CORE LOG

BH NO. 14

PROJECT Atherley Narrows Bridge	ORIENTATION Vertical	ELEVATION (m) 219.0	DATUM Geodetic	PROJECT NO. SP2106
LOCATION Highway 12, Orillia, Ontario	DATE STARTED 03/23/98	COMPLETED 03/27/98	LOGGED BY H. Lohse	DRAWING NO. 35
CLIENT DS-Lea Associates Ltd.	DRILLER Malone	DRILL TYPE	CORE BARREL NXL	SHEET 1 of 2

1 ELEV. (m)	2 DEPTH (m)	3 SYMBOL	4 GENERAL DESCRIPTION	JOINT CHARACTERISTICS							12 WEATHERING	13 STRENGTH	14 FRACTURE FREQUENCY	15 RUN No.	16 RECOVERY %	17 RQD	18 WATER RECOVERY %	19 WATER COLOUR
				5 No. OF SETS	6 JOINT TYPE	7 ORIENTATION	8 SPACING	9 ROUGHNESS	10 FILLING	11 APERATURE (mm)								
219.0			Water depth was 0.95 m															
218.0	1																	
	2																	
	3																	
	4																	
	5																	
	6		See borehole log for soil description															
	7																	
	8		Casing advanced to 210.3 m															
210.5	9		LIMESTONE: fine grained, medium grey, generally unweathered Core at top of Run 1 was broken up	1	B	F	C	RP	T	O				1	61	0		
								VC	RU					2	95	20		

CORE LOG

BH NO. 14

PROJECT Atherley Narrows Bridge	ORIENTATION Vertical	ELEVATION (m) 219.0	DATUM Geodetic	PROJECT NO. SP2106
LOCATION Highway 12, Orillia, Ontario	DATE STARTED 03/23/98	COMPLETED 03/27/98	LOGGED BY H. Lohse	DRAWING NO. 36
CLIENT DS-Lea Associates Ltd.	DRILLER Malone	DRILL TYPE	CORE BARREL NXL	SHEET 2 of 2

1	2	3	4	JOINT CHARACTERISTICS							12	13	14	15	16	17	18	19
				5	6	7	8	9	10	11								
ELEV. (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	No. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERATURE (mm)	WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No.	RECOVERY %	ROD	WATER RECOVERY %	WATER COLOUR
219.0																		
	-11																	
207.3																		
206.6	-12		SAND: well graded, silty N = 40															
	-13		Casing advanced to 13.0 m Split spoon sample at 13.1 m recovered very dense silty fine to coarse sand, feldspar was noted to be present in the sand Run 4 contained granitic gravel fragments															
	-14		Hole open to 14.1 m after Run 4, sand caved to about 450 mm above cored depth of 14.6 m Casing advanced to 14.6 m Could not get core barrel down hole past 14.2 m, casing probably bent. Split-barrel at 14.6 m retrieved medium to coarse sand (probable cuttings) Tricone encountered a hard layer from 14.8 to 14.9.1 m, otherwise easy drilling and sand in hole															
	-15		Split-barrel at 15.1 m retrieved silt till to sandy silt till															
202.8	-16		Casing advanced to 15.2 m Triconed to 15.8 m, sand entering hole Casing driven to 16.1 m Split-barrel at 16.2 m recovered a few rock cuttings															
202.6	-17		Gull River Formation Lithographic limestone fragments recovered Triconed to 16.4 m, very hard at this level End of Borehole															
	-18																	
	-19																	

Project: Atherley Narrows Bridge

Sheet No. 1 of 1

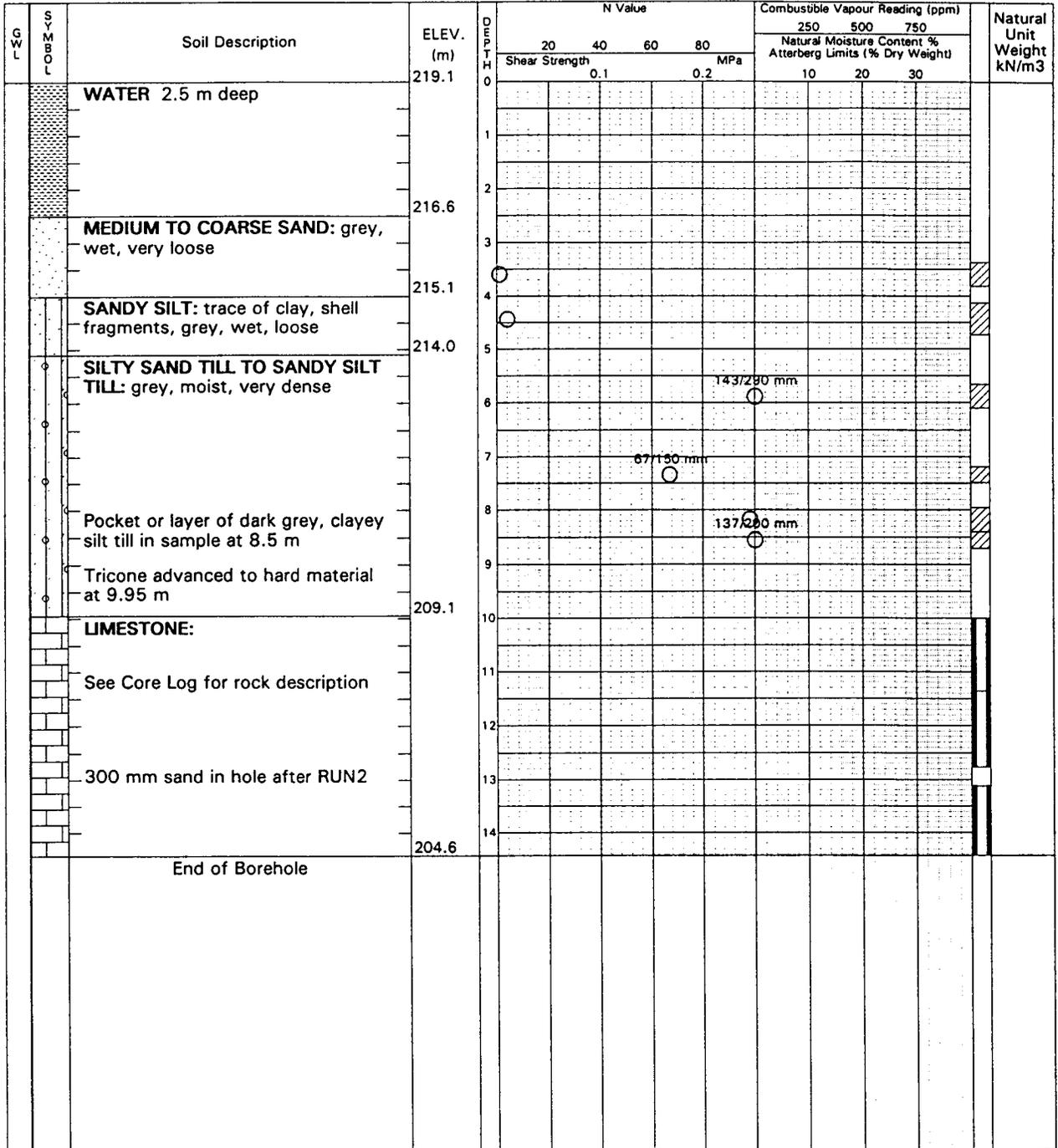
Location: Highway 12, Orillia, Ontario

Date Drilled: April 1, 1998

Drill Type: Wash Boring

Datum: Geodetic

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Sensitivity
- Piezometric Water Level
- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer



WATER LEVEL RECORD:

Time	Water Level (m)	Depth to Cave (m)

CORE LOG

BH NO. 15

PROJECT Atherley Narrows Bridge	ORIENTATION Vertical	ELEVATION (m) 219.1	DATUM Geodetic	PROJECT NO. SP2106
LOCATION Highway 12, Orillia, Ontario	DATE STARTED 04/01/98	COMPLETED 04/01/98	LOGGED BY H. Lohse	DRAWING NO. 38
CLIENT DS-Lea Associates Ltd.	DRILLER Malone	DRILL TYPE	CORE BARREL NXL	SHEET 1 of 1

ELEV. (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	JOINT CHARACTERISTICS							WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No.	RECOVERY %	ROD	WATER RECOVERY %	WATER COLOUR
				No. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERATURE (mm)								
219.1	1																	
	2																	
	3																	
	4																	
	5																	
	6																	
	7																	
	8																	
	9																	
	10																	
209.0	10																	
	11		LIMESTONE: fine grained, generally unweathered, moderate strength Trace of mud on joint surfaces at 10.5 and 11 m in Run 1											1	83	20		
	12		Dipping and vertical joints with oxidized surfaces in Run 2	3	B C	F D V	C VC	RP RU	T Sa	0 to 300				2	75	41		
206.3	13		Sand layer about 300 mm thick	1	B	F	C VC	RP	T	0				3	76	19		
206.0	13																	
204.6	14		Core barrel was stuck in borehole in Run 3 due to sand layers. Lost core in Run 3 assumed to be left in hole.															
	15		End of Borehole Note: Borehole blocked at 10.9 m on completion.															
	16																	
	17																	
	18																	
	19																	

Date Drilled: April 5, 1998

Drill Type: Wash Boring

Datum: Geodetic

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Sensitivity
- Piezometric Water Level
- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer

GWL	SYMBOL	Soil Description	ELEV. (m)	DEPTH	N Value				Combustible Vapour Reading (ppm)			Natural Unit Weight kN/m ³	
					20	40	60	80	250	500	750		
		WATER 2.60 m deep	219.2	0	Shear Strength 0.1 0.2 MPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)				
		MARL AND ORGANIC SILT: assumed, not sampled Casing driven to 5.7 m	216.6	1									
		Peat washed out of casing from about 4.8 to 5.1 m	213.5	2									
		SAND: assumed, only crushed sand (probable cuttings) recovered	212.9	3									
		SILTY SAND TILL: trace of gravel, grey, moist, very dense		4									
				5									
				6									
				7									
				8									
				9									
				10									
		End of Borehole Note: Casing broke at about 10.6 m depth. Borehole moved 0.5 m north and restarted. The second hole was also abandoned after triconing to about 6 m in the casing. A probable piece of steel from the old timber crib in this area destroyed the tricone. The hole was then moved to the 16A location and restarted.	208.6										

WATER LEVEL RECORD:

Time	Water Level (m)	Depth to Cave (m)



Shaheen and Peaker Limited
Consulting Geo-Environmental Engineers

Project: Atherley Narrows Bridge

Sheet No. 1 of 1

Location: Highway 12, Orillia, Ontario

Date Drilled: April 5, 1998

Drill Type: Wash Boring

Datum: Geodetic

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Sensitivity
- Piezometric Water Level
- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer

G W L	S Y M B O L	Soil Description	ELEV. (m)	D E P T H	N Value				Combustible Vapour Reading (ppm)			Natural Unit Weight kN/m ³
					20	40	60	80	250	500	750	
					Shear Strength 0.1 0.2 MPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)			
		Advanced casing to about 7 m without triconing or sampling	219.2	0								
		Started triconing and driving casing through till from about 7 m to about 11.2 m where driving resistance and tricone resistance indicated top of bedrock. Tried to lower core barrel, but casing bent and core barrel could not be lowered to 11.2 m. Boreholes was then advanced by triconing and resistance was noted. Samples of the cuttings were obtained.	208.2	11								
		LIMESTONE AND SAND LAYERS: hard drilling, probable limestone	207.6	12								
		easy drilling, probable sand	206.9	12								
		hard drilling, probable limestone	206.8	12								
		easy drilling, probable sand	206.8	12								
		hard drilling, probable limestone	206.7	13								
		easy drilling, probable sand	206.1	13								
		easy drilling with occasional hard layers	206.1	13								
		End of Borehole Note: There was insufficient time to advance the borehole deeper.	205.8	13								

WATER LEVEL RECORD:

Time	Water Level (m)	Depth to Cave (m)

GWL	SYMBOL	Soil Description	ELEV. (m)	DEPTH (m)	N Value				Combusible Vapour Reading (ppm)			Natural Unit Weight kN/m ³	
					Shear Strength MPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)				
					20	40	60	80	250	500	750		
		LIMESTONE AND SAND LAYERS: hard drilling, probable limestone	208.2	11	0.1		0.2			10	20	30	
		easy drilling, probable sand	207.6										
		hard drilling, probable limestone	206.9										
		easy drilling, probable sand	206.8										
		hard drilling, probable limestone	206.8										
		easy drilling, probable sand	206.7										
		easy drilling with occasional hard layers	206.1	13									
		easy drilling with occasional hard layers	206.1										
		End of Borehole Note: There was insufficient time to advance the borehole deeper.	205.8										

Enlargement of Drawing 40

WATER LEVEL RECORD:

Time	Water Level (m)	Depth to Cave (m)



Shaheen and Peaker Limited
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Project: Atherley Narrows Bridge

Sheet No. 1 of 1

Location: Highway 12, Orillia, Ontario

Date Drilled: April 14, 1998

Drill Type: Wash Boring

Datum: Geodetic

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Sensitivity
- Piezometric Water Level
- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer

GWL	SYMBOL	Soil Description	ELEV. (m)	DEPTH (m)	N Value				Combustible Vapour Reading (ppm)			Natural Unit Weight kN/m ³	
					20	40	60	80	250	500	750		
		FILL: sandy silt trace of clay, occasional cobbles, brown, moist, loose	220.0	0									
		Recovered only wood chips at 1.3 m		1									
		SANDY SILT TILL: numerous gravel sizes, grey, moist, very dense	217.3	3									
		Encountered sand while advancing casing at about 5.2 m		4									
		Encountered sand at about 5.8 m	213.9	6									
		Casing bent at about 6.15 m. Hole abandoned and redrilled to 7.1 m. Coring started at 7.19 m. See Core Log.		7									

WATER LEVEL RECORD:

Time	Water Level (m)	Depth to Cave (m)



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 Consulting Geo-Environmental Engineers

CORE LOG

BH NO. 17

PROJECT Atherley Narrows Bridge	ORIENTATION Vertical	ELEVATION (m) 220.0	DATUM Geodetic	PROJECT NO. SP2106
LOCATION Highway 12, Orillia, Ontario	DATE STARTED 04/17/98	COMPLETED 04/20/98	LOGGED BY H. Lohse	DRAWING NO. 43
CLIENT DS-Lea Associates Ltd.	DRILLER Malone	DRILL TYPE Longyear	CORE BARREL BX	SHEET 1 of 1

ELEV. (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	JOINT CHARACTERISTICS							WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No.	RECOVERY %	ROD	WATER RECOVERY %	WATER COLOUR
				No. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERATURE (mm)								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
220.0																		
	1																	
	2																	
	3																	
	4																	
	5																	
	6																	
212.8	7																	
212.1	8		Till: recovered rounded limestone gravel and limestone fragments with till on fractures											1	41	0	100	gr.
	9		LIMESTONE: fine grained, medium grey, generally unweathered, moderate strength Traces of mud on fractures in top of Run 2 Some fracture surfaces were oxidized in Run 2	1	B	F	C	RU	T	0				2	74	0	100	gr.
	10						VC	RP						3	87	0	100	grey
	11		There were no obvious drops of the core barrel during drilling											4	99	19	100	grey
	12			2	B	F								5	73	16	100	grey
	13			C	V									6	98	51	100	grey
206.1	14		End of Borehole															
	15																	
	16																	
	17																	
	18																	
	19																	

CORE LOG

BH NO. 18

PROJECT Atherley Narrows Bridge	ORIENTATION Vertical	ELEVATION (m) 219.6	DATUM Geodetic	PROJECT NO. SP2106
LOCATION Highway 12, Orillia, Ontario	DATE STARTED 04/21/98	COMPLETED 04/22/98	LOGGED BY H. Lohse	DRAWING NO. 44
CLIENT DS-Lea Associates Ltd.	DRILLER Malone	DRILL TYPE CME75	CORE BARREL BX	SHEET 1 of 1

ELEV. (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	JOINT CHARACTERISTICS							WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No.	RECOVERY %	RQD	WATER RECOVERY %	WATER COLOUR
				No. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERATURE (mm)								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
219.6	0		Borehole advanced to with hollow stem augers to 11.7 m without sampling															
	1																	
	2																	
	3																	
	4																	
	5																	
	6																	
	7																	
	8																	
	9																	
	10																	
	11		Split-barrel sample at 11.7 m recovered very dense sandy silt till, N value was 70/40 mm Casing driven to 12.3 m															
207.9	12		TILL: recovered limestone fragments with mud coating											1	57	0	100	gr.
206.9	13		LIMESTONE: fine grained, medium grey, unweathered Small voids noted when drilling at 13.1 m. These were less than about 100 mm thick Some joint surfaces in Run 2 were mud coated						SC					2	94	13	100	gr.
	14			1	B	F	C	RP	T	O				3	91	37	100	grey
	15						VC	RU						4	93	60	100	grey
	16													5	100	38	40	gr.
202.4	17		VERY FINE LIMESTONE: light grey, unweathered (Gull River Formation)											6	100	86	0	
	18			1	B	F	C	RP	T	O								
200.6	19		End of Borehole															

CORE LOG

BH NO. 19

PROJECT Atherley Narrows Bridge	ORIENTATION Vertical	ELEVATION (m) 219.7	DATUM Geodetic	PROJECT NO. SP2106
LOCATION Highway 12, Orillia, Ontario	DATE STARTED 04/23/98	COMPLETED 04/23/98	LOGGED BY H. Lohse	DRAWING NO. 45
CLIENT DS-Lea Associates Ltd.	DRILLER Malone	DRILL TYPE CME750	CORE BARREL BX	SHEET 1 of 1

ELEV. (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	JOINT CHARACTERISTICS							WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No.	RECOVERY %	RQD	WATER RECOVERY %	WATER COLOUR
				No. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERATURE (mm)								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
219.7	0		Borehole advanced with hollow stem augers and triconing to about 11.6 m depth without sampling.															
	1																	
	2																	
	3																	
	4																	
	5																	
	6																	
	7																	
	8																	
	9																	
	10																	
	11																	
208.1	12		LIMESTONE: fine grained, medium grey, unweathered 100 to 125 mm void at 12 m							125				1	78	33	100	gr.
	13													2	92	23	100	grey
	14		100 mm void at 14.5 m	1	B	F	C	RP	T	0				3	95	73	100	grey
	15		Poor to no water recovery below about 15 m							100								
204.0	16		VERY FINE GRAINED LIMESTONE: unweathered, light grey	1	B	F	C	RP	T	0				4	95	76	25	grey
203.0	17		End of Borehole															
	18																	
	19																	

Project: Atherley Narrows Bridge

Sheet No. 1 of 1

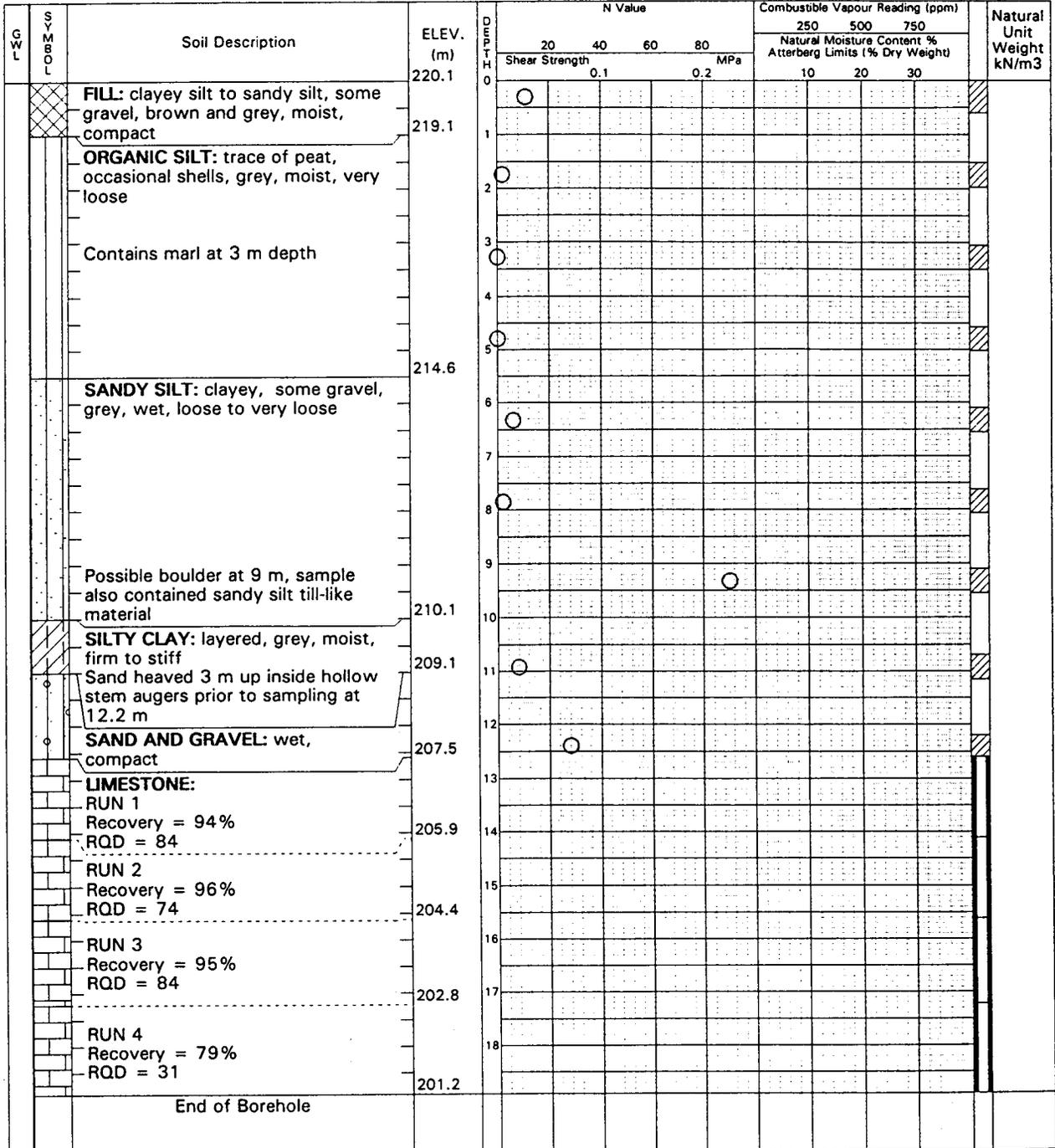
Location: Highway 12, Orillia, Ontario

Date Drilled: May 5, 1998

Drill Type: Hollow Stem Augers

Datum: Geodetic

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Sensitivity
- Piezometric Water Level
- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer



WATER LEVEL RECORD:

Time	Water Level (m)	Depth to Cave (m)



Shaheen and Peaker Limited
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Project: Atherley Narrows Bridge

Sheet No. 1 of 1

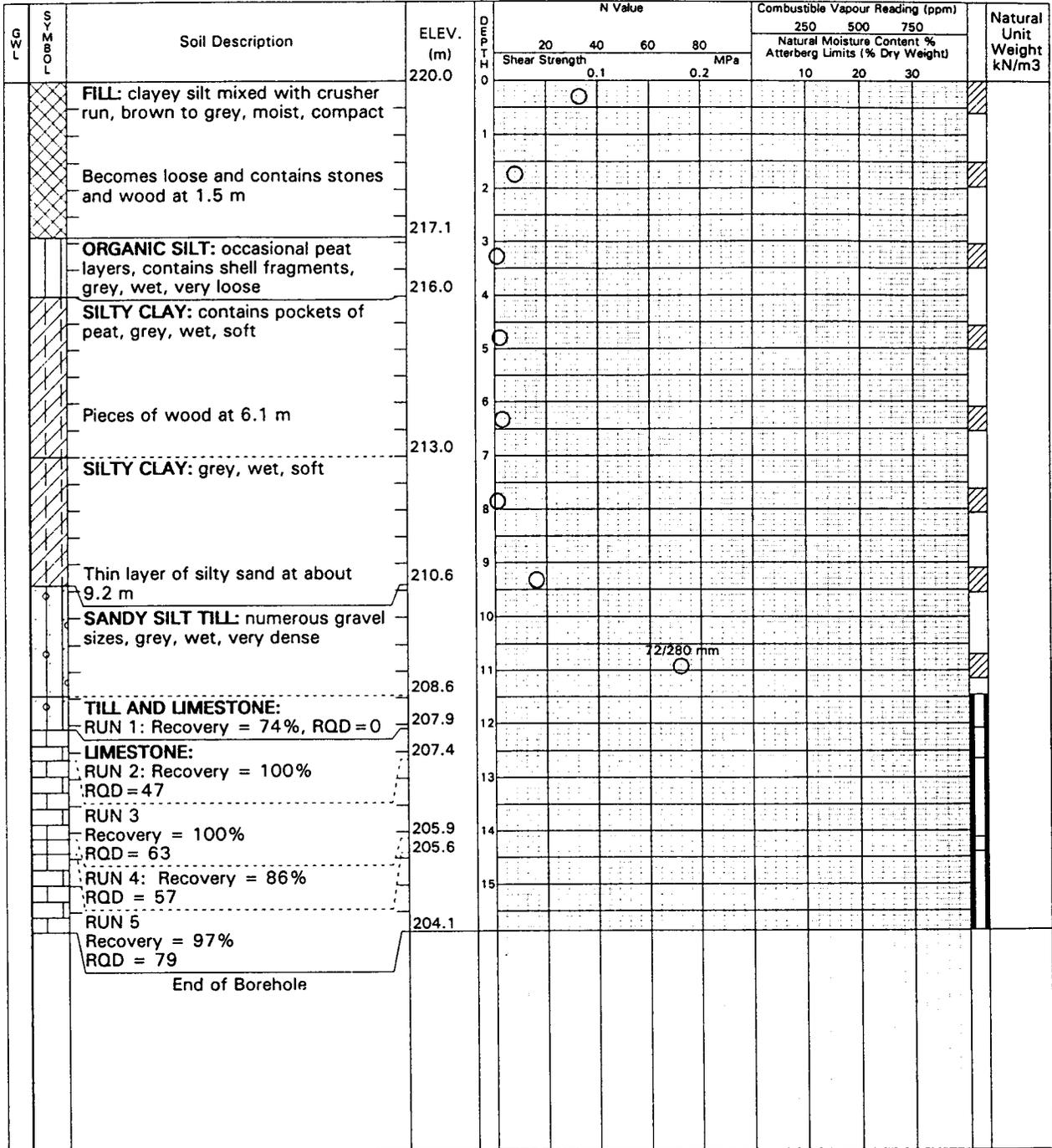
Location: Highway 12, Orillia, Ontario

Date Drilled: May 6, 1998

Drill Type: Hollow Stem Augers

Datum: Geodetic

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Sensitivity
- Piezometric Water Level
- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer



WATER LEVEL RECORD:

Time	Water Level (m)	Depth to Cave (m)



Shaheen and Peaker Limited
Consulting Geo-Environmental Engineers

CORE LOG

BH NO. 23

PROJECT Atherley Narrows Bridge	ORIENTATION Vertical	ELEVATION (m) 219.1	DATUM Geodetic	PROJECT NO. SP2106
LOCATION Highway 12, Orillia, Ontario	DATE STARTED 05/13/98	COMPLETED 05/21/98	LOGGED BY H. Lohse	DRAWING NO. 49
CLIENT DS-Lea Associates Ltd.	DRILLER Malone	DRILL TYPE	CORE BARREL NX/BX	SHEET 1 of 1

ELEV. (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	JOINT CHARACTERISTICS							WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No.	RECOVERY %	RQD	WATER RECOVERY %	WATER COLOUR
				No. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERATURE (mm)								
219.1	1		WATER ~1.7 m deep															
217.4	2		Soft Material not sampled															
213.4	6		Probable Till not sampled Casing advanced by triconing and hammering N casing															
210.9	8		Triconing very slow below about 8.25 m (Probable Limestone)															
	9		LIMESTONE WITH SAND LAYERS: fine grained, medium grey, unweathered Easy coring from about 8.35 m to 8.5 m, and from from 8.62 m to 8.75 m, sand/silt and broken rock washed out	1	B	F	C	RP	T	130			1	53	0			
	10									130			2	26	0			
	11		Coarse to fine sand and silt washed up between 10.49 m and 10.95 m	2	B	F	C	RP	T	0			3	45	0			
	12												4	64	0			
	13												5	57	0			
	14			2	B	F	VC	RP	T	0			6	80	46			
	15												7	75	36			
	16												8	74	61			
202.7	17		VERY FINE LIMESTONE: light grey, unweathered (Gull River Formation)										9	91	61			
201.3	18		End of Borehole															
	19																	



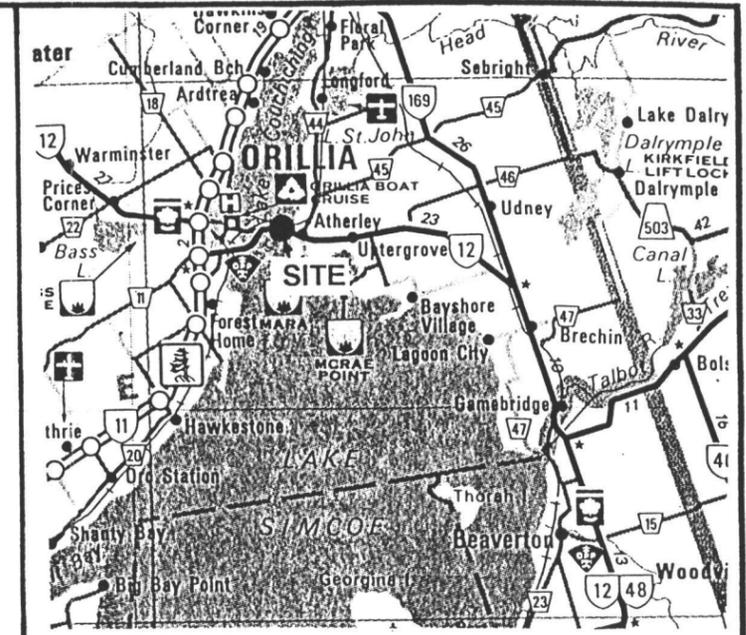
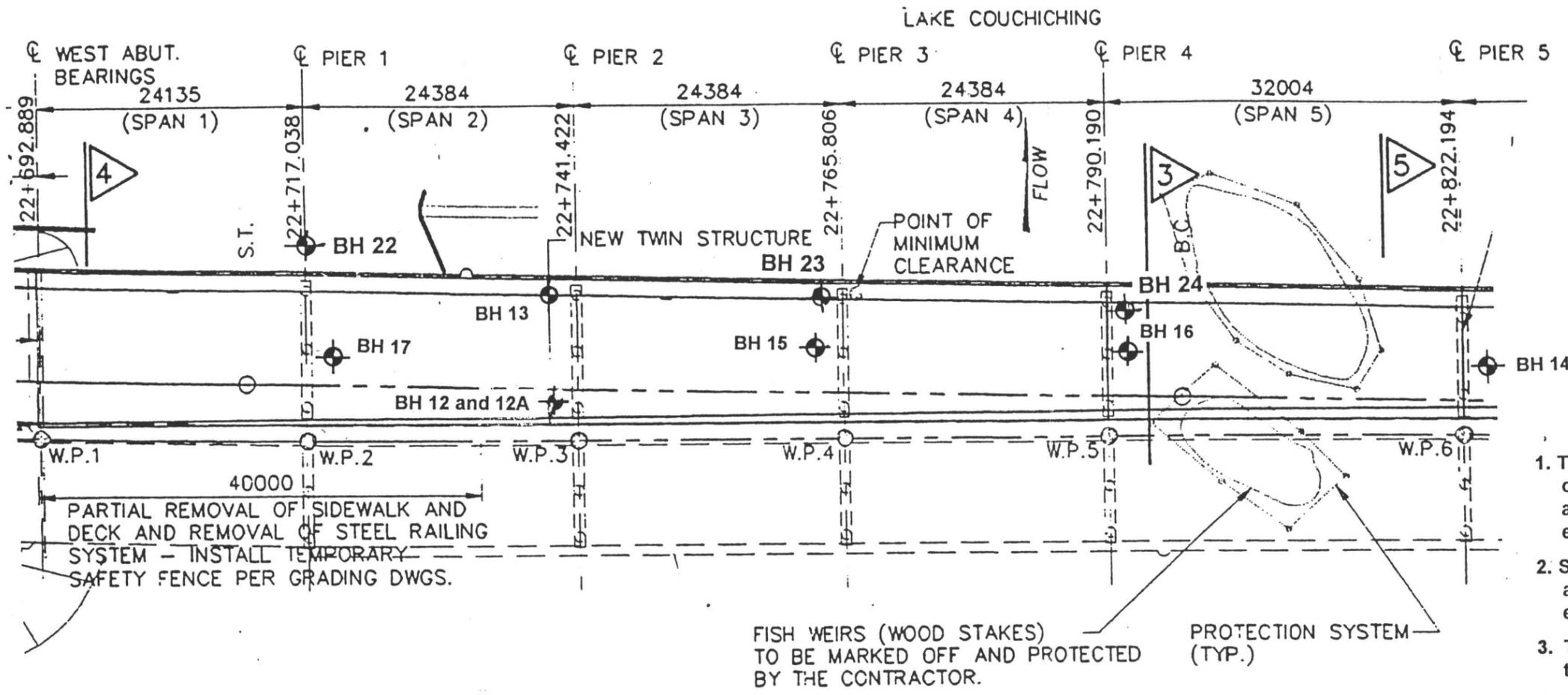
Shaheen & Peaker Limited
Consulting Geo-Environmental Engineers

CORE LOG

BH NO. 24

PROJECT Atherley Narrows Bridge	ORIENTATION Vertical	ELEVATION (m) 219.4	DATUM Geodetic	PROJECT NO. SP2106
LOCATION Highway 12, Orillia, Ontario	DATE STARTED 05/24/98	COMPLETED 05/25/98	LOGGED BY H. Lohse	DRAWING NO. 50
CLIENT DS-Lea Associates Ltd.	DRILLER Malone	DRILL TYPE	CORE BARREL NX/BX	SHEET 1 of 1

ELEV. (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	JOINT CHARACTERISTICS								WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No.	RECOVERY %	ROD	WATER RECOVERY %	WATER COLOUR
				No. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERATURE (mm)									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
219.4	1		WATER ~ 3.0 m deep																
216.4	3		Soft Material not sampled																
213.7	6		Silt Till Casing advanced by triconing and hammering N casing																
209.5	10		GRANITIC BOULDER, ~ 80 mm, overlying: LIMESTONE WITH SAND LAYERS, fine grained, medium grey, unweathered	2	B C	F V D	C VC	RP UP	T	0				1	92	48			
	12		sand and limestone layers for ~460 mm											2	32	7			
	13													3	46	0			
	15		sand layer at 14.6 m, ~250 mm thick											4	58	15			
	16													5	40	0			
201.9	18		VERY FINE LIMESTONE, light grey, unweathered (Gull River Formation)											6	78	7			
201.2	18		End of Borehole																
	19																		



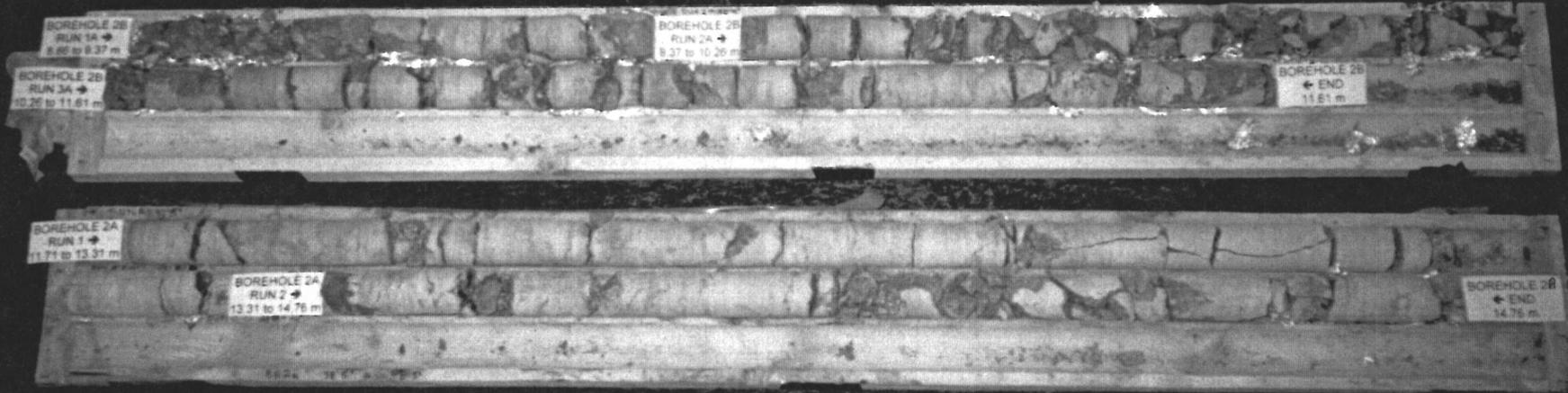
SITE LOCATION PLAN

NOTES

1. The boundaries and soil types have been established only at borehole locations. Between boreholes they are assumed and may be subject to considerable error.
2. Soil samples will be retained in storage for 3 months and then destroyed unless the client advises an extended time period is required.
3. Topsoil quantities should not be established from the information provided at the borehole locations.
4. Borehole elevations should not be used to design building(s) or floor slab(s) or parking lot(s) grades.
5. This drawing forms part of the report (project number as referenced) and should only be used in conjunction with this report.

SHAHEEN & PEAKER LIMITED		
PLAN SHOWING BOREHOLE LOCATIONS		
GEOTECHNICAL INVESTIGATION ATHERLEY NARROWS BRIDGE HIGHWAY 12 ORILLIA, ONTARIO		
PROJECT: SP2106	SCALE: ~1:500	DRAWING NO. 1A

Photographs



BOREHOLE 2B
RUN 1A →
8.65 to 8.37 m

BOREHOLE 2B
RUN 2A →
8.37 to 10.26 m

BOREHOLE 2B
RUN 3A →
10.26 to 11.61 m

BOREHOLE 2B
← END
11.61 m

BOREHOLE 2A
RUN 1 →
11.71 to 13.31 m

BOREHOLE 2A
RUN 2 →
13.31 to 14.76 m

BOREHOLE 2A
← END
14.76 m

BOREHOLE 3
RUN 1
11.23 @ 11.55 m

BOREHOLE 3
RUN 1
11.23 @ 11.55 m

BOREHOLE 3
RUN 1
11.23 @ 11.55 m

BOREHOLE 3
END
11.50 m

BOREHOLE 4
RUN 1 →
10.94 to 11.91 m

BOREHOLE 4
RUN 2 →
11.91 to 13.44 m

BOREHOLE 4
← END
13.44 m

23 11:24

BOREHOLE 5
RUN 1 →
10.82 to 11.28 m

BOREHOLE 5
RUN 2 →
11.28 to 12.09 m

BOREHOLE 5
RUN 4 →
12.09 to 12.83 m

BOREHOLE 5
RUN 3 →
12.09 to 12.83 m

BOREHOLE 5
RUN 5 →
13.64 to 14.10 m

BOREHOLE 5
← END
14.12 m

23 12:09

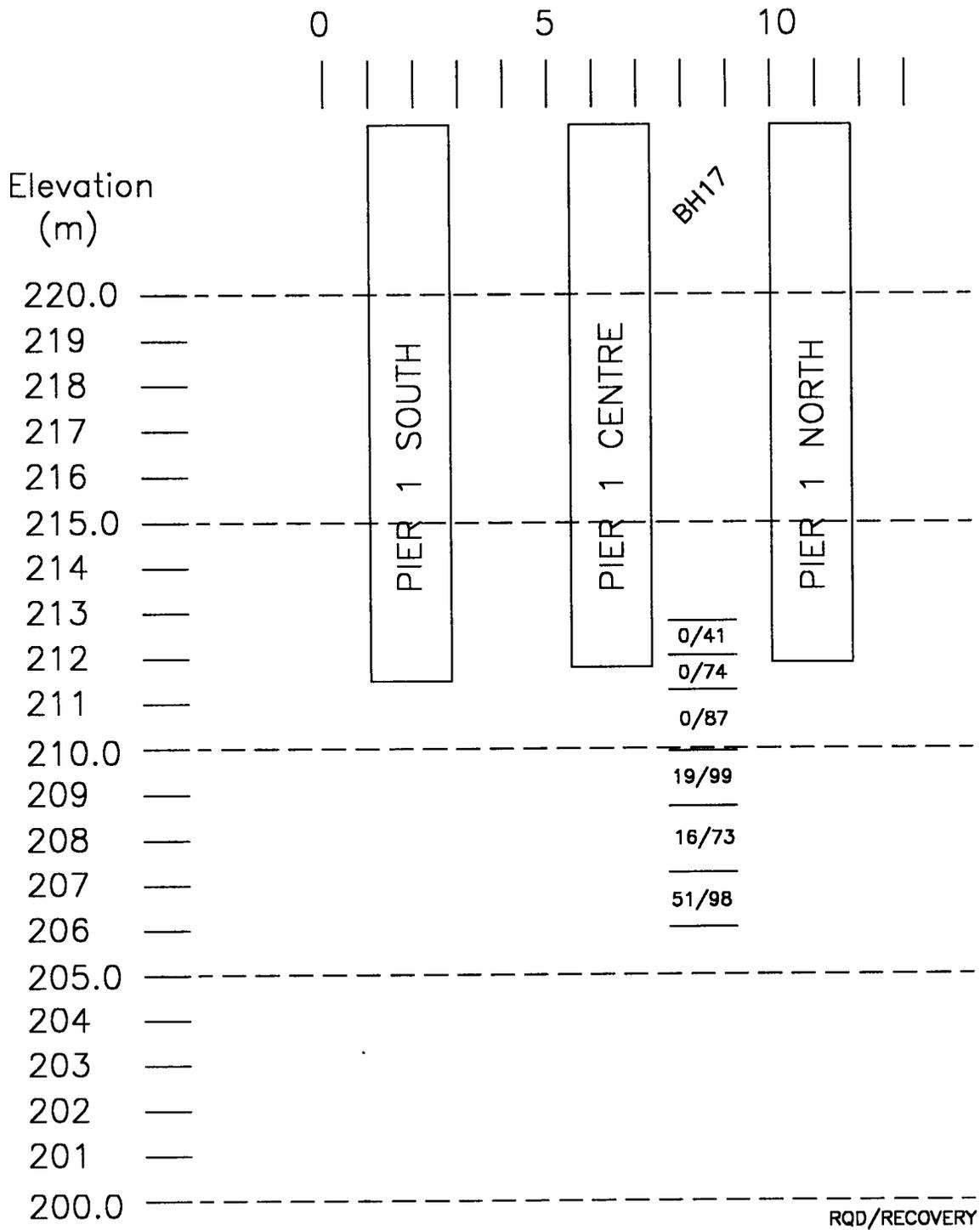
**SKETCH OF CONDITIONS AT PIERS
ATHERLEY NARROWS BRIDGE
HIGHWAY 12
ORILLIA, ONTARIO**

**Prepared for
DS-LEA ASSOCIATES LTD.**

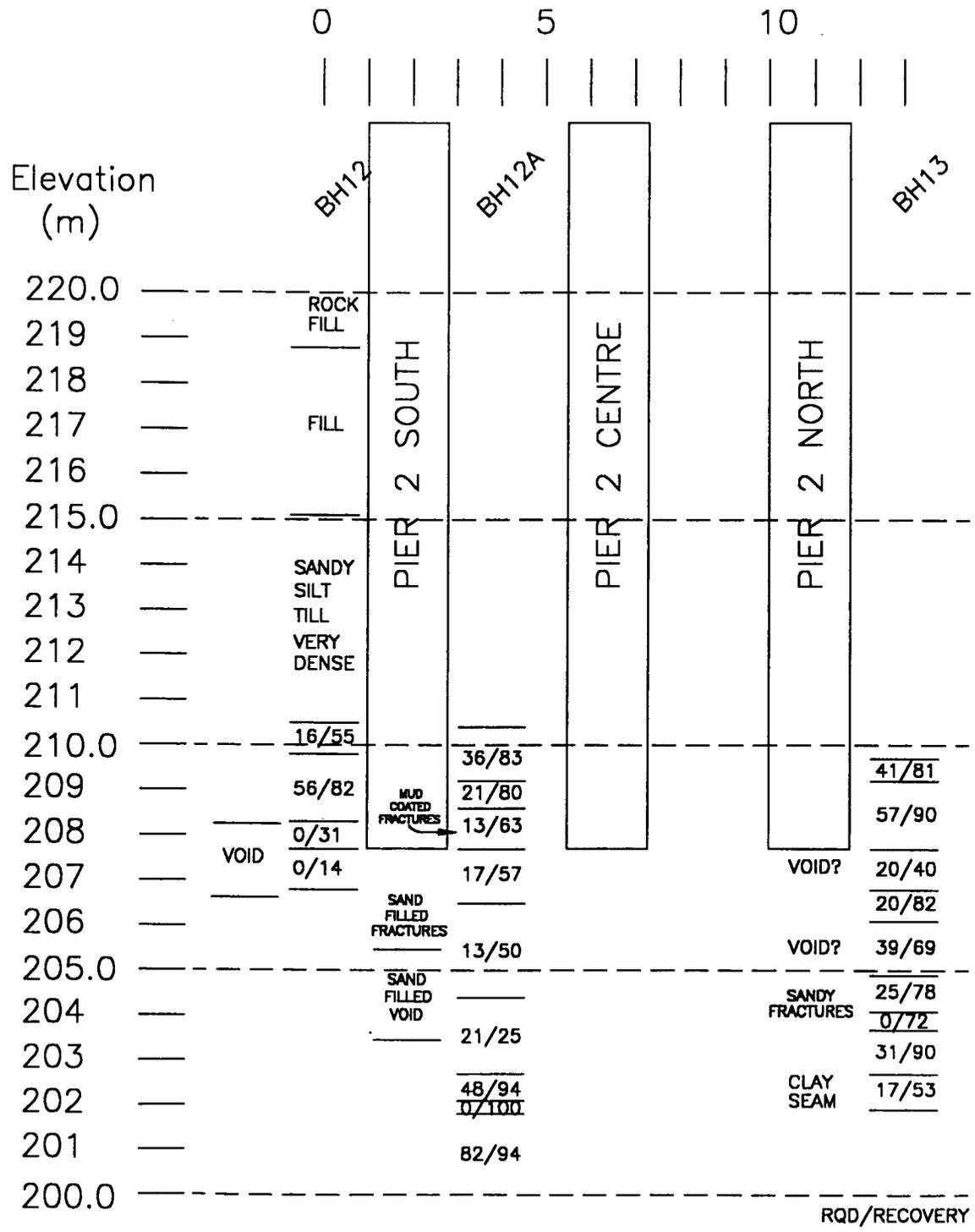
**Prepared by
SHAHEEN & PEAKER LIMITED**

**Project: SP2106
April 29, 1998**

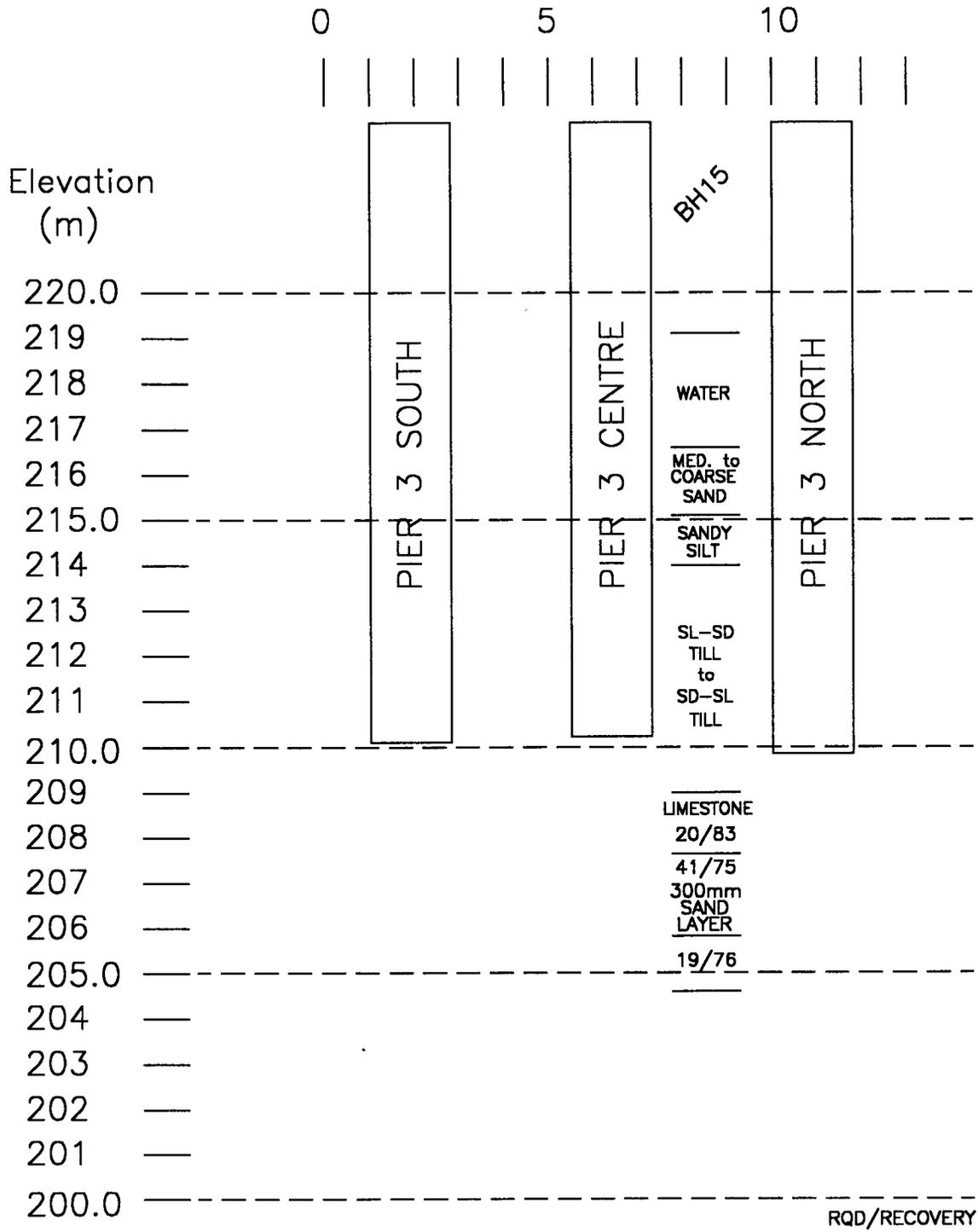
**250 Galaxy Boulevard
Etobicoke, Ontario
M9W 5R8
Tel: (416) 213-1255
Fax: (416) 213-1260**



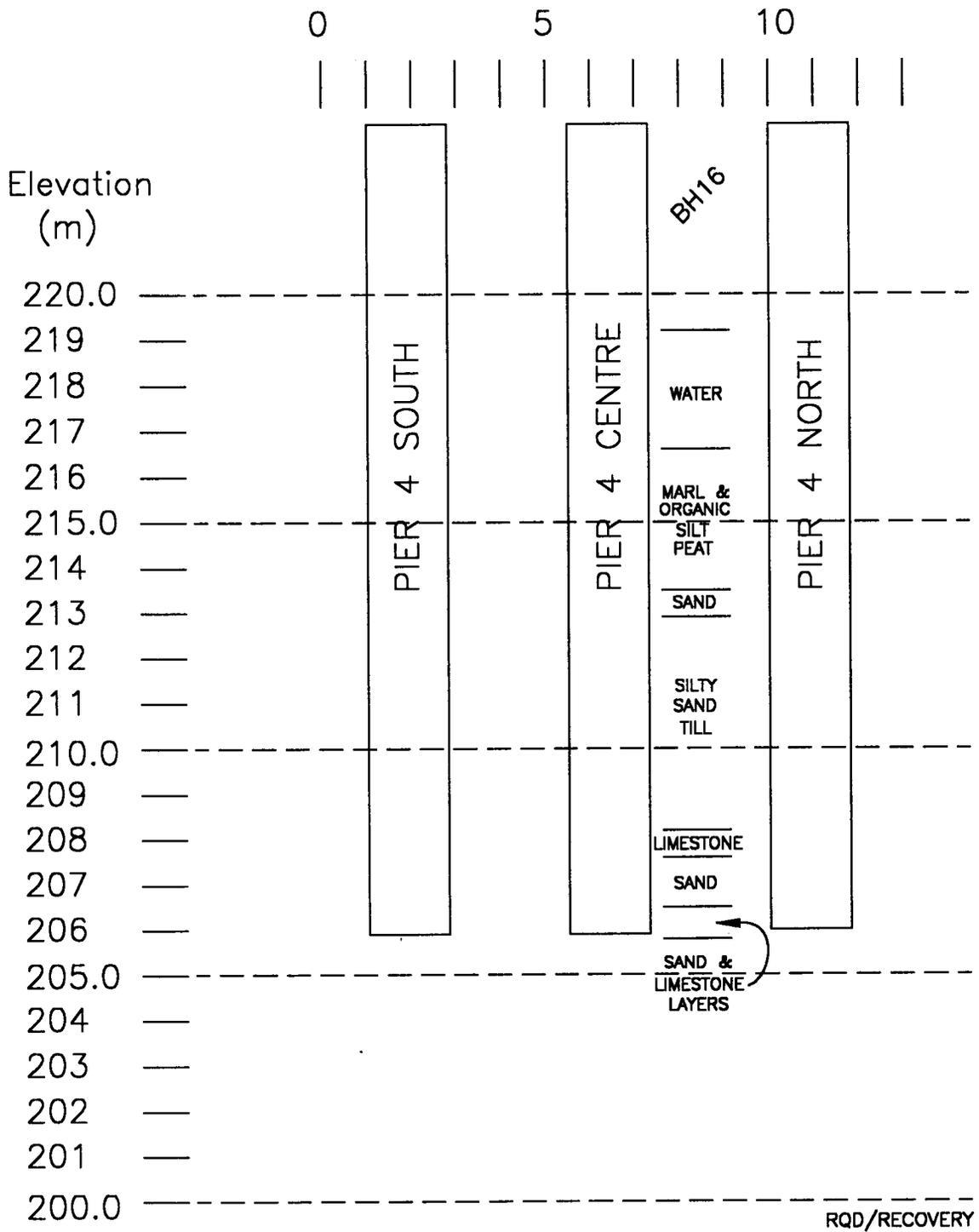
SKETCH OF CONDITIONS AT PIER 1



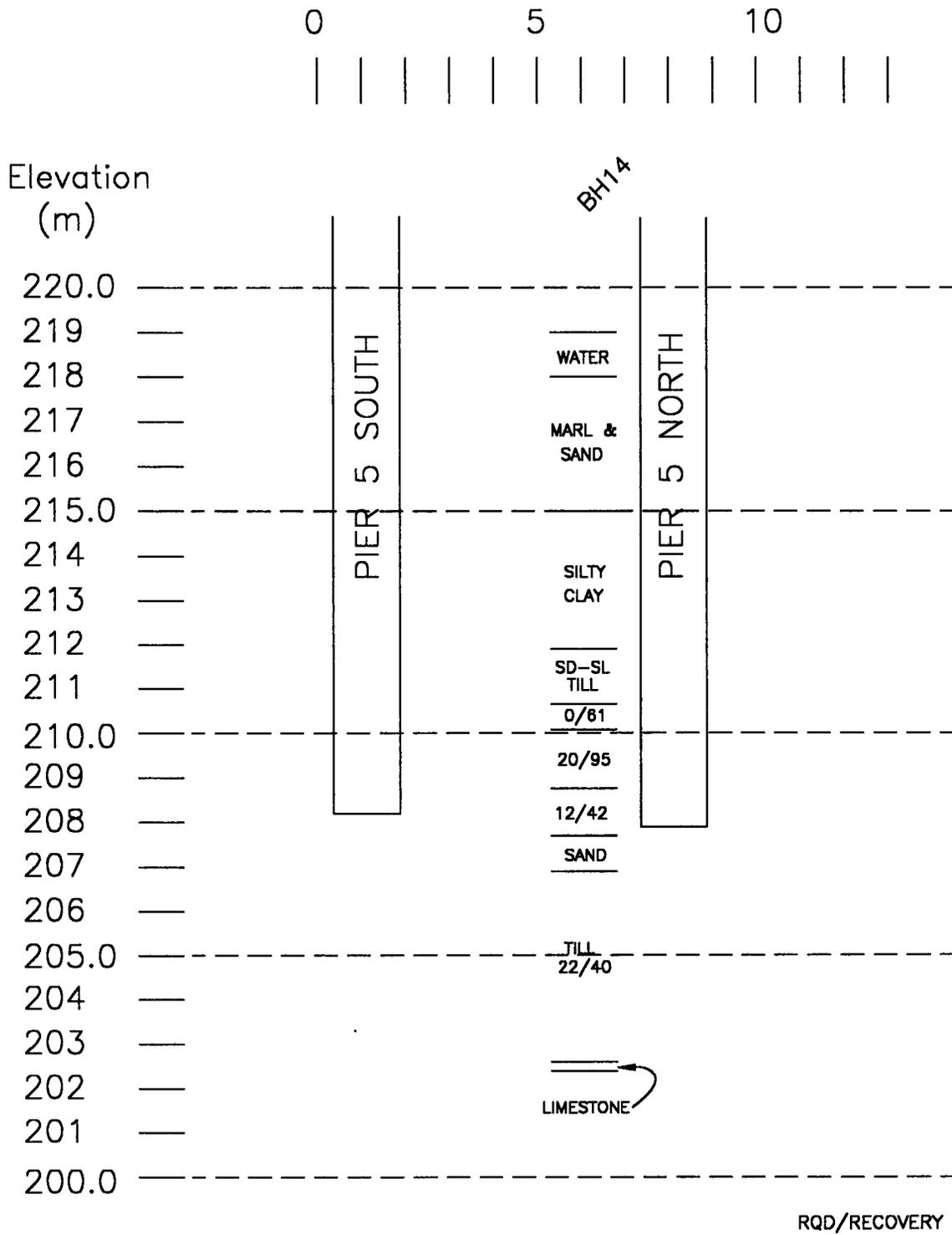
SKETCH OF CONDITIONS AT PIER 2



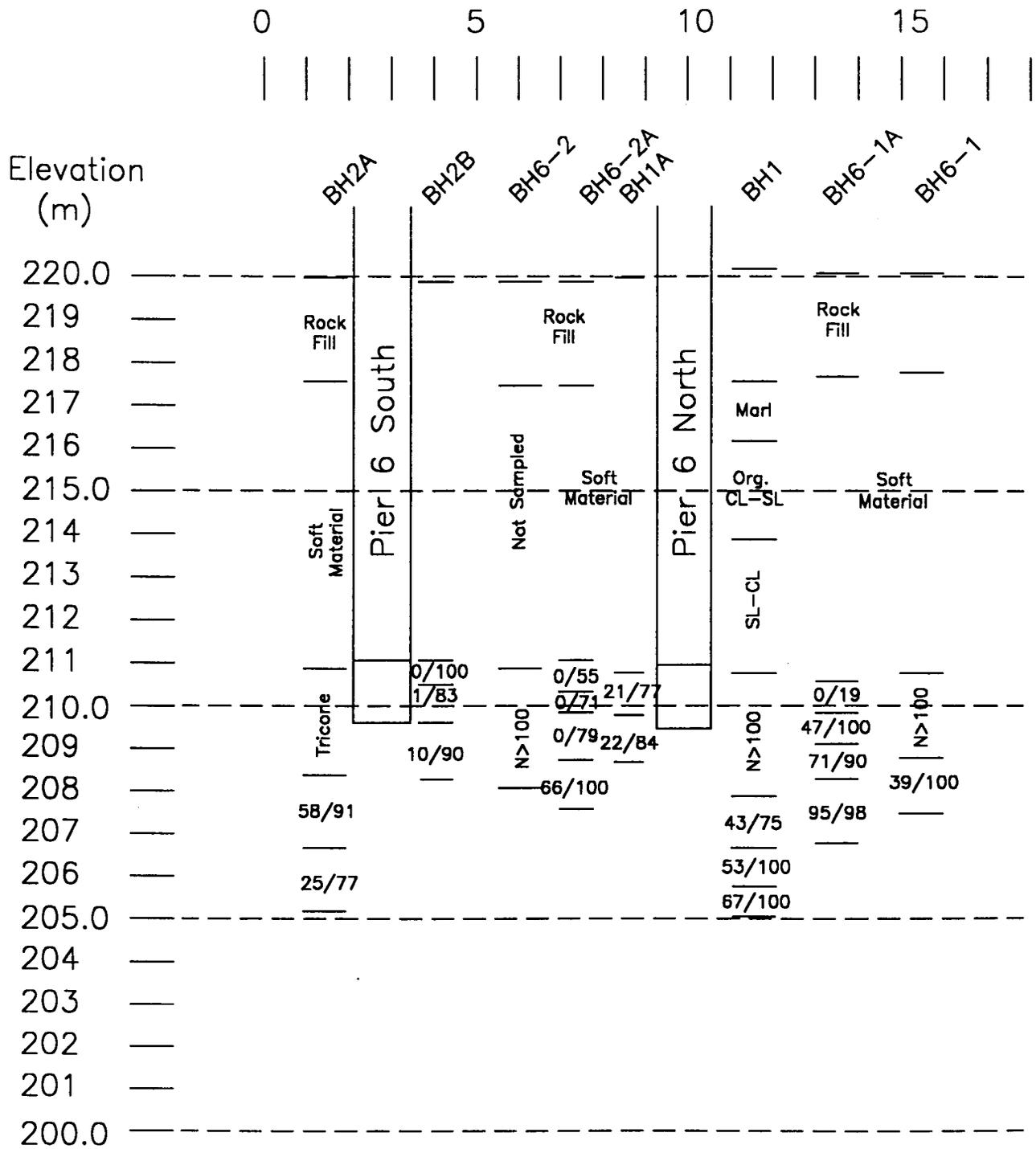
SKETCH OF CONDITIONS AT PIER 3



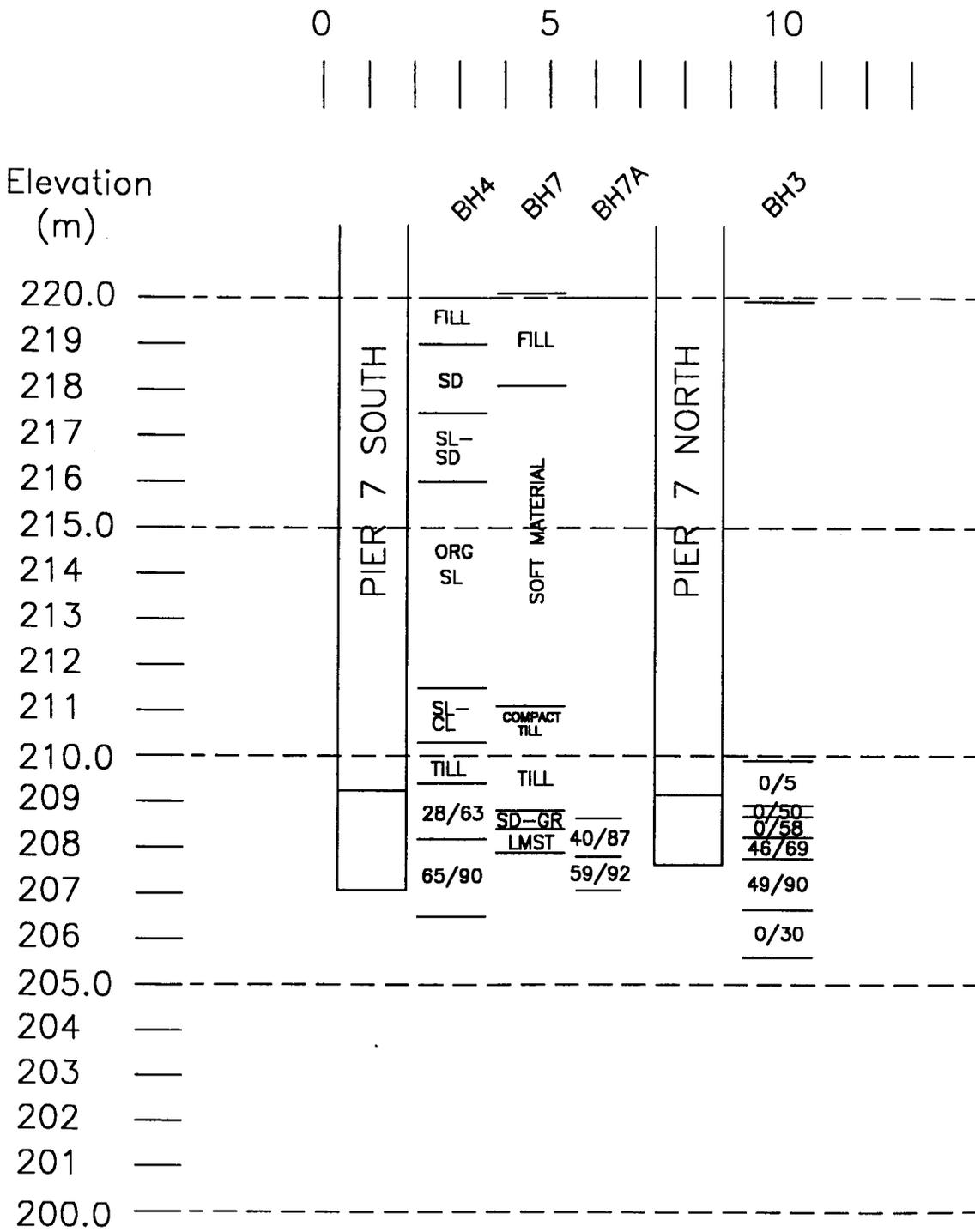
SKETCH OF CONDITIONS AT PIER 4



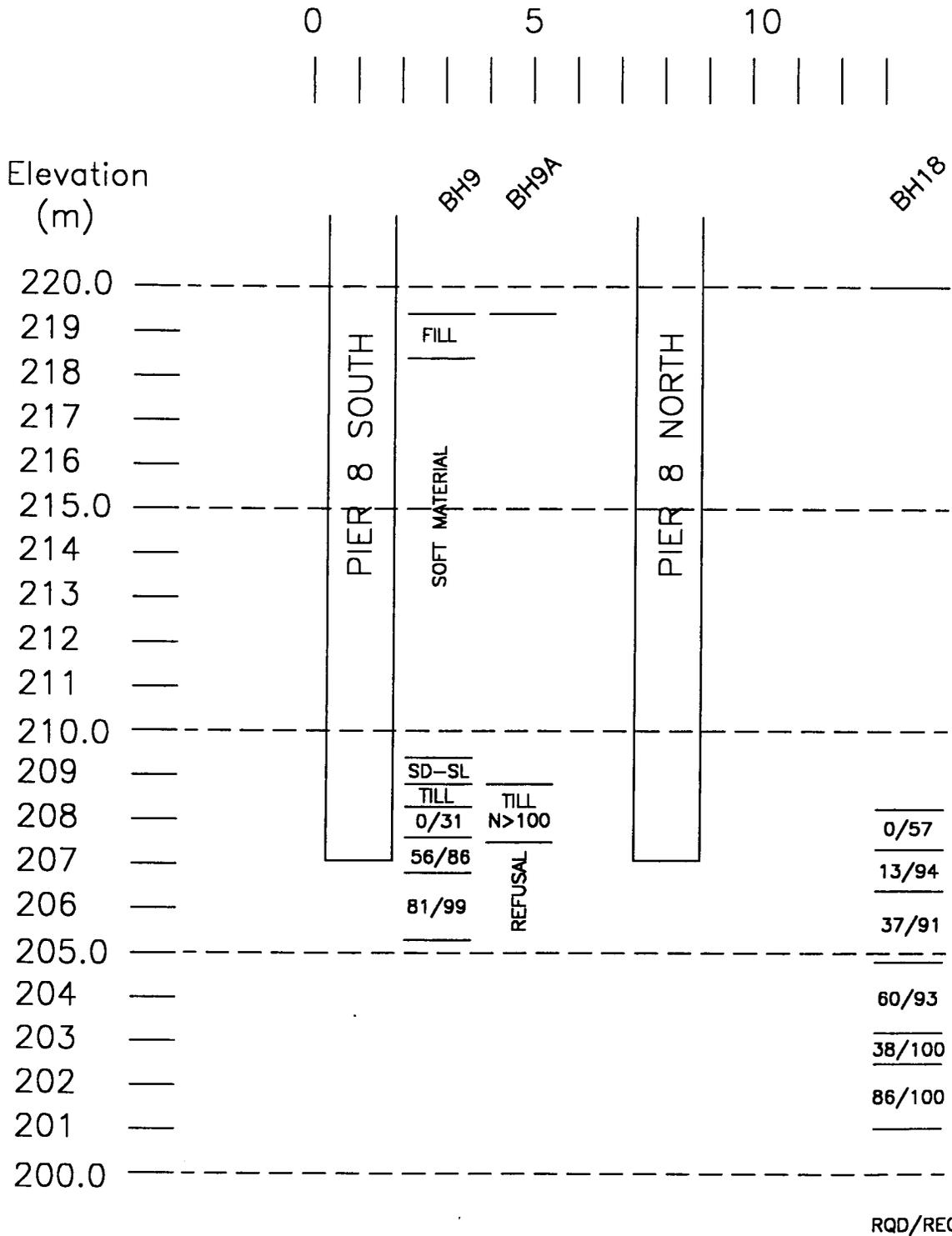
SKETCH OF CONDITIONS AT PIER 5



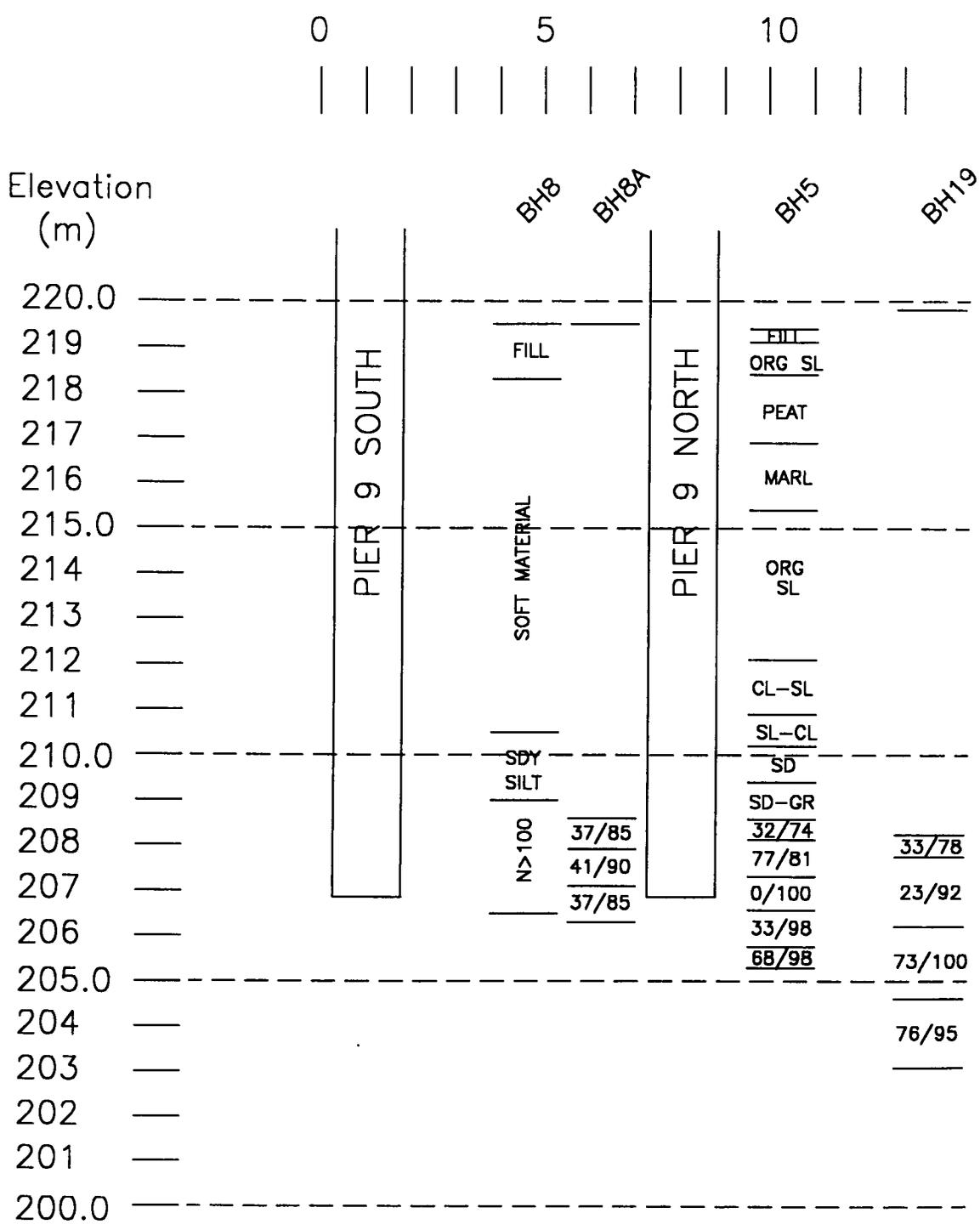
SKETCH OF CONDITIONS AT PIER 6



SKETCH OF CONDITIONS AT PIER 7



SKETCH OF CONDITIONS AT PIER 8



RQD/RECOVERY

SKETCH OF CONDITIONS AT PIER 9