

GEOTECHNICAL INVESTIGATION REPORT
FOR SEWER CONSTRUCTION
HIGHWAY 11, HEARST
W.P. 722-89-00

for

STANLEY CONSULTING GROUP LTD.

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Job No. 97 KF 119

MAY 1998

Peto MacCallum Ltd.
CONSULTING ENGINEERS

Job No. 97 KF 119

May 20, 1998

Stanley Consulting Group Ltd.
1400 Rymal Road East
Hamilton, Ontario
L8W 3N9

Attention: Mr. F. Evan Wilson, P.Eng.

Gentlemen

Re: Geotechnical Investigation Report
Sewer Construction
Highway 11, Hearst
W.P. 722-89-00

We are pleased to present our report on the geotechnical investigation completed at the above referenced site. This work was authorized verbally by Mr. F. Evan Wilson, P.Eng.

The attached report provides details of the project methodology, and summarized site conditions together with recommendations for sewer construction. It should be noted that a gasoline type odour was detected in borehole 12.

We trust this report has been completed within our terms of reference, and sufficient for your immediate requirements. If you have any questions or require further information, please do not hesitate to contact our office.



Sincerely

PETO MacCALLUM LTD.


G. Mitchell, P.Eng.
Manager, Geotechnical Engineering

GM:cs

TABLE OF CONTENTS

Page No.

1.0	INTRODUCTION	1
2.0	SITE DESCRIPTION	1
3.0	INVESTIGATION PROCEDURES	1
4.0	SUBSURFACE CONDITIONS	2
5.0	DISCUSSION AND RECOMMENDATIONS	5

FIGURE 1 TO 5 PARTICLE SIZE DISTRIBUTION CHARTS

LIST OF ABBREVIATIONS

BOREHOLE LOGS

**GEOTECHNICAL INVESTIGATION REPORT
FOR SEWER CONSTRUCTION
HIGHWAY 11, HEARST
W.P. 722-89-00**

1.0 INTRODUCTION

This report summarizes the results of a geotechnical investigation which was carried out at the above referenced site for sewer construction proposed as part of Highway 11 reconstruction in Hearst, Ontario. The sewer construction will extend from Station 17+900 Way Township (Fountain Street) to Station 13+300 Kendall Township (Barrette Street) in Hearst, Ontario. The proposed sewer depths are generally expected to be in the range of 3 to 3.5 m below existing grade with depths extending up to 5.0 m locally.

2.0 SITE DESCRIPTION

Highway 11 within the Town of Hearst is a two lane roadway with gravel shoulders and centre turn lanes.

The ground surface at the site is relatively level and the ground surface elevations within the project limits vary from about 238.97 to 245.75 m at the borehole locations. The Mattawishkwia River crosses Highway 11 just east of the proposed sewer works.

3.0 INVESTIGATION PROCEDURES

The field work was carried out during the period of November 11 to 19, 1997 and involved the drilling of twenty three (23) boreholes drilled from depths of 5.20 to 9.75 m below existing grade.

The boreholes were advanced with a CME 45 truck mounted drillrig equipped with continuous flight solid stem augers, supplied and operated by a specialist drilling contractor.

Representative samples of the overburden were secured at regular intervals throughout the depth explored. Standard penetration tests were carried out during sampling operations using conventional split spoon equipment. Groundwater observations were made in the boreholes during and following completion of drilling and in piezometers installed in select boreholes.

The field work was supervised throughout by a member of our engineering staff who directed the drilling and sampling process, prepared the stratigraphic logs, monitored groundwater conditions and cared for the recovered samples. The ground surface elevations were referred to bench marks supplied by C.C. Parker Consultants Limited.

All samples secured during the investigation were returned to our laboratory for detailed visual examination. The laboratory testing program consisted of natural moisture content determination tests on all recovered samples, five particle size distribution analysis and three atterberg limit tests.

4.0 SUBSURFACE CONDITIONS

We refer to the appended Log of Borehole sheets for details of the drilling work including pavement construction details, soil descriptions, inferred stratigraphy, standard penetration "N" values, groundwater observations during and upon completion of drilling, and natural moisture content determination test results..

In general, the subsurface stratigraphy contacted in the boreholes comprises an existing pavement structure and fill overlying a discontinuous peat layer. Beneath the peat the native overburden comprised extensive deposits of varved clay and silt underlain by silt till. Localized seams of silty sand were contacted at the east limit of the project.

The existing pavement structure and mixed fill typically extended to depths of 0.65 to 2.20 m below existing grade.

Fibrous peat was encountered beneath the fill in about 25% of the boreholes. The peat varied in thickness from 0.30 to 1.35 m. Moisture contents of the peat measured 150 to 320%.

Beneath the peat the majority of the boreholes contacted a deposit of clay or varved clay. The varved clay extended to depths of 2.30 to 5.70 m below the existing grade. The clay is typically firm to very stiff with occasional soft zones based on standard penetration "N" values of 3 to 15 blows per 0.30 m penetration of the split spoon sampler. Moisture contents of the clay varied from about 22 to 34%. The results of liquid and plastic limits carried out on a sample of the clay are shown on the Log of Borehole sheets and revealed a liquid limit of 39, a plastic limit of 20 with a plasticity index of 19. A typical particle size distribution chart for the clay is provided on Figure 1.

Beneath the clay and varved clay an extensive silt deposit was contacted which extended to the termination depth of most of the boreholes. The silt is typically loose to compact based on standard penetration "N" values of 5 to 20 blows per 0.30 m. Moisture contents of 20 to 28% show typically moist to wet conditions. Typical particle size distribution charts for the silt are presented on Figures 2 and 3, appended.

Towards the eastern limit of the project the silt grades to sandy silt and silty sand at depth. A typical particle size distribution for the silty sand and sand are provided on Figures 4 and 5. The majority of the boreholes terminated in the silt deposit.

Beneath the silt deposits several boreholes contacted a silt till deposit. The silt till varied from loose to very dense based on standard penetration "N" values of 6 to 80 blows per 0.30 m.

Groundwater observations carried out in the open boreholes as well as in piezometers installed in the boreholes have revealed that the majority of the subsoils are relatively impermeable and seepage into the boreholes was restricted to more permeable sand and sandy silt seams. The wet sand and sandy silt seams are more extensive at the east end of the project. Based on soil colouring, moisture contents and piezometer readings, the stabilized groundwater level lies at depths of about 1.5 to 3.0 m below existing grade.

5.0 DISCUSSION AND RECOMMENDATIONS

The project involves the proposed installation of new sewers with subsequent reconstruction of Highway 11 between Fountain Street and Barrette Street in Hearst, Ontario. It is understood that the proposed sewer invert levels will generally be in the range of 3.0 to 3.5 m below existing grade with depths extending locally up to 5.0 m.

Excavations for the installation of the new services will generally extend through the existing pavements, fill, and discontinuous peat, into the native overburden deposits of varved clay and silt. Localized sand and silty sand, seams will be encountered at the east end of the project.

In general, excavations may be carried out with conventional open cut procedures. Excavations should be carried out in compliance with the Ontario Occupational Health and Safety Act for Type 3 Soils with any unsupported side slopes trimmed back at 45 degrees to the horizontal.

No major groundwater control problems are envisaged for the majority of sewer excavations. Any groundwater infiltration from wet seams within the native clay or silt soils should be controlled using conventional sump pumping techniques. However, at the east end of the project more substantial inflow should be expected from the sand and sandy silt seams and more sophisticated dewatering measures may be required if excavations extend into these deposits.

The boreholes indicate that the pipe subgrade should comprise native varved clay or silt. Trenching should be carried out in accordance with OPSS 514.07.06.

Conventional granular bedding material and cover material should be Class B bedding in accordance with "Rigid Pipe Bedding Cover and Backfill Type 3 Soil - Earth Excavation" OPSD 802.031. The bedding course and cover material should comprise Granular "A" material.

Above the cover material, the trenches should be backfilled with inorganic on-site soils placed in 300 mm thick lifts compacted to 95% standard Proctor maximum dry density.

Based on the results of the insitu content tests, much of the excavated varved clay and silt, will require drying prior to compaction. Any wet soils which cannot be properly compacted and all organic soils should be discarded. If time is not available for drying the excavated soils or if construction operations are carried out at times other than the dry Summer season, then some imported materials will likely be required for sewer trench backfilling purposes. Care must be exercised to ensure that the frost susceptibility of the trench backfill is similar to that of the native soils otherwise, frost tapers will be required.

Frequent inspection by experienced geotechnical personnel should be carried out to examine and approve potential sources of backfill material and to carefully inspect placement and verify the compaction by insitu density testing using nuclear gauges.

To minimize potential problems, backfilling operations should follow closely after excavation. Excavations for sewer installations should not remain open for more than one day. This will minimize wetting up of the subgrade material. Should construction extend into the Winter season, particular attention should be given to ensure that frozen material is not used as backfill.

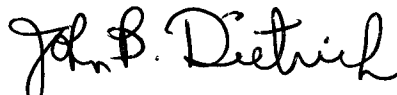
The field work for this investigation was carried out under the supervision of D. Jotham and D. MacRae, P.Eng. using equipment supplied and operated by K & S Drilling Ltd. This geotechnical report was prepared by G. Mitchell, M.Eng., P.Eng. and was reviewed by Mr. John B. Dietrich, P.Eng.

Sincerely,

PETO MacCALLUM LTD.



G. Mitchell, P.Eng.
Manager, Geotechnical Engineering



John B. Dietrich, P.Eng.
Managing Director

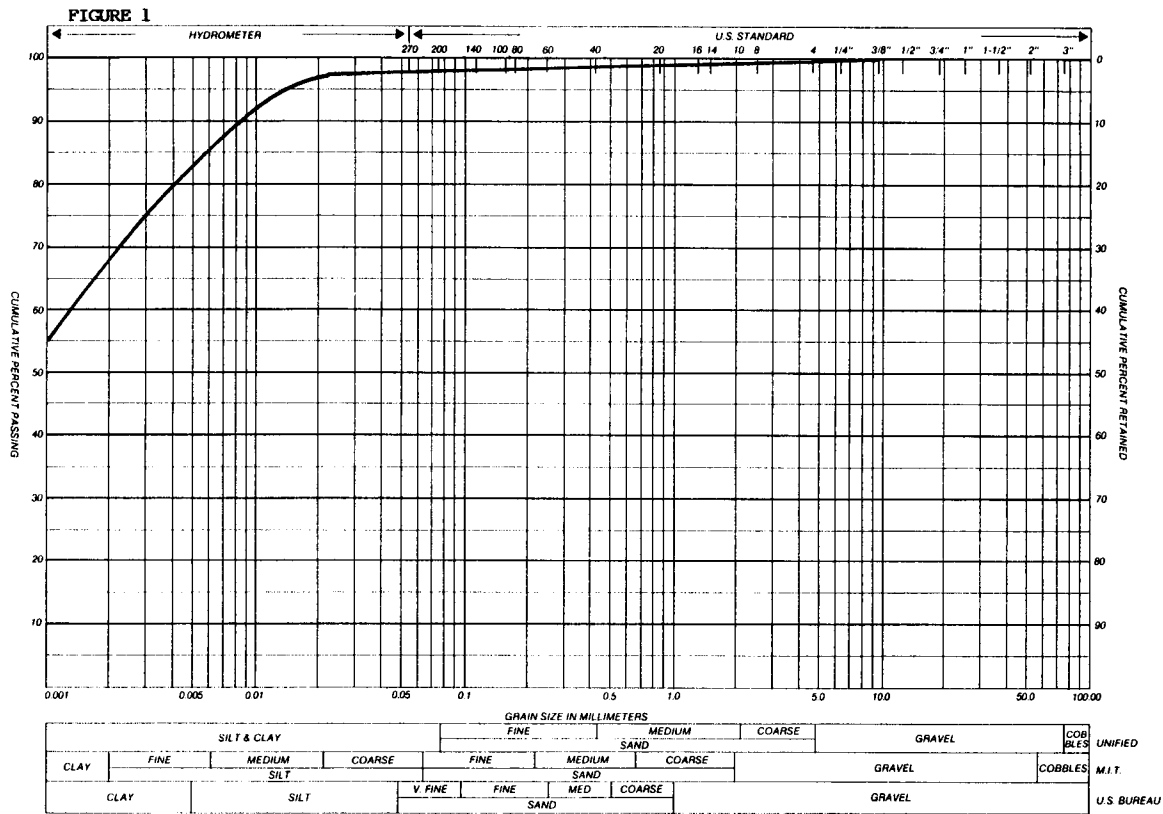
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Peto MacCallum Ltd.

CONSULTING ENGINEERS

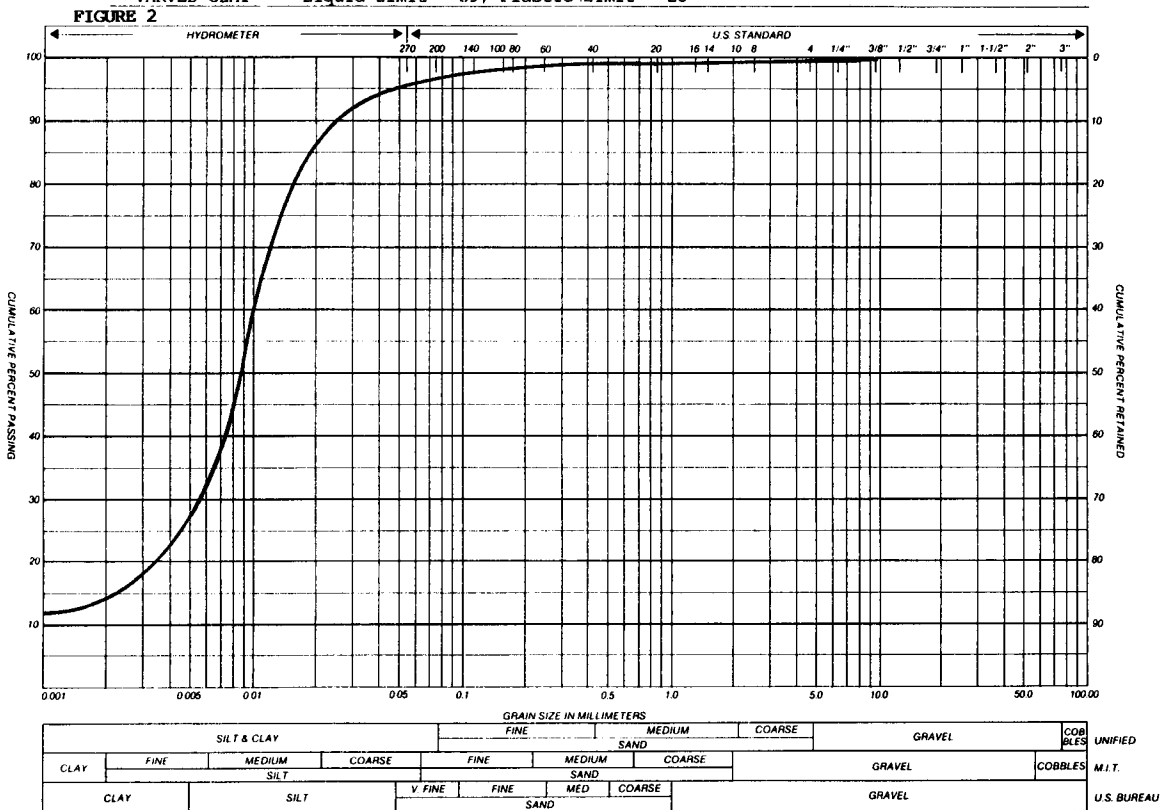
PARTICLE SIZE DISTRIBUTION CHART

OUR PROJECT NO. 97 KF 119



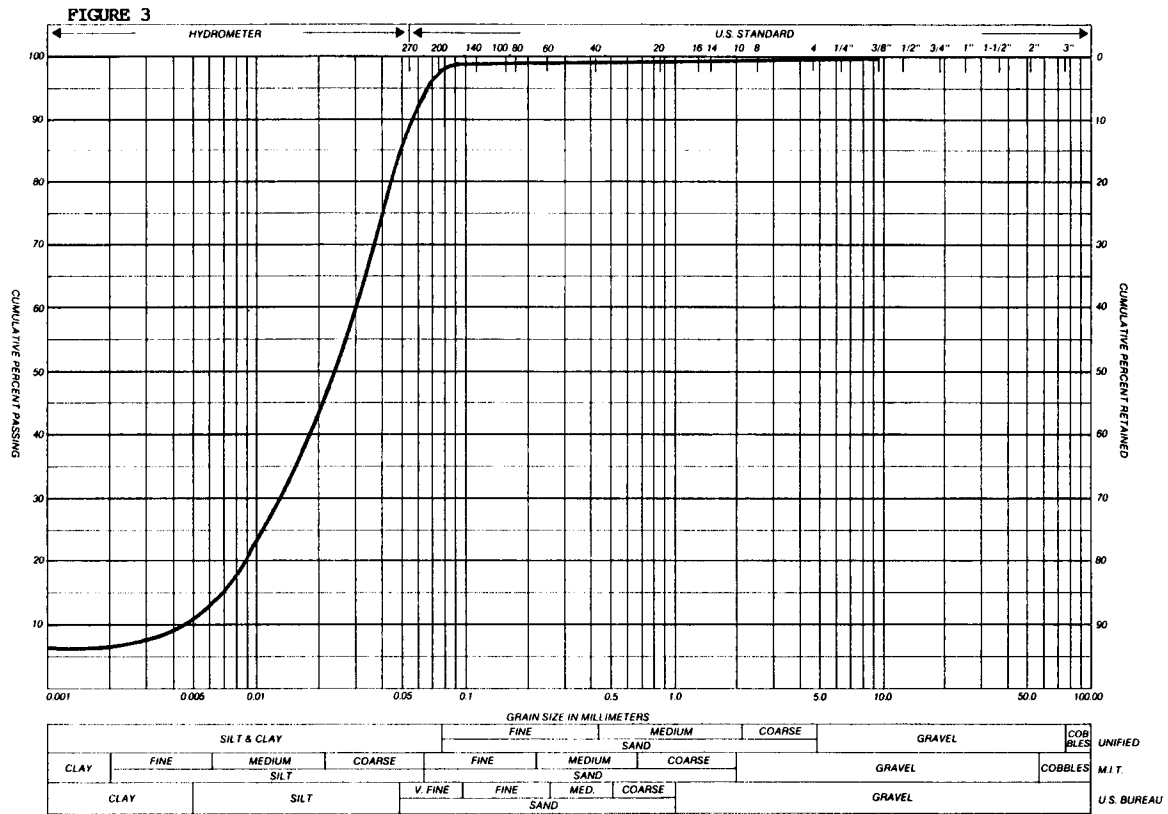
REMARKS Borehole 10, Sta. 10+474, 7.00 Rt CL, Kendall Township, Sample 4, Depth 2.30 to 2.90 m

VARVED CLAY Liquid Limit - 39, Plastic Limit - 20



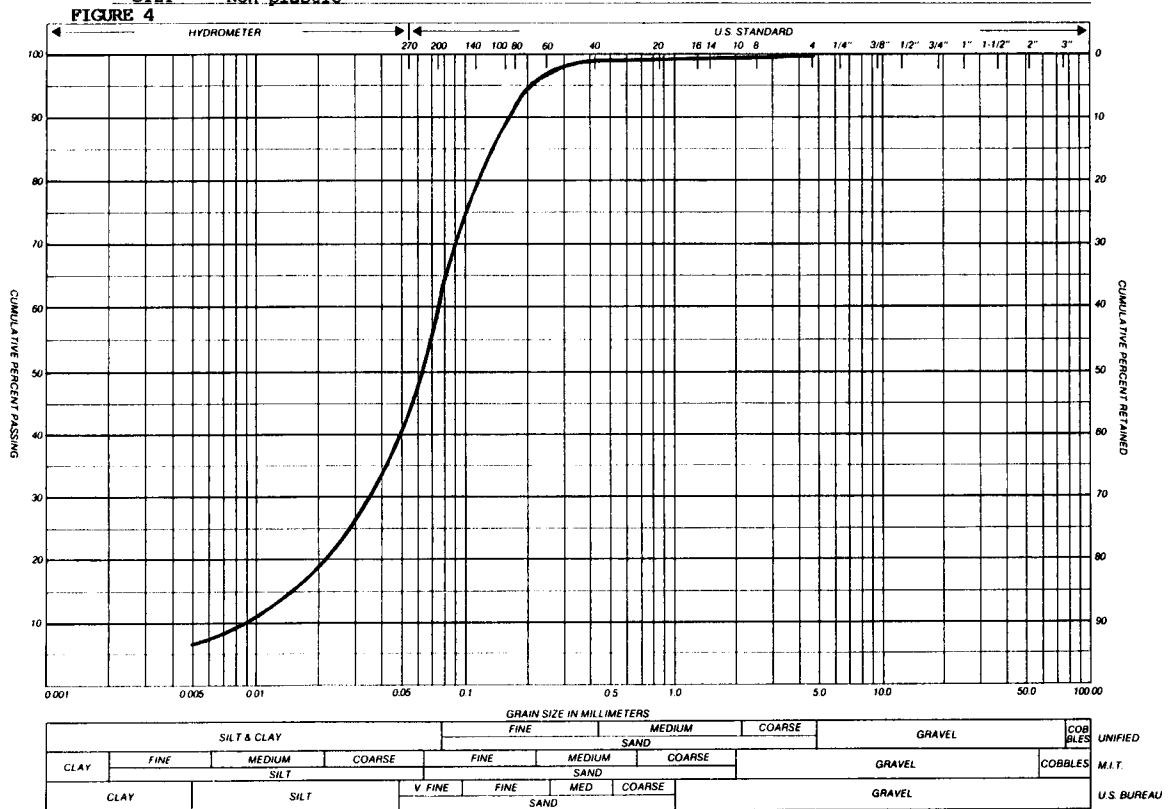
REMARKS Borehole 2, Sta. 17+942 8.60 Lt CL, Way Township, Sample 6, Depth 3.80 to 4.40 m

SILT Non Plastic



REMARKS Borehole 22, Sta. 12+987 6.10 Lt CL, Kendall Township, Sample 4, Depth 3.05 to 3.65 m

SILT Non plastic



REMARKS Borehole 22, Sta. 12+987 6.10 Lt CL, Kendall Township, Sample 5, Depth 4.55 to 5.20 m

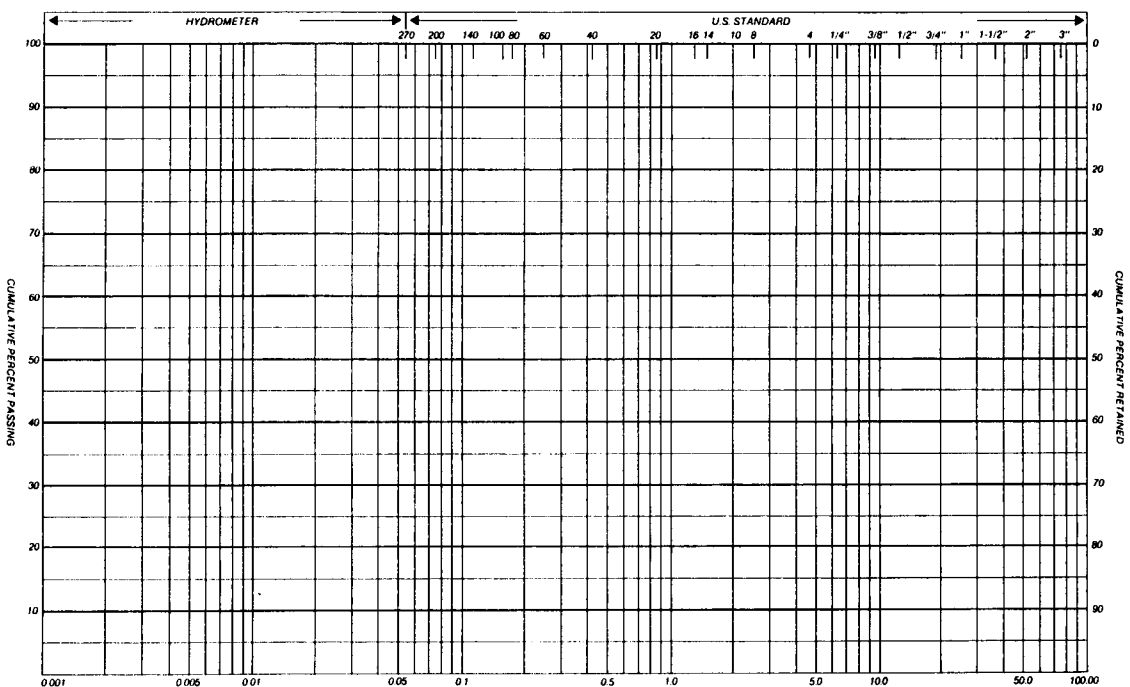
SANDY SILT

Figure 5 is a semi-logarithmic graph used for soil analysis, showing the relationship between sieve size and cumulative percent passing/retained. The x-axis represents sieve size in inches (top) and U.S. Standard sieve numbers (bottom). The y-axis represents cumulative percent passing (left) and cumulative percent retained (right). A curve is plotted showing the distribution of material.

Sieve Size (inches)	U.S. Standard Sieve Number	Cumulative Percent Passing (%)	Cumulative Percent Retained (%)
0.075	20	~5	~95
0.15	10	~10	~90
0.3	60	~25	~75
0.6	30	~60	~40
1.18	16	~90	~10
2.0	10	~95	~5
4.75	40	~98	~2
7.5	20	~99	~1
10	15	~100	~0

[illegible]

REMARKS Borehole 20, Sta. 12+650 5.90 Lt CL, Kendall Township, Sample 7, Depth 6.10 to 6.70 m
SAND

[illegible]

REMARKS

LIST OF ABBREVIATIONS

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N', - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 0.3m INTO THE SUBSOIL. DRIVEN BY MEANS OF A 63.5kg HAMMER FALLING FREELY A DISTANCE OF 0.76m.

DYNAMIC PENETRATION RESISTANCE: - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 51mm, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS. 0.3m INTO THE SUBSOIL. THE DRIVING ENERGY BEING 475J PER BLOW.

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS:-

<u>CONSISTENCY</u>	<u>'N' BLOWS/0.3m</u>	<u>c kPa</u>	<u>DENSENESS</u>	<u>'N' BLOWS/0.3m</u>
VERY SOFT	0 - 2	0 - 12	VERY LOOSE	0 - 4
SOFT	2 - 4	12 - 25	LOOSE	4 - 10
FIRM	4 - 8	25 - 50	COMPACT	10 - 30
STIFF	8 - 15	50 - 100	DENSE	30 - 50
VERY STIFF	15 - 30	100 - 200	VERY DENSE	> 50
HARD	> 30	> 200		
W.T.P.L. WETTER THAN PLASTIC LIMIT		D.T.P.L. DRIER THAN PLASTIC LIMIT		
A.P.L. ABOUT PLASTIC LIMIT				

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B.	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T.	SLOTTED TUBE SAMPLE		
	P.H. SAMPLE ADVANCED HYDRAULICALLY		
	P.M. SAMPLE ADVANCED MANUALLY		

SOIL TESTS

Qu	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL		

LOG OF BOREHOLE NO. 1 (STA. 17+906, 9.40 Lt CL, WAY TOWNSHIP)

PROJECT HIGHWAY 11, W.P. 722-89-00

OUR PROJECT NO. 97 KF 119

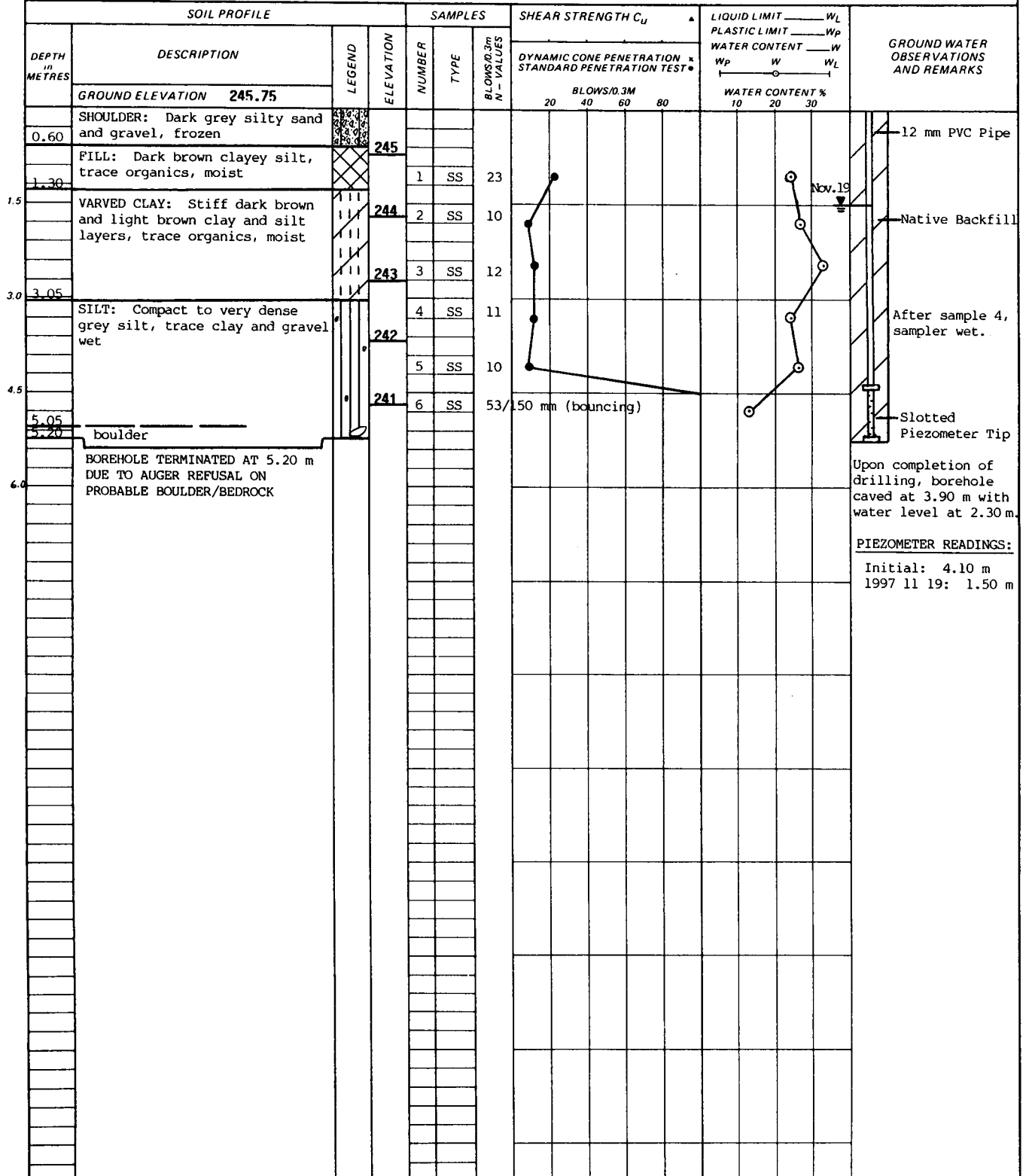
LOCATION Hearst, Ontario

BORING DATE 1997 11 11

ENGINEER G. Mitchell

BORING METHOD Continuous Flight Solid Stem Augers

TECHNICIAN D. Jotham



NOTES:

CHECKED BY: *[Signature]*

LOG OF BOREHOLE NO. 2 (STA. 17+942, 8.60 LT CL, WAY TOWNSHIP)

PROJECT HIGHWAY 11, W.P. 722-89-00

OUR PROJECT NO. 97 KF 119

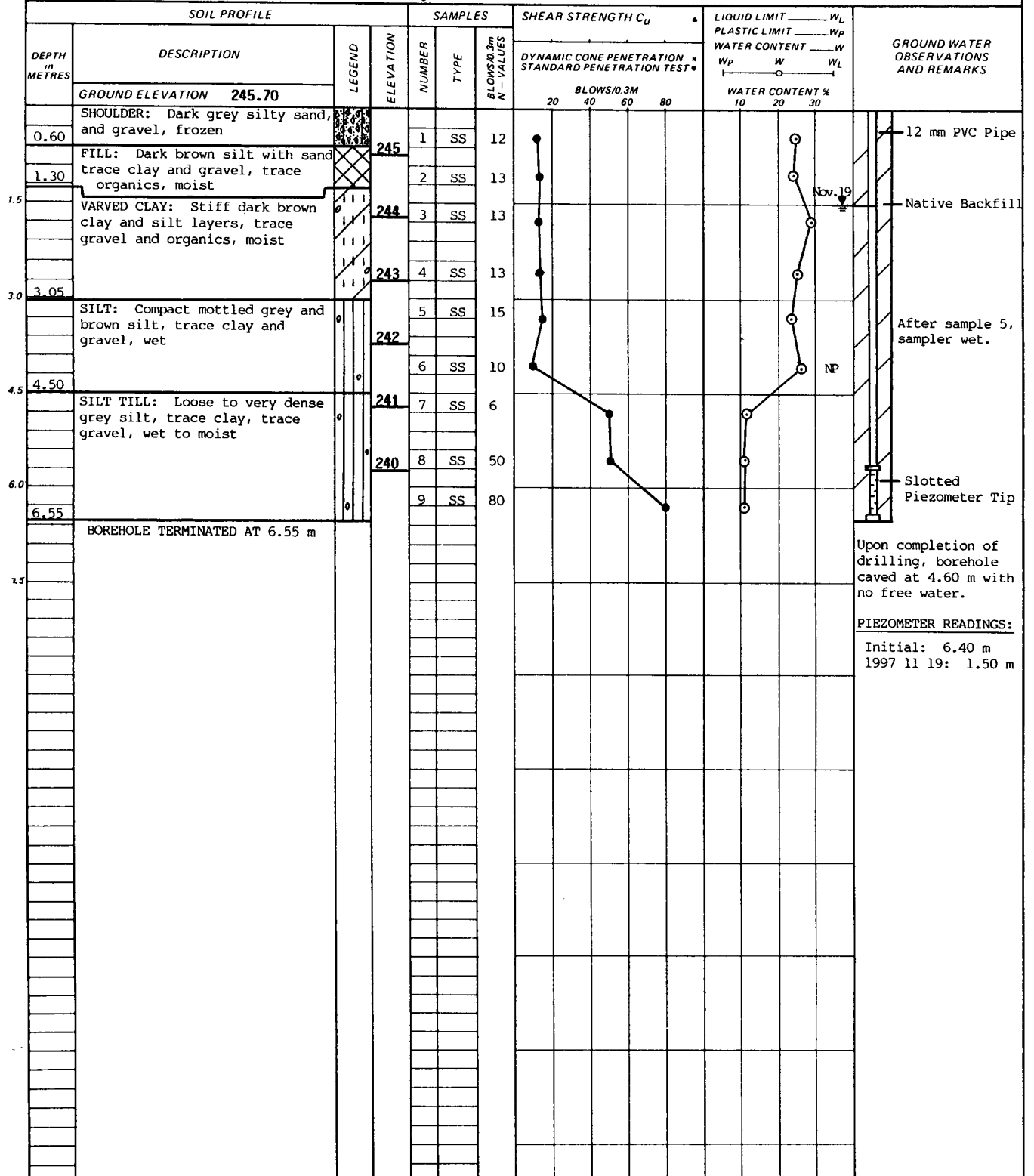
LOCATION Hearst, Ontario

BORING DATE 1997 11 11

ENGINEER G. Mitchell

BORING METHOD Continuous Flight Solid Stem Augers

TECHNICIAN D. Jotham



NOTES:

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LOG OF BOREHOLE NO. 3 (STA. 18+050, 8.00 Lt CL, WAY TOWNSHIP)

PROJECT HIGHWAY 11, W.P. 722-89-00

OUR PROJECT NO. 97 KP 119

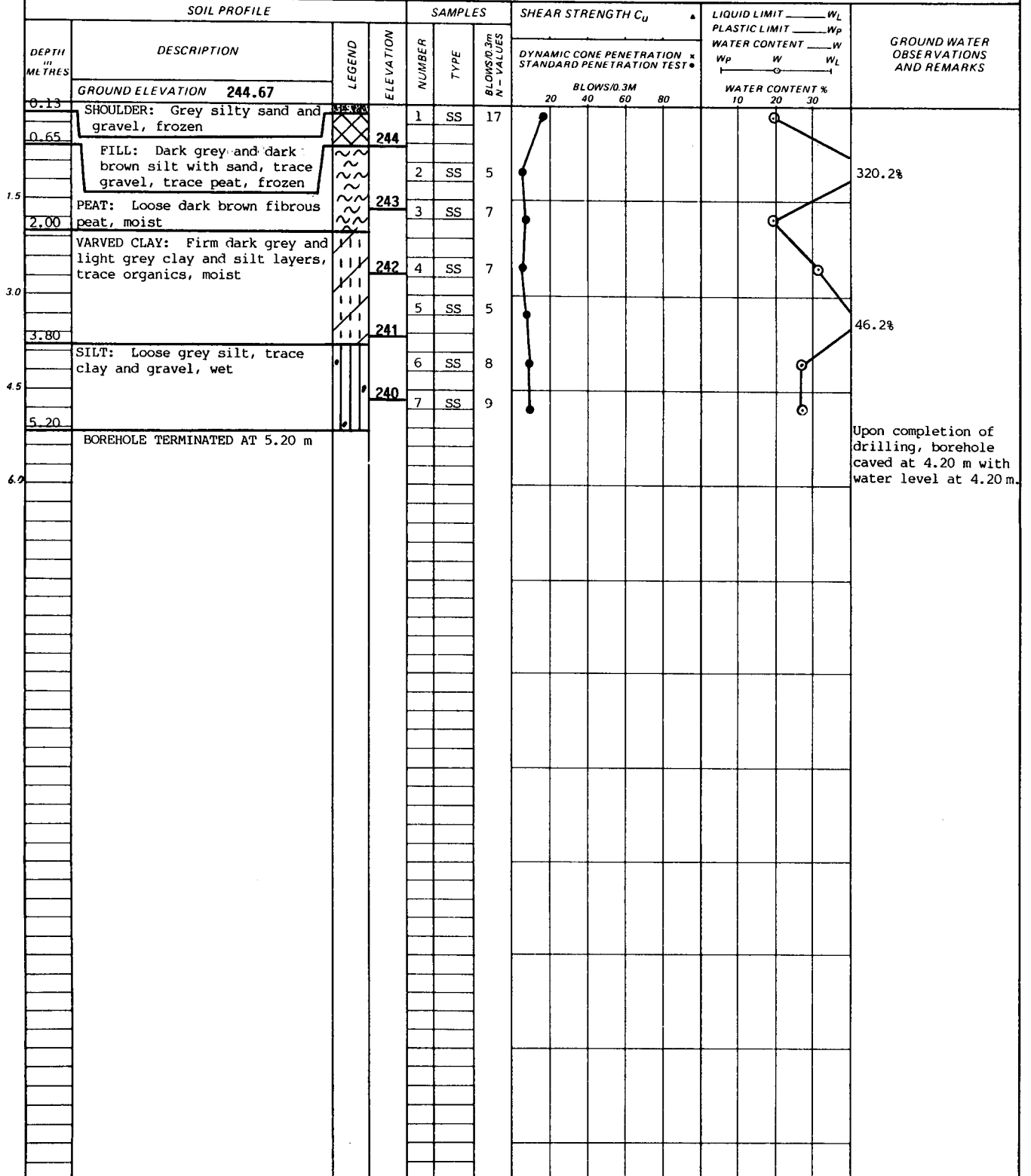
LOCATION Hearst, Ontario

BORING DATE 1997 11 11

ENGINEER G. Mitchell

BORING METHOD Continuous Flight Solid Stem Augers

TECHNICIAN D. Jotham



Upon completion of drilling, borehole caved at 4.20 m with water level at 4.20 m.

NOTES:

CHECKED BY: *AG*

LOG OF BOREHOLE NO.

4 (STA. 18+124, 10.80 Rt CL, WAY TOWNSHIP)

PROJECT HIGHWAY 11, W.P. 722-89-00

OUR PROJECT NO. 97 KP 119

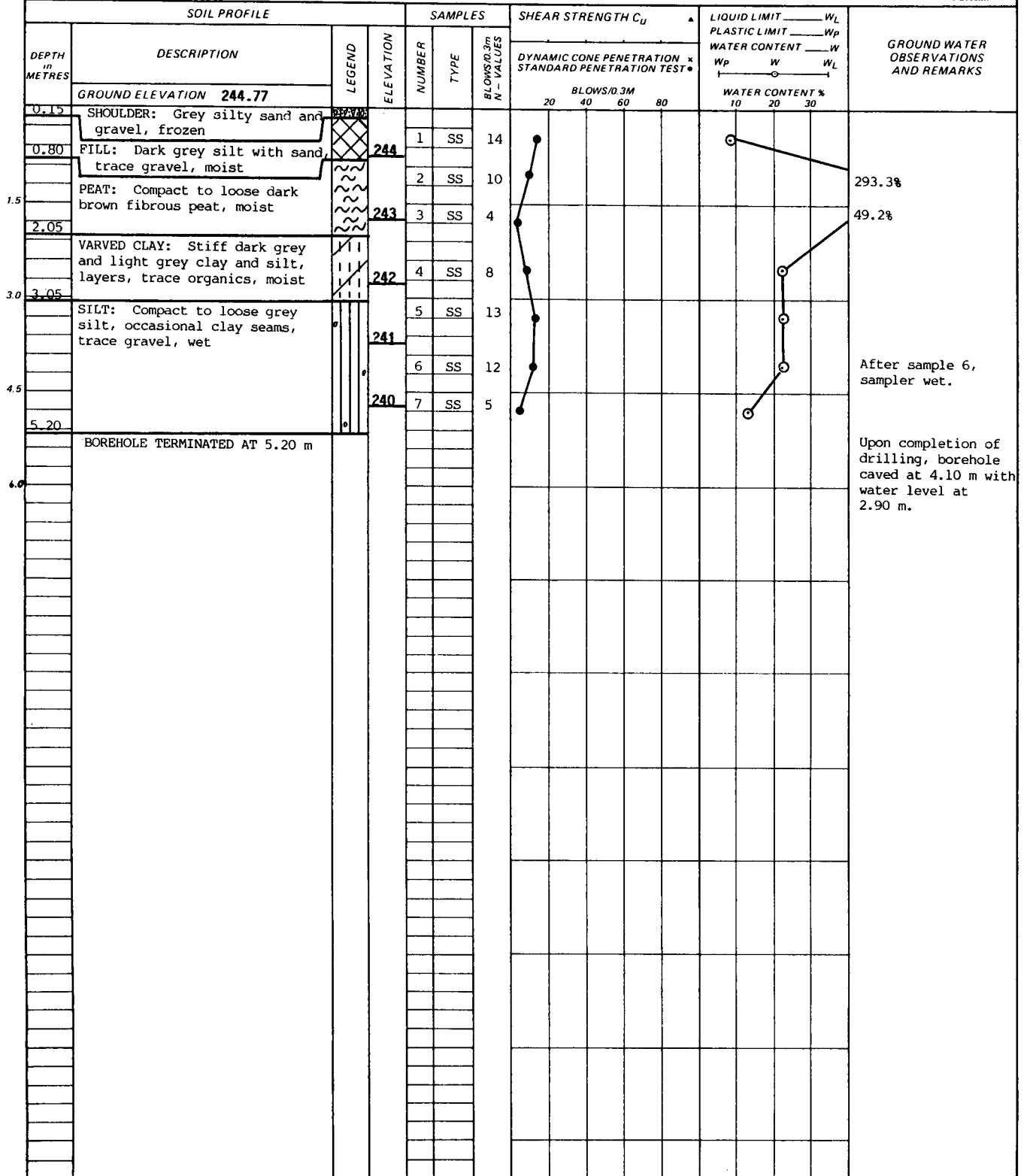
LOCATION Hearst, Ontario

BORING DATE 1997 11 11

ENGINEER G. Mitchell

BORING METHOD Continuous Flight Solid Stem Augers

TECHNICIAN D. Jotham



NOTES:

CHECKED BY: *[Signature]*

LOG OF BOREHOLE NO. 5 (STA. 18+156, 8.80 Rt CL, WAY TOWNSHIP)

PROJECT HIGHWAY 11, W.P. 722-89-00

OUR PROJECT NO. 97 KF 119

LOCATION Hearst, Ontario

BORING DATE 1997 11 11

ENGINEER G. Mitchell

BORING METHOD Continuous Flight Solid Stem Augers

TECHNICIAN D. Jotham

SOIL PROFILE				SAMPLES		SHEAR STRENGTH C_u		LIQUID LIMIT W_L		GROUND WATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST *	PLASTIC LIMIT W_p	WATER CONTENT W	
GROUND ELEVATION 244.94										
0.10	SHOULDER: Brown silty sand with gravel, frozen			1	SS	7				<p>12 mm PVC Pipe</p> <p>Native Backfill 294.4%</p> <p>Nov 19</p> <p>Slotted Piezometer Tip</p> <p>After sample 6, sampler wet.</p> <p>Upon completion of drilling, borehole caved at 4.20 m with water level at 2.00 m</p> <p>PIEZOMETER READINGS:</p> <p>Initial: 4.10 m</p> <p>1997 11 19: 2.45 m</p>
1.05	FILL: Dark brown silt with sand trace gravel, trace organics, moist		244	2	SS	7				
1.35	PEAT: Dark brown fibrous peat, moist		243	3	SS	4				
2.30	CLAY: Firm dark grey clay with silt, trace organics, moist		242	4	SS	4				
3.0	PEAT: Dark brown fibrous peat, moist		241	5	SS	7				
3.80	VARVED CLAY: Firm dark grey and light grey clay and silt layers, trace organics, moist		240	6	SS	7				
4.50	CLAY: Firm grey clay with silt, moist to wet			7	SS	10				
5.20	SILT: Compact grey silt, trace clay, wet									
6.0	BOREHOLE TERMINATED AT 5.20 m									

NOTES:

CHECKED BY: *[Signature]*

LOG OF BOREHOLE NO. 6 (STA. 18+238, 8.00 Rt CL, WAY TOWNSHIP)

PROJECT HIGHWAY 11, W.P. 722-89-00

LOCATION Hearst, Ontario

BORING DATE 1997 11 11

OUR PROJECT NO. 97 KF 119

ENGINEER G. Mitchell

BORING METHOD Continuous Flight Solid Stem Augers

TECHNICIAN D. Jotham

SOIL PROFILE						SAMPLES	SHEAR STRENGTH C _d		Liquid Limit — W _L Plastic Limit — W _p Water Content — W W_p W W_L	GROUND WATER OBSERVATIONS AND REMARKS
DEPTH IN METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST *	BLOWS/0.3M 20 40 60 80	WATER CONTENT % 10 20 30	
	GROUND ELEVATION 244.68									
0.45	SHOULDER: Brown silty sand, moist	[Symbol]	244	1	SS	6				
1.05	FILL: Dark brown and grey mixture of clay with silt, trace sand and gravel, trace organics, moist	[Symbol]		2	SS	16				
1.25	PEAT: Dark brown fibrous peat, moist	[Symbol]	243	3	SS	15				
2.30	VARVED CLAY: Very stiff dark brown and light brown clay and silt layers, trace gravel, moist	[Symbol]	242	4	SS	19				
3.00	SILT: Compact mottled brown silt with clay, trace gravel, moist	[Symbol]	241	5	SS	21				
4.50	becoming brown, occasional wet silt seams	[Symbol]	240	6	SS	21				
5.20	becoming grey silt, moist to wet	[Symbol]								
	BOREHOLE TERMINATED AT 5.20 m									Upon completion of drilling, borehole open with no free water.

NOTES:

CHECKED BY: LY

LOG OF BOREHOLE NO. 7 (STA. 18+358, 8,80 Rt CL, WAY TOWNSHIP)

PROJECT HIGHWAY 11, W.P. 722-89-00

OUR PROJECT NO. 97 KF 119

LOCATION Hearst, Ontario

BORING DATE 1997 11 12

ENGINEER G. Mitchell

BORING METHOD Continuous Flight Solid Stem Augers

TECHNICIAN D. Jotham

SOIL PROFILE				SAMPLES		SHEAR STRENGTH C_u		LIQUID LIMIT W_L		GROUND WATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST *		PLASTIC LIMIT W_p	
									WATER CONTENT W	
									W_p W W_L	
	GROUND ELEVATION 244.40									
0.62	SHOULDER: 100 mm crushed granular over 520 mm of fine to medium sand, trace silt and gravel, moist		244	1	SS	11				
				2	SS	11				
1.5	FILL: Dark brown clay with silt, trace gravel, trace organics, moist		243	3	SS	14				
2.30	CLAY: Stiff mottled brown clay with silt, trace gravel, moist		242	4	SS	17				
2.75				5	SS	20				
3.00	SILT: Compact mottled brown silt with clay, trace sand and gravel, moist		241							
	becoming grey									
4.20			240	6	SS	9				
4.5	becoming grey silt, trace gravel, occasional clay seams, moist to wet									
5.20	SILT TILL: Stiff grey clayey silt, trace gravel, moist									
	BOREHOLE TERMINATED AT 5.20 m									
6.0										
									</	

Upon completion of drilling, borehole open with no free water.

NOTES:

CHECKED BY: *[Signature]*

LOG OF BOREHOLE NO. 8 (STA. 10+245, 8.10 Rt CL, KENDALL TOWNSHIP)

PROJECT HIGHWAY 11, W.P. 722-89-00

OUR PROJECT NO. 97 KF 119







LOCATION Hearst, Ontario

BORING DATE 1997 11 12

ENGINEER G. Mitchell

BORING METHOD Continuous Flight Solid Stem Augers

TECHNICIAN D. Jotham

SOIL PROFILE				SAMPLES			SHEAR STRENGTH C_u		LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			GROUND WATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST *	WATER CONTENT % W_P W W_L				
	GROUND ELEVATION 243.21											
	SHOULDER: 450 mm of crushed granular over 450 mm of fine silty sand, trace gravel, moist		243									
0.90				1	SS	42						
	FILL: Dark brown clay and silt, trace gravel, some dark brown fibrous peat, moist		242	2	SS	12						
1.50				3	SS	11						
	becoming dark brown mixture of silt and sand, trace wood, trace organics, moist		241	4	SS	8						
2.20				5	SS	2						
	VARVED CLAY: Stiff to soft dark brown and light brown clay and silt layers, trace gravel, trace organics, moist		240	6	SS	3						
3.00				7	SS	7						
	becoming grey, moist to wet		239									
4.50												
	SILT: Loose grey silt with clay, trace gravel, wet		238									
5.20												
	BOREHOLE TERMINATED AT 5.20 m											
6.00												

NOTES:

CHECKED BY: LY

LOG OF BOREHOLE NO. 9 (STA. 10+348, 7.70 Rt CL, Kendall Township)

PROJECT HIGHWAY 11, W.P. 722-89-00

OUR PROJECT NO. 97 KP 119

















LOCATION Hearst, Ontario

BORING DATE 1997 11 12

ENGINEER G. Mithcell

BORING METHOD Continuous Flight Solid Stem Augers

TECHNICIAN D. Jotham

SOIL PROFILE				SAMPLES		SHEAR STRENGTH C_u		LIQUID LIMIT W_L			GROUND WATER OBSERVATIONS AND REMARKS			
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST *		PLASTIC LIMIT W_p					
									WATER CONTENT W					
							BLOWS/0.3M		WATER CONTENT %					
	GROUND ELEVATION 242.57						20	40	60	80	10	20	30	
0.60	SHOULDER: 400 mm of crushed granular, frozen over 200 mm of brown fine to medium sand, trace silt and gravel, moist		242	1	SS	22								
1.20				2	SS	14								
1.50	FILL: Dark brown and grey silt with clay, trace gravel, trace organics, and wood, moist		241	3	SS	10								
2.85	PEAT: Dark brown fibrous peat, moist		240	4	SS	10								
3.0				5	SS	6								
4.20	VARVED CLAY: Stiff to firm dark brown and light brown clay and silt layers, trace gravel, moist to wet becoming grey		239											
4.5			238											
5.20	SILT: Loose grey silt, trace clay and sand, wet			6	SS	9								
	BOREHOLE TERMINATED AT 5.20 m													
6.0														

Upon completion of drilling, borehole caved at 4.20 m with water level at 4.20

NOTES:

CHECKED BY: *[Signature]*

LOG OF BOREHOLE NO. 10 (STA. 10+474, 7.00 Rt CL, KENDALL TOWNSHIP)

PROJECT HIGHWAY 11, W.P. 722-89-00

OUR PROJECT NO. 97 KF 119

LOCATION Hearst, Ontario

BORING DATE 1997 11 12

ENGINEER G. Mitchell

BORING METHOD Continuous Flight Solid Stem Augers

TECHNICIAN D. Jotham

SOIL PROFILE				SAMPLES		SHEAR STRENGTH C_u		LIQUID LIMIT W_L		GROUND WATER OBSERVATIONS AND REMARKS	
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST *		PLASTIC LIMIT W_p		
							BLOWS/0.3M		WATER CONTENT W		
							20 40 60 80		10 20 30		
	GROUND ELEVATION 242.24										
	SHOULDER: 600 mm of crushed granular, frozen over 650 mm of brown fine to coarse sand, trace silt and gravel, moist to wet		242	1	SS	52					
1.25			241	2	SS	9					
1.5	FILL: Brown mixture of clay and silt, trace sand and gravel, trace peat to 1.80 m, moist			3	SS	14					
2.15			240								
	VARVED CLAY: Stiff grey and brown clay and silt layers, trace organics, moist			4	SS	11					
3.00			239	5	SS	7					
	CLAY: Firm grey clay, occasional silt seams, trace gravel, moist										
4.25			238								
4.5	SILT : Loose grey silt with clay, wet			6	SS	8					
5.20			237								
	BOREHOLE TERMINATED AT 5.20 m										
6.0											

Upon completion of drilling, borehole caved at 4.25 m with no free water.

NOTES:

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LOG OF BOREHOLE NO. 11 (STA. 10+642, 33.00 Rt CL, KENDALL TOWNSHIP)

PROJECT HIGHWAY 11, W.P. 722-89-00

OUR PROJECT NO. 97 KF 119

LOCATION Hearst, Ontario

BORING DATE 1997 11 12

ENGINEER G. Mitchell

BORING METHOD Continuous Flight Solid Stem Augers

TECHNICIAN D. Jotham

SOIL PROFILE				SAMPLES			SHEAR STRENGTH C_u		LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			GROUND WATER OBSERVATIONS AND REMARKS		
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST *				WATER CONTENT % W_P W W_L			
							BLOWS/0.3M 20 40 60 80							
	GROUND ELEVATION 240.75													
0.60	PAVEMENT STRUCTURE: 70 mm of asphaltic concrete over 530 mm of crushed granular, frozen		240	1	SS	17								Upon completion of drilling, borehole caved at 3.80 m with no free water.
1.50	FILL: Dark brown and grey mixture of clay, silt, sand and gravel, trace peat, moist		239	2	SS	8								
				3	SS	8								
	VARVED CLAY: Firm dark grey and light grey clay and silt layers, trace gravel, trace organics, moist to wet		238	4	SS	5								
3.00				5	SS	8								
	SILT: Loose grey silt with clay trace sand and gravel, wet		237											
4.20														
4.50	SILT TILL: Loose grey clayey silt, trace gravel, wet to moist		236	6	SS	9								
5.20														
	BOREHOLE TERMINATED AT 5.20 m													
6.00														

NOTES:

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LOG OF BOREHOLE NO.

12 (STA. 11+474, 7.05 Rt CL, KENDALL TOWNSHIP)

PROJECT HIGHWAY 11, W.P. 722-89-00

OUR PROJECT NO. 97 KF 119

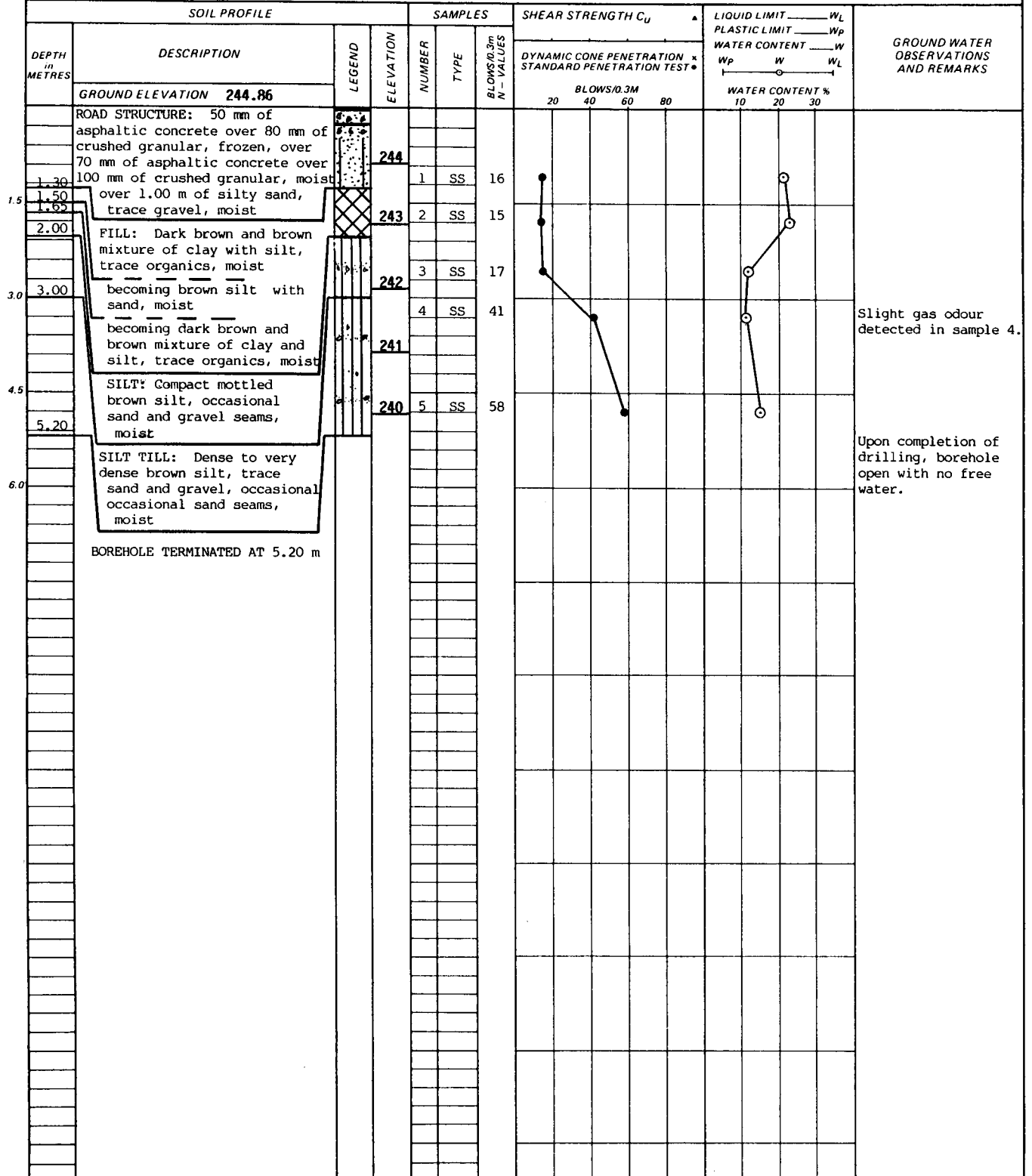
LOCATION Hearst, Ontario

BORING DATE 1997 11 12

ENGINEER G. Mitchell

BORING METHOD Continuous Flight Solid Stem Augers

TECHNICIAN D. Jotham



NOTES:

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LOG OF BOREHOLE NO. 13 (STA. 11+544, 6.90 Rt CL, KENDALL TOWNSHIP)

PROJECT HIGHWAY 11, W.P. 722-89-00

OUR PROJECT NO. 97 KF 119

LOCATION Hearst, Ontario

BORING DATE 1997 11 18

ENGINEER G. Mitchell

BORING METHOD Continuous Flight Solid Stem Augers

TECHNICIAN D. Jotham

SOIL PROFILE				SAMPLES		SHEAR STRENGTH C_u		LIQUID LIMIT W_L		GROUND WATER OBSERVATIONS AND REMARKS	
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST		PLASTIC LIMIT W_P		
							BLOWS/0.3M		WATER CONTENT %		
							20 40 60 80		10 20 30		
	GROUND ELEVATION 244.55										
	ROAD STRUCTURE: 60 mm of asphaltic concrete over 370 mm of crushed granular, frozen, over 1.17 m of brown fine to medium sand, trace silt and gravel, moist		244								
1.5	1.60		243	1	SS	14					
	SILT: Compact mottled brown silt with clay, trace gravel, moist		242	2	SS	22					
			242	3	SS	26					
3.0	3.00		241	4	SS	71					
	becoming very dense brown silt with sand, trace gravel, moist		241								
	4.00		240								
	becoming grey, wet		240								
4.5	5.20			5	SS	75/175 mm					
	BOREHOLE TERMINATED AT 5.20 m										
6.0											
				</							

Upon completion of
drilling, borehole
caved at 4.00 m with
water level at
3.80 m.

NOTES:

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14 (STA. 11+590, 8.70 Lt CL, KENDALL TOWNSHIP)

OUR PROJECT NO. 97 KF 119

BORING DATE 1997 11 18

ENGINEER G. Mitchell

TECHNICIAN D. Jotham

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15 (STA. 11+730, 56.00 Rt CL, KENDALL TOWNSHIP)

OUR PROJECT NO. 97 KF 119

BORING DATE 1997 11 18

ENGINEER G. Mitchell

TECHNICIAN D. Jotham

1.5

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LOG OF BOREHOLE NO.

16 (STA. 12+144, 20.00 Lt CL, KENDALL TOWNSHIP)

PROJECT HIGHWAY 11, W.P. 722-89-00

OUR PROJECT NO. 97 KF 119

LOCATION Hearst, Ontario

BORING DATE 1997 11 18

ENGINEER G. Mitchell

BORING METHOD Continuous Flight Solid Stem Augers

TECHNICIAN D. Jotham

SOIL PROFILE				SAMPLES		SHEAR STRENGTH C_u		LIQUID LIMIT W_L			GROUND WATER OBSERVATIONS AND REMARKS
DEPTH "m" METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST *		WATER CONTENT %		
							BLOWS/0.3M		WATER CONTENT %		
							20	40	60	80	
	GROUND ELEVATION 240.02										
	ROAD STRUCTURE: 50 mm of asphaltic concrete over 350 mm of crushed granular, moist over										
0.80	400 mm of brown fine to medium sand, trace silt, and gravel, wet		239	1	SS	12					
1.20				2	SS	13					
1.5											
	FILL: Dark brown and brown brown mixture of clayey silt, trace gravel and organics, moist		238								
2.50				3	SS	8					
3.0				4	SS	6					
	SILT: Stiff mottled brown clayey silt, trace gravel, moist		237								
4.20											
	VARVED CLAY: Firm grey clay and silt layers, trace gravel, moist to wet		236								
4.5											
	SILT TILL: Dense grey silt with sand, trace gravel, moist		235	6	SS	43					
5.20											
	BOREHOLE TERMINATED AT 5.20 m										
6.0											

Upon completion of drilling, borehole caved at 4.10 m with water level at 3.90 m.

Upon completion of drilling, borehole caved at 4.10 m with water level at 3.90 m.

NOTES:

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LOG OF BOREHOLE NO.

17 (STA. 12+287, 6.55 Rt CL, KENDALL TOWNSHIP)

PROJECT HIGHWAY 11, W.P. 722-89-00

OUR PROJECT NO. 97 KF 119

LOCATION Hearst, Ontario

BORING DATE 1997 11 18

ENGINEER G. Mitchell

BORING METHOD Continuous Flight Solid Stem Augers

TECHNICIAN D. Jotham

SOIL PROFILE				SAMPLES		SHEAR STRENGTH C_u		LIQUID LIMIT W_L		GROUND WATER OBSERVATIONS AND REMARKS
DEPTH IN METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST •	PLASTIC LIMIT W_p		
								WATER CONTENT W		
								W_p	W_L	
	GROUND ELEVATION 239.52							WATER CONTENT % 10 20 30		
0.34	SHOULDER: 340 mm of silty									Upon completion of drilling, borehole caved at 4.20 m with water level at 3.80 m
0.55	crushed granular, frozen		239							
0.65										
1.30	FILL: Brown clayey silt, trace gravel, moist			1	SS	13				
	becoming brown fine to medium sand, moist		238	2	SS	16				
	PEAT: Dark brown amorphous peat, moist		237	3	SS	10				
3.05	VARVED CLAY: Stiff to very stiff dark brown and light brown clay and silt layers, trace gravel, moist		236	4	SS	6				
3.80	CLAY: Firm grey silty clay, trace sand and gravel, moist to wet			5	SS	12				
4.50	SILT: Compact grey silt, trace clay and gravel, wet		235	6	SS	16				
5.20	SILT TILL: Compact grey silt with sand, trace gravel, moist									
6.0	BOREHOLE TERMINATED AT 5.20 m									

Upon completion of drilling, borehole caved at 4.20 m with water level at 3.80 m

NOTES:

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LOG OF BOREHOLE NO.

18 (STA. 12+367, 32.00 Lt CL, KENDALL TOWNSHIP)

PROJECT HIGHWAY 11, W.P. 722-89-00

OUR PROJECT NO. 97 KF 119

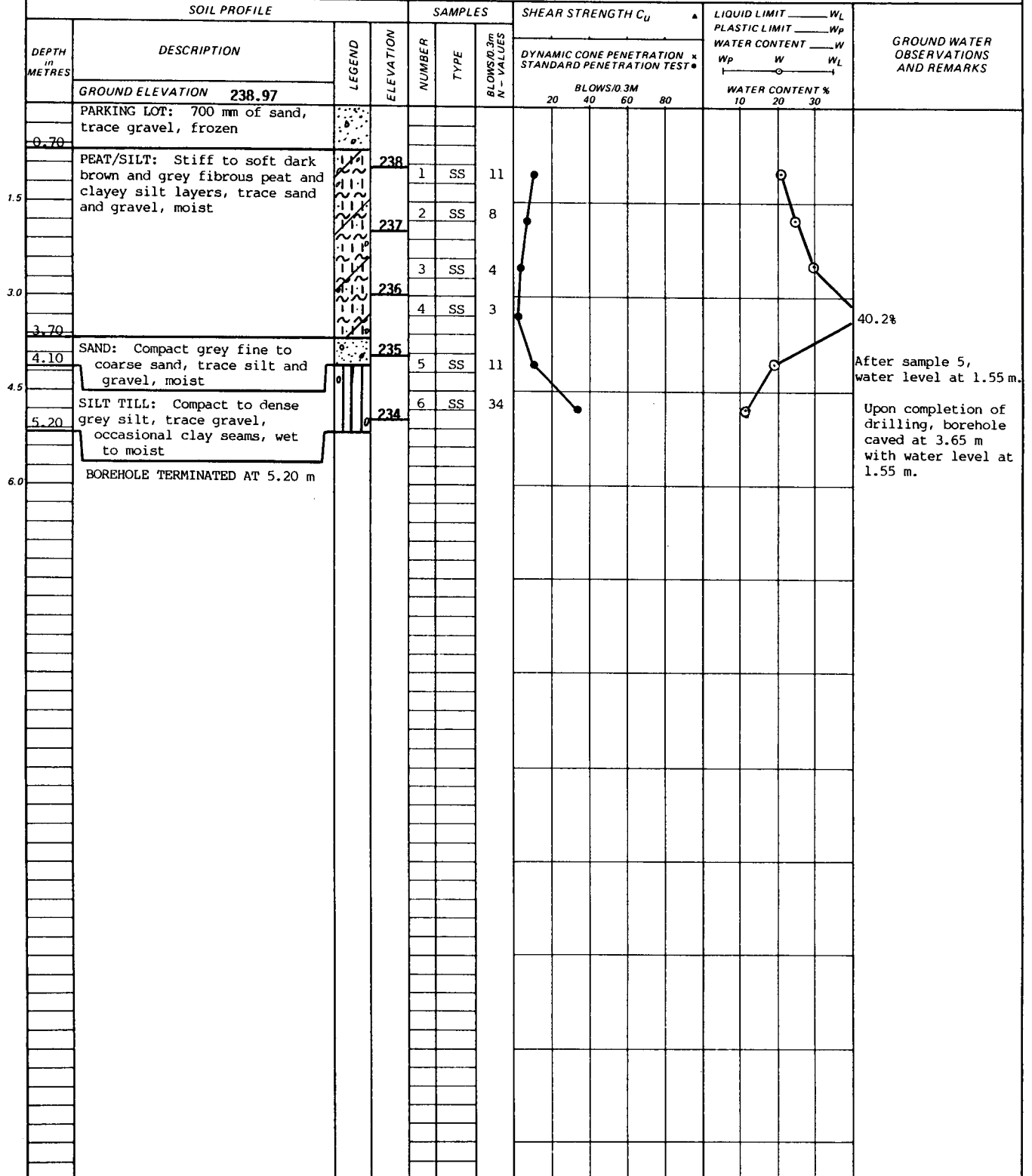
LOCATION Hearst, Ontario

BORING DATE 1997 11 18

ENGINEER G. Mitchell

BORING METHOD Continuous Flight Solid Stem Augers

TECHNICIAN D. Jotham



NOTES:

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LOG OF BOREHOLE NO. 19 (STA. 12+558, 6.25 Lt CL, KENDALL TOWNSHIP)

PROJECT HIGHWAY 11, W.P. 722-89-00

OUR PROJECT NO. 97 KF 119

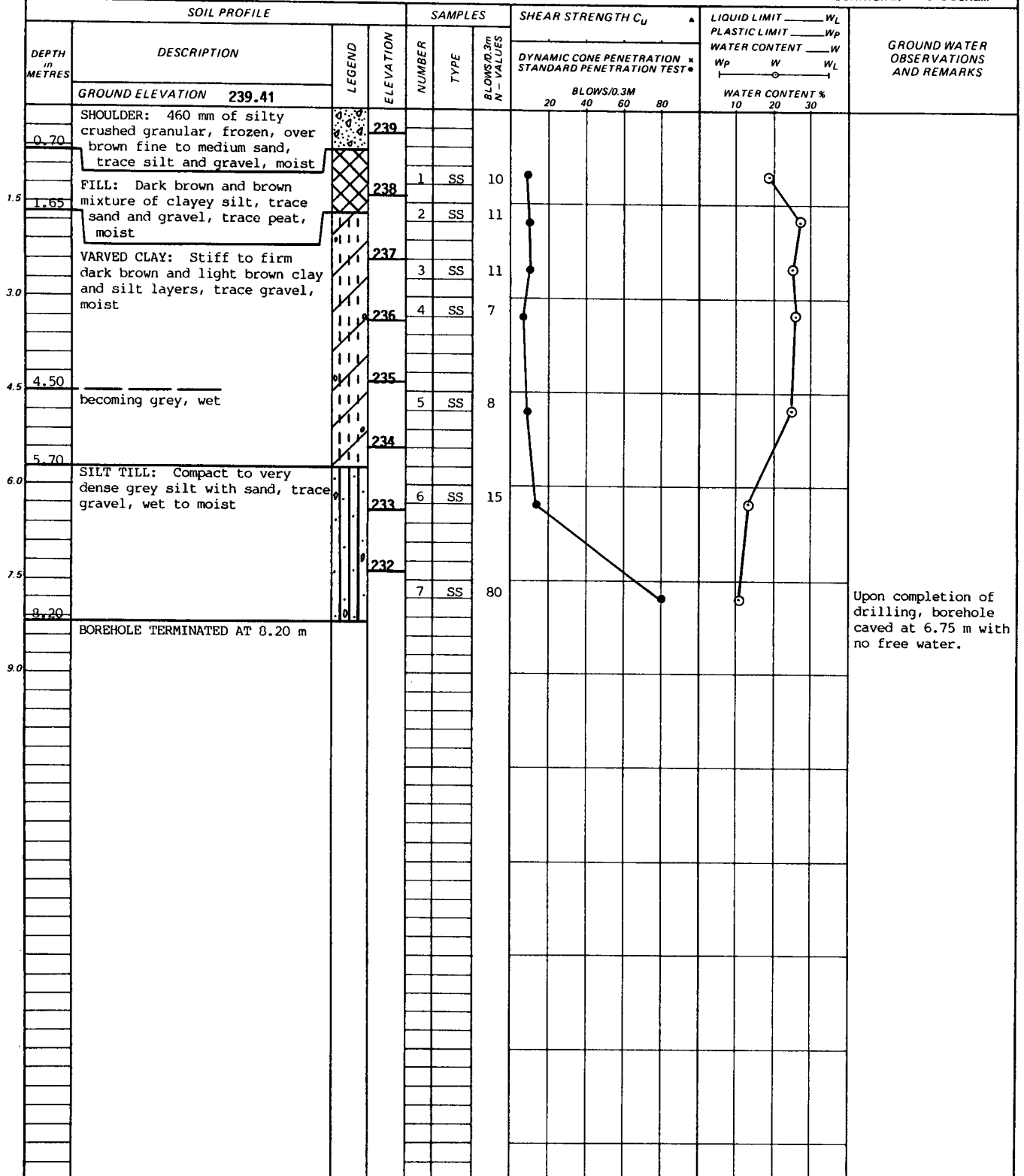
LOCATION Hearst, Ontario

BORING DATE 1997 11 18

ENGINEER G. Mitchell

BORING METHOD Continuous Flight Solid Stem Augers

TECHNICIAN D. Jotham



NOTES:

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LOG OF BOREHOLE NO.

20 (STA. 12+650, 5.90 Lt CL, KENDALL TOWNSHIP)

PROJECT HIGHWAY 11, W.P. 722-89-00

OUR PROJECT NO. 97 KP 119

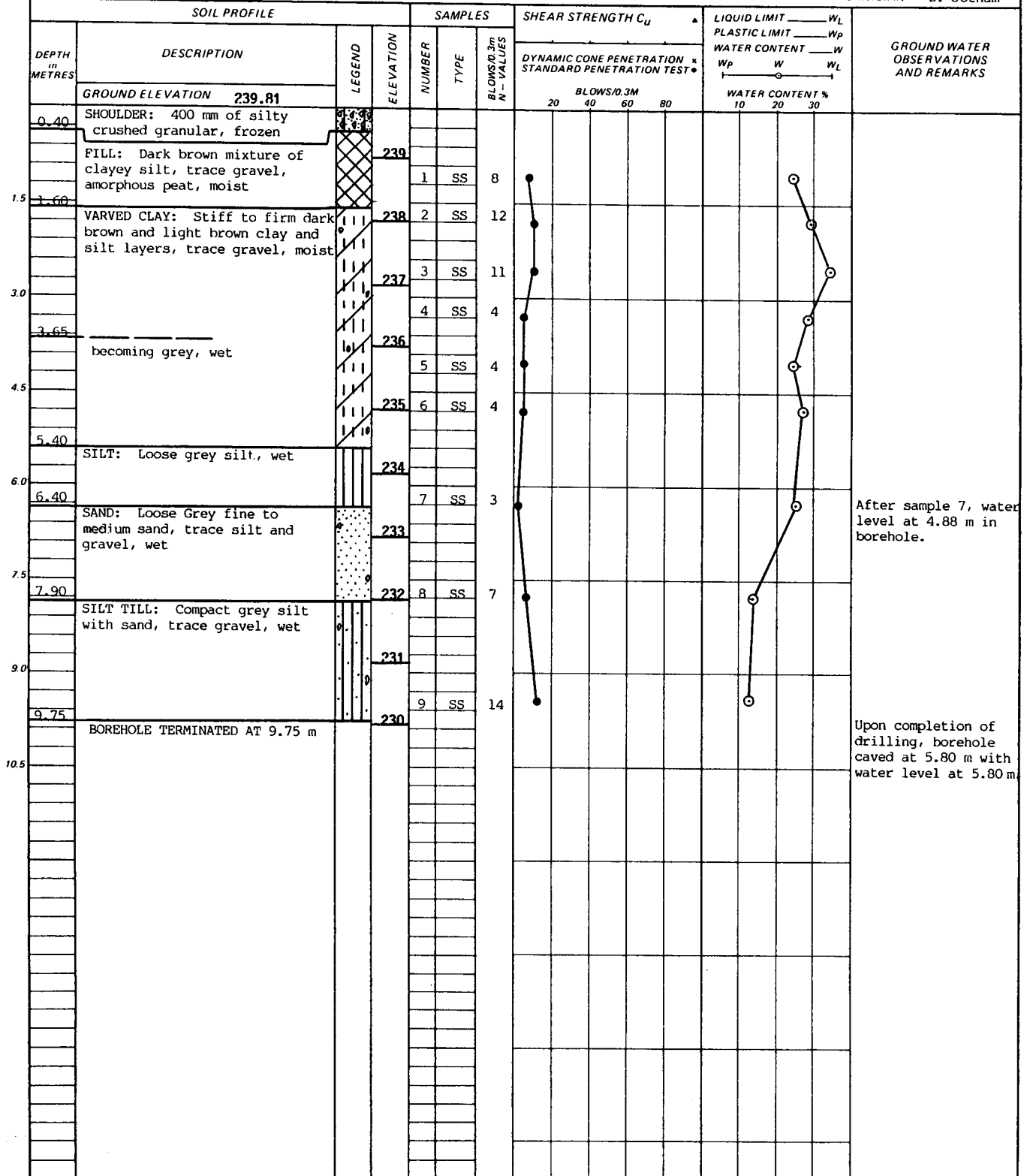
LOCATION Hearst, Ontario

BORING DATE 1997 11 19

ENGINEER G. Mitchell

BORING METHOD Continuous Flight Solid Stem Augers

TECHNICIAN D. Jotham



NOTES:

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LOG OF BOREHOLE NO. 21 (STA. 12+844, 6.60 Lt CL, KENDALL TOWNSHIP)

PROJECT HIGHWAY 11, W.P. 722-89-00

LOCATION Hearst, Ontario

BORING DATE 1997 11 19

OUR PROJECT NO. 97 KF 119

ENGINEER G. Mitchell

BORING METHOD Continuous Flight Solid Stem Augers

TECHNICIAN D. Jotham

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NOTES:

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LOG OF BOREHOLE NO. 22 (STA. 12+987, 6.10 Lt CL, KENDALL TOWNSHIP)

PROJECT HIGHWAY 11, W.P. 722-89-00

OUR PROJECT NO. 97 KF 119

LOCATION Hearst, Ontario

BORING DATE 1997 11 19

ENGINEER G. Mitchell

BORING METHOD Continuous Flight Solid Stem Augers

TECHNICIAN D. Jotham

SOIL PROFILE				SAMPLES			SHEAR STRENGTH C_u		LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W		GROUND WATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST *		WATER CONTENT %		
							BLOWS/0.3M 20 40 60 80		WATER CONTENT % 10 20 30		
	GROUND ELEVATION 240.43										
0.65	SHOULDER: 400 mm of silty crushed granular, frozen, over 250 mm silty sand, moist		240								
1.50	FILL: Dark brown mixture of clay and silt, trace peat, moist		239	1	SS	14					
2.30	VARVED CLAY: Stiff dark brown and light brown clay and silt layers, trace gravel, moist		238	2	SS	11					
3.00	SILT: Compact mottled brown silt, trace sand and gravel, moist to wet		237	3	SS	12					
3.90				4	SS	19					NP After sample 4, sampler wet.
4.50	SANDY SILT: Loose grey sandy silt, occasional silt seams, wet		236	5	SS	9					
5.20	BOREHOLE TERMINATED AT 5.20 m										Upon completion of drilling, borehole caved at 3.50 m with water level at 2.75 m.
6.00											
										</	

NOTES:

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LOG OF BOREHOLE NO. 23 (STA. 13+286, 6.50 Lt CL, KENDALL TOWNSHIP)

PROJECT HIGHWAY 11, W.P. 722-89-00

LOCATION Hearst, Ontario

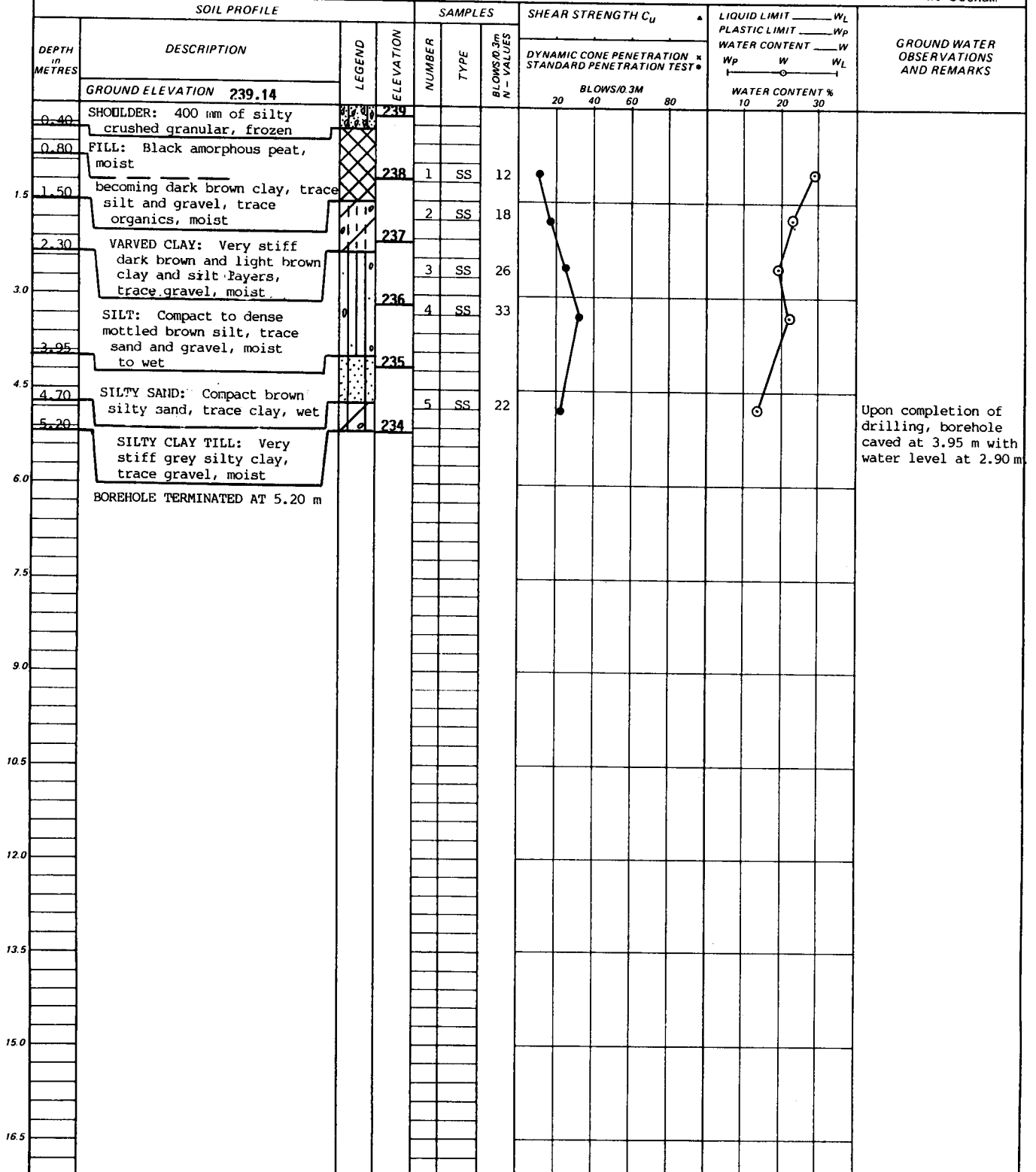
BORING METHOD Continuous Flight Solid Stem Augers

BORING DATE 1997 11 19

OUR PROJECT NO. 97 KP 119

ENGINEER G. Mitchell

TECHNICIAN D. Jotham



NOTES:

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