

GEOCRES No. 42F-15DIST. 53 REGION W.P. No. 29-97-00CONT. No. W. O. No. STR. SITE No. HWY. No. 11LOCATION FROM THE FRASER RIVER BRIDGE
WESTERLY TO THE REGIONAL BOUNDARY
36.3KMNo of PAGES -OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.REMARKS:

FOUNDATION INVESTIGATION AND DESIGN REPORT

W.P. 29-97-00

HIGHWAY 11

**FROM THE FRASER RIVER BRIDGE
WESTERLY TO THE REGIONAL BOUNDARY, 36.3 km
MTO DISTRICT 53, NEW LISKEARD**

for

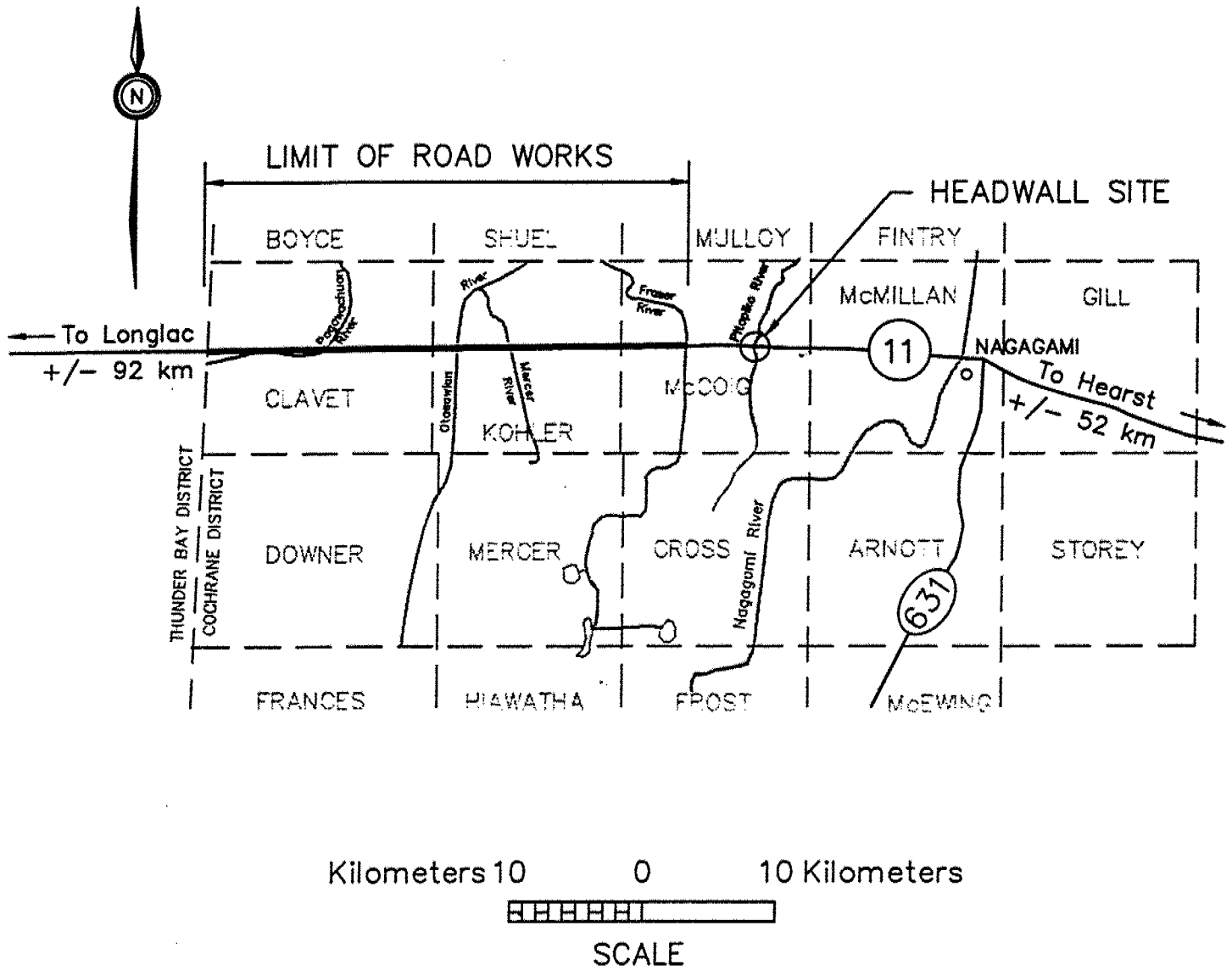
PHILIPS PLANNING + ENGINEERING LIMITED

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Job No. 97 TF 78
Report 2

APRIL, 1998



KEY PLAN
W.P. 29-97-00

TABLE OF CONTENTS

Page No.

	KEY PLAN	i
1.0	FOUNDATION INVESTIGATION REPORT	1
1.1	INTRODUCTION	1
1.2	SITE DESCRIPTION	2
1.3	INVESTIGATION PROCEDURES	2
1.4	SUBSURFACE CONDITIONS	4
2.0	FOUNDATION DESIGN REPORT	9
2.1	DISCUSSION AND RECOMMENDATIONS	9
2.2	CLOSING	13

FIGURE 1 TO 6 PARTICLE SIZE DISTRIBUTION CHARTS

LIST OF ABBREVIATIONS

LOG OF BOREHOLE SHEETS

DRAWINGS 1 TO 4 SITE SKETCHES

Peto MacCallum Ltd.

C O N S U L T I N G E N G I N E E R S

FOUNDATION INVESTIGATION AND DESIGN REPORT FOR CULVERT TREATMENTS HIGHWAY 11, FROM THE REGIONAL BOUNDARY WESTERLY TO THE FRASER RIVER BRIDGE, 36.3 km W.P. 29-97-00

1.0 FOUNDATION INVESTIGATION REPORT

1.1 INTRODUCTION

Peto MacCallum Ltd. was retained by Philips Planning and Engineering Limited as part of the Total Project Management (TPM) team to carry out a detailed soils investigation and to prepare a Pavement Design Report and Foundation Investigation and Design Report for Work Project (W.P.) 29-97-00. The Pavement Design Report has been forwarded under separate cover.

The original Terms of Reference identified seven culverts as potentially requiring treatment. Upon review, Philips Planning + Engineering Limited recommended remedial work be carried out at the following four locations:

- 1) 20+420, Township of Clavet - concrete culvert
- 2) 24+441, Township of Kohler - timber culvert
- 3) 13+408, Township of McCoig - corrugated steel pipe (CSP) sideroad culvert
- 4) Pitopiko River, Township of McCoig - twin (CSP) culvert south headwall

1.2 SITE DESCRIPTION

The four foundation investigation locations are located on Highway 11, in the Townships of Clavet, Kohler and McCoig between about 70 and 100 km west of Hearst, Ontario within District 53 - New Liskeard. The work will be carried out as part of Work Project (W.P.) 29-97-00 which extends from the Fraser River Bridge, westerly 36.3 km to the Regional Boundary. Location 4 (Pitopiko River) is located east of the work project limits.

The project is located in the Abitibi Uplands, part of the Canadian Shield physiographic province. The local topography is very flat and is typified by poorly drained sphagnum muskeg and black spruce dominated forest (Smith, S.L., Quaternary Stratigraphic Drilling Transect Timmins to the Moose River Basin, Ontario, Geologic Survey of Canada, 1992). Typical soils comprise Cochrane Till which is described as non-sorted silt and clay tills with granulars, cobbles and boulders. The inorganic soils are typically overlain by varying depths of peat and muck and underlain by relatively hard, primarily igneous bedrock (Sado, E.V., Fullerton, D.S., and Farrand, W.R., Quaternary Geologic Map of the Lake Nipigon 4° x 6° Quadrangle, U.S.A. and Canada, 1994).

1.3 INVESTIGATION PROCEDURES

The field work was carried out inconjunction with the pavement design soils investigation during October and November, 1997. The field work specific to the foundation investigations comprised a total of ten (10) boreholes and four (4) dynamic cone penetration tests advanced to depths of 0.60 to 11.90 m below existing grade.

The boreholes were advanced with a CME 55 track mounted drillrig and a CME 45 truck mounted drillrig equipped with continuous flight hollow and solid stem augers, supplied and operated by specialist drilling contractors. Manual hand augering was also carried out to obtain supplemental surficial organic thicknesses.

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.

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 borehole locations and ground surface elevations were surveyed by Philips Planning + Engineering Limited and are related to the geodetic datum. The borehole at Location 4 (Pitopiko River) was referred to a local temporary benchmark set at 100.00.

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 most recovered samples, six particle size distribution analyses and three atterberg limit tests.

1.4 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" and dynamic cone values, shear strength test results, groundwater observations during and upon completion of drilling, and natural moisture content determination test results. The logs of testholes drilled locally as part of the pavement design investigation have also been included for convenience.

Location 1 - 20+420, Township of Clavet

The culvert at Location 1 is a 3.0 m wide by 1.8 m high rigid frame concrete structure with approximately 3 m of earth cover. Surface water flow through the culvert was negligible at the time of the field work. The culvert is showing signs of distress including lowering of the mid-section of the culvert relative to the ends, and two major breaks at the approximate edge-of-shoulder locations. The distress also includes cracking throughout the length of the culvert, and some deterioration and spalling of the concrete at the ends. Discussions with the MTO Patrol Supervisor indicate that loss of granular material has been experienced from the north road shoulder which may be caused by migration of material through the culvert cracks. It is understood that concrete has been poured into these road shoulder voids in the past.

In general, the subsurface stratigraphy contacted at Location 1 comprised road embankment fills and surficial peat overlying native silt and glacial till deposits.

The road embankment contacted in borehole 101, drilled through the road, comprises the surficial pavement structure over interstratified sand and silt with traces of gravel and clay. The borehole was terminated at 5.10 m depth, near the base of the culvert, upon refusal to auger on wood which may be part of the original culvert form. Borehole 102 located near the edge of the embankment contacted silt with clay. The embankment fills are generally loose to compact based on standard penetration "N" values of 8 to 15 blows per 0.30 m penetration of the split spoon sampler. The embankment soils below the road are typically moist based on moisture contents of 8 to 13% and the soils near the edge of the embankment are wet based on a moisture content of 31%.

Surficial wet black amorphous peat was contacted to 0.60 m depth in borehole 103 located near the south end of the culvert.

The native inorganic deposits encountered below the road embankment fills and peat consist of silt with varying amounts of clay and traces of sand and gravel. The silt is underlain by glacial tills comprising silty clay and silt with sand, a trace of gravel, and occasional cobbles and boulders. The native deposits range from very loose to loose/soft and become compact with depth based on standard penetration "N" and dynamic cone values in the range of 4 to 12 and shear strengths of 18 to 50 kPa. Moisture contents of 13 to 40% reflected moist/drier than plastic limit (D.T.P.L.) conditions becoming saturated/wetter than plastic limit (W.T.P.L.) with depth. A typical particle size distribution chart for the silt is presented on Figure 1 appended.

Soil colouring and moisture contents indicate that the stabilized groundwater level lies around 3.0 m below the culvert level or 7.5 m below the road grade, at about elevation 229.

Location 2 - 24+441, Township of Kohler

The culvert at Location 2 is a 1.5 m wide by 1.4 m high timber culvert. The culvert accommodates a watercourse with a water depth of about 1 m at the time of the field work. Asphalt patching indicates that the overlying roadway has experienced distortions/settlements over the south half (east-bound lane) of the culvert.

The subsurface conditions around the timber comprised the surficial road embankment, fill, and peat overlying silt and silt till deposits.

The road embankment contacted in borehole 205 located on the road comprised the surficial pavement over sand fill with silt and gravel, a trace of clay and silty zones. The embankment fill extends to 3.80 m below the road grade, near the base of the culvert. The sand fill is loose to compact based on standard penetration "N" values of 5 to 12 and is moist, becoming saturated near the creek level. Typical particle size distribution charts for the road embankment fill are presented on Figures 2 and 3, appended.

Boreholes 201 and 204 located off the road embankment encountered localized fill and peat to depths of 0.10 m to 0.80 m below existing grade.

The native inorganic deposits encountered beneath the road embankment, fill and peat comprised a major silt till deposit with a localized silt deposit in borehole 204. The native deposits are generally loose to dense based on standard penetration "N" and dynamic cone values of 5 to 47 blows per 0.30 m. The deposits are typically moist becoming saturated at depth based on moisture contents of 5 to 22%. A typical particle size distribution analysis of the sandy silt till is presented on Figure 4, appended.

The stabilized groundwater level is believed to lie around the creek level at about 3.3 m below the road grade or elevation 253.0, based on soil colouring and groundwater conditions.

Location 3 - 13+408, Township of McCoig

The culvert at Location 3 comprises a CSP (approximate diameter 600 mm) about 25 m south of Highway 11 on a one-lane sideroad. The culvert appears to be located too high and is blocking local drainage patterns as evidenced by surface water ponding around the culvert. The CSP is also in a state of disrepair.

Borehole 301 drilled near the CSP culvert contacted a surficial sand road structure over loose to compact/stiff sandy and clayey silt till. The till is typically moist becoming wet at depth. A particle size distribution chart for the sandy silt till is included on Figure 5, appended.

Surface water existed near the culvert, however the stabilized regional groundwater level is believed to lie below the depth of exploration.

Location 4 - Pitopiko River, Township of McCoig

Location 4 comprises the south concrete headwall of twin 3.7 m diameter CSP's which accommodate the Highway 11/Pitopiko River crossing. The headwall is in a serious state of deterioration in that the upper portion of the wall has fractured from its foundation section and rotated.

Borehole 401 located by the south headwall contacted 1.20 m of loose sandy silt fill over sandy silt till. The native till is loose becoming very dense at depth based on standard and dynamic cone penetration "N" values in the range of 9 to 50 blows per 0.30 m. Moisture contents of 8 to 17% reflect saturated conditions. A typical particle size distribution chart for the sandy silt till is presented on Figure 6, appended.

The stabilized groundwater level matches the water level of the Pitopiko River at a depth of about 1.5 m at the borehole location, or elevation 95.8.

2.0 FOUNDATION DESIGN REPORT

2.1 DISCUSSION AND RECOMMENDATIONS

Location 1 - 20+420, Township of Clavet

The relative lowering of the midsection of the culvert is believed to be caused by long-term settlements beneath the road embankment. The ends of the culvert have not settled as much as the middle section of the culvert. As a result the culvert has cracked below the edge of shoulder on both sides.

It is understood that concrete collars will be constructed across the top and down both walls of the culvert at the two major crack locations.

Excavations for collar construction will generally extend through the surficial pavement, and road embankment fills, and possibly slightly into the native silt. Concrete may be contacted within the fill embankment and borehole 101 indicates that wood forming materials may also be present around the culvert.

Construction excavations can be carried out with conventional open cut procedures where space permits. Unsupported excavation side slopes should be trimmed back at 45° to the horizontal in compliance with the Ontario Occupational Health and Safety Act, for Type 3 Soils.

Shoring may be required if two lanes of traffic are to be provided throughout construction. We recommend a shoring system comprising timber lagging, soldier piles, wales and rakers be employed to support excavation faces. The shoring system should be designed to resist the lateral earth pressure. Provided some minor ground subsidence is acceptable adjacent to the excavation, the unfactored coefficient of active earth pressure " K_a " may be assumed as 0.3, the unfactored coefficient of passive earth pressure " K_p " assumed as 4, and the unfactored bulk unit weight of the retained soil may be taken as 21.0 kN/m³.

In general, no major groundwater control problems are envisaged for excavations terminating near the culvert base. Conventional sump pumping from pits within the excavations should be sufficient to control any groundwater infiltration or surface water entering the excavation.

Granular frost tapers should be reinstated as excavated.

Location 2 - 24+441, Township of Kohler

The distortions/settlements being experienced on the roadway at Location 2 are believed to be related to migration of road embankment soil into the culvert and possible piping of material along the culvert.

We understand the proposed remediation involves pressure injecting grout around the existing timber culvert below the area of road settlement.

Based on the field investigation, the fill soils around the culvert comprise sand with silt and gravel, a trace of clay and some silty zones. For design purposes, the coefficient of permeability, k is approximated as 1×10^{-4} to 1×10^{-5} cm/sec and the void ratio, e is estimated at 0.30 to 0.35 for the soils surrounding the culvert. Based on the relatively impermeable nature of the culvert backfill, the soils are marginally groutable and it will likely be necessary to use a chemical type grout with a tight grout hole spacing.

Location 3 - 13+408, Township of McCoig

The replacement of the CSP sideroad culvert should be straightforward from a geotechnical perspective. Reference should be made to OPSD 802.014 using OPSS Granular "A" around the pipe.

Location 4 - Pitopiko River, Township of McCoig

We understand it is currently proposed to remove the portion of the existing headwall above the creek bed level and excavate behind the lower portion of the wall for construction of a new concrete gravity retaining wall founded 1.5 m below the creek bed level.

It is envisioned that the excavation will extend through the road embankment fills and into the underlying native sandy silt till. Excavations will generally extend through road embankment fills and into the underlying native loose to very dense sandy silt till. Excavations may be carried out with conventional open cut procedures. Unsupported excavation side slopes should be trimmed back at 45° to the horizontal in compliance with the Ontario Occupational Health and Safety Act for Type 3 soils. It will be necessary to temporarily brace the portion of the existing foundation wall which will remain in place.

Significant groundwater infiltration is anticipated below the creek level. However, the infiltration should be controllable by sump pumping from pits within the excavation.

Based on the results of the borehole, the native sandy silt till contacted at the site should be suitable to support of the proposed retaining wall. Spread footings founded a minimum of 0.3 m into the native silt till deposit may be designed for the following:

- i) a factored bearing capacity at ultimate limit states of 225 kPa;
- ii) a bearing capacity at serviceability limit states of 150 kPa; or
- iii) an allowable stress design bearing capacity of 150 kPa.

The founding surface should be examined by experienced geotechnical personnel prior to concreting to ensure that no loose zones exist and that the subgrade soils are capable of supporting the design load.

The new wall should be designed to resist the lateral earth pressures. Provided the backfill adjacent to the wall is free draining Granular "B" or equivalent, perimeter drains are provided above the creek level and the footing is founded on undisturbed native silt till, the following unfactored values may be assumed in design:

- K_a = active earth pressure coefficient = 0.50
- γ = unit weight of Granular "B" fill above the water table = 21 kN/m³
- γ_{sat} = unit weight of Granular "B" fill below the water table = 11 kN/m³
- $\tan\phi$ = coefficient of friction between footing and native soil = 0.42

2.2 CLOSING

The recommendations contained in this report are based on conditions at the time of the field work. This report was written by Mr. D. MacRae, P.Eng., Project Engineer, was reviewed by Mr. G. Mitchell, M.Eng. P.Eng., Manager, Geotechnical Engineering and was approved by Mr J.B. Dietrich, P.Eng, Managing Director.

Details of the investigation and the recommendations given in this report are considered to be complete. However, should any questions arise, please do not hesitate to contact this office.



PETO MacCALLUM LTD.

A handwritten signature in black ink, appearing to read "D. MacRae", written over a horizontal line.

D. MacRae, P.Eng
Project Engineer

A handwritten signature in black ink, appearing to read "G. Mitchell", written over a horizontal line.

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

DM/GM:cs

PARTICLE SIZE DISTRIBUTION CHART

OUR PROJECT NO. 97 TF 78

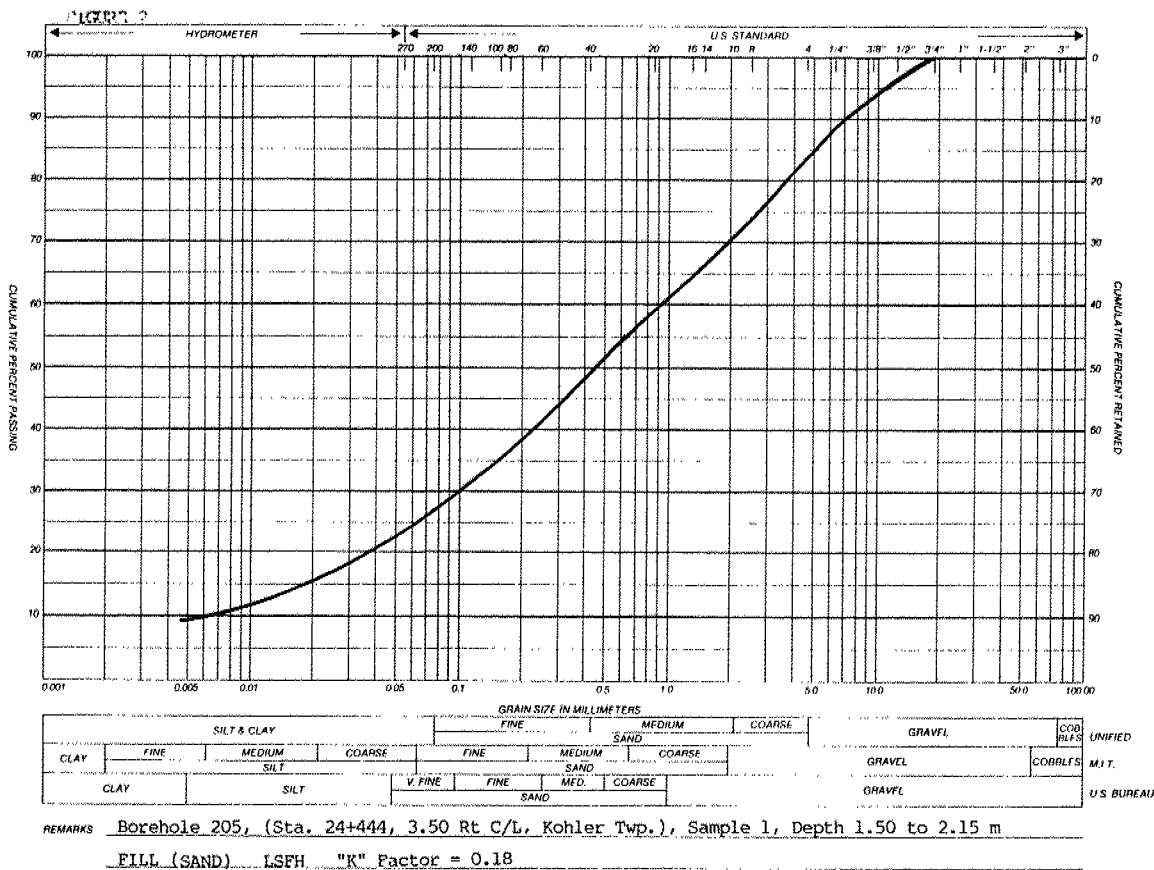
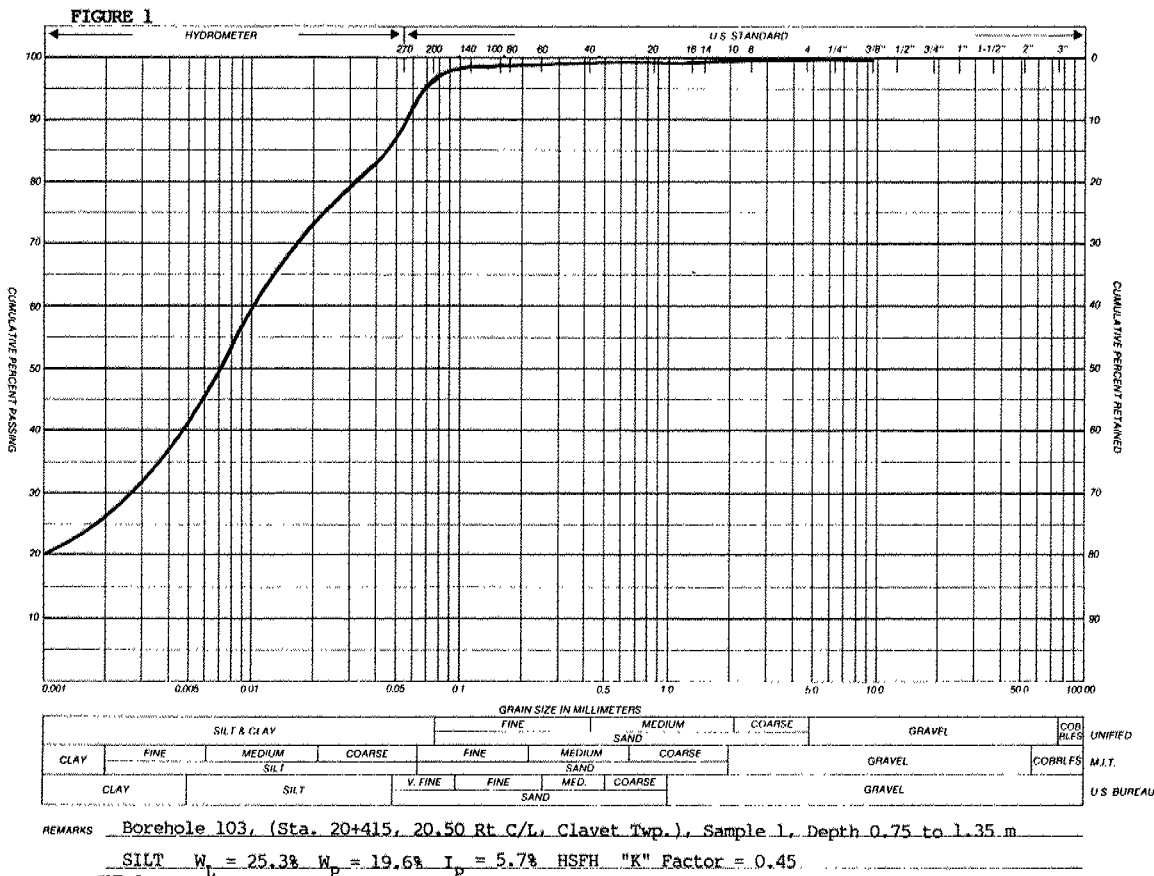
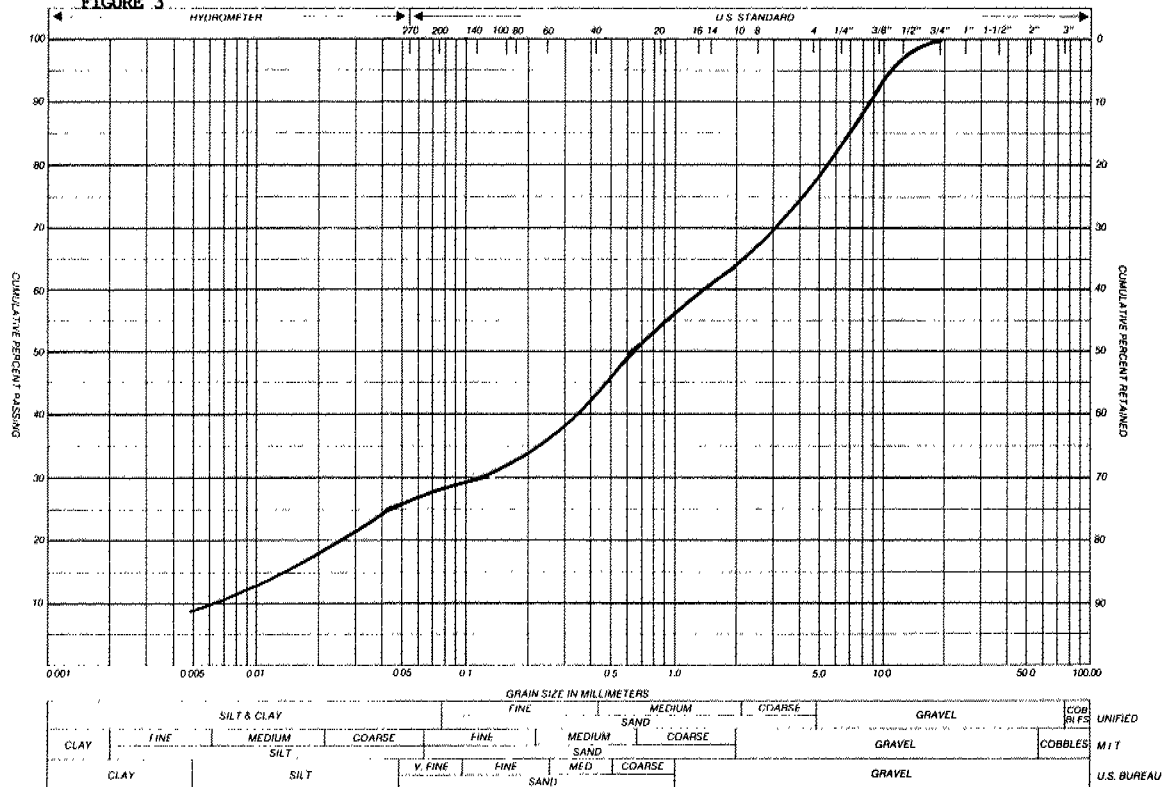


FIGURE 3



OUR PROJECT NO. 97 TF 78

Figure 5 is a semi-logarithmic graph used for soil classification. The vertical axis (y-axis) represents the cumulative percent passing, ranging from 0 to 100 in increments of 10. The horizontal axis (x-axis) represents grain size in millimeters on a logarithmic scale, ranging from 0.001 to 100.0. The graph includes several scales and classification ranges:

- Top Scales:**
 - HYDROMETER:** 270, 200, 140, 100, 80, 60, 40, 20, 18, 14, 10, 8, 4, 1 1/4, 3/8, 1/2, 3/4, 1, 1 1/2, 2, 3
 - U.S. STANDARD:** 20, 18, 14, 10, 8, 4, 1 1/4, 3/8, 1/2, 3/4, 1, 1 1/2, 2, 3
- Bottom Scale:** 0.001, 0.006, 0.01, 0.05, 0.1, 0.5, 1.0, 5.0, 100, 500, 1000
- Classification Ranges (Grain Size in Millimeters):**
 - CLAY:** 0.001 to 0.006 mm
 - SILT & CLAY:** 0.006 to 0.075 mm
 - SILT:** 0.075 to 0.06 mm
 - SAND:** 0.06 to 4.75 mm
 - FINE SAND:** 0.06 to 0.425 mm
 - MED. SAND:** 0.425 to 0.85 mm
 - COARSE SAND:** 0.85 to 4.75 mm
 - GRAVEL:** 4.75 to 75 mm
 - COBBLES:** 75 to 100 mm

A smooth curve is plotted on the graph, representing the cumulative percent passing for a given grain size. The curve starts at 100% passing for 0.001 mm and reaches 0% passing at 100.0 mm.

REMARKS	Borehole 301, (Sta. 13+407, 25.00 m Rt C/L, McCoig Twp.) Sample 2, Depth 0.65 to 1.35 m
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SANDY SILT (TILL) $W_L = 17.7\%$ $W_p = 14.0\%$ $I_p = 3.7\%$ LSFH "K" Factor = 0.23

FIGURE 6

HYDROMETER

U.S. STANDARD

GRAIN SIZE IN MILLIMETERS

CUMULATIVE PERCENT PASSING

CUMULATIVE PERCENT REMAINED

CLAY FINE MEDIUM COARSE FINE MEDIUM COARSE SAND GRAVEL COBBLES UNIFIED

CLAY FINE MEDIUM COARSE FINE MEDIUM COARSE SAND GRAVEL COBBLES M.T.

CLAY SILT V FINE FINE MED COARSE SAND GRAVEL U.S. BUREAU

REMARKS: Borehole 401 (Pitopiko River), Sample 4, Depth 1.80 to 2.45 m

SANDY SILT (TILL) $W_L = 15.9\%$ $W_P = 13.1\%$ $I_P = 2.8\%$ LSFH "K" Factor = 0.27

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		

GEOTECHNICAL SURVEY DATA	
W.P. 29-97-00	
SURVEY DATE	TYPE OF SURVEY
October, November, 1997	Peto MacCallum Ltd. Power Auger, Power Excavator, Hand Auger
<p>NOTES</p> <ol style="list-style-type: none">1. Conditions and pavement depths apply only to the date of survey.2. The boundaries between the strata have been established only at core/borehole locations. Between cores/boreholes the boundaries are assumed and may be subject to error.3. Soils are described according to the MTO Soils Classification System.4. Pavement core locations were established using random numbers.5. Abbreviations for boring and test data conform to OPSD 100.06.6. Dimensions are in metres and/or millimetres unless otherwise shown. Stations in kilometres + metres.7. In the logs of testholes, the abbreviation D+/- represents the difference in ground surface elevation of points offset from the C/L. Geodetic elevations are provided where available.	

LOG OF BOREHOLE NO. 101 & 102

PROJECT W.P. 29-97-00, Highway 11

OUR PROJECT NO. 97 TF 78

LOCATION From Fraser River Bridge, Westerly to the Regional Boundary, 36.3 km

BORING DATE 1997 11 02


ENGINEER G. Mitchell

BORING METHOD Continuous Flight Hollow Stem Augers

TECHNICIAN B. Squire

SOIL PROFILE				SAMPLES			SHEAR STRENGTH C_u		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 *		WATER CONTENT %					
							BLOWS/0.3M 20 40 60 80		10 20 30					
BOREHOLE 101 Sta. 20+417, 3.60 m Lt C/L, Clavet Twp. GROUND ELEVATION 236.02														
0.47	70 mm of asphaltic concrete over 400 mm of crushed gravel, granular, moist		235	1	SS	15							Upon completion of drilling and removal of augers, borehole caved at 4.30 m with no free water.	
1.50	FILL: Brown fine to medium sand trace silt, trace gravel, moist becoming light brown silt, trace sand, trace gravel, trace organics, moist		234	2	SS	8								
2.20	becoming brown fine to medium sand, trace silt, trace gravel, moist		233	3	SS	10								
3.00			232	4	SS	10								
3.70			231	5	SS	11								
4.50	becoming light brown silt, trace clay, trace sand, moist													
5.10	wood													
BOREHOLE TERMINATED AT 5.10 m DUE TO REFUSAL TO AUGER ON WOOD														
BOREHOLE 102 Sta. 20+414, 14.50 Lt C/L, Clavet Twp. GROUND ELEVATION 233.02														
1.30	FILL: Dark brown silt with clay, trace sand and gravel, organics, wet		232	1	SS	10								
1.50	SILT: Compact light brown silt with clay, trace sand and gravel, occasional cobbles and boulders, moist (till)		231	2	SS	11								
3.00			230	3	SS	10								
3.60	becoming light brown and grey													
BOREHOLE TERMINATED AT 3.60 m DUE TO REFUSAL TO AUGER ON BOULDERS/BEDROCK														

NOTES:

CHECKED BY: 

LOG OF BOREHOLE NO. 103 (Sta. 20+415, 20.50 Rt C/L, Clavet Twp.)

PROJECT W.P. 29-97-00, Highway 11

OUR PROJECT NO. 97 TF 78

LOCATION From Fraser River Bridge, Westerly to the Regional Boundary, 36.3 km

BORING DATE 1997 11 2 & 3

ENGINEER G. Mitchell

BORING METHOD Continuous Flight Solid Stem Augers

TECHNICIAN B. Squire

SOIL PROFILE				SAMPLES			SHEAR STRENGTH C_u (kPa) ▲		LIQUID LIMIT W_L		PLASTIC LIMIT W_P		GROUND WATER OBSERVATIONS AND REMARKS	
DEPTH METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	50	100	150	200	WATER CONTENT %			
							DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST *				WATER CONTENT %			
							BLOWS/0.3M				WATER CONTENT %			
	GROUND ELEVATION 231.74						20	40	60	80	10	20	30	
0.60	PEAT: Black amorphous peat, wet		231											
1.40	SILT: Very loose to loose grey silt with clay, trace sand and gravel, moist		230	1	SS	4								
2.20	becoming loose to compact mottled light brown and grey silt, trace clay, trace gravel, moist		229	2	SS	6								
3.00	becoming layered with dark brown clayey silt, D.T.P.L. to W.T.P.L.		228	3	SS	4								
			228	4	SS	8								
4.5	SILTY CLAY: Soft to very stiff light grey silty clay, trace sand and gravel, occasional cobbles, W.T.P.L. (till)		227	5	SS									
			226											
6.0			225	6	SS									
			225											
7.50			224	7	SS									
	SILT: Compact to very dense light grey silt with sand, trace clay, occasional cobbles and boulders, saturated (till)		223											
9.0			222	8	SS	8								
			221	9	SS									
10.95	BOREHOLE TERMINATED AT 10.95 m DUE TO REFUSAL TO AUGER ON PROBABLE BEDROCK													
12.0														

20/100 mm (bouncing)

Upon completion of augering and removal of augers, free water at 0.15 m (surficial water).

NOTES:

- ▲ Undrained shear strength determined from pocket penetrometer test
 ■ Undrained shear strength determined from vane shear test
 □ Remoulded shear strength determined from vane shear test
 S = Sensitivity = Undrained shear strength/Remoulded shear strength

CHECKED BY

W.P. 29-97-00, HIGHWAY 11
FROM FRASER RIVER BRIDGE,
WESTERLY TO THE REGIONAL BOUNDARY, 36.3 KM
TOWNSHIP OF CLAVET

20+395 3.40 Lt C/L D -100 (El. 236.22)
Culvert @ 20+420

0 - 200 Asph
200 - 300 Cr Gr Moist
w @ 250 = 5.9%
300 - 2.50 Br F-Med Sa W Si Tr Gr Moist

20+400 7.00 Rt C/L D -450

0 - 050 Br Med Sa Tps W Gr Moist
050 - 200 Br Med Sa W Gr Tr Si Moist
200 - 450 Lt Br F Sa W Si Moist

20+400 15.50 Rt C/L D -4.25

0 - 075 Br Med Sa Tps W Gr Moist
075 - 200 Br Med Sa W Si Moist
200 - 550 Lt Br F Sa W Si Moist
Wet @ 300

20+407 3.70 Lt C/L D -080 (El. 236.11)
Culvert @ 20+420

0 - 100 Asph
100 - 200 Cr Gr Moist
200 - 1.20 Br F-Med Sa W Si Tr Gr Moist
1.20 - 1.80 Br Si W Sa Tr Gr Moist
1.80 - 2.50 Br F Sa Tr Si & Gr Moist

20+432 3.40 Lt C/L D -070 (El. 236.03)
Culvert @ 20+420

0 - 240 Asph
240 - 340 Cr Gr Moist
340 - 1.20 Br F-Med Sa W Si Tr Gr Moist
1.20 - 1.80 Br Si W Sa Tr Gr Moist
1.80 - 2.50 Br F Sa Tr Si & Gr Moist

20+445 3.30 Lt C/L D -080 (El. 236.02)
Culvert @ 20+420

0 - 310 Asph
310 - 380 Cr Gr Moist
380 - 1.65 Br F-Med Sa W Si Tr Gr Moist
1.65 - 2.50 Br Si W Sa Tr Gr Moist
w @ 2.05 = 8.1%

LOG OF BOREHOLE NO. 201 & 202

PROJECT W.P. 29-97-00, Highway 11

OUR PROJECT NO. 97 TF 78

LOCATION From Fraser River Bridge, Westerly to the Regional Boundary, 36.3 km

BORING DATE 1997 11 06/16

ENGINEER G. Mitchell

BORING METHOD Continuous Sampling (BH. 201)/Hand Sampling (BH. 202)

TECHNICIAN D. MacRae

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	
	BOREHOLE 201 Sta. 24+433, 14.5 m Lt C/L, Kohler Twp. GROUND ELEVATION 253.79									
0.50	FILL: 075 mm of dark brown clayey silt topsoil, moist over			1	SS	3				Upon completion of coring, borehole caved at 2.00 m with free water at 1.50 m.
0.80	brown sandy silt, organics, moist		253	2	SS	7				
1.50	PEAT: Dark brown amorphous peat, moist		252	3	SS	19				
	SILT: Compact to dense grey silt with clay, trace sand, trace gravel, saturated (till)			4	SS	31				
3.0	becoming sandy silt with clay, sand layers, trace gravel		251	5	SS	26				
3.65	BOREHOLE TERMINATED AT 3.65 m		250	6	SS	49				
4.5										
	BOREHOLE 202 Sta. 24+446, 14.50 m Lt C/L, Kohler Twp. GROUND ELEVATION 253.30									
0.10	PEAT: Dark brown amorphous peat, moist		253							
0.60	SILT: Light brown silt with clay, trace sand, trace gravel, moist (till)									
7.5	BOREHOLE TERMINATED AT 0.60 m									

NOTES:

CHECKED BY: *JM*

LOG OF BOREHOLE NO. 203 & 204

PROJECT W.P. 29-97-00, Highway 11

LOCATION From Fraser River, Westerly to the Regional Boundary, 36.3 km

BORING DATE 1997 11 16

OUR PROJECT NO. 97 TF 78

ENGINEER G. Mitchell

BORING METHOD Hand Sampling (BH. 203)/Continuous Sampling (BH. 204)

TECHNICIAN D. MacRae

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 *		WATER CONTENT %		
							BLOWS/0.3M		WATER CONTENT %		
							20	40	60		80

LOG OF BOREHOLE NO.

205 (Sta. 24+444, 3.50 Rt. C/L, Kohler Twp.)

PROJECT W.P. 29-97-00, Highway 11

OUR PROJECT NO. 97 TP 78


LOCATION From Fraser River Bridge, Westerly to the Regional Boundary, 36.3 km

BORING DATE 1997 11 07


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		W_P W W_L 10 20 30			
	GROUND ELEVATION 256.31											
0.43	230 mm of asphaltic concrete over 200 mm of crushed granular, moist		256								Upon completion of drilling, borehole caved at 3.60 m with no free water.	
	FILL: Brown sand with silt and gravel, trace clay, silty zones, moist		255									
				1	SS	12						
			254									
				2	SS	7						
			253									
				3	SS	5						
			252									
				4	SS	18						
			251									
				5	SS	12						
			250									
				6	SS	90 @ 50 mm						
			249									
				7	SS	120 @ 150 mm						
	BOREHOLE TERMINATED AT 7.80 m											

NOTES:

CHECKED BY: 

W.P. 29-97-00, HIGHWAY 11
FROM FRASER RIVER BRIDGE,
WESTERLY TO THE REGIONAL BOUNDARY, 36.3 KM
TOWNSHIP OF KOHLER

24+417 3.40 Rt C/L D -020 (El. 256.32)
Culvert @ 24+441

0 - 110 Asph
110 - 230 Cr Gr Moist
230 - 2.50 Br Si(y) Sa Moist to Wet

24+429 3.50 Rt C/L D -060 (El. 256.31)
Culvert @ 24+441

0 - 100 Asph
100 - 360 Cr Gr Moist
360 - 1.80 Br F Sa W Si Tr Gr Moist
1.80 - 2.50 Br Si(y) Sa Tr Gr Moist to Wet

24+450 7.25 Lt C/L D -900

0 - 050 Br Med Sa Tps W Gr Moist
050 - 550 Br Med Sa W Gr Tr Si Moist

24+450 10.75 Lt C/L D -2.00

0 - 050 Br Med Sa Tps W Gr Moist
050 - 500 Lt Br F Sa W Si Moist

24+453 3.50 Rt C/L D -040 (El. 256.35)
Culvert @ 24+441

0 - 100 Asph
100 - 340 Cr Gr Moist
340 - 2.50 Br Si(y) Sa Tr Gr Moist to Wet

24+466 3.40 Rt C/L D -040 (El. 256.36)
Culvert @ 24+441

0 - 100 Asph
100 - 310 Cr Gr Moist
310 - 2.50 Br Si(y) Sa Tr Gr Moist to Wet

LOG OF BOREHOLE NO. 301 (Sta. 13+407, 25.00 m Rt. C/L, McCoig Twp.)

PROJECT W.P. 29-97-00, Highway 11

OUR PROJECT NO. 97 TF 78

LOCATION From Fraser River, Westerly to the Regional Boundary, 36.3 km

BORING DATE 1997 11 15

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	WATER CONTENT % W_p W W_L	
	GROUND ELEVATION 250.65										
0.30	FILL: Brown fine to medium sand, with gravel, trace silt, moist		250	1	SS	21					Upon completion of coring, borehole open with no free water.
0.70	becoming grey sand			2	SS	9					
1.20											
1.5	SANDY SILT: Loose brown sandy silt with clay, trace gravel, moist (till)		249	3	SS	12					
2.00	becoming stiff clayey silt										
2.90	becoming compact silt with sand, moist to wet	248	4	SS	22						
3.0	BOREHOLE TERMINATED AT 2.90 m										
					</						

NOTES:

CHECKED BY:

LOG OF BOREHOLE NO. 401 (Pitopiko River)

PROJECT W.P. 29-97-00, Highway 11

OUR PROJECT NO. 97 TF 78

LOCATION From Fraser River, Westerly to the Regional Boundary, 36.3 km

BORING DATE 1997 11 06

ENGINEER G. Mitchell

BORING METHOD Continuous Sampling

TECHNICIAN D. MacRae

[illegible]

NOTES:

CHECKED BY:

$20+400$

3.05 x 1.83 x 30.6m
Concrete Culvert
Rigid Frame Box Type

20+500



ROCK OUTCROP

3C GR

.3C GR

3C GR

~~HEARST~~

3C GR

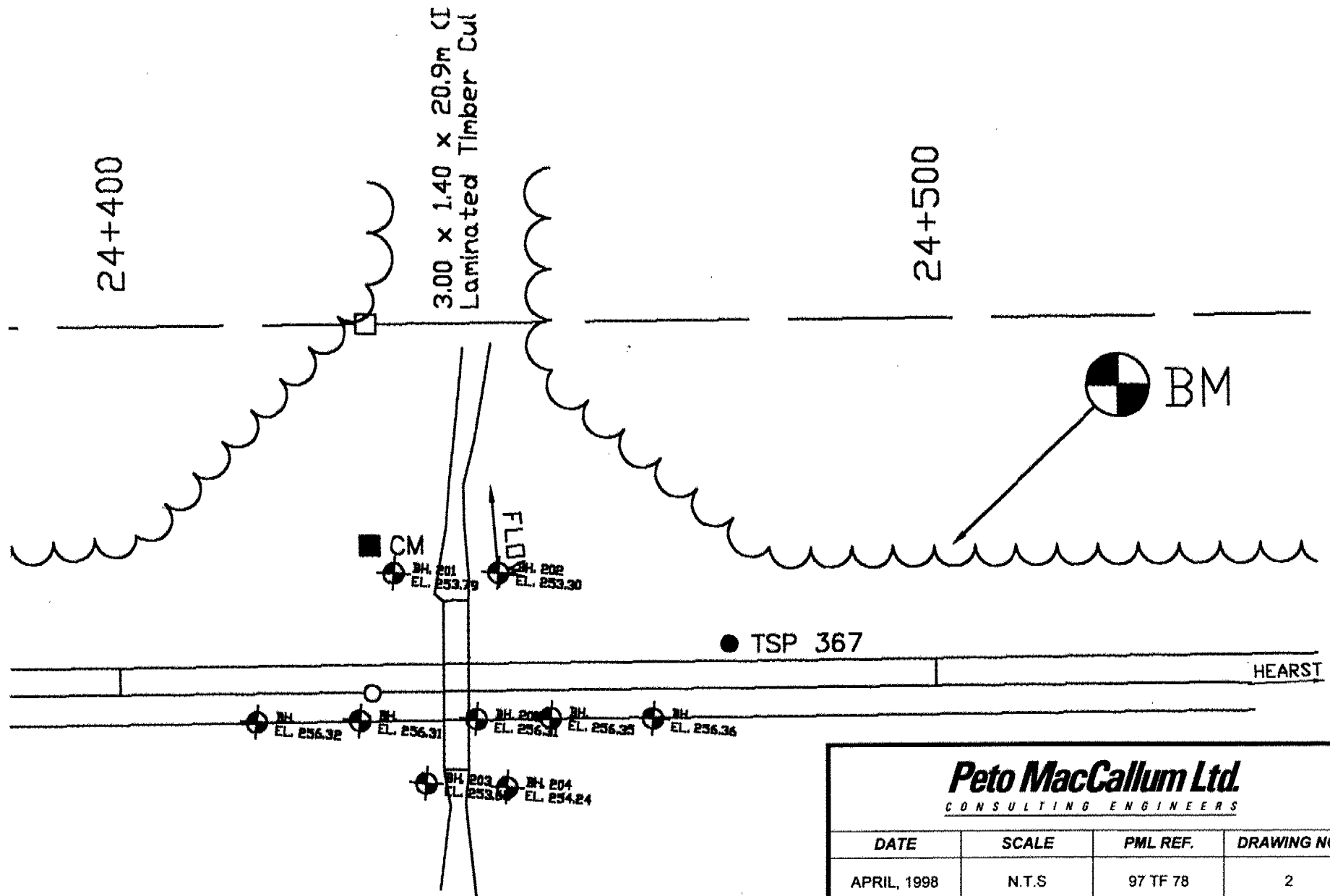
0.57-3.60


 M1 103
 EL 231.74

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CONSULTING ENGINEERS

DATE	SCALE	PML REF.	DRAWING NO.
APRIL, 1998	N.T.S	97 TF 78	1

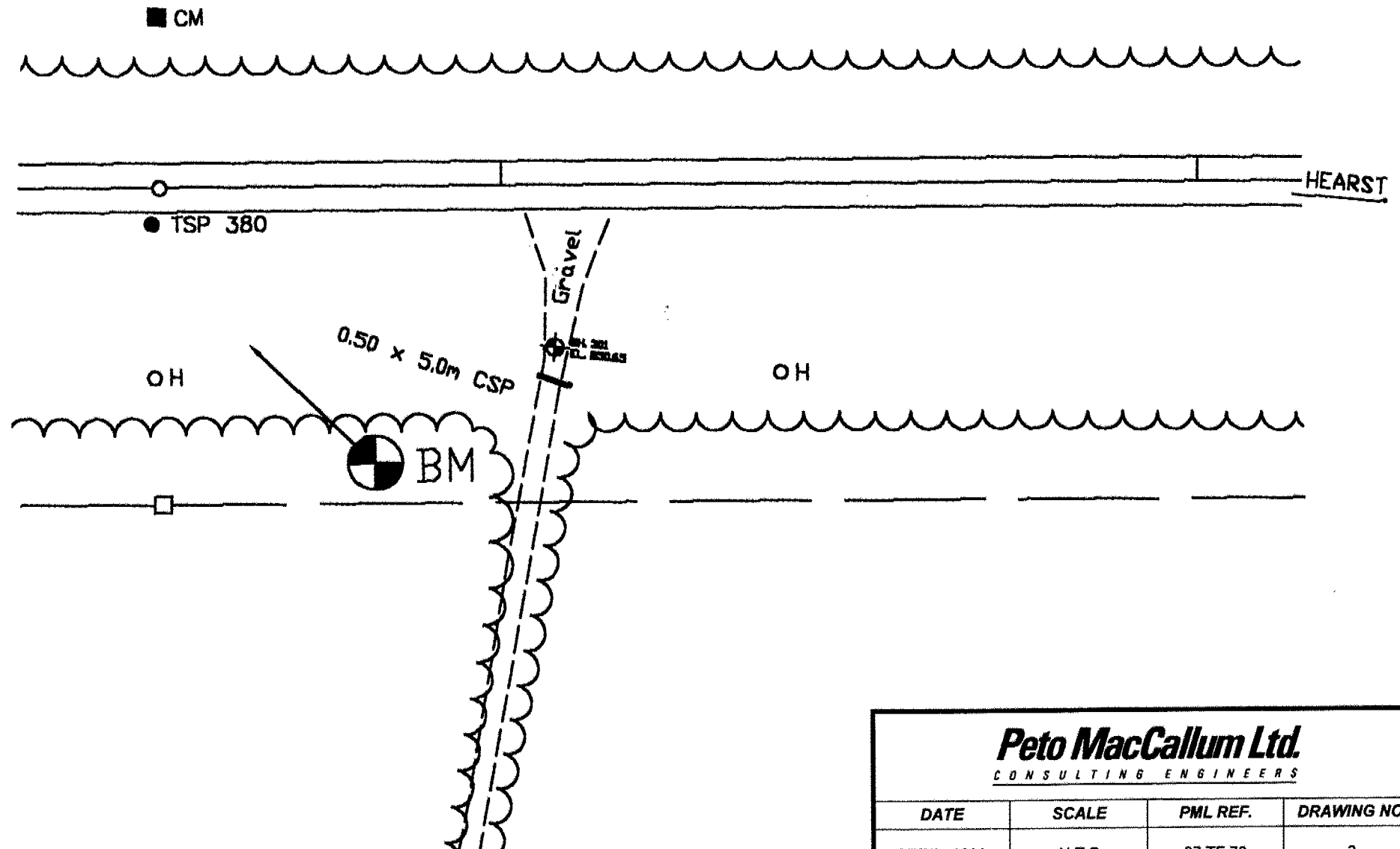
**SITE SKETCH
LOCATION 2**



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DATE	SCALE	PML REF.	DRAWING NO.
APRIL, 1998	N.T.S	97 TF 78	2

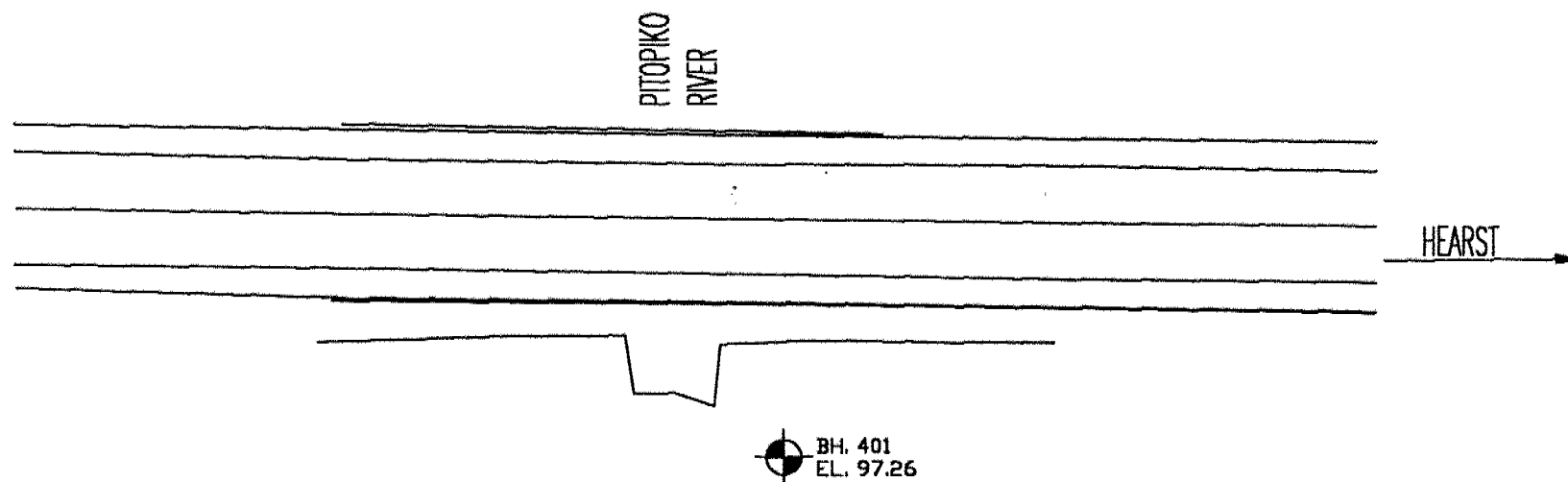
SITE SKETCH LOCATION 3



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CONSULTING ENGINEERS

DATE	SCALE	PML REF.	DRAWING NO.
APRIL, 1998	N.T.S	97 TF 78	3

**SITE SKETCH
LOCATION 4**



NOTE:
ELEVATION REFERRED TO A LOCAL TEMPORARY BENCH
MARK SET AT ELEVATION 100.00 (METRIC, ASSUMED)

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DATE	SCALE	PML REF.	DRAWING NO.
APRIL, 1998	N.T.S	97 TF 78	4