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STR. SITE No. 19-535

HWY. No.

LOCATION Hwy 402 and Hwy 2 Interchange

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. 5

REMARKS: documents to be unfolded before microfilming photos included

G1-30 SEPT 1976

PETO MacCALLUM LTD.

165 CARTWRIGHT AVENUE, TORONTO, ONTARIO M6A 1V5

CONSULTING GEOTECHNICAL, INSPECTION & TESTING ENGINEERS

Phone (416) 789-4105

May 8, 1975

MAY - 9 1975

Job. No. 75 F 56

Ministry of Transportation and
Communications, Ontario
West Building
1201 Wilson Avenue
Downsview, Ontario M3M 1J8

Attention: Mr. A. Rutka, P. Eng.
Manager, Geotechnical office

Dear Sir:

Re: Foundation Investigation Report
Hwy. 402 and Hwy. 2 Interchange
Line A WP 41-66-19/20

We are pleased to present our report on the foundation investigation carried out for the proposed Hwy. 402 and Hwy. 2 interchange structures.

The attached report provides complete details of the work carried out, the soils and groundwater conditions encountered and specific recommendations for design and construction from geotechnical considerations.

For convenience, for emphasis and for clarity, a synopsis has been included as a preface to the report, outlining the important recommendations.

We trust that this report is complete within our terms of reference. We are available for further consultation as required. We thank you for the opportunity to be of service to the Ontario Ministry of Transportation and Communications.

Yours very truly,

PETO MacCALLUM LTD.

C. F. Freeman, P. Eng.
Chief Engineer

CFF/mj

SYNOPSIS

The results of an investigation carried out at the site of the existing Hwy. 2 and proposed Hwy. 402 interchange are reported.

The site is underlain by deltaic sands, silts and gravels to an average depth of 25 feet below which firm to stiff silty clays and very stiff to hard glacial silty clay tills are encountered with increasing depth. Dolomite bedrock is interpreted from geological reports at depths greater than 100 feet.

A seasonally variable perched water condition is present in the surficial granulars. Sub-artesian water appears to emanate below depths of 45 feet, under heads in excess of 30 feet.

Recommendations are made for founding the proposed bridge structures on spread footings at about an elevation 690±. Minimal problems are anticipated in the construction of these.

As an alternative driven friction piles approximately 40 feet long refusing in the glacial till stratum at about elevation 660± are recommended. Anticipated capacities will be of the order of 30 Tons per pile.

Minimal problems are anticipated in the construction of approach embankments. Slopes of 2 horizontal to 1 vertical are recommended.

If the proposed bridge spans are continuous pile foundations are recommended. For simply supported spans economics will govern the choice between spread footings and pile foundations.

1.0 INTRODUCTION:

Existing Highway 2 and proposed Highway 402 cross approximately ½ mile south west of Delaware, Ontario. The purpose of this investigation is to evaluate the soil conditions at the site and give suitable recommendations for the design and construction of the proposed bridges and associated approach embankments. Peto MacCallum Ltd., were retained as geotechnical engineering consultants for the project by letter of confirmation dated April 17, 1975 from the Ontario Ministry of Transportation and Communications, Geotechnical office.

2.0 FIELD WORK:

Field work for this investigation was carried out during the period April 9 and April 17, 1975 inclusive. A total of 20 boreholes were laid out on either side of the line 'A' for the proposed two bridges. Soil borings were carried out using track mounted Mobil B38 and CME 55 drill rigs equipped with continuous flight augers. Standard penetration and dynamic cone penetration tests were carried out. A maximum depth of 71.5 feet was reached to evaluate the sub-surface conditions.

The locations of the boreholes and dynamic penetration tests, together with inferred soil stratigraphy are shown on the appended drawings 1 and 2. Detailed logs of each borehole are given on the appended borehole logs.

The samples obtained during the investigation were returned to the Toronto laboratory for examination and testing. Results of the visual classification tests are considered in the preparation of the borehole logs.

All elevations in the report are referred to the geodetic datum using N8W on the N.E. root of 2.5' Pine 316' Rt. of station 560 + 12 off Hwy. 2 provided by M.T.C. London with T.B.M. elevation 701.73.

3.0 LABORATORY TESTING:

Besides determining the laboratory water content of all the recovered samples a limited number of identification and classification tests were conducted. These are comprised of laboratory gradings on the granular soils and Atterberg limits tests on the cohesive soils. Quick Triaxial compression tests in the laboratory were carried out to determine the shear strengths profile. In addition two consolidation tests were carried out to determine the settlement characteristics of the clayey stratum. Laboratory tests results are appended.

4.0 SITE AND GEOLOGY:

The site of the proposed interchange is located approximately 14 miles S.W. of London, Ontario on Hwy. 2 and approximately 0.5 miles S.W. of the junction of Hwys. 2 and 81. The site is located west of the Thames River. Though there are low ridges present in the area especially along the banks of the river, the topography in the area of

the proposed interchange is generally flat. Surficially the soil is comprised of sandy loam and land usage is agriculture.

The area is located in the Caredoc Sand Plains physiographic region. The sands and silts encountered at shallow depths were laid in a deltaic environment over the lacustrine clays of glacial Lake Whittlesey.

From known geological records drift thickness is more than 100 feet and bedrock is a brown dolomite of Norfolk formation belonging to the middle Devonian age.

5.0 SOIL PARTICULARS:

The following soil strata were encountered at the site.

5.1 TOPSOIL:

Topsoil was encountered in all the boreholes with the exception of boreholes 4, 13 and 18 located off Hwy. 2. It is a dark brown sandy silt with some organic content. The thickness of the top soil layer is between 6 inches and 9 inches approximately.

5.2 FILL:

Fill was encountered in boreholes 4, 13 and 18 located on the west shoulder of Hwy. 2. The fill consists of a mixture of brown silty sand and gravel with traces of organic matter. The relative density varies from loose to compact. ('N' values in the standard penetration test vary from a low of 4 to

a high of 14). Water content varies from 8 percent to 15 percent. Fill thickness varies from 1.5 feet in borehole 18 to 5.7 feet in borehole 4.

5.3 SURFICIAL GRANULAR DEPOSITS:

These deposits are believed to have been laid under a deltaic environment associated with the early Thames River. They extend down to depths ranging from 16 feet to 24 feet on the average, except in borehole 1 where they extend down to 30 feet. They are encountered underlying top soil or fill as the case may be. They are generally loose to compact and contain perched water, the level of which is seasonally variable. Within these deposits the following distinctive layers are recognized.

5.3.1 Sandy Silt:

This is a thin discontinuous layer occurring at shallow depths and comprised of brown fine sand and sandy silt with traces of organic matter. The relative density is rated as loose to compact. ('N' values range from 5 to 14). The water content is in the range of 20 to ? percent.

5.3.2 Sand:

This also can be classified as a surficial stratum. This deposit is brown in colour. Surficially the texture is fine, but becomes coarse and gravelly with depth. The relative density is loose to compact ('N' values range from 5 to 30). The water content has an average value of 10 percent. Higher values recorded are attributed to silt seams. Samples below depths of 7 feet are noted to be generally saturated.

5.3.3 Gravel:

This deposit occurs underlying the surficial sand. The colour is brown and silt and sand contents are variable. In many instances the transition is gradual. Because of the layering of sands and fine gravels in this stratum it is difficult to distinctly identify the stratigraphic change with the surficial sand. The relative density of this deposit can be rated as loose to compact. The average water content is around 10 percent, although higher values are recorded in some instances due to an increased silt content.

5.3.4 Silt:

This is a discontinuous layer occurring between the surficial sands and gravels and the underlying lacustrine clays. It is grey in colour and generally it is in a loose to compact state. ('N' values vary from 8 to 18), with the exception of borehole 16 where an 'N' value of 27 blows per foot is registered. The silt stratum is stratified with layers of fine sand and seams of silty clay. Natural water content is in the order of 25 percent.

Typical grading curves for the granular soils are appended.

5.4 SILTY CLAY:

Underlying the surficial granular deposits described in the previous section a grey silty clay layer was encountered in all the boreholes with the exception of borehole 6. This stratum occurs between depths of 16 to 24 feet (average elevation 675±) and terminates at depths of 22 to 35 feet, (average elevation 665±).

Boreholes 1. 8 and 16 terminated in this deposit.

This grey silty clay is varved with seams of silt and fine sand. The consistency varies from firm to stiff ('N' values range from 6 to 28) and the water contents are wetter than the plastic limit. (LL = 28 to 44 percent, PL = 18 to 21 percent, W = 20 to 30 percent). The variations are attributable to varying silt contents.

Laboratory 'quick' triaxial tests gave shear strength values ranging from 843 p.s.f. to 2866 p.s.f. with an average common value of the order of 1500 p.s.f. Two consolidation tests were conducted on samples from this stratum. Pre-consolidation pressures inferred are 2.7 and 2.9 k.s.f. indicating that the silty clay stratum is lightly overconsolidated.

5.5 SILTY CLAY TILL:

This grey glacial silty clay till is encountered underlying the silty clay described in section 5.4 excepting in borehole 6 where it directly underlies the surficial granulars described in section 5.3.

The consistency of this till varies from stiff to hard. ('N' values range from 11 to 51). Laboratory shear strength values measured from 'quick' triaxial tests vary from 1510 p.s.f. to 5083 p.s.f. with an average value in the order of 2600 p.s.f. This till has a low plasticity (LL = 27 percent, PL = 14 percent) and the insitu water contents (15 to 20 percent) are wetter than the plastic limit.

Within this till, thick (8 to 14 feet) discontinuous layers of very dense ('N' values ranging from 66 to more than 100) sandy silt are noted distinctly

in boreholes 3, 5 and 6. In borehole 7, this stratum is encountered immediately underlying the silty clay deposit described in section 5.4 and extends down to the terminal depth of the borehole.

It is likely that these sandy silts are of glacio-fluvial origin deposited during inter-glacial stages.

6.0 GROUND WATER:

Particulars of the groundwater conditions encountered during drilling are recorded on the appended borehole logs to which reference is made.

A perched water condition exists in the surficial granular soils at depths ranging from 6 to 11 feet below existing grade corresponding to elevations of 691 to 686. This water level is considered to be seasonally fluctuating in the order of 2 to 3 feet. As intermittent thaw was taking place at the time of the investigation the water levels recorded are perhaps seasonal highs.

In addition to the perched water described above, ground water under sub-artesian pressure appears to emanate below depths of 45 feet. This condition was noted in boreholes 3, 4, 17, 18 and 20. The water level in a standpipe installed in borehole 3 to a depth of 50 feet rose to approximately 2.8 feet below present grade.

It is likely that some of this water is trapped in the dense sandy silt seams within the till. Existing water well logs from the Ontario Ministry of the Environment are interpreted to give variable conditions

at depth on the occurrence of ground water. It is likely that the Thames River to the east of the site controls the ground water conditions in the area to some extent.

Water samples recovered from the boreholes were tested in the laboratory. The pH values recorded were 7.4 and 7.6 and a sulphate content of 30 p.p.m. These values indicate negligible sulphate attack on foundation concrete.

7.0 DISCUSSION:

7.1 GENERAL:

Proposed Hwy. 402 will have four lanes, two in each direction. Proposed interchange will consist of two separate parallel bridges. Anticipated maximum clear spans will be about 80 feet, with an angle of skew of about 17 degrees.

Approach embankments on either side will be about 20 feet high and longer than 500 feet.

7.2 FOUNDATION SELECTION AND DESIGN:

Because reasonably competent soils are present at the site to depths of 50 feet, foundations in the overburden are recommended. Deep foundations to bedrock are not considered as the depths will be greater than 100 feet and no special advantage will be derived.

7.2.1 Spread Footings:

Spread footings located above the water table at elevation 690 are feasible. The average 'N' value in the standard penetration test is about 10 for the sands and gravel. Some of the lower values recorded are attributable to the seasonal changes in water level. We are of the opinion that during dry weather the perched water level is likely to be slightly lower and it will be possible to apply compactive effort to increase the relative density of the sand stratum to some extent.

We recommend using a net bearing pressure of 3 k.s.f. at elevation 690± subject to inspection. Assuming that the approximate width of the footing will be a maximum of 15 feet or less anticipated total settlement will be in the range of 1 to 1.5 inches. Recommended frost cover requirement is 6 feet.

In recommending the allowable bearing capacity due consideration has been given to avoid overloading the firm to stiff silty clay stratum underlying the surficial granulars and inducing unacceptable long term settlements. Under the recommended bearing pressures we are of the opinion that more than 50 percent of the settlements will occur during construction and long term settlements will be in the order of ½ to 3/4 inch maximum.

7.2.2 Friction Piles:

As an alternative pile foundations merit consideration. Driven displacement piles are likely to refuse at approximate elevation 660±. Thus the anticipated pile lengths will be in the order of 40 feet.

Anticipated capacity per pile will be in the order 30 Tons.

Both closed end steel tube piles filled with concrete and precast concrete piles may be considered. Steel 'H' piles will penetrate to greater depths and are not recommended. Design capacity is arrived at by using end bearing capacity and frictional capacity. The value is compatible with the pile driving formulae available.

A summary of soil parameters for a simplified soils profile for computations of pile capacity are given in appendix A at the back of this report.

It is noted that ground water under sub-artesian pressure is present below the 45 feet depth. It is unlikely that apparent refusal to driven piles by pore pressure buildup will be attained at a higher than anticipated elevation based on the dynamic cone penetration tests. Besides free draining granular materials will be in contact for a large portion of the pile length. Any requirements for redriving should be based on the performance of the test piles.

The actual working capacity of the piles however, should be established by two full scale load tests, one carried out at the west abutments and the other at the east abutments. The tests should be carried out to at least twice the design load. Pile capacities during installation may be estimated using the Hiley Formula as per M.T.C. DD-1219 April 1965.

Recommended minimum spacing between piles is 3 feet in the short direction. Assuming that the anticipated loads will be less than 2400 kips per pier or abutment.

We are of the opinion that an adequate factor of safety (greater than 3) is available for group action. Anticipated group settlement is in the range of 1 to 1.5 inches. However as the piles will be terminating in the very stiff to hard glacial silty clay till, long term settlements are likely to be less than 1 inch.

7.2.3 Bored Caissons or Piers:

Though bored caissons or piers taken into the dense silty clay till are feasible designed for friction and end bearing, we do not favour their use due to the ground water conditions requiring liners and pumping and uncertainty of successful belling in the dense sandy silt seams within the till.

Besides the presence of sub-artesian water in the till stratum will likely create difficulties during installation. Hence the design of these caissons is not looked into any further.

7.3 CONSTRUCTION

The following comments are pertinent to the construction of the bridges and approaches.

7.3.1 Abutments and Piers:

Construction of the abutments and piers as required will not present any unusual problems either using spread footings or piles. The footings or pile caps will be located above the perched water table. Any localized lowering of water table can be handled by sump pumps.

We recommend inspection of the footing beds and compaction by vibratory or other means prior to forming footings. Any soft spots should be sub-excavated and made good with compact granular. After the footing beds are exposed and inspected we recommend pouring a skim coat of concrete if any delay is anticipated in pouring the entire footing.

The excavations will be relatively shallow and will be in granular materials. Construction slopes of 1½ horizontal to 1 vertical may be anticipated.

Assuming that granular materials are available locally in the area and will be used as backfill behind abutments and compacted we recommend the following parameters for designing the retaining structures.

Bulk unit weight = 135 p.c.f.
Co-efficient of active earth pressure K_a = 0.3
Angle of internal friction between soil and wall = 32 degrees.

7.3.2 Approach Embankments:

To meet the grade of the proposed structure approach fills approximately 20 feet high will be required on either side.

Prior to placing the fill we recommend excavating the top soil layer for later reuse as a base for the sod for embankment. We recommend inspecting the exposed fine sands and silts and removing or compacting any soft spots as required.

Assuming that locally available sands will be used for embankment construction we do not anticipate any slope or base stability problems, using embankment slopes of 2 horizontal to 1 vertical. A safety factor greater than 1.3 is available. Considering the presence of soft silty clay stratum underneath the embankment at depth, total anticipated settlement will be in the range of 3 to 4 inches. Long term settlements will be in the order of 1 inch.

As the underlying soils are lightly overconsolidated we do not anticipate negative skin friction loads requiring special attention or lateral movements of the bridge abutments if pile foundations are used.

A large portion of the pile length will be in granular materials.

The proposed crossing is on land and requires only standard erosion protection measures such as seeding/sodding, toe drains etc., no special problems are recognized on the site.

7.4 RECOMMENDATIONS:

Based on the soils conditions at the site we are of the opinion that the choice between spread footings and driven friction cum end bearing piles is to be made on other considerations.

If the proposed structure is comprised of continuous spans then pile foundations are recommended; due to lower anticipated differential settlements compared with spread footings.

For simply supported spans, the choice will be made based on economical factors, considering the types of foundations for other proposed bridges in the area, availability of pile driving equipment and materials.

If the costs are comparable we favour friction cum end bearing piles as foundations for the bridges.

PETO MacCALLUM LTD.

GDP/mj

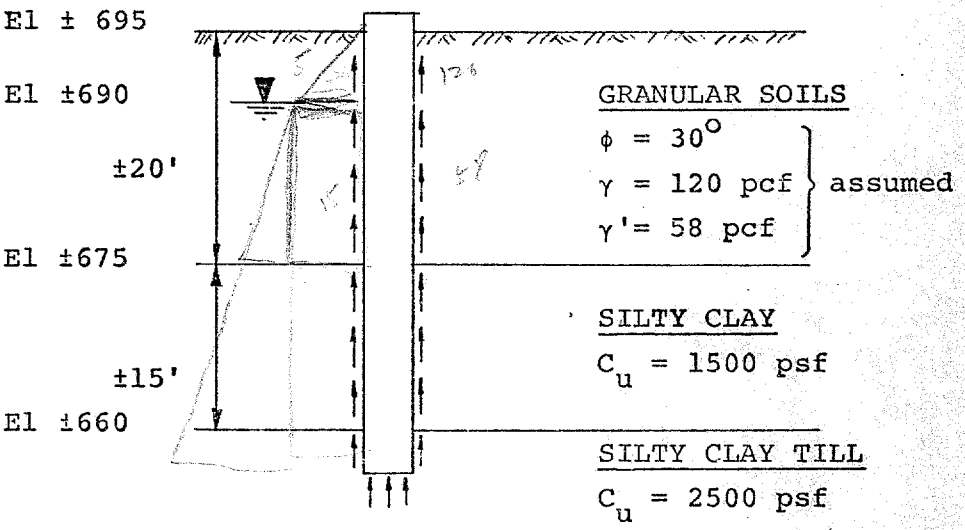
G. D. Prasad, Ph.D., P.Eng.

REGISTERED PROFESSIONAL ENGINEER
G. D. PRASAD
PROVINCE OF ONTARIO

APPENDIX A

SIMPLIFIED SOILS PROFILE FOR DESIGN PURPOSES

AND DESIGN OF 12" DIAM. CLOSED END STEEL PILE



TOTAL PILE CAPACITY P = Skin friction in granular Soils P_1 +
Adhesion in silty clay P_2 +
Adhesion in silty clay till P_3 +
End bearing P_4

Skin Friction in granular soils P_1 = K_s x tan δ x average vertical effective stress x area subject to friction.

Ks = 0.5

δ = 2/3φ i.e. 20°

P_1 = 0.5 x 0.365 x (½ x 120 x 5 x 5 + 120 x 5 x 15 + ½ x 58 x 15 x 15) x 3

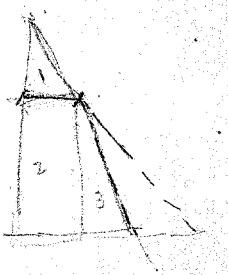
P_1 ≃ 9.0 kips.

Adhesion in silty clay P_2 = C_a x area subject to adhesion.

C_a = C_u (Tomlinson)

P_2 = 1500 x 3 x 15

P_2 ≃ 67.0 kips



Adhesion in silty clay till $P_3 = C_a$ x area subject to adhesion

Assume $C_a = 0.8\ C_u$ in till due to remolding
Take C_a = 2000 psf
Assume penetration in till = 5 ft.
$P_3 = 2000 \times 3 \times 5 \approx 30.0$ kips

End bearing in the till P_4 = end bearing pressure x base area

$P_4 = (CN_c + \gamma D)$ base area
$P_4 = (2500 \times 9 + 120 \times 5 + 58 \times 35) \times 0.78$
$P_4 \approx 21.0$ kips

Total pile capacity = 9.0 + 67.0 + 30.0 + 21.0 ≈ 128 kips

The anticipated load per pile is 60 kips.
Therefore the available safety factor is

$$\frac{128}{60} > 2$$

M.T.C. Pile Driving - Ref. No. DD-1219 - April 65

Using a Delmag D12 hammer, W=1.38 Tons
Weight = 12" steel tube pile at 28 lbs/ft., 40 ft. long plus helmet 0.25 ton gives P = 0.81 ton

$$\frac{P}{W} = \frac{0.81}{1.38} = 0.585$$

Assuming a set of 2 blows per inch and a rebound of 0.5 inch:
Estimated ultimate capacity = 220 kips
Safe working capacity = 60 kips

Measured set and rebound in the field will indicate the actual capacity achieved.

JOB NO. 75.F...56

"QUICK" TRIAXIAL COMPRESSION TEST RESULTS

B.H.#	Sa.#	Depth Ft.	Natural Water Content%	Unit Weight p.c.f. Wet	Unit Weight p.c.f. Dry	Void Ratio	Degree of Saturation %	Cell Pressure P.S.I.	Failure Strain%	Shear Strength p.s.f.	Remarks
3	8	25.0	26.4	126.6	100.2	0.68	100	23.0	20.0	1360	Stiff gr.si. clay
4	10	35.0	16.2	138.0	118.8	0.41	100	30.0	20.0	5083	Hard gr.si.cl till
5	5	20.0	31.6	120.8	91.8	0.83	100	19.0	4.5	843	Firm gr.si. clay
7	6	24.0	24.7	135.7	108.8	0.54	100	22.0	20.0	1260	Stiff,gr.si. clay
8	5	20.0	26.6	125.5	99.4	0.69	100	18.0	6.0	1325	Stiff,gr.si.
9	5	19.0	28.3	128.0	99.8	0.68	100	17.0	14.0	1102	" " clay
9	6	24.0	19.4	134.1	112.3	0.50	100	22.0	20.0	1520	Stiff,gr.si.cl till
10	8	25.0	18.6	137.0	115.5	0.46	100	22.0	7.0	2866	V.stiff gr.si clay
11	9	30.0	19.7	134.8	112.6	0.49	100	25.0	20.0	1918	Stiff,gr.si.cl till
12	7	20.0	29.4	126.0	97.5	0.73	100	18.0	19.0	1440	Stiff,gr.si. clay
12	8	25.0	17.7	134.0	113.6	0.48	100	22.0	20.0	1510	Stiff,gr.si.cl till
13	8	30.0	24.2	126.0	101.2	0.66	100	28.0	11.0	2010	V.stiff,gr.si. clay
13	10	35.0	18.3	137.5	116.6	0.45	100	32.0	18.0	2040	V.stiff,gr.si. cl.till
14	7	25.0	23.0	134.8	109.6	0.53	100	22.0	20.0	1540	Stiff,gr.si. clay
15	6	29.0	26.4	128.8	101.9	0.65	100	27.0	15.0	1116	" " "
17	7	30.0	20.0	134.6	112.2	0.50	100	27.0	20.0	1400	" " "
18	10	35.0	15.6	139.6	120.8	0.39	100	30.0	20.0	3263	V.stiff,gr.si. cl.till
19	6	25.0	30.5	126.0	96.0	0.75	100	22.0	18.0	1200	Stiff,gr.si. clay
20	6	20.0	30.4	112.5	91.5	0.84	100	18.0	5.0	1920	" " "
20	8	30.0	17.1	137.7	117.5	0.43	100	25.0	20.0	3088	V.stiff,gr.si cl.till

Job No. 75 F 56

ATTERBERG LIMIT TEST RESULTS

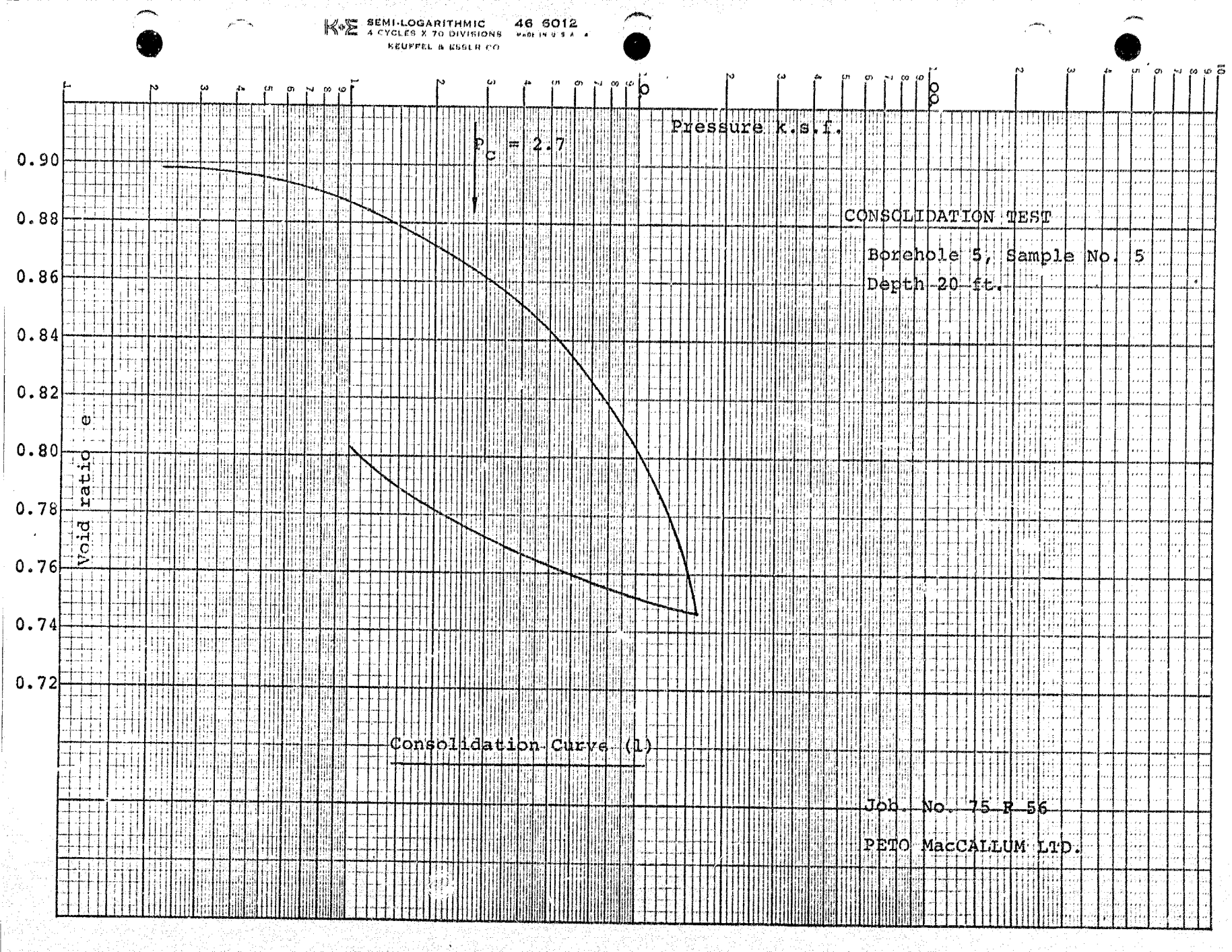
Borehole No.	Sample No.	Depth	Natural Water Content %	Liquid Limit	Plastic Limit	Plasticity Index	Remarks
5	5	20'-22"	31.6	44.0	21.0	23.0	Silty clay of low plasticity
12	8	25'-26'6"	18.2	27.0	14.0	13.0	Silty clay till of low plasticity
17	7	30'-31'6"	21.4	28.0	14.0	14.0	Silty clay of low plasticity
20	6	20'-22'	30.4	34.0	18.0	16.0	Silty clay of low plasticity

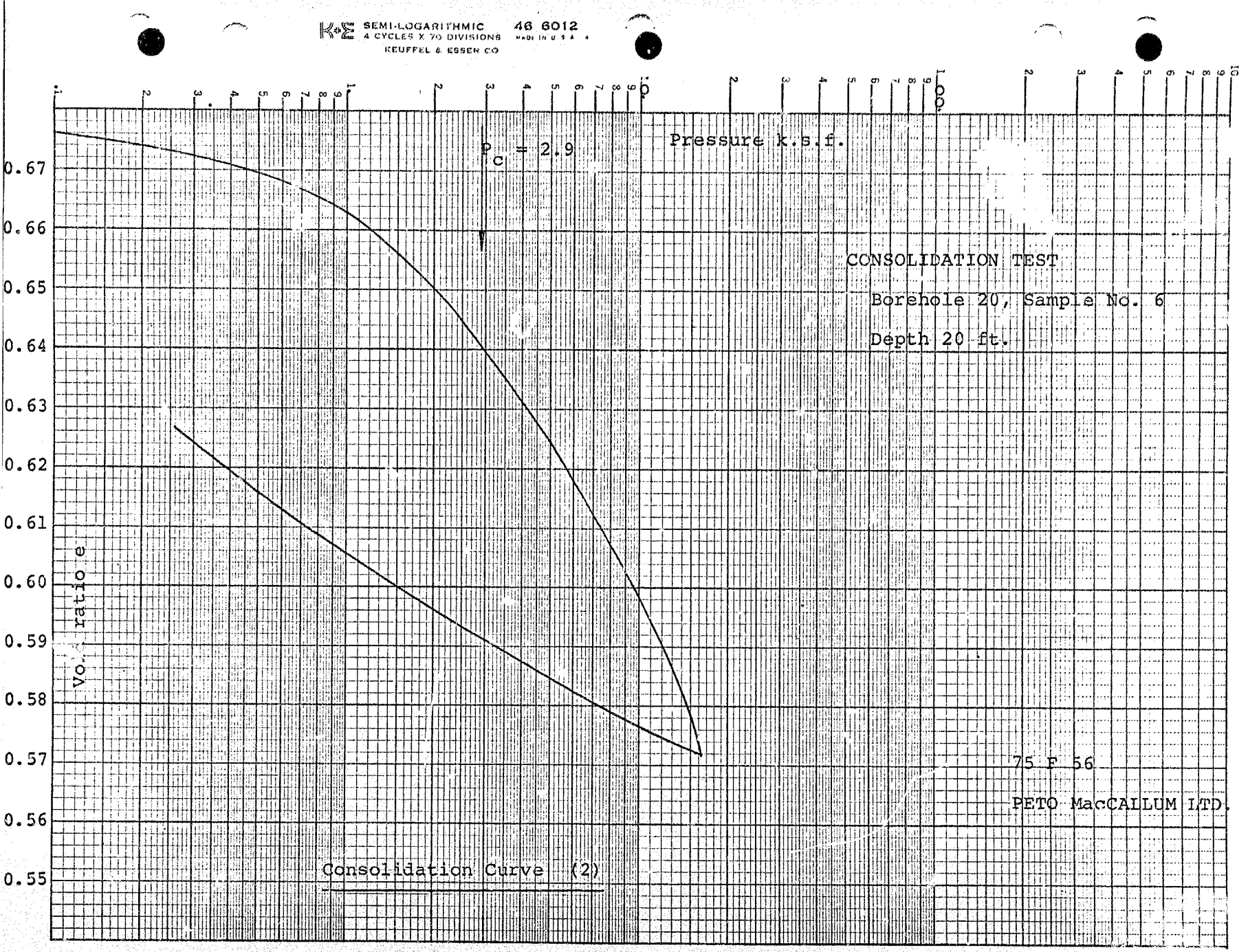
Job No. 75 F 56

p.H. VALUE AND SULPHATE CONTENTS OF WATER SAMPLES

B.H. #	Depth	p.H. Value	Sulphate Content p.p.m. as SO_4	Relative Degree of Sulphate Attack on Concrete
8	Water	7.4	30	Negligible
13	Water	7.6	30	Negligible
18	Water	7.4	30	Negligible

K&E SEMI-LOGARITHMIC 46 5012
4 CYCLES X 70 DIVISIONS MADE IN U.S.A.
KEUFFEL & ESSER CO

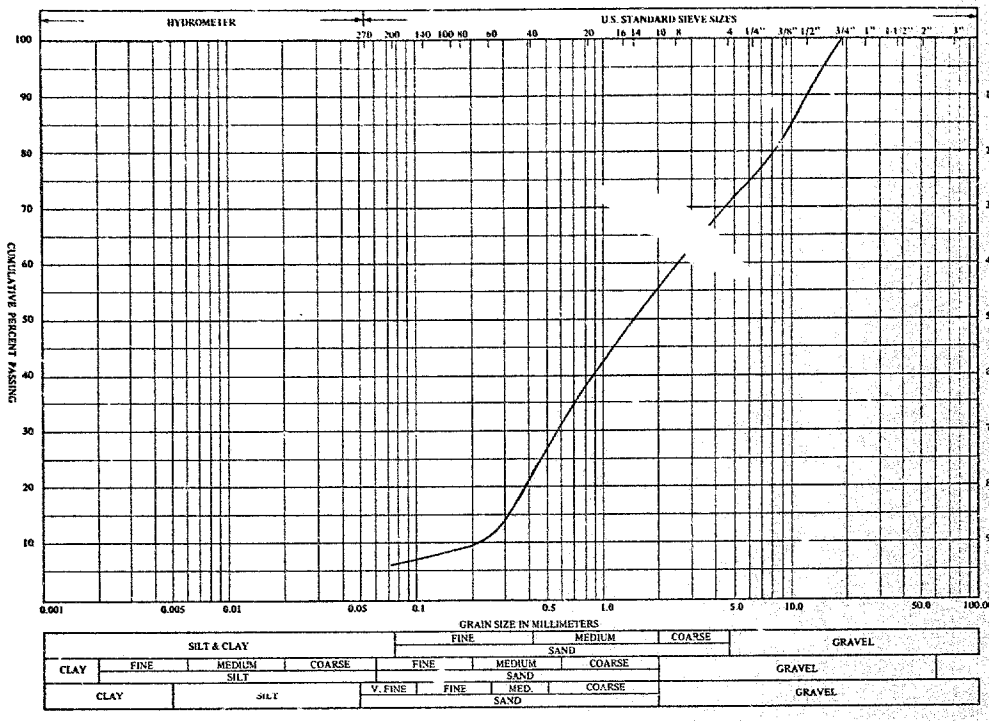



K&E SEMI-LOGARITHMIC 46 6012
4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO
Pc = 2.9
Pressure k.s.f.
0.67
0.66
0.65
0.64
0.63
0.62
0.61
0.60
0.59
0.58
0.57
0.56
0.55
Vo. ratio e
CONSOLIDATION TEST
Borehole 20, Sample No. 6
Depth 20 ft.
75 F 56
PETO MacCALLUM LTD.
Consolidation Curve (2)

PETO MacCALLUM LTD.

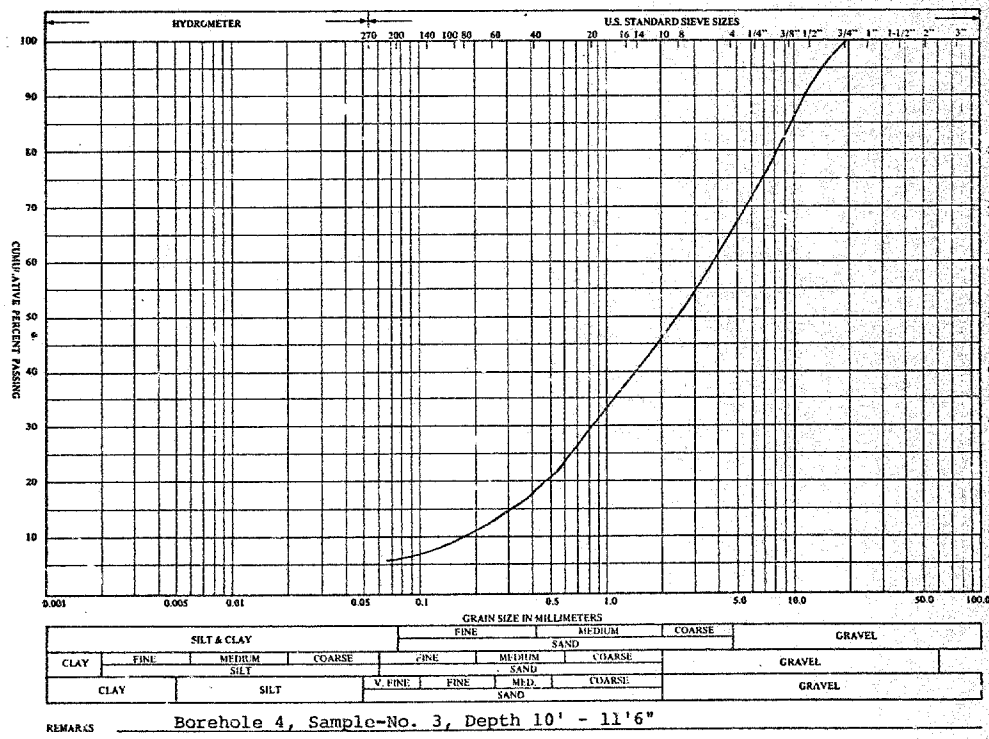
JOB NUMBER 75 F 56

PARTICLE SIZE DISTRIBUTION CHART



REMARKS Borehole 20, Sample No. 2 Depth 5'-6'6"

Gravelly sand



REMARKS Borehole 4, Sample-No. 3, Depth 10' - 11'6"

Gravelly sand

(Sample at the boundary between the gravelly sand layer and the sandy gravel layer)

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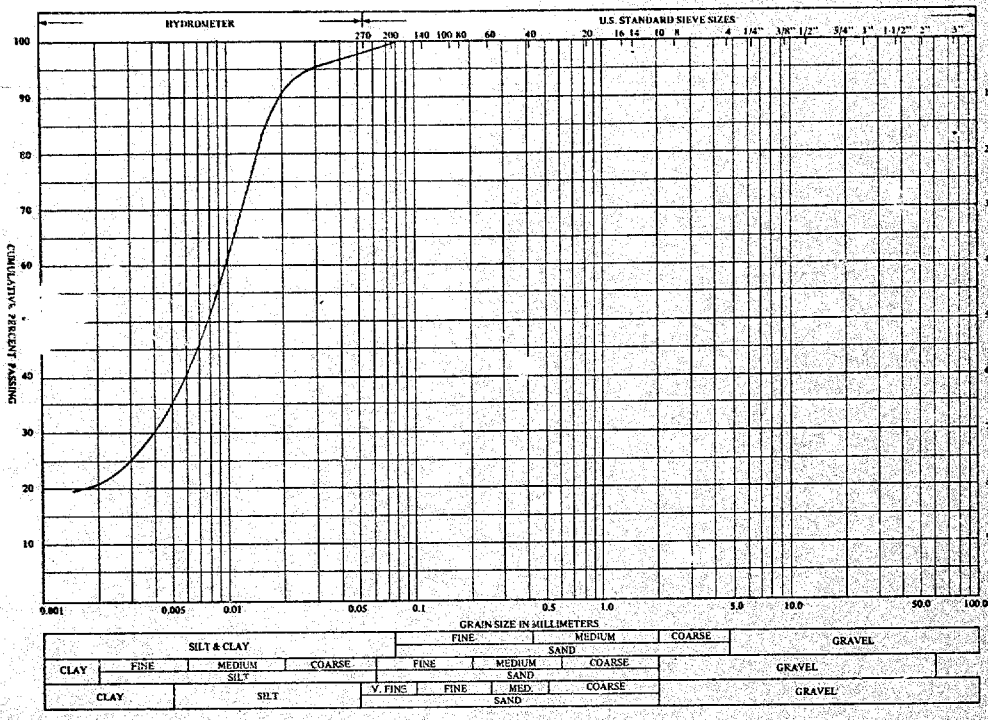
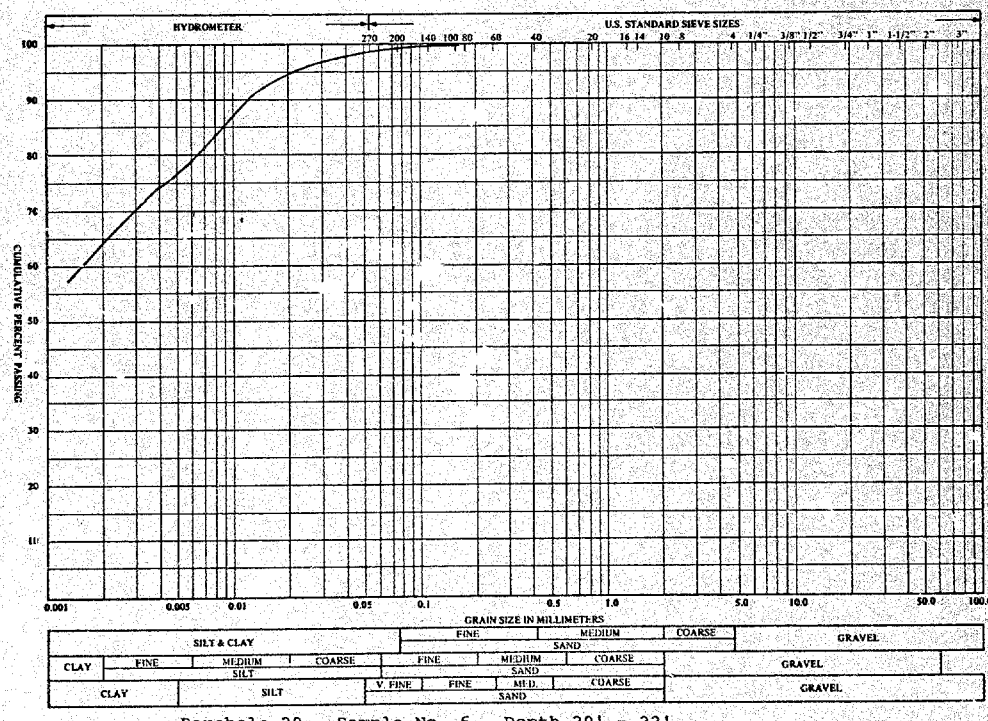
JOB NUMBER 75 F 56

PARTICLE SIZE DISTRIBUTION CHART



REMARKS Borehole 20, Sample No. 5, Depth 15' - 16'6"

Clayey silt.



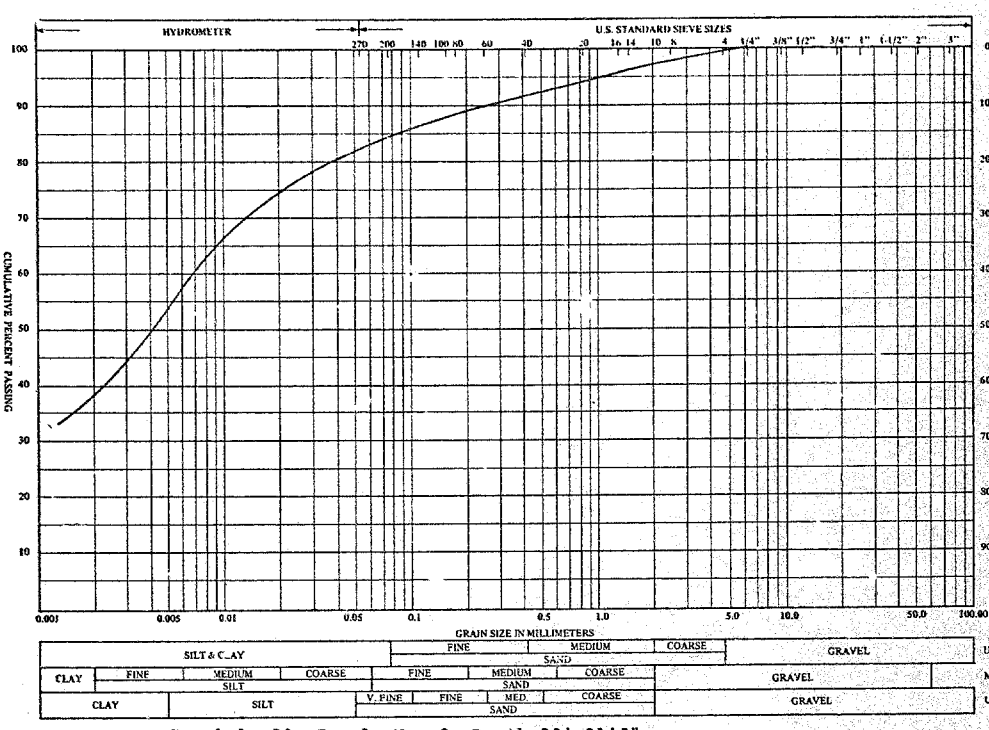
REMARKS Borehole 20, Sample No. 6, Depth 20' - 22'

Silty clay

PETO MacCALLUM LTD.

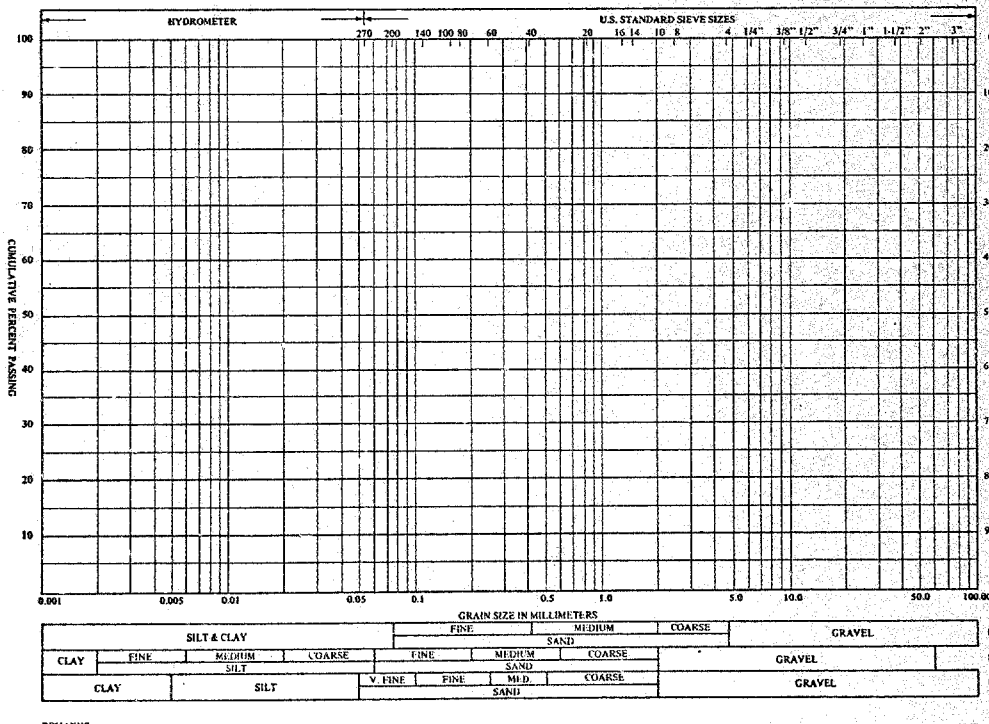
JOB NUMBER 75 F 56

PARTICLE SIZE DISTRIBUTION CHART



REMARKS Borehole 20, Sample No. 8, Depth 30'-31'6"

Sandy silty clay (till)



REMARKS

PETO MacCALLUM LTD.
CONSULTING GEOTECHNICAL ENGINEERS

LOG OF BOREHOLE No. 2

JOB NAME Proposed Crossing at King's Hwy.2 & Proposed King's Hwy.402 - Line 'A' JOB No. 75 F 56

LOCATION Station 609 + 92 o/s 62' Lt. ℄ Line 'A' BORING DATE April15,1975 ENGINEER GDP/MB

BORING METHOD Hollow Stem Auger & Cone Test TECHNICIAN JBS

DEPTH	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/FOOT N - VALUES
	GROUND ELEVATION: 698.6					
0.5	Topsoil					
	Sand, silty, fine to ±3.0 becoming coarser at depth with trace of gravel becoming coarse sand and gravel below ±20.0		695	1	SS	6
				2	SS	15
			690	3	SS	20
			685	4	SS	30
	Compact Brown		680	5	SS	16
			675	6	SS	11
			670	7	SS	12
30.0	Silty clay					
	Stiff Brown		665	8	SS	20
34.5	Mixture of silty clay, some sand and gravel (Glacial silty clay till)		660	9	SS	29
40.5			658.			
	End of borehole					

SHEAR STRENGTH C_u ▲

DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST •

BLOWS/FOOT 20 40 60 80

LIQUID LIMIT W_L
PLASTIC LIMIT W_P
WATER CONTENT W
W_P W W_L

WATER CONTENT % 10 20 30

GROUNDWATER OBSERVATIONS AND REMARKS

W.L ±10.2

Water @ 11.5

Water @ 12.5 in Hollow stem

Water @ 18.0

Backup 2' in augers

Water @ 29.0

Water @35.0

After pulling Augers
Water @ 10.2

NOTES:

CHECKED BY KK

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PETO MacCALLUM LTD.
CONSULTING GEOTECHNICAL ENGINEERS

LOG OF BOREHOLE No. 3

JOB NAME: Proposed Crossing at King's Hwy.2 and Proposed King's Hwy.402 Line 'A' JOB No. 75 F 56
LOCATION: Sta. 610 + 80 o/s 94' Lt. ℄ Line 'A' BORING DATE April14,1975 ENGINEER GDP/MB
BORING METHOD: Hollow Stem Augers & Cone Test TECHNICIAN WJ

DEPTH	DESCRIPTION (GROUND ELEVATION: 698.1)	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/FOOT N - VALUES
0.7	Topsoil Sandy silt					
	Sandy silt - some fine sand occasional organic matter Compact Brown					
2.5	Sand, silty fine to medium, some gravel		695	1	SS	12
				2	SS	16
	Compact Brown		690	3	SS	13
9.0	Gravel, sandy - some cobbles			4	SS	14
			685	5	SS	11
	Compact Brown					
15.0	Sand, silty, fine to coarse with some gravel Compact Brown			6	SS	20
18.0	Silt - stratified silt and clay layers -		680			
	Compact Grey			7	SS	12
22.0	Silty clay- silt seams and pockets odd 0.5 in. to 1.0 in. layers of silt.		675			
	Very stiff Grey			8	SS	18
			670			
30.0	Mixture of silty clay, some sand and gravel (Glacial silty clay till)			9	SS	21
			665			
	Hard Grey			10	SS	51
			660			
40.0	Silt: stratified silt and clayey silt seams- Some sandy silt seams. Odd rounded gravel.			11	SS	71
			655			
	Very dense Grey			12	SS	132
48.0			650			
	Mixture of silty clay, some sand and gravel. (Glacial silty clay till) Hard Grey			13	SS	50
51.5			646.6			
	End of borehole					

SHEAR STRENGTH C_u ksf (2 3 4 5) ▲
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
BLOWS/FOOT (20 40 60 80)

LIQUID LIMIT W_L
PLASTIC LIMIT W_P
WATER CONTENT W
W_P W W_L
WATER CONTENT % (10 20 30)

GROUNDWATER OBSERVATIONS AND REMARKS

WL 2.8
April 25, 1975

After Sa. #5
Hollow stem to 10.0
water at 10.4
cave at 10.5

After Sa. #6
Hollow stem at 15.0
water at 10.4

bentonite seal

standpipe P3

When hole at 48.0
Hollow stem at 45.0
Water up to 14.5
Hole at 51.5
Hollow stem at 40.0
Water bailed out, unable to bail below 19.0

Time	WL
2:50pm	19.0
2:51pm	17.2
2:52pm	16.6
2:57pm	14.3

NOTES:

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PETO MacCALLUM LTD.
CONSULTING GEOTECHNICAL ENGINEERS

LOG OF BOREHOLE No. 4

JOB NAME Proposed Crossing at King's Hwy.2 & Proposed King's Hwy.402 Line 'A' JOB No. 75 F 56

LOCATION Sta 611 + 17 o/s 89'Lt. $\mathcal{L}$ Line 'A' BORING DATE April 9 ,1975 ENGINEER GDP/MB

BORING METHOD Hollow Stem Augers & Cone Test TECHNICIAN W.J.

DEPTH	DESCRIPTION	LEGEND	ELEVATION	SAMPLES NUMBER	SAMPLES TYPE	BLOWS/FOOT N-VALUES
	GROUND ELEVATION: 699.7					
	Fill. Mixed sand, sandy silt and gravel - Trace of organic matter Loose Brown			1	SS	4
5	5.7		695	2	SS	11
	Sand, silty fine to coarse, some gravel,					
10	±10.0 Compact Brown		690	3	SS	22
	Gravel, fine, sandy more sandy and silty with depth			4	SS	15
15	Compact Brown		685	5	SS	22
20	±20.0		680	6	SS	14
	Silt, clayey, increasing clay content with depth					
	24.0 Compact Grey		675	7	TW	-
25	Silty clay, thin layers and pockets of silt			8	SS	28
30	Stiff to very stiff Grey		670	9	SS	14
35	±35.0		665	10	SS	35
	Mixture of silty clay, some sand and gravel (Glacial silty clay till)					
40			660	11	SS	37
	Hard Grey		655			
45				12	SS	39
50			650	13	SS	36
	51.5		648.2			
	End of borehole					
55						
60						

SHEAR STRENGTH C_u ksf
2 3 4 5
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST •
BLOWS/FOOT
20 40 60 80

LIQUID LIMIT W_L
PLASTIC LIMIT W_P
WATER CONTENT W
W_P W W_L
WATER CONTENT %
10 20 30

GROUNDWATER OBSERVATIONS AND REMARKS

W.L. 11.5'±

After Sa. #4 hole at 13.5 casing to 10.0 cave at 11.1 water below cave

After Sa. #5 hole at 16.6 casing to 15'

Time	W.L.
2:30pm	13.3
2:35pm	12.8
2:40pm	12.75

sand coming up inside the hollow stem

After Sa. #12 hole at 46.5 hollow stem at 44.0 water at 11.75

On completion, augers pulled, hole caved at 11.5 water below cave

NOTES:

CHECKED BY:

PETO MacCALLUM LTD.
CONSULTING GEOTECHNICAL ENGINEERS

LOG OF BOREHOLE No. 5

JOB NAME: Proposed Crossing at King's Hwy.2 & Proposed King's Hwy.402 - Line 'A' JOB No. 75 F 56

LOCATION: Station 612 + 00 o/s 82 Lt ℄ Line 'A' BORING DATE: April 11,1975 ENGINEER: GDP/MB

BORING METHOD: 7" Hollow Stem & 3" Solid Auger TECHNICIAN: IBS

DEPTH	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/FOOT N-VALUES	GROUNDWATER OBSERVATIONS AND REMARKS
	GROUND ELEVATION: 696.0					
0.7	Topsoil					
	Sand, silty near the top medium to coarse	695	1	SS	4	
		690	2	SS	8	
	Loose to compact Brown	685	3	SS	13	W.L. 8'± (assumed) After Sa. #3 Water @ 8.0
16.2		680	4	SS	13	After Sa. #4 Water @ 12.0
18.0	Silt, with odd clay layers Compact Grey					
	Silty clay with occasional silt seams	675	5	TW		
			6	SS	9	
	Stiff Grey	670	7	SS	10	After Sa. #6 Water @ 18.2 Water @ 21
30.5		665	8	SS	20	
	Mixture of silty clay, some sand and gravel (Glacial silty clay till)					
35.0	Very stiff Grey					
	Sandy silt with odd clay layers and seams	660	9	SS	91	Augers to 40, dry After 1½ hr. water @ 34'
	Very dense Grey	655	10	SS	66	
		650	11	SS	95	After Sa. #11 water @ 44'
49.0						
51.5	Mixture of silty clay, sand gravel (Glacial silty clay till) Hard Grey	645	12	SS	62	B.H. dry
	End of borehole	644.5				

SHEAR STRENGTH C_u ksf (2 3 4 5)

DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST •
BLOWS/FOOT (20 40 60 80)

LIQUID LIMIT W_L
PLASTIC LIMIT W_P
WATER CONTENT W
W_P W W_L
WATER CONTENT % (10 20 30)

NOTES:

CHECKED BY: KK

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CONSULTING GEOTECHNICAL ENGINEERS

LOG OF BOREHOLE No. 6

JOB NAME Proposed Crossing at King's Hwy.2 & Proposed King's Hwy.402 - Line 'A' JOB No. 75 F 56

LOCATION Sta. 612 + 50 o/s 80' Lt. ℄ Line 'A' BORING DATE April 12,1975 ENGINEER GDP/MB

BORING METHOD Hollow Stem Auger TECHNICIAN JBS

DEPTH	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/FOOT N - VALUES	GROUNDWATER OBSERVATIONS AND REMARKS
	GROUND ELEVATION: 695.7						
0.8	Topsoil		695				
	Sand, fine, trace of gravel - silty with some organic content near the surface -			1	SS	2	
5	Becoming coarser with depth		690	2	SS	11	W.L. 6.7 April 25,1975
10	Loose to compact Brown		685	3	SS	11	After Sa. #3 Water @ 7.8
15	15.0			4	SS	16	
	Silt Odd clay seams and odd sand layers		680				
20	Loose Grey						
	20.5		675	5	SS	8	After Sa. #5 Water @ 17
	Mixture of silty clay, some sand and gravel (Glacial silty clay till)						
25	Odd sandy silt layers			6	SS	13	Water @21
	Stiff Grey		670				
30				7	SS	15	Bentonite seal
	31.0+		665				
	Sandy silt, with odd clay seams and pockets						
35			660	8	SS	100/10"	Standpipe P6
40	Very dense Grey		655	9	SS	95	April 17,8 am WL 4.5 pipe blocked at 34.0 April 25,1pm W.L. 6.7
	43.0+						
45	Mixture of silty clay, some sand and gravel (Glacial silty clay till)		650	10	SS	22	
	Very stiff Grey						
50	50.5		645.2	11	SS	26	On completion hole dry After pulling auger wet cave at 8.0
	End of borehole						
55							
60							

SHEAR STRENGTH C_u ▲

DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST •
BLOWS/FOOT 20 40 60 80

LIQUID LIMIT W_L
PLASTIC LIMIT W_P
WATER CONTENT W
W_P W W_L
WATER CONTENT % 10 20 30

NOTES: Standpipe 6A installed at Sta. 612 + 60 o/s 80' Lt.

CHECKED BY KK

PETO MacCALLUM LTD.
CONSULTING GEOTECHNICAL ENGINEERS

LOG OF BOREHOLE No. 7

JOB NAME Proposed Crossing at King's Hwy.2 & Proposed King's Hwy.402 - Line 'A' JOB No. 75 F 56

LOCATION Station 612 + 65 o/s 53' lt. ℄ Line 'A' BORING DATE April 14,1975 ENGINEER GDP/MB

BORING METHOD Hollow Stem Auger TECHNICIAN JBS

DEPTH	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/FOOT N - VALUES
	GROUND ELEVATION: 695.7				
0.7	Topsoil	695			
	Sand, silty, fine to medium, becoming coarser below ±3.0 with some gravel and less silt		1	SS	8
		690	2	SS	17
	Compact Grey	685	3	SS	18
		680	4	SS	12
18.0	Silty clay with sandy silt layers and odd sand layers - till like at depth	675	5	SS	8
	Stiff Grey	670	6	SS	14
29.5	Sandy silt with odd clayey silt layers	665	7	SS	78
	Very dense Grey	660	8	SS	100/11"
40.5	End of borehole	655.2	9	SS	66

SHEAR STRENGTH C_u ksf (2, 3, 4, 5)
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST •
BLOWS/FOOT (20, 40, 60, 80)

LIQUID LIMIT W_L
PLASTIC LIMIT W_P
WATER CONTENT W
W_P W W_L
WATER CONTENT % (10, 20, 30)

GROUNDWATER OBSERVATIONS AND REMARKS

W.L. ±7.7 (assumed)

Hole jumped on completion Water @ 37.0

After 1 hour water @ 28.0 cave @ 36.0 with augers still in hole

NOTES:

CHECKED BY: KK

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PETO MacCALLUM LTD.
CONSULTING GEOTECHNICAL ENGINEERS

LOG OF BOREHOLE No. 8

JOB NAME: Proposed Crossing at King's Hwy.2 and Proposed King's Hwy.402 Line 'A' JOB No. 75 F 56
LOCATION: Station 613 + 65 o/s 50' Lt. ℄ Line 'A' BORING DATE: April 10,1975 ENGINEER: GDP/MB
BORING METHOD: Hollow Stem Auger TECHNICIAN: JBS

DEPTH	DESCRIPTION (GROUND ELEVATION: 695.8)	LEGEND	ELEVATION	SAMPLES NUMBER	SAMPLES TYPE	BLOWS/FOOT N-VALUES	GROUNDWATER OBSERVATIONS AND REMARKS
0.7	Topsoil, sandy silt		695				
	Sandy silt with fine sand Loose Brown			1	SS	6	
4.7							
	Sand, medium to coarse some silt and fine sandseams		690	2	SS	18	
7.0	Compact Brown						W.L. at 8.3 April 25, 1975
	Gravel, sandy						
10							
11.0	Compact Brown		685	3	SS	12	Piezometer P8 April 14, 1975 water at 7.5
	Silt, clayey some clay layers and seams						
	Compact Grey						After sa. #3 water at 7.5
15			680	4	SS	18	
17.5							
	Silty clay						
20	Silt seams and pockets some pebble		675	5	TW		
				6	SS	13	After Sa. #6 water at 7.1
25							
	Stiff Grey		670	7	SS	13	
30							
			664.8	8	SS	21	On completion, after pulling augers to 26.5 water at 27.0 After pulling auger to 13.0 water at 7.5
31.5	End of borehole						
35							
40							
45							
50							
55							
60							

SHEAR STRENGTH C_u ksf (2 3 4 5)
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST •
BLOWS/FOOT (20 40 60 80)

LIQUID LIMIT W_L
PLASTIC LIMIT W_P
WATER CONTENT W
W_P W W_L
WATER CONTENT % (10 20 30)

NOTES:

CHECKED BY: KK

MEMBER OF THE ASSOCIATION OF CONSULTING ENGINEERS OF CANADA

PETO MacCALLUM LTD.
CONSULTING GEOTECHNICAL ENGINEERS

LOG OF BOREHOLE No. 9

JOB NAME: Proposed Crossing at Kings Hwy.2 and Proposed King's Hwy.402 Line 'A'
JOB No. 75 F 56
LOCATION: Station 613 + 65 o/s 66' Rt. ℄ Line 'A'
BORING DATE: April 14,1975
ENGINEER: GBE/DJB
BORING METHOD: Hollow Stem Auger
TECHNICIAN: JBS

GROUND ELEVATION: 694.0

DEPTH	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/FOOT N-VALUES
0.7	Topsoil					
	Sandy silt to very fine sand Loose Brown		690	1	SS	5
7.0				2	SS	8
	Sand, medium to coarse trace gravel Compact Brown		685	3	SS	19
13.0±						
	Silt, with odd clay layers Compact Grey		680	4	SS	12
18.0±						
	Silty clay Occasional silt layers Stiff Grey		675	5	SS	11
22.0±						
	Mixture of silty clay, some sand and gravel (Glacial silty clay till) Stiff Grey		670	6	SS	11
			665			
30.5			663.5	7	SS	17
	End of borehole					

SHEAR STRENGTH C_u ksf: 2 3 4 5
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST •
BLOWS/FOOT: 20 40 60 80

LIQUID LIMIT W_L
PLASTIC LIMIT W_P
WATER CONTENT W
W_P W W_L
WATER CONTENT %: 10 20 30

GROUNDWATER OBSERVATIONS AND REMARKS

- W.L ±5.8
- Water @ 6.0
- Water @ 9.0
  Backup to 12.5
- Water 14.5
- Water @ 19.0
- Water @ 28.0
- After pulling Augers water & cave @ 5.8

NOTES:

CHECKED BY: KE

PETO MacCALLUM LTD.
CONSULTING GEOTECHNICAL ENGINEERS

LOG OF BOREHOLE No. 10

JOB NAME: Proposed Crossing at King's Hwy.2 and Proposed King's Hwy.402 Line 'A' — JOB No. 75 F 56
LOCATION: Sta. 612 + 65 o/s 64' Rt. ℄ Line 'A' — BORING DATE: April 12,1975 — ENGINEER: GDP/MB
BORING METHOD: Hollow Stem Auger — TECHNICIAN: W.J.

DEPTH	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/FOOT N-VALUES
	GROUND ELEVATION: 694.3					
0.7	Topsoil, sandy silt					
2.0	Sandy silt, Brown					
	Sand, silty, fine to medium layers of coarse sand and gravel, layers of silty fine sand and fine sand		690	1	SS	11
6.3	Compact Light brown			2	SS	11
	Gravel, sandy			3	SS	16
9.5	Compact Brown		685			
	Silt, stratified			4	SS	9
	Layers of wet silt and silty clay			5	SS	8
	Loose Brown to 9.5 Grey below		680			
16.0				6	SS	8
	Silty clay, Some silt seams, trace of gravel		675			
	Firm to stiff Grey			7	SS	12
			670			
27.0				8	TW	
	Mixture of silty clay, some sand and gravel (Glacial silty clay till)		665	9	SS	20
				10	SS	28
	Very stiff to hard Grey		660			
				11	SS	51
			655			
41.5				12	SS	35
	End of borehole		652.8			

SHEAR STRENGTH C_u KSF (2, 3, 4, 5) ▲
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
BLOWS/FOOT (20, 40, 60, 80)

LIQUID LIMIT W_L
PLASTIC LIMIT W_P
WATER CONTENT W
W_P W W_L
WATER CONTENT % (10, 20, 30)

GROUNDWATER OBSERVATIONS AND REMARKS

▼W.L ±6.2

After Sa #3 water at 6.2 cave at 6.5 casing to 5.0

On completion water at 6.2 cave at 10.0 no casing

NOTES:

CHECKED BY:

PETO MacCALLUM LTD.
CONSULTING GEOTECHNICAL ENGINEERS

LOG OF BOREHOLE No. 11

JOB NAME Proposed Crossing at King's Hwy.2 and proposed King's Hwy.402 Line 'A' JOB No. 75 F 56

LOCATION Sta 611 + 86 o/s 96 Rt. ℄ Line 'A' BORING DATE April 12,1975 ENGINEER GDP/MB

BORING METHOD Hollow Stem Auger & Cone Test TECHNICIAN WJ

DEPTH	DESCRIPTION	LEGEND	ELEVATION	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS FOOT 'N' VALUES
	GROUND ELEVATION: 694.6					
0.8	Topsoil, sandy silt					
2.5	Sandy silt, some organic matter. Compact Brown			1	SS	11
	Sand, silty, fine to medium Layers of medium to coarse sand and fine gravel Compact Brown		690	2	SS	14
6.0				3	SS	14
	Gravel, some fine sand Compact Brown		685	4	SS	18
13.0						
	Silt, stratified Layers of silt and silty clay Loose Grey		680	5	SS	9
±20.0			675	6	TW	
	Silty clay, layers and seams of silt Sandy silt pockets and seams, some pebbles Stiff to very stiff Grey			7	SS	12
±26.0			670	8	SS	19
	Mixture of silty clay, some sand and fine gravel (Glacial silty clay till)		665	9	SS	15
			660			
	Very stiff Grey			10	SS	21
			655	11	SS	30
			650	12	SS	17
			645			
51.5			643.1	13	SS	22
	End of borehole					

SHEAR STRENGTH C_u ksf (2 3 4 5)

DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST •

BLOWS/FOOT (20 40 60 80)

LIQUID LIMIT W_L
PLASTIC LIMIT W_P
WATER CONTENT W
W_P W W_L

WATER CONTENT % (10 20 30)

GROUNDWATER OBSERVATIONS AND REMARKS

W.L. ±7.0
After Sa #3 water at 7.0 casing to 5.0

On completion water at 7.0 no casing

NOTES:

CHECKED BY: KK

PML/504

MEMBER OF THE ASSOCIATION OF CONSULTING ENGINEERS OF CANADA

PETO MacCALLUM LTD.
CONSULTING GEOTECHNICAL ENGINEERS

LOG OF BOREHOLE No. 12

JOB NAME: Proposed Crossing at King's Hwy.2 and Proposed King's Hwy.402 Line 'A' JOB No. 75 F 56
LOCATION: Sta. 611 + 56 o/s 94 Rt. ℄ Line 'A' BORING DATE: April 14,1975 ENGINEER: GDP/MB
BORING METHOD: Hollow Stem Augers TECHNICIAN: WJ

DEPTH	DESCRIPTION	LEGEND	ELEVATION	SAMPLES NUMBER	SAMPLES TYPE	BLOWS/FOOT N-VALUES
	GROUND ELEVATION: 694.7					
0.7	Topsoil ly silt					
2.3	Sandy silt, slightlyorganic Loose Brown					
	Sand, silty, fine to medium Layers of silty fine sand, some gravel		690	1	SS	10
5				2	SS	10
	Becoming coarse with more gravel below ±7.0			3	SS	9
			685			
10	Loose to compact Brown			4	SS	10
13.0				5	SS	16
	Silt: Stratified silt and silty clay		680			
15	Brown to 14.0			6	SS	10
	Loose then grey					
18.0						
	Silty clay silt and sandy silt lenses and seams		675	7	SS	10
20						
	Stiff Grey					
25.0			670			
	Mixture of silty clay, some sand and gravel (Glacial silty clay till)			8	SS	14
30			665	9	SS	24
35			660	10	SS	34
40	Very stiff Grey		655	11	SS	37
45			650	12	SS	24
50			645			
51.5			643.2	13	SS	27
	End of borehole					
55						
60						

SHEAR STRENGTH C_u 2 3 4 5 ksf
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST •
BLOWS/FOOT 20 40 60 80

LIQUID LIMIT W_L
PLASTIC LIMIT W_P
WATER CONTENT W
W_P W W_L
WATER CONTENT % 10 20 30

GROUNDWATER OBSERVATIONS AND REMARKS

clay backfill

W.L. 7.3
April 25,1975

After sa #3 hollow stem @ 5.0 water at 7.3

sand backfill

Piezometer P 12

On completion Auger pulled to 35' hole dry and open to 51.5

NOTES: Piezometer installed in another hole 5' N.E. of B.H. 12, augered to 18' without sampling

CHECKED BY: KK

PETO MacCALLUM LTD.
CONSULTING GEOTECHNICAL ENGINEERS

LOG OF BOREHOLE No. 13

JOB NAME Proposed Crossing at King's Hwy.2 and Proposed King's Hwy.402 Line 'A' JOB No. 75 F 56
LOCATION Station 610 + 70 o/s 88' Rt. ℄ Line 'A' BORING DATE April 9,1975 ENGINEER GDP/MB
BORING METHOD Hollow Stem Auger to 30', 3" Solid Auger to End of Borehole TECHNICIAN JBS

DEPTH	DESCRIPTION GROUND ELEVATION: 698.5	LEGEND	ELEVATION	SAMPLES NUMBER	SAMPLES TYPE	BLOWS/FOOT N - VALUES	GROUNDWATER OBSERVATIONS AND REMARKS
	Fill, silty sand and gravel						
	At ±3.0, a 3" sand layer		695	1	SS	14	
5.5	Compact Brown			2	SS	13	
	Sand, fine to coarse silty near the top trace of gravel		690	3	SS	14	
	Compact Brown			4	SS	14	▼ W.L. ±9.5
±13.0			685				
	Gravel, fine, sandy, coarser with depth			5	SS	17	After Sa #5 casing at 15.0 Water at 11.9 sand backing up to 13.2
	Compact Brown		680	6	SS	24	
24.0			675				
	Silty clay, Silt seams and pockets some pebbles			7	SS	9	
	Stiff Grey		670	8	TW		
32.0							
	Mixture of silty clay, some sand and fine gravel		665	9	SS	17	After Sa #9 water at 30.0
	(Glacial silty clay till)			10	SS	25	
			660				After Sa #10 water at 25.0 seepage from overlying sand
	Very stiff to hard Grey			11	SS	39	
			655				
				12	SS	23	
			650				
51.5				13	SS	25	On completion water at 37.0 After pulling augers water at 9.5 cave at 17.0
	End of borehole		647.0				

SHEAR STRENGTH C_u ksf (2 3 4 5) ▲
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
BLOWS/FOOT (20 40 60 80)

LIQUID LIMIT W_L
PLASTIC LIMIT W_P
WATER CONTENT W
W_P W W_L
WATER CONTENT % (10 20 30)

NOTES:

CHECKED BY: KK

MEMBER OF THE ASSOCIATION OF CONSULTING ENGINEERS OF CANADA

PETO MacCALLUM LTD.
CONSULTING GEOTECHNICAL ENGINEERS

LOG OF BOREHOLE No. 14

JOB NAME Proposed Crossing at King's Hwy.2 & Proposed King's Hwy.402 - Line 'A' JOB No. 75 F 56

LOCATION Sta. 610 + 28 o/s 85' Rt. ℄ Line 'A' BORING DATE April 17,1975 ENGINEER GDP/MB

BORING METHOD Hollow Stem Auger & Cone Test TECHNICIAN WJ

DEPTH	DESCRIPTION	LEGEND	ELEVATION	SAMPLES NUMBER	SAMPLES TYPE	BLOWS/FOOT N VALUES
	GROUND ELEVATION: 696.7					
0.7	Topsoil					
	Sandy silt, fine sand, some organic matter Compact Brown		695	1	SS	14
4.0						
5	Sand, silty, fine to medium becoming coarser with depth Some gravel			2	SS	11
			690	3	SS	22
10						
	Loose to compact Brown		685	4	SS	8
15.0						
15	Gravel, with coarse sand			5	SS	19
	Compact Brown		680			
19.0						
20	Silt: layered Layers of silt and siltysand					
22.0	Compact Grey			6	SS	11
	Silty Clay: Some silt seams and odd pebbles		675			
25				7	SS	15
			670			
30	Stiff Grey					
				8	SS	16
			665			
35 ±35.0						
	Mixture of silty clay, some sand and gravel (Glacial silty clay till) Pockets and seams of silt			9	SS	20
			660			
40				10	SS	23
			655			
45				11	SS	16
			650			
50				12	SS	17
51.5						
	End of borehole		645.2			
55						
60						

SHEAR STRENGTH C_u ksf
2 3 4 5

DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST •

BLOWS/FOOT
20 40 60 80

LIQUID LIMIT W_L
PLASTIC LIMIT W_P
WATER CONTENT W
W_P W W_L

WATER CONTENT %
10 20 30

W.L. ±9.7

GROUNDWATER OBSERVATIONS AND REMARKS

After Sa # 4
Hollow stem at 10'
Water at 9.7

After Sa #5
Hollow stem at 15.0
Sand backing up to 14.0

On completion hole caved at 10.0
water at 9.7

NOTES:

CHECKED BY: KK

PML/504

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LOG OF BOREHOLE No. 15

JOB NAME Proposed Crossing at King's Hwy.2 & Proposed King's Hwy.402 - Line 'A' JOB No. 75 F 56

LOCATION Station 609 + 92 o/s 54' Rt. ℄ Line 'A' BORING DATE April 15,1975 ENGINEER GDP/MB

BORING METHOD Hollow Stem Auger & Cone Test TECHNICIAN JBS

DEPTH	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/FOOT N-VALUES
	GROUND ELEVATION: 698.1					
0.8	Topsoil					
	Sand, Silty and fine near the top Medium from ±3.0 to ±9.5 Medium to coarse with gravel below ±9.5		695	1	SS	9
				2	SS	13
			690			
				3	SS	23
	Loose to compact brown		685			
			680			
20.0				4	SS	18
	Silt Compact Brown					
23.0±			675			
	Silty clay with odd silt seams Stiff Grey			5	SS	13
			670			
31.0				6	SS	12
	Mixture of silty clay, some sand and gravel (glacial silty clay till)		665			
				7	SS	13
	Stiff to hard Grey		660			
40.5			657.6	8	SS	42
	End of Borehole					

SHEAR STRENGTH C_u ksf (2 3 4 5)
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST •
BLOWS/FOOT (20 40 60 80)

LIQUID LIMIT W_L
PLASTIC LIMIT W_P
WATER CONTENT W
W_P W W_L
WATER CONTENT % (10 20 30)

GROUNDWATER OBSERVATIONS AND REMARKS

▼ W.L. 10.0±
Water @ 10.5±
Water @ 18'
Water @ 38'
After pulling Auger Water @ 10.0

NOTES:

CHECKED BY: KK

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LOG OF BOREHOLE No. 16

JOB NAME Proposed Crossing at King's Hwy. 2 and Proposed King's Hwy.402 Line 'A' JOB No. 75 F 56
LOCATION Station 608 + 92 o/s 51' Rt. ℄ Line 'A' BORING DATE April 17,1975 ENGINEER GDP/MB
BORING METHOD Hollow Stem Auger TECHNICIAN JBS

DEPTH	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/FOOT N - VALUES	GROUNDWATER OBSERVATIONS AND REMARKS
	GROUND ELEVATION: 697.9						
0.9	Topsoil						
	Sandy silt to silty fine sand Very loose Brown		695	1	SS	2	
4.0±							
5	Sand, medium to coarse with frequent gravel			2	SS	12	
			690				
10	Loose to dense Brown			3	SS	9	▽W.L. ± 9.2 Water 10.5
			685				
15				4	SS	32	Water @ 10.5
18.5			680				
20	Silt Dense Brown to 21 then grey			5	SS	27	
22.0							
	Silty clay with silt layers and pockets		675				
25				6	SS	13	
	Stiff Grey		670				
30							Water 20.5
31.5			666.4	7	SS	9	After pulling Augers, water at 9.2 cave 10.0
	End of borehole						
35							
40							
45							
50							
55							
60							

SHEAR STRENGTH C_u ▲
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
BLOWS/FOOT 20 40 60 80

LIQUID LIMIT W_L
PLASTIC LIMIT W_P
WATER CONTENT W
W_P W W_L
WATER CONTENT % 10 20 30

NOTES:

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LOG OF BOREHOLE No. 17

JOB NAME: Proposed Crossing at King's Hwy.2 and Proposed King's Hwy.402 Line 'A' JOB No. 75 F 56
LOCATION: Sta. 610 + 54 ℄ Line 'A' BORING DATE: April 16,1975 ENGINEER: GDP/MB
BORING METHOD: Hollow Stem Auger TECHNICIAN: WJ

DEPTH	DESCRIPTION (GROUND ELEVATION: 697.6)	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/FOOT N - VALUES
0.8	Topsoil, sandy silt					
2.7	Sandy silt, some fine sand, some organic matter Loose Brown		695	1	SS	16
5	Sand, silty fine to medium			2	SS	20
9.0	Compact Brown		690			
10	Gravel, sandy occasional sand layers more sandy with depth			3	SS	11
15	Loose to compact Brown		685	4	SS	8
18.0	Silty clay: layers and seams of silt		680			
20				5	SS	13
25	Stiff to very stiff. Grey		675	6	TW	lost
30			670	7	SS	28
32.0	Mixture of silty clay, some sand and gravel		665			
35	(Glacial silty clay till)			8	SS	35
40	Occasional sandy silt seams		660	9	SS	38
45			655	10	SS	31
50	Very stiff to hard Grey		650	11	SS	27
55			645	12	SS	24
60	continued next page		640	13	SS	20

SHEAR STRENGTH C_u ksf (2 3 4 5)
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST •
BLOWS/FOOT (20 40 60 80)

LIQUID LIMIT W_L
PLASTIC LIMIT W_P
WATER CONTENT W
W_P W W_L
WATER CONTENT % (10 20 30)

GROUNDWATER OBSERVATIONS AND REMARKS

▼ ±9.7 W.L.

Hole at 12.0
hollow stem
at 10.0
water at 10.5

Hole and Hollow stem at 45'
no water
After Sa #10

Time	W.L.
2:30pm	18.7
2:31pm	15.7
2:32pm	13.8
2:33pm	12.5
2:38pm	12.1
2:43pm	11.7
2:48pm	11.7

NOTES:

CHECKED BY: LJ

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CONSULTING GEOTECHNICAL ENGINEERS

LOG OF BOREHOLE No. 17

continued

JOB NAME: Proposed Crossing at King's Hwy.2 and Proposed King's Hwy.402 Line 'A'
JOB No. 75 F 56

LOCATION: Sta. 610 + 54 ℄ Line 'A"
BORING DATE: April 16,1975
ENGINEER: GDP/MB

BORING METHOD: Hollow Stem Augers
TECHNICIAN: WJ

SOIL PROFILE				SAMPLES			SHEAR STRENGTH C_u ▲	LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W	GROUNDWATER OBSERVATIONS AND REMARKS
DEPTH	DESCRIPTION GROUND ELEVATION:	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/FOOT N - VALUES	DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST • BLOWS/FOOT 20 40 60 80	W_P W W_L WATER CONTENT % 10 20 30	
			635	13	SS	20			
5									
			630	14	SS	34			
10									
71.5			626.1	15	SS	31			On completion hole caved at 10.5 water at 9.7
	End of borehole								
15									
20									
25									
30									
35									
40									
45									
50									
55									
60									

NOTES:

CHECKED BY: KL

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CONSULTING GEOTECHNICAL ENGINEERS

LOG OF BOREHOLE No. 18

JOB NAME: Proposed Crossing at King's Hwy. 2 and Proposed King's Hwy.402 Line 'A' — JOB No. 75 F 56

LOCATION: Sta 610 + 91 ℄ Line 'A' — BORING DATE: April 10,1975 — ENGINEER: GDP/MB

BORING METHOD: Hollow Stem Auger & Cone Test — TECHNICIAN: WJ

DEPTH	DESCRIPTION	LEGEND	ELEVATION	SAMPLES: NUMBER	SAMPLES: TYPE	BLOWS/FOOT N-VALUES
	GROUND ELEVATION: 699.0					
	Fill, sandy gravel					
1.5	Loose Brown					
	Sandy silt, some fine gravel		695	1	SS	6
	some organic matter					
5.3	Loose Brown					
	Sandy silty, fine to coarse, some gravel			2	SS	13
	Gravel layers 2" to 3" thick		690	3	SS	16
	Compact Brown			4	SS	12
13.0						
	Gravel, sandy		685			
	Compact Brown			5	SS	21
19.5			680			
	Silt, clayey, clay seams			6	SS	15
24.0	Compact Grey		675			
	Silty clay, Seams of sandy silt-lenses and pockets of silt			7	SS	15
	Very stiff Grey		670	8	TW	
				9	SS	22
±34.0			665			
	Mixture of silty clay, sand and gravel (Glacial silty clay till)			10	SS	28
			660			
	Very stiff to hard Grey			11	SS	27
			655			
				12	SS	34
			650			
51.5			647.5	13	SS	28
	End of borehole					

SHEAR STRENGTH C_u ksf: 2 3 4 5

DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST •

BLOWS/FOOT: 20 40 60 80

LIQUID LIMIT ——— W_L
PLASTIC LIMIT ——— W_P
WATER CONTENT ——— W

W_P W W_L

WATER CONTENT %: 10 20 30

GROUNDWATER OBSERVATIONS AND REMARKS

▼ W.L. 8.4 ft. April 25,1975

After Sa. #5 hole at 16.5 casing to 15.0

Time	W.L.
9:30am	12.5
9:35am	11.7
9:40am	11.5

clay backfill

piezometer P18

After Sa #11, hole at 41.5 hollow stem at 40.0, hole dry

After sa #12 hole at 46.6 hollow stem at44.0

Time	W.L.
10:45am	22.0
10:46am	18.75
10:47am	15.6
10:57am	11.5

Water vailed out unable to bail below 14.0

Time	W.L.
11:10am	14.0
11:10a	12.25
11:12a	11.5
11:17am	11.5

(water sample taken)

NOTES:

CHECKED BY: LL

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PETO MacCALLUM LTD.
CONSULTING GEOTECHNICAL ENGINEERS

LOG OF BOREHOLE No. 19

JOB NAME: Proposed Crossing at King's Hwy.2 and Proposed King's Hwy.402 Line 'A' JOB No. 75 F 56
LOCATION: Station 611 + 76 ℄ Line 'A' BORING DATE: April 10,1975 ENGINEER: GDP/MB
BORING METHOD: Hollow Stem Augers to 20' then 3" Solid Augers TECHNICIAN: JBS

SOIL PROFILE | SAMPLES | SHEAR STRENGTH C_u ▲ | LIQUID LIMIT W_L, PLASTIC LIMIT W_P, WATER CONTENT W | GROUNDWATER OBSERVATIONS AND REMARKS

DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
BLOWS/FOOT: 20 40 60 80
WATER CONTENT %: 10 20 30

DEPTH	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/FOOT N-VALUES	GROUNDWATER OBSERVATIONS AND REMARKS
	GROUND ELEVATION: 695.4						
0.7	Topsoil, silty sand						
	Sandy silt with fine sand						
3.0	Loose Brown			1	SS	7	
	Sand, medium to coarse some gravel coarser with depth		690	2	SS	8	W.L. 7'±
	Loose to compact Brown		685	3	SS	22	After Sa #3 water at 8' sand backing up to 8.5
15.5			680	4	SS	18	
	Silt, claye with clayseams Compact Grey						
18.0	Silty clay frequent silt seams and pockets some pebbles		675	5	SS	6	
	Firm to stiff Grey		670	6	SS	10	
±30.0	Mixture of silty clay, some sand and gravel (Glacial silty clay till)		665	7	SS	14	
			660	8	SS	32	After Sa #8 water at 32.0
			655	9	SS	41	After Sa #9 water at 37.0
	Hard Grey		650	10	SS	42	After Sa #10 water at 41.0
			645	11	SS	43	On completion water at 47.0 1 hr. later, water at 40.0 After pulling augers, wet cave at 7.0
51.5			643.9				
	End of borehole						

NOTES:

CHECKED BY EK

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LOG OF BOREHOLE No. 20

JOB NAME Proposed Crossing at King's Hwy.2 and Proposed King's Hwy.402 Line 'A' JOB No. 75 F 56

LOCATION Sta. 612 + 17 ℄ Line 'A' BORING DATE April 11.1975 ENGINEER GDP/MB

BORING METHOD Hollow Stem Auger TECHNICIAN W.S.

DEPTH	DESCRIPTION	LEGEND	ELEVATION	SAMPLES: NUMBER	TYPE	BLOWS/FOOT & 'N' VALUES
	GROUND ELEVATION: 695.4					
0.6	Topsoil, sandy silt					
1.8	Sandy silt Brown					
	Sand, silty, fine to coarse with some gravel			1	SS	14
			690	2	SS	11
				3	SS	8
	Loose to compact Brown					
11.3			685	4	SS	17
	Silt, clayey some clay seams More clayey with depth					
	Compact Brown to 14.0 then grey		680	5	SS	13
±20.						
	Silty clay some silt seams		675	6	TW	
					vane	
	Very stiff Grey		670	7	SS	11
25.5						
	Mixture of silty clay, sand and gravel (Glacial silty clay till)					
	Pockets of sandy silt		665	8	SS	26
			660	9	SS	29
			655	10	SS	24
			650	11	SS	29
	Very stiff to hard, Grey					
			645	12	SS	36
			640	13	SS	20
			635	14	SS	25
	continued next page					

SHEAR STRENGTH C_u ksf (2 3 4 5)

DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST •
BLOWS/FOOT (20 40 60 80)

LIQUID LIMIT W_L
PLASTIC LIMIT W_P
WATER CONTENT W
W_P W W_L
WATER CONTENT % (10 20 30)

GROUNDWATER OBSERVATIONS AND REMARKS

▼ W.L. ±6.8

After Sa. #4 hole at 11.5 casing to 10.0

time	W.L.
5:15pm	7.6
7:30am (next day)	7.3

Hole dry from ±20 to ±31.

Some seepage from ±39 to 41.6
After Sa #10 water rose to 36.0 in 15 min.

NOTES: * Field vane

CHECKED BY: KC

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LOG OF BOREHOLE No. 20 continued.

JOB NAME: Proposed Crossing at King's Hwy. 2 and Proposed King's Hwy.402 Line 'A' JOB No. 75 F 56

LOCATION: Sta. 612 + 17 ℄ Line 'A' BORING DATE: April 11,1975 ENGINEER: GDP/MB

BORING METHOD: Hollow Stem Auger TECHNICIAN: W.J.

DEPTH	DESCRIPTION (GROUND ELEVATION:)	LEGEND	ELEVATION	SAMPLES NUMBER	SAMPLES TYPE	BLOWS/FOOT N VALUES
				14	SS	25
5			630	15	SS	27
10			625	16	SS	25
71.5			623	9		
	End of borehole					

SHEAR STRENGTH C_u ▲

DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●

BLOWS/FOOT
20 40 60 80

LIQUID LIMIT ——— W_L
PLASTIC LIMIT ——— W_P
WATER CONTENT ——— W

W_P W W_L

WATER CONTENT %
10 20 30

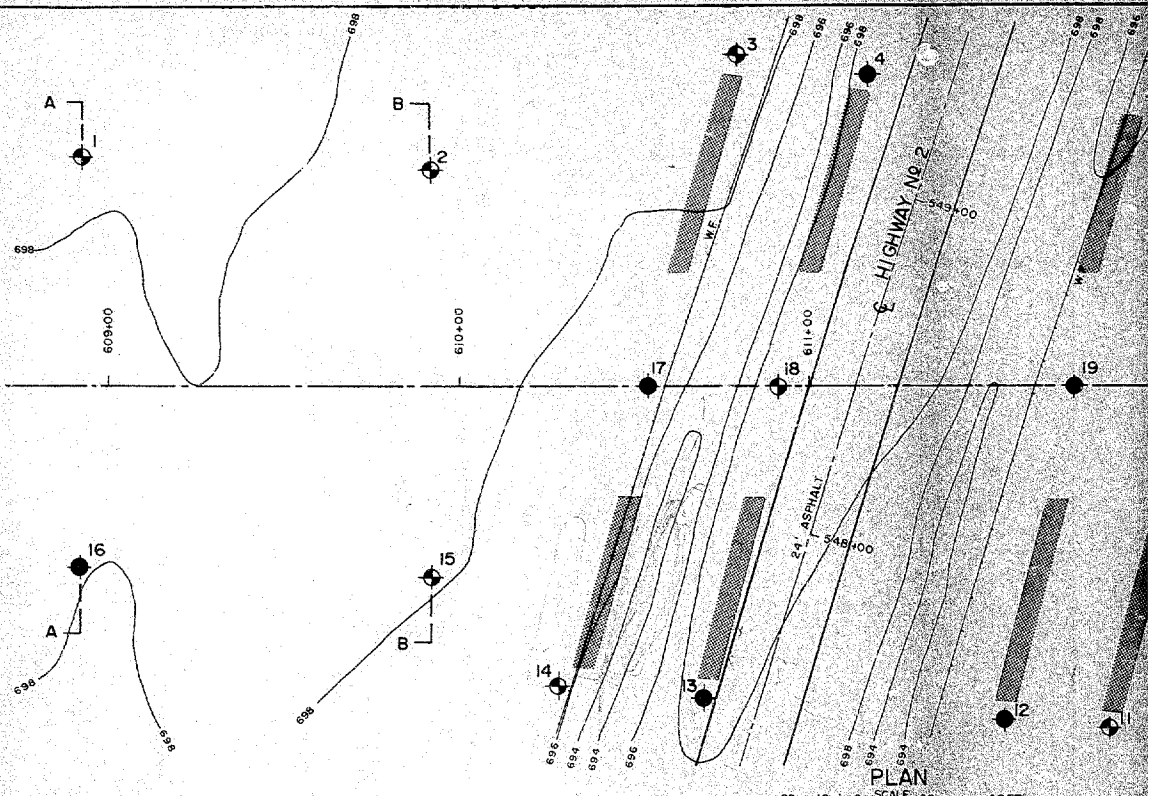
GROUNDWATER OBSERVATIONS AND REMARKS

After pulling out of hollow stem, hole caved at 7.5 water at 6.8

NOTES:

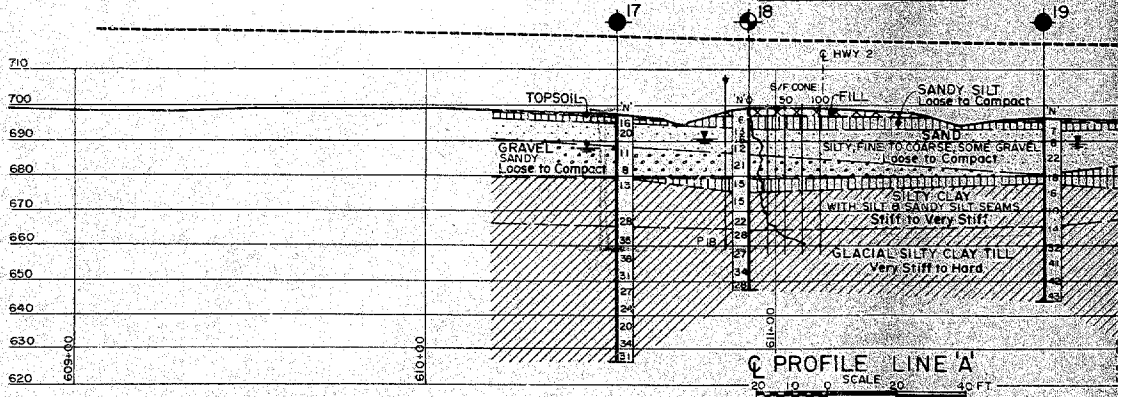
CHECKED BY: KK

MEMBER OF THE ASSOCIATION OF CONSULTING ENGINEERS OF CANADA



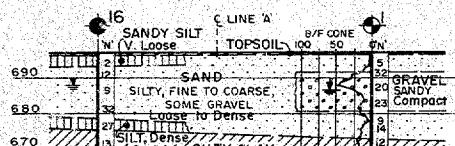
PLAN

SCALE 20 10 0 20 40 FT

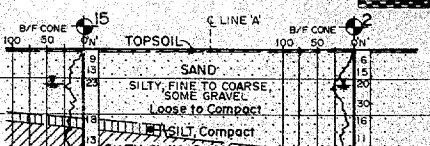


℄ PROFILE LINE 'A'

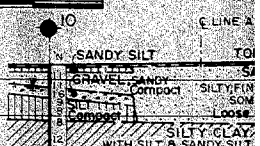
SCALE 20 10 0 20 40 FT



A-A



B-B

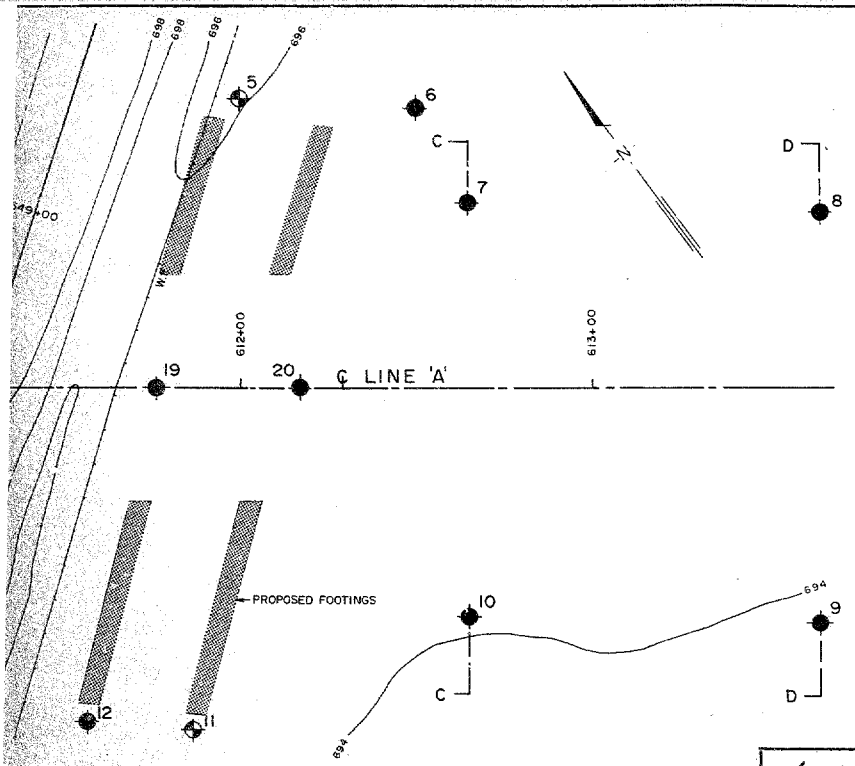


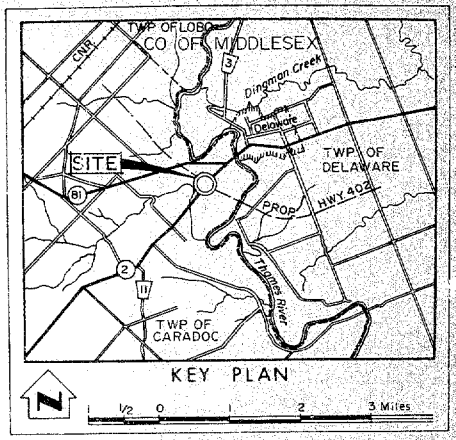
C-C

SECTIONS

VERT 20 10 0 20 40 FT

HORIZ 30 15 0 30 60 FT





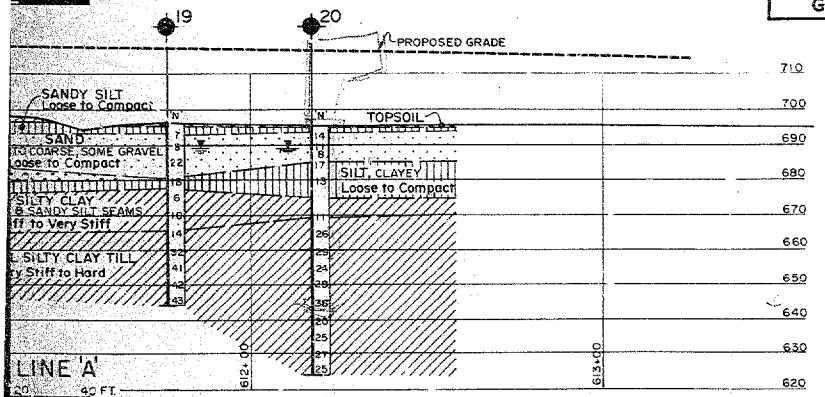
LEGEND

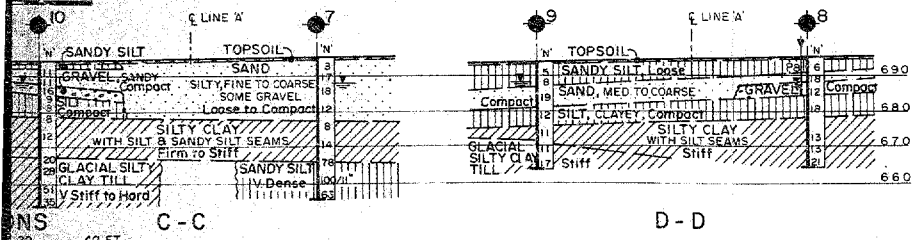
- Bore Hole
- Dynamic Cone Penetration Resistance Test
- Bore Hole & Cone Test
- Water Levels, established at time of field investigation: APRIL 1975
- PIEZOMETER OR STANDPIPE

NO.	ELEVATION	STATION	OFFSET
1	697.9	608+92	66' LT
2	698.6	609+32	62' LT
3	698.1	610+80	89' LT
4	695.7	611+17	89' LT
5	696.0	612+00	82' LT
6	695.7	612+50	80' LT
7	695.7	612+65	53' LT
8	695.8	613+65	50' LT
9	694.0	613+65	66' RT
10	694.3	612+65	64' RT
11	694.6	611+86	96' RT
12	694.7	611+56	94' RT
13	698.5	610+70	88' RT
14	696.7	610+28	85' RT
15	698.1	609+92	54' RT
16	697.9	608+92	51' RT
17	697.6	610+54	℄
18	699.0	610+91	℄
19	695.4	611+76	℄
20	695.4	612+17	℄

40I14-90

GEOCRES No.





— NOTE —

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

REVISIONS			
	DATE	BY	DESCRIPTION

PETO MacCALLUM LTD.

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO
ENGINEERING SERVICES BRANCH: GEOTECHNICAL OFFICE - SOIL MECHANICS SECTION

PROPOSED CROSSING AT KING'S HWY. 2 AND PROPOSED KING'S HWY. 402 LINE 'A'

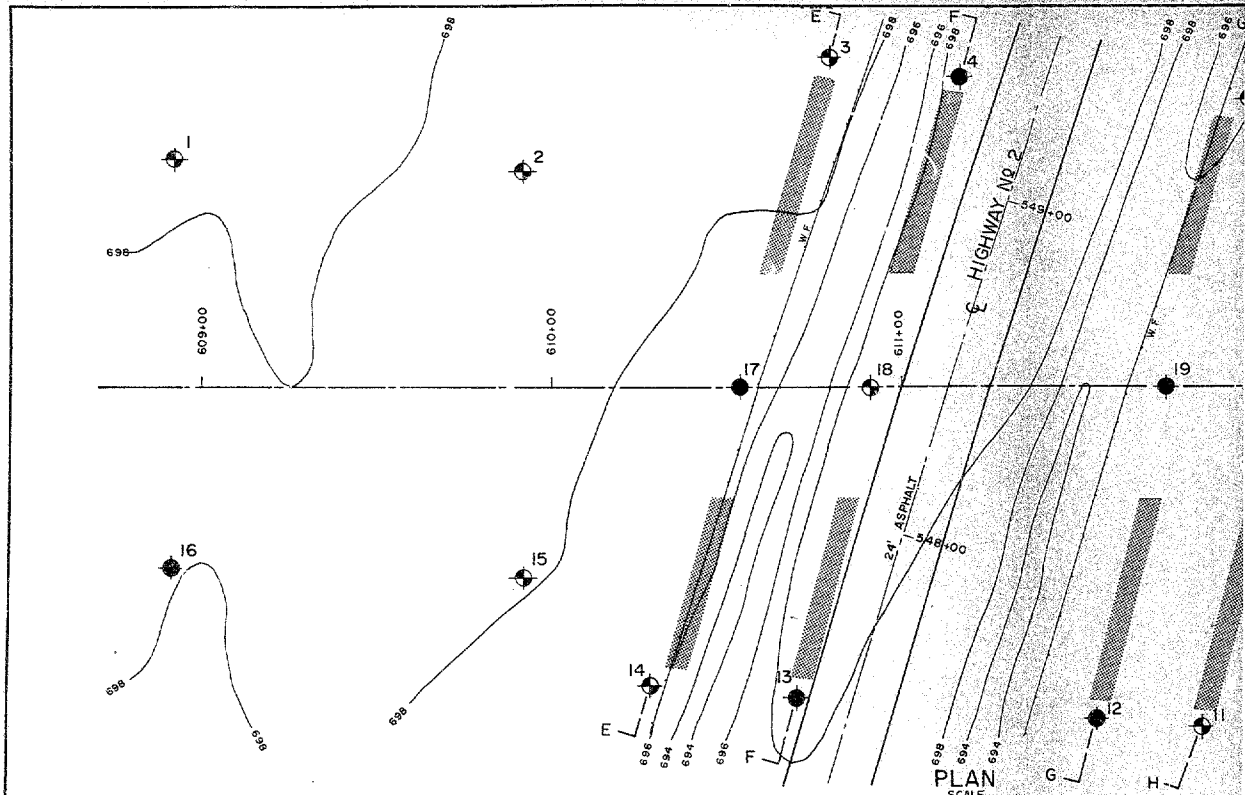
HIGHWAY NO 2 & 402 DIST NO 2

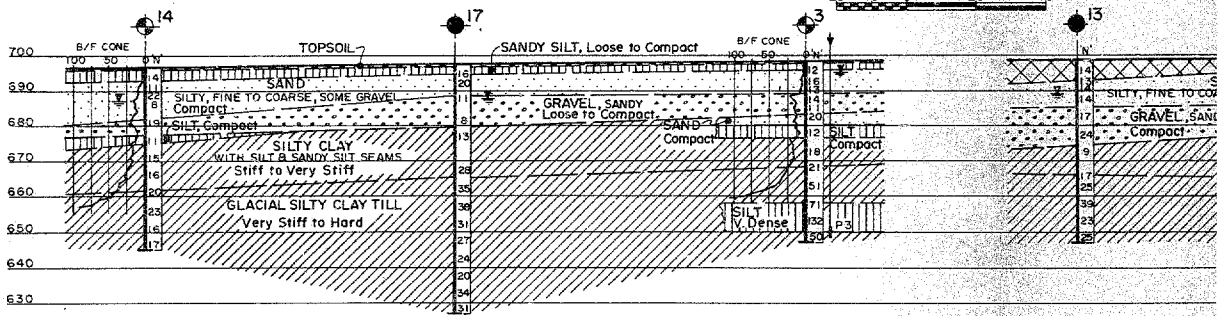
CO. MIDDLESEX

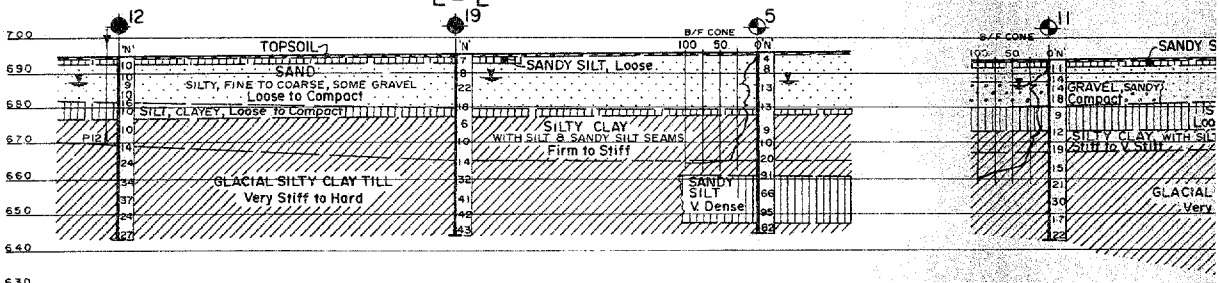
TWP CARADOC LOT 23 CON RANGE I NLR

BORE HOLE LOCATIONS & SOIL STRATA

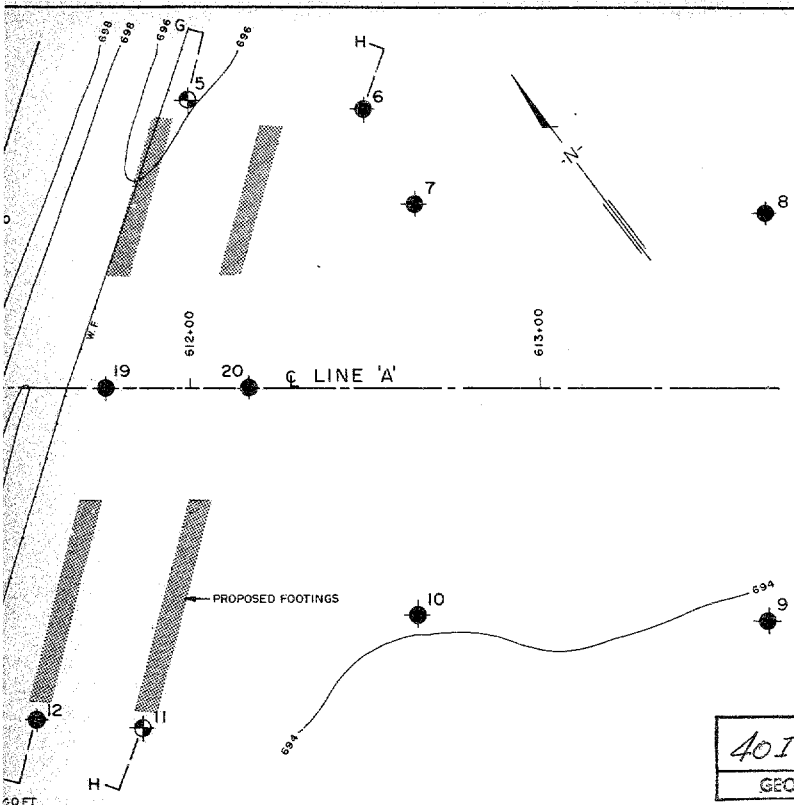
SUBMD M.B	CHECKED	W.P. NO 41-66-19-20	DRAWING NO 1
DRAWN K.K	CHECKED M.B	W.O. NO 75E56	
DATE MAY 1975		SITE NO 19-535	BRIDGE DRAWING NO
APPROVED		CONT NO	

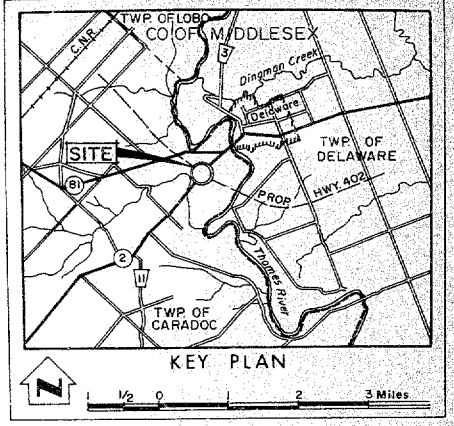






SECTIONS
SCALE
20 10 0 20 40 FT



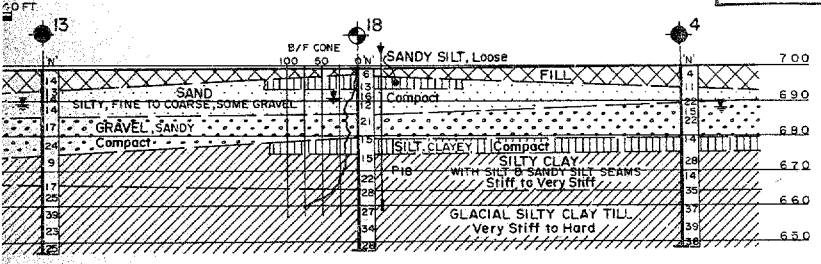


LEGEND

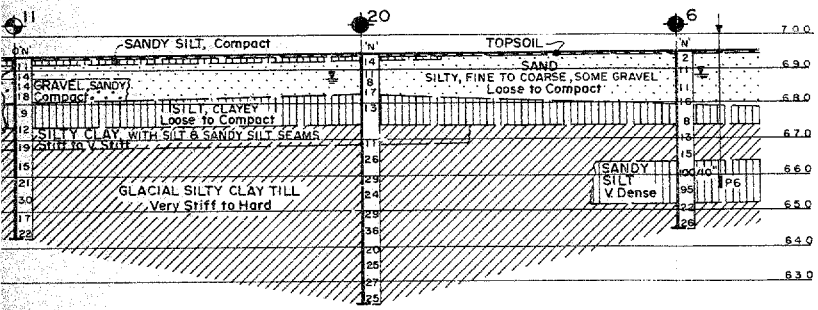
- Bore Hole
- Dynamic Cone Penetration Resistance Test
- Bore Hole & Cone Test
- Water Levels established at time of field investigation. APRIL 1975
- PIEZOMETER OR STANDPIPE

NO.	ELEVATION	STATION	OFFSET
1	697.9	608+92	66' LT.
2	698.6	609+92	62' LT.
3	698.1	610+80	94' LT.
4	698.7	611+17	89' LT.
5	698.0	612+00	82' LT.
6	695.7	612+50	80' LT.
7	695.7	612+65	53' LT.
8	695.8	613+65	50' LT.
9	694.0	613+65	96' RT.
10	694.3	612+65	64' RT.
11	694.6	611+86	96' RT.
12	694.7	611+56	94' RT.
13	698.5	610+70	88' RT.
14	696.7	610+28	85' RT.
15	698.1	609+92	54' RT.
16	697.9	608+92	51' RT.
17	697.6	610+54	
18	699.0	610+91	
19	695.4	611+76	
20	695.4	612+17	

40I 14-90
GEOCRES No.



F - F



H - H

— NOTE —

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

REVISIONS			
	DATE	BY	DESCRIPTION

PETO MacCALLUM LTD.

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

PROPOSED CROSSING AT KING'S HWY. 2
AND
PROPOSED KING'S HWY. 402 LINE 'A'

HIGHWAY NO 2 & 402 DIST NO 2
CO MIDDLESEX
TWP CARADOC LOT 23 CON RANGE I NLR

BORE HOLE LOCATIONS & SOIL STRATA

SUBMD M.B.	CHECKED	W.P. NO 41-66-19-20	DRAWING NO. 2
DRAWN K.K.	CHECKED M.B.	W.O. NO 75F56	
DATE MAY 1975		SITE NO 19-535	BRIDGE DRAWING NO.
APPROVED		CONT NO	

MICRO-TRACE 100-5-74

PETO MACCALLUM LTD.
165 CARTWRIGHT AVENUE, TORONTO, ONTARIO M6A 1V5
CONSULTING GEOTECHNICAL, INSPECTION & TESTING ENGINEERS

WORK ORDER NO.: 75 F 56
DATE April 4th, 1975
INEERS
K 1B6
'Phone (416) 669-1867

JOB NAME: Proposed Crossing at King's Hwy. 2 and proposed King's Hwy.402 Line A

AUTHORITY FOR THE WORK Verbal, Mr. K. Selby of MTC, to be confirmed by letter

REPORT DISTRIBUTION 12 cc: Client
1 cc: PML Hamilton
1 cc: PML Toronto

W.P. 41-66-19/20

CLIENT → Min. of Trans.& Comm. Ontario
West Bldg.,
1201 Wilson Avenue,
DOWNSVIEW, Ontario. M3M 1J8

ATTENTION Mr.K. Selby, P.Eng.

PROJECT ENGINEER G. D. Prasad/M. Bechai

TECHNICIAN W. Junker/J. Simpson

OPERATOR Atcost Drill Inc.

CLIENTS PHONE NO. 248-3282

This is formal notice work will proceed in accordance with these instructions. If your instructions were received verbally there are two copies of this work order. Please sign and return one copy as confirmation of your requirements.

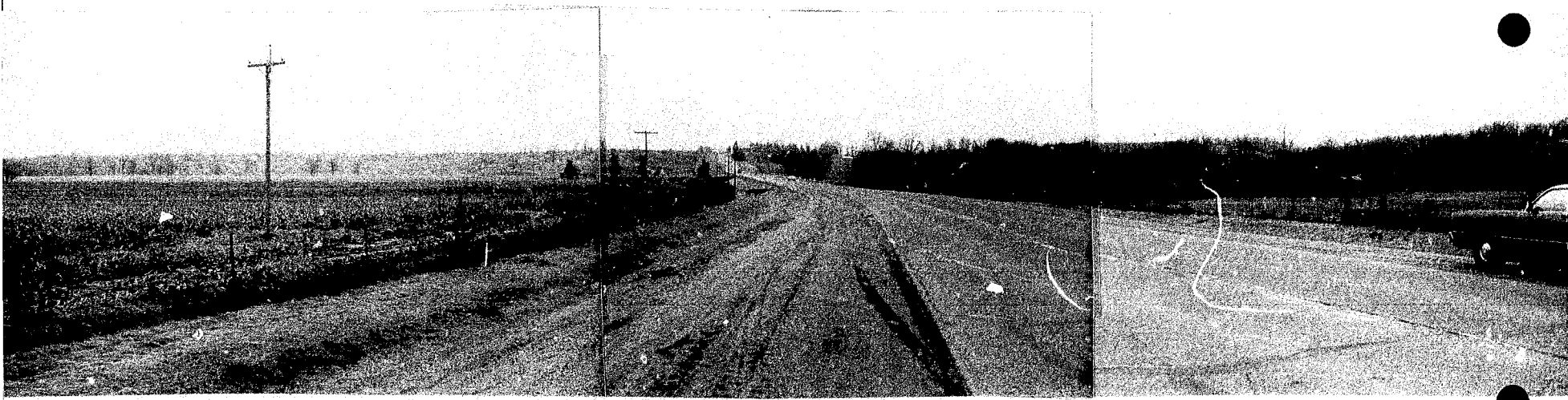
Signed by ..... On behalf of ..... Date .....

PROJECT LOCATION & DESCRIPTION Approx. 14 miles S.W. of London, Ontario & on Hwy. 2 approx. 0.5 miles S.W. of the junction of Hwys. 2 & 81. It is proposed to construct two bridges to carry proposed Hwy. 402 over existing Hwy. 2. The investigation is required to explore & report on the foundation conditions for the proposed structures including the support conditions for the proposed ± 20 ft. high approach embankments in the immediate vicinity of the new bridge structures. Note clients requirements as defined under Article 2 - Engineering Services et al in the formal agreement.

FIELD INSTRUCTIONS Check reference points & centre lines with clients survey rep. Layout proposed boreholes, survey these in & record elevations to client's geodetic T.B.M. given on his drawings. Drill & sample 20 boreholes in accordance with project engineers' requirements. Contact local residents presently occupying property which will be affected by drilling operations. Record any damage to private property that may occur as a result of the drilling operations & agree this with the local resident before leaving site on completion of Fieldwork. Prepare appropriate M.T.C. damage report & record form as and if necessary.

W.P. 41-66-19 E.B.L., -20 W.B.L. Hwy. 2 Interchange Overpass

Highway 402 Bridge Site 19-535



General View looking west on Highway 2

DOCUMENT [illegible]

GEOCRES No. 40714-90

DIST. 2 REGION Southwestern

W.P. No. 41-66-19/20

CONT. No. 75-66

W. O. No.

STR. SITE No. 19-535

HWY. No.

LOCATION Hwy 402 & Hwy. 2 Interchange

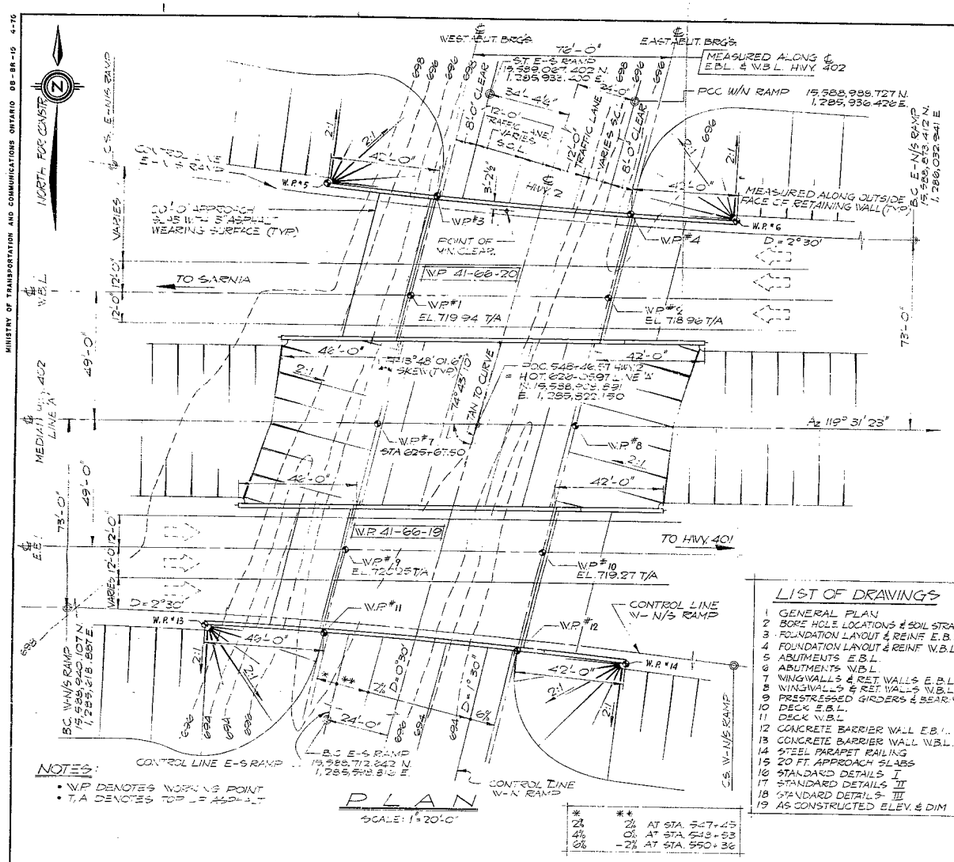
OVERSIZE DRAWINGS TO BE RECORDED [illegible] PAGE 5

REMARKS:

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS ONTARIO 06-BR-15 4-76

40 J 14-90

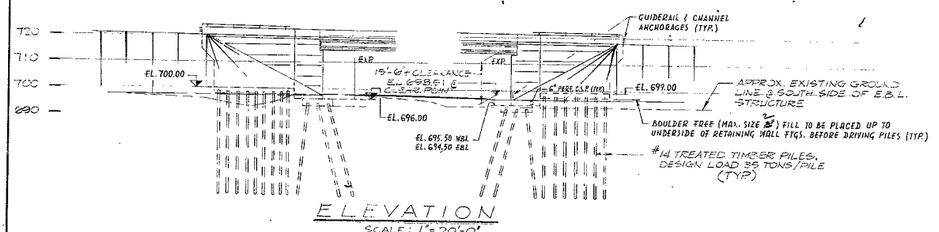
DIST. 2	
CONT No	
WP No 41-66-19 & 20	
HWY. 2 INTERCH. OVERPASS	SHEET:
GENERAL PLAN	



PLAN

SCALE: 1" = 20'-0"

NOTES:
- W.P. DENOTES WORKING POINT
- T/A DENOTES TOP OF ASPHALT



ELEVATION

SCALE: 1" = 20'-0"

LIST OF DRAWINGS

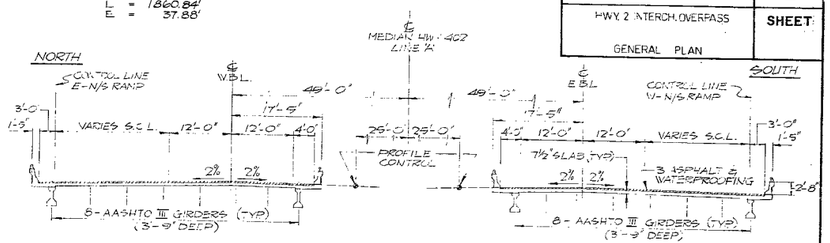
1	GENERAL PLAN
2	BORE HOLE LOCATIONS & SOIL STRATA
3	FOUNDATION LAYOUT & REINF. E.B.L.
4	FOUNDATION LAYOUT & REINF. W.B.L.
5	ABUTMENTS E.B.L.
6	ABUTMENTS W.B.L.
7	WINGWALLS & RET. WALLS E.B.L.
8	WINGWALLS & RET. WALLS W.B.L.
9	PRESTRESSED GIRDERS & BEARINGS
10	DECK E.B.L.
11	DECK W.B.L.
12	CONCRETE BARRIER WALL E.B.L.
13	CONCRETE BARRIER WALL W.B.L.
14	STEEL PARAPET RAILING
15	20 FT. APPROACH SLABS
16	STANDARD DETAILS I
17	STANDARD DETAILS II
18	STANDARD DETAILS III
19	AS CONSTRUCTED ELEV. & DIM.

*	**
2%	2% AT STA. 547+43
4%	0% AT STA. 548+63
6%	-2% AT STA. 550+36

HWY 2 CURVE DATA

Δ = 9° 18' 15"
D = 0° 30'
R = 11459.16'
T = 932.41'
L = 1860.84'
E = 37.88'

BM 691.55
GEODETIC DATUM
N & W IN S. ROOT 1.5' MAPLE 63' LT. 542+41



TYPICAL DECK SECTION

SCALE: 1" = 10'-0"

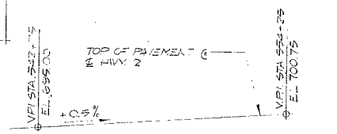
CONCRETE QUANTITIES

CONCRETE QUANTITIES ARE LISTED BELOW FOR THE APPROPRIATE CONCRETE LUMP SUM TENDER ITEMS:

	W.P. 41-66-19 (E.B.L.)	W.P. 41-66-20 (W.B.L.)
CONCRETE IN ABUTMENTS, WINGWALLS & RET. WALLS	447 CU. YDS.	423 CU. YDS.
CONCRETE IN DECK & DIAPHRAGMS	118 CU. YDS.	116 CU. YDS.
CONCRETE IN BARRIER WALLS	28 CU. YDS.	28 CU. YDS.
CONCRETE IN APPROACH SLABS	82 CU. YDS.	83 CU. YDS.

PROFILE OF HWY 402 LINE 'A'

N.T.S.



PROFILE OF HWY 2

N.T.S.

NOTE:

THE APPROACH SLABS, DECK WATERPROOFING AND PAVING ARE NOT PART OF THE BRIDGE PORTION OF THE CONTRACT.

NOTES:

CLASS OF CONCRETE

DECK & BARRIER WALLS	4000 PSI.
PRECAST GIRDERS	6000 PSI.
REMAINDER	3000 PSI.

REINFORCING STEEL

PRECAST GIRDERS	GRADE 40
DECK SLAB (TRANSVERSE)	GRADE 60
REMAINDER	GRADE 60

CLEAR COVER TO REINFORCING STEEL

FOOTINGS, ABUTMENTS & RET. WALLS	3"
DECK, TOP	2" BOTT. 1½"
BARRIER WALLS	1½"
APPROACH SLABS	2"

AND/OR AS NOTED ON DRAWINGS.

CONSTRUCTION NOTES:

THE CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BEARING SEATS TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF ± 1/8". NO CONCRETE SHALL BE PLACED ABOVE THE ABUTMENT BEARING SEATS UNTIL THE CONCRETE IN THE DECK HAS BEEN PLACED.

TO ACHIEVE THE MINIMUM CLEAR COVER OF 2" SPECIFIED IN THE DECK, THE TOP LAYER SHALL BE PLACED, PRIOR TO CONCRETING WITH A CLEAR COVER OF 2½ ± ½" TOLERANCE

REGISTERED PROFESSIONAL ENGINEER K. E. PILGRIM PROVINCE OF ONTARIO

FOR REDUCED PLAN
USE SCALE BELOW
10 11 12
3 INCHES ON ORIGINAL PLAN

RECEIVED SEP 08 1976 MINISTRY OF TRANSPORTATION AND COMMUNICATIONS ONTARIO BRIDGE OFFICE

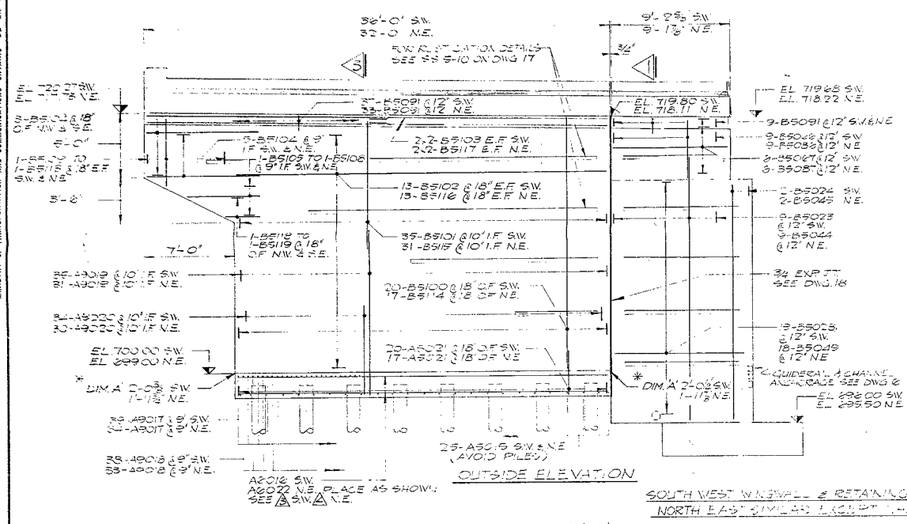
REVISIONS	DATE	BY	DESCRIPTION
DESIGN K.P.	CHECK K.V.	LOADING HS20-44	DATE AUG '76
DRAWING T.L.	CHECK K.P.	SITE No 19-535	DWG 1

TRANSLAR 200-8-75

40J14-90

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS ONTARIO DS-BR-15 4-75

CONT No	
WP No 41-86-19 & -20	
HWY. 2 INTERCH. C PASS	SHEET
WINGWALLS & RET. WALLS W.B.L.	



NOTES:

I.F. DENOTES INSIDE FACE
O.F. DENOTES OUTSIDE FACE
E.F. DENOTES EACH FACE

SCALE: ¼"=1'-0"

REVISIONS			
NO.	DATE	BY	DESCRIPTION

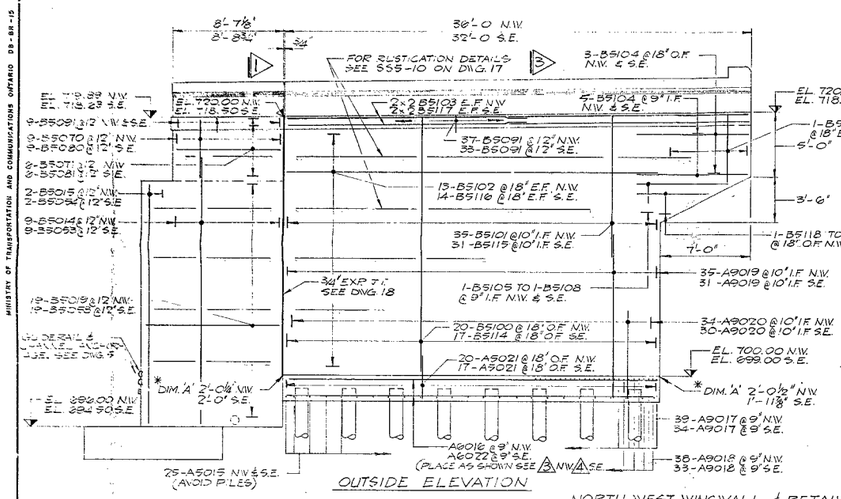
DESIGN K.P.	CHECK R.E.	LOADING A9/20-22	DATE AUG 75
DRAWING T.L.	CHECK T.P.	SITE No 19-556	DWG 5

TRANSLAT 1M-4-75

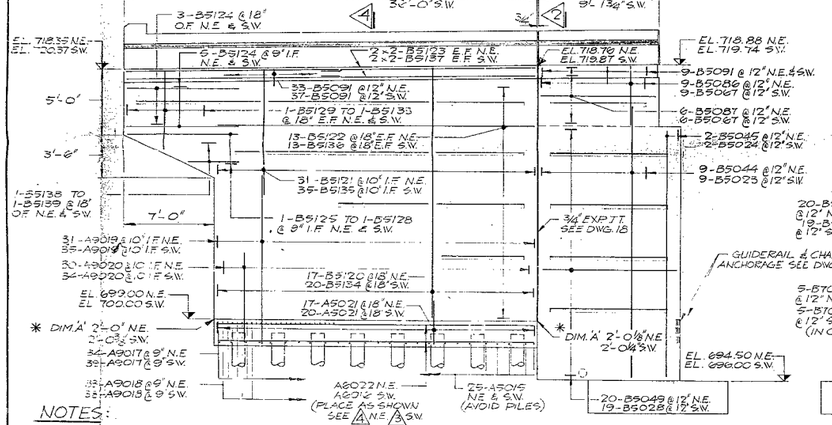
40J14-90

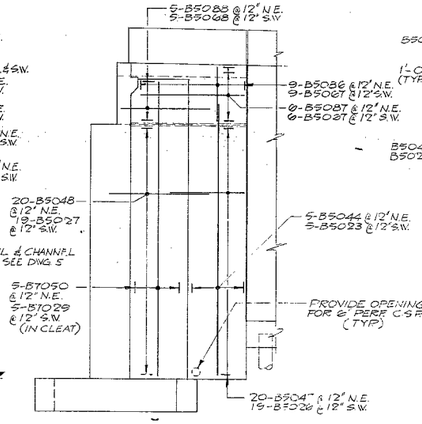
MINISTRY OF TRANSPORTATION AND COMMUNICATIONS ONTARIO DS-88-15 4-75

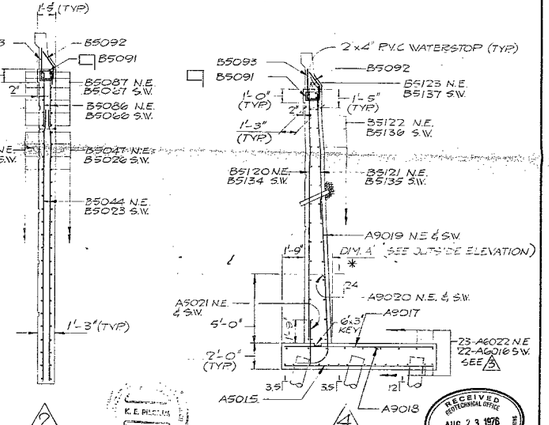
CONT No	
WP No 41-66-19 & 3-20	
HWY 2 INTERCH. O'PASS	SHEET
WINGWALLS & RET. WALLS E.B.L.	



NORTH WEST WINGWALL & RETAINING WALL SHOWN
SOUTH EAST SIMILAR EXCEPT WHERE NOTED







NOTES:
- I.F. DENOTES INSIDE FACE.
- O.F. DENOTES OUTSIDE FACE.
- E.F. DENOTES EACH FACE.

SCALE: ¼" = 1'-0"

NORTH EAST WINGWALL & RETAINING WALL SHOWN.
SOUTH WEST SIMILAR EXCEPT WHERE NOTED.

K.E. BELCHUM
PROFESSIONAL ENGINEER

RECEIVED
REGIONAL OFFICE
AUG 23 1976
RURAL MECHANICAL ENGINEERING

FOR REDUCED PLAN
USE SCALE BELOW
0 1 2 3
3 INCHES ON ORIGINAL PLAN

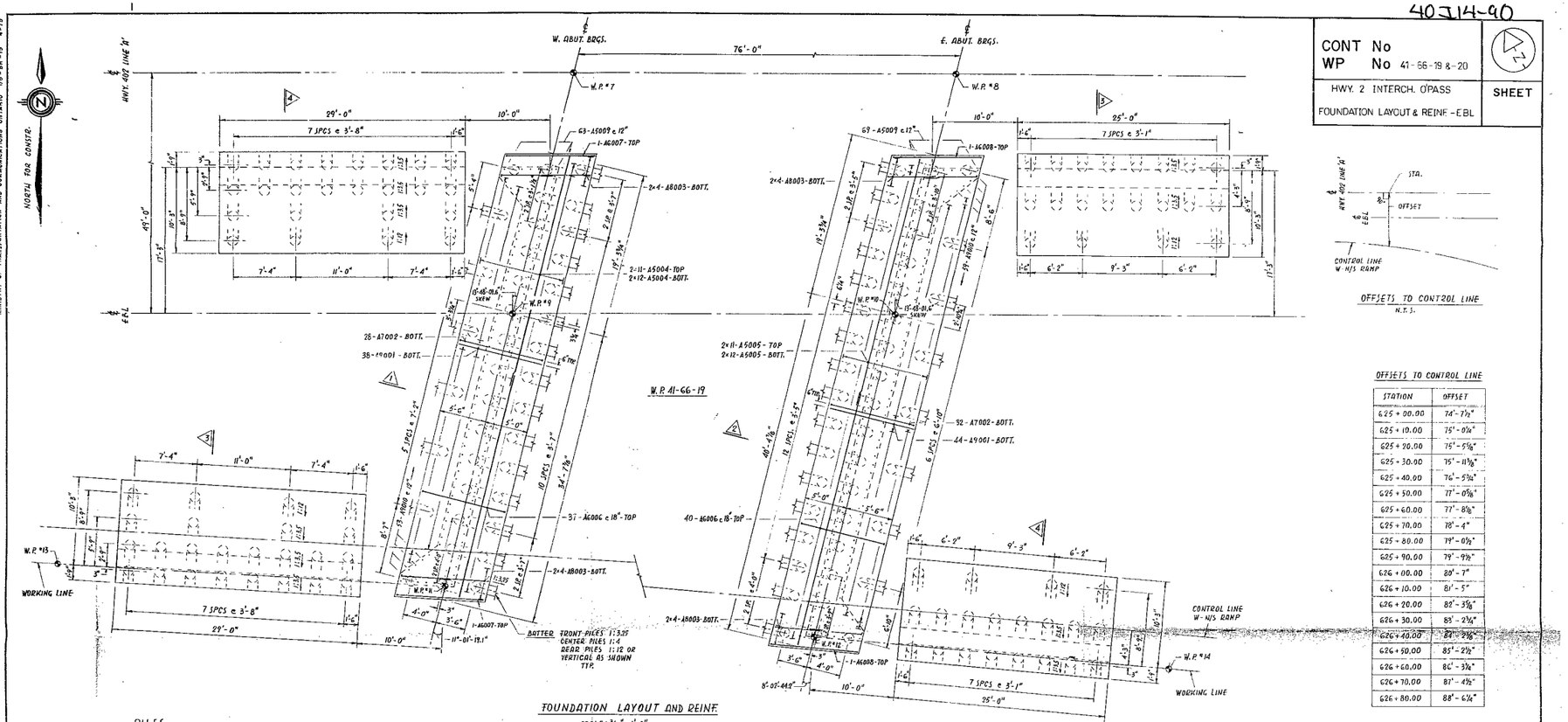
REVISIONS		
DATE	BY	DESCRIPTION
DESIGN K.P.	CHECK R.V.	LOADING HS20-44 DATE AUG 76
DRAWING T.L.	CHECK K.P.	SITE No 19-535 DWG 7

TRANSLAR 334-6-75

40J14-90

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS ONTARIO 00-BR-15 4-75

CONT No	
WP No 41-66-19 & 20	
HWY. 2 INTERCH. O'PASS	SHEET
FOUNDATION LAYOUT & REINF - E.B.L.	



OFFSETS TO CONTROL LINE
N.T.S.

OFFSETS TO CONTROL LINE

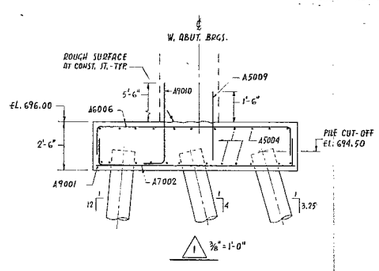
STATION	OFFSET
625 + 00.00	74'-7½"
625 + 10.00	75'-0⅛"
625 + 20.00	75'-5⅛"
625 + 30.00	75'-11⅜"
625 + 40.00	76'-5¾"
625 + 50.00	77'-0⅜"
625 + 60.00	77'-8⅛"
625 + 70.00	78'-4"
625 + 80.00	79'-0½"
625 + 90.00	79'-9½"
626 + 00.00	80'-7"
626 + 10.00	81'-5"
626 + 20.00	82'-3⅛"
626 + 30.00	83'-2¼"
626 + 40.00	84'-2⅛"
626 + 50.00	85'-2½"
626 + 60.00	86'-3¼"
626 + 70.00	87'-4½"
626 + 80.00	88'-6¼"

FOUNDATION LAYOUT AND REINF

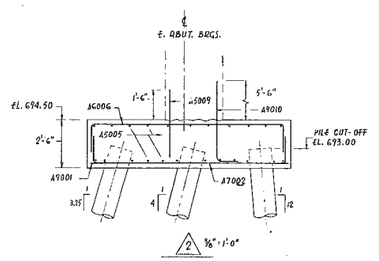
SCALE: 3/16" = 1'-0"

PILES

LOCATION	QTY.	LENGTH	BATTER	TYPE
W. ABUT.	15	50'-0"	1:3.25	#14 TREATED TIMBER PILES
	15	50'-0"	1:4	
	6	50'-0"	1:12	
	2	50'-0"	VERT.	
W. ABUT. RET. WALLS	40	50'-0"	1:3.5	
	8	50'-0"	1:12	
E. ABUT.	17	49'-0"	1:3.25	
	17	49'-6"	1:4	
	7	49'-0"	1:12	
	2	49'-0"	VERT.	
E. ABUT. RET. WALLS	32	50'-0"	1:3.5	
	8	50'-0"	1:12	



1 3/8" = 1'-0"



2 3/8" = 1'-0"

CO-ORDINATES

W.P.#	NORTH	EAST
7	15,588,927.85	1,285,788.68
8	15,588,890.48	1,285,854.81
9	15,588,891.14	1,285,754.06
10	15,588,853.69	1,285,820.19
11	15,588,847.04	1,285,731.35
12	15,588,825.40	1,285,793.50
13	15,588,896.62	1,285,697.45
14	15,588,881.14	1,285,827.79

REGISTERED PROFESSIONAL ENGINEERS
K. E. PILGRIM
PROVINCE OF ONTARIO

FOR REDUCED PLAN
USE SCALE BELOW
10 11 12 13
3 INCHES ON ORIGINAL PLAN

NOTES:

- PILE SPACINGS TO BE MEASURED AT UNDERSIDE OF FOOTINGS.
- PILES TO BE DRIVEN IN ACCORDANCE WITH STD. SS3-11 USING DESIGN LOAD OF 35 TONS/PILE.
- TIMBER PILES SHALL BE TREATED WITH CREOSOTE TO GIVE A RETENTION OF 8 LBS/CU. FT.
- SEE DWG. 7 FOR SECTIONS 3, 4 AND RETAINING WALL FOOTING REINF.
- THIS DWG. TO BE READ IN CONJUNCTION WITH DWG. 5.

RECEIVED
AUG 23 1976
HIGHWAY ENGINEERING DIVISION

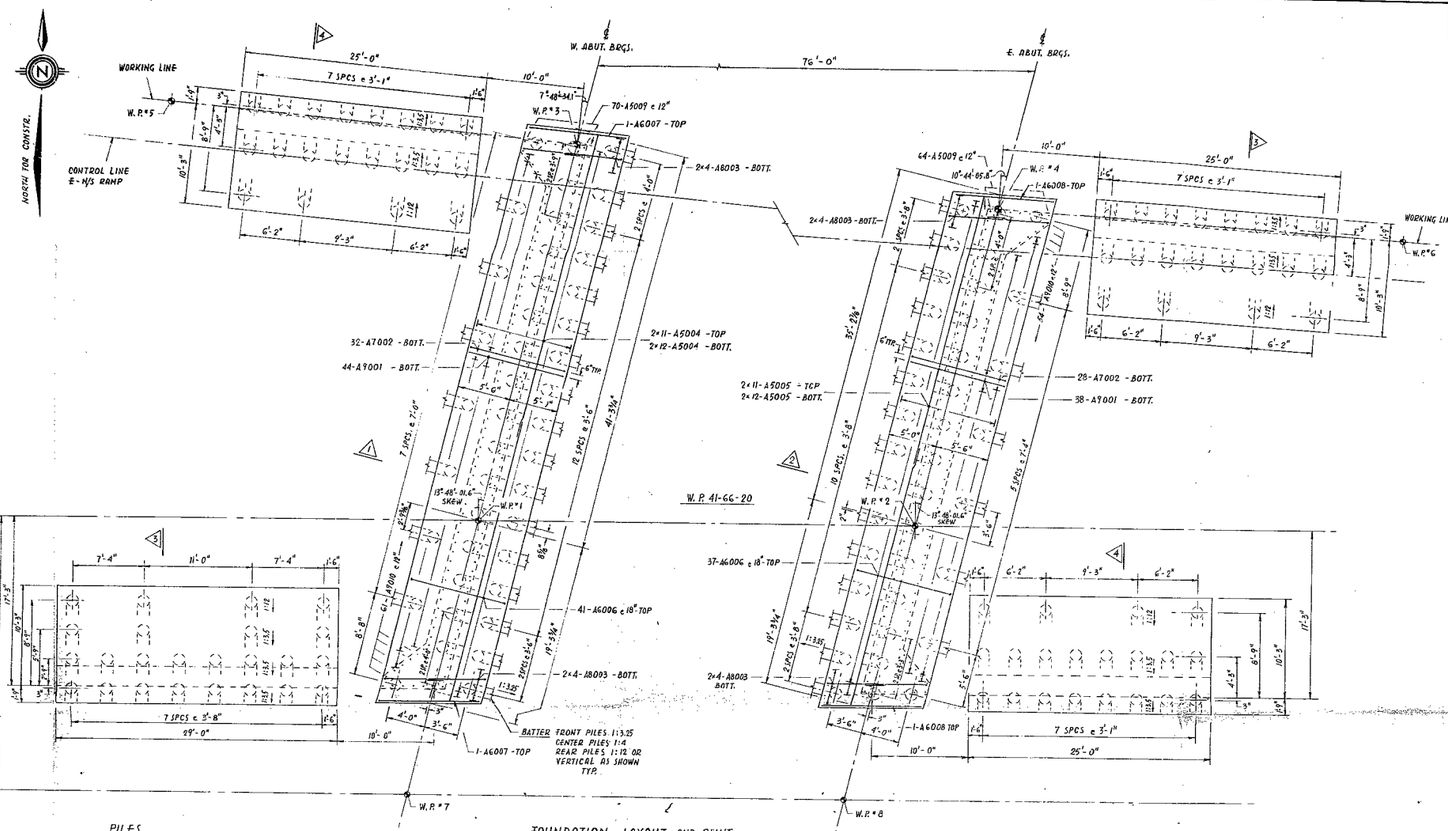
REVISIONS			
DATE	BY	DESCRIPTION	
DESIGN K.P.	CHECK K.E.	LOADING HS 20-44	DATE AUG. '76
DRAWING P.K.	CHECK K.P.	SITE No 19-335	DWG 3

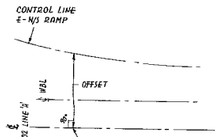
TRANSLAM 1964-1975

40314-90

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS ONTARIO DS-BR-15 4-75

CONT No	
WP No 41-66-19 & -20	
HWY. 2 INTERCH. O'PASS	SHEET
FOUNDATION LAYOUT & REINF-WBL	





OFFSETS TO CONTROL LINE
N.T.S.

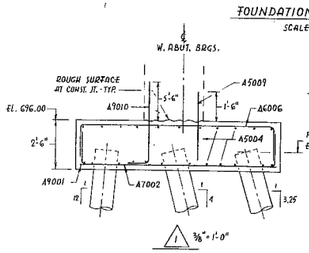
OFFSETS TO CONTROL LINE

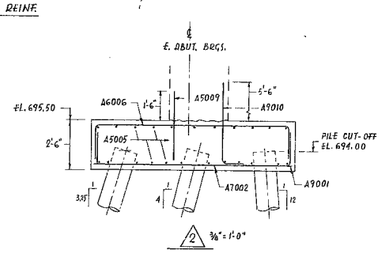
STATION	OFFSET
625 + 30.00	89' - 9⅜"
625 + 40.00	88' - 7⅛"
625 + 50.00	87' - 5¼"
625 + 60.00	86' - 4"
625 + 70.00	85' - 3⅛"
625 + 80.00	84' - 3⅛"
625 + 90.00	83' - 3⅜"
626 + 00.00	82' - 4½"
626 + 10.00	81' - 5⅝"
626 + 20.00	80' - 7⅛"
626 + 30.00	79' - 10"
626 + 40.00	79' - 1"
626 + 50.00	78' - 4½"
626 + 60.00	77' - 8½"
626 + 70.00	77' - 1⅞"
626 + 80.00	76' - 6⅞"
626 + 90.00	75' - 11⅝"
627 + 00.00	75' - 5⅞"
627 + 10.00	75' - 0⅝"

PILES

LOCATION	QTY.	LENGTH	BATTER	TYPE
W. ABUT.	17	50'-0"	1:3.25	=14 TREATED TIMBER PILES
	17	50'-0"	1:4	
	7	50'-0"	1:12	
	2	50'-0"	VERT.	
W. ABUT. RET. WALLS	36	50'-0"	1:3.5	
	8	50'-0"	1:12	
E. ABUT.	19	49'-0"	1:3.25	
	13	49'-0"	1:4	
	15	49'-0"	1:12	
	2	49'-0"	VERT.	
E. ABUT. RET. WALLS	32	50'-0"	1:3.5	
	8	50'-0"	1:12	

FOUNDATION LAYOUT AND REINF.
SCALE: 3/16" = 1'-0"





CO-ORDINATES

W.P.*	NORTH	EAST
1	15,588,964.35	1,285,823.29
2	15,588,921.10	1,285,889.45
3	15,588,993.51	1,285,850.60
4	15,588,951.65	1,285,912.56
5	15,589,017.90	1,285,816.41
6	15,588,994.01	1,285,947.95
7	15,588,927.85	1,285,788.68
8	15,588,890.40	1,285,854.81

NOTES:

- PILE SPACINGS TO BE MEASURED AT UNDERSIDE OF FOOTINGS.
- PILES TO BE DRIVEN IN ACCORDANCE WITH STD. SS 3-11 USING DESIGN LOAD OF 35 TONS/PILE.
- TIMBER PILES SHALL BE TREATED WITH CREOSOTE TO GIVE A RETENTION OF 8 LBS/CU. FT.
- SEE DWG. 8 FOR SECTIONS A, B AND RETAINING WALL FOOTING REINF.
- THIS DWG. TO BE READ IN CONJUNCTION WITH DWG. 6

ONTARIO PROFESSIONAL ENGINEER K. E. PILGRIM

FOR REDUCED PLAN
USE SCALE BELOW
3 INCHES ON ORIGINAL PLAN

RECEIVED AUG 23 1976 HIGHWAY DESIGN SECTION

REVISIONS	DATE	BY	DESCRIPTION

DESIGN K.E.	CHECK K.E.	LOADING MS 20-44	DATE AUG '76
DRAWING F.K.	CHECK C.D.	SITE No 19-595	DWG 7

BD TRANSLAR 1-M-4-75