

Plot on 30M3 map
North of n° 65

1850 Jane Street
Weston, Ontario
241-4644

William A. Trow

Project: J1598

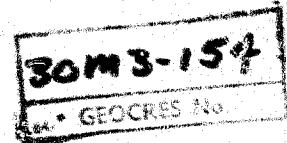
Soil Mechanics
Consultants
W. A. Trow
MSc. MEIC. P. Eng.
K. Peaker
PhD. MEIC. P. Eng.
D. H. Shields
PhD. MEIC. P. Eng.

↓ BA 1925
Associates Ltd.

Mr. A. Rutka, P.Eng.,
Chief Materials & Research Engineer,
Materials and Research Section,
Department of Highways of Ontario,
Parliament Buildings,
Toronto, Ontario

October 2, 1964

Attention: Mr. A.G. Stermac, P.Eng.



Re: Foundation Investigation
DeCew Road Underpass
W.P. 92-65, Highway 406

Dear Sirs:

With reference to your authorization dated August 31, we enclose the results of the completed foundation report for the above site. For your convenience, a summary of our findings and recommendations follows.

- 1) The site of the proposed underpass is underlain by a stiff to very stiff laminated silty clay. This clay becomes softer with depth and terminates at the contact with limestone bedrock some 44 feet from ground surface.
- 2) Foundations for the piers can be either spread footings using a net bearing pressure of $3\frac{1}{2}$ tons/ft.² below frost level, or piles driven to refusal. Abutment foundations are suggested to be piled because of the spill-through type of abutment in present use. Recommended piles are 10 inches at 42 lbs./ft., carrying a design load of 50 tons/pile.

- 3) No problems associated with settlement, ground water, or stability of the approach embankment exists at this site.

Our conclusions have resulted after considering the more detailed information which follows.

THE SITE

The site of the proposed underpass is located $\frac{1}{4}$ mile east of Highway No. 14, on Decew Road. At this location the proposed Highway No. 406 will pass under the Decew Road by means of a proposed structure incorporating two main spans of 73 feet each and two 39 foot approach spans. The area around the site is generally level and used for agricultural purposes. Approximately 100 yards south of this intersection is Gibson Lake, - a storage reservoir for Decew generating station.

FIELD INVESTIGATION

The field investigation at this site comprised three uncased boreholes advanced using continuous flight auger equipment. To prove bedrock a diamond core drill was moved onto borehole No. 3 and approximately 5 feet of bedrock core extracted. To confirm that bedrock was at a uniform elevation over the site, auger holes A, B, C and D were located as shown on Dwg. 1. These holes A, B, C and D were advanced without sampling to refusal on assumed bedrock surface.

Sampling during the site investigation was carried out using conventional thin walled Shelby tubes for relatively undisturbed samples, and supplemented with split spoon samples used primarily for identification.

Where permitted by the cohesive strength of the clay, in-situ vane tests were carried out using a vane apparatus which does not incorporate a strain control device.

LABORATORY TESTS AND SUBSOIL

The results of the borings indicating the subsoil encountered are shown in detail on the borehole logs, Dwg. 1 to 3. The results of laboratory testing appear in graphical form on these drawings. In addition to the detailed subsoil information provided on the borehole logs, an estimated subsoil stratigraphy is included on the Site Plan Dwg. Information on the settlement characteristics of the subsoil has been included on Dwg. 4, the results from a consolidation test.

GROUND WATER

The location of ground water at the site was established at elevation 558.0. This elevation corresponds to the approximate elevation of the upper level of Gibson Lake. Gibson Lake was found to fluctuate up to 4 feet daily because of demands at the Decew power station. Because of the impermeable nature of the stiff to very stiff silty clay, no problems with ground water in excavations are to be expected at this site.

ENGINEERING CONSIDERATIONS

As indicated by the borehole logs and Dwg. 5, the stratified or laminated silty clay can be divided into two layers when considering the shear strength of the clay. The upper level, above elevation 542, has shear strength values varying from 2200 to 7900 psf, and is therefore classed as very stiff to hard; below elevation 542, the shear strength varies from 1100 to 2200 and is stiff to very stiff.

1. FOUNDATIONS

a) Piers - The foundation for the piers of the proposed footings may be placed on spread footings. Assuming that these footings are founded 6 to 8 feet below the existing road level or at approximately elevation 560.0, the allowable net bearing capacity, q , can be found from the expression:

$$q = C.N_c$$

where:	C	is estimated from figure 5 to equal 3000 psf, the conservative average shear strength for a distance below the footing approximately equal to the width of the footing
	$N_c=6.1$	determined from Skempton's relationship where $N_c=5(1+0.2 \frac{D}{B})(1+0.2 \frac{L}{B})$ and the width B is assumed = 10ft., length L = 110 ft.

By incorporating a safety factor of 2.5 the net bearing capacity recommended for the piers is 3.5 tons./ft.². Alternatively, the piers may be founded on piles driven to refusal at the bedrock surface, elevation 522. Because of their ease of driving and the high carrying capacity, steel H piles are recommended if piles are used to support the piers. Steel H piles, 10 inches @ 42 lb./ft. are recommended to carry a design load of 50 tons./pile.

For the support of the abutments at this site it is recommended that steel H piles be driven to refusal at elevation 522, the bedrock surface. Piles similar to those suggested for the piers, i.e., 10" @ 42 lb./ft. designed for 50 tons/pile are recommended. The additional load caused by consolidation of the fill and thus negative skin friction on the pile will be easily carried by these piles by a slight reduction of the safety factor. Thus no

allowance for negative skin friction need be made. The use of spread footings founded on the fill has not been considered because of obvious settlement problems. The recommended use of piles for the abutments assumes these abutments to be the spill through type constructed after the fill is in place. If abutments incorporating earth retaining facilities are considered, the recommendations given for spread footings for the piers also apply.

2. SETTLEMENT

If a piled foundation is used, no settlement of the bridge is to be expected, however, settlement under the loading of the approach fill can be considered. A rough estimate of this settlement has been made, (Dwg. 4), and shows the consolidation settlement to amount to 0.2 feet. Numerous assumptions have been made in order to estimate this settlement. In fact, measurements on similar material indicate that little actual settlement takes place. Because of observations on existing structures plus the fairly low calculated estimate of consolidation settlement, it is estimated that no settlement, (either elastic or consolidation) problem exists at this site.

3. STABILITY OF APPROACH EMBANKMENTS

No problems associated with the stability of the approach embankment are present because of the high shear strength of the subsoil.

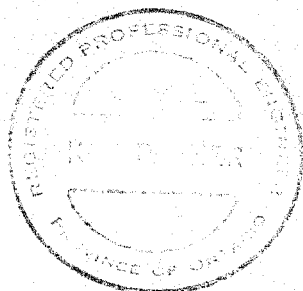
If we can be of further assistance with this project please contact this office.

Yours very truly,



K. Peaker, P.Eng.




KP:GC
ENCLS.



SITE INVESTIGATIONS SOIL MECHANICS CONSULTATION

DRAWING NO. 100
PROJECT NO. 100

PENETRATION RESISTANCE

2" O.D. SPLIT TUBE 
2" I.D. SHELBY TUBE 
2" DIA. CONE 

SHEAR STRENGTH

UNDRAINED TRIAXIAL ⊕
AT OVERBURDEN PRESSURE
UNCONFINED COMPRESSION ⊗
VANE TEST AND SENSITIVITY IS: +

NATURAL MOISTURE CONTENT

ATTERBERG LIMITS

LIQUID LIMIT

PLASTIC LIME

SAMPLE TYPE

2" O.D. SPLIT TUBE _____
2" I.D. SHELBY TUBE _____
3" O.D. SHELBY TUBE _____

BOREHOLE NO. 3
PROJECT DeCaw Road Overpass of Proposed Hwy. 406
LOCATION Twp. 4 of Thorold, Co. Welland, Ontario
HOLE LOCATION See Dwg. 1.
HOLE ELEVATION 566.9 ft.
DATUM

SYMBOL	SOIL DESCRIPTION	ELEV FEET	DEPTH FEET	PENETRATION RESISTANCE				350 FT. LB BLOWS/FT 80	NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS % DRY WEIGHT	SAMPLE TYPE AND No.	NATURAL UNIT WEIGHT P.C.F.
				SHEAR STRENGTH							
	Hard Shoulder of Existing Road	566.3	0	1000	2000	3000	4000		10 20 30		
	WILL-silty clay, rare gravel pos. organisms.	564.0									
	CLAY-silty, stratified clay; brown and very stiff to approx. 25 ft. depth.	558.0	10								130.7
			20								127.2
			30								
			40								
			50								
			60								
			70								
		542.0									
	-gray and stiff to very stiff below approx. 25 ft. depth.		30								121.5
			40								115.5
			50								120.0
			60								
			70								

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SITE INVESTIGATIONS • SOIL MECHANICS CONSULTATION

LEGEND




DRAWING 2
PROJECT No. 71593

BOREHOLE No. 2
PROJECT DeGow Road Overpass of Proposed Hwy. 406
LOCATION Eve. of Thorold, Co. Welland, Ontario
HOLE LOCATION See Dwg. 1.
HOLE ELEVATION 566.24 ft.
DATUM _____

PENETRATION RESISTANCE

2" O.D. SPLIT TUBE 
2" I.D. SHELBY TUBE 
2" DIA. CONE 

SHEAR STRENGTH

UNDRAINED TRIAXIAL AT OVERBURDEN PRESSURE 
UNCONFINED COMPRESSION 
VANE TEST AND SENSITIVITY (S₁) 

NATURAL MOISTURE CONTENT AND LIQUIDITY INDEX

ATTERBERG LIMITS

LIQUID LIMIT

PLASTIC LIMIT

SAMPLE TYPE

2" O.D. SPLIT TUBE _____
2" I.D. SHELBY TUBE _____
3" O.D. SHELBY TUBE _____

30M3-154
GEOCRES No. _____

SYMBOL	SOIL DESCRIPTION	ELEV FEET	DEPTH FEET	PENETRATION RESISTANCE				NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS % DRY WEIGHT	SAMPLE TYPE AND No.	NATURAL UNIT WEIGHT P.C.F.
				20	40	60	350 FT. LB BLOWS FT. 80			
	Shoulder of existing road.	566.24	0	SHEAR STRENGTH P.S.F.				10 20 30		
	CL - silty clay with a few pieces of gravel and trace organics.	561.9								123.5
	CLAY - silty stratified clay, brown and very stiff above approx. 21 feet.	557.5	10							123.2
			20							124.5
		545.0								121.5
	grey and stiff to very stiff below approx. 21 feet.		30							122.3
			40							125.0
			50							124.7
	AUGER REFUSAL & ASSUMED BEDROCK		60							
	End of Hole	522.4	70							

Notes: 1) & 2) As in hole 1.
3) Hole open to 6' 7" after 3 days.

SITE INVESTIGATIONS SOIL MECHANICS CONSULTATION

PROJECT No. 41573

PENETRATION RESISTANCE

SHEAR STRENGTH

UNDRAINED TRIAXIAL ⊕
AT OVERBURDEN PRESSURE
UNCONFINED COMPRESSION ⊗
VANE TEST AND SENSITIVITY (S) †

ATTERBERG LIMITS

PLASTIC LIMIT

SAMPLE TYPE

2" O.D. SPLIT TUBE

2" I.D. SHELBY TUBE.

3 O.D. SHELBY TUBE

PROJECT DeSew Road Overhaul of Processed Hwy. 406

LOCATION Twn. of Thorold, Co. Welland, Ontario

HOLE LOCATION See Swat. 1.

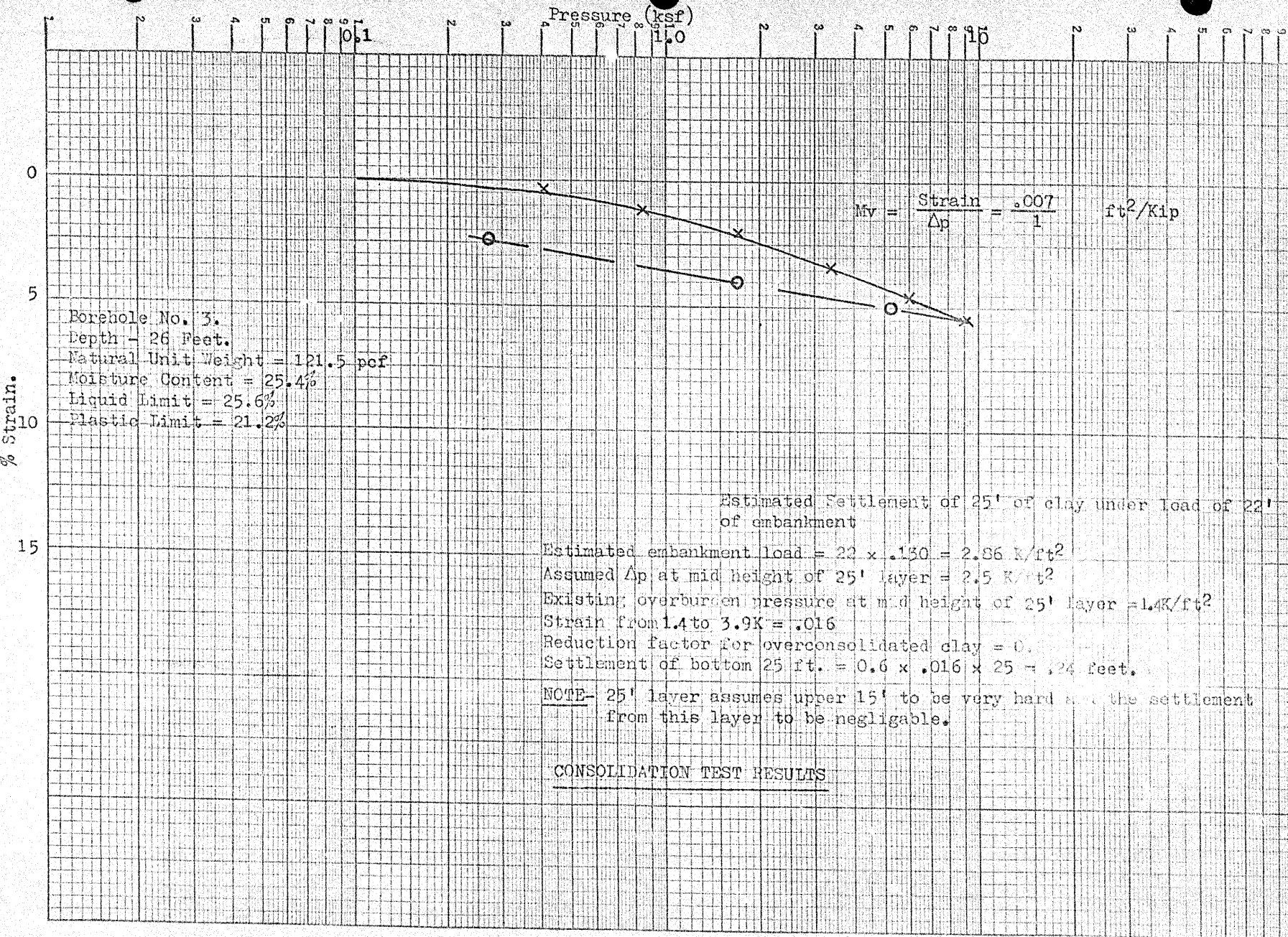
HOLE ELEVATION 557.5 ft.

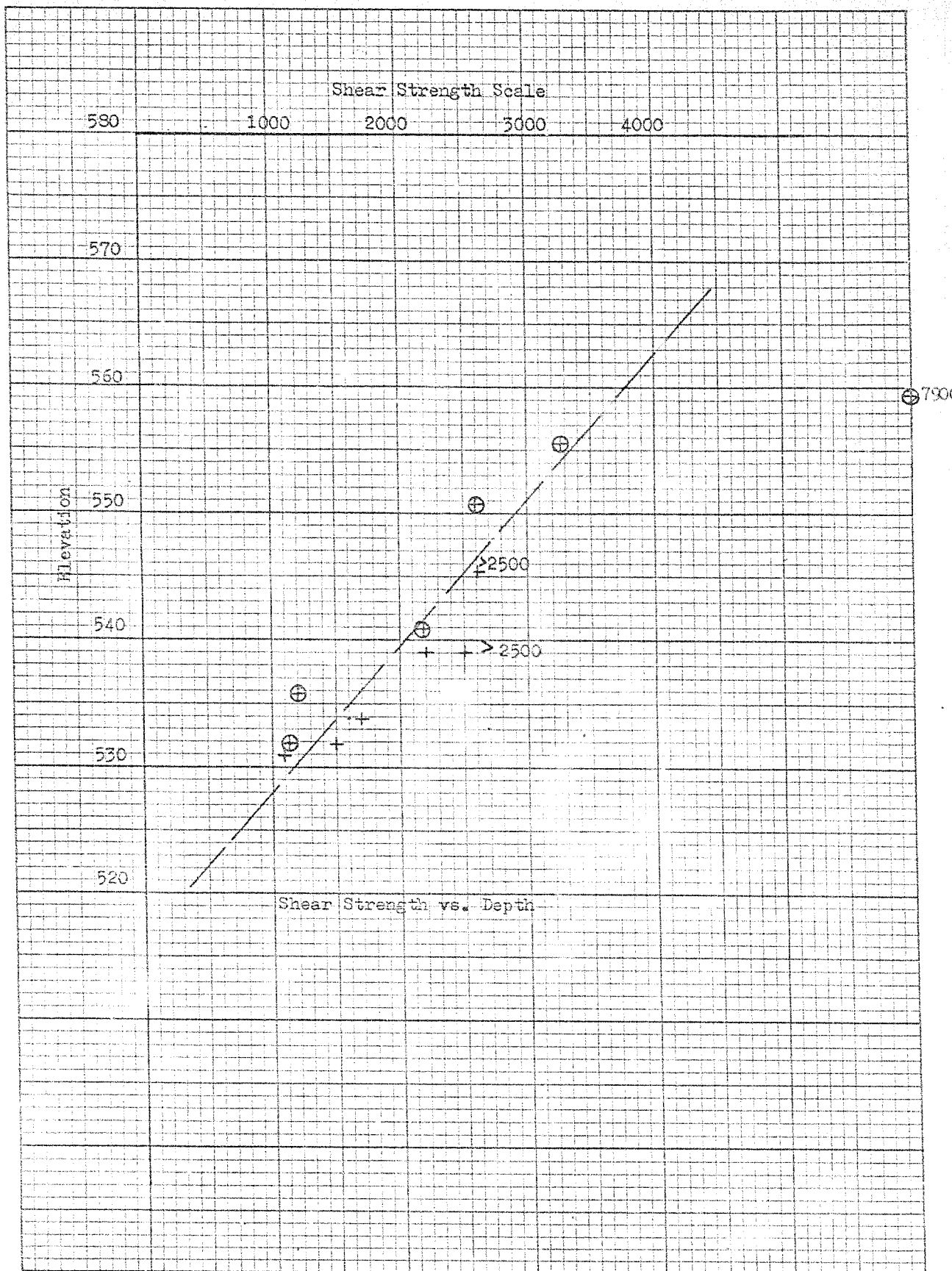
DATUM _____

SYMBOL	SOIL DESCRIPTION	ELEV. FEET	DEPTH FEET	PENETRATION RESISTANCE 350 FT. LB. BLOWS FT. 80				NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS % DRY WEIGHT	SAMPLE TYPE AND NO	NATURAL UNIT WEIGHT P.C.F.
				20	40	60	80			
	Shoulder of existing road	567.5	0	1000 2000 3000 4000				10 20 30		
	Light silty sand and gravel.	566.0								
	Light silty stratified clay, brown and very stiff above approx. 23 1/2 ft.	558.5	10							125.0
										126.0
			20							124.0
		544.0		Problems 24-0						127.0
	Grey and stiff to very stiff below approximately 23 1/2 ft.		30							125.5
			40							125.0
			50							116.8
	Bottom of hole at assumed bedrock	523.7	60							
	End of Hole		70							
Notes:	1) Hole advanced with continuous flight auger equipment and uncased.									
	2) Ground water stabilized at approximately the same level as the closely adjacent Gibson Lake storage reservoir.									
	3) Hole open to 18' 5" after 5 days.									

Project: J1598

Page 4.





30 M3

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. A. M. Toye,
Bridge Engineer,
Bridge Division.

FROM: Foundation Section,
Materials & Testing, Div.,
Room 107, Lab. Bldg.

Attention: Mr. S. McCombie

DATE: October 9, 1964.

OUR FILE REF.

IN REPLY TO

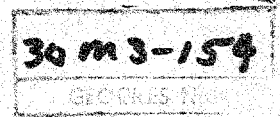
SUBJECT:

FOUNDATION INVESTIGATION REPORT

For

DeCew Road Underpass
W.P. 92-53;

Hwy 406



Attached, please find the report for the above mentioned structure submitted by the Consultant W. A. Trow & Assor. We have reviewed the report and are in agreement with the recommendations given by the Consultant. It is believed that the information contained in the report will be adequate for your further design work.

Should there be any questions that you would like to discuss please feel free to call on our office.

AGA/PB
Attach.

cc: Messrs. A. M. Toye (2)
H. A. Tregaskes
H. D. McMillan
G. K. Hunter (2)
H. Greenland
T. J. Kovich
A. Watt

A. G. Stermac
A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER.

Foundations Office
General Files

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 30m 3-154

DIST. 4 REGION CENTRAL

W.P. No. _____

CONT. No. _____

W. O. No. _____

STR. SITE No. _____

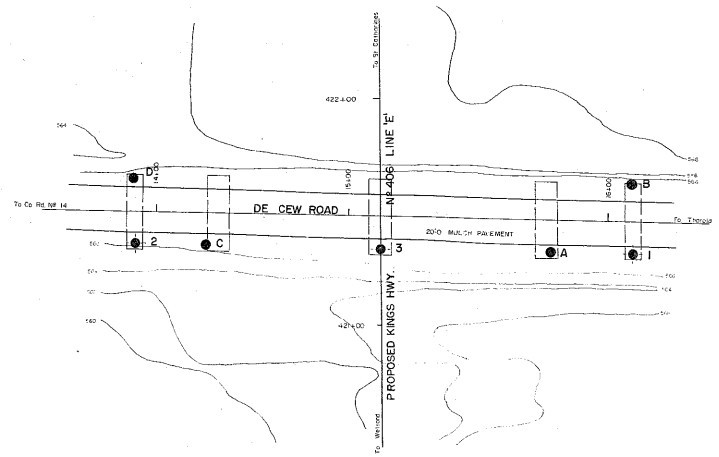
HWY. No. 406

LOCATION HWY 406 & DF CEN RD.

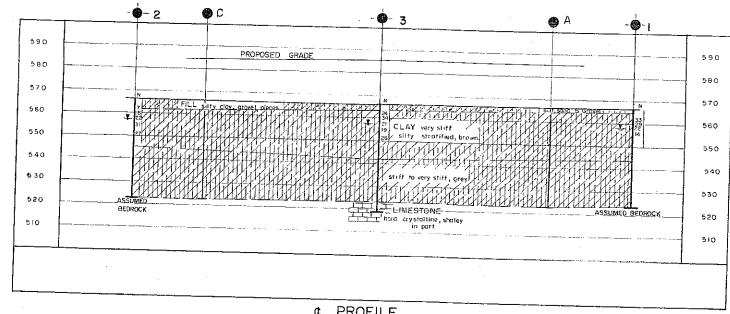
OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT 1

REMARKS: DOCUMENTS TO BE UNFOLDED BEFORE

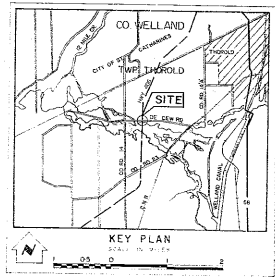
MICRO FILM



PLAN
SCALE 1" = 40' FEET



PROFILE
SCALE 1" = 40' FEET



- LEGEND
- Bore Hole
 - Core Sample Location
 - Bore & Core Penetration Hole
 - Water Sheds (solid line) or (dashed line) of field investigation

NO	ELEVATION	STATION	INFEET
1	567.5	421+28	111' R/L
2	566.2	421+37	109' L/L
3	565.9	421+53	6'
A	567.4	421+31	74' R/L
B	567.6	421+62	112' R/L
C	565.3	421+50	78' L/L
D	566.1	421+67	111' L/L

30M3-152
30M3-152

NOTE
The boundaries between the areas have been established only at the bore hole locations. Between the bore holes the boundaries are inferred from geological evidence and may be subject to considerable error.

30M3-154

PROJ. 1598 WILLIAM A. TROW AND ASSOCIATES LIMITED

DEPARTMENT OF HIGHWAYS - ONTARIO

PROPOSED CROSSING AT
DE CEW ROAD

KING'S HIGHWAY NO. 405 LINE E. DIST. NO. 4

CO. WELLAND TWP. THOROLD LOT 37 COR.

DATE: 1984

BY: [Signature]

FOR: [Signature]

Map 30M3