Planning
Engineering
Project Management

FENCO

1 Yonge Street
Toronto Canada
416 361-4723
Cable Foundaneng
Telex 02 2814

April 9th., 1973

Mr. W.C. Friedmann, P. Eng.,
Regional Expressway Design Engineer
Ministry of Transportation and
Communications
Central Region
3501 Dufferin Street
DOWNSVIEW 460, Ontario

73-11-008

Attention: Mr. N. Sen

Dear Sirs:

HIGHWAY 401 - 410
W.P. 127-66-32 - 127-66-34
CONTRACT 1
ADVANCED STORM SEWER

This is confirm our discussions with regards to the above contract. Although the status of the proposed Brittania Road is uncertain at this time, in order for FENCO to meet the design completion date of May 16th., 1973, we are proceeding with the design, based on provision for Brittania Road. This provision necessitates the lowering of the sewer by an additional 15 feet and therefore, becomes more economical to tunnel in its entirety within the interchange complex. The alignment of the sewer is recommended to be modified to simplify tunnelling operation.

We trust the above meets with your approval, and if you require, would be pleased to discuss the project further.

Yours very truly,
FOUNDATION OF CANADA ENGINEERING
CORPORATION LIMITED

R.S. Adachi, P. Eng.,
ASSISTANT CHIEF ENGINEER
TRANSPORTATION

RSA/jar
3983-101-1
cc: G. Burkhardt
M. Devata, R. Fitzgibbon

Design Services Branch,
Downsview, Ontario.
M3M 1J8

April 16, 1973.

Telephone: 248-3282.

Canadian Longyear Limited,
35 Brydon Drive,
Rexdale, Ontario.

Dear Sirs:

This letter confirms our request of April 12, 1973, for the supply of a Bombardier Mounted Auger machine together with all necessary equipment, as specified under the terms of our Contract Agreement, at Hwy. 10 and Hwy. 401 on April 12, 1973.

Mobilization will be from your yard at Toronto.

Our Project Number is W.O. 73-11008.

Yours truly,

M. Devata,
Supervising Foundations Engineer,
For: A. G. Storrar,
Principal Foundations Engineer.

MD/ao

cc: W. W. Fry
(Attn: Mrs. M. Andrews)

Foundations Files
Documents

73-1108

Planning
Engineering
Project Management

FENCO

1 Yonge Street
Toronto Canada
416 · 361-4722
Cable Foundaneng
Telex 02 2814

March 27, 1973

April 25

Mr. M. Devata
Supervising Foundations Engineer
Design Services Branch
Ministry of Transportation and Communications
1201 Wilson Avenue
West Building
Downsview, Ontario
M3M 1J8

Dear Sir,

HIGHWAY 401 - HIGHWAY 410 INTERCHANGE
ADVANCE GRADING AND STORM SEWER CONTRACT
W.P. 127-66-34

We enclose for your information a preliminary print of our drawing 3983-1T-100 showing plan and profile of the proposed storm sewer. At present neither the alignment nor profile have been finalized. The location shown as "Line 2" is preferred for alignment, and is presently under review by Structural Planning Office. Invert elevation for the sewer is not yet settled because of Brittania Road, but if the sewer is in rock then its depth may not be critical.

We understand that MTC is to lay out the sewer, and we hope this information will enable you to initiate your investigation.

Yours very truly,
FOUNDATION OF CANADA ENGINEERING
CORPORATION LIMITED

B.T. Stone
SECTION LEADER

BTS/bhw
3983-101-1
Enc.

cc: Mr. W.C. Friedmann
MTC Downsview

DOMINION SOIL INVESTIGATION LIMITED
CONSULTING SOIL & FOUNDATION ENGINEERS
104 CROCKFORD BLVD., SCARBOROUGH, ONT. M1R 3C6 · (416)751-6565 · TELEX 02-21210 · CABLES: DOMSOIL

T3-11006

April 24, 1973

Ministry of Transportation
and Communications
Design Services Branch,
1201 Wilson Avenue,
Downsview, Ontario.
M3M 1J8

Attention: Mr. M. Devata, P.Eng.
Supervising Foundation Engineer.

Dear Sirs:

Re: Drill Rental for Sewer Project
Hwy 401 & Hwy 403

This is to confirm that we will undertake the above job at the following footage rates:

Augering through overburden	$ 3.50/ft.
Drilling for BXL core in shale bedrock	$ 8.00/ft.
Reaming casing if required	$ 4.00/ft.

Mobilization charges from our yard to jobsite and return will be $ 1.25/mile. Diamond bits, core barrels or any other equipment required to carry out the above job is included in the footage rates stipulated above.

We trust you will find this in order.

Yours very truly,

DOMINION SOIL INVESTIGATION LIMITED

A. Bonca,
President.

AB:eh

13-1008

Planning
Engineering
Project Management

FENCO

1 Yonge Street
Toronto Canada
416 · 361-4722
Cable 'Foundaneng'
Telex 02 2814

April 25, 1973

Mr. M.S. Devata
Supervising Foundations Engineer
Design Services Branch
Ministry of Transportation and Communications
1201 Wilson Avenue
Downsview, Ontario
M3M 1J3

Dear Sir,

HIGHWAY 401 - HIGHWAY 410 INTERCHANGE
ADVANCE GRADING AND STORM SEWER CONTRACT
W.P. 127-66-34

Enclosed are two prints of drawing 3983-1T-100 revision 1, showing the up-dated sewer location, indicated as "line 3" on the plan and profile.

Yours very truly,
FOUNDATION OF CANADA ENGINEERING
CORPORATION LIMITED

B.T. Stone
SECTION LEADER

BTS/bhw
3983-101-1
Enc.

cc: Mr. W.C. Friedmann, P.Eng.
MTC
Downsview, Ontario

Design Services Branch,
1201 Wilson Avenue,
Downsview, Ontario.
M3M 1J8

Telephone: 248-3282.

April 27, 1973.

Dominion Soil Investigation Ltd.,
104 Crockford Blvd.,
Scarborough, Ontario.
M1R 3C6

Dear Sirs:

This letter confirms our request of March 24, 1973, for the supply of a C.M.E. 45 Auger machine together with all necessary equipment, as specified under the terms of your recent letter dated April 24, 1973, at Dixie Rd. and Hwy. 401 on March 25, 1973.

Mobilisation will be from your yard in Toronto.

Our Project Number is W.O. 73-11008.

Yours truly,

MD/ao

M. Devata,
Supervising Foundations Engineer,
A. G. Stermac,
Principal Foundations Engineer.

c.c. W. W. Fry For:
(Attn: Mrs. J. McLaren)

Foundations Files
Documents

FENCO

Planning
Engineering
Project Management

1 Yonge Street
Toronto, Canada M5E 1E7
416-361-4722
Cable Foundaneng
Telex 02 2814

June 27, 1973

Mr. A.G. Stermac, P.Eng.
Principal Foundation Engineer
Ministry of Transportation and
Communications
West Building
Downsview 464, Ontario

Attention Mr. M. Devata
Supervising Foundation Engineer

Dear Sirs,

HIGHWAYS 401 & 410 INTERCHANGE
ADVANCED GRADING & STORM SEWER
W.P. 127-66-34

Please find enclosed sheets nos. 6, 12, 13, 19, 22, 23 and 27 as you requested. These drawings cover the access shaft, the sewer openings at Heart Lake Road and the storm sewer itself.

Yours very truly,
FOUNDATION OF CANADA ENGINEERING
CORPORATION LIMITED

B.T. Phalp

B.T. Phalp, P.Eng.
SUPERVISING ENGINEER

BTP/tf
3983
enc:

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

30M12-85

TO: Mr. G. C. E. Burkhardt, Regional Structural Plng. Eng., Toronto Regional Office.

FROM: Foundations Office, Design Services Branch, West Bldg., Downsview.

ATTENTION:

DATE: June 28, 1973.

OUR FILE REF.

IN REPLY TO JUL - 6 1973

SUBJECT:

FOUNDATION INVESTIGATION REPORT

For

Proposed South Trunk Sewer
From Heart Lake Road to LIttle
Etobicoke Creek, Hwy. 401 - 403
Town of Mississauga, Cty. Peel
District 6 Toronto
W.O. 73-11008 W.P. 127-66-34
CONT. 73-124

Attached we are forwarding to you our detailed foundation investigation report on the subsoil conditions existing at the above-mentioned site.

We believe that the factual data and recommendations contained therein will prove adequate for your design requirements. Should additional information be required, please do not hesitate to contact our Office.

A. G. Stermac
Principal Foundations Engineer/

AGS/js
*attach.
c.c. E.J. Orr
B. R. Davis
A. Rutka
R. S. Pillar
H. Greenland
B. J. Giroux
C. Mirza
G. A. Wrong
B. A. Singh
Foundations Files
Documents

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FOUNDATION INVESTIGATION REPORT

For

Proposed South Trunk Sewer
From Heart Lake Road to Little
Etobicoke Creek, Hwy. 401 - 403
Town of Mississauga, Cty. Peel
District 6 Toronto
W.O. 73-11008 W.P. 127-66-34

1. *INTRODUCTION*

In conjunction with the construction program of Hwy. 401 and Hwy. 403, it is proposed to install a new trunk sewer along the south side of Hwy. 401 from Little Etobicoke Creek westerly to 401/410/403 interchange and then along proposed Hwy. 410 northerly to some 500 feet north of existing Britannia Road. The Foundations Office was requested to carry out a subsurface investigation for this trunk sewer. The request was initiated by the Regional Systems Design Office, Central Region. The detail of the proposed sewer system were submitted by Foundation of Canada Engineering Corporation Ltd. (Plan No. 3983-1T-100). Subsequently, an investigation was carried out by this Office to determine the subsoil, bedrock and groundwater condtitions at the site.

It is understood that the proposed south trunk sewer will be constructed under two contracts. This report will deal with the eastern portion of the proposed truck sewer, from station 139+00 (near existing Heart Lake Road) to Station 154+00 (the outfall end at the Little Etobicoke Creek), which will likely be constructed first. The remaining portion of this trunk sewer which is to be constructed under a separate contract will be covered in a separate foundation report W.O. 73-11014.

.../2

2. DESCRIPTION OF THE SITE AND GEOLOGY

The site under investigation is located some 600 feet south of existing Hwy. 401 from Heart Lake Road to Little Etobicoke Creek, in the Town of Mississauga, County of Peel. The ground surface, in the vicinity of the site, varies from elevations 564 to 514 and is generally sloping towards the Little Etobicoke Creek. The land is primarily used for farming purposes.

Physiographically, the site is situated in the region known as the "Peel Plain." The characteristic deposit in the vicinity of the area under investigation, is composed of a cohesive glacial till whose thickness is quite variable. In this region, the Credit River, Oakville and Etobicoke Creeks have cut deep valleys into the overburden. There is, therefore, no large undrained depression, swamp or bog in this area, although in many of the interstream areas drainage is still imperfect.

The overburden is underlain by grey shale bedrock of the Meaford-Dundas formation, Ordovician Period.

3. FIELD AND LABORATORY WORK

Seven sampled boreholes were put down during the course of field investigation. The borings were advanced by continuous flight auger machines (commercially known as C.M.E. 45) adapted for soil sampling purposes.

Samples of the overburden were obtained in a 2" O.D. split-spoon sampler at required depths. The sampler was hammered into the soil with a driving energy of 350 ft.-lb. per blow, in accordance with the specifications for Standard Penetration Test. Bedrock was proven in all of the boring locations by obtaining BXL size rock core samples.

Groundwater level observations were carried out, during the period of the investigation, in the open boreholes.

.../3

The soil, bedrock and groundwater conditions encountered at the boring locations, are presented in the Record of Borehole sheets. The location and elevation of the various boreholes were surveyed, in the field, by Construction Personnel from District #6 (Toronto). The elevations in this report are referred to a Geodetic datum. Boring locations and elevations, together with an estimated stratigraphical profile along the proposed sewer line are shown on Drawing No. 73-11008A.

All samples were subjected to careful visual examination in the field and subsequently in the laboratory. Following this examination, laboratory tests were carried out on selected representative samples to determine the physical properties of the various soil types encountered; namely,

Natural Moisture Contents
Atterberg Limits
Grain-Size Distribution

The results of this testing are plotted on the Record of Borehole sheets and summarized on Figures No. 1 to 2, inclusive, all contained in Appendix I of this report.

4. *SUBSOIL AND BEDROCK CONDITIONS:*

4.1 *General:*

The overburden across the site is composed of a heterogeneous mixture of hard, clayey silt, sand and gravel (glacial till). The thickness of this cohesive glacial till stratum varies from 6 to 13 feet. The overburden is underlain by shale bedrock.

The stratigraphical sequence encountered in the borings is plotted on the Record of Borehole sheets. Stratigraphical profile has been inferred from this data and shown on Drawing No. 73-11008A. The subsoil and bedrock encountered from ground surface downward, are presented in the following subsections.

.../4

4.2 *Heterogeneous Mixture of Clayey Silt, to silty clay, Sand and Gravel (Glacial Till):*

The glacial till is composed of a heterogeneous mixture of clayey silt to silty clay, sand and gravel. This stratum was encountered in all boring locations. The thickness of this stratum varies between 6 (B.H. #2) to 13 (B.H. #7) feet. Grain size distribution curves, for the samples of this glacial till stratum, are plotted in an envelope form on Figure 1 of the Appendix.

Results of Atterberg Limit Tests, performed on samples recovered in this stratum were plotted on the Record of Borehole sheets, as well as on the plasticity chart, Figure 2. They are also tabulated below:

	Range	Average
Liquid Limit (W_L) %	29 - 43	37
Plastic Limit (W_p) %	17 - 23	21
Natural Moisture Content (w) %	10 - 19	14

Standard penetration testing was carried out within this stratum and the results were plotted on the Record of Borehole sheets. The "N" values vary from 12 blows/foot near the ground surface generally increasing with depth to 100 blows per 3 inches. It is estimated that the consistency of this cohesive material varies from very stiff to hard.

4.3 BEDROCK

Bedrock was proven in all of the boring locations by obtaining 5 to 50 feet of BXL size rock core samples. The rock samples were carefully examined by Mr. K. W. Ingham, Geologist. Mr. Ingham presented the results of his bedrock description, as well as an interpretation of geological conditions existing at this site, in a memo to this Office, dated June 14, 1973. A copy of this memo is enclosed in the Appendix of this report.

.../5

The bedrock encountered at the boreholes is a dark grey thin bedded shale with minor thin limestone bands. The upper portion of the bedrock is generally in a weathered condition. The thickness of this weathered zone ranges from 2 to 7 feet.

The bedrock surface was found to be at elevation 560 at the west end of this stretch of the trunk sewer, and sloping to elevation 511 at the outfall end.

5. *GROUNDWATER CONDITIONS:*

Groundwater level observations have been carried out during the period of the investigation by recording the water level in the open boreholes. The observations are recorded on the Record of Borehole sheets and summarized on Drawing No. 73-11008A. The results of the measurements in the open boreholes indicate that the groundwater level, ranges from 1 to 9 feet below existing ground surface, which corresponds to elevation between 512 (B.H. #1) and 563 (B.H. #100).

6. *DISCUSSION AND RECOMMENDATIONS:*

6.1 *General:*

It is proposed to install a 5,500 foot storm trunk sewer in conjunction with the construction program of Hwy. 401 & Hwy. 403 in the Town of Mississauga, County of Peel. As mentioned previously, this report will deal with the 1500 foot long portion of the sewer between Heart Lake Road and Little Etobicoke Creek. The diameter of this portion of the sewer will be 10 feet.

The invert of the sewer, which is shown on Drawing No. 73-11008A will range from elevation 520 (at Heart Lake Road) to elevation 514 at Little Etobicoke Creek. At this grade it will be located from 5 to 46 feet below the existing ground surface.

.../6

The predominant stratum across the site is a deposit of cohesive glacial till, up to 13 feet in thickness. It is underlain by shale bedrock.

The invert of the sewer will, in general be located within the shale bedrock. At the outfall end of the sewer, however, the invert will be located within the glacial till.

It is understood that between station 139+00 to station 146+00, the sewer will be installed using rock tunnelling procedures. From station 146+00 to the outfall end, it is believed that a cut and cover method will be used.

6.2 Sewer Constructed by Open Cut Methods: (Station 146+00 to Station 154+00)

The sewer excavations will be carried out through the cohesive glacial till stratum into the shale bedrock. The Maximum depth of excavation will be of the order of 35 feet. Temporary cuts of this height will be inherently stable with respect to a deep-seated rotational type of failure provided that the cuts are constructed with 1:1 slopes within the overburden and weathered shale bedrock. If, due to space restrictions, slopes steeper than that specified or vertical cuts are desired in the overburden and weathered shale bedrock, the excavation should be properly sheeted and braced.

The prevailing groundwater level, as recorded during the course of field investigation is, in general, well above the invert elevations of the trunk sewer. In view of the impervious nature of the glacial till stratum, groundwater seepage into the excavation will be negligible in quantity.

It is believed that this can be handled by employing standard techniques, such as pumping from sumps.

It is recommended that the sewer bedding adhere to standards currently being used by the Ministry, specifically for class 'B-3' or 'B-4' or unyielding foundation

...../7

(Standard No. DD-823), and be placed in a dry trench. In addition, particular attention should be paid to the compaction and shaping of the bedding material. Backfill for the sewer excavations should comply with Standard No. DD-813-B currently used by the Ministry.

6.3 SEWER CONSTRUCTION BY TUNNELLING THROUGH BEDROCK Station 139+00 to Station 146+00

Between the aforementioned Stations the proposed sewer will be located within the sound shale bedrock. It is understood that this section of the sewer will be constructed by tunnelling through the shale bedrock.

For bridging purposes, a minimum of 10 feet of sound rock cover is required. In order to provide adequate bridging support for the sewer tunnel at the proposed Heart Lake Road, it is recommended that the tunnelling should be carried out prior to the roadway cuts in this area. For estimating purposes it may be assumed that about 10% overbreak could occur in a sewer of this diameter.

The groundwater level recorded during the field investigation is up to 45 feet above the proposed sewer invert. Since the tunnel will be situated within the shale bedrock, water under pressure may enter the tunnel through the fractures and fissures in the shale. Therefore, necessary measures to overcome this problem must be taken.

It is believed that tunnelling may be accomplished either by conventional drill and blast methods, or by the use of tunnelling machines.

At this stage, the design detail of the tunnel liner and related information is not available, therefore it is extremely difficult to give specific recommendations.

However, this Office will provide necessary information once the specific details become available.

7. *MISCELLANEOUS:*

The field work performed between April 12 and 28, 1973, was carried out under the supervision of Messrs. V. Korlu and J. Bangs, Project Foundations Engineers.

The drilling equipment used was owned and operated by Canadian Longyear Ltd. (Toronto) and Dominion Soil Investigation Ltd. (Toronto).

This report was prepared by Mr. C. S. Poon, Project Foundations Engineer, and was reviewed by Mr. M. Devata, Supervising Foundations Engineer.

C. S. Poon, P. Eng.

REGISTERED PROFESSIONAL ENGINEER C.S.L.POON PROVINCE OF ONTARIO

M. Devata, P. Eng.

MD/CSP/js
June 28, 1973.

APPENDIX I

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

TO: Mr. M. Devata,
Sup. Foundation Engineer.

FROM: K. W. Ingham

ATTENTION:

DATE: June 14, 1973

OUR FILE REF.

IN REPLY TO

SUBJECT: Foundation Investigation 73-11008;
Highways 401 and 410, Storm Sewers

A brief description is given below for 6 boreholes drilled to bedrock at this site, together with the appropriate bedrock elevation.

Hole No. 1 — Bedrock at 512.4

6.0 - 11.3	Shale; dark greenish grey, platy to fissile, minor thin limestone bands, weathered throughout.
11.3 - 15.0	Shale; dark grey, medium bedded.

Hole No. 2 — Bedrock at 520.5

6.0 - 7.2	Shale; dark greenish grey, badly weathered.
7.2 - 7.9	Limestone; light grey, fine grained, thin bedded, partially fractured.
7.9 - 15.1	Shale; dark grey, thin bedded, minor limestone bands 0.1 to 0.2 ft. in thickness, moderately weathered zones throughout.
15.1 - 16.0	Shale; dark grey, thin to medium bedded.

Hole No. 3 — Bedrock at 526.3

7.5 - 11.0	Shale; dark grey, thin bedded, badly to moderately weathered, limestone 7.7 to 8.0 ft.
11.0 - 13.0	Shale; dark grey, thin bedded, moderately weathered, minor thin limestone bands.

Hole No. 3 - Cont'd

13.0 - 13.5	Limestone; medium grey, fine grained.
13.5 - 23.0	Shale; dark grey, thin to medium bedded, occasional thin limestone bands, limestone 21.2 to 21.6 ft., moderately weathered throughout.
23.0 - 25.5	Shale; dark grey, medium bedded.

Hole No. 4 — Bedrock at 530.7

6.8 - 8.0	Till changing to badly weathered shale.
8.0 - 8.3	Limestone; medium to dark grey, fine grained.
8.3 - 12.3	Shale; dark grey, platy to fissile, badly weathered.
12.3 - 18.0	Shale; dark grey, thin bedded, moderately weathered, minor thin limestone bands.
18.0 - 18.3	Limestone; light grey, fine grained.
18.3 - 18.9	Shale; dark grey, thin bedded, moderately weathered.
18.9 - 19.6	Limestone; light grey, fine grained, thin moderately weathered shale seams in the lower 0.4 ft.
19.6 - 29.0	Shale; dark grey, thin to medium bedded, occasional limestone layers 0.1 to 0.2 ft. in thickness.

Hole No. 7 — Bedrock at 541.6

12.5 - 19.7	Shale; dark grey, platy to fissile, badly weathered.
19.7 - 23.1	Shale; dark grey, thin bedded, moderately weathered, minor thin limestone bands.

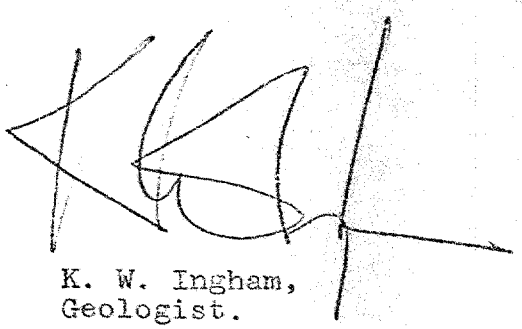
Hole No. 7 - Cont'd

23.1 - 23.6	Limestone; medium grey, fine grained, shaly in the lower 0.3 ft.
23.6 - 25.5	Shale; dark grey, thin bedded, moderately weathered.
25.5 - 39.5	Shale; dark grey, medium bedded, occasional bands of limestone 0.1 to 0.3 ft. in thickness.
39.5 - 43.4	Interbedded dark grey shale and medium grey limestone, thin to medium bedded.
43.4 - 44.3	Shale; dark grey, medium bedded.

Hole No. 10

Bedrock at 557.0

7.0 - 12.1	Shale; dark grey, thin to medium bedded, frequent bands of limestone 0.2 to 0.3 ft. in thickness, poor core recovery.



K. W. Ingham,
Geologist.

KWI:mv

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS - ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIO / OFFICE

RECORD OF BOREHOLE No 1

JOB 73-11008 — LOCATION Co-ords. 15,857,632 N; 961,023 E. — ORIGINATED BY VK

W.P. 127-66-34 — BORING DATE April 12, 1973 — COMPILED BY GSP

DATUM Geodetic — BOREHOLE TYPE Auger, Cone Test and BXL Rock Core — CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT
518.4	Ground Level				
0.0	Het.mix.of clayey silt,sand & gravel. (Glacial Till)		1	SS	12
511.4	Brown Stiff to Hard		2	SS	119/11"
7.0	Shale Bedrock		3	SS	100/3"
507.1	weathered				
11.3	Dark Grey		4	RC BXL	90%
503.4	Sound				
15.0	End of Borehole				

ELEV. SCALE: 510, 500

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — 20 40 60 80 100

SHEAR STRENGTH P.S.F. — ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE

100/8"

LIQUID LIMIT w_L — PLASTIC LIMIT w_P — WATER CONTENT w — w_P w w_L

WATER CONTENT % — 10 20 30

BULK DENSITY γ P.C.F.

REMARKS

GR SA SI

3 41 47

▼ 512.0

20
15 ⊹ 5 % STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS - ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No. 2

JOB 73-11008 — LOCATION Co-ords. 15,857,620; 960,876 E. — ORIGINATED BY VK

W.P. 127-66-34 — BORING DATE April 13, 1973 — COMPILED BY CSP

DATUM Geodetic — BOREHOLE TYPE Auger, Cone Test and BXL Rock Core — CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 — SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	LIQUID LIMIT w_L — PLASTIC LIMIT w_P — WATER CONTENT w — WATER CONTENT % 10 20 30	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT					
526.5	Ground Level									
0.0	Het.mix.of clayey silt,sand & gravel. (Glacial Till)		1	SS	33					▼ 524.1
520.5	Brown Hard		2	SS	100/3"					
518.6	weathered		3	BXL	83%	520				
7.9	Shale Bedrock Dark Grey		4	BXL	87%		100/5"			
510.5	Sound		5	BXL	70%					
16.0	End of Borehole		6	BXL	100%	510				

20
15 ◇ 5 % STRAIN AT FAILURE
10

OFFICE REPORT - SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 3

JOB 73-11008 — LOCATION Co-ords. 15,857,609 N; 960,726 E. — ORIGINATED BY VK

W.P. 127-66-34 — BORING DATE April 13, 1973 — COMPILED BY CSP

DATUM Geodetic — BOREHOLE TYPE Auger, Cone Test and BXL Rock Core — CHECKED BY

SOIL PROFILE ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
533.8	Ground Level					
0.0	Het.mix.of silty clay,sand & gravel. (Glacial Till)		1	SS	48	530
526.3	Brown Hard		2	SS	59	
7.5	badly to moderately weathered		3	BXL	100%	
520.8			4	BXL	90%	520
13.0	Shale Bedrock Dark Grey		5	BXL	100%	
508.3	Sound		6	BXL	100%	510
25.5	End of Borehole					500

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — 20 40 60 80 100

SHEAR STRENGTH P.S.F. — ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE

100/5"

LIQUID LIMIT w_L — PLASTIC LIMIT w_P — WATER CONTENT w

WATER CONTENT % — 10 20 30

BULK DENSITY γ P.C.F.

REMARKS — GR SA SI CL

2 25 52 21

530.0

June 18/73

20
15 ◇ 5 % STRAIN AT FAILURE
10

OFFICE REPORT SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS–ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 4

JOB 73-11008 — LOCATION Co-ords. 15,857,590 N; 960,624 E. — ORIGINATED BY VK

W.P. 127-66-34 — BORING DATE April 16, 1973 — COMPILED BY CSP

DATUM Geodetic — BOREHOLE TYPE Auger, Cone Test and BXL Rock Core — CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT
537.5	Ground Level				
0.0	Het.mix.of clayey silt, sand & gravel. (Glacial Till)		1	SS	29
530.7	Brown. V.Stiff to Hard		2	SS	71/9"
6.8			3	BXL	50%
525.2	weathered		4	BXL	94%
12.3	Shale Bedrock		5	BXL	100%
	Dark Grey		6	BXL	100%
508.5	Sound		7	BXL	100%
29.0	End of Borehole				

ELEV. SCALE: 530, 520, 510, 500

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT: 20 40 60 80 100

SHEAR STRENGTH P.S.F.: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE

100/9"

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

WATER CONTENT % 10 20 30

BULK DENSITY γ P.C.F.

REMARKS

GR SA SI

▽ 536.3 June 18/

12 10 49

OFFICE REPORT ON SOIL EXPLORATION

20 / 15 ◇ 5 / 10 % STRAIN AT FAILURE

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS - ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 7

JOB 73-11008 — LOCATION Co-ords. 15,857,320 N; 960,264 E. — ORIGINATED BY JB

W.P. 127-66-34 — BORING DATE April 25, 1973 — COMPILED BY CSP

DATUM Geodetic — BOREHOLE TYPE Auger and BXL Rock Core — CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE
554.1	Ground Level					
0.0	Met.mix.of clayey silt to silty clay, sand and gravel. (Glacial Till)		1	SS	39	550
			2	SS	52	
			3	SS	131	
			4	SS	136	
541.6	Brown-Grey Hard		5	SS	117	
12.5			6	BXL	60%	540
			7	BXL	58%	
534.4	weathered		8	BXL	100%	
19.7	Shale Bedrock		9	BXL	82%	
			10	BXL	94%	530
	Dark Grey		11	BXL	100%	
			12	BXL	90%	
	Sound		13	BXL	90%	520
514.1			14	BXL	90%	
40.0	End of Borehole					510

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

LIQUID LIMIT w_L
PLASTIC LIMIT w_P
WATER CONTENT w
w_P — w — w_L
WATER CONTENT %
10 20 30

BULK DENSITY γ P.C.F.

REMARKS

▽ 551.1 June 18/73

GR SA SI CL
0 5 72 23

20
15 ◇ 5 % STRAIN AT FAILURE
10

SOIL EXPLORATION
OFFICE REPORT

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS - ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 10

JOB 73-11008 — LOCATION Co-ords. 15,857,050 N; 959,906 E. — ORIGINATED BY JB

W.P. 127-66-34 — BORING DATE April 28, 1973 — COMPILED BY CSP

DATUM Geodetic — BOREHOLE TYPE Auger and EXL Rock Core — CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W	BULK DENSITY γ	REMARKS
ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	WATER CONTENT %	P.C.F.	GR. SA. SI. C
564.0	Ground Level									
0.0	Het.mix.of silty clay,sand & gravel. (Glacial Till)		1	SS	88	560		○		▼ 562.0
557.0	Brown Hard									
7.0	Shale Bedrock			RC						
551.9	Dark Grey Moderately weathered		2	BXL	63%					
12.1	End of Borehole					550				

OFFICE REPORT — SOIL EXPLORATION

20
15 ◇ 5 % STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 100

JOB 73-11008 — LOCATION Co-ords. 15,856,946 N; 959,758 E. — ORIGINATED BY CSP

W.P. 127-66-34 — BORING DATE May 11, 12, 1973 — COMPILED BY CSP

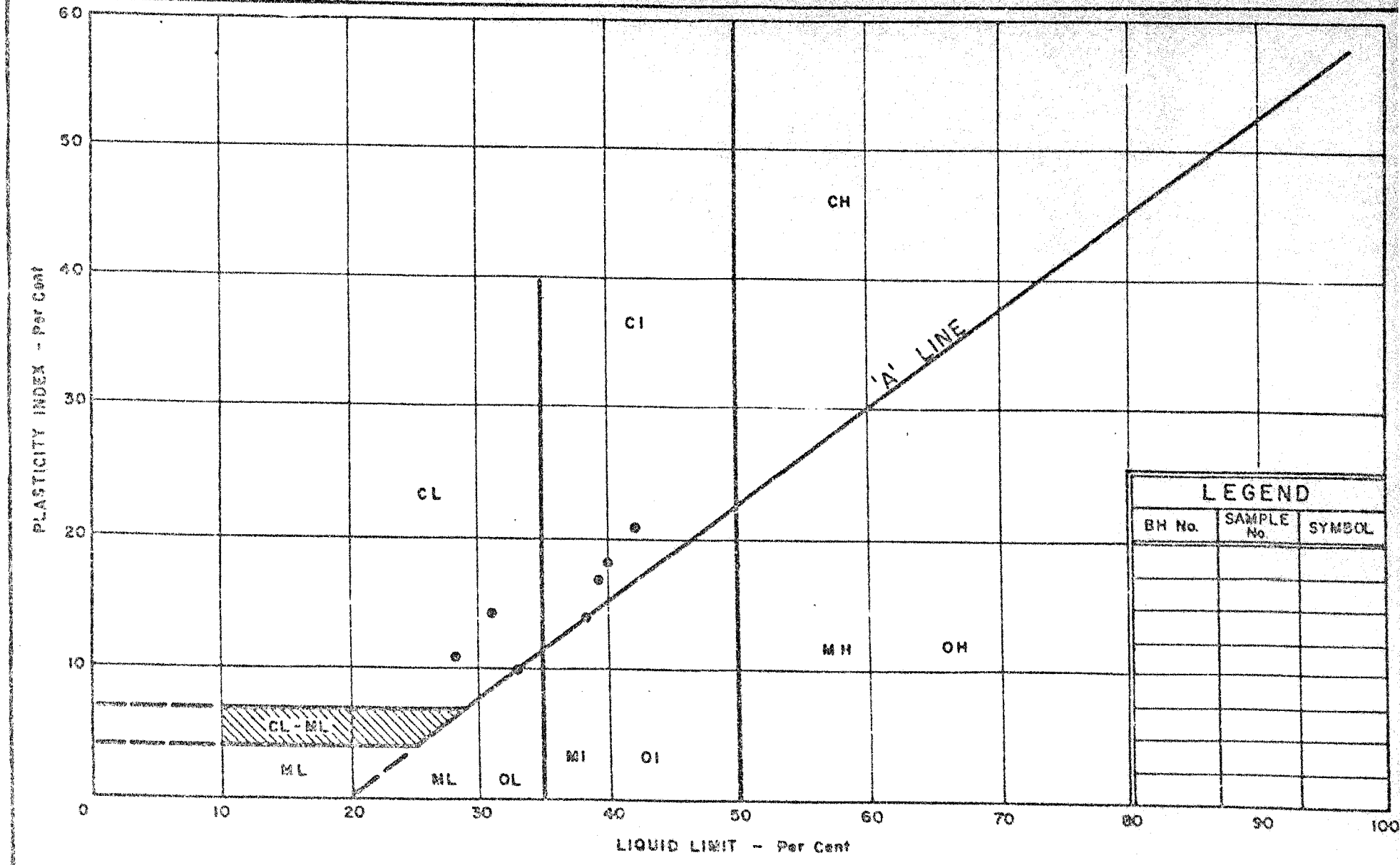
DATUM Geodetic — BOREHOLE TYPE Auger and BXL Rock Core — CHECKED BY

SOIL PROFILE ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT; SHEAR STRENGTH P.S.F. ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w (w_P — w — w_L); WATER CONTENT % 15 30 45	BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. C
567.6	Ground Level									
0.0	Het.mix.of silty clay sand and gravel. (Glacial Till)		1	SS	37				563.6 ▼	5 3 52
560.8	Brown-Grey Hard		2	SS	100/3"					
6.8			3	BXL	85%	560				
555.6	weathered		4	BXL	75%					
12.0			5	BXL	100%					
	Shale Bedrock		6	BXL	92%	550				
	with occasional		7	BXL	96%					
	limestone bands		8	BXL	100%	540				
	(max. 3" thick)		9	BXL	97%					
			10	BXL	97%	530				
	Dark Grey		11	BXL	100%					
			12	BXL	98%	520				
511.1	Sound		13	BXL	100%					
56.5	End of Borehole					510				

15 ◇ 20 5 % STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

REVISED JUNE 1966



DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

PLASTICITY CHART

GLACIAL TILL

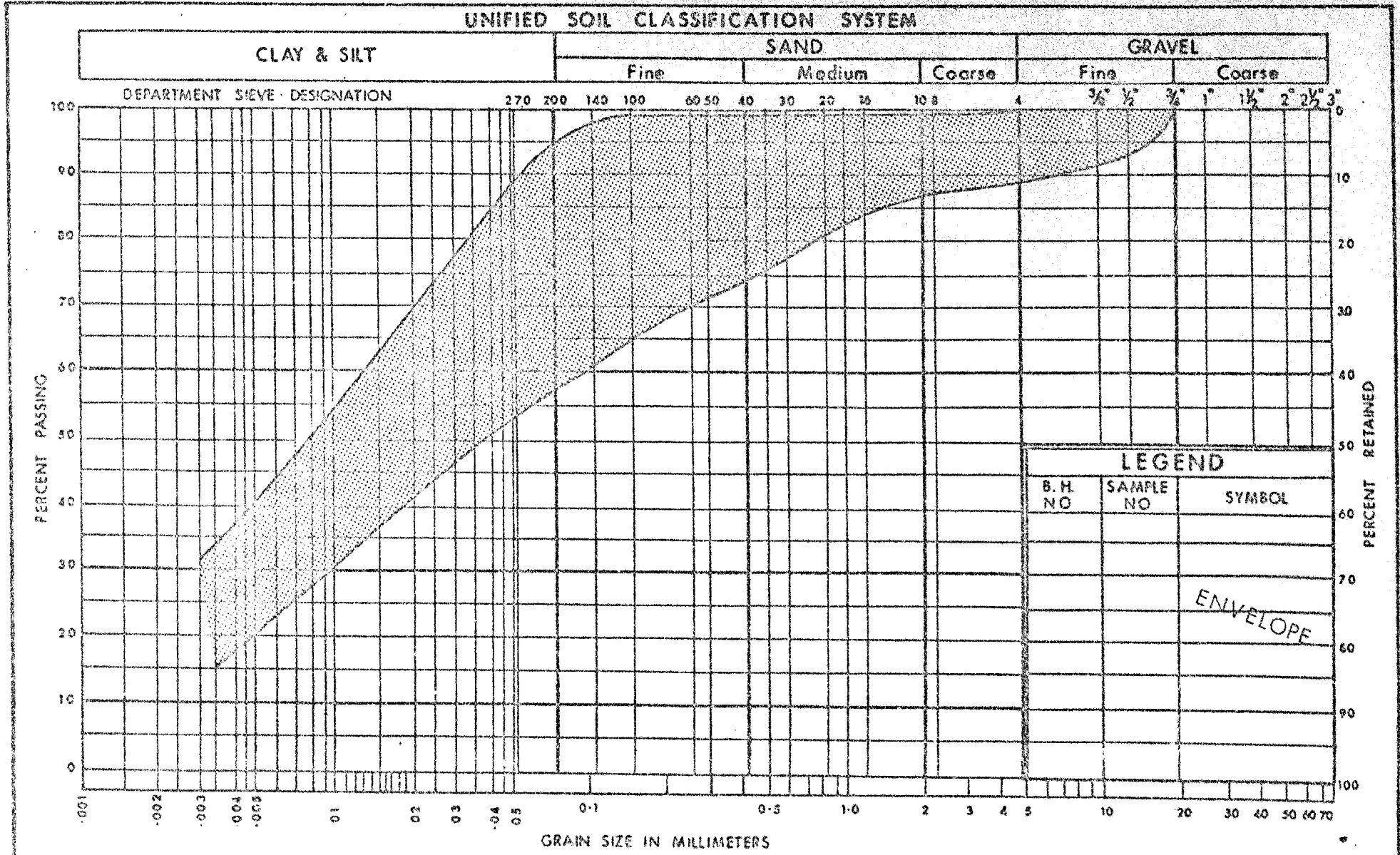
HET. MIX. OF CLAYEY SILT TO SILTY CLAY, SAND & GRAVEL

W.P. No. 127 - 66 - 34

JOB No. 73 - 11008

FIG. 1

FORM CD-MT-
REV. AUG. 1971



DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

DESIGN SERVICES BRANCH

GRAIN SIZE DISTRIBUTION

GLACIAL TILL

HET. MIX. OF CLAYEY SILT TO SILTY CLAY, SAND & GRAVEL

W.P. No. 127 - 66 - 34

JOB No. 73 - 11008

FIG. 2

FD-1 (Rev. Jan. 73)

ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

PENETRATION RESISTANCE

'N' = STANDARD PENETRATION RESISTANCE : - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE : - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL. THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

DESCRIPTION OF SOIL

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

CONSISTENCY	c LB./SQ.FT.
VERY SOFT	0 - 250
SOFT	250 - 500
FIRM	500 - 1000
STIFF	1000 - 2000
VERY STIFF	2000 - 4000
HARD	> 4000

DENSENESS	'N' BLOWS / FT.
VERY LOOSE	0 - 4
LOOSE	4 - 10
COMPACT	10 - 30
DENSE	30 - 50
VERY DENSE	> 50

TERMS TO BE USED IN DESCRIBING SOILS :-

TRACE < 10 % , SOME 10 - 25 % , WITH 25 - 40 % , > 40 % SILTY, SANDY, GRAVELLY, CLAYEY ETC.

TYPE OF SAMPLE

S.S.	SPLIT SPOON
W.S.	WASHED SAMPLE
S.T.	SLOTTED TUBE SAMPLE
A.S.	AUGER SAMPLE
C.S.	CHUNK SAMPLE
T.W.	THINWALL OPEN
T.P.	THINWALL PISTON
O.S.	OESTERBERG SAMPLE
F.S.	FOIL SAMPLE
R.C.	ROCK CORE

P.H. SAMPLE ADVANCED HYDRAULICALLY

P.M. SAMPLE ADVANCED MANUALLY

SOIL TESTS

U	UNCONFINED COMPRESSION
UU	UNCONSOLIDATED UNDRAINED TRIAXIAL
CIU	CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL
CID	" " DRAINED "
CAU	" ANISOTROPIC UNDRAINED "
CAD	" " DRAINED "
L.V.	LABORATORY VANE
F.V.	FIELD VANE
C	CONSOLIDATION
S	SENSITIVITY

FD-9b (Rev. Jan. 73)

ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

SOIL PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_s	UNIT WEIGHT OF SOLID PARTICLES
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
S_r	DEGREE OF SATURATION
w_L	LIQUID LIMIT
w_P	PLASTIC LIMIT
I_P	PLASTICITY INDEX
w_S	SHRINKAGE LIMIT
I_L	LIQUIDITY INDEX $= \frac{w - w_P}{I_P}$
I_C	CONSISTENCY INDEX $= \frac{w_L - w}{I_P}$
e_{max}	VOID RATIO IN LOOSEST STATE
e_{min}	VOID RATIO IN DENSEST STATE
I_D	DENSITY INDEX $= \frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY D_r IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
m_v	COEFFICIENT OF VOLUME CHANGE $= \frac{-\Delta e}{(1+e)\Delta \sigma'}$
c_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX $= \frac{\Delta e}{\Delta \log_{10} \sigma'}$
T_v	TIME FACTOR $= \frac{c_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION INTERCEPT
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF EFFECTIVE STRESS $\tau_f = c' + \sigma' \tan \phi'$
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF TOTAL STRESS $\tau_f = c_u + \sigma \tan \phi$
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	= 3·1416
e	BASE OF NATURAL LOGARITHMS 2·7183
$\log_e a$ OR $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ OR $\log a$	LOGARITHM OF a TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
σ'	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ε	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNGS MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

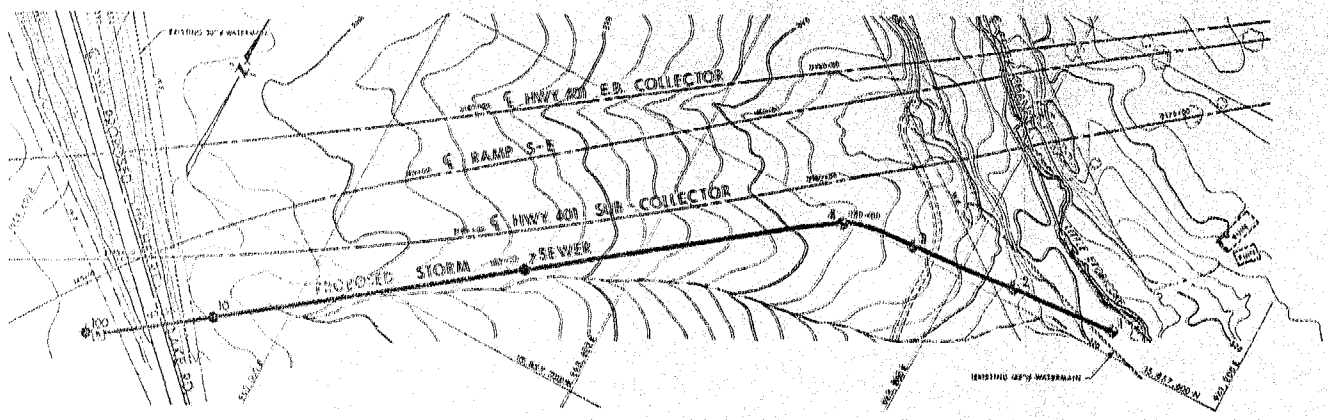
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_o	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

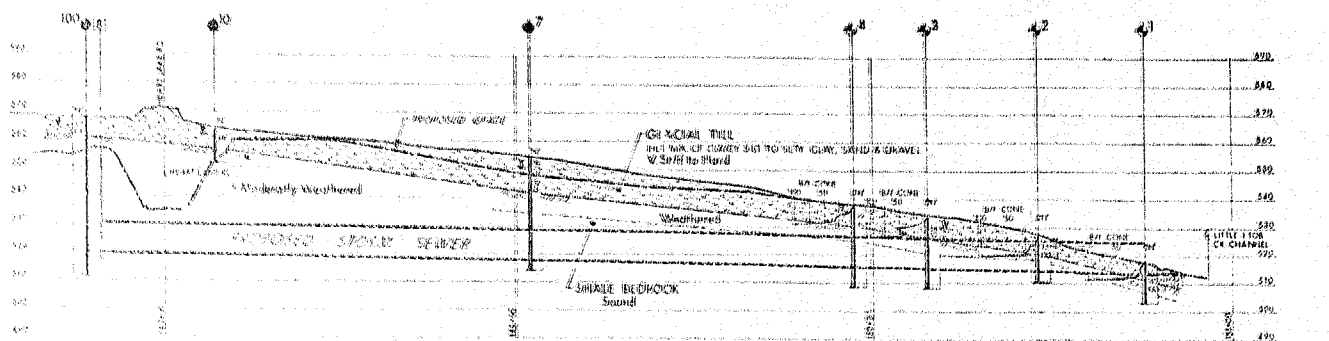
B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL

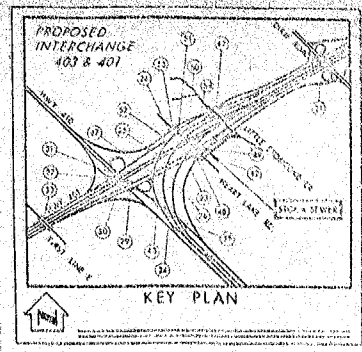


PLAN



PROFILE

REF No. Plan 3983-11-100



KEY PLAN

LEGEND

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- Water Levels established at time of field investigation April 1973 & June 1973
- (B) Access Shaft

NO.	ELEVATION	CO-ORDINATES NORTH	CO-ORDINATES EAST
1	518.4	15,857,632	961,023
2	526.5	15,857,620	960,876
3	553.8	15,857,609	960,726
4	537.5	15,857,590	960,624
7	554.1	15,857,350	960,264
10	564.0	15,857,059	959,906
100	567.6	15,856,948	959,758

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	

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS - ONTARIO
DESIGN SERVICES BRANCH - FOUNDATIONS SECTION

PROPOSED STORM SEWER

HEART LAKE ROAD TO LITTLE ETOBICOKE CREEK

HIGHWAY NO. 401 & 410 DIST NO. 6

CO. PEEL

TOWN OF MISSISSAUGA LOT CON.

BORE HOLE LOCATIONS & SOIL STRATA

SUBMD C.P.	CHECKED	W.P. NO.	DRAWING NO. 73 - 11098A
DRAWN S.K.	CHECKED	SITE NO.	
DATE JUNE 15, 1973	SITE NO.		REVISED DRAWING NO.
APPROVED	CONT. NO.		

13-11008

Minutes of Meeting

Date: November 12, 1973

Present:

D.A.MacDonald M. Dvatta ✓ I. Tremain L. Bowering T. Leonardelli	Ministry of Transportation and Communications, District 6, Toronto
W. Barrie W. Johnson	C.A. Pitts Engineering Construction Limited
A. Kargas	Sudbury Mining

1. D.A. MacDonald emphasized the importance of the contractor and his sub-contractors complying with instructions given by Ministry personnel.

2. The present situation, with regard to safety in the tunnel, was discussed. The contractor proposed the following measures to provide safe working conditions:

a) 6' rock bolts installed at 4' centres in the ceiling of the tunnel;

b) 4" x 4", #9 wire mesh for support between the rock bolts;

c) the application of 1" to 4" of shot-crete

d) timber shoring at the entrance of the tunnel to a point 10' past the area saturated with water.

3. Arrangements were made for all present to meet, at the site, at 4:00 p.m., to review the shot-crete.

4. I. Tremain emphasized the regulations regarding the right of way at the haul road crossing of Heart Lake Road. He requested that the contractor ensure that his operators are aware of the regulations and that they exhibit the necessary caution when crossing Heart Lake Road.

5. W. Barrie questiond the accuracy of the quantities indicated on the plans for fill areas C and D. L. Bowering will review these quantities.

L.B:lm

L. Bowering,
Project Supervisor.

675-6478

SUDBURY MINING CONTRACTORS LIMITED

SPECIALISTS IN ALL TYPES OF ROCK WORK

P.O. BOX 1045 — SUDBURY, ONT.

Nov. 20,1973.

C.A. Pitts Engineering Construction Ltd.,
30 Commercial Road,
Toronto,Ontario.

Att. Mr. W. A. Barrie P.Eng.

M.T.C. Contract 73-124

Dear sir,

The following is our proposed procedure for the construction of the 120" Monolithic Tunnel Pipe on the above named contract.

(1) Drill off 6' or 8' round. Drilling pattern as required by varying rock conditions.

(2) Blast the round.

(3) Much the round and scale all loose rock.

(4) Rock bolt the tunnel roof approximately 30^{o} each side of the centre line, using 7/8" x 6'-0" rockbolts and a minimum plate size of 8" x 8" and tightened with a minimum torque of 200 ft. lbs. The exact pattern of the rockbolts will be dictated by the rock conditions. At this time 4" x 4"x 9 gauge will be placed and anchored by the rockbolts as required.

(5) Repeat the procedure.

(6) The roof of the tunnel and as much of the walls as necessary will be covered by 1" to 2" of shotcrete once or twice a week depending on the conditions of the rock & the rate of tunnel advance.

The time estimate for completion of the tunnel construction is as follows:-

739-7

675-6478

SUDBURY MINING CONTRACTORS LIMITED

SPECIALISTS IN ALL TYPES OF ROCK WORK

P.O. BOX 1045 — SUDBURY, ONT.

(1) Drilling, muching etc. (approx. 490 l.f.)
90'/week (5 days x 2 shifts) - 6 weeks
Allowing for a complete shut down over Christmas & New Years
Completion date January 11, 1974.

(2) Concrete lining (approx. 615 l.f.)
150'/week (5 days x 2 shifts) - 5 weeks
Completion date February 15, 1974.

We believe that this proposal is in line with that discussed with your Mr. A. Drummond, Mr. A.R. McDonald, Mr. W. Johnson and Mr. Pullerits of Albery, Pullerits, Dickson & Associates and Mr. A. Bayne. consultant Mining Engineer on November 19, 1973.

Yours etc.,
Sudbury Mining Contractors Ltd.
A. Kangas
President

Bus. 368-3283 Res. 485-6793

ARTHUR S. BAYNE, B.Sc., P.ENG.
CONSULTING, MINING AND INDUSTRIAL ENGINEER

A. S. BAYNE AND COMPANY
EXAMINATIONS - FEASIBILITY STUDIES
EVALUATION - MANAGEMENT

12 RICHMOND STREET EAST
SUITE 427
TORONTO, ONTARIO

SUDBURY MINING CONTRACTORS
LIMITED

Aulis (Al) Kangas

P.O. BOX 1045
SUDBURY,
ONTARIO

AREA CODE 705
BUS. PHONE 675-6478
RES. PHONE 675-3735

73907

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30 COMMERCIAL ROAD, — TORONTO 17, ONTARIO

Telephone: 421-7373

Mr. H. Greenland District Engineer
District 6
Ministry of Transportation & Communications
Downsview,Ontario.

Nov. 20,1973.

Att. Mr. D.A. MacDonald,P. Eng.
Construction Engineer.

M.T.C. Contract 73-124

Gentlemen,

We are enclosing a proposed procedure for the construction of the 120" Monolithic Tunnel Pipe on the above contract as submitted to us by our Sub-Contractor, Sudbury Mining Contractors Ltd. We concur that this procedure will be satisfactory. If there are any questions regarding this procedure please contact Mr. A. R. Drummond P. Eng., Chief Engineer or Mr. W. Barrie,P.Eng. Vice-President.

Your approval as soon as possible will be appreciated.

Yours truly,
C.A. Pitts Engineering Construction Ltd.

W.A. Johnson,P.Eng.,
Project Manager

739.7

73-1008

Minutes of Meeting

November 23, 1973.

Present: D.A. MacDonald,
I. Tremain,
C. Poon, ✓
L. Bowering,
T. Leonardelli. — Ministry of Transportation and Communications, District 6, Toronto.

W. Barrie,
W. Johnson. — C.A. Pitts Engineering Construction Limited.

A. Kangas. — Sudbury Mining.

1/Various aspects of the contractor's proposal dated November 20, 1973 were discussed.

a/Rock bolts - it was decided to place rock bolts as outlined in the proposal spaced 3' to 4' longitudinally. This spacing will be treated with flexibility as rock conditions dictate.

b/Wire mesh - the placing of wire mesh was discussed but will be reviewed at the site Monday morning.

c/Shotcrete - this operation will be performed twice per week at times determined by the progress of the other operations.

2/D. MacDonald informed the contractor that all safety measures are to be completed to the face prior to the holiday shut down.

3/I. Tremain requested that additional lighting be provided at the tunnel site and inside the tunnel where permissible.

4/The timber shoring mentioned at a previous meeting was discussed. At this time it was decided to dispense with this shoring.

5/D. MacDonald requested that an access be provided to the tunnel in addition to the existing scraper route. A. Kangas stated that a ladder access will be provided Monday.

L.R. Bowering,
Project Supervisor.

LRB:lm

Golder Associates
CONSULTING GEOTECHNICAL ENGINEERS

November 28, 1973

Mr. A. G. Stermac, P.Eng.,
Principal Foundation Engineer,
Ministry of Transportation & Communications,
Design Services Branch,
West Building,
201 Wilson Avenue,
Downsview, Ontario.

Attention: Mr. M. Devata, P.Eng.,
Supervising Foundation Engineer

RE: STORM SEWER TUNNEL,
HEART LAKE ROAD TO LITTLE ETOBICOKE CREEK,
HWY 401, DISTRICT NO. 6 (TORONTO),
CONTRACT 73-124 W.O. 73-11008A

Dear Sirs:

Our Mr. Seychuk and the writer visited the above job site yesterday with your Messrs. Devata, MacDonald and Tremain.

This letter records our preliminary findings. We have requested further information, and following receipt of this we will issue a formal report on the problems.

A tunnel is under construction at the above site by C. A. Pitts Ltd. Eventually the finished tunnel will contain a circular storm water sewer 10 ft. internal diameter, the tunnel lining being a plain concrete ring of 12 in. minimum thickness.

The excavation for the tunnel is wholly in bedrock, which is the Dundas shale which contains thin beds of limestone.

The excavation must stand until the permanent concrete lining is placed, which will be in two or three months, or more if any delays occur in construction.

The Ministry is concerned about the safety of men working in the tunnel in view of the support methods in use by the contractor and has asked us to comment on these methods from the point of view of safety and to suggest improvements in them if we consider this to be necessary.

At present some 150 linear ft. of tunnel have been excavated leaving about 450 ft. more to be excavated to complete the tunnel.

The bedrock is a soft fissile shale containing thin limestone beds at irregular intervals. The shale is laminated and jointed. The bedding is approximately horizontal. The shale is soft and weathers rapidly when exposed to air and water especially when there are no confining stresses. The limestone is harder than the shale and much more resistant to weathering, but the beds are thin and vertically jointed and horizontal continuity of a bed is by no means certain.

The problem can be divided into two parts which are:-

1. What mining and support methods should be used to ensure the safety of that portion of the tunnel which is still to be excavated?

2. What support methods should be used in the excavated portion where stress release has occurred and probably some deterioration of the shale has already taken place?

1. <u>Section still to be excavated</u>

In the soft rock at this site it is certain that some temporary support will be required in a tunnel of 12 ft. diameter. In addition to support, measures must be taken to prevent softening of the shale when exposed to air and water.

Although steel ribs or timber could be used, in our opinion rock bolting and guniting and steel mesh can be used provided these operations are properly carried out.

The mining should be done with the minimum amount of explosive required to get satisfactory breakdown of the muck. Too much explosive will open joints in the surrounding rock, which should be avoided.

Following blasting, loose rock in the roof and walls should be scaled immediately, and the blasted and scaled rock should be mucked out. The exposed rock of the tunnel roof and walls should then be gunited. We understand that two shifts are working and that each shift does two rounds. By 'immediately' above we mean at the end of every two shifts, although to gunite at the end of each shift would be better. Guniting must be carried out at 24 hour intervals at the most. To gunite twice a week is not acceptable. Too much deterioration of the shale can occur in this time.

After guniting the roof should be bolted. This should be done the next day at the latest. Suggested details of bolting will be given in our later report. At this stage it can be stated that 30^{o} each side of the roof centre line is not sufficient and some rock bolts longer than 6 ft. will probably be required.

After rock bolting steel mesh should be placed under the bolted section and supported by the bolts.

The purposes of the operations described above are the following:

1) Scaling - to remove loose and dangerous blocks of rock from the roof and walls.

2) Guniting - to seal the face and prevent the softening of the shale by the action of air, water and water vapour.

3) Bolting - to support horizontal slabs of rock in the roof which are below the natural arch of rock which will be formed by strains in the rock following the release of stress.

4) Meshing - to prevent the fall of blocks of rock situated between joints and between bolts and rendered loose by release of stress which is a gradual process.

Properly carried out we think these measures will be satisfactory.

2. Section already excavated

The support of the roof of the section already excavated is not satisfactory and deterioration can be expected over the two to three months or longer before the permanent tunnel lining is placed. While it is true that no one can say with certainty that further roof falls will occur it is equally true that no one can say that they will not. In our opinion the probability of further falls is high, and it does not take a very big block of rock to injure or kill a man even though he is wearing a hard hat.

It is too late to adopt completely the measures suggested above for the section still to be excavated.

It is not suggested that complete collapse of the tunnel roof will occur, but it is highly likely that small to large blocks or slabs of rock will fall from the roof from time to time over the next few months as softening of the shale occurs and stresses are released in the rock below the natural arch which will gradually form in the rock above the roof of the tunnel.

What roof bolting exists appears to be sporadic; some bolts are obviously ineffective. What guniting has been done is also sporadic and the small amount of steel mesh is inadequate.

To remedy this situation the first essential is adequate lighting so that the existing conditions can be assessed. When this is available a careful inspection of the roof conditions should be made.

It seems to us likely that in the portal section for a distance of 50 to 60 feet into the tunnel it will be necessary to support the roof from the floor (even if only temporarily) by timber or steel ribs. When the roof is supported an attempt can be made to complete the steel bolting. But due to the time for which this material has been exposed and the consequent stress release which has taken place this will be a much more hazardous

operation than it would have been if it had been carried out immediately after excavation. Protection for the drilling crew against falling blocks of rock will be needed.

The steps needed for this section therefore are

a) provision of adequate lighting
b) inspection of rock conditions in roof
c) probably further scaling
d) temporary support from the floor, particularly in the portal section
e) further roof bolting on a pattern related to the ascertained condition of the rock in the roof and probably using much longer bolts than would have been necessary originally
f) guniting?
g) steel mesh support

Alternatively permanent support from the floor by steel ribs and timber could be used in which case roof bolts and steel mesh would not be required.

It is probably too late for guniting to be of much use in this section.

As one proceeds into the tunnel the rock conditions seem to improve somewhat and the technique adopted can probably approach that suggested for the section still to be excavated.

The opinions expressed above are tentative and subject to modification in our final report after receipt of further information. However the principles stated above will not change.

Yours truly,

H. Q. GOLDER & ASSOCIATES LTD.

for H. Q. Golder, P.Eng.

HQG:jb
73907

73-1006

Golder Associates
CONSULTING GEOTECHNICAL ENGINEERS

December 12, 1973

Ministry of Transportation
& Communications,
Design Services Branch,
Downsview 464, Ontario.

Attention: Mr. A. G. Stermac

RE: STORM SEWER TUNNEL,
HEART LAKE ROAD TO LITTLE ETOBICOKE CREEK

Dear Sir:

We have received from you the further information which we asked for on the above project, viz.

a) cross-sections drawn to scale of the tunnel as excavated at chainages

143+20

144+10

and 145+10

b) detailed logs of boreholes 100 and 7 showing the location and thickness of limestone beds encountered.

We give our comments on this information below.

Borehole logs

The borehole logs confirm visual inspection of the cut at the tunnel portal that the limestone beds are thin and sparse.

c.c. four copies of this letter were sent to D. MacDonald for distribution

Dec. 1973

The log of BH 7 shows a bed of limestone 8½ inches thick at elevation 531.

This is probably the roof of the existing tunnel shown in the cross-section at chainage 145+10.

Apart from this bed there are three beds of limestone above the tunnel which are 2" to 3" thickness.

The log of BH 100 shows some limestone in the walls of the tunnel and a bed 8" thick just below the crown. This bed will be removed in the tunnel excavation. There is a bed 2½" thick about 6" above the concrete lining. This will probably be removed. About 4 ft. above the concrete lining there is a bed of limestone 5" thick. There is no other limestone in the zone of stress release created by the tunnel.

This information means that we cannot look to beds of the much stronger limestone to provide support for the tunnel roof. The roof support must be designed to be safe in the shale.

Cross-sections

Chainage 145+10

This is near the portal. The floor of the tunnel is several feet below invert level of the tunnel.

The tunnel walls in shale have already assumed a slope of just over 70° to the horizontal above the centre line leaving a horizontal slab of limestone as the roof with a span of 9.5 ft. As this limestone is probably only 8½" thick and contains vertical joints, this cannot be considered safe.

We do not know whether the roof is already timbered at this cross-section, but if not this should be done immediately.

Chainage 144+10

The floor of the tunnel is here at the correct level and the excavation shows an overbreak of about 6" on radius. The span of the roof slab is 5 ft. We have no boring at this

section, but if the roof is in limestone we must assume the bed to be of the order of 2" to 3" thick.

The attitude of the walls above the centre line is just less than 60° to the horizontal.

Chainage 143+20

This section is similar to 144+10. The roof slab is 3.5 ft. in span and the wall angle above the centre line is just over 55° to the horizontal.

The changes in roof span and wall angle as one proceeds into the tunnel suggest that deterioration of the shale in the roof is already occurring, although the available measurements are too meagre to be sure of this. However the data point to the necessity for treating the roof as a softening shale and not a hard limestone.

Comments

The design of the roof support system is a matter for the contractor.

We give our ideas on what we consider would be safe for your guidance.

The comments made in our letter of November 28th about speed of installation of the support system should be considered part of this advice.

We think the roof bolt system should consist of five bolts at each cross-section, one vertical on the centre line one on each side at 45° to the vertical and one in between on each side at 22½° to the vertical, the line of the bolts passing approximately through the centre of the tunnel.

For the 45° bolts a length of 6 ft. is adequate. The 22½° bolts might be acceptable at a length of 6 ft. but 8 ft. would be better. The vertical bolt should be at least 8 ft. long and 10 ft. would be better.

The spacing along the tunnel should be 4 ft. to 6 ft.

It is assumed that guniting and steel mesh will be used in conjunction with the bolts.

We know of no theory on which bolt spacing can be calculated. The above suggestions are based on drawing on your cross-sections the possible way in which the shale above the tunnel will loosen and how the natural arch will form. In soft, horizontally bedded and vertically jointed shale the arch will go to about the radius of the tunnel above the excavated section or even higher. This accounts for the suggested length of the vertical bolt.

On-site inspection, with good lighting, should be carried out as excavation proceeds. This may make it possible to relax the above recommendations somewhat.

We believe that this letter and our previous one give you the information which you need and that it will not be necessary to prepare a more formal report. However we shall be happy to do so should you wish.

Yours truly,

H. Q. GOLDER & ASSOCIATES LTD.

H. Q. Golder, P.Eng.

HQG:jb
73907

Foundations Office,
Design Services Branch,
1201 Wilson Avenue,
Downsview, Ontario.
M3M 1J8

December 17th, 1973.

Golder Associates,
Consulting Geotechnical Engineers,
3151 Wharton Way,
Mississauga, Ontario.

Attention: Dr. H. Q. Golder, P. Eng.

Dear Dr. Golder:

Re: Storm Sewer Tunnel
Heart Lake Road to Little Etobicoke Creek
Highway 401, District #6 (Toronto)
Contract 73-124, W.O. 73-11008

This is to acknowledge the receipt of your letter of November 28th, 1973, outlining the preliminary recommendations and subsequent letter of December 12th, 1973, with the final comments regarding the above mentioned project.

We would like to express our appreciation for your prompt and valuable comments with regard to the construction of the sewer tunnel.

Yours truly,

AGS.

A. G. Stermac,
PRINCIPAL FOUNDATIONS ENGINEER.

MD/ji
c.c. Foundations File
Documents

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 30M12-085

DIST. 6 REGION Central

W.P. No. 127-66-34

CONT. No. 73-124

W. O. No. 73-11-008

STR. SITE No.:

HWY. No. 401/403

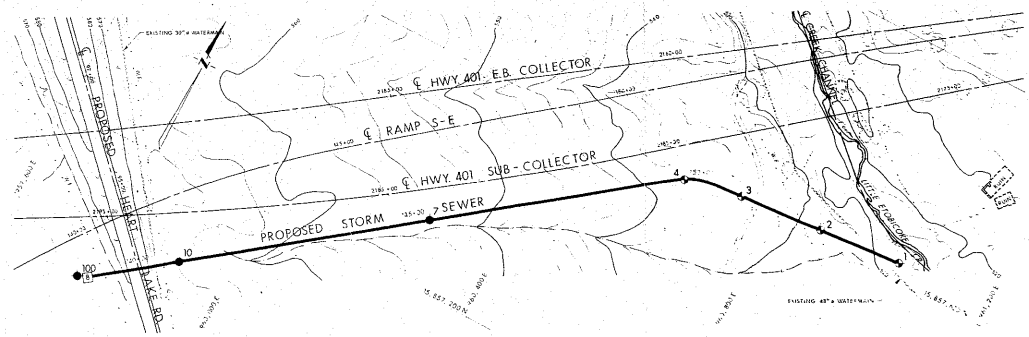
LOCATION Prop. S. Trunk Sewer from Heart Lake Rd. to Little Etobicoke Creek.

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT 4

REMARKS: DOCUMENTS TO BE UNFOLDED BEFORE MICROFILM

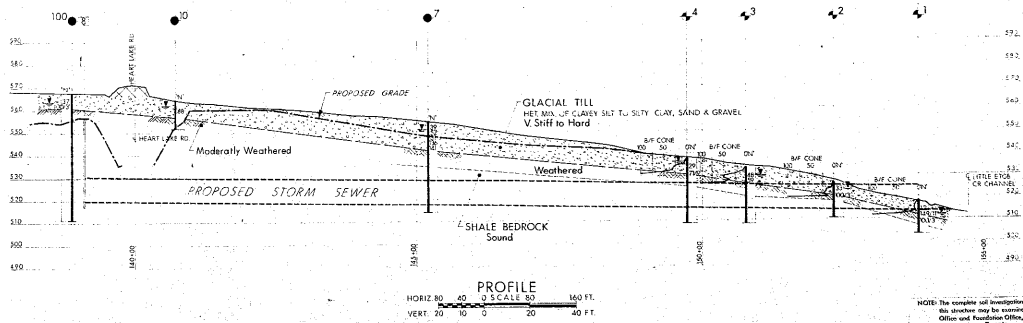
GI-20 2571-1976

27



PLAN

HORIZ. 80 40 0 SCALE 80 160 FT.



PROFILE

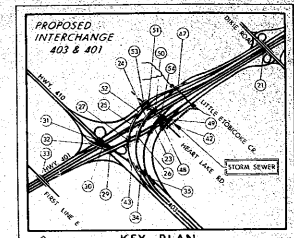
HORIZ. 80 40 0 SCALE 80 160 FT.

VERT. 20 10 0 20 40 FT.

NOTE: The complete soil investigation report for this structure may be examined at the Bridge Office and Foundation Office, Downsview, and at the Toronto District Office.

REF. No: Plan 3983-17-100

30M 12-85



KEY PLAN

LEGEND

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- Water Levels established at time of field investigation April 1973 & June 1973.
- Access Shaft

NO	ELEVATION	CO-ORDINATES NORTH	CO-ORDINATES EAST
1	518.2	15,857,632	961,323
2	526.5	15,857,670	960,876
3	533.8	15,857,609	960,726
4	537.5	15,857,590	960,624
7	551.1	15,857,329	960,264
10	564.0	15,857,050	959,906
100	567.6	15,856,946	959,758

— 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

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO
DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

PROPOSED STORM SEWER

HEART LAKE ROAD TO LITTLE ETOBICOKE CREEK

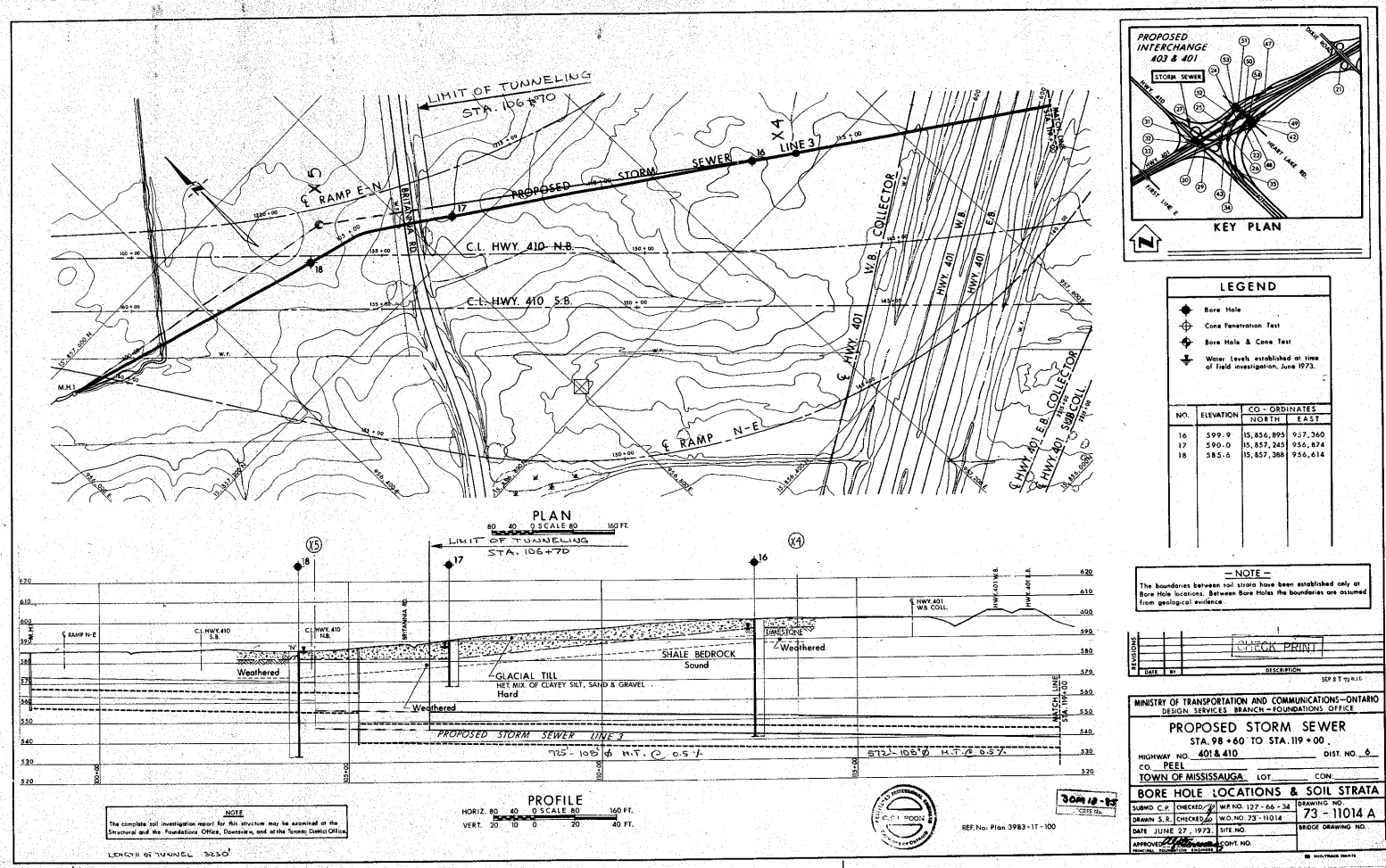
HIGHWAY NO. 401 & 410 DIST. NO. 6

CO. PEEL

TOWN OF MISSISSAUGA LOT CON.

BORE HOLE LOCATIONS & SOIL STRATA

SUBMD C.P.	CHECKED	W.P. NO. 127-66-34	DRAWING NO. 73-11008A
DRAWN S.R.	CHECKED	W.O. NO. 73-11008	
DATE JUNE 15, 1973		SITE NO.	BRIDGE DRAWING NO.
APPROVED PRINCIPAL FOUNDATION ENGINEER		CONT. NO.	



LEGEND

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- Water Levels established at time of field investigation, June 1973.

NO.	ELEVATION	CO-ORDINATES NORTH	CO-ORDINATES EAST
16	599.9	15,856,895	937,360
17	590.0	15,857,245	956,874
18	585.6	15,857,388	956,614

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

CHECK PRINT
SEP 8 T 73 M.J.G.

REVISIONS		
DATE	BY	DESCRIPTION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO
DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

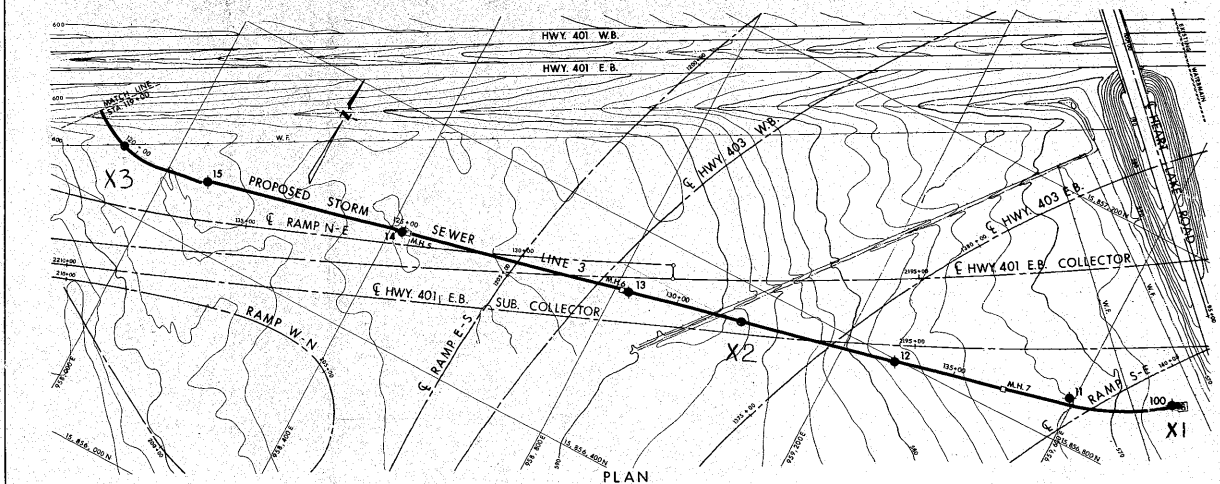
PROPOSED STORM SEWER
STA. 98 +60 TO STA. 119 +00.

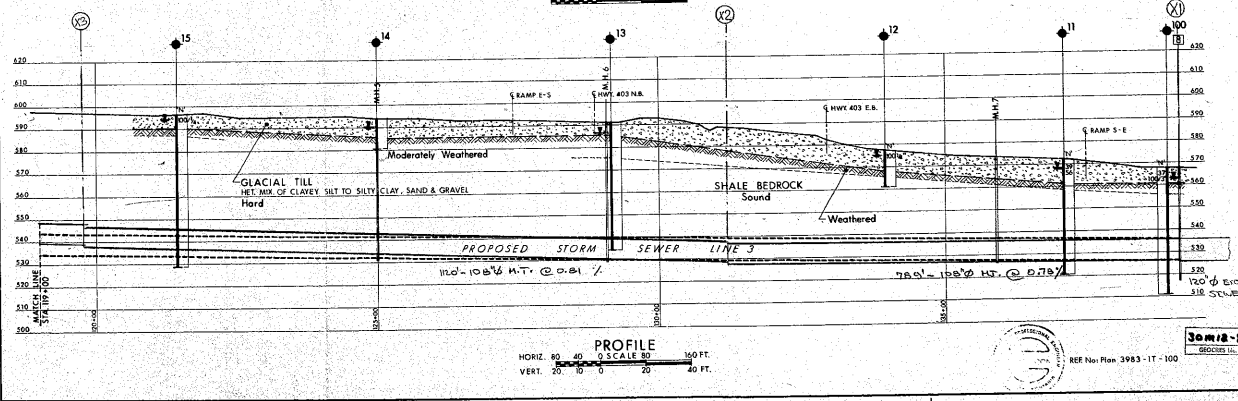
HIGHWAY NO. 401 & 410 DIST. NO. 6
CO. PEEL
TOWN OF MISSISSAUGA LOT CON.

BORE HOLE LOCATIONS & SOIL STRATA

SUBMD C.P.	CHECKED	W.P. NO. 127-66-34	DRAWING NO. 73-11014 A
DRAWN S.R.	CHECKED	W.O. NO. 73-11014	
DATE JUNE 27, 1973.		SITE NO.	BRIDGE DRAWING NO.
APPROVED		CONT. NO.	

PRINCIPAL FOUNDATION ENGINEER





SEE DWG. No. 73 - 11014 A

KEY PLAN
SCALE IN MILES

LEGEND

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- Water Levels established at time of Field Investigation. May & June 73.
- [8] Access Shaft

NO.	ELEVATION	CO-ORDINATES NORTH	EAST
11	572.2	15,856,878	959,592
12	577.5	15,856,794	959,293
13	590.8	15,856,690	958,823
14	593.8	15,856,597	958,420
15	596.4	15,856,515	958,074
100	567.6	15,856,946	959,758

— 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	
		CHECK PRINT	
		SEP 5 7 '73 W.H.	

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO
DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

PROPOSED STORM SEWER
STA. 119+00 TO HEART LAKE ROAD

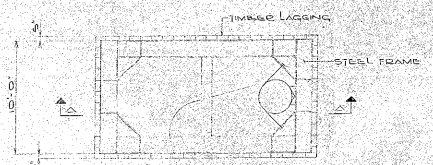
HIGHWAY NO. 401 & 410 DIST. NO. 6
CO. PEEL
TOWN OF MISSISSAUGA LOT ____ CON. ____

BORE HOLE LOCATIONS & SOIL STRATA

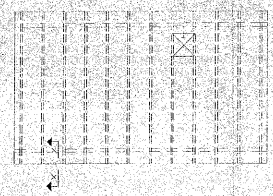
SUBMD. C. P.	CHECKED	W.P. NO. 127-66-34	DRAWING NO. 73-11014 B
DRAWN S. R.	CHECKED	W.O. NO. 73-11014	
DATE JUNE 22, 1973.		SITE NO.	BRIDGE DRAWING NO.
APPROVED		CONT. NO.	

REF No: Plan 3983-IT-100

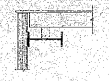
GEOCRES No. 30M12-85



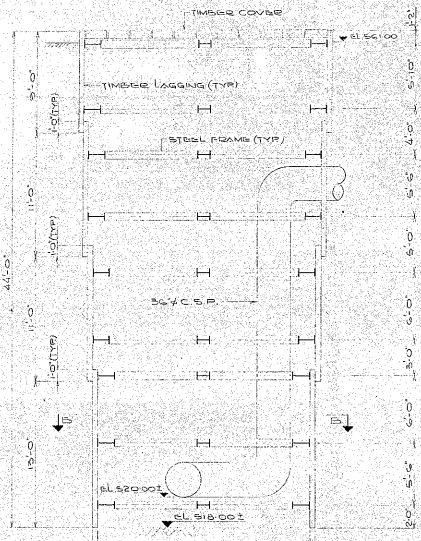
SECTION B-B
SCALE: ¼"=1'-0"



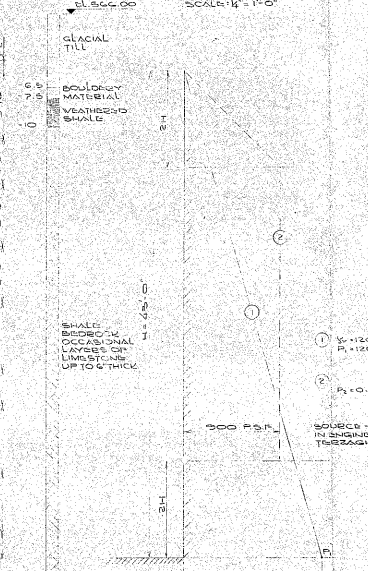
TIMBER COVER
SCALE: ¼"=1'-0"



SECTION X-X
SCALE: ½"=1'-0"



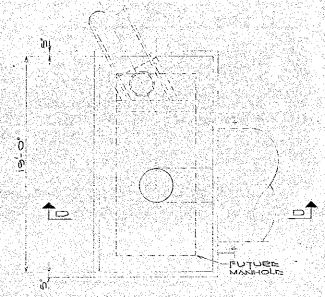
SECTION A-A
SCALE: ¼"=1'-0"



EARTH PRESSURE DIAGRAM

LAGGING & FRAMES TO BE DESIGNED USING (1) OR (2) WHICHEVER GIVES HIGHER HORIZONTAL FORCES.

BOREHOLE LOG

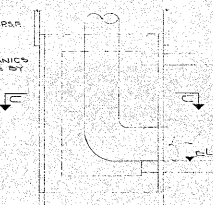


SECTION C-C
SCALE: ¼"=1'-0"

① K_a=120 P.C.F. K_a=0.5
P_a=120×C.22×45×11=1250 P.S.F.

② P_a=0.8×1250×0.9=900 P.S.F.

SOURCE - p.347 SOIL MECHANICS IN ENGINEERING PRACTICE BY TERZAGHI & PECK.



SECTION D-D
SCALE: ¼"=1'-0"

NOTES:

- TIMBER COVER MUST BE CAPABLE OF SUPPORTING A LIVE LOAD OF 100 P.S.F.
- TIMBER LAGGING & STEEL FRAMES MUST BE DESIGNED TO WITHSTAND THE HORIZONTAL PRESSURES INDICATED AT WORKING STRESSES.
- CONTRACTOR TO INSTALL ACCESS LADDERS IN SHAFT WITH SAFETY LANDINGS.
- TIMBER COVER TO BE SECURELY FASTENED TO SHAFT.
- ACCESS SHAFT TO BE LEFT IN PLACE AT THE CONCLUSION OF THE CONTRACT.

REVISIONS			
	DATE	BY	DESCRIPTION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS
ONTARIO

FOUNDATION OF CANADA ENGINEERING CORPORATION LIMITED

HIGHWAY 401 AND 410
TRUNK STORM SEWER OUTLET

KING'S HIGHWAY No. 401 DIST. No. 6
CO. OF PEEL
TWP OF MISSISSAUGA LOT 4 CON. III

SEWER ACCESS SHAFT

APPROVED	STRUCTURAL ENGINEER		CONTRACT No.	
DESIGN	B.T.D.	CHECK	W.P. No.	127-66-34
DRAWING	V.A.T.	CHECK	SITE No.	SHEET
DATE		LOADING		

FENCO W.P. 3985-IK-103

30M 18-55
SOURCES No.

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