DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. 40P7-51

DIST. 3 REGION

W.P. No. 163-88-02

CONT. No. 94-12

W. O. No.

STR. SITE No. 33-36/W

HWY. No. 7 & 8

LOCATION Hwy 7 & 8 / Reg. Rd. 51
Overpass W.B.L

No. OF PAGES - —

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

Ministry of Transportation
Ontario

FILE No. _____ **DATE** _____

REMARKS Construction

Layton

(1) Senior Supervisor Steven [illegible]

Supervisor Teena Tapio

519-634-5025

FAX) 519-634-5026

(2) John

(3) Jonathan Warner.

ADM-G-24 79-06

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DIST. 3
CONT No
WP No 163-88-01

REG. RD 51 O'PASS E.B.L.

GENERAL ARRANGEMENT

SHEET

Fenco — FENCO ENGINEERS INC.

LIST OF DRAWINGS

GENERAL NOTES

CLASS OF CONCRETE ..... 30 MPa
(UNLESS OTHERWISE NOTED)

CLEAR COVER TO REINFORCING STEEL

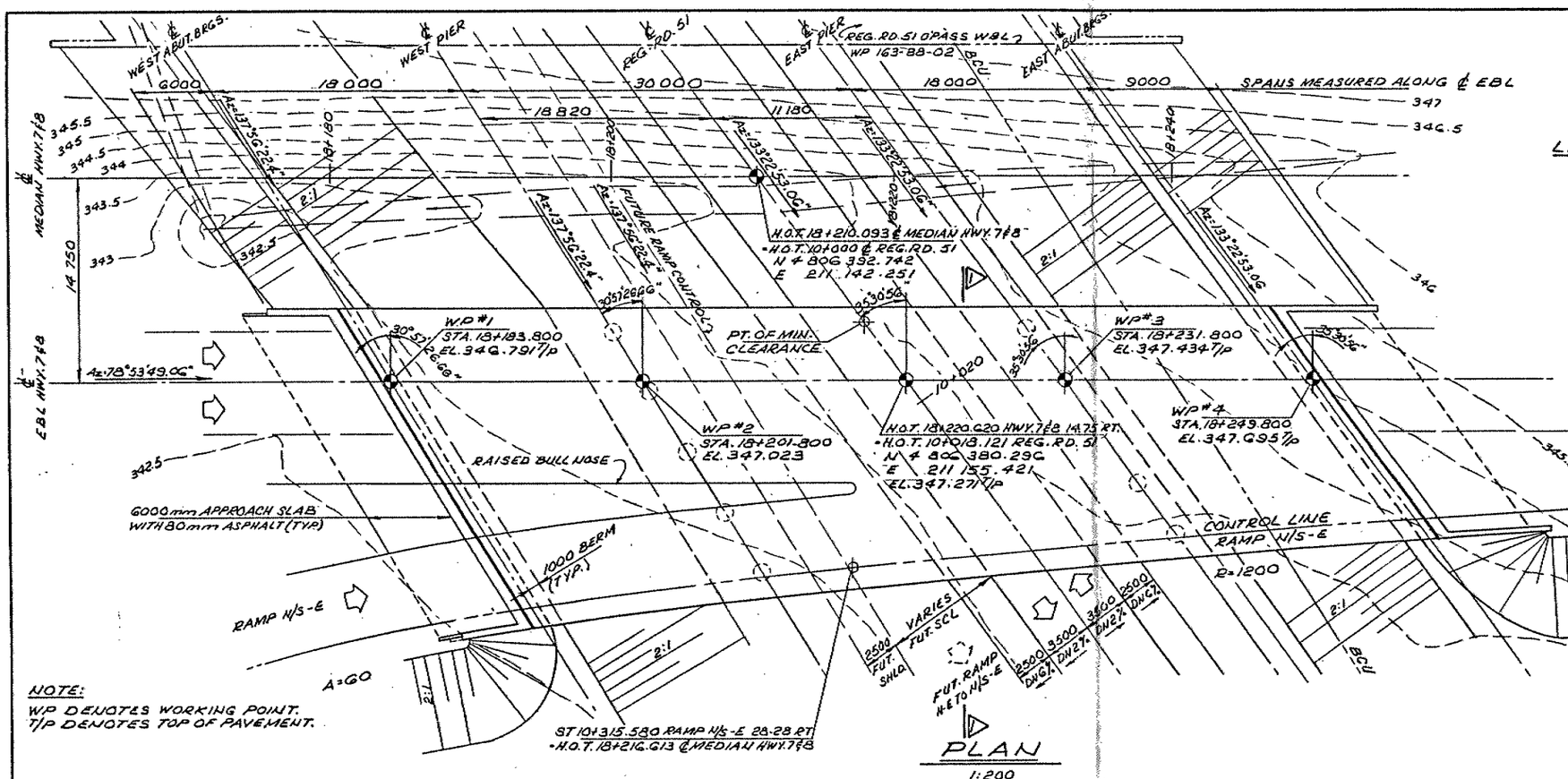
FOOTINGS		100±25
ABUTMENTS & WINGWALLS	FRONT FACE	80±20
	BACK FACE	70±20
PIERS		80±20
DECK	TOP	70±20
	BOTTOM	40±10
REMAINDER		70±20

(UNLESS OTHERWISE NOTED)

REINFORCING STEEL SHALL BE GRADE 400 UNLESS OTHERWISE SPECIFIED. BAR MARKS WITH THE SUFFIX 'C' DENOTE COATED BARS.

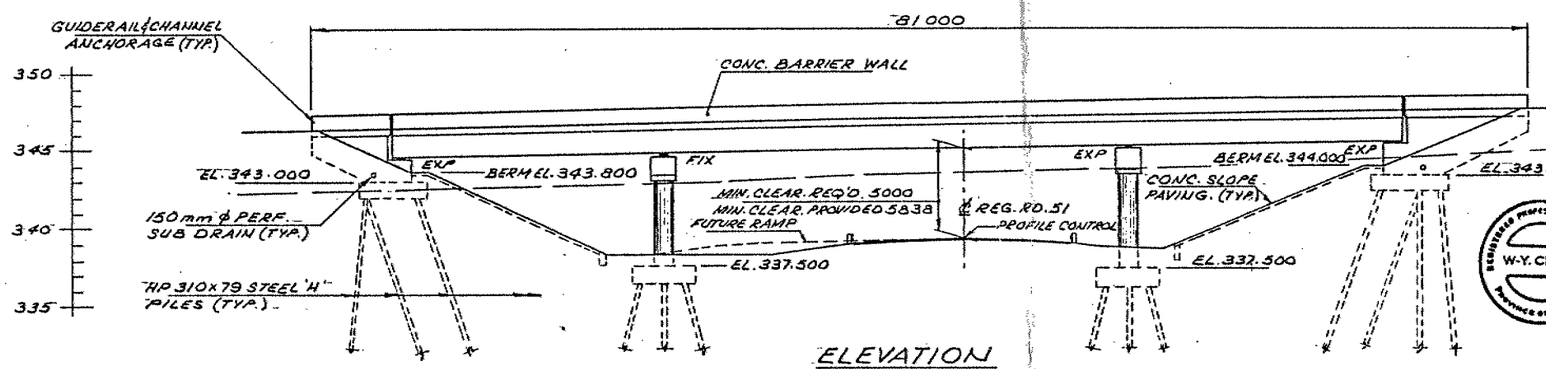
CONSTRUCTION NOTES

IF THE ACTUAL BEARING HEIGHTS ARE DIFFERENT THAN THE ASSUMED BEARING HEIGHTS GIVEN WITH THE BEARING DESIGN DATA, THE CONTRACTOR SHALL ADJUST THE BEARING SEAT ELEVATIONS AND THE REINFORCING STEEL TO SUIT THE ACTUAL HEIGHTS.

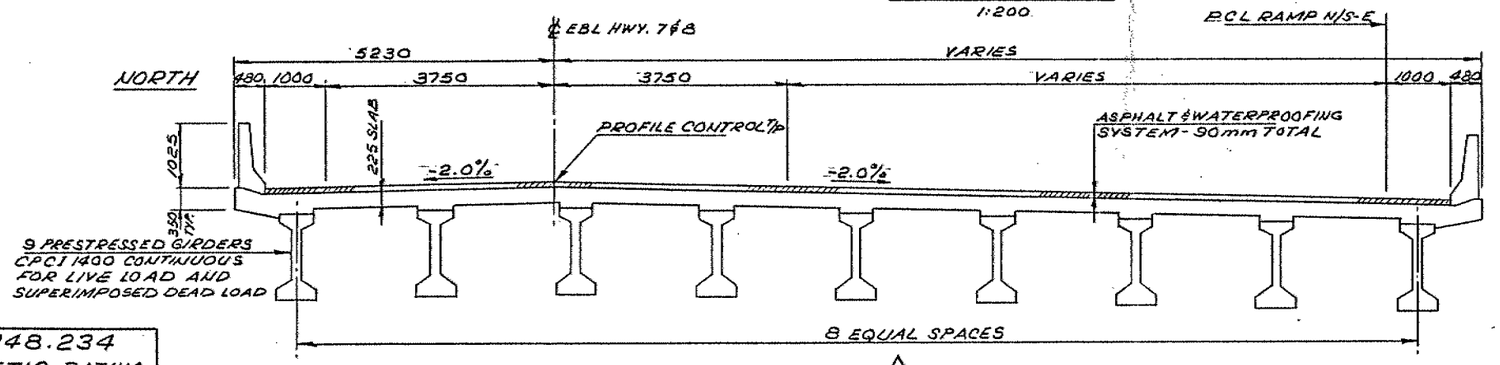


PLAN
1:200

NOTE:
W.P. DENOTES WORKING POINT.
T/P DENOTES TOP OF PAVEMENT.



ELEVATION
1:200



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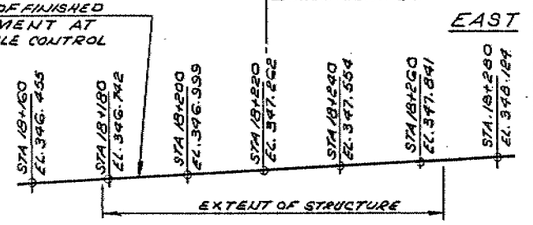
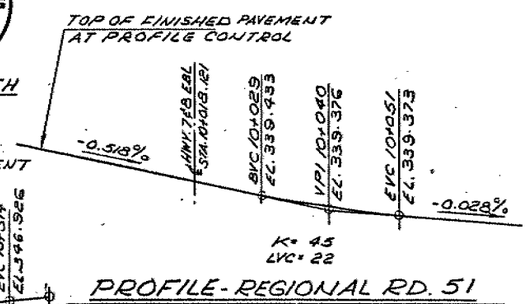
BM 348.234
GEODETIC DATUM
TOP OF PIB 40.1LT.
18+278.7 (℄ MEDIAN)



PROFILE - HWY. 7 & 8 EBL
NTS



PROFILE - REGIONAL RD. 51
NTS

PROFILE - RAMP N/S-E
NTS

APPLICABLE STANDARDS

OPSD-3502 MIN. GRANULAR BACKFILL REQUIREMENTS

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION

DESIGN WYC	CHK KSM	CODE OHBDC-83	LOAD CLASS A	DATE AUG. 1991			
DRAWN FJW	CHK WYC	SITE 33-316	STRUCT	SCHEME	DWG. 1		

REGISTERED PROFESSIONAL ENGINEER W-Y. CHOW PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER S. K. SARKAR PROVINCE OF ONTARIO

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

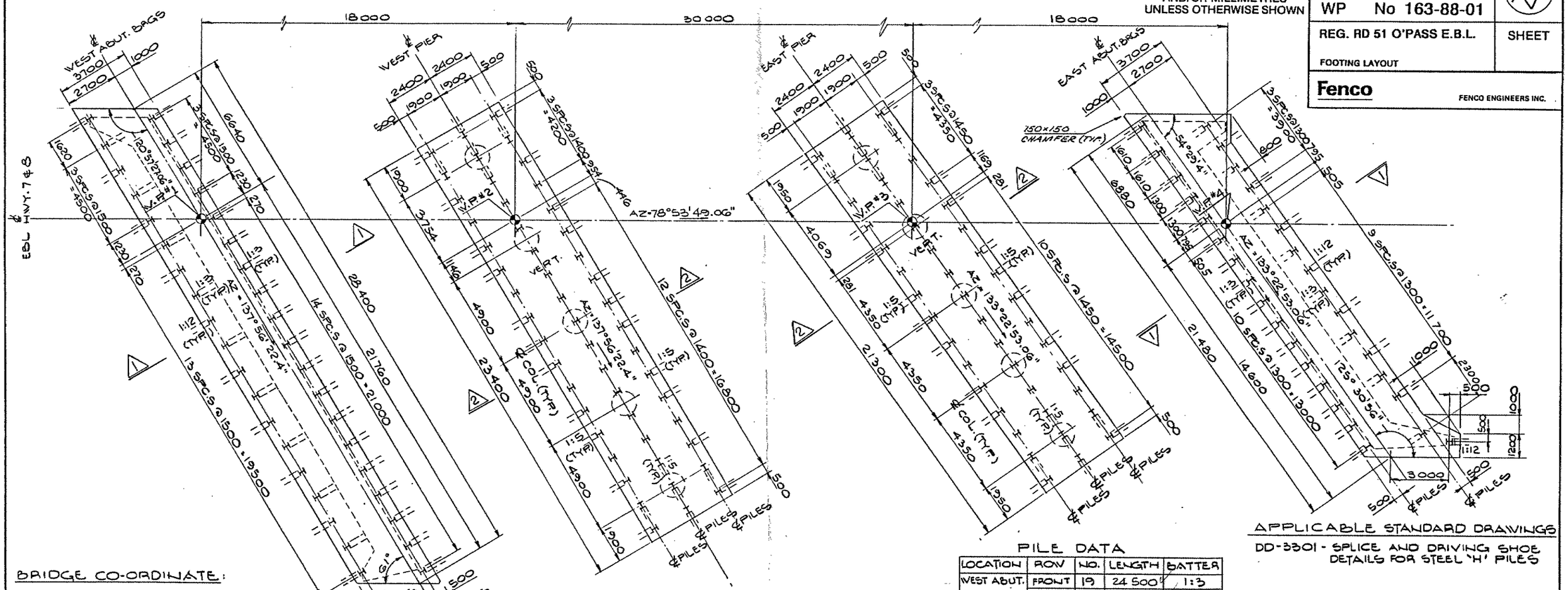
CONT No
WP No 163-88-01

REG. RD 51 O'PASS E.B.L.

SHEET

FOOTING LAYOUT

Fenco — FENCO ENGINEERS INC.



FOOTING PLAN AND PILE LAYOUT

1:100

BRIDGE CO-ORDINATE:

POINT	N	E
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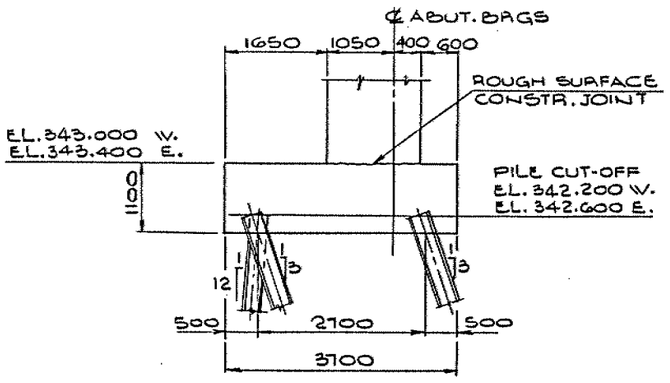
W.P.#2	4806376.671	211136.954
W.P.#3	4806382.448	211166.392
W.P.#4	4806385.915	211184.055



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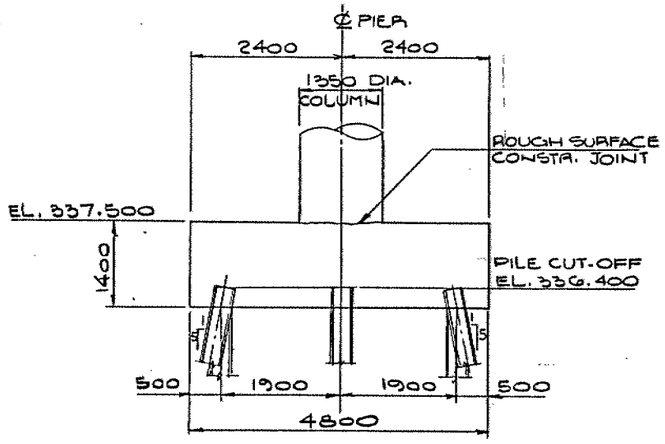


1:50

PILE DATA

LOCATION	ROW	NO.	LENGTH	BATTER
WEST ABUT.	FRONT	19	24500	1:3
	BACK	9	24500	1:3
	BACK	10	23300	1:12
WEST PIER	W. SIDE	13	17800	1:5
	W. SIDE	4	17400	VERT.
	CENTRE	6	17800	1:5
	CENTRE	11	17400	VERT.
	E. SIDE	13	17800	1:5
	E. SIDE	4	17400	VERT.
EAST PIER	W. SIDE	11	17800	1:5
	W. SIDE	4	17400	VERT.
	CENTRE	6	17800	1:5
	CENTRE	9	17400	VERT.
	E. SIDE	11	17800	1:5
	E. SIDE	4	17400	VERT.
EAST ABUT.	FRONT	16	24900	1:3
	BACK	8	24900	1:3
	BACK	8	23700	1:12

APPLICABLE STANDARD DRAWINGS

DD-3301 - SPLICE AND DRIVING SHOE DETAILS FOR STEEL 'H' PILES

NOTES:

- PILES ARE HP 310 x 79
- PILES SPACING TO BE MEASURED AT THE UNDERSIDE OF FOOTINGS
- PILE LENGTH SHOWN ON THE DRAWING IS THE THEORETICAL LENGTH BELOW CUT-OFF
- PILES TO BE DRIVEN IN ACCORDANCE WITH STD 55103-11 USING AN ULTIMATE CAPACITY OF 1500 kN PER PILE BUT MUST BE DRIVEN BELOW EL. 319.00.
- PILES TO BE DRIVEN WITH A DRIVING HAMMER HAVING A RATED ENERGY OF 53000 JOULES/BLOW.

PILE DESIGN DATA

- DESIGN LOAD AT SLS II 500 kN/PILE FACTORED CAPACITY AT ULS 700kN/PILE

LICENSED PROFESSIONAL ENGINEER — M. S. K. DEOGON — PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER — S. K. SARKAR — PROVINCE OF ONTARIO

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION

DESIGN WD/SS	CHK SS/MD	CODE CHBDC-83	LOAD CLASS 7A	DATE AUG. 1991			
DRAWN MK	CHK MSKD	SITE 33-36/E	STRUCT	SCHEME	DWG. 3		

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

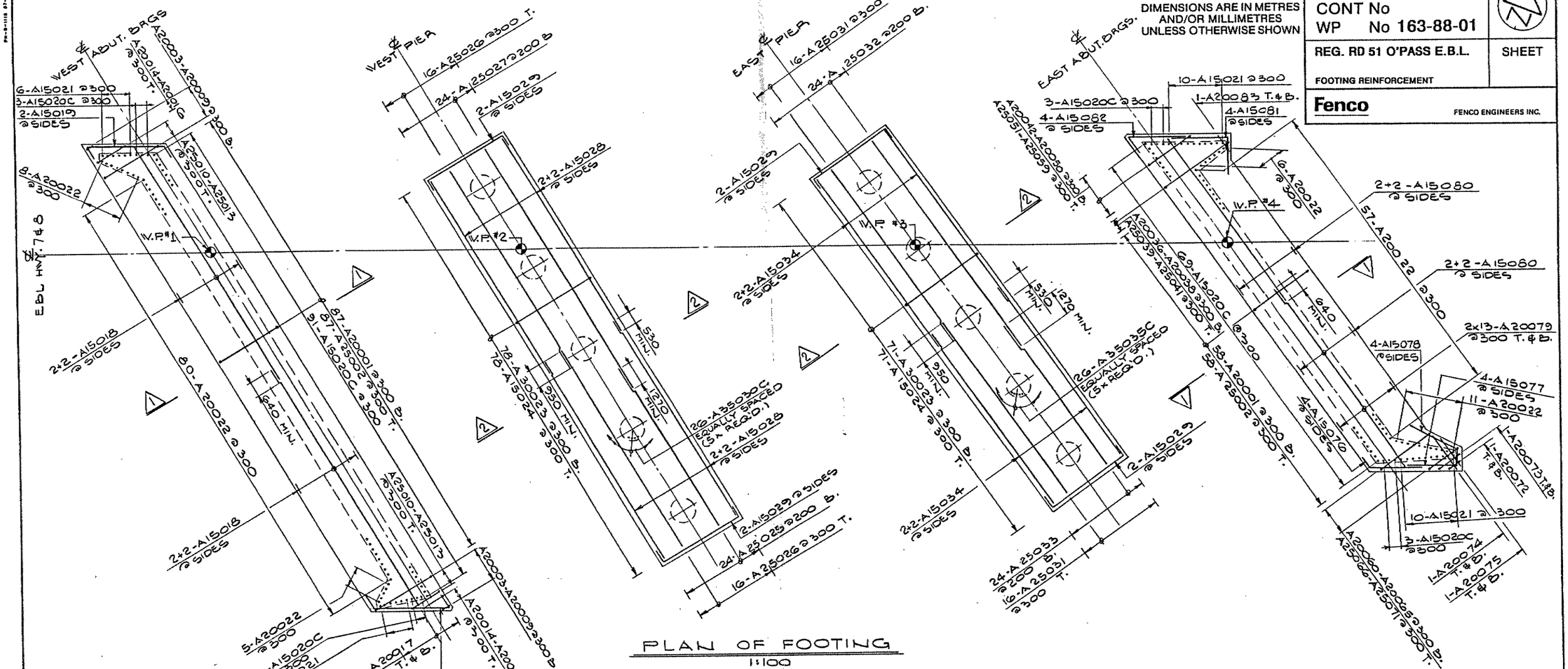
CONT No
WP No 163-88-01

REG. RD 51 O'PASS E.B.L.

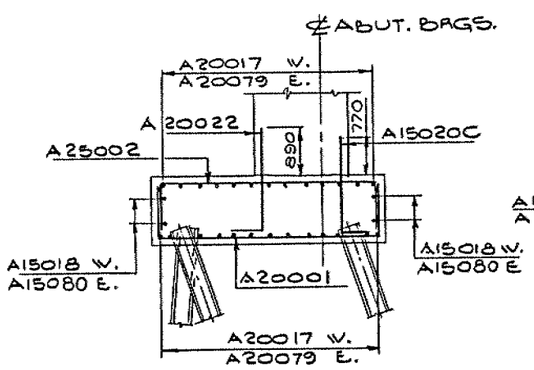
SHEET

FOOTING REINFORCEMENT

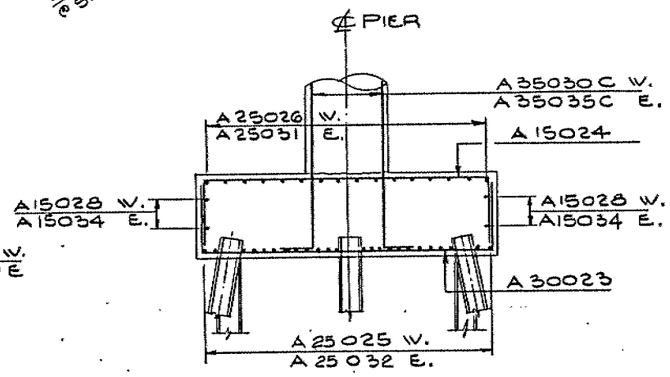
Fenco — FENCO ENGINEERS INC.



PLAN OF FOOTING
1:100



1 1:50



2 1:50

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

LICENSED PROFESSIONAL ENGINEER — N. S. K. DEOGON — PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER — S. K. SARKAR — PROVINCE OF ONTARIO

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN N.D/S.S	CHK S.S/N.D	CODE OHBDC '83	LOAD CLASS 'A'	DATE AUG. 1991		
DRAWN M.K	CHK N.S.K.D	SITE 33-361 E	STRUCT	SCHEME	DWG. 4	

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DIST. 3
CONT No
WP No 163-88-02

REG. RD 51 O'PASS W.B.L.

GENERAL ARRANGEMENT

SHEET

Fenco — FENCO ENGINEERS INC.

LIST OF DRAWINGS

GENERAL NOTES:

CLASS OF CONCRETE ..... 30 MPa (UNLESS OTHERWISE NOTED)

CLEAR COVER TO REINFORCING STEEL

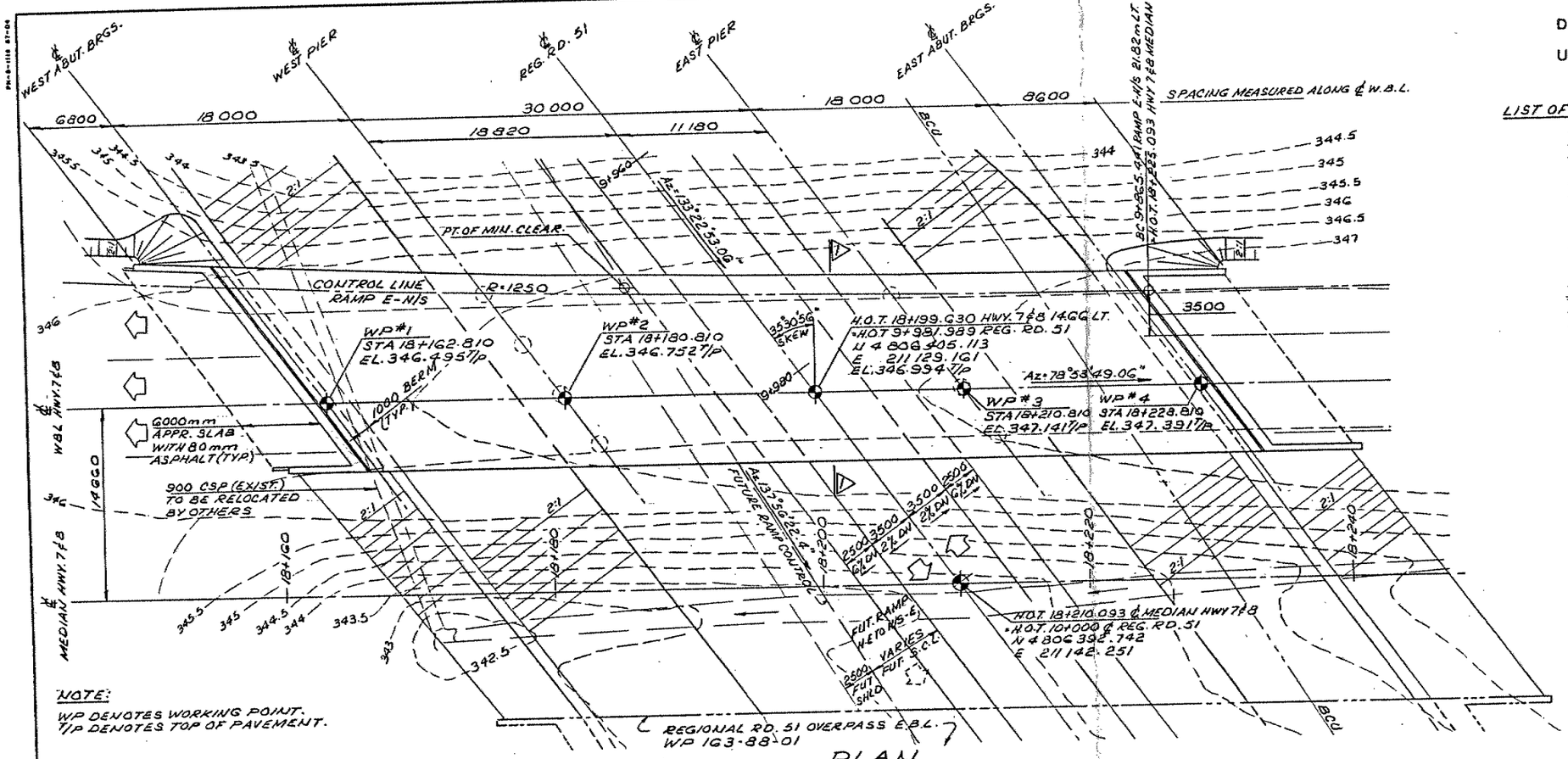
FOOTINGS		100 ± 25
ABUTMENTS & WINGWALLS	FRONT FACE	80 ± 20
	BACK FACE	70 ± 20
PIERS		80 ± 20
DECK	TOP	70 ± 20
	BOTTOM	40 ± 10
REMAINDER		70 ± 20

(UNLESS OTHERWISE NOTED)

REINFORCING STEEL SHALL BE GRADE 400 UNLESS OTHERWISE SPECIFIED. BAR MARKS WITH THE SUFFIX 'C' DENOTE COATED BARS.

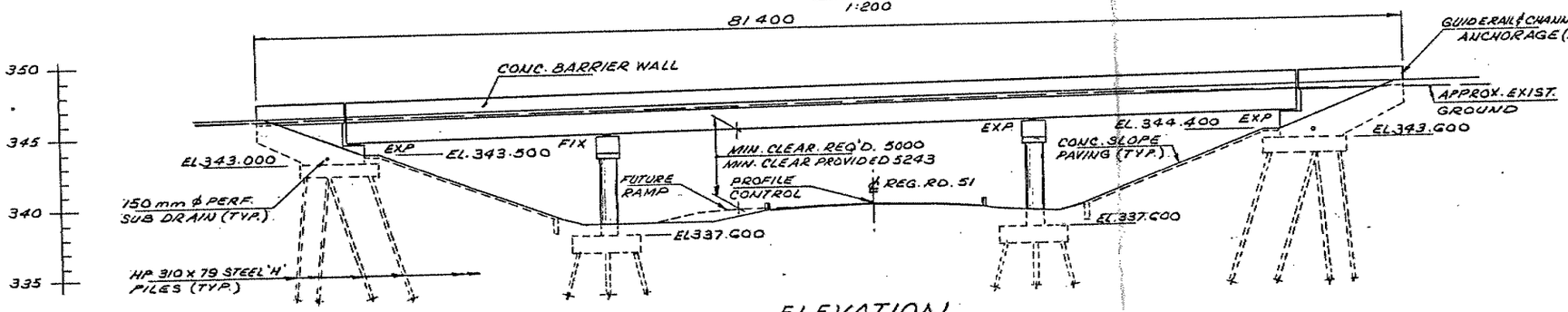
CONSTRUCTION NOTES

IF THE ACTUAL BEARING HEIGHTS ARE DIFFERENT THAN THE ASSUMED BEARING HEIGHTS GIVEN WITH THE BEARING DESIGN DATA, THE CONTRACTOR SHALL ADJUST THE BEARING SEAT ELEVATIONS AND THE REINFORCING STEEL TO SUIT THE ACTUAL HEIGHTS.

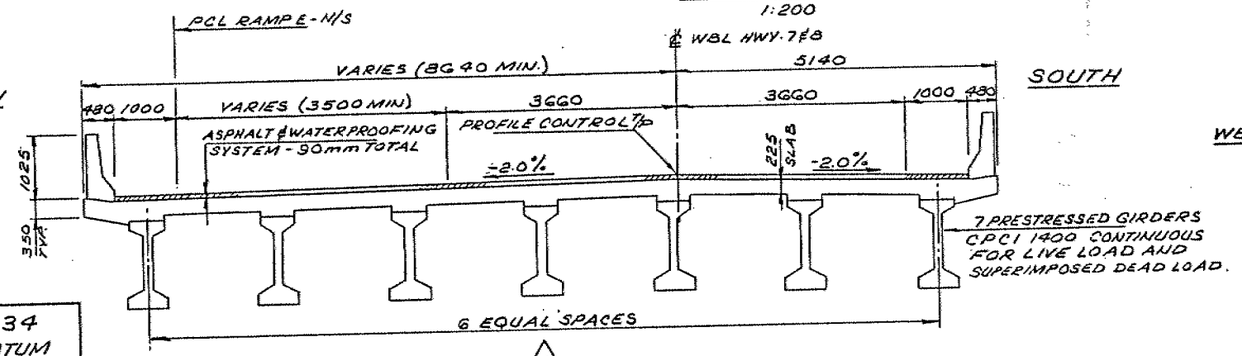


NOTE:
WP DENOTES WORKING POINT.
T/P DENOTES TOP OF PAVEMENT.

PLAN
1:200



ELEVATION
1:200



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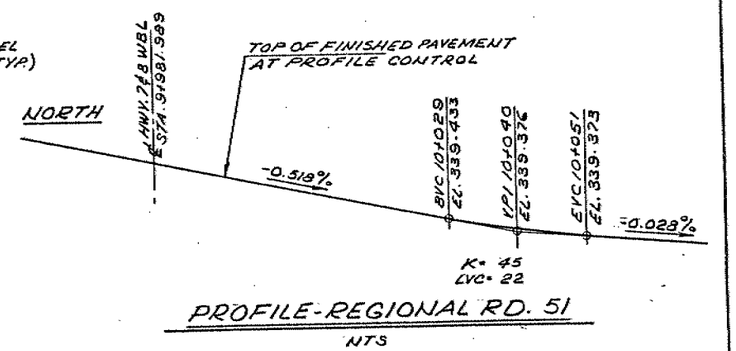
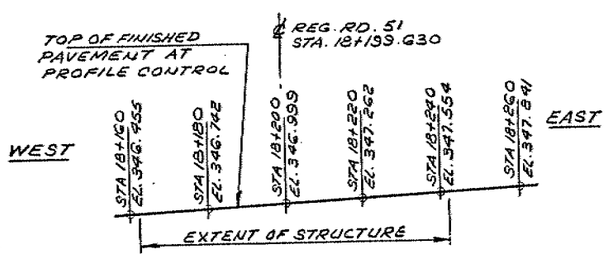


PROFILE - REGIONAL RD. 51
NTS



PROFILE - HWY. 7 & 8 WBL
NTS

REGISTERED PROFESSIONAL ENGINEER W-Y. CHOW PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER S. K. SARKAR PROVINCE OF ONTARIO

APPLICABLE STANDARDS

OD-3502 MIN. GRANULAR BACKFILL REQUIREMENTS

BM. 348.234
GEODETIC DATUM
TOP OF R/B 40.1 LT.
18+278.7 (℄ MEDIAN)

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION

DESIGN WYC	CHK SS	CODE OHBDC-83	LOAD CLASS A	DATE AUG/1991			
DRAWN FJJ	CHK WYC	SITE 33-36/M	STRUCT	SCHEME	DWG. 1		

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No

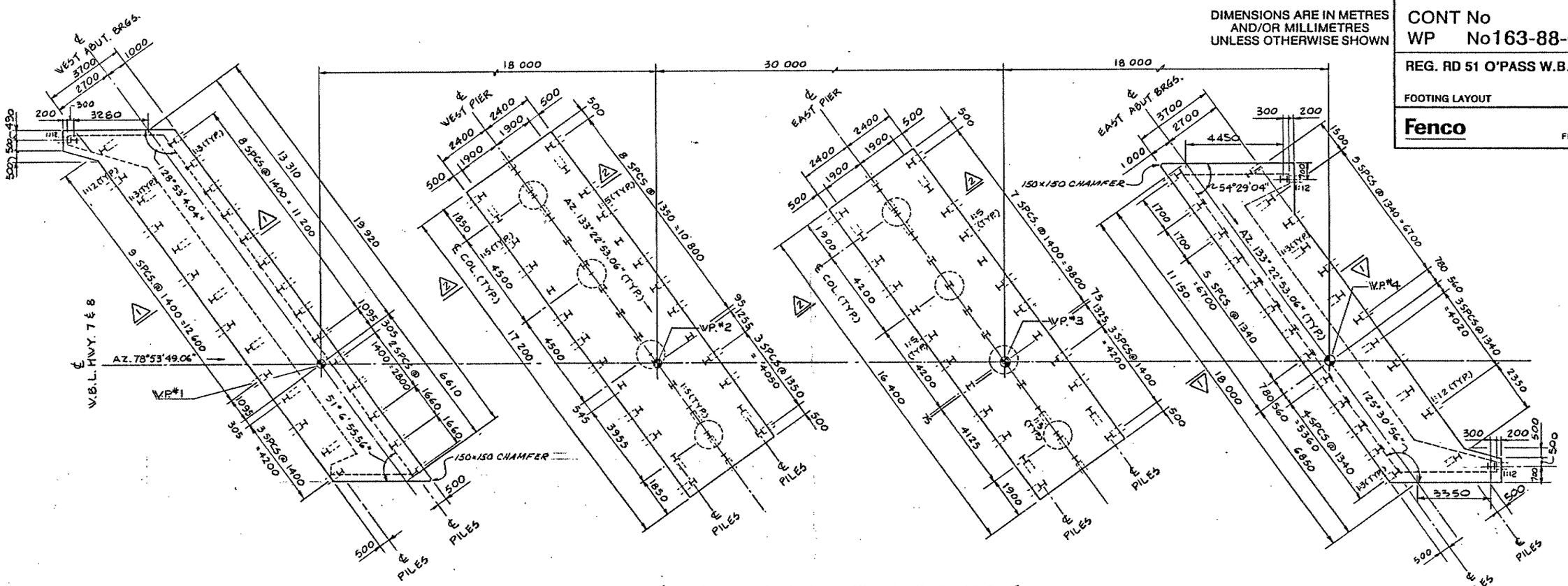
WP No 163-88-02

REG. RD 51 O'PASS W.B.L.

SHEET

FOOTING LAYOUT

Fenco FENCO ENGINEERS INC.

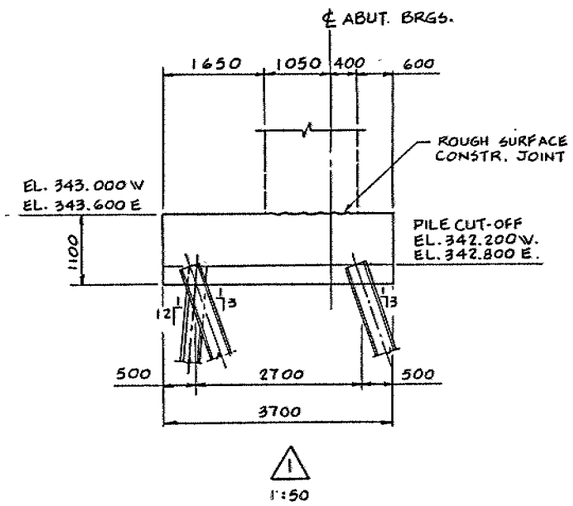


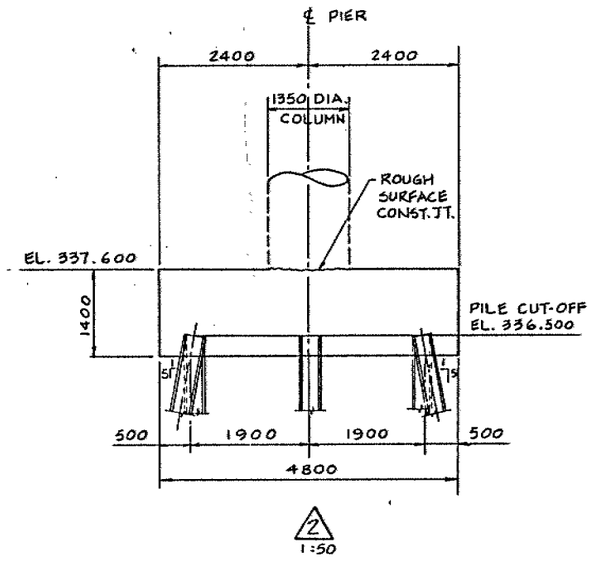
FOOTING PLAN AND PILE LAYOUT

1:100

BRIDGE CO-ORDINATE :

POINT	N	E
W.P.#1	4806398.022	211093.030
W.P.#2	4806401.489	211110.693
W.P.#3	4806407.266	211140.132
W.P.#4	4806410.732	211157.795





LOCATION	ROW	NO.	LENGTH	BATTER
WEST ABUT.	FRONT	14	24 500	1:3
	BACK	7	24 500	1:3
	BACK	8	23 300	1:12
WEST PIER	W. SIDE	11	17 900	1:5
	W. SIDE	2	17 500	VERT.
	CENTRE	6	17 900	1:5
	CENTRE	7	17 500	VERT.
	E. SIDE	11	17 900	1:5
	E. SIDE	2	17 500	VERT.
EAST PIER	W. SIDE	10	17 900	1:5
	W. SIDE	2	17 500	VERT.
	CENTRE	6	17 900	1:5
	CENTRE	6	17 500	VERT.
	E. SIDE	10	17 900	1:5
	E. SIDE	2	17 500	VERT
EAST ABUT.	FRONT	13	25 100	1:3
	BACK	6	25 100	1:3
	BACK	8	23900	1:12

NOTES :

- PILES ARE HP 310×79
- PILES SPACING TO BE MEASURED AT THE UNDERSIDE OF FOOTINGS.
- PILE LENGTH SHOWN ON THE DRAWING IS THE THEORETICAL LENGTH BELOW CUT-OFF.
- PILES TO BE DRIVEN IN ACCORDANCE WITH STD SS103-11 USING AN ULTIMATE CAPACITY OF 1500 KN PER PILE BUT MUST BE DRIVEN BELOW EL. 319.000
- PILES TO BE DRIVEN WITH A DRIVING HAMMER HAVING A RATED ENERGY OF 53000 JOULES/BLOW.

PILE DESIGN DATA

- DESIGN LOAD AT SLS II = 500 KN/PILE FACTORED CAPACITY AT ULS = 700 KN/PILE

APPLICABLE STANDARD DRAWINGS

DD 3301 - SPLICE AND DRIVING SHOE DETAILS FOR STEEL 'H' PILES.

REGISTERED PROFESSIONAL ENGINEER W-Y. CHOW PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER S. K. SARKAR PROVINCE OF ONTARIO

DRAWING NOT TO BE SCALED

100 mm ON ORIGINAL DRAWING

REVISIONS			
NO.	DATE	BY	DESCRIPTION

DESIGN W.Y.C.	CHK'D W.Y.C.	CODE OHBDC-83	LOAD CLASS 'A'	DATE AUG. 1991	
DRAWN S. L.	CHK'D S.K.S.	SITE 33-36/W	STRUCT	SCHEME	DWG. 3

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

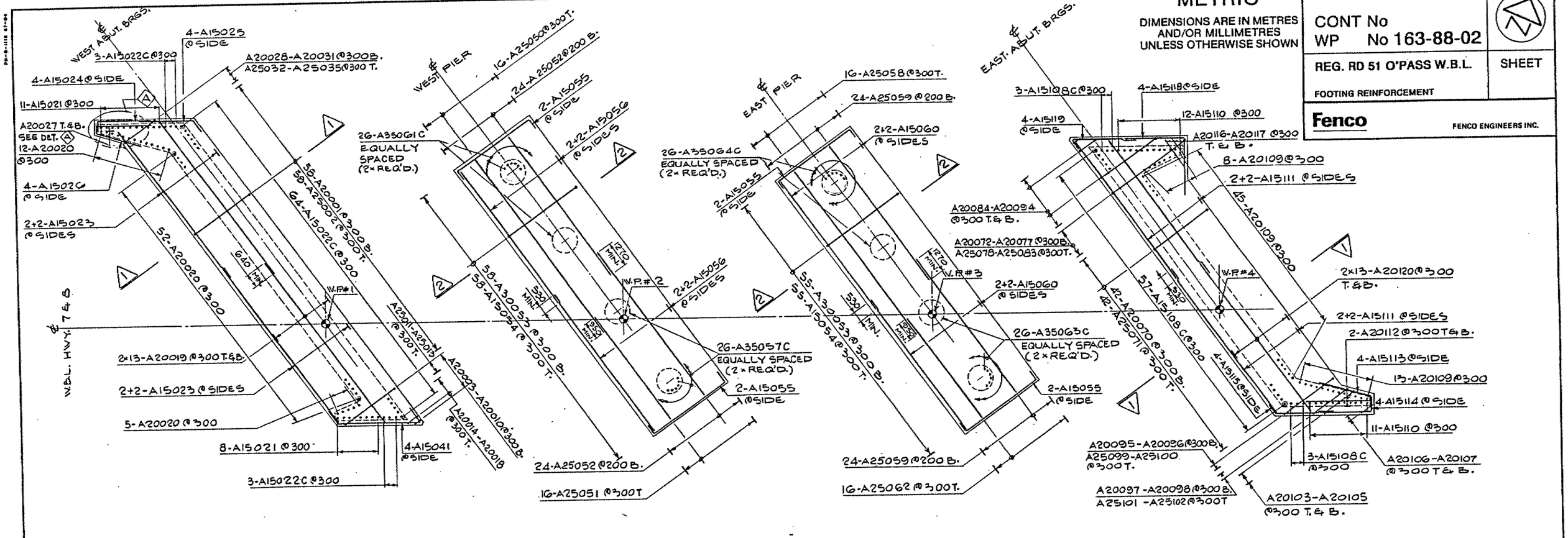
CONT No
WP No 163-88-02

REG. RD 51 O'PASS W.B.L.

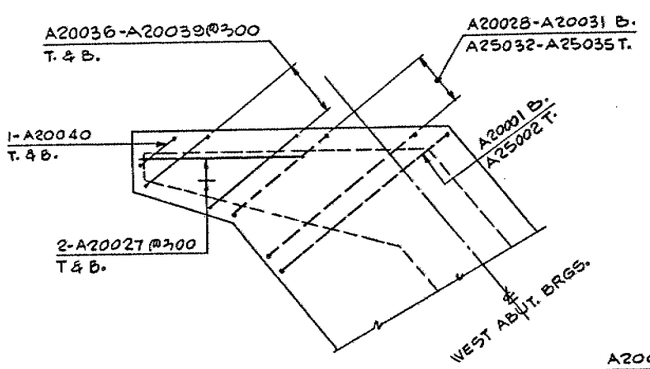
FOOTING REINFORCEMENT

SHEET

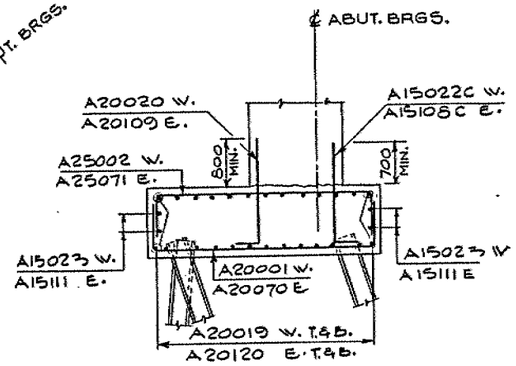
Fenco FENCO ENGINEERS INC.



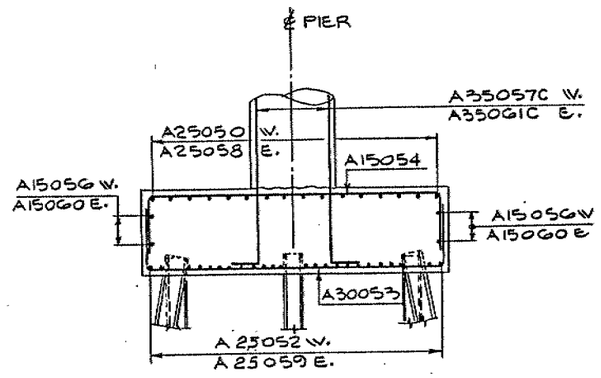
PLAN OF FOOTING
1:100



A
1:50



1
1:50



2
1:50

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION

DESIGN	CHK	CODE OH8DC-83	LOAD CLASS 'A'	DATE AUG 1991			
DRAWN M.M.	CHK	SITE 33-361E	STRUCT	SCHEME	DWG. 4		

LICENSED PROFESSIONAL ENGINEER H. S. K. DEOGON PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER S. K. SARKAR PROVINCE OF ONTARIO

FILE COPY

GEO-CANADA LTD.

HIGHWAYS 7 & 8 OVERPASS AT REGIONAL ROAD 51
SITES 33-361E AND 33-361W
W.P. 163-88-01 AND 163-88-02
DISTRICT 3
SOUTHWESTERN REGION, LONDON

CONT. 94-12

GEOCRES # 40P7-51

Ref. No. G-91.0101
March 1991

Prepared for:

Ministry of Transportation
Foundation Design Section
Room 315, Central Building
1201 Wilson Avenue
Downsview, Ontario
M3M 1J8

Distribution:

15 Copies - Ministry of Transportation
2 Copies - Geo-Canada Ltd.

CONTENTS

APPENDIX

ENCLOSURES

FOUNDATION INVESTIGATION REPORT

FOR

HIGHWAYS 7 & 8 OVERPASS AT REGIONAL ROAD 51

SITES 33-361E AND 33-361W

W.P. 163-88-01 AND 163-88-02

DISTRICT 3

SOUTHWESTERN REGION, LONDON

1.0 INTRODUCTION

This report presents the results of a geotechnical investigation for the proposed Highway 7 and 8 overpass at Regional Road 51, near New Hamburg, Ontario. The investigation was carried out for the Ministry of Transportation, in order to provide geotechnical input for the design of the structures and related earth works.

The fieldwork was carried out between 91 01 16 and 91 01 28 under the supervision of an engineer and a technician. The work consisted of putting down eight boreholes and twelve dynamic cone penetration tests. Borings were advanced by hollow stem continuous flight augers to depths ranging between 25 and 33 m.

.../...

2.0 FIELD AND LABORATORY WORK

The boreholes and cone test locations in the field were laid out by Geo-Canada Ltd., with the assistance of preliminary site plans provided by M.T.O. The actual borehole and cone test locations were subsequently surveyed by M.T.O., who also established the borehole and cone test elevations.

In the boreholes, soil samples were taken by the standard penetration test method at 0.76 m intervals of depth within the upper 6 m of the soil strata; below 6 m, the sampling interval was increased to 1.5 m. In soft to firm cohesive soils, in situ vane shear tests were performed in the boreholes to assess the undrained shear strength of the soil, and relatively undisturbed soil samples were also taken by pushing thin walled shelby tube samplers into these cohesive soils.

Piezometers were installed in six boreholes to monitor the groundwater conditions. The piezometers were read daily during the fieldwork, and three additional times in the four week period following completion of the fieldwork.

The soil samples were re-examined and selectively tested in the laboratory. Representative samples were tested for their index properties such as moisture content, grain size distribution and consistency (Atterberg) limits. One dimensional consolidation, unconfined compression and standard Proctor compaction tests were also performed. The test results are summarized on the Records of Boreholes attached to this report, and are plotted on Figures 1 to 10, inclusive.

The enclosed Drawing Nos. 1638801-A and 1638802-A show the borehole locations.

.../...

3.0 SITE DESCRIPTION

The site is located approximately 60 m to the east of the present intersection of Highways 7 and 8, and Regional Road 51 in the Township of Wilmot, Ontario. It is about 20 km west of Waterloo, and about 2 km east of the Nith River.

The area surrounding the site is a series of rolling hills which gently slope toward the southwest. Just north of the highway, the Baden Hills are a prominent feature. The highway itself slopes down from east to west, crossing a tributary stream of the Nith River, at about 300 m west of Regional Road 51.

Geologically, the site is located near the west limit of the physiographic region known as the Waterloo Hills. These hills are formed of either ridges of sandy till or kame moraines. The moraines were laid down towards the end of the last ice age as the Wisconsinen Glacier started to retreat from the area. The intervening low areas between the hills are mostly occupied by outwash sands. The Baden hills to the north of the site are sand and gravel domes about 60 m high. Around the base are areas of outwash sand and numerous kettle lakes and smaller swamps. West of the Waterloo Hills is the Stratford Till Plain, which is a generally flat, poorly drained plain. The dominant soil type in this plain is a clay loam.

.../...

4.0 SUBSURFACE CONDITIONS

4.1 General

The general stratigraphy at the site consists of a thick deposit of stratified silt, clayey silt and silty clay, which is underlain by silty clay (till) at depths ranging between 20.6 and 27.2 m. (For brevity and ease of expression, the stratified silt, clayey silt and silty clay deposit will be referred to in this report as the "Silt and Clay" stratum). The silt and clay deposit is firm to very stiff while the underlying silty clay (till) stratum is hard. A relatively thin layer of silty clay with a glacial till structure overlies the silt and clay stratum at three of the borehole locations. In Boreholes 5 to 8, which were drilled through the existing embankment of the highway, a 3.7 to 5.2 m thick sand and silty clay fill was encountered.

At the time of the investigation the groundwater level was high. It was recorded close to the existing ground surface in Boreholes 2 to 4.

Details of the subsurface conditions are presented in the Records of Boreholes attached to this report. In the following paragraphs, the relevant properties of the various soil units are briefly described.

4.2 Sand Fill

Sand fill was encountered in Boreholes 5 to 8 which were drilled through the existing highway embankment. It extends from the ground surface or the underside of the granular road base to depths ranging from 0.6 to 3.7 m.

.../...

The sand is poorly graded and contains a trace to some gravel, and a trace of silt. The grading curves of two samples of the sand fill are shown on Figure 1. These samples contain 3 to 15% gravel, 77 to 86% sand, and 8 to 11% silt and clay. Their moisture contents are 9 to 13%. Traces of organic matter and topsoil are also found in the sand fill.

The standard penetration blow counts ('N'-values) recorded in the sand fill vary from 18 to 62 blows per 0.3 m. The dynamic cone penetration blow counts are between 24 and 50 blows per 0.3 m. These results indicate compact to very dense conditions.

4.3 Clayey Silt Fill

The compaction of the fill materials in Boreholes 5, 6 and 7 changed from sand to clayey silt at 0.6 to 3.0 m depth. The thickness of the clayey silt fill ranges from 1.1 to 4.6 m, resulting in a total fill thickness of 4.1 to 5.2 m at the borehole locations.

The clayey silt fill also contains a trace of sand and gravel, and some organic matter. It has moisture contents of 16 to 18%. A typical sample of the clayey silt fill was found to have a liquid limit of 30%, plastic limit of 18%, and a plasticity index of 12.

SPT 'N'-values ranging from 10 to 35 blows per 0.3 m were recorded in the clayey silt fill, suggesting stiff to hard consistency.

.../...

4.4 **Upper Silty Clay**

A relatively thin layer of silty clay was found at the surface of Boreholes 1 and 3, and underneath the existing fill in Borehole 7. The thickness of this stratum is about 1.4 to 2.6 m.

This is a well-graded soil in which silt and clay are the dominant soil fractions. It also contains some sand and a trace of gravel. 'N'-values of 14 to 33 blows per 0.3 m recorded in this deposit suggest that it is stiff to hard. The embedded gravel in the silty clay give it a till like structure and suggest glacial origin.

A standard Proctor compaction test performed on the silty clay obtained a maximum dry density of 18.7 kN/m^3 at an optimum moisture content of 13.5%.

4.5 **Stratified Silt and Clay**

This deposit forms the majority of the soil profile in each borehole. It extends from the existing ground surface or the underside of the shallow surficial soils (fill or silty clay) to depths between 20.6 and 27.2 m (El. 318.9 to 322.6 m).

This is a stratified deposit comprised of alternate layers of silt, clayey silt, silty clay and clay. It also contains a trace to some sand. The thickness of the individual layers varies from a few millimetres to a few centimetres. The silt layers are non plastic to slightly plastic, often wet, and dilatant. The clayey layers are low to medium or occasionally highly plastic.

.../...

Figures 2 and 3 show the grading curves of the predominantly silty and the more clayey samples of this deposit, respectively. The nine silt or clayey silt samples shown on Figure 2 contain no gravel, 1 to 37% sand (mostly less than 30%), 52 to 88% silt, and 10 to 23% clay. The eight silty clay or clay samples shown on Figure 3 contain 0 to 3% sand, 16 to 62% silt (mostly over 50%), and 34 to 83% clay.

The natural moisture contents of the stratified silt and clay deposit range from 11 to 31%. Some of the samples are non plastic, while some have low to high plasticity. The liquid limits, plastic limits, and plasticity indices of twenty-two clayey soil samples tested are 11 to 72%, 15 to 30%, and 5 to 42, respectively. Their liquidity indices vary from 0.01 to 1.4. The results of the Atterberg limit tests plotted on the Plasticity Charts are shown on Figures 7A, 7B and 7C.

In Borehole 3, an approximately 1.0 m thick sand layer was found embedded in the silt and clay deposit at about El. 341$\pm$ m. Figure 4 shows the grading curve of this sand which is composed of 4% gravel, 93% sand, and 3% soil fines (silt and clay).

The 'N'-values recorded in the stratified silt and clay deposit range from 8 to 36 blows per 0.3 m. In situ vane shear tests performed in the weaker layers revealed undrained shear strength of 50 to over 75 kPa. Due to the random presence of silt layers however, the validity or the relevance of these tests can be questioned. An unconfined compression test on a sufficiently long clayey sample obtained an undrained shear strength value of 59 kPa. These test results indicate that the consistency of this soil stratum is firm to hard, but mostly stiff to very stiff.

.../...

The dynamic cone penetration blow counts in this material vary widely, from 3 blows per 0.3 m near the surface to over 100 blows at greater depth. The higher penetration resistances can probably be attributed to the rapid build up of friction or adhesion on the shaft of the drill rods.

The results of two one dimensional consolidation tests of the silt and clay deposit are shown on Figures 9 and 10. The initial void ratios of the tested samples are between 0.61 and 0.65, and the compression indices are 0.085 and 0.018, respectively.

4.6 Lower Silty Clay (Glacial Till)

Underlying the stratified silt and clay deposit in all the boreholes is a silty clay (till). The surface of this deposit was contacted between Elevations 322.6 and 318.9 m. The thickness of this stratum is not known as it extends beyond the bottom of the holes. It is a well graded deposit as shown by the grading curves of four samples of this soil (Figure 5). These samples contain 0 to 25% gravel, 2 to 32% sand, 28 to 59% silt, and 32 to 39% clay.

The natural moisture contents of this material are between 16 and 24%. Its liquid limits, plastic limits, and plasticity indices are 33 to 44%, 17 to 18%, and 15 to 24, respectively (see Figure 8). The liquidity indices are between -0.1 and 0.25. The 'N'-values in the silty clay till range from 32 blows per 0.3 m to 60 blows for 125 mm. The above test results show that this is a low to medium plastic silty clay of hard consistency.

.../...

4.7 Groundwater Conditions

Piezometers were installed in six boreholes. These were monitored over a period of four weeks. The results are summarized in Table 1 below.

The water levels in the piezometers were rising at a slow rate, and some may not have reached equilibrium even at the end of the monitoring period. However, it is inferred that the water levels will stabilize at about El. 344 m. Further readings should be able to confirm this.

TABLE 1

WATER LEVEL READINGS

BH	Date	91.01.17	91.01.18	91.01.22	91.01.27	91.01.31	91.02.08	91.02.22
	Ground Surface Elev. (m)	Water Level (Depth/Elev.)						
2	343.0	11.1 331.9	8.5 334.5	4.5 338.5	3.7 338.3	2.3 340.7	1.6 341.4	0.9 342.1
3	344.5	---	26.5 318.0	9.4 335.1	3.7 340.8	0.1 344.4	0.4 344.1	0.2 344.3
4	344.7	---	---	9.2 335.5	6.2 338.5	0.9 343.8	0.6 344.1	0.1 344.6
5	346.0	---	---	23.8 322.2	7.6 338.4	3.6 342.4	2.9 343.1	2.7 343.3
6	346.6	---	---	---	dry	4.9 341.7	4.3 342.3	3.8 342.8
7	346.9	---	---	---	31.6 315.3	20.4 326.5	11.3 335.6	5.4 341.5

.../...

5.0 DISCUSSION AND RECOMMENDATIONS

5.1 Proposed Construction

It is proposed to construct twin overpasses to carry the Highway 7 and 8 traffic over Regional Road 51. The new structures will be located approximately 60 m east of the present intersection. The reconstructed highway will be a divided highway. The westbound lanes will follow the existing roadway while the eastbound lanes will be located to the south on a new embankment.

Two alternate forms of structures are being considered for this intersection. Proposal 1 is a three-span structure with open spill through abutments. The spans will be approximately 18 m, 30 m and 18 m. Proposal 2 is a single, 30 m span structure with enclosed abutments and retaining walls.

The proposed road grade is about El. 347 m for the highway and about El. 339.5 for Regional Road 51.

5.2 Engineering Evaluation of Subsurface Conditions

Generally consistent subsurface conditions were encountered in the boreholes. Apart from some fill and a relatively thin layer of silty clay (till) near the ground surface, the stratigraphy is comprised of a thick deposit of stratified silt and clay overlying silty clay (till).

.../...

The composition of the existing fill materials ranges from sand to silty clay. Most of the sand fill is relatively clean but the clay fill contains traces of organic matter. In some boreholes old topsoil was found at the base of the fill layer. The existing fill materials appear to have been compacted but the degree of compaction is variable, judging from the range of standard penetration blow counts recorded in the fill. Because of its variable composition and degree of compaction, and its organic content, the fill is not a suitable foundation bearing stratum.

The stratified silt and clay deposit is the major significant soil deposit. This is a layered deposit consisting of slightly plastic to non plastic silt and low to highly plastic clay. This soil is firm to hard, but mostly stiff to very stiff. It can support lightly loaded footings but the bearing capacity of this soil is probably insufficient for a heavy bridge structure. Settlements would also likely exceed tolerable limits. It is, however a suitable bearing stratum for friction pile foundations. Although locally the silt zones predominate, overall this soil unit is expected to behave as a cohesive material. Piles driven into the stratified silt and clay will derive their load carrying capacity mainly from skin friction (adhesion) acting on the pile shaft.

The liquidity indices of this soil unit range from near 0.0 to 1.4. The lower values are associated with the more clayey layers, which suggests that the clay layers are lightly preconsolidated. The silt layers are saturated and dilatant, but silts are generally less compressible than clays. Therefore overall, the stratified silt and clay deposit is not a highly compressible material. The results of two consolidation tests seem to confirm that the soil compressibility is medium to low. Nevertheless some settlement is expected to occur under the weight of the new road embankment fill, i.e. mostly in the eastbound lanes.

.../...

The lower silty clay (till) is hard and highly preconsolidated. It should therefore be a good bearing stratum for pile foundations. The capacity of piles driven into this soil layer would be derived from both end bearing and skin friction.

The upper silty clay (till) is a cohesive soil which can be cut to steep angles and will remain temporarily stable without lateral support. The stratified silt and clay is expected to behave as an essentially cohesive deposit, but there are zones within this stratum in which the silt layers dominate. The silt layers are non plastic to slightly plastic, mostly saturated and dilatant, and may not remain stable for longer than a few days, even if the excavation is cut back to 45 degrees. In the long term, even a 2H:1V slope could experience stability problems unless the slope is well drained, this is discussed in more detail in Section 5.5 of this report.

5.3 Foundation

Since spread footings founded on the stratified silt and clay would not have the required load carrying capacity, the bridge structures will have to be founded on piles. Piles driven into the stratified silt and clay layer will derive their load carrying capacity mainly from skin friction. Piles which penetrate into the lower silty clay (till) stratum will obtain additional capacity from end bearing. Timber, precast concrete, steel tube or H-piles are possible alternative pile types.

The estimated pile capacities are given in Table 2. A full scale load test is recommended to confirm the pile capacities.

.../...

TABLE 2

ESTIMATED PILE CAPACITIES

Pile Type	Size	Estimated Toe Elev. (m)	Estimated Pile Capacity (kN)	
			Ultimate Limit State	Serviceability Limit State Type II
Timber	#36	324 (1) 332 (2)	330 330	225 225
Steel Tube	305 OD x 4.4 mm wall	323 (1) 331 (2)	320 320	320 320
	324 OD x 6.3 mm wall	319 - 315	715	450
Precast Concrete	500 mm square	323 (1) 328 (2) 319 - 315	850 1000 1310	575 600 880
Steel H	HP 310 x 79	319 - 315	700	525

(1) For piers, and abutments of single span structure
(2) For abutments of 3 span structure

The friction piles supporting the bridge abutments are expected to experience settlements equal to the anticipated settlements of the embankments, i.e. about 45 to 70 mm at the eastbound lanes and about 10 to 18 mm at the westbound lanes. On the other hand, end bearing piles driven into the lower silty clay (till) will be subject to some downdrag forces. However, since the rate of settlement under the approach embankments is expected to be rather rapid, and the negative skin friction mobilized by the low strain deformations caused in the soil by the settlement will be small, the downdrag forces will also be small and in our opinion, they can be safely ignored.

.../...

Friction piles should be driven to the required toe elevation using a hammer with a ram weight at least 25% of the weight of the pile. The driving of precast concrete piles should be carried out with utmost care; the driving energy should be reduced if suddenly hard or easy driving conditions are encountered. For timber piles, the driving energy of the hammer should not exceed 30,000 joules/blow.

End bearing piles should be driven to a practical set in the lower silty clay (till). The required final set should be established with a load test, but it is estimated that piles driven with a hammer having a rated energy of 53,000 joules/blow would develop the estimated capacity at a final set of 4 to 8 mm/blow. Estimated toe elevations where these sets are expected to be achieved are shown in Table 2. The piles should be driven to or below the estimated toe elevation and should be monitored by the Hiley Formula, in accordance with M.T.O. Standard SS103-10 or SS103-11. All piles should be re-tapped after twenty-four hours to ensure that no relaxation has occurred.

Lateral loads should be resisted by raking piles.

5.4 Lateral Earth Pressure and Retaining Walls

For the single span option, some fairly high (approximately 7 m) retaining walls will be required. Conventional reinforced concrete retaining walls require good and uniform foundation support which the native soil will not be able to provide unless larger than 30 mm total and differential settlements can be tolerated. It may therefore be necessary to support cast in place concrete retaining walls on piles. Pile capacities can be obtained from Table 2.

.../...

As an alternative to rigid concrete retaining walls, reinforced earth walls could be used. These walls are more flexible, can tolerate larger deformations, and can therefore be founded on the stratified silt and clay.

Based on the measured undrained shear strength of the stratified silt and clay, the factored bearing capacity at Elevation 339 m is 150 kPa and 100 kPa at Ultimate Limit State and Serviceability Limit State (estimated 40 mm settlement) respectively.

For the design of the retaining walls, a lateral earth pressure distribution which increases linearly with depth according to the following expression can be assumed.

$$p = K \gamma d$$

where p = unit earth pressure, kPa

K = coefficient of lateral earth pressure

γ = unit weight of backfill, kN/m^3

d = depth below top of wall

The unit weight and effective angle of shearing resistance (unfactored) can be taken as 21.1 kN/m^3 and 30 degrees, respectively, for Granular 'B' backfill, and 22.8 kN/m^3 and 35 degrees for Granular 'A' backfill.

For a sloping backfill, the direction of the earth pressure can be taken to be parallel to the surface of the backfill.

.../...

A positive drainage system (eg. drain pipes, weep holes) should be installed behind the retaining walls to prevent the build up of groundwater above the base of the wall.

For the evaluation of the stability of the wall against sliding, the unfactored angle of friction between the base of the reinforced earth wall and the native soil can be taken as 25 degrees.

5.5 Approach Embankments

The approach embankments at the cut for Regional Road 51 will be about 8 m high, and will be formed by cutting into the native soil or the existing fill, and in the case of the eastbound lanes, by placing fill. The preliminary bridge layout plans show a distance of 18 m between the piers and the abutments of the three span bridge alternative. This would allow the forward slope to be formed at a 2H:1V gradient.

In order to evaluate the safety of the cut and fill slopes, stability analyses were carried out, using a computer programme. The following soil parameters have been adopted in the analyses. The effective angle of shearing resistance (φ') of the two major soil units was estimated from the measured index properties.

.../...

TABLE 4

SOIL PARAMETERS USED IN STABILITY ANALYSIS

Soil	Unit Weight (kN/m^3)	Effective Cohesion	Effective Shearing Angle (degrees)
Fill	20.0	0	33
Stratified Silt and Clay	20.0	0	30

The analysis was carried out in terms of effective stresses since the stability of a cut slope is more critical in the long term when its stability is governed by the effective shear strength parameters of the soil.

The slope profiles analyzed are shown in Figures 11 to 11C. The stratigraphy is relatively simple, being composed of fill overlying stratified silt and clay. The local positive effect of the surface layer of silty clay (till) is ignored on the grounds that, although this layer is stronger than the silt and clay deposit, it is thin and is not present in all the boreholes.

Behind the slope surface, the groundwater level was assumed to be at El. 344 m, which is the water level observed at the time of the investigation. Near the face of the slope, the elevation of the phreatic surface was varied in the analyses to simulate the effect of lowering the water level to various depths below the slope surface. The slope angle was also varied from 2H:1V to 2.5H:1V and the slope cross section through the perched abutments of the three-span structure was chosen as being the most critical.

.../...

A large number of potential failure surfaces were examined for each combination of slope angle and phreatic surface to arrive at the minimum factor of safety (F.S.) for each condition. The results of the analyses are summarized in Table 5 below.

TABLE 5

STABILITY ANALYSIS RESULTS

Slope Height (m)	Slope Angle	Position of Phreatic Surface (m below slope surface)	Minimum F.S.
8	2H:1V	0.0	0.62
		1.0	0.95
		2.0	1.11
		3.0	1.11
	2.5H:1V	0.0	0.84
		1.0	1.14
		2.0	1.33

The results tabulated in Table 5 show that an undrained slope would be unstable even at a 2.5H:1V gradient. The F.S. increases as the phreatic surface is depressed below the slope surface, but for a 2H:1V slope, our analysis indicates that groundwater control alone cannot increase the F.S. higher than 1.11. For this project, a minimum F.S. of 1.25 is recommended. Therefore the finished slope surface should not be steeper than 2.5H:1V and subsoil drainage on the slope will be required to ensure that the water level remains at least 2 m below the slope surface at all times. Alternatively the outer 3 m of the embankments could

.../...

be constructed of granular fill (Granular 'B' quality or better), as shown on Figure 12. (Figure 11C shows that a 2 m thick granular shell is not sufficient to ensure a minimum F.S. of 1.25.)

The weight of the 2.5 to 4 m high new fill which will be placed to raise the grades in the eastbound lanes is expected to cause some settlement. Based on the results of the two consolidation tests performed on samples of the stratified silt and clay deposit (Figures 9 and 10), about 45 to 70 mm settlement is expected. The consolidation test results also show that the rate of consolidation is rapid due to the silt layers in the soil. Calculations show that primary consolidation should be completed within three months after the fill has been placed. In practice the actual consolidation rate is often more rapid than the calculations indicate, due to lateral drainage.

In the westbound lanes the settlement is estimated to be of the order of 10 to 18 mm.

Clean granular fill material should be used for embankment construction. Prior to placing the new fill materials, all topsoil should be removed. The fill should be placed in 200 mm loose lifts and compacted to 95% standard Proctor maximum dry density.

The finished slope surfaces should be seeded or sodded to prevent surface erosion.

.../...

5.6 Drainage

Drainage ditches or subdrains will be provided on both sides of the cut for the regional road to keep the subgrade well drained. Because of the layered structure of the soil deposits and the presence of nearly impervious clay layers these drainage measures however will not be effective to control the groundwater level in the slope of the cut. In order to lower the groundwater to a sufficient depth below the slope surface and to achieve a desirable F.S., French drains should be installed on the slopes. Figure 13 shows the recommended French drain details.

In the event that the 3 m thick granular blanket shown on Figure 12 is used to stabilize the 2:1 slopes, French drains will not be required but a perforated drain pipe should be installed at the toe of the slope to collect the water seepage from the slope.

5.7 Construction Conditions

The trafficability of the site soils could affect scheduling and rate of progress. Trafficability is expected to be poor due to the high groundwater table and the cohesive nature of the site soils. Some of the clay layers are highly plastic and therefore slippery when wet. At the same time, the silt layers are saturated, and some of the non plastic silt layers are dilatant. After the silt dilates, it will become jelly like and will not be able to support heavy construction equipment. Dilation can be prevented by lowering the groundwater level ahead of the excavation. Temporary dewatering could also be required in order to maintain the stability of the cuts and embankments until the permanent French drains can be installed. Without dewatering, the non plastic silt layers and sand seams may not be stable for more

.../...

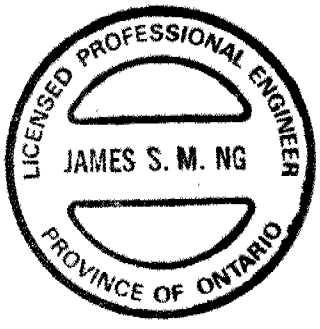
than a few days even at 45° slope. Dewatering of the stratified silt and clay would likely require the use of closely spaced vacuum well points, surrounded by sand wicks to hydraulically connect all the silt layers. Drainage will be slow and the well points would have to be pumped for a long period of time to be effective.

The silty clay layers and the silty clay (till) can be excavated to 45 degrees at which angle they will remain temporarily stable. The excavated silt and clay will be too wet to be recompacted to a high density. Therefore they cannot be immediately re-used for embankment construction or backfilling purposes.

6.0 STATEMENT OF LIMITATION

The Statement of Limitation, as quoted in Appendix "A", is an integral part of this report.

GEO-CANADA LTD.



James Ng, P.Eng.

Ivan P. Lieszkowszky, P.Eng.

JN:IPL/uo

APPENDIX

APPENDIX
"A"
Statement of Limitation

The conclusions and recommendations in this report are based on information determined at the borehole locations. Soil and groundwater conditions between and beyond the boreholes may differ from those encountered at the borehole locations, and conditions may become apparent during construction which could not be detected or anticipated at the time of the soil investigation.

The design recommendations given in this report are applicable only to the project described in the text, and then only if constructed substantially in accordance with details of alignment and elevations stated in the report. Since all details of the design may not be known to us, in our analysis certain assumptions had to be made. The actual conditions may, however, vary from those assumed, in which case changes and modifications may be required to our recommendations.

We recommend, therefore, that we be retained during the final design stage to review the design drawings and to verify that they are consistent with our recommendations or the assumptions made in our analysis. We recommend also that we be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered in the boreholes. In cases where these recommendations are not followed, the company's responsibility is limited to interpreting accurately the information encountered at the boreholes.

The comments given in this report on potential construction problems and possible methods are intended only for the guidance of the design engineer. The number of boreholes may not be sufficient to determine all the factors that may affect construction methods and costs. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work.

ENCLOSURES

Ministry of Transportation Ontario

Enclosure 1

RECORD OF BOREHOLE No 1 METRIC

W P 163-88-01 LOCATION Sta. 18+178.3 O/S 10.9 m Rt C/L Hwy 7 & 8 ORIGINATED BY PWD

DIST 3 HWY 7 and 8 BOREHOLE TYPE Hollow Stem Augering COMPILED BY JN

DATUM Geodetic DATE 91 01 16/17 CHECKED BY IPL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (o UNCONFINED, • QUICK TRIAXIAL, + FIELD VANE, x LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
343.2	Ground Surface							20 40 60 80 100	10 20 30		
0.0	150 mm Topsoil					*					
	SILTY CLAY trace of gravel moist brown till like very stiff		1	SS	21		342				
341.8											
1.4	SILT AND CLAY stratified alternate layers of silt, clayey silt silty clay and clay grey stiff to very stiff		2	SS	11						
			3	SS	18						
			4	SS	9		340				
			5	SS	11						
			6	SS	9						
			7	SS	11		338				
			8	SS	13						
	silt layers predominate										
	clay layers predominate		9	SS	9		336	>+			
			10	SS	11		334	>+			Pushed Shelby Tube at 9.9 m, no recovery. Consolidation Test Fig. 9
	silt layers predominate		11	TW	PH		332	d	o	21.0	0 4 86 10
			12	SS	13			>+			
331.2											
12.0	Continued										

OFFICE REPORT ON SOIL EXPLORATION

+3, x5 : Numbers refer to Sensitivity

15 (20/10) 5 (%) STRAIN AT FAILURE

Ministry of Transportation Ontario

Enclosure 1A

RECORD OF BOREHOLE No 1 (CONT.) METRIC

W P 163-88-01 LOCATION Sta. 18+178.3 O/S 10.9m Rt. C/L Hwy 7 &8 ORIGINATED BY PWD

DIST 3 HWY 7 and 8 BOREHOLE TYPE Hollow Stem Augering COMPILED BY JN

DATUM Geodetic DATE 91 01 16/17 CHECKED BY IPL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
331.2	Continuation										
12.0	SILT AND CLAY as above stiff to very stiff		13	SS	15		330				
			14	SS	23		328				
			15	SS	19						
			16	SS	19		326				
	mainly clay		17	SS	12		324	>+			Soil backed up 4.5 m into hollow stem augers.
322.6			18	SS	19						
20.6	SILTY CLAY some sand trace of embedded gravel grey hard (Glacial Till)		19	SS	49		322				
			20	SS	44		320				
319.2											
24.0	Continued										

OFFICE REPORT ON SOIL EXPLORATION

+3, ×5 : Numbers refer to Sensitivity

15 (20/10) 5 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

Enclosure 1B

RECORD OF BOREHOLE No 1 (CONT.) METRIC

W P 163-88-01 LOCATION Sta. 18+178.3 O/S 10.9 m Rt C/L Hwy 7 & 8 ORIGINATED BY PWD

DIST 3 HWY 7 and 8 BOREHOLE TYPE Hollow Stem Augering COMPILED BY JN

DATUM Geodetic DATE 91 01 16/17 CHECKED BY IPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
319.2	Continuation										
24.0	SILTY CLAY (TILL)										
318.5	hard		21	SS	66 /150 mm						
24.7	END OF BOREHOLE Borehole backfilled groundwater conditions not established										

OFFICE REPORT ON SOIL EXPLORATION

$+^{3}$, $\times^{5}$: Numbers refer to Sensitivity

20
15 ⊹ 5 (%) STRAIN AT FAILURE
10

Ministry of Transportation Ontario

Enclosure 2

RECORD OF BOREHOLE No 2 METRIC

W P 163-88-01 LOCATION Sta. 18+212.0, O/S 27.5 m Rt. C/L Hwy 7 & 8 ORIGINATED BY SC

DIST 3 HWY 7 and 8 BOREHOLE TYPE Hollow Stem Augering and Cone Test COMPILED BY JN

DATUM Geodetic DATE 91 01 16/17 CHECKED BY IPL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
343.0	Ground Surface										
0.0	300 mm Topsoil										
	SILT AND CLAY										
	stratified						Seal				
			1	SS	11	W.L 342.1 90.02.22	342		o		0 3 50 47
								CONE TEST			
			2	SS	16				o		
	moist, brown										
	wet, grey		3	SS	11				o		0 6 77 17
	alternate layers of silt, clayey silt, silty clay and clay stiff to very stiff						340				
			4	SS	14						
			5	SS	21				o		
			6	SS	18		338				
			7	SS	16				o	N.P.	
			8	SS	8						
			9	SS	20		336		o		
			10	SS	20						
			11	SS	13				o		0 3 77 20
							334				
			12	SS	13						
	clay layers predominate between 10 m and 18 m depth		13	SS	10		332		o		
331.0 12.0	Continued										

OFFICE REPORT ON SOIL EXPLORATION

$+^3$, $\times^5$: Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

Enclosure 2A

RECORD OF BOREHOLE No 2 (CONT.) METRIC

W P 163-88-01 LOCATION Sta. 18+212.0, O/S 27.5 m Rt. C/L Hwy 7 & 8 ORIGINATED BY SC
DIST 3 HWY 7 and 8 BOREHOLE TYPE Hollow Stem Augering and Cone Test COMPILED BY JN
DATUM Geodetic DATE 91 01 16/17 CHECKED BY IPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						GR SA SI CL
331.0	Continuation										
12.0	**SILT AND CLAY** as above stiff to very stiff		14	SS	18		330	Cone Test			
			15	SS	13		328				
			16	SS	22		326				
	silt layers predominate		17	SS	15		324				
			18	SS	16		322				
			19	SS	22		320				0 7 71 22
321.4											
21.6	**SILTY CLAY** some sand trace of gravel grey very stiff to hard (Glacial Till)		A 20 B	SS	28						
			21	SS	68						
319.0											
78.0	Continued										

OFFICE REPORT ON SOIL EXPLORATION

+3, ×5 : Numbers refer to Sensitivity

20
15 ⊖ 5 (%) STRAIN AT FAILURE
10

Ministry of Transportation Ontario

Enclosure 2B

RECORD OF BOREHOLE No 2 (CONT.) METRIC

W P 163-88-01 LOCATION Sta. 18+212.0, O/S 27.5 m Rt. C/L Hwy 7 & 8 ORIGINATED BY SC

DIST 3 HWY 7 and 8 BOREHOLE TYPE Hollow Stem Augering and Cone Test COMPILED BY JN

DATUM Geodetic DATE 91 01 16/17 CHECKED BY IPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%) (10 20 30 40)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						GR SA SI CL
319.0	Continuation										
24.0	**SILTY CLAY** some sand trace of gravel grey hard (Glacial Till)		22	SS	41		318		W = 44		0 32 32 36
316.8			23	SS	60/125 mm	PIEZOMETER					
26.2	**END OF BOREHOLE**										

Date W.L.

91.01.17 331.9
91.01.18 334.5
91.01.22 338.5
91.01.27 338.3
91.01.31 340.7
91.02.08 341.4
91.02.22 342.1

OFFICE REPORT ON SOIL EXPLORATION

+3, x5 : Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation Ontario

Enclosure 3

RECORD OF BOREHOLE No 3 METRIC

W P 163-88-01 LOCATION Sta. 18+229.5, O/S 10.0 m Rt. C/L Hwy 7 & 8 ORIGINATED BY PWD

DIST 3 HWY 7 and 8 BOREHOLE TYPE Hollow Stem Augering COMPILED BY JN

DATUM Geodetic DATE 91 01 17/18 CHECKED BY IPL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT Wl / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
344.5	Ground Surface							20 40 60 80 100	10 20 30 40		
0.0	170 mm Topsoil SILTY CLAY trace of embedded gravel brown till structure stiff		1	SS	14	W.L. 344.3 91.02.22	344				
343.1											
1.4	SILT AND CLAY stratified alternate layers of silt, clayey silt, silty clay and clay		2	SS	14						0 13 64 23
			3	SS	19		342			41	
	sand seam trace of gravel wet		4	SS	9						4 93 (3)
	grey stiff to very stiff		5	SS	10		340				
			6	SS	8						
			7	SS	9		338				
	silt layers predominate		8	TW	PH				O N.P.	20.2	0 5 77 18
			9	SS	15						
			10	SS	11*		336				*no recovery 1st attempt
	very stiff to hard		11	SS	21						
			12	SS	33		334				
	firm		13	SS	8						
332.5											
12.0	Continued										

OFFICE REPORT ON SOIL EXPLORATION

+3, ×5 : Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

Enclosure 3A

RECORD OF BOREHOLE No 3 (CONT.) METRIC

W P 163-88-01 LOCATION Sta. 18+229.5, O/S 10.0 m Rt. C/L Hwy 7 & 8 ORIGINATED BY PWD
DIST 3 HWY 7 and 8 BOREHOLE TYPE Hollow Stem Augering COMPILED BY JN
DATUM Geodetic DATE 91 01 17/18 CHECKED BY IPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100)	PLASTIC LIMIT W_p / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%) 10 20 30 40	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
332.5	Continuation										
12.0	SILT AND CLAY (as above) very stiff to stiff		14	SS	24		332		o		
	silt layers predominate										
	clay layers predominate		15	SS	9		330	>+			
			16	SS	12			>+	o—o		0 1 77 22
			17	SS	19		328				
			18	SS	17		326		o		
			19	SS	14		324				
			20	SS	18				o		
	hard						322				
	mostly clay		21	SS	36	*					* No recovery 1st attempt
320.5	24.0 Continued										

+³, x⁵ : Numbers refer to Sensitivity

20
15 ◇ 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation Ontario

Enclosure 3B

RECORD OF BOREHOLE No 3 (CONT.) METRIC

W P 163-88-01 LOCATION Sta. 18+229.5, O/S 10.0 m Rt., C/L Hwy 7 & 8 ORIGINATED BY PWD

DIST 3 HWY 7 and 8 BOREHOLE TYPE Hollow Stem Augering COMPILED BY JN

DATUM Geodetic DATE 91 01 17/18 CHECKED BY IPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						GR SA SI CL
320.5	Continuation										
24.0	SILTY CLAY some sand trace of embedded gravel grey hard (Glacial Till)		22	SS	64		320				1 27 34 38
			23	SS	64		318				
316.6			24	SS	70	PIEZOMETER					
27.9	END OF BOREHOLE Date W.L. 91.01.18 318.0 91.01.22 335.1 91.01.27 340.8 91.01.31 344.4 91.02.08 344.1 91.02.22 344.3										

OFFICE REPORT ON SOIL EXPLORATION

$+^3$, $\times^5$: Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

Enclosure 4

RECORD OF BOREHOLE No 4 METRIC

W P 163-88-01 LOCATION Sta. 18+250.1, O/S 23.2 m Rt. C/L Hwy 7 & 8 ORIGINATED BY SC
DIST 3 HWY 7 and 8 BOREHOLE TYPE Hollow Stem Augering and Cone Test COMPILED BY JN
DATUM Geodetic DATE 91 01 18 CHECKED BY IPL

SOIL PROFILE ELEV/DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT W_p / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
344.7	Ground Surface										
0.0	350 mm Topsoil						Seal				
	SILT AND CLAY stratified					W.L. 344.6	91.02.22				
			1	SS	14		344	Cone Test			
			2	SS	13						
	brown, silt layers predominate grey, more clay										
			3	SS	20		342				
	alternate layers of silt, clayey silt and silty clay		4	SS	10			>+			
	stiff to very stiff		5	SS	20						
			6	SS	22		340				
			7	SS	13						
			8	SS	17		338				
			9	SS	12						
							336				
			10	SS	14						
	clay layers predominate silt layers predominate										
			11	SS	20		334				
332.7 12.0	Continued										

OFFICE REPORT ON SOIL EXPLORATION

+3, ×5 : Numbers refer to Sensitivity

20 / 15 ○ 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation Ontario

Enclosure 4A

RECORD OF BOREHOLE No 4 (CONT.) METRIC

W P 163-88-01 LOCATION Sta. 18+250.1, O/S 23.2 m Rt. C/L Hwy 7 & 8 ORIGINATED BY SC

DIST 3 HWY 7 and 8 BOREHOLE TYPE Hollow Stem Augering and Cone Test COMPILED BY JN

DATUM Geodetic DATE 91 01 18 CHECKED BY IPL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
332.7	Continuation										
12.0	SILT AND CLAY										
	as above very stiff		12	SS	17		332				
			13	SS	22		330				
			14	SS	22						
	silt layers predominate clay layers predominate firm		15	SS	7		328				
	hard trace of gravel		16	SS	30		326				
	very stiff to stiff		17	SS	20		324				
	silt layers predominate wet		18	SS	13		322				
			19	SS	19						
320.7											

24.0 Continued

OFFICE REPORT ON SOIL EXPLORATION

+3, ×5 : Numbers refer to Sensitivity

15 (20/10) 5 (%) STRAIN AT FAILURE

Ministry of Transportation Ontario

Enclosure 4B

RECORD OF BOREHOLE No 4 (CONT.) METRIC

W P 163-88-01 LOCATION Sta. 18+250.1, O/S 23.2 m Rt, C/L Hwy 7 and 8 ORIGINATED BY SC

DIST 3 HWY 7 and 8 BOREHOLE TYPE Hollow Stem Augering and Cone Test COMPILED BY JN

DATUM Geodetic DATE 91 01 18 CHECKED BY IPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W_P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W_L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	WATER CONTENT (%)				GR SA SI CL
320.7	Continuation												
24.0	**SILT AND CLAY** as above mainly silt layers very stiff		20	SS	26		320						
318.9													
25.8	**SILTY CLAY** some sand grey hard (Glacial Till)		21	SS	70		318						
316.8			22	SS	5 9		PIEZOMETER						
27.9	**END OF BOREHOLE** No further progress due to lack of augers												

Date W.L.

91.01.22 335.5
91.01.27 338.5
91.01.31 343.8
91.02.08 344.1
91.02.22 344.6

OFFICE REPORT ON SOIL EXPLORATION

+3, x5 : Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

Enclosure 5

RECORD OF BOREHOLE No 5 METRIC

W P 163-88-02 LOCATION Sta. 18+153.0, O/S 25.0 m LT, C/L Hwy 7 & 8 ORIGINATED BY PWD
DIST 3 HWY 7 and 8 BOREHOLE TYPE Hollow Stem Augering and Cone Test COMPILED BY JN
DATUM Geodetic DATE 91 01 21/22 CHECKED BY IPL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
346.0	Ground Surface							20 40 60 80 100	10 20 30		
0.0	FILL sand						Seal				
	clayey silt and sand moist brown		1	SS	10				0		15 77 (8)
			2	SS	19		344	Cone Test			
			3	SS	18						
			4	SS	15	W.L. 343.3 91.02.22	342		0		
			5	SS	11						
	some organics grey/brown		6	SS	23				0		
340.8											
5.2	SILT AND CLAY stratified alternate layers of silt, clayey silt silty clay and clay grey stiff		7	SS	14		340		0		
			8	SS	12				10		0 4 83 13
			9	SS	12		338	4.3			
	silt layers predominate clay layers predominate		10	SS	8				0	72	0 1 16 83 Pushed Shelby Tube at 9.9 m but no recovery
			11	SS	13		336				
	clay layers predominate silt layers predominate										
334.0			12	TW	PH		334				
12.0	Completed										

OFFICE REPORT ON SOIL EXPLORATION

+3, ×5 : Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

Enclosure 5A

RECORD OF BOREHOLE No 5 (CONT.) METRIC

W P 163-88-02 LOCATION Sta. 18+153.0, O/S 25.0 m LT, C/L Hwy 7 & 8 ORIGINATED BY PWD
DIST 3 HWY 7 and 8 BOREHOLE TYPE Hollow Stem Augering and Cone Test COMPILED BY JN
DATUM Geodetic DATE 91 01 21/22 CHECKED BY IPL

SOIL PROFILE ELEV/DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: o UNCONFINED, • QUICK TRIAXIAL, + FIELD VANE, × LAB VANE 20 40 60 80 100	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
334.0	Continuation									
12.0	SILT AND CLAY as above stiff to very stiff		13	SS	13			o		
			14	SS	12		332	+		
			15	SS	14		330			0 1 65 34
			16	SS	10			+		
			17	SS	13		328	o		
			18	SS	14		326			
			19	SS	23		324	o		
			20	SS	23					Soilbacked up 3 m into hollow stem augers
322.0 24.0	Continued									

OFFICE REPORT ON SOIL EXPLORATION

$+^3$, $\times^5$: Numbers refer to Sensitivity

15 20/10 5 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

Enclosure 5B

RECORD OF BOREHOLE No 5 (CONT.) METRIC

W P 163-88-02 LOCATION Sta. 18+153.0, O/S 25.0 m LT, C/L Hwy 7 & 8 ORIGINATED BY PWD

DIST 3 HWY 7 and 8 BOREHOLE TYPE Hollow stem Augering and Cone Tests COMPILED BY JN

DATUM Geodetic DATE 91 01 22 CHECKED BY IPL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
322.0	Continuation										
24.0	SILTY CLAY some sand, gravel grey hard (Glacial Till)		21	SS	36					41	25 15 28 32
			22	SS	38		320				
			23	SS	32		318				
316.6			24	SS	36		PIEZOMETER				
29.4	END OF BOREHOLE										

Date W.L.
91.01.22 322.2
91.01.27 338.4
91.01.31 342.4
91.02.08 343.1
91.02.22 343.3

OFFICE REPORT ON SOIL EXPLORATION

+3, ×5 : Numbers refer to Sensitivity

20
15 ⊹ 5 (%) STRAIN AT FAILURE
10

Ministry of Transportation
Ontario

Enclosure 6

RECORD OF BOREHOLE No 6 METRIC

W P 163-88-02 LOCATION Sta. 18+183.7, O/S 9.2 m Lt, C/L Hwy 7 and 8 ORIGINATED BY SC

DIST 3 HWY 7 and 8 BOREHOLE TYPE Hollow Stem Augering COMPILED BY JN

DATUM Geodetic DATE 91 01 24 CHECKED BY IPL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
346.6	Ground Surface										
0.0	600 mm granular road base						346				
	FILL — sand, trace of gravel, asphalt, moist, brown		1	SS	18		Seal				
			2	SS	54						
	clayey silt, trace of sand, grey		3	SS	16		344				
			4	SS	13						
342.3						W.L. 342.8 91.02.22					
4.3	SILT AND CLAY — stratified alternate layers of silt, clayey silt, silty clay and clay		5	SS	20		342				
	clay layers predominate, brown; silt layers grey predominate		6	SS	16		340				
			7	SS	17						
	firm to stiff		8	SS	9						
			9	SS	18		338	>4			
			10	SS	21						
	silt layers predominate		11 A B	SS	10						
	clay layers predominate						336				
			12	SS	17						
								+ 4.7			
			13	SS	13						
334.6	Continued										

OFFICE REPORT ON SOIL EXPLORATION

+3, ×5 : Numbers refer to Sensitivity

15 20/10 5 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

Enclosure 6A

RECORD OF BOREHOLE No 6 (CONT.) METRIC

W P 163-88-02 LOCATION Sta. 18+183.7, O/S 9.2 m Lt. C/L Hwy 7 and 8 ORIGINATED BY SC
DIST 3 HWY 7 and 8 BOREHOLE TYPE Hollow Stem Augering COMPILED BY JN
DATUM Geodetic DATE 91 01 24 CHECKED BY IPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
334.6	Contination										
12.0	**SILT AND CLAY**										
	as above		14	SS	14		334				
	grey										
	stiff to very stiff										
			15	SS	26		332				
			16	SS	14		330				
			17	SS	18						
			18	SS	27		328				
			19	SS	19		326				
			20	SS	15		324				
			21	SS	19						
322.6											Soil backed up 0.6 m into augers
24.0	Continued										

OFFICE REPORT ON SOIL EXPLORATION

$+^3$, $\times^5$: Numbers refer to Sensitivity

15 20/10 5 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

Enclosure 6B

RECORD OF BOREHOLE No 6 (CONT.) METRIC

W.P 163-88-02 LOCATION Sta. 18+183.7, O/S 9.2 m Lt, C/L Hwy 7 and 8 ORIGINATED BY SC

DIST 3 HWY 7 and 8 BOREHOLE TYPE Hollow Stem Augering COMPILED BY JN

DATUM Geodetic DATE 91 01 24 CHECKED BY IPL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
322.6	Continuation										
24.0 / 322.3	SILT AND CLAY										
24.3	SILTY CLAY some sand trace of gravel grey hard (Glacial Till)		22	SS	38		322				
			23	SS	62		320				
			24	SS	52		318				
317.2			25	SS	50	PIEZOMETER					
29.4	END OF BOREHOLE										

Date W.L.
91.01.27 dry
91.01.31 341.7
91.02.08 342.3
91.02.22 342.8

OFFICE REPORT ON SOIL EXPLORATION

+3, ×5 : Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

Ministry of Transportation Ontario

Enclosure 7

RECORD OF BOREHOLE No 7 METRIC

W P 163-88-02 LOCATION Sta. 18+203.9, O/S 23.2 m Lt., C/L Hwy 7 and 8 ORIGINATED BY SC

DIST 3 HWY 7 and 8 BOREHOLE TYPE Hollow Stem Augering and Cone Test COMPILED BY JN

DATUM Geodetic DATE 91 01 21/22 CHECKED BY IPL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT Wl — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
346.9	Ground Surface										
0.0	600 mm granular road base						Seal				
	FILL						346				
	sand some silt		1	SS	42			Cone Test			
			2	SS	29						
			3	SS	24						
	trace of decomposed wood dark brown/black						344				
	clayey silt trace gravel brown		4	SS	35						
342.8											
4.1	SILTY CLAY some sand trace of embedded gravel brown till structure very stiff to hard		5	SS	21		342				MDD=18.7 kN/m³ OMC=13.5%
			5A	AS		▽	W.L. 341.5 91.02.22				
340.2			6	SS	33						
6.7	SILT AND CLAY stratified alternate layers of silt, clayey silt, silty clay and clay		7	SS	15		340				0 2 59 39
			8	SS	13						
			9	SS	14						
	clay layers predominate						338				
	silt layers predominate		10	SS	16						
	grey stiff to very stiff		11	SS	22						
			12	SS	20		336				
334.9			13	SS	24						
12.0	Continued										

OFFICE REPORT ON SOIL EXPLORATION

+3, ×5 : Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

Enclosure 7A

RECORD OF BOREHOLE No 7 (CONT.) METRIC

W P 163-88-02 LOCATION Sta. 18+ 203.9, O/S 23.2 m lt, C/L Hwy 7 and 8 ORIGINATED BY SC
DIST 3 HWY 7 and 8 BOREHOLE TYPE Hollow Stem Augering and Cone Test COMPILED BY JN
DATUM Geodetic DATE 91 01 21/22 CHECKED BY IPL

SOIL PROFILE ELEV/DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
334.9	Continuation									
12.0	**SILT AND CLAY**									
	as above		14	SS	24					
	stiff to						334			
	very stiff		15	SS	17					
			16	SS	16					
	silt layers predominate						332			
	clay layers predominate		17	SS	9			>4		
			18	SS	18		330			
			19	SS	15		328			
			20	SS	20		326			
			21	SS	16					
							324			
			22	SS	16					
322.9										
24.0	Continued									

OFFICE REPORT ON SOIL EXPLORATION

+3, ×5 : Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

Ministry of Transportation Ontario

Enclosure 7B

RECORD OF BOREHOLE No 7 (CONT.) METRIC

W P 163-88-02 LOCATION Sta. 18+203.9, O/S 23.2 m Lt. C/L Hwy 7 & 8 ORIGINATED BY SC

DIST 3 HWY 7 and 8 BOREHOLE TYPE Hollow Stem Augering and Cone Test COMPILED BY JN

DATUM Geodetic DATE 91 01 21/22 CHECKED BY IPL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
322.9	Continuation										
24.0	SILT AND CLAY as above very stiff		23	SS	19		322				
320.8			24	SS	37						
26.1	SILTY CLAY some sand trace of gravel grey hard (Glacial Till)		25	SS	59		320				
			26	SS	59		318				
			27	SS	44		316				
314.4			28	SS	47		PIEZOMETER				
32.5	END OF BOREHOLE										

Date	W.L.
91.01.27	315.3
91.01.31	326.5
91.02.08	335.6
91.02.22	341.5

OFFICE REPORT ON SOIL EXPLORATION

+3, ×5 : Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

Ministry of Transportation Ontario

Enclosure 8

RECORD OF BOREHOLE No 8 METRIC

W P 163-88-02 LOCATION Sta. 18+230.4, O/S 8.9 m Lt. C/L Hwy 7 & 8 ORIGINATED BY PWD

DIST 3 HWY 7 and 8 BOREHOLE TYPE Hollow Stem Augering COMPILED BY JN

DATUM Geodetic DATE 91 01 24 CHECKED BY IPL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT Wl / WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
347.3	Ground Surface										
0.0	Granular road base — FILL sand trace of gravel		1	SS	34		346		o		3 86 (11)
			2	SS	48						
			3	SS	30		344				
	with organics (Topsoil)		4	SS	62				o		
343.6											
3.7	SILT AND CLAY Stratified alternate layers of silt, clayey silt, silty clay, and clay		5	SS	27						0 37 52 11
			6	SS	11		342	>+			
			7	SS	12			>+	o		
	silt layers predominate clay layers predominate		8	SS	12			>+			
	grey stiff to very stiff		9	SS	13		340				0 1 62 37
			10	SS	11		338	>+			
			11	TW	PH						Consolidation Test Fig.10 21.1 0 3 59 38
	clay layers predominate silt layers predominate firm		12	SS	6				o		
335.3 12.0	Continued						336	>+			

+3, ×5 : Numbers refer to Sensitivity

15 20 5 10 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation Ontario

Enclosure 8A

RECORD OF BOREHOLE No 8 (CONT.) METRIC

W P 163-88-02 LOCATION Sta. 18+230.4, O/S 8.9 m Lt, C/L Hwy 7 & 8 ORIGINATED BY PWD

DIST 3 HWY 7 and 8 BOREHOLE TYPE Hollow Stem Augering COMPILED BY JN

DATUM Geodetic DATE 91 01 24 CHECKED BY IPL

SOIL PROFILE ELEV/DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL / WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
335.3	Continuation										
12.0	SILT AND CLAY										
	as above										
	stiff to very stiff		13	SS	18						
							334				
			14	SS	13					44	0 0 47 53
							332				
			15	SS	23				0		
							330				
			16	SS	21						
	silt layers predominate										
	clay layers predominate										
			17	SS	23						
							328				
	hard										
			18	SS	34						0 0 50 50
	very stiff										
							326				
			19	SS	24						
							324				
			20	SS	22						
323.3 74.0	Continued										

OFFICE REPORT ON SOIL EXPLORATION

+3, ×5 : Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

Enclosure 8B

RECORD OF BOREHOLE No 8 (CONT.) METRIC

W P 163-88-02 LOCATION Sta. 18+230.4, O/S 8.9 m Lt, C/L Hwy 7 and 8 ORIGINATED BY PWD
DIST 3 HWY 7 and 8 BOREHOLE TYPE Hollow Stem Augering COMPILED BY JN
DATUM Geodetic DATE 91 01 24 CHECKED BY IPL

SOIL PROFILE ELEV/DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L WATER CONTENT (%) 10 20 30 40	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
323.3	Continuation										
24.0	SILT AND CLAY as above very stiff		21	SS	29	*					
	clay layers predominate silt layers predominate		22	SS	17		322				Soil backed up 2.1 m into hollow stem augers.
320.1							320				
27.2	SILTY CLAY some sand trace of gravel grey hard (Glacial Till)		23	SS	68				01		0 5 46 49
			24	SS	60		318				
			25	SS	57						
314.8			26	SS	77		316				
32.5	END OF BOREHOLE * Groundwater condition not established										

OFFICE REPORT ON SOIL EXPLORATION

+3, ×5 : Numbers refer to Sensitivity

20
15 ◇ 5 (%) STRAIN AT FAILURE
10

Ministry of Transportation Ontario

Enclosure 9

RECORD OF BOREHOLE No CT 1 METRIC

W P 163-88-01 LOCATION Sta. 18+187.0, O/S 23.7 Rt C/L Hwy 7 and 8 ORIGINATED BY SC

DIST 3 HWY 7 and 8 BOREHOLE TYPE Cone Penetration Test COMPILED BY JN

DATUM Geodetic DATE 91 01 21 CHECKED BY IPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						GR SA SI CL
342.7	Ground Surface										
0.0							342	Cone Test			
							340				
							338				
							336				
							334				
							332				
330.8											
11.9	END OF CONE TEST										

OFFICE REPORT ON SOIL EXPLORATION

$+^3$, $\times^5$: Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

Enclosure 10

RECORD OF BOREHOLE No CT 2 METRIC

W P 163-88-0 1 LOCATION Sta. 18+196.8, O/S 10.0 m Rt., C/L Hwy 7 and 8 ORIGINATED BY PWD

DIST 3 HWY 7 and 8 BOREHOLE TYPE Augering and Cone Penetration Test COMPILED BY JN

DATUM Geodetic DATE 91 01 21 CHECKED BY IPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) SHEAR STRENGTH kPa (o UNCONFINED, • QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT W_p — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_l WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
343.3	Ground Surface										
0.0	SILT AND CLAY layered brown						342				Augered to 3.0 m without sampling
340.3											
3.0	END OF AUGERING						340	Cone Test			
							338				
							336				
							334				
							332				
331.3											
12.0	Continued										

OFFICE REPORT ON SOIL EXPLORATION

$+^3$, $\times^5$: Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation Ontario

Enclosure 10A

RECORD OF BOREHOLE No CT. 2 (CONT.) METRIC

W P 163-88-01 LOCATION Sta. 18+196.8, O/S 10.0 m Rt, C/L Hwy 7 and 8 ORIGINATED BY PWD

DIST 3 HWY 7 and 8 BOREHOLE TYPE Augering and cone penetration test COMPILED BY JN

DATUM Geodetic DATE 91 01 21 CHECKED BY IPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	PLASTIC LIMIT Wp — NATURAL MOISTURE CONTENT W — LIQUID LIMIT WL WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
331.3	Continuation										
12.0							330	Cone Test			
							328				
325.9							326				
17.4	END OF CONE TEST										

OFFICE REPORT ON SOIL EXPLORATION

+3, ×5 : Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation Ontario

Enclosure 11

RECORD OF BOREHOLE No CT 3 METRIC

W P 163-88-01 LOCATION Sta. 18+242.7, O/S 25.6 m Rt C/L Hwy 7 and 8 ORIGINATED BY SC

DIST 3 HWY 7 and 8 BOREHOLE TYPE Augering and Cone Penetration Test COMPILED BY JN

DATUM Geodetic DATE 91 01 17 CHECKED BY IPL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT Wl — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
344.0	Ground Surface										
0.0	320 mm Topsoil										
	SILT AND CLAY layered brown						342				Augered to 4.0 m without sampling
340.0							340				
4.0	END OF AUGERING							Cone Test			
							338				
							336				
							334				
333.3											
10.7	END OF CONE TEST										

OFFICE REPORT ON SOIL EXPLORATION

+3, ×5 : Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

Enclosure 12

RECORD OF BOREHOLE No CT 4 METRIC

W P 163-88-01 LOCATION Sta. 18+245.7, 0/S 10.7 m Rt. C/L Hwy 7 and 8 ORIGINATED BY SC

DIST 3 HWY 7 and 8 BOREHOLE TYPE Augering and Cone Penetration Test COMPILED BY JN

DATUM Geodetic DATE 91 01 17 CHECKED BY IPL

SOIL PROFILE ELEV/DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (o UNCONFINED, • QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
345.1	Ground Surface										
0.0	300 mm Topsoil										
	SILT AND CLAY layered brown						344	1st Cone Test			
342.7							342	End of first cone test moved 0.3 m north	Augered to 2.4 m		
2.4	END OF AUGERING							2nd Cone Test			
							340				
							338				
							336				
334.4											
10.7	END OF CONE TEST										

OFFICE REPORT ON SOIL EXPLORATION

+3, ×5 : Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

Enclosure 13

RECORD OF BOREHOLE No CT 5 METRIC

W P 163-88-02 LOCATION Sta. 18+164.5, O/S 8.8 m Lt, C/L Hwy 7 and 8 ORIGINATED BY SC

DIST 3 HWY 7 and 8 BOREHOLE TYPE Augering and Cone Penetration Test COMPILED BY JN

DATUM Geodetic DATE 91 01 25 CHECKED BY IPL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
346.3	Ground Surface										
0.0	FILL						346				Augered to 0.6 m
345.7	granular road base (frozen)										
0.6	END OF AUGERING						344	Cone Test			
							342				
339.9							340				
6.4	END OF CONE TEST										

OFFICE REPORT ON SOIL EXPLORATION

+3, ×5 : Numbers refer to Sensitivity

20
15 ⊹ 5 (%) STRAIN AT FAILURE
10

Ministry of Transportation
Ontario

Enclosure 14

RECORD OF BOREHOLE No CT 6 METRIC

W P 163-88-02 LOCATION Sta. 18+173.5, O/S 23.3 m Lt, C/L Hwy 7 and 8 ORIGINATED BY PWD

DIST 3 HWY 7 and 8 BOREHOLE TYPE Augering and Cone Penetration Test COMPILED BY JN

DATUM Geodetic DATE 91 01 24 CHECKED BY IPL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT Wl — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
346.4	Ground Surface										
0.0	FILL sand and gravel						346				
345.8											
0.6	FILL sand some clay brown/black										Augered to 6.9 m without sampling
344.0							344				
2.4	SILT AND CLAY layered brown										
339.5							342				
							340				
6.9	END OF AUGERING							Cone Test			
334.4							338				
							336				
12.0	Continued										

OFFICE REPORT ON SOIL EXPLORATION

+3, x5 : Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation Ontario

Enclosure 14A

RECORD OF BOREHOLE No CT 6 (CONT) METRIC

W P 163-88-02 LOCATION Sta. 18+173.5, O/S 23.3 m Lt C/L Hwy 7 and 8 ORIGINATED BY SC

DIST 3 HWY 7 and 8 BOREHOLE TYPE Augering and Cone Penetration Test COMPILED BY JN

DATUM Geodetic DATE 91 01 24 CHECKED BY IPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT Wp — NATURAL MOISTURE CONTENT W — LIQUID LIMIT Wl WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
334.4	Continuation										
12.0							334	Cone Test			
332.1							332				
14.3	END OF CONE TEST										

OFFICE REPORT ON SOIL EXPLORATION

+3, ×5 : Numbers refer to Sensitivity

15 20 5 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

Enclosure 15

RECORD OF BOREHOLE No CT 7 METRIC

W P 163-88-02 LOCATION Sta. 18+212.8, O/S 8.9 m Lt C/L Hwy 7 and 8 ORIGINATED BY SC

DIST 3 HWY 7 and 8 BOREHOLE TYPE Augering and Cone Penetration Test COMPILED BY JN

DATUM Geodetic DATE 91 01 25 CHECKED BY IPL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT W_p / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
346.9	Ground Surface										
0.0	FILL sand and gravel										
346.0							346				
0.9	FILL sand brown										Augered to 7.0 m without sampling
341.9							344				
							342				
5.0	SILT AND CLAY layered brown										
339.9							340				
7.0	END OF AUGERING							Cone Test			
							338				
							336				
334.9											
12.0	Continued										

OFFICE REPORT ON SOIL EXPLORATION

$+^3$, $\times^5$: Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

Enclosure 15A

RECORD OF BOREHOLE No CT 7 (CONT) METRIC

W P 163-88-02 LOCATION Sta. 18+212.8, O/S 8.9 m Lt C/L Hwy 7 and 8 ORIGINATED BY SC

DIST 3 HWY 7 and 8 BOREHOLE TYPE Augering and Cone Penetration Test COMPILED BY JN

DATUM Geodetic DATE 91 01 25 CHECKED BY IPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT Wp	NATURAL MOISTURE CONTENT W	LIQUID LIMIT Wl	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	WATER CONTENT (%)				GR SA SI CL
334.9	Continuation												
12.0							334	Cone Test					
							332						
							330						
							328						
326.5													
20.4	END OF CONE TEST												

OFFICE REPORT ON SOIL EXPLORATION

+3, ×5 : Numbers refer to Sensitivity

20
15 ◇ 5 (%) STRAIN AT FAILURE
10

Ministry of Transportation Ontario

Enclosure 16

RECORD OF BOREHOLE No CT 8 METRIC

W P 163-88-02 LOCATION Sta. 18+220.4, O/S 23.4 m Lt C/L Hwy 7 and 8 ORIGINATED BY SC

DIST 3 HWY 7 and 8 BOREHOLE TYPE Augering and Cone Penetration Test COMPILED BY JN

DATUM Geodetic DATE 91 01 24 CHECKED BY IPL

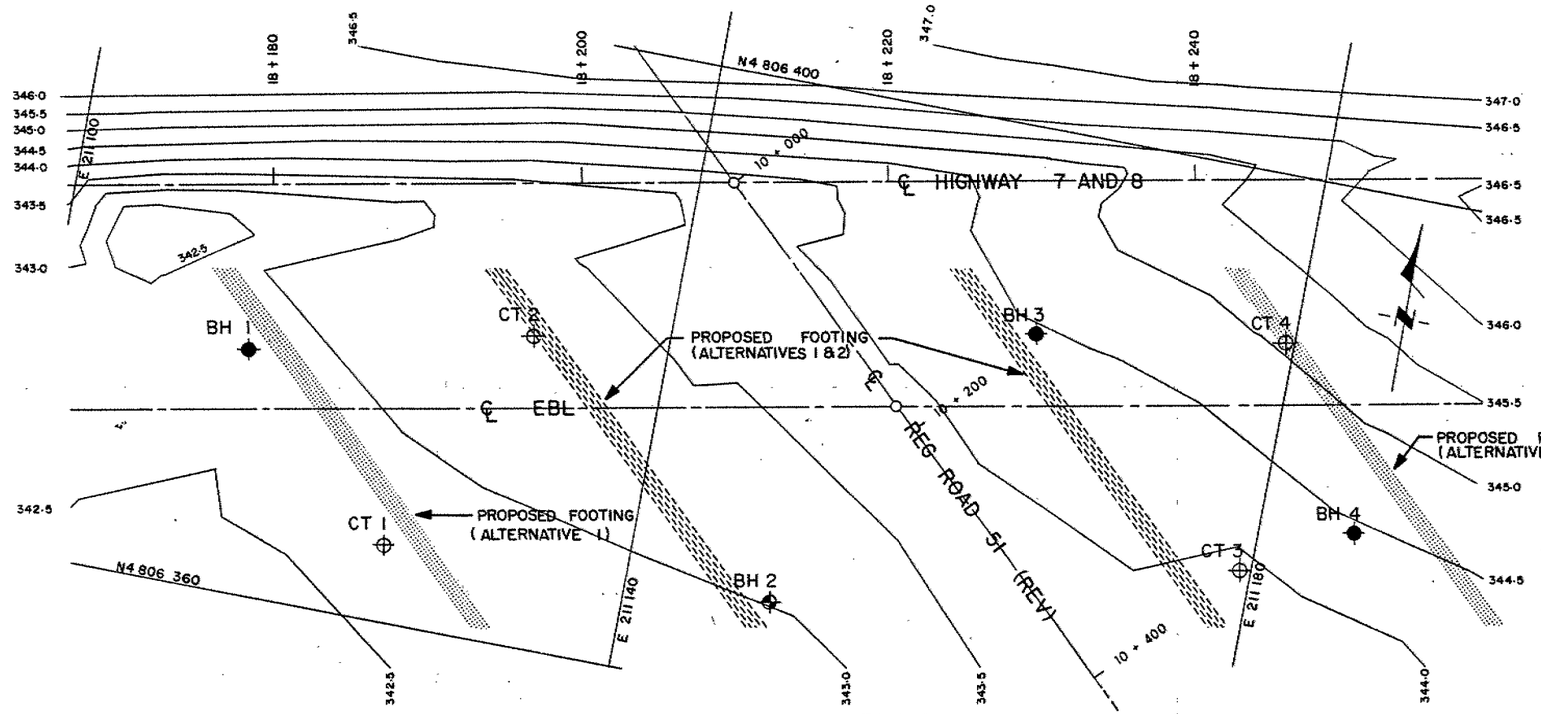
SOIL PROFILE ELEV/DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (o UNCONFINED, • QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
347.1	Ground Surface							20 40 60 80 100			
0.0	FILL sand and gravel (frozen)										Augered to 0.9 m without sampling
346.2											
0.9	END OF AUGERING						346	Cone Test			
							344				
							342				
340.4											
6.7	END OF CONE TEST										

OFFICE REPORT ON SOIL EXPLORATION

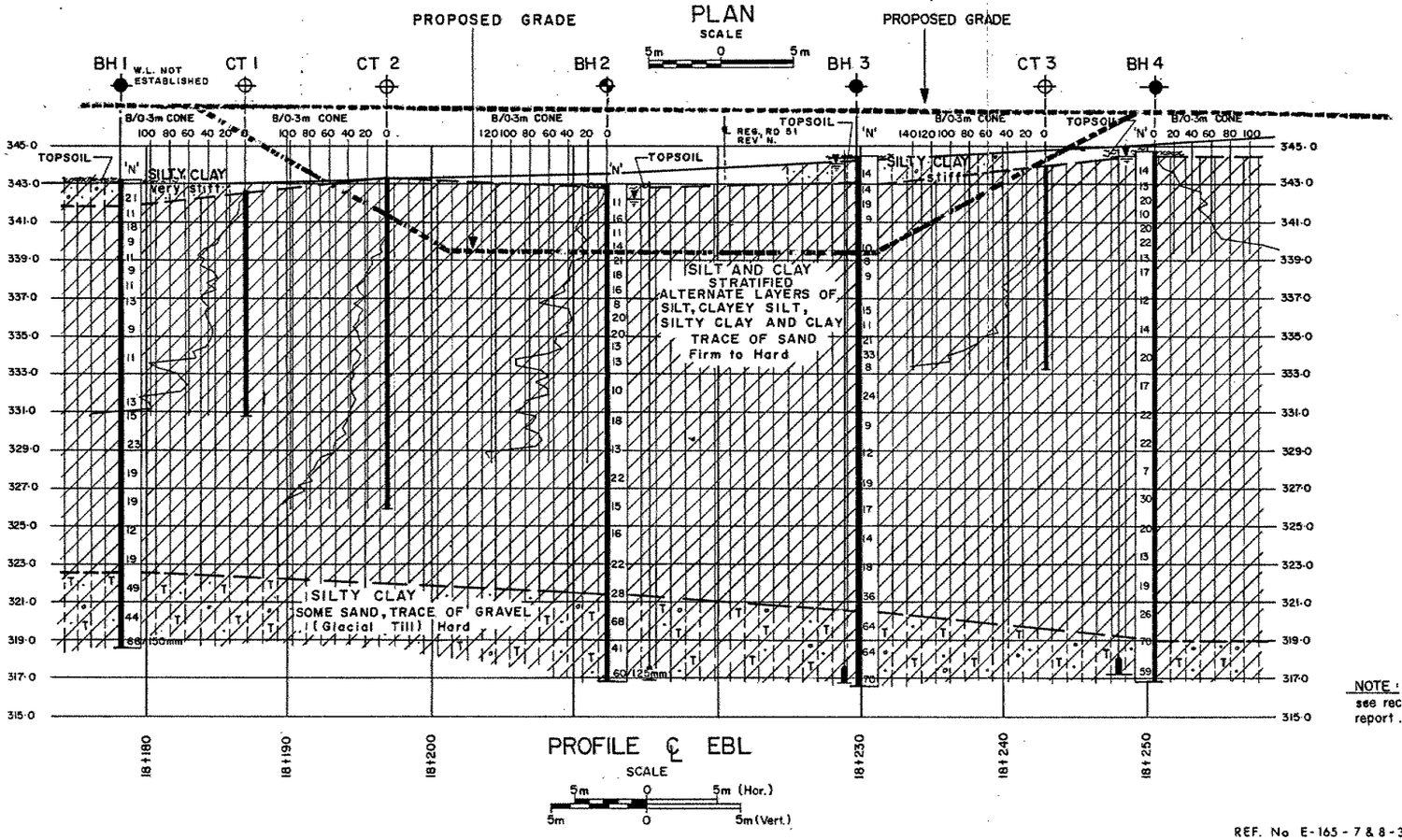
+3, ×5 : Numbers refer to Sensitivity

20
15 ◇ 5 (%) STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION, ONTARIO PH-0-207 88 10



PLAN
SCALE 5m 0 5m



PROFILE ℄ EBL
SCALE 5m 0 5m (Hor.) 5m 0 5m (Vert.)

NOTE : For record of CT4, see records of borehole in report .

REF. No E-165-7 & 8-3, 1989-09

METRIC

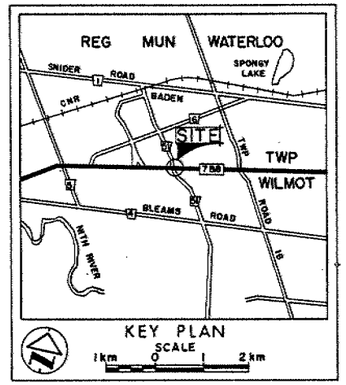
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No
WP No 163-88-01

REG. RD. 51 OVERPASS E.B.L.
BORE HOLE LOCATIONS & SOIL STRATA

SHEET

GEO - CANADA LTD



NOTE :
CONE TESTS # 2,3 and 4 WERE PRE-AUGERED TO VARIOUS DEPTHS PRIOR TO START OF CONE TEST

LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- N Blows/0·3m (Std Pen Test, 475 J/blow)
- CONE Blows/0·3m (60° Cone, 475 J/blow)
- W L at time of investigation 91 01 and 91 02
- Piezometer

No	ELEVATION	CO-ORDINATES NORTH	EAST
BH 1	343·2	4 806 376·0	211 113·0
BH 2	343·0	4 806 366·2	211 149·6
BH 3	344·5	4 806 386·6	211 163·4
BH 4	344·7	4 806 377·8	211 186·0
CT 1	342·7	4 806 365·0	211 124·2
CT 2	343·3	4 806 380·4	211 131·2
CT 3	344·0	4 806 374·0	211 179·2
CT 4	345·1	4 806 389·0	211 179·4

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

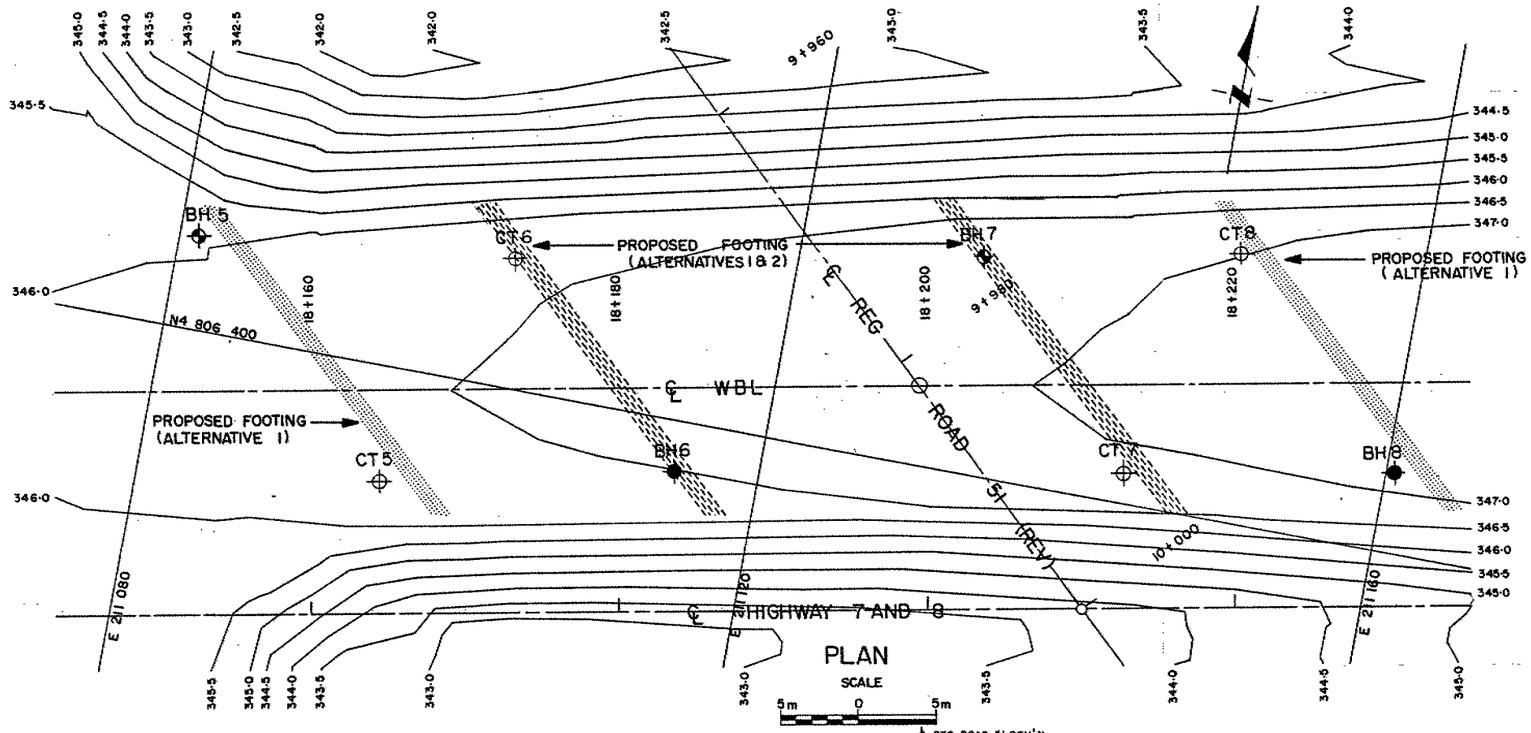
NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

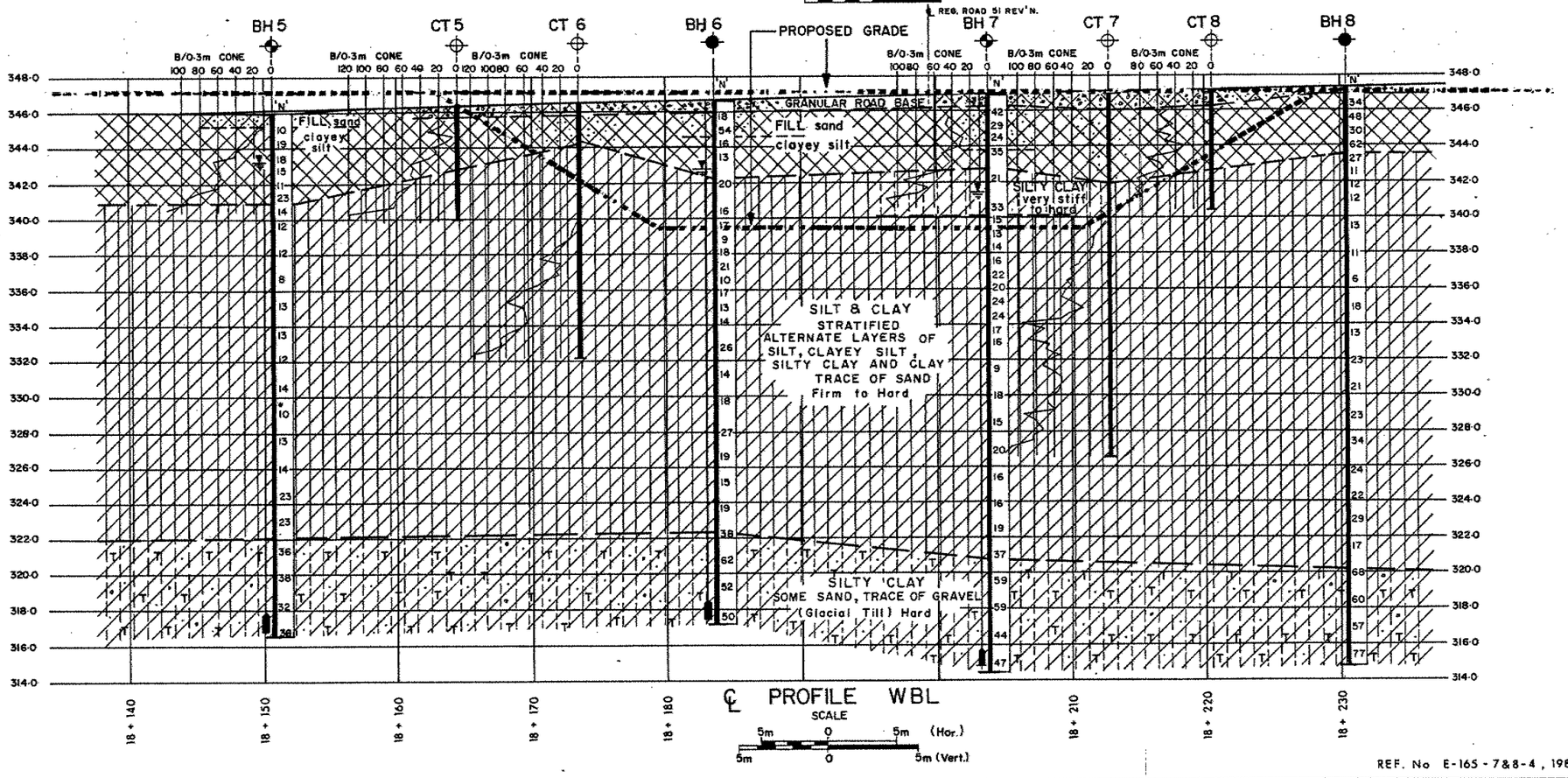
REV.	DATE	BY	DESCRIPTION

Geocres No 40P7-51

HWY No	7 and 8 E. B. L.		DIST 3
SUBM'D JN	CHECKED IPL	DATE 1991 03 15	SITE 33-36IE
DRAWN IRD	CHECKED	APPROVED	DWG 1638801-A

MINISTRY OF TRANSPORTATION, ONTARIO PH-0-207 88.10





REF. No E-165-7&8-4, 1989-09

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No
WP No 163-88-02

REG. RD. 51 OVERPASS W.B.L.
BORE HOLE LOCATIONS & SOIL STRATA

SHEET

GEO-CANADA LTD

SEE DRAWING 1638801-A

KEY PLAN
SCALE

NOTE:
CONE TEST # 5,6,7 and 8 WERE PRE-AUGERED TO VARIOUS DEPTHS PRIOR TO START OF CONE TEST.

LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- W.L at time of investigation 91 01 and 91 02
- Piezometer

No	ELEVATION	CO-ORDINATES NORTH	CO-ORDINATES EAST
BH5	346·0	4 806 406.0	211 081.2
BH6	346·6	4 806 396.6	211 114.6
BH7	346·9	4 806 414.4	211 131.8
BH8	347·3	4 806 405.2	211 160.6
CT5	346·3	4 806 392.4	211 095.8
CT6	346·4	4 806 408.6	211 101.8
CT7	346·9	4 806 402.0	211 143.2
CT8	347·1	4 806 417.6	211 148.0

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

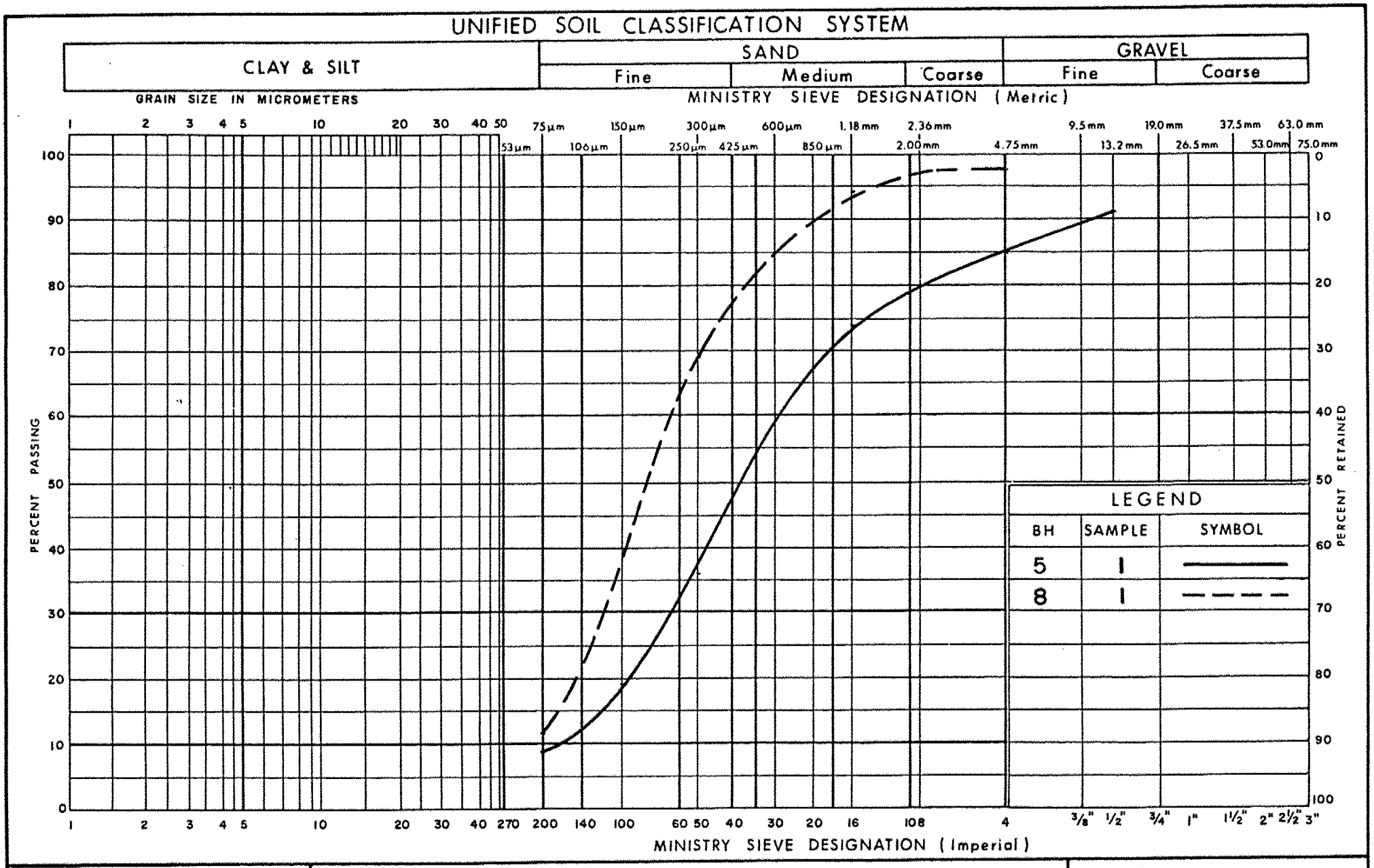
NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

REV	DATE	BY	DESCRIPTION

Geocras No 40P7-51

HWY No	7 and 8 W.B.L.		DIST 3
SUBM'D JN	CHECKED IPL	DATE 1991 03 15	SITE 33-361 W
DRAWN IRD	CHECKED	APPROVED	DWG 1638802-A

78 12 M



Ministry of Transportation
Ontario

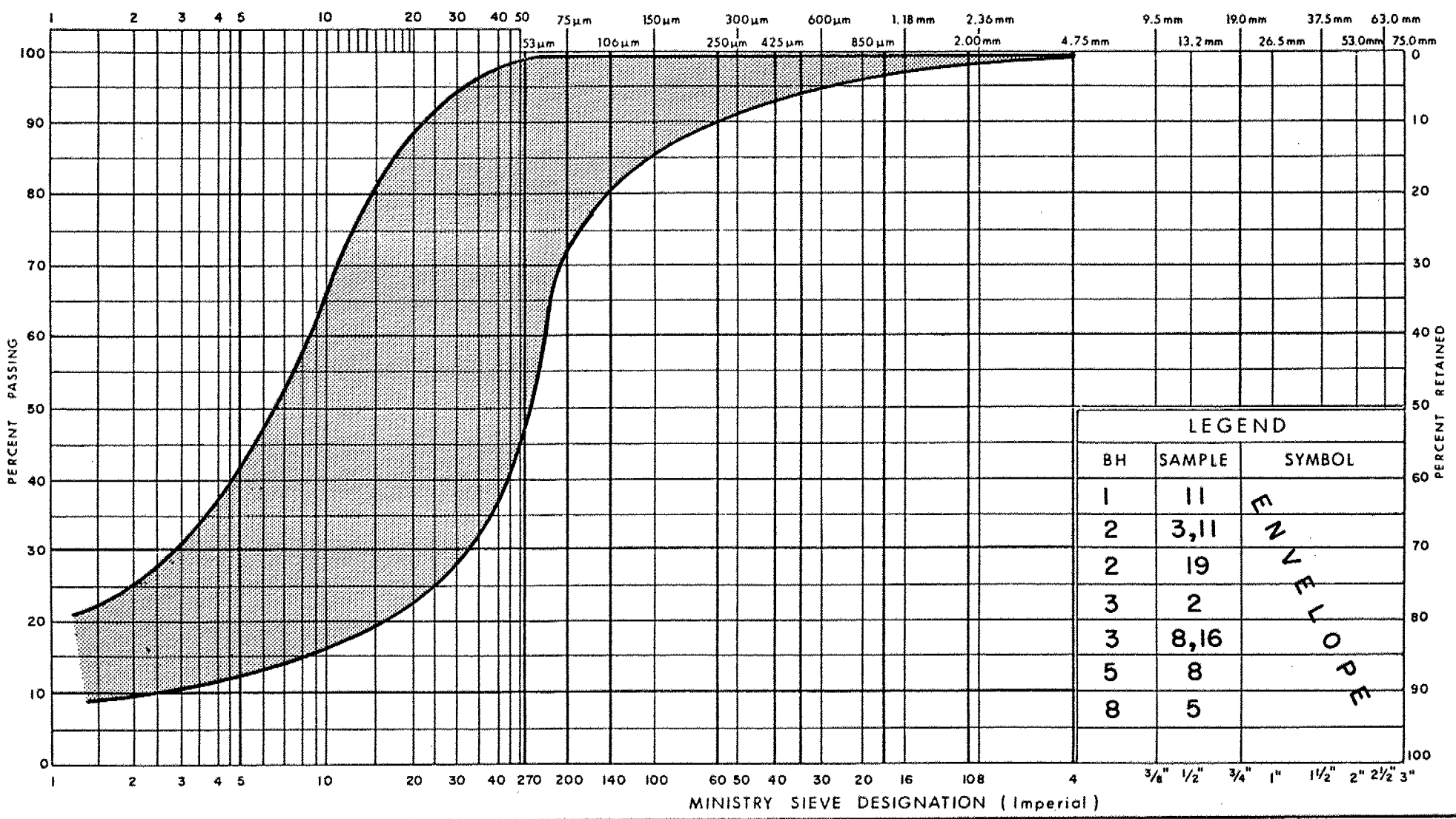
GRAIN SIZE DISTRIBUTION
SAND FILL

FIG No 1
W P 163-88-01/02

78 12 M

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND		
BH	SAMPLE	SYMBOL
1	11	ENVELOPE
2	3,11	
2	19	
3	2	
3	8,16	
5	8	
8	5	

Ministry of Transportation
Ontario

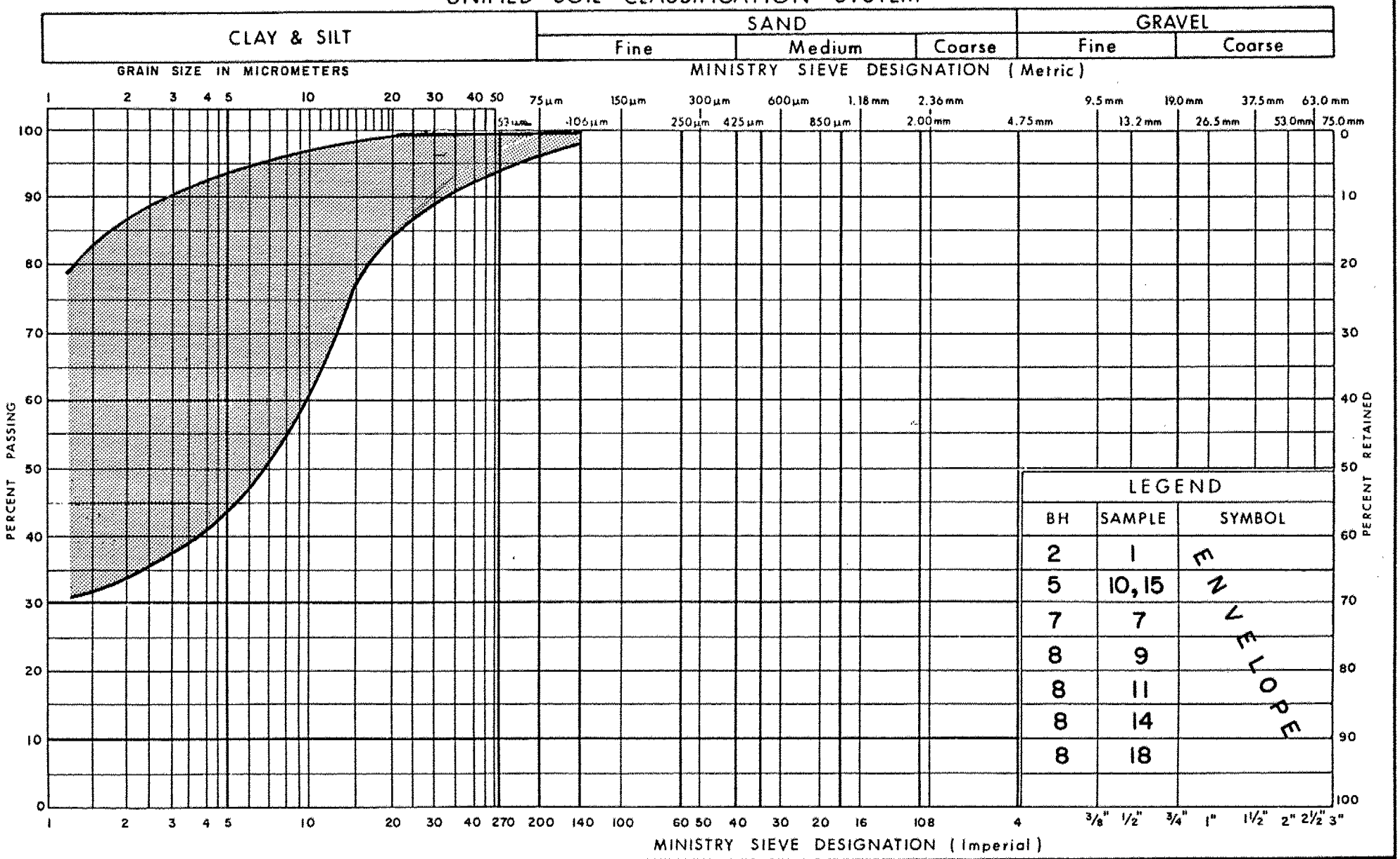
GRAIN SIZE DISTRIBUTION
STRATIFIED SILT AND CLAY
SILT AND CLAYEY SILT LAYERS, TRACE TO SOME SAND

FIG No 2

W P 163-88-01/02

78 12 M

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION
STRATIFIED SILT AND CLAY
SILTY CLAY AND CLAY LAYERS

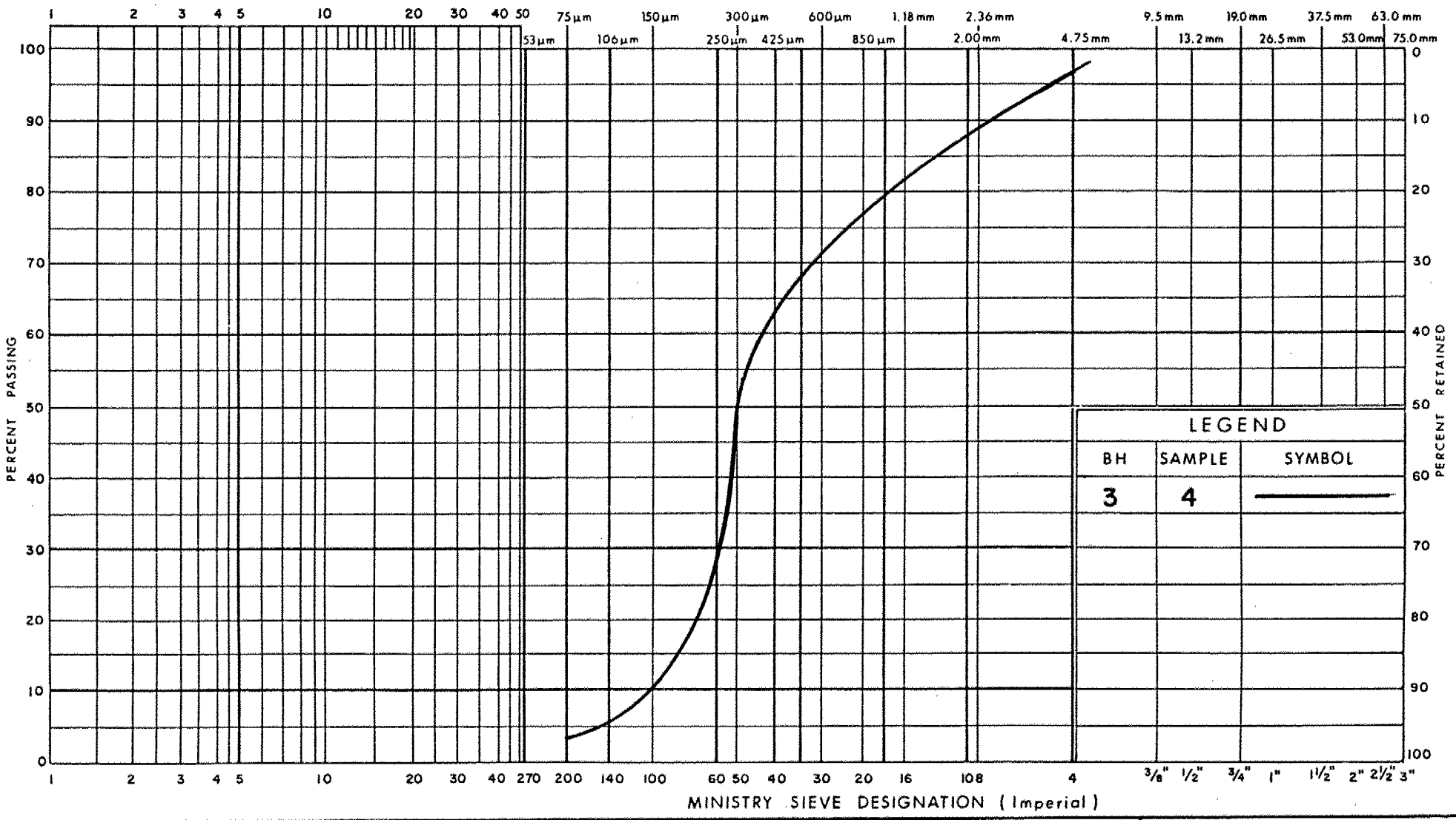
FIG No 3

W P 163-88-01/02

78 12 M

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



Ministry of Transportation
Ontario

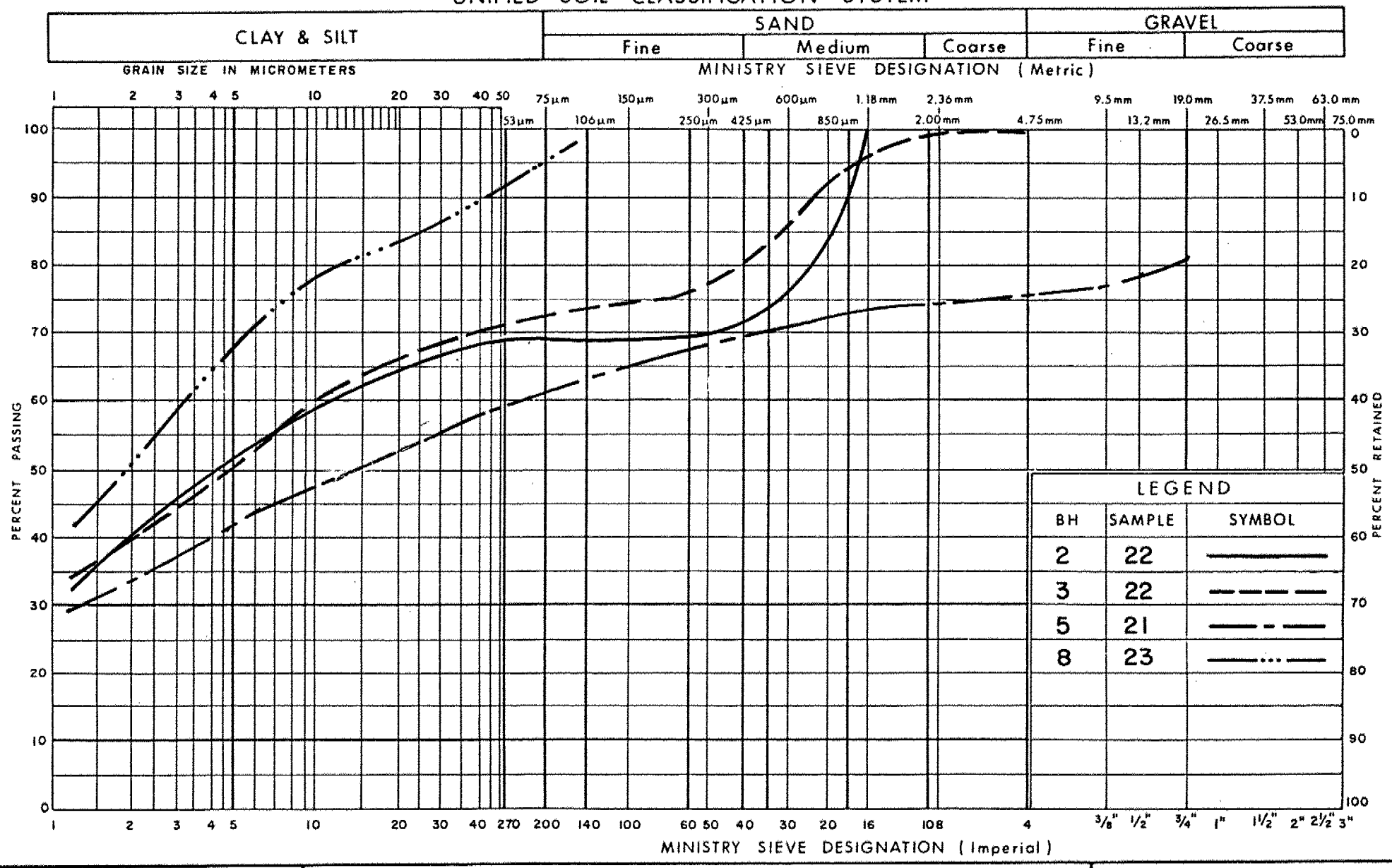
GRAIN SIZE DISTRIBUTION

SAND, TRACE OF GRAVEL AND SILT

FIG No 4

W P 163-88-01/02

UNIFIED SOIL CLASSIFICATION SYSTEM

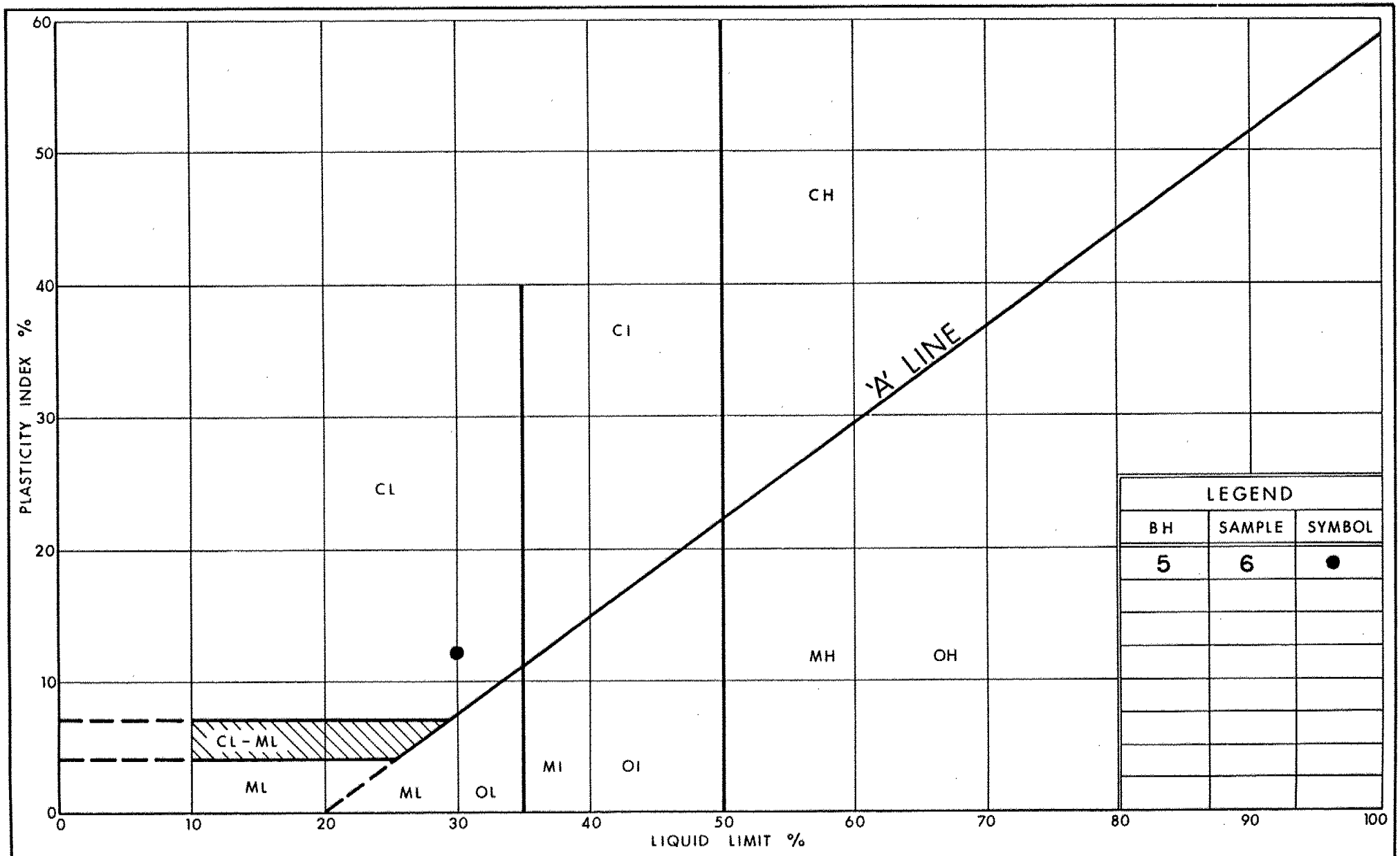


Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

SILTY CLAY WITH TRACE TO SOME SAND AND GRAVEL
(GLACIAL TILL)

FIG No 5
W P 163-88-01/02



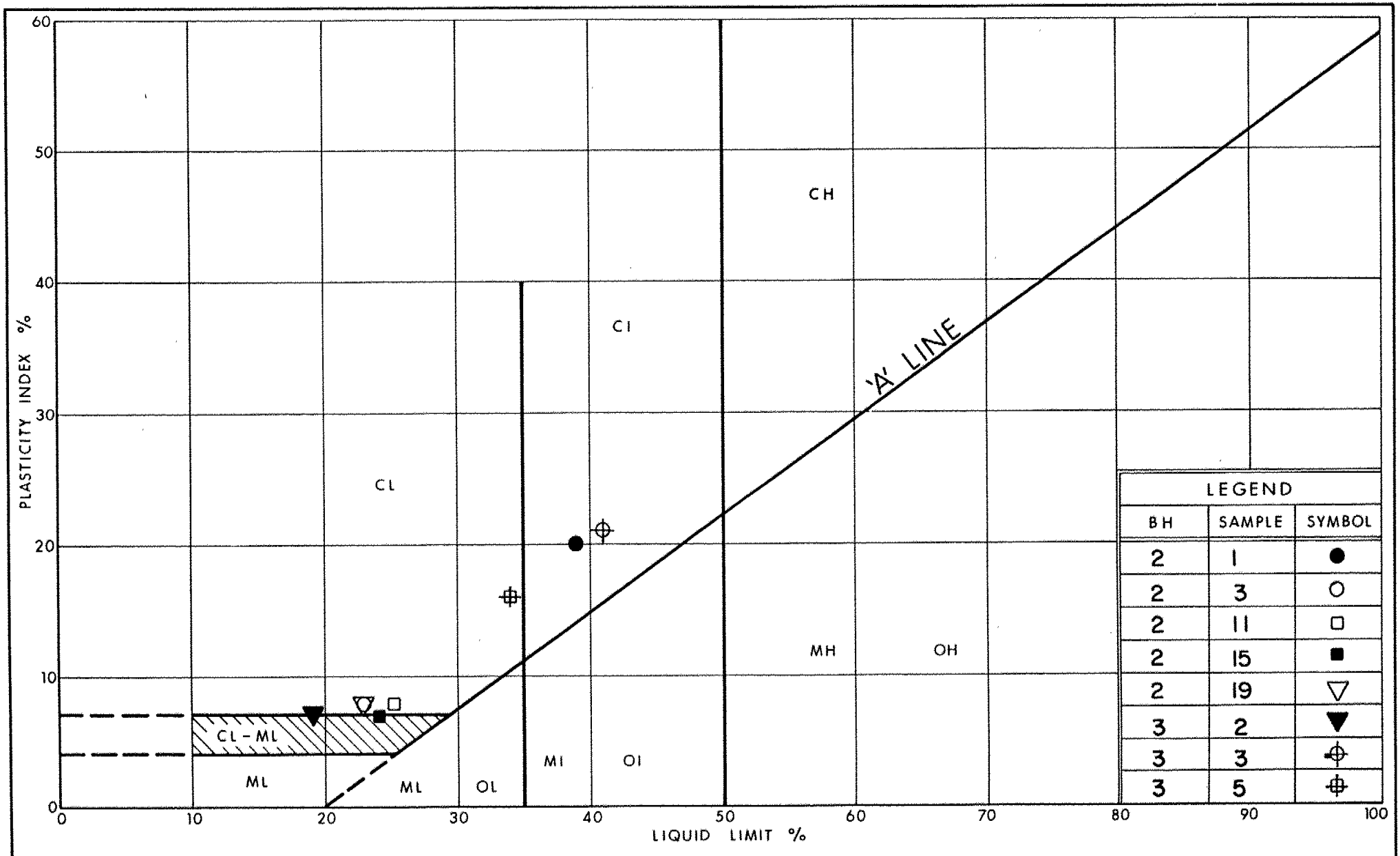
Ministry of Transportation
Ontario

PLASTICITY CHART

CLAYEY SILT FILL

FIG No 6

W P 163-88-01/02

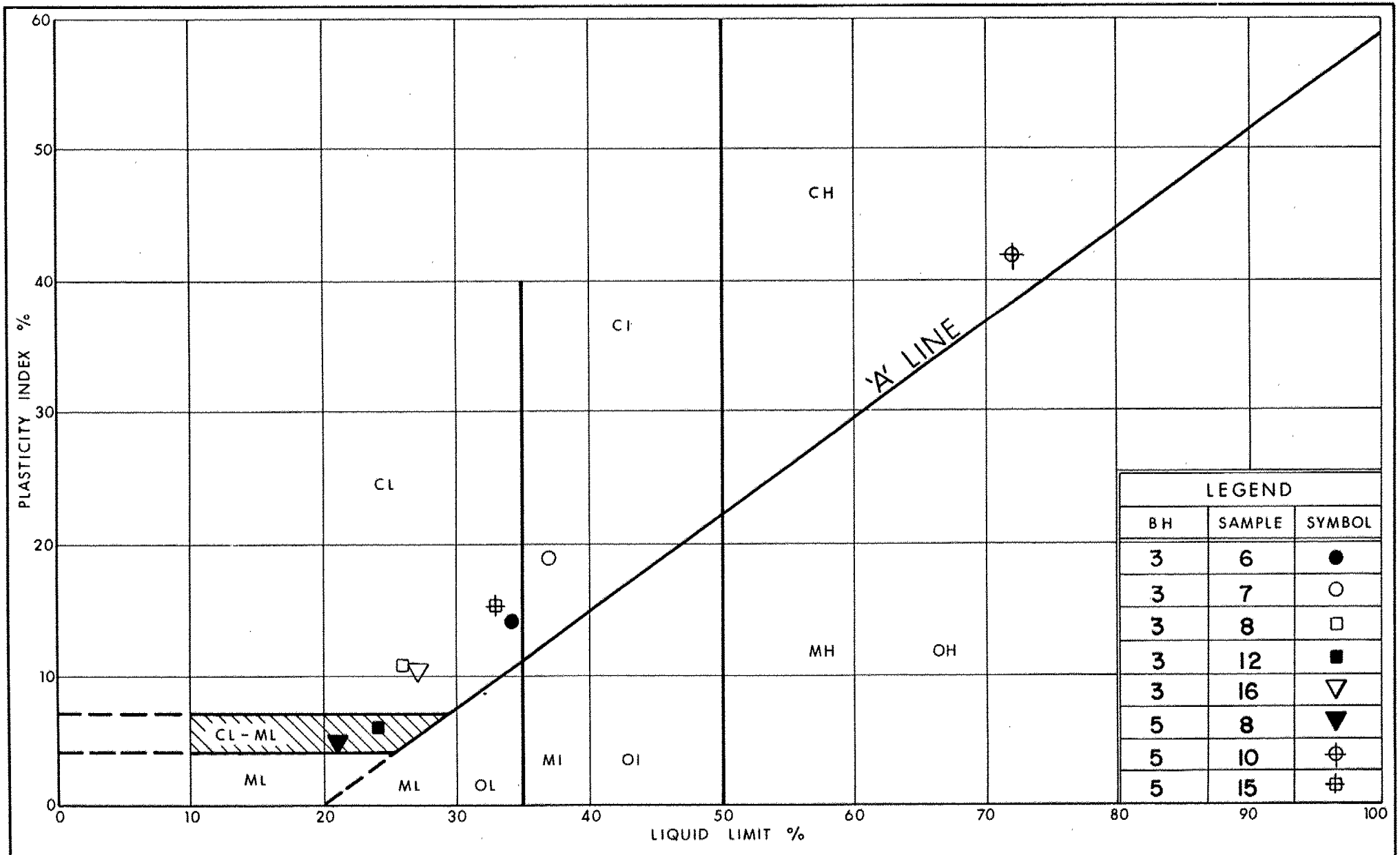


Ministry of Transportation
Ontario

PLASTICITY CHART
STRATIFIED SILT AND CLAY

FIG No 7 A
W P 163-88-01/02

Oct 75, FF-S-21



Ministry of Transportation
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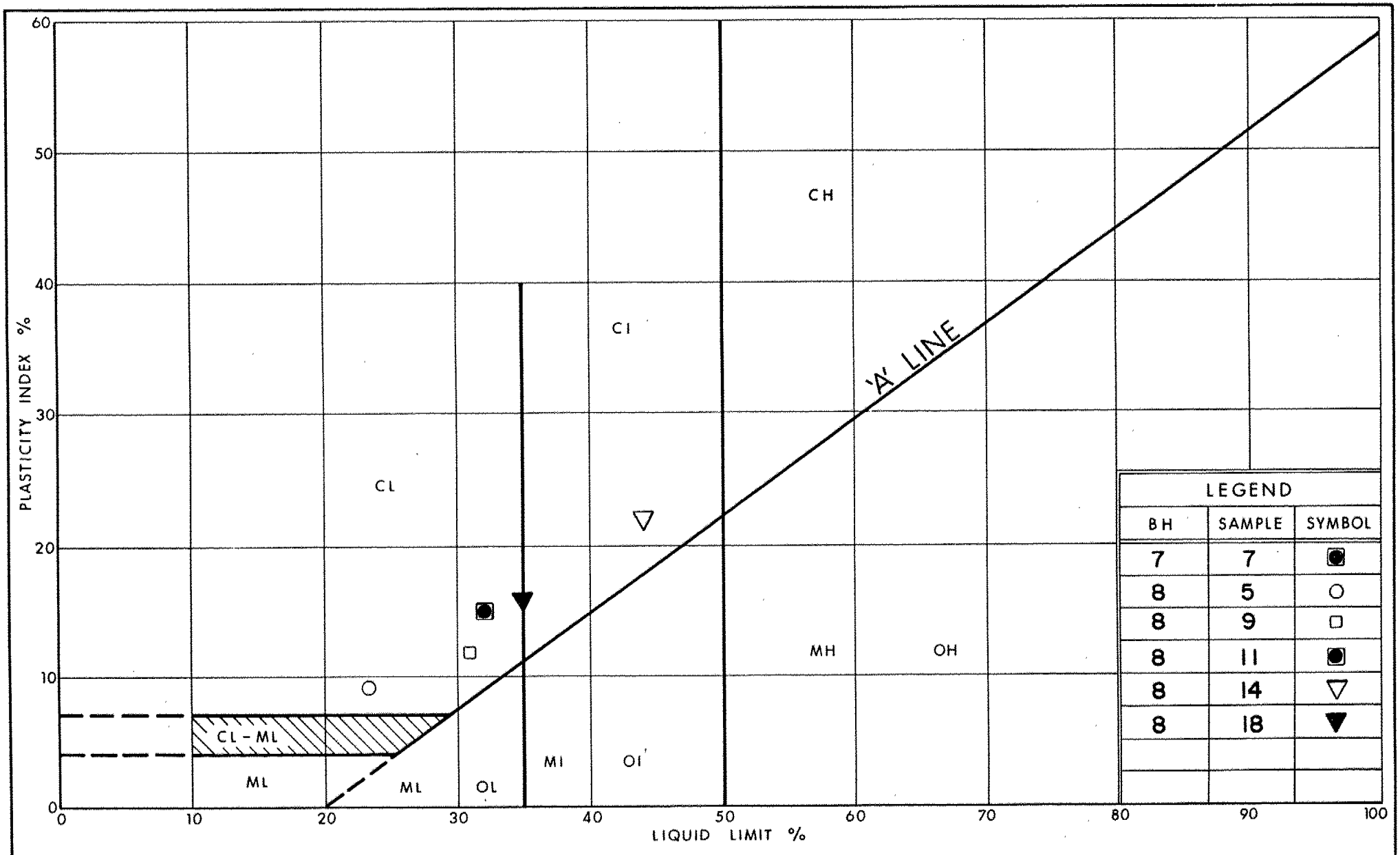
PLASTICITY CHART
STRATIFIED SILT AND CLAY

FIG No 7B
W P 163-88-01/02

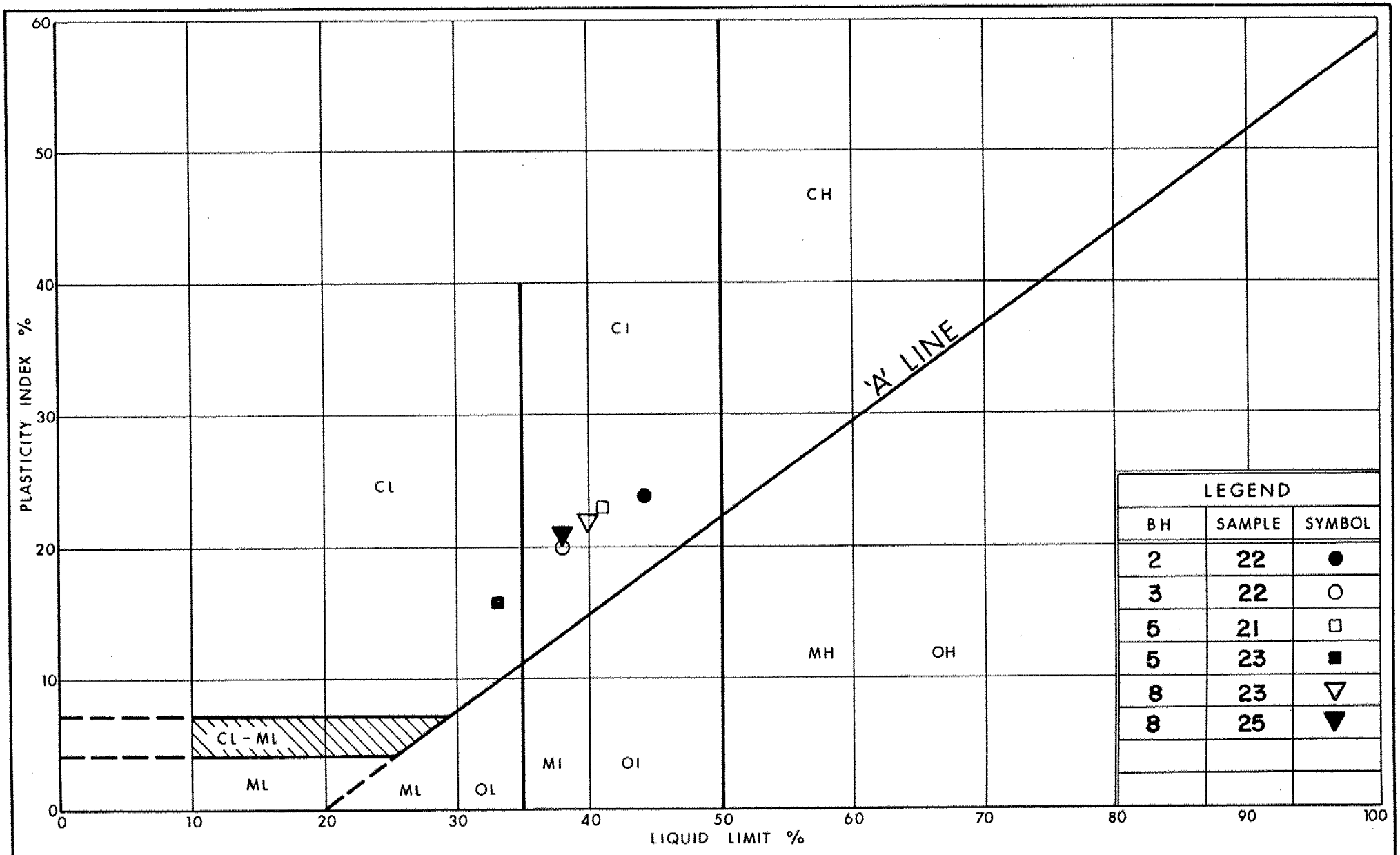


Ministry of Transportation
Ontario

PLASTICITY CHART
STRATIFIED SILT AND CLAY

FIG No 7C
W P 163-88-01/02

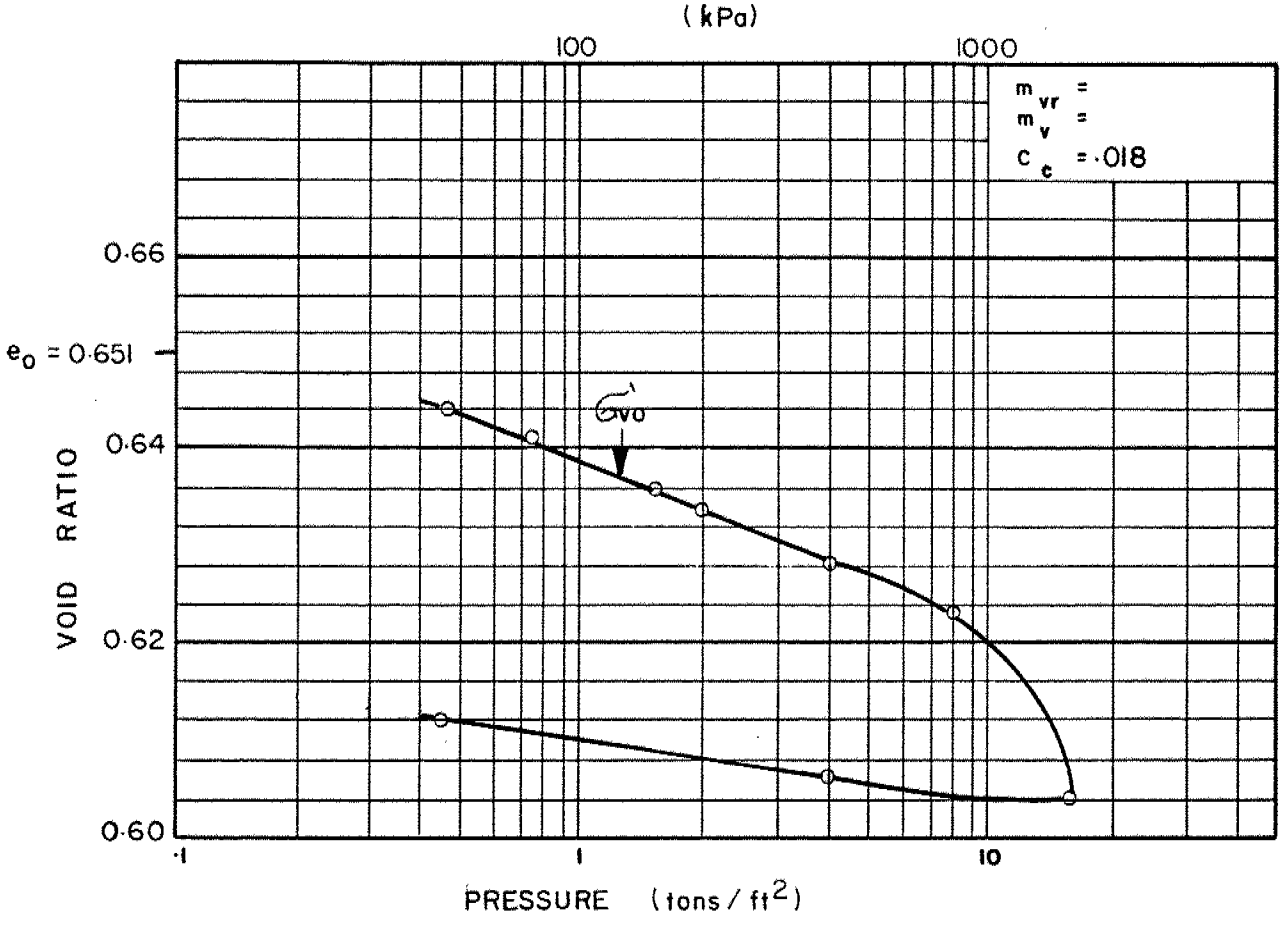
Oct 75, FF-S-21



Ministry of Transportation
Ontario

PLASTICITY CHART
SILTY CLAY
(GLACIAL TILL)

FIG No 8
W P 163-88-01/02



BOREHOLE 1

SAMPLE 11

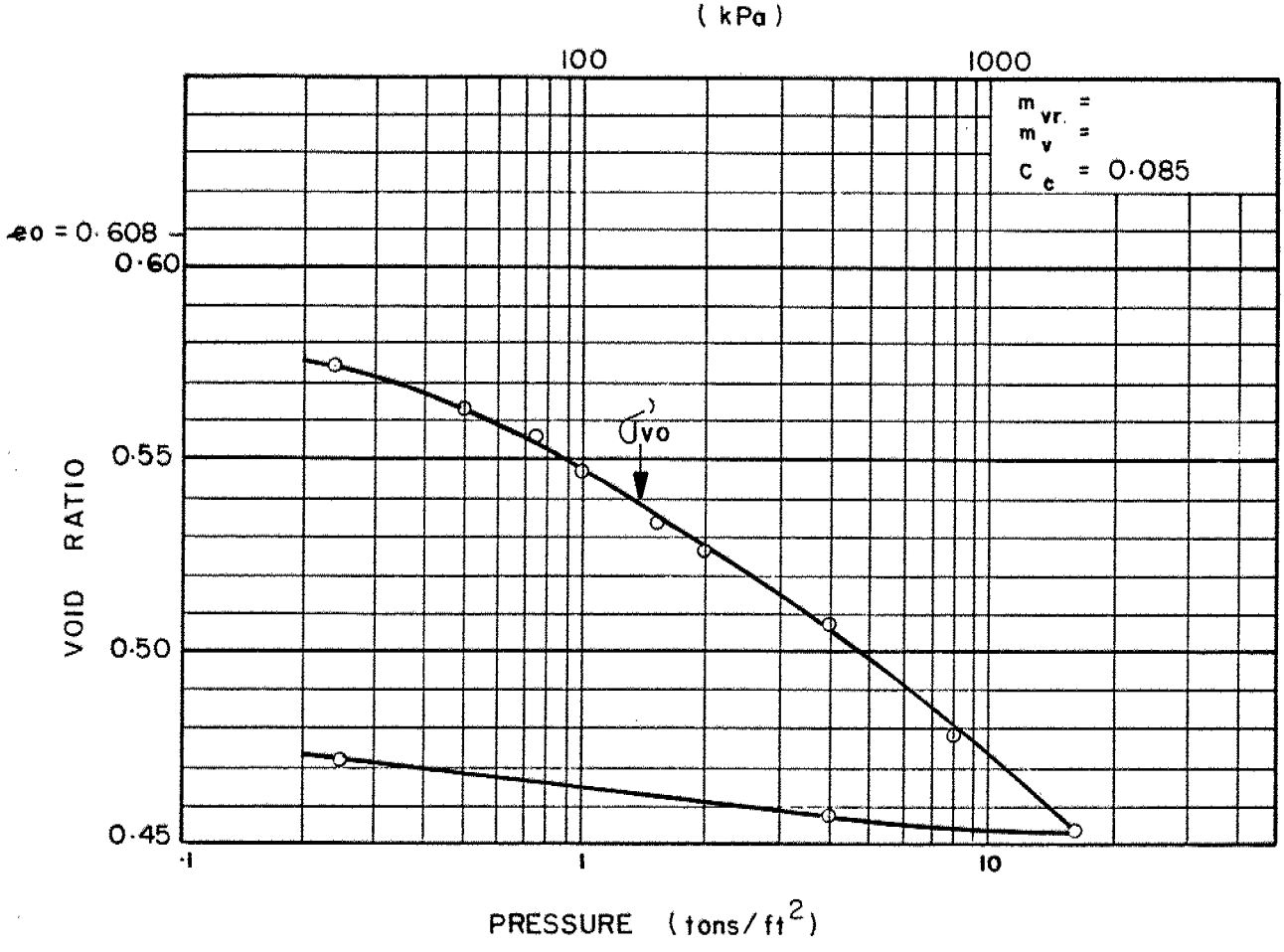
DEPTH/ELEV. 10·7/ 332·5m

CONSOLIDATION TEST

163-88-01/02

FIG. 9

GEO-CANADA LTD.



BOREHOLE 8

SAMPLE 11

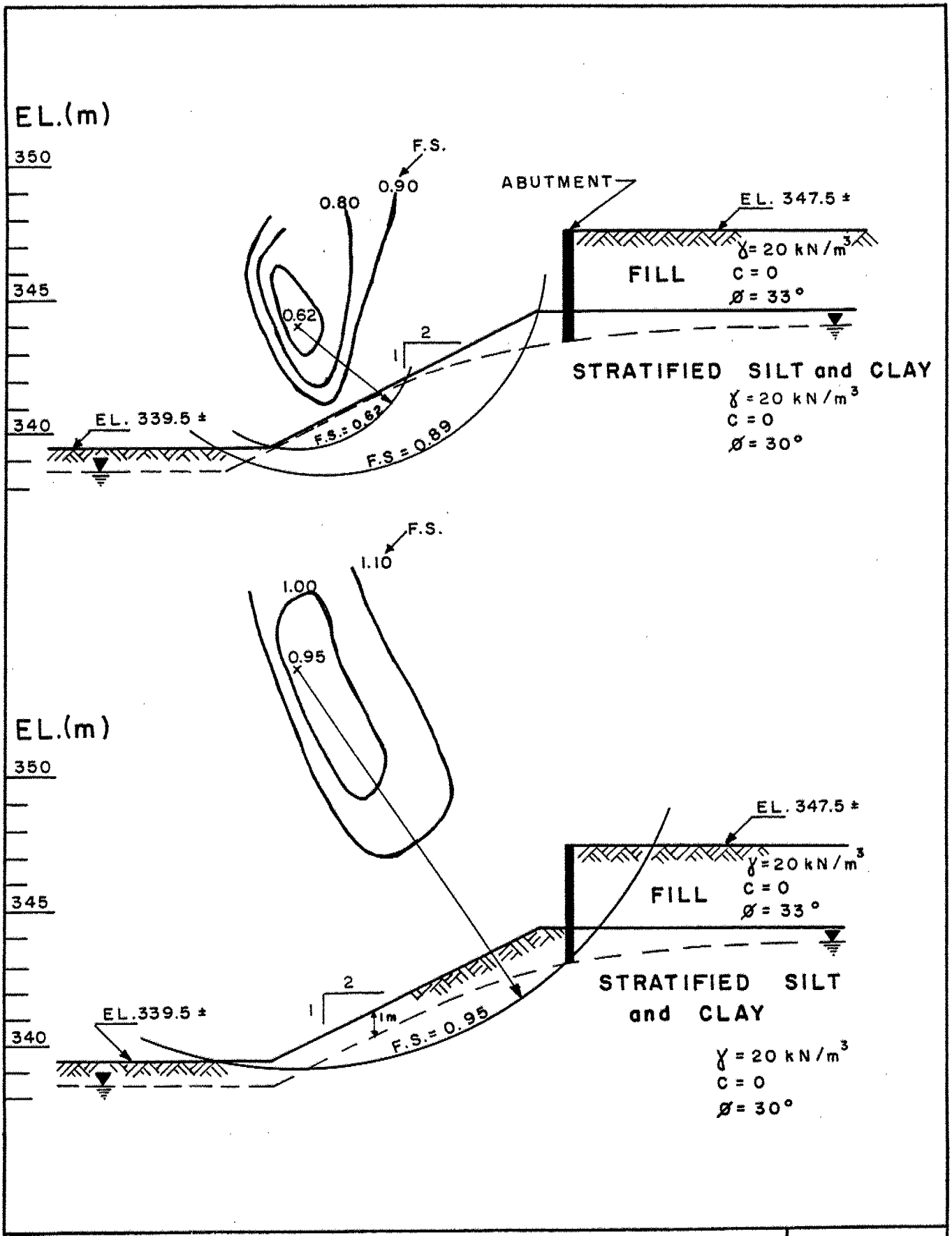
DEPTH/ELEV. 10·8/336·5 m

CONSOLIDATION TEST

163-88-01/02

FIG. 10

GEO-CANADA LTD.

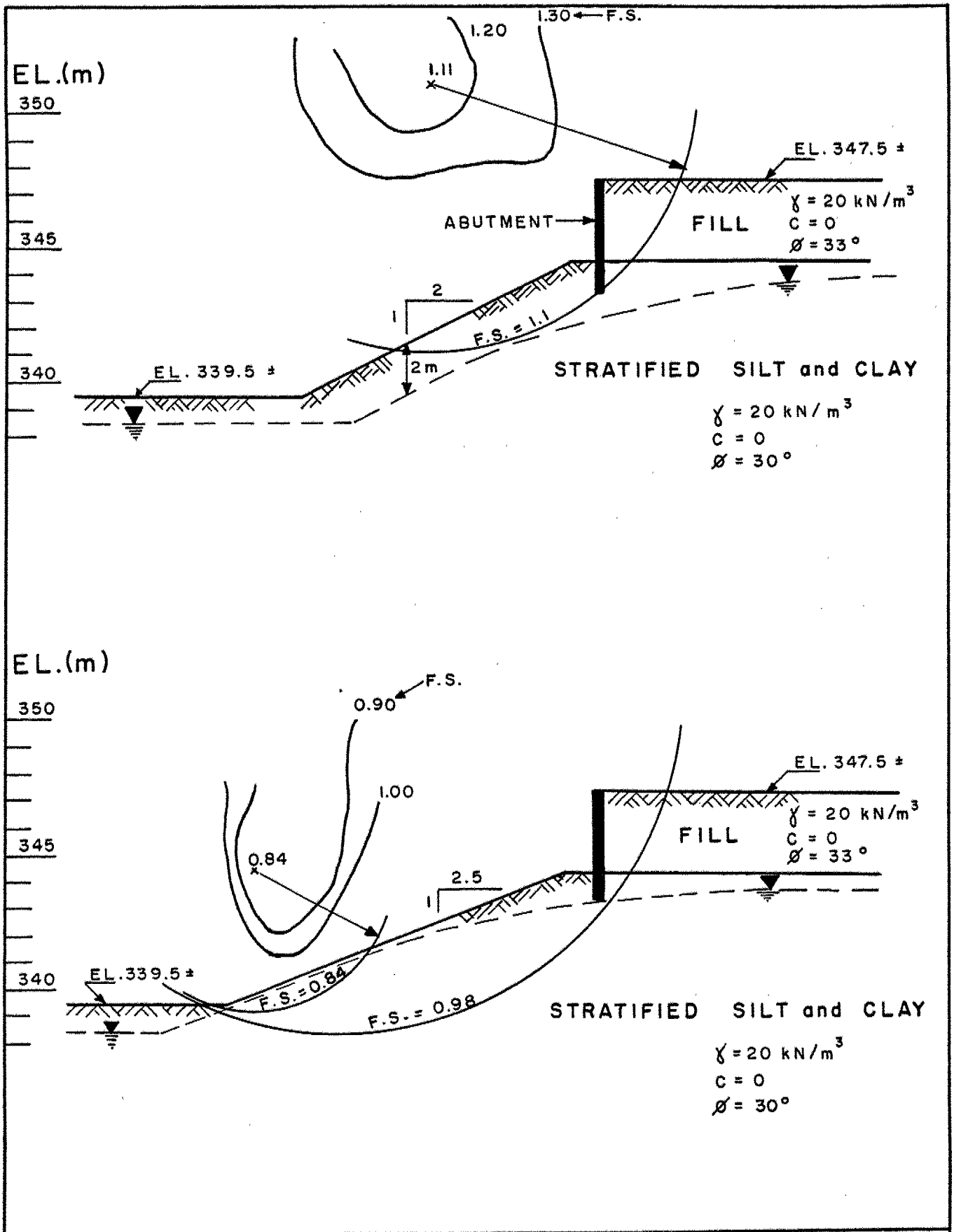


SLOPE PROFILE AND STABILITY ANALYSIS RESULTS

G-91.0101

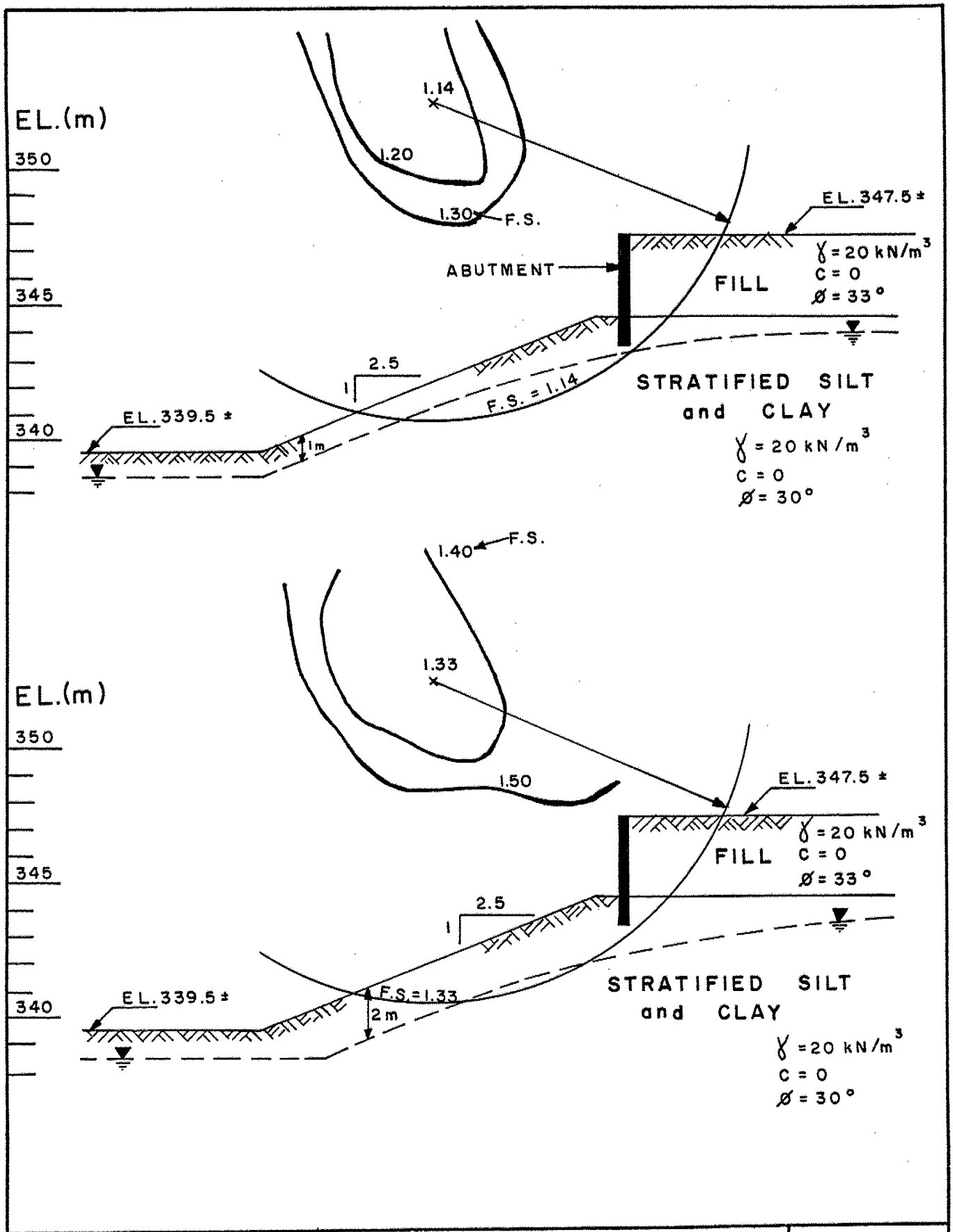
FIG. 11

GEO-CANADA LTD.



SLOPE PROFILE AND STABILITY ANALYSIS RESULTS	G-91.0101 FIG 11A

GEO-CANADA LTD.

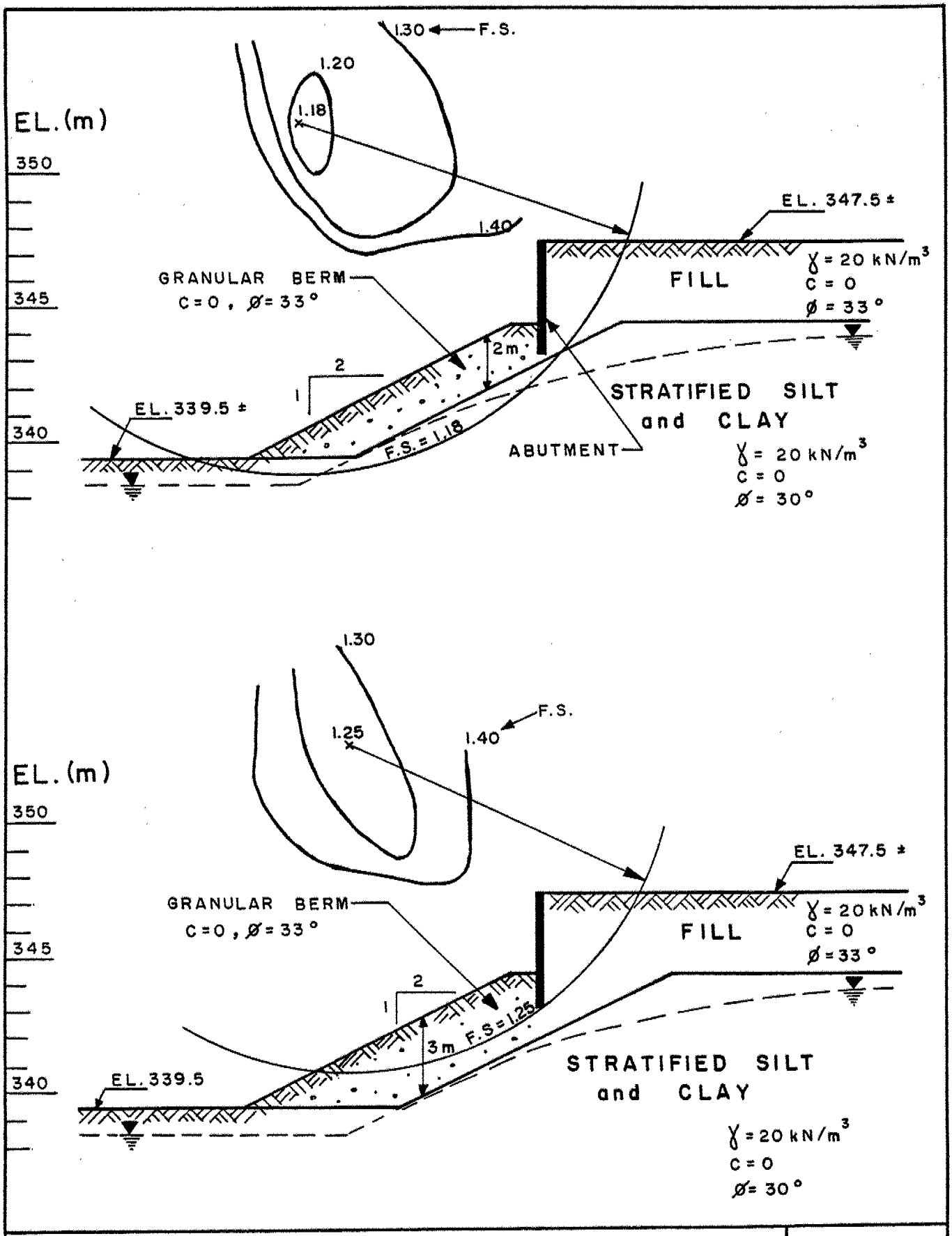


SLOPE PROFILE AND STABILITY ANALYSIS RESULTS

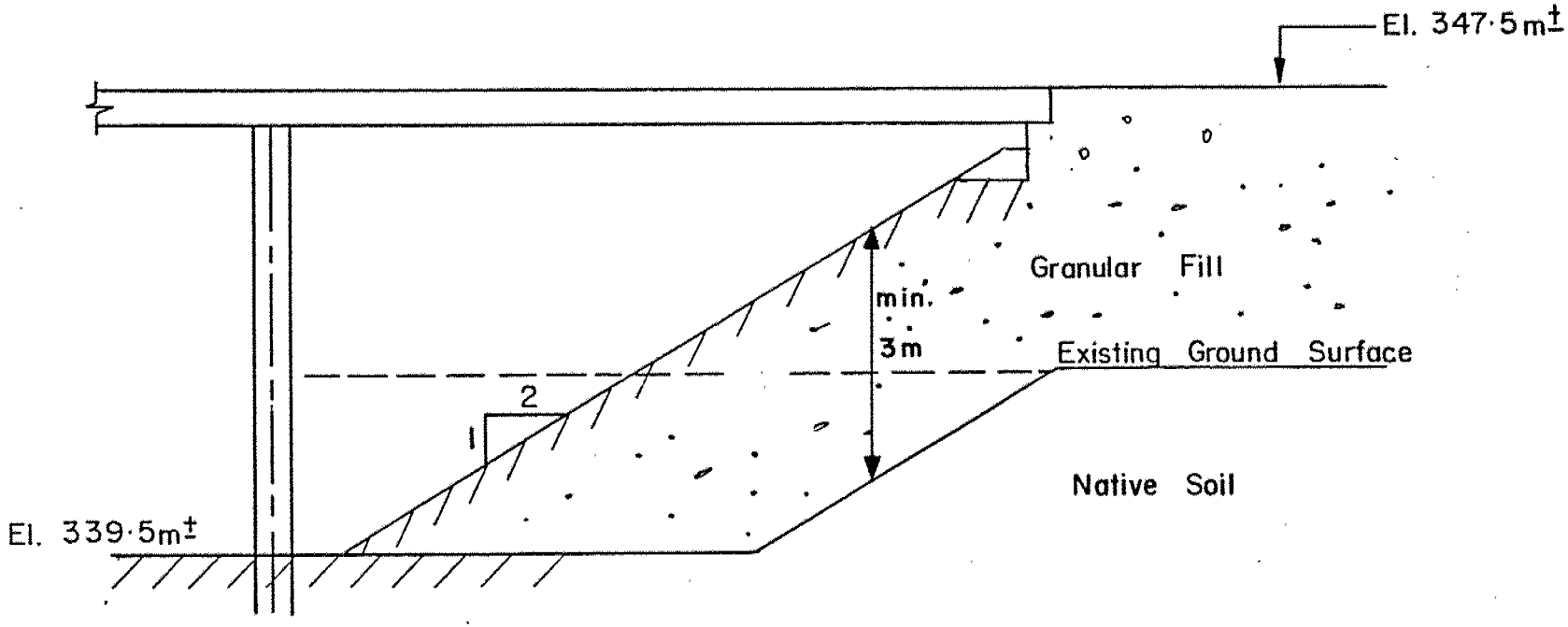
G-91.0101

FIG. 11 B

GEO-CANADA LTD.



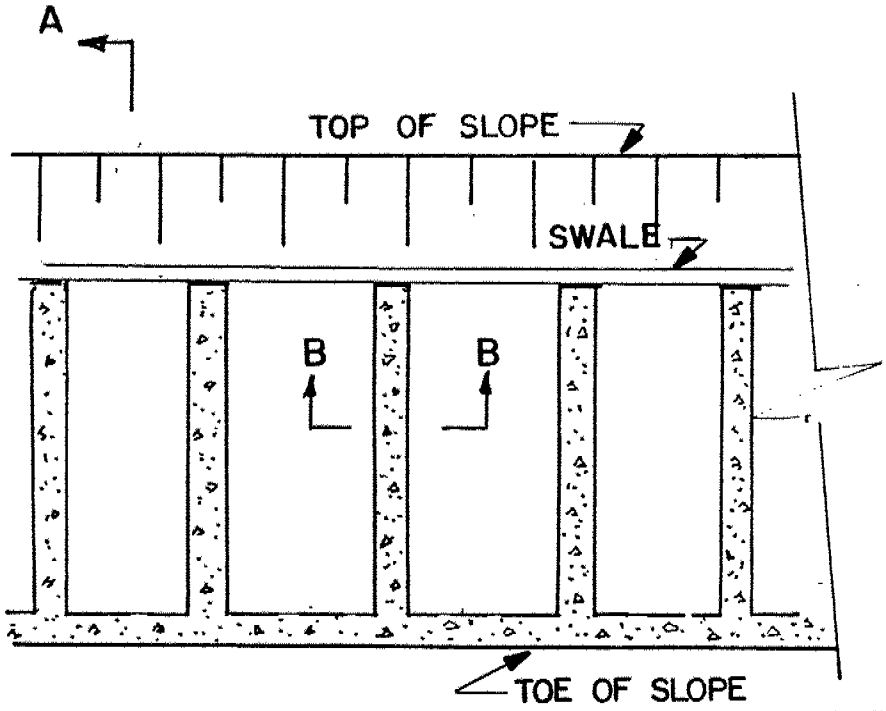
SLOPE PROFILE AND STABILITY ANALYSIS RESULTS	G-91.0101 FIG. 11C



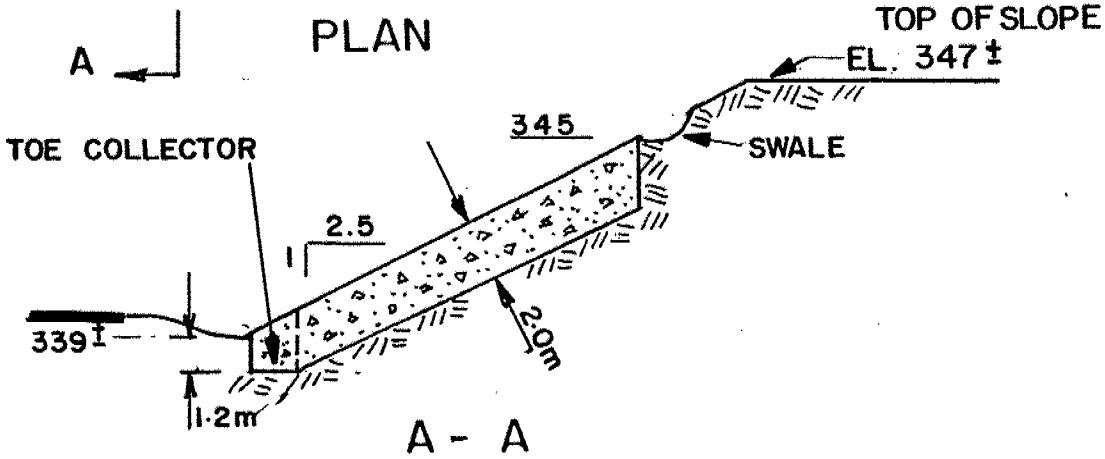
PROPOSED SLOPE TREATMENT
FOR F.S = 1·25

WP 163-88-01/02

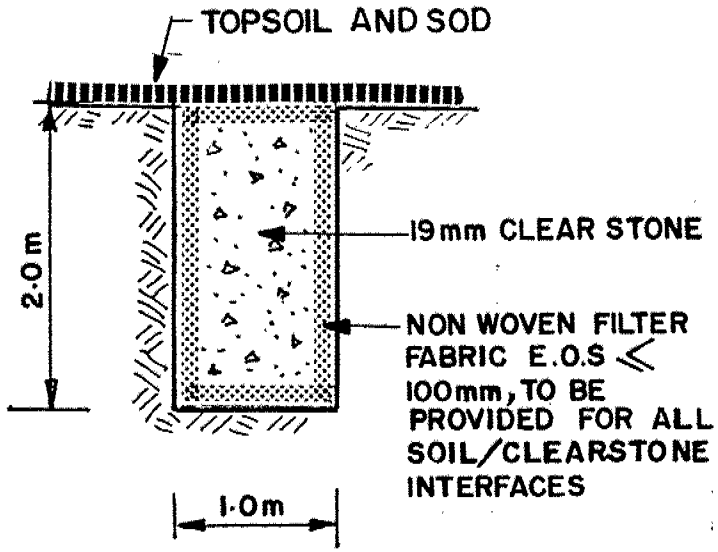
FIG. 12



PLAN



A - A



B - B

NOTE : SPACING OF FRENCH DRAINS 6.0m c/c.

N.T.S.

SCHEMATIC DETAILS OF FRENCH DRAINS

WP 163-88-01/02

FIG. 13