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GEOCRES No. 40I 14 -99

DIST. 2 REGION

W.P. No. 40-66-06/07

CONT. No.

W. O. No.

STR. SITE No. 19 - 532

HWY. No. 402

LOCATION CNR OVERHEAD,

2.4 MILES WEST OF Hwy 2

No OF PAGES -

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:



To: **Memorandum**



To: Mr. A. P. Watt
Regional Structural Planning Engineer
Southwestern Region
London, Ontario

From: Soil Mechanics Section
Engineering Materials Office
West Building, Downsview

Attention:

Date: December 16, 1976

Our File Ref.

In Reply to

40114-104

Subject: REVISED FOUNDATION RECOMMENDATIONS

FOR

W.P. 40-66-04, Site 19-533 - 40114-101A
W.P. 40-66-06, Site 19-532 - 40114-099A
W.P. 40-66-08, Site 19-531 - 40114-100A

INTRODUCTIONS

The grade for Hwy. #402 has been lowered in the vicinity of the above structure sites. According to the present design, the originally planned overpass structures will become underpasses and subways.

Due to these changes the Soil Mechanics Section have been asked to review the validity of the recommendations contained in the previously issued foundation investigation reports for the structures in question. This memo is in compliance with the request. Our summarized and/or revised recommendations for the individual structures are as follows:

COUNTY ROAD #14 UNDERPASS

W.P. 40-66-04 (Formerly W.P. 40-66-04 & 05)

Site 19-533

Co. Middlesex, Con. 2, Twp. Caradoc

Lot 23

District 2 (London)

General Information

Hwy. #402 centreline: Sta: 511 + 39.85 Line "A"

Proposed Profile Grades:

Hwy. #402, El. 778.5± (Formerly El. 812±)

Co. Rd. #14, El. 801± (Formerly same as the existing grade: El. 790)

Average original ground level: El. 783±

Span Lengths: 111' - 111'

Subsurface Conditions

Descriptions are contained in the original foundation investigation report, issued February, 1976.

Recommendations

Recommendations given in the original foundation report are valid except for the following changes:

- a) 12 3/4" O.D. and 1/4" thick wall steel tube piles should achieve a design load of 50 tons per pile if driven to El. 742±.
- b) Due to the grade change, excavations for pier pile caps may be located below the groundwater level, in which case a dewatering scheme will be required to prevent 'boiling' of the foundation soil which consists of sandy silt or silty sand.
- c) The approaches to the structure will have forward slopes part cut and part fill and side slopes of fill only. Provided 2:1 slopes are constructed, no stability problems are anticipated. No bouldery fill should be placed in the approaches at locations through which piles have to be driven. At these locations, the maximum grain sizes should be restricted to 2 inches.

C.N.R. SUBWAY

W.P. 40-66-06 (Formerly W.P. 40-66-06 & 07)

Site 19-532

Co. Middlesex, Con. 2, Twp. Caradoc,

Lot 23

District 2 (London)

General Information

Hwy. #402 centreline: Sta: 492 + 42.25 Line "A" = 100 + 00 C.N.R. RE of NR
Profile Grades:

Hwy. #402, El. 782± (Proposed) (Formerly El. 832±)

Top of rail, El. 804± (Existing and proposed)

Average original ground level: El. 797±

Span Lengths: 36' - 86' - 74' - 36'

Tentatively proposed culverts:

a) 48" Ø pipe culvert

Sta: 98 + 95, Invert El. 775±

b) 8' x 4' concrete box culvert

Sta: 100 + 93, Invert El. 774±

Subsurface Conditions

Description contained in the original foundation investigation report issued December, 1976.

Recommendations

The following changes to recommendations given in the original foundation report are required:

- a) In the case of Franki type piles, the bulbs should be formed at El. 780± for the abutments and at El. 765± for the piers.
- b) For steel tube piles (12 3/4 in. dia.) a design load of 50 tons per pile should be achieved if driven to El. 750±.
- c) The pile caps for the piers will be located below the groundwater level. Therefore, a dewatering scheme will be required to prevent 'boiling' of the fine sand subsoil during excavation.
- d) The pile caps should be protected against frost action with a minimum of 4 feet of earth cover.
- e) Culverts will be located at the following locations: (C.N.R. chainage)
 Sta: 98 + 95: 48" dia. pipe, Invert El. 775±
 Sta: 100 + 93: 8' x 4' conc. box, Invert El. 774±

The inverts of both culverts will be located some 9' - 10' below the observed groundwater level. Consequently, a dewatering scheme will be required for the culverts' installations.

This can be achieved using interlocking steel sheet piles driven to depths below the excavation base equal to the height of the prevailing groundwater level above it.

Both culverts should be installed and backfilled before excavating for the structure footings.

- f) Hwy. #402 will be in an approximate 18 foot deep cut. The lower portion of this cut will be below the groundwater level. It may be necessary to install subdrains at the toes of slopes and an 18" thick blanket of granular 'A' to act as a filter in order to stabilize the lower slopes if they are subject to groundwater seepage. This can be assessed during construction.

The cuts should be constructed with 2:1 slopes.

TWP. ROAD (CON. 3rd) UNDERPASS

W.P. 40-66-08 (Formerly W.P. 40-66-08 & 09)

Site 19-531

Co. Middlesex, Con. 2 & 3, Twp. Caradoc

Lot 23

District 2 (London)

General Information

Hwy. #402 centreline: Sta: 480 + 76.92 Line "A"

Proposed profile grades:

Hwy. #402, El. 787± (Formerly El. 820, Scheme B and El. 826, Scheme A)

Twp. Rd., El. 806± (Formerly same as the existing grade El. 798±)

Average original ground level: El. 797±

Span Lengths: 105' - 105'

Subsurface Conditions

Description contained in the original foundation investigation report issued February, 1976.

Recommendations

According to the new proposal, the following changes in the recommendations are offered:

- a) The underside of the pier footing will be located at El. 780±. At this level, an allowable bearing value of 2.0 t.s.f. may be used for spread footing type foundation.
- b) Franki type displacement piles may be used for footing support. The bulbs of the piles can be formed at El. 780± for the abutments and at El. 770± for the pier.
- c) In the case of 12 3/4" O.D. and 1/4" thick wall steel tube piles, a design load of 50 tons per pile may be achieved at El. 740±.
- d) The observed groundwater level was found to be between El. 784 and El. 788.

Excavations for footings or pile caps carried out below these levels will require a dewatering scheme. The base may 'boil' due to the unbalanced hydrostatic water pressure. If closed interlocking steel sheet piling is incorporated into the scheme, it should be driven to a depth below the base of the excavation equal to the prevailing groundwater pressure head existing above this level.

- e) The embankment material should not contain grain sizes larger than 2 inches.

MISCELLANEOUS

Please ensure that copies of this memorandum are attached to each of the three original foundation investigation reports.

P. Payer

P. Payer

Senior Engineer

For

K. G. Selby

Supervising Engineer

PP/KGS/jf

cc: A.P. Watt (2) ✓
R.S. Pillar
A.E. McKim
B.J. Giroux
G.A. Wrong
A. Wittenberg
J.R. Roy
R. Hore
Files
Record Services





Memorandum

40 I 14 - 99

GEOCREs No.

To: Mr. A.P. Watt (2)
Regional Structural Planning Engineer,
Southwestern Region, London.

From: Soil Mechanics Section,
Geotechnical Office,
West Building, Downsview.

Attention:

Date: November 27, 1975.

Our File Ref.

In Reply to

DEC 08 1975

Subject:

FOUNDATION INVESTIGATION REPORT

W.P. 40-66-06/07
Site 19-532
Hwy. 402 District 2
CNR Overhead EBL/WBL
2.4 Miles West of Hwy. 2

Attached we are forwarding to you our detailed Foundation Investigation Report on the subsoil conditions existing at the above mentioned site.

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

K.G. SELBY,
Supervising Engineer.

cc: E.J. Orr
B.R. Davis
B.J. Giroux
G.A. Wrong
A. Wittenberg
J.R. Roy
D.P. Collins
R. Hore
J. Anderson)
A. Crowley) memo only
G. Sloan)
Files
Record Services

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FOUNDATION INVESTIGATION REPORT

W.P. 40-66-06/07
Site 19-532
Hwy. 402 District 2
CNR Overhead EBL/WBL
2.4 Miles West of Hwy. 2

1. INTRODUCTION

This report is to provide information for the design and construction of the proposed structure and its approaches at the above mentioned site. The subsoil information is based on eight sampled boreholes and four dynamic cone penetration tests.

2. SITE DESCRIPTION

The proposed site is in the Township of Caradoc two miles east of the Town of Mount Brydges. The railway runs on a low embankment raising it about six feet above the surrounding land which is gently rolling. A tobacco farm is situated to the south of the railway property while to the north there is a mixed hardwood bush.

Physiographically, the area in which the site is located is referred to as the 'Caradoc Sand Plain'.

3. SUBSOIL

(3.1) General

Subsoil consists of about 60 feet of sand laid down as a deltatic deposit at an early postglacial outlet of the Thames River. Beneath this is approximately 50 feet of silt containing varying amounts of fine sand and some clay, which in turn overlies a deposit of silty clay which was penetrated to a shallow depth by the deepest borehole.

(3.2) Sand

Sand extends from the surface to a depth of from 55 to 75 feet. The upper portion of the deposit (25 feet in thickness)

consists primarily of fine sand but does contain varying amounts of silt (grain size distribution shown as an envelope in Figure 1). Concentrations of silt generally range from the low thirties near the surface to less than 10% at the 25 foot level. There are, however, occasional pockets with much higher silt contents. The middle portion of the deposit (approximately 10 feet in thickness) is a well graded sand containing a trace of both silt and gravel (grain size distribution shown as an envelope in Figure 2). The lower portion of the deposit (up to 45 feet in thickness) is generally fine sand with a silt content of less than 10%. There are, however, pockets with much higher silt contents. The relative density of the deposit is highly variable ranging from loose to very dense. Standard Penetration 'N' values varied from four to in excess of 100 blows per foot with the very low blows being found in the upper ten feet. Laboratory tests indicate a moisture content of approximately 20% for the fine sand below the water table and 15% for the well graded sand.

(3.3) Silt Some Clay

This deposit found below the sand is approximately 50 feet in thickness. It is primarily silt but contains enough clay to give some slight plasticity to portions of the deposit. Its relative density is compact to dense with Standard Penetration 'N' values ranging from 25 to over 50.

(3.4) Silty Clay

This deposit found some 120 feet below the surface has a very stiff consistency. It is highly plastic and has a moisture content close to 30%.

(3.5) Groundwater

Groundwater was encountered in the fine sand at approximate elevation 783.

4. DISCUSSION AND RECOMMENDATIONS

(4.1) General

Highway 402 will pass over the CNR tracks on a three span structure with each span being 45 feet in length. Approach embankments will be approximately 35 feet in height.

(4.2) Franki Piles

Any or all of the structure footings may be supported on Franki type displacement caissons. To form these piles the drive tube should be advanced to elevation 780 with the bulb of the pile formed below this elevation. Piles with the following shaft diameters (inside diameter of the drive tube) will develop the following design bearing capacities.

14 in. - 70 tons
18 in. - 125 tons
22 in. - 150 tons

The cost of installing these piles complete with all material other than reinforcing steel may be estimated assuming \$25.00, \$28.00 and \$32.00 per linear foot for the 14 inch, 18 inch and 22 inch types, respectively.

(4.3) Steel Tube Piles

Alternatively, the structure footings may be supported on steel tube piles (12-3/4" x 1/2") driven to elevation 760. A safe design load of 35 tons per pile should be assumed for design purposes. Any horizontal loading should be resisted by battered piles.

(4.4) Dewatering

No dewatering problems are anticipated as the pile caps will be founded above the groundwater level.

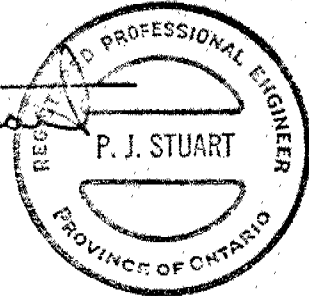
(4.5) Settlements

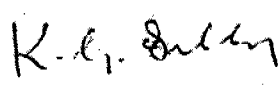
Settlements of the pile caps, which will occur as the load is applied, will be less than 1 inch.

(4.6) Approach Embankments

No stability problems are anticipated with embankment fills (35 feet) if 2:1 slopes are employed. Cobbles exceeding a 3 inch diameter should be removed from fill placed at locations through which piles have to be driven.


P. STUART,
Project Engineer.




K.G. SELBY,
Supervising Engineer.

November, 1975

APPENDIX

RECORD OF BOREHOLE NO 1

WP 40-66-06/07 LOCATION Co-ords. 15,598,253 N; 1,276,754 E. ORIGINATED BY PJS
 DIST 2 HWY 402 BORING DATE Oct. 1 to 3, 1975 COMPILED BY GP
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger (3 1/2") CHECKED BY GP

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	W_P	W	W_L		
795.8	Ground Level															GR SA SI CL
0.0			1	SS	5	790										
	Silt		2	SS	23											0 25 71 4
	Fine sand, some to a trace of silt		3	SS	45											0 86 (14)
	Loose to Very Dense		4	SS	52	780										
			5	SS	14											
	Well Graded Sand		6	SS	40	770										0 94 (6)
			7	SS	72											
			8	SS	23	760										0 96 (4)
			9	SS	37											
			10	SS	67	750										0 98 (2)
744.3			11	SS	92											
51.5	End of Borehole															

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

RECORD OF BOREHOLE NO 2

WP 40-66-06/07 LOCATION Co-ords. 15,598,140 N; 1,276,663 E. ORIGINATED BY PJS
 DIST 2 HWY 402 BORING DATE Oct. 3 to 6, 1975 COMPILED BY GP
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger (3 1/2") CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W	UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	W_P — W — W_L WATER CONTENT % 10 20 30		
796.4	Ground Level									GR SA SI CL
0.0	Fine sand, with to a trace of silt		1	SS	6	790				0 68 (32)
			2	SS	19					
			3	SS	37					
	Loose to Very Dense		4	SS	43	780				0 71 (29)
			5	SS	15					
			6	SS	34					0 93 (7)
			7	SS	24					
	Well Graded Sand		8	SS	64	770				7 84 (9)
			9	SS	29					
			10	SS	95	760				0 91 (9)
			11	SS	58					
			12	SS	50	750				
	Silt		13	SS	154	740				0 23 73 4
			14	SS	71					
736.4										
60.0	Silt, some clay		15	SS	35	730				0 0 85 15
			16	SS	25	720				
	Compact to Dense		17	SS	37	710				
692.4						700				
104.0										

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

RECORD OF BOREHOLE NO 2 Continued

WP 40-66-06/07 LOCATION Co-ords. 15,598,140 N: 1,276,663 E. ORIGINATED BY PJS
DIST 2 HWY 402 BORING DATE October 3 to 6, 1975 COMPILED BY GP
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger (3 1/2") CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	W_P	W	W_L		
692.4	Continued															
104.0	Silt, some clay		18	SS	26	690										
684.4	Compact to Dense															
112.0	Silty clay					680										
	Very Stiff															
674.9			19	SS	27											
121.5	End of Borehole															
	Note: W.L. not established															

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 3

WP 40-66-06/07 LOCATION Co-ords. 15,598,249 N: 1,276,709 E. ORIGINATED BY PJS
 DIST 2 HWY 402 BORING DATE Oct. 7, 1975 COMPILED BY GP
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger, 'B' Casing CHECKED BY *GP*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT				LIMIT			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	100	W _p	W _L	W _p		
792.5	Ground Level														
0.0	Fine sand, some to a trace of silt		1	SS	5	790									0 73 (27)
			2	SS	13										
			3	SS	12										
	Loose to Very Dense		4	SS	42	780									0 84 (16)
			5	SS	41										
			6	SS	16										
			7	SS	18										
	Well Graded Sand		8	SS	42	770									8 86 (6)
			9	SS	31										
			10	SS	13										
			11	SS	87	760									
			12	SS	36										
			13	SS	19	750									0 98 (2)
			14	SS	54										
738.5						740									
54.0	Silt, some sand		15	SS	52										0 17 77 6
736.0	Very Dense														
56.5	End of Borehole														

RECORD OF BOREHOLE NO 4

WP 40-66-06/07 LOCATION Co-ords. 15,598,193N: 1,276,665E ORIGINATED BY FJS
 DIST 2 HWY 402 BORING DATE October 8, 1975 COMPILED BY GP
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W			UNIT WEIGHT Y	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	W _P	W	W _L		
792.5	Ground Level															
0.0	Fine sand, with to a trace of silt		1	SS	10	790							o			0 62 (38)
			2	SS	23											
	Loose to Very Dense		3	SS	7											
			4	SS	20	780										0 90 (10)
			5	SS	18											
			6	SS	14								o			0 96 (4)
			7	SS	33											
	Well Graded Sand		8	SS	38	770							o			2 96 (2)
			9	SS	57											
			10	SS	43								o			
			11	SS	29	760										
			12	SS	100/7"											
			13	SS	39											
			14	SS	150	750										
			15	SS	150								o			0 88 (12)
736.2			16	SS	141/10"	740										
56.3	End of Borehole Note: W.L. not established															

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 5

WP 40-66-06/07 LOCATION Cor-ords. 15,598,310 N; 1,276,672 E. ORIGINATED BY PJS
 DIST 2 HWY 402 BORING DATE October 10, 1975 COMPILED BY GP
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
795.1	Ground Level															
0.0	Fine sand, with to a trace of silt		1	SS	7	790										0 71 (29)
			2	SS	17											
			3	SS	19											
	Loose to Very Dense		4	SS	22											
			5	SS	34	780										0 91 (9) 0 97 (3)
			6	SS	27											
			7	SS	18											
	Well Graded Sand		8	SS	41	770										9 85 (6)
			9	SS	45											
			10	SS	101	760										
			11	SS	61											0 92 (8)
			12	SS	157	750										
			13	SS	67											
						740										
733.6			14	SS	37											0 78 (22)
61.5	End of Borehole Note: W.L. not established															

RECORD OF BOREHOLE No 6

WP 40-66-06/07 LOCATION Co-ords. 15,598,216 N; 1,276,598 E. ORIGINATED BY PJS
 DIST 2 HWY 402 BORING DATE October 9, 1975 COMPILED BY GP
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger 'B' Casing CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT				LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L	
797.8	Ground Level														
0.0	Fine sand with to a trace of silt		1	SS	4										0 73 (27)
			2	SS	22										
			3	SS	28										
			4	SS	27										
	Loose to Very Dense		5	SS	23										0 93 (7)
			6	SS	26										
			7	SS	9										
			8	SS	14										
			9	SS	40										
	Well Graded Sand		10	SS	30										31 64 (5)
			11	SS	23										
			12	SS	105										
			13	SS	31										
746.3			14	SS	22										
51.5	End of Borehole														
	Note: W.L. not established														

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

RECORD OF BOREHOLE NO 7

WP 40-66-06/07 LOCATION Co-ords. 15,598,330 N; 1,276,626 E. ORIGINATED BY PJS
DIST 2 HWY 402 BORING DATE Oct. 15 & 16, 1975 COMPILED BY GP
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger 'B' Casing CHECKED BY

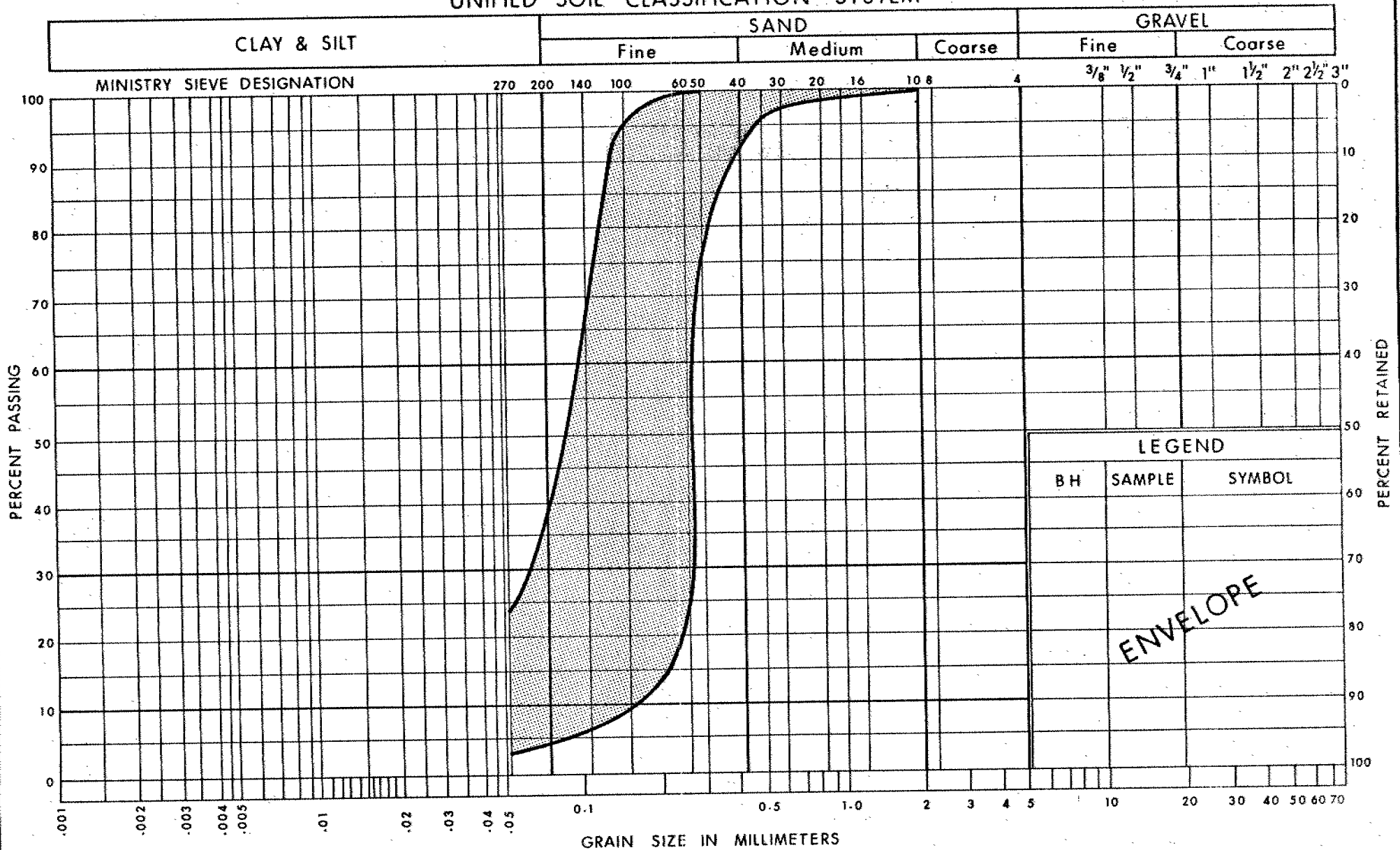
SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P — W — W_L WATER CONTENT % 10 20 30	UNIT WEIGHT γ	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100			
796.0	Ground Level													
0.0	Fine sand, some to a trace of silt.		1	SS	7									
			2	SS	4									
			3	SS	7									
	Loose to Very Dense		4	SS	45									0 82 (18)
			5	SS	22									
	Well Graded Sand		6	SS	42									
			7	SS	18									
			8	SS	81									0 91 (9)
			9	SS	22									
			10	SS	56									0 94 (6)
744.5			11	SS	60									
51.5	End of Borehole													

RECORD OF BOREHOLE NO 8

WP 40-66-06/07 LOCATION Co-ords. 15,598,266 N; 1,276,583 E. ORIGINATED BY PJS
 DIST 2 HWY 402 BORING DATE October 14 & 15, 1975 COMPILED BY GP
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger (3 1/2") CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT —WL PLASTIC LIMIT —WP WATER CONTENT —w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	Wp	w	WL		
795.9	Ground Level															GR SA SI CL
0.0	Fine sand, some to a trace of silt		1	SS	11	790										0 74 (26)
			2	SS	10											
			3	SS	30											
	Compact to Very Dense		4	SS	15	780										0 83 (17)
			5	SS	33											
			6	SS	34											
			7	SS	28											
	Well Graded Sand		8	SS	64	770										
			9	SS	144											0 87 (13)
			10	SS	78	760										
			11	SS	109											
			12	SS	41	750										0 84 (16)
			13	SS	126											
						740										
			14	SS	47											
						730										
			15	SS	42											
718.9						720										
77.0	Silt, some sand.															
714.4	Very Dense		16	SS	58											
81.5	End of Borehole															

UNIFIED SOIL CLASSIFICATION SYSTEM



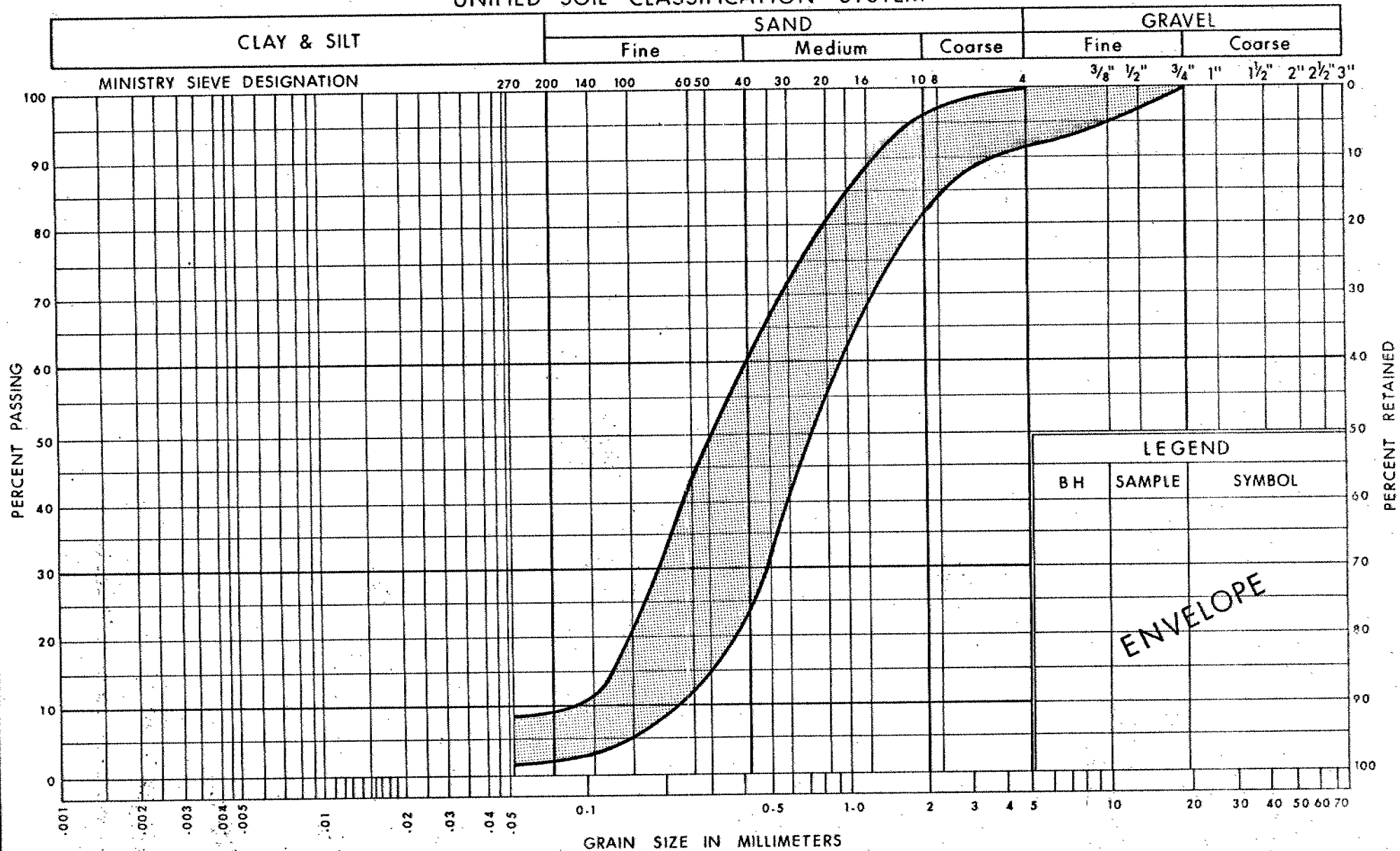
GRAIN SIZE DISTRIBUTION
FINE SAND
WITH TO TRACE OF SILT

FIG No 1
WP 40-66-06 & 07



Ministry of
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Communications
Ontario
ENGINEERING SERVICES BRANCH

UNIFIED SOIL CLASSIFICATION SYSTEM



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Communications
Ontario
ENGINEERING SERVICES BRANCH

GRAIN SIZE DISTRIBUTION
WELL GRADED SAND

FIG No 2

W P 40-66-06 & 07

ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

PENETRATION RESISTANCE

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

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

DESCRIPTION OF SOIL

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

<u>CONSISTENCY</u>	<u>c LB./SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 250	VERY LOOSE	0 - 4
SOFT	250 - 500	LOOSE	4 - 10
FIRM	500 - 1000	COMPACT	10 - 30
STIFF	1000 - 2000	DENSE	30 - 50
VERY STIFF	2000 - 4000	VERY DENSE	> 50
HARD	> 4000		

TERMS TO BE USED IN DESCRIBING SOILS :-

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

TYPE OF SAMPLE

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

P.H. SAMPLE ADVANCED HYDRAULICALLY

P.M. SAMPLE ADVANCED MANUALLY

SOIL TESTS

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

ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

SOIL PROPERTIES

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

GENERAL

π	≈ 3.1416
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e \sigma$ OR $\ln \sigma$	NATURAL LOGARITHM OF σ
$\log_{10} \sigma$ OR $\log \sigma$	LOGARITHM OF σ TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

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

EARTH PRESSURE

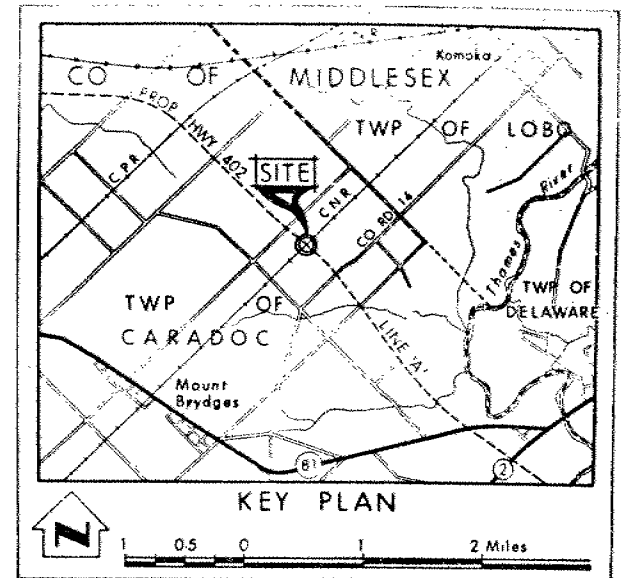
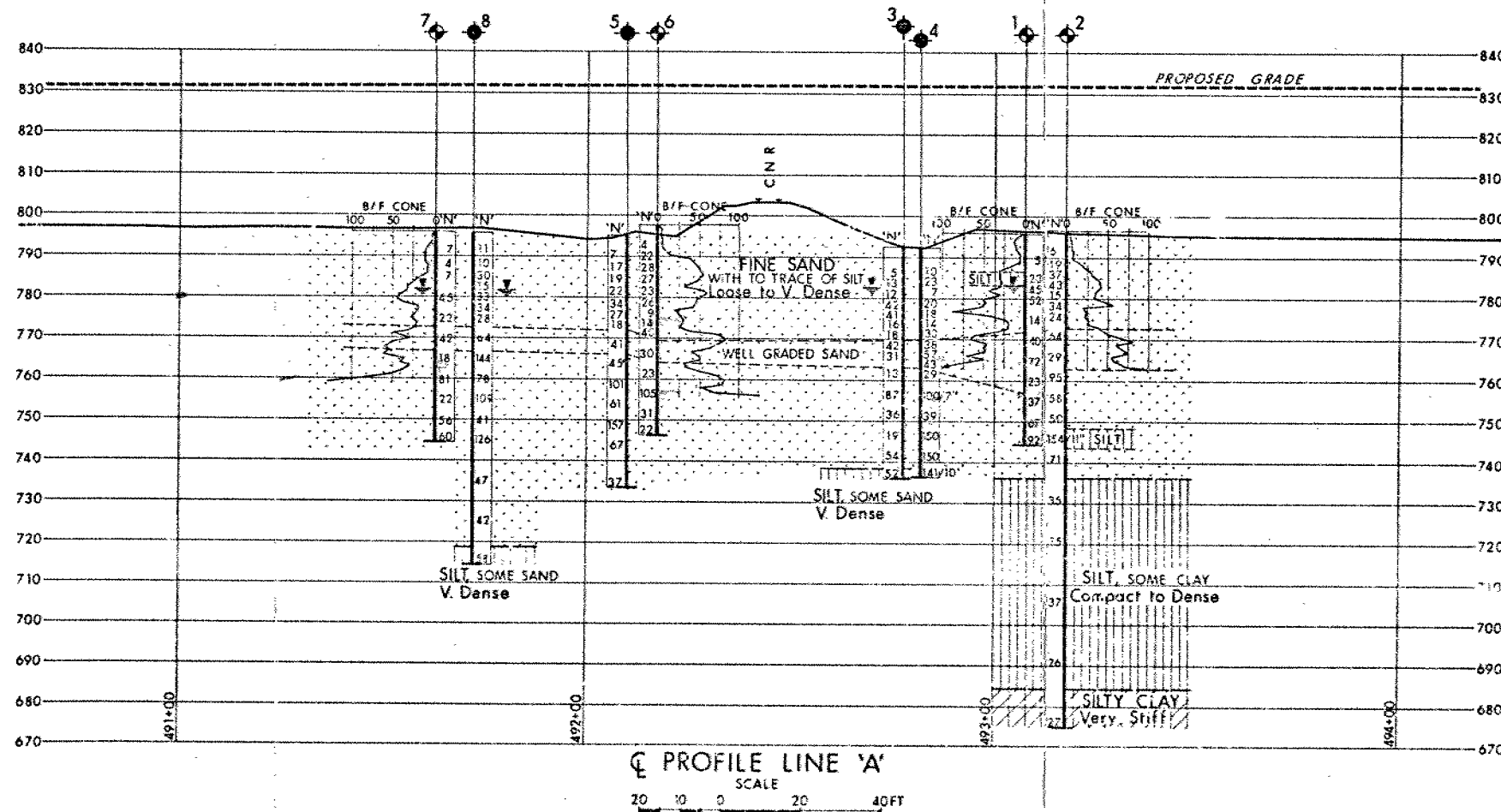
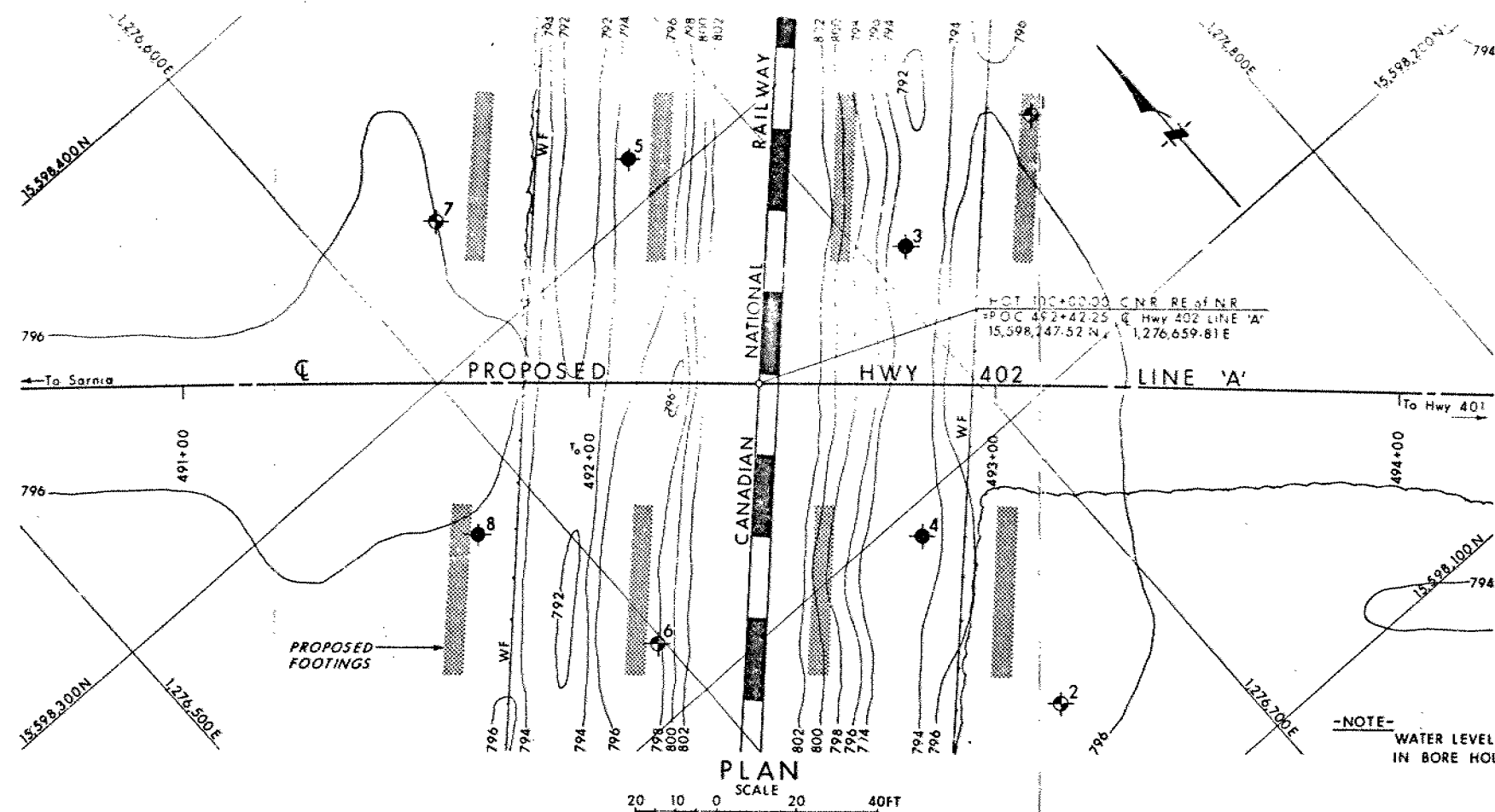
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

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

SLOPES

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



LEGEND			
	Bore Hole		
	Dynamic Cone Penetration Resistance Test		
	Bore Hole & Cone Test		
	Water Levels established at time of field investigation, Oct 1975		

NO.	ELEVATION	CO-ORDINATES NORTH	EAST
1	795.8	15,598,253	1,276,754
2	796.4	15,598,140	1,276,663
3	792.5	15,598,249	1,276,709
4	792.5	15,598,193	1,276,665
5	795.1	15,598,310	1,276,672
6	797.8	15,598,216	1,276,598
7	796.0	15,598,330	1,276,626
8	795.9	15,598,266	1,276,583

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: FOR CONTRACT DOCUMENT
The complete foundation investigation report for this structure may be examined at the Structural Office and Foundations Office, Downsview, and at the LONDON District Office.

REVISIONS	DATE	BY	DESCRIPTION

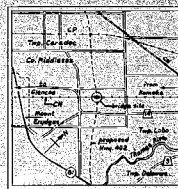
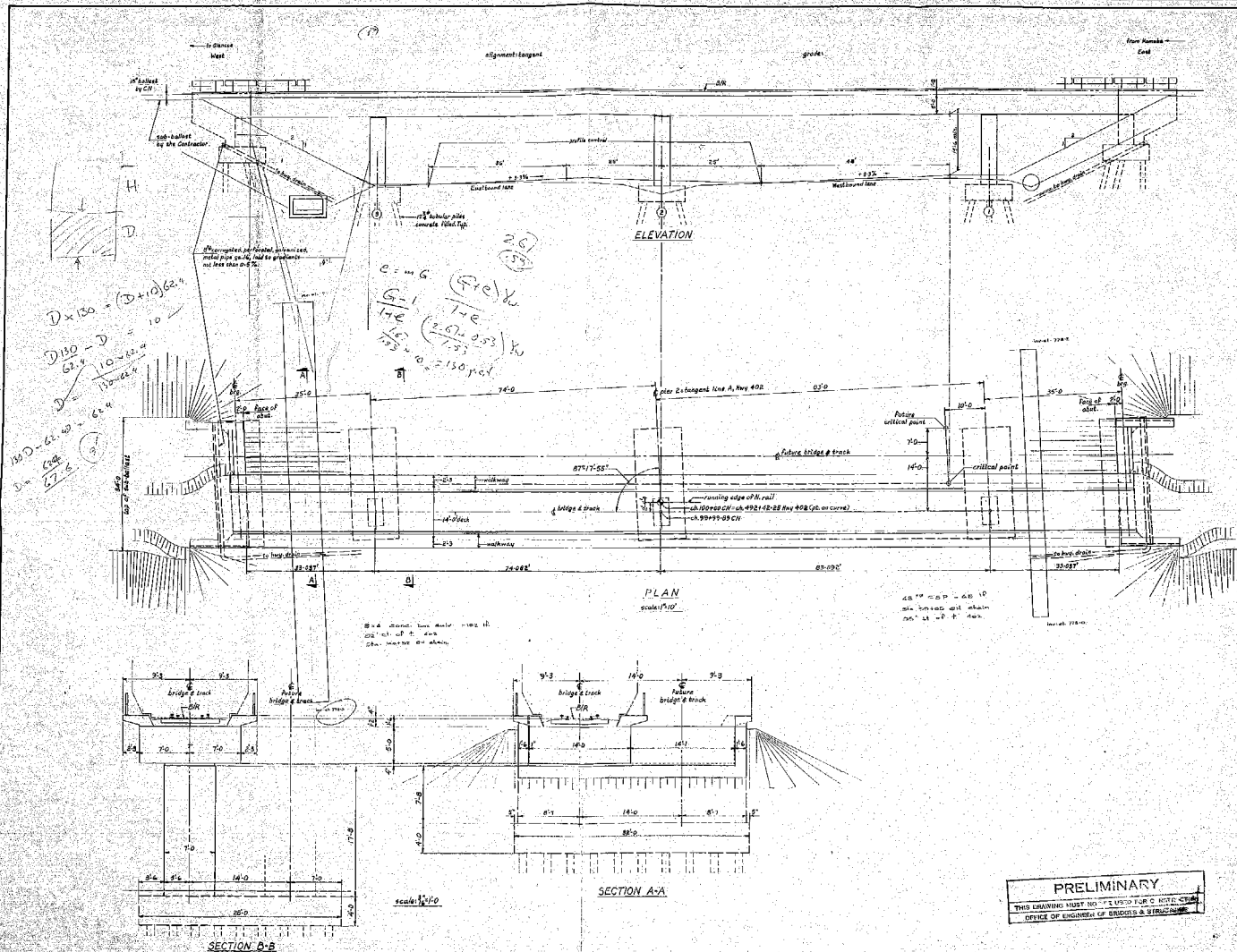
MINISTRY OF TRANSPORTATION AND COMMUNICATIONS--ONTARIO
ENGINEERING SERVICES BRANCH--GEOTECHNICAL OFFICE--SOIL MECHANICS SECTION

SOUTH C N R

HIGHWAY NO. Prop. 402 LINE 'A' DIST. NO. 2
CO. MIDDLESEX
TWP. CARADOC LOT 23 CON. II

BORE HOLE LOCATIONS & SOIL STRATA

SUBWD P.J.S. CHECKED	W.P. NO. 40-66-06 & 07	DRAWING NO.
DRAWN BY	W.P. NO.	406606 & 07-A
DATE Nov. 24 1975	SITE NO. 19-532	SCALE DRAWING NO.
APPROVED	CONT. NO.	



LOCATION PLAN
Scale 1/10 miles

GENERAL NOTES:

- A new reinforced concrete bridge consisting of 4 continuous spans supported on 5 piers & abutments is to be constructed to carry existing C.R. track with provision made for a future track over proposed Highway 402.
- Alignment & base of rail elevation remains unchanged.
- Live load Cooper E70 & lateral impact.
- Material specifications: Concrete, CSA A23.1-2 Reinforcing steel, CSA A632-12, 18.
- Station: Bench Mark 194-52 (geodetic) will be mounted in back face of abutment pier at 23' left of centerline 492+10 on 6 median of Highway 402 (Line A).
- Authorization:

Reference drawings: Ministry of Transportation & Communications of Ontario drawings
 Bridge 018
 Highway Crossing Plan: E-4088
 Plan & Profile, Hwy. 402: ETR-97-402/21-0
 Horizontal & Vertical Control: ETR-97-402/21-0

LIST OF DRAWINGS:

ESTIMATED QUANTITIES:

PRELIMINARY
 THIS DRAWING MUST NOT BE USED FOR CONSTRUCTION
 OFFICE OF ENGINEER OF BRIDGES & STRUCTURES

Project Name	Highway 402 Subway
Location	Near Mount Brydges, Ont.
Scale	1/10
Author	Chief Engineer
Checked	Chief Engineer
Approved	Chief Engineer
Date	2008
Project No.	AA923-3-06