

G.I.-30 SEPT. 1976

GEOCRES No. 40I14-31DIST. 2 REGION W.P. No. 88-69-01CONT. No. 79-20W. O. No. STR. SITE No. HWY. No. St. Thomas ExpresswayLOCATION Caughill Ravine
Slope StabilityNo of PAGES - =====OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. REMARKS:

MEMORANDUM

TO: Mr. A. P. Watt, (2)
Regional Structural Planning Eng.,
Southwestern Region,
London, Ontario.

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

ATTENTION:

DATE: September 6, 1973.

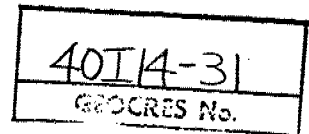
OUR FILE REF.

IN REPLY TO

SEP 14 1973

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For
Storm Trunk Sewer, St. Thomas Expressway
City of St. Thomas, Co. of Elgin
District No. 2 (London)
W.O. 73-11017 -- W.P. 88-69-01



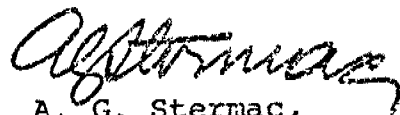
Cont. 79-20

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

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

AGS/ao
Attch.

c.c. E. J. Orr
B. R. Davis
A. Rutka
A. Wittemberg
L. E. Walker
B. J. Giroux
J. R. Roy
G. A. Wrong
B. A. Singh


A. G. Stermac,
PRINCIPAL FOUNDATIONS ENGINEER.

Foundations Files ✓
Documents

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FOUNDATION INVESTIGATION REPORT
For
Storm Trunk Sewer, St. Thomas Expressway
City of St. Thomas, Co. of Elgin
District No. 2 (London)
W.O. 73-11017 -- W.P. 88-69-01

1. INTRODUCTION:

A request for a foundation investigation for a storm trunk sewer in conjunction with the proposed St. Thomas Expressway was received from Mr. A. P. Watt, Regional Structural Planning Engineer, Southwestern Region, in a memo dated March 29, 1973.

Subsequently, the Foundations Office carried out a field investigation to determine the subsoil and groundwater conditions existing along the proposed route of the storm sewer.

This report contains all the factual data from this investigation, together with recommendations pertaining to the excavation for and installation of the storm sewer.

2. DESCRIPTION OF THE SITE AND GEOLOGY:

The site is located in the City of St. Thomas. The sewer runs in an east to west direction from a point some 500 ft. east of Centennial Avenue, to Kettle Creek at the westerly limit of the city. The sewer runs parallel to the south side of the proposed St. Thomas Expressway and will empty into Kettle Creek. The total length of the sewer is about 2.5 miles.

The area east of Ontario St. through which the sewer traverses is essentially flat, some of it barren, some cultivated farmland and some containing light industrial buildings. The greater length of the sewer runs through or along the side of a

relatively steep-sided, bush and tree covered, 200 to 400-foot-wide stream valley.

Physiographically, the area is located in the region referred to as the Mount Elgin Ridges.

3. FIELD AND LABORATORY INVESTIGATION PROCEDURES:

A total of 30 sampled boreholes and 24 dynamic cone penetration tests were carried out during the course of the field work. Boring was achieved by means of a conventional diamond drill rig and two C.M.E. hollow stem auger machines, all of which were adapted for soil sampling purposes. An additional five sampled boreholes and four adjacent dynamic cone penetration tests from previous investigations (W.O.'s 71-11063, 64, 65, 66 and 71) were added to the above-mentioned field work.

During the field work disturbed samples were obtained by means of a standard 2 inch O.D. split spoon sampler; the energy used in driving it conformed to the requirements of the Standard Penetration Test.

Undisturbed samples were recovered using 2 inch I.D. Shelby Tubes which were pushed into the soil hydraulically or by hand. In addition, in situ vane tests were carried out within the softer more compressible portions of the stratum.

Dynamic cone penetration tests were carried out adjacent to 24 boreholes. Driving energy to advance the cone was 350 ft.-lb. per blow.

All boreholes were surveyed by personnel from London Region Engineering Surveys Office. The locations and elevations of the borings are shown on Drawings No. 73-11017 A, B, C, D, E and F, which accompany this report.

All borehole samples were subjected to a careful visual examination and classification in the field and subsequently in the laboratory.

Following this inspection laboratory tests were carried out on selected samples to determine the following physical properties:

Atterberg Limits
Moisture Content
Grain-Size Distribution
Unconfined Shear Strength
Bulk Density

The test results are summarized on the Record of Borehole sheets and on Figures 1 to 3 contained in the Appendix of this report.

4. SUBSOIL CONDITIONS:

4.1) General:

For purposes of subsoil description, the length of the proposed storm sewer has been divided into two sections which are designated by stations. Going from west to east these sections are as follows:

4.2) Sta. 172+30 to Sta. 249+00:

4.2.1) General:

The subsoil along this section of the storm sewer consists of silty clay underlain by clayey silt. The boreholes placed in this section range from S10 to S30 and S32 to S35. No conspicuous sand layers were intersected, but it is possible that some randomly distributed water bearing sand seams could be present. At some borehole locations the silty clay and clayey silt strata are overlain by surficial material consisting of either sand fill material or a heterogeneous mixture of soil types. At two borehole locations near the C.N.R. tracks the clayey silt stratum is underlain by a sand stratum. The subsoil profile described from ground level downwards is as follows:

4.2.2) Surficial Material:

At four borehole locations the silty clay and clayey silt strata were overlain by a surficial deposit. At Boreholes S32 and

S35 a surficial deposit of fill material was encountered. At Borehole S32 the fill material consisted of 3 feet of sand and gravel. At Borehole S35 the fill material consisted of 9.3 feet of compact sand with clayey silt and some gravel.

A surficial deposit of sand was encountered at Borehole S16. This deposit consisted of compact sand, some gravel and silt and a trace of clay.

Finally, at Borehole S33, a 6-foot-thick layer consisting of a mixture of soil types was encountered. This layer consists of a heterogeneous mixture of silty clay, sand, and gravel and is stiff to very stiff.

4.2.3) Silty Clay:

This stratum, which does not occur at all borehole locations, has a maximum thickness of 35 feet. It consists of firm to hard silty clay, a trace to some sand, traces of gravel, and occasional silt seams.

Standard Penetration 'N' values for this stratum range from 6 to 44 blows per foot with an average value of 20 blows per foot. The results of laboratory tests on selected samples are as follows:

	<u>Range of Values</u>	<u>Average Value</u>
Natural Moisture Content (%)	16 - 33	25
Liquid Limit	33 - 53	43
Plasticity Index	12 - 30	20
Undrained Shear Strength (p.s.f.)	720 - 3200	1900
Bulk Density (p.c.f.)	120 - 128	124
Sand (%)	0 - 20	3
Gravel (%)	0 - 7	1
Silty Clay (%)	80 - 100	96

The results of tests for Atterberg limits indicate a soil of medium plasticity.

4.2.4) Clayey Silt:

This stratum was encountered at all borehole locations with all but two boreholes being terminated in this stratum. Where

boreholes were terminated in this material the depth of penetration of the stratum ranged from 4 to 64 feet. At Boreholes S26 and S35 this stratum was completely penetrated. The thickness of the stratum in these boreholes was 50 feet and 61.3 feet, respectively.

This stratum consists of firm to hard clayey silt, with to traces of sand, traces of gravel, and occasional pockets and seams of silt.

Standard Penetration 'N' values range from 8 to greater than 100 blows per foot with an average value of 29 blows per foot. The results of laboratory tests on selected samples are as follows:

	<u>Range of Values</u>	<u>Average Value</u>
Natural Moisture Content (%)	6 - 37	18
Liquid Limit	18 - 37	28
Plasticity Index	4 - 20	13
Undrained Shear Strength (p.s.f.)	1070 - 4600	2100
Bulk Density (p.c.f.)	121 - 140	133
Sand (%)	0 - 37	15
Gravel (%)	0 - 9	2
Clayey Silt (%)	61 - 100	83

The results of tests for Atterberg limits indicate a soil of low plasticity.

4.2.4) Sand:

This stratum was encountered in Boreholes S26 and S35 where it was penetrated 24 feet and 7.2 feet, respectively. It consists of very dense sand, a trace to some silt and traces of gravel. Standard Penetration 'N' values range from 74 to over 100 blows per foot. The natural moisture content is between 15 and 20%. The grain-size distribution is about 80 to 90% sand, 0 to 5% gravel, and 5 to 20% fines.

4.3) Sta. 249+00 to Sta. 286+00:

4.3.1) General:

The subsoil along this section of the storm sewer consists of a deposit of clayey silt which is 31.5 feet deep or

deeper at all borehole locations. No conspicuous sand layers were intersected, but it is possible that some randomly distributed sand seams could be present. The boreholes situated within the range of the above stations are S1 to S9 and S31. The description of the clayey silt stratum is as follows:

4.3.2) Clayey Silt:

This stratum consists of firm to hard clayey silt, a trace to some sand, and traces of gravel. This stratum was penetrated to a minimum depth of 31.5 feet and to a maximum depth of 51.5 feet.

Standard Penetration 'N' values for this stratum range from 6 to 126 blows per foot with an average value of 30 blows per foot. Two unconfined compression tests on samples selected from very stiff layers in this stratum give unconfined shear strengths of about 3000 p.s.f. The bulk densities for these samples averaged about 135 p.c.f.

Tests for natural moisture content and Atterberg limits gave the following results:

	<u>Range of Values</u>	<u>Average Value</u>
Natural Moisture Content (%)	12 - 34	18
Liquid Limit	26 - 38	31
Plasticity Index	10 - 21	14

These results indicate that the subsoil is of low plasticity.

Grain-size analyses gave the following grain-size distribution.

	<u>Range of Values</u>	<u>Average Value</u>
Gravel (%)	0 - 9	2
Sand (%)	5 - 16	11
Clayey Silt (%)	82 - 94	87

5. GROUNDWATER CONDITIONS:

Because of the relatively impermeable nature of the subsoil and rains during the period of the field work, groundwater levels could not be established with any precision in some boreholes. The following water levels were observed in various boreholes, commencing from the west or tail end.

Borehole No.

Elevation

S28	672 (estimated)
S27	Not established
S35	716.7
S26	Not established
S25	Not established
S24	Not established
S23	709.3
S34	Not established
S22	695.4
S21	712.1
S20	Not established
S19	Not established
S18	Not established
S33	Not established
S17	Not established
S16	Not established
S15	Not established
S14	Not established
S13	734.2
S30	Not established
S12	718.4
S29	Not established
S11	738.8
S32	Not established
S10	Not established
S9	Not established
S8	Not established
S31	715.2
S7	Not established
S6	Not established
S5	Not established
S4	Not established
S3	Not established
S2	Not established
S1	Not established

6. DISCUSSION AND RECOMMENDATIONS:

It is proposed to construct a storm trunk sewer from Centennial Avenue to Kettle Creek along the proposed St. Thomas Expressway. The sewer varies in diameter from 48 in. at its head end to 120 in. at its tail end. The invert elevation of the sewer near the Centennial Avenue is 793 ft. and at the outfall end is about 684 ft. The total length of the sewer is approximately 11400 ft.

The groundwater, in general, is at or below the invert elevation of the sewer. A notable exception is at the C.N.R. subway.

Since the future performance of the sewer pipe is dependent to a very great extent on the type and quality of the bedding used, it is essential that the latter be placed and compacted under dry conditions. Because of the relatively impermeable nature of the subsoil, no major dewatering problems are anticipated. However, some seepage from the sides may occur because of the presence of layers of non-cohesive material.

With regard to bedding for the proposed sewer, the following recommendations are made:

- i) Soil at or slightly below the invert level should be assumed to be of yielding nature for the entire length of sewer.
- ii) Bedding for sewer pipes should be provided as per M.T.C. Standard DD-823.
- iii) Backfill for sewer pipes should be provided as per M.T.C. Standard DD-813-B.

An allowable bearing capacity of 2 t.s.f. may be assumed for the design of sewer manhole foundations.

Excavations in the cohesive overburden, with side slopes of 1:1 should remain stable during the course of the work, provided the depth of the sloping portion does not exceed about 25 ft. Vertical slopes must be sheeted and adequately braced at all times. In the vicinity of Sta. 194+00 the existing slopes are covered with dumped garbage. All loose material on the slopes within the area

to be excavated should be removed before proceeding with excavation.

The comments and recommendations in the foregoing paragraphs are based on the assumption that the groundwater conditions as determined during the field investigation will apply during construction. However, it will be the responsibility of the contractor, to determine exactly the groundwater conditions which prevail during construction, and to take such steps as are necessary to ensure dry safe working conditions.

It is recommended that a minimum distance of 10 ft. be maintained between the excavation and the edge of the footing for the future structures in this area. The sewer excavation should be backfilled before commencing construction of footings adjacent to it.

7. MISCELLANEOUS:

The field work for this project was carried out during the period of May 8 to June 5, 1973, under the supervision of Messrs. L. J. Hodge and P. Korgemagi, Project Foundations Engineers.

The equipment used was owned and operated by Dominion Soil Investigation Ltd. and P.V.K. and Sons Ltd.

The entire project was under the supervision of Mr. A. Prakash, Senior Foundations Engineer, who also prepared this report. The report was reviewed by Mr. K. G. Selby, Supervising Foundations Engineer.

EA Wood

for A. Prakash, P. Eng.



K G. Selby

K. G. Selby, P. Eng.

AP/ao

Sept. 5, 1973.

APPENDIX I

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 51

JOB 72-11017 LOCATION Co-ords. 15,549,372 N; 1,362,359 E.
 W.P. 88-69-01 BORING DATE May 16, 1973
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone

ORIGINATED BY MY
 COMPILED BY LJH
 CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	SHEAR STRENGTH P.S.F. O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE.	LIQUID LIMIT —WL PLASTIC LIMIT —WP WATER CONTENT —W Wp — W — WL WATER CONTENT % 20 40 60	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS/FOOT						
813.0	Ground Level										
0.0						810					2 10 61 27
	Stiff to Hard Very Stiff Clayey silt, some sand, traces of gravel. Brown		1	SS	12						
			2	SS	32						
			3	SS	18						
			4	SS	15						1 11 60 28
			5	SS	19						
			6	SS	17						
776.5			7	SS	15	780					3 13 56 28
36.5	End of Borehole										W.L. not established

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO S 2

JOB 73-11017

LOCATION Co-ords. 15,549,403 N; 1,361,853 E.

ORIGINATED BY MY

W.P. 88-69-01

BORING DATE May 16, 1973

COMPILED BY LJH

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & Cone

CHECKED BY

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT			BULK DENSITY	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	BLOWS / FOOT	20	40	60	80	100	PLASTIC LIMIT			WATER CONTENT
811.7	Ground Level															
0.0	Hard Very Stiff Clayey silt, some sand, traces of gravel. Brown		1	SS	48	810										
			2	SS	126	800										8 8 55 29
			3	SS	32											
			4	SS	21	790										1 12 57 30
			5	SS	20											
			6	SS	15	780										2 10 51 37
775.2			7	SS	20											
36.5	End of Borehole														W.L. not established	

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 53

JOB 73-11017

LOCATION Co-ords. 15,549,388 N; 1,361,514 E.

ORIGINATED BY MY

W.P. 88-69-01

BORING DATE May 8 & 9, 1973

COMPILED BY LJH

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

CHECKED BY

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w w_p ——— w ——— w_L WATER CONTENT % 20 40 60	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE					
801.4	Ground Level								
0.0	Clayey silt, some sand, trace of gravel Very Stiff to Hard Brown ----- Grey		1	SS	21	800			3 16 65 16
			2	SS	50				
			3	SS	52	790			2 12 51 35
			4	SS	34				
			5	Tw	PH	780			137 1 12 57 30
			6	SS	46				
			7	SS	59	770			
			8	SS	31				2 13 55 30
			9	SS	24				
755.9	End of Borehole								
45.5									N.L. not established

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 54

JOB 73-11017

LOCATION Co-ords. 15,549,374 N; 1,361,080 E.

ORIGINATED BY MY

W.P. 88-69-01

BORING DATE May 16, 1973

COMPILED BY LJH

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & Cone

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ P.C.F. GR. SA. SI. CL.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	w_p	w	w_L		
802.6	Ground Level															
	Hard Very Stiff Clayey silt, some sand, traces of gravel. Brown		1	SS	56	800										
			2	SS	36	790										2 10 48 40
			3	SS	15											
			4	SS	16	780										9 9 49 33
			5	SS	19											
			6	SS	22	770										4 10 58 28
			7	SS	29											
761.1			8	SS	28											1 10 48 42
41.5	End of Borehole					760										W.L. not established

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 55

JOB 73-11017

LOCATION Co-ords. 15,549,388 N; 1,360,633 E.

ORIGINATED BY MY

W.P. 88-69-01

BORING DATE May 16, 1973

COMPILED BY LJH

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & Cone

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_P WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	w_P	w	w_L		
798.9	Ground Level															
0.0	Stiff to Hard Very Stiff Clayey silt, some sand, traces of gravel. Brown		1	SS	14							10				1 12 53 34
			2	SS	55	790										
			3	SS	33											
			4	SS	24	780						10				4 13 53 30
			5	SS	22											
			6	SS	22	770										
			7	SS	25							10				2 13 55 30
			8	SS	25	760										
752.4			9	SS	30							10				2 9 56 33
46.5	End of Borehole					750										WL not established

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO S6

JOB 73-11017

LOCATION Co-ords. 15,549,375 N; 1,360,173 E.

ORIGINATED BY MY

W.P. 88-69-01

BORING DATE May 9, 1973

COMPILED BY LJH

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & Cone

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE	LIQUID LIMIT w_L	BULK DENSITY	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT	PLASTIC LIMIT w_p			WATER CONTENT w
							SHEAR STRENGTH P.S.F.				WATER CONTENT %
792.7	Ground Level						\circ UNCONFINED \bullet QUICK TRIAXIAL	$+$ FIELD VANE \times LAB VANE	w_p w w_L	γ	P.C.F. GR.SA.SI.CL
0.0	Brown Grey Stiff to Hard Very Stiff Clayey silt, some sand, traces of gravel.		1	SS	10	790					0 14 66 20
			2	SS	56						
			3	SS	43	780					1 15 48 36
			4	SS	32						
			5	TW	PH	770				134	4 9 47 40
			6	SS	21						
			7	SS	30	760					1 15 47 37
			8	SS	24						
748.7				9	SS	25	750				1 15 50 34
44.0	End of Borehole										W.L. not established

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 57

JOB 73-11017

LOCATION Co-ords. 15,549,406 N; 1,359,671 E.

ORIGINATED BY MY

W.P. 88-69-01

BORING DATE May 17, 1973

COMPILED BY LJH

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & Cone

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W				BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	20	40	60		
788.8	Ground Level															
0.0																
	Firm Very Stiff to Hard		1	SS	6											
			2	SS	31	780									1 9 60 30	
	Clayey silt, some sand, traces of gravel.		3	SS	29											
			4	SS	19	770									3 11 56 30	
	Brown		5	SS	29											
			6	SS	27	760									0 8 51 41	
			7	SS	35											
			8	SS	30	750										
			9	SS	21										3 9 54 31	
						740										
737.3			10	SS	30											
51.5	End of Borehole														W.L. not established	

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 58

JOB 73-11017

LOCATION Co-ords. 15,549,405 N; 1,359,254 E.

ORIGINATED BY MY

W.P. 88-69-01

BORING DATE May 17, 1973

COMPILED BY LJH

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F.				WATER CONTENT % w_p ——— w ——— w_L				
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE								
785.2	Ground Level														
0.0	Clayey silt, some sand, traces of gravel. Very Stiff to Hard Brown		1	SS	26	780							d ———		1 9 56 34
			2	SS	45										
			3	SS	33	770									
			4	SS	27								o ———		2 12 53 33
			5	SS	36	760									
			6	SS	26								d ———		3 14 52 31
			7	SS	28	750									
			8	SS	31										
			9	SS	31	740							d ———		2 10 56 32
738.7	End of Borehole														W.L. not established
46.5							730								

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 59

JOB 73-11017

LOCATION Co-ords. 15,549,397 N; 1,358,871

ORIGINATED BY MY

W.P. 88-69-01

BORING DATE May 17, 1973

COMPILED BY LJH

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT			LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w w_p ——— w ——— w_L			BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE			WATER CONTENT % 20 40 60				
778.0	Ground Level.													
0.0	Clayey silt, traces of sand & gravel. Very Stiff Brown					770								2 5 53 40
			1	SS	21									
			2	SS	22									
			3	SS	20									
			4	SS	21									
			5	SS	21									
			6	SS	22									
			7	SS	24									
736.5			8	SS	27	740								1 6 48 45
41.5	End of Borehole					730								W.L. not established

DESIGN SERVICES BRANCH

RECORD OF BOREHOLE NO S10

FOUNDATIONS OFFICE

JOB 73-11017

LOCATION Co-ords. 15,549,407 N; 1,358,490 E.

W.P. 88-69-01

BORING DATE May 17, 1973

ORIGINATED BY MY

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & Cone

COMPILED BY LJH

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — w_L			BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT					PLASTIC LIMIT — w_p				
							20	40	60	80	100	WATER CONTENT — w				
												w_p	w	w_L		
SHEAR STRENGTH P.S.F.						WATER CONTENT %										
○ UNCONFINED + FIELD VANE						20 40 60										
● QUICK TRIAXIAL X LAB VANE																
775.6	Ground Level															
0.0	Clayey silt		1	SS	29	770									P.C.F.	GR. SA. SI. CL.
	Silty clay, traces of sand and gravel.		2	SS	21	760										
	Very Stiff		3	SS	24	750										
	Brown		4	SS	21	740										
742.6			5	SS	26	730										
33.0	Clayey silt, some sand, traces of gravel.		6	SS	13											
	Very Stiff to Hard.	7	SS	26												
729.1	Brown	8	SS	26												
46.5	End of Borehole	9	SS	38												
															W.L. not established	
					</											

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO S11

 JOB 73-11017 LOCATION Co-ords. 15,549,411 N; 1,357,771 E.
 W.P. 88-69-01 BORING DATE May 9, 1973
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone

 ORIGINATED BY MY
 COMPILED BY LJH
 CHECKED BY ...

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	w_p	w	w_L	
764.8	Ground Level														
0.0	Silty clay, trace to some sand & traces of gravel.		1	SS	14	760									3 20 40 37
	Stiff to Hard		2	SS	39										1 1 38 60
	Grey-Brown		3	SS	18	750									
			4	SS	17										
			5	TW	PH	740									122 0 1 35 64
734.8			6	SS	17										
30.0	Clayey silt, traces of sand & gravel.		7	SS	23	730									2 8 54 36
	Hard		8	SS	10										
	Grey-Brown		9	SS	36	720									
			10	SS	29										5 7 43 25
710.8			11	SS	28										
54.0	End of Borehole					710									

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO S12

JOB 73-11017

LOCATION Co-ords. 15,549,402 N; 1,357,478 E.

ORIGINATED BY MY

W.P. 88-69-01

BORING DATE May 10, 1973

COMPILED BY LJH

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & Cone

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w			BULK DENSITY γ P.C.F.	REMARKS			
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT 20 40 60 80 100					SHEAR STRENGTH P.S.F.					WATER CONTENT % w_p ——— w ——— w_L		
							SHEAR STRENGTH P.S.F.					WATER CONTENT %							
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					2000 4000							
763.4	Ground Level															GR.SA.SI.CL.			
0.0	Silty clay, traces of sand & gravel.		1	SS	16	760										1 3 51 45			
	Stiff to Very Stiff		2	SS	27														
	Grey		12	TW	PH														
			3	SS	11	750													
			13	TW	PM														
743.4			4	SS	10														
20.0			14	TW	PM														
	Clayey silt, some sand, traces of gravel.		5	SS	9	740													
			15	TW	PM														
			6	SS	8														
			16	TW	PM														
	gravel.		7	SS	19	730													
			17	SS	24														
	Firm to Hard		8	SS	31														
	Grey		9	SS	35	720													
			10	SS	30														
709.4			11	SS	35	710													
54.0	End of Borehole																		
						700													

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO S13

JOB 73-11017

LOCATION Co-ords. 15,549,401 N; 1,357,182 E.

ORIGINATED BY MY

W.P. 88-69-01

BORING DATE May 10, 1973

COMPILED BY LJH

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & Cone

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W				BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	W_P	W	W_L		
763.2	Ground Level															
0.0	Silty clay, traces of sand, occ. silt pockets & seams. Brown Grey Brown		1	SS	17	760										0 1 39 60
			2	SS	29											0 2 39 59
			3	SS	20	750										
	Stiff to Very Stiff		4	SS	17											
			5	TW	PH	740									12h	0 0 38 62
			6	SS	14											
731.2			7	SS	31	730										3 16 45 36
32.0	Clayey silt, some sand, traces of gravel. Very Stiff to Hard Grey-Brown		8	SS	35											
			9	SS	20	720										
			10	SS	20											5 23 38 34
709.2			11	SS	22	710										
54.0	End of Borehole															
						700										

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO S14

JOB 73-11017

LOCATION Co-ords. 15,549,409 N; 1,356,828

ORIGINATED BY MY

W.P. 88-69-01

BORING DATE May 11, 1973

COMPILED BY LJH

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & Cone

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P — W — W_L WATER CONTENT % 20 40 60	BULK DENSITY γ P.C.F. GR. SA. SI. CL.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT					
761.0	Ground Level									
0.0	Firm to Hard Brown Grey V.Stiff Silty clay, traces of sand & gravel.		1	SS	9	760				0 0 40 60
			2	SS	35	750				
			3	SS	21	740				0 0 43 57
			4	SS	23					
			5	SS	21					
731.0			6	SS	20	730				
30.0	Clayey silt, some sand, traces of gravel. Very Stiff to Hard. Grey		7	SS	26	720				3 16 46 35
			8	SS	36					
			9	SS	26	710				7 22 44 27
			10	SS	26					
707.0			11	SS	38	700				W.L. not established
54.0	End of Borehole									

DESIGN SERVICES BRANCH

RECORD OF BOREHOLE NO S 15

FOUNDATIONS OFFICE

JOB 73-11017

LOCATION Co-ords. 15,549,378 N; 1,356,506 E.

W.P. 88-69-01

BORING DATE May 14, 1973

ORIGINATED BY MY

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & Cone

COMPILED BY LJH

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			BULK DENSITY γ P.C.F. GR. SA. SI. CL.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	w_p	w	w_L		
761.5	Ground Level															
	Clayey silt Very Stiff Hard Brown Grey		1	SS	21	760						10	1			1 23 51 25
			2	SS	30											
	Silty clay, traces of sand & gravel. Very Stiff		3	SS	22	750										
			4	SS	18							10	1			1 2 35 62
			5	SS	21	740										
734.5			6	SS	23											
30.0	Clayey silt, some sand, traces of gravel. Very Stiff		7	SS	26	730						10	1			2 15 52 31
			8	SS	20											
			9	SS	23	720						10	1			2 14 44 40
			10	SS	24											
			11	SS	22	710										
705.5			12	SS	22							10	1			4 20 42 34
59.0	End of Borehole					700										W.L. not established

OFFICE REPORT SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO S 16

JOB 73-11017

LOCATION Co-ords. 15,549,385 N; 1,356,210 E.

ORIGINATED BY MY

W.P. 88-69-01

BORING DATE May 14, 1973

COMPILED BY LJH

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & Cone

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				LIQUID LIMIT —WL PLASTIC LIMIT —WP WATER CONTENT —W			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	WP	W	WL	
763.7	Ground Level														
0.0	Sand, some gravel & silt, trace of clay.					760									
755.7	Compact. Brown		1	SS	18										9 68 21 2
8.0	Silty clay, traces of sand & gravel.		2	SS	33										
	Hard Stiff		3	SS	31	750									
	Grey		4	SS	13										0 0 46 54
			5	SS	12	740									
733.7			6	TW	PH										
30.0	Clayey silt, some sand, traces of gravel.		7	SS	18	730									3 16 55 24
	Stiff to Very Stiff		8	SS	28										
	Grey		9	SS	28	720									2 14 39 45
			10	SS	14										
			11	SS	13	710									2 26 42 30
702.2			12	TW	PH										
61.5	End of Borehole					700									W.L. not established

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO S 17

JOB 73-11017 LOCATION Co-ords. 15,549,384 N; 1,355,917 E. ORIGINATED BY MY
 W.P. 88-69-01 BORING DATE May 14, 1973 COMPILED BY LJH
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT w_L			BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT	20	40	60	80	100	PLASTIC LIMIT w_p	WATER CONTENT w		
762.5	Ground Level															
0.0	Silty Clay, traces of sand & gravel.	Firm to Hard V.Stiff	1	SS	6	760										7 10 35 48
			2	SS	32											
			3	SS	16	750										
	Grey		4	SS	20											
			5	SS	21	740										0 0 33 67
			6	SS	26											
732.5			7	SS	38	730										4 15 42 39
30.0	Clayey silt, some sand, traces of gravel.		8	SS	35											
			9	SS	31	720										3 17 42 38
	Very Stiff to Hard		10	SS	17											
	Grey		11	SS	13	710										
			12	SS	27											9 24 42 25
			13	SS	44	700										
693.5			14	SS	47											2 17 47 34
69.0	End of Borehole					690										W.L. not established

RECORD OF BOREHOLE NO S 18

JOB 73-11017

LOCATION Co-ords. 15,549,281 N; 1,355,315 E.

ORIGINATED BY MY

W.P. 88-69-01

BORING DATE May 14, 1973

COMPILED BY LJH

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & Cone

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100		LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w w_p — w — w_L		BULK DENSITY γ P.C.F. GR. SA. SI. CL.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE		WATER CONTENT % 20 40 60			
756.2	Ground Level											
0.0	Silty clay, trace of sand. Very Stiff Grey		1	SS	21	750						0 0 42 58
			2	SS	16							
			3	SS	15	740						
736.2			4	SS	16							
20.0	Clayey silt, some sand, traces of gravel. Very Stiff		5	SS	21	730						0 18 47 35
			6	SS	29							
			7	SS	26	720						3 14 49 34
			8	SS	31							
	----- silty clay -----		9	SS	12	710						0 0 47 53
			10	SS	21							
			11	SS	28	700						
			12	SS	17							5 25 44 26
689.7			13	SS	18	690						
66.5	End of Borehole					680						W.L. not established

OFFICE REPORT ON SOIL EXPLORATION

15 ϕ 5 % STRAIN AT FAILURE

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO S 19

JOB 73-11017

LOCATION Co-ords. 15,549,229 N; 1,355,078 E.

ORIGINATED BY LJJH

W.P. 88-69-01

BORING DATE May 31, 1973

COMPILED BY LJJH

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & Cone

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	w_p	w	w_L		
740.2	Ground Level															
0.0	Clayey silt, some sand, traces of gravel.		1	SS	8	740										
			2	SS	21	730										2 15 48 35
			3	SS	16											
	Grey		4	SS	21	720										0 12 48 40
			5	SS	28											
			6	SS	31	710										4 13 42 41
	Firm to V.Stiff		7	SS	37											
	Hard															
703.7	End of Borehole															
36.5						700										W.L. not established

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO S 20

JOB 73-11017

LOCATION Co-ords. 15,549,069 N; 1,354,738 E.

ORIGINATED BY MY

W.P. 88-69-01

BORING DATE May 15, 1973

COMPILED BY LJH

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & Cone

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	w_p	w	w_L	
736.7	Ground Level														
0.0	Silty clay, trace of sand & gravel.		1	SS	13										0 4 27 69
731.7	Stiff Brown														
5.0			2	SS	23	730									
			3	SS	27										
	Clayey silt, some sand, traces of gravel.		4	SS	33	720									2 13 46 39
			5	SS	20										
			6	SS	20	710									
	Very Stiff to Hard		7	SS	27										8 25 43 24
			8	SS	20	700									
	Grey		9	SS	18										2 21 47 30
			10	SS	24	690									
			11	SS	24										1 17 44 38
			12	SS	32	680									
			13	SS	19										
667.7			14	SS	23	670									0 1 77 22
69.0	End of Borehole					660									W.L. not established

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO S 21

JOB 73-11017

LOCATION Co-ords. 15,549,011 N; 1,354,364 E.

ORIGINATED BY MY

W.P. 88-69-01

BORING DATE May 15, 1973

COMPILED BY LJH

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & Cone

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	W_P	W	W_L		
755.1	Ground Level															
0.0	Silty clay traces of sand and gravel	Hard Very Stiff to Stiff Brown Grey-Brown	1	SS	11	750										1 0 52 47
			2	SS	23											
			3	SS	12	740										0 0 39 61
			4	TW	PH											
			5	SS	12	730										1 1 28 70
			6	TW	PH											
723.1																
32.0	Clayey silt, some sand, traces of gravel.	Stiff to Very Stiff Grey-Brown	7	SS	13	720										2 12 51 35
			8	SS	16											
			9	SS	18	710										
			10	SS	12											
			11	SS	19											
			12	SS	13											
			13	TW	PH											
688.6																
66.5	End of Borehole															

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO S 22

JOB 73-11017

LOCATION Co-ords. 15,548,970 N; 1,353,985 E.

ORIGINATED BY MY

W.P. 88-69-01

BORING DATE May 15, 1973

COMPILED BY LJH

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & Cone

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT —WL PLASTIC LIMIT —WP WATER CONTENT —W			BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	WP	W	WL		
736.4	Ground Level															
0.0			1	SS	8											
	Clayey silt		2	SS	21	730						10				0 6 56 38
			3	SS	21											
	some sand, traces of gravel.		4	SS	12	720						10				0 3 52 45
			5	SS	12											
	Brown		6	SS	13	710						10				1 15 44 40
	Firm to V. Stiff		7	SS	25											
	Hard		8	SS	25	700						10				1 18 45 36
			9	SS	28											
			10	SS	32	690										

	silty clay		11	SS	32	680						10				0 1 49 50
682.4	End of Borehole															
54.0						680										

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO S 23

JOB 73-11017

LOCATION Co-ords. 15,548,941 N; 1,353,278 E.

ORIGINATED BY L.J.H.

W.P. 88-69-01

BORING DATE May 23, 1973

COMPILED BY L.J.H.

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & Cone

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	w_p	w	w_L		
719.3	Ground Level															
0.0	Silty clay, trace of sand.		9	TW	PH											
			1	SS	12											0 1 40 59
707.3	Stiff Brown		10	TW	PH	710										
			2	SS	11											
12.0	Clayey silt, trace to some sand, traces of gravel.		11	TW	PH										138	2 20 44 34
			3	SS	21											2 22 45 31
			4	SS	22	700										
	Stiff to Very Stiff		5	SS	23											2 17 42 39
			6	SS	34	690										
			7	SS	25											1 1 51 47
677.8			8	SS	30	680										
41.5	End of Borehole					670										

FOUNDATIONS OFFICE

CHECKED BY

15 ϕ 5 20
10

% STRAIN AT FAILURE

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO S 25

JOB 73-11017

LOCATION Co-ords. 15,548,867 N; 1,352,540 E.

ORIGINATED BY PK

W.P. 88-69-01

BORING DATE June 4, 1973

COMPILED BY LJB

DATUM Geodetic

BOREHOLE TYPE Diamond Drill

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE				WATER CONTENT % w_p w w_L 20 40 60				
717.9	Ground Level														
0.0	Brown Stiff to Very Stiff Hard Grey Clayey silt, some sand, traces of gravel.		1	SS	9										3 13 55 29 2 13 64 21
			2	SS	23	710									
			3	SS	46										
			4	SS	32	700									
			5	SS	47										
			6	SS	34	690									
			7	SS	32	680									
675.9			8	SS	62										
42.0	End of Borehole					670								W.L. not established	

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 529

JOB 73-11017

LOCATION Co-ords. 15,549,405 N; 1,357,622 E.

ORIGINATED BY LJH

W.P. 88-69-01

BORING DATE May 30, 1973

COMPILED BY LJH

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE			LIQUID LIMIT ——— w_L			BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT			PLASTIC LIMIT ——— w_p				
							SHEAR STRENGTH P.S.F.			WATER CONTENT ——— w				

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO S 27

JOB 73-11017

LOCATION Co-ords. 15,549,007 N; 1,351,561 E.

ORIGINATED BY LJH

W.P. 88-69-01

BORING DATE May 22, 1973

COMPILED BY LJH

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & Cone

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	W_P	W	W_L		
712.8	Ground Level															
0.0	Clayey silt with to traces of sand, traces of gravel. Stiff to Very Stiff Brown		1	SS	12	710										3 28 51 18
			2	SS	30											
			3	SS	18	700										3 13 48 36
			4	TW	PM51 P112"											
			5	SS	19	690										0 6 53 41
			6	SS	38											
			7	SS	90	680										0 24 54 22
			8	SS	90											
668.3			9	SS	100	670										3 35 45 17
44.5	End of Borehole					660										WL not established

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO S 26

JOB 73-11017

LOCATION Co-ords. 15,518,895 N; 1,352,008 E.

ORIGINATED BY AP

W.P. 88-69-01

BORING DATE May 16, 17, 18, 1973

COMPILED BY LJH

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & Cone

CHECKED BY MK

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	w_p	w	w_L		
751.3	Ground Level															
0.0	Silty clay, trace to some sand. Stiff		1	SS	16	750										
			2	SS	15	740										0 0 42 58
	Brown Grey.		3	SS	12											
731.3			4	SS	18											0 13 47 40
20.0	Clayey silt, trace to some sand, traces of gravel. Stiff to Hard		5	SS	37	730										
			6	SS	35	720										2 6 55 37
			7	SS	15											
	Grey		8	SS	17	710										0 4 50 46
			9	TW	PH										132	
			10	SS	11	700									134	
			11	TW	PH											
	Silty Clay		12	SS	28	690										0 2 54 44
			13	SS	36											
681.3			14	SS	36	680										1 17 51 31
70.0	Sand, some silt. Very Dense Grey		15	SS	142											
			16	SS	100/5"	670										
			17	SS	100/5"											
			18	SS	74	660										0 82 (18)
657.3			19	SS	95											
94.0	End of Borehole					650										W.L. not established

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO S 28

JOB 73-11017

LOCATION Co-ords. 15,549,232 N; 1,351,076 E.

ORIGINATED BY PK

W.P. 88-69-01

BORING DATE May 29, 1973

COMPILED BY L.J.H.

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & Cone

CHECKED BY J.S.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT W_L			BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT	20	40	60	80	100	PLASTIC LIMIT W_P	WATER CONTENT W		
676.0	Ground Level						SHEAR STRENGTH P.S.F.					WATER CONTENT %			P.C.F.	GR.SA.SI.CL.
							O UNCONFINED + FIELD VANE X QUICK TRIAXIAL X LAB VANE					W_P — W — W_L 20 40 60				
	V.Stiff		1	SS	15											
	Clayey silt		2	SS	65	670										1 18 52 29
	with to some		3	SS	100											
	sand, traces		4	SS	100	660										2 37 46 15
	of gravel.	Brown	5	SS	100											
		Grey	6	SS	100	650										
	Hard															
649.3																
27.3	End of Borehole					640										

OFFICE REPORT SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO S 30

JOB 73-11017

LOCATION Co-ords 15,549,397 N; 1,357,323 E.

ORIGINATED BY LJH

W.P. 88-69-01

BORING DATE May 30, 1973

COMPILED BY LJH

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & Cone

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w w_p ——— w ——— w_L			BULK DENSITY γ P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE 2000 4000		WATER CONTENT % 20 40 60					
765.1	Ground Level													
0.0	Silty clay, traces of sand, <div>Brown</div> occ.seams of silt. <div>Grey</div> Stiff to Very Stiff					760								
			1	TW	PH		750							
			2	TW	PH									
			3	TW	PH									
			4	SS	16		740							
733.1			5	SS	12									
32.0	Clayey silt, some sand, traces of gravel, occasional seams of silt. Stiff to Very Stiff					730								
			6	SS	15									
			7	SS	20									
			8	SS	25		720							
			9	SS	26									
713.6														
51.5	End of Borehole					710							W.L. not established	

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO S31(5, 71-11063)

JOB 73-11017

LOCATION Co-ords. 15,549,368 N; 1,359,522 E.

ORIGINATED BY AP

W.P. 88-69-01

BORING DATE July 9, 1971

COMPILED BY AP

DATUM Geodetic

BOREHOLE TYPE Cont. Flight Auger & Cone

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P — W — W_L WATER CONTENT % 20 40 60	BULK DENSITY γ P.C.F. GR. SA. SI. CL.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS/FOOT					
790.2	Ground Level									
0.0	Clayey silt, some sand, traces of gravel (Glacial Till) Very Stiff to Hard		1	SS	32	790				1 12 58 29
			2	SS	34	780				2 10 51 37
			3	SS	25	770				1 6 49 44
			4	SS	43	760				1 9 48 42
			5	SS	26	750				3 10 57 30
			6	SS	31	740				
			7	SS	34	730				
			8	SS	30	720				
			9	SS	33	710				
			10	SS	41					
708.7			11	SS	46	710				715.2 July 13/71 3 21 45 31
81.5	End of Borehole									

REVISED JANUARY 1975

RECORD OF BOREHOLE NO S 32 (BH.#4 W.O. 71-11064)

W.O. 71-11064)

LOCATION Co-ords. 15,549,411 N; 1,358,147 E.

ORIGINATED BY AP

BORING DATE July 5, 1971

COMPILED BY AP

BOREHOLE TYPE Hollow Stem Auger & Cone

CHECKED BY

REVISÉ JANUARY 1975

20
15 ϕ 5 % STRAIN AT FAILURE
10

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO S 33 (B.H.#4, W.O. 71-11071)

JOB 73-11017

LOCATION Co-ords. 15,549,374 N; 1,355,590 E.

ORIGINATED BY AP

W.P. 88-69-01

BORING DATE July 29, 1971

COMPILED BY AP

DATUM Geodetic

BOREHOLE TYPE Cont. flight auger and cone

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	w_p	w	w_L		
760.8	Ground Level															
0.0	Het. mix. of silt, clay, sand & gravel.		1	SS	22	760										7 15 36 42
754.8	Stiff to Very Stiff.		2	TW	PH											
6.0	Silty clay, trace to some sand, traces of gravel.		3	SS	20	750										0 0 32 68
			4	SS	22											
			5	TW	PH											
738.8	Very Stiff		6	SS	20	740										
22.0	Clayey silt, some sand, trace of gravel.		7	TW	PH											140 2 18 50 30
			8	SS	30	730										
	Very Stiff to Hard		9	TW	PH											
719.3			10	SS	40	720										1 17 45 37
41.5	End of Borehole															W.L. not established
						710										

REVISED JANUARY 1975

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO S 34 (B.H.#4, W.O. 71-11065)

JOB 73-11017

LOCATION 15,548,941 N; 1,353,624 E.

ORIGINATED BY PP

W.P. 88-69-01

BORING DATE July 19, 1971

COMPILED BY PP

DATUM Geodetic

BOREHOLE TYPE Cont. Flight Auger

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W			BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	W _P	W	W _L		
750.5	Ground Level															
0.0	Silty clay, Stiff to Very Stiff		1	TW	PH	750									125	0 0 50 50
			2	TW	PH	740									123.5	
735.5			3	TW	PH										1140	
15.0	Clayey silt, some sand traces of gravel, occasional pockets & seams of silt.		4	TW	PH	730									137	
			5	TW	PH										137	
			6	TW	PH	720									128	
			7	TW	PH										121	
	Stiff to Hard		8	TW	PH	710									126	
			9	TW	PH										137	
701.6			10	TW	PH											
49.0	End of Borehole					700										W.L. not established

REVISED JANUARY 1975

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

 RECORD OF BOREHOLE N^o S 35 (BH#2, W.O. 71-11066)

JOB 73-11017

LOCATION Co-ords. 15,549,934 N; 1,351,902 E.

ORIGINATED BY PP

W.P. 88-69-01

BORING DATE August 10 & 11, 1971

COMPILED BY PP

DATUM Geodetic

BOREHOLE TYPE Washbore, NX & BX Casing

CHECKED BY JIS

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT			LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F.			WATER CONTENT % w_p — w — w_L				
							○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE						
748.0	Ground Level													GR. SA. SI. CL.
0.0	Fill Material; Sand with clayey silt, some gravel.		1	SS	19									15 45 28 12
738.7	Compact		2	SS	17	740								
9.3	Clayey silt with sand and trace of gravel. Firm to Hard.		3	SS	32									4 14 54 28
			4	SS	31	730								
			5	SS	21									
			6	SS	12	720								
			7	TW	PM									
			8	TW	PM	710								134
			9	SS	22									
			10	SS	29	700								
			11	TW	PM									140
			12	SS	31	690								
			13	SS	31									
677.4			14	SS	59	680								
70.6		Sand, traces of silt and gravel.		15	SS	87								
670.2	Very Dense													
77.8	End of Borehole					670								
REVISED JANUARY 1975														

REVISED JANUARY 1975

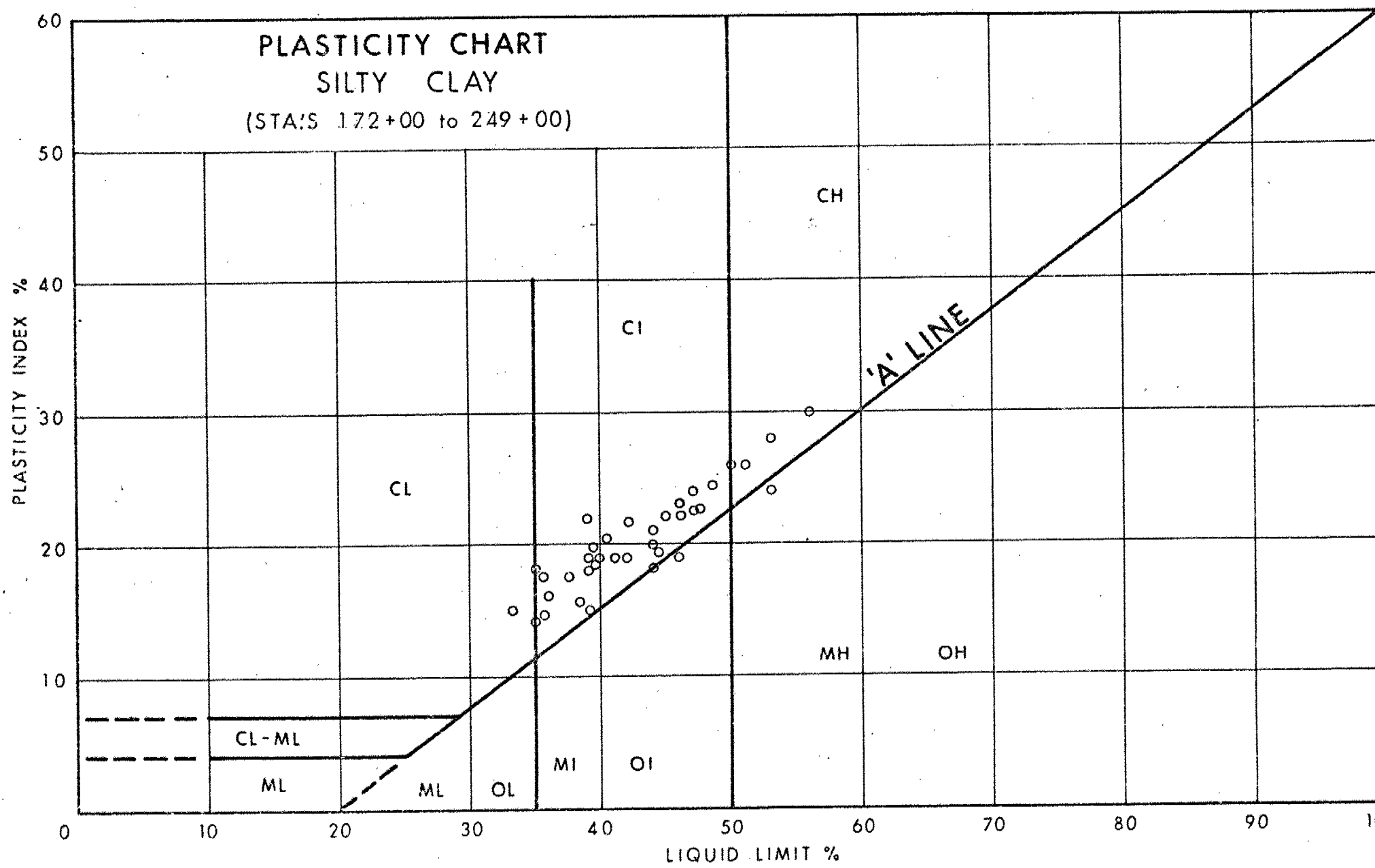


FIG. 1

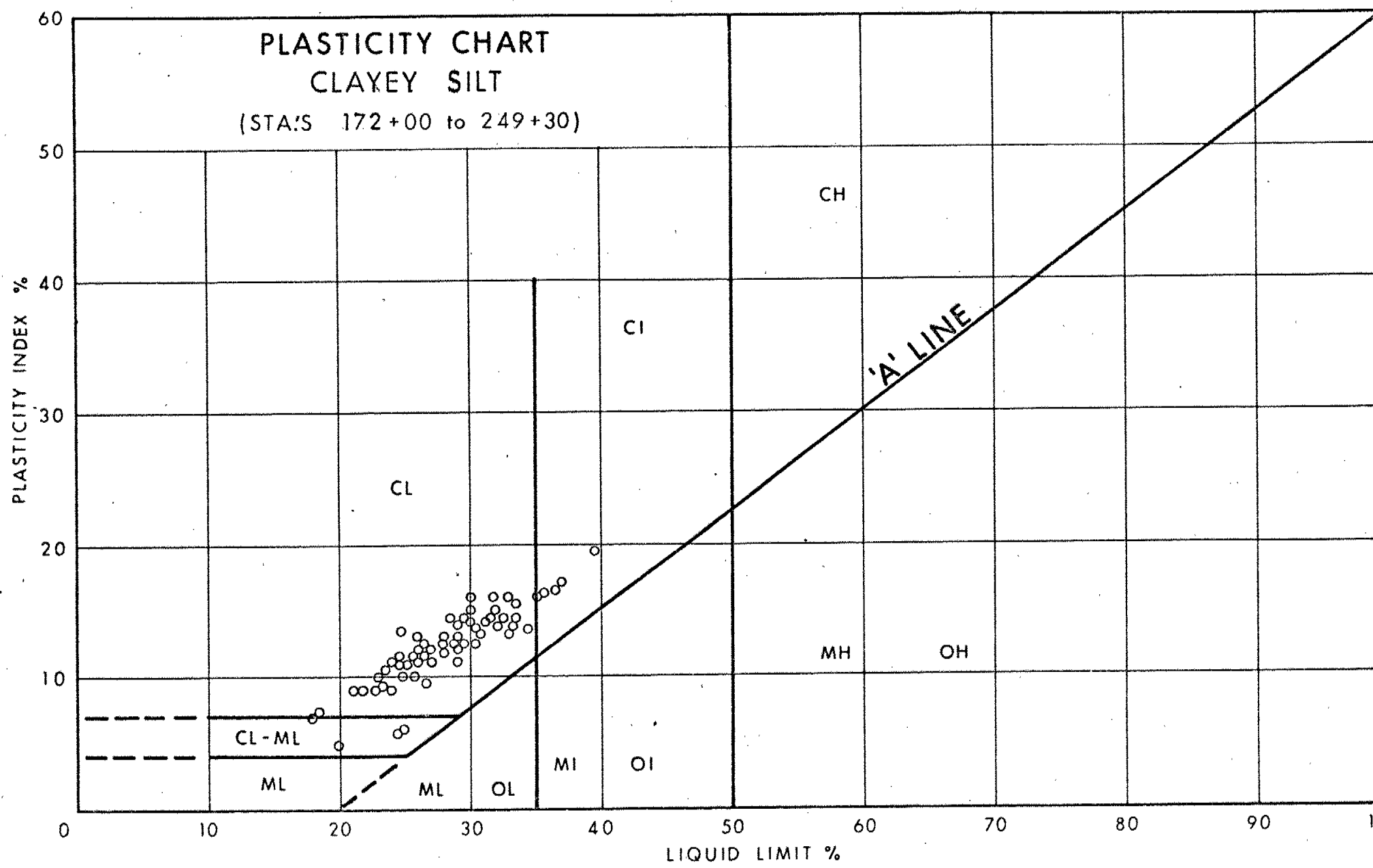


FIG. 2

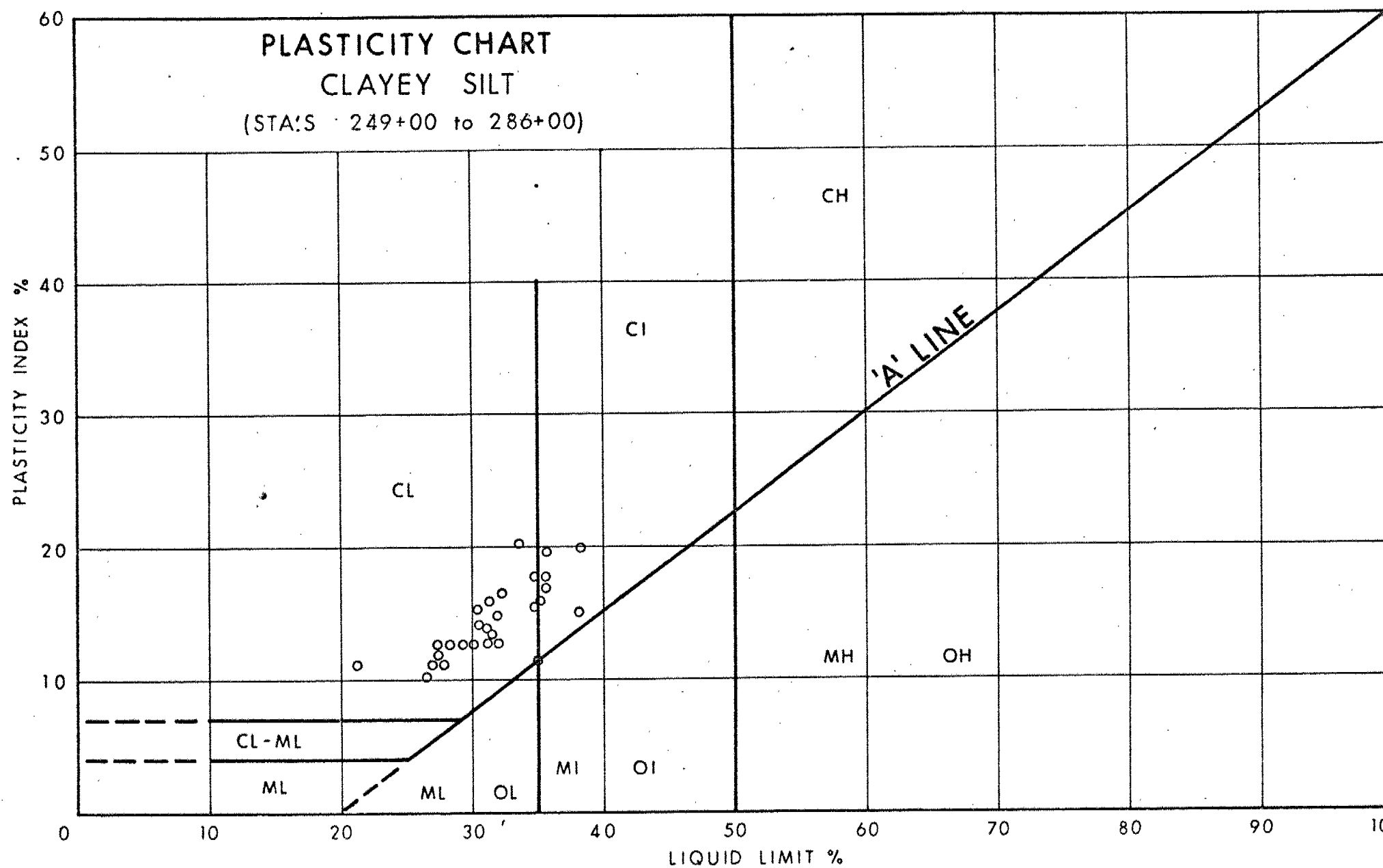


FIG. 3

ABBREVIATIONS & SYMBOLS USED IN THIS REPORTPENETRATION 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
$\log_e a$ OR $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ OR $\log a$	LOGARITHM OF a TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
$\bar{\sigma}$	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

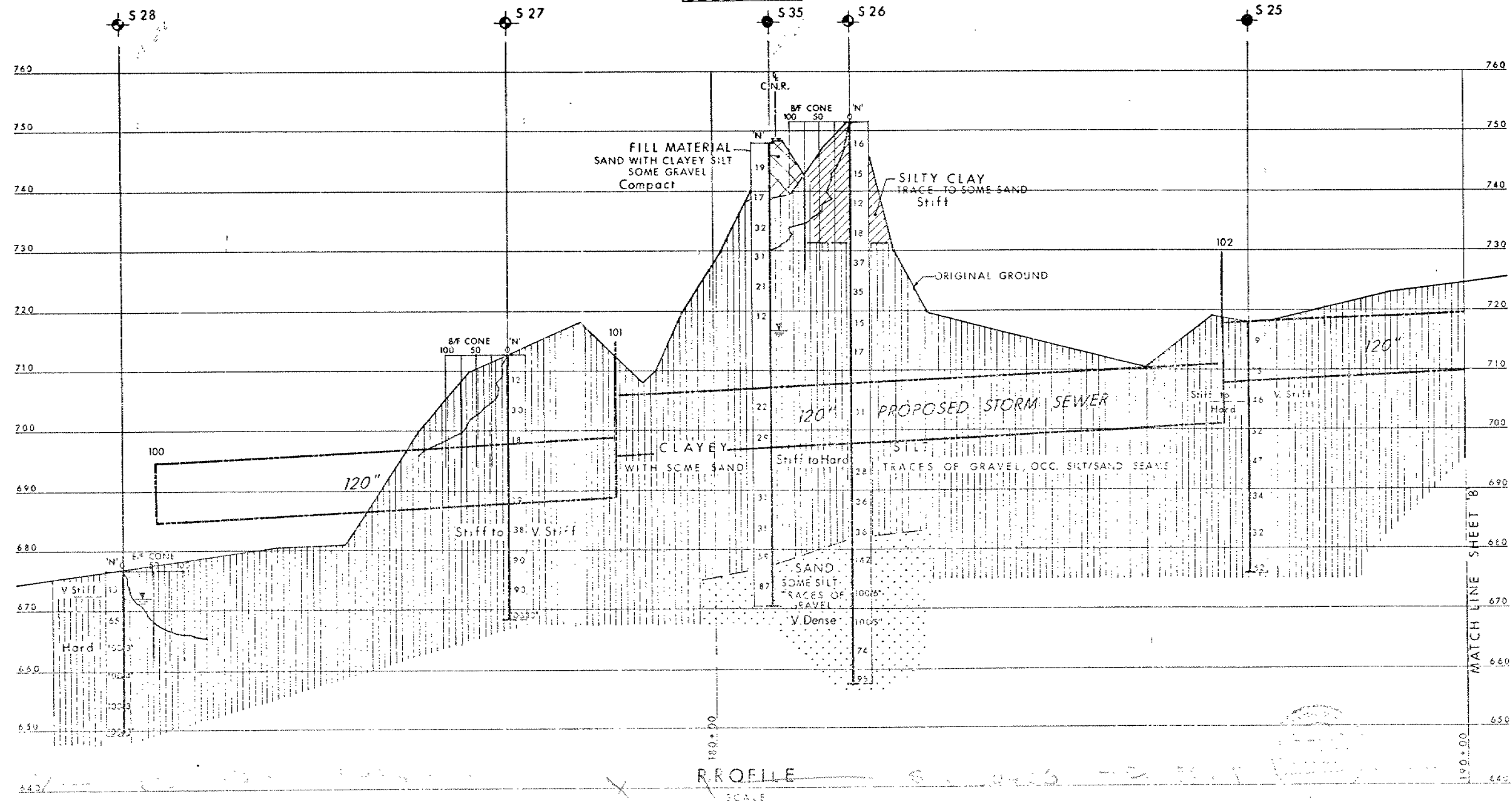
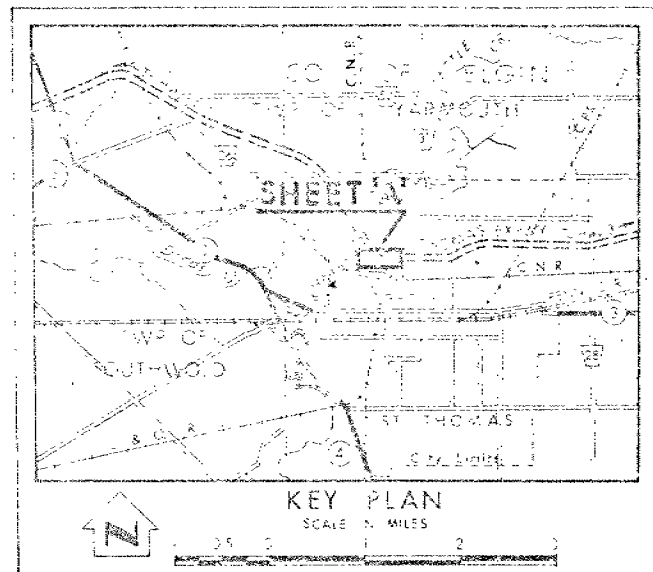
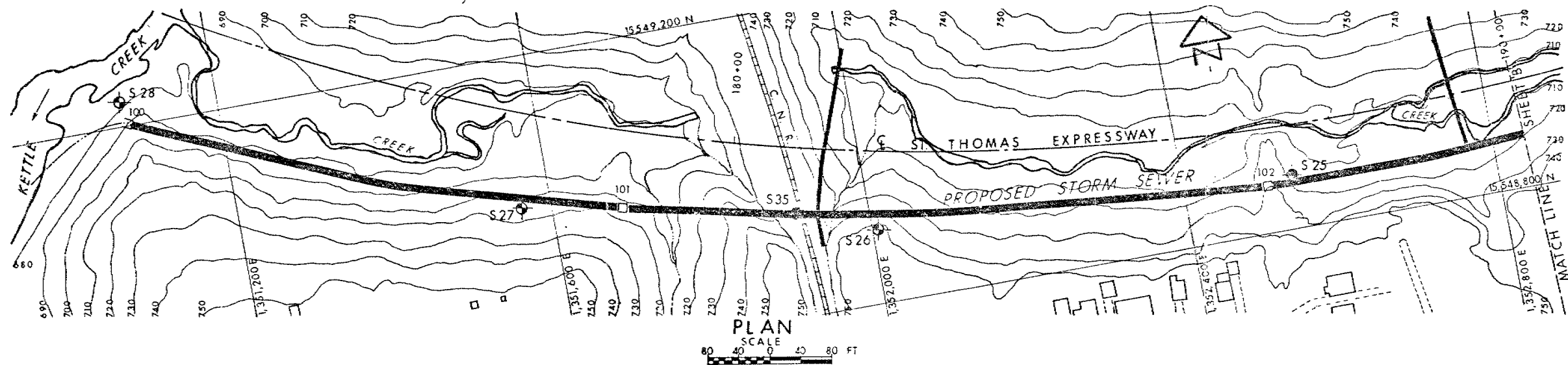
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

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		
	Cone Penetration Test		
	Bore Hole & Cone Test		
	Water Levels established at time of field investigation.		
	Water Levels not established for Bore Holes N9 S25, S26, S27.		
NO.	ELEVATION	CO-ORDINATES	
		NORTH	EAST
S25	717.9	15,548,867	1,352,546
S26	751.3	15,548,895	1,352,008
S35	748.0	15,548,934	1,351,902
S27	712.8	15,549,007	1,351,561
S28	676.6	15,549,232	1,351,076

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

REVISIONS	DATE	BY	DESCRIPTION

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

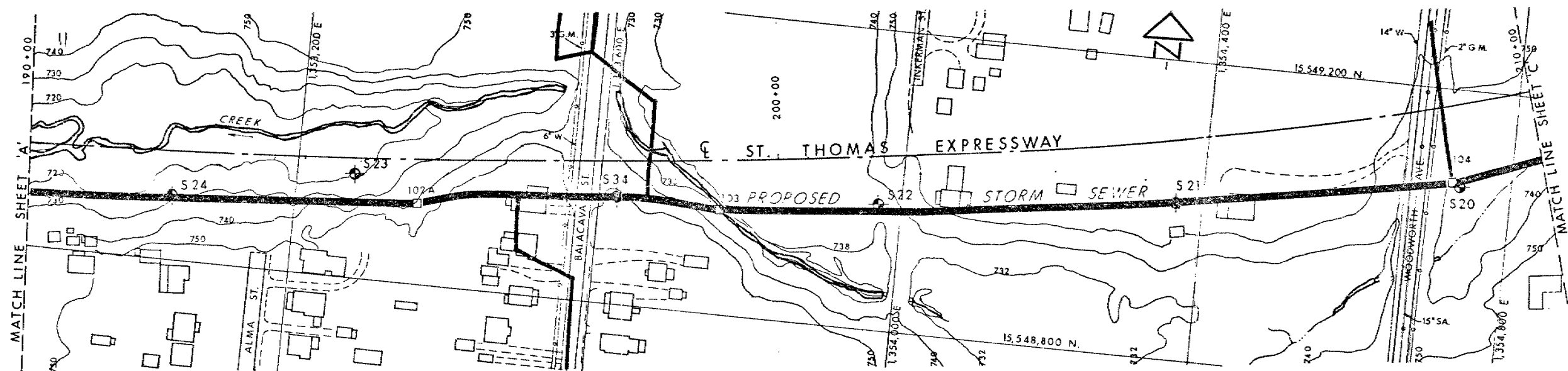
STORM SEWER

HIGHWAY NO. 100 PROP. ST. THOMAS EXPWY. DIST. NO. 2
CC. ELGIN CITY OF ST. THOMAS
TWP. YARMOUTH LOT. CON.

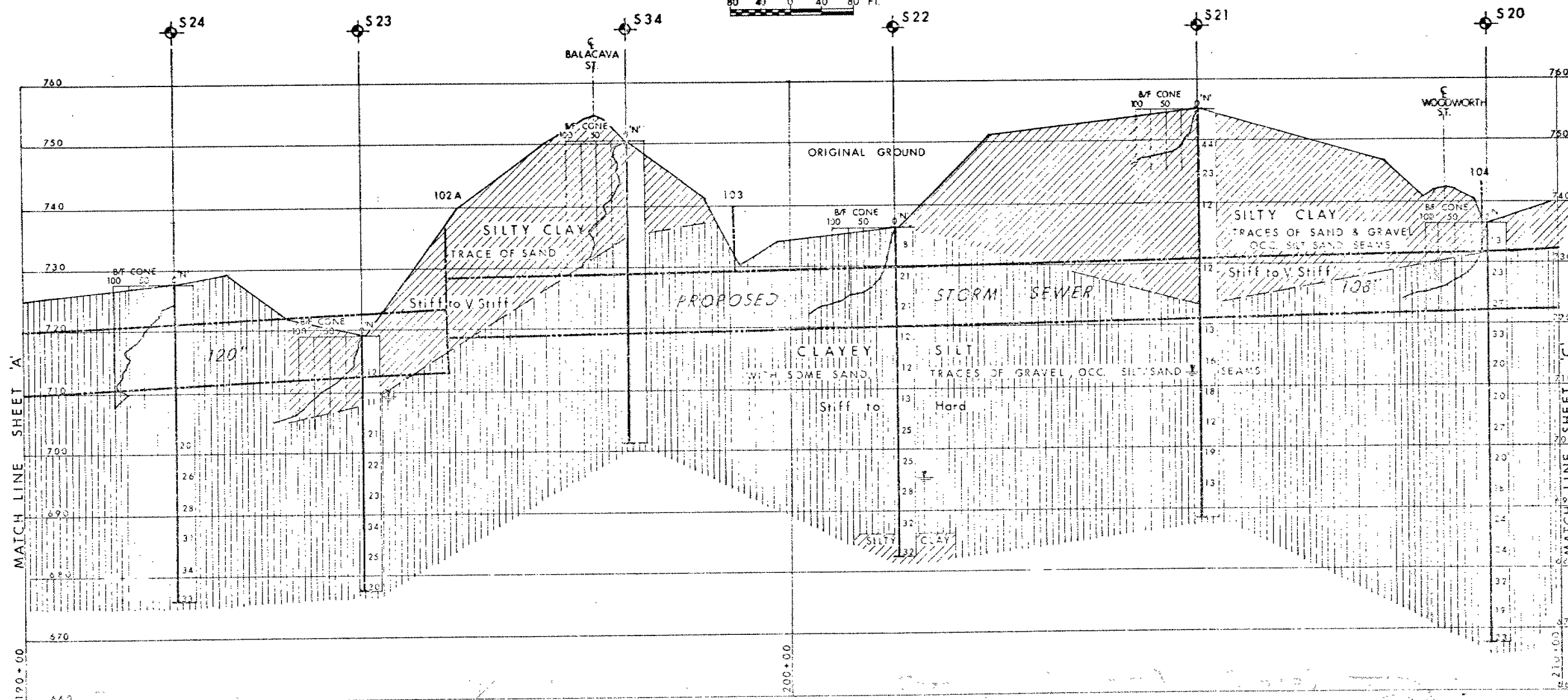
BORE HOLE LOCATIONS & SOIL STRATA

DRAWN BY: J. P. McLEOD
CHECKED BY: J. P. McLEOD
DATE: 12/1/73
PROJECT NO.: 73-11017A

APPROVED BY: J. P. McLEOD
DATE: 12/1/73
PROJECT NO.: 73-11017A

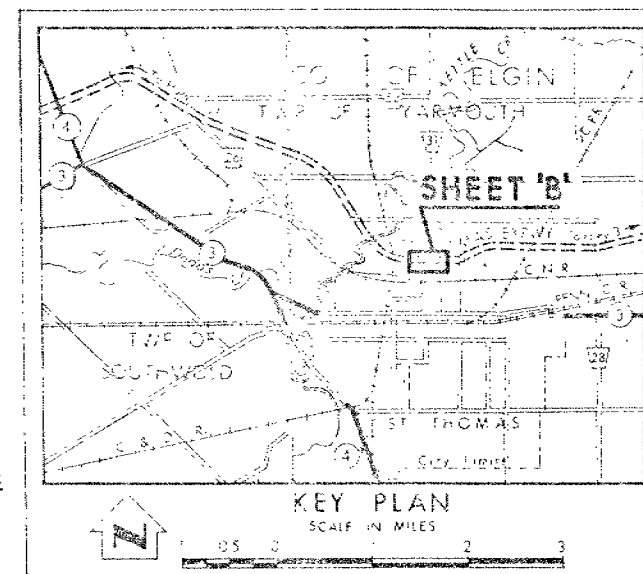


PLAN
SCALE
80 40 0 40 80 FT.



PROFILE

HOR. SCALE 1" = 40' FT.
VER. SCALE 1" = 5' FT.



LEGEND

- Bore Hole
- ⊕ Cone Penetration Test
- ⊕ Bore Hole & Cone Test
- Water Levels established at time of field investigation, May 1973
Water Levels not established for Bore Holes No S20, S24 & S34.

NO.	ELEVATION	CO-ORDINATES	
		NORTH	EAST
S20	736.7	15,549,069	1,354,738
S21	755.1	15,549,011	1,354,364
S22	736.4	15,548,970	1,353,985
S34	750.5	15,548,941	1,353,624
S23	719.3	15,548,941	1,353,278
S24	727.8	15,548,887	1,353,039

NOTE

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

REVISED	DATE	BY	DESCRIPTION

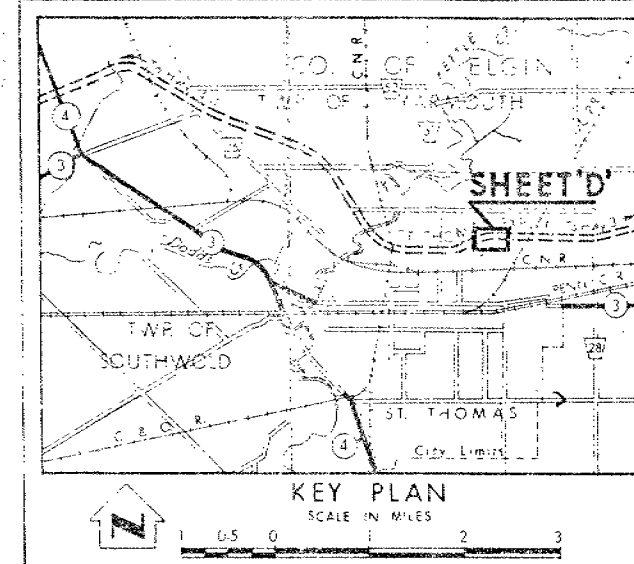
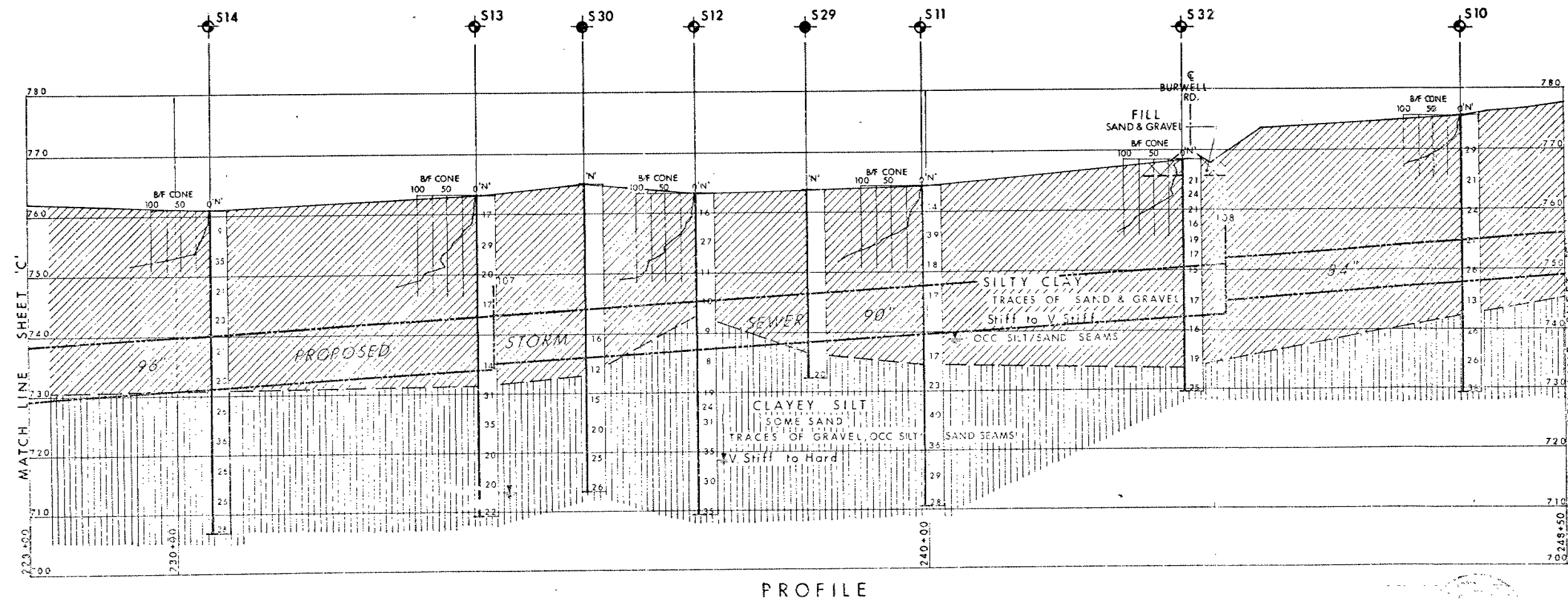
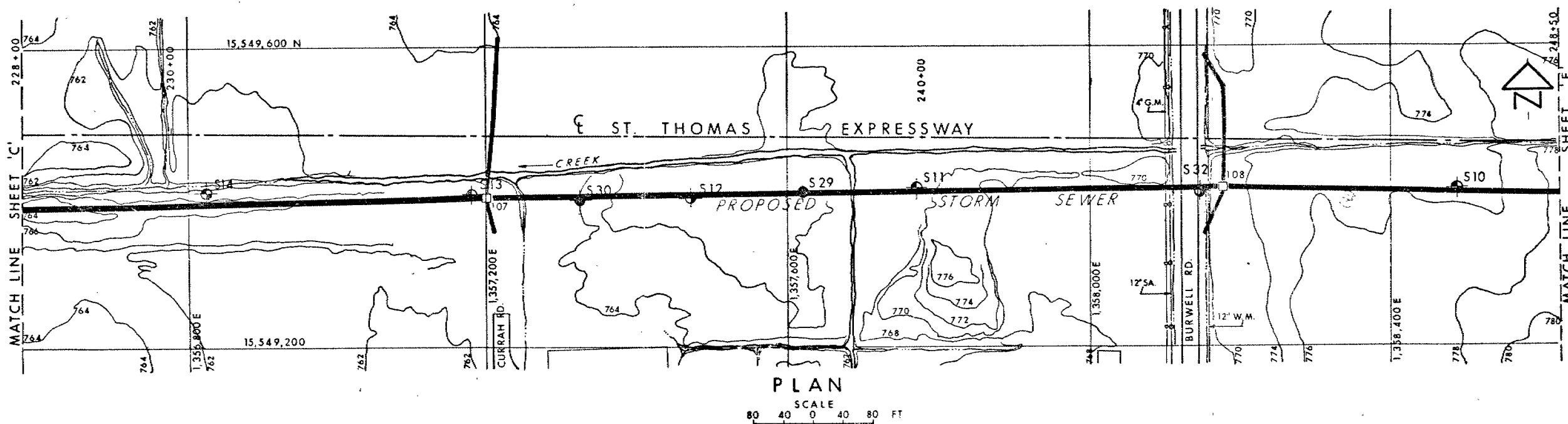
MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO
DESIGN SERVICES BRANCH—FOUNDATIONS DIVISION

STORM SEWER

HIGHWAY NO. PROP. ST. THOMAS EXPWY, DIST. NO. 2
CO. ELGIN CITY OF ST. THOMAS
TWP. YARMOUTH LOT CON

BORE HOLE LOCATIONS & SOIL STRATA

SLEVD. A. P. CHAND. & ASSOC. INC.	DRAWING NO.
DRAWN BY: J. CHAND. & ASSOC. INC.	73-11017B
DATE: 15 JUL 1973	SCALE: 1" = 40' FT.
APPROVED: J. CHAND.	PROJECT: STORM SEWER
PROJECT: STORM SEWER	PROJECT: STORM SEWER



LEGEND			
	Bore Hole		
	Cone Penetration Test		
	Bore Hole & Cone Test		
	Water Levels established at time of field investigation, May 1973		
	Water Levels not established for Bore Holes N- S10, S14, S29, S30 & S32		
NO.	ELEVATION	CO-ORDINATES	
		NORTH	EAST
S10	775.6	15,549,407	1,358,490
S32	768.7	15,549,411	1,358,147
S11	764.8	15,549,405	1,357,771
S29	763.9	15,549,405	1,357,622
S12	763.4	15,549,402	1,357,478
S30	765.1	15,549,397	1,357,323
S13	763.2	15,549,401	1,357,182
S14	761.0	15,549,409	1,356,828

NOTE

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

REVISIONS	DATE	BY	DESCRIPTION

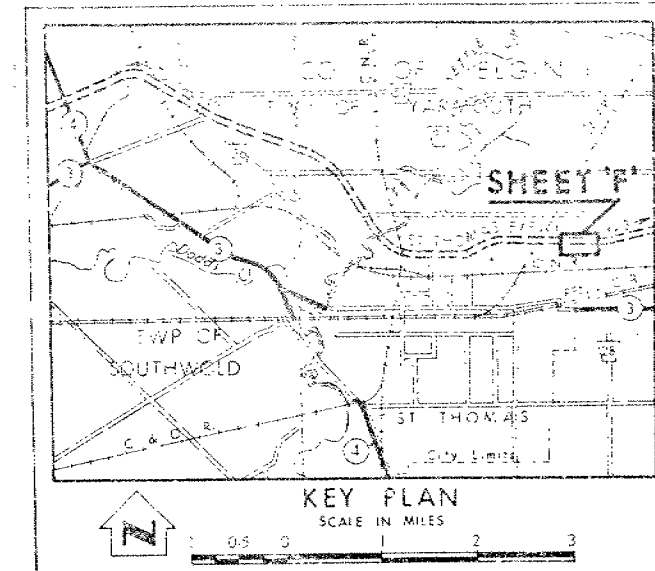
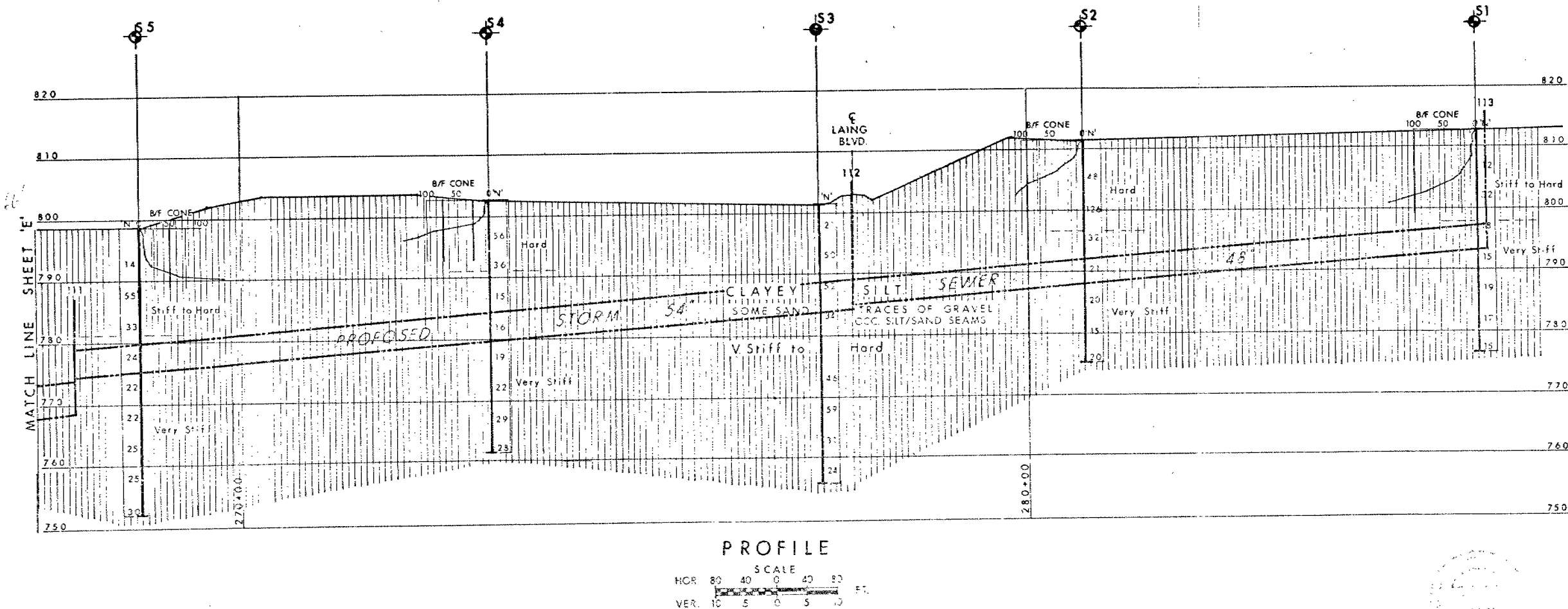
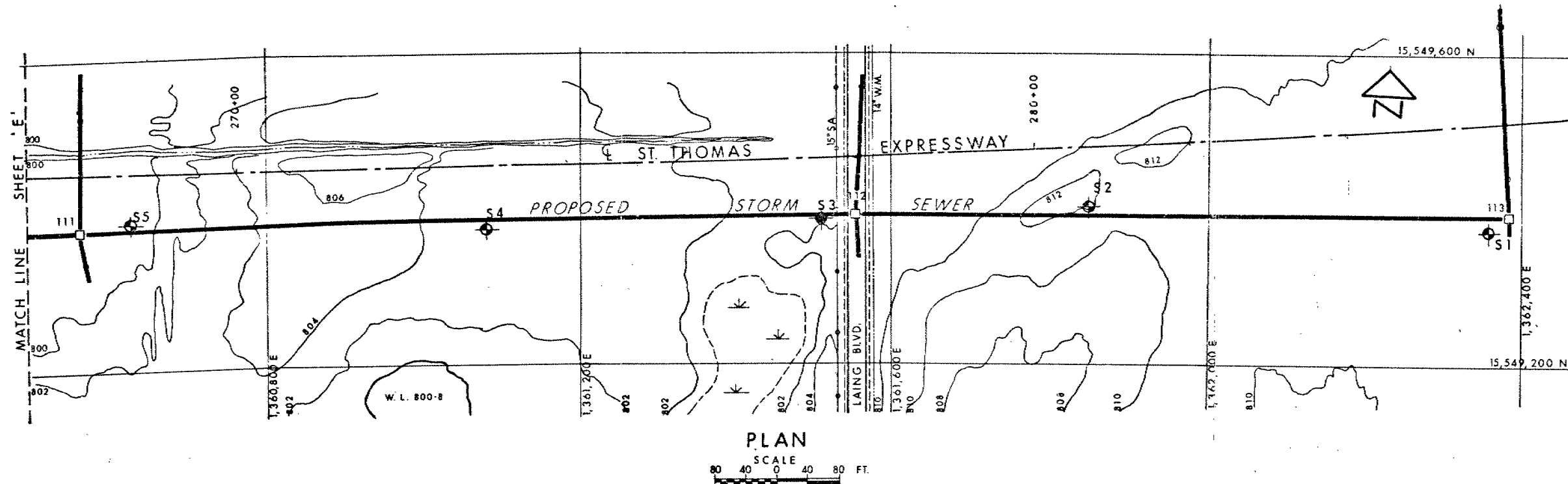
MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO
DESIGN SERVICES BRANCH—FOUNDATIONS OFFICE

STORM SEWER

HIGHWAY NO. PROP. ST. THOMAS EXPWY. DIST. NO. 2
CO. ELGIN CITY OF ST. THOMAS
TWP. YARMOUTH LOT. CCN. 2

BORE HOLE LOCATIONS & SOIL STRATA

SUBMITTAL CHECKED	W.P.N.D. 89-67-01	DRAWING NO.
DRAWN BY	W.P.N.D. 73-11017D	
DATE	15 AUG 1973	BRIDGE DRAWING NO.
APPROVED	W.P.N.D. 73-11017D	



LEGEND

- Bore Hole
- ⊕ Cone Penetration Test
- ⊕ Bore Hole & Cone Test
- NOT Water Levels established at time of field investigation, May 1973

NO.	ELEVATION	CO-ORDINATES	
		NORTH	EAST
S1	813.0	15,549,372	1,362,359
S2	811.7	15,549,403	1,361,853
S3	801.4	15,549,388	1,361,514
S4	802.6	15,549,374	1,361,080
S5	798.9	15,549,388	1,360,533

NOTE

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

REVISIONS	DATE	BY	DESCRIPTION

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

STORM SEWER

HIGHWAY NO. PROP. ST. THOMAS EXPW. DIST. NO. 2
CO. ELGIN, CITY OF ST. THOMAS
TWP. YARMOUTH LOT CON. 9

BORE HOLE LOCATIONS & SOIL STRATA

SUBNO. 3 F. 106210	TWP. NO. 2	CON. NO. 9
DR. NO. 106210	TWP. NO. 2	CON. NO. 9
DATE: 1973	EXT. NO. 1	PROJ. DRAWING NO. 73-110175
APPROVED: [Signature]	EXT. NO. 1	PROJ. DRAWING NO. 73-110175

REF. 3-120-18

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

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

FROM: Soil Mechanics Section
Geotechnical Office
West Bldg., Downsview

ATTENTION:

DATE: January 14, 1975

OUR FILE REF. W.P. 88-69-01

IN REPLY TO

SUBJECT:

REVISION TO FOUNDATION INVESTIGATION REPORT
For
Storm Trunk Sewer
St. Thomas Expressway
London - District #2
W.P. 88-69-01
(Foundation W.O. 73-11017)

Enclosed are REVISED Borehole Log Sheets for boreholes
S31, S32, S33, S34, and S35 on the above project.

In order to avoid future claims for misinformation,
please destroy existing borehole logs S31 to S35
inclusive.



CM:mt
Attach.

C. Mirza, Head
Soil Mechanics Section

cc: E. J. Orr
B. R. Davis
A. Wittenberg
L. E. Walker
B. J. Giroux
J. R. Roy
G. A. Wrong
P. Lewycky
Foundation Files

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

TO: Mr. A. P. Watt, (2) ✓
Regional Structural Location Engineer,
Southwestern Region,
London, Ontario.

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

ATTENTION:

DATE: September 19, 1973.

OUR FILE REF.

IN REPLY TO

SEP 24 1973

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For
Slope Stability of Caughill Ravine
Along St. Thomas Expressway
City of St. Thomas, County of Elgin
District No. 2 (Elgin)
W.O. 73-11023 -- W.P. 88-69-01

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

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

A. G. Stermac

A. G. Stermac,
PRINCIPAL FOUNDATIONS ENGINEER.

AGS/ao
Attch.

c.c. E. J. Orr
B. R. Davis
A. Rutka
A. Wittenberg
L. E. Walker
B. J. Giroux
J. R. Roy
G. A. Wrong
B. A. Singh

Foundations Files
Documents

RECEIVED
BRIDGE PLANNING

SEP 26 1973

SOUTHWESTERN REGION

FOUNDATION INVESTIGATION REPORT
For
Slope Stability of Caughill Ravine
along St. Thomas Expressway
City of St. Thomas County of Elgin
District No. 2 (Elgin)
W.O. 73-11023 - W.P. 88-69-01

1. INTRODUCTION:

A request for a foundation investigation to check the stability of slopes of Caughill Ravine in the vicinity of the crossing of the proposed St. Thomas Expressway and C.N.R. tracks was received from Mr. A.P. Watt, Regional Structural Location Engineer, Southwestern Region, in a memo dated March 29, 1973. Subsequently, the Foundations Office carried out a field investigation to determine the subsoil conditions existing at the site.

This report contains all the factual data from this investigation, together with our recommendations pertaining to the stability and design of the proposed slopes.

2. DESCRIPTION OF THE SITE AND GEOLOGY:

The site of potential slope failure is located on the north side of the proposed St. Thomas Expressway, south of Brock Street and 300 - 500 ft. east of C.N.R. track in the city of St. Thomas.

The Caughill Ravine runs in an east to west direction. The Ravine at this location is some 300 - 400 ft. wide and 50 - 60 ft. deep. The natural slopes of the valley in this general area are approximately 3 horizontal to 1 vertical, and covered

TABLE OF CONTENTS

1. INTRODUCTION.
2. DESCRIPTION OF THE SITE AND GEOLOGY.
3. FIELD AND LABORATORY INVESTIGATION PROCEDURES.
4. SUBSOIL CONDITIONS.
 - 4.1) General.
 - 4.2) Fill Material.
 - 4.3) Clayey Silt.
 - 4.4) Heterogeneous Mixture of Sand, Silt, Clay and Gravel (Glacial Till).
5. GROUNDWATER CONDITIONS.
6. DISCUSSION AND RECOMMENDATIONS.
7. MISCELLANEOUS.

with bush and trees. It is reported that some slippage of the north slope has occurred in the past at this particular location. A visit to the site indicated that there is evidence of some failure. The failure does not appear to be deep seated.

Physiographically, the site is located in the region referred to as the Mount Elgin Ridges.

3. FIELD AND LABORATORY INVESTIGATION PROCEDURES:

A total of two sampled boreholes accompanied by two dynamic cone penetration tests were carried out during the course of the field work. Boring was achieved by means of a CME 750 hollow stem auger machine which was adapted for soil sampling purposes. During the field work, disturbed samples were obtained by means of a standard 2 inch O.D. split-spoon sampler; the energy used in driving it, conformed to the requirements of the Standard Penetration Test. Driving energy to advance the cones was 550 ft. lbs. per blow.

One "undisturbed" sample was recovered using 2 inch I.D. Shelby Tube which was pushed into the soil by hand. A field vane test was attempted 18 inches below this sample.

All boreholes were surveyed in the field by personnel from Southwestern Region Engineering Surveys Section. The locations and elevations of the borings and cone tests are shown on Drawing No. 73-11023A which accompanies this report.

All borehole samples were subjected to a careful visual examination and classification in the field and subsequently in the laboratory. Following this inspection, laboratory tests were carried out on selected samples to determine the following physical properties:

- Atterberg Limits
- Moisture Content
- Grain Size Distribution
- Unconfined Undrained Shear Strength

The results of the field and laboratory tests are summarized on the Record of Borehole Sheets contained in the Appendix of this report.

4. SUBSOIL CONDITIONS:

4.1) General:

Generally, similar subsoil conditions were found to prevail in both boreholes. The boreholes were put down near the top of the slope. The subsoil consisted of 27 ft. of firm to very stiff fill material, underlain by very stiff to hard clayey silt, which in turn was underlain by very dense glacial till. Drawing No. 73-11023A shows the general stratigraphical profile in this area based on information contained in the Record of Borehole Sheets. A more detailed description of the subsoil with regards to soil properties follows:

4.2) Fill Material:

This material was found from ground level down to a depth of 27 ft. in both boreholes (i.e. to el. 710 to 716). The material consisted of zones of silty clay and clayey silt with sand and traces of gravel. Occasional pockets or thin seams of organic material were encountered throughout this depth. The material was heterogeneous in nature. Only one "undisturbed" sample was obtained. An unconfined compression test was performed on it, indicating an undrained shear strength in excess of 750 p.s.f. A field vane test was attempted 18 in. below this sample, but it was not possible to turn the vane, indicating an undrained shear strength of 2,000 p.s.f. It appears that this material was placed without any compaction and was, therefore, heterogeneous in composition and erratic in shear strength from place to place.

Tests for natural moisture content and Atterberg Limits gave the following results:

Liquid Limit	23 - 41 %
Plastic Limit	13 - 21 %
Natural Moisture Content	16 - 25 %
Bulk Density	126 p.c.f.

Grain size analyses gave the following range of distributions:

Gravel	0 - 8 %
Sand	8 - 45 %
Silt	34 - 52 %
Clay	17 - 41 %

4.3) Clayey Silt:

This deposit was encountered in both boreholes. In Borehole A-1 it was 30 ft. in thickness, while Borehole A-2 was terminated in this deposit after penetrating for 34.5 ft. into it. The material consisted of very stiff to hard clayey silt with some sand and traces of gravel. Standard Penetration Test 'N' values varied from 22 to 40 blows per foot. The shear strength is believed to be in excess of 2,000 p.s.f.

Physical properties of the material as determined from the laboratory tests were as follows:

Liquid Limit	24 - 35 %
Plastic Limit	13 - 18 %
Natural Moisture Content	12 - 19 %

Two grain size analyses gave the following distribution:

Gravel	1 - 3 %
Sand	14 - 16 %
Silt	45 - 49 %
Clay	36%

4.4) Heterogeneous Mixture of Sand, Silt, Clay and Gravel (Glacial Till):

This material was intersected in Borehole A-1 only, which was terminated in this stratum. The material consisted of an heterogeneous mixture of sand, silt, clay and gravel and is of glacial origin. Standard Penetration Test 'N' values were 100 blows for 4 inch penetration indicating a very dense state.

Laboratory tests performed on one sample from this stratum indicated the following physical properties:

Liquid Limit	17%
Plastic Limit	11%
Natural Moisture Content	10%

A grain size analysis performed on this sample indicated the following distribution:

Gravel	6 %
Sand	38 %
Silt	45 %
Clay	11 %

5. GROUNDWATER CONDITIONS:

Due to the relatively impermeable nature of the subsoil and short duration of the field work, groundwater levels at the site could not be established conclusively.

6. DISCUSSION AND RECOMMENDATIONS:

As already mentioned in the preceding paragraphs, it appears that some fill material was placed at this location on the slopes. This material was not compacted. However, it did settle under its own weight, and became stronger with depth.

The failure which has occurred at this site, appears from a visual observation to be a slope failure and not a deep seated base failure. This is supported by the fact that the underlying original ground is relatively quite competent and is not liable to fail under the weight of the fill placed here. The average slopes in this area, as well as at the location of the failure are approximately 3 horizontal to 1 vertical.

Stability analyses were carried out in terms of effective stresses to determine the factor of safety against long term failure. The following assumptions were made for computation purposes:

	c' p.s.f.	ϕ' degrees	γ p.c.f.
Fill Material	100	26	126
Clayey Silt	100	27	130
Glacial Till	200	35	130
Geometry	- As shown on Drawing No. 73-11025A Sec. B-B		
Groundwater	- At assumed ground surface		
Tension Crack	- 5 ft. deep		

The groundwater at the ground surface represents the conditions during spring when the slope would be wet, the groundwater would be at its highest, and a failure is likely to occur. The results of these computations showed that a critical situation existed in the upper (fill) portion of the slope in that the factor of safety was in the vicinity of 1.0. Further analyses were carried out with the assumption that the groundwater level would be 4 ft. below and parallel to the ground surface. Under the assumed condition, the safety factor increased to an acceptable value.

In view of the foregoing, it is believed that, prior to rebuilding the failed portion of the slope, a drainage system should be installed with the objective of depressing the groundwater level within the slope, so that it is never higher than 4 ft. below the ground surface on the slopes. Such a scheme is shown on Drawing No. 73-11025B and consists of a cut-off drain about 8 ft. deep located on top of the slope and on the south side of the road, together with counterfort drains at 30 ft. intervals running down the slope, connected by a further drain running through the failed area parallel to the road centre-line. These drains should be at least 2 ft. wide and must be backfilled with free-draining granular material, installed in the bottom of all drains which should finally discharge into the creek or the storm sewer. It is important to ensure that the drains be deep enough to prevent their outlets freezing up, or a buildup of water might occur in the slopes.

7. MISCELLANEOUS:

The field investigation was carried out on May 31, 1973, under the supervision of Mr. L.J. Hodge, Project Foundations Engineer. The entire project was under the supervision of Mr. A. Prakash, Senior Foundations Engineer, who also prepared this report.

The equipment used was owned and operated by Dominion Soils Investigations Company Limited.

This report was reviewed by Mr. K.G. Selby, Supervising Foundations Engineer.



A. Prakash
A. Prakash, P. Eng.

K. G. Selby
K.G. Selby, P. Eng.

AP/zh
September 18, 1973.

APPENDIX I

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO A1

JOB 73-11023

LOCATION Co-ords. 15,549,152 N; 1,352,124 E.

ORIGINATED BY LJH

W.P. 88-69-01

BORING DATE May 31, 1973

COMPILED BY LJH

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & Cone

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE			LIQUID LIMIT — w_L			BULK DENSITY	REMARKS		
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT					PLASTIC LIMIT — w_p				
							20	40	60	80	100	WATER CONTENT — w				
							SHEAR STRENGTH P.S.F.					w_p — w — w_L				
						○ UNCONFINED + FIELD VANE					WATER CONTENT %			γ	P.C.F.	
						● QUICK TRIAXIAL x LAB VANE					10 20 30					
737.4	Ground Level															
0.0	Fill Material															
	Zones of silty clay & clayey silt with sand and traces of gravel		1	SS	4											4 45 34 17
			2	SS	6											
	occasional pockets or thin seams of organic material.		3	Tw	PM											3 20 52 25
	Firm to Very Stiff Brown		4	SS	15											
710.4			5	SS	24											
27.0	Clayey silt, some sand, traces of gravel.		6	SS	27											
			7	SS	40											3 16 45 36
	Very Stiff to Hard		8	SS	32											
	Grey		9	SS	36											
			10	SS	34											
680.4																
57.0	Het. mix. of sand, gravel, clay & silt. Grey (Glacial Till)		11	SS	100	4"										
673.0	Very Dense		12	SS	100	4"										6 38 45 11
64.4	End of Borehole														W.L. not established	

RECORD OF BOREHOLE NO A2

JOB 73-11023

LOCATION Co-ords. 15,549,120 N; 1,352,193 E.

ORIGINATED BY L.J.H.

W.P. 88-69-01

BORING DATE May 31, 1973

COMPILED BY L.J.H.

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & Cone

CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	w_p	w	w_L		
742.7	Ground Level															
0.0	Fill Material					740										
	Zones of silty clay & clayey silt with sand & traces of gravel.		1	SS	6											
			2	SS	6	730										8 33 40 19
	occasional thin seams or pockets of black organic material.		3	SS	10											
	Firm to Very Stiff		4	SS	15	720										0 8 51 41
715.7	Brown		5	SS	25											
27.0	Clayey silt, some sand, traces of gravel.		6	SS	25	710										
			7	SS	22											
	Very Stiff to Hard		8	SS	30	700										1 14 49 36
	Grey		9	SS	23											
			10	SS	29	690										
681.2			11	SS	35	680										1 7 66 26
61.5	End of Borehole															W.L. not established

20
15 \diamond 5 % STRAIN AT FAILURE
10

OFFICE RECORD ON SOIL EXPLORATION

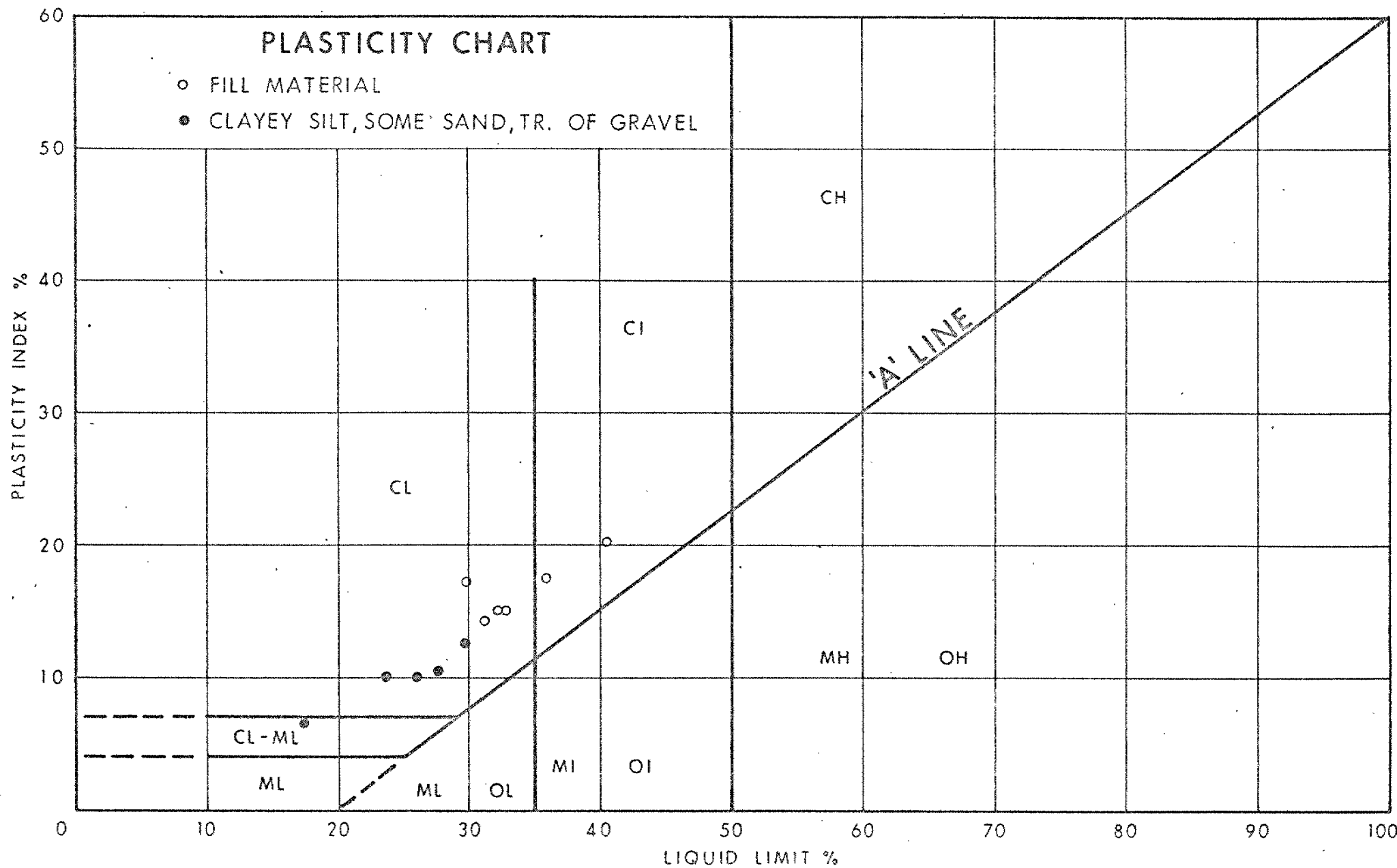


FIG. 1

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

EARTH PRESSURE

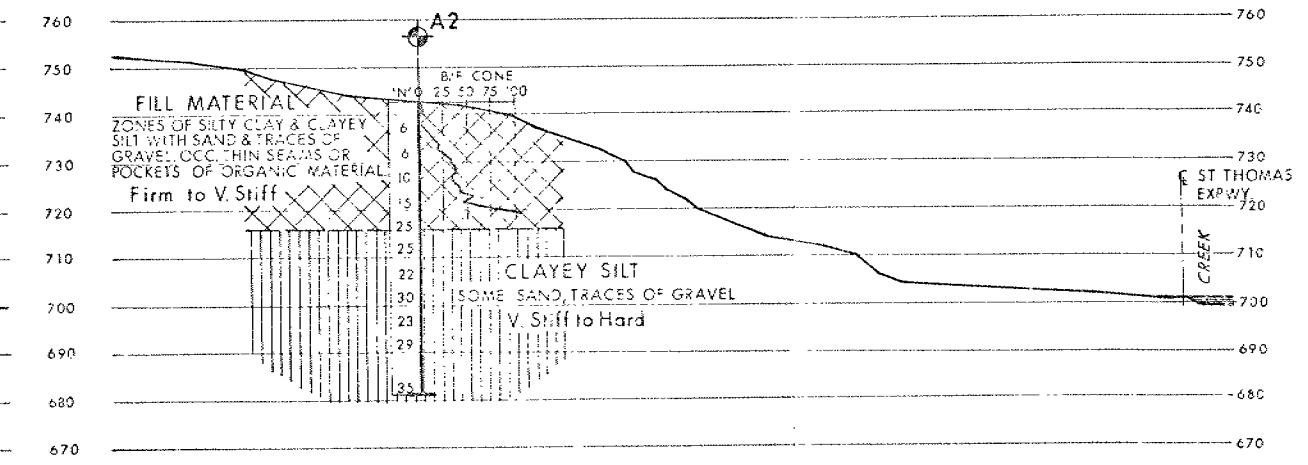
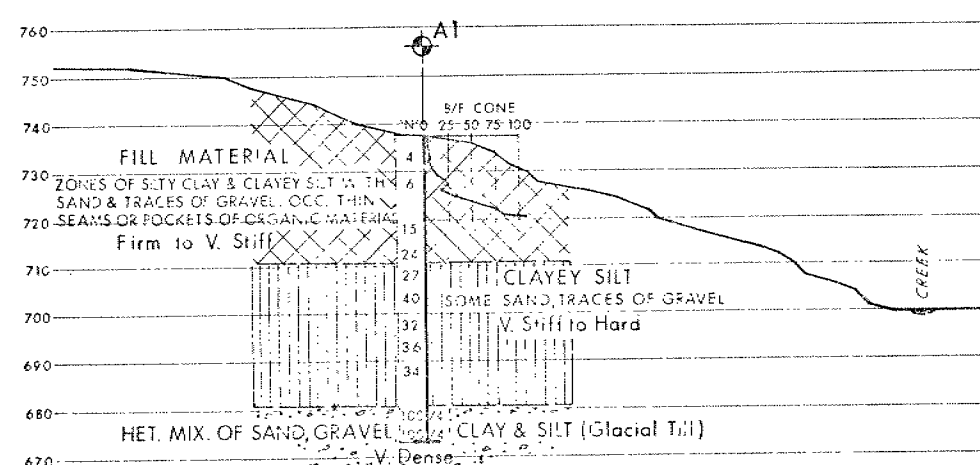
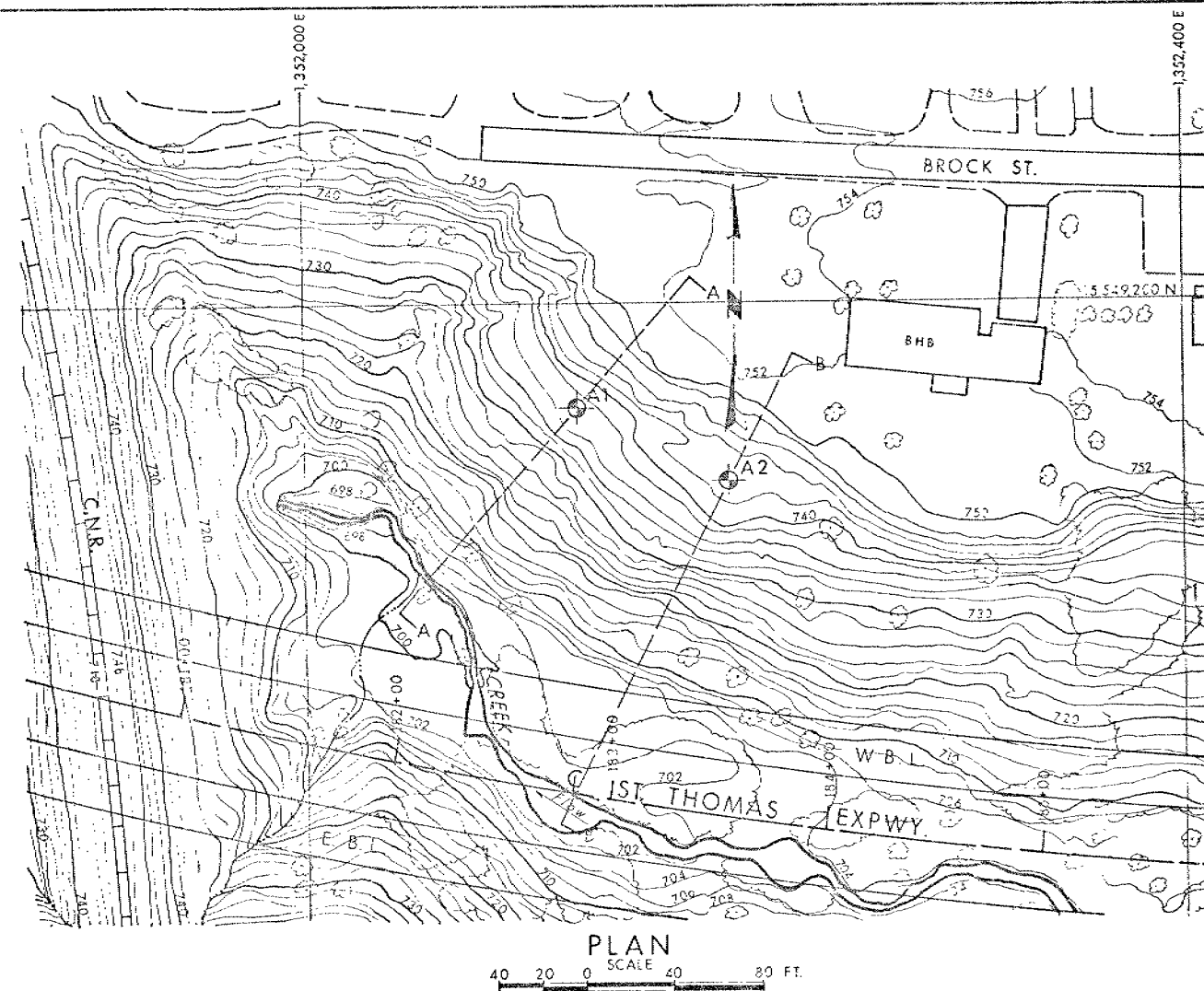
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

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

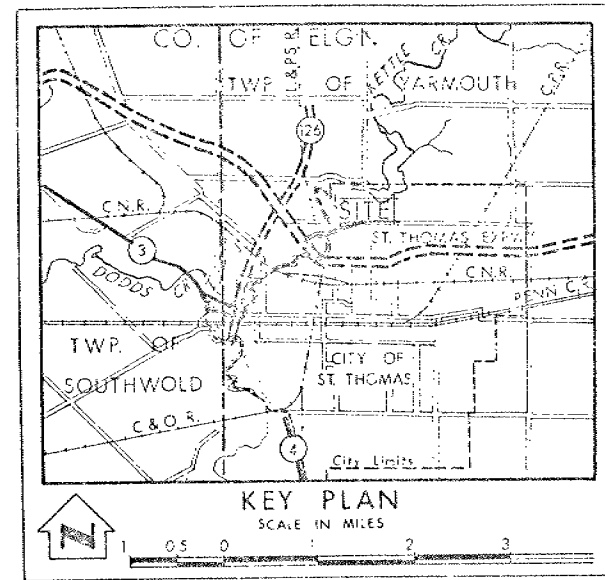
SLOPES

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



SECTIONS

20 10 0 SCALE 20 40 FT.



LEGEND			
	Bore Hole		
	Core Penetration Test		
	Bore Hole & Cone Test		
	Water Levels established at time of field investigation, MAY, 1973.		
NO.	ELEVATION	CO-ORDINATES	
		NORTH	EAST
A1	737.4	15,549,152	1,352,124
A2	742.7	15,549,120	1,352,193

NOTE

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

CONTRACT DOCUMENT NOTE

The complete soil investigation report for this structure may be examined at the Structural and the Foundations Office, Downsview, and at the London District Office.

DATE	BY	DESCRIPTION

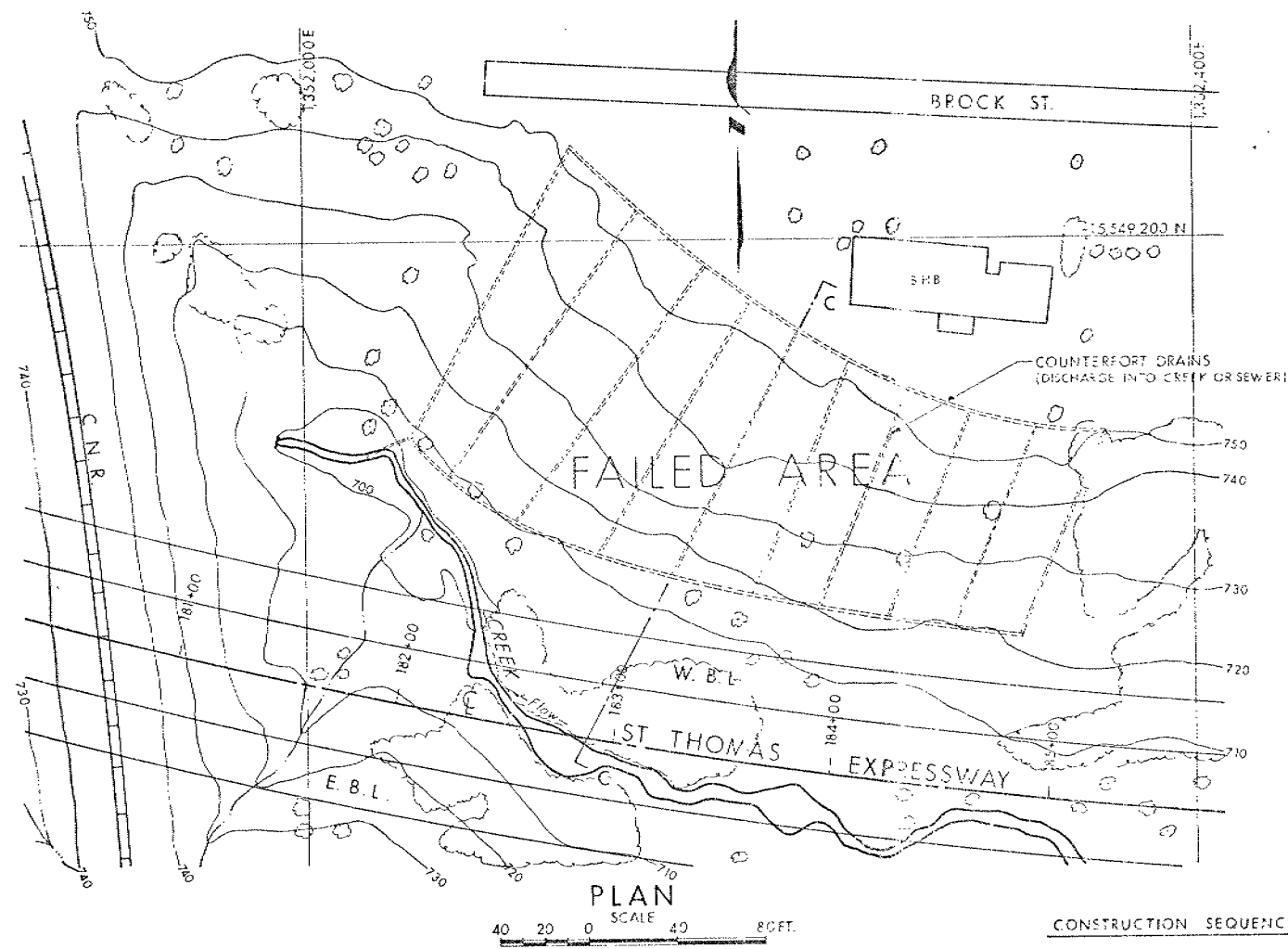
MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO
DESIGN SERVICES BRANCH—FOUNDATIONS OFFICE

CAUGHILL RAVINE STABILITY

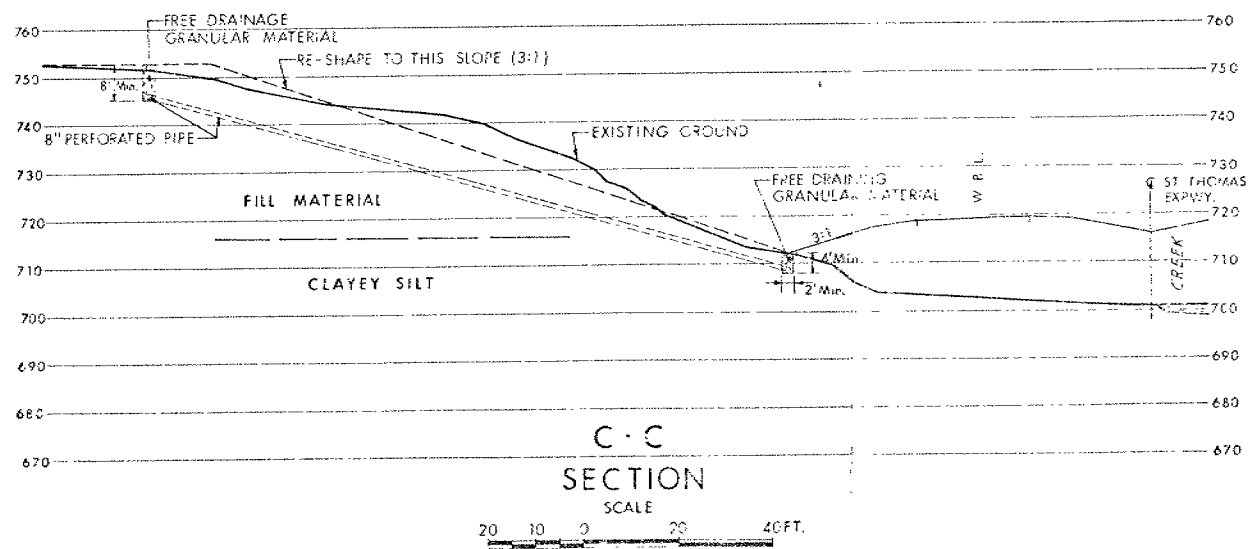
HIGHWAY NO. ST. THOMAS EXPWY. DIST. NO. 2
CO. ELGIN CITY OF ST. THOMAS
TWP. YARMOUTH LOT CON.

BORE HOLE LOCATIONS & SOIL STRATA

SUPV. CHECKED DRAWN DATE
DATE BY NO. 73-1023A
DATE BY NO.



- CONSTRUCTION SEQUENCE**
- ① - TRIM SLOPE TO LINE SHOWN (3:1 Slope)
(Remove all ORGANICS)
 - ② - EXCAVATE DRAINS AS SHOWN
 - ③ - PLACE PIPES & BACKFILL DRAINS WITH GRANULAR
 - ④ - REBUILD FAILED AREA



SEE DRAWING NO. 73-11023A

KEY PLAN
SCALE IN MILES

LEGEND

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

NO.	ELEVATION		

NOTE

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

REVISIONS	DATE	BY	DESCRIPTION

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

CAUGHILL RAVINE STABILITY

HIGHWAY NO. ST. THOMAS EXPWY DIST. NO. 2
CO. ELGIN City of ST. THOMAS
TWP. YARMOUTH LOT. CON.

PROPOSED SLOPE TREATMENT

DESIGNED BY W.D. NO. DRAWING NO. 73-11023B
CHECKED BY DATE BEFORE DRAWING NO.
APPROVED BY DATE