

MEMORANDUM

TO: Mr. T. J. Kovich,
Regional Materials Engineer,
Central Region (Toronto),
Room 134-A, Lab. Bldg.

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

ATTENTION:

DATE: February 25, 1971

OUR FILE REF.

IN REPLY TO

JUN 15 1971

SUBJECT:

FOUNDATION INVESTIGATION REPORT

For

Proposed Storm Sewer
Hwy. #400 (Station 284+00)
Westerly to Arrow Road
Borough of North York, County of York
District No. 6 (Toronto)
W.O. 71-11011 -- W.P. 105-70-01
CONT 71-013

30M11-132

GEORES No.

Attached, we are forwarding to you our detailed foundation investigation report on the subsoil conditions existing at the above structure 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/MdeF
Attach.

cc: Messrs. F. G. Allen
D. W. Farren
G. K. Hunter (2)
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Foundations Files ✓
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A. G. Stermac

A. G. Stermac
PRINCIPAL FOUNDATION ENGINEER

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FOUNDATION INVESTIGATION REPORT
For
Proposed Storm Sewer
Hwy. #400 (Station 284+00)
Westerly to Arrow Road
Borough of North York, County of York
District No. 6 (Toronto)
W.O. 71-11011 -- W.P. 105-70-01

1. INTRODUCTION:

In conjunction with the reconstruction of Hwy. #400, a storm sewer, extending from Hwy. #400 (Station 284+00) westerly along the Bortor Rd. road allowance to Arrow Road, is to be constructed. The Foundation Section was requested verbally by Mr. T. J. Kovich, Regional Materials Engineer, Central Region, to carry out a subsurface investigation along the proposed sewer alignment. An investigation was subsequently carried out by this Section to determine the subsoil and groundwater conditions.

This report contains all the factual data obtained during this investigation as well as recommendations pertaining to the excavation for, and installation of, the storm sewer.

2. SITE AND GEOLOGY:

The site is located immediately north of Sheppard Avenue, between Hwy. #400 and Arrow Road. The terrain, which is grass-covered, rises gradually in a westerly direction varying between elevations 472 and 480. The area is zoned for light industry, thus numerous factories and showrooms are located in the vicinity of the site.

Physiographically this area is situated in the region known as the "Peel Plain". The predominant overburden deposit is composed of a glacially deposited silty clay; this deposit is generally of the order of 25 to 35 feet thick. The cohesive stratum is underlain by glacial till.

2. SITE AND GEOLOGY: (cont'd.) ...

The overburden sequence is underlain by grey shale of the Meaford-Dundas and Blue Mountain formations, Ordovician Period.

3. FIELD AND LABORATORY WORK:

Eight boreholes, each accompanied by a dynamic cone penetration test, were put down along the proposed alignment of the sewer, by means of a continuous flight power auger machine (Penndrill).

Samples were obtained at various depths by means of a 2-inch O.D. split-spoon sampler which was hammered into the soil in accordance with the specifications for the Standard Penetration Test. The same procedure was used to advance the dynamic cone penetration tests. In addition, wherever possible, relatively undisturbed samples were obtained from the cohesive portions of the subsoil by pushing in 2-inch I.D. Shelby tubes. In-situ vane tests were carried out in the cohesive portions of the subsoil in order to determine the undrained shear strength of this subsoil.

Groundwater level conditions across the site were obtained, during the period of the investigation, by recording the water levels in the open boreholes.

Borelog sheets for the borings are contained in this report. The borehole locations and elevations were surveyed by personnel from Engineering Surveys (Central Region). The elevations given in this report are referenced to a Geodetic datum. The locations and elevations of all the borings are shown on Drawing No. 71-11011A, together with a centre-line stratigraphical profile across the site.

The soil samples were subjected to a careful visual examination in the field and subsequently in the laboratory. Following this examination, laboratory tests were carried out on representative samples in order to determine the physical properties of the overburden, namely:

3. FIELD AND LABORATORY WORK: (cont'd.) ...

Natural Moisture Content
Atterberg Limits
Undrained Shear Strength
Grain-size Distribution

The results of this testing are plotted on the individual Borelog sheets as well as on Figures No. 1 and 2, all of which are included in the Appendix to this report.

4. SUBSOIL CONDITIONS:

4.1) General:

The surficial stratum across the site is composed of a hard to firm clayey silt to silty clay which is between 28 and 30 feet in thickness. The cohesive stratum is underlain by a competent glacial till sheet.

The boundaries of the various deposits are shown on the accompanying Borelog sheets. The inferred stratigraphical profile, along the centre-line of the proposed sewer, is plotted on Drawing No. 71-11011A.

From ground surface downward, the various soil types encountered are as follows:

4.2) Clayey Silt to Silty Clay:

Underlying a thin topsoil cover is the predominant stratum across the site which is composed of a grey clayey silt to silty clay with a trace of sand. The thickness of this cohesive stratum varies from 29 to 30 feet. The upper 9 to 13.5 feet is mottled brown in colour, which would indicate that this zone has been subjected to desiccation. Random seams of silt, up to 4 inches in size, are present throughout the deposit.

The engineering properties of this stratum are summarized in the following table:

4. SUBSOIL CONDITIONS: (cont'd.) ...

4.2) Clayey Silt to Silty Clay: (cont'd.) ...

<u>Identity Tests:</u>	<u>Upper Desiccated Zone</u>		<u>Lower Zone</u>	
	<u>Range</u>	<u>(Average)</u>	<u>Range</u>	<u>(Average)</u>
Bulk Density (p.c.f.) (γ)	--		112 - 130	(120)
Liquid Limit (%) (W_L)	28.5 - 49.5	(36)	26.5 - 48.5	(34)
Plastic Limit (%) (W_P)	17 - 24.5	(23)	16.5 - 24.5	(23)
Natural Water Content (%) (W)	17.5 - 28.5	(23)	21 - 42	(32)
Liquidity Index	neg. - 0.5	(0.2)	0.3 - 1.1	(0.7)
<u>Undrained Shear Strengths (C_u) (p.s.f.)</u>				
In-situ Field Vane Tests	--		500 - >2,000	
Laboratory Tests	--		450 - 1,600	
Sensitivity (S_t)	--		2.0 - 5.0	(2.9)
<u>'N' Values - (Blows/ft.)</u>				
	12 - 55	(25)	7 - 12	

The Atterberg limit results given in the table, are also summarized on the Plasticity Chart, Figure #1. The testing indicates that the cohesive stratum is inorganic with a plasticity in the low to intermediate range. The corresponding liquidity indices indicate that the natural moisture content of the upper desiccated zone is at or slightly above the plastic limit, while the lower zone has a moisture content which is in close proximity to the liquid limit.

4. SUBSOIL CONDITIONS: (cont'd.) ...

4.2) Clayey Silt to Silty Clay: (cont'd.) ...

The undrained shear strength of that portion of the cohesive subsoil, located beneath the upper desiccated zone, was determined by carrying out testing both in the field and laboratory. The results are plotted on the borelog sheets and enumerated in the aforementioned table. Based on these results, it is estimated that the consistency of this lower portion of the deposit varies from firm to stiff. Standard penetration tests carried out within this zone confirmed this consistency range. The standard penetration tests, carried out within the upper desiccated zone, however, indicates that the consistency in this zone ranges from stiff to hard.

4.3) Glacial Till Deposit:

The cohesive stratum is underlain by a competent glacial till deposit. This deposit was not fully penetrated at any of the boring locations; it was, however, proven to extend for a depth of 7.0 feet. The glacial till is primarily cohesive in nature, being composed of clayey silt with some sand and gravel. There are random granular zones throughout; in these areas the till is composed of a matrix of silt and sand binding gravel. Grain-size distribution testing, for samples obtained from the till using 2-inch O.D. equipment, was performed; the resulting curves are plotted on Figure #2.

Standard penetration testing, carried out within the glacial till, gave 'N' values which range between 14 and 65 blows/ft. Based on this testing it is estimated that the consistency of the deposit ranges from very stiff to hard.

5. GROUNDWATER CONDITIONS:

Groundwater level observations have been carried out, during the period of the investigation, in the open boreholes. These are recorded on the borelog sheets and summarized on Drawing No. W.O. 71-11011A. The readings indicate that the water

5. GROUNDWATER CONDITIONS: (cont'd.) ...

level in the open boreholes varies between elevations 470 and 475, corresponding to depths of from 2 to 8.5 feet below existing ground level.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

It is proposed to construct a storm sewer in conjunction with the proposed reconstruction of Hwy. #400, in the Township of North York, County of York. The 48-inch diameter sewer, which will be approximately 1,100 feet long, will run easterly from Arrow Road along the road allowance for proposed Bartor Road terminating at Hwy. #400.

The proposed invert of the sewer, which is shown on Drawing No. W.O. 11011A, is to range from elevation 463, near Hwy. #400, to elevation 456 at Arrow Road. At this grade the sewer will be located anywhere from 10 to 24 feet below existing ground surface. The sewer will be founded within the clayey silt to silty clay stratum. As discussed previously, the prevailing groundwater level, at the time of the investigation, ranged from elevation 470 to 475. In general, therefore, the sewer will be located approximately 7 to 17 feet below the groundwater level.

It is understood that the sewer construction will be carried out by open cut methods.

6.2) Sewer Construction by Open Cut Methods:

As discussed previously, the sewer excavation will extend anywhere from 10 to 24 feet into the cohesive stratum. Temporary cuts, in this area, will be inherently stable against a deep-seated rotational type of failure, provided the cuts are maintained as follows:

6. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

6.2) Sewer Construction by Open Cut Methods: (cont'd.) ...

<u>Depth of Cut</u> (ft.)	<u>Slope of Cut</u> (Horizontal : Vertical)
0 - 20	1 : 1
21 - 24	1½ : 1

If, due to space restrictions, slopes steeper than those specified above are desired, the excavations should be sheeted. In all cases, the provisions adopted in the designated working areas should comply with the Trench Excavation Act.

The excavation will extend below the groundwater level recorded during the period of the investigation. Since the cohesive stratum is relatively impervious, the groundwater seepage into the excavation should be negligible. Random water-bearing granular seams and layers are, however, present within this deposit. If such zones are intersected, the inflow could readily be handled by conventional means, such as pumping from sumps.

It is recommended that the pipe bedding on this project adhere to standards currently being used by the Department, specifically for Class B-1 Bedding on a Yielding Foundation - (Standard No. S.D. -8-40). The bedding must always be placed in a dry trench, and particular attention should be paid to compaction and shaping of the bedding material.

6.3) Dewatering Procedures:

Comments and recommendations relating to dewatering and stability of the excavation mentioned in the previous paragraphs, are based on the assumption that the conditions, encountered during the period of the investigation (February, 1971), will apply during the construction. This may or may not be the case. It will be the responsibility of the Contractor to determine the conditions which prevail during construction, and to take steps as are necessary to ensure dry, safe working conditions.

6. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

6.3) Dewatering Procedures: (cont'd.) ...

It is believed that, if the sewer is constructed continuously from Arrow Road, easterly drainage of any granular seams or layers may occur thus alleviating the situation considerably. Permanent drainage of the sewer trench into any existing manholes should be provided, using at each manhole, a short (20 ft.) length of 6-inch diameter, perforated pipe, surrounded with a suitable filter material; the pipe should discharge into the manhole.

7. MISCELLANEOUS:

The field work for this project was carried out during the period of February 5 to 12, 1971, under the immediate supervision of Mr. V. Korlu, Project Foundation Engineer.

The equipment used was owned and operated by Canadian Longyear Co., Ltd., Toronto.

This report was written by Mr. B. T. Darch, Senior Foundation Engineer. This project was carried out under the general supervision of Mr. M. Devata, Supervising Foundation Engineer, who also reviewed this report.

February, 1971

APPENDIX I

~~ADDITIONAL INFORMATION~~

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 2

FOUNDATION SECTION

JOB 70-11011

LOCATION Arrow Rd. Sewer 5 + 70 0

ORIGINATED BY VK

W.P. 105-70-1

BORING DATE February 8, 1971

COMPILED BY JDN

DATUM Geodetic

BOREHOLE TYPE Pen Drill

CHECKED BY

[illegible]

FOUNDATION SECTION

JOB	71-11011	LOCATION	Arrow Rd. Sewer	8 + 40	Ø	ORIGINATED BY	VK
W.P.	105-70-1	BORING DATE	February 9, 1971			COMPILED BY	JDW
DATUM	Geodetic	BOREHOLE TYPE	Pen Drill			CHECKED BY	LD

[illegible]

FOUNDATION SECTION

CHECKED BY *AK*

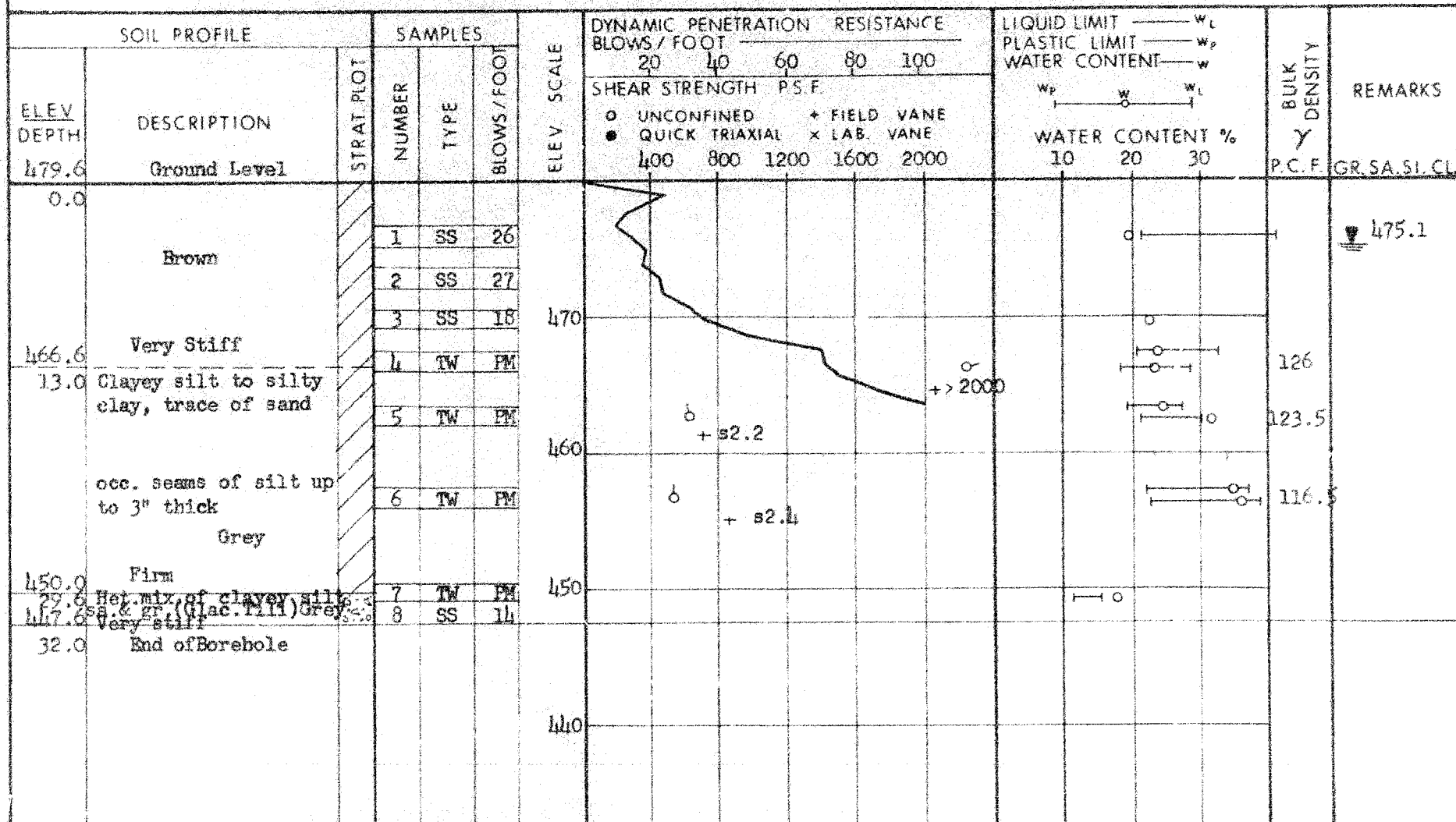
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DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 5

FOUNDATION SECTION

JOB 71-11011 LOCATION Arrow Rd. Sewer 4 + 60 Ø ORIGINATED BY VK
 W.P. 105-70-1 BORING DATE February 11, 1971 COMPILED BY JDW
 DATUM Geodetic BOREHOLE TYPE Pen Drill CHECKED BY



FOUNDATION SECTION

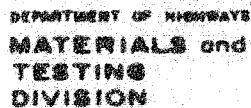
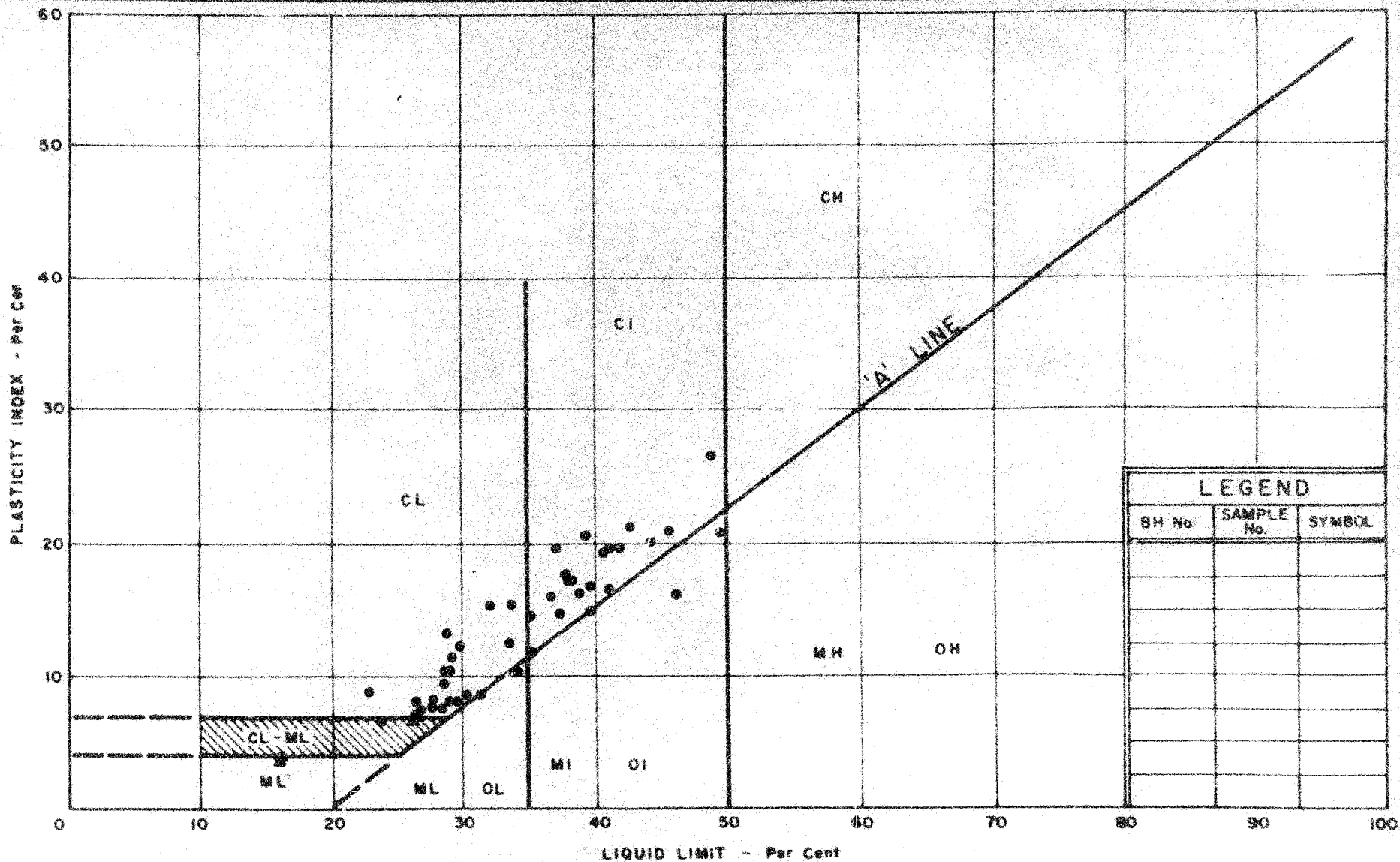
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SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION	RESISTANCE	LIQUID LIMIT	PLASTIC LIMIT	WATER CONTENT	BULK DENSITY	REMARKS			
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT			W _L	W _p			W		
							20	40	60	80	100					
							SHEAR STRENGTH P.S.F.							WATER CONTENT %		
						400	800	1200	1600	2000	10	20	30			
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE										
479.5	Ground Level															
0.0																
	Brown		1	SS	20											
			2	SS	31											
			3	SS	34	470										
466.0	Very Stiff to Hard		4	SS	30											
13.5	Clayey silt to silty clay, trace of sand		5	TW	PM											
	(occ. seams of silt up to 3" thick)		6	TW	PM	460										
	Grey		7	TW	PM											
450.0	Firm to Stiff															
29.5	Het. mix. of clayey silt, sand & gravel		8	SS	34	450										
	(Glacial Till)															
443.0	Hard		9	SS	65											
36.5	End of Borehole					440										

FOUNDATION SECTION

CHECKED BY

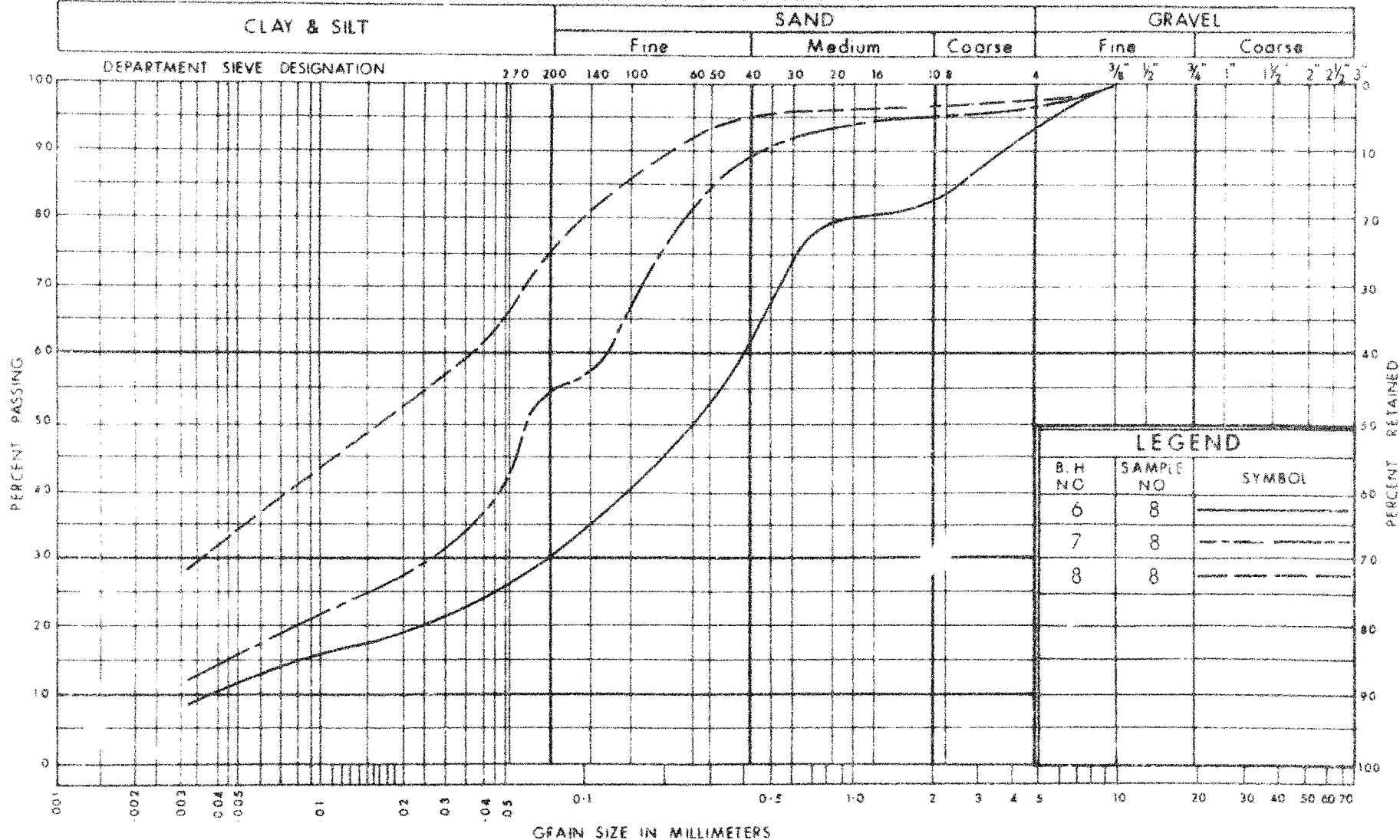
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- - SILTY CLAY TO CLAYEY SILT
- ▲ - GLACIAL TILL

FIG. N° 1

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

GRAIN SIZE DISTRIBUTION
GLACIAL TILL
HETEROGENEOUS MIXTURE OF CLAYEY SILT, SAND AND GRAVEL

W.P. No. 105-70-1

JOB No. 71-11011

FIG. No 2

CONT. 71-13

HWY. 400 WLY.

TO ARROW ROAD

DIST. 6

30M11-132

