cc: Foundations Office (Rm. 110)

Mr. B. H. Davis,
Bridge Engineer,
Bridge Division.

Attention: Mr. G. McCombie

Foundation Section,
Materials & Testing Div.,
Room 107, Lab. Bldg.

September 16, 1966

SEP 16 1966

FOUNDATION INVESTIGATION REPORT FOR D.R.O.
BY DOMINION SOIL INVESTIGATION LIMITED --
Proposed Culvert under Hwy. 400 Extension
At Queen's Drive - District #6 (Toronto).
-- S.F. 193-66 --

Attached, please find the report for the above mentioned site, prepared and submitted by the consultant, Dominion Soil Investigation Ltd.

We have reviewed the report and believe that it contains all the information necessary for your further design work. Should you, however, require additional information, or would like to discuss any aspect of the foundations of this structure, please feel free to call on this Office.

A. O. Stermac,
PRINCIPAL FOUNDATION ENGINEER

AOS/Mief
Attach.

cc: Messrs. B. H. Davis (2)
E. A. Tregaskes
D. W. Farren
C. E. Hunter (2)
F. Allen
W. E. Kelly-Bryan
T. J. Kovica
A. Watt

Foundations Office
Gen. Files

66-F 208

DEPARTMENT OF HIGHWAYS, ONTARIO
MATERIALS & TESTING DIVISION
DOWNSVIEW, ONTARIO

REPORT
ON
SOIL AND FOUNDATION INVESTIGATION
FOR
PROPOSED CULVERT
UNDER
HIGHWAY NO. 400 EXTENSION
AT
QUEEN'S DRIVE

W. P. 193-66

Submitted by

DOMINION SOIL INVESTIGATION LIMITED
77 CROCKFORD BLVD.
SCARBOROUGH ONTARIO

OUR REF: NO. 6-9-9
SEPTEMBER, 1966

C O N T E N T S

INTRODUCTION

A request by the Materials and Testing Division of the Department of Highways, Ontario, has been received to carry out a soil investigation at the site of a proposed box culvert near Queen's Drive. The proposed culvert will be constructed in an open cut extending approximately 10 to 16 ft. below the present ground surface. The height of the embankment at this point will be approximately 30 feet.

A preliminary soil investigation has been previously carried out by the Foundations Section of the Department in 1965. The results of this investigation were reported on April 1st, 1965, and in the preparation of this report, reference was made to boreholes near this site.

The present investigation consisted of three boreholes located along the centre line of the proposed culvert, one at each extreme end of the culvert and the third under the centre line of the proposed embankment.

This report describes the soil conditions encountered in the investigation and gives recommendations for the design and construction of the culvert and the stability of the embankment. The procedures followed in the field and laboratory testing are given in Appendix "A".

SITE AND GEOLOGY

The site is located in a low lying area about 500 ft. south-east of Queen's Drive near Venice Drive. At this point, a small creek crosses the area in the east-westerly direction, and intersects the centre line of the proposed Highway No. 400 Extension at about Station 89.66 ft. Part of the earth fill embankment of the highway immediately north of the creek has been already constructed.

The previous investigation has indicated that the bedrock in the area lies at a considerable depth and is covered by glacial and interglacial deposits of the Pleistocene period. These glacial deposits are overlain by a thin veneer of lake and flood plain deposits.

SOIL CONDITIONS

The borings indicate that the site is underlain by a fine sandy silt to silty sand deposit, ranging between 2 and 5 ft. in thickness. The elevation of the base of this deposit is about 394 to 391 ft., dropping off in the westerly direction.

Underlying this surficial stratum and extending to about elevation 310 ft. (information obtained from D.H.O. report) a grey-coloured clayey silt till, that is, a glacial deposit in which the soil fines predominate, was encountered. Within this generally very stiff till stratum, a distinct layer of firm to stiff silty clay was encountered. At each borehole location, the surface of this clay was found at elevation 384± ft., but its thickness varied between 5 and 17 ft.

For a detailed account of the soil conditions encountered in the boreholes, reference should be made to the individual borehole logs. In the following paragraphs, the main characteristics of the different soil types will be discussed.

Surficial Deposits

The top 2 to 5 feet of the subsoil consists of granular deposits ranging in composition from generally fine sandy silt or silty sand to silty sand and gravel. Based on the penetration tests, the relative density of these deposits is estimated to be generally loose. Traces of organic matter were also noticed in the recovered samples.

Clayey Silt

The significant soil stratum in the area is a glacial till consisting of clayey silt with some sand and embedded gravel. The surface of this till was encountered generally at elevation 393 ft., and based on the evidence obtained in the previous investigation, it extends to about elevation 310 ft. The overall thickness of this stratum, therefore, is about 80 ft. Based on visual and tactile examinations, it is estimated that the clayey silt consists of about 20% clay, 50% silt, 20% sand and about 10% gravel. In view of the short time available for the preparation of this report, the actual grain size distribution of only one representative sample was determined in the laboratory (Enclosure 6) but for a more complete documentation of the deposit, reference should be made to the report and laboratory tests prepared by the Department.

The consistency limits of the clayey silt were determined by Atterberg Tests which indicate that the average Liquid Limit of the soil is about 22%, with a Plasticity Index of about 8. The results of these tests are plotted on the individual borehole logs and are summarized on Enclosure 5 in Appendix "B".

The natural moisture content of the stratum ranges between 12 and 15%, and is generally at or near the Plastic Limit. The Liquidity Index ranges between 0 and 0.13.

The undrained shear strength of the soil was measured in the field by vane test apparatus, and although the measured values range between 1900 and 4700 lbs. per square foot, 2500 lbs. per square foot could be considered as an average value. The consistency of this stratum, therefore, can be described as generally very stiff to hard. Approximately the same range of consistencies can be inferred from the Standard Penetration Test which gave "N" values varying between 15 and 42 blows per foot.

Silty Clay

Interbedded in the clayey silt till, there is a layer of a grey-coloured silty clay. The surface of this layer was encountered at about elevation 384 ft. The thickness of this stratum, however, varies between 5 ft. in Borehole No. 1 and about 17 ft. in Borehole No. 3, that is, it increases in thickness in the westerly direction.

Atterberg Tests indicate that the soil within this zone is a clay of intermediate plasticity with a Liquid Limit of about 34 to 39%, and a Plasticity Index of 14 to 17. The natural moisture content ranges between 24 and 32% which is considerably higher than

the Plastic Limit of the material. The Liquidity Indices range between 0.4 and 0.7.

There was a considerable variation noticed in the undrained shear strength of the soil. The in-situ shear strength of the soil in Boreholes Nos. 1 and 2 ranges between 1900 and 2600 lbs. per square foot, indicating a stiff to very stiff consistency. There is, however, a marked decrease in the consistency of the soil in the westerly direction as the shear strength values measured in the field in Borehole No. 3, or on undisturbed samples in the laboratory, range only between 800 and 1500 lbs. per square foot. The average shear strength of the soil between elevations 380 and 370 ft. at this location can be considered only as 900 lbs. per square foot. The Standard Penetration Tests performed within this stratum confirm this firm to stiff consistency.

GROUNDWATER CONDITIONS

The position of the free standing water levels in the boreholes was carefully observed during the drilling and up to the end of the field work. The final water levels as recorded in the boreholes are shown on the borehole logs, indicating a variation in the groundwater level between 389 and 393 ft. The lowest water level observed in Borehole No. 1, however, may not reflect the true groundwater level since this borehole was the one which was completed last and the time available for observation may have been too short to reach static equilibrium in the impervious subsoil.

DISCUSSION

A 330 ft. long, 18 ft. by 8 ft. reinforced box culvert is proposed with invert elevations ranging between 384 and 382.75 ft. Open cut method is proposed for the construction of the culvert in a trench about 10 and 16 ft. deep and 22 to 24 ft. wide. The finished grade of the earth embankment will be at about elevation 420 ft., that is, on top of the culvert the thickness of the earth cover will be about 28 ft. The proposed side slopes of the embankment are 3 horizontal in 1 vertical. Possible problems arising in the design and construction of the culvert are:

(1) the bearing capacity of the subsoil at the proposed subgrade level.

(2) the maximum total and differential settlement of the culvert.

(3) the stability of the embankment.

(4) the excavation and dewatering of the trench.

These will be discussed briefly in the following paragraphs.

1. Bearing Capacity

The net pressure increment at the base of the culvert under maximum loading condition will be about 4700 lbs. per square foot at the mid-point of the culvert, and about 2000 lbs. per square foot at the two ends.

The safe bearing capacity (S.F. = 3.0) of the subgrade between Stations 4+00 and about 6+00 is 5000 lbs. per square foot and therefore along this section no stability problems are foreseen.

More critical conditions exist at the west end of the culvert where the subgrade is only a firm clay with an average shear strength of about 900 lbs. per square foot. In view of the small surcharge load in front of the culvert, the possibility of local shear failure of the firm silty clay has to be investigated. Calculations indicate that the factor of safety against local shear failure is about 2.0 which, though lower than the normally desirable value of 3.0, in the present case is considered to be adequate.

2. Settlement

Due to the increase in the effective stresses below the culvert after construction, settlement of the structure can be expected. The total movement will be partly the result of the elastic deformation of the subsoil and partly due to the long-term consolidation settlement of the clay deposit.

The maximum elastic deformation of the subsoil due to the added weight of the embankment and structure was calculated at the mid-point of the culvert to be about 2½ inches, and about 1.2 inches at the two ends. In addition to this, the subsoil will undergo long-term consolidation settlement, the amount of which was estimated at the centre as 5½ inches, and about 0.8 inches at the two ends. The magnitude of the total movement at the centre, therefore, will be of the order of 8 inches, and about 2 inches at the ends.

As a result of this differential movement, the magnitude of which is of the order of 6 inches, the culvert will be subjected to flexural and axial tensile stresses. A monolitically built culvert should be designed to resist these stresses. Alternatively,

it is suggested that the culvert be constructed with flexible joints.

3. Stability of Embankments

The stability of the 30 ft. high embankment with 3 to 1 side slopes was analysed in terms of total stresses, and assuming that the failure will take place along a cylindrical surface which in case of "isotropic" soil types is generally a valid assumption. The analysis for a limited number of trial failure surfaces indicates that the factor of safety against failure occurring along these circular arcs is of the order of 2. This is considered to be adequate and, therefore, no stability problems are foreseen.

4. Construction

There are no serious dewatering or excavation problems anticipated during the construction of the culvert in an open trench as proposed. The depth of the trench will range between 10 and about 16 ft. The walls of the trench within the very stiff clayey silt will be stable on a nearly vertical face without support. Nominal shoring, however, is recommended to comply with the Trench Excavators' Act.

To avoid inconvenient working conditions at the bottom of the trench due to the plastic "sticky", clay subgrade, it is recommended that as soon as the desired excavation level was reached, a working mat of granular material or lean concrete be placed at the bottom.

In view of the low permeability of the subsoil, there are no serious dewatering problems foreseen.

Since a relatively large amount of material will be excavated, its suitability for fill material will likely be considered. There will be three main soil types encountered during the excavation:

(a) fine silty sand or sandy silt

(b) clayey silt (till)

(c) silty clay

a) The fine sandy silt deposit encountered in the top 2 or 5 feet of the subsoil is considered to be suitable for fill material, however, in view of the uniform particle sizes, its use is limited to areas where a high degree of compaction is not required.

b) In view of the well-graded nature of the clayey silt till, as illustrated on the enclosed grain size distribution curve, (Enclosure No. 6) this material is considered suitable for fill material. The natural moisture content of this stratum is about 12 to 14%, which is probably slightly above the optimum moisture content of the material. Because of the clayey nature of the subsoil, adequate compaction of the material however can only be achieved by heavy smoothwheel or sheepsfoot type of rollers.

c) Approximately 2 ft. of the grey silty clay encountered below elevation 384 ft. will have to be removed. In view of the high plasticity and high natural moisture content of this material, any handling of this soil will be difficult, and therefore its use as fill material is not recommended.

CONCLUSIONS

The investigation has indicated that the site in the proposed construction area is underlain by a generally very stiff clayey silt till extending to elevation about 310 ft.

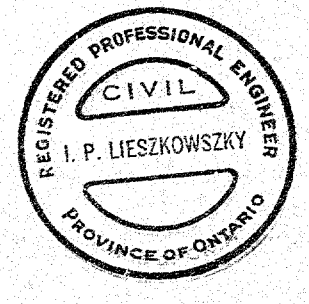
The factor of safety against general and local shear failure occurring under the proposed culvert was calculated to be 3 and 2 respectively.

The maximum total movement at the centre of the culvert due to the elastic and long-term consolidation settlement of the subsoil was calculated to be 8 inches, and about 2 inches at the two ends. The maximum differential movement, therefore, will be of the order of 6 inches. To avoid the overstressing of the culvert by the flexural and longitudinal tensile stresses induced by this differential movement, it is recommended that it be constructed in short units and flexible joints.

There are no stability problems foreseen from the construction of an approximately 30 ft. high embankment having a side slope of 3 horizontal in 1 vertical.

No dewatering or excavation problems are foreseen which would require more than usual attention.

The suitability of the different soil types excavated from the trench are discussed in the report.



DOMINION SOIL INVESTIGATION LIMITED,

IPL/jvm

I. P. Lieszkowszky, P. Eng.
Chief Engineer.

A P P E N D I X "A"

PROCEDURES

Authorization to carry out the work was contained in a letter dated September 9th, 1966.

The work in the field was carried out by a standard diamond drill machine on September 9th, 12th, 13th and 14th, 1966.

Both disturbed and undisturbed samples were recovered at 2½ ft. intervals by means of a 2-inch outside diameter split spoon sampler or by a 2-inch inside diameter thin-walled shelby tube sampler. When recovering disturbed soil samples, the sampler was driven 13 inches into undisturbed ground using 350 ft/lb. energy. The number of blows for the last 12 inches of penetration was recorded as the Standard Penetration Resistance or "N" value. Adjacent to each borehole, a dynamic cone penetration test was performed. In the cone test, the same driving energy was used as in the Standard Penetration Test, but a 2-inch diameter 60 degree cone was fitted to the end of the drilling rods and it was driven continuously until practical refusal (100 blows/ft.) was encountered.

Where the consistency of the subsoil permitted, the in-situ shear strength of the soil was measured by a four-blade, 2 inch diameter vane tester apparatus.

The results of the borings and penetration tests are indicated on the attached borehole logs, and the inferred subsoil profile is shown on the Plan and Profile drawing enclosed in the side pocket at the rear of the report.

All elevations mentioned in this report are referred to

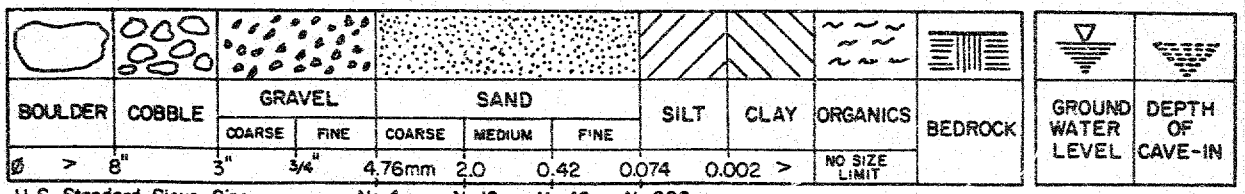
the ground level at Station 4+50. The elevation of the ground surface at this point was obtained from the Plan and Profile drawing supplied to us by the Department as 396.0 ft.

A P P E N D I X "B"

FIELD AND LABORATORY TEST RESULTS

LIST OF SYMBOLS, ABBREVIATIONS AND NOMENCLATURE.

SOIL COMPONENTS AND GROUND WATER CONDITIONS.



SAMPLE TYPES.

AS	Auger sample	RC	Rock core	TP	Piston, thin walled tube sample
CS	Sample from casing	%	Recovery	TW	Open, thin walled tube sample
ChS	Chunk sample	SS	Split spoon sample	WS	Wash sample

SAMPLER ADVANCED BY static weight : w
" pressure : p
" tapping : t

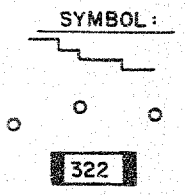
OBSERVATIONS MADE WHILE CORING: Steady pressure; No pressure; Intermittent pressure; Washwater returns; Washwater lost

PENETRATION RESISTANCES.

DYNAMIC PENETRATION RESISTANCE : to drive a 2"ϕ, 60° cone attached to the end of the drilling rods into the ground, expressed in blows per foot.

STANDARD PENETRATION RESISTANCE, -N- : to drive a 2" outside dia, split spoon sampler 1 foot into the ground, expressed in blows per foot.

SYMBOL:



EXTRAPOLATED -N- VALUE

The energy for the penetration resistances is supplied by a 140 lb. hammer falling 30 inches

SOIL PROPERTIES.

W %	Water content	γ	Natural bulk density (unit weight)	k	Coeff. of permeability
LL %	Liquid limit	e	Void ratio	C	Shear strength — in terms of total stress
PL %	Plastic limit	RD	Relative density	ϕ	Angle of int. friction — in terms of total stress
PI %	Plasticity index	C_v	Coeff. of consolidation	C'	Cohesion — in terms of effective stress
LI	Liquidity index	m_v	Coeff. of volume compressibility	ϕ'	Angle of int. friction — in terms of effective stress

UNDRAINED SHEAR STRENGTH.

— DERIVED FROM —

TRIAXIAL COMPRESSION — UNCONFINED TEST — St

LABORATORY VANE TEST — St

FIELD VANE TEST — St

POCKET PENETROMETER TEST — St

Strain at failure is represented by direction of stem: 20%, 15%, 5%, 10%

St : sensitivity = $\frac{\text{shear strength in undisturbed state}}{\text{shear strength in remoulded state}}$

SOIL DESCRIPTION.

COHESIONLESS SOILS :	RD :	COHESIVE SOILS :	C lbs/sq.ft.
Very loose	0 – 15 %	Very soft	less than 250
Loose	15 – 35 %	Soft	250 – 500
Compact	35 – 65 %	Firm	500 – 1000
Dense	65 – 85 %	Stiff	1000 – 2000
Very dense	85 – 100 %	Very stiff	2000 – 4000
		Hard	over 4000

GEOTECHNICAL DATA SHEET FOR BOREHOLE 1 Sta. 3+98 – 1 Ft. Lt. ℄

OUR REFERENCE NO. 6 - 9 - 9

CLIENT D. H. O.
PROJECT PROPOSED CULVERT
LOCATION HWY. Nº 400,
DATUM ELEVATION STA. 4+50 – El. 396·0 ft.

METHOD OF BORING WASHBORING
DIAMETER OF BOREHOLE 2 3/8"
DATE SEPT. 14, 1966
W.P. 193 – 66

ENCLOSURE NO. 2

ELEVATION ft	DEPTH ft	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES N Arrangement of Sampler	PENETRATION RESISTANCE blows per foot 2,0 4,0 6,0 8,0 10,0 / SHEAR STRENGTH 1000 lbs sq ft 1 2 3 4 5	CONSISTENCY water content % PL W LL	REMARKS
396·0	0	GROUND SURFACE							
395·0		12" TOPSOIL Loose, Brown SANDY SILT some gravel and clay.		1	S.S.	7			
393·8	2·2	Very Stiff Grey - Brown Mottled CLAYEY SILT with some sand and embedded gravel. (GLACIAL TILL)		2	S.S.	22			
390·0	5			3	S.S.	27			W.L. El. 389·0 ft. Sept. 14, 1966
				4	S.S.	36			
385·0	10			5	S.S.	29			
384·0	12·0	Very Stiff Grey SILTY CLAY		6	S.S.	25			
380·0	15			7	T.W.	P	+3·7		
379·0	17·0	Stiff to V. Stiff Grey CLAYEY SILT (GLACIAL TILL) occasional silt seams or lenses below El. 373 ft.		8	S.S.	14	+2·0		
375·0	20			9	T.W.	P	+6·0		
				10	S.S.	35	+2·3		
370·0	25			11	S.S.	24	+2·9		
				12	T.W.	P	+7·5		
365·0	30			13	S.S.	23			
	31·5	END OF BOREHOLE							
360·0	35								

VERTICAL SCALE 1 IN TO 5 FT

DOMINION SOIL INVESTIGATION LIMITED

MADE D.A.M. CHD.

GEOTECHNICAL DATA SHEET FOR BOREHOLE 2 Sta. 5+50 - ℄

OUR REFERENCE NO. 6 - 9 - 9

CLIENT: D. H. O.
PROJECT: PROPOSED CULVERT
LOCATION: HWY. Nº 400
DATUM ELEVATION: STA. 4+50 - El. 396·0

METHOD OF BORING: WASH BORING
DIAMETER OF BOREHOLE: 2 3/8"
DATE: SEPT. 9 - 12, 1966
W.P. 193 - 66

ENCLOSURE NO. 3

ELEVATION ft	DEPTH ft	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES N — Blows per 0.5 ft Advancement of Sampler	PENETRATION RESISTANCE blows per foot 2,0 4,0 6,0 8,0 10,0 / SHEAR STRENGTH 1000 lbs. sq ft 1 2 3 4 5	CONSISTENCY water content % PL W LL 10 20 30 60	REMARKS
397·7	0	GROUND SURFACE							
		6" TOPSOIL Loose to Compact Brown FINE SANDY SILT trace of organic matter		1A	C.S.				
395·0									
392·7	5	Very Stiff Grey - Brown Mottled CLAYEY SILT with some sand and embedded gravel (GLACIAL TILL)		1	S.S.	17			WL. El. 393·2 ft. Sept. 14, 1966
390·0									
	10			2	S.S.	23			Gr. 8 % ; Sa. 25% Si. 47% ; Cl. 20%
385·0									
383·7	14·0								
	15	Stiff to V. Stiff Grey SILTY CLAY		3	S.S.	16			
380·0				4	T.W.	P	+1·5		γ = 123 P.C.F.
	20			5	S.S.	12	+8·0		
375·0				6	T.W.	P			
373·7	24·0						+2·2		
	25	Very Stiff to Hard Grey CLAYEY SILT (TILL)		7	S.S.	14	+2·4		
370·0				8	T.W.	P	+1·7		
	30			9	S.S.	15	+2·0		
365·0				10	S.S.	19			
	35			11	S.S.	17			
360·0				12	S.S.	31			
	40			13	S.S.	27			
355·0									
	45			14	S.S.	26			
350·0									
	50			15	S.S.	42			
345·0	51·5	END OF BOREHOLE							

VERTICAL SCALE: 1 IN TO 5 FT

DOMINION SOIL INVESTIGATION LIMITED

MADE D.A.M. CH'D

GEOTECHNICAL DATA SHEET FOR BOREHOLE . . 3 . . Sta. 7+00 - ℄

OUR REFERENCE NO. 6 - 9 - 9

CLIENT D.H.O.
PROJECT PROPOSED CULVERT
LOCATION HWY. Nº 400
DATUM ELEVATION STA. 4+00 - EL 396.0 ft

METHOD OF BORING WASHBORING
DIAMETER OF BOREHOLE 2 3/8"
DATE SEPT 13, 1966
W.P. 193-66

ENCLOSURE NO. 4

ELEVATION ft	DEPTH ft	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES Pen. Resist. Blows per ft.	REMARKS
393.8	0	GROUND SURFACE					
		6" TOPSOIL		1	SS	4	
		Loose, Brown SILTY FINE SAND					
390.8	3.0			2	SS	8	
390.0		Compact, Brown SILTY SAND and GRAVEL					
388.3	5.5	Very Stiff Grey-Brown, Mottled CLAYEY SILT with some sand and gravel (GLACIAL TILL)		3	SS	80/8"	
385.0	10						
383.3	10.5			4 A B	SS	11	
				5	TW	P	
380.0	15	Firm to Stiff Grey SILTY CLAY		6	SS	6	
				7	TW	P	
375.0	20			8	SS	5	
				9	TW	P	
370.0	25			10	SS	14	
365.8	28.0			11	TW	P	
365.0	30	Very Stiff to Hard Grey CLAYEY SILT (TILL)		12	SS	24	
360.0				13	SS	30	
	35			14	SS	18	
355.0	40			15	SS	20	
	41.5	END OF BOREHOLE					
350.0							

SHEAR STRENGTH 1000 lbs/sq ft: 1 2 3 4 5

CONSISTENCY Water Content %: Pl. W Ll.

W.L. El 391.3 ft
Sept 14, 1966
Gr. 40% ; Sa 50%
Si. 10%

γ = 122 P.C.F.

VERTICAL SCALE 1 IN. TO 5 FT.

DOMINION SOIL INVESTIGATION LIMITED

MADE D.A.M. CHD.

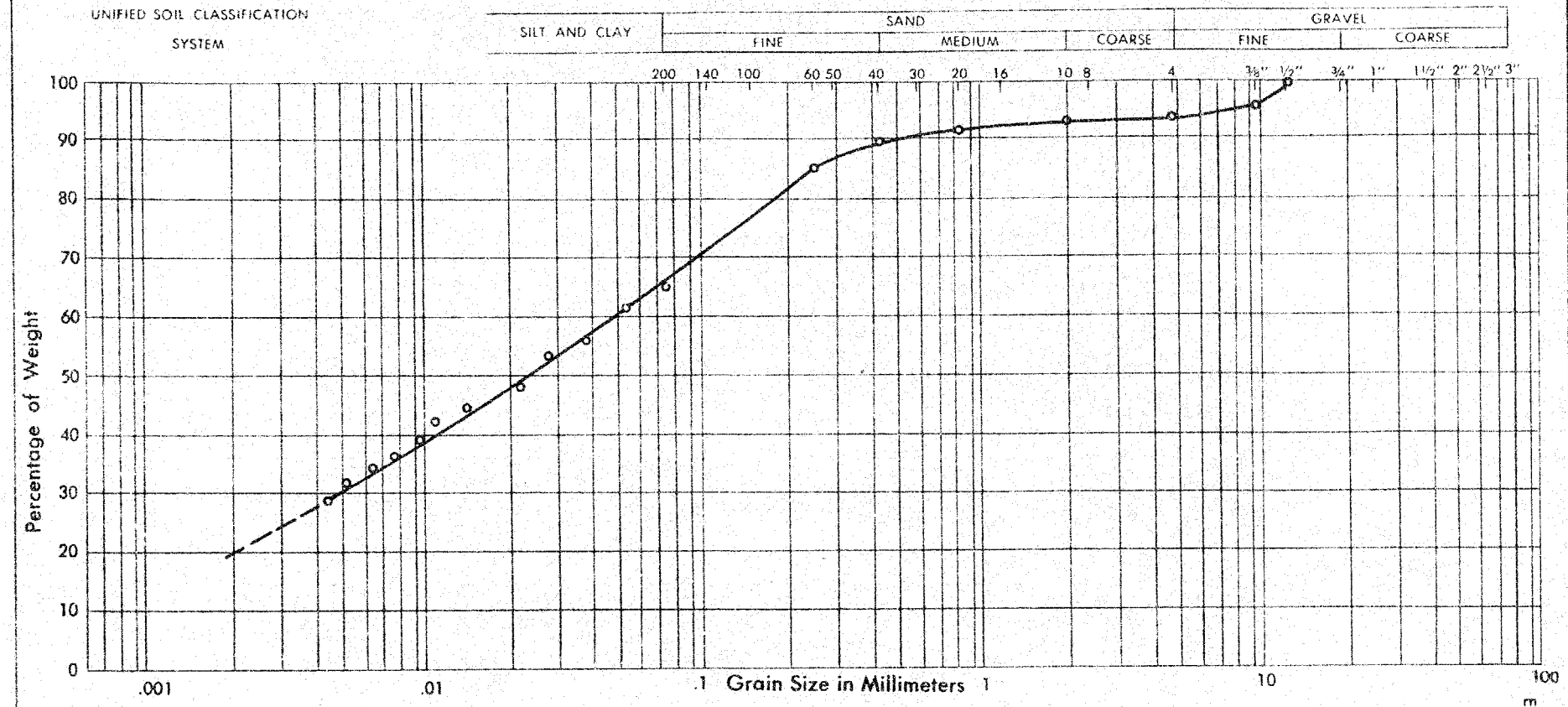
SAMPLE DETAILS				CONSISTENCY					UNDRAINED COMPRESSION		UNIT WEIGHT	REMARKS
BOREHOLE	SAMPLE	TYPE	AVERAGE DEPTH (FEET)	NATURAL WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX	LIQUIDITY INDEX	SHEAR STRENGTH (P.S.FT.)	AXIAL STRAIN AT FAILURE (%)	(P.C.FT.)	
2	1	S.S.	5	12·7								
	2	S.S.	10	13·5	22·0	14·1	7·9	0				SIEVE ANALYSIS – Encl. Nº 6
	3	S.S.	15	24·5								
	4	T.W.	17·5	28·2	39·0	22·1	16·9	0·36	1587	6·9	123	
	5	S.S.	20	24·4								
	7	S.S.	25	15·0	21·8	14·0	7·8	0·13				
	9	S.S.	30	14·7								
	11	S.S.	35	12·9								
	12	S.S.	37·5	12·6								
	13	S.S.	40	12·4								
	14	S.S.	45	12·1								
	15	S.S.	50	14·2								
3	2	S.S.	2·5									SIEVE ANALYSIS – Encl. Nº 7
	3	S.S.	5	12·2								
	4 B	S.S.	10	30·8								
	5	T.W.	12·5	27·9					860	7·5	122	
	6	S.S.	15	28·6	33·4	19·7	13·7	0·650				
	8	S.S.	20	32·3								
	10	S.S.	25	20·7								

TABLE OF LABORATORY TEST RESULTS

DOMINION SOIL INVESTIGATION LIMITED

GRAIN SIZE DISTRIBUTION

OUR REFERENCE NO. 6 - 9 - 9



PROJECT: PROPOSED CULVERT

LOCATION: HWY. Nº 400 EXTENSION

BOREHOLE NO.: 2

SAMPLE NO.: 2

DEPTH OF SAMPLE: 10' - 11·5'

ELEVATION OF SAMPLE: 387 ± ft

COEFFICIENT OF UNIFORMITY

COEFFICIENT OF CURVATURE

Classification of Sample and Group Symbol:

CLAYEY SILT with some sand and a trace of gravel

PLASTIC PROPERTIES:

LIQUID LIMIT % =

PLASTIC LIMIT % =

PLASTICITY INDEX % =

MOISTURE CONTENT % —

ACTIVITY

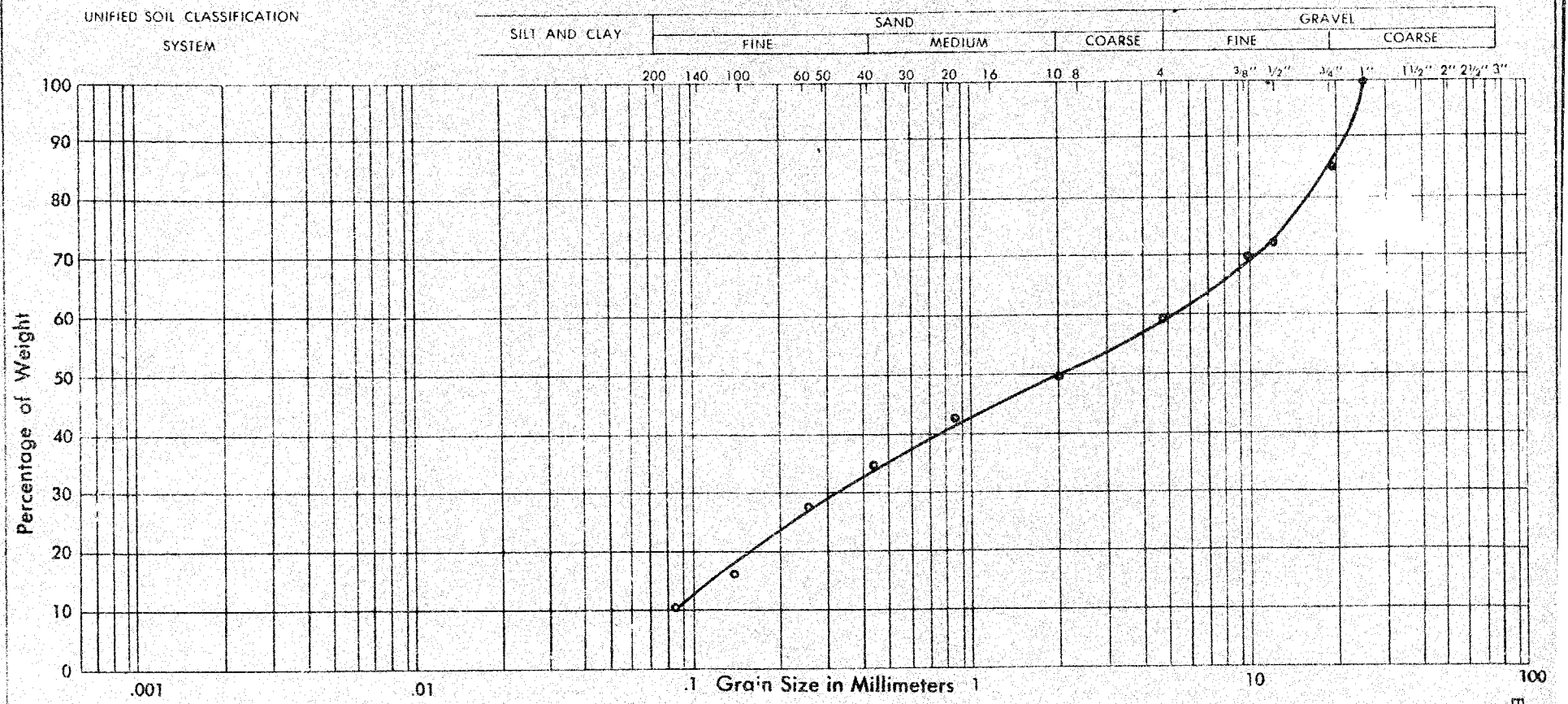
Enclosure No. 6

DOMINION SOIL INVESTIGATION LIMITED

GRAIN SIZE DISTRIBUTION

OUR REFERENCE NO 6-9-9

UNIFIED SOIL CLASSIFICATION SYSTEM



PROJECT: PROPOSED CULVERT

LOCATION: HWY. Nº 400 EXTENSION

BOREHOLE NO.: 3

SAMPLE NO.: 2

DEPTH OF SAMPLE: 2·5'- 4'

ELEVATION OF SAMPLE: 390 ± ft

COEFFICIENT OF UNIFORMITY

COEFFICIENT OF CURVATURE

Classification of Sample and Group Symbol:

SAND & GRAVEL with some silt

PLASTIC PROPERTIES:

LIQUID LIMITED % =

PLASTIC LIMIT % =

PLASTICITY INDEX % =

MOISTURE CONTENT % =

ACTIVITY =

Enclosure No. 7

cc: Mr. H. Szymanski (1cy. 2)

Hwy. 401 & Keele St.,
Downsview, Ontario.

September 9, 1966

Materials and Testing Division

Dominion Soil Investigation Ltd.,
77 Crockford Blvd.,
Scarborough, Ontario.

Attention: Mr. A. Bonga

Re: Letter of Authority - Foundation Investigation
W.P. 193-66 -- Queen's Drive Culvert,
Hwy. 400 Extension, District 6 (Toronto)

Dear Sir:

This is to authorize you to carry out the foundation investigation at the above mentioned site. The necessary drawings were given to your representative on September 9, 1966.

It is understood that the field work will not be started later than Monday, September 12, 1966. You are kindly requested to submit the report, or a letter containing your recommendations pertaining to the foundations of the structure, by not later than September 16, 1966. We realize that this is a very short time, but in view of the information that is available about the subsoil conditions in the area, we feel that you can meet our requirements. Should any difficulties arise in the course of the work, you are kindly requested to get in touch with the Foundation Section right away.

The field work should at all times, be supervised by a qualified Soils Engineer. Any deviation from this agreement has to meet our prior approval.

Previous requirements as to preliminary borehole information and laboratory testing program should be followed.

Twelve (12) copies of the report will be required for our distribution.

Since the drawing accompanying the foundation report, showing the location of borings, the inferred subsoil conditions, etc., is to become a contract drawing, you are requested to prepare it in

cont'd. /2 ...

accordance with the C.S.A. Standards. To enable you to do this, we are supplying you with a sample drawing with all the necessary explanations, together with linen sheet for your drawing. You are also requested to provide us with a Cronaflex copy of the drawing.

Charges for the work will be in accordance with your Schedule of Rates effective April 1, 1966, and invoice to be addressed to the attention of the undersigned.

We are attaching Purchase Order S-008806, covering the purchase of any new material required for this work, in order that you may use this as a basis for exemption from the Federal Tax for such purchase. The Exemption Certificate is printed thereon.

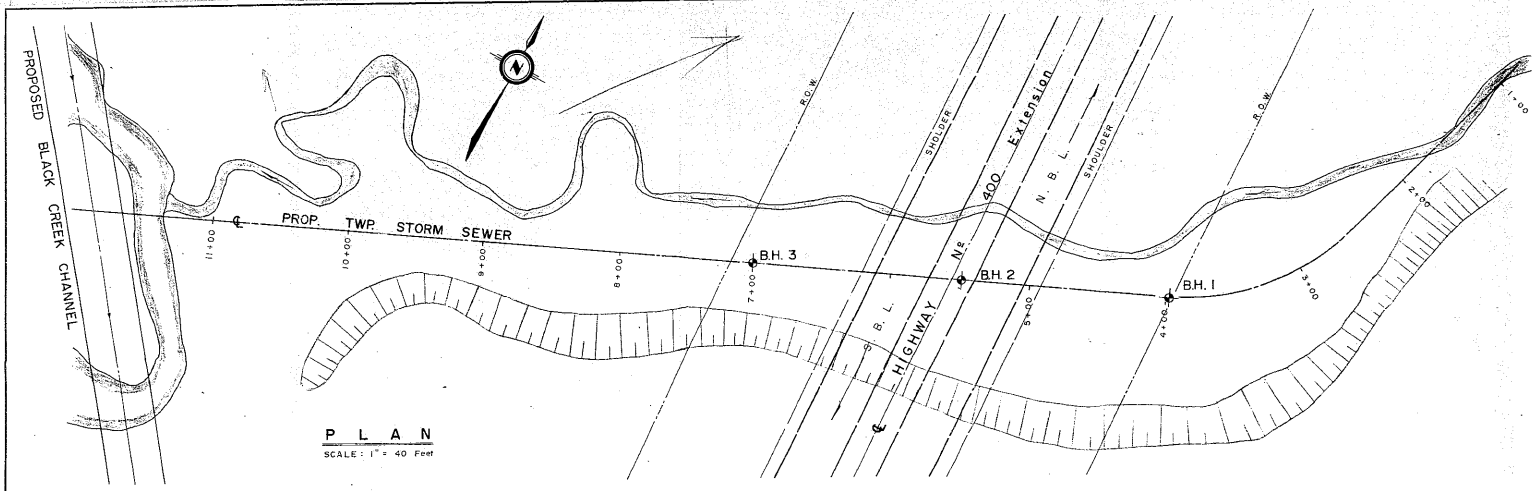
Yours very truly,

for A. Rutka,
MATERIALS & TESTING ENGINEER

AGS/Mac?
Attach.

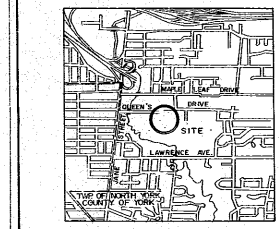
cc: Messrs. S. McCombie
C. K. Hunter
W. S. Melinyshyn
F. Allen
T. J. Kovich
H. Konings
Mrs. I. Steinberg
H. Szymanski (2)
A. Crowley
Foundations Office
Gen. Files (2)

#66-F-208
W.P. #193-66
HWY #400
EXTENSION
PROPOSED
CULVERT



P L A N

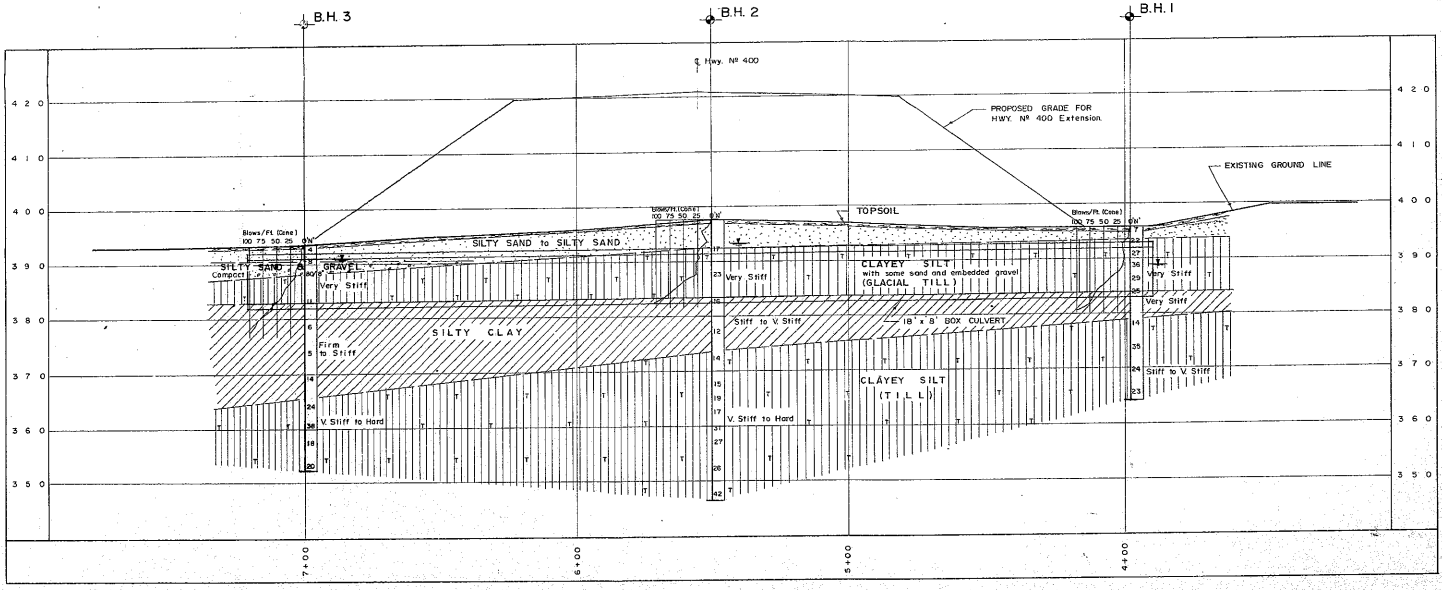
SCALE : 1" = 40 Feet



KEY PLAN

SCALE IN FEET

1000 0 2000 4000 6000



℄ PROFILE ALONG PROPOSED SEWER

SCALE: Horizontal - 1" = 20 Feet
Vertical - 1" = 10 Feet

LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation. (Sept. 14, 1966)

NO.	ELEVATION	STATION	OFFSET
1	396.04	3+98	1' LT.
2	397.74	5+50	℄
3	393.80	7+00	℄

– NOTE –

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

PRINT RECORD		
NO.	FOR	DATE

REVISIONS		
DATE	BY	DESCRIPTION

DOMINION SOIL INVESTIGATION LIMITED

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION - FOUNDATION SECTION

PROPOSED CULVERT
(HWY. No 400, STA. 89+66±)

KING'S HIGHWAY NO. 400 Extension DIST. NO. 6
CO. YORK
TWP. NORTH YORK LOT CON.

BORE HOLE LOCATION & SOIL STRATA

SUBM'D. I. L.	CHECKED	W.P. NO. 193-66	DRAWING NO. 6-9-9
DRAWN D.A.M.	CHECKED	JOB NO. 6-9-9	
DATE SEPT. 15, 1966		SITE NO.	BRIDGE DRAWING NO.
APPROVED ... PROVINCIAL FOUNDATION ENGINEER		CONT. NO.	