



FOUNDATION TECHNICAL MEMORANDUM

For

MAPLE ROAD UNDERPASS

HIGHWAY 403

MTO WEST REGION 59 STRUCTURE REHABILITATIONS

SITE 1-151, CONTRACT 8

GWP 3094-12-00

GEOGRAPHIC TOWNSHIP OF BURFORD

BRANT COUNTY, ONTARIO

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Appendix A – Previous Foundation Investigation Reports (GEOCRE 40P1-59)

- Reference 1: Foundation Investigation Report for Maple Road Underpass, 6.1 km West of Highway #24A, W.P. 161-60-01, Site No. 1-151, Hwy. #403, District #4 (Hamilton), dated February 3, 1982.
- Reference 2: Foundation Investigation Report for Burford Twp. Rd. Overpass of Proposed Hwy. #403 1.5 Miles West of Brantford West Limits, District #4 (Hamilton), W.O. 72-11046, W.P. 71-62, dated July 11, 1972.



Reference 3: General Arrangement Drawing, Maple Road Underpass, DWG 1, 6.1 Km West of Highway 24A, Sheet 134, Site No. 1-151, Dist. No. 4, Hwy. 403, Cont. No. 81-43, W.P. 71-62-01, dated July, 1980.

Reference 4: Footings Drawing, Maple Road Underpass, DWG 3, Sheet 136, Site No. 1-151, Dist. No. 4, Hwy. 403, Cont. No. 81-43, W.P. 71-62-01, dated July, 1980.

Appendix B – Site Photograph

FOUNDATION TECHNICAL MEMORANDUM

For

Maple Road Underpass Highway 403
MTO West Region 59 Structure Rehabilitations
Site 1-151, Contract 8, GWP 3094-12-00
Township of Burford
Brant County, Ontario

1. INTRODUCTION

The Foundation Engineering Services for the present project involve the detail foundation investigation and design for the rehabilitation of 59 structures in MTO West Region along Highways 4, 6, 401, 402 and 403. Ten (10) Group Work Projects (GWP's) are contemplated to be completed between 2014 and 2020.

This technical memorandum summarizes the factual results of geotechnical data based on the review and compilation of existing subsurface information from relevant reports in the MTO GEOCREST Library for the Maple Road Underpass Highway 403. The Foundation Engineering recommendations from the initial foundation reports are summarized with reference to the "Canadian Highway Bridge Design Code" (CHBDC) and follow in general the "Guidelines for Professional Engineers providing Geotechnical Engineering Services".

From the Minutes of Meeting Report, dated June 3, 2016, it is understood that semi-integral conversion may not be the preferred rehabilitation strategy and that Preservation Management Strategy (PMS) consisting of expansion joint replacement, patch, waterproof and pave, patch repairs and concrete sealer applied to the concrete barrier walls to be undertaken at this underpass structure location.

The purpose of the technical memorandum is to summarize the subsurface and groundwater conditions and foundation recommendations based on available reports at the structure location for the design project team's reference.

The elevations in this report are expressed in meters, unless otherwise noted.



2. PROJECT SITE BACKGROUND AND GEOLOGY

The Maple Road Underpass Highway 403 is located about 8.0 km north of the Town of Burford in the Geographic Township of Burford, Brant County, Ontario. A key plan is shown in Figure 1.

The existing underpass is a two span post tensioned concrete voided slab structure that carries two through lanes over Highway 403. The immediate vicinity is relatively flat. Agricultural lands at the north and south sides were observed in the vicinity of the structure. A creek is running in the vicinity of the structure. It appears that the creek was diverted from the structure location by constructing a culvert approximately 53.0 m on the south side of the underpass structure under Maple Road and another culvert on the east side, approximately 54.0 m, from the centre of the Maple Road Underpass structure under Highway 403.

Physiographically, the site of the underpass is located in the region referred to as Norfolk Sand Plain. The sands and silts of this region were deposited as a delta in glacial lakes Whittlesey and Warren. A significant meltwater discharge from the Grand River area entered the lakes between the glacial ice-front and moraines to the north-west, which resulted in the delta from west to east as the glacier withdrew. The moraines are partially buried by sand in present time.

The deposits in this region range in thickness from 1.0 to 20.0 m with an average thickness of 5.0 to 10.0 m. Most of the drainage is by relatively short rivers and streams that cut deeply into the sand plain. Drainage is good near the main streams and their tributaries. However, in some intermorainal and interfluvial sections, the drainage is poor. The bedrock underlying the area consists of alternating layers of gray shale and dolostone of Salina Formation of the Upper Silurian Epoch. The bedrock surface at the site location is between elevation 213.0 and 221.0, typically 34.0 to 42.0 m below ground level (Map 2035, Bedrock Topography of the Brantford Area, Southern Ontario, Ontario Department of Mines).



3. SOURCE OF INFORMATION

The following reports and drawings, appended in Appendix A, were available for review and information for the underpass structure, subsoil information and original foundation recommendations.

1. Foundation Investigation Report for Maple Road Underpass, 6.1 km West of Highway #24A, W.P. 161-60-01, Site No. 1-151, Hwy. #403, District #4 (Hamilton), Contract No. 81-43. Foundation Office, Department of Transportation and Communications, dated February 3, 1982 (received by Pavement and Foundation Design Section), GEOCRES No. 40P1-59. (Reference 1)
2. Foundation Investigation Report for Burford Twp. Rd. Overpass of Proposed Hwy. #403 1.5 Miles West of Brantford West Limits, District #4 (Hamilton), W.O. 72-11046, W.P. 71-62, Foundation Office, Department of Transportation and Communications, dated July 11, 1972, GEOCRES No. 40P1-59. (Reference 2)
3. General Arrangement Drawing, Maple Road Underpass, DWG 1, 6.1 Km West of Highway 24A, Sheet 134, Site No. 1-151, Dist. No. 4, Hwy. 403, Cont. No. 81-43, W.P. 71-62-01, Ministry of Transportation and Communications Ontario, dated July, 1980. (Reference 3)
4. Footings Drawing, Maple Road Underpass, DWG 3, Sheet 136, Site No. 1-151, Dist. No. 4, Hwy. 403, Cont. No. 81-43, W.P. 71-62-01, Ministry of Transportation and Communications Ontario, dated July, 1980. (Reference 4)

4. SITE RECONNAISSANCE

As part of the current foundation engineering assessment study, a site reconnaissance of the Maple Road Underpass Highway 403 was carried out on August 28, 2015.

The site photographs present the conditions of the Maple Road Underpass including visible portions of the abutments and pier, and abutment slope assessment based on visible areas, apparent areas of soil erosion and abutment slope cover.



The site inspection revealed that the vicinity of the underpass structure abutment locations was covered by vegetation. Both abutment front slopes were covered by concrete panels (Photographs 1 and 2). Weep holes were not observed in the abutment walls. Shrubs and grasses were observed growing between the concrete panels where the sealant between the panels was degraded (Photographs 1 and 2). Vertical cracks were observed on the abutment walls. Both east and west slopes adjacent to the abutments were observed to be vegetated and no evidence of slope erosion was noted (Photographs 4 to 7). Minor cracks were observed on the east and west wingwalls of the north and south abutments (Photographs 4 to 7). The centre pier column at the time of site reconnaissance was observed with minor surficial cracks with no spalling of concrete or exposure of rebar (Photograph 3).

5. PREVIOUS FOUNDATION INVESTIGATION AND SUBSURFACE CONDITIONS

A revised foundation investigation report (Reference 1) presenting only the factual subsurface and groundwater conditions was prepared by the Department of Transportation and Communications, dated February 3, 1982 (received by Pavement and Foundation Design Section). The general subsurface conditions presented in this section are based on the foundation investigation report referred in Reference 1.

The field investigation was carried out during the period of May 9 to 17, 1972 for the project that included a total of eight sampled boreholes (numbered 1, 4, 6, 7, 9, 12, 13, and 16) accompanied by dynamic cone penetration test (DCPT) and seven individual DCPTs (numbered 2, 3, 5, 10, 11, 14, and 15). The sampled boreholes were advanced to 7.7 to 11.1 m, elevation 245.6 to 249.0. The DCPTs in all the boreholes were advanced to termination depths of 6.3 to 8.2 m, elevation 248.9 to 250.3.

The Foundation Investigation Report (Reference 1) includes the Borehole Locations & Soil Strata Drawing (DWG 2, dated December 13, 1979). The general layout of the structure is shown in Reference 3.

The boreholes were drilled by a muskeg vehicle mounted continuous flight auger machine equipped with 83 mm I.D. hollow stem augers.



5.1 General

Generally, in the sampled boreholes, 1.2 to 2.0 m thick organic sand to sandy silt overlaid 5.3 to 10.1 m thick compact to very dense sand, which in turn overlaid very dense 1.0 to 2.2 m thick sandy silt to silty sand till.

5.1.1 Organic sand to sandy silt

A 1.2 to 2.0 m thick surficial organic sand to sandy silt was encountered in boreholes 4, 6, 7, 9 and 13 at elevation 256.5 to 257.6, which extended to 1.2 to 2.0 m, elevation 254.8 to 255.6. N values recorded were between 2 and 26, indicating very loose to compact compactness.

Atterberg limit tests were carried out on selected samples from boreholes 4 and 13. The liquid limits obtained were 19 and 22 and the plastic limits were 17. The plasticity indices were 2 and 5. The moisture content determinations of the organic deposit samples ranged from 11 to 42%.

5.1.2 Sand

A 5.3 to 10.1 m thick loose to very dense sand deposit was encountered surficially in boreholes 1, 12 and 16, elevation 256.6 to 256.7, and below organic deposit in boreholes 4, 6, 7, 9 and 13 at 1.2 to 2.0 m, elevation 254.8 to 255.6 and extended to 6.7 and 11.1 m, elevation 243.6 to 248.9. Borehole 4 was terminated in the sand deposit at 8.4 m, elevation 249.0. Organic and decomposed vegetable matter inclusions were encountered within the upper 1.0 m, elevation 255.7 to 255.8, in boreholes 1, 12 and 16.

Due to the high groundwater levels encountered in the boreholes, instability of the sands developed at the bottom of the boreholes and was assumed that some loosening of the sand had been caused by quick condition under the unbalanced hydrostatic heads. To mitigate the quick condition under the unbalanced hydrostatic heads, water pressure was applied during drilling in most of the boreholes.



N values recorded generally ranged from 10 to more than 100, indicating compact to very dense. In boreholes 1, 4, 6 and 12, N values 3 to 7 were recorded in the upper sand deposit, indicating very loose to loose local zones. One N value of 7 was recorded in borehole 16 at approximate elevation 252.9, probably due to hydraulic disturbance. The moisture content of the sand deposit ranged between 8 and 23%.

Grain size analyses were carried out on selected sand representative samples. The samples contained 0 to 23% gravel, 68 to 91% sand and 8 to 17% silt and clay sized particles.

In borehole 16, a silty sand seam was encountered within the sand layer. Grain size analysis determined that the sample from borehole 16 consisted 1% gravel, 75% sand, 20% silt and 4% clay sized particles.

5.1.3 Sandy Silt to Silty Sand Till

A 1.0 to 2.2 m thick very dense sandy silt to silty sand till deposit was encountered in boreholes 1, 6, 7, 9, 12, 13 and 16 at 6.7 to 10.1 m, elevation 246.6 to 249.9, which extended to the borehole termination depths 7.7 to 11.1 m, elevation 245.6 to 248.9. N values recorded were over 100. From approximate elevation 246.6 to 249.6 m to the bottom of the boreholes, sandy silts with some clay and gravel were encountered.

A grain size analysis on a silty sand till sample from borehole 6 determined that the sample contained 1% gravel, 48% sand, 45% silt and 6% clay sized particles. Atterberg limits determined on a silty sand sample from borehole 6 determined liquid and plastic limits of 17 and 12, respectively, with a plasticity index of 5.

A grain size analysis on a sandy silt till samples from borehole 7 determined that the sample contained 22% gravel, 30% sand, 37% silt and 11% clay sized particles and the corresponding Atterberg liquid and plastic limits determined were 17 and 13, respectively, with a plasticity index of 4. Atterberg liquid limits determined on two other selected sandy silt till samples from boreholes 1 and 16 were 15 and the plastic limits were 10 and 12, with plasticity index values of 3 and 5.



A grain size analysis on a sand till sample from borehole 13 determined that the sample contained 3% gravel, 85% sand, 12% silt and clay sized particles.

5.1.4 Groundwater

Groundwater level was established in each borehole within the uppermost organic deposit. The boreholes were left open for few days to establish the groundwater level following completion of drilling. The stabilized groundwater levels in the boreholes were established between 0.2 and 0.9 m (0.8 and 3.0 ft.), elevation 256.3 to 256.9 (841 to 843 ft.).

6. FOUNDATION

6.1 Previous Foundation Recommendations

The previous foundation recommendations presented in the following sections are based on the original report (Reference 2). It was recommended that the proposed twin overpass structures carry Highway 403 over Maple Road (formerly Burford Township road). The top of granular of Highway 403 at the crossing was designed to be at elevation 263.7 (865 ft.) with approach fills of 6.4 to 6.8 m (21 to 22.5 ft.). It was assumed that the perched abutments would be constructed within the fill.

Based on the investigation, a very dense glacial till stratum was encountered at about elevation 246.6 to 249.6 (809 to 819 ft.)



6.1.1 Structure Foundation

The original foundation investigation report (Reference 2) recommended that spread foundations for the proposed overpass structure were not economically feasible due to uppermost 3.0 to 4.6 m (10 to 15 ft.) very loose to compact sand combined with organic contents and high groundwater pressures. It was recommended that the piers and abutments be supported on piles driven into the very dense glacial deposit. The report indicated that the use of steel tubular piles was considered to be the most practical based on the soil conditions encountered. The piles were to be driven according to Standard BD-82-7, using design loads of 533.8 kN (60 ton) per pile. It was indicated that the load recommended may be achievable by driving 323.85 mm (12.75 inch) outer diameter (O.D) steel tube piles to approximately 8.2 to 10.4 m (27 to 34 ft.), elevation 246.9 to 248.4 (810 to 815 ft.). It was recommended that the approach fills at the abutment locations should be devoid of bouldery fill material because in constructing the perched abutments the pile caps could be placed within the embankments. The report recommended 1.2 m (4 ft.) cover for the pile caps for frost protection.

The report (Reference 2) indicated that no stability problems were expected for the approach fills provided the approaches were constructed with 2 horizontal to 1 vertical slope.

It was recommended that the surficial organic deposit be removed under the approach fills, footings and proposed road beds and replaced by suitable backfill. The horizontal and vertical extent of the organic matter was to be determined by the Regional Materials Engineer.

The report recommended that a dewatering scheme would be necessary for excavations below the groundwater level because the sand was susceptible to quick conditions due to unbalanced hydrostatic heads. It was assumed that excavations extending below the groundwater level would 'boil up'.

Based on the General Arrangement Drawing (Reference 3), the final design was changed from an overpass to an underpass structure to carry Maple Road over the future twin Highway 403. The grades at the approaches were to be raised about 8.5 m from the ground level. A round voided post-tensioned concrete slab structure was to be constructed. The top of the 800 mm thick pile



caps was at elevation 262.0 and 262.3 at the north and south abutments, respectively and the top of the 1500 mm thick pile cap for the centre pier was at elevation 257.0. In the drawing, it was shown that 310x110 H piles were to be driven at the abutments and centre pier and that compacted fill (maximum 75 mm particle size) was to be placed to bottom of footing elevation before driving piles at the abutments. A organic silt layer up to 2.0 m thick was to be removed and replaced with granular fill at the ground level. A 150 mm diameter perforated corrugated steel pipe (CSP) was to be placed behind each abutment wall.

Based on the Footings Drawing (Reference 4), the 310x110 H piles were to be driven in accordance with Standard SS-103-11 using a design load of 900 kN (101 tons) per pile.

The following table summarizes the pile data based on the Footings Drawing (Reference 4). The pile lengths shown in the following table were the theoretical lengths below cut-off.

SUMMARY OF PILE DATA				
LOCATION (PILE TYPE)	BATTER	NUMBER REQUIRED	LENGTH, mm	PILE CUT-OFF ELEVATION, m
North Abutment (310x110 H Piles)	1:3	5	16500	261.550
	Vertical	2	15500	
	1:9	2	15750	
Centre Pier (310x110 H Piles)	1:3	10	10500	255.950
	1:9	4	10000	
South Abutment (310x110 H Piles)	1:3	5	16750	261.850
	Vertical	2	16000	
	1:9	2	16000	



6.2 Assessment of Foundation Parameters

Based on the previous investigation and subsurface conditions encountered, the following table summarizes the foundation design parameters that were recommended in the previous reports (References 1 and 2), contract drawings (References 3 and 4) and the updated geotechnical reaction at SLS and factored geotechnical resistance at ULS are provided.

FOUNDATION DESIGN PARAMETERS

FOUNDATION	PROBABLE PILE TIP ¹	PREVIOUS WORKING STRESS VALUES ²	PREVIOUS EQUIVALENT LIMIT STATE DESIGN VALUES		LIMIT STATE DESIGN VALUES UPDATED TO CURRENT INDUSTRY PRACTICE ³	
		SAFE BEARING LOAD	SLS BEARING REACTION/LOAD	ULS FACTORED GEOTECHNICAL REACTION/LOAD	SLS BEARING REACTION/LOAD	ULS FACTORED GEOTECHNICAL REACTION/LOAD
North abutment (310x110 H Piles)	245.9 to 246.1	900 kN (101 tons)	900 (kN)	1260 (kN)	900 (kN)	1260 (kN)
Centre Pier (310x110 H Piles)	246.0					
South abutment (310x110 H Piles)	245.9 to 246.0					

- Notes:**
1. Founding pile tip elevation was estimated based on pile data provided in References 3 and 4.
 2. Working stress design value (Reference 3). The Serviceability Limit State design values are based on the working stress. No field verification data was available for review.
 3. Resistance Factor = 0.4 for deep foundations (CFEM 4th edition)
Assumed a Factor of Safety is 3 (CFEM 4th edition).
 4. The pile tip elevation at approximate elevation 246.0 is about 3.0 m into the 100 blow till soils and provided the piles were driven to an adequate set should be sufficient to develop the 900 kN design capacity.

The Peak Ground Acceleration (PGA) for the site is 0.084 (National Building Code of Canada, 2015). The soil classification for seismic design should be in accordance with Clause 4.4.3.2 of the CHBDC (2014).

The bearing resistance for inclined loads should be reduced in accordance with the requirements of clause 6.10.4 of the CHBDC 2014 Edition.

The foundation frost penetration depth at the site is 1.2 m according to OPSD 3090.101.



7. DISCUSSION

It is understood that semi-integral conversion may not be the preferred rehabilitation strategy and that Preservation Management Strategy (PMS) consisting of expansion joint replacement, patch, waterproof and pave, patch repairs and concrete sealer applied to the concrete barrier walls to be undertaken at this underpass structure location. From a geotechnical point of view, at the present time, foundation work for the underpass structure is not expected.

However, if any major rehabilitation is undertaken for the proposed interchange at this location, it is recommended that the foundation capacity at the abutment locations should be verified prior to any major construction work. Further, the Structural Engineer should verify the pile type and configuration used for the underpass structure.

A temporary support system may be required for the rehabilitation of the underpass structure and the construction for temporary support system should conform to OPSS 404 and 539. The contractor is responsible for the selection, detailed design and performance of the roadway protection scheme. The contractor should monitor the movement of the roadway protection system.

The slopes adjacent to both abutments are visually stable without signs of erosion. However, the embankments which are greater than 8.0 m in height were constructed with a 2H:1V slope but not benched as per current practice (OPSD 202.010).

8. CLOSURE

This Technical Memorandum was prepared by Mr. N. Rahman, P.Eng, Project Engineer and was reviewed by Mr. B. R. Gray, M.Eng, P.Eng., Principal Consultant. Mr. R. Ng, MBA, PhD, P.Eng., MTO Designated Principal Contact conducted an independent review of the report.

We trust this memo is sufficient for your immediate needs. Please, do not hesitate to contact us if you have any inquiries and/or comments.

Yours very truly,

Peto MacCallum Ltd.



Nazibur Rahman, P.Eng.
Project Engineer



Brian R. Gray, M.Eng, P.Eng.
Principal Consultant



Robert Ng, MBA, PhD, P.Eng.
MTO Designated Principal Contact

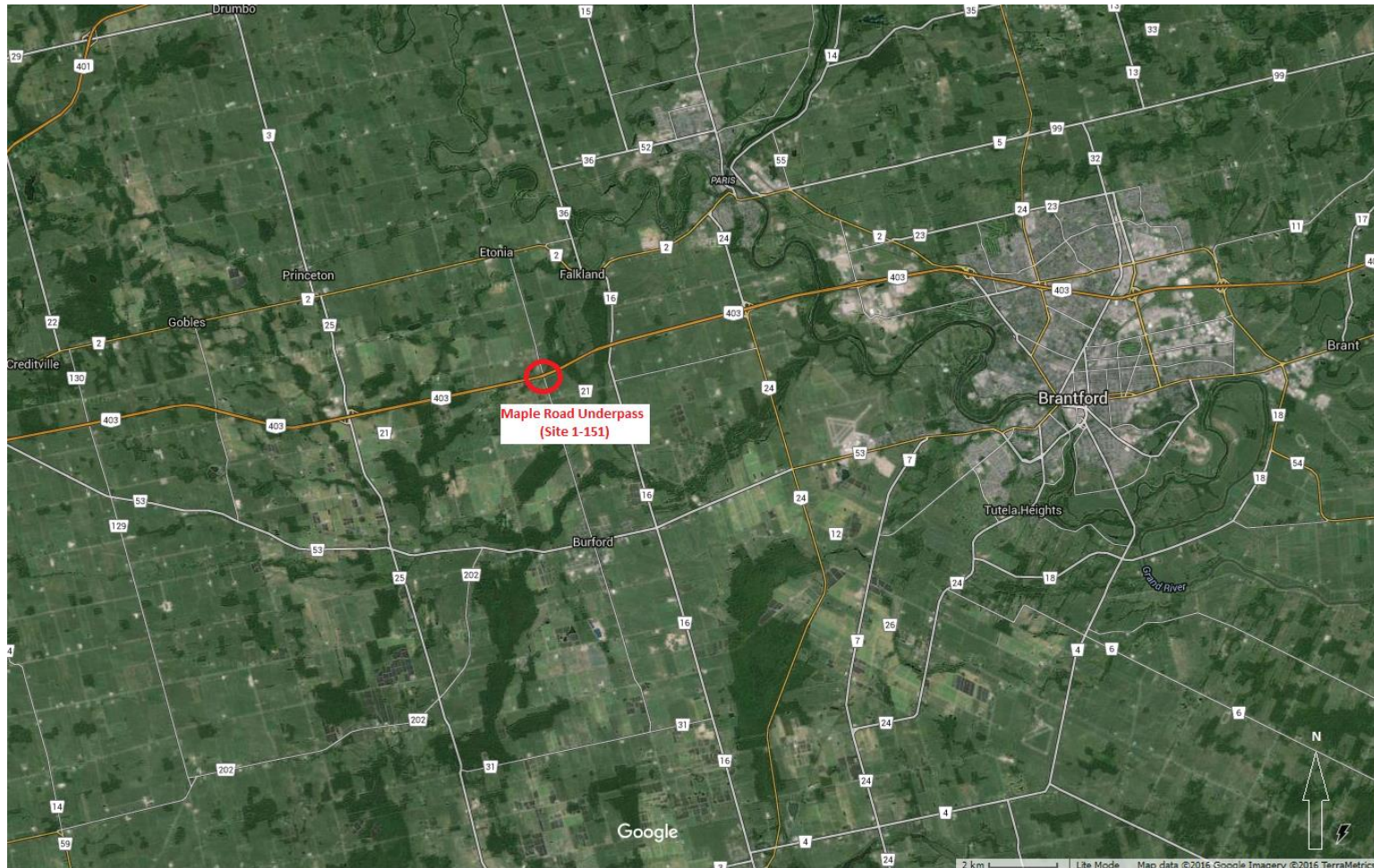


TABLE 1

LIST OF STANDARD SPECIFICATIONS REFERENCED IN REPORT

DOCUMENT	TITLE
OPSS 404	Construction Specification for Support Systems
OPSS 539	Construction Specification for Temporary Protection Systems
OPSD 3090.101	Foundation Frost Depth for Southern Ontario
OPSD 202.010	Slope Flattening Using Surplus Excavated Material On Earth or Rock Embankment

Figure 1 – Key Plan





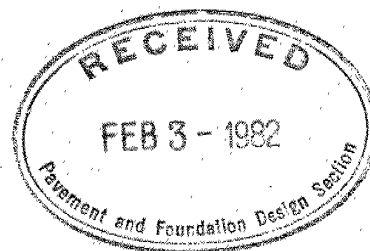
APPENDIX A

Appendix A – Previous Foundation Investigation Reports (GEOCRE5 40P1-59)

- Reference 1: Foundation Investigation Report for Maple Road Underpass, 6.1 km West of Highway #24A, W.P. 161-60-01, Site No. 1-151, Hwy. #403, District #4 (Hamilton), dated February 3, 1982.
- Reference 2: Foundation Investigation Report for Burford Twp. Rd. Overpass of Proposed Hwy. #403 1.5 Miles West of Brantford West Limits, District #4 (Hamilton), W.O. 72-11046, W.P. 71-62, dated July 11, 1972.
- Reference 3: General Arrangement Drawing, Maple Road Underpass, DWG 1, 6.1 Km West of Highway 24A, Site No. 1-151, Dist. No. 4, Hwy. 403, W.P. 71-62-01, dated July, 1980.
- Reference 4: Footings Drawing, Maple Road Underpass, DWG 3, Site No. 1-151, Dist. No. 4, Hwy. 403, W.P. 71-62-01, dated July, 1980.

FOUNDATION INVESTIGATION REPORT

CONTRACT NO 81-43



Ministry of
Transportation and
Communications

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Note: For purposes of the Contract these reports supercede all other foundation reports prepared by or for the Ministry in connection with the above mentioned projects.

FOUNDATION INVESTIGATION REPORT
For
Maple Road Underpass
6.1 Km West of Hwy. #24A
W. P. 71-62-01; Site No. 1-151
Hwy. #403; District #4 (HAMILTON)

INTRODUCTION

A foundation investigation was carried out during the period of 72-05-09 and 72-05-17. The field work consisted of eight sampled boreholes. In addition, dynamic cone penetration tests were carried out adjacent to each borehole and also at seven other locations.

The borings were advanced by a muskeg vehicle mounted continuous flight auger machine equipped with 83 mm I. D. Hollow stem augers.

SITE DESCRIPTION AND GEOLOGY (At the time of the Field Investigation)

The site of the proposed crossing is situated some 8 Km north of the town of Burford, along existing Maple Road. The general topography is undulating. The vicinity is occupied by farmlands, the main crop being corn. There is a small stream running through the site of the proposed project, the depth of which is about 0.5m.

Geologically, the area belongs to the physiographic region known as the "Norfolk Sand Plain". The sands and silts of this region were deposited as a delta in glacial lakes Whittlesey and Warren. A great discharge of meltwater from the Grand River area entered the lakes between the ice-front and the moraines to the north-west, building the delta from west to east as the glacier withdrew. The moraines today are partially buried by sand.

SUBSURFACE CONDITIONS (At the time of the Field Investigation)

General:

Granular type subsoils predominate at the site, consisting of

sands with traces of silt and gravel, underlain by sandy silts with some clay and gravel (glacial till). The surficial soils contain some organic and vegetable matter within a depth of about 1.4m.

Reference should be made to the Record of Borehole sheets for boundary elevations of the different soil types. These sheets also contain the description of the soil types and in summarized form, the results of all field and laboratory tests performed. The stratigraphical sections shown on Drawing No. 2 are based upon these informations. The drawing also shows the locations and elevations of the borings. A brief description of the different deposits are as follows.

Fine to Medium Sands:

The sand layers were found to extend to some 6.7 - 10.1m below ground level (elevation 246.6 - 249.6m). The uppermost 0.9 - 1.8m of the sands are contaminated with organic and decomposed vegetable matter. The organic content renders this portion of the soils rather impervious and slightly plastic. Under the dark grey and black organic soils, the fine to medium sands are grey in colour, containing up to 20% silt size particles and occasionally traces of gravel. Standard penetration "N" values recorded within this stratum range from 4 blows per 0.3m up to over 100 blows per 0.3m corresponding to loose to very dense relative density. Due to the high groundwater level, instability of the sands developed quite frequently at the bottom of the holes. It is assumed that some loosening of the sands was caused by quick conditions under the unbalanced hydrostatic heads. In order to alleviate boiling of the sands, water pressure was applied in most of the borings.

The natural moisture contents within the upper 6.1m or so was measured to range from 15% to 20%, diminishing to 9% - 12% below this depth.

Sandy Silt With Some Clay and Gravel (Glacial Till):

Around elevation 246.6 - 249.6m extending to the bottom of boreholes, sandy silts with some clay and gravel were encountered. Very high penetration resistances were noted in this deposit, 100 blows usually resulting in less than 0.3m penetration. Atterberg limit tests yielded plastic limits of 11% - 13% and liquid limits of 15% - 16%. Laboratory grain size analyses revealed a heterogeneous particle distribution, the range of gravel particles being 1% - 22%, sand 30% - 85%, silt 12% - 45% and clay 5% - 11%.

Groundwater Conditions:

Groundwater levels were established in each borehole within the uppermost organic deposit, as shown on the borelog sheets. Boreholes were left open for a few days after completion, and the equilibrium water levels were recorded to be between 0.2m and 0.9m below ground level, corresponding to geodetic elevations of 256.3 - 256.9m.

P. Payer
P. Payer, P. Eng.
Foundations Engineer



K. G. Selby
K. G. Selby, P. Eng.
Senior Foundations Engineer



RECORD OF BOREHOLE No 1

METRIC

W P 71-62-01 LOCATION Sta. 9+970.0, o/s 14.9 m RT @ Maple Road ORIGINATED BY WVU
DIST 4 HWY 403 BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY RS
DATUM Geodetic DATE 1972 05 16 & 17 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
256.6	Ground Level												
0.0	Organics		1	SS	5		256						
	Fine to medium sand with some silt and gravel.		2	SS	26		254						
			3	SS	20								
	Loose to very dense.		4	SS	30								
			5	SS	43								
	Grey.		6	SS	21								
			7	SS	60								
249.9			8	SS	100/127 mm		250						
6.7	Sandy silt, some gra.		9	SS	100/25 mm								
248.9	(Glacial Till) v. dense												
7.7	End of Borehole												

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 2

METRIC

W P 71-62-01 LOCATION Sta. 9+982.3, o/s 14.9 m RT @ Maple Road ORIGINATED BY WVU
DIST 4 HWY 403 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY RS
DATUM Geodetic DATE 1972 05 16 CHECKED BY RS

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE						
256.5 0.0	Ground Level									
249.9										
6.6	End of Cone Test									

+3, x5: Numbers refer to
Sensitivity

20
15-5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 3

METRIC

W P 71-62-01 LOCATION Sta. 9+971.0, o/s 4.9 m RT @ Maple Road ORIGINATED BY WVU
DIST 4 HWY 403 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY RS
DATUM Geodetic DATE 1972 05 15 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100					
								SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					
								WATER CONTENT (%)					
257.4	Ground Level												
0.0							256						
							254						
							252						
250.1													
7.3	End of Cone Test							100/279 mm					

⁺₃, ⁺₅ : Numbers refer to Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 4

METRIC

W P 71-62-01 LOCATION Sta. 9+982.0, o/s 4.6 m RT of Maple Road ORIGINATED BY WVU
DIST 4 HWY 403 BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY RS
DATUM Geodetic DATE 1972 05 15 CHECKED BY RS

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE								
257.4	Ground Level											
0.0	Organic sand, some sl. Black and grey.		1	SS	26							
255.4			2	SS	5							
2.0	Fine to medium sand with some silt and traces of gravel. Loose to very dense. Grey.		3	SS	7							
			4	SS	17							
			5	SS	32							
			6	SS	30							
			7	SS	67							
			8	SS	104							
249.0												
8.4	End of Borehole											

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 6

METRIC

W P 71-62-01 LOCATION Sta. 9+981.7, o/s 4.9 m LT of Maple Road ORIGINATED BY WVU
DIST 4 HWY 403 BOREHOLE TYPE Hollow Stem Auger COMPILED BY RS
DATUM Geodetic DATE 1972 05 16 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
257.3	Ground Level												
0.0	Organic sandy silt some roots. Loose. Black and grey.		1	SS	5		256						
255.3			2	SS	5								
2.0	Fine to medium sand. Very loose to dense. Grey.		3	SS	3								
			4	SS	19								
			5	SS	24								
			6	SS	22								
			7	SS	31								
			8	SS	44								
249.0													
8.3	Silty sand traces of clay (Glacial Till) Very dense		9	SS	162/254		248						1 48 45 6
247.1			10	SS	100/127								
10.2	End of Borehole												

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 7

METRIC

W P 71-62-01 LOCATION Sta. 9+970.1, o/s 14.9 m LT @ Maple Road ORIGINATED BY WVU
DIST 4 HWY 403 BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY RS
DATUM Geodetic DATE 1972 05 17 CHECKED BY RC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100						WATER CONTENT (%) 10 20 30
								SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						
256.5	Ground Level												GR SA SI CL	
0.0	Organic sandy silt some roots. Black and grey.		1	SS	5		256							
254.8			2	SS	9									
1.7	Fine to medium sand, some silt. Loose to very dense. Grey.		3	SS	15		254						2 81 (17)	
			4	SS	17									
			5	SS	43		252							
			6	SS	38									
			7	SS	62		250							
249.5			8	SS	148/		279 mm						22 30 37 11	
7.0	Sandy silt with clay and gravel. (Glacial Till) Hard.													
247.7			9	SS	116/		279 mm							
8.8	End of Borehole													

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 9

METRIC

W P 71-62-01 LOCATION Sta. 10+018.3, o/s 14.6 m RT of Maple Road ORIGINATED BY WVU
DIST 4 HWY 403 BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY RS
DATUM Geodetic DATE 1972 05 11 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100					
256.5	Ground Level													
0.0	Organic sandy silt some roots.													
255.3	Black and grey.		1	SS	2									
1.2	Fine to medium sand to gravelly sand, traces of silt.		2	SS	10									
			3	SS	13									
	Loose to very dense.		4	SS	20									
			5	SS	21									
			6	SS	24									
			7	SS	42									
249.5			8	SS	100/152 mm									
7.0	Silty sand some clay & gravel.													
	Glacial Till.													
247.8	Very dense.		9	SS	100/152 mm									
8.7	End of Borehole													

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 10

METRIC

W P 71-62-01 LOCATION Sta. 10+030.2, o/s 14.9 m RT @ Maple Road ORIGINATED BY WVU
DIST 4 HWY 403 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY RS
DATUM Geodetic DATE 1972 05 12 CHECKED BY RS

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		NATURAL MOISTURE CONTENT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20 40 60 80 100	W _p W W _L	PLASTIC LIMIT	LIQUID LIMIT		
256.6	Ground Level												
0.0													
249.3	End of Cone Test												
7.3													

+3, x⁵: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 11

METRIC

W P 71-62-01 LOCATION Sta. 10+018.3, o/s 4.3 m RT of Maple Road ORIGINATED BY WVU
DIST 4 HWY 403 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY RS
DATUM Geodetic DATE 1972 05 13 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
257.3	Ground Level												
							256						
							254						
							252						
							250						
249.7													
7.6	End of Cone Test							100/279 mm					

+3, x5: Numbers refer to Sensitivity 20
15 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 12

METRIC

W P 71-62-01 LOCATION Sta. 10+029.9, o/s 5.8 m RT @ Maple Road ORIGINATED BY WVU
DIST 4 HWY 403 BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY RS
DATUM Geodetic DATE 1972 05 12 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES									
256.7	Ground Level													
0.0	Trace of Organics		1	SS	4		256							
			2	SS	9									
	Fine to medium sand, traces of silt.		3	SS	13		254							
			4	SS	12									
	Loose to very dense.		5	SS	39		252							
			6	SS	57									
			7	SS	15		250							
			8	SS	95									
248.5														
8.2	Silty sand, traces of clay and gravel. (Glacial Till)		9	SS	131		248							
	Very dense.													
246.3			10	SS	165/	292 mm								
10.4	End of Borehole													

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 13

METRIC

W P 71-62-01 LOCATION Sta. 10+018.0, o/s 3.4 m LT of Maple Road ORIGINATED BY WVU
DIST 4 HWY 403 BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY RS
DATUM Geodetic DATE 1972 05 09 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	SHEAR STRENGTH					
257.6	Ground Level							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	10 20 30					
0.0	Organic sandy silt mottled grey and black Very loose.		1	SS	4									
255.6			2	SS	7		256							
2.0	Fine to medium sand, traces of silt.		3	SS	19									
	Compact to dense.		4	SS	27		254							
			5	SS	22									
			6	SS	32		252							
			7	SS	41									
			8	SS	25		250							
249.4														
8.2	Sandy silt to sand with some silt, traces of clay and gravel. (Glacial Till)		9	SS	100/127 mm		248							
247.3	Very dense.		10	SS	100/127 mm								3 85 (12)	
10.3	End of Borehole													

+3, x5 : Numbers refer to
Sensitivity

20
15
10

5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 14

METRIC

W P 71-62-01 LOCATION Sta. 10+029.3, o/s 5.8 m LT @ Maple Road ORIGINATED BY WVU
DIST 4 HWY 403 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY RS
DATUM Geodetic DATE 1972 05 12 CHECKED BY RS

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	SHEAR STRENGTH					
257.4	Ground Level						20 40 60 80 100						
0.0													
249.8													
7.6	End of Cone Test						100/254 mm						

+³, x⁵: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 15

METRIC

W P 71-62-01 LOCATION Sta. 10+018.0, o/s 14.9 m LT of Maple Road ORIGINATED BY WVU
DIST 4 HWY 403 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY RS
DATUM Geodetic DATE 1972 05 11 CHECKED BY RS

[illegible]

+3, x5: Numbers refer to Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 16

METRIC

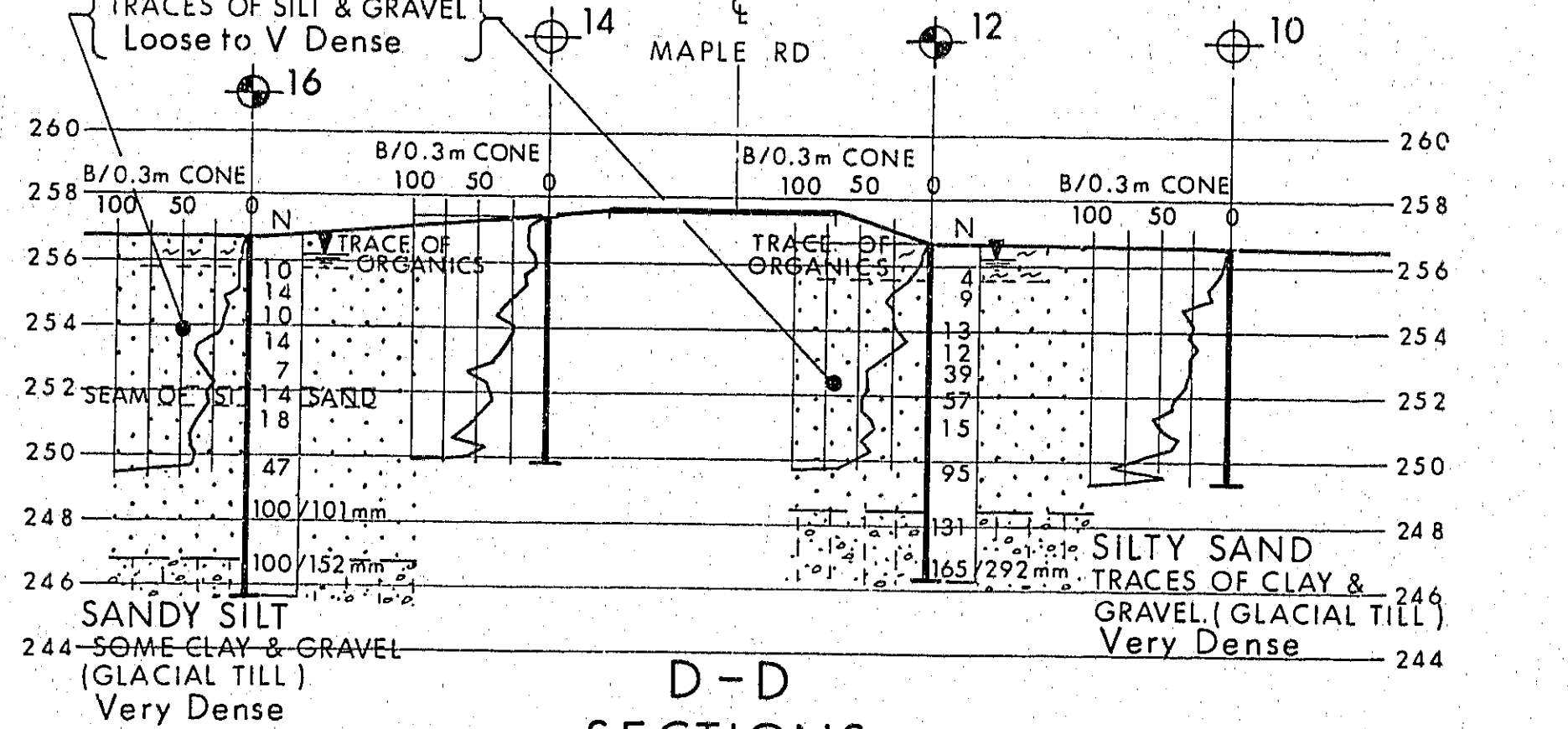
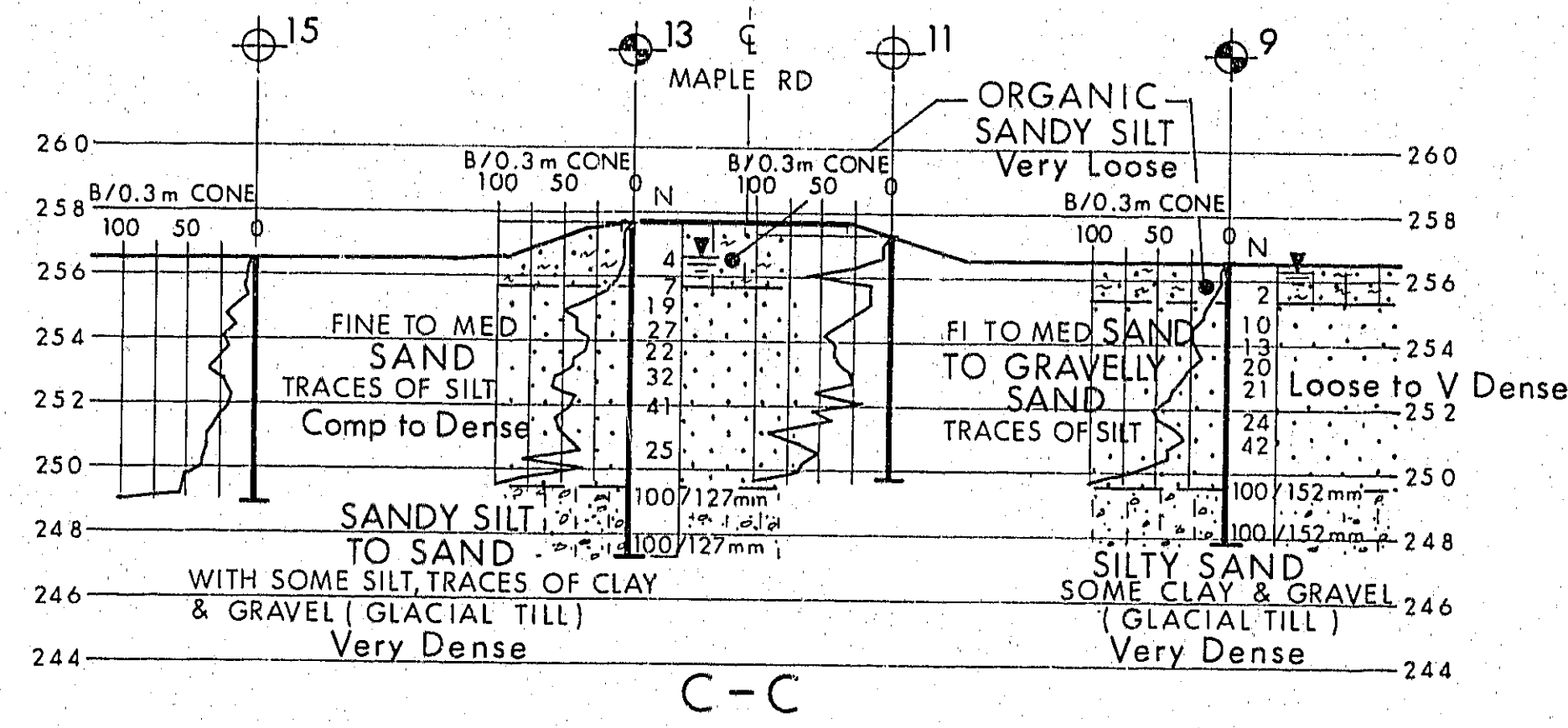
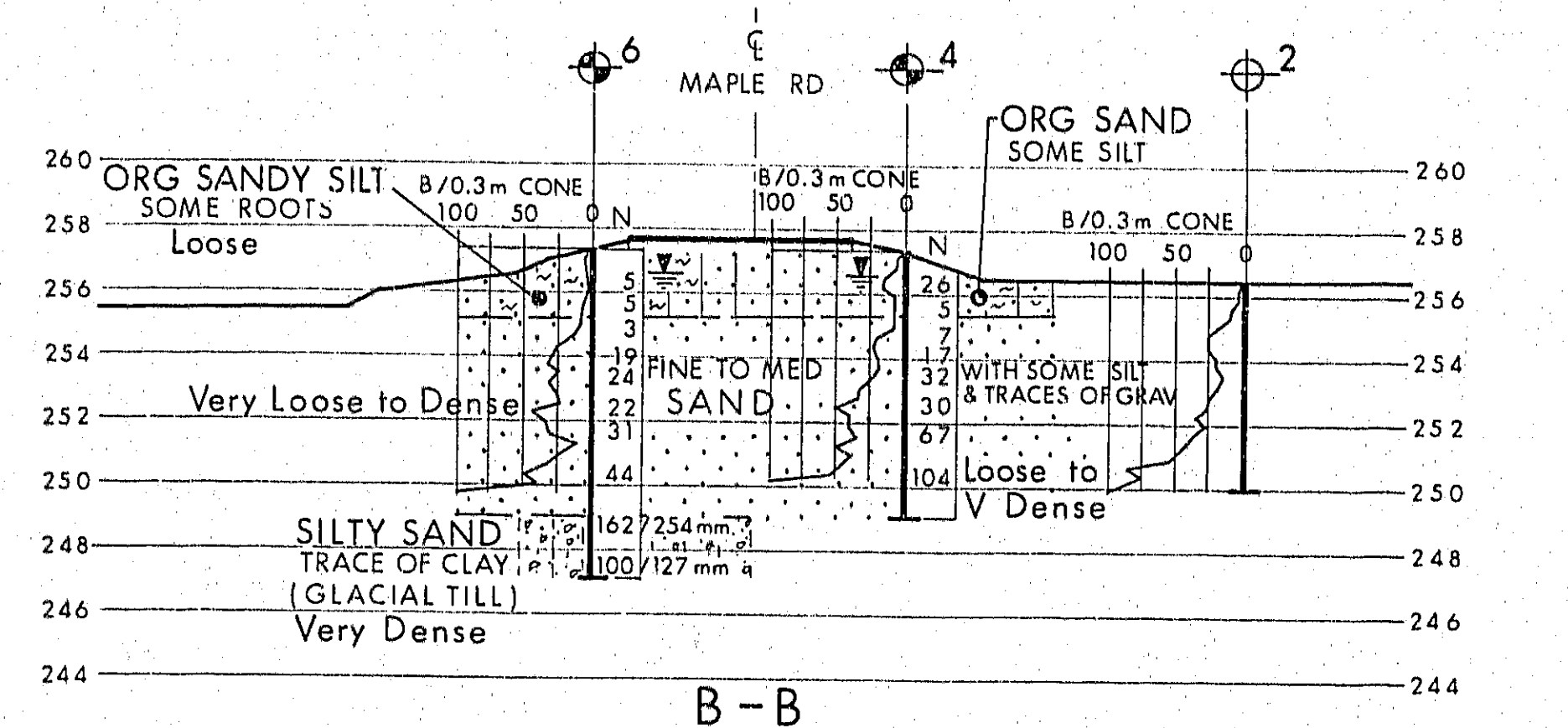
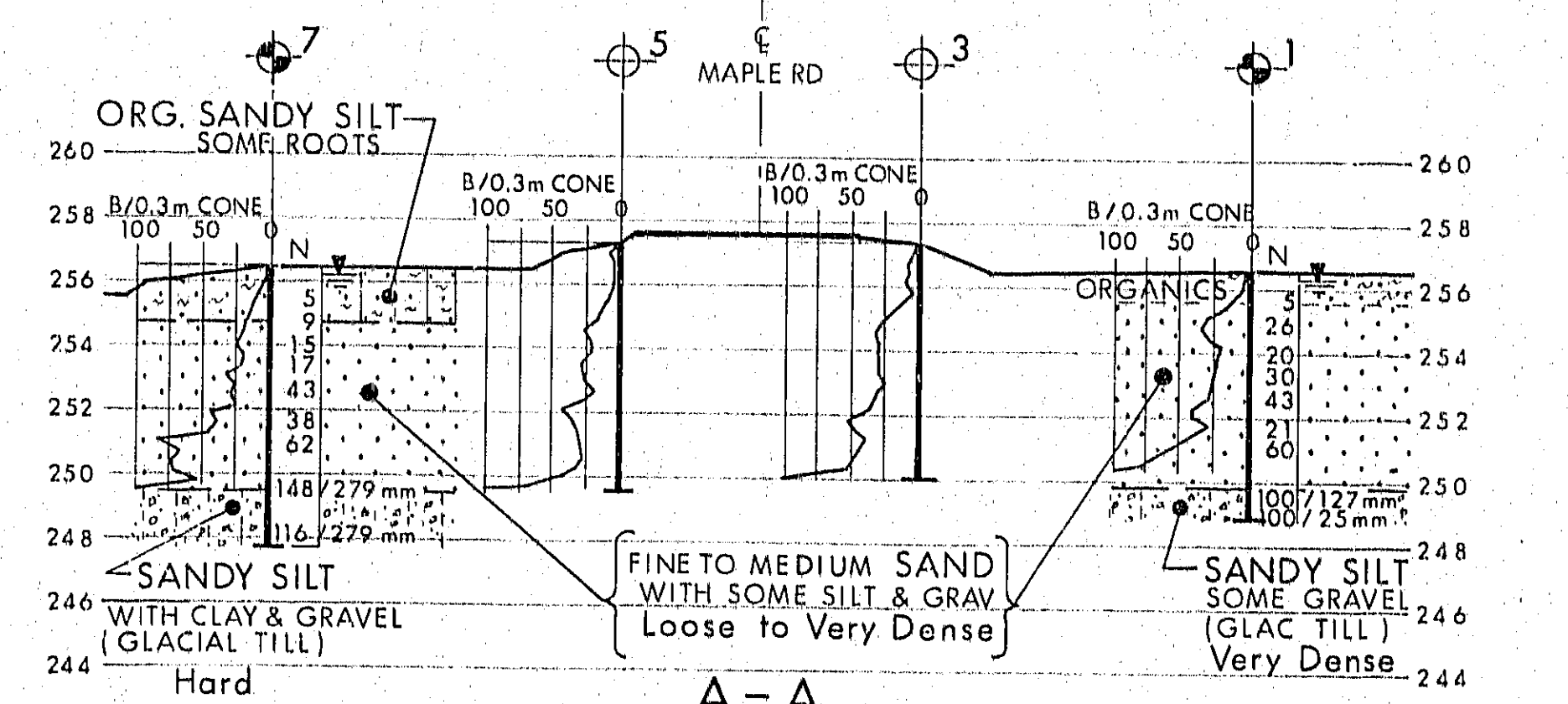
W P 71-62-01 LOCATION Sta. 10+029.3, o/s 14.9 m LT of Maple Road ORIGINATED BY WVU
DIST 4 HWY 403 BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY RS
DATUM Geodetic DATE 1972 05 09 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
256.7	Ground Level												
0.0	Trace of Organics		1	SS	10		256						
			2	SS	14								
	Fine to medium sand traces of silt and gravel.		3	SS	10		254						
			4	SS	14								
	Seam of silty sand		5	SS	7		252						
			6	SS	14								
			7	SS	18								
	Loose to very dense		8	SS	47		250						
	Grey		9	SS	100	101 mm	248						
246.6			10	SS	100	152 mm	246						
10.1	Sandy silt some clay and gravel (Glacial Till) Very dense												
245.6													
11.1	End of Borehole												

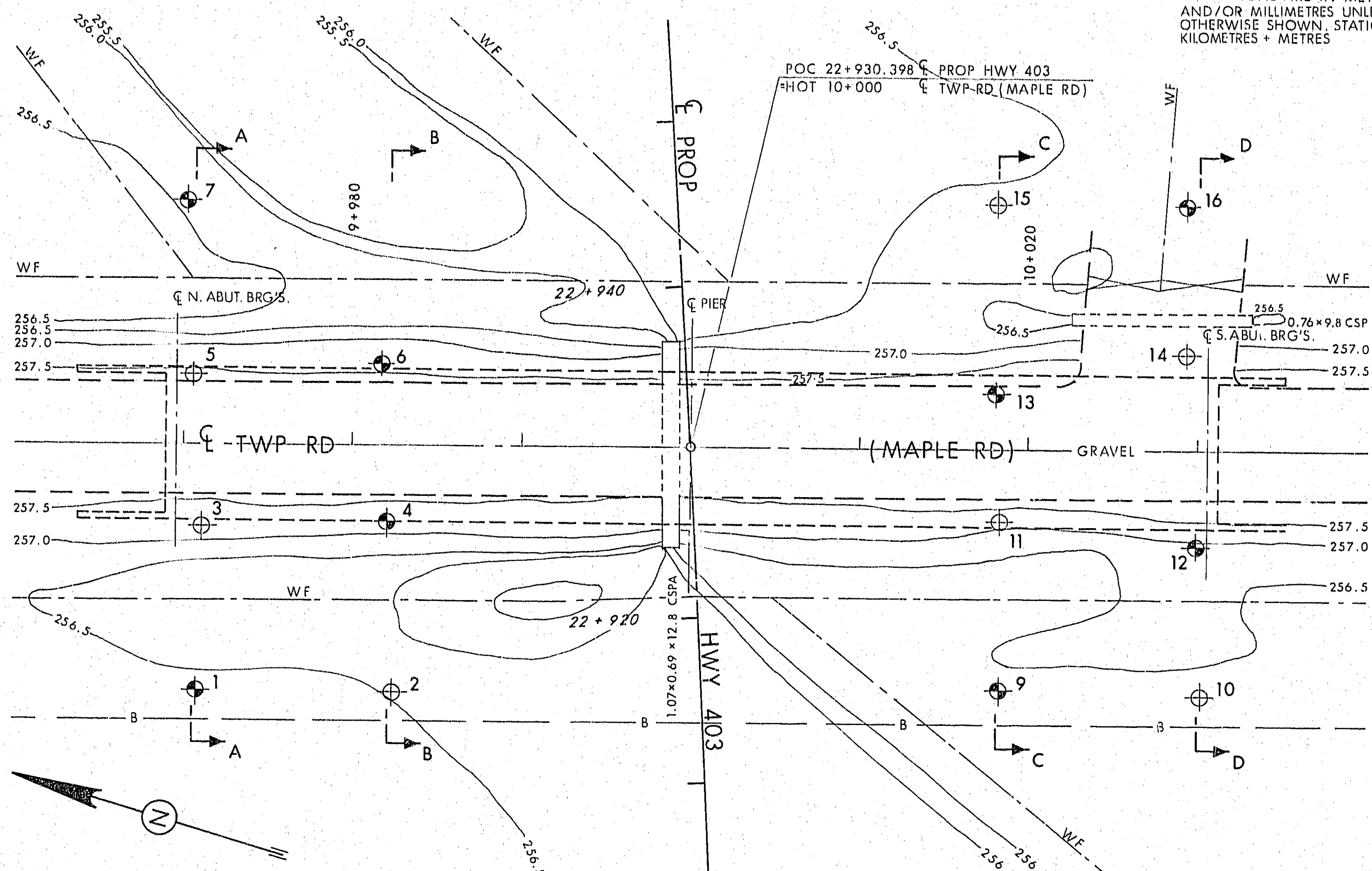
OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to
Sensitivity

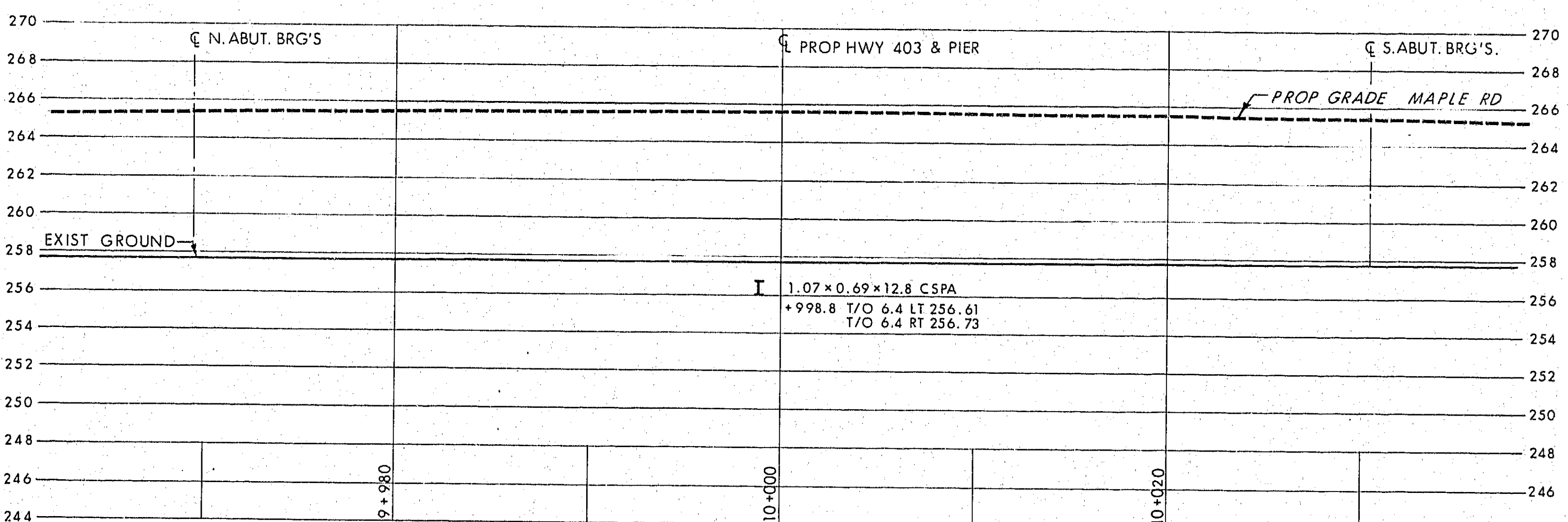
20
15 \div 5 (%) STRAIN AT FAILURE
10



D-D SECTIONS
SCALE
5m 4 3 2 1 0 5m



PLAN
SCALE
5m 4 3 2 1 0 5m

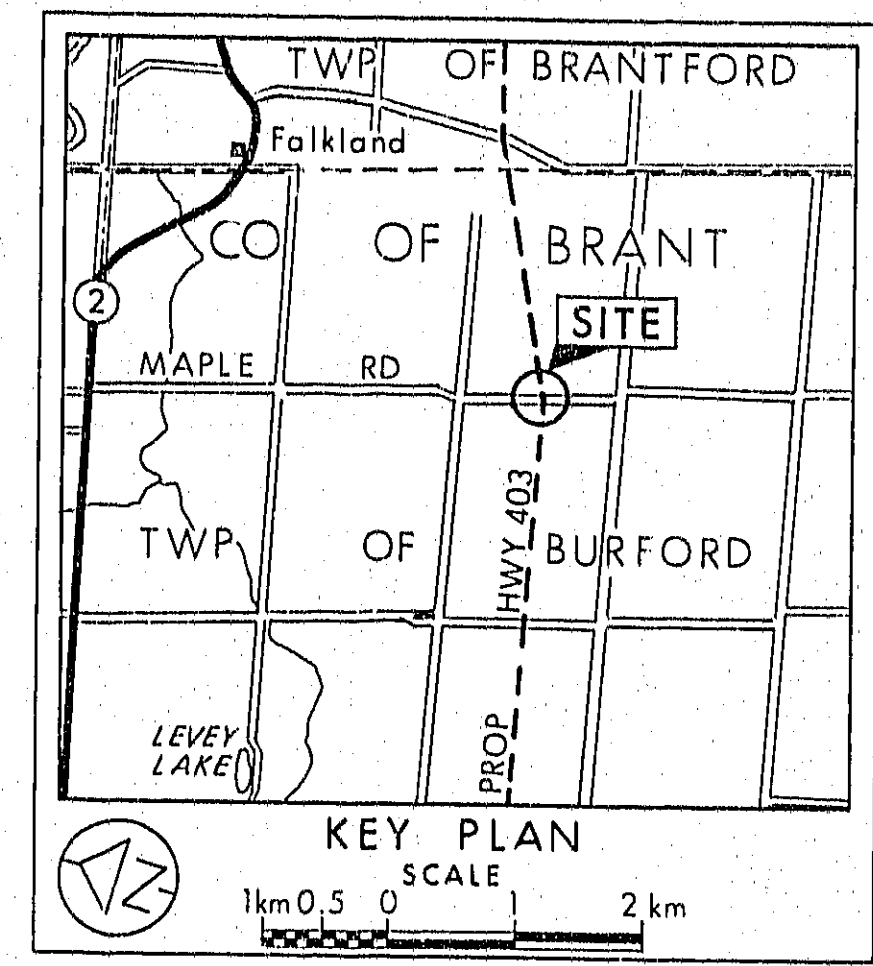


PROFILE-MAPLE RD
SCALE
5m 4 3 2 1 0 5m

METRIC

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

CONT No 81-43		SHEET 155
WP No 71-62-01		
MAPLE ROAD UNDERPASS (6.1 km West of Hwy 24A) BORE HOLE LOCATIONS & SOIL STRATA		



LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- WL at time of investigation 1972 05

No	ELEVATION	STATION	OFFSET MAPLE ROAD
1	256.6	9+970.7	14.9m RT
2	256.5	9+982.3	14.9m RT
3	257.4	9+971.0	4.9m RT
4	257.4	9+982.0	4.6m RT
5	257.3	9+970.4	4.3m LT
6	257.3	9+981.7	4.9m LT
7	256.5	9+970.1	14.9m LT
9	256.5	10+018.3	14.6m RT
10	256.6	10+030.2	14.9m RT
11	257.3	10+018.3	4.3m RT
12	256.7	10+029.9	5.8m RT
13	257.6	10+018.0	3.4m LT
14	257.4	10+029.3	5.8m LT
15	256.5	10+018.0	14.9m LT
16	256.7	10+029.3	14.9m LT

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

Geocres No 40P1-59

HWY No 403	CHECKED	DATE 1979 12 13	DIST 4
SUBWD KS	CHECKED	APPROVED	SITE 1-151
DRAWN RS	CHECKED	APPROVED	DWG 2

MEMORANDUM

Reference 2

To: Mr. A. P. Watt, (4)
Regional Structural Planning Eng.,
Southwestern Region,
London, Ontario.

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

ATTENTION: Mr. S. Jants.

DATE: July 11, 1972.

OUR FILE REF. IN REPLY TO JUL 20 1972

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For
Burford Twp. Rd. Overpass of Proposed
Hwy. #403 1.5 Mi. West of Brantford
West Limits, District #4 (Hamilton)
W.O. 72-11046 --- W.P. 71-62
21-43

40 P1-59
GEOCRIS No.

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.

cc: Messrs. D. W. Farren

B. R. Davis

A. Rutka

W. A. Zonnenberg

C. R. Robertson

B. J. Giroux

J. R. Roy

G. A. Wrong

B. A. Singh

A. G. Stermac
A. G. Stermac,
PRINCIPAL FOUNDATIONS ENGINEER.

Foundations Files
Documents

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 - 4.3) Sandy Silt With Some Clay and Gravel (Glacial Till).
 - 4.4) Groundwater Conditions.
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 - 5.1) General.
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-

FOUNDATION INVESTIGATION REPORT
For
Burford Twp. Rd. Overpass of Proposed
Hwy. #403 1.5 Mi. West of Brantford West Limits
District #4 (Hamilton)
W.O. 72-11046 --- W.P. 71-62

1. INTRODUCTION:

The Foundations Office was requested by Mr. S. Jants, Bridge Planning Technician, South-Western Region, to carry out a foundation investigation at the site of Burford Township Road (Maple Rd.) overpass of proposed Hwy. #403. The memo containing the request was dated March 23, 1972. In accordance with the request, a field and subsequent laboratory investigation was carried out under the supervision of this Office; the results of which are compiled in this report, together with recommendations concerning structure foundations.

2. DESCRIPTION OF THE SITE AND GEOLOGY:

The site of the proposed crossing is situated some five miles north of the town of Burford, along existing Maple Rd. The general topography is undulating. The vicinity is occupied by farmlands, the main crop being corn. There is a small stream running through the site of the proposed project, the depth of which varies between 1 foot and 2 feet.

Geologically, the area belongs to the physiographic region known as the "Norfolk Sand Plain". The sands and silts of this region were deposited as a delta in glacial lakes Whittlesey and Warren. A great discharge of meltwater from the Grand River area entered the lakes between the ice-front and the moraines to the north-west, building the delta from west to east as the glacier withdrew. The moraines today are partially buried by sand.

3. FIELD AND LABORATORY INVESTIGATIONS:

The field investigation consisted of eight sampled boreholes and some fifteen dynamic cone penetration tests. Soil sampling was carried out according to conventional methods, by means of split-spoon samplers. The sampler was advanced by a 140 lbs. hammer, falling freely a distance of 30 inches. The number of hammer blows required to drive the sampler 12 inches into the soil was recorded as the Standard Penetration "N" value. The recovered soil samples were examined and identified in the field by the field technician. Upon arrival in the laboratory all the samples were again classified, using some simple routine tests. Some of the representative specimens were subjected to grain size analyses, Atterberg limit tests and moisture content determinations.

Field and laboratory test results are plotted on the accompanying borelogs. The locations and elevations of the borings are shown on Drawing #72-11046A, together with the estimated stratigraphical cross sections, projected to the proposed footing locations.

4. SUBSOIL CONDITIONS:

4.1) General:

Granular type subsoils predominate at the site, consisting of sands with traces of silt and gravel, underlain by sandy silts with some clay and gravel (glacial till). The surficial soils contain some organic and vegetable matter within a depth of 4-5 ft. A brief description of the deposits follows.

4.2) Fine to Medium Sands:

The sand layers were found to extend to some 22 ft. - 33 ft. below ground level (elevation 809-819 ft.). The uppermost 3-6 ft. of the sands are contaminated with organic and decomposed vegetable matter. The organic content renders this portion of the soils rather impervious and slightly plastic. Under the dark grey and black organic soils, the fine to medium sands are grey

in colour, containing up to 20% silt size particles and occasionally traces of gravel. Standard penetration "N" values recorded within this stratum range from 4 blows per ft. up to over 100 blows per ft. corresponding to loose to very dense relative density. Due to the high groundwater level, instability of the sands developed quite frequently at the bottom of the holes. It is assumed that some loosening of the sands was caused by quick conditions under the unbalanced hydrostatic heads. In order to alleviate boiling of the sands, water pressure was applied in most of the borings.

The natural moisture contents within the upper 20 ft. or so was measured to range from 15% to 20%, diminishing to 9% - 12% below this depth.

4.3) Sandy Silt With Some Clay and Gravel (Glacial Till):

Around elevation 809 ft. - 819 ft. extending to the bottom of boreholes, sandy silts with some clay and gravel were encountered. Very high penetration resistances were noted in this deposit, 100 blows usually resulting in less than 12 inch penetration. Atterberg limit tests yielded plastic limits of 11% - 13% and liquid limits of 15% - 16%. Laboratory grain size analyses revealed a heterogeneous particle distribution, the range of gravel particles being 1% - 22%, sand 30% - 85%, silt 12% - 45% and clay 5% - 11%.

4.4) Groundwater Conditions:

Groundwater levels were established in each borehole within the uppermost organic deposit, as shown on the borelog sheets. Boreholes were left open for a few days after completion, and the equilibrium water levels were recorded to be between 0.8 ft. and 3 ft. below ground level, corresponding to geodetic elevations of 841 ft. - 843 ft.

5. DISCUSSION AND RECOMMENDATIONS:

5.1) General:

The present proposal calls for a twin overhead structure at this location, to carry proposed Hwy. #403 over Burford Twp. road (Maple Rd.). The top of granular of Hwy. #403 at the crossing is designed to be at elevation 865 ft. some 20 ft. above the existing grade of Maple Road. The height of the approach fills will be some 21 - 22.5 ft., and it is surmised that perched abutments will be constructed within the fills.

As discussed earlier, beneath a 22-23 ft. deep deposit of very loose to very dense sand layer, very dense glacial tills were observed around elevation 809 ft. - 819 ft.

5.2) Structure Foundation:

On account of the uppermost 10-15 ft. of very loose to compact sands, combined with organic contents and high water pressures, spread foundations for the proposed structure do not appear to be economically feasible. It is recommended, therefore, that the entire structure, abutments as well as piers be supported on piles, driven into the very dense glacial deposit. It is felt that the use of steel tubular piles will be the most practical under the existing soil conditions. Piles should be driven according to Standard BD-82-7, using design loads of 60 ton per pile. On 12-3/4 O.D. steel tubes above loads may be reached by driving the piles to elevation 810 ft. - 815 ft., some 27-34 ft. below general ground surface. In constructing perched abutments, pile caps may be poured within the embankments. In this event care should be taken not to place bouldery fill at the pile locations. Four foot cover should be provided for the pile caps for frost protection.

No stability problems are foreseen for the approach embankments, provided that they are built with 2 horizontal to 1 vertical slopes.

The surficial organic material should be removed under the approach fills, footings and proposed road beds and replaced by suitable backfill. The horizontal and vertical extent of the organic deposit ought to be determined by the Regional Materials

Engineer.

It is assumed that excavations extending below the groundwater level will "boil up" due to the susceptibility of the sands to unbalanced hydrostatic heads. In order to eliminate quick conditions, a dewatering scheme will be necessary for the excavations below the groundwater level.

6. MISCELLANEOUS:

The field work carried out during May 9 - 17, 1972, was supervised by Mr. W. V. Urie, Field Technician.

The equipment used was owned and operated by P.V.K. Drilling Company, Burford, Ontario.

This report was prepared by Mr. A. K. Barsvary, Senior Foundations Engineer, and reviewed by Mr. K. G. Selby, Supervising Foundations Engineer.

A. K. Barsvary

A. K. Barsvary, P. Eng.

K. G. Selby

K. G. Selby, P. Eng.

AKB/ao

July 10, 1972.



APPENDIX I

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

DESIGN SERVICES BRANCH

RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

JOB 72-11046

LOCATION 100 + 96 49' Lt.

ORIGINATED BY W.V.U.

W.P. 71-62

BORING DATE May 16-17, 1972

COMPILED BY A.K.B.

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

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					WATER CONTENT %				
							20	40	60	80	100	w_p	w	w_L		
SHEAR STRENGTH P.S.F.							UNCONFINED					FIELD VANE				
							QUICK TRIAXIAL					LAB. VANE				
641.8	Ground level.					640										
0.0	Organics															
	Fine to medium sand with some silt and gravel.		1	SS	5											
			2	SS	26											
			3	SS	20											
			4	SS	30											
	Loose to very dense.		5	SS	43	830										
	Gray.		6	SS	21											
			7	SS	60											
819.8						820										
22.0	Sandy silt, some gra.		8	SS	100/5"											
816.7	(Glacial fill) v. dense		9	SS	100/5"											
25.1	End of borehole.															

End of Cons. elev. 621.0

0 67 (13)

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

DESIGN SERVICES BRANCH

RECORD OF BOREHOLE No. 2

FOUNDATION SECTION

JOB 72-11046

LOCATION 100 + 58 49' Lt.

ORIGINATED BY W.V.U.

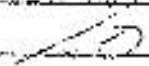
W.P. 71-62

BORING DATE May 16, 1972

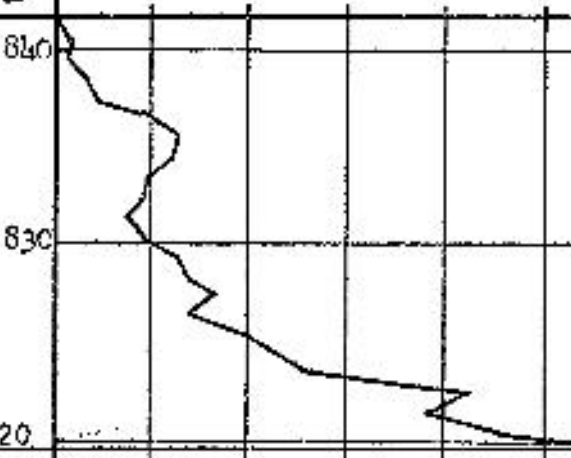
COMPILED BY P.Y.

DATUM Geodetic

BOREHOLE TYPE Dynamic Cone Penetration

CHECKED BY 

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — w_L		BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT 20 40 60 80 100					PLASTIC LIMIT — w_p			
						SHEAR STRENGTH P.S.F.					WATER CONTENT — w				
						○ UNCONFINED + FIELD VANE * QUICK TRIAXIAL x LAB. VANE					w_p — w — w_L WATER CONTENT %				
841.1	Ground level.					840									G2, SA, SI, CL
0.0						830									
819.6						820									
21.8	End of cone test.														



DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

DESIGN SERVICES BRANCH

RECORD OF BOREHOLE No. 4

FOUNDATION SECTION

JOB 72-110b6

LOCATION 100 + 59 15' Lt. G

ORIGINATED BY W.V.U.

W.P. 71-62

BORING DATE May 15, 1972

COMPILED BY P.V.

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		20	40	60	80	100	WATER CONTENT % w_p ——— w ——— w_L 10 20 30				
844.4	Ground level.															
0.0	Organic sand some sl. Black and gray.		1	SS	26											
637.9			2	SS	5											
6.5			3	SS	7											
	Fine to medium sand with some silt and traces of gravel.		4	SS	17											
			5	SS	32											
			6	SS	30											
			7	SS	67											
	Loose to very dense.															
	Grey.		8	SS	104											
816.9																
27.5	End of borehole.															

End of cone elev. 826.8

840

830

820

810

W.L. 842.0

1 91 (8)

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

DESIGN SERVICES BRANCH

RECORD OF BOREHOLE No. 6

FOUNDATION SECTION

JOB 72-11046

LOCATION 100 + 60 16' Rt. 8

ORIGINATED BY W.V.U.

W.P. 71-62

BORING DATE May 16, 1972

COMPILED BY P.H.

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

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					WATER CONTENT % w_p — w — w_L				
							SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE									
844.1	Ground level.															
0.0	Organic sandy silt some roots. Loose.		1	SS	5	840										
337.6	Black and grey.		2	SS	5											
6.5	Fine to medium sand.		3	SS	3											
	Very loose to dense.		4	SS	19											
	Grey.		5	SS	21	830										
			6	SS	22											
			7	SS	31											
			8	SS	14	820										
817.1							End of cone elev. 819.2									
27.0	Silty sand traces of clay (Glacial Till)		9	SS	162/10"										1 48 45 6	
810.7	Very dense.		10	SS	100/5"											
33.4	End of borehole.					810										

End of cone elev. 819.2

1 48 45 6

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	B.H. # DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS / FOOT		20 40 60 80 100	W _p ———— W _L			
							SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE		WATER CONTENT % 10 20 30		
811.4	Ground level.										
0.0	Organic sandy silt some roots.		1	SS	5	81.0					
835.9	Black and grey.		2	SS	9						
5.5	Fine to medium sand, some silt.		3	SS	15						
			4	SS	17	83.0					
	Loose to very dense.		5	SS	43						
			6	SS	38						
	Grey.		7	SS	62						
818.4			8	SS	118/11"	82.0					
23.0	Sandy silt with clay and gravel.										
812.4	Hard.		9	SS	116/11"						
29.0	End of borehole.					81.0					

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

DESIGN SERVICES BRANCH

RECORD OF BOREHOLE No. 9

FOUNDATION SECTION

JOB 72-11046

LOCATION 99 + 40 48' Lt. E

ORIGINATED BY W.V.U.

W.P. 71-62

BORING DATE May 11, 1972

COMPILED BY P.M.

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	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80			100
847.0	Ground level.											
837.1	Organic sandy silt some roots. Black and grey.	1	SS	2	840							
840		2	SS	10								
840	Fine to medium sand to gravelly sand, traces of silt.	3	SS	13								
		4	SS	20	830							
		5	SS	21								
		6	SS	24								
	Loose to very dense.	7	SS	42								
818.4		8	SS	100/6"	820							
23.0	Silty sand some clay. Glacial Till. & gravel											
812.9	Very dense.	9	SS	100/6"								
28.5	End of borehole.				810							

End of cone elev. 818.4'

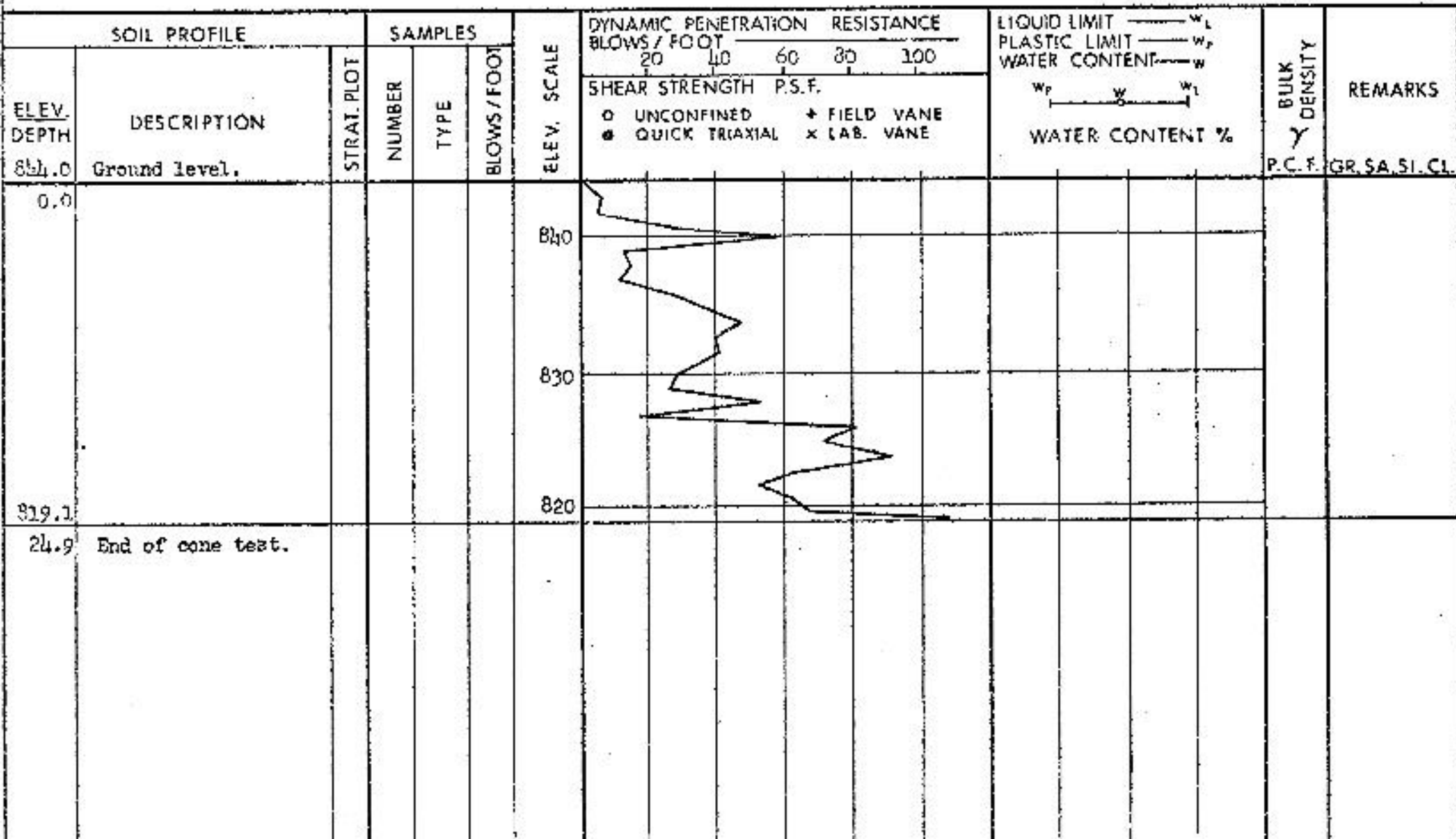
23 66 (9)

FOUNDATION SECTION

CHECKED BY _____

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE	LIQUID LIMIT W_L	BULK DENSITY γ	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	PLASTIC LIMIT W_P			WATER CONTENT W
							20	40			60
							SHEAR STRENGTH P.S.F.		WATER CONTENT %		
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE				
811.8	Ground level.					810			P.C.F.	GR, SA, SI, CL	
0.0						830					
						820					
818.0											
23.6	End of cone test.					810					

CHECKED BY



FOUNDATION SECTION

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					SHEAR STRENGTH P.S.F.					WATER CONTENT % 10 20 30
							20	40	60	80	100	○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB. VANE				
812.3	Ground level.																
0.0	Trace of Organics		1	SS	11	840											
			2	SS	9												
	Fine to medium sand,		3	SS	13												
	traces of silt.		4	SS	12												
			5	SS	39	830											
	Loose to very dense.		6	SS	57												
			7	SS	15												
			8	SS	95	820											
815.3																	
27.0	Silty sand, traces of clay and gravel. (Glacial Till)		9	SS	131												
808.3	Very dense.		10	SS	165/111	810											
3b.0	End of borehole.					800											

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

DESIGN SERVICES BRANCH

RECORD OF BOREHOLE No. 13

FOUNDATION SECTION

JOB 72-11046

LOCATION 99 + 41 11' Rt. §

ORIGINATED BY W.V.U.

W.P. 71-62

BORING DATE May 9, 1972

COMPILED BY P.M.

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 %				
845.0	Ground level.															
0.0	Organic sandy silt mottled grey and black. Very loose.		1	SS	11											
839.5			2	SS	7											
6.5	Fine to medium sand, traces of silt.		3	SS	19											
			4	SS	27											
			5	SS	22											
	Compact to dense.		6	SS	32											
			7	SS	41											
			8	SS	25											
816.0			9	SS	100/5"											
27.0	Sandy silt to sand with some silt, traces of clay and gravel. (Glacial Till) v. dense.															
811.1			10	SS	100/5"											
33.9	End of borehole.															

End of cone elev. 818.2

3 85 (12)

FOUNDATION SECTION

CHECKED BY

[illegible]

FOUNDATION SECTION

CHECKED BY

[illegible]

ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' - 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>'N' BLOWS / FT.</u>	<u>C LB. / SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B.	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T.	SLOTTED TUBE SAMPLE		
	P.H. SAMPLE ADVANCED HYDRAULICALLY		
	P.M. SAMPLE ADVANCED MANUALLY		

SOIL TESTS

Q _u	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Q _{cu}	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Q _d	DRAINED TRIAXIAL	S	SENSITIVITY

ABBREVIATIONS 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
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

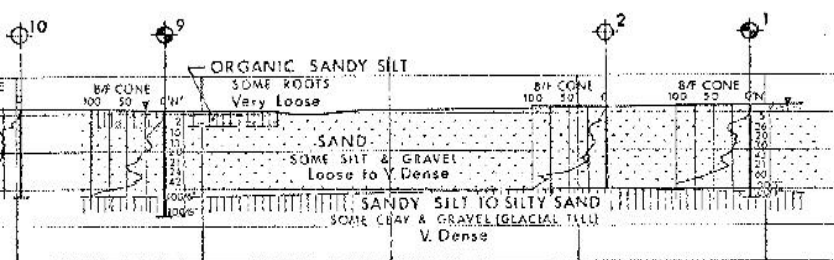
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

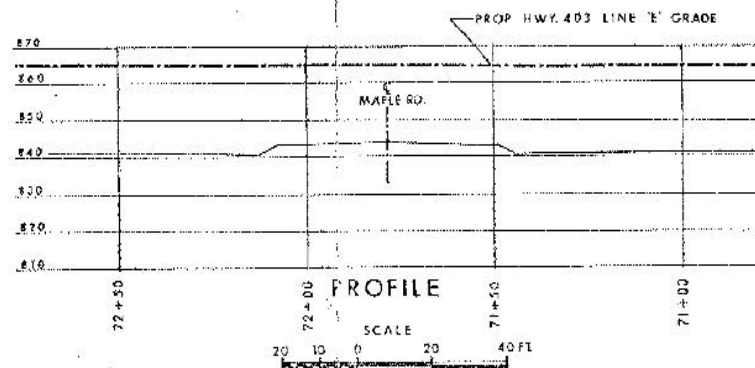
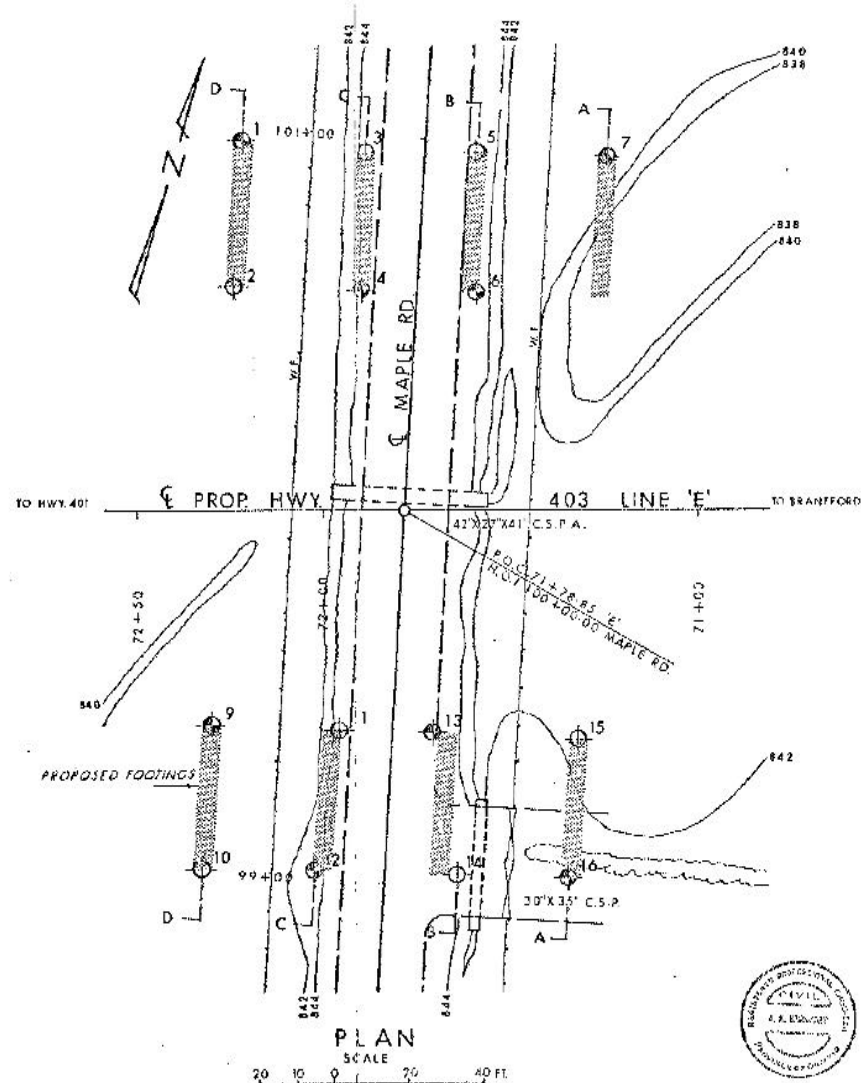
B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION





SLOPES

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



D-D
SECTIONS



LEGEND		
	Bore Hole	
	Ground Penetration Radar	
	Bore Hole & Casing	
	Water Levels of Field Investigation	

NOTE: BORE HOLE 8 NOT

— NOTE —

The boundaries between soil strata here are Bore Hole locations. Between Bore Holes the boundaries are inferred from geological evidence and may be

DATE	BY
------	----

MINISTRY OF TRANSPORTATION
DESIGN SERVICES BRANCH

MAPLE

HIGHWAY NO. 403 PROP. LINE
CO. BRANT
TWP. BURFORD CO. CO.

BORE HOLE LOCATION

SLIP NO A. 2 CHECKED : SWP NO 71-6

DRAWN BY C. J. S. CHECKED BY [Signature]	R.B. NO. 72-1
DATE 11 JULY 1972	SHEET NO.

APPROVED FOR RELEASE CONT. NO.
FBI - NEW YORK

REF. No. E-4884-1



STATE
ENGINEERING DIVISION
ENGINEERING MATERIALS OFFICE

— CIVIL ENGINEERING DIVISION—ENGINEERING MATERIALS OFFICE—SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 1

NET 113

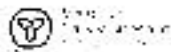
W.P. 71-62 LOCATION Sta. 9+970.0, off 15.9 x RT of Napier Road ORIGINATED BY HCB
DIST 4 DIST 403 BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY FS
DATUM Geodetic DATE 1972 05 16 & 17 CHECKED BY RLS

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE (PCT)					WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
DEPTH (FEET)	DESCRIPTION	NUMBER	TYPE	VALUES			20	40	60	80	100			
238.6	Ground Level													
0.0	Origin					236								
	Fine to medium sand with some silt and gravel.	1	SS	5										
		2	SS	25										
		3	SS	20										
		4	SS	30										
	Loose to very dense.	5	SS	45										
	Grey.	6	SS	21										
		7	SS	60										
248.8						250								
6.7	Sandy silt, some gra.	8	SS	100	107									
248.9	(Glacial Till) v. dense	9	SS	180	105									
7.7	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

3, 4, 5 : Numbers refer to
Sensitivity

20
15
10 : 1% STRAIN AT FAILURE



RECORD OF BOREHOLE No 2

30.7610

W.P. 71-62 LOCATION Sta. 94962.0, o/s 14.9 m ET 8 Maple Road ORIGINATED BY DMU
 DIST 4 HWY 503 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY BR
 DATUM Geodetic DATE 1972 05 16 CHECKED BY RS

SOIL PROFILE		SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE (MPa)		SHEAR STRENGTH		WATER CONTENT (%)		UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. (DEPTH)	DESCRIPTION	STRAT. PLAT.	NUMBER	TYPE		25	40	60	80	100	120		
256.3	Ground Level												
0.0													
209.9													
6.6	End of Cone Test												

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 3

RECORD

W.P. 21-62 LOCAL ON Sta. 91971.0, off S.E. & Eagle Road ORIGINATED BY STT
 DIST. A HWY. 503 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AS
 DATUM Geodetic DATE 1972 BY 15 CHECKED BY STT

SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	EMPAVOR SOLE PENETRATION RESISTANCE (LOD)					WATER CONTENT (%)	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
FILE DEPT.	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE			20	40	60	80	100			
250.4	Ground Level													
250.3														
250.2														
250.1														
7.3	End of Cone Test													

OFFICE REPORT ON SOIL EXPLORATION



Highway Engineering Division
Materials Office - Soil Mechanics Section

HIGHWAY ENGINEERING DIVISION-ENGINEERING MATERIALS OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 4

Sheet 1

W.P. 51-62 LOCATION: Sta. 9+302.0, 0/2 4.6 x RT & Maple Road ORIGINATED BY: JMC
 DIST. 5.0 km. 400 BOREHOLE TYPE: Fulling, Static Auger and Cone Test COMPILED BY: SE
 DATUM: Seaderas DATE: 1972-03-15 CHECKED BY: J.S.

SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	E-LOGS CONE PENETRATION RESISTANCE PLOT		WATER CONTENT (%)	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT. UNIT	NUMBER	TYPE VALUES			25 40 60 80 100	25 40 60 80 100			
257.4	Ground Level										
255.4	Organic sand, some silty. Black and grey.		1	SS - 26		256					
			2	SS - 5							
254.0	Fine to medium sand with some silt and traces of gravel.		3	SS - 7		254					
			4	SS - 17							
	Loose to very dense.		5	SS - 12							
	Grey.		6	SS - 10		252					
			7	SS - 57							
			8	SS - 106		250					
253.0											
6.4	End of Borehole										


4, 5: Numbers refer to Sensitivity
 15-20: STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION



FT2TC

DATE	71-62	LOCATION	Sta. 94970.4, Sta. 4.3 on E & Maple Road	ORIGINATED BY	WTC
DET	4	FWY	405	ROTHHOLE TYPE	Dynamic Cone Penetration Test
DATE	Goodell	DATE	1972 05 12	CHECKED BY	RE

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE F.C.T.	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV. FEET	DESCRIPTION	SPT NO.	NUMBER	TYPE			N _v VALUES			20 40 60 80 100
							SHEAR STRENGTH	WATER CONTENT (%)		
							<input type="checkbox"/> UNCONFINED <input type="checkbox"/> FIELD VANE			
							<input checked="" type="checkbox"/> DILK TESTER <input checked="" type="checkbox"/> LAB VANE			
257.9	Ground Level									
0.0										
249.5										
2.9	End of Data Test						100 / 352			

¹, ⁵: Numbers refer to Sensitivity

10-6-1 [%] STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION



Highway Engineering Division
Engineering Materials Office - Soil Mechanics Section

RECORD OF BOREHOLE No 6

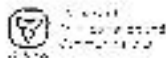
NETRIC

W.F. 71-62 LOCATION Sta. 54981.7, off H 4.0 x 11.7, Kettle Creek
DIST 4 HWY 403 BOREHOLE TYPE Hollow Stem Auger
DATE M. Seaside DATE 1972 03 16
ORIGINATED BY JBI
COMPILED BY BU
CHECKED BY JCS

SOIL PROFILE		SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE (PSF)		UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELV. DEPTH	DESCRIPTION	NUMBER	TYPE			20 40 60 80 100	100		
257.3	Ground level								
0.0	Organic sandy silt some roots. Brown, black and grey.	1	SS	5	256				
255.3		2	SS	5					
2.0	Fine to medium sand. Very loose to dense. Grey.	3	SS	3	254				
		4	SS	12					
		5	SS	24					
		6	SS	22	252				
		7	SS	31					
		8	SS	46	250				
249.0									
8.0	Silty sand traces of clay (Glacial Till) Very dense	9	SS	152	254				1 48 45 1
247.1					248				
10.2	End of Borehole	10	SS	170	122				

+3, x3 Numbers refer to
Secondary
20
15-20 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 7

METRIC

W.P. 71-52 LOCATION Sta. 54273.1, on 14.2 m E & Maple Road ORIGINATED BY JFC
 DIST. A HWY. 403 BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY SS
 DATUM Geodetic DATE 1972 03 17 CHECKED BY JFC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION TEST RESULTS (LOG)				UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
DEPTH	DESCRIPTION	SPHAT NO.	NUMBER	TYPE			20	40	60	100		
226.5	Ground Level											
0.0	Organic sandy silt some roots. Black and grey.		1	SS		256						
236.9			2	SS								
1.7	Fine to medium sand, some silt, loose to very dense. Grey.		3	SS		254						
			4	SS								
			5	SS		252						
			6	SS								
			7	SS		250						
249.5			8	SS	249							
7.0	Sandy silt with clay and gravel. (Glacial till)					248						
247.7	Expd.		9	SS	247							
5.5	End of Borehole											

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 9

MEETED

W.P. 71-62 LOCATION Hwy. 101018.2, a/s 14.6 n 32 E Maple Road ORIGINATED BY J.S.
DIST. 4 HWY. 403 BOREHOLE TYPE Hollow Stem Auger and Open Spot COMPILED BY J.S.
SATUR. Conductive DATE 1972 04 11 CHECKED BY J.S.

SOIL PROFILE		STRAT. PLOT	SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
DEPTH	DESCRIPTION		NUMBER	TYPE			70	40	60	80	100		
256.5	Ground Level												
0.0	Organic sandy silt and roots.												
255.3	Black and grey.		1	SS	5								
1.2	Fine to medium sand to gravelly sand, brown of silt.		2	SS	10								
	Loose to very dense.		3	SS	15								
			4	SS	20								
			5	SS	21								
			6	SS	24								
			7	SS	52								
246.5													
7.0	Silty sand some clay & gravel, Glacial till.		8	SS	100	150							
247.0	Very dense.		9	SS	100	150							
8.7	End of Borehole												

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 10

METRIC

W = 71-62 LOCATION 228, 101030.2, n/e 50-5 n 30 E Maple Road ORIGINATED BY 753
 DIST 4 HWY 403 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY ES
 DATUM Gauderie DATE 1972 05 12 CHECKED BY FS

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W _n	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS \$ GRAIN SIZE DISTRIBUTION [%] OR SK, SI, CL	
ELEV DEPTH	DESCRIPTION	STRAT %DOT	NUMBER	TYPE			VALUES	20	40	60	80						100
												0 UNCONFINED 1 FIELD VALUE					
												4 QUICK TRIAXIAL 8 LAB VALUE					
238.5	Ground Level																
0.0							236										
						250											
						252											
						254											
						256											
243.3	End of Cone Test																
7.3																	

 1 kg/cm^2 - Numbers refer to
Sensitivity

 $15-20$ % STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 11

NETS-20

W.P. 77-66 LOCATION Sta. 10+015.8, a/w 4.5 m RT 2 Maple Road ORIGINATED BY JSC
 DIST 4 Hvy 403 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY JS
 DATUM Geodetic DATE 1977 05 15 CHECKED BY JS

Elev Sta-TH	SOIL PROFILE		SAMPLES		GROUND WATER CONDITIONS	FLEWATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION [%] GR SA SI CL
	DESCRIPTION	STRAI POST	NUMBER	TYPE			20 40 60 80 100	5-SEAR STRENGTH	Wp	NATURAL MOISTURE CONTENT W _n	W _L		
257.3	Ground Level							UNLIMITED GLIDE TRIAXIAL					
						256							
						254							
						252							
249.7	End of Cone Test					250							
7.6								100/275					

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 12

NEETC

W.P. 71-62 LOCATION: Sec. 10H029.9, n/a 5.8 P. 30. P. Maple Road ORIGINATED BY: KWT
 DIST. 4 HWY. 403 BOREHOLE TYPE: Hollow Stem Auger and Cone Test COMPLETED BY: BS
 DAT. N. Goodell DATE: 1972 03 12 CHECKED BY: R.E.

SOIL PROFILE		SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE (PLOT)		WATER CONTENT (%)	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
DEPTH	DESCRIPTION	NUMBER	TYPE			20 40 60 80 100	50 100			
224.7	Ground Level									
224.5	0.5 Trace of Organic	1	SS	4	236					
		2	SS	5						
		3	SS	11	234					
		4	SS	12						
		5	SS	15						
		6	SS	57	232					
		7	SS	13						
		8	SS	14	230					
240.5										
240.5	8.2 Silty sand, traces of clay and gravel. (Clasical fill)	9	SS	100	248					
248.5	Very dense.	10	SS	105	242					
248.5	End of Borehole									

OFFICE REPORT ON SOIL EXAMINATION

3, x 5 : Numbers refer to Sensitivity

20
15
10
% STRAIN AT FAILURE



RECORD OF BOREHOLE No 13

10/11/62

W.P. 71-62 LOCATION Blm. 104015-3, n/r 3-A n LT 6 Maple Road ORIGINATED BY RVH
 DIST. 4 HWY. 403 BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY RS
 DATUM Seaside DATE 1972, 05, 09 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
DEPTH (ft)	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH								
								WATER CONTENT (%)								
								QUICK TRIAXIAL								
0.0	Ground Level									10	20	30		GR SA S CL		
0.6	Organic sandy silt, reddish gray and black. Very loose.		1	SS	4											
0.8			2	SS	5											
1.0	Fine to medium sand, traces of silt.		3	SS	12											
			4	SS	17											
	Coarser to coarse.		5	SS	20											
			6	SS	23											
			7	SS	31											
			8	SS	25											
2.0			9	SS	100	127 cm										
2.2	Sandy silt to sand with some silt, traces of clay and gravel. (Glacial Till)															
2.4	Very dense.		10	SS	100	127 cm									1 65 (12)	
10.3	End of Borehole															

+2, x5 Numbers refer to Sensitivity

20
15
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
-60
-65
-70
-75
-80
-85
-90
-95
-100
[%] STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXHIBITION



Highway Engineering Division
Engineering Materials Office - Soil Mechanics Section

Highway Engineering Division - Engineering Materials Office - Soil Mechanics Section

RECORD OF BOREHOLE No 14

METRIC

W.P. 11-62 LOCATION Sta. 10+00.3, 4/4 x 1.5 x 1.7 # Maple Road ORIGINATED BY WJC
DST 4 4/4 403 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY JS
DATUM Road Surface DATE 1992 05 12 CHECKED BY JWC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE (kgf)					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
FIELD DEPTH	DESCRIPTION	STRAT. FLOT	NUMBER	TYPE			IN VALUES	SHEAR STRENGTH									WATER CONTENT (%)	
								O UNCONSOLIDATED * FIELD VALUE * QUICK TACKLE * LAB VALUE										
257.4	Ground Level															OR SA S CL		
0.0																		
249.6																		
7.6	End of Cone Test																	

*3, *5: Numbers refer to Sensitivity 20
15 10 (% STRAIN AT FAILURE)

OFFICE REPORT ON SOIL EXPLORATION



W.P.	73-62	LOCAL ON Sta. 101618.0, o/s LA. 2 on LI. 2 Maple Road	ORIGINATED BY	W.C.
DEPT	4 HWY	403	BOREHOLE TYPE	Drilling Core Parameters Test
DATE	1972 05 11		COMPILED BY	JS
Geol.	Geology		CHECKED BY	W.C.

[illegible]

+3, +5; Numbers refer to Sensitivity

75 \pm 5 [%] STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 16

METRIC

W.P. 71-52 LOCATION Sta. 10+029.2, s/a 14-5 on E 7 N 1/2 Sec 16
DIST 4 P.W. 400 BOREHOLE TYPE Suction Stem Auger and Cone Test COMPLETED BY SS
DATUM Gneissic DATE 1972.05.04 CHECKED BY KS

SOIL PROFILE			SAMPLES			GRINDING WATER CONVENTIONS	ELEVATION SCALE	HYDRAULIC CONDUCTIVITY			UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
DEPTH	DESCRIPTION	STRAT. PLOT	NUMBERS	TYPE	% VALUES			75	40	60		
236.7	Ground level											
236.7	Trace of Organics		1	SS	13		236					
			2	SS	14		234					
	Fine to medium sand traces of silt and gravel.		3	SS	15							
			4	SS	16							
			5	SS	17							
	Sand of silty sand		6	SS	18							
			7	SS	19							
	Looks to very dense		8	SS	20							
	Gray		9	SS	100	101	242					
240.6	Sandy silt some clay and gravel (Glacial Till) Very dense		10	SS	100	152	246					
245.6	End of Borehole											

OFFICE REPORT ON SOIL EXPLORATION

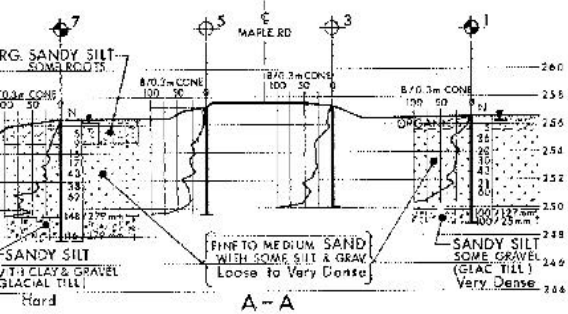
METRIC

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

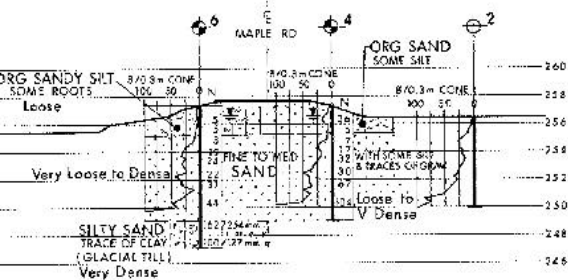
CONT No 51-43
WP No 71-62-01

MAPLE ROAD UNDERPASS
(6.1km West of Hwy 244)
BORE HOLE LOCATIONS & SOIL STRATA

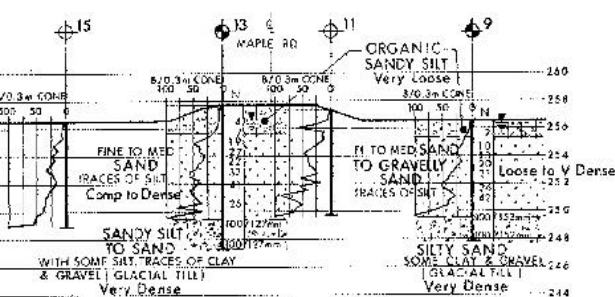
SHEET
135



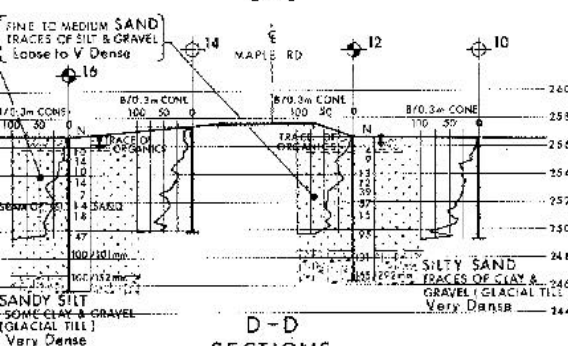
A-A



B-B

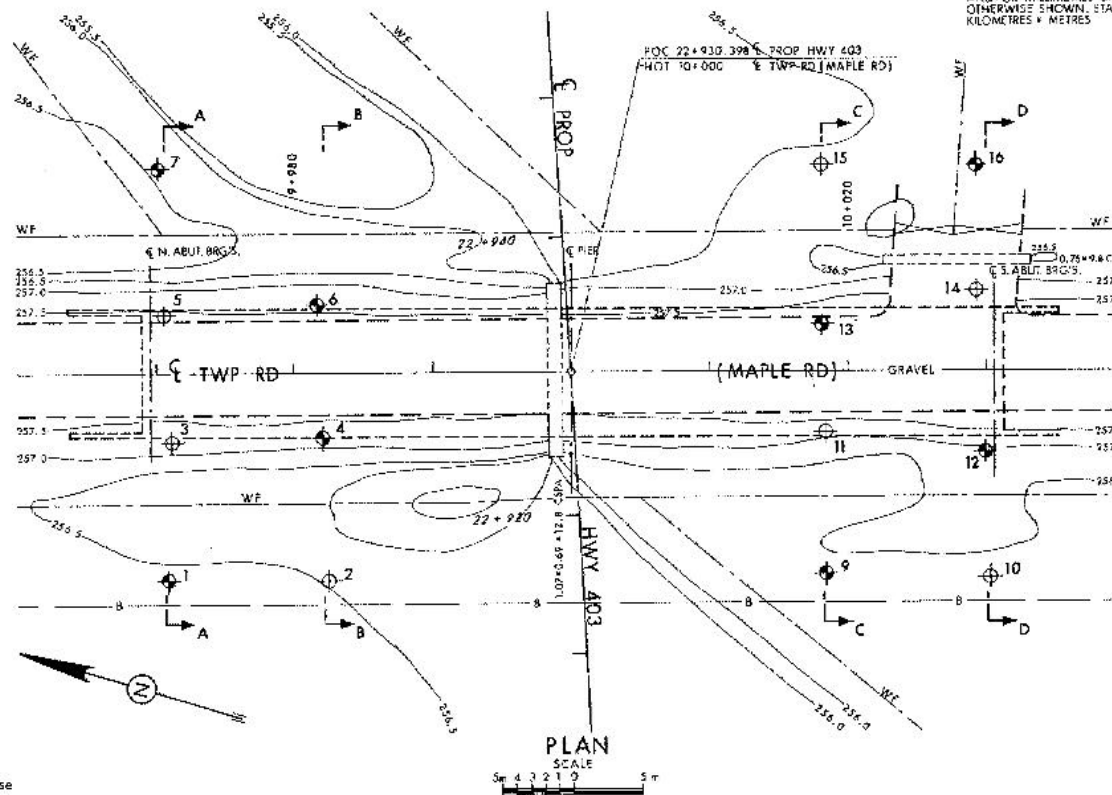


C-C



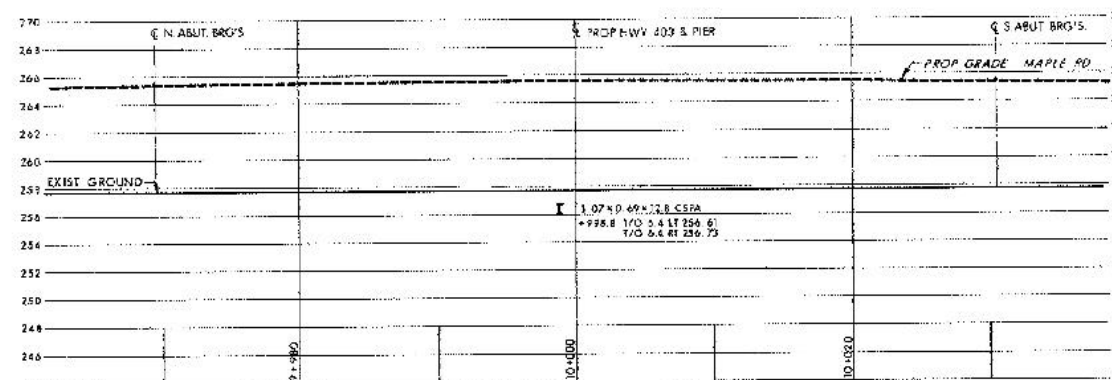
D-D
SECTIONS

SCALE
5m 4 3 2 1 0 5m



PLAN

SCALE
5m 4 3 2 1 0 5m



PROFILE-MARLE RD

SCALE
5m 4 3 2 1 0 5m



LEGEND

- ◆ Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ◆ Bore Hole & Cone
- N 8-m/0.3m (Std Pen Test, 475 J/blow)
- CONE 6-m/0.3m (60° Cone, 475 J/blow)
- ≡ WL at time of investigation 1972 C5

No	ELEVATION	STATION	OFFSET E MARLE RD
1	256.5	9+920.7	14.9m RT
2	256.5	9+982.3	14.9m RT
3	257.4	9+971.0	4.9m RT
4	257.4	9+982.0	4.6m RT
5	257.3	9+970.4	4.3m LT
6	257.3	9+981.7	4.9m LT
7	256.5	9+970.1	14.9m LT
8	256.5	10+018.3	14.6m RT
9	256.5	10+020.2	14.9m RT
10	257.3	10+018.3	4.3m RT
11	256.7	10+029.9	5.8m RT
12	257.6	10+018.0	3.4m LT
13	257.4	10+029.3	5.3m LT
14	256.5	10+018.0	14.9m LT
15	256.7	10+029.3	14.9m LT

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

Geocres No 40P1-59

HWY No 403	CHECKED	DATE 1979 12 13	DIST 4
SURV NO 5	CHECKED	DATE 1979 12 13	SITE 1-151
DRAWN R.S.	CHECKED	DATE 1979 12 13	DWG 2

DIST. No 4 HWY. 403
CONT No B1-43
WP No 71-62-01



MAPLE ROAD UNDERPASS
6.1 Km West of Highway 24A
GENERAL ARRANGEMENT

SHEET
134

METRIC

DIMENSIONS ARE IN MILLIMETRES
UNLESS OTHERWISE SHOWN.
ELEVATIONS, COORDINATES, CURVE
AND ALIGNMENT DATA ARE IN METRES.
STATIONS ARE IN KILOMETRES + METRES.

NOTES

CLASS OF CONCRETE

DECK & PIER COLUMN - 35 MPd
BARRIER WALLS - 30 MPd
REMAINDER - 20 MPd
OR AS NOTED ON THE DRAWINGS.

REINFORCING STEEL

GRADE 400
REINFORCING BAR MARKS WITH
SUFFIX 'C' TO BE COATED BARS.

CLEAR COVER TO REINF. STEEL

FOOTINGS, ABUTMENTS
AND PIER COLUMN - 75 mm
DECK TOP - 50 mm
DECK BOTTOM - 40 mm
OR AS NOTED ON THE DRAWINGS.

CONSTRUCTION NOTES

THE CONTRACTOR IS RESPONSIBLE
FOR FINISHING THE BEARING
SEATS DEAD LEVEL TO THE
SPECIFIED ELEVATIONS WITH A
TOLERANCE OF ± 3 mm.
NO CONCRETE SHALL BE PLACED
ABOVE THE ABUTMENT BEARING
SEATS UNTIL THE CONCRETE IN
THE DECK HAS BEEN PLACED,
STRESSED AND GROUTED.

TO ACHIEVE THE MINIMUM CLEAR
COVER OF 50 mm SPECIFIED AT
TOP OF DECK, THE TOP LAYER OF
REINFORCEMENT SHALL BE
PLACED PRIOR TO CONCRETING,
WITH A CLEAR COVER OF 65 ± 15 mm
TOLERANCE.

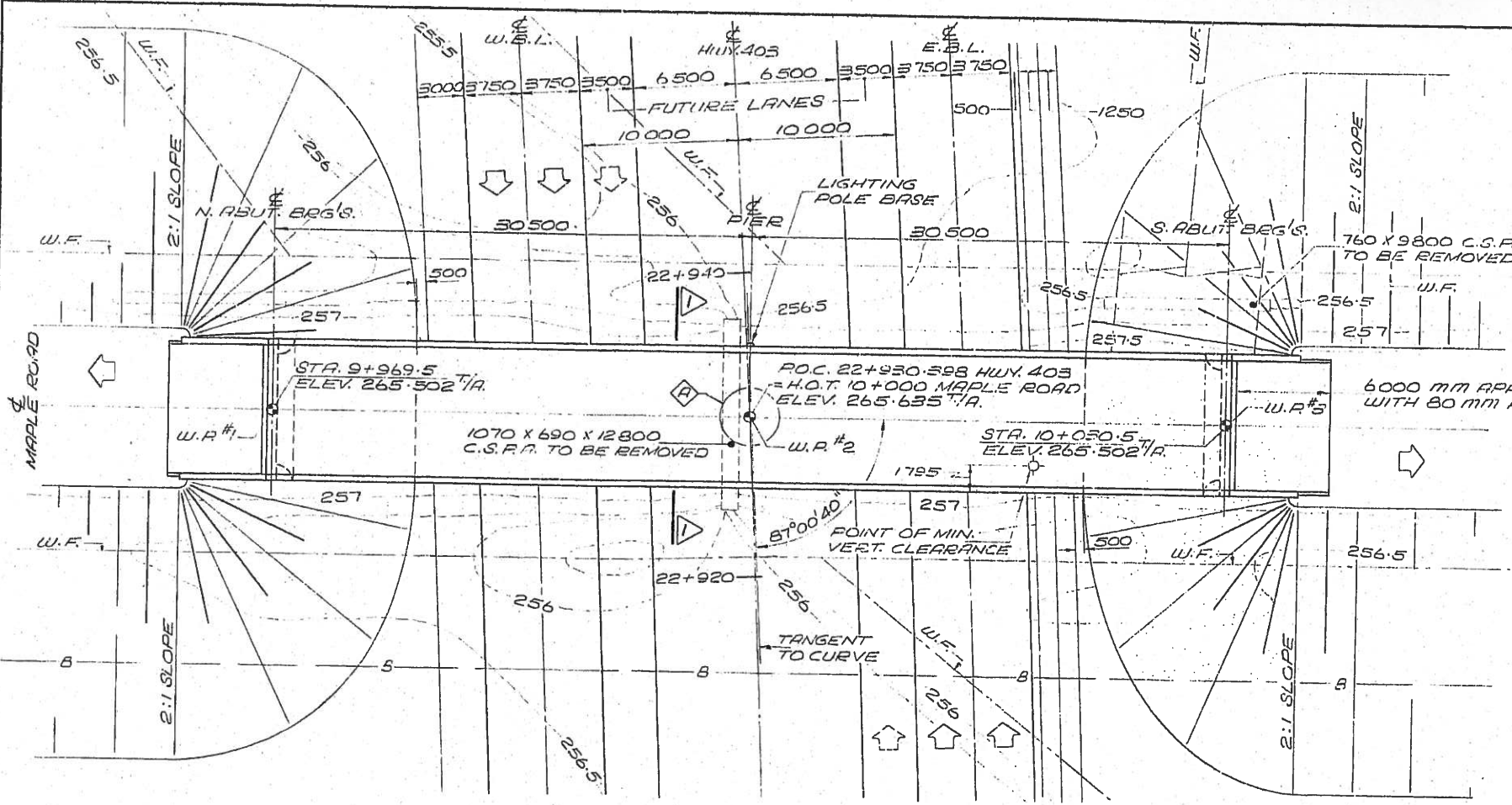
LIST OF DRAWINGS

- 1 GENERAL PLAN
- 2 BOREHOLE LOCATION & SOIL STRATA
- 3 FOOTINGS
- 4 NORTH ABUTMENT
- 5 SOUTH ABUTMENT
- 6 PIER DETAILS
- 7 DECK DETAILS & ABUT. BEARINGS
- 8 LONGITUDINAL CABLE DETAILS
- 9 TRANSVERSE CABLE DETAILS
- 10 DECK REINFORCING I
- 11 DECK REINFORCING II
- 12 BARRIER WALL
- 13 6000 APPROACH SLAB
- 14 DETAILS OF CONC. SLOPE PAVING
- 15 AS CONSTRUCTED ELEV. & DIM.
- 16 STANDARD DETAILS I
- 17 STANDARD DETAILS II
- 18 STANDARD DETAILS III
- 19 BRIDGE ELECTRICAL DETAILS TYPE IV
- 20 BRIDGE DATE & SITE NUMBER DATA
- 21 PILE DRIVING-STEAM & DIESEL HAMMERS

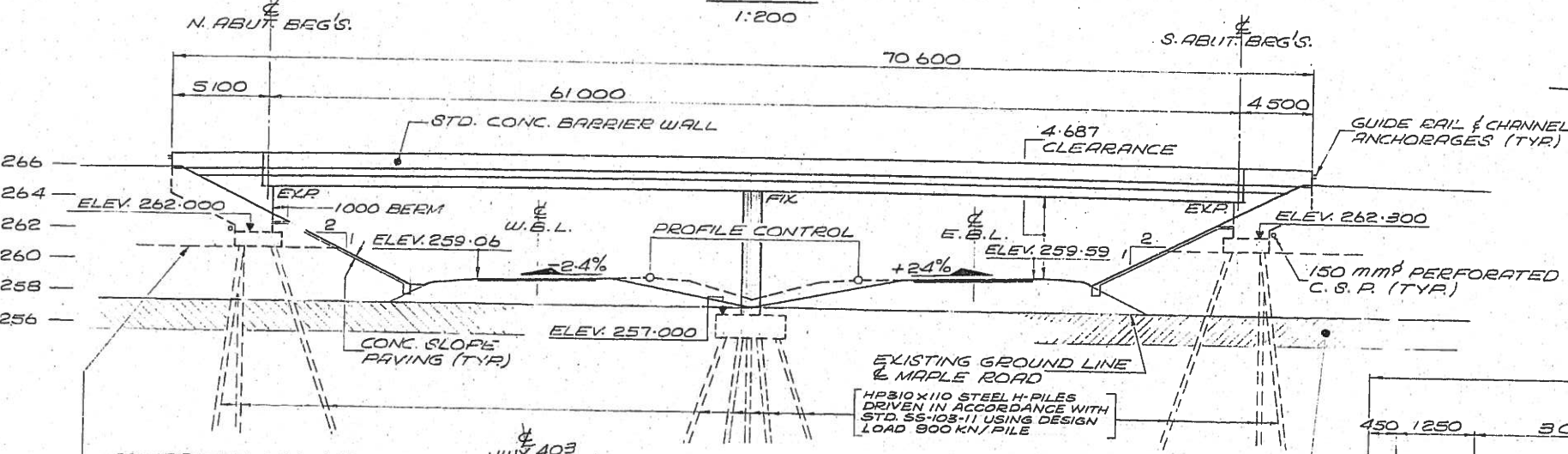
CONCRETE QUANTITIES

CONCRETE QUANTITIES ARE LISTED
BELOW FOR THE APPROPRIATE
LUMP SUM TENDER ITEMS:

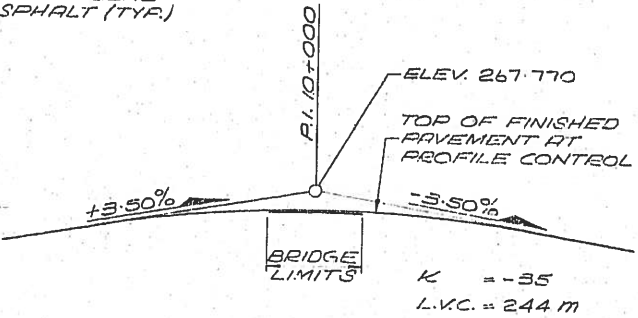
CONCRETE IN ABUTMENTS AND WINGWALLS	20 MPd	70 m ³
PIER COLUMN	35 MPd	8 m ³
PRESTRESSED CONCRETE IN BRIDGE DECK		477 m ³
CONC. IN BARRIER WALLS		35 m ³
CONC. IN APPROACH SLABS		26 m ³
CONC. IN SLOPE PAVING		27 m ³



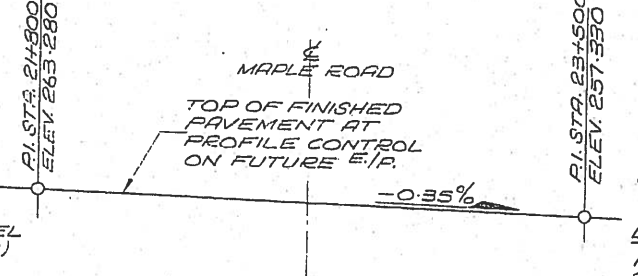
PLAN
1:200



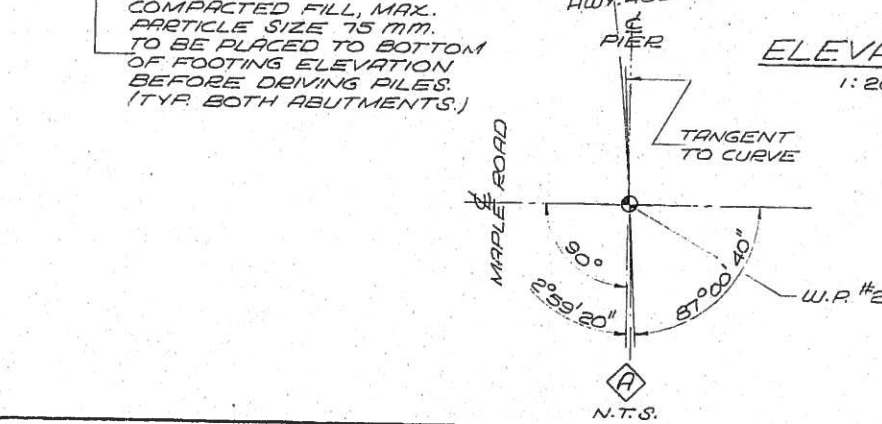
ELEVATION
1:200



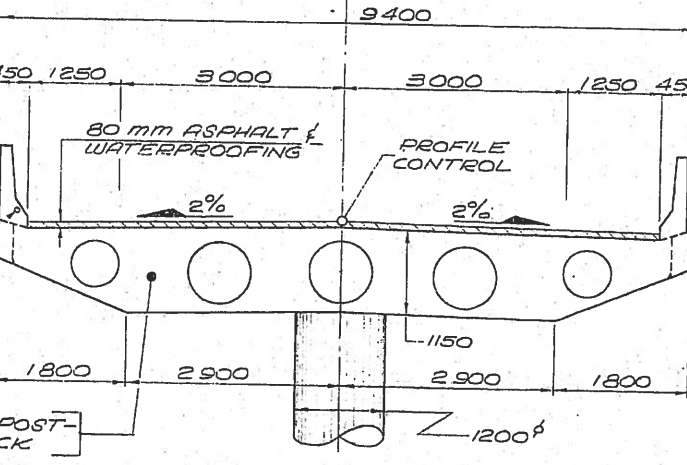
PROFILE OF MAPLE ROAD
N.T.S.



PROFILE OF HWY. 403
N.T.S.



AN EXISTING LAYER OF ORGANIC
SILT UP TO APPROXIMATELY 2
METRES IN THICKNESS SHALL
BE REMOVED AND REPLACED
WITH GRANULAR FILL. FOR
DETAILS SEE GRADING DRAWINGS
(TYR. BOTH ABUTMENTS.)



1:50

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING



DATE	BY	DESCRIPTION
DESIGN	A. K.	CHECK PKR
DRAWING	E.D.W.	CHECK PKR
DATE	1-1-81	DATE
DWG	1	

DIST. No 4 HWY. 403
 CONT No 31-43
 WP No 71-62-01



MAPLE ROAD UNDERPASS
 FOOTINGS

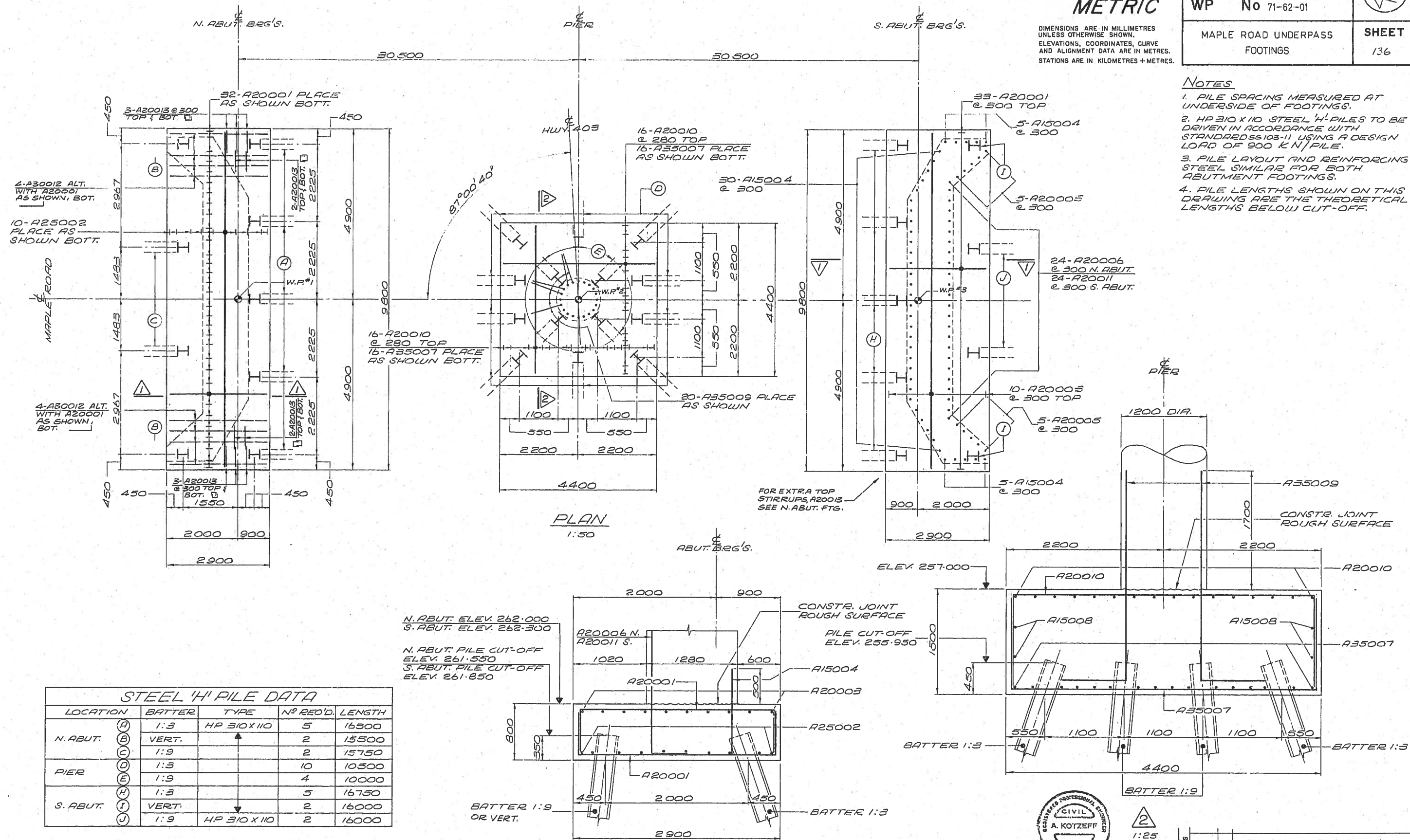
SHEET
 136

METRIC

DIMENSIONS ARE IN MILLIMETRES
 UNLESS OTHERWISE SHOWN.
 ELEVATIONS, COORDINATES, CURVE
 AND ALIGNMENT DATA ARE IN METRES.
 STATIONS ARE IN KILOMETRES + METRES.

NOTES

1. PILE SPACING MEASURED AT UNDERSIDE OF FOOTINGS.
2. HP 310 X 110 STEEL 'H'-PILES TO BE DRIVEN IN ACCORDANCE WITH STANDARD S8103-11 USING A DESIGN LOAD OF 900 K N/PILE.
3. PILE LAYOUT AND REINFORCING STEEL SIMILAR FOR BOTH ABUTMENT FOOTINGS.
4. PILE LENGTHS SHOWN ON THIS DRAWING ARE THE THEORETICAL LENGTHS BELOW CUT-OFF.



DRAWING NOT TO BE SCALED
 100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION
1			
2			
3			
4			
5			
6			
7			
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APPENDIX B

Site Photographs



Photograph 1: Looking at the south abutment of the Maple Road Underpass Structure. Vertical cracks were observed on the abutment wall. Weep holes were not observed in the abutment wall. Sealant between the concrete panels appeared degraded at locations where grasses and shrubs are growing. The toe of the front slope was covered partially with gravel (August 28, 2015).



Photograph 2: Looking at the north abutment of the Maple Road Underpass Structure. Random cracks were observed on the abutment wall. Weep holes were not observed in the abutment wall. Sealant between the concrete panels appeared degraded at locations where grasses and shrubs are growing. Few of the concrete panels appeared to have been rehabilitated. The toe of the front slope was vegetated with localized erosion of soil at ground surface (August 28, 2015).



Photograph 3: Looking north at the pier of Maple Road Underpass Structure. Surficial cracks were observed on the pier (August 28, 2015).



Photograph 4: Looking at the east wingwall and the adjacent slope of the south abutment of the Maple Road Underpass Structure. Surficial cracks were observed on the wingwall. The slope is vegetated and effect of erosion on the slope face was not observed (August 28, 2015).



Photograph 5: Looking at the west wingwall and the adjacent slope of the south abutment of the Maple Road Underpass Structure. Surficial cracks were observed on the wingwall. The slope is vegetated and effect of erosion on the slope face was not observed (August 28, 2015).



Photograph 6: Looking at the west wingwall and the adjacent slope of the north abutment of the Maple Road Underpass Structure. Surficial cracks were observed on the wingwall. The slope is vegetated and effect of erosion on the slope face was not observed (August 28, 2015).



Photograph 7: Looking at the east wingwall and the adjacent slope of the north abutment of the Maple Road Underpass Structure. Minor cracks were observed on the wingwall. The slope is vegetated and effect of erosion on the slope face was not observed (August 28, 2015).