



**FOUNDATION TECHNICAL MEMORANDUM**

**for**

**WEST QUARTER TOWNLINE ROAD UNDERPASS**

**HIGHWAY 403**

**MTO WEST REGION 59 STRUCTURE REHABILITATIONS**

**SITE 1-149, CONTRACT 8**

**GWP 3094-12-00**

**GEOGRAPHIC TOWNSHIP OF BURFORD**

**BRANT COUNTY, ONTARIO**

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- Reference 2. General Arrangement Drawing, Twp. Rd. Rev. U'Pass, 6.3 km East of Hwy. 53, Sheet 133, DWG 1, Site No. 1-149, Dist. No. 4, Cont. No. 83-10, WP No. 73-62-01, dated August, 1981.





Reference 3. Footing Layout & Reinforcing Drawing, Twp. Rd. U'Pass, DWG 3, Sheet 135, Site No. 1-149, Dist. No. 4, Cont. No. 83-10, WP No. 73-62-01, dated August, 1981.

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**FOUNDATION TECHNICAL MEMORANDUM**

**For**

West Quarter Townline Road Underpass Highway 403  
MTO West Region 59 Structure Rehabilitations  
Site 1-149, Contract 8, GWP 3094-12-00  
Township of Burford  
Brant County, Ontario

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**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 GEOCRE Library for the West Quarter Townline 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 West Quarter Townline Road Underpass Highway 403 is located about 13.5 km northwest 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.

Physiographically, the site of the underpass structure is located in the region referred to as Mount Elgin Ridges, consisting of a succession of ridges and vales. The ridges are moraines of pale brown calcareous clay or silty clay, while in the vales, it is common to find alluvium of gravel, sand or silt. The bedrock underlying the area consists of alternating layers of gray Shale and Dolostone of Salina Formation of Upper Silurian Epoch. The bedrock surface at the site location is between elevation 221.0 and 229.0 (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.

- Reference 1. Foundation Investigation Report for Burford Twp. Road Underpass of Proposed Hwy. #403, 13.3 Mi. West of Brantford West Limits, District #4, W.O. 72-11045, W.P. 73-62-01, Cont. No. 83-10, Site No. 1-149, Department of Transportation and Communications, dated July 4, 1972, GEOCREs No. 40P2-29.
- Reference 2. General Arrangement Drawing, Twp. Rd. Rev. U'Pass, 6.3 km East of Hwy. 53, Sheet 133, DWG 1, Site No. 1-149, Dist. No. 4, Cont. No. 83-10, WP No. 73-62-01, dated August, 1981.





Reference 3. Footing Layout & Reinforcing Drawing, Twp. Rd. U'Pass, DWG 3, Sheet 135, Site No. 1-149, Dist. No. 4, Cont. No. 83-10, WP No. 73-62-01, dated August, 1981.

#### **4. SITE RECONNAISSANCE**

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

The site photographs present the conditions of the West Quarter Townline Road Underpass including visible portions of the abutments and pier, and abutment slope assessment based on visible areas, apparent areas if any 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. Few shrubs and grasses were observed growing (south abutment) 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 with no effect of erosion (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**

The general subsurface conditions presented in this section are based on the foundation investigation report referred in Reference 1. The borehole locations and soil strata are shown in the attached DWG 736201-A (Reference 1).

The field investigation was carried out during the period of April 5 to 24, 1972 for the project that included a total of seven sampled boreholes (numbered 1 to 7) accompanied by six dynamic cone





penetration tests (DCPTs) adjacent to boreholes 2 to 7. The sampled boreholes were advanced to 8.8 to 30.2 m (29.0 to 99.0 ft.), elevation 248.3 to 269.6 (814.7 to 884.4 ft.). The DCPTs adjacent to the six boreholes were advanced to approximate termination depths of 3.1 to 4.4 m (10.3 to 14.4 ft), elevation 273.1 to 275.5 (896.0 to 904.0 ft.).

The boreholes were investigated by utilizing a CME 55 drill rig equipped with continuous hollow stem flight augers. The samples were retrieved in accordance with the Standard Penetration Tests. The penetration resistances, N values, were measured by the number of blows for 0.3 m (1 ft.) penetration. The N values and the results of the laboratory testing results were presented in the accompanying Record of Borehole logs. No undisturbed soil samples were obtained based on the stiff to hard cohesive layers encountered in the boreholes.

## **5.1 General**

Generally, alternating layers of stiff to hard cohesive soils and compact to very dense granular deposits were encountered in the sampled boreholes. The upper cohesive soils encountered were identified to be clayey silt and the lower cohesive soils encountered were identified as silty clay. The granular deposits were variable and stratified consisting of sandy silts, silty sands, gravelly sands and sandy gravels.

### **5.1.1 Sand/Silty Sand/Sandy Silt**

Surficial 1.2 to 1.5 m (4.0 to 5.0 ft.) thick compact sand/silty sand/sandy silt was encountered in boreholes 1 to 4, which extended to elevation 276.3 to 277.2 (906.4 to 909.4 ft.). N values recorded ranged from 12 to 18.

Grain size analyses were carried out on selected samples. One selected sample included 12% clay, 50 % silt, 29% sand and 9% gravel sized particles and the second selected sample included 19% clay and silt, and 81% sand sized particles. Moisture content determinations of the granular deposits ranged from 16 to 22%.





### 5.1.2 Clayey Silt

A 6.4 to 8.7 m (21.0 to 28.5 ft.) thick stiff to hard clayey silt layer was encountered in all seven boreholes. The cohesive layer was encountered surficially in boreholes 5, 6 and 7, which extended to elevation 268.5 to 271.7 (880.9 to 891.3 ft.). In boreholes 1 to 4, the cohesive layer was encountered below the uppermost granular deposits at 1.2 to 1.5 m (4.0 to 5.0 ft.), elevation 276.3 to 277.2 (906.4 to 909.4 ft.), which extended to 7.8 to 8.5 m (25.5 to 28.0 ft.), elevation 269.3 to 270.6 (883.4 to 887.9 ft.). Within the upper 1.5 to 3.0 m (5.0 to 10.0 ft.), N values recorded ranged between 8 and 17, below which depth N values recorded were up to 85.

Grain size analyses were carried out on selected samples. The samples included 30 to 43% clay, 52 to 65% silt, 2 to 5% sand and 0 to 5% gravel sized particles. The Atterberg liquid limits ranged from 19 to 32 and the plastic limits were between 12 and 19. The plasticity index values ranged from 7 to 15. A sample from borehole 7 exhibited Atterberg liquid limit of 37 and a plastic limit of 21. Moisture content determinations obtained were approximately 10 to 21%.

### 5.1.3 Silty Clay

Stiff to hard 3.0 to 3.4 m (10.0 to 11.0 ft.) thick silty clay deposit was encountered in the deeper boreholes 1, 3 and 7 at 11.4 to 11.6 m (37.5 to 38.0 ft.), elevation 266.4 to 267.1 (873.9 to 876.3 ft.), intercepting the granular layer. The deposits extended to 14.6 to 14.9 m (48.0 to 49.0 ft.), elevation 263.2 to 264.0 (863.4 to 866.3 ft.). N values recorded ranged between 14 and 70.

Grain size analyses were carried out on selected silty clay representative samples. The samples included 30 and 66% clay, 33 and 69% silt and 1% sand sized particles. The Atterberg liquid limits ranged from 36 to 39 and the plastic limits were 18. The plasticity index values ranged from 18 to 21. Moisture content determinations obtained were around 28%.





#### 5.1.4 Granular Deposits (Layers of silt, sand and gravel)

A 1.1 to 4.6 m thick granular soil layer, with variable amounts of sand, silt and gravel, was encountered below the clayey silt layer in all boreholes at 6.7 to 8.7 m (22.0 to 28.5 ft.), elevation 268.5 to 271.7 (880.9 to 891.3 ft.), which extended to 8.8 to 11.6 m (29.0 to 38.0 ft.), elevation 266.4 to 269.6 (873.9 to 884.4 ft.). Boreholes 2, 4, 5 and 6 were terminated in this layer at 8.8 to 10.4 m (29.0 to 34.0 ft.), elevation 266.8 to 269.6 (875.4 to 884.4). N values ranged from 30 to more than 100, indicating dense to very dense compactness conditions.

Grain size analyses were carried out on selected upper granular soil samples. The silty sand to sandy silt samples included 6 to 21% clay, 34 to 71% silt, 11 to 60% sand and 0 to 8% gravel sized particles. The sand to gravelly sand samples included 3 to 20% clay and silt, 61 to 81% sand and 8 to 24% gravel sized particles.

As discussed above, a silty clay deposit in boreholes 1, 3 and 7, intercepted the granular layer at 11.4 to 11.6 m (37.5 to 38.0 ft.), elevation 266.4 to 267.1 (873.9 to 876.3 ft.) in boreholes 1, 3 and 7. Below the silty clay, sandy silt to silty sand with irregular layers of clayey silt were encountered in boreholes 1, 3 and 7, which extended to the termination depths 24.1 to 30.2 m (79.0 to 99.0 ft.), elevation 248.3 to 253.7 (814.7 to 832.4 ft.). N values recorded varied from 1 to more than 100. The low N values reportedly were considered unreliable because quick conditions developed in several locations at the bottom of the holes in view of the unbalance hydrostatic head. It was inferred that the compactness condition of the granular layers ranged from dense to very dense.

Grain size analyses were carried out on selected lower granular soil samples. The samples included 2 to 24% clay, 17 to 85% silt, 5 to 75% sand and 0 to 11% gravel sized particles.

Moisture content determinations of the granular deposit samples ranged from 9 to 22%.





#### 5.1.5 Groundwater

Groundwater level was established in each borehole within the uppermost sandy/clayey silt deposit. The groundwater levels were encountered at 0.0 (borehole 5) to 0.6 m (0.0 to 2.0 ft.), elevation 277.2 to 278.2 (909.4 to 911.7 ft.), which were inferred to be at or near the yearly high water table.

### 6. FOUNDATION

#### 6.1 Previous Foundation Recommendations

Two alternative schemes were provided in the report (Reference 1) for the structure. The first alternative was a five span underpass structure and the second alternative was a two span underpass structure. The overall length of the structure indicated in the report (Reference 1) was approximately 83.2 m (273.0 ft.). The top of pavement of Highway 403 at the crossing was designed to be at elevation 278.9 (915.0 ft.) and the proposed grade of the West Quarter Townline Road at elevation 285.6 (937 ft.) with approach fills of approximately 6.1 m (20.0 ft.) high.

Based on the investigation, the subsoils were found to consist of deposits of stiff to hard clayey silt and silty clay overlying compact to very dense stratified sandy silt, silty sand and gravelly sand.

##### 6.1.1 Foundations

The foundation investigation report (Reference 1) considered the very stiff to hard clayey silt encountered below 1.2 to 2.4 m (5.0 to 8.0 ft.) to be competent load bearing layer. Based on the subsoil conditions encountered the report recommended that spread foundations for the proposed structure for both the five span and two span structure schemes to be economically feasible provided that the footing was established at or below elevation 275.8 (905.0 ft.) with a safe design load of up to 287 kPa (3 tsf) for the footing bases. The report recommended 1.2 m (4.0 ft.) cover for the footings for frost protection.





Alternatively, the report (Reference 1) suggested that perched abutments or the entire structure be supported on piles and recommended that 323.85 mm (12.75 in.) outer diameter (O.D) steel tube piles be selected if this option was chosen by the designer. The piles were to be driven according to Standard BD-82-7, using design loads of 533.8 kN (60.0 ton) per pile. It was indicated that the recommended loads may be achievable by driving the tube piles to approximate elevation 268.2 to 269.7 (880.0 to 885.0 ft.). It was recommended that the embankments at the abutment locations should be devoid of bouldery fill material, if the pile option was selected.

#### 6.1.2 Dewatering and Approach Fill Stability

The foundation investigation report (Reference 1) indicated that the uppermost 1.2 to 1.5 m (4.0 to 5.0 ft.) deep sandy silts were susceptible to conditions of unbalanced hydrostatic head due to lack of cohesive strength. However, based on the recommended footing levels of elevation 275.9 (905.0 ft.) or below, it was anticipated that the base of the excavations will be within the underlying cohesive clayey silts and that no quick conditions were anticipated to occur at the bottom of excavations. Some seepage along the sides of the excavations was anticipated. The report recommended that open pumping from shallow sumps, dug at the perimeter of the oversize excavations would achieve controlling the water.

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

#### 6.2 Drawings

Based on the General Arrangement Drawing (Reference 2), the proposed structure was to carry the West Quarter Townline Road over Highway 403. The grades at the approaches were raised about 4.0 to 7.5 m from the then existing ground level. A round voided post-tensioned concrete slab structure was to be constructed. Minimum 300 and 600 mm thick topsoil and soft ground were removed from the north and south abutment areas, respectively. The side and rear slopes of the embankments were inclined at 2H:1V. The front slopes of the embankments were protected with concrete paving. A 150 mm diameter perforated pipe was to be placed behind each abutment wall.





Based on the Footing Layout and Reinforcing Drawing (Reference 3), the top of the 800 mm thick footing was at elevation 280.400 at the north and south abutments and the top of the 1400 mm thick 7240 x 7240 mm footing for the centre pier was at elevation 277.300. It was inferred from the drawing that the bottom of the footings at the north and south abutments were placed at elevation 279.6 and the pier footing was placed at elevation 275.9. A 150 mm thick mass concrete was placed within 12 hours of footing excavation at the centre pier location from elevation 275.75 to 275.9.

### 6.3 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 report and the updated geotechnical reaction at SLS and geotechnical resistance at factored ULS are provided.

FOUNDATION DESIGN PARAMETERS

FOUNDATION AND TYPE	ELEVATION OF FOOTINGS (m) <sup>1</sup>	PREVIOUS WORKING STRESS VALUES <sup>2</sup> (kPa)	PREVIOUS EQUIVALENT LIMIT STATE DESIGN VALUES (kPa)		LIMIT STATE DESIGN VALUES UPDATED TO CURRENT INDUSTRY PRACTICE <sup>3</sup> (kPa)	
		SAFE BEARING LOAD (kPa)	SLS BEARING REACTION/LOAD	FACTORED ULS GEOTECHNICAL REACTION/LOAD	SLS BEARING REACTION/LOAD	FACTORED ULS GEOTECHNICAL REACTION/LOAD
North abutment (Spread Footing)	279.6	325 <sup>5</sup>	325	487	325	487
Centre Pier (Spread Footing)	275.9	287	287	430	287	430
South abutment (Spread Footing)	279.6	325 <sup>5</sup>	325	487	325	487

- Notes:**
1. Elevation of Footings was based on References 2 and 3.
  2. Working stress design value. The Serviceability Limit State design values are based on the working stress. No field verification data was available for review.
  3. Resistance Factor = 0.5 for Shallow foundations (CFEM 4<sup>th</sup> edition)  
Assumed a Factor of Safety is 3 (CFEM 4<sup>th</sup> edition).
  4. The North and South abutments were placed on engineered fill (compacted granular pad class 'A') based on General Arrangement Drawing (Reference 2).
  5. Based on general recommendations for footings placed on granular fill compacted to M.T.C. Specifications.





The Peak Ground Acceleration (PGA) for the site is 0.078 (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 spread footing founding elevations, layout and reinforcement 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.





## 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

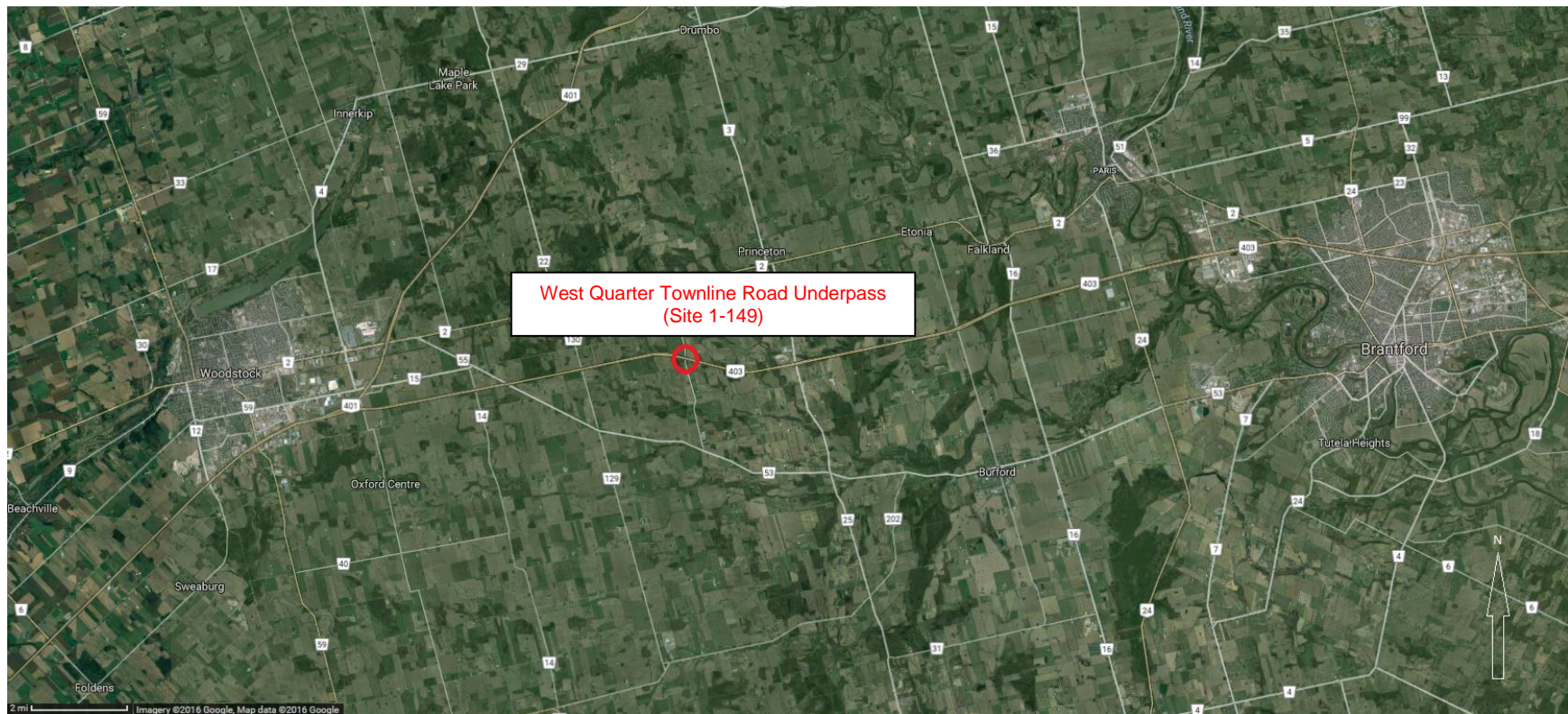
LIST OF STANDARD SPECIFICATIONS REFERENCED IN REPORT

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





**Figure 1 – Key Plan**







## **APPENDIX A**

### Appendix A – Previous Foundation Investigation Reports (GEOCRE 40P2-29)

- Reference 1. Foundation Investigation Report for Burford Twp. Road Underpass of Proposed Hwy. #403, 13.3 Mi. West of Brantford West Limits, District #4, W.O. 72-11045, W.P. 73-62-01, Cont. No. 83-10, Site No. 1-149, dated July 4, 1972.
- Reference 2. General Arrangement Drawing, Twp. Rd. Rev. U'Pass, 6.3 km East of Hwy. 53, Sheet 133, DWG 1, Site No. 1-149, Dist. No. 4, Cont. No. 83-10, WP No. 73-62-01, dated August, 1981.
- Reference 3. Footing Layout & Reinforcing Drawing, Twp. Rd. U'Pass, DWG 3, Sheet 135, Site No. 1-149, Dist. No. 4, Cont. No. 83-10, WP No. 73-62-01, dated August, 1981.



DOCUMENT MICROFILMING IDENTIFICATIONGEOCRES No. 40P2-29DIST. 4 REGION W.P. No. 73-62-01CONT. No. 83-10W. O. No. STR. SITE No. 1-149HWY. No. 403LOCATION Barford Twp Rd. UnderpassNo of PAGES -OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.REMARKS:



DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

MEMORANDUM

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

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

ATTENTION: Mr. B. J. McKenna.

DATE: July 4, 1972.

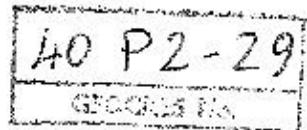
OUR FILE REF.

IN REPLY TO JUL 10 1972

SUBJECT:

FOUNDATION INVESTIGATION REPORT  
For

Burford Twp. Road Underpass  
of Proposed Hwy. #403, 13.3 Mi. West  
of Brantford West Limits, District #4  
W.O. 72-11045 -- W.P. 73-62-00



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,  
PRINCIPAL FOUNDATIONS ENGINEER.

Foundations Files  
Documents



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FOUNDATION INVESTIGATION REPORT  
For  
Burford Twp. Road Underpass  
of Proposed Hwy. #403, 13.3 Mi. West  
of Brantford West Limits, District #4  
W.O. 72-11045      --      W.P. 73-62-00

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1. INTRODUCTION:

The results of a foundation investigation, conducted at the site of the proposed Burford Twp. Road Underpass of Hwy. #403 are reported. The investigation was requested by Mr. B. J. McKenna, Bridge Location Engineer, Southwestern Region, in a memo dated February 29, 1972.

Subsequent to the request a field investigation was carried out under the supervision of the Foundations Office. Boreholes were located and surveyed by personnel of the Engineering Survey Office, Southwestern Region.

2. DESCRIPTION OF THE SITE AND GEOLOGY:

The existing Twp. Road at the future crossing is proposed to be shifted westerly. The site of the structure is wooded, fairly level ground, with considerable stagnant water partially covering the surface. The general land use is agricultural, tobacco being the main produce. There are a few oil wells in the vicinity.

Geologically the area belongs to the physiographic region known as the "Mount Elgin Ridges, " consisting of a succession of ridges and vales. The ridges are moraines of pale brown calcareous clay or silty clay, while in the vales it is common to find alluvium of gravel, sand or silt. The ridges are well drained, while poor drainage prevails in hallows.



### 3. FIELD AND LABORATORY INVESTIGATIONS:

Some seven borcholes, and adjacent to the holes six dynamic cone penetration tests were implemented during the course of the field work. Borings were carried out by means of a continuous hollow stem flight auger (CME 55) taking frequent samples in accordance with the Standard Penetration Tests. Penetration resistancies measured by the number of hammer blows applied for 1 ft. penetration are recorded on the accompanying borelogs, together with the results of the laboratory testing. On account of the very stiff to hard consistencies of the cohesive layers, no undisturbed soil samples were taken.

Upon recovery samples were identified, recorded and stored in glass jars. Visual classifications of all the samples were carried out in the laboratory, and representative samples were subjected to laboratory testing in order to determine Atterberg limits, natural moisture contents and grain size distributions. On attached Drawing #72-11045A the locations and elevations of the borings as well as the estimated soil profile are shown.

### 4. SUBSOIL CONDITIONS:

#### 4.1) General:

A somewhat complex soil stratigraphy was encountered in the borings, layers alternating between cohesive and granular deposits. The cohesive layers were identified to be clayey silts with traces of sand and gravel and silty clays. The granular deposits were found to be stratified, consisting of sandy silts, silty sands, gravelly sands and sandy gravels. A brief description of the various strata is given as follows.

#### 4.2) Clayey Silt, Traces of Sand and Gravel:

This is the uppermost material at the south portion of the proposed structure. Under the north half, however, it



was found to be overlain by a 4 - 5 ft. deep surficial sandy silt layer. The depth of the clayey silts is about 22 - 28 ft. terminating at elevation 880 ft. - 891 ft. Within the upper 5 - 10 ft. penetration 'N' values ranging from 8 blows/ft. to 17 blows/ft. were recorded, below which depth 'N' values increase up to 85 blows/ft. The stratum exhibits some cohesion; plastic limits were measured to fall between 12% and 19%, liquid limits between 19% and 32%. The average natural moisture content was estimated to be 15%. Grain size distributions indicate a fairly heterogeneous deposit, the range of gravel particles being 0 - 5%, the sand 2 - 5%, silt 52% - 65% and clay 30 - 43%.

#### 4.3) Silty Clay:

A second cohesive deposit was found in the deeper boreholes (B.H.'s #1, #3 and #7) intercepting the granular layers at around elevation 874-876 ft. The thickness of this stratum is some 10 - 11 ft., extending to elevation 863 ft. - 866 ft. On account of its medium plasticity the material was classified to be silty clay of stiff to hard consistency. Penetration resistances obtained within this layer vary between 14 blows/ft. to 70 blows/ft. Plastic limits of the clays average 18%, liquid limits 36 - 39%, with natural moisture contents around 28%.

#### 4.4) Layers of Silt, Sand and Gravel:

Around elevation 881 ft. - 891 ft. the cohesive material was found to be underlain by layers and seams of granular deposits, intercepted by a 10 - 11 ft. thick clay layer as discussed above. The granular layers were identified to be silty sands, sandy gravels and sandy silts. Traces of clay size particles were usually found in every soil sample, occasionally the clay content being sufficient to render the sample very slightly plastic. The measured penetration 'N' values are considered to be unreliable, since in several



locations quick conditions developed at the bottom of holes in view of the unbalanced hydrostatic head. It appears reasonable to assume that the relative density of the granular layers varies between dense and very dense. The results of grain size analyses of the individual samples are marked on the borelogs.

#### 4.5) Groundwater Conditions:

Groundwater levels were established at each borehole location and they were found to be very high, usually around 1.5-2.0 ft. below ground level. In certain boreholes the water level has risen up to the ground surface. It is surmised that the observed water levels were at or near the yearly high water table.

### 5. DISCUSSION AND RECOMMENDATIONS:

#### 5.1) General:

Two alternative schemes are submitted for this crossing. The first scheme calls for a five span underpass structure, while the second proposal utilizes a two span bridge. The overall length of the structure will be some 273 ft. The elevation of the top of pavement of Hwy. #403 is designed to be 915 ft.; the proposed grade of the Twp. Road at the Crossing being elevation 937 ft. with some 20 ft. high approach fills.

Subsoils were found to consist of deposits of clayey silt and silty clay of stiff to hard consistency and stratified sandy silts, silty sands and gravelly sands of compact to very dense relative density.

#### 5.2) Foundations:

Beneath the surficial 5-8 ft. thick deposit, the very stiff to hard clayey silts are considered to be competent load bearing soils. As a consequence spread footings appear



to be the most economical for both the five span as well as the two span structures, footing being placed at or below elevation 905 ft. At this elevation safe design loads up to 3 t.s.f. may be used on the footing bases. A minimum cover of 4 ft. should be provided for the footings for frost protection.

Perched abutments or the entire structure may also be supported on piles. If piled foundations are chosen by the designer, the use of 12-3/4 O.D. steel tubes are recommended. Piles ought to be driven according to Standard BD-82-7, using 60 ton/pile design loads. It is estimated that above loads will be achieved by driving the tubes to approximate elevation 880 ft. - 885 ft. Care should be taken not to place bouldery material within the embankments at the locations of the abutments, if piled foundations are adopted.

### 5.3) Dewatering and Approach Fill Stability:

The uppermost 4-5 ft. deep sandy silts were noted to lack cohesive strength; thus these soils are susceptible to conditions of unbalanced hydrostatic head. It is, however, believed that at the recommended footing levels of elevation 905 ft. or below the base of the excavations will be within the underlying cohesive clayey silts. No quick conditions are anticipated to occur, therefore, at the bottom of the excavations. Some seepage will take place along the sides of the excavations, but open pumping from shallow sumps, dug at the perimeter of the oversize excavations will likely handle the water.

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

### 6. MISCELLANEOUS:

The field work carried out during April 5 - 20, 1972, was supervised by Mr. W. V. Uric, Field Technician. The



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

This report was written 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

June 30/72



## APPENDIX I



## DESIGN SERVICES BRANCH

## RECORD OF BOREHOLE No. 1

## FOUNDATION SECTION

JOB 72-11045

LOCATION Sta. 101 + 02, 13<sup>th</sup> St. & Dwy. Rd., Reykjavik

ORIGINATED BY W.V.U.

W.P. 73-62-00

BORING DATE April 13, 1972

COMPILED BY A.K.B.

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

CHECKED BY S.O.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			BULK DENSITY $\gamma$	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT.	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.		WATER CONTENT %				
913.7	Ground level.						○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    x LAB. VANE	$w_p$ — $w$ — $w_L$	10      20      30			P.C.F.	GR. SA. SI. CL.
0.0	Fine to medium sand.												
908.7	Compact.		1	SS	12	910							
5.0	Clayey silt, traces of sand.  Very stiff to hard.  Brown.		2	SS	20								
			3	SS	51								
			4	SS	23								
			5	SS	52	900							
			6	SS	57								
			7	SS	80								
			8	SS	85	890							0 5 52 43
887.7													
26.0	Layers of silty sand and sandy gravel.		9	SS	55								
			10	SS	73	880							
875.7	Very dense.		11	SS	39								
38.0	Silty clay.  Very stiff to hard.		12	SS	21	870							
			13	SS	70								
864.7													
49.0	Layers of sandy silt, Silty sand and clayey silt.  Hard and loose to very dense.  Greyish brown.		14	SS	1	860							
			15	SS	2175"								0 14 80 6
			16	SS	23	850							
			17	SS	19								
			18	SS	17	840							0 5 71 24
			19	SS	7	830							2 75 17 6
814.7			20	SS	81	820							5 49 41 5
99.0	End of borehole.												



## DESIGN SERVICES BRANCH

## RECORD OF BOREHOLE No. 2

FOUNDATION SECTION

JOB 72-11045

LOCATION Sta. 101 + 44, 13' W. of 7 Twp. Rd. Revision

ORIGINATED BY W.V.D.

W.P. 73-62-00

BORING DATE April 18, 1972

COMPILED BY A.K.B.

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

CHECKED BY A.K.B.

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION BLOWS / FOOT 20 40 60 80 100	RESISTANCE	LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$ $w_p$ — $w$ — $w_L$	BULK DENSITY $\gamma$	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLAT	NUMBER	TYPE						
913.4	Ground level.									
909.4	Sandy silt, traces of clay & gravel.		1	SS	16					9 29 50 12
4.0	Clayey silt, traces of sand.		2	SS	18					
	Very stiff to hard.		3	SS	17					
	Brown.		4	SS	33					
			5	SS	46					
			6	SS	39					5 2 58 35
			7	SS	43					
887.9			8	SS	62					
20.5	Silty sand to sand.		9	SS	68					0 60 34 6
884.6			10	SS	81					8 81 (11)
29.0	End of borehole.									



## DESIGN SERVICES BRANCH

## RECORD OF BOREHOLE No. 3

FOUNDATION SECTION

JOB 72-11045

LOCATION Sta. 100 + 43, O/S 13' Lt. &amp; Typ. Rd. Revision

ORIGINATED BY W.V.U.

W.P. 73-62-00

BORING DATE April 14, 1972

COMPILED BY A.K.B.

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 $\gamma$	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		20	40	60	80	100	$w_p$	$w$	$w_L$		
911.4	Ground level.														
0.0	Silty sand, some organics.		1	SS	10										0 81 (19)
906.4	Compact.		2	SS	7										
5.0	Clayey silt, traces of sand.		3	SS	26										
	Stiff to hard.		4	SS	36										
	Brown.		5	SS	44										
			6	SS	40										0 2 63 35
			7	SS	42										
			8	SS	75										
883.4			9	SS	37										0 20 71 9
28.0	Layers of sandy silt and gravelly sand.		10	SS	100/7"										19 61 (20)
873.6	Very dense.		11	SS	24										
37.5	Silty clay. Stiff to very stiff.		12	SS	34										0 1 33 66
863.4			13	SS	63										
46.0	Sandy silt, irregular layers of clayey silt.		14	SS	14										
	Loose to compact.		15	SS	17										0 13 85 2
	Very stiff.		16	SS	44										
	Greyish brown.		17	SS	17										
			18	SS	6										
832.4			19	SS	22										0 7 69 24
79.0	End of borehole.														



DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS  
DESIGN SERVICES BRANCH

# RECORD OF BOREHOLE No. 4

FOUNDATION SECTION

JOB 72-11045 LOCATION Sta. 100 + 03 G/S 13' Rt. & Twp. Road Revision ORIGINATED BY W.V.U.  
W.P. 73-62-00 BORING DATE April 5, 1972 COMPILED BY A.K.B.  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY W.V.U.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION	RESISTANCE	LIQUID LIMIT	PLASTIC LIMIT	WATER CONTENT	BULK DENSITY $\gamma$ P.C.F.	REMARKS					
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS/FOOT		BLOWS/FOOT	20	40	60	80			100	$w_p$	$w$	$w_L$	
							SHEAR STRENGTH P.S.F.											
							○ UNCONFINED			+ FIELD VANE								
							● QUICK TRIAXIAL			x LAB. VANE								
										WATER CONTENT %								
										10			20			30		
912.3	Ground level.																	
0.0	Sandy silt, some organics. Compact.		1	SS	13	910												
907.8			2	SS	27													
4.5	Clayey silt, traces of sand and gravel.		3	SS	35													
	Very stiff to hard.		4	SS	21													
	Brown.		5	SS	34	900												
			6	SS	34													
			7	SS	34													
			8	SS	39	890												
684.3			9	SS	35													
28.0	Silty sand to gravelly sand.																	
378.3	Dense to very dense.		10	SS	100	880												
34.0	End of borehole.																	



DESIGN SERVICES BRANCH

## RECORD OF BOREHOLE No. 5

FOUNDATION SECTION

JOB 72-11045

LOCATION Sta. 90 + 74 O/S 10' LL. &amp; Twp. Road Revision

ORIGINATED BY W.V.U.

W.P. 73-62-00

BORING DATE April 24, 1972

COMPILED BY A.K.B.

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

CHECKED BY A.P.

SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W		BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER TYPE	BLOWS/FOOT	SHEAR STRENGTH P.S.F.	Wp — W — WL WATER CONTENT %			
909.4	Ground level.								
	Clayey silt, traces of sand and gravel.		1 SS 14						
			2 SS 27						
	Stiff to hard.		3 SS 24						
			4 SS 43						0 4 65 31
	Brown.		5 SS 42						
			6 SS 36						
			7 SS 68						
			8 SS 44						2 4 60 34
880.9									
28.5	Layers of sandy silt & clayey silt.		9 SS 39						
875.4									
			10 SS 57						8 11 60 21
34.0	End of borehole.								



DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

DESIGN SERVICES BRANCH

## RECORD OF BOREHOLE No. 6

FOUNDATION SECTION

JOB 72-11045

LOCATION Sta. 98 + 92 O/S 13' Rt. E. Imp. Road Revision

ORIGINATED BY W.V.U.

W.P. 73-62-00

BORING DATE April 20, 1972

COMPILED BY A.K.B.

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

CHECKED BY S.R.

SOIL PROFILE		SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION BLOWS / FOOT 20 40 60 80 100	RESISTANCE	LIQUID LIMIT — W <sub>L</sub> PLASTIC LIMIT — W <sub>P</sub> WATER CONTENT — W	BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER TYPE						
912.3	Ground level.								
0.0	Clayey silt, traces of sand.		1 SS 13	10			○		6 23 50 21
			2 SS 24				○		
			3 SS 62				○		
	Stiff to hard.		4 SS 67				○		
			5 SS 42				○		
	Brown.		6 SS 34				○		1 3 60 36
			7 SS 40				○		
890.3				890					
22.0	Layers of sandy silt, clayey silt and sandy gravel.		8 SS 30				○		0 38 53 9
			9 SS 50				○		
878.3	Very dense.			880					18 79 (3)
34.0	End of borehole.								



DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

DESIGN SERVICES BRANCH

## RECORD OF BOREHOLE No. 7

FOUNDATION SECTION

JOB 72-11045

LOCATION Sta. 98 + 61 O/S 13' Lt. &amp; Twp. Rd. Revision

ORIGINATED BY W.V.U.

W.P. 73-62-00

BORING DATE April 20-21, 1972

COMPILED BY A.K.B.

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

CHECKED BY

SOIL PROFILE		STRAT. PLOT	SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$		BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE		20	40	60	80		
914.3	Ground level.										
0.0	Clayey silt, traces of sand.		1	SS	13						
	Stiff to hard.		2	SS	8						
	Brown.		3	SS	53						
			4	SS	66						
			5	SS	54						
			6	SS	35						
			7	SS	29						
891.3			8	SS	26						0 39 53 8
23.0	Fine sandy silt and sandy gravel.		9	SS	32						
	Dense to very dense.		10	SS	52						
876.3			11	SS	18						0 1 69 30
38.0	Silty clay.										
	Very stiff.										
866.3			12	SS	19						
48.0	Sandy silt and silty sand.										
	Traces of clay and gravel.		13	SS	32						0 10 79 11
	Compact to very dense.		14	SS	17						
	Greyish brown.		15	SS	100						1 68 (31)
			16	SS	100/5"						
825.3			17	SS	100/4"						11 40 39 10
89.0	End of borehole.										



## ABBREVIATIONS USED IN THIS REPORT

### SOIL PROPERTIES

$\gamma$	UNIT WEIGHT OF SOIL (BULK DENSITY)
$\gamma_s$	UNIT WEIGHT OF SOLID PARTICLES
$\gamma_w$	UNIT WEIGHT OF WATER
$\gamma_d$	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
$\gamma'$	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
g	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
$\tau_f$	SHEAR STRENGTH
$c'$	EFFECTIVE COHESION INTERCEPT
$\phi'$	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
$c_u$	APPARENT COHESION
$\phi_u$	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
$\mu$	COEFFICIENT OF FRICTION
$S_1$	SENSITIVITY

### GENERAL

$\pi$	: 3.1418
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e \sigma$ OR $\ln \sigma$	NATURAL LOGARITHM OF $\sigma$
$\log_{10} \sigma$ OR $\log \sigma$	LOGARITHM OF $\sigma$ 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
$\sigma$	NORMAL STRESS
$\sigma'$	NORMAL EFFECTIVE STRESS ( $\bar{\sigma}$ IS ALSO USED)
$\tau$	SHEAR STRESS
$\epsilon$	LINEAR STRAIN
$\gamma$	SHEAR STRAIN
$\nu$	POISSON'S RATIO ( $\mu$ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
$\eta$	COEFFICIENT OF VISCOSITY

### EARTH PRESSURE

d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
$\delta$	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS RELATING 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
$\beta$	ANGLE OF SLOPE TO HORIZONTAL



## 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' BLDWS / FT.</u>	<u>c LB. / SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLDWS / 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

Qu	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL	S	SENSITIVITY







METRIC

CONT No 83-10  
WP No 73-62-01

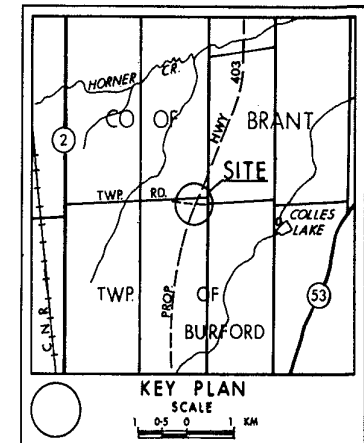
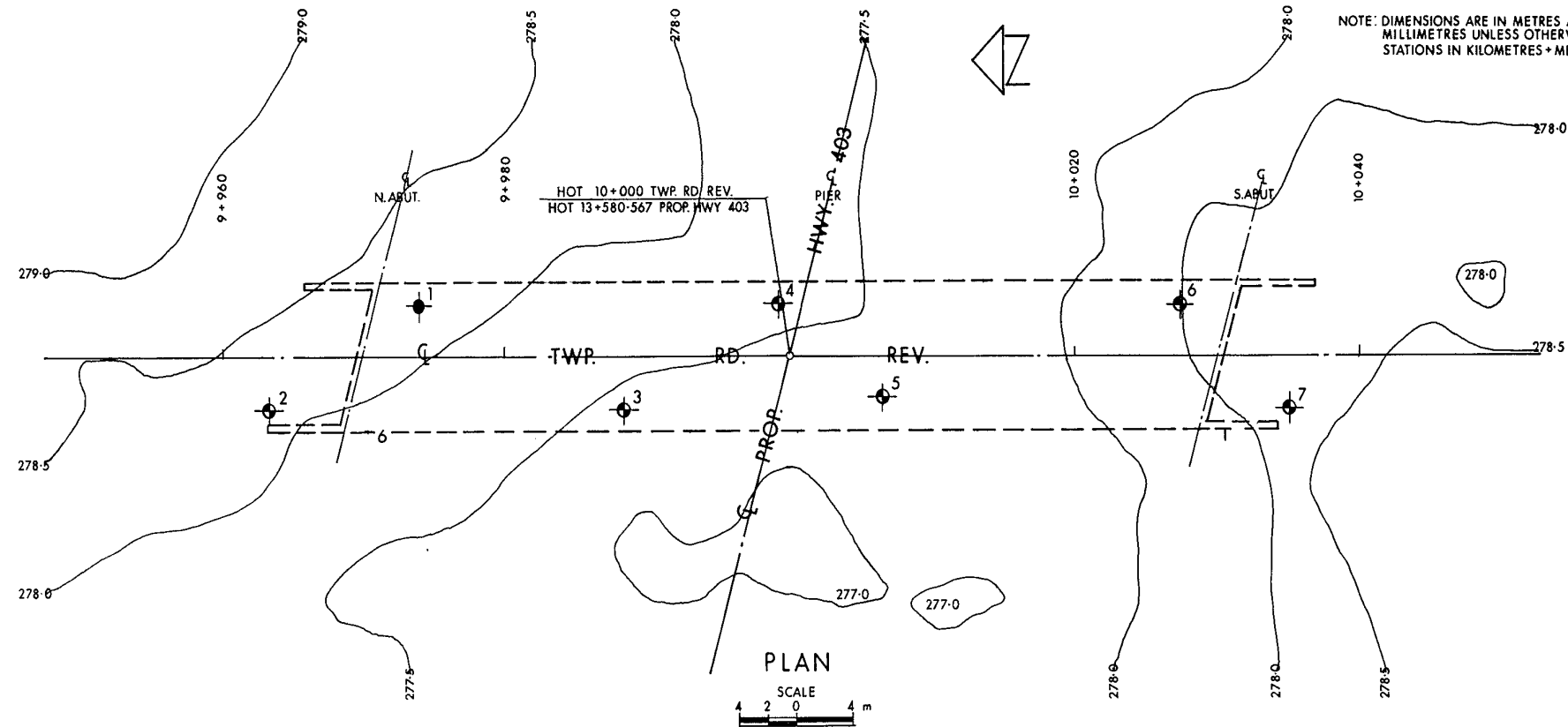


TWP RD. REV. CROSSING AT HWY 403

SHEET

BORE HOLE LOCATIONS & SOIL STRATA

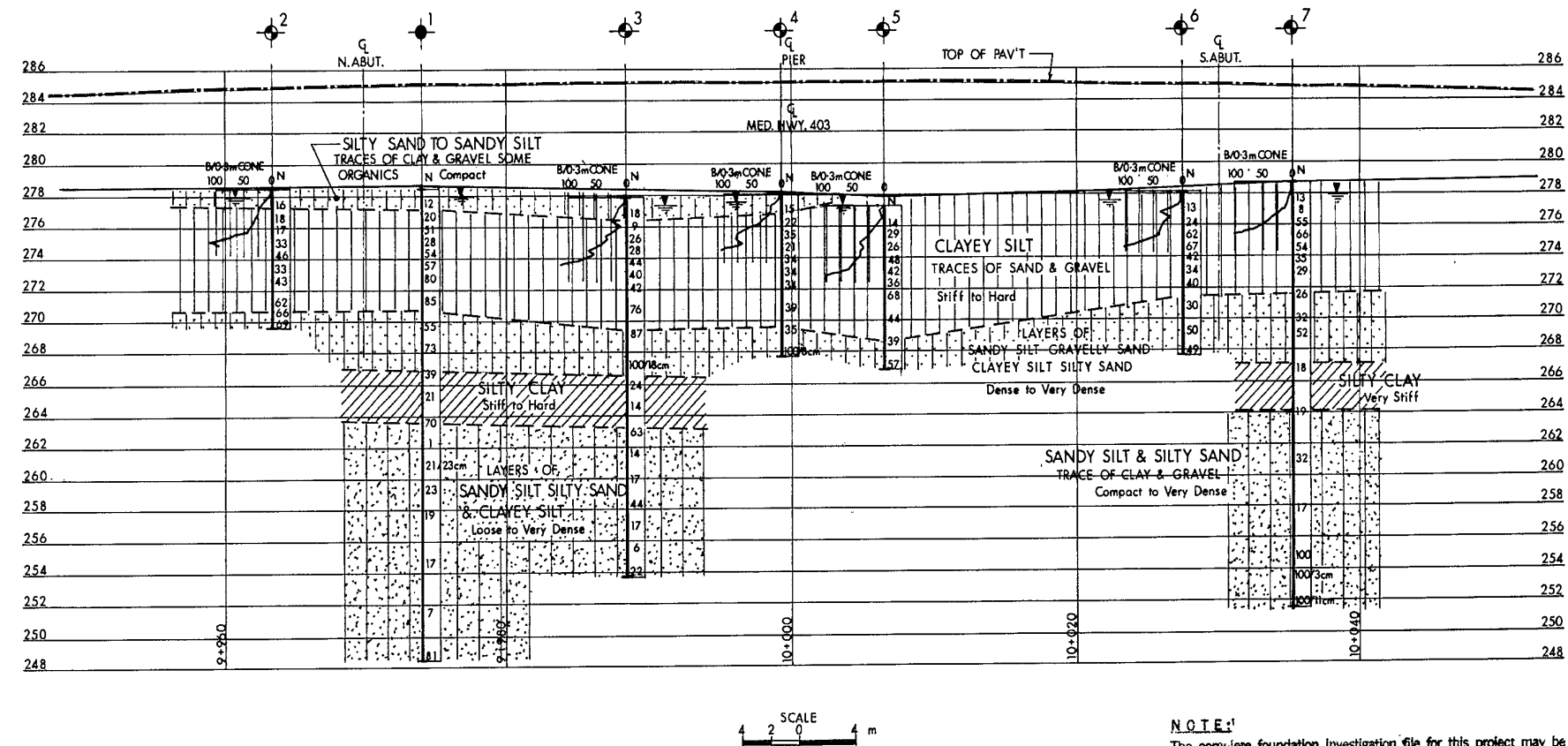
134



#### 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 72 04 14

No	ELEVATION	STATION	OFFSET
1	278.5	9+974.1	3.1 LT.
2	278.4	9+963.1	3.1 RT.
3	277.8	9+988.2	3.2 RT.
4	278.1	9+999.1	3.1 LT.
5	277.2	10+006.3	2.2 RT.
6	278.1	10+027.2	3.1 LT.
7	278.7	10+035.0	3.1 RT.



#### NOTE:

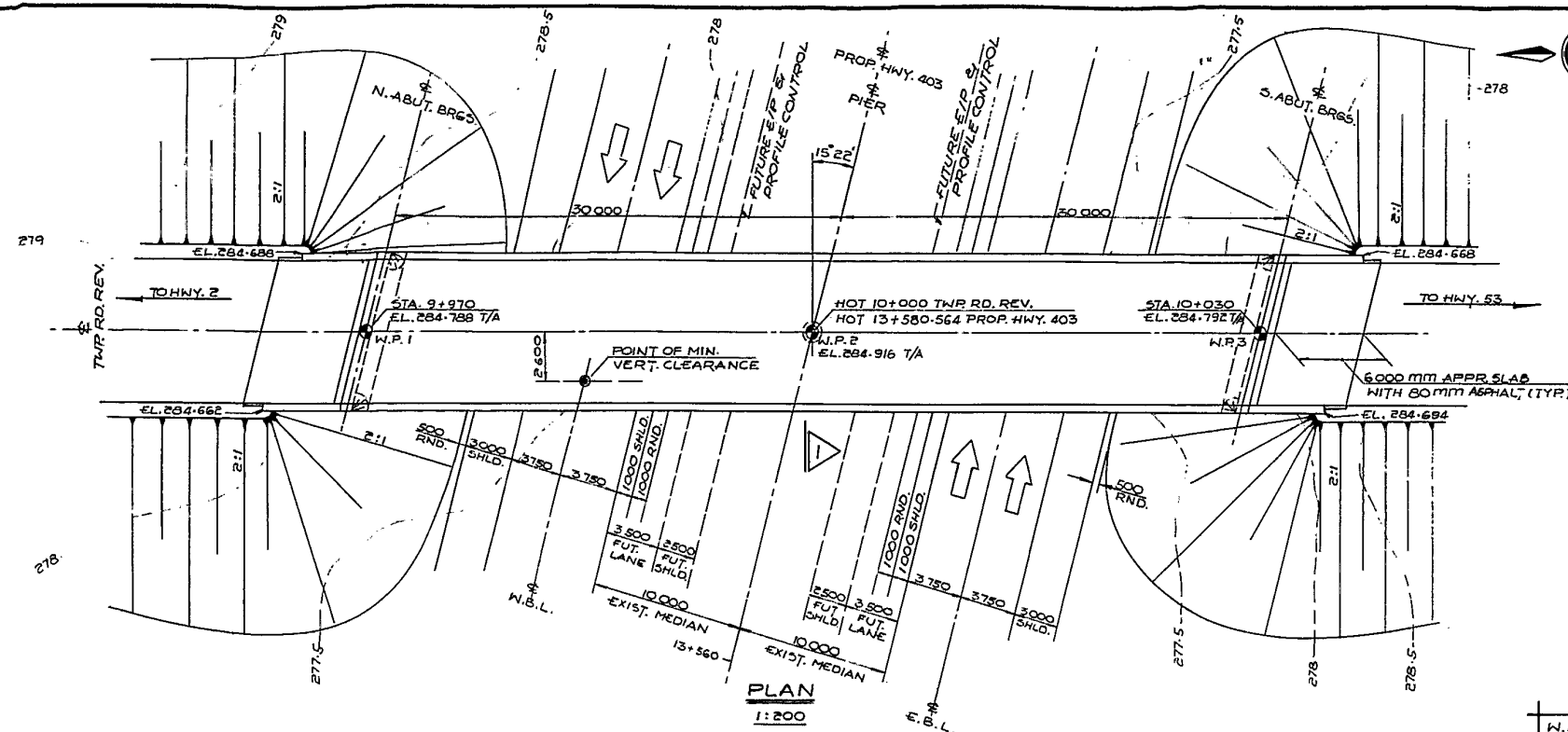
The complete foundation investigation file for this project may be examined at the Engineering Materials Office, Downsview. Information contained in this file and any supplementary files is specifically excluded in accordance with the conditions of Section 102.2 of Form 100.

REVISIONS	DATE	BY	DESCRIPTION

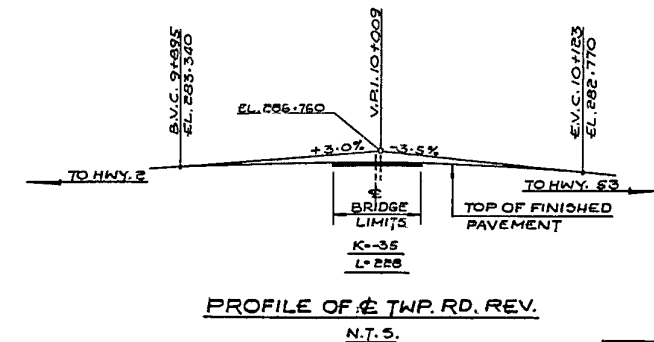
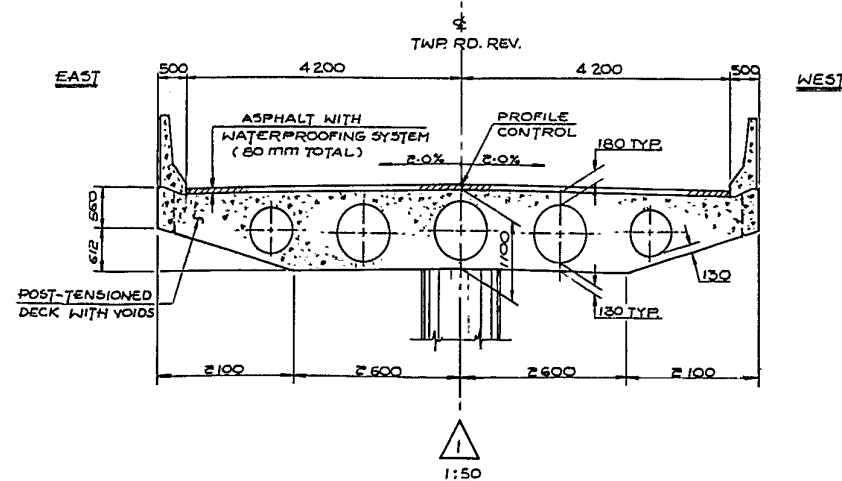
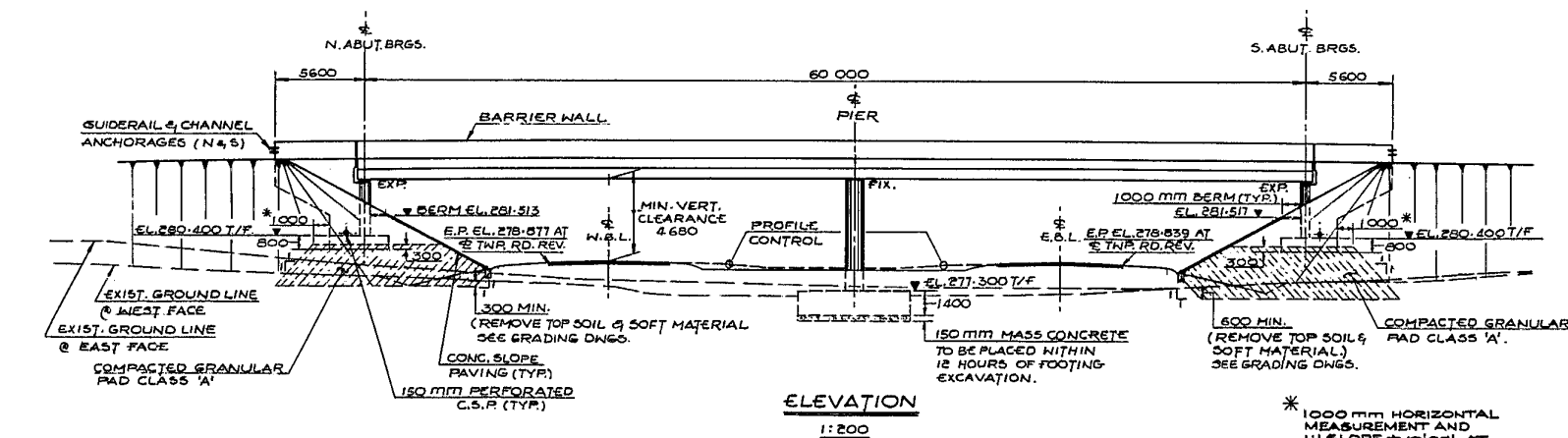
Geocres No 40P2-29

HWY No	403	DIST	4
SUBM'D BY	CHECKED	DATE	81 11 10
DRAWN BY	CHECKED	DATE	81 11 10
		SITE	1-149
		DWG	736201-A





N.P. = WORKING POINT  
T/A = TOP OF ASPHALT  
T/F = TOP OF FOOTING



BM 277.694  
N & W IN ROOT 0-24 STUMP  
70.6 RT. 13+704.3

TOP OF FINISHED  
PAVEMENT AT  
PROFILE CONTROL  
ON E/P OF FUTURE  
LANES.

**PROFILE OF PROP. HWY. 403**  
N.T.S.

DRAWING NOT TO BE SCALED  
100 mm ON ORIGINAL DRAWING

**METRIC**

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

DIST. No 4  
**CONT No 83-10**  
**WP No 73-62-01**  
TWP. RD. REV. U'PASS  
6.3 KM EAST OF HWY. 53  
**GENERAL ARRANGEMENT**

**SHEET**  
133

### NOTES

#### CLASS OF CONCRETE

DECK & PIER COLUMN — 35 MPa  
ABUTMENTS, WING WALLS &  
BARRIER WALLS — 30 MPa  
REMAINDER — 20 MPa

#### REINFORCING STEEL

GRADE 400  
BAR MARK WITH SUFFIX 'C' DENOTES  
COATED BAR.

#### NOMINAL CLEAR COVER AND TOLERANCE TO REINF. STEEL

ITEM	mm
FOOTINGS	100 ± 25
ABUTMENTS FRONT	80 ± 20
ABUTMENTS BACK	70 ± 20
PIER COLUMN	80 ± 20
DECK TOP	70 ± 20
DECK BOT. AND SIDES	50 ± 10
REMAINDER UNLESS OTHERWISE NOTED	70 ± 20

#### CONSTRUCTION NOTES

THE CONTRACTOR IS RESPONSIBLE FOR  
FINISHING THE BEARING SEATS DEAD  
LEVEL TO THE SPECIFIED ELEVATIONS  
WITH A TOLERANCE OF ± 3 mm.

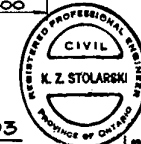
#### CONCRETE QUANTITIES

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

CONCRETE IN PIER, ABUTS. & WING WALLS  
35 MPa — 9 m<sup>3</sup>  
30 MPa — 105 m<sup>3</sup>  
PRESTRESSED CONCRETE BRIDGE DECK — 447 m<sup>3</sup>  
CONCRETE IN BARRIER WALLS — 36 m<sup>3</sup>  
CONCRETE IN APPROACH SLABS — 26 m<sup>3</sup>  
CONCRETE IN SLOPE PAVING — 24 m<sup>3</sup>

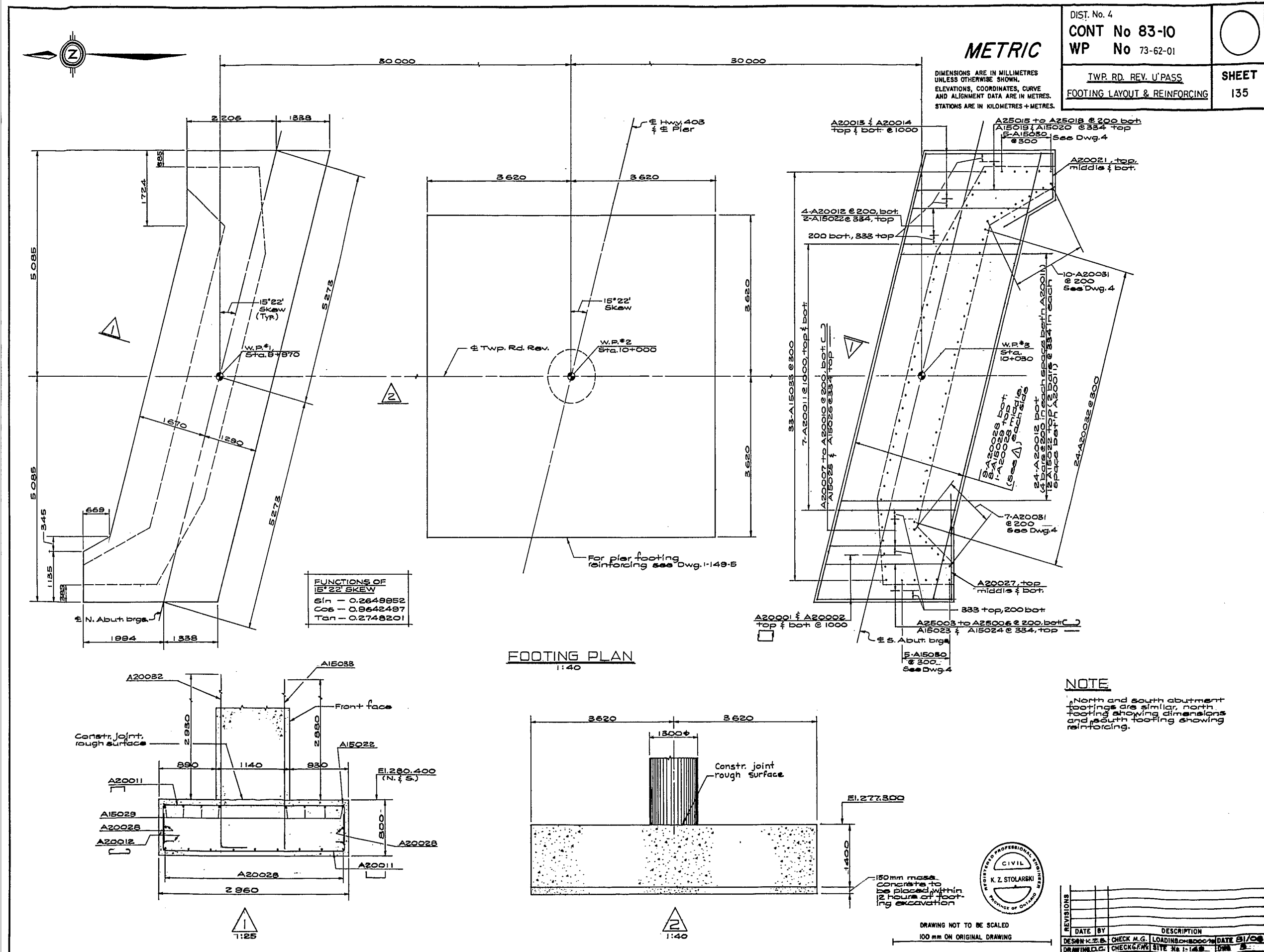
#### LIST OF DRAWINGS

- 1-149-1 GENERAL ARRANGEMENT.
- 2 BOREHOLE LOCATION & SOIL STRATA.
- 3 FOOTING LAYOUT & REINFORCING.
- 4 NORTH & SOUTH ABUTMENTS.
- 5 PIER & PIER FOOTING.
- 6 DECK DETAILS & ABUT. BEARINGS.
- 7 LONGITUDINAL CABLE DETAILS.
- 8 TRANSVERSE CABLE DETAILS I
- 9 TRANSVERSE CABLE DETAILS II
- 10 DECK REINFORCING I
- 11 DECK REINFORCING II
- 12 BARRIER WALL.
- 13 6000 MM APPROACH SLAB
- 14 DETAILS OF CONC. SLOPE PAVING
- 15 AS CONSTRUCTED ELEV. & DIM.
- 16 BRIDGE DATE & SITE NUMBER DATA
- 17 STANDARD DETAILS.



REVISIONS	DATE	BY	CHECK	DESCRIPTION	DATE
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					







Foundation Technical Memorandum

West Quarter Townline Road Underpass Highway 403, MTO West Region 59 Structure Rehabilitations

Site 1-149, Contract 8, GWP 3094-12-00, Index No.: 344FTM

PML Ref.: 13KF006H-TR, June 12, 2017

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## **APPENDIX B**

Site Photographs





**Photograph 1:** Looking at the south abutment of the West Quarter Townline 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 with soil (August 28, 2015).





**Photograph 2:** Looking at the north abutment of the West Quarter Townline Road Underpass Structure. Vertical cracks were observed on the abutment wall. Sealant between the concrete panels appeared degraded at locations. Weep holes were not observed in the abutment wall. The toe of the front slope was covered with soil (August 28, 2015).





**Photograph 3:** Looking northeast at the pier of West Quarter Townline 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 West Quarter Townline Road Underpass Structure. Surficial cracks were observed on the wingwall. The slope is vegetated and 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 West Quarter Townline Road Underpass Structure. Surficial cracks were observed on the wingwall. The slope is vegetated and 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 West Quarter Townline Road Underpass Structure. Surficial cracks were observed on the wingwall. The slope is vegetated and 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 West Quarter Townline Road Underpass Structure. Minor cracks were observed on the wingwall. The slope is vegetated and erosion on the slope face was not observed (August 28, 2015).