



THURBER ENGINEERING LTD.

**PRELIMINARY FOUNDATION INVESTIGATION AND DESIGN REPORT
HIGHWAY 401 MEDIAN SEWER
COUNTY ROAD 41 INTERCHANGE TO PALACE ROAD INTERCHANGE
GREATER NAPANEE, ONTARIO
GWP NO. 4459-04-00 and 4197-13-00**

**Latitude: 44.265944
Longitude: -76.951322**

GEOCRES No. 31C-277

Report

to

AECOM

Date: August 7, 2018
File: 10035



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1. INTRODUCTION

This report presents a summary of the factual subsurface information for the new Highway 401 median sewer between the Highway 401 interchanges at County Road 41 and Palace Road in the geographic Township of Richmond, in the Town of Greater Napanee, Ontario. It also provides preliminary foundation design recommendations for installation of the new sewer.

The purpose of this desktop study report is to summarize currently available subsurface information pertinent to the foundation aspects of the sewer installation works. The information includes previous foundation reports and contract drawings available from the Ministry of Transportation Ontario (MTO), geological maps, water well records, a site reconnaissance visit, and a current preliminary pavement investigation. It also presents preliminary foundation recommendations for installation of the new sewer. No foundation boreholes have been drilled specifically for the sewer at this stage. It is noted that the proposed horizontal alignment and vertical profile of the sewer are not yet defined. Additional investigation and analysis may be required in any subsequent detail design phase of the project.

Thurber carried out this desktop study as a sub-consultant to AECOM under the MTO Consultant Assignment Number 4015-E-0003.

2. SITE DESCRIPTION

2.1 General

The new median sewer will be located along the existing median of Highway 401 from the interchange at County Road 41 to the Napanee River and from Palace Road to the Napanee River, with a combined length of a little over 3 km. Between the two interchanges, Highway 401 is a four-lane divided highway, which crosses Sucker Creek, a former railway spur line, Newburgh Road, and the Napanee River. Select photographs of the highway are included in Appendix C.



2.2 Geology

The project area is situated within the physiographic region known as the Napanee Plain. The Napanee Plain is characterized by a thin veneer of glacial till underlain at relatively shallow depths by limestone bedrock of the Bobcaygeon Formation. Thick glacial sediments are present in the deep river and stream valleys in the region.

2.3 Topography and Land Use

The Highway 401 corridor addressed in this project generally runs in an east to west orientation along relatively flat terrain. A portion of the corridor from a point approximately 275 m west of the railway crossing to Newburgh Road is within a rock cut, with exposed limestone bedrock visible along both sides of the highway. The land usage along the corridor includes commercial and institutional developments between the County Road 41 interchange and the railway crossing, and generally undeveloped, forested, or agricultural land between the railway crossing and the Palace Road interchange.

3. STUDY PRODECURES

The desktop study is based on geotechnical data gathered from available sources with no foundation borehole drilling and sampling in this phase of the work. Borehole information was however available from the preliminary pavement investigation conducted by Thurber as part of this project.

Information on existing surface and subsurface conditions along the highway corridor have been collected from the following sources:

- Review of existing foundation investigation and design reports for the County Road 41, Sucker Creek, Napanee River, and Palace Road bridge structures available from the MTO GEOCREs system, and selected information from archived contract files.
- Review of preliminary pavement investigation report for the Highway 401 improvement project.
- Review of existing contract drawings prepared for portions of the project corridor.
- Review of published geological information and Ontario water well records for the study area.
- Site reconnaissance visit by the Thurber project engineer to observe and document the existing highway corridor, cuts, embankments and any visible geological/geotechnical features.



Imperial units in the original GEOCREs files have been converted to metric.

3.1 MTO GEOCREs Files

Existing foundation/geotechnical information relevant to the site corridor has been obtained from the MTO GEOCREs library. The documents used for the desktop study are listed below and the relevant drawings and borehole logs are included in Appendix A:

Reference 1 (GEOCREs 31C00-062): Foundation Report for the Proposed Structure at Hwy. 401 Line 'C' and Highway 41 Crossing, Lots 21 AND 22, Con. II, Township of Richmond, Approximately 1 Mile North of Napanee. W.P. 33-59. W.J. F-59-28. Prepared by the MTO Department of Highways Materials and Research Section, Dated June 22, 1959.

Reference 2 (GEOCREs 31C00-061): Highway 401 Line 'C' & Selby Creek Diversion Crossing, Lot 22, Concession II, Twp. Of Richmond, Approx. 1 Mile North of Napanee, W.P. 29-59, W.J. F-59-25, dated June 1959.

Reference 3 (GEOCREs 31C00-165): Foundation Investigation and Design, Bridge Structure for E-N Ramp over Sucker Creek, Detail Design – Short-Term Intersection Improvements at Highway 401 and County Road 41. G.W.P. 331-99-0, Agreement No. 4005-A-000206. Town of Greater Napanee, Eastern Region, dated April 2003.

Reference 4 (GEOCREs 31C00-065): Preliminary Site Investigation for the Proposed Crossing of Highway No. 401 at the Napanee River near Napanee, Ontario, for the Department of Highways-Ontario. Prepared by Hunting Technical and Exploration Services Limited. Dated December 4, 1958.

Reference 5 (GEOCREs 31C00-063): Foundation Investigation for Proposed Crossing Highway 401-Line "C", Township of Fredericksburgh, Counties of Lennox & Addington, Ontario Department of Highways. W.P. 33-59. Prepared by Universal Geotechnique Limited. Dated December 1959.

3.2 Preliminary Pavement Investigation Report

A preliminary pavement investigation for the Highway 401 interchange at County Road 41, including median improvements was conducted by Thurber as part of this project. The borehole logs for pavement boreholes advanced near the Highway 401 median are included in Appendix B. The pavement investigation report is entitled, "Draft Preliminary Pavement Design Report, MTO Eastern Region Agreement 4015-E-0003, Highway 401 Interchange Improvements



Including Median Improvements, Highway 401 / County Road 41 Interchange (IC579), Greater Napanee, Lennox and Addington Area, G.W.P. 4459-04-00", dated January 25, 2018.

The locations of median pavement boreholes relevant to a median sewer are plotted on the highway drawing included in Appendix B. These boreholes were used to assist in the assessment of the potential sewer subgrade.

3.3 Contract Drawings

Contract drawings and quantity sheets were prepared in 2003 by the MTO Eastern Region for Grading, Drainage, Granular Base, Hot Mix Paving and Median Barrier for Highway 401 from 0.7 m west of County Road 41 to 1.3 km east of Palace Road (WP No. 4524-02-01, Contract No. 2003-4015). The drawings show removal and replacement of portions of an existing median storm sewer, which included trench excavation in bedrock.

Contract drawings and quantity sheets were prepared in 2004 by the MTO Eastern Region for Grading, Drainage, Granular Base, Hot Mix Paving, Intersection Improvements, Electrical and Structural for the Highway 401 and County Road 41 Interchange (WP No. 31-99-00, Contract No. 2004-4016). The drawings show the approximate bedrock level below Highway 401 in the vicinity of the Sucker Creek bridge (approximate Elevation 94.3 to 92.6 m).

3.4 Geological and Water Well Record Information

During the preparation of this report, reference was made to Chapman and Putnam, "The Physiography of Southern Ontario", Third Edition, Ontario Geological Survey, Special Volume 2, Ministry of Natural Resources, 1984.

The Ministry of Environment and Energy's water well record database was also reviewed to assess the approximate depth to bedrock as recorded on the closest available well records to the Highway 401 corridor (generally greater than 200 m from the highway corridor).

3.5 Site Reconnaissance Visit

A site reconnaissance visit was carried out by Thurber's project engineer during the preparation of this report. The site corridor was visited and documented for visible geological/geotechnical features.



Based on the site observations, at the County Road 41 interchange, Highway 401 is constructed on an embankment that reaches approximately 6 m above the original ground surface. No bedrock exposures were noted at this interchange.

East of the County Road interchange until approximately 275 m west of the railway crossing bridge, Highway 401 is constructed on a low embankment or the corridor is nearly at-grade with the surrounding land.

The portion of Highway 401 from approximately 275 m west of the railway crossing bridge, easterly to the west side of the Newburgh Road bridge is in a rock cut, which is up to approximately 5 m deep at the railway crossing. The observed bedrock appeared to be limestone.

East of the Newburgh Road bridge, Highway 401 is constructed on a low embankment or the corridor is nearly at-grade with the surrounding land.

At the Palace Road interchange, the site observations noted that Palace Road to the south of Highway 401 is in an approximately 5 m deep rock cut. To the north, Palace Road is in a shallow cut, apparently in earth, on the east side and essentially at grade on the west side.

4. DESCRIPTIONS OF SUBSURFACE CONDITIONS

4.1 County Road 41 Interchange

The field investigation outlined in Reference 1 consisted of two sampled boreholes with adjacent dynamic cone penetration tests (DCPTs) at the north west and south east quadrants of the site and two separate DCPTs at the north east and south west quadrants of the site. The two boreholes were drilled and sampled through the overburden in conjunction with Standard Penetration Tests (SPTs) to depths of 2.2 to 3.0 m below the original ground surface (Elevations 94.1 to 93.3 m). Bedrock was confirmed below the soil sampling depth by coring in both of the boreholes to depths ranging from 3.7 to 4.5 m below the original ground surface (Elevations 92.6 to 91.9 m). The four DCPTs were advanced to depths ranging from 2.2 to 3.1 m below the original ground surface (Elevations 94.1 to 93.3 m), where they encountered refusal on inferred bedrock.

The site was originally overlain by a layer of topsoil that ranged in thickness from 50 to 300 mm.

Clay was encountered below the topsoil in both of the sampled boreholes. The thickness of the clay ranged from 1.9 to 3.0 m, with the base of the layer lying at Elevations 94.1 to 93.3 m. In the south east quadrant of the site, the grey soil was described as gravelly sandy clay. In the north west of the site, the soil transitioned from brown to grey at a depth of 1.5 m and the description



changed from sandy clay to silty clay. The report stated that the clay contained 20 to 30% sand and 21 to 35% silt. SPT 'N' values ranged from 10 to 39 blows per 0.3 m indicating a stiff to hard consistency. Three measured moisture contents ranged from 7.2 to 32.7%. One Atterberg Limit Test in the sandy clay yielded a plastic limit of 31.9% and a liquid limit of 59.7% (Plasticity Index of 27.8%) indicating that the clay is of high plasticity (CH).

Bedrock was encountered below the gravelly sandy clay at a depth of 2.2 m at the south east quadrant of the site (Elevation 93.3 m) and below the silty clay at a depth of 3.0 m at the north west quadrant of the site (Elevation 94.1 m). Two DCPTs were terminated upon refusal on probable bedrock at the north east and south west quadrants of the site at depths of 2.3 and 3.1 m below the ground surface, respectively (Elevations 93.9 and 93.2 m, respectively). The original investigation described the bedrock as "very sound" fine-grained dolomitic limestone with shaley partings.

Observed groundwater levels in the open boreholes upon completion of drilling varied between Elevations 96.2 and 95.5 m at the time of the investigation. These were short term observations made prior to the formation of existing approach cuts for this structure, and therefore likely did not represent stabilized groundwater conditions.

4.2 Highway 401 Bridge over Sucker Creek

The field investigation outlined in Reference 2 consisted of 1 borehole (labelled 4) with an adjacent DCPT and three separate DCPTs advanced for the construction of the existing Highway 401 bridge structure over Sucker Creek. The report stated that no sampling was conducted in the overburden due to the shallow bedrock depth. Bedrock was confirmed below the overburden by coring in one of the boreholes from a depth of 1.1 m to a depth of 2.7 m below the original ground surface (Elevations 92.1 to 90.6 m). The DCPTs were terminated upon refusal on probable bedrock at depths ranging from 1.1 to 1.5 m below the existing ground surface (Elevations 91.8 to 91.6 m).

The site was originally overlain by a layer of alluvial topsoil that ranged in thickness from 0.5 to 1.2 m.

With the exception of the south west borehole, the topsoil was underlain by an alluvium deposit of sand and gravel with some clay. The thickness of the deposit ranged from 0.6 to 0.9 m, with the base of the layer lying at Elevations 92.1 to 91.6 m.

Bedrock was encountered below the topsoil in the south west quadrant of the site at a depth of 1.2 m (Elevation 91.8 m), and underlying the sand and gravel in the remaining boreholes at depths



ranging from 1.1 to 1.5 m below the existing ground surface (Elevations. 92.1 to 91.6 m). The original investigation described the bedrock as fine-grained limestone in a “very sound” condition with no sign of fracture or weathering.

Although not specified in the borehole logs, the report stated that the water table was encountered at the ground surface at approximate Elevation 93.3 m. This was a short term observation made prior to the formation of existing approach cuts for this structure, and therefore likely did not represent stabilized groundwater conditions.

4.3 Highway 401 E-N Ramp Bridge over Sucker Creek

The field investigation outlined in Reference 3 consisted of 4 sampled boreholes (labelled 7 to 10) advanced to the north of the Highway 401 bridge over Sucker Creek. The four boreholes were drilled and sampled through the overburden in conjunction with SPTs to depths ranging from 0.3 to 0.8 m below the original ground surface (Elevations 92.7 to 92.5 m). Bedrock was confirmed below the soil sampling depth by coring in two of the boreholes to depths ranging from 3.5 to 3.8 m below the original ground surface (Elevation 89.5 m). The remaining two boreholes were terminated upon refusal on probable bedrock at depths ranging from 0.6 to 0.8 m below the existing ground surface (Elevation 92.7 m).

Silty clay till was encountered from the ground surface to the west of Sucker Creek. The thickness of the till ranged from 0.3 to 0.6 m, with the base of the layer encountered at Elevation 92.7 m. The till was brown to grey in colour and contained trace to some sand and gravel. SPT ‘N’ values in the till ranged from 7 to 9 blows per 0.3 m penetration indicating a firm to stiff consistency.

Silty clay with topsoil was encountered from the ground surface to the east of Sucker Creek. The thickness of the silty clay was 0.8 m and had a base elevation that ranged from 92.7 to 92.5 m. The silty clay was brown in colour. SPT ‘N’ values in the silty clay ranged from 5 to 9 blows per 0.3 m penetration indicating a firm to stiff consistency. Higher ‘N’ values were encountered in this layer directly overlying bedrock and are not representative of the layer.

Bedrock was encountered below the silty clay with topsoil to the east of Sucker Creek at a depth of 0.8 m (Elevations 92.7 to 92.5 m) and bedrock was encountered underlying the silty clay till on the west side of Sucker Creek at depths ranging from 0.3 to 0.6 m (Elevation 92.7 m). Where cored on both sides of the creek, the bedrock was described as fresh, massive, medium to fine crystalline, grey, strong to very strong limestone with interbeds of finely laminated, dark grey to black shaley limestone.



With the exception of a 0.3 m thick zone of highly fractured rock at a depth of 1.7 m below the rock surface near the creek, the fracture index ranged from 1 to 3 fractures per 0.3 m. The measured Rock Quality Designation (RQD) ranged from 42 to 85% indicating poor to good quality.

Strength testing carried out on the rock yielded unconfined compressive strength (UCS) values ranging from 105 to 125 MPa indicating very strong rock. The strength of the rock generally increased with depth.

All boreholes with the exception of the borehole to the immediate west of Sucker Creek were dry upon completion of drilling. The base of the remaining borehole was observed as wet prior to coring bedrock. A piezometer was sealed in the bedrock at this borehole location. The water level was recorded as frozen 0.2 m above the ground surface 5 weeks after completion of drilling (Elevation 93.2 m) and recorded as frozen at the ground surface 3 months after completion of drilling (Elevation 93 m).

The borehole location and strata drawing derived from a GA provided to Golder Associates stated that the normal water level in Sucker Creek is at Elevation 92.6 m with a high water level at Elevation 94.0 m.

It is anticipated that the water level at the site is at or just below the ground surface and is influenced by the creek level. These are short term observations made prior to the formation of existing approach fills for this structure, and therefore likely did not represent stabilized groundwater conditions.

4.4 Highway 401 Bridge over Napanee River

The field investigation outlined in Reference 4 consisted of 9 sampled boreholes to depths of 12.2 to 24.7 m below the original ground surface (Elevations 73.8 to 61.3 m). Six of the boreholes were drilled for the proposed bridge abutments, and three of the boreholes were drilled for the approach fills along the proposed Highway 401 centreline. Soil sampling was conducted in conjunction with SPTs, and Shelby Tubes were collected for undisturbed sampling of clay soils.

The surficial soils at the original ground surface consisted of organic topsoil underlain by very loose to loose silty sand with organic matter, which extended to depths of approximately 1.7 to 3.5 m (Elevations 84.4 to 82.5 m). SPT 'N' values in the silty sand ranged from 1 to 6 blows per 0.3 m of penetration.

The silty sand deposit was underlain by a 7.4 to 10.8 m thick layer of interbedded silt and clay, which extended to depths from 10.1 to 14.3 m (Elevations 75.9 to 71.7 m). The silt and clay ranged



in consistency from very stiff, based on a maximum undrained shear strength of 117 kPa in the upper part of the layer, decreasing with depth to a minimum undrained shear strength of 19 kPa (soft).

The silt and clay layer is underlain by a 1.2 to 8.4 m thick deposit of silty sand to sand and silt, which ranged to sand with trace silt and extended to depths from 11.3 to 20.7 m (Elevations 74.7 to 65.3 m) where encountered. Gravelly layers were also encountered within the deposit. The deposit varied from very loose to very dense, based on SPT 'N' values ranging from 1 to greater than 100 blows per 0.3 m of penetration.

A sand and silt glacial till deposit with trace gravel and clay was encountered below the above layers, overlying possible limestone bedrock. The glacial till was penetrated in one borehole at a depth of 21.6 m (Elevation 64.3 m), where limestone was encountered. The limestone was not sufficiently penetrated by coring to prove it to be bedrock. The till deposit was compact to very dense, based on SPT 'N' values of 25 to greater than 100 blows per 0.3 m of penetration.

Observed groundwater levels noted on the borehole logs varied between Elevations 85.8 and 85.3 m at the time of the investigation. It is anticipated that the water level at the site is at or just below the ground surface adjacent to the river and is influenced by the river level. These are short term observations made prior to the formation of existing approach fills for this structure, and therefore likely did not represent stabilized groundwater conditions.

4.5 Palace Road Interchange

The field investigation outlined in Reference 5 consisted of 5 sampled boreholes, which were drilled in conjunction with SPTs to depths of 3.7 to 9.1 m below the original ground surface (Elevations 101.5 to 95.4 m) for the Palace Road overpass. Bedrock was confirmed below the sampled depth by coring at all five borehole locations to depths ranging from 5.3 to 9.9 m below the original ground surface (Elevations 98.6 to 94.6 m). DCPTs were advanced adjacent to the fourth and fifth boreholes at the north of the site from surface to depths of approximately 5.2 m and 4.7 m respectively (Elevations 98.1 and 99.8 m).

The site was originally overlain by a layer of dark brown loam containing organic matter. This topsoil ranged in thickness from 0.6 to 1.3 m.

Below the topsoil, the site was underlain by a sand and silt to silty sand till with some gravel and trace organic inclusions. The upper portion of the till was generally loose to compact with SPT 'N' values ranging from 4 to 15 blows for 0.3 m of penetration. However, near the centre of the site, the upper till had SPT 'N' values ranging from 20 to 32 blows for 0.3 m of penetration.



indicating a compact density. The thickness of this layer ranged from 1.5 to 1.8 m, with the base of the layer lying at Elevations 100.5 to 103.8 m. Although this layer was described as clayey though visual identification, laboratory testing on selected samples indicated only trace clay was present.

The lower portion of the till at the north of the site was compact with SPT 'N' values ranging from 16 to 19 blows for 0.3 m of penetration. To the south of the site, the till was compact to very dense with SPT 'N' values ranging from 23 to 62 blows for 0.3 m of penetration. Higher 'N' values were identified in locations with higher gravel contents. The thickness of this layer ranged from 2.1 to 6.8 m, with the base of the layer lying at Elevations 101.5 to 94.9 m.

A layer of sand, gravel, and boulders were identified overlying the bedrock where rock coring was commenced within the till.

Grey limestone bedrock was encountered below the till at depths of 4.6 to 9.6 m, or Elevations ranging from 101.5 to 94.9 m. The original investigation described the limestone bedrock as "fairly sound" with occasional shale and sandstone partings. Core recovery in the bedrock ranged from 0 to 99 % with a majority between 80 and 95%.

Observed groundwater levels in the open boreholes upon completion of drilling varied between Elevations 103.3 and 103.5 m at the time of the investigation. These were short term observations made prior to the formation of existing approach cuts for this structure, and therefore likely did not represent stabilized groundwater conditions.

Artesian conditions were observed at the north west of the site at approximate Elevation 97.1 m. The initial flow rate was $3.2 \times 10^{-5} \text{ m}^3/\text{s}$ but dissipated within a period of two hours.

4.6 Highway 401 Median between County Road 41 and Palace Road

The preliminary pavement investigation outlined in Section 3.2 consisted of 14 power-augered boreholes drilled in June 2016 along the Highway 401 Eastbound and Westbound median shoulders (inside shoulders) to depths from 1.4 to 3.0 m below the existing ground surface.

The pavement boreholes encountered 35 to 125 mm of asphalt at the surface of the median shoulders, which was underlain by granular base and subbase fill layers and extended to depths ranging from 0.5 to 1.1 m below the ground surface. The underlying subgrade soils ranged from granular material with variable amounts of sand, gravel and fines to clay with variable amounts of silt, sand, and gravel. Frequent cobbles were noted in the granular subgrade. The pavement



boreholes were drilled into the subgrade soils until reaching a maximum depth of 3.0 m, or until no further penetration (NFP) could be achieved, due to refusal on either rock fill or bedrock.

The boreholes where refusal on possible bedrock occurred were mainly located between Sta. 18+824 (approximately 200 m east of Sucker Creek) and 19+849 Richmond Township (approximately 50 m west of Newburgh Road), where the possible bedrock was encountered at depths from 1.4 to 2.4 m below the ground surface. One borehole at Sta. 10+433 Fredericksburgh Township, just west of the Palace Road interchange, also encountered possible bedrock at a depth of 1.8 m below the ground surface. The boreholes that encountered possible rock fill were terminated at depths from 1.5 to 2.4 m, and were located at Sta. 18+664 Richmond Township (approximately 60 m east of Sucker Creek), and between Sta. 20+362 Richmond Township (approximately 400 m east of Newburgh Road) and 10+040 Fredericksburgh Township (just east of Napanee River).

5. FOUNDATION RECOMMENDATIONS FOR MEDIAN SEWER

Whether the trench subgrade lies in earth, fill or in bedrock can only be determined after supplementary investigation and when the sewer invert profile has been established. However, based on the available information and for planning purposes, the anticipated subgrade is as follows:

| Sewer Section | Anticipated Subgrade |
|-------------------------|---|
| 18+250 to 18+600 | Highway fill, especially at County Road 41, or native earth |
| 18+600 to 19+150 | Through this section, the pavement boreholes indicate rock fill or bedrock. However, the "refusal" in the pavement boreholes is more likely a thin layer of rock fill, which will be underlain by earth. |
| 19+150 to 20+300 | This is basically the stretch where the highway is in a rock cut or nearly at grade. Therefore, unless the sewer invert is very shallow, it should be anticipated that the subgrade will be bedrock and some bedrock excavation may be required to reach the desired profile. |
| 20+300 to Napanee River | In this section, the bedrock surface will be plunging into the buried valley. Accordingly, earth/earth fill/granular fill subgrade would be anticipated except where rock fill has been placed. |
| Napanee River to 10+400 | Anticipated earth/earth fill/granular fill subgrade except where rock fill has been placed |
| 10+400 to 10+700 | In this section, the bedrock surface will be rising from the buried valley and the sewer subgrade will transition from earth/earth fill/granular fill |



| Sewer Section | Anticipated Subgrade |
|---------------|--|
| | to bedrock and some bedrock excavation may be required to reach the desired profile. |

5.1 Excavation and Groundwater Control

It is anticipated that installation of the new median sewer will be carried out by trenching. Based on the available borehole information, the soil stratigraphy encountered along the median typically consists of pavement structure (asphalt on granular) and granular subgrade soils overlying limestone bedrock or possible rock fill. Native soils consisting of clay, silt, and glacial till may also be encountered above the bedrock at some locations.

All excavations should conform to the requirements of the latest edition of the Ontario Occupational Health & Safety Act (OHSA), its regulations and other applicable local regulations. For the purpose of OHSA, the fill, granular subgrade, and native soils above the groundwater level may be classified as Type 3 soils, and soils below the groundwater level as Type 4 soils. Excavated bedrock is considered as Type 1 soil.

In general, shallow, vertically sided excavations in soil not exceeding 3 m in depth may be carried out within roadway protection systems (temporary shoring) or steel trench boxes where applicable. Temporary trench excavations in bedrock may employ vertical sidewalls. Water control in the form of sump pumping will generally be required to maintain dry excavations.

Use of a hydraulic excavator should be suitable for excavation in the fill and native soils. Provision should be made for handling of possible obstructions in the fill, or potential cobbles or boulders in the granular subgrade soils during excavation. Excavation of the limestone bedrock or rock fill may require the use of heavy excavation equipment and rippers, supplemented by pneumatic rock breakers where thick layers of harder rock are encountered.

5.2 Sewer Installation

Prior to placement of the pipe bedding, the base of the trench excavation must be properly dewatered and dry, and free of disturbed or loose soil. In order to confirm uniformity along the alignment, the exposed subgrade should be inspected and approved prior to placing and compacting the bedding. Any identified disturbed/wet soils should be sub-excavated and replaced with compacted granular materials. It is critical that the pipe be supported on well prepared bedding overlying a competent and uniform subgrade in order to minimize the potential for differential settlement.



It is recommended that sewer pipe installation, trenching, backfilling and compacting be carried out in accordance with OPSS.PROV 401, OPSS.PROV 410, OPSS 492 and OPSD 802.030, OPSD 802.031, OPSD 802.032, and OPSD 802.033 as appropriate. Care must be exercised when compacting the fill immediately above the crown of the pipe in order not to damage the pipe. Reference should also be made to OPSS.PROV 501 and OPSS.PROV 1010.

6. FUTURE WORK

A supplemental geotechnical investigation consisting of additional boreholes along the sewer alignment is recommended, with a maximum borehole spacing of 100 m. It is recommended that the boreholes penetrate to a minimum of 1 m below the design subgrade level and to sufficient depth to provide information required for the design of roadway protection. If refusal is encountered at a shallower depth, the boreholes should be completed to full depth by coring to confirm the level of the bedrock surface and the nature and hardness of the rock material to be excavated. Strength testing should be conducted on bedrock core samples to provide sufficient information for the contractor to assess the appropriate equipment for trench excavation in bedrock. Piezometers should be installed in selected boreholes to measure the groundwater level along the sewer alignment.



7. MISCELLANEOUS

Mr. Mark Farrant, P.Eng. and Mr. Alastair Gorman, P.Eng. prepared the Preliminary Foundation Investigation and Design Report. Dr. P.K. Chatterji, P.Eng. a Designated Principal Contact for MTO Foundations projects, reviewed the report.

Thurber Engineering Ltd.



Mark Farrant, P.Eng.
Geotechnical Engineer



Alastair Gorman, P.Eng.
Senior Associate / Senior Geotechnical Engineer



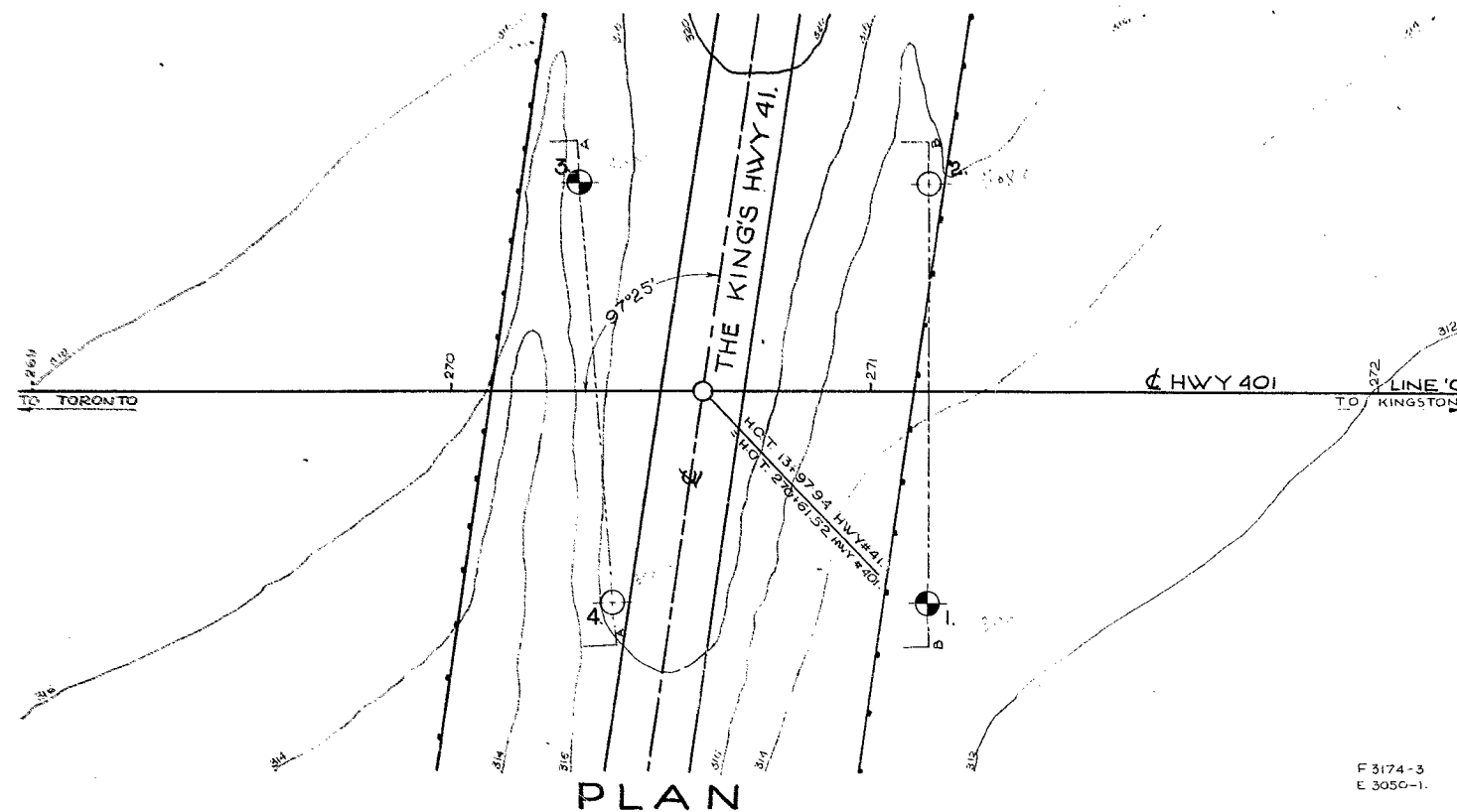
P.K. Chatterji, P.Eng.
Review Principal, Designated MTO Contact



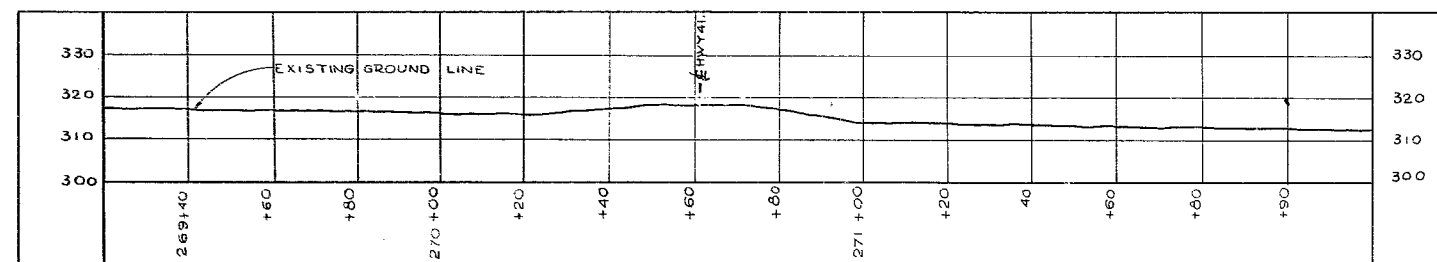
Appendix A

GEOCRES Files

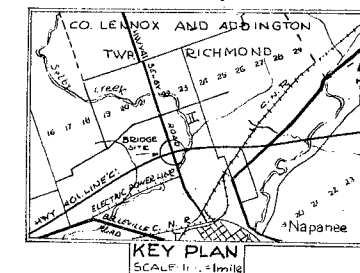
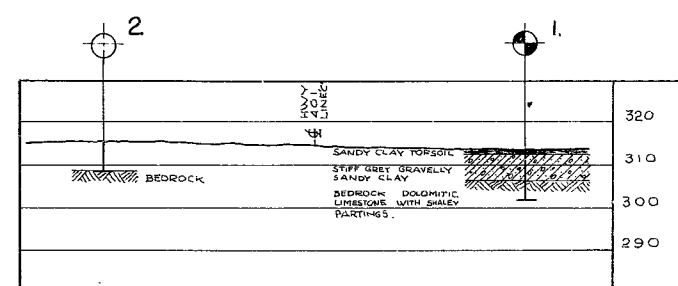
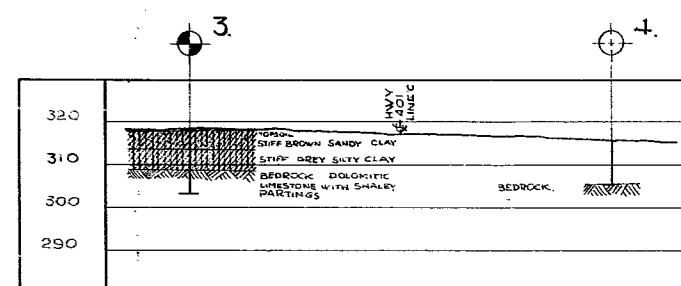
59-F-28
W.P. # 28-59
Hwy. # 401 ;
Hwy. # 41
CROSSING
CON. # 2
1 MILE N. OF
NAPANEE



F 3174-3
E 3050-1.



F 3174-2
4016-42.



LEGEND

BORE & PENETRATION HOLE

PENETRATION HOLE

| HOLE NO. | ELEVATION | STATION | DISTANCE FROM C |
|----------|-----------|---------|-----------------|
| 1. | 313.4 | 271+14 | 50 RT. |
| 2. | 315.8 | 271+14 | 50 LT. |
| 3. | 318.7 | 270+30 | 50 LT. |
| 4. | 315.9 | 270+38 | 50 RT. |

NOTE

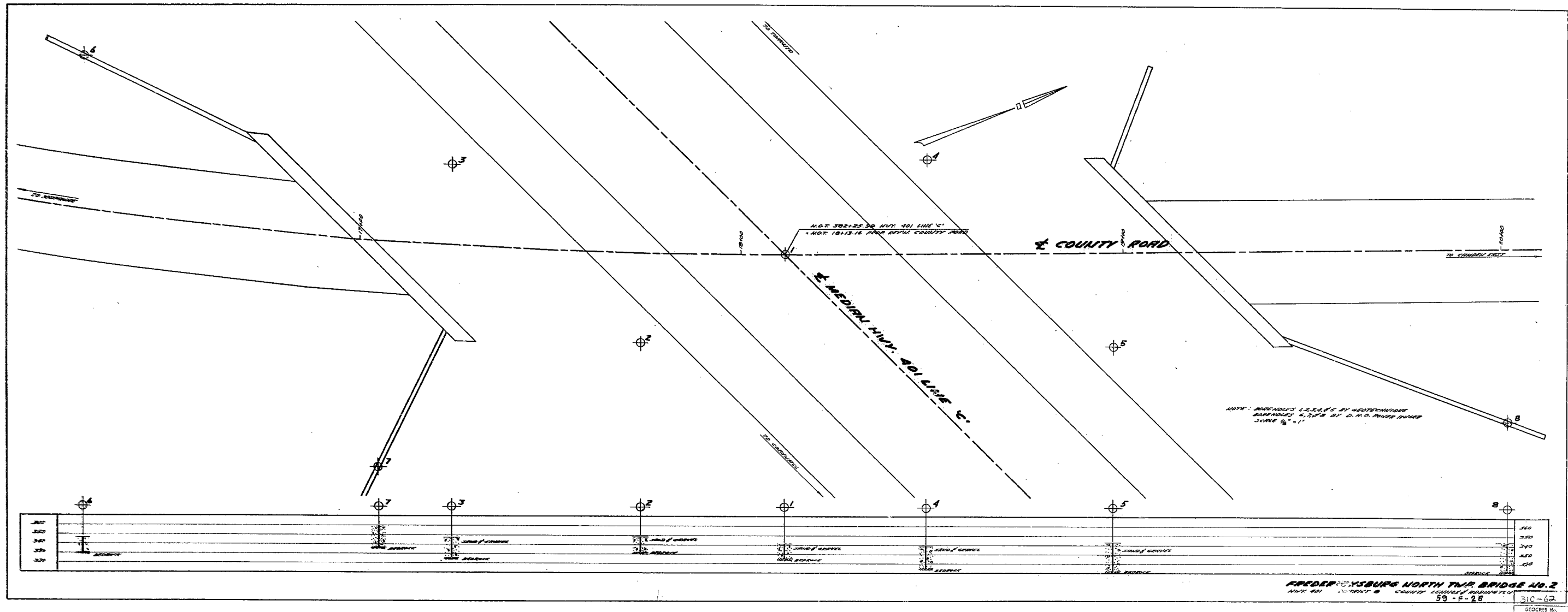
THE BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN ESTABLISHED ONLY AT BORE HOLE LOCATIONS. BETWEEN BORE HOLES THE BOUNDARIES ARE ASSUMED FROM GEOLOGICAL EVIDENCE AND MAY BE SUBJECT TO CONSIDERABLE ERROR.

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH SECTION

HIGHWAY 401 PROPOSED CROSSING

SHOWING POSITIONS & ELEVATIONS OF HOLES

HWY. 401 LINE 'C' DISTRICT 8 COUNTY, LENNOX AND ADDINGTON
TOWNSHIP RICHMOND 101 21 22 CON II
LOCATION 1 mile NORTH OF NAPANEE
DRAWN BY T. SZEGVARY CHECKED BY W.P. 28-59
DATE 1. JUNE 1959 APPROVED BY DRAWING NO.
SCALE 1" = 20' F 59-28A



SUMMARY OF FIELD & LABORATORY TESTS

JOB # - 59 - 28

W.P. 28-59.

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS AND RESEARCH SECTION

W.P. 28-59. BORE HOLE NO. 1
JOB F 59-28. STATION 271/14 (50' Rt.)
DATUM Geodetic COMPILED BY B.K.
BORING DATE April 16/59 CHECKED BY A.L.

LEGEND

SS 1/2 UNCONFINED COMPRESSION (Qu) O
TW VANE TEST (C) AND SENSITIVITY (S) +
NATURAL MOISTURE AND LIQUIDITY INDEX X
LIQUID LIMIT —
PLASTIC LIMIT —

| SYMBOL | DESCRIPTION | ELEV. FEET | DEPTH FEET | STRENGTH AND PENETRATION RESISTANCE | | | |
|--------|---|------------|------------|-------------------------------------|------|------|-------------|
| | | | | 2000 | 4000 | 6000 | 8000 P.S.F. |
| | Ground Level. ∇ | 313.4 | | 50 | | | |
| | Sandy Clay Topsoil | 312.4 | | 100 | | | |
| | Stiff grey gravelly sandy clay. | | 5 | | | | |
| | Bedrock. | 306.2 | | | | | |
| | Dolomitic Limestone with Shaley Partings. | | 10 | | | | |
| | | 301.4 | | | | | |
| | End of Borehole. | | 15 | | | | |
| | | | 20 | | | | |

| CONSISTENCY | SAMPLE | NATURAL UNIT WT. P.C.F. |
|----------------------------|--------|-------------------------|
| | | |
| MOIST. CONTENT - % DRY WT. | | |
| | TW1 | 151.5 |
| | RC | |

Borehole No. 1.

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS AND RESEARCH SECTION

W.P. 28-59. BORE HOLE NO. 2.
JOB F 59-28 STATION 271/14 (50' Lt.)
DATUM Geodetic. COMPILED BY B.K.
BORING DATE April 17/59 CHECKED BY A.L.

LEGEND

| | | |
|----|-----------------------------------|----|
| SS | 1/2 UNCONFINED COMPRESSION (Qu) | 0 |
| TW | VANE TEST (C) AND SENSITIVITY (S) | + |
| | NATURAL MOISTURE AND | LI |
| | LIQUIDITY INDEX | X |
| | LIQUID LIMIT | |
| | PLASTIC LIMIT | |

| SYMBOL | DESCRIPTION | ELEV. FEET | DEPTH FEET | STRENGTH AND PENETRATION RESISTANCE | | | |
|--------|---------------|---------------|---------------|--|------|------|------|
| | | | | 2000 | 4000 | 6000 | 8000 |
| ↓ | Ground Level. | 315.8 | | | 50 | | 100 |
| ///X\\ | Bedrock. | 308.2 | | | | | |

[illegible]

Borehole No. 2

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS AND RESEARCH SECTION

W.P. 28-59. BORE HOLE NO. 3.
 JOB F 59-28. STATION 270+38 (50' Lt.)
 DATUM Geodetic. COMPILED BY B.K.
 BORING DATE April 17/59 CHECKED BY A.L.

LEGEND

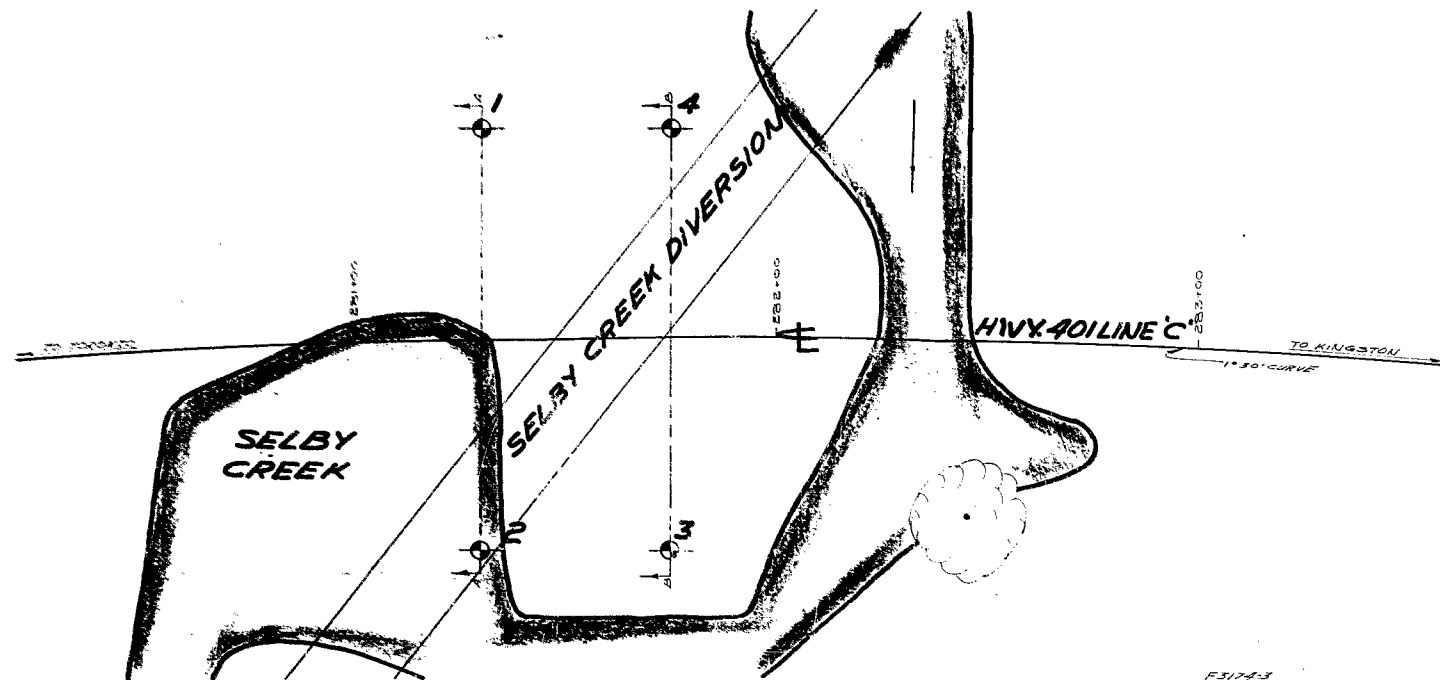
2" DIA. SPLIT TUBE ----- SS
 2" SHELBY TUBE ----- TW
 2" SPLIT TUBE ----- O
 2" DIA. CONE ----- LI
 2" SHELBY ----- X
 CASING -----
 1/2 UNCONFINED COMPRESSION (Q_u) ----- O
 VANE TEST (C) AND SENSITIVITY (S) ----- +
 NATURAL MOISTURE AND LIQUIDITY INDEX ----- LI
 LIQUID LIMIT ----- X
 PLASTIC LIMIT -----

| SYMBOL | DESCRIPTION | ELEV. FEET | DEPTH FEET | STRENGTH AND PENETRATION RESISTANCE | | | |
|--------|---|------------|------------|-------------------------------------|------|------|-------------|
| | | | | 2000 | 4000 | 6000 | 8000 P.S.F. |
| | Ground Level. | 318.7 | | | 50 | | 100 |
| | TOP SOIL | 2" | | | | | |
| | Stiff Brown Sandy Clay. $W_L 7$ | 315.7 | | | | | |
| | | 313.7 | 5 | | | | |
| | Stiff Grey Silty Clay. | | | | | | |
| | | 308.7 | 10 | | | | |
| | Bedrock. | | | | | | |
| | Dolomitic Limestone with Shaley Partings. | 303.7 | 15 | | | | |
| | End of Borehole. | | 20 | | | | |

| CONSISTENCY | SAMPLE | NATURAL UNIT WT. P.C.F. |
|----------------------------|--------|-------------------------|
| MOIST. CONTENT - % DRY WT. | | |
| | TW 1 | 118.0 |
| | SS 2 | 123.5 |
| | RC | |

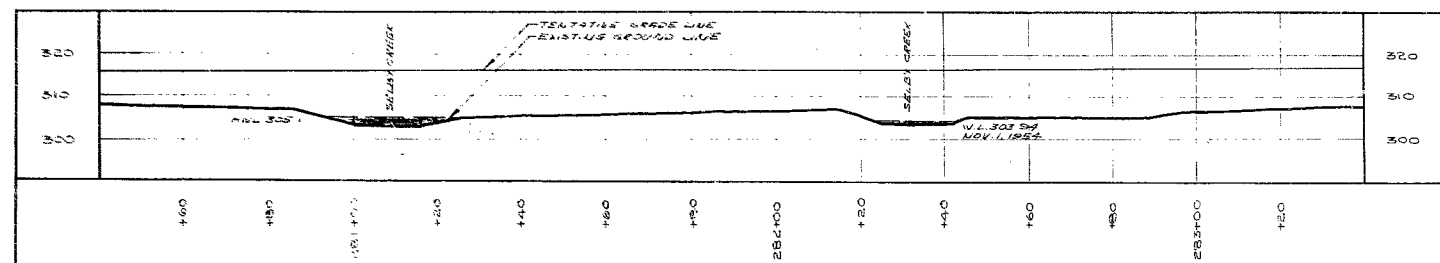
Borehole No. 3.

59-F-25
W.P. # 29-59
Hwy. # 401
SELBY CREEK
DIVERSION
CON. # 2
1 MILE N. OF
NAPANEE



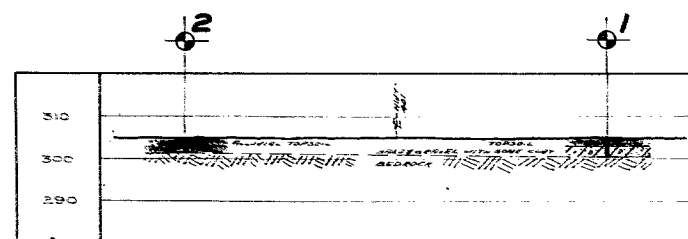
PLAN

F5174-3

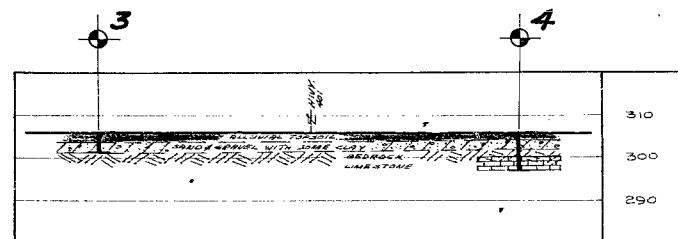


PROFILE

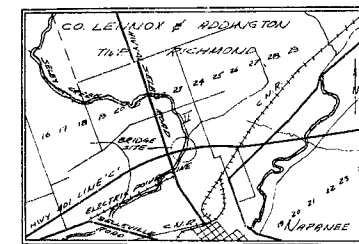
F5174-2
4014-42



A-A



B-B



KEY PLAN
SCALE 1/4" = 1/4 MI.

LEGEND

- BORE HOLE
- PENETRATION HOLE
- BORE & PENETRATION HOLE

| HOLE NO. | ELEVATION | STATION | DISTANCE FROM E |
|----------|-----------|---------|-----------------|
| 1 | 305.0' | 281+30 | 50 FT. |
| 2 | 305.0' | 281+30 | 50 FT. |
| 3 | 306.0' | 281+75 | 50 FT. |
| 4 | 306.0' | 281+75 | 50 FT. |

NOTE

THE BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN ESTABLISHED ONLY AT BORE HOLE LOCATIONS. BORE HOLES THE BOUNDARIES ARE AS SHOWN. EVIDENCE AND MAY BE SUBJECT TO ERROR.

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH SECTION

SELBY CREEK DIVERSION PROPOSED CROSSING

SHOWING POSITIONS & ELEVATIONS OF HOLES

| | | |
|-----------------------------------|-------------|--------------------------|
| HWY 401 | DISTRICT 8 | COUNTY LENOX & ADDINGTON |
| TOWNSHIP RICHMOND | LOT 22 | CON. II |
| LOCATION R.R. 1 MI. N. OF WARRICK | | |
| DRAWN BY T. MELLOWS | CHECKED BY | W.P. 23-59 |
| DATE AUGUST 1959 | APPROVED BY | DRAWING NO. |
| SCALE 1/4" = 20 FT. | | F59-25A |

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS AND RESEARCH SECTION

W.P. 29-59 BORE HOLE NO. 1

JOB F-59-25 STATION 281/30 (50' Lt.)

DATUM Geodetic COMPILED BY B.K.

BORING DATE Apr. 16/59 CHECKED BY A.L.

2" DIA. SPLIT TUBE -----
2" SHELBY TUBE -----
2" SPLIT TUBE -----
2" DIA. CONE -----
2" SHELBY -----
CASING -----

LEGEND

1/2 UNCONFINED COMPRESSION (Qu) --- O
VANE TEST (C) AND SENSITIVITY (S) --- +
NATURAL MOISTURE AND LIQUIDITY INDEX --- LI
LIQUID LIMIT --- X
PLASTIC LIMIT ---

| SYMBOL | DESCRIPTION | ELEV. FEET | DEPTH FEET | STRENGTH AND PENETRATION RESISTANCE | |
|--------|-----------------------------------|---------------|---------------|--|----|
| | | | | P. S. F. BLOWS/FT. | |
| ↓ | Groundlevel | 305.0 | | 10 | 20 |
| | Topsoil | 303.0 | | 30 | 40 |
| | Sand and gravel with some clay | 300.6 | | 7.2 BLOWS PER INCH | |
| | Bedrock | 4.4 | 5 | Refused @ Elev 300.6 | |
| | | | 10 | | |
| | | | 15 | | |
| | | | 20 | | |

[illegible]

Borehole 1

MATERIALS AND RESEARCH SECTION

W.P. 29-59

BORE HOLE NO. 2

JOB F-59-25

STATION 281/30 (50' Rt.)

DATUM Geodetic

COMPILED BY B.K.

BORING DATE Apr. 17/59.

CHECKED BY A.L.

2" DIA. SPLIT TUBE

2" SHELBY TUBE

2" SPLIT TUBE

2" DIA. CONE

2 SHELBY

CASING -

1/2 UNCONFINED COMPRESSION (Qu)

VANE TEST(C)AND SENSITIVITY(S)

NATURAL MOISTURE AND

LIQUIDITY INDEX

LIQUID LIMIT
PLASTIC LIMIT

PLASTIC LINT

| SYMBOL | DESCRIPTION | ELEV. FEET | DEPTH FEET | STRENGTH AND PENETRATION RESISTANCE | |
|--------|------------------|---------------|---------------|--|----------|
| | | | | P.S.F. | |
| | ↓ Groundlevel | 305.0 | | 10 | 20 30 40 |
| | Alluvial topsoil | 301.2 | | Cone Refusal at 301.2 | |
| | Bedrock | 3.8 | 5 | | |
| | | | 10 | | |
| | | | 15 | | |
| | | | 20 | | |

[illegible]

Borehole 2.

DEPARTMENT OF HIGHWAYS - ONTARIO

W.P. 29-59 BORE HOLE NO. 3

JOB F-59-25 STATION 281.75 (50' Rt.)

DATUM Geodetic COMPILED BY B.K.

BORING DATE Apr. 17/59. CHECKED BY A.L.

2" DIA. SPLIT TUBE _ _ _ _ _

2" SHELBY TUBE _ _ _ _ _

2" SPLIT TUBE ————— ○————○

2" DIA. CONE _____

2 SHELBY
CASINO

CASING ----- * *

LEGEND

1/2 UNCONFINED COMPRESSION (Q_u) — 0



VANE TEST (C) AND SENSITIVITY (S) -- +^s

NATURAL MOISTURE AND LI

LIQUIDITY INDEX _ _ _ _ _ X

LIQUID LIMIT _____

PLASTIC LIMIT _____

| SYMBOL | DESCRIPTION | ELEV. FEET | DEPTH FEET | STRENGTH AND PENETRATION RESISTANCE | | | | |
|--|--------------------------------|---------------|---------------|--|----|----|----|-----------|
| | | | | P.S.F. | | | | |
| | ↓ Groundlevel | 306.0 | | 10 | 20 | 30 | 40 | BLOWS/FT. |
| | Alluvial topsoil | 304.0 | | | | | | |
|  | Sand and gravel with some clay | 301.2' | | | | | | |
|  | Bedrock | 4.8' | 5 | | | | | |
| | | | 10 | | | | | |
| | | | 15 | | | | | |
| | | | 20 | | | | | |

[illegible]

Borehole 3.

W.P. 29-59 BORE HOLE NO. 4
JOB F-59-25 STATION 281+76 (50' Lt.)
DATUM Geodetic COMPILED BY B.K.
BORING DATE Apr. 17/59 CHECKED BY A.L.

LEGEND

1/2 UNCONFINED COMPRESSION (Qu) --- O
VANE TEST (C) AND SENSITIVITY (S) --- + S
NATURAL MOISTURE AND LIQUIDITY INDEX --- LI
LIQUID LIMIT --- X
PLASTIC LIMIT ---

Borehole 4.

| SYMBOL | DESCRIPTION | ELEV. FEET | DEPTH FEET | STRENGTH AND PENETRATION RESISTANCE | | | |
|--------|--------------------------------|---------------|---------------|--|----|----|----|
| | | | | P.S.F. | | | |
| | ↓ Groundlevel | 306.0' | | 10 | 20 | 30 | 40 |
| | Alluvial topsoil | 304.5' | | | | | |
| | Sand and gravel with some clay | 302.3' | | | | | |
| | Bedrock | 3.7 | 5 | | | | |
| | Limestone | | | | | | |
| | | 297.2' | | | | | |
| | End of hole | 8.8 | 10 | | | | |
| | | | 15 | | | | |
| | | | 20 | | | | |

[illegible]

Golder Associates Ltd.

2390 Argentia Road
Mississauga, Ontario, Canada L5N 5Z7
Telephone: (905) 567-4444
Fax: (905) 567-6561



REPORT ON

**FOUNDATION INVESTIGATION AND DESIGN
BRIDGE STRUCTURE FOR
E-N RAMP OVER SUCKER CREEK
DETAIL DESIGN – SHORT-TERM INTERCHANGE IMPROVEMENTS
AT HIGHWAY 401 / COUNTY ROAD 41
G.W.P. 331-99-00, AGREEMENT NO. 4005-A-000206
TOWN OF GREATER NAPANEE, EASTERN REGION**

Submitted to:
Earth Tech Canada Inc.
205 Commerce Valley Drive West
Markham, Ontario
L3T 7W3

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Markham, Ontario
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Mississauga, Ontario



April 2003



021-1149-2

| PROJECT 021-1149 | | RECORD OF BOREHOLE No 7 | | | | 1 OF 1 | | METRIC | | | | | | | | |
|--|--|---|--------|------|----------------------------|-------------------|---|--------------------|--|--|--|---|-------------------|--|---|--|
| W.P. 331-99-00 | | LOCATION N 4903019.0; E 267945.9 | | | | ORIGINATED BY PKS | | | | | | | | | | |
| DIST 6 HWY 401 | | BOREHOLE TYPE 108mm I.D. Hollow Stem Augers | | | | COMPILED BY DKB | | | | | | | | | | |
| DATUM Geodetic | | DATE December 12, 2002 | | | | CHECKED BY ASP | | | | | | | | | | |
| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | | | "N" VALUES | SHEAR STRENGTH kPa | | | | | WATER CONTENT (%) | | | |
| 93.4 | GROUND SURFACE | | | | | | <div style="display: flex; justify-content: space-between;"> 20 40 60 80 100 20 40 60 80 100 </div> | | | | | <div style="display: flex; justify-content: space-between;"> 10 20 30 10 20 30 </div> | | | | |
| 0.0 | Silty Clay, trace sand and gravel (TILL) | [Hatched Box] | 1 | SS | 9 | 93 | | | | | | | | | | |
| 92.7 | Firm Brown/grey Moist | [Hatched Box] | | | | | | | | | | | | | | |
| 0.6 | END OF BOREHOLE Refusal on probable bedrock | | | | | | | | | | | | | | | |
| Note: 1. Open borehole dry upon completion of drilling. | | | | | | | | | | | | | | | | |

MISS_MTO 021-1149.GPJ ON_MOT.GDT 22/8/03

| PROJECT 021-1149 | | RECORD OF BOREHOLE No 8 | | | | 1 OF 1 | | METRIC | | | |
|------------------|---|---|---------|------|------------|--|-----------------|---|---------------------------------|--|--|
| W.P. 331-99-00 | | LOCATION N 4903023.0; E 267964.4 | | | | ORIGINATED BY PKS | | | | | |
| DIST 6 HWY 401 | | BOREHOLE TYPE 108mm I.D. Hollow Stem Augers | | | | COMPILED BY DKB | | | | | |
| DATUM Geodetic | | DATE December 12, 2002 | | | | CHECKED BY ASP | | | | | |
| SOIL PROFILE | | | SAMPLES | | | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | 20 40 60 80 100 | W _p W W _L | | |
| 93.0 | GROUND SURFACE | | | | | | | | | | |
| 0.0 | Silty Clay, some sand and gravel (Till) | | 1 | SS | 7 | | | | | | |
| 0.3 | Firm Brown Fresh, massive, medium to fine crystalline, grey, strong to very strong LIMESTONE, with interbeds of finely laminated dark grey to black shaley limestone. Styolitic. Fracturing is bedding -parallel with fresh to slightly altered surfaces. For borehole coring details refer to Record of Drillhole 8. | | | | | | | | | | |
| 89.5 | | | | | | | | | | | |
| 3.5 | END OF BOREHOLE Refusal on probable bedrock Notes: 1. Base of open borehole wet prior to coring bedrock. 2. Water frozen in piezometer at 0.2m above ground surface (El. 93.2m) on January 22, 2003. 3. Water frozen in piezometer at the ground surface (El. 93.0m) on March 18, 2003. | | | | | | | | | | |

MISS_MTO 021-1149.GPJ ON_MCT.GDT 22/8/03

PROJECT: 021-1149

RECORD OF DRILLHOLE: 8

SHEET 2 OF 2

LOCATION: N 4903023.0; E 267964.4

DRILLING DATE: December 12, 2002

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 55 Track Mount

DRILLING CONTRACTOR: Marathon Drilling Ltd.

| DEPTH SCALE METRES | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (m) | RUN No. | CORRECTION | | | | | | | | | | CORRECTION | | | | | | | | | | HYDRAULIC CONDUCTIVITY K _f cm ² /sec | DIAMETRAL POINT LOAD INDEX (MPa) | NOTES WATER LEVELS INSTRUMENTATION |
|-----------------------|-----------------|-----------------|--------------|----------------------------|---------|------------------------------|--|---------------------------------|--|---------|--|------------|--|------------------------|--|------------|--|-----------|--|-------------|--|----------------|--|--|--|--|--|--|
| | | | | | | PENETRATION RATE (mm/min) | | FLUSH | | COLOUR | | % RETURN | | FR/FX-FRACTURE F-FAULT | | J-JOINT | | SM-SMOOTH | | FL-FLEXURED | | BC-BROKEN CORE | | | | | | |
| | | | | | | CL-CLEAVAGE | | SH-SHEAR | | VN-VEIN | | P-POLISHED | | S-SLICKENSIDED | | PL-PLANAR | | R-ROUGH | | UE-UNEVEN | | MB-MECH. BREAK | | | | | | |
| | | | | | | ST-STEPPED | | C-CURVED | | W-WAVY | | B-BEDDING | | | | | | | | | | | | | | | | |
| RECOVERY | | R.Q.D. % | | FRACT. INDEX PER 0.3 | | DISCONTINUITY DATA | | TYPE AND SURFACE DESCRIPTION | | | | | | | | | | | | | | | | | | | | |
| TOTAL CORE % | | SOLID CORE % | | DIP w/1 CORE AXIS | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | | | | | | | | | |
| 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| PROJECT 021-1149 | | RECORD OF BOREHOLE No 9 | | 1 OF 1 | | METRIC | | | | | | | | | | | | | | |
|------------------|--|---|---------|-------------------|------------|--|-----------------|-----------------|--------------------|----------------|---|---|-------------------|----------|-------------|-------------|--|---------------------------------------|--|--|
| W.P. 331-99-00 | | LOCATION N 4903028.9; E 267989.6 | | ORIGINATED BY PKS | | | | | | | | | | | | | | | | |
| DIST 6 HWY 401 | | BOREHOLE TYPE 108mm I.D. Hollow Stem Augers | | COMPILED BY DKB | | | | | | | | | | | | | | | | |
| DATUM Geodetic | | DATE December 12, 2002 | | CHECKED BY ASP | | | | | | | | | | | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | SHEAR STRENGTH kPa | | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT | | | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | 20 40 60 80 100 | 20 40 60 80 100 | W _p | W | W _L | WATER CONTENT (%) | 10 20 30 | γ | GR SA SI CL | | | | |
| 93.3 | GROUND SURFACE | | | | | | | | | | | | | | | | | | | |
| 0.0 | Silty Clay with topsoil Firm Brown Moist | | 1 | SS | 9 | | 93 | | | | | | | | | | | | | |
| 92.5 | | | 2 | SS | 100/15 | | | | | | | | | | | | | | | |
| 0.8 | Fresh, massive, medium to fine crystalline, grey, strong to very strong LIMESTONE, with interbeds of finely laminated dark grey to black shaley limestone. Styolitic. Fracturing is bedding-parallel with fresh to slightly altered surfaces. For borehole coring details refer to Record of Drillhole 9. | | | | | | 92 | | | | | | | | | | | | | |
| | | | | | | | 91 | | | | | | | | | | | | | |
| | | | | | | | 90 | | | | | | | | | | | | | |
| 89.5 | | | | | | | | | | | | | | | | | | | | |
| 3.8 | END OF HOLE Note: 1. Open borehole dry prior to coring bedrock. | | | | | | | | | | | | | | | | | | | |

MISS_MTO 021-1149.GPJ ON_MOT.GDT 22/8/03

SHEET 2 OF 2

DATUM: Geodetic

DRILLING CONTRACTOR: Marathon Drilling Ltd.

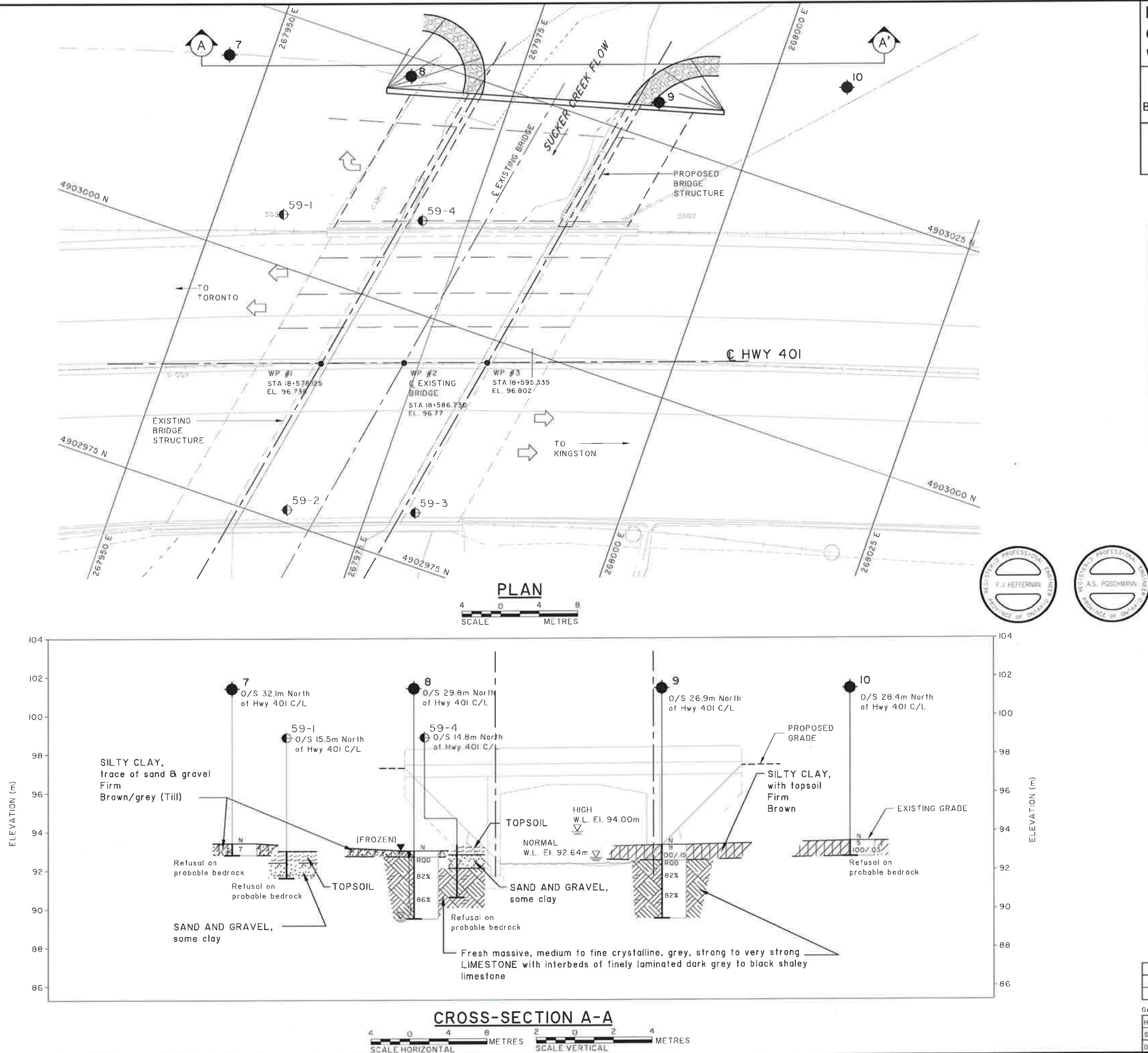
[illegible]

CHECKED: DKB

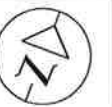


| PROJECT 021-1149 | | RECORD OF BOREHOLE No 10 | | | | 1 OF 1 | | METRIC | | | | | | | |
|------------------|---|---|---------|-------------------|------------|--|-----------------|-----------------|---|---------------------------------|-------------------|-------------|---|---------------------------------------|--|
| W.P. 331-99-00 | | LOCATION N 4903036.7; E 268007.5 | | ORIGINATED BY PKS | | | | | | | | | | | |
| DIST 6 HWY 401 | | BOREHOLE TYPE 108mm I.D. Hollow Stem Augers | | COMPILED BY DKB | | | | | | | | | | | |
| DATUM Geodetic | | DATE December 12, 2002 | | CHECKED BY ASP | | | | | | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT | | REMARKS & GRAIN SIZE DISTRIBUTION (%) | |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | 20 40 60 80 100 | 20 40 60 80 100 | W _p W W _L | WATER CONTENT (%) | 10 20 30 | γ | GR SA SI CL | |
| 93.5 | GROUND SURFACE | | | | | | | | | | | | | | |
| 0.0 | Silty Clay with topsoil Firm Brown Moist | | 1 | SS | 5 | | 93 | | | | | | | | |
| 92.7 | | | 2 | SS | 100/05 | | | | | | | | | | |
| 0.8 | END OF BOREHOLE Refusal on probable bedrock Note: 1. Open borehole dry upon completion of drilling. | | | | | | | | | | | | | | |

MISS. MTO 021-1149.GPJ ON MOT GDT 22/8/03



DIST. HWY. 401
CONT No. 99-232
WP No. 331-99-00



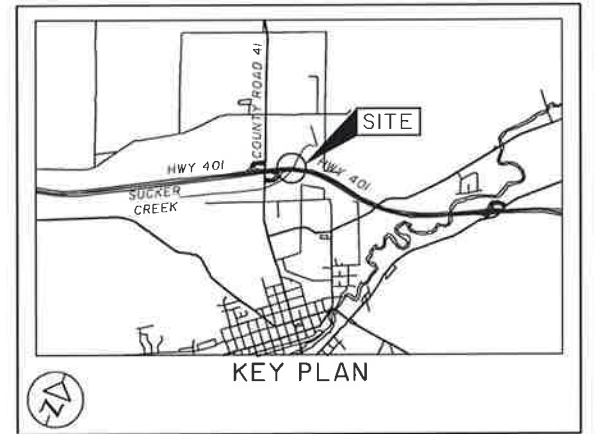
HIGHWAY 401
SUCKER CREEK BRIDGE
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN



LEGEND

- Borehole - Current Golder Associates Ltd. Investigation
- Borehole - Previous MTO Investigation (W.P. 29-59), dated June 1959
- Seal
- Piezometer
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen Test, 475 j/blow)
- 100% Rock Quality Designation (RQD)
- WL in piezometer, on March 18, 2003
- WL in borehole upon completion of drilling

| No. | ELEVATION | CO-ORDINATES | |
|--------|-----------|--------------|----------|
| | | NORTHING | EASTING |
| 7 | 93.4 | 4903019.0 | 267945.9 |
| 8 | 93.0 | 4903023.0 | 267964.4 |
| 9 | 93.3 | 4903028.9 | 267989.6 |
| 10 | 93.5 | 4903036.7 | 268007.5 |
| 59-1 * | 93.0 | 4903005.1 | 267956.6 |
| 59-2 * | 93.0 | 4902976.3 | 267967.1 |
| 59-3 * | 93.3 | 4902980.4 | 267979.7 |
| 59-4 * | 93.3 | 4903009.2 | 267970.5 |

* Northing and Easting coordinates obtained from approximate location of previous boreholes shown on the Control Drawing D-4427-1 (W.P. 29-59), dated December 1959.

NOTES

The boundaries between soil strata have been established only at borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

The complete foundation investigation and design report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview, Information contained in this report and related documents are specifically excluded in accordance with the conditions of Section GC 2.01 of OPS Gen Cond.

REFERENCE

Digital file provided by EARTH TECH (CANADA INC) LONDON, ONTARIO, Titled "HWY 401 SUCKER CREEK BRIDGE GENERAL ARRANGEMENT" Dated Feb. 2003, received Mar. 5, 2003.

| NO. | DATE | BY | REVISION |
|-----|------|----|----------|
| | | | |

Geocres No. _____ PROJECT NO. 02I-II49-2 DIST. _____

HWY. 401 SUBM'D. DKB CHKD. DATE: MAR. 2003 SITE: _____

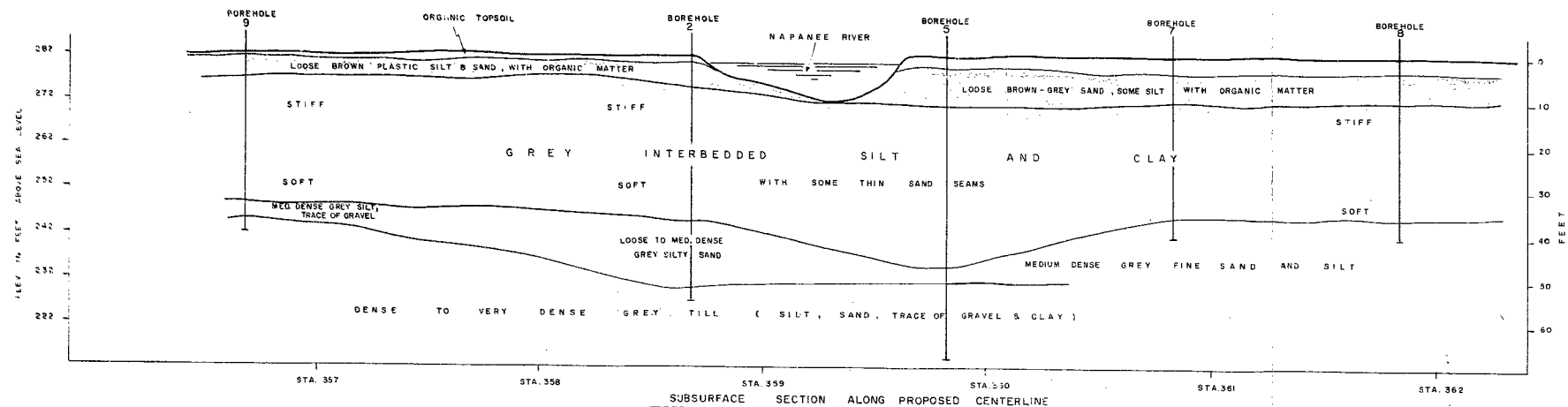
DRAWN: JFC CHKD. APPD. DWG. 1

#58-F-216-C

HWY. #401

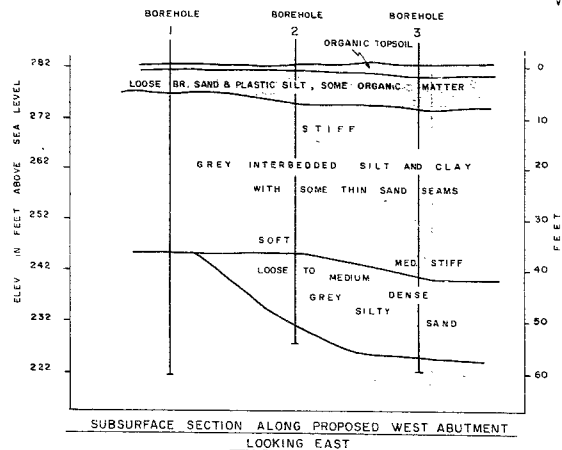
NAPANEE RIVER,

NAPANEE

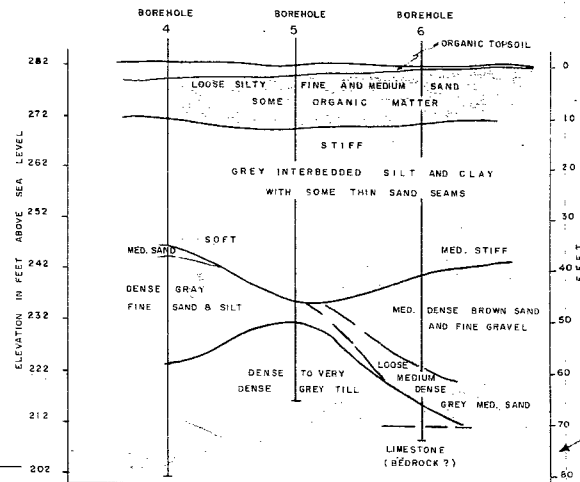


SUBSURFACE SECTION ALONG PROPOSED CENTERLINE

Scale -
 hor. - 1" = 40'
 vert. - 1" = 20'



SUBSURFACE SECTION ALONG PROPOSED WEST ABUTMENT
 LOOKING EAST



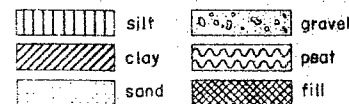
SUBSURFACE SECTION ALONG PROPOSED
 EAST ABUTMENT LOOKING EAST

PROPOSED CROSSING OF NAPANEE RIVER
 AND KING'S HIGHWAY No. 401

JOB No. H415/58 LOCATION HWY. 401 NAIJNEE RIVER
CLIENT DEPARTMENT OF HIGHWAYS ONTARIO
COORDINATES STA. 258 + 70 50' L. OF CL.
ELEV. (surface) 282.9 (collar) — Datum GEOD.
BOREHOLE NUMBER —
DATE (started) MAY 8, 1958 (finished) MAY 12, 1958
RIG No. 1 TYPE JUN. LONGYEAR

HUNTING TECHNICAL AND EXPLORATION SERVICES

BOREHOLE No. 1

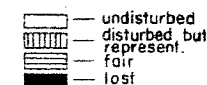


x — standard penetr. 2 s.s.
Δ — vane shear
o — pocket penetrometer

C — consolidation test
M — mechanical analysis
T — triaxial shear
K — permeability
U — unconfined compression

S.S. — split spoon
S.T. — Shelby tube
T.W.P. — thin walled piston
D.B. — diamond bit

SAMPLE CONDITION



| BORING LOG | | | | | FIELD TESTS | | | | | | | LABORATORY TESTS | | | | | |
|--------------|--------------|--------------|----------------------|-----|---|--|-------|---------|-------|---|------|------------------|--|---|------------------------------|------|--|
| SCALE FT. | DEPTH FT. | ELEV. FT. | WATER OBSERVATION | LOG | DESCRIPTION | SHEAR STRENGTH (TONS PER SQUARE FOOT) | | SAMPLES | | | | | | | ATTERBERG LIMITS WP X—O W | | REMARKS |
| | | | | | | 1/2 | 1 1/2 | NO. | COND. | DEPTH | | TYPE | RECOVERY LENGTH REC. DIST. DRIV. | PENETRATION RESISTANCE (BLOWS PER FOOT) | — NATURAL WATER CONTENT | | |
| | | | | | | | | | | STANDARD PENETRATION TEST (BLOWS PER FOOT) | | | | | | FROM | |
| | | | | | | 20 | 40 | 60 | | | | | | | | | |
| | 1.0 | 282.9 | | | BROWN TOPSOIL | | | | | | | | | | | | |
| | | 281.9 | | | | | | | | | | | | | | | |
| 5 | 6.0 | 276.9 | G.W.L. MAY 15 | | LOOSE BROWN PLASTIC SILT AND SAND SOME ORGANIC MATTER | X | | | 1 | | 2-0 | 3-5 | SS | 9/18 | 6 | | |
| | 8.5 | 274.4 | | | STIFF GREY BROWN SILT AND CLAY | X | | | 2 | | 5-0 | 6-5 | SS | 15/18 | 5 | | |
| 10 | | | | | | | | | 3 | | 8-0 | 9-5 | SS | 14/18 | 12 | | |
| | | | | | STIFF GREY INTERBEDDED SILT AND CLAY WITH THIN SAND SEAMS | | | | 4 | | 10-0 | 11-5 | ST | 18/18 | — | | 3" OSTERBERG |
| 15 | | | | | | | | | 5 | | 15-0 | 16-5 | ST | 15/18 | 5 | | |
| 20 | | | | | | | | | 6 | | 20-0 | 21-5 | ST | 18/18 | 2 | | |
| 25 | | | | | | | | | 7 | | 25-0 | 26-5 | ST | 18/18 | — | | 3" OSTERBERG |
| 30 | | | | | | | | | 8 | | 30-0 | 31-5 | ST | 18/18 | 1 | | |
| 35 | | | | | SOFT GREY INTERBEDDED SILT AND CLAY WITH THIN SAND SEAMS | | | | 9 | | 35-0 | 36-5 | ST | 18/18 | — | | 35' END OF H CASING 3" OSTERBERG STONES INFLUENCING VANE READING |
| 40 | 38.5 | 244.4 | | | | | | | 10 | | 40-0 | 41-5 | SS | 12/18 | 55 | | |
| 45 | | | | | VERY DENSE GREY TILL CONSISTING OF SILT AND FINE SAND WITH TRACE OF COARSE SAND, GRAVEL AND CLAY | | | | 11 | | 44-0 | 44-5 | SS | 5/6 | 74/6" | | |
| 50 | | | | | | | | | | | | | | | | | |
| 55 | | | | | | | | | | | | | | | | | |
| 60 | 61.3 | 221.6 | | | END OF BOREHOLE | | | | 12 | | 60-0 | 61-3 | SS | 12/16 | 130 | | |

JOB No. H 415/58 CATION HWY 401 NAPANEE RIVER

CLIENT DEPARTMENT OF HIGHWAYS - ONTARIO

COORDINATES STA. 358+66 48' R. OF CL

ELEV. (surface) 282.7 (coll.) — Datum GEOD.

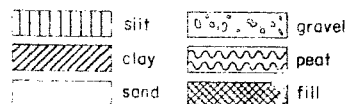
BOREHOLE NUMBER 3

DATE (started) APR. 30, 1953 (finished) MAY 2, 1958

RIG No. 1 TYPE JUN. A LONGYEAR

HUNTING TECHNICAL AND EXPLORATION SERVICES

BOREHOLE No. 3

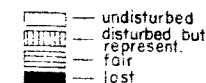


x — standard penetr. 2 s.s.
 Δ — vane shear
 o — pocket penetrometer

C — consolidation test
 M — mechanical analysis
 T — triaxial shear
 K — permeability
 U — unconfined compression





S.S. — split spoon
 S.T. — shelly tube
 T.W.P. — thin walled piston
 D.B. — diamond bit

SAMPLE CONDITION



| BORING LOG | | | | FIELD TESTS | | | | | | | | | | LABORATORY TESTS | | | |
|------------|-------|-------|-------------------|-------------|---|--|-------|---|----|---------|-----|------|------------------|---------------------|--|---|---|
| SCALE | DEPTH | ELEV | WATER OBSERVATION | LOG | DESCRIPTION | SHEAR STRENGTH (TONS PER SQUARE FOOT) | | STANDARD PENETRATION TEST (BLOWS PER FOOT) | | SAMPLES | | | | ATTERBERG LIMITS | | REMARKS | |
| FT | FT | FT | | | | 1/2 | 1 1/2 | 20 | 40 | 60 | No. | COND | DEPTH FROM TO | TYPE | RECOVERY LENGTH REC. DIST. DRIV. | PENETRATION RESISTANCE (BLOWS PER FOOT) | WD X — O W I ● — NATURAL WATER CONTENT |
| | | 282.7 | | | | | | | | | | | | | | | |
| | 2.0 | 280.7 | | | BROWN TOPSOIL | x | | | | | 1 | | 0 1.5 | SS | 18/18 | 1 | |
| 5 | | | | | LOOSE BROWN SAND AND SILT SOME ORGANIC MATTER | x | | | | | 2 | | 3.0 4.5 | SS | 12/18 | 5 | |
| | 6.3 | 276.4 | GW.L | | | | | | | | 3 | | 6.0 7.5 | SS | 15/18 | 1 | |
| | 8.0 | 274.7 | | | LOOSE GREY GRAVEL | x | | | | | 4 | | 9.0 10.5 | ST | 10/18 | 9 | |
| 10 | | | | | STIFF GREY INTERBEDDED SILT AND CLAY WITH THIN SAND SEAMS | Δ | Δ | | | | 5 | | 14.0 15.5 | ST | 18/18 | 5 | |
| 15 | | | | | | Δ | Δ | | | | 6 | | 19.0 20.5 | ST | 15/18 | 4 | |
| 20 | | | | | | Δ | Δ | | | | 7 | | 24.0 25.5 | ST | 18/18 | 1 | END NX CASING 25' |
| 25 | | | | | | Δ | Δ | | | | 8 | | 29.0 30.5 | ST | 18/18 | 1 | |
| 30 | | | | | MEDIUM STIFF GREY INTERBEDDED SILT AND CLAY WITH THIN SAND SEAMS | Δ | Δ | | | | 9 | | 34.0 35.5 | ST | | 0 | PENETRATION BY ROD WEIGHT |
| 35 | | | | | | Δ | Δ | | | | 10 | | 39.0 40.5 | ST | | 1 | 4 BLOWS ON SS 18" RECOVERY |
| | 37.8 | 244.9 | | | GRAVEL LAYER | | | | | | 11 | | 44.0 45.5 | ST | 0/18 | 4 | RECOVERED 16" WITH SS |
| | 38.5 | 244.2 | | | | | | | | | 12 | | 49.0 50.5 | SS | 16/18 | 65* | * SAMPLER STUCK IN CASING |
| 40 | | | | | MEDIUM STIFF GREY VARVED SILT AND CLAY | | | | | | 13 | | 54.0 55.5 | SS | 16/18 | 24 | |
| 45 | | | | | | x | | | | | 14 | | 59.0 60.0 | SS | 5/12 | 150 | END BX CASING 59' - PROBABLE BOULDER AT 60' |
| 50 | | | | | LOOSE TO MEDIUM DENSE GREY SILTY FINE SAND (SOME GRAVEL FRAGMENTS) | | | | | | | | | | | | |
| 55 | | | | | | | | | | | | | | | | | |
| | 57.5 | 225.2 | | | | | | | | | | | | | | | |
| 60 | | | | | VERY DENSE GREY TILL | | | | | | | | | | | | |
| | 60.0 | 222.7 | | | END OF BOREHOLE | | | | | | | | | | | | TILL CONSISTS OF SILT AND SAND WITH SOME FINE GRAVEL AND TRACE OF CLAY |

BOREHOLE No. 4

| SAMPLE | CONDITION |
|---|--------------------------|
|  | undisturbed |
|  | disturbed but represent. |
|  | fair |
|  | lost |

[illegible]




HUNTING TECHNICAL AND EXPLORATION SERVICES




ELEV. (surface) 282.0 (collar) — Datum GEOD.

BOREHOLE NUMBER 5

DATE (started) APR. 16, 1958 (finished) APR. 18, 1958

R:G 1 TYPE JUN. LONGYEAR






 silt
 clay
 sand

 gravel
 peat
 fill

- x — standard penetr. 2 s.s.
- Δ — vane shear
- — pocket penetrometer

C — consolidation test
M — mechanical analysis
T — triaxial shear
K — permeability
U — unconfined compression

S.S. — split spoon
ST. — shelby tube
T.W.P. — thin walled piston
D.B. — diamond bit

| SAMPLE CONDITION | |
|---|--------------|
|  | undisturbed |
|  | disturbed by |
|  | represent |
|  | fair |
|  | lost |

EUSING LOG

FIELD TESTS

LABORATORY TESTS

[illegible]

JOB No. H 415/58 LOCATION HWY 401 NAPANEE RIVER

CLIENT DEPARTMENT OF HIGHWAYS - ONTARIO

COORDINATES STA 359 + 82 50' RT. OF CL.

ELEV (surface) 282.0 (color) — Datum GEOD.

BOREHOLE NUMBER 6

DATE (started) APR. 19, 1958 (finished) APR. 22, 1958

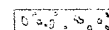
RIG No. 1 TYPE JUN. LONGYEAR

HUNTING TECHNICAL AND EXPLORATION SERVICES

BOREHOLE No. 6



silt



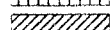
gravel

x — standard penetr. 2 s.s.

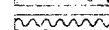
C — consolidation test

SS — split spoon

SAMPLE CONDITION



clay



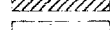
peat

Δ — vane shear

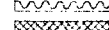
M — mechanical analysis

ST — Shelby tube

— undisturbed



sand



fill

o — pocket penetrometer

T — triaxial shear

T.W.P. — thin walled piston

— disturbed, but representative

K — permeability

D.B. — diamond bit

— lost

U — unconfined compression

BORING LOG

FIELD TESTS

LABORATORY TESTS

| SCALE | | | DEPTH FT | ELEV FT | WATER OBSERVATION | LOG | DESCRIPTION | SHEAR STRENGTH (TONS PER SQUARE FOOT) | | S A M P L E S | | | | | | | ATTERBERG LIMITS | | | REMARKS |
|---|-------|-------|-------------|------------|----------------------|-----|---|--|-------|------------------|------|--|---|--------------------------|-------|-------|---------------------|--|------|----------------------------------|
| 1/2 | | 1/2 | | | | | | No. | COND. | DEPTH FROM TO | TYPE | RECOVERY LENGTH REC. D:ST. DRIV. | PENETRATION RESISTANCE (BLOWS PER FOOT) | WP X—O WL | | | | | | |
| STANDARD PENETRATION TEST (BLOWS PER FOOT) | | | | | | | | | | | | | | NATURAL WATER CONTENT | | | | | | |
| 20 40 60 | | | | 25 50 75 | | | | | | | | | | | | | | | | |
| 1.0 | 282.0 | 281.0 | | | | | ORGANIC TOPSOIL | X | | 1 | | 0 | 1.5 | SS | 13/18 | 2 | | | | |
| 5 | | | | | | | VERY LOOSE SILTY FINE AND MEDIUM SAND WITH ORGANIC MATTER | X | | 2 | | 5.0 | 6.5 | SS | 13/18 | 2 | | | | |
| 10 | 11.3 | 270.7 | | | | | | X | | 3 | | 10.0 | 11.5 | SS | 18/18 | 3 | | | | |
| 15 | | | | | | | STIFF GREY INTERBEDDED SILT AND CLAY WITH SOME THIN SAND SEAMS | | | 4 | | 15.0 | 16.5 | ST | 13/18 | 14 | | | 2.25 | 1.50 |
| 20 | | | | | | | | | | 5 | | 20.0 | 21.5 | ST | 18/18 | 10 | | | | |
| 25 | | | | | | | | | | 6 | | 25.5 | 27.0 | ST | 13/18 | 4 | | | | |
| 30 | | | | | | | | | | 7 | | 30.0 | 31.5 | ST | 18/18 | 4 | | | | |
| 35 | | | | | | | MEDIUM STIFF GREY INTERBEDDED SILT AND CLAY WITH SOME THIN SAND SEAMS | | | 8 | | 35.0 | 36.5 | ST | 14/18 | 1 | | | 0.70 | 0.21 |
| 40 | 40.5 | 241.5 | | | | | | | | 9 | | 40.0 | 41.5 | ST | 18/18 | 1 | | | | |
| 45 | | | | | | | | | | 10 | | 45.0 | 46.5 | SS | 18/18 | 10 | | | | |
| 50 | | | | | | | MEDIUM DENSE BROWN SAND AND FINE GRAVEL | | | 11 | | 50.0 | 51.5 | SS | 0/18 | 20 | | | | RECOVERED WITH SIDE SLIT SAMPLER |
| 55 | | | | | | | | | | 12 | | 55.0 | 56.5 | SS | 0/18 | 16 | | | | " " " " " |
| 60 | 60.0 | 222.0 | | | | | | | | 13 | | 60.5 | 62.0 | SS | 18/18 | 8 | | | | |
| 65 | | | | | | | LOOSE TO MEDIUM DENSE GREY MEDIUM SAND TRACE OF SILT | | | 14 | | 65.0 | 66.5 | SS | 16/18 | 22 | | | | |
| 70 | 71.0 | 211.0 | | | | | MEDIUM DENSE GREY CLAY AND SILT | | | 15 | | 70.0 | 70.5 | ST | 5/5 | 3/5" | | | | REFUSAL WITH 25 BLOWS |
| 73.0 | 209.0 | | | | | | LIMESTONE (?BEDROCK) | | | 16 | | 70.4 | 71.0 | SS | 6/7 | 10/7" | | | | |
| 75 | | | | | | | END OF BOREHOLE | | | 17 | | 71.0 | 73.0 | DB | 24/24 | - | | | | |

| RIG | No | I | TYPE | JUN. | LONG | YEAR |
|-----|----|---|------|------|------|------|
|-----|----|---|------|------|------|------|

BOREHOLE No. 7

○ — pocket penetrometer





100

K — permeability

U — unconfined compression

D.B. — diamond bi

SAMPLE CONDITION

 — undisturbed
 — disturbed but represent.
 — fair
 — lost

[illegible]

CLIENT DEPARTMENT OF HIGHWAYS - ONTARIO
COORDINATES STA 361 + 84 CL.

HUNTING TECHNICAL AND EXPLORATION SERVICES







BOREHOLE No. 8

Elev. (surface) 281.0 (collar) — Datum GEOD.

BOREHOLE NUMBER -- 8

DATE (started) APR. 26, 1958 (finished) APR. 26, 1958

| R.G. | No. | I | TYPE | JUN. | LONG | YEAR |
|------|-----|---|------|------|------|------|
|------|-----|---|------|------|------|------|





| | | | |
|---|------|---|--------|
|  | silt |  | gravel |
|  | clay |  | peat |
|  | sand |  | fill |

x — standard penetr. 2 S.S.
 Δ — vane shear
 o — pocket penetrometer

C — consolidation test
M — mechanical analysis
T — triaxial shear
K — permeability
U — unconfined compression

S.S. — split spoon
S.T. — shelby tube
T.W.P. — thin walled piston
D.B. — diamond bit

SAMPLE CONDITION

 — undisturbed
 — disturbed but represent.
 — fair
 — lost

BOPING LOG

FIELD TESTS

LABORATORY TESTS

[illegible]

BORING LOG

FIELD TESTS

LABORATORY TESTS

[illegible]

| | | | |
|---------------------------|----|----------|--|
| SHEAR | | STRENGTH | |
| (TONS PER SQUARE FOOT) | | | |
| 1/2 | 1 | 1 1/2 | |
| STANDARD PENETRATION TEST | | | |
| (BLOWS PER FOOT) | | | |
| 20 | 40 | 60 | |

| S A M P L E S | | | | | |
|---------------|------|------------------|------|--|---------------------------|
| No. | COND | DEPTH FROM TO | TYPE | RECOVERY LENGTH REC. DIST. DRIV. | PENETRATION RESISTANCE |
| | | | | | |

ATTERBERG
 LIMITS WP X—O w
 ● — NATURAL
 WATER CONTENT

[illegible]

| TESTS | |
|-------|---------|
| | REMARKS |

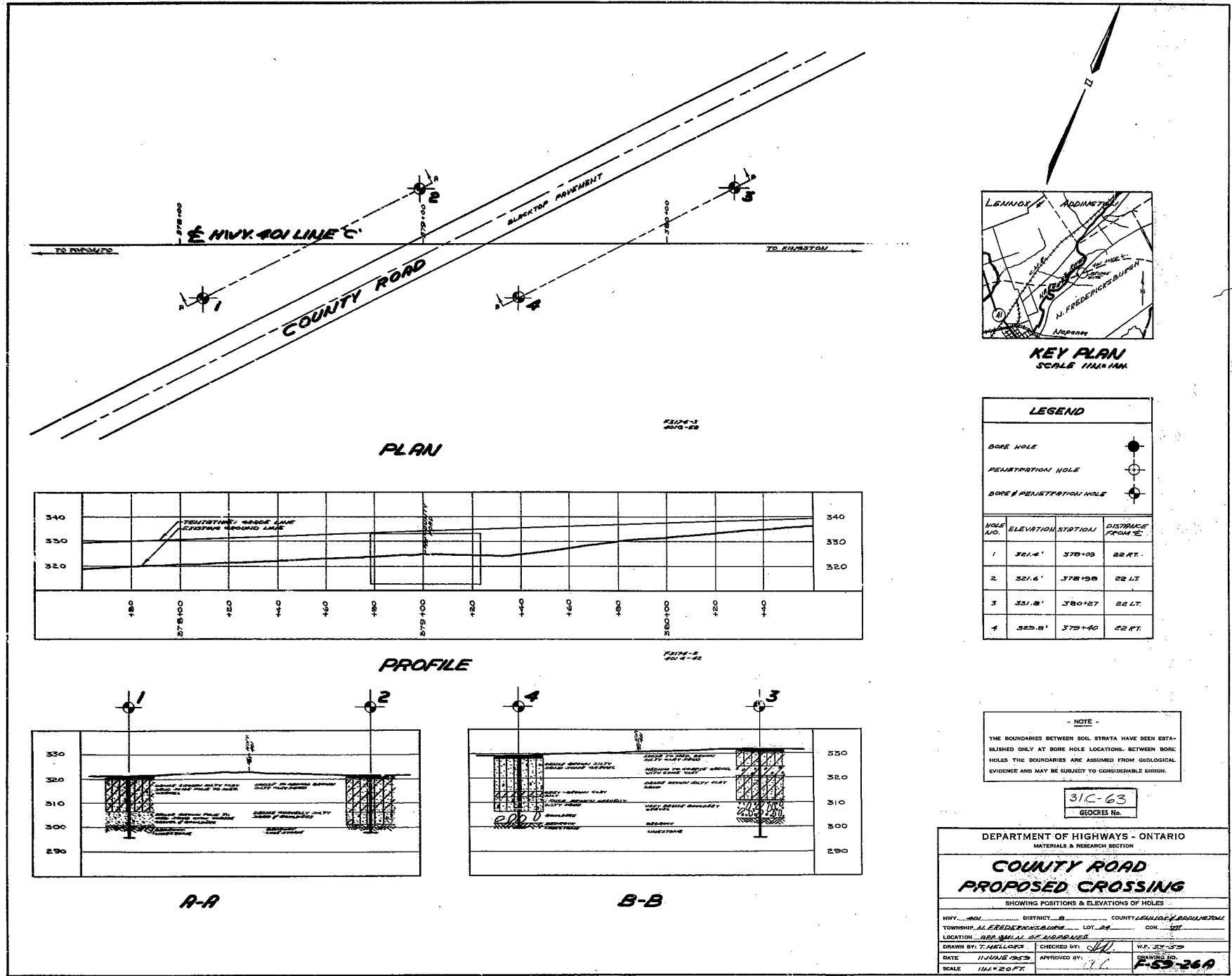
W.P. 33-59

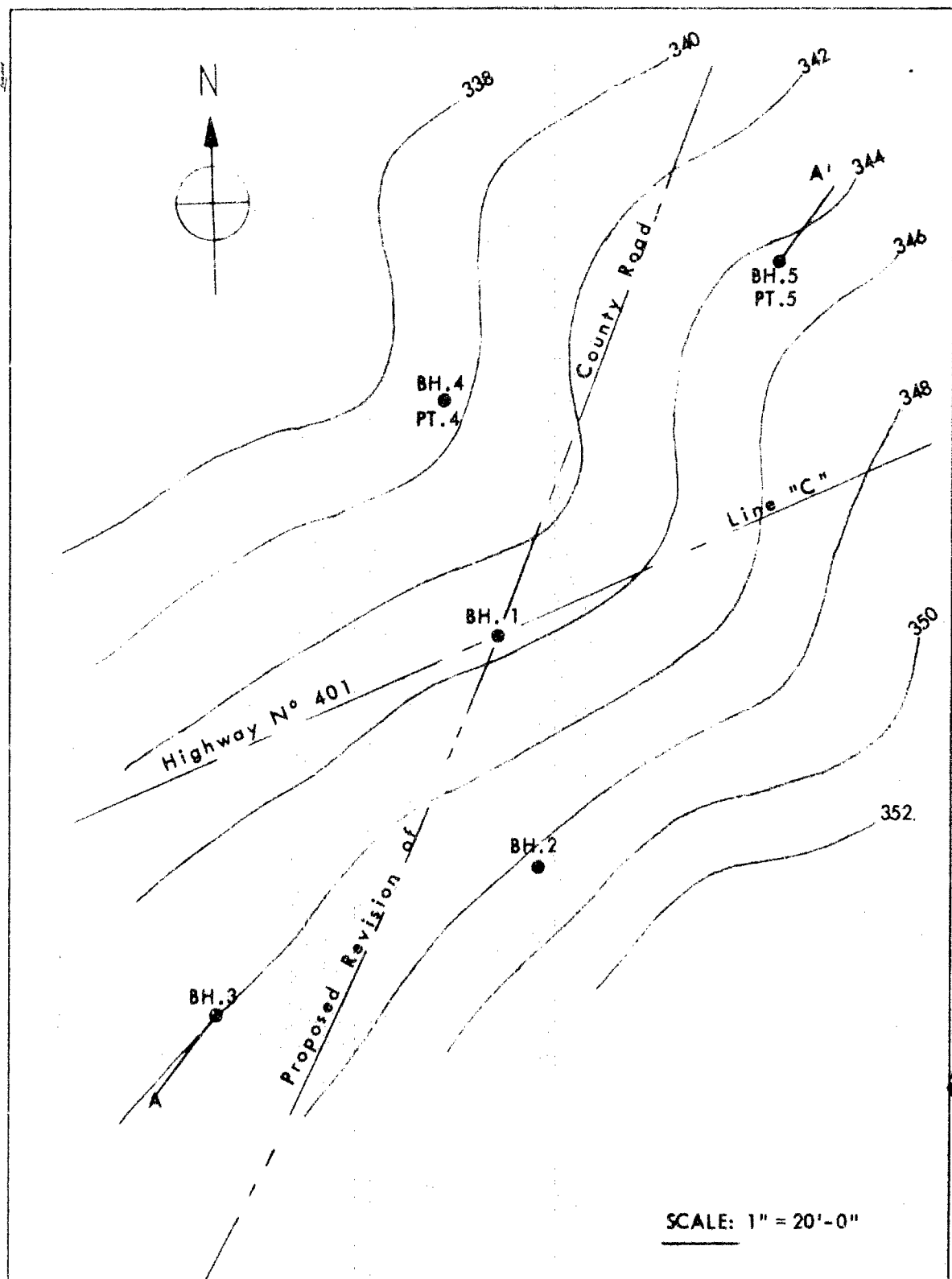
HWY. 401

COUNTY ROAD

PROP. CROSSING

31C-63





This sketch is a copy of part of plan E-3689-1 supplied by D.H.O.

PROJECT Proposed Crossing Hwy. 401 - Line "C"
Napanee

TITLE Borehole Location Plan

DRG NO. 2 ORDER NO. T.411/59

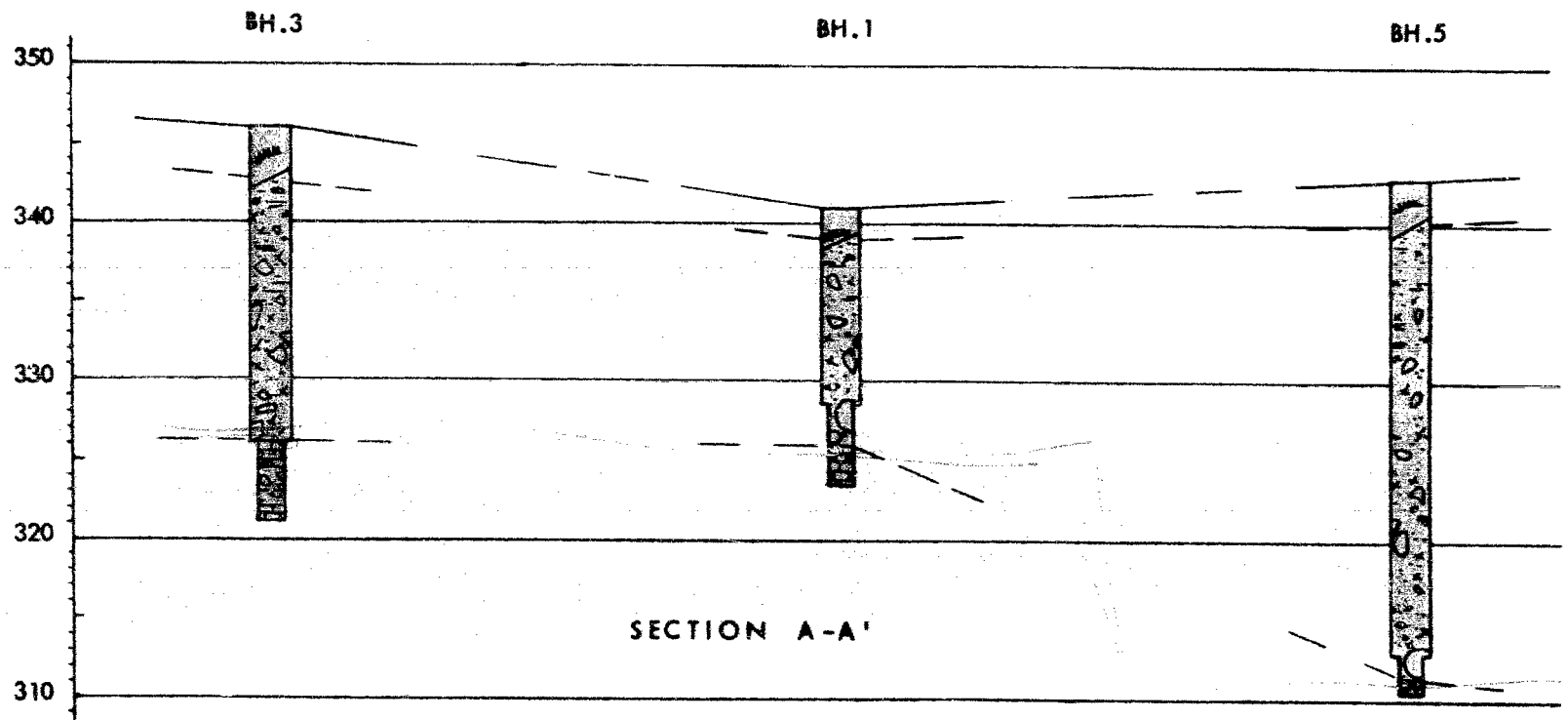


UNIVERSAL
GEOTECHNIQUE
LIMITED

PROJECT Proposed Crossing Hwy. 401 - Line "C"
TITLE Geological Section
DRG. NO. 3 ORDER NO. T.411/59



UNIVERSAL
GEOTECHNIQUE
LIMITED



LEGEND

- | | |
|--|------------|
| | TOP SOIL |
| | SANDY TILL |
| | BEDROCK |

SCALE

Horizontal 1" = 20'-0"
Vertical 1" = 10'-0"


SOIL MECHANICS LABORATORY

BOREHOLE LOG

PROJECT Proposed Crossing Hwy. 401 - Line "C", Napanee, Ontario ORDER NO. I.411/59
 CLIENT Ontario Department of Highways W.P. 33-59

BOREHOLE NO. BH.1 DIAMETER 2-1/2" & AX CASING BX

BOREHOLE LOCATION See Sketch INCLINATION Vertical BEARING ---

| DESCRIPTION OF STRATA | ELEVATION | LEGEND | SAMPLE | DEPTH | THICKNESS | N | REMARKS |
|--|-----------|--|--------|-----------------|-----------|--------|-----------------------------------|
| Dark brown loam with organic matter. TOP SOIL. | +341.0 |  | | Zero | | | |
| Loose brown somewhat clayey SAND with gravel & some organic matter. | | | • 1 | | | 5 | Wet. Medium to high dry strength. |
| Firm brown somewhat clayey silty SAND with fine to medium subangular gravel. | | | • 2 | | | 20 | do |
| Firm to dense do | | | • 3 | | | 32 | do |
| Firm brown silty SAND with fine to medium subangular gravel. | | | • 4 | | | 23 | Wet. Medium dry strength. |
| do | | | • 5 | 12'-3" | | 62(3") | do High N due to gravel. |
| Sand and gravel. | | | | 15'-0" | | | |
| Grey crystalline limestone. Varied jointing. Fairly sound rock. | | | | 17'-6" | | | 15' to 17'-6" core recovery 99%. |
| | | | | End of Borehole | | | |

SCALE: 1" = 5'-0" • DISTURBED SAMPLE

■ UNDISTURBED SAMPLE

SOIL MECHANICS LABORATORY

BOREHOLE LOG

PROJECT Proposed Crossing Hwy. 401 - Line "C", Napanee, Ontario ORDER NO. T.411/59
W.P. 33-59CLIENT Ontario Department of HighwaysBOREHOLE NO. BH.2 DIAMETER 2-1/2" & AX CASING BXBOREHOLE LOCATION See Sketch INCLINATION Vertical BEARING ---FORM G-1A 800
UNITED STATES GEOLOGICAL SURVEY

| DESCRIPTION OF STRATA | ELEVATION | LEGEND | SAMPLE | DEPTH | THICKNESS | N | REMARKS |
|---|-----------|--------|--------|-----------------|-----------|----|-------------------------------------|
| Dark brown loam with organic matter. TOP SOIL. | + 348.0 | | | Zero | | | |
| Dark brown silty SAND with gravel and some organic matter. | | | 1 | | | 5 | Damp. Medium dry strength. |
| Loose brown somewhat clayey silty SAND with fine to coarse subangular gravel. Some gravel decomposed. | | | 2 | | | 4 | Moist. Medium to high dry strength. |
| do | | | 3 | | | 5 | (8") do |
| Decomposed boulder | | | 4 | | | 43 | (4") |
| Brown fine to coarse SAND with gravel. | | | 5 | | | | |
| Firm light brown silty generally fine SAND with fine to medium subangular gravel. | | | 6 | | | 23 | Wet. Medium dry strength. |
| Dense light brown generally fine SAND with some fine gravel. | | | 7 | | | 55 | Wet. Low dry strength. |
| Dark argillaceous limestone with black shale partings. Exhibits horizontal bedding. Jointing from parallel to 45° to core length. Sound rock. | | | | 15'-0" | | | 15'-0" to 19'-8" core recovery 99% |
| do | | | | | | | 19'-8" to 21'-6" core recovery 90% |
| do | | | | | | | 21'-6" to 23'-4" No recovery. |
| At 24' to 24'-9" grey limestone. Broken core. | | | | | | | 23'-4" to 25'-0" core recovery 70% |
| Grey to dark grey limestone with black shale partings. Includes breccia containing sandstone fragments. Some jointing parallel to 20° to core length. Horizons of solution cavities. Probable healed fault zone. Fairly sound rock. | | | | 30'-0" | | | 25'-0" to 30'-0" core recovery 95% |
| | | | | End of Borehole | | | |

SCALE: 1" = 5'-0" • DISTURBED SAMPLE

■ UNDISTURBED SAMPLE

SOIL MECHANICS LABORATORY

BOREHOLE LOG

PROJECT Proposed Crossing Hwy. 401 - Line "C", Napanee, Ontario ORDER NO. L411/59

CLIENT Ontario Department of Highways W.P. 33-59

BOREHOLE NO. BH.3 DIAMETER 2-1/2" & AX CASING BX

BOREHOLE LOCATION See Sketch INCLINATION Vertical BEARING ---

FORM G-1A 800
UNIVERSAL LTD.

| DESCRIPTION OF STRATA | ELEVATION | LEGEND | SAMPLE | DEPTH | THICKNESS | N | REMARKS |
|---|-----------|--------|--------|-----------------|-----------|----|-------------------------------------|
| | +346.0 | | | Zero | | | |
| Dark brown loam with organic matter. TOP SOIL. | | | • 1 | | | 4 | Damp |
| Loose brown somewhat clayey silty fine to coarse SAND with fine subangular gravel. Traces of organic matter. | | | • 2 | | | 7 | Moist. Medium to high dry strength. |
| Loose brown somewhat clayey silty SAND with fine to medium subangular gravel, pockets of medium to coarse sand. | | | • 3 | | | 7 | Wet. Medium to high dry strength. |
| Dense light brown silty fine to coarse SAND with fine to medium subangular gravel. | | | • 4 | | | 43 | Wet. Medium dry strength. |
| do | | | • 5 | | | 39 | Moist. Medium dry strength. |
| | | | • 6 | | | 34 | do |
| | | | • 7 | 19'-10" | | 16 | (10") No recovery |
| 20' to 22' grey to dark grey argillaceous limestone. Occasional shale partings. | | | | | | | 20'-0" to 25'-0" core recovery 95% |
| 22' to 24' breccia includes sandstone fragments. | | | | | | | |
| 24' to 25' grey sandy limestone with solution cavities. Some jointing at 45° to core length. | | | | 25'-0" | | | |
| | | | | End of Borehole | | | |

SOIL MECHANICS LABORATORY

BOREHOLE LOG

PROJECT Proposed Crossing Hwy. 401 - Line "C", Napanee, Ontario ORDER NO. T.411/59

CLIENT Ontario Department of Highways W.P. 33-59

BOREHOLE NO. BH.4 DIAMETER 2-1/2" & AX CASING BX

BOREHOLE LOCATION See Sketch INCLINATION Vertical BEARING ---













| DESCRIPTION OF STRATA | ELEVATION | LEGEND | SAMPLE | DEPTH | DI. CASING | N | REMARKS |
|--|-----------|-------------|--------|-----------------|------------|----|--|
| Dark brown loam with organic matter. TOP SOIL. | + 339.0 | UNDISTURBED | • 1 | Zero | | 4 | Moist. |
| Very loose brown somewhat clayey silty generally fine SAND with fine to medium subangular gravel. Some organic concentrations. | | | • 2 | | | 2 | Wet. Medium to high dry strength. |
| Loose light brown somewhat clayey silty SAND with fine subangular gravel. | | | • 3 | | | 11 | do |
| | | | • 4 | | | 23 | No recovery. |
| Firm light brown generally fine silty SAND with fine to coarse subangular gravel. | | | • 5 | artesian | | 34 | Moist. Low to medium dry strength. High N due to gravel. Water under artesian pressure rising to 340'. |
| | | | • 6 | 20'-0" | | - | Wash sample 20'-0" to 22'-6" core recovery 50%. |
| Sand, gravel & boulders. | | | | 22'-6" | | | 22'-6" to 25'-0" core recovery 80%. |
| Grey limestone with varied jointing. Broken core. | | | | 25'-0" | | | |
| | | | | End of Borehole | | | |

SCALE: 1" = 5'-0" • DISTURBED SAMPLE

■ UNDISTURBED SAMPLE

SOIL MECHANICS LABORATORY

BOREHOLE LOGPROJECT Proposed Crossing Hwy. 401 - Line "C", Napanee, Ontario ORDER NO. I.411/59CLIENT Ontario Department of Highways W.P. 33-59BOREHOLE NO. BH.5 DIAMETER 2-1/2" & AX CASING BXBOREHOLE LOCATION See Sketch INCLINATION Vertical BEARING ---

| DESCRIPTION OF STRATA | ELEVATION | LEGEND | SAMPLE | DEPTH | THICKNESS | N | REMARKS |
|--|-----------|---|-----------------|--------|-----------|----|--|
| | +343.0 | | | Zero | | | |
| Dark brown loam with organic matter. TOP SOIL. | |  | • 1 | | | 6 | Damp. |
| | |  | • 2 | | | 10 | Wet. No recovery. |
| Brown to grey generally fine silty SAND. Little clay. | |  | • 3 | | | 15 | Wet. No recovery. 7' - 10' wash sample. |
| Firm brown generally fine silty SAND with fine to medium subangular gravel. | |  | • 4 | | | 19 | Moist. Medium dry strength. |
| do | |  | • 5 | | | 16 | do |
| Light brown fine silty SAND with fine to medium subangular gravel. | |  | • 6 | | | - | |
| Firm brown somewhat silty fine to coarse SAND with fine to medium subangular gravel. | |  | • 7 | | | 16 | Moist. Low to medium dry strength. |
| Firm brown generally medium to coarse SAND with fine gravel. | |  | • 8 | | | 18 | Wet. Low dry strength. |
| do | |  | • 9 | | | - | do |
| Sand, gravel & boulders. | |  | | 30'-0" | | | |
| Grey argillaceous limestone with joints at 20° to core length. | |  | | 31'-6" | | | 30' to 31'-6" core recovery 20% |
| Broken core. | |  | | 32'-6" | | | 31'-6" to 32'-6" core recovery 75%. |
| | | | End of Borehole | | | | |

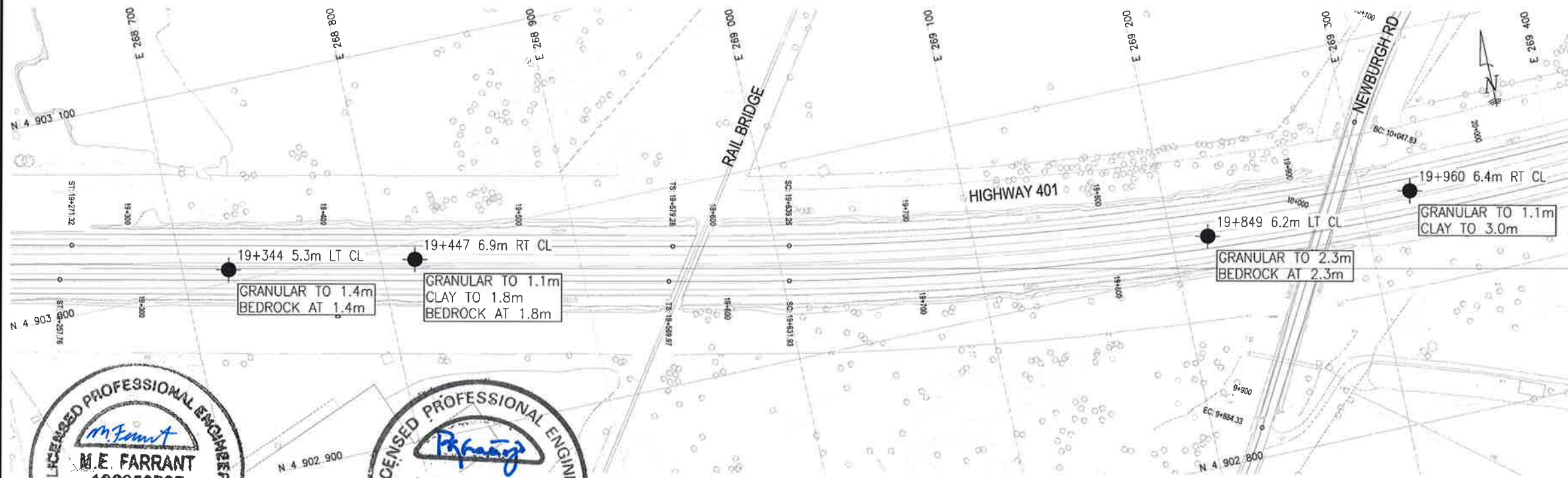
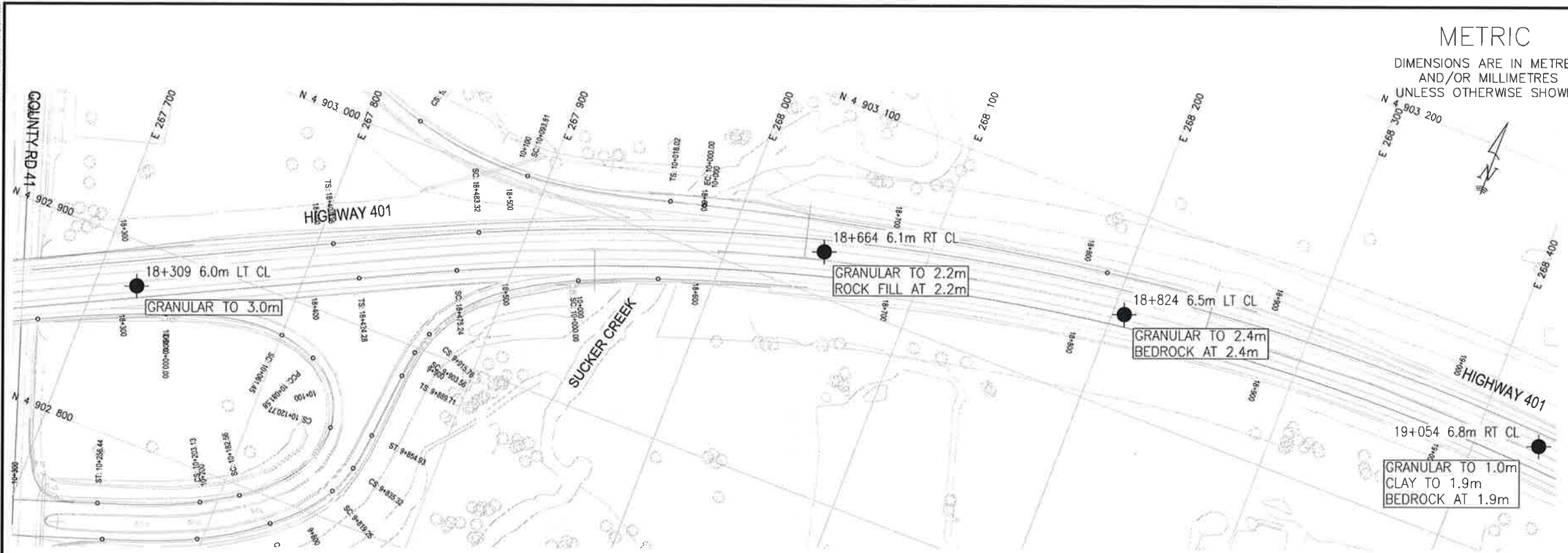
SCALE: 1" = 5'-0" • DISTURBED SAMPLE

■ UNDISTURBED SAMPLE



Appendix B

Pavement Investigation Borehole Logs



METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

GWP No 4459-04-00
/4197-13-00

HIGHWAY 401 MEDIAN SEWER
COUNTY RD 41 INTERCHANGE
TO PALACE RD INTERCHANGE
BOREHOLE LOCATIONS PLAN

SHEET

AECOM



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

| | |
|------|---------------------------------------|
| ● | Borehole |
| ⊙ | Borehole and Cone |
| N | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE | Blows /0.3m (60° Cone, 475J/blow) |
| PH | Pressure, Hydraulic |
| ▽ | Water Level |
| ⬇ | Head Artesian Water |
| ⬆ | Piezometer |
| 90% | Rock Quality Designation (RQD) |

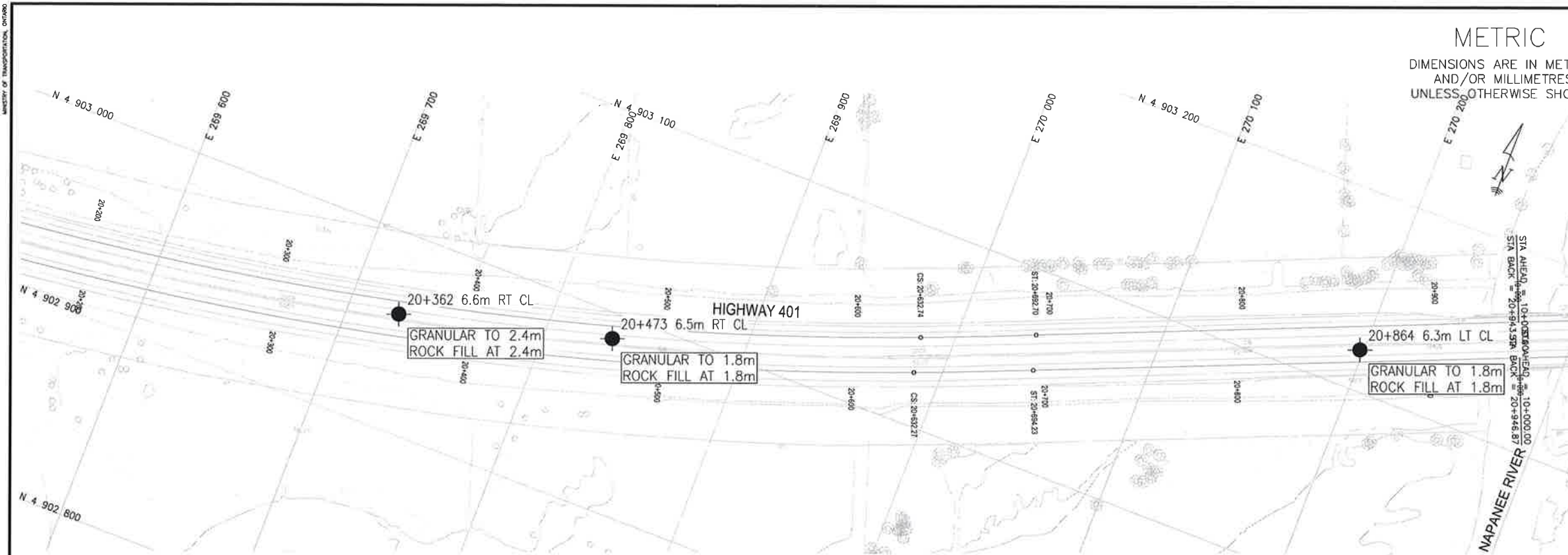
| NO | ELEVATION | NORTHING | EASTING |
|-------------------|-----------|-------------|-----------|
| 10+040 2.4m RT CL | — | 4 903 172.0 | 270 309.8 |
| 10+433 5.8m LT CL | — | 4 903 317.0 | 270 675.2 |
| 10+555 6.8m RT CL | — | 4 903 369.8 | 270 785.3 |
| 18+309 6.0m LT CL | — | 4 902 877.9 | 267 720.9 |
| 18+664 6.1m RT CL | — | 4 903 022.5 | 268 048.2 |
| 18+824 6.5m LT CL | — | 4 903 048.2 | 268 206.0 |
| 18+824 6.5m LT CL | — | 4 903 006.5 | 268 723.0 |
| 19+447 6.9m RT CL | — | 4 902 991.5 | 268 817.6 |
| 19+849 6.2m LT CL | — | 4 902 917.0 | 269 218.6 |
| 19+880 6.4m RT CL | — | 4 902 917.7 | 269 325.4 |
| 20+362 6.6m RT CL | — | 4 902 959.2 | 269 725.9 |
| 20+473 6.5m RT CL | — | 4 902 987.0 | 269 833.7 |
| 20+864 6.3m LT CL | — | 4 903 120.7 | 270 198.1 |

-NOTES-

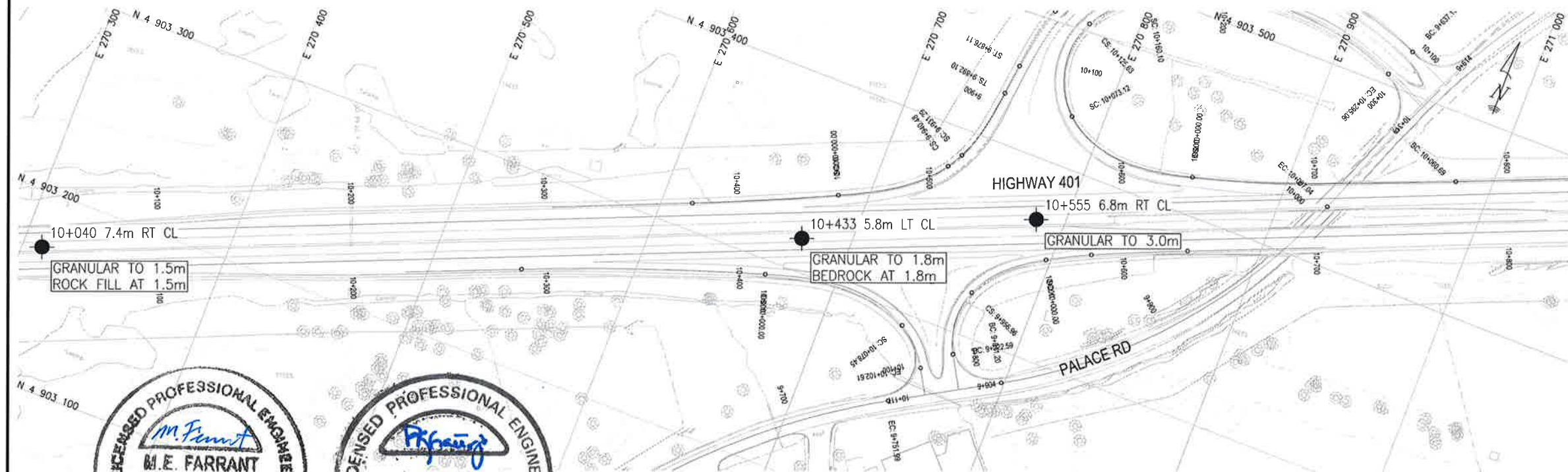
- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCREs No.

| REVISIONS | DATE | BY | DESCRIPTION |
|-----------|------|---------|---------------|
| DESIGN | MEF | CHK AEG | CODE |
| DRAWN | AN | CHK MEF | SITE |
| | | | STRUCT |
| | | | DWG 1 |
| | | | DATE FEB 2018 |



PLAN
50 0 50 100m
SCALE 1:2500



PLAN
50 0 50 100m
SCALE 1:2500

GWP No 4459-04-00
/4197-13-00

HIGHWAY 401 MEDIAN SEWER
COUNTY RD 41 INTERCHANGE
TO PALACE RD INTERCHANGE
BOREHOLE LOCATIONS PLAN

AECOM



THURBER ENGINEERING LTD.



KEYPLAN
LEGEND

| | |
|------|---------------------------------------|
| ● | Borehole |
| ⊙ | Borehole and Cone |
| N | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE | Blows /0.3m (60' Cone, 475J/blow) |
| PH | Pressure, Hydraulic |
| ▽ | Water Level |
| ⊕ | Head Artesian Water |
| ⊕ | Piezometer |
| 90% | Rock Quality Designation (RQD) |

| NO | ELEVATION | NORTHING | EASTING |
|-------------------|-----------|-------------|-----------|
| 10+040 7.4m RT CL | — | 4 903 172.0 | 270 309.8 |
| 10+433 5.8m LT CL | — | 4 903 317.0 | 270 675.2 |
| 10+555 6.8m RT CL | — | 4 903 369.8 | 270 785.3 |
| 18+308 6.0m LT CL | — | 4 902 877.9 | 267 720.9 |
| 18+684 6.1m RT CL | — | 4 903 022.5 | 268 048.2 |
| 18+824 6.5m LT CL | — | 4 903 048.2 | 268 206.0 |
| 18+344 5.3m LT CL | — | 4 903 006.5 | 268 723.0 |
| 18+447 6.9m RT CL | — | 4 902 991.5 | 268 817.6 |
| 18+849 6.2m LT CL | — | 4 902 917.0 | 269 218.6 |
| 18+980 6.4m RT CL | — | 4 902 917.7 | 269 325.4 |
| 20+362 6.6m RT CL | — | 4 902 959.2 | 269 725.9 |
| 20+473 6.5m RT CL | — | 4 902 987.0 | 269 833.7 |
| 20+864 6.3m LT CL | — | 4 903 120.7 | 270 198.1 |

-NOTES-

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No.

| REVISIONS | DATE | BY | DESCRIPTION |
|-----------|------|---------|---------------|
| DESIGN | MEF | CHK AEG | CODE |
| DRAWN | AN | CHK MEF | SITE |
| | | | STRUCT |
| | | | DWG 2 |
| | | | DATE FEB 2018 |

**Highway 401 From CR 41 to Palace Road
GWP 4459-04-00 and GWP 4197-13-00**

Greater Napanee, Lennox & Addington Area

Borehole Records

Page 1 of 2

Highway 401 Median

18+309 **6.0 Lt CL EB ISH**
Point 17
0 - 40 Asph
40 - 600 Br Sa(y) Gr Tr Si, Comp
AS-1 w = 2%
Percent Passing: 4.75 mm = 37%
0.075 mm = 5%
600 - 3.0 Br Gr W Sa Tr Si Freq Cob, Comp
AS-2 w = 2%
Percent Passing: 4.75 mm = 25%
0.075 mm = 5%
Cave @ 1.1

18+664 **6.1 Rt CL WB ISH**
Point 37
0 - 80 Asph
80 - 850 Br Gr and Sa Some Si, dry, D
850 - 2.15 Br Sa and Gr Some Si Freq Cob,
dry, Comp
2.15 - NFP RF
Cave @ 1.0

18+824 **6.5 Lt CL EB ISH**
Point 18
0 - 45 Asph
45 - 500 Br Sa(y) Gr Tr Si
500 - 1.1 Br Gr W Sa Tr Si Freq Cob
1.1 - 2.35 Br Sa W Cl W Si Some Gr
Occ Cob, V Stiff
AS-1 w = 16%
Percent Passing: 4.75 mm = 89%
0.075 mm = 51%
0.005 mm = 28%
w_L = 38%
w_P = 17%
P_I = 21%
Unified Soil Classification = CI
2.35 - NFP BR
Cave @ 1.55

19+054 **6.8 Rt CL WB ISH**
Point 36
0 - 50 Asph
50 - 650 Br Gr and Sa Some Si, dry, D
AS-1
650 - 1.0 Br Sa and Gr Some Si Freq Cob,
dry, Comp
AS-2
1.0 - 1.85 Br Cl W Si, moist, V Stiff
AS-3
1.85 - NFP BR
Cave @ 1.5

19+344 **5.3 Lt CL EB ISH**
Point 19
0 - 85 Asph
85 - 850 Br Sa(y) Gr Tr Si, dry, Comp
AS-1
850 - 1.4 Br Gr W Sa Tr Si Freq Cob, dry,
Comp
AS-2
1.4 - NFP BR
Cave @ 800

19+447 **6.9 Rt CL WB ISH**
Point 27
0 - 100 Asph
100 - 600 Br Sa and Gr Some Si, Comp
AS-1 w = 2%
Percent Passing: 4.75 mm = 56%
0.075 mm = 10%
600 - 1.1 Br Sa(y) Gr Tr Si Freq Cob, Comp
AS-2 w = 2%
Percent Passing: 4.75 mm = 40%
0.075 mm = 9%
1.1 - 1.8 Br Cl W Si W Sa Some Gr, V Stiff
AS-3 w = 16%
Percent Passing: 4.75 mm = 86%
0.075 mm = 63%
0.005 mm = 37%
w_L = 43%
w_P = 23%
P_I = 31%
Unified Soil Classification = CI
1.8 - NFP BR
Cave @ 1.15

DRAFT



Appendix C

Site Photographs



Highway 401 Looking West Toward Sucker Creek and County Road 41 Interchange



Highway 401 Looking East Toward Sucker Creek Bridge



Highway 401 Looking West From Palace Road Interchange