

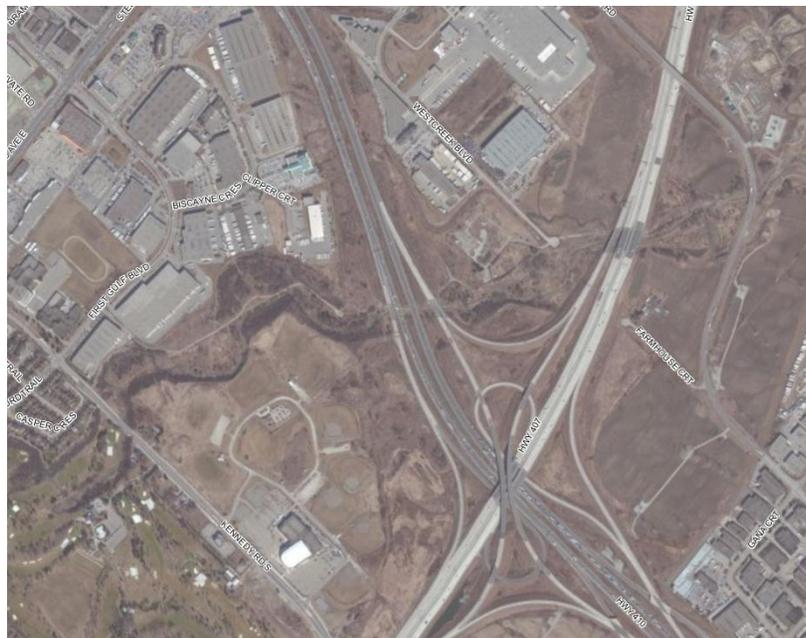


June 2013

FOUNDATION INVESTIGATION AND DESIGN REPORT

Median Sewer Highway 410 Widening From South of Highway 401 to Queen Street Regional Municipality of Peel G.W.P. 2144-07-00

Submitted to:
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REPORT





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PART A

**FOUNDATION INVESTIGATION REPORT
MEDIAN SEWER
HIGHWAY 410 WIDENING
FROM SOUTH OF HIGHWAY 401 TO QUEEN STREET
REGIONAL MUNICIPALITY OF PEEL
G.W.P. 2144-07-00**



1.0 INTRODUCTION

Golder Associates Ltd. (Golder) was retained by URS Canada Inc. (URS) on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services in support of the preliminary design for the widening of Highway 410 from south of Highway 401 to Queen Street in the Cities of Mississauga and Brampton in the Regional Municipality of Peel, Ontario. This report summarizes the available existing subsurface information and provides foundation recommendations for the proposed median sewer installation associated with the overall Highway 410 widening project.

The design recommendations provided in this report for the proposed median sewer alignment are based on the subsurface information outlined below, and the Highway 410 information (existing and proposed widening) provided by URS. The information provided by URS included:

- Highway 410 Plan drawing: Hwy410_Plan.dwg, provided on September 18, 2012;
- Highway 410 Storm Sewer Plan and Profile drawing: 2012 09 19 - Storm Sewer Drawings (Plan & Profile).dwg, provided on September 19, 2012 and September 27, 2012;
- Highway 410 Utilities drawing: Hwy410_Uilities.dwg, provided September 18, 2012;
- Highway 410 Existing Topography drawing: Hwy 410 - Triangles 3-D.dwg, provided on September 18, 2012;
- Heart Lake Tunnel Alignment drawing: Heart Lake Tunnel Alignment – Hwy410 Drainage.dwg, provided September 27, 2012; and
- Contract drawings for existing structures along the Highway 410 alignment: Matheson Blvd overpass, 401/403/410 interchange ramps (underpasses), Heart Lake Tunnel, Courtney Park Drive underpass, Derry Road underpass, Highway 407 Flyover (underpass), Etobicoke Creek overpass, Steeles Avenue underpass, Glidden Road overpass, Canadian National Railway overhead, and the Orenda Road overpass.

The terms of reference and scope of work for the foundation investigation are outlined in MTO's Request for Proposal (RFP) dated November 2010, and in Section 6.8 of URS's *Technical Proposal* for this assignment.

1.1 Background Information

The subsurface information used in the preparation of this report was obtained from Golder's current borehole investigation program for the Highway 410 widening project (i.e. associated bridge structures, stormwater ponds, culvert extensions, overhead signs, high mast lights and the median sewers); as well as previous Foundation Investigation Reports prepared by others and available from the MTO Pavement and Foundation Section's GEOCRES database. The previous reports referenced from the GEOCRES database are as follows:

- **MTO GEOCRES No. 30M12-012:** Report title "Foundation Report on Underpass bridge at Highway 401 "Line "A" crossing Road Allowance (Lot 14, Con.VI) one mile northwest of Liagar, W.P. 78-57, W.J. F57-18," by Department of Highways, Ontario, Materials & Research Branch, Foundations Section, dated August 15, 1957.



- **MTO GEOCREs No. 30M12-025:** Report titled “Foundation Investigation for the Proposed Structure, Hwy. 401 EB Collector and Sub-Collector, Over Hwy 410 (Bridge No. 29), Town of Mississauga, County of Peel, District #6 (Toronto), W.O. 72-11166 – W.P. 127-66-22,” by Ministry of Transportation and Communications, Foundations Office, dated April 19, 1973.
- **MTO GEOCREs No. 30M12-026:** Report titled “Foundation Investigation Report for the Proposed Structure at Hwy. 401 WB Collector over Hwy. 410 (Bridge #31) Site #24-323, District #6 (Toronto), W.O. 72-11167 – W.P. 127-66-20,” by Ministry of Transportation and Communications, Foundations Office, dated April 30, 1973.
- **MTO GEOCREs No. 30M12-066:** Report titled “Foundation Investigation Report for the Proposed Structure No. 43, Ramp ‘E-S’ over Hwy. 410 NB core and collector, Town of Mississauga, County of Peel, Site No. 24-326, District No. 6 (Toronto), W.O. 73-11074 – W.P. 127-66-24,” by Ministry of Transportation and Communications, Foundations Office, dated September 26, 1973.
- **MTO GEOCREs No. 30M12-086:** Report titled “Foundation Investigation Report for Proposed South Trunk Sewer from Heart Lake Road to North of Britannia Road, Hwy. 401-403-410 Complex, Town of Mississauga, County of Peel, District #6 (Toronto), W.O. 73-11014 – W.P. 127-66-53,” by Ministry of Transportation and Communications, Foundations Office, dated August 1, 1973.
- **MTO GEOCREs No. 30M12-088:** Report titled “Foundation Investigation Report for the Proposed Ramp N-E Structure at the Crossing of Hwy 401 and Hwy 410 (Bridge #32), Site No. 24-325, Town of Mississauga, County of Peel, District #6 (Toronto), W.O. 73-11031 – W.P. 127-66-23,” by Ministry of Transportation and Communications, Ontario, dated July 18, 1973.
- **MTO GEOCREs No. 30M12-090:** Report titled “Preliminary Foundation Investigation Report for Proposed Hwy’s #403 and 401 from west limits of 401/27 Interchange through 401/403/410 Complex south-westerly to Hwy. #10, Town of Mississauga, County of Peel, District 6, Toronto, W.O. 72-11053, W.P. 127-66-01,” by Ministry of Transportation and Communications, Foundations Office, dated July 18, 1972.
- **MTO GEOCREs No. 30M12-098:** Report titled “Foundation Investigation Report for Proposed Hwy 410 Underpass at Existing Hwy 7, Site #24-343, Town of Brampton, County of Peel, District No. 6 (Toronto), W.O. 73-11108, W.P. 134-73-02,” by Ministry of Transportation and Communications, Ontario, Soil Mechanics Section, dated March 29, 1974.
- **MTO GEOCREs No. 30M12-110:** Report titled “Preliminary Foundation Investigation Report for Proposed Hwy. 410 from South Limits of Hwy. 401 to Hwy. 7, Regional Municipality of Peel, Cities of Mississauga and Brampton, District #6, Toronto, W.P. 103-69-00,” by Ministry of Transportation and Communications, Soil Mechanics Section, Geotechnical Office, dated July 31, 1975.
- **MTO GEOCREs No. 30M12-113:** Report titled “Foundation Investigation Report for W.P. 36-74-01, Hwy. 403, District 6, Toronto, Proposed Culvert at the Crossing of Hwy. 403 and Little Etobicoke Creek (West Branch) just South of Matheson Blvd.,” by Ministry of Transportation and Communications, Soil Mechanics Section, dated March, 1976.
- **MTO GEOCREs No. 30M12-115:** Report titled “Foundation Investigation Report for W.P. 36-74-02/03, Site No. 24-354, Matheson Blvd. SB Overpass Bridge No. 60, Matheson Blvd. NB Overpass Bridge No. 59,



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Hwy. 403, District 6, Toronto” by Ministry of Transportation and Communications, Soil Mechanics Section, Geotechnical Office, dated April 22, 1976.

- **MTO GEOCREs No. 30M12-117:** Report titled “Foundation Investigation and Design Report, W.P. 103-69-09, Site 24-313, Hwy.410, District 6, Toronto, Etobicoke Creek Bridge,” by Ministry of Transportation and Communications, dated June 28, 1976.
- **MTO GEOCREs No. 30M12-122:** Report titled “Foundation Investigation and Design Report, W.P. 103-69-08, Hwy. 410 from Steeles Avenue Southerly to Derry Road, Culverts” by Ministry of Transportation and Communications, Soil Mechanics Section, Geotechnical Office, dated December 21, 1976.
- **MTO GEOCREs No. 30M12-135:** Report titled “Foundation Investigation Report for Industrial Access Road Underpass, 1.2 Miles North of Hwy. 401/410, W.P. 103-69-13, Site 24-41, Hwy. 410, District 6, Toronto,” by Ministry of Transportation and Communications, Highway Engineering Division, Engineering Materials Office, Soil Mechanics Section, dated October, 1978.
- **MTO GEOCREs No. 30M12-149A:** Report titled “Foundation Investigation Report for Culvert Sta. 13-125.659 under Hwy. 410, W.P. 21-79-03, Hwy. 410, District 6, Toronto,” by Ministry of Transportation and Communications, Engineering Materials Office, Pavement and Foundation Design Section, dated August 25, 1982.
- **MTO GEOCREs No. 30M12-149B:** Report titled “Foundation Investigation Report for the Proposed Storm Sewer along Highway 410 (Station 430+00 to Station 470+00), Tow of Brampton, County of Peel, District 6 (Toronto), W.O. 73-11115, W.P. 134-73-01,” by Ministry of Transportation and Communications, Ontario, Soil Mechanics Section, dated May 1, 1974.
- **MTO GEOCREs No. 30M12-159:** Report titled “Foundation Investigation Report for Bridge #34, Hwy 403 W.B. Expressway over Hwy 410 N.B. Expressway and Ramp S-W, W.P. 127-66-70, Site 24-81-464, Hwy 403, District 6, Toronto,” by Ministry of Transportation and Communications, Engineering Materials Office, Pavement & Foundation Design Section, dated April 20, 1982.
- **MTO GEOCREs No. 30M12-160:** Report title “Foundation Investigation Report for Bridge #35, Hwy 403 E.B. Expressway over Hwy 410 N.B. Expressway and Ramp S-W, W.P. 127-66-69, Site 24-81-463, Hwy 403, District 6, Toronto,” by Ministry of Transportation and Communications, Engineering Materials Office, Pavement & Foundation Design Section, dated May 5, 1982.
- **MTO GEOCREs No. 30M12-171:** Report titled “Foundation Investigation Report for Hwy. 410/CNR Overhead, W.P. 21-79-01; Site 24-145-477, District 6, Toronto,” prepared by Dominion Soil Investigation Inc., Consulting Engineers, dated March 16, 1984.
- **MTO GEOCREs No. 30M12-172:** Report titled “Foundation Investigation Report for Orenda Road Overpass, W.P. 21-79-02; Site 24-145-476, Hwy. 410, District 6, Toronto,” by Morton & Partners Limited, Consulting Engineers and Engineering Geologists, dated August 17, 1982.
- **MTO GEOCREs No. 30M12-176:** Report titled “Geotechnical Investigation, Retaining Walls, Highway 410 (Brampton By-Pass), Site 24, W.P. 21-79-15, Toronto,” by Dominion Soil Investigation Inc., dated September, 1982.



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- **MTO GEOCRES No. 30M12-186:** Report titled “Foundation Investigation Report for Glidden Road Overpass, W.P. 21-79-16; Site 24-145-487, Hwy # 410, District 6, Toronto,” by Ministry of Transportation and Communications, dated June 4, 1985.
- **MTO GEOCRES No. 30M12-187:** Report titled “Foundation Investigation Report for Steeles Avenue Underpass, W.P. 21-79-18; Site 24-81-488, Hwy 410, Toronto,” by Ministry of Transportation and Communications, Soil Mechanics Section, Geotechnical Office, dated October 18, 1984.
- **MTO GEOCRES No. 30M12-189:** Report titled “Foundation Investigation Report for Bridge #32, Ramp N-E 401/410 Interchange, W.P. 54-82-11; Site 24-325, District 6, Toronto,” by Ministry of Transportation and Communications, Engineering Materials Office, Foundation Design Section, dated November 6, 1984.
- **MTO GEOCRES No. 30M12-190:** Report titled “Foundation Investigation Report for Bridge #67, Ramp W-N, Hwy. 401/Hwy. 410 Interchange, W.P. 54-82-10; Site 24-492, District 6, Toronto,” by Ministry of Transportation and Communications, Engineering Materials Office, Pavement and Foundation Design Section, dated November 27, 1984.
- **MTO GEOCRES No. 30M12-193:** Report titled “Foundation Investigation Report for Derry Road Underpass, W.P. 103-69-15, Site 24-81-495, Hwy. 410, Toronto,” by Ministry of Transportation and Communications, Soil Mechanics Section, Geotechnical Office, dated June 18, 1987.
- **MTO GEOCRES No. 30M12-195:** Report titled “Foundation Investigation Report for N.B.L. Structure Widening, Hwy # 410, W.P. 103-69-17; Site No. 24-81-313, District 6, Toronto,” by Engineering Materials Office, Foundation Design Section, dated March 26, 1986.
- **MTO GEOCRES No. 30M12-196:** Report titled “Foundation Investigation Report for W.P. 54-82-09; High Mast Lighting (Hwy. 401/Hwy. 410 Interchange), Hwy. 401, Toronto,” by Ministry of Transportation and Communications, Soil Mechanics Section, Geotechnical Office, dated March 30, 1987.
- **MTO GEOCRES No. 30M12-204:** Report titled “Foundation Investigation Report for Courtney Park Drive Underpass, 2.0 Kilometres North of Hwy 401/410, WP 103-69-19, Site 24-441, Hwy 410, District 6, Toronto,” by Ministry of Transportation and Communications, Foundation Design Section, dated June 9, 1989.
- **MTO GEOCRES No. 30M12-205:** Report titled “Foundation Investigation Report for Hwy 401 – Hwy 410 Overpass Eastbound Core Lanes/Westbound Core Lanes, WP 54-82-15&16; Site No. 24-493, District #6, Toronto,” by Ministry of Transportation and Communications, Engineering Materials Office, Foundation Design Section, dated June 7, 1988.
- **MTO GEOCRES No. 30M12-229:** Report titled “Foundation Investigation Report for High Mast Lighting, Hwy 410, Steeles Avenue to Highway 7N, W.P. 697-96-00, Central Region,” by Ministry of Transportation, Ontario, dated October 8, 1996.

The previous boreholes used in this report have been renamed to show the MTO GEOCRES reference number followed by the original borehole designation. For example, the boreholes from MTO GEOCRES Report No. 30M12-117 have been renamed as 117-X, where X is the original borehole number.



The following points are noted regarding determining the locations of the previous boreholes, and assessing the previous boreholes for potential use with respect to the foundation design and construction recommendations for the proposed median sewer installation:

- The borehole locations in the previous Foundation Investigation Reports for the Highway 410 corridor are referenced to a number of coordinate or station systems. In general, the boreholes from all the GEOCRE reports were referenced to a global datum, and could be converted to the MTM NAD83 coordinate system. The accuracy of these borehole locations is considered to be generally consistent with the original survey.
- In general, the majority of the existing boreholes were located within approximately 50 m of the centerline of the median sewer alignment, and varied in spacing along the alignment. Where gaps were identified in the existing information, additional strategically placed boreholes have been completed as part of the current scope of work. Golder has reviewed the topography and subsurface conditions for the available boreholes along the proposed sewer alignment to confirm that the conditions are relatively consistent and applicable within the various sections outlined below.
- Where multiple boreholes were located within the same area of the median sewer alignment, all borehole information was considered in the design and construction recommendations.
- At several locations along the median sewer alignment, the existing boreholes were drilled from original ground surface prior to the construction of the Highway 410 embankment and / or cuts in these areas. The existing boreholes do not provide information on the material type and properties of the embankment fills or below the bottom of the cuts. In addition, the proposed grade along the median will be raised slightly to accommodate the median widening of Highway 410. It has been assumed that the existing Highway 410 fills were constructed to engineered fill standards and that the new fills will also be constructed to engineered fill standards. The material below the level of the cuts was considered to be consistent with the surrounding geology and may include fills and/or weathered materials (i.e. local shale bedrock), as applicable.

2.0 SITE DESCRIPTION

The proposed median sewer alignment begins approximately 0.7 km south of Matheson Boulevard and runs about 11.4 km north along Highway 403 / Highway 410 to just south of Clark Boulevard. The currently proposed crown of the sewer varies between about 1 m to 3 m below the proposed top of pavement (crown of road), which is proposed to vary from an approximate Elevation (El.) of El. 156 m at the southern limit of the alignment, to about El. 217 m at the proposed end of the alignment south of Clarke Boulevard. The proposed top of pavement (crown of road) is generally coincidental with the top of existing ground at the southern limit of the proposed alignment; and then varies up to approximately 3 m above the existing ground surface along the majority of the alignment moving north. These proposed areas of fill are generally located within the median ditch that currently separates the north of southbound lanes of Highway 410.



3.0 INVESTIGATION PROCEDURES

A total of nineteen (19) boreholes were drilled and one test pit dug in October and November 2012 as part of a geotechnical investigation program to support the proposed median sewer alignment. Fifteen (15) boreholes (12-1 to 12-8, 12-13 to 12-18 and C16-1) were drilled using a CME-75 drill rig and four boreholes (12-9 to 12-12) were drilled using a CME-55 drill rig. Boreholes 12-1 to 12-9, 12-12 and C16-1 were drilled using a truck-mount drill rig while Boreholes 12-10, 12-11 and 12-13 to 12-20 were drilled using track-mount equipment. The drill rigs were supplied and operated by Geo-Environmental Drilling Inc. of Milton, ON, and DBW Drilling of North York, ON. Three different CME-75 drill rigs were used to drill the boreholes; a 70 mm inner diameter hollow stem auger, a 108 mm inner diameter hollow stem auger, and a 101 mm diameter solid stem auger, as noted on the Borehole Records (Appendix A). The CME-55 drill rig utilized a 101 mm diameter solid stem auger. The one test pit, Test Pit C16-2, was hand dug to a depth of about 0.25 m below existing ground surface (see Appendix A).

The boreholes were advanced to depths ranging from approximately 4.5 m to 9.8 m below existing ground surface, including bedrock coring. Soil samples were obtained from approximately 0.6 m and 1.5 m intervals of depth using a 50 mm outer diameter split-spoon sampler driven by an automatic hammer in accordance with the Standard Penetration Test (SPT) procedure (ASTM D1586-08a Standard Test Method for Standard Penetration Test). Bedrock coring was completed in Boreholes 12-3 to 12-8, 12-13 to 12-15 and C16-1 using an HQ triple-tube diamond drill core barrel.

The groundwater conditions were observed in the open boreholes and test pit during and immediately following the drilling/digging operations. The water levels observed in the boreholes and test pit following completion of drilling/digging are indicated on the Borehole and Test Pit Records contained in Appendix A. All boreholes were backfilled with bentonite upon completion, in accordance with Ontario Regulation 903 (as amended).

The field work was supervised on a full-time basis by members of Golder's engineering staff who located the boreholes and the test pit in the field, cleared all locates of potential buried conflicts, directed the drilling/digging, sampling, in situ testing operations, and logged the subsurface conditions. The soil samples were identified in the field, placed in labelled containers and transported to Golder's laboratory in Mississauga for further examination and laboratory testing. Index and classification tests consisting of water content determinations, Atterberg limits testing and grain size distribution analyses were carried out on selected soil samples. Point load index and unconfined compression (UC) tests were carried out on selected rock samples.

The borehole and test pit locations were established in the field by Golder personnel relative to site features. The ground surface elevation at each borehole and the test pit were estimated from the digital terrain model for the site as provided by URS. The borehole and test pit locations (referenced to the MTM NAD83 co-ordinate system) and ground surface elevations (referenced to geodetic datum) are summarized in the following table and are shown on Drawings 1 to 13. These drawings also show the locations of boreholes advanced as part of previous investigations undertaken along the proposed alignment.

Borehole No.	MTM NAD83 Northing (m)	MTM NAD83 Easting (m)	Ground Surface Elevation (m)	Borehole Depth (m)
12-1	4,831,684.5	293,473.6	154.0	9.8
12-2	4,832,044.7	293,126.9	162.5	9.5
12-3	4,832,719.3	292,532.9	169.5	4.5



Borehole No.	MTM NAD83 Northing (m)	MTM NAD83 Easting (m)	Ground Surface Elevation (m)	Borehole Depth (m)
12-4	4,832,947.0	292,338.8	173.0	4.5
12-5	4,833,124.6	292,098.7	172.0	4.7
12-6	4,833,263.0	291,876.3	173.0	4.7
12-7	4,833,508.7	291,631.5	176.0	4.5
12-8	4,833,866.9	291,282.9	180.0	9.1
12-9	4,834,184.3	290,966.4	183.0	8.8
12-10	4,834,449.2	290,709.2	185.5	9.5
12-11	4,835,114.2	290,066.4	183.5	9.5
12-12	4,836,085.5	289,128.5	189.1	8.2
12-13	4,836,711.3	288,541.9	193.5	4.7
12-14	4,837,913.0	288,085.2	193.5	8.8
12-15	4,838,615.1	287,574.0	197.0	9.3
12-16	4,838,833.4	287,367.5	201.5	7.8
12-17	4,839,261.0	286,946.7	212.0	8.7
12-18	4,840,141.1	286,094.7	215.8	9.2
C16-1	4,832,538.1	292,671.7	169.1	5.6
Test Pit No.	MTM NAD83 Northing (m)	MTM NAD83 Easting (m)	Ground Surface Elevation (m)	Test Pit Depth (m)
C16-2	4,832,534.5	292,665.7	168.1	0.25

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

This section of Highway 410 is located within the Peel Plain physiographic region, as delineated in *The Physiography of Southern Ontario* (Chapman and Putnam, 1984).

The Peel Plain physiographic region covers the central portions of the Regional Municipalities of York, Peel and Halton. The general topography of this region consists of level to gently rolling terrain, sloping gradually southward toward Lake Ontario. A surficial till sheet, which generally follows the surface topography, is present throughout much of this area. The till, which is mapped in this area as Halton Till, typically consists of clayey silt to silty clay, with occasional sand to silt zones. Shallow, localized deposits of loose sand and silt and/or soft clay can overlie this uppermost till sheet, and these represent relatively recent deposits, formed in small glacial meltwater ponds scattered throughout the Peel Plain and concentrated near river valleys. The recent sand, silt and clay and uppermost till deposits in this area overlie and are interbedded with stratified deposits of sand, silt and clay. The study area, in the western portion of the Peel Plain, is underlain by grey shale of the Georgian Bay Formation.



4.2 Subsurface Conditions

As part of the current subsurface investigation, nineteen (19) boreholes (Boreholes 12-1 to 12-20 and C16-1) and one test pit (Test Pit C16-2) were advanced along the shoulder and center median area of Highway 410. The borehole and test pit locations, ground surface elevations and interpreted stratigraphic conditions are shown on Drawings 1 to 13. Boreholes 12-1 to 12-8, 12-12 and C16-1 were drilled on the shoulder of the northbound lane. These boreholes were drilled on the left shoulder with the exception of Borehole 12-5, which was drilled on the right shoulder. Boreholes 12-9 to 12-11 and 12-13 to 12-18 were drilled at the center median (i.e. in the ditch separating the north and southbound lanes). Test Pit C16-2 was dug in the center median area adjacent to Borehole C16-1.

The detailed subsurface soil and groundwater conditions encountered in the boreholes advanced as part of the current investigation and the results of in situ and laboratory testing are given on the Borehole Records contained in Appendix A. The results of geotechnical laboratory testing are also contained in Appendix B. The borehole information from the previous Golder (associated with the Highway 410 widening project) and MTO investigations are presented in Appendix C.

The stratigraphic boundaries shown on the Borehole Records and on the interpreted stratigraphic profile and cross-sections on Drawings 1 to 13 are inferred from observations of drilling progress and from non-continuous sampling and, therefore, represent transitions between soil types rather than exact planes of geological change. The subsoil conditions will vary between and beyond the borehole and test pit locations.

In general, the subsurface conditions at the site consisted of surficial layers of topsoil, asphalt, roadway base granular fill and cohesive fill. These fill units were generally underlain by a clayey silt till deposit along the majority of the proposed alignment, which was all underlain by shale bedrock. In the following sections, the subsurface conditions are described in greater detail for sections of chainage along the median sewer alignment. The soil and groundwater conditions were based on the results of the boreholes and test pit advanced as part of the geotechnical investigation program. These results were compared with the subsurface conditions interpreted in earlier Golder and MTO reports and borehole logs.

4.2.1 Station (St.) 2+190 to St. 2+750 (South of Matheson Blvd.)

Two boreholes were advanced between stations 2+190 and 2+750 (12-1 and 12-2) to complement Boreholes 113-3 and 113-4, which were completed during the 1970's, see Drawing 1. The subsurface conditions anticipated to be encountered are summarized below. The present ground surface along this section of the sewer ranges on average from an approximate Elevation (El.) of 156 m to 165 m from south to north. It is understood that there will be no appreciable grade raise along this section of the sewer.

4.2.1.1 Fill

An approximately 200 mm thick layer of asphalt was encountered starting at existing ground surface in Borehole 12-2. A layer of sand and gravel fill (with SPT "N" values ranging from 17 blows to 35 blows per 0.3 m of penetration, indicating a compact to dense relative density) was found underlying the asphalt in Borehole 12-2, and from ground surface to a depth of 0.8 m below existing ground surface in Borehole 12-1. Underlying the granular fill was a layer of clayey silt fill with sand, trace gravel and containing wood fragments, to depths ranging from about 1.5 m to 2.2 m below existing ground surface. The measured SPT "N" values in the clayey silt fill ranged from 6 blows to 46 blows per 0.3 m of penetration, indicating a firm to hard relative density.



Although not specifically encountered during the current investigation, the thickness of the fill unit may extend to approximately 7 m below existing ground surface based on historic site information.

4.2.1.2 Clayey Silt Till

A clayey silt till deposit was encountered underlying the fill units in the current boreholes and within the previously completed boreholes. The thickness of the till unit ranged from about 7.3 m to 8.3 m along this section of the proposed sewer alignment, and the current boreholes (12-1 and 12-2) were terminated within this unit. The thickness of the till appears to decrease towards Matheson Boulevard where the previously completed boreholes indicate a layer thickness of approximately 3 m.

The deposit generally consists of clayey silt with sand, trace to some gravel, and contained cobbles in the soil matrix. Atterberg limits testing completed on selected samples indicated that the plastic limits generally ranged from approximately 12 per cent to 17 per cent, liquid limits from about 18 per cent to 33 per cent, and corresponding plasticity indices of 6 to 16. The natural water content ranged from approximately 8 per cent to 16 per cent. The measured SPT "N" values within the clayey silt till ranged from 7 blows to over 50 blows per 0.3 m (or less) of penetration, suggesting a firm to hard relative density.

4.2.1.3 Silt to Silty Sand

Although not specifically encountered during the current investigation, the historic boreholes along this section of the proposed sewer alignment indicate an approximately 1.3 m thick layer of (likely discontinuous) silt to sandy silt underlying the clayey silt till. SPT "N" values of 133 blows per 0.3 m of penetration and 165 blows per 0.2 m of penetration were measured in the silt deposit indicating a very dense relative density.

4.2.1.4 Groundwater Conditions

The groundwater levels in the open boreholes were encountered at depths of about 7 m to 9 m below existing ground surface, and were assumed to have insufficient time to adequately recover. However, based on previously completed borehole and piezometer information in this area, the groundwater table is anticipated to be approximately 3 m to 4 m below the existing ground surface. It should be noted that the water table is expected to fluctuate seasonally in response to changes in precipitation and snow melt, and is expected to be higher during the spring season.

4.2.2 St. 2+750 to St. 4+950 (Including Matheson Boulevard, Highways 403 / 410 / 401 Interchanges and the Heart Lake Tunnel)

Six boreholes (12-3 to 12-7 and C16-1) were advanced between Matheson Boulevard and St. 4+950, and a shallow test pit (C16-2) was also completed in close proximity to Borehole C16-1 (see Drawings 2 and 3). The purpose of these recent boreholes and test pit were to confirm and complement the subsurface information provided by the previously completed nineteen boreholes (025-3 to 025-6, 026-3, 026-4, 066-4, 086-17, 086-18, 090-16, 115-5, 115-6, 189-7, 190-11; MB-1 to MB-5) that were advanced during the 1970's and more recently. The subsurface conditions anticipated to be encountered are summarized below. The present ground surface along this section of the sewer ranges on average from approximately El. 165 m to El. 177 m from south to north. It is understood that there will be no appreciable grade raise along this section south of Highway 401, transitioning to an approximately 3 m grade raise in the section north of Highway 401.



4.2.2.1 Fill

An approximately 200 mm thick layer of asphalt was encountered starting at existing ground surface in Boreholes 12-3 to 12-7. An approximately 0.6 m thick layer of sand and gravel fill (i.e. road base material) was found underlying the asphalt layer. The sand and gravel fill unit was generally brown, with SPT “N” values ranging from 3 blows to 60 blows per 0.3 m of penetration, indicating a compact to dense state of compactness. Borehole 12-6 was an exception, where an approximately 0.7 m thick layer of dense silty sand fill with some gravel and trace to some clay was found underlying the surficial asphalt layer. Although not encountered in Boreholes 12-3 to 12-7 it is anticipated that clayey silt fill may also be encountered along the proposed sewer alignment, and may vary in thickness from 0.3 m to over 1.5 m within the road footprint and near bridge structures.

4.2.2.2 Shale Bedrock

Based on the results of the recent site investigation, the top of bedrock is generally located about 0.8 m below the existing ground surface for the length of proposed sewer alignment between Matheson Boulevard and St. 4+950. This corresponds well with the historic borehole information which indicates that a significant portion of this section of highway is within a cut (up to approximately 8 m deep) into the underlying native shale bedrock that was made for the original Highway 403/410 construction. The shale bedrock is of Georgian Bay Formation and is slightly weathered to fresh, laminated, grey and contains strong to very strong fossiliferous limestone interbeds and clay seams. Point load and UC tests conducted on selected samples resulted in unconfined compressive strength (UCS) values ranging from approximately 12 MPa to 102 MPa (with an average value of 46 MPa), which indicated a general rock mass strength of weak to medium strong.

The quality of the bedrock near surface was considered to be very poor to poor and increased in quality with depth. This is indicative of the weathering process typically observed in exposed areas of this formation.

4.2.2.3 Groundwater Conditions

Based on the observations made during the various site investigations and our understanding of the site, it is anticipated that the groundwater table is located approximately 1 m to 1.5 m below the existing ground surface between Matheson Boulevard and St. 4+950. It should be noted that the water table is expected to fluctuate seasonally in response to changes in precipitation and snow melt, and is expected to be higher during the spring season.

4.2.3 St. 4+950 to St. 6+250 (Between Heart Lake Tunnel and Courtney Park Drive)

Three boreholes (12-8 to 12-10) were advanced between St. 4+950 and St. 6+250 as part of site investigation program for the proposed median sewer, see Drawings 3 and 4. These boreholes complemented Boreholes P1-1 to P1-3, which were advanced at the site of a proposed stormwater management pond. The subsurface conditions anticipated to be encountered are summarized below. The present ground surface along this section of the sewer ranges on average from approximately El. 177 m to El. 186 m from south to north. It is understood that there will be an average grade raise of approximately 1.5 m along this section of the alignment.



4.2.3.1 Fill

An approximately 200 mm thick layer of asphalt was encountered in Borehole 12-8, and up to 100 mm of topsoil was encountered at ground surface in Boreholes 12-9 and 12-10. Underlying these surficial units was an approximately 0.4 m to 0.7 m thick layer of clayey silt fill in Boreholes 12-9 and 12-10, and sand and gravel fill in Borehole 12-8. The fill was generally brown, with SPT “N” values ranging from 5 blows to 24 blows per 0.3 m of penetration in the clayey silt, suggesting a firm to very stiff relative density, and 39 blows per 0.3 m of penetration in the sand and gravel, which suggests a dense compactness.

4.2.3.2 Clayey Silt Till

A clayey silt till deposit was encountered underlying the surficial fill units in the current boreholes and within previously completed boreholes. The thickness of the till along this section of the alignment ranged from approximately 6.8 m in Borehole 12-8 to at least 8.7 m in Borehole 12-10. The till was brown to grey, contained sand and trace to some gravel, and had SPT “N” values ranging from 8 blows to 77 blows per 0.3 m of penetration, indicating a stiff to hard relative density. Cobbles and boulders were encountered approximately 3.0 m below the existing ground surface in some of the boreholes. Atterberg limits testing on selected samples of the till deposit estimated the plastic limit to range from 12 per cent to 16 per cent, the liquid limit to range from 18 per cent to 28 per cent, and corresponding plasticity indices of 5 per cent to 13 per cent.

4.2.3.3 Shale Bedrock

Shale bedrock was encountered at a depth of approximately 7.6 m below existing ground surface (at about El. 172.4 m) in Borehole 12-8 underlying the clayey silt till. The shale was slightly weathered to fresh, laminated, grey, and contained strong to very strong fossiliferous limestone interbeds and clay seams. Point load tests were conducted on selected cores of the shale sampled from Borehole 12-8 resulting in UCS values ranging from 83 MPa to 171 MPa. These UCS values may be attributed to the fact that the shale cores were sampled from a greater depth and the presence of strong to very strong limestone interbeds within the shale bedrock. Historic Borehole 110-1 encountered bedrock at approximately El. 170.8 m, suggesting that the depth to the top of the bedrock generally increases towards the north limit of this section along the proposed median sewer alignment.

4.2.3.4 Groundwater Conditions

The groundwater level was not observed in open Boreholes 12-8 and 12-10 upon completion of drilling, and was observed at a depth of approximately 8.4 m below the existing ground surface (at about El. 174.6 m) in Borehole 12-9. It was assumed that the groundwater was still in the process of recovering when these observations were made. Based on available piezometric information and our understanding of the site, it is anticipated that the groundwater table is located approximately 1.5 m to 4 m below the existing ground surface along this section of the proposed median sewer. The water table is expected to fluctuate seasonally in response to changes in precipitation and snow melt, and is expected to be highest during the spring season.

4.2.4 St. 6+250 to St. 9+000 (Including Courtney Park Drive, Derry Road and Highway 407 Flyover)

Two boreholes (12-11 and 12-12) were advanced between Courtney Park Drive and Highway 407 as part of the site investigation for the installation of the proposed median sewer, see Drawings 4 to 6. The purpose of these boreholes was to complement and confirm the findings of fourteen (14) historic boreholes (110-1 to 110-3, 122-1(1), 122-1(2), 122-2(1), 122-2(2), 135-3, 135-4, 193-7, 193-8, and 204-4 to 204-6) and the ten (10)



previously completed boreholes associated with the overall Highway 410 widening project (C4-1, C4-2, C5-1, C5-2, P2-1 to P2-3, and P3-1 to P3-3). The subsurface conditions anticipated to be encountered are summarized below. The present ground surface along this section of the sewer ranges on average from approximately El. 186 m to El. 194 m from south to north. It is understood that the grade raise along this section will generally range from 1 m to 3 m, with an average grade raise of approximately 2 m.

4.2.4.1 *Fill*

A clayey silt fill containing some sand, trace gravel and organics was encountered in the existing center median area along this section of the proposed median sewer alignment. The fill was generally brown and had a thickness of approximately 300 mm. An SPT "N" value of 6 blows per 0.3 m of penetration was measured in the clayey silt fill, indicating a firm relative density.

4.2.4.2 *Clayey Silt Till*

A brown to grey clayey silt till deposit was found to underlie the clayey silt fill along this section of the proposed median sewer alignment. This deposit ranged in thickness from approximately 2.7 m to 6.7 m thick in Boreholes 12-11 and 12-12. The thickness of the till deposit is anticipated to vary between about 1 m and 15 m within the limits of this section based on historic and previously completed borehole information. Atterberg limits testing performed on selected samples of the till deposit estimated the plastic limit to range from 12 per cent to 17 per cent, the liquid limit to range from about 17 per cent to 32 per cent, and corresponding plasticity indices of 5 per cent to 15 per cent. The natural water content ranged from approximately 7 per cent to 19 per cent. The measured SPT "N" values ranged from 17 blows per 0.3 m of penetration to 100 blows per 0.15 m of penetration, indicating a very stiff to hard relative density.

4.2.4.3 *Silt to Sand and Silt*

It is anticipated that layers of silt to sand and silt, containing trace clay and trace to some gravel, are contained within and underlie the clayey silt till unit. Layers of silt to sand and silt were encountered approximately 3.0 m below the existing ground surface (at about El. 180.5 m) in Borehole 12-11, and were also encountered during historic and previously completed site investigations associated with the overall Highway 410 widening project. The thickness of this layer(s) is anticipated to vary along this section of the proposed median sewer alignment. The measured SPT "N" values ranged from 17 blows to 53 blows per 0.3 m of penetration, indicating a compact to very dense state of compactness.

4.2.4.4 *Groundwater Conditions*

The groundwater level is anticipated to be approximately 3 m to 4 m below the existing ground surface along this section of the proposed median sewer. It should be noted that the water table is expected to fluctuate seasonally in response to changes in precipitation and snow melt, and is expected to be higher during the spring season.

4.2.5 *St. 9+000 to St. 9+650 (Including Etobicoke Creek)*

A single borehole (12-13) was advanced along the proposed median sewer alignment between the Highway 407 overpass and Etobicoke Creek, see Drawings 6 and 7. This borehole complements four historic boreholes (110-4, 117-1, 195-1 and 195-4) and thirteen (13) previously completed boreholes associated with the overall Highway 410 widening project (P4-1 to P4-3, and EC-1 to EC-10). The subsurface conditions anticipated to be encountered are summarized below. The present ground surface along this section of the sewer ranges on average from approximately El. 194 m to El. 190 m from south to north, excluding Etobicoke Creek, which drops



to an elevation below approximately El. 186 m. It is understood that a grade raise along this section will generally range from 1 m to 2 m, with an average grade raise of approximately 1.5 m.

4.2.5.1 Fill

An approximately 100 mm thick layer of topsoil was found to be underlain by an approximately 0.7 m thick layer of clayey silt fill starting at the ground surface. This clayey silt fill contained some sand, trace gravel and organics, is anticipated to be less than 1 m thick between St. 9+000 and St. 9+150, and may approach a thickness of about 0.1 m towards Etobicoke Creek. An SPT “N” value of 5 blows per 0.3 m of penetration was measured in the fill, indicating a firm relative density. An Atterberg limits test performed on a sample of the fill estimated a liquid limit of 34 per cent, a plastic limit of 18 per cent, and a corresponding plasticity index of 16 per cent. The sample had a natural water content of 18 per cent.

4.2.5.2 Clayey Silt Till

Although not encountered in Borehole 12-13 of the current site investigation, a layer of brown to grey clayey silt till containing sand and gravel is believed to exist at the southern limit of this section based the historic borehole records. The till unit is anticipated to be approximately 5.2 m thick near St. 8+975 and may thin out to zero near St. 9+150. The historic SPT “N” values suggest that this till has a hard relative density.

4.2.5.3 Sand and Gravel

A native sand and gravel layer was encountered in the boreholes that were completed for the associated bridge structure close to Etobicoke Creek for the Highway 410 widening project. The unit contained trace to some silt and clay, and was wet, due in part to the presence of the creek. This unit is not anticipated to be encountered during the installation of the median sewer based on the current information, as it was encountered at the general elevation of the creek and below the proposed sewer invert elevations in this area.

4.2.5.4 Shale Bedrock

Slightly weathered to fresh, laminated, grey, weak to medium strong shale bedrock (Georgian Bay Formation) containing strong to very strong fossiliferous limestone interbeds and clay seams was encountered in Borehole 12-13 underlying the clayey silt fill, and is believed to exist close to the existing ground surface along this particular section of the proposed median sewer alignment. The top of bedrock is anticipated to be less than 1 m below the existing ground surface (i.e. between approximately El. 192 m and El. 193 m) between St. 9+150 and Etobicoke Creek, but at a greater depth south of St. 9+150.

4.2.5.5 Groundwater Conditions

The groundwater table is anticipated to be between about El. 191 m and El. 192 m along the proposed median sewer alignment between St. 9+000 and St. 9+500. The water table is expected to fluctuate seasonally in response to changes in precipitation and snow melt, and is expected to be higher during the spring season.

4.2.6 St. 9+650 to St. 11+500 (Including Steeles Avenue)

Two boreholes (12-14 and 12-15) were advanced between St. 9+650 and St. 11+500 along the proposed median sewer alignment, see Drawings 7 to 10. These boreholes obtained additional subsurface information along this section of the sewer alignment, and complemented the information obtained from the nine historic boreholes (110-5, 122-3(1), 122-3(2), 122-4(1), 122-4(2), 122-5(1), 122-5(2), 187-3 and 187-4) and the six previously completed boreholes associated with the overall Highway 410 widening project (P5-1 to P5-3, and



P6A-1 to P6A-3). The subsurface conditions anticipated to be encountered are summarized below. The present ground surface along this section of the sewer ranges on average from approximately El. 190 m to El. 198 m from south to north. It is understood that there will be an average grade raise of about 1.5 m along this section of the alignment.

4.2.6.1 *Fill*

A brown clayey silt fill layer was encountered below an approximately 100 mm thick layer of topsoil along this section of the proposed sewer alignment. The clayey silt fill layer is anticipated to be approximately less than 0.5 m thick over the majority of the alignment, and possibly as thick as 2 m between St. 10+150 and St. 10+900 based on the available borehole information. The measured SPT “N” values ranged from 9 blows to 23 blows per 0.3 m of penetration, indicating a stiff to very stiff consistency.

4.2.6.2 *Clayey Silt Till*

The clayey silt till deposit was found underlying the surficial fill units in Boreholes 12-14 and 12-15. The till was generally brown to grey, containing trace to some gravel and cobbles, and is anticipated to vary in thickness along this section of the proposed sewer alignment. Borehole Records from current and past site investigations suggest that the till increases in thickness from approximately 2 m at Etobicoke Creek, to over 10 m between St. 10+200 and St. 10+800, to approximately 4 m at the northern limit of this section. A layer of cobbles and boulders was encountered within the deposit in Borehole 12-14 as described below. Atterberg limits testing conducted on selected samples of the till estimated the plastic limit to range from approximately 12 per cent to 15 per cent, the liquid limit to range from about 18 per cent to 27 per cent, and corresponding plasticity indices ranging from 6 per cent to 12 per cent. The natural water content was estimated to range between 6 per cent and 12 per cent. The measured SPT “N” values ranged from 23 blows to 90 blows per 0.3 m of penetration, indicating a very stiff to hard relative density.

4.2.6.3 *Cobbles and Boulders*

An approximately 2.3 m thick layer of cobbles and boulders was encountered in Borehole 12-14 at a depth of approximately 4 m below the existing ground surface (i.e. at approximately El. 189.5 m and some 2.5 m below the sewer invert level). This layer was not encountered at the adjacent boreholes approximately 150 m south and 200 m north of Borehole 12-14.

4.2.6.4 *Shale Bedrock*

Grey, slightly weathered to fresh, laminated shale bedrock (Georgian Bay Formation) with strong to very strong fossiliferous limestone interbeds and clay seams was encountered underlying the native clayey silt in Borehole 12-15. Unconfined compression and point load testing of selected samples measured UCS values of 13 MPa and 22 MPa, indicating a general rock mass strength ranging from weak to medium strong. While the subsurface conditions encountered indicate that the top of bedrock may be below the proposed invert of the median sewer along the majority of this section of the alignment, the bedrock was encountered close to the existing ground surface near the northern limit at an approximately 6.0 m depth below the existing ground surface (at about El. 191.0 m) in Borehole 12-15. Historic borehole records (see Appendix C1) indicate that the top of bedrock may even be closer to the surface further north from St. 11+325.



4.2.6.5 Groundwater Conditions

The groundwater table is anticipated to be approximately 3 m to 4 m below the existing ground surface along this particular section of the proposed median sewer alignment. It is important to note that the water table is expected to fluctuate seasonally in response to changes in precipitation and snow melt, and is expected to be higher during the spring season.

4.2.7 St. 11+500 to St. 13+400 (Including Glidden Road, the Canadian National (CN) Rail overpass and Orenda Road)

Three boreholes (12-16 to 12-18) were advanced along the proposed median sewer alignment between St. 11+500 and St. 13+400, see Drawings 10 to 12, to complement the subsurface information from the forty-four (44) previously completed boreholes (110-6 to 110-8, 122-6(1), 149A-2, 149A-3, 149B-1 to 149B-7, 171-6, 171-7, 186-2, 186-11, 229-16(1) and 229-21; GR-1 to GR-7, CN-1 to CN-10, and OR-1 to OR-8). The subsurface conditions anticipated to be encountered are summarized below. The present ground surface along this section of the sewer ranges on average from approximately El. 198 m to El. 216 m from south to north. It is understood that there will be an average grade raise of approximately 1.5 m along this section of the alignment.

4.2.7.1 Fill

Fill materials consisting primarily of clayey silt and silty clay were encountered underlying a surficial topsoil layer, which was about 100 mm thick or less at the investigated borehole locations. In Borehole 12-17, a thin layer of sand and silt fill was encountered underlying the topsoil, and an approximately 0.5 m thick layer of pulverized asphalt was found at a depth of approximately 3.8 m below existing ground surface. Based on the results of current and historic site investigations, it is anticipated that the thickness of the fill layer ranges from less than 0.5 m at the southern limit of this section, to upwards of approximately 9 m in the vicinity of Orenda Road, and then decreases to about 3 m at the north end of this section. The predominant clayey silt fill units were brown to grey, and contained some sand and gravel. The measured SPT "N" values ranged from 2 blows to 23 blows per 0.3 m of penetration, indicating a soft to very stiff relative density. Atterberg limits testing conducted on selected samples of the clayey silt fill material estimated the plastic limit to range from 16 per cent to 25 per cent, the liquid limit to range from 30 per cent to 46 per cent, and corresponding plasticity indices ranged from 14 per cent to 26 per cent. The natural water content was estimated to range from about 11 per cent to 29 per cent.

4.2.7.2 Sandy Silt

An approximately 3.2 m thick layer of sandy silt was encountered underlying the fill in Borehole 12-18. The sandy silt was brown and contained trace gravel and clay. The measured SPT "N" values ranged from 9 blows to over 57 blows per 0.3 m of penetration, indicating a loose to very dense state of compactness. The natural moisture content was estimated to range from about 12 per cent to 13 per cent based on test results from selected samples.

4.2.7.3 Clayey Silt Till

A clayey silt till deposit was encountered beneath the surficial fill units. The till was brown to grey and contained trace sand to with sand, and some gravel to with gravel. Although not encountered during the site investigation, cobbles and / or boulders are anticipated to be present at depth within the till deposit. The measured SPT "N" values in the till ranged from 25 blows to over 92 blows per 0.3 m of penetration, indicating that the clayey silt till had a very stiff to hard relative density. The plastic limit ranged from about 15 per cent to 16 per cent, the liquid



limit ranged from 27 per cent to 29 per cent, and corresponding plasticity indices ranged from 12 per cent to 13 per cent. The natural water content ranged from about 5 per cent to 12 per cent.

4.2.7.4 Shale Bedrock

Although not encountered in Boreholes 12-16, 12-17 and 12-18 the shale bedrock was found below the clayey silt till at an approximate 10 m to 14 m depth, some 6 to 10 m below the sewer invert level, in boreholes put down at the adjacent bridge structures.

4.2.7.5 Groundwater Conditions

The groundwater level was observed at depths of approximately 7.3 m and 8.6 m below the existing ground surface in Boreholes 12-16 and 12-17, respectively, and were anticipated to be still recovering at the time of observation. Historic information suggests that the groundwater level may be located approximately 4 m to 6 m below the existing ground surface along this median sewer section, and may be as high as 2 m below ground surface at the southern and north limits of this section. The water table is expected to fluctuate seasonally in response to changes in precipitation and snow melt, and is expected to be higher during the spring season.

4.2.8 Highway 403 Westbound (Southbound) – St. 4+250 to St. 4+600

One borehole (12-6) was advanced as part of the median sewer site investigation between St. 4+250 and St. 4+600, see Drawing 13. This borehole was advanced to complement the eight historic boreholes which were previously completed (25-3 to 25-6, 26-3, 26-4, 90-16, and 189-7). The subsurface conditions anticipated to be encountered are summarized below. The present ground surface along this section of the sewer ranges on average from approximately El. 173 m to El. 176 m from south to north. It is understood that there will be no appreciable grade raise along this section.

4.2.8.1 Fill

An approximately 200 mm thick layer of asphalt was encountered starting at the existing ground surface in Borehole 12-6. The asphalt was underlain by an approximately 0.7 m thick layer of silty sand fill (i.e. road base material). The silty sand fill was brown and contained some gravel and trace to some clay. An SPT “N” value of 41 blows per 0.3 m of penetration was measured in the fill, which suggests a dense state of compactness. Although no boreholes were advanced in the center median area between St. 4+250 and St. 4+600, clayey silt fill is anticipated to also be present along this section of the median sewer alignment.

4.2.8.2 Shale Bedrock

Shale bedrock was encountered underlying the silty sand fill at an approximate depth of 0.8 m below the existing ground surface in Borehole 12-6. This corresponds well with the historic borehole information which indicates that a significant portion of this section of the highway is within a cut (up to approximately 8 m deep) into the underlying native shale bedrock that was made for the original Highway 403 / 410 construction. The shale bedrock encountered was of the Georgian Bay Formation, and was slightly weathered to fresh, laminated, grey, and weak to medium strong and contained strong to very strong fossiliferous limestone interbeds and clay seams.



4.2.8.3 *Groundwater Conditions*

The groundwater level is anticipated to be approximately 1 m to 2 m below existing ground surface along this section of the proposed median sewer alignment. It should be noted that the water table is expected to fluctuate seasonally in response to changes in precipitation and snow melt, and is expected to be higher during the spring season.



FOUNDATION INVESTIGATION AND DESIGN REPORT - MEDIAN SEWER

5.0 CLOSURE

This Foundation Investigation Report was prepared by Mr. Geoff Lay, M.A.Sc., E.I.T., and reviewed by Dr. Graeme Skinner, P.Eng., with input from Ms. Lisa Coyne, P.Eng., a geotechnical engineer and Principal with Golder. Mr. Fin Heffernan, P.Eng., a Designated MTO Foundations Contact for Golder, conducted an independent review of this report

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PART B

**FOUNDATION DESIGN REPORT
MEDIAN SEWER
HIGHWAY 410 WIDENING
FROM SOUTH OF HIGHWAY 401 TO QUEEN STREET
REGIONAL MUNICIPALITY OF PEEL
G.W.P. 2144-07-00**



6.0 DISCUSSION AND ENGINEERING RECOMMENDATIONS

This section of the report provides engineering guidelines on the geotechnical design aspects of the project based on our interpretation of the available borehole information and project requirements. The information in this portion of the report is provided for the guidance of the designers and is intended for this project only. Where comments are made on construction, they are provided to highlight those aspects that could affect the detailed design of the project, and for which special provisions may be required in the Contract Documents. Those requiring information on aspects of construction should make their own interpretation of the factual information provided as such interpretation may affect equipment selection, proposed construction methods, scheduling and the like.

It is understood that the entire alignment of the median sewer is proposed to be constructed within the existing shoulder or median of the highway, and not below the travelled portions of the highway or within the road structure itself. Based on the information provided by the designer, we understand that the median sewer will be constructed using an open-cut (also called cut-and-cover) construction method. Further, it is understood from the project team that the median sewer will be constructed with reinforced concrete pipe along its entire length.

The open-cut excavation method is considered feasible for the proposed median sewer alignment, unless noted otherwise below. Consideration will need to be given to potential traffic staging and disruptions / delays depending on the final design alignment, proximity to existing roads and construction staging / scheduling.

The following sections of the report discuss the general design and construction considerations for the installation of the median sewer, as well as the various sewer pipe diameters, burial depths / grade raises, anticipated subsurface soil / bedrock conditions, installation recommendations for the various sections identified along the proposed alignment.

6.1 GENERAL DESIGN AND CONSTRUCTION CONSIDERATIONS

6.1.1 Excavations - Soil

Temporary excavations in overburden for the proposed alignment can be carried out using conventional open-cut procedures, as discussed above, with trenches having nominal side slopes conforming to the latest version of the Ontario Occupational Health and Safety Act (OHSA). In general, the native overburden soils encountered during the subsurface investigation are classified as Type 2 soils: OHSA indicates that any open excavation in Type 2 soils deeper than 1.2 m, should be made with nominal side slopes of 1 horizontal to 1 vertical (1H:1V), sloped to within 1.2 m of the bottom of the excavation, or to the top of bedrock. The various fill materials identified along the proposed alignment should be classified as Type 3 soils and excavations in these soils should be made with slopes no steeper than 1H:1V, with no vertical walls. Excavations should be undertaken in accordance with Ontario Provincial Standard Specification (OPSS) 401 (Trenching, Backfilling and Compacting).

Portions of the temporary excavations extending through the native clayey silt soils and fill material are not anticipated to encounter significant volumes of groundwater seepage. Groundwater seepage into the excavation may occur as a result of the groundwater table being located within or above these materials, or being left open for an extended period of time. It is anticipated that groundwater encountered within excavations in these soils can be handled by pumping from properly constructed and filtered sumps located within the excavations. Significant seepage could occur within the granular fill materials or if zones/layers of predominantly granular



soils are intercepted within the clayey silt deposits and where excavation extend into weathered or fractured zones of shale bedrock. Shallower excavation side slopes may be required where perched or high groundwater conditions occur to minimize surficial sloughing. Care should be taken to direct surface water away from the open excavations.

Till soils randomly contain cobbles and boulders and the Contract Documents must identify this fact to bidders.

Temporary protection system, as discussed below, should be provided at locations where space limitations prevent construction of sufficiently shallow slopes or where required to provide protection to existing structures/foundations, buried services, roadways or other existing facilities. Any existing services present were likely constructed using open-cut methods, unless noted otherwise, and the service trenches are anticipated to be backfilled with variable fill materials. In areas where the excavations for the sewer intersect the utility backfill materials, further flattening of the side slopes of the excavations may be required.

6.1.2 Excavations - Bedrock

Temporary excavations in bedrock can be carried out using conventional open-cut procedures, as discussed above, with trenches having nominal side slopes conforming to the latest version of the OHSA. Where sound and stable bedrock (i.e. below the weathered zone) is encountered, OHSA indicates that the rock may be excavated with vertical side slopes. A near-vertical orientation (approximately 1H:10V) is recommended to minimize potential undercutting of shale layers, provided that the sewer trench and backfilling are completed within a short period of time (i.e. with a one to two day period) to minimize weathering of the shale bedrock exposed in the excavation. .

Standard excavating equipment, such as backhoes, should be adequate for excavation of the sewer trench in the overburden soils. A hydraulic hammer (i.e. hoe-ram) could be used for excavation of bedrock materials. Pneumatic breakers or chisels will be required to break and remove the harder limestone layers that exist within the shale bedrock as blasting, and vibration/hammering is not permitted adjacent to structures. Excavations should be undertaken in accordance with OPSS 401 (Trenching, Backfilling and Compacting) and OPSS 403 (Rock Excavation in Open Cut).

6.1.3 General Installation Considerations

Concrete sewer pipe bedding and backfill should be compatible with the type and class of pipe, the surrounding subsoil and anticipated loading conditions, and should be designed in accordance with MTO standards as indicated in the Ontario Provincial Standard Drawing (OPSD) 802 or suitable equivalent. The excavated subsoils may be reused as non-structural backfill provided they are free of topsoil, organics or other deleterious material, are at suitable water contents, and are suitably placed and compacted as noted below. The majority of the native site soils may be reused for non-structural trench backfill and at a minimum height of 300 mm above the crown of the pipe (i.e. not surrounding the pipe). All topsoil and organic materials should be wasted or used for landscaping purposes.

All trench backfill materials at a minimum height of 300 mm above the pipe crown should be placed in maximum 300 mm loose lifts and uniformly compacted to at least 95 percent of SPMDD at depth in pavement areas and at least 98 percent of the material's SPMDD within 1 m of pavement subgrade (i.e. base of pavement structure) level under the highway and highway shoulder.



If water contents of the site soils at the time of construction are too high, or if there is a shortage of suitable in-situ material, then an approved imported sandy material which meets the requirements for OPSS Select Subgrade Material (SSM) could be used. It should be placed and compacted as indicated above. Backfilling operations during cold weather should avoid inclusions of frozen lumps of material, snow and ice, and backfilling with fine grained (i.e. silts and/or clays) materials should not be undertaken.

Settlement of the compacted trench backfill should be anticipated, and the majority of such settlement should take place within about 6 months following the completion of trench backfilling operations. This settlement will be reflected at the ground surface and may be compensated for, where necessary, by placing additional granular material as required. Alternatively, if the asphalt binder course is placed shortly following the completion of trench backfilling operations in these areas, any settlement that may be reflected by subsidence of the surface of the binder asphalt should be compensated for by placing an additional thickness of binder asphalt or by padding.

The design frost depth for the proposed median sewer alignment is estimated to be 1.2 m to 1.3 m below ground surface. To avoid undue differential movements or settlement of ground surface adjacent to and over the trench, the general backfill materials should match, as practically as possible, the native or fill material exposed in the trench walls. Backfill within the zone of frost penetration below the bedrock surface should consist of non-frost susceptible material such as Granular A or Granular B Type 1 conforming to OPSS specifications.

A soil unit weight of 21 kN/m³ should be used for the purposes of calculating the overburden soil pressures. The design hydrostatic groundwater table elevations are discussed for the individual sections below.

6.1.4 Potential Conflict Considerations

Based on the median sewer design information provided, potential conflicts with overhead/changeable message signs, high mast light poles, bridge structures and utilities have been identified along the proposed alignment as noted in the individual sections below. It should be noted that the potential conflicts and approximate reference stationing have been identified from the information provided (as noted above). The following general recommendations are applicable to the potential conflicts identified in the individual sections, unless noted otherwise:

Potential Conflict	Design Considerations
Overhead Signs (OHS) and Changeable Message Sign (CMS)	Median sewer should be located beyond the zone of soil bounded by a line extending at 30° down from the edge of the foundation, to the full excavation depth. Otherwise, median sewer and backfill shall be appropriately designed for vertical and lateral loading conditions.
High Mast Light (HML) Poles	Median sewer should be located beyond the zone of soil bounded by a line extending at 30° down from the edge of the foundation, to the full excavation depth. Otherwise, median sewer and backfill shall be appropriately designed for vertical and lateral loading conditions.
Bridge Structure Foundations	Median sewer should be located beyond the zone of soil bounded by a line extending at 30° down from the edge of the foundation, to the full excavation depth. Otherwise, median sewer and backfill shall be appropriately designed for vertical and lateral loading conditions. If sufficient space is not available temporary protection systems shall be utilized, as required, and monitored to a minimum recommended Performance Level of 1B (as per OPSS 539). Vibration monitoring and protection will be required where excavation into the shale bedrock is undertaken in the vicinity of existing



Potential Conflict	Design Considerations
	foundation elements. Vibrations should be limited to a maximum limit of 100 mm/sec (peak particle velocity).
Utilities (i.e. electrical, fibre optic, ATMS)	Utilities to be suitably exposed and supported as per OHSA. Where temporary protection is required, it should be for a minimum Performance Level 2 and monitored as per OPSS 539. Higher Performance Levels (i.e. 1a or 1b) should be required for vital utilities such as larger high pressure pipelines.

It should be noted that the elevation (i.e. burial depth) of the existing utilities along the alignment are unknown at this time, may be in direct conflict with the proposed median sewer installation, and should be resolved prior to construction.

6.1.5 Temporary Protection Systems

Temporary protection systems will be required where sufficient space is not available to permit open-cut excavations in the vicinity of the existing highway/shoulder, utilities, and foundations for other structures. Based on the subsurface conditions along the alignment and the likely excavation geometry, it is anticipated that a soldier pile lagging system would be suitable with internal bracing (struts), anchors or rakers to provide lateral support. A driven interlocking sheetpile system, again with internal bracing, anchors or rakers, could also be utilized, but consideration should be given to the potential for encountering cobbles and/or boulders in the surficial soils. Alternatively a ‘trench box’ may be used provided that any gaps or space between the trench box and the sides of the excavation are backfilled immediately following excavation and placement of the trench box to prevent lateral movement of the soil, provided that lateral movements in the soils adjacent to the trench box will meet the performance levels as noted above. An interlocking sheetpile system has an advantage with respect to controlling groundwater seepage where zones of perched groundwater are present. However, groundwater seepage and the potential loss of fine soil particles can be mitigated if a soldier pile and lagging system is adopted, by backing the lagging with filter cloth in areas where the temporary shoring intercepts zones of perched groundwater or significant seepage.

Lateral support elements should be designed to accommodate the loads applied from earth pressures and surcharge pressures from area, line or point loads, as well as the impact of sloping ground behind the system. The temporary excavation support system should be designed and constructed in accordance with OPSS 539 (*Construction Specification for Temporary Protection Systems*). The lateral movement of the temporary protection / shoring systems should meet the Performance Levels for the individual conflicts as indicated above, or Performance Level 2 for highway/shoulder protection as specified in OPSS 539.

6.1.6 Performance Level Requirements and Monitoring

A settlement instrumentation and monitoring program will be required at all structure crossings and at some existing utility crossings. A Non-Standard Special Provision (NSSP) for the supply and installation of settlement monitoring equipment is included in Appendix D in this regard, and the specific monitoring locations, frequency of monitoring, and any review / trigger level (etc.) should be established prior to construction.

The installation of in-ground settlement points (consisting of sleeved iron bars set 0.3 m above the sewer obvert elevation), utility monitoring points, and monitoring points on bridges, should be also considered at accessible locations. The elevation of the top of the bar and/or at the monitoring points would be read using conventional precision levelling equipment (where applicable). The in-ground monitoring points provide the best measure of



the ground settlement effects, as they are generally unaffected by frost heave, thaw settlement or the bridging action of the pavement structure.

Monitoring of settlement instruments on this project may be constrained by the continuous and high traffic volume and the limited periods during which access to the highway can be obtained. Settlement points on or near the road could be read remotely and the use of electromagnetic distance measuring (EDM) equipment is recommended, with reading reflectors installed on the highway. A specialist surveying firm should be retained to confirm the set-up and to carry out the settlement monitoring during construction; their equipment and procedures must be capable of surveying the settlement point elevations to within ± 2 mm of the actual elevation.

A settlement monitoring plan should be established as part of the Contract Documents. The settlement monitoring plan should be consistent with the requirements in OPSS 539. All monitoring points should be read at least three times (on separate days) before the start of sewer installation to establish a pre-construction baseline, and monitoring should then continue on a regular basis. The effectiveness of this monitoring method could be impacted by weather conditions if the work is undertaken during the winter months. As discussed above, the movement of the temporary protection systems should meet the Performance Levels for the individual conflicts as indicated above, or Performance Level 2 for highway/shoulder protection as specified in OPSS 539.

6.1.7 Section Specific Construction Considerations and Recommendations

6.1.7.1 St. 2+190 to St. 2+750 (South of Matheson Blvd.)

The subsurface conditions anticipated to be encountered below any asphalt layers along this section of the median sewer installation are anticipated to consist primarily of compact to dense granular fill and firm to hard clayey silt fill and till units. The present ground surface along this section of the sewer ranges on average from approximately El. 156 m to El. 165 m from south to north, and it is understood that there will be no appreciable grade raise along this section. The median sewer invert elevation along this section generally ranges from 153.5 m to 162.5 m, with an average anticipated excavation depth of 3 m below existing ground surface. The sewer pipe through this section of the alignment ranges from 300 mm diameter to 525 mm diameter concrete pipe.

Based on the existing subsurface information, excavation should follow OHSAA guidelines for Type 3 soils, and minimal groundwater seepage into the excavation is anticipated to be encountered. Installation of the sewer should be undertaken as noted above (OPSD 802 or equivalent).

Based on the median sewer design information provided, the following table identifies potential conflicts over this section of the proposed alignment that should be addressed as noted above:



Potential Conflict	Approximate Station (m)	Approximate Distance from Centerline of Median Sewer
OHS #50	2+050	
Advanced Traffic Management System (ATMS) Cable	2+103	Crossing
OHS #1	2+270	1.6 m
OHS #2	2+530	2.0 m

Consideration should be given to locating the median sewer further from the OHS foundation elements wherever possible.

6.1.7.2 St. 2+750 to St. 4+950 (Including Matheson Blvd, Highways 403 / 410 / 401 Interchanges and the Heart Lake Tunnel)

The subsurface conditions along this section of the median sewer installation are anticipated to consist primarily of up to about 0.6 m to 1.5 m of compact to dense sand and gravel and stiff to very stiff clayey silt fill, overlying the weathered / intact weak to medium strong shale bedrock. The present ground surface along this section of the sewer ranges on average from approximately El. 165 m to El. 178 m from south to north and it is understood that there will be no appreciable grade raise along this section south of Highway 401, transitioning to an approximately 2 m grade raise in the stretch of section north of Highway 401. The median sewer invert elevation along this section generally ranges from 162.5 m to 176 m, with an anticipated average excavation depth of up to 3 m below existing ground surface. The sewer pipe through this section of the alignment ranges from 300 mm diameter to 675 mm diameter concrete pipe.

Based on the existing subsurface information, excavation should follow OHSA guidelines for Type 3 soils above the intact bedrock, and near vertical (1H:10V) side walls in the bedrock as noted above. Minimal groundwater seepage into the excavation is anticipated to be encountered. This is with the exception of sand and gravel fill layers which may be found in the vicinity of existing bridge structures, and moderate seepage may be encountered. Installation of the sewer should be undertaken as noted above (OPSD 802 or equivalent).

Based on the median sewer design information provided, the following table identifies potential conflicts over this section of the proposed alignment that should be addressed as noted above:

Potential Conflict	Approximate Station (m)	Approximate Distance from Centerline of Median Sewer
ATMS	2+855	Crossing
Electrical Line	2+883	Crossing
OHS #3	2+950	2.1 m from CB at end of sewer segment
Gas Main	2+954	3.6 m from CB at end of sewer segment
OHS #4	3+190	2.3 m
ATMS	3+347	Crossing
Electrical Line	3+393	Crossing ¹



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Potential Conflict	Approximate Station (m)	Approximate Distance from Centerline of Median Sewer
Electrical Line	3+665	Crossing ¹
Electrical Line	3+823 to 3+953	Overlapping
Electrical Line	3+854	Crossing
Hwy 401 E Express – Hwy 403 W Structure	3+865	14 m
Hwy 401 E Collector – Hwy 403 W Collector Structure	3+964	Crossing
OHS #5	4+120	1.2 m
Electrical Line	4+111	Crossing
OHS #5	4+120	1.2 m
Electrical Line	4+232 to 4+419	2.7 m
ATMS	4+235	Crossing
Hwy 401 W collector - Dixie N/S Structure	4+235	Crossing
Hwy 401 EBL Collector Structure	4+249	Crossing
Hwy 410 N - Hwy 401 E Collector Structure	4+300	Crossing
Hwy 401 EBL Express Structure	4+358	Crossing
Hwy 401 WBL Express Structure	4+378	Crossing
Hwy 401 WBL Collector Structure	4+425	2.2 m from CB at end of sewer segment
OHS #6	4+580	1.6 m
Electrical Line	4+650	Crossing
Watermain	4+680	Crossing
Watermain	4+700	Crossing
Heart Lake Tunnel	4+840	Crossing
Electrical Line	4+873	Crossing
Electrical Line	4+873 to 4+950	5.2 m
HML P1	4+893	1.3 m

¹ It is understood that the median sewer cannot be relocated in this area, this conflict will need to be appropriately addressed at time of construction, as recommended in Section 6.1.

Consideration should be given to locating the median sewer further from any foundation elements (i.e. bridge structures, OHS, HML poles, etc.).



Matheson Boulevard Overpass

South of the Matheson Boulevard overpass, the median sewer is proposed to terminate at about St. 2+890 with an invert elevation of about El. 164 m; the south limit of the bridge foundations extends to approximately St. 2+895, with spread footings founded at about El. 159 m. North of the Matheson Boulevard overpass, the median sewer is proposed to terminate at around St. 2+945 with an invert elevation of about El. 165 m; the north limit of the bridge foundations extends to approximately St. 2+930 with spread footings founded at about El. 159 m. Thus, no conflicts are expected between the median sewer and the Matheson Boulevard overpass structure based on the available information.

Highways 403 / 410 / 401 Interchanges

Highway 403 W Express - 401 E Express: Based on the currently proposed horizontal alignment, the median sewer will be in close proximity to the Highway 403 W Express - 401 E Express structure foundations at about St. 3+800. The invert of the median sewer is at an elevation of about El. 171.5 m in this area, while the bridge structure is founded on spread footings with a bottom of footing elevation of about El. 173.5 m. The proposed median sewer alignment appears to be within approximately 14 m of the edge of the footing. Thus, the median sewer excavation is anticipated to be located outside of a zone extending outward and downward from the structure footings at about 1.5H:1V. Protection systems will be required if the median sewer is located closer to the footing, as discussed above.

Highway 401 E Express - 403 W Express: The median sewer will be in close proximity or immediately adjacent to the Highway 401 E Express - 403 W Express structure foundations at about St. 3+865. The invert of the median sewer is at an elevation of about El. 171 m in this area, while the bridge structure is founded on spread footings with a bottom of footing elevation of about El. 169.5 m. The proposed median sewer alignment appears to be within less than approximately 1.5 m of the edge of the footings, and thus the excavation may be directly above or close to the edge and top of the footing. Consideration should be given to locating the median sewer further from the existing foundations.

Highway 401 E Collector - 403 W Collector: The median sewer will be in close proximity or immediately adjacent to the Highway 401 E Collector - 403 W Collector structure foundations at about St. 3+960. The invert of the median sewer is at an elevation of about El. 171 m in this area, while the bridge structure is founded on spread footings with a bottom of footing elevation of about El. 169 m. The proposed median sewer alignment appears to be within approximately 2.8 m of the edge of the footings, and thus the excavation may be close to or just above the edge and top of the footing. Consideration should be given to locating the median sewer further from the existing foundations.

Highway 401 W Collector - Dixie and Highway 401 E Collector - 403 W Collector: The median sewer will be in close proximity or immediately adjacent to the Highway 401 W Collector - Dixie and Highway 401 E Collector - 403 W Collector structure foundations at about St. 4+260. The invert of the median sewer is at an elevation of about El. 169.5 m in this area, and the bridge structure is founded on spread footings with approximately the same bottom of footing elevation (El. 169.5 m). The proposed median sewer alignment appears to be within approximately 2.6 m of the edge of the footings, and thus the median sewer excavation is expected to be adjacent to and just below the edge and bottom of the footing. Consideration should be given to locating the median sewer further from the existing foundations.



Highway 410 N - 401 E Collector: Contract Drawings for the Highway 410 N - 401 E Collector structure have not been made available, and could not be located in the GEOCRE system at the time of preparing this report. However based on the available information and similar structures in the area, the median sewer appears to be in close proximity or immediately adjacent to the structure. The invert of the median sewer is at an elevation of about El. 169.5 m in this area, and it is anticipated that the bridge structure is founded on spread footings with a bottom of footing elevation of about El. 169.5 m. The proposed median sewer alignment appears to be within approximately 1.4 m of the edge of the footings, and thus the excavation may be adjacent to and just below the edge and bottom of the footing. Upon confirmation of the existing foundation geometry, consideration should be given to locating the median sewer further from the existing foundations.

Highway 401 E Express: The median sewer appears to be immediately adjacent to (less than 1.5 m from) the Highway 401 Express structure foundations at about St. 4+360 as noted above and based on the available information. The invert of the median sewer is at an elevation of about El. 170 m in this area, and the bridge structure is founded on spread footings with approximately the same bottom of footing elevation (El. 170 m). It is recommended that the median sewer be located further from the existing foundations due to the anticipated overlap with the existing footings.

Highway 401 W Express: The median sewer appears to be in close proximity to (less than 2.5 m from) the Highway 401 W Express structure foundations at about St. 4+380. The invert of the median sewer is at an elevation of about El. 170 m in this area, and the bridge structure is founded on spread footings with approximately the same bottom of footing elevation (El. 170 m). Based on the currently proposed horizontal alignment, the proposed excavation is expected to be immediately adjacent to or slightly overlapping the edge of the footing. Consideration should be given to locating the median sewer further from the existing foundations, or addressing this potential conflict as noted above, as it is anticipated that exposing the edge of the footings may be necessary for the currently proposed alignment and installation method.

Highway 401 W Collector: The median sewer appears to be in close proximity or immediately adjacent to the Highway 401 W Collector structure foundations at about St. 4+425. The invert of the median sewer is at an elevation of about El. 170.5 m in this area, while the bridge structure is founded on spread footings with a bottom of footing elevation of about El. 172 m. The proposed median sewer alignment appears to be within about 1.5 m of the existing footings, and the excavation will be required to extend approximately 1.5 m below the footing founding level. It is recommended that the median sewer be located further from the existing foundations to avoid the potential overlap with the existing footings. The horizontal distance between the edge of the footing and the median sewer excavation should be consistent with the recommendations provided above regarding the zone of influence of footings.

Heart Lake Tunnel

Based on the information provided and discussions with the project team, it is understood that the Heart Lake Tunnel passes beneath the median sewer in the vicinity of St. 4+840, with a crown elevation of approximately El. 174.3 m, and was constructed using a Tunnel Boring Machine (TBM) along this section of its alignment. The existing ground surface elevation is approximately El. 176 m in this location, with a proposed grade raise of 1.5 m. The invert elevation of the median sewer at this location is at about El 175.3 and the excavation level with a minimum bedding of 300 mm would be approximately El 175. In Borehole 86-18 approximately 80 m



away from the crossing the weathered and intact bedrock is at elevations of about El 175.2 and El 174.5, respectively. Thus, there appears to be approximately less than 1 m of bedrock cover between the Heart Lake Tunnel and the proposed median sewer excavation.

Additional boreholes will be required prior to construction where the median sewer crosses the existing Heart Lake Tunnel in order to verify the elevations of the top of weathered and intact bedrock, as well as the condition and nature of the bedrock pillar between the two excavations.

The proposed open-cut method can be used for the installation of the median sewer in this section. However, careful excavation and monitoring will be necessary to minimize any potential impacts on the existing Heart Lake Tunnel. The use of hoe-ramming should not be permitted within approximately 10 m of the tunnel due to the potential for vibrations to impact and damage the tunnel liner. Within the upper moderately to highly weathered zone and for some of the fresh to slightly weathered rock below, it may be possible to excavate the trench using lines of closely spaced drill holes along the final trench walls and a large excavator. Thick limestone or siltstone layers, as noted in the nearby boreholes, may impede the excavation and additional drilling and/or other excavation methods such as hydraulic-splitting or chemical expansion agents (i.e. Bristar) may be required to excavate the bedrock in this area, especially for harder layers. It should be noted that the existing tunnel was supported with rock bolts in the crown area and the new trench excavation may encounter these rock bolts.

Vibration and visual monitoring of the existing Heart Lake Tunnel should be undertaken pre-, during, and post-construction. Vibrations will likely need to be kept below the recommended maximum limits (peak particle velocity) shown below to prevent any damage to the tunnel.

Maximum Peak Particle Velocity Values Element	Frequency Hz	PPV mm/s
Structures and Pipelines	≤ 40	20
	> 40	50
Concrete and Grout < 72 hours from placement	N/A	10

The excavation of the new trench for the median sewer is not expected to result in significant rock swelling induced loads on the existing tunnel lining. This is primarily due to the fact that the previously weathered upper zone of bedrock in this area would normally have already swelled in the past such that any further swelling due to the excavation would be limited and any such swelling would be further mitigated by to the net positive loading due to the grade raise in this area which will provide additional confinement. Therefore, construction of the median sewer is anticipated to have no significant impact on the Heart Lake Tunnel, provided strict construction and monitoring practices are followed, and this section of the sewer is excavated and backfilled (including the grade raise) in an expedient manner (i.e. within a 7 day period).

6.1.7.3 St. 4+950 to St. 6+250 (Between Heart Lake Tunnel and Courtneypark Drive)

The subsurface conditions anticipated to be encountered along this section of the median sewer installation consist primarily of stiff to very stiff clayey silt till. The present ground surface along this section of the sewer ranges on average from approximately El. 177 m to El. 186 m from south to north, and it is understood that there will be an average grade raise of about 1.5 m along this section of the alignment. The median sewer invert elevation along this section generally ranges from 176 m to 185.5 m, with an average anticipated excavation



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depth of 1 m to 1.5 m below existing ground surface. The sewer pipe through this section of the alignment ranges from 375 mm diameter to 750 mm diameter concrete pipe.

Based on the existing subsurface information, excavation should follow OSHA guidelines for Type 2 soils, and minimal groundwater seepage into the excavation is anticipated to be encountered. Installation of the sewer should be undertaken as noted above (OPSD 802 or equivalent).

Based on the median sewer design information provided, the following table identifies potential conflicts over this section of the proposed alignment that should be addressed as noted above:

Potential Conflict	Approximate Station (m)	Approximate Distance from Centerline of Median Sewer
Electrical Line	4+950 to 5+193	5.2 m
OHS #26	4+970	1.4 m
HML P2	5+015	1.3 m
Sanitary Main	5+106	Crossing
HML P3	5+158	1.2 m
OHS #27	5+170	1.2 m
HML P4	5+298	1.0 m
OHS #7	5+400	1.3 m
HML P5	5+450	0.9 m
Electrical Line	5+454	Crossing
OHS #28	5+600	1.2 m
HML P6	5+614	1.0 m
HML P7	5+783	1.1 m
OHS #9	5+920	0.6 m
HML P8	5+952	1.0 m
OHS #29	5+970	0.8 m
HML P9	6+111	1.1 m

Consideration should be given to locating the median sewer further from any foundation elements (i.e. bridge structures, OHS, HML poles, etc.).

6.1.7.4 St. 6+250 to St. 9+000 (Including Courtnepark Drive, Derry Road and Highway 407 Flyover)

The subsurface conditions anticipated to be encountered along this section of the median sewer installation consist primarily of stiff to very stiff clayey silt fill or native till units. The present ground surface along this section of the sewer ranges on average from approximately El. 183.5 m to El. 194 m from south to north, and it is understood that there will be an average grade raise of about 2 m along this section of the alignment. The median sewer invert elevation along this section generally ranges from 186 m at Station 6+250, to 193 m at Station 9+000 with an average anticipated excavation depth of 0.5 m to 1 m below existing ground surface. The sewer pipe through this section of the alignment ranges from 300 mm diameter to 750 mm diameter concrete pipe.



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Based on the existing subsurface information, excavation should follow OSHA guidelines for Type 2 soils or Type 3 soils in the native and fill units, respectively, and minimal groundwater seepage into the excavation is anticipated to be encountered. This is with the exception of sand and gravel fill layers which may be found in the vicinity of existing bridge structures, where moderate seepage may be encountered. Installation of the sewer should be undertaken as noted above (OPSD 802 or equivalent).

Based on the median sewer design information provided, the following table identifies potential conflicts over this section of the proposed alignment that should be addressed as noted above:

Potential Conflict	Approximate Station (m)	Approximate Distance from Centerline of Median Sewer
Courtneypark Drive Underpass	6+355	Crossing ¹
Electrical Line	6+341	Crossing
Electrical Line	6+369	Crossing
Bell Cable	6+392	Crossing
Electrical Line	6+295 to 7+690	1.3 m
HML P13	6+437	0.9 m
OHS #49	6+520	2.0 m
HML P15	6+602	1.0 m
Sanitary Main	6+756	Crossing
HML P16	6+767	1.0 m
OHS #11	6+865	0.3 m
HML P17	6+929	1.2 m
HML P18	7+095	1.3 m
OHS #30	7+180	0.5 m
HML P19	7+260	1.1 m
OHS #12	7+305	0.3 m
Sanitary main	7+335	Crossing
HML P20	7+423	1.0 m
HML P21	7+571	1.1 m
OHS #13	7+670	0.5 m
OHS #31	7+700	0.8 m
Bell cable	7+735	Crossing
HML P22	7+743	0.9 m
Derry Road Underpass	7+838	3.1 m ¹
Water Main	7+875	Crossing
HML P23	7+889	0.8 m
OHS #14	7+910	1.3 m
OHS #15	8+030	0.7 m
Electrical Line	7+992 to	2.5 m



FOUNDATION INVESTIGATION AND DESIGN REPORT - MEDIAN SEWER

Potential Conflict	Approximate Station (m)	Approximate Distance from Centerline of Median Sewer
	8+936	
Sanitary Main	8+312	Crossing
OHS #16	8+420	0.6 m
Gas Main	8+613	Crossing
Electrical Line	8+641	Crossing
OHS #32	8+770	0.2 m
HML P24	8+902	1.1 m
Hwy 407 Flyover	8+940 to 9+005	Crossing ¹

¹ It is understood that the median sewer cannot be relocated in this area, this conflict will need to be appropriately addressed at time of construction, as recommended in Section 6.1.

Consideration should be given to locating the median sewer further from any foundation elements (i.e. bridge structures, OHS, HML poles, etc.).

Courtneypark Drive Underpass

The median sewer appears to be in close proximity to or immediately adjacent to the Courtneypark Drive underpass structure foundations at about St. 6+350. The invert of the median sewer is at an elevation of about El. 185.5 m in this area, while the bridge structure is founded on spread footings with a bottom of footing elevation of about El. 183.8 m. The excavations are not expected to extend below the footing founding level, but consideration should be given to locating the median sewer further from the existing foundations due to the potential for overlap and/or exposing the edge of the existing footings. At no time should the excavation for the median sewer undermine the foundations, unless special provisions, suitable protection systems and monitoring are approved and undertaken (as discussed above).

Derry Road Underpass

At the south side of the Derry Road underpass structure, the median sewer is proposed to terminate at approximately St. 7+792 with an invert elevation of about El. 185 m and the envelop of the bridge structure foundations extends to approximately St. 7+795 with spread footings founded at about El. 184.8 m. At the north side of the bridge structure, the median sewer is proposed to terminate at approximately St. 7+834 with an invert elevation of about El. 185 m and the envelop of the bridge structure extends to approximately St. 7+834 with spread footings founded at about El. 184.8 m. The proposed median sewer alignment appears to be within approximately 0.5 m of the edge of the footings on the south side of the structure, and within approximately 2 m of the edge of the footings on the north side of the structure, and thus the excavations may be adjacent to and just below the edge and bottom of the footings. Based on the available information, consideration should be given to locating the north and south limits of the median sewer further from the ends of the existing foundations, or addressing these potential conflicts as noted above, as it is anticipated that exposing the footings would be necessary for the currently proposed alignment and installation method. At no time should the excavation for the median sewer undermine the foundations, unless special provisions, suitable protection systems and monitoring are approved and undertaken (as discussed above).



Highway 407 Flyover

The median sewer appears to be in close proximity to or immediately adjacent to the Highway 407 flyover structure foundations at about St. 8+940 to 9+005. The invert of the median sewer is at an elevation of about El. 193 m in this area, while the structure is founded on spread footings with a bottom of footing elevation of about El. 190 m. The proposed median sewer alignment appears to be within approximately 2 m of the edge of the footings, and thus the excavation is expected to be adjacent to and slightly above the edge and top of the existing footings.

6.1.7.5 St. 9+000 to St. 9+650 (Including Etobicoke Creek)

The subsurface conditions anticipated to be encountered along this section of the median sewer installation consist primarily of stiff to very stiff clayey silt fill and till, underlain by weak to medium strong bedrock. The present ground surface along this section of the sewer ranges on average from approximately El. 194 m to El. 190 m from south to north, excluding Etobicoke Creek which drops to an elevation below approximately El. 186 m. It is understood that there will be an average grade raise of 1 m to 2 m along this section of the alignment. The median sewer invert elevation along this section generally ranges from 193.5 m at Station 9+000 to 190 m at Station 9+430, to 191 m at Station 9+650 with an average anticipated excavation depth of 0.5 m to 1 m below existing ground surface. The sewer pipe through this section of the alignment ranges from 300 mm diameter to 525 mm diameter concrete pipe.

Based on the existing subsurface information, excavation should follow OSHA guidelines for Type 3 soils and near vertical (1H:10V) side walls in the bedrock as noted above. Minimal groundwater seepage into the excavation is anticipated to be encountered. Installation of the sewer should be undertaken as noted above (OPSD 802 or equivalent).

Based on the median sewer design information provided, the following table identifies potential conflicts over this section of the proposed alignment that should be addressed as noted above:

Potential Conflict	Approximate Station (m)	Approximate Distance from Centerline of Median Sewer
HML P25	9+065	1.0 m
Electrical Line	9+070	Crossing ¹
Electrical Line	9+000 to 9+550	Overlapping
OHS #33	9+150	3.5 m
HML P26	9+534	5.5 m

¹ It is understood that the median sewer cannot be relocated in this area, this conflict will need to be appropriately addressed at time of construction, as recommended in Section 6.1.

Consideration should be given to locating the median sewer further from any foundation elements (i.e. bridge structures, OHS, HML poles, etc.).

Etobicoke Creek Bridge

At the south side of the bridge, the median sewer is proposed to terminate at approximately St. 9+555 with an invert elevation of about El. 191 m, and the envelope of the bridge foundations extends to about St. 9+590 with a



pile cap founded at about El. 188 m. At the north side of the bridge structure, the median sewer is proposed to terminate at approximately St. 9+710 with an invert elevation of about El. 189.5 m, and the envelope of the bridge structure extends to about St. 9+650 with spread footings founded at about El. 188.2 m. Thus, no conflicts are expected between the median sewer and the bridge structure based on the available information.

6.1.7.6 St. 9+650 to St. 11+500 (Including Steeles Avenue)

The subsurface conditions anticipated to be encountered along this section of the median sewer installation consist primarily of stiff to very stiff clayey silt fill or till units. It should be noted that an approximately 2.3 m thick layer of cobbles and boulders was encountered within the till unit at Borehole 12-14. The present ground surface along this section of the sewer ranges on average from approximately El. 190 m to El. 198 m from south to north, and it is understood that there will be an average grade raise of 1.5 m along this section of the alignment. The median sewer invert elevation along this section generally ranges from 189.5 m to 197.5 m with an average anticipated excavation depth of 1 m below existing ground surface. The sewer pipe through this section of the alignment ranges from 300 mm diameter to 900 mm diameter concrete pipe.

Based on the existing subsurface information, excavations should follow OSHA guidelines for Type 2 and Type 3 soils for the till and fill units, respectively, and minimal groundwater seepage into the excavation is anticipated to be encountered. Installation of the sewer should be undertaken as noted above (OPSD 802 or equivalent).

Based on the median sewer design information provided, the following table identifies potential conflicts over this section of the proposed alignment that should be addressed as noted above:

Potential Conflict	Approximate Station (m)	Approximate Distance from Centerline of Median Sewer
Electrical Line	9+712 to 9+873	5.1 m
HML P27	9+859	3.6 m
OHS #34	9+870	6.0 m
Electrical Line	9+912 to 10+273	6.0 m
HML P28	10+010	4.3 m
HML P29	10+179	3.1 m
OHS #17	10+200	1.7 m
OHS #35	10+230	4.5 m
Electrical Line	10+463 to 10+778	5.2 m
HML P31	10+511	2.9 m
OHS #19	10+640	1.6 m
Watermain	10+650	Crossing
HML P32	10+667	1.6 m
OHS #20	10+720	1.6 m
Electrical Line	10+756	Crossing ¹
HML P33	10+842	2.5 m
Electrical Line	10+817 to 11+500	0.5 m



Potential Conflict	Approximate Station (m)	Approximate Distance from Centerline of Median Sewer
HML P34	11+003	1.4 m
Electrical Line	11+048	Crossing ¹
Steeles Ave Underpass	11+090	Crossing ¹
Bell Cable	11+106	Crossing
HML P36	11+165	2.3 m
CMS #48	11+187	1.8 m
Watermain	11+267	Crossing
Water Main	11+286	Crossing
Gas Main	11+300	Crossing
HML P37	11+316	1.4 m
TV Cable	11+418	Crossing
Fiberoptic Cable	11+442	Crossing
Watermain	11+452	Crossing
HML P38	11+479	1.2 m

¹ It is understood that the median sewer cannot be relocated in this area, this conflict will need to be appropriately addressed at time of construction, as recommended in Section 6.1.

Consideration should be given to locating the median sewer further from any foundation elements (i.e. bridge structures, OHS, HML poles, etc.).

Steeles Avenue Underpass

The median sewer appears to be in close proximity or immediately adjacent to the Steeles Avenue underpass structure foundations at about St. 11+085 as noted above and based on the available information. The invert of the median sewer is at an elevation of about El. 193.5 m in this area, while the bridge structure is founded on spread footings with a bottom of footing elevation of about El. 191.5 m. The proposed median sewer alignment appears to be within approximately 2.3 m of the edge of the footings, and the excavation may be in close proximity, but slightly above the edge and top of the footings.

6.1.7.7 St. 11+500 to St. 13+400 (Including Glidden Road, the CN Rail overpass and Orenda Road)

The subsurface conditions anticipated to be encountered along this section of the median sewer installation consist primarily of stiff to very stiff clayey silt fill and compact to dense (occasionally loose) sand and gravel to silt / sand fill materials. The present ground surface along this section of the sewer ranges on average from approximately El. 198 m to El. 216 m from south to north, and it is understood that there will be an average grade raise of 1.5 m along this section of the alignment. The median sewer invert elevation along this section generally ranges from 197.5 m at Station 11+500, to 219 m at Station 12+750, to 215 m at Station 13+400 with an average anticipated excavation depth of 0.5 m to 1.5 m below existing ground surface. The sewer pipe through this section of the alignment ranges from 300 mm diameter to 900 mm diameter concrete pipe.

Based on the existing subsurface information, excavation should follow OHSA guidelines for Type 3 soils, and minimal groundwater seepage into the excavation is anticipated to be encountered. This is with the exception of



FOUNDATION INVESTIGATION AND DESIGN REPORT - MEDIAN SEWER

sand / silt layers where moderate seepage may be encountered. Installation of the sewer should be undertaken as noted above (OPSD 802 or equivalent).

Based on the median sewer design information provided, the following table identifies potential conflicts over this section of the proposed alignment that should be addressed as noted above:

Potential Conflict	Approximate Station (m)	Approximate Distance from Centerline of Median Sewer
Electrical Line	11+500 to 11+900	0.5 m
OHS #37	11+525	0.9 m
HML P39	11+622	2.3 m
HML P40	11+780	1.4 m
Watermain	11+872	Crossing
Watermain	11+876	Crossing
OHS #38	11+960	0.8 m
HML P41	11+971	0.6 m
Electrical Line	11+945 to 12+260	1.7 m
HML P42	12+126	0.6 m
Electrical Line	12+236	Crossing
Electrical Line	12+309 to 12+460	1.6 m
OHS #39	12+400	0.7 m
HML P44	12+449	0.5 m
HML P45	12+638	0.9 m
Electrical Line	12+595 to 12+755	0.9 m
OHS #40	12+900	3.2 m
Gas Main	12+899	5.3 m
HML P47	12+986	1.0 m
Electrical Line	12+905 to 13+013	2.0 m
Electrical Line	13+175 to 13+400	3.2 m
OHS #23	13+200	0.6 m
HML P49	13+319	0.4 m
Watermain	13+400	5.3 m

Consideration should be given if possible to locating the median sewer further from any foundation elements (i.e. bridge structures, OHS, HML poles, etc.).



Glidden Road Overpass

At the south side of the bridge structure, the median sewer is proposed to terminate at approximately St. 11+900 with an invert elevation of about El. 204.5 m, and the envelope of the bridge structure foundations extends to approximately St. 11+903 with spread footings founded at about El. 189.5 m. At the north side of the bridge structure, the median sewer is proposed to terminate at approximately St. 11+945 with an invert elevation of about El. 190 m, and the envelope of the bridge structure extends to approximately St. 11+930 with spread footings founded at about El. 189.5 m. Thus, no conflicts are expected between the median sewer and the bridge structure foundations based on the available information. However, the retaining wall at the south side of the structure (El. 198.5 m to El. 205.6 m) may require special provisions, temporary protection and monitoring during construction of the median sewer, as the median sewer is proposed to terminate within approximately 3 m of the backside of the wall and will likely be located above the cantilever footing.

CN Rail Overhead

At the south side of the overhead structure, the median sewer is proposed to terminate at approximately St. 12+460 with an invert elevation of about El. 215 m, and the envelope of the overhead structure foundations extends to approximately St. 12+485 with a pile cap founded at about El. 213 m. At the north side of the bridge structure, the median sewer is proposed to terminate at approximately St. 12+595 with an invert elevation of about El. 216.5 m, and the envelope of the overhead structure extends to approximately St. 12+560 with a pile cap founded at about El. 214 m. Based on the available information and design drawings, no conflicts are expected between the median sewer and the bridge structure foundations.

Orenda Road Overpass

At the south side of the bridge structure, the median sewer is proposed to terminate at approximately St. 12+765 with an invert elevation of about El. 219 m, and the envelope of the bridge structure foundations extends to approximately St. 12+845 with spread footings founded at about El. 212 m. At the north side of the bridge structure, the median sewer is proposed to terminate at approximately St. 12+905 with an invert elevation of about El. 218 m, and the envelope of the bridge structure extends to approximately St. 12+870 with spread footings founded at about El. 212 m. Thus, no conflicts are expected between the median sewer and the bridge structure based on the available information.

6.1.7.8 Highway 403 Westbound (Southbound) – St. 4+250 to St. 4+600

The subsurface conditions along this section of the median sewer installation are anticipated to consist primarily of up to a thin layer of stiff to very stiff clayey silt fill overlying weathered / intact weak to medium strong shale bedrock. The present ground surface along this section of the sewer ranges on average from approximately El. 174 m to El. 176 m from south to north and it is understood that there will be no appreciable grade raise along this section of the alignment. The median sewer invert elevation along this section generally ranges from 172 m to 173 m, with an anticipated excavation depth of 3 m to 4 m below existing ground surface. The sewer pipe through this section of the alignment ranges from 300 mm diameter to 375 mm diameter concrete pipe.

Based on the existing subsurface information, excavation should follow OHSAA guidelines for Type 3 soils and near vertical (1H:10V) side walls in the bedrock as noted above. Minimal groundwater seepage into the excavation is anticipated to be encountered. This is with the exception of sand and gravel fill layers which may



FOUNDATION INVESTIGATION AND DESIGN REPORT - MEDIAN SEWER

be found in the vicinity of existing bridge structures, and moderate seepage may be encountered. Installation of the sewer should be undertaken as noted above (OPSD 802 or equivalent).

Based on the median sewer details provided, the following table identifies potential conflicts over this section of the proposed alignment that should be addressed as noted above:

Potential Conflict	Approximate Station (m)	Approximate Distance from Centerline of Median Sewer
ATMS Cable	4+262	Crossing
ATMS Cable	4+262 to 4+452	1.5 m
410 N - 401 E collector Structure	4+350	Crossing
401 W collector - Dixie N/S Structure	4+275	Crossing
Hwy 401 EBL Collector Structure	4+290	Crossing
Hwy 401 EBL Express Structure	4+372	Crossing
Hwy 401 WBL Express Structure	4+390	Crossing
Hwy 401 WBL Collector Structure	4+437	Crossing
Ramp 401 W - 410 N Collector Structure	4+525	Crossing
ATMS Cable	4+452	Crossing
Electrical Cable	4+463	Crossing

Consideration should be given to locating the median sewer further from any foundation elements (i.e. bridge structures, OHS, HML poles, etc.).

Highway 401 W Collector - Dixie and 401 E Collector - 403 W Collector: The median sewer appears to be in close proximity to or immediately adjacent to the Highway 401 W Collector - Dixie and Highway 401 E Collector - 403 W Collector structure foundations at about St. 4+280. The invert of the median sewer is at an elevation of about El. 172 m in this area, and the bridge structure is founded on spread footings with the same approximate bottom of footing elevation (El. 172 m). The proposed median sewer alignment appears to be within approximately 1.5 m of the edge of the footings, and thus the excavation may be adjacent to and just below the edge and bottom of the footing. Consideration should be given to locating the median sewer further from the existing foundations, or addressing this potential conflict as noted above as it is anticipated that exposing the edge of the footings may be necessary for the currently proposed alignment and installation method. At no time should the excavation for the median sewer undermine the foundations, unless special provisions, suitable protection systems and monitoring are undertaken (as discussed above).

Highway 410 N - 401 E Collector: Contract Drawings for the 410 N - 401 E collector structure have not been made available, and could not be located in the GEOCRESS system at the time of preparing this report. However based on the available information and similar structures in the area, the median sewer crossing the Highway 410 N – 401 E Collector structure appears to be at a sufficient distance from the foundation elements based on



the available information. The invert of the median sewer is at an elevation of about El. 172 m in this area, and it is anticipated that the bridge structure is founded on spread footings with a bottom of footing elevation of about El. 170 m. The proposed median sewer alignment appears to be within approximately 2.8 m of the edge of the footings. Thus, upon confirmation of the existing foundation geometry, no conflicts are expected between the median sewer and the bridge structure; however, this should be confirmed through design or as-constructed drawings for the existing structure.

Highway 401 E Express: The median sewer crosses the Highway 401 E Express structure at about St. 4+370, but appears to be at a sufficient distance from the foundation elements based on the proposed horizontal alignment and available structure drawings. The invert of the median sewer is at an elevation of about El. 172 m in this area, while the bridge structure is founded on spread footings with a bottom of footing elevation of about El. 171.5 m. The proposed median sewer alignment appears to be about 10 m from edge of the footings. Thus, no conflicts are expected between the median sewer and the bridge structure.

Highway 401 W Express: The median sewer crosses the Highway 401 W Express structure at about St. 4+390, but appears to be at a sufficient distance from the foundation elements based on the proposed horizontal alignment and available structure drawings. The invert of the median sewer is at an elevation of about El. 172 m in this area, while the bridge structure is founded on spread footings with a bottom of footing elevation of about El. 171.5 m. The proposed median sewer alignment appears to be approximately 12 m from the edge of the footings. Thus, no conflicts are expected between the median sewer and the bridge structure.

Highway 401 W Collector: The median sewer crosses the Highway 401 W Collector structure at about St. 4+460 as noted above, but appears to be at a sufficient distance from the foundation elements based on the proposed horizontal alignment and the available structure drawings. The invert of the median sewer is at an elevation of about El. 172.5 m in this area, while the bridge structure is founded on spread footings with a bottom of footing elevation of about El. 171 m. The proposed median sewer alignment appears to be approximately 12 m from the edge of the footings. Thus, no conflicts are expected between the median sewer and the bridge structure.

Highway 401 W - 410 N Collector: Contract Drawings for the 401 W - 410 N collector structure have not been made available, and could not be located in the GEOCRE system at the time of preparing this report. The invert of the proposed median sewer is at an elevation of about El. 172.5 m in this area, and it is anticipated that the bridge structure is founded on spread footings with a bottom of footing elevation of about El. 172 m. The proposed median sewer alignment appears to be within approximately 4 m of the edge of the footings. Thus, upon confirmation of the existing foundation geometry, consideration should be given to addressing any potential conflict (as noted above), or locating the median sewer further from the existing foundations if in close proximity. At no time should the excavation for the median sewer undermine the foundations, unless special provisions, suitable protection systems and monitoring are approved and undertaken (as discussed above).



FOUNDATION INVESTIGATION AND DESIGN REPORT - MEDIAN SEWER

7.0 CLOSURE

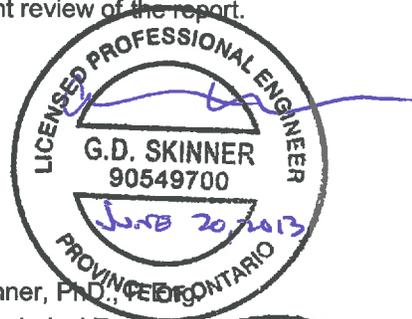
This Foundation Design Report was prepared by Mr. Matthew Kelly, P.Eng., and reviewed by Dr. Graeme Skinner, P.Eng., with technical input from Ms. Lisa Coyne, P.Eng., a geotechnical engineer and Principal with Golder and Mr. Murty Devata, P.Eng., a specialist consultant with Golder. Mr. Fin Heffernan, P.Eng., a MTO Designated Foundations Contact for Golder, conducted an independent review of the report.

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2013june20 highway 410 median sewer.docx



REFERENCES

Chapman, L.J., and Putnam, D.F., 1984. *The Physiography of Southern Ontario*, 3rd Edition. Ontario Geological Survey, Special Volume 2. Ontario Ministry of Natural Resources.

Ontario Provincial Standard Specifications (OPSS)

- OPSS 401 Trenching, Backfilling and Compacting
- OPSS 403 Rock Excavation in Open Cut
- OPSS 539 Construction Specification for Temporary Protection Systems
- OPSS 1010 Select Subgrade Material (SSM)

Ontario Provincial Standard Drawings (OPSD)

- OPSD 802 Construction Specification for Topsoil

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

CONT No.
GWP No. 2144-07-00

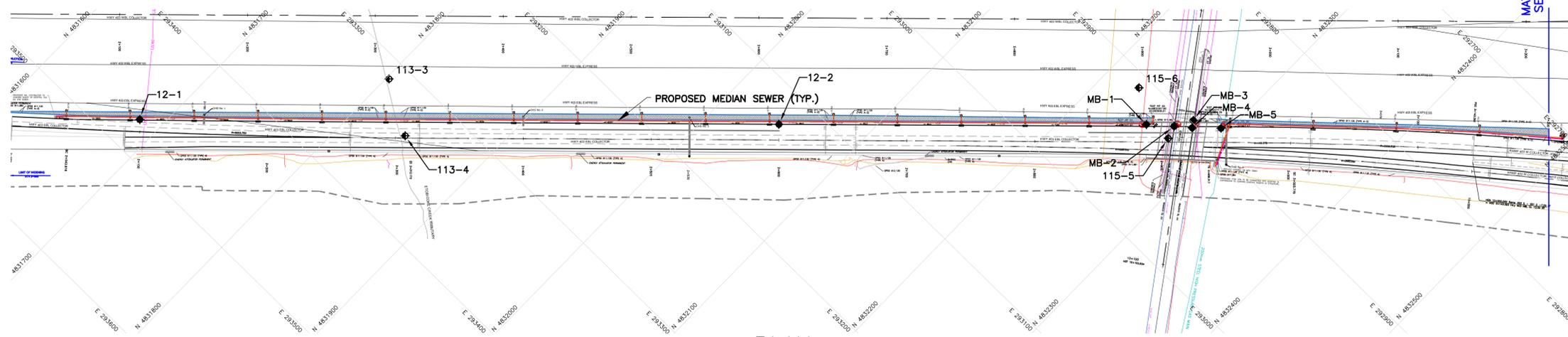


STATION 2+000 to 3+200
HIGHWAY 410 WIDENING
BOREHOLE LOCATIONS AND SOIL STRATA

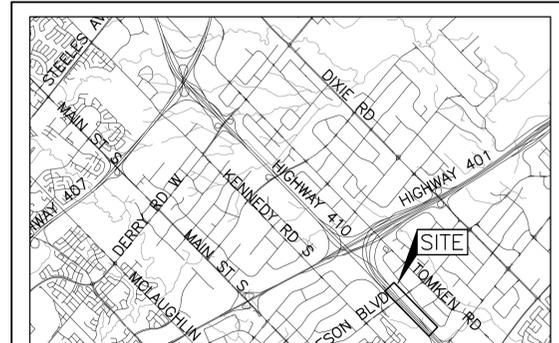
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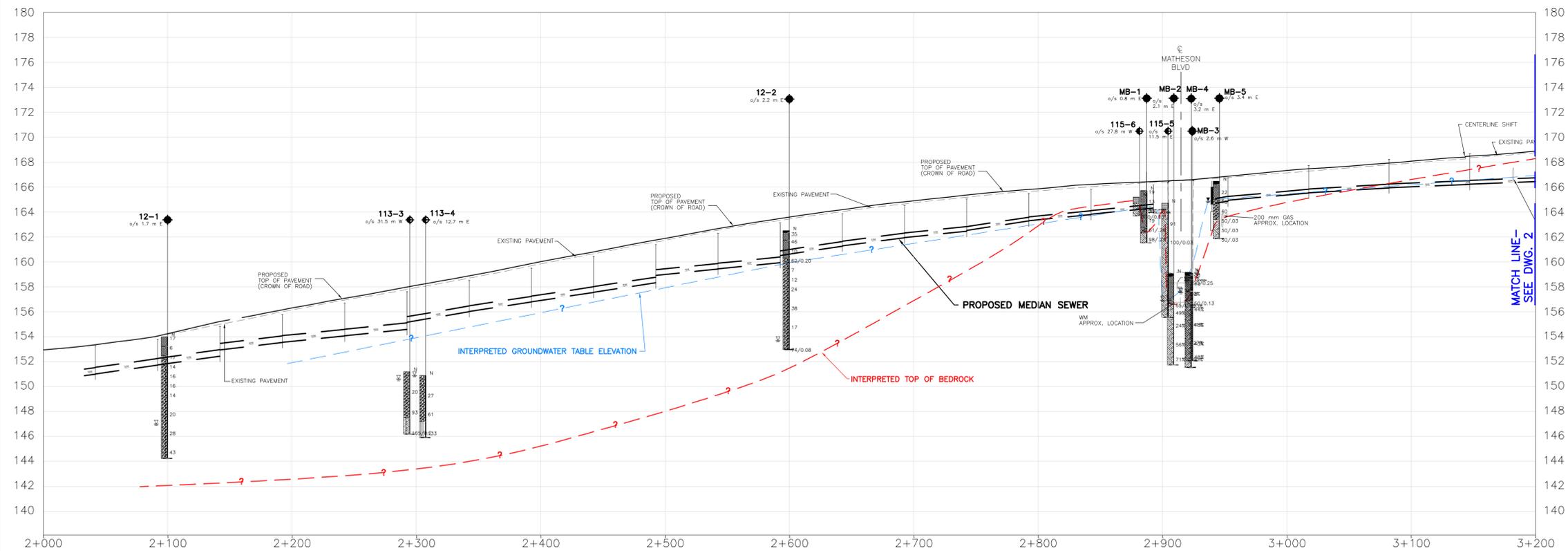
Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



PLAN
SCALE
40 0 40 80 m



KEY PLAN
SCALE
2 0 2 4 km



STORM SEWER PROFILE

HORIZONTAL SCALE
40 0 40 80 m
VERTICAL SCALE
4 0 4 8 m

LEGEND

- Borehole - Current Investigation
- ⊙ Borehole - Previous Investigation
- ⊥ 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, measured on MMM DD, YYYY
- ▽ WL upon completion of drilling

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
12-1	154.0	4831684.5	293473.6
12-2	162.5	4832044.7	293126.9
113-3	151.2	4831801.9	293314.7
113-4	150.9	4831841.8	293337.6
115-5	164.7	4832270.1	292921.9
115-6	165.2	4832226.2	292909.7
MB-1	165.7	4832250.3	292926.1
MB-2	159.1	4832266.9	292911.9
MB-3	159.1	4832274.4	292898.2
MB-4	159.2	4832277.8	292903.0
MB-5	166.5	4832294.2	292887.4

NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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 is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.



REFERENCE

Base plans provided in digital format by URS Canada Inc., (Drawing File Hwy410_Uilities.dwg, received Sept 19, 2012, "2013 02 07 - Hwy410_Plan.dwg and 2013 02 07 - Hwy410_Profile (sewers).dwg", received Feb. 07, 2013).

Geocres No. 30M12-362

HWY. 410	PROJECT NO. 11-1111-0083	DIST. CENTRAL
SUBM'D. GDS	CHKD. LCC	DATE: Jun. 20, 2013
DRAWN: JFC	CHKD. GDS	APPD. LCC
		DWG. 1

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

CONT No.
GWP No. 2144-07-00

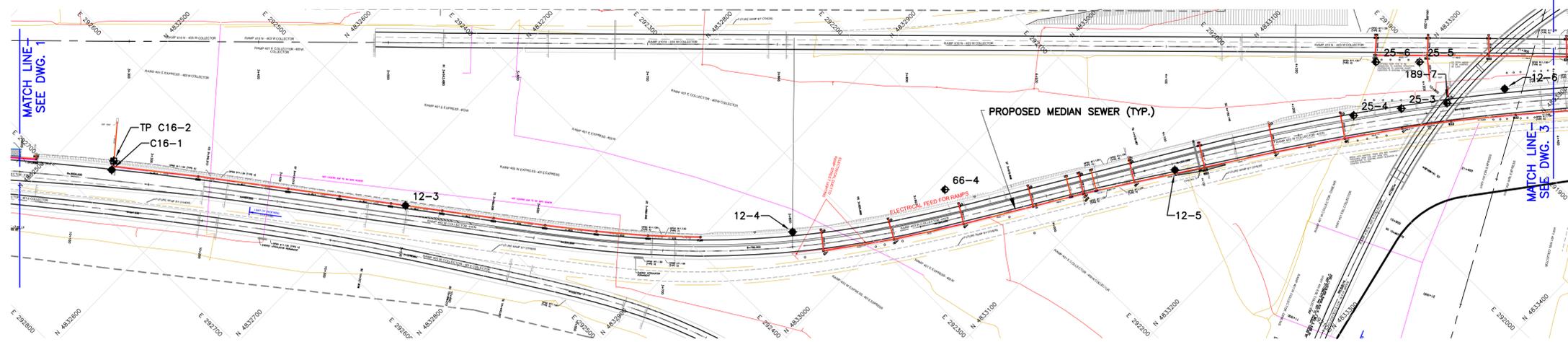


STATION 3+200 to 4+400
HIGHWAY 410 WIDENING
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



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PLAN
SCALE
0 40 80 m



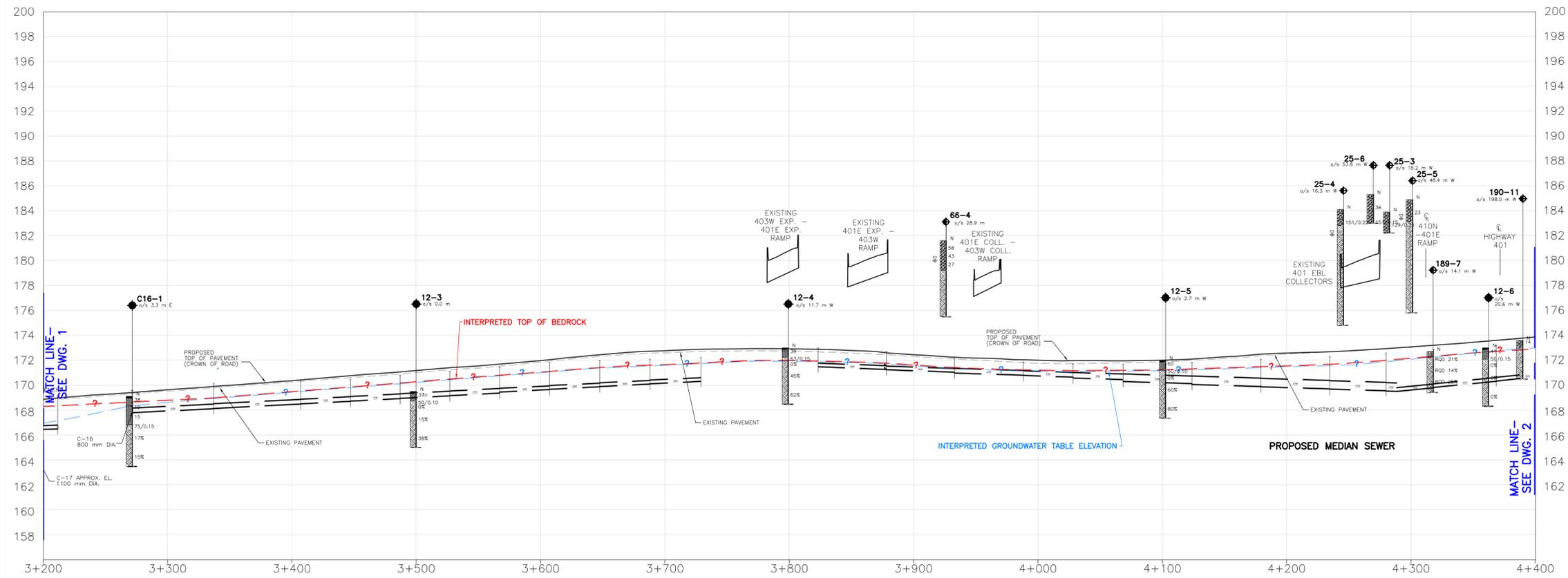
KEY PLAN
SCALE
0 2 4 km

LEGEND

- Borehole - Current Investigation
- ◐ Borehole - Previous Investigation
- Test Pit
- 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, measured on MMM DD, YYYY
- ≡ WL upon completion of drilling

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
12-3	169.5	4832719.3	292532.9
12-4	173.0	4832947.0	292338.8
12-5	172.0	4833124.6	292098.7
12-6	173.0	4833263.0	291876.3
25-3	183.9	4833216.5	291942.8
25-4	184.1	4833193.9	291972.4
25-5	184.9	4833201.6	291907.5
25-6	185.3	4833177.5	291931.0
66-4	181.6	4833008.3	292233.3
189-7	172.7	4833238.9	291915.2
190-11	173.6	4833148.0	291738.0
C16-1	169.1	4832538.1	292671.7
TP C16-2	168.1	4832534.5	292665.7



STORM SEWER PROFILE
HORIZONTAL SCALE
0 40 80 m
VERTICAL SCALE
4 8 m



REFERENCE
Base plans provided in digital format by URS Canada Inc., (Drawing File Hwy410_Uilities.dwg, received Sept. 19, 2012, "2013 02 07 - Hwy410_Plan.dwg and 2013 02 07 - Hwy410_Profile (sewers).dwg", received Feb. 07, 2013).

NOTES
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Geocres No. 30M12-362

HWY. 410	PROJECT NO. 11-1111-0083	DIST. CENTRAL
SUBM'D. GDS	CHKD. LCC	DATE: Jun. 20, 2013
DRAWN: JFC	CHKD. GDS	APPD. LCC
		DWG. 2

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

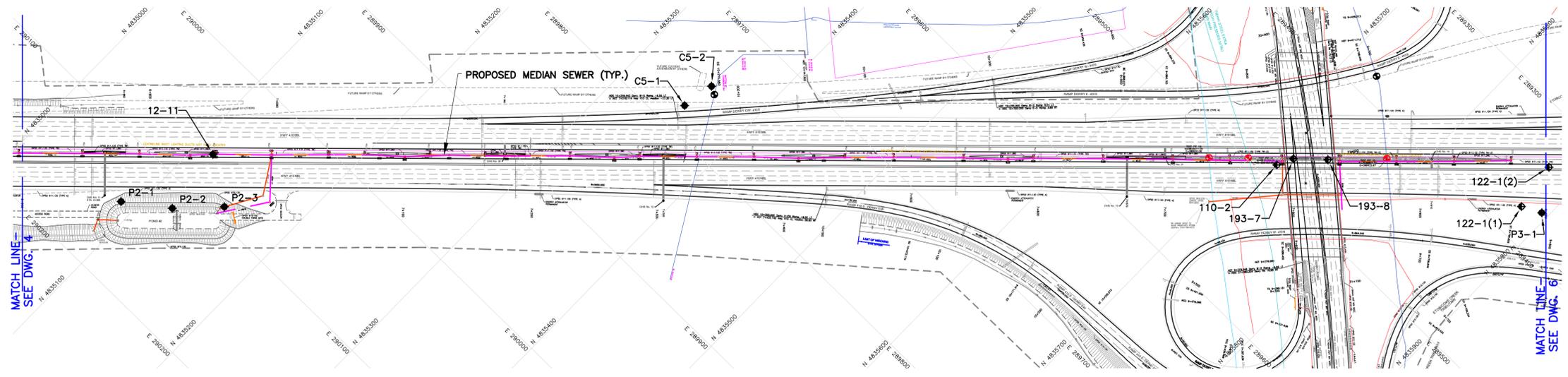
CONT No.
GWP No. 2144-07-00



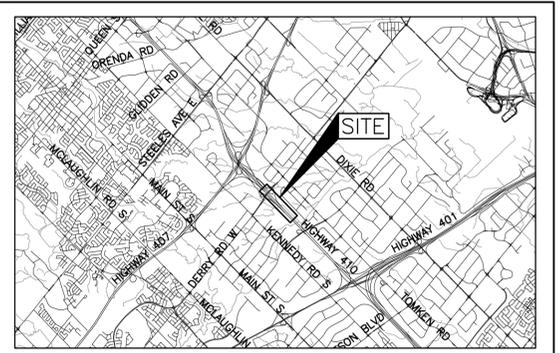
STATION 6+800 to 8+000
HIGHWAY 410 WIDENING
BOREHOLE LOCATIONS AND SOIL STRATA



Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



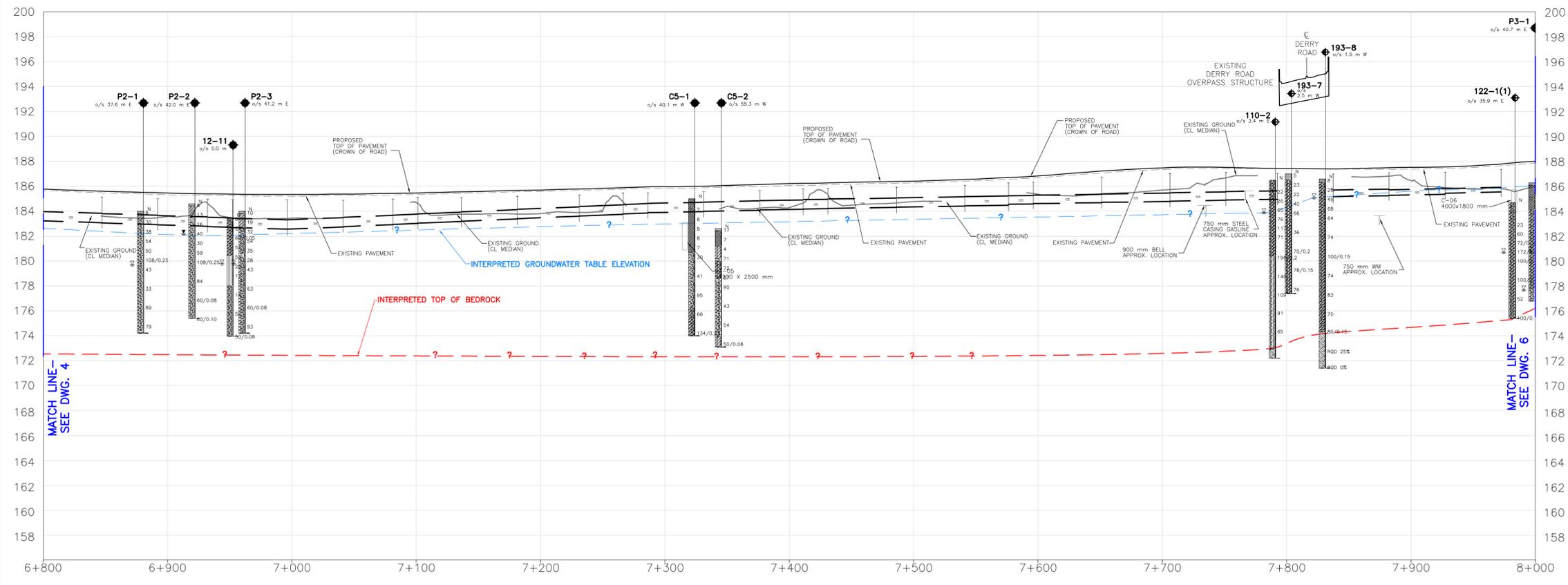
PLAN
SCALE
0 40 80 m



KEY PLAN
SCALE
0 2 4 km

LEGEND

- Borehole - Current Investigation
- ⊕ Borehole - Previous Investigation
- ⊥ 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, measured on MMM DD, YYYY
- ▽ WL upon completion of drilling



STORM SEWER PROFILE
HORIZONTAL SCALE
0 40 80 m
VERTICAL SCALE
0 4 8 m

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
12-11	183.5	4835114.2	290066.4
110-2	186.5	4835719.2	289486.8
122-1(1)	184.7	4835879.9	289375.5
193-7	187.0	4835725.2	289474.2
193-8	186.6	4835745.2	289455.7
C4-1	185.1	4834903.6	290226.0
C4-2	182.1	4834902.1	290206.4
C5-1	185.0	4835353.1	289779.4
C5-2	182.6	4835357.7	289753.8
P2-1	184.0	4835088.4	290143.5
P2-2	184.6	4835120.9	290119.1
P2-3	184.0	4835149.4	290089.6
P3-1	186.3	4835894.7	289367.8

NOTES

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REFERENCE

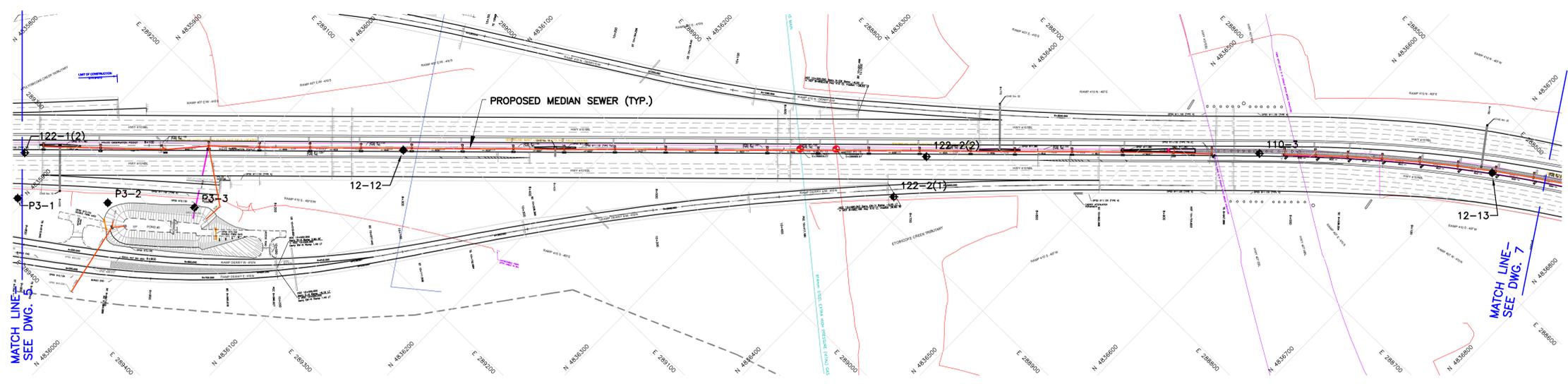
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Geocres No. 30M12-362

HWY. 410	PROJECT NO. 11-1111-0083	DIST. CENTRAL
SUBM'D. GDS	CHKD. LCC	DATE: Jun. 20, 2013
DRAWN: JFC	CHKD. GDS	APPD. LCC
		SITE: DWG. 5



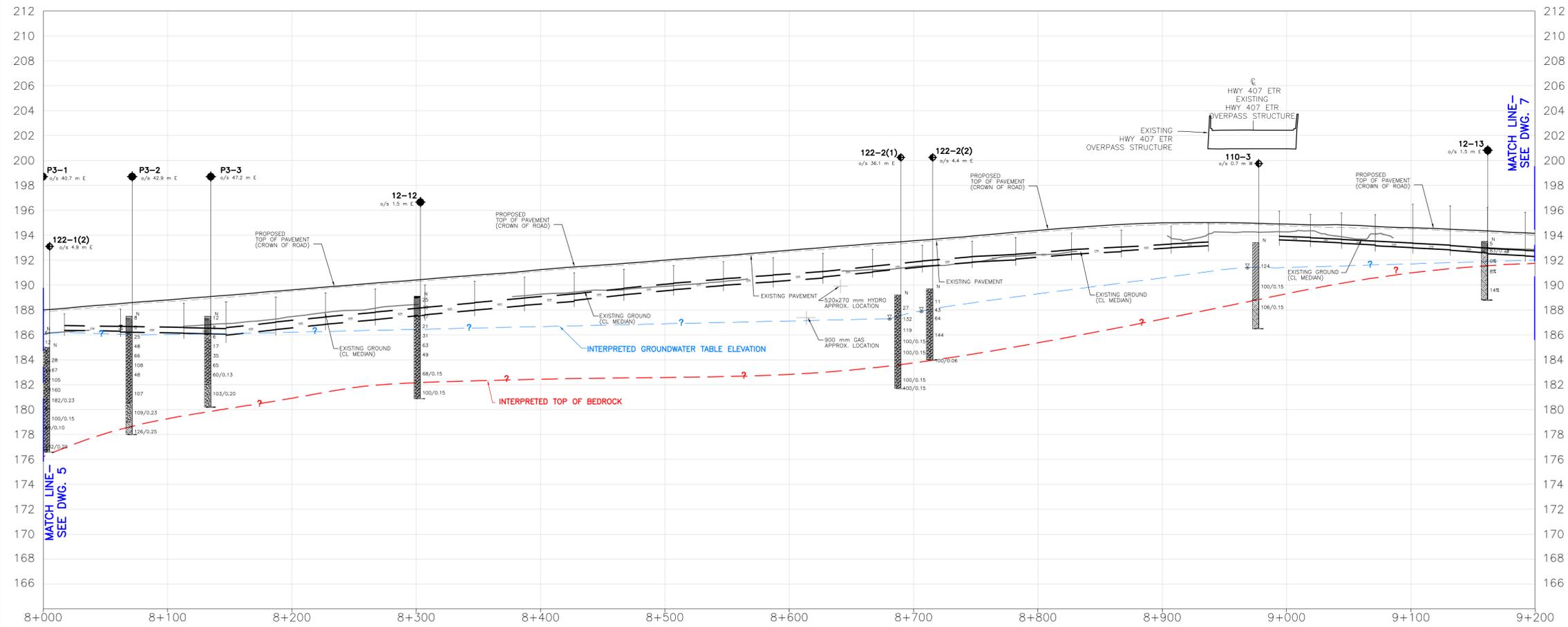
Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



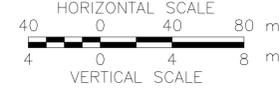
PLAN
SCALE
0 40 80 m



KEY PLAN
SCALE
0 2 4 km



STORM SEWER PROFILE



LEGEND

- Borehole - Current Investigation
- ⊙ Borehole - Previous Investigation
- ⊞ 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, measured on MMM DD, YYYY
- ▽ WL upon completion of drilling

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
12-12	189.1	4836085.5	289128.5
12-13	193.5	4836711.3	288541.9
110-3	193.4	4836569.6	288659.2
122-1(2)	184.9	4835873.8	289338.3
122-2(1)	189.2	4836387.4	288884.8
122-2(2)	189.7	4836383.7	288844.2
P3-1	186.3	4835894.7	289367.8
P3-2	187.5	4835948.0	289320.8
P3-3	187.5	4835999.4	289275.7

NOTES

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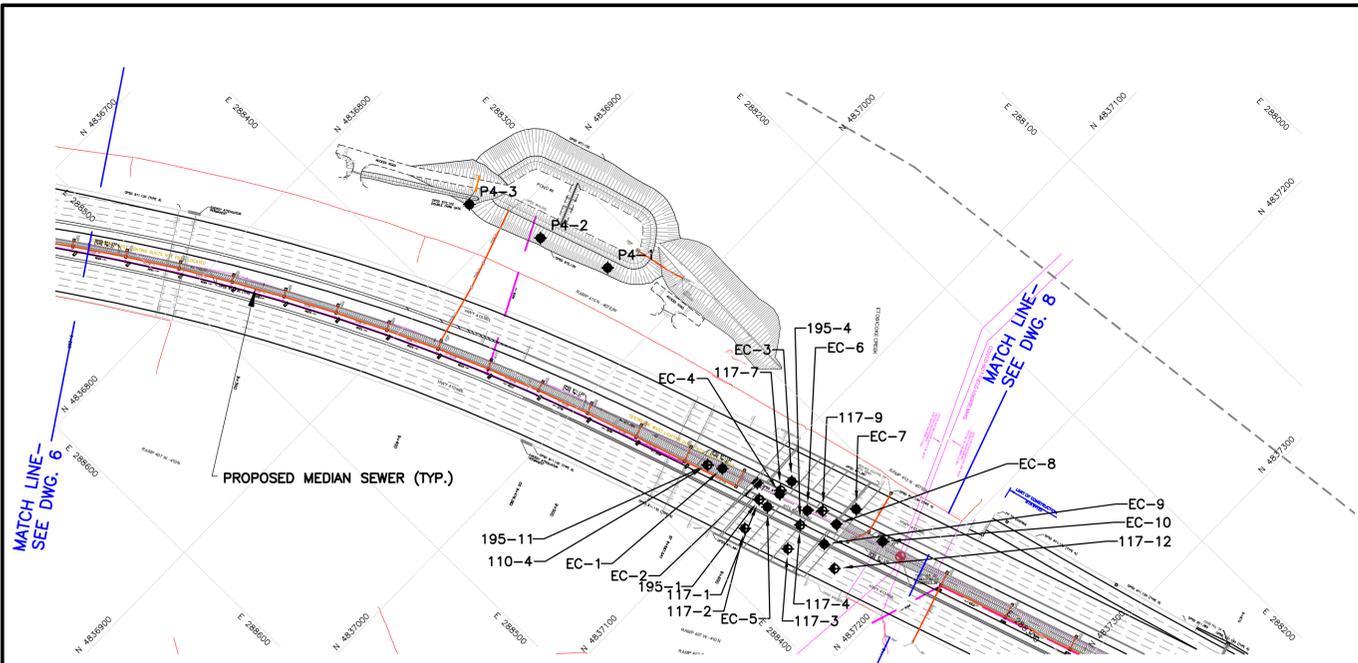
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Base plans provided in digital format by URS Canada Inc., (Drawing File Hwy410_Uilities.dwg, received Sept. 19, 2012, "2013 02 07 - Hwy410_Plan.dwg and 2013 02 07 - Hwy410_Profile (sewers).dwg", received Feb. 07, 2013).

Geocres No. 30M12-362

HWY. 410	PROJECT NO. 11-1111-0083	DIST. CENTRAL
SUBM'D. GDS	CHKD. LCC	DATE: Jun. 20, 2013
DRAWN: JFC	CHKD. GDS	APPD. LCC
		DWG. 6





BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
110-4	187.7	4837074.1	288362.0
117-1	186.8	4837107.9	288355.6
117-2	187.0	4837113.4	288372.7
117-3	186.5	4837138.4	288364.2
117-4	186.3	4837134.1	288349.8
117-7	187.5	4837112.8	288343.7
117-12	196.9	4837164.6	288353.8
195-1	186.8	4840196.8	286039.4
195-1	186.8	4837107.9	288355.7
195-4	186.3	4837134.1	288349.9
EC-1	190.5	4837081.3	288357.7
EC-2	190.1	4837100.8	288350.0
EC-3	187.0	4837113.8	288335.9
EC-4	186.9	4837114.0	288345.6
EC-5	187.0	4837114.0	288355.5
EC-6	186.6	4837131.2	288341.4
EC-7	191.9	4837150.1	288321.9
EC-8	188.4	4837148.2	288335.5
EC-9	191.7	4837151.0	288348.1
EC-10	191.4	4837173.2	288324.4
P4-1	192.3	4836957.9	288322.7
P4-2	192.1	4836919.7	288337.0
P4-3	191.6	4836878.4	288351.3

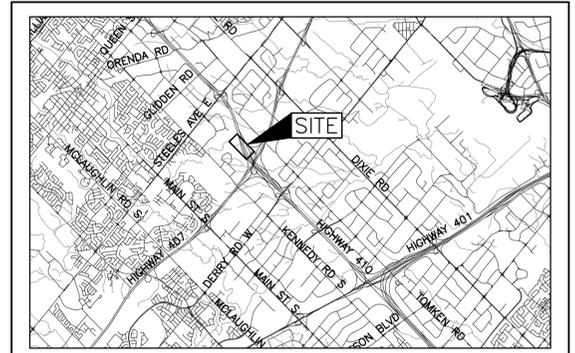
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No.
GWP No. 2144-07-00

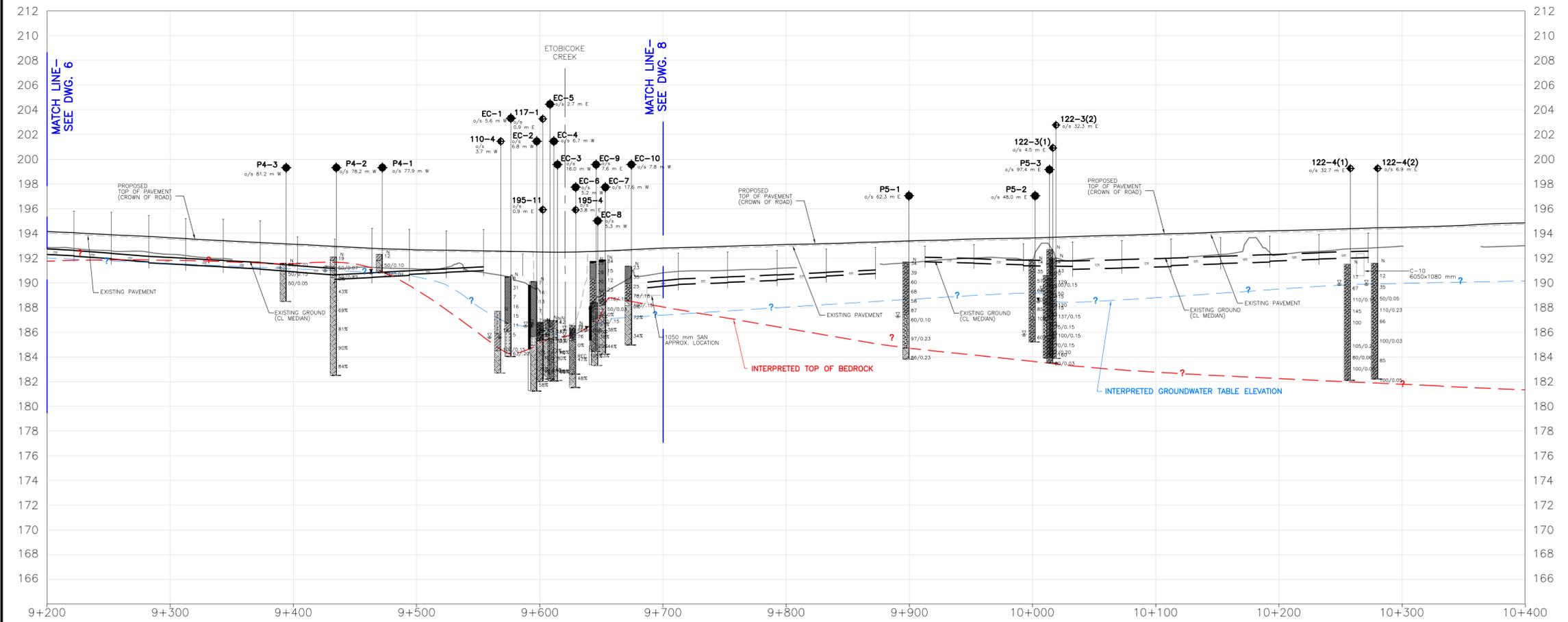
STATION 9+200 to 9+700
HIGHWAY 410 WIDENING

BOREHOLE LOCATIONS AND SOIL STRATA

Golder Associates
Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



- LEGEND**
- Borehole - Current Investigation
 - ⊙ Borehole - Previous Investigation
 - ⊞ 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, measured on MMM DD, YYYY
 - ▽ WL upon completion of drilling



STORM SEWER PROFILE

HORIZONTAL SCALE
40 0 40 80 m

VERTICAL SCALE
4 0 4 8 m

NOTES

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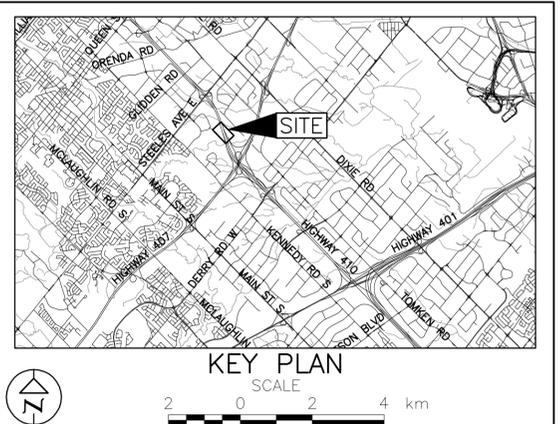
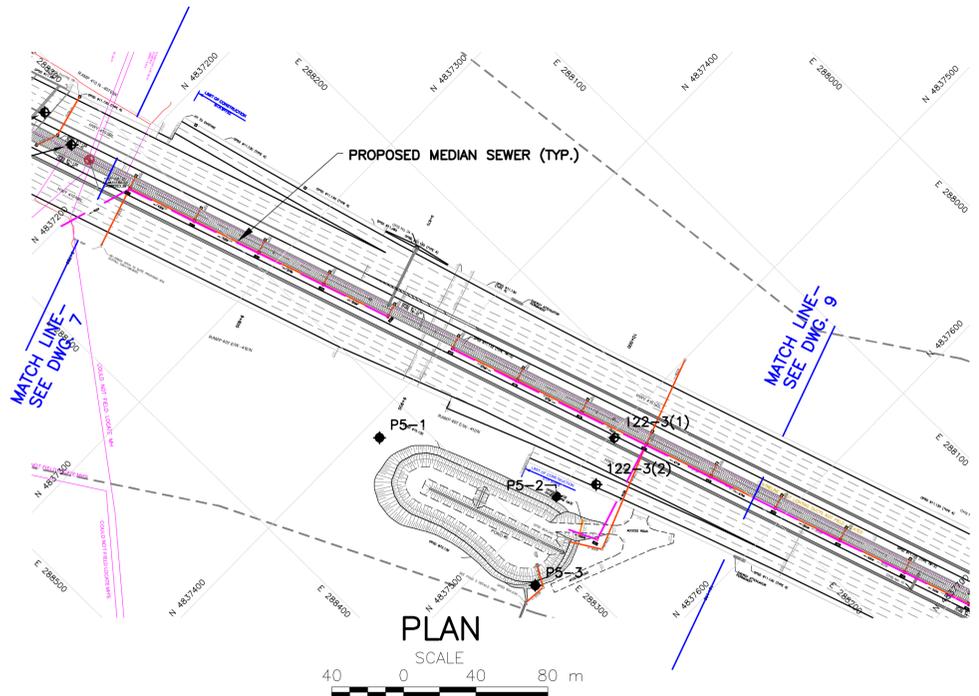
REGISTERED PROFESSIONAL ENGINEER
F. J. HEFFERNAN
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
G.D. SKINNER
90549790
June 20, 2013
PROVINCE OF ONTARIO

Geocres No. 30M12-362	PROJECT NO. 11-1111-0083	DIST. CENTRAL
HWY. 410	CHKD. LCC	DATE: Jun. 20, 2013
SUBM'D. GDS	CHKD. GDS	SITE:
DRAWN: JFC	APPD. LCC	DWG. 7



Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



LEGEND

- Borehole - Current Investigation
- ⊙ Borehole - Previous Investigation
- ⊥ 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, measured on MMM DD, YYYY
- ▽ WL upon completion of drilling

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
122-3(1)	192.7	4837502.3	288229.7
122-3(2)	192.0	4837513.3	288255.4
P5-1	191.7	4837409.1	288320.9
P5-2	191.8	4837502.0	288275.5
P5-3	190.6	4837528.2	288319.0

NOTES

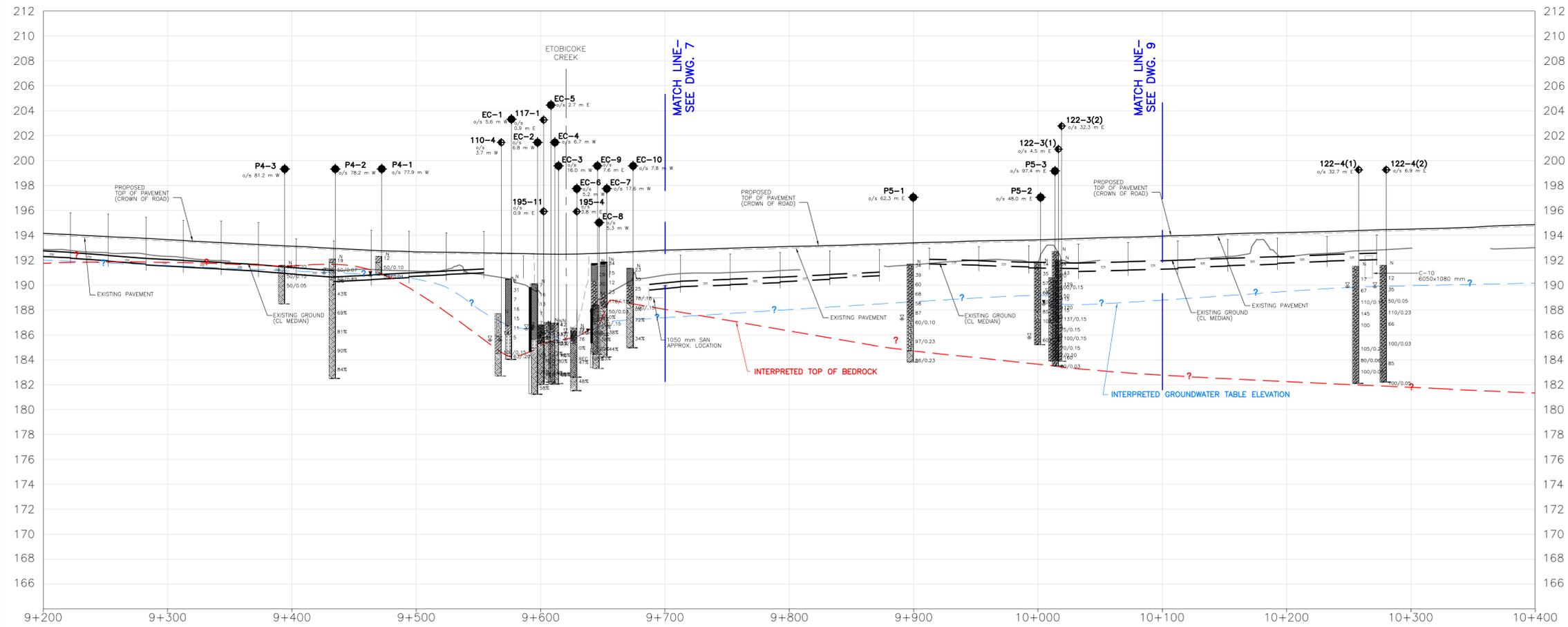
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STORM SEWER PROFILE
HORIZONTAL SCALE 40 0 40 80 m
VERTICAL SCALE 4 0 4 8 m



Geocres No. 30M12-362

HWY. 410	PROJECT NO. 11-1111-0083	DIST. CENTRAL
SUBM'D. GDS	CHKD. LCC	DATE: Jun. 20, 2013
DRAWN: JFC	CHKD. GDS	APPD. LCC
		DWG. 8

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

CONT No.
GWP No. 2144-07-00

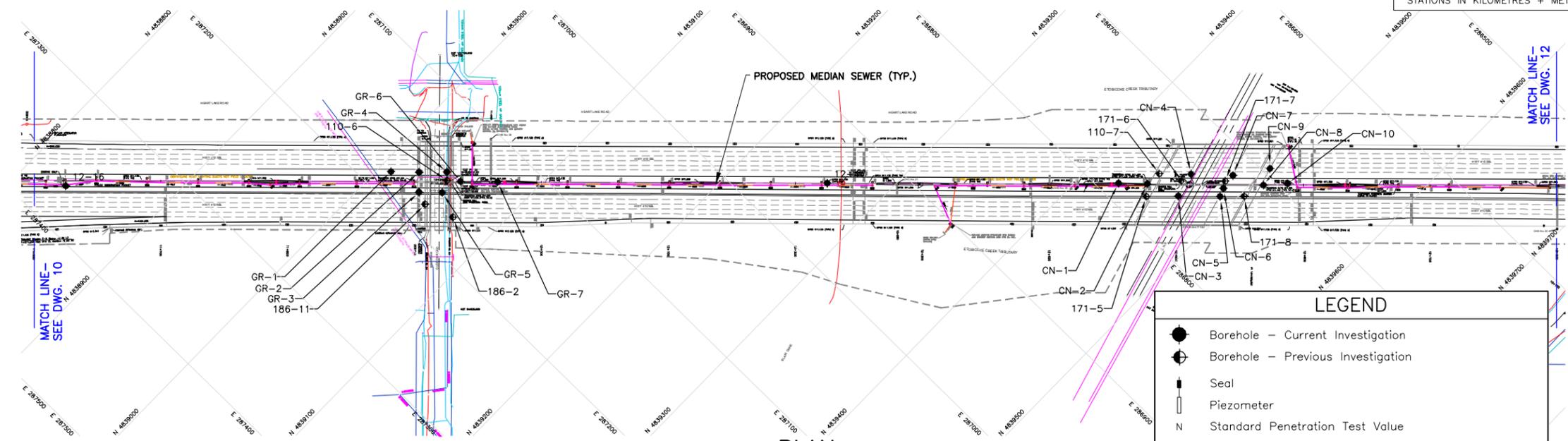


STATION 11+600 to 12+800
HIGHWAY 410 WIDENING
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

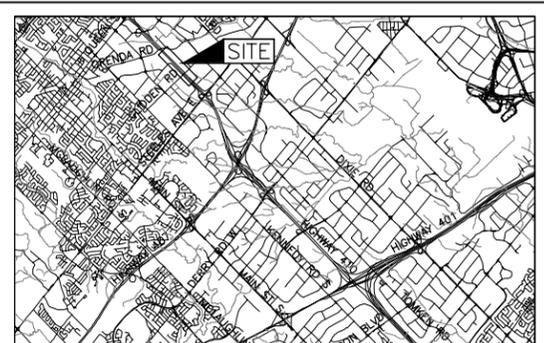


Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA

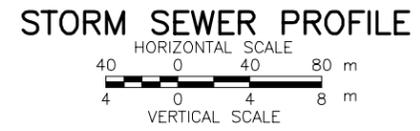
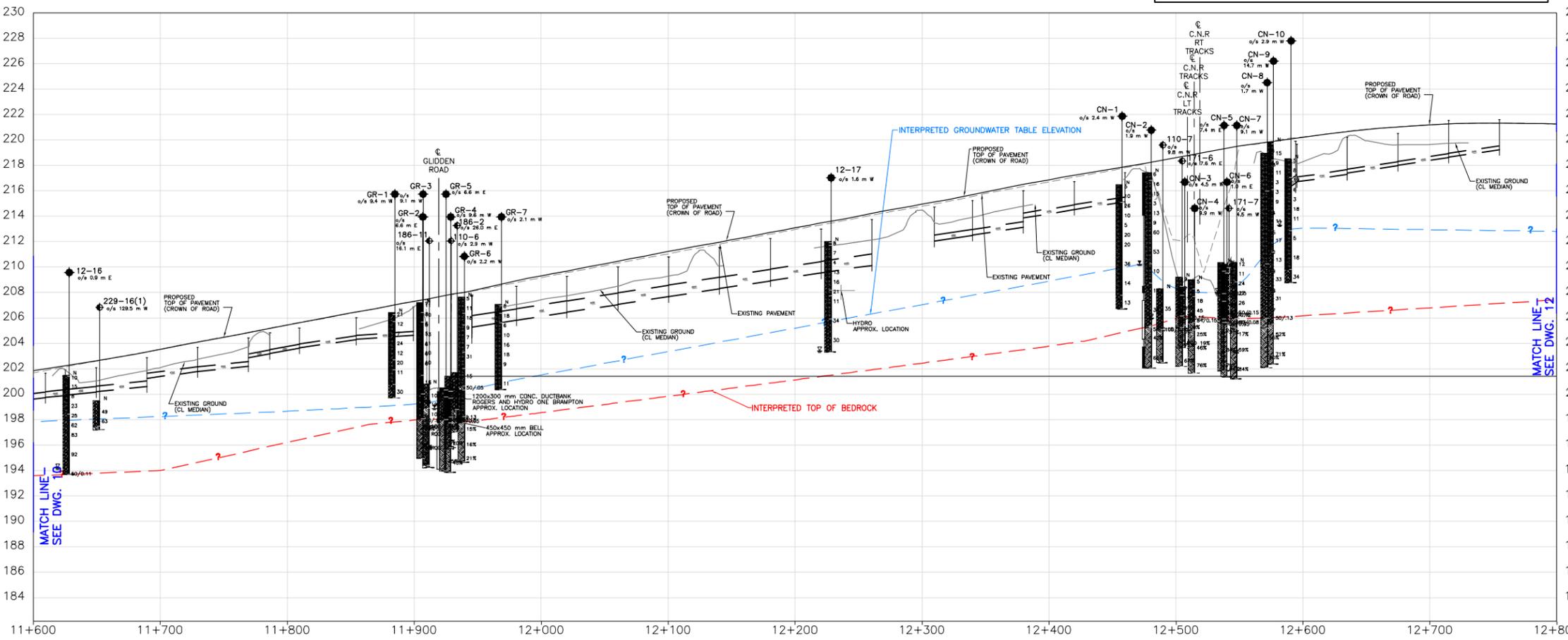


LEGEND

- Borehole - Current Investigation
- Borehole - Previous Investigation
- ⊥ 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, measured on MMM DD, YYYY
- ≡ WL upon completion of drilling



No.	ELEVATION	NORTHING	EASTING
12-16	201.5	4838833.4	287367.5
12-17	212.0	4839261.0	286946.7
110-6	201.4	4839045.2	287154.4
171-5	207.9	4839448.0	286778.5
171-6	208.5	4839459.0	286750.5
171-7	210.1	4839484.0	286726.5
171-8	209.7	4839503.0	286724.5
186-2	201.7	4839068.7	287171.9
186-11	200.8	4839046.0	287180.0
CN-1	216.5	4839425.0	286786.4
CN-2	217.4	4839441.7	286770.8
CN-3	209.2	4839465.8	286760.7
CN-4	209.0	4839460.9	286741.3
CN-5	210.4	4839489.5	286737.8
CN-6	210.2	4839486.8	286731.4
CN-7	210.4	4839485.3	286719.0
CN-8	218.9	4839507.7	286707.7
CN-9	219.8	4839502.3	286694.8
CN-10	218.5	4839520.5	286693.7
GR-1	206.4	4839008.9	287180.4
GR-2	207.1	4839025.0	287165.3
GR-3	207.2	4839035.9	287176.5
GR-4	200.4	4839040.5	287149.7
GR-5	200.5	4839049.0	287164.0
GR-6	207.7	4839053.3	287147.6
GR-7	207.1	4839074.4	287127.5



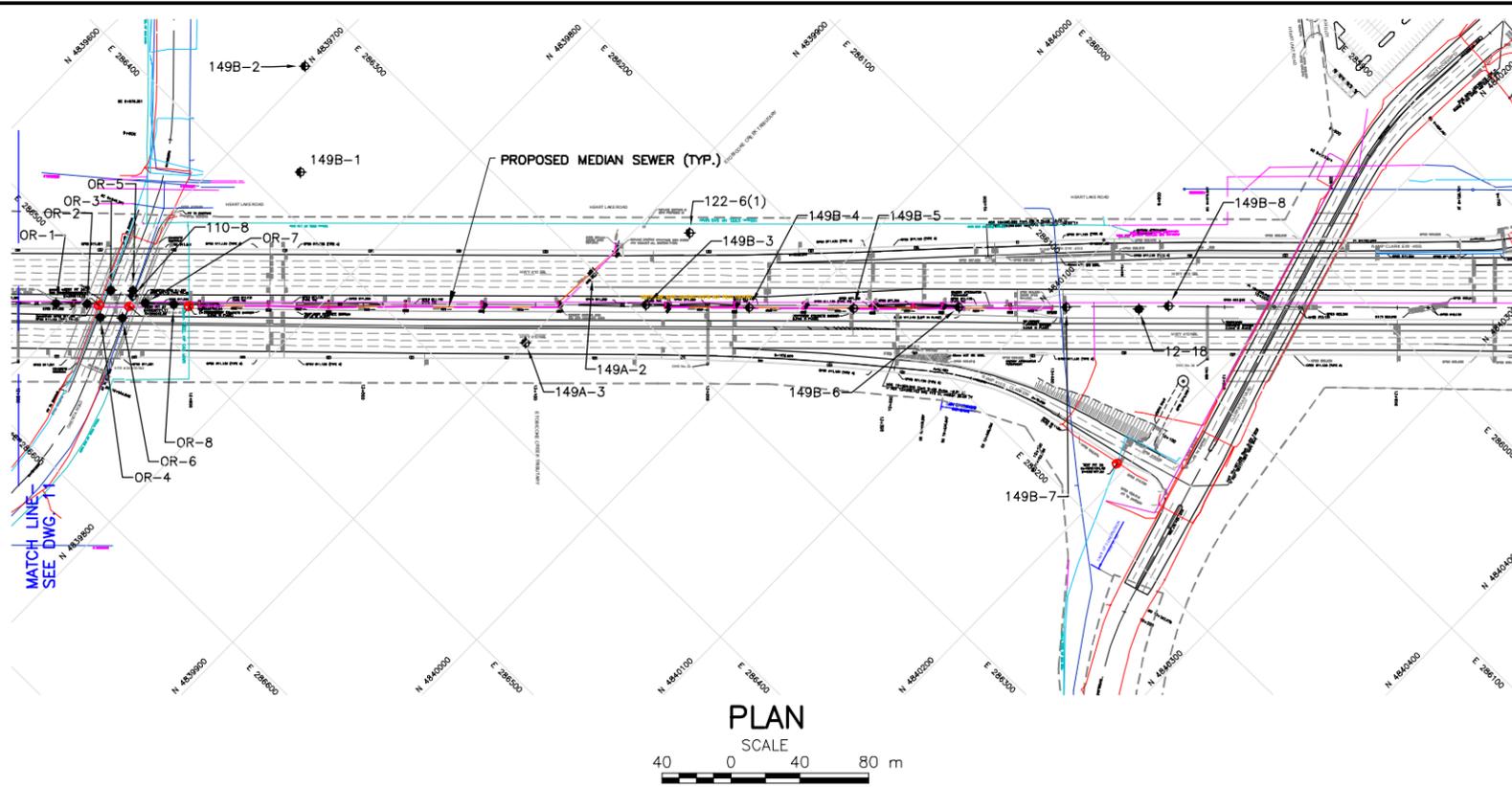
REFERENCE
Base plans provided in digital format by URS Canada Inc., (Drawing File Hwy410_Uilities.dwg, received Sept. 19, 2012, "2013 02 07 - Hwy410_Plan.dwg and 2013 02 07 - Hwy410_Profile (sewers).dwg", received Feb. 07, 2013).

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Geocres No. 30M12-362		PROJECT NO. 11-1111-0083	DIST. CENTRAL
HWY. 410	CHKD. LCC	DATE: Jun. 20, 2013	SITE:
SUBM'D. GDS	CHKD. GDS	APPD. LCC	DWG. 11

FILE: C:\Users\jfc\Documents\2011-11-11-0083 (URS, Peel Region)\Highway Storm Sewer\1111110083\41011.dwg
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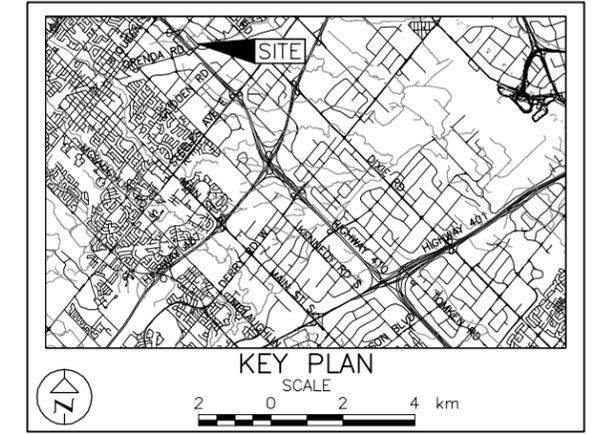


METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

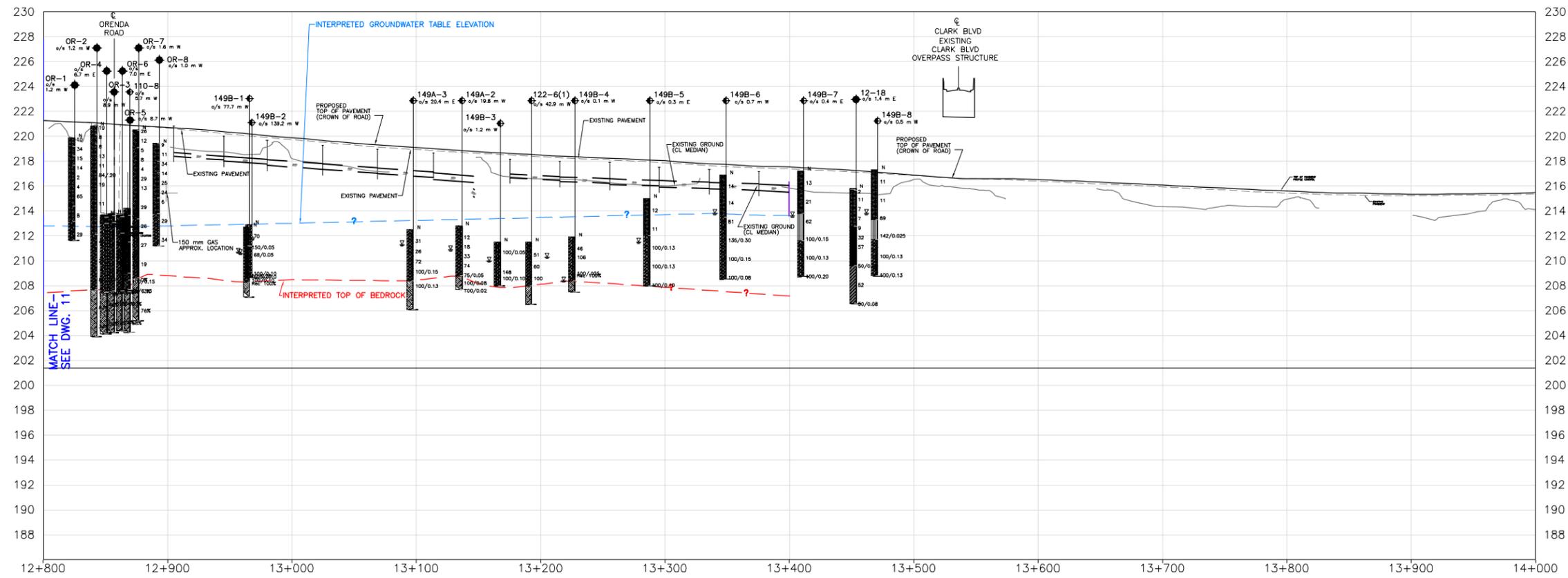
CONT No. GWP No. 2144-07-00
STATION 12+800 to 13+400
HIGHWAY 410 WIDENING
BOREHOLE LOCATIONS AND SOIL STRATA



Golder Associates
Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
12-18	215.8	4840141.1	286094.7
110-8	214.2	4839718.2	286497.2
122-6(1)	211.5	4839924.0	286245.2
149A-2	212.8	4839899.9	286301.2
149A-3	212.5	4839900.1	286357.3
149B-1	212.7	4839737.8	286377.9
149B-2	212.9	4839696.7	286332.2
149B-3	211.5	4839935.0	286292.7
149B-4	211.9	4839978.8	286251.9
149B-5	215.0	4840022.4	286210.1
149B-6	216.9	4840065.7	286166.8
149B-7	217.2	4840110.2	286123.3
149B-8	217.3	4840152.3	286081.2
195-1	186.8	4837107.9	288355.7
OR-1	219.9	4839689.5	286531.3
OR-2	220.8	4839702.4	286519.0
OR-3	213.8	4839707.0	286503.7
OR-4	213.7	4839713.5	286519.2
OR-5	213.8	4839716.3	286495.0
OR-6	213.7	4839722.9	286510.5
OR-7	220.5	4839726.3	286495.1
OR-8	219.4	4839738.6	286484.1



LEGEND

- Borehole - Current Investigation
- ⊙ Borehole - Previous Investigation
- ⊥ 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, measured on MMM DD, YYYY
- ▽ WL upon completion of drilling

NOTES

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STORM SEWER PROFILE
HORIZONTAL SCALE 40 0 40 80 m
VERTICAL SCALE 4 0 4 8 m



Geocres No. 30M12-362

HWY. 410	PROJECT NO. 11-1111-0083	DIST. CENTRAL
SUBM'D. GDS	CHKD. LCC	DATE: Jun. 20, 2013
DRAWN: JFC	CHKD. GDS	APPD. LCC
		DWG. 12

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

CONT No.
GWP No. 2144-07-00



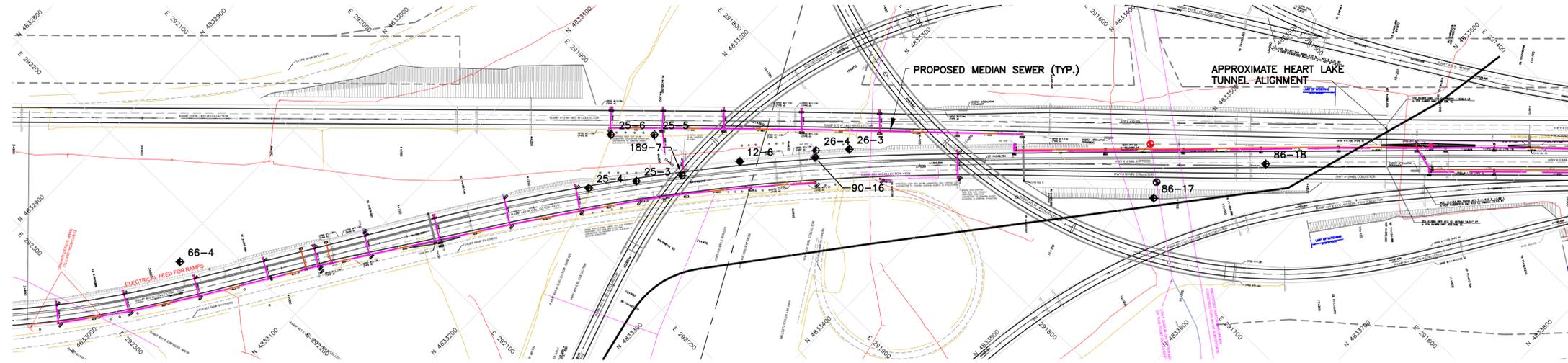
STATION 4+260 to 4+580
HIGHWAY 410 WIDENING - HIGHWAY 403
WBL (SBL) SECTION

SHEET

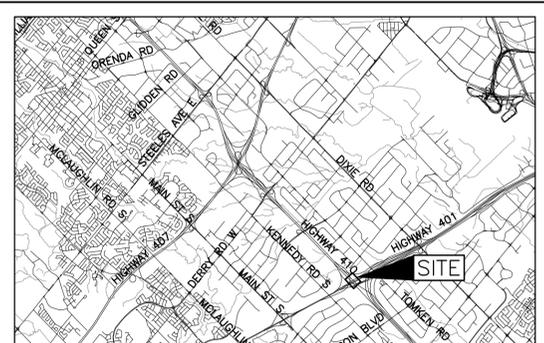
BOREHOLE LOCATIONS AND SOIL STRATA



Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



PLAN
SCALE
40 0 40 80 m



KEY PLAN
SCALE
2 0 2 4 km

LEGEND

- Borehole - Current Investigation
- ⊕ Borehole - Previous Investigation
- ⊥ Seal
- ⊥ Piezometer
- N Standard Penetration Test Value
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- ▽ WL in piezometer
- ▽ WL upon completion of drilling

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
12-6	173.0	4833263.0	291876.3
25-3	183.9	4833216.5	291942.8
25-4	184.1	4833193.9	291972.4
25-5	184.9	4833201.6	291907.5
25-6	185.3	4833177.5	291931.0
26-3	183.5	4833316.8	291810.6
26-4	184.3	4833299.1	291829.2
90-16	184.2	4833302.2	291833.4
189-7	172.7	4833238.9	291915.2

NOTES

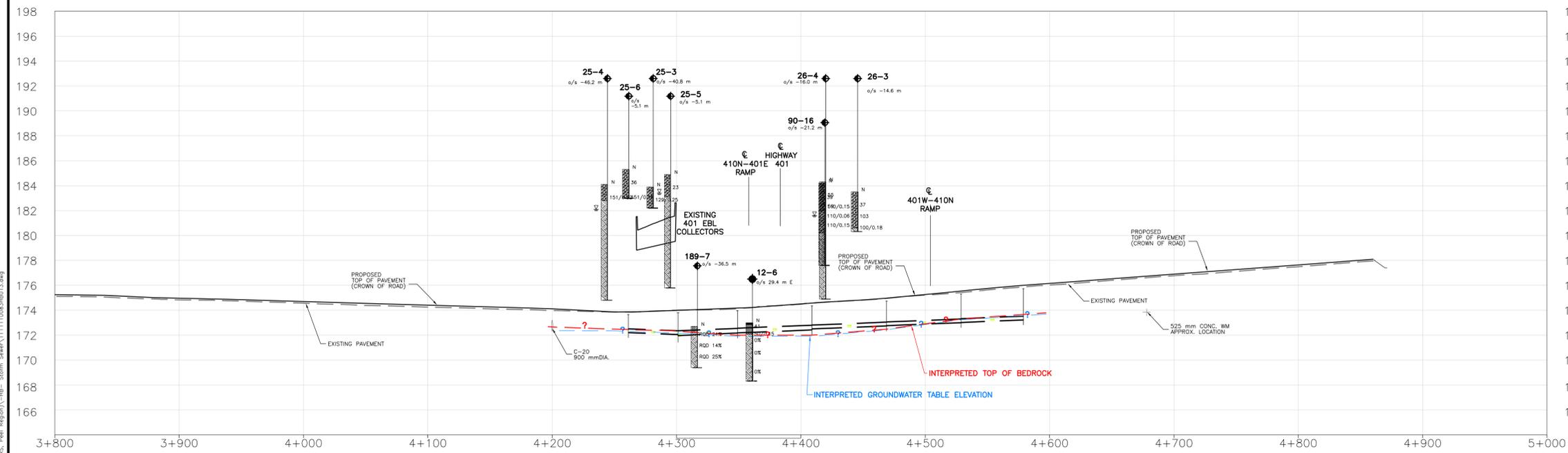
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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 is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

Base plans provided in digital format by URS Canada Inc., (Drawing File Hwy410_Uilities.dwg, received Sept. 19, 2012, "2013 02 07 - Hwy410_Plan.dwg and 2013 02 07 - Hwy410_Profile (sewers).dwg", received Feb. 07, 2013).



STORM SEWER PROFILE
HORIZONTAL SCALE
40 0 40 80 m
VERTICAL SCALE
4 0 4 8 m



Geocres No. 30M12-362

HWY. 410	PROJECT NO. 11-1111-0083	DIST. CENTRAL
SUBM'D. GDS	CHKD. LCC	DATE: Jun. 20, 2013
DRAWN: JFC	CHKD. GDS	APPD. LCC
		DWG. 13



APPENDIX A

Borehole and Test Pit Records from Current Investigation



LIST OF ABBREVIATIONS

The abbreviations commonly employed on Records of Boreholes, on figures and in the text of the report are as follows:

I. SAMPLE TYPE

AS	Auger sample
BS	Block sample
CS	Chunk sample
SS	Split-spoon
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

II. PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg (140 lb.) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) drive open sampler for a distance of 300 mm (12 in.)

Dynamic Cone Penetration Resistance; N_d :

The number of blows by a 63.5 kg (140 lb.) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH:	Sampler advanced by hydraulic pressure
PM:	Sampler advanced by manual pressure
WH:	Sampler advanced by static weight of hammer
WR:	Sampler advanced by weight of sampler and rod

Piezo-Cone Penetration Test (CPT)

A electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm² pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (Q_t), porewater pressure (PWP) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

V. MINOR SOIL CONSTITUENTS

Percent by Weight	Modifier	Example
0 to 5	Trace	Trace sand
5 to 12	Trace to Some (or Little)	Trace to some sand
12 to 20	Some	Some sand
20 to 30	(ey) or (y)	Sandy
over 30	And (cohesionless) or With (cohesive)	Sand and Gravel Silty Clay with sand / Clayey Silt with sand

III. SOIL DESCRIPTION

(a) Cohesionless Soils

Density Index	N
Relative Density	Blows/300 mm or Blows/ft
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) Cohesive Soils Consistency

	kPa	C_u, S_u	psf
Very soft	0 to 12		0 to 250
Soft	12 to 25		250 to 500
Firm	25 to 50		500 to 1,000
Stiff	50 to 100		1,000 to 2,000
Very stiff	100 to 200		2,000 to 4,000
Hard	over 200		over 4,000

IV. SOIL TESTS

w	water content
w_p	plastic limit
w_l	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test ¹
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement ¹
D_R	relative density (specific gravity, G_s)
DS	direct shear test
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO ₄	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane (LV-laboratory vane test)
γ	unit weight

Note: 1 Tests which are anisotropically consolidated prior to shear are shown as CAD, CAU.



LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I. GENERAL

π	3.1416
$\ln x$,	natural logarithm of x
$\log_{10} x$	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta \sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
ν	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress = $(\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

(a) Index Properties (continued)

w	water content
w_l or LL	liquid limit
w_p or PL	plastic limit
I_p or PI	plasticity index = $(w_l - w_p)$
w_s	shrinkage limit
I_L	liquidity index = $(w - w_p) / I_p$
I_C	consistency index = $(w_l - w) / I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_α	secondary compression index
m_v	coefficient of volume change
C_v	coefficient of consolidation (vertical direction)
C_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio = σ'_p / σ'_{vo}

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = $\tan \delta$
c'	effective cohesion
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p'	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

* Density symbol is ρ . Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density multiplied by acceleration due to gravity)

Notes: 1
2

$$\tau = c' + \sigma' \tan \phi'$$

$$\text{shear strength} = (\text{compressive strength})/2$$



LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

WEATHERINGS STATE

Fresh: no visible sign of weathering

Faintly weathered: weathering limited to the surface of major discontinuities.

Slightly weathered: penetrative weathering developed on open discontinuity surfaces but only slight weathering of rock material.

Moderately weathered: weathering extends throughout the rock mass but the rock material is not friable.

Highly weathered: weathering extends throughout rock mass and the rock material is partly friable.

Completely weathered: rock is wholly decomposed and in a friable condition but the rock and structure are preserved.

BEDDING THICKNESS

<u>Description</u>	<u>Bedding Plane Spacing</u>
Very thickly bedded	Greater than 2 m
Thickly bedded	0.6 m to 2 m
Medium bedded	0.2 m to 0.6 m
Thinly bedded	60 mm to 0.2 m
Very thinly bedded	20 mm to 60 mm
Laminated	6 mm to 20 mm
Thinly laminated	Less than 6 mm

JOINT OR FOLIATION SPACING

<u>Description</u>	<u>Spacing</u>
Very wide	Greater than 3 m
Wide	1 m to 3 m
Moderately close	0.3 m to 1 m
Close	50 mm to 300 mm
Very close	Less than 50 mm

GRAIN SIZE

<u>Term</u>	<u>Size*</u>
Very Coarse Grained	Greater than 60 mm
Coarse Grained	2 mm to 60 mm
Medium Grained	60 microns to 2 mm
Fine Grained	2 microns to 60 microns
Very Fine Grained	Less than 2 microns

Note: * Grains greater than 60 microns diameter are visible to the naked eye.

CORE CONDITION

Total Core Recovery (TCR)

The percentage of solid drill core recovered regardless of quality or length, measured relative to the length of the total core run.

Solid Core Recovery (SCR)

The percentage of solid drill core, regardless of length, recovered at full diameter, measured relative to the length of the total core run.

Rock Quality Designation (RQD)

The percentage of solid drill core, greater than 100 mm length, recovered at full diameter, measured relative to the length of the total core run. RQD varied from 0% for completely broken core to 100% for core in solid sticks.

DISCONTINUITY DATA

Fracture Index

A count of the number of discontinuities (physical separations) in the rock core, including both naturally occurring fractures and mechanically induced breaks caused by drilling.

Dip with Respect to Core Axis

The angle of the discontinuity relative to the axis (length) of the core. In a vertical borehole a discontinuity with a 90° angle is horizontal.

Description and Notes

An abbreviation description of the discontinuities, whether naturally occurring separations such as fractures, bedding planes and foliation planes or mechanically induced features caused by drilling such as ground or shattered core and mechanically separated bedding or foliation surfaces. Additional information concerning the nature of fracture surfaces and infillings are also noted.

Abbreviations

JN Joint	PL Planar
FLT Fault	CU Curved
SH Shear	UN Undulating
VN Vein	IR Irregular
FR Fracture	K Slickensided
SY Stylolite	PO Polished
BD Bedding	SM Smooth
FO Foliation	SR Slightly Rough
CO Contact	RO Rough
AXJ Axial Joint	VR Very Rough
KV Karstic Void	
MB Mechanical Break	

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No 12-1	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4831684.5 ; E 293473.6</u>	ORIGINATED BY <u>SB</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME 75 Truck-mount, 101 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>AV</u>	
DATUM <u>Geodetic</u>	DATE <u>November 11, 2012</u>	CHECKED BY <u>GDS</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)						
						20	40	60	80	100	20	40	60	80	100	10	20	30	GR	SA	SI	CL	
154.0	GROUND SURFACE																						
0.0	Sand and gravel (FILL) Compact Black and grey Moist		1	SS	17																		
153.2																							
0.8	Clayey silt with sand, trace gravel, containing wood fragments (FILL) Firm Grey Moist		2	SS	6																		
152.5																							
1.5	CLAYEY SILT with SAND, trace gravel (TILL) Stiff to hard Grey Moist		3	SS	17																		2 35 45 18
			4	SS	14																		
			5	SS	16																		
			6	SS	16																		
			7	SS	14																		
			8	SS	20																		2 39 44 15
			9	SS	28																		

PROJECT 11-1111-0083 **RECORD OF BOREHOLE No 12-2** **SHEET 1 OF 1** **METRIC**
G.W.P. 2144-07-00 **LOCATION** N 4832044.7 ; E 293126.9 **ORIGINATED BY** SB
DIST Central **HWY** 410 **BOREHOLE TYPE** CME 75 Truck-mount, 101 mm Diameter Solid Stem Augers **COMPILED BY** AV
DATUM Geodetic **DATE** November 12, 2012 **CHECKED BY** GDS

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)							
						20	40	60	80	100	20	40	60	80	100	10	20	30		GR	SA	SI	CL	
162.5	GROUND SURFACE																							
0.0	ASPHALT																							
0.2	Sand and gravel (FILL)																							
161.7	Dense Grey Moist		1	SS	35																			
0.8	Clayey silt with sand, trace gravel, containing wood fragments and oxidation staining (FILL)		2	SS	46																			
	Stiff to hard Grey Moist to dry		3	SS	10																			
160.3	CLAYEY SILT with SAND, trace to some gravel, containing cobbles (TILL)		4	SS	62/0.20																			
2.2	Firm to hard Grey Moist		5	SS	7																			
			6	SS	12																			
			7	SS	24																			
			8	SS	38																			12 33 37 18
			9	SS	17																			
			10	SS	74/0.08																			
153.0	END OF BOREHOLE																							
9.5	NOTES: 1. Water level in open borehole at a depth of 8.8 m (Elev. 153.7 m) below ground surface on completion of drilling. 2. Borehole backfilled with bentonite.																							

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+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No 12-3	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4832719.3 ; E 292532.9</u>	ORIGINATED BY <u>SB</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME 75 Truck-mount, 101 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>AV/GL</u>	
DATUM <u>Geodetic</u>	DATE <u>November 14, 2012</u>	CHECKED BY <u>GDS</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)									
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20	40	60	80	100	10	20	30
169.5	GROUND SURFACE																								
0.0	ASPHALT																								
0.2	Sand and gravel, trace clay (FILL)		1	SS	37																				
168.7	Dense Brown Moist SHALE (BEDROCK)		2	SS	50/0.10																				
0.8	Bedrock cored from 1.0 m to 4.5 m Refer to Record of Drillhole 12-3 for rock coring details		1	RC	REC 50%																			RQD = 0%	
			2	RC	REC 83%																				RQD = 15%
			3	RC	REC 94%																				RQD = 36%
165.0	END OF BOREHOLE																								
4.5	NOTES: 1. Open borehole dry prior to rock coring. 2. Borehole backfilled with bentonite.																								

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 2/20/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT:

RECORD OF DRILLHOLE: 12-3

SHEET 1 OF 1

LOCATION: N 4832719.3 ;E 292532.9

DRILLING DATE:

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 75 Truck-mount

DRILLING CONTRACTOR: DBW Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	Legend										NOTES					
							JN - Joint	BD - Bedding	PL - Planar	PO - Polished	MB - Mechanical Break	FLT - Fault	FO - Foliation	CJ - Curved	K - Slickensided	BR - Broken Rock		SH - Shear	CO - Contact	UN - Undulating	SM - Smooth	NOTE: For additional abbreviations refer to list of abbreviations & symbols.
							VN - Vein	OR - Orthogonal	ST - Stepped	RO - Rough	VR - Very Rough	CJ - Conjugate	CL - Cleavage	IR - Irregular								
RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY			Diametral Point Load		RMC -Q' AVG.										
FLUSH	TOTAL CORE %	SOLID CORE %		B Angle	DIP w/ ZL CORE AXIS	TYPE AND SURFACE DESCRIPTION	Ur	Ja	Ja	K, cm/sec	10 ⁰	10 ¹	10 ²	10 ³	2	4	6					
				168.50																		
1	NQRC NW Casing	BEDROCK SURFACE		1.00	1																	
2		SHALE BEDROCK (GEORGIAN BAY FORMATION), containing fossiliferous LIMESTONE interbeds Slightly weathered to fresh Grey Laminated Weak to medium strong, containing strong to very strong interbeds		2															9.5 MPa (Axial)			
3				3															(Axial)			
4																			(Axial)			
		END OF DRILLHOLE		164.99 4.51																		

GTA-RCK 018 111110083.GPJ GAL-MISS.GDT 2/20/13

DEPTH SCALE

1 : 50



LOGGED: SB

CHECKED: GDS

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No 12-4	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4832947.0 ; E 292338.8</u>	ORIGINATED BY <u>SB</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME 75 Truck-mount, 101 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>AV/GL</u>	
DATUM <u>Geodetic</u>	DATE <u>November 15, 2012</u>	CHECKED BY <u>GDS</u>	

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 (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					W _p	W			W _L	GR
173.0	GROUND SURFACE																	
0.0	ASPHALT																	
0.2	Sand and gravel (FILL) Dense Brown Moist		1	SS	39								o					
172.2	SHALE (BEDROCK)		2	SS	63/0.15													
0.8	Bedrock cored from 1.1 m to 4.5 m Refer to Record of Drillhole 12-4 for rock coring details		1	RC	REC 100%		172											RQD = 0%
			2	RC	REC 90%		171											RQD = 45%
			3	RC	REC 100%		170											RQD = 62%
168.5	END OF BOREHOLE						169											
4.5	NOTES: 1. Open borehole dry prior to rock coring. 2. Borehole backfilled with bentonite.																	

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PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No 12-5	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4833124.6 ; E 292098.7</u>	ORIGINATED BY <u>SB</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME 75 Truck-mount, 101 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>AV/GL</u>	
DATUM <u>Geodetic</u>	DATE <u>November 15 and 16, 2012</u>	CHECKED BY <u>GDS</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
172.0	GROUND SURFACE															
0.0	ASPHALT															
0.2	Sand and gravel (FILL) Very dense Brown Moist		1	SS	60						o					
171.2	SHALE (BEDROCK)		2	SS	50/0.10											
0.8	SHALE (BEDROCK)		1	RC	REC 100%											RQD = 0%
	Bedrock cored from 1.2 m to 4.7 m Refer to Record of Drillhole 12-5 for rock coring details		2	RC	REC 88%											RQD = 60%
			3	RC	REC 97%											RQD = 80%
167.3	END OF BOREHOLE															
4.7	NOTES: 1. Open borehole dry prior to rock coring. 2. Borehole backfilled with bentonite.															

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 2/20/13

PROJECT:

RECORD OF DRILLHOLE: 12-5

SHEET 1 OF 1

LOCATION: N 4833124.6 ;E 292098.7

DRILLING DATE:

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 75 Truck-mount

DRILLING CONTRACTOR: DBW Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	LEGEND										NOTES					
							JN - Joint	BD - Bedding	PL - Planar	PO - Polished	MB - Mechanical Break	FLT - Fault	FO - Foliation	CJ - Curved	K - Slickensided	BR - Broken Rock		SH - Shear	CO - Contact	UN - Undulating	SM - Smooth	NOTE: For additional abbreviations refer to list of abbreviations & symbols.
							VN - Vein	OR - Orthogonal	ST - Stepped	RO - Rough	VR - Very Rough	CJ - Conjugate	CL - Cleavage	IR - Irregular								
RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY		Diameter		RMC - Q											
FLUSH	TOTAL CORE %	SOLID CORE %		B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Ur	Ja	Jn	K, cm/sec	Point Load (MPa)	AVG.										
				170.78																		
1		BEDROCK SURFACE		1.22																		
2	NORC NW Casing	SHALE BEDROCK (GEORGIAN BAY FORMATION), containing fossiliferous LIMESTONE interbeds Slightly weathered to fresh Grey Laminated Weak to medium strong, containing strong to very strong interbeds																				
2													(Diametral)									
3														(Axial)								
4													(Axial)									
5		END OF DRILLHOLE		167.34																		
6				4.66																		
7																						
8																						
9																						
10																						
11																						

GTA-RCK 018 111110083.GPJ GAL-MISS.GDT 2/20/13

DEPTH SCALE

1 : 50



LOGGED: SB

CHECKED: GDS

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No 12-6	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4833263.0 ; E 291876.3</u>	ORIGINATED BY <u>SB</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME 75 Truck-mount, 101 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>AV/GL</u>	
DATUM <u>Geodetic</u>	DATE <u>November 16, 2012</u>	CHECKED BY <u>GDS</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W _p	W			W _L	GR
173.0	GROUND SURFACE																	
0.0	ASPHALT																	
0.2	Silty sand, some gravel, trace to some clay (FILL)		1	SS	41													
172.1	Dense Brown Moist		2	SS	50/0.15													18 55 20 7
0.9	SHALE (BEDROCK)																	
	Bedrock cored from 1.1 m to 4.7 m		1	RC	REC 95%													RQD = 0%
	Refer to Record of Drillhole 12-6 for rock coring details		2	RC	REC 52%													RQD = 0%
			3	RC	REC 73%													RQD = 0%
168.3	END OF BOREHOLE																	
4.7	NOTES: 1. Open borehole dry prior to rock coring. 2. Borehole backfilled with bentonite.																	

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 2/20/13

+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No 12-7	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4833508.7 ; E 291631.5</u>	ORIGINATED BY <u>SB</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME 75 Truck-mount, 101 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>AV/GL</u>	
DATUM <u>Geodetic</u>	DATE <u>November 18 and 19, 2012</u>	CHECKED BY <u>GDS</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					
176.0	GROUND SURFACE																
0.0	ASPHALT																
0.2	Sand and gravel (FILL)																
175.2	Compact Brown Moist SHALE (BEDROCK)																
0.8	Bedrock cored from 1.5 m to 4.5 m Refer to Record of Drillhole 12-7 for rock coring details																
			1	SS	23												
			2	SS	68/0.23		175										
			1	RC	REC 84%		174										RQD = 25%
			2	RC	REC 94%		173										
							172										RQD = 21%
171.5	END OF BOREHOLE																
4.5	NOTES: 1. Open borehole dry prior to rock coring. 2. Borehole backfilled with bentonite.																

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 2/20/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No 12-8	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4833866.9 ; E 291282.9</u>	ORIGINATED BY <u>SB</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME 75 Truck-mount, 101 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>AV/GL</u>	
DATUM <u>Geodetic</u>	DATE <u>November 19, 2012</u>	CHECKED BY <u>GDS</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
			NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20	40	60	80	100	10	20
180.0	GROUND SURFACE																							
0.0	ASPHALT																							
0.2	Sand and gravel (FILL)																							
179.2	Dense Brown Moist		1	SS	39																			
0.8	CLAYEY SILT with SAND, trace to some gravel (TILL)		2	SS	49		179																	
	Very stiff to hard Grey Moist		3	SS	29		178													12	26	42	20	
	Containing cobbles below 3.0 m		4	SS	32		177																	
			5	SS	45		176																	
			6	SS	77		175																	
			7	SS	65/0.15		174														15	35	41	9
	Shale fragments below 6.1 m		8	SS	80/0.15		173																	
							172																	
172.4	SHALE (BEDROCK)						172																	
7.6	Bedrock cored from 7.6 m to 9.1 m		1	RC	REC 87%		171																	
	Refer to Record of Drillhole 12-8 for rock coring details																							
170.9	END OF BOREHOLE																							
9.1	NOTES: 1. Open borehole dry prior to rock coring. 2. Borehole backfilled with bentonite.																							

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 2/20/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 12-10 SHEET 1 OF 1 **METRIC**

PROJECT 11-1111-0083 G.W.P. 2144-07-00 LOCATION N 4834449.2 ; E 290709.2 ORIGINATED BY TWB

DIST Central HWY 410 BOREHOLE TYPE CME 55 Track-mount, 101 mm Diameter Solid Stem Augers COMPILED BY AV

DATUM Geodetic DATE October 12, 2012 CHECKED BY GDS

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)						
						20	40	60	80	100	20	40	60	80	100	10	20	30	GR	SA	SI	CL	
185.5	GROUND SURFACE																						
0.0	TOPSOIL																						
184.7	Clayey silt, some sand, trace gravel, containing organics and rootlets (FILL)		1	SS	24																		
0.8	Very stiff Brown Moist		2	SS	26																		3 35 43 19
	CLAYEY SILT with SAND, trace to some gravel (TILL)		3	SS	21																		
	Stiff to hard Grey to brown Moist		4	SS	10																		
			5	SS	8																		
			6	SS	8																		
			7	SS	9																		
			8	SS	13																		
			9	SS	50/0.05																		19 38 34 9
176.0	END OF BOREHOLE		10	SS	12/0.05																		
9.5	NOTES: 1. Open borehole dry on completion of drilling. 2. Borehole backfilled with bentonite.																						

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 2/20/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No 12-11	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4835114.2 ; E 290066.4</u>	ORIGINATED BY <u>TWB</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME 55 Track-mount, 101 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>AV</u>	
DATUM <u>Geodetic</u>	DATE <u>October 9, 2012</u>	CHECKED BY <u>GDS</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
			NUMBER	TYPE	"N" VALUES			20	40					
183.5	GROUND SURFACE													
183.2	Clayey silt, some sand, trace gravel, containig organics and rootlets (FILL) Firm Brown Moist		1	SS	6		183							
0.3	CLAYEY SILT with SAND, trace to some gravel (TILL) Very stiff to hard Brown Moist		2	SS	27		182							
			3	SS	50/0.08		181							6 35 50 9
			4	SS	51		180							
180.5	SILT trace to some sand, trace clay Compact to very dense Grey to brown Moist		5	SS	53		179							0 5 92 3
			6	SS	22		178							
			7	SS	17		177							
178.0	Sandy SILT to SAND and SILT, trace clay, trace to some gravel (TILL) Compact to very dense Grey Moist		8	SS	14		176							
			9	SS	52		175							5 23 69 3
			10	SS	50/0.08		174							
174.0	END OF BOREHOLE PRACTICAL AUGER REFUSAL													
9.5	NOTES: 1. Water level in open borehole at a depth of 3.7 m (Elev. 180.3 m) below ground surface on completion of drilling. 2. Borehole backfilled with bentonite.													

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 2/20/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No 12-12	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4836085.5 ; E 289128.5</u>	ORIGINATED BY <u>SB</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME 55 Truck-mount, 101 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>AV/GL</u>	
DATUM <u>Geodetic</u>	DATE <u>November 19, 2012</u>	CHECKED BY <u>GDS</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
189.1	GROUND SURFACE															
0.0	ASPHALT					189										
0.2	Sand and gravel, occasional cobbles (FILL) Compact Brown Moist		1	SS	25											
			2	SS	10	188										
187.6	CLAYEY SILT with SAND, trace to some gravel (TILL) Very stiff to hard Brown to grey Moist		3	SS	17	187										
1.5			4	SS	21							—○—			7	35 40 18
			5	SS	31	186										
			6	SS	63	185						○				
			7	SS	49	184										
			8	SS	68/0.15	183						○ —				
			9	SS	100/0.15	182						○			5	43 40 12
180.9	END OF BOREHOLE PRACTICAL AUGER REFUSAL (ON INFERRED BEDROCK)					181										
8.2	NOTES: 1. Borehole dry upon completion of drilling. 2. Borehole backfilled with bentonite.															

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 2/20/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No 12-13	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4836711.3 ; E 288541.9</u>	ORIGINATED BY <u>PC</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME 75 Track-mount, 70 mm I.D. Hollow Stem Augers</u>	COMPILED BY <u>AV/GL</u>	
DATUM <u>Geodetic</u>	DATE <u>October 25, 2012</u>	CHECKED BY <u>GDS</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					W _p	W			W _L	GR
193.5	GROUND SURFACE																	
0.0	TOPSOIL																	
192.7	Clayey silt with sand, trace to some gravel, containing rootlets (FILL)		1	SS	5													
0.8	Firm Brown Moist SHALE (BEDROCK)		2	SS	83/0.18								φ					
	Bedrock cored from 1.5 m to 4.7 m		1	RC	REC 100%													RQD = 0%
	Refer to Record of Drillhole 12-13 for rock coring details		2	RC	REC 100%													RQD = 8%
			3	RC	REC 80%													RQD = 14%
188.8	END OF BOREHOLE																	
4.7	NOTES: 1. Open borehole dry upon completion of drilling. 2. Borehole backfilled with bentonite.																	

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 2/20/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT:

RECORD OF DRILLHOLE: 12-13

SHEET 1 OF 1

LOCATION: N 4836711.3 ;E 288541.9

DRILLING DATE:

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 75 Track-mount

DRILLING CONTRACTOR: Geo-Environmental Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY		Diameter Point Load Index (MPa)	RMC -Q' AVG.	NOTES		
								TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn				K, cm/sec	
								JOINTS	FAULTS			FO	CU	UN	ST	IR	VR				PO	K
		BEDROCK SURFACE		192.00																		
2	NGRC NW Casing	SHALE BEDROCK (GEORGIAN BAY FORMATION), containing fossiliferous LIMESTONE interbeds Slightly weathered to fresh Grey Laminated Weak to medium strong, containing strong to very strong interbeds		1.50	1																	
				2																		
				3																		
4																						
		END OF DRILLHOLE		188.82																		
5				4.68																		
6																						
7																						
8																						
9																						
10																						
11																						

GTA-RCK 018 111110083.GPJ GAL-MISS.GDT 2/20/13

DEPTH SCALE

1 : 50



LOGGED: PC

CHECKED: GDS

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No 12-14	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4837913.0 ; E 288085.2</u>	ORIGINATED BY <u>PC</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME 75 Track-mount, 108 mm I.D. Hollow Stem Augers</u>	COMPILED BY <u>AV/GL</u>	
DATUM <u>Geodetic</u>	DATE <u>October 21, 2012</u>	CHECKED BY <u>GDS</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
			NUMBER	TYPE	"N" VALUES			20	40						60	80	100	20	40
193.5	GROUND SURFACE																		
0.7	TOPSOIL Clayey silt, some sand, some gravel, trace rootlets (FILL) Stiff to very stiff Brown Moist		1	SS	9		193												
			2	SS	23														
192.0							192												
1.5	CLAYEY SILT with SAND, trace to some gravel (TILL) Very stiff Brown to gery Moist		3	SS	28														
			4	SS	26		191						6	33	43	18			
			5	SS	28		190												
189.5			6	SS	50/0.18														
4.0	COBBLES and BOULDERS		1	RC	REC 70%		189							RQD = 0%					
			2	RC	REC 24%		188							RQD = 0%					
187.2																			
	SAND and GRAVEL		7	SS	85		187												
6.5	CLAYEY SILT with SAND, trace to some gravel (TILL) Hard Grey Moist						186												
			8	SS	80								8	38	44	10			
184.7							185												
8.8	END OF BOREHOLE PRACTICAL AUGER REFUSAL NOTES: 1. Borehole dry upon completion of drilling. 2. Borehole backfilled with bentonite.																		

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 2/20/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT 11-1111-0083 **RECORD OF BOREHOLE No 12-15** **SHEET 1 OF 1** **METRIC**
G.W.P. 2144-07-00 **LOCATION** N 4838615.1 ; E 287574.0 **ORIGINATED BY** PC
DIST Central **HWY** 410 **BOREHOLE TYPE** CME 75 Track-mount, 108 mm I.D. Hollow Stem Augers **COMPILED BY** AV/GL
DATUM Geodetic **DATE** October 21, 2012 **CHECKED BY** GDS

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)	
						20	40	60	80	100								
197.0	GROUND SURFACE																	
0.0	TOPSOIL																	
0.1	Clayey silt, some sand, some gravel (FILL)		1	SS	10													
196.2	Stiff Brown Moist		2	SS	23													
0.8	CLAYEY SILT with SAND, trace to some gravel, containing cobbles and boulders (TILL)		3	SS	28													
	Very stiff to hard		4	SS	30										10	32	43	15
	Brown to grey Moist		5	SS	75													
			6	SS	83										9	39	39	13
			7	SS	90													
191.0	SHALE (BEDROCK)		1	RC	REC 74%													RQD = 0%
6.0	Bedrock cored from 6.0 m to 9.3 m		2	RC	REC 28%													RQD = 0%
	Refer to Record of Drillhole 12-15 for rock coring details		3	RC	REC 100%													RQD = 20%
187.7	END OF BOREHOLE																	
9.3	NOTES: 1. Open borehole dry upon completion of drilling. 2. Borehole backfilled with bentonite.																	

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 2/20/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 12-17 SHEET 1 OF 1 **METRIC**

PROJECT 11-1111-0083 G.W.P. 2144-07-00 LOCATION N 4839261.0 ; E 286946.7 ORIGINATED BY PC

DIST Central HWY 410 BOREHOLE TYPE CME 75 Track-mount, 108 mm I.D. Hollow Stem Augers COMPILED BY AV

DATUM Geodetic DATE October 22, 2012 CHECKED BY GDS

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
212.0	GROUND SURFACE												
0.0	TOPSOIL												
0.3	Sand and silt, trace gravel, trace rootlets (FILL) Brown Moist		1	SS	8								
	Clayey silt, some sand, some gravel (FILL) Soft to very stiff Brown Moist		2	SS	7	211							
			3	SS	4	210							
			4	SS	13								
			5	SS	16	209							
208.2	Pulverized asphalt (FILL)		6	SS	21	208							
207.7	Clayey silt, some sand, some gravel, trace asphalt, trace organics (FILL) Stiff Grey to dark grey Moist		7	SS	11	207						20 19 41 20	
205.9	CLAYEY SILT, some sand, some gravel (TILL) Hard Dark brown to grey Moist		8	SS	34	206						16 20 44 20	
			9	SS	30	205							
203.3	END OF BOREHOLE PRACTICAL AUGER REFUSAL					204							
8.7	NOTES: 1. Water level in open borehole at a depth of 8.6 m (Elev. 202.9 m) below ground surface on completion of drilling. 2. Borehole backfilled with bentonite.												

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 2/20/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No 12-18	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4840141.1 ; E 286094.7</u>	ORIGINATED BY <u>PC</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME 75 Track-mount, 70 mm I.D. Hollow Stem Augers</u>	COMPILED BY <u>AV</u>	
DATUM <u>Geodetic</u>	DATE <u>October 24, 2012</u>	CHECKED BY <u>GDS</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
			NUMBER	TYPE	"N" VALUES			20	40					
215.8	GROUND SURFACE													
0.0	TOPSOIL													
0.1	Silty clay, some sand, some gravel, trace organics and rootlets (FILL) Soft to stiff Brown Moist		1	SS	2									
			2	SS	11									
			3	SS	7									
			4	SS	7									
212.8														
3.0	Sandy SILT, trace gravel, trace clay Loose to very dense Brown Moist		5	SS	9									
			6	SS	32									1 26 70 3
			7	SS	57									
209.6														
6.2	CLAYEY SILT with SAND and GRAVEL (FILL) Hard Grey Moist		8	SS	50/0.08									
			9	SS	52									34 21 34 11
206.6														
9.2	END OF BOREHOLE		10	SS	50/0.08									
	NOTES: 1. Borehole dry upon completion of drilling. 2. Borehole backfilled with bentonite.													

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 2/20/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No C16-1	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4832538.1 ; E 292671.7</u>	ORIGINATED BY <u>SB</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME 75 Truck-mount, 101 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>AV/GL</u>	
DATUM <u>Geodetic</u>	DATE <u>November 14, 2012</u>	CHECKED BY <u>GDS</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					W _p	W			W _L	GR	SA
						20	40	60	80	100									
169.1	GROUND SURFACE																		
0.0	ASPHALT																		
0.2	Sand and gravel, trace to some silt, trace to some clay (FILL)		1	SS	38														
168.3	Dense Brown Moist		2	SS	19														
0.8	Gravelly sand and silt, some clay (FILL)		3	SS	15														
	Compact Brown Moist																		
166.8	SHALE (BEDROCK) containing limestone interbeds		4	SS	75/0.15														
2.3	Bedrock cored from 2.6 m to 5.6 m																		
	Refer to Record of Drillhole C16-1 for rock coring details		1	RC	REC 97%													RQD = 17%	
			2	RC	REC 56%													RQD = 15%	
163.5	END OF BOREHOLE																		
5.6	NOTES: 1. Open borehole dry prior to rock coring. 2. Borehole backfilled with bentonite.																		

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 2/20/13

PROJECT:

RECORD OF DRILLHOLE: C16-1

SHEET 1 OF 1

LOCATION: N 4832538.1 ; E 292671.7

DRILLING DATE:

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 75 Truck-mount

DRILLING CONTRACTOR: DBW Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR FLUSH	RECOVERY			FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY			Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES
							TOTAL CORE %	SOLID CORE %	R.Q.D. %		TYPE AND SURFACE DESCRIPTION			K, cm/sec					
							000000	000000	000000		B Angle	DIP w.r.t. CORE AXIS	Ur	Ja	Jn	10 ⁰			
		BEDROCK SURFACE		166.51															
3	NORC NW Casing	SHALE BEDROCK (GEORGIAN BAY FORMATION), containing fossiliferous LIMESTONE interbeds Slightly weathered to fresh Grey Laminated Weak to medium strong, containing strong to very strong interbeds		2.59	1														
4																			
5																			
6		END OF DRILLHOLE		163.46															
7				5.64															
8																			
9																			
10																			
11																			
12																			

GTA-RCK 018 111110083.GPJ GAL-MISS.GDT 2/20/13

DEPTH SCALE

1 : 50



LOGGED: SB

CHECKED: GDS

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No TP C16-2	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4832534.5 ; E 292665.7</u>	ORIGINATED BY <u>SB</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>Hand-Dug Test Pit</u>	COMPILED BY <u>EB</u>	
DATUM <u>Geodetic</u>	DATE <u>November 15, 2012</u>	CHECKED BY <u>LCC</u>	

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	20	40	60	80	100	W _p	W		
168.1	GROUND SURFACE	XXXX														
0.0	Clayey silt, trace sand, trace gravel, containing rootlets and organics (FILL)															
0.3	Soft Brown Wet REFUSAL ON SHALE BEDROCK															

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 2/20/13



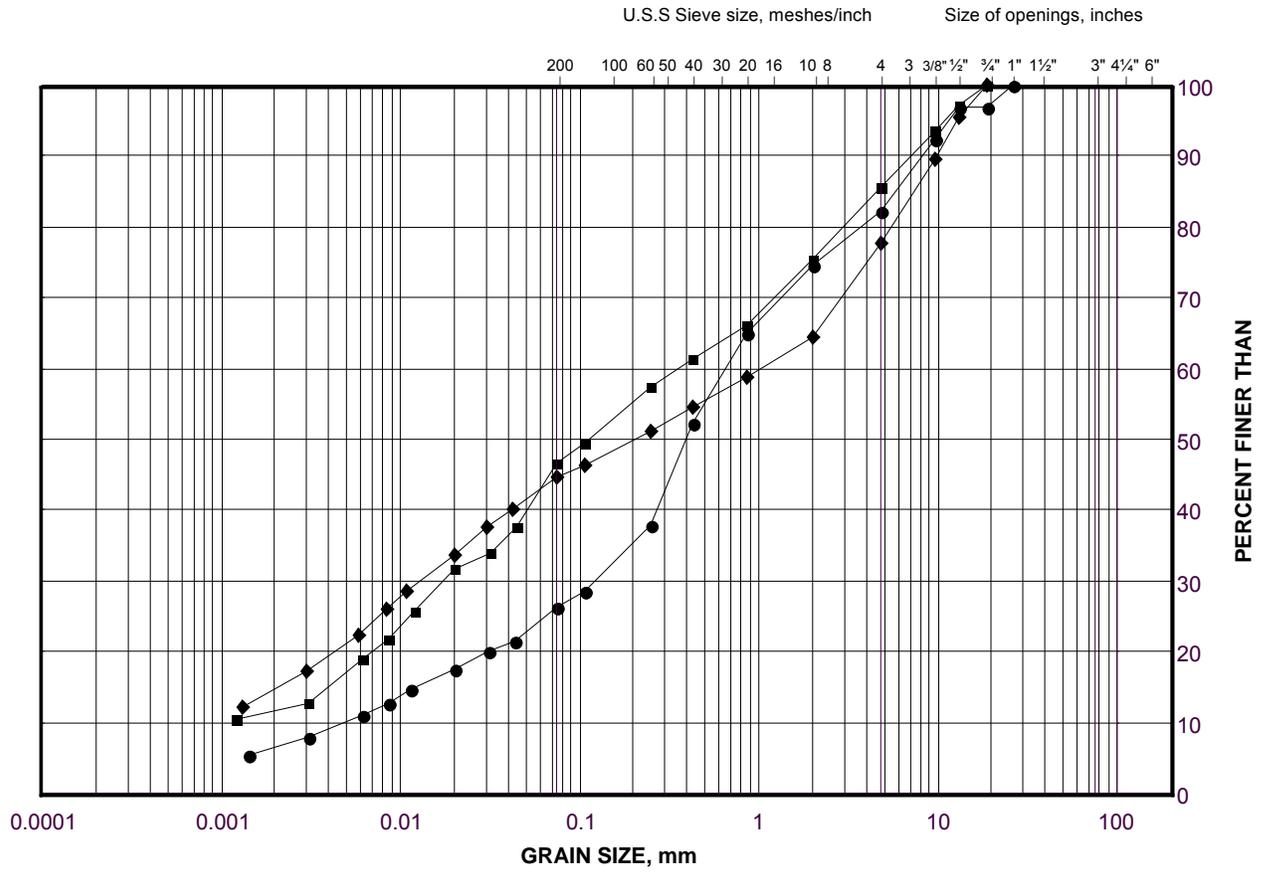
APPENDIX B

Laboratory Test Results

GRAIN SIZE DISTRIBUTION

Sand Fill

FIGURE B1



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

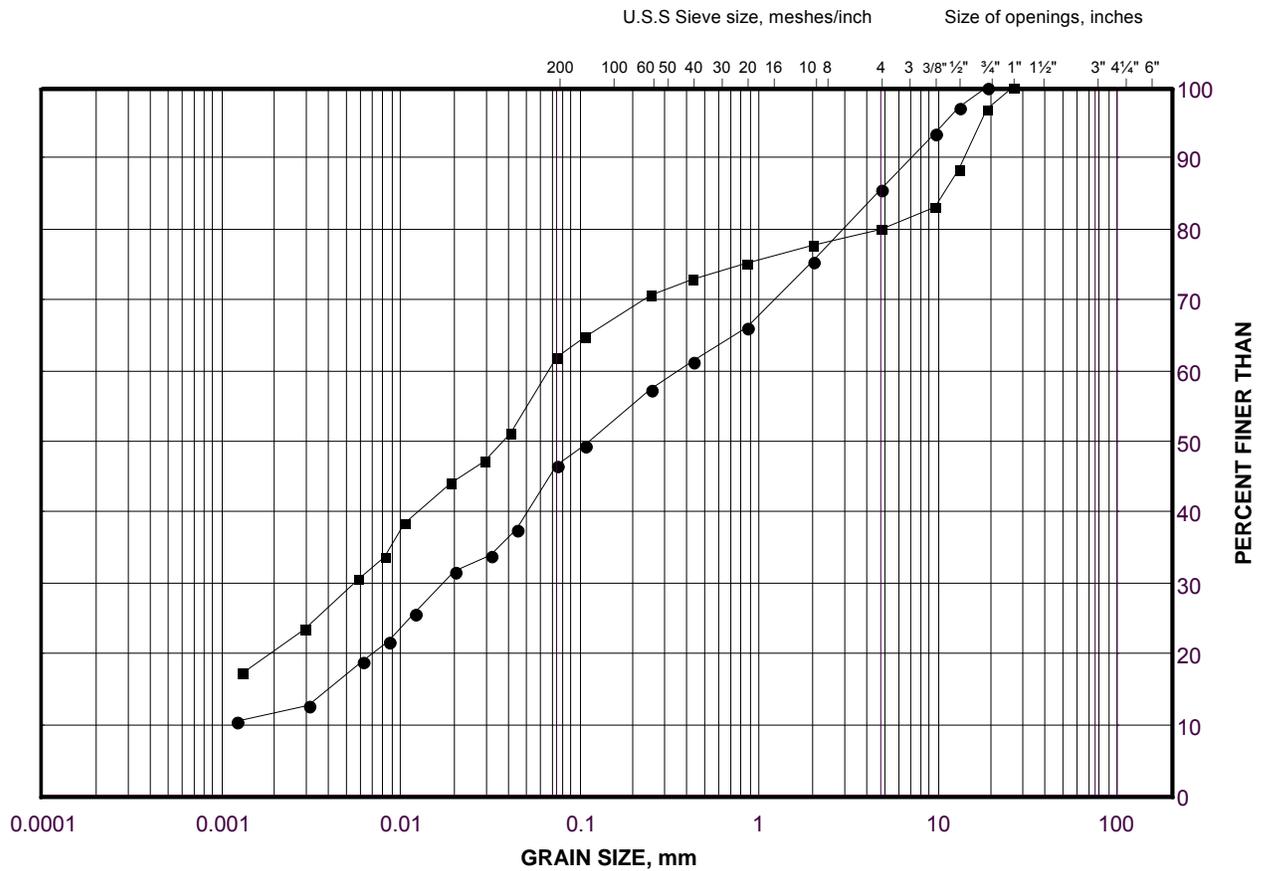
LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	12-6	2	174.2
■	12-19	2A	212.8
◆	C16-1	3	167.2

GRAIN SIZE DISTRIBUTION

Clayey Silt Fill

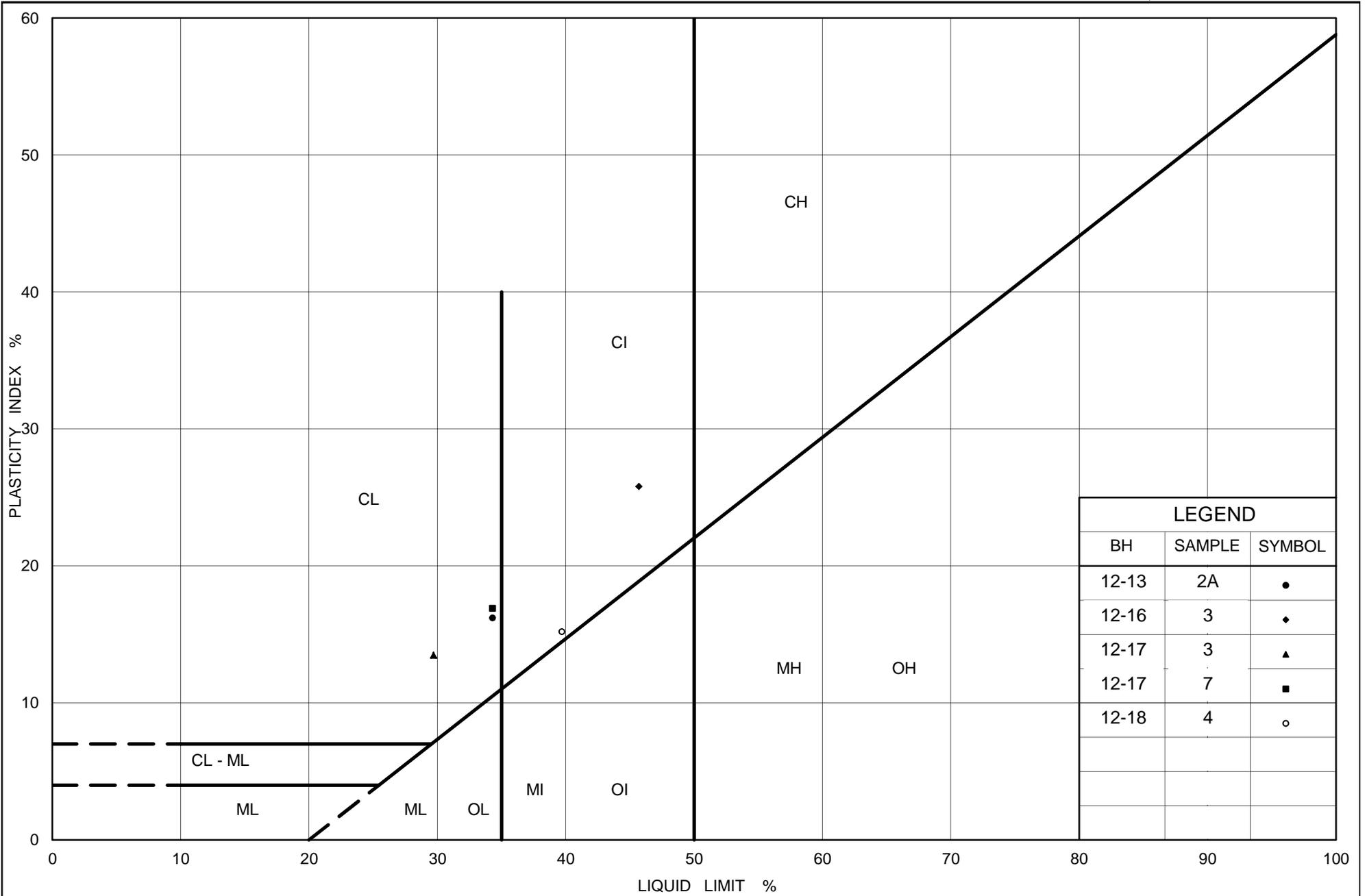
FIGURE B2



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	12-19	2A	212.8
■	12-17	7	206.9



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PLASTICITY CHART

Clayey Silt Fill

Figure No. B3

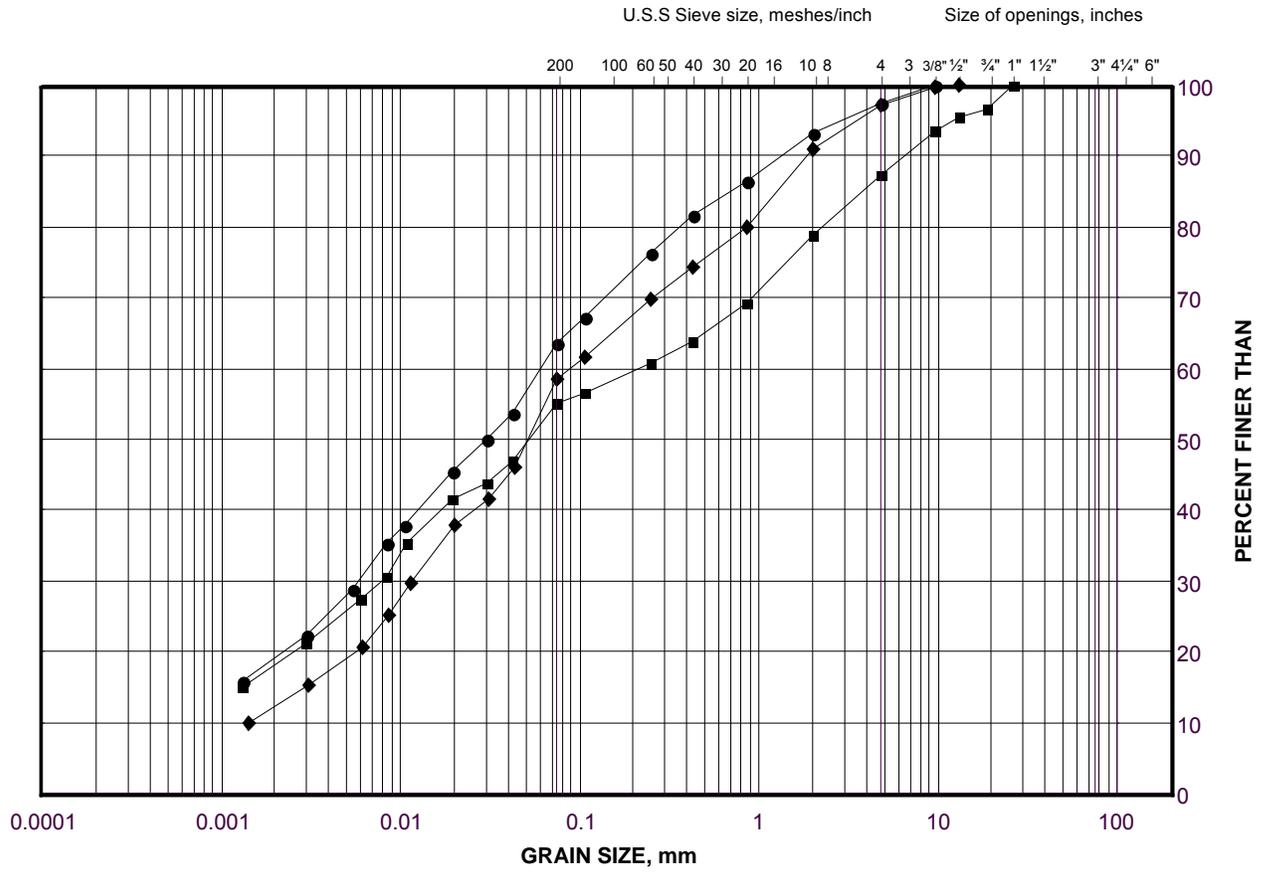
Project No. 11-1111-0083

Checked By: GL/GDS

GRAIN SIZE DISTRIBUTION

Clayey Silt Till

FIGURE B4



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

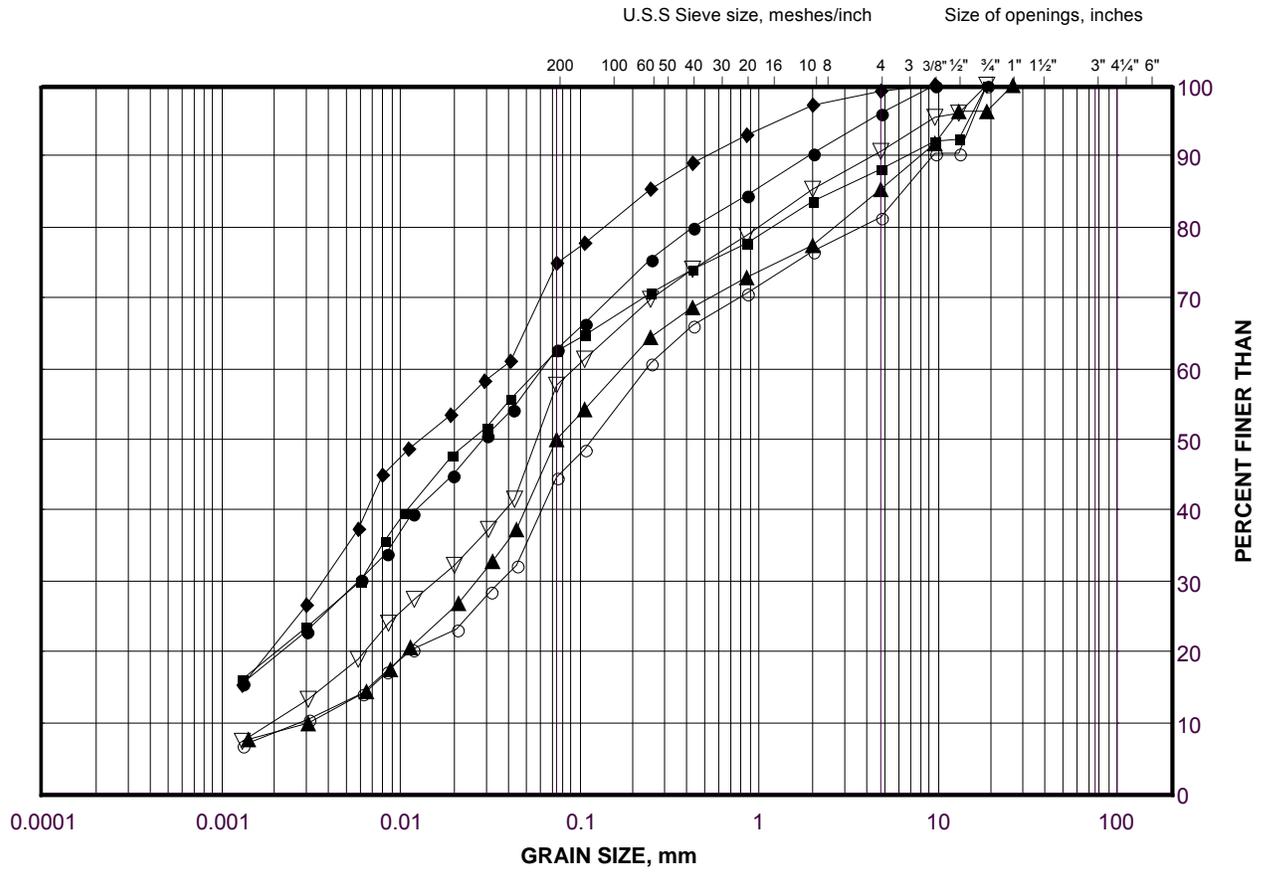
LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	12-1	3	152.5
■	12-2	8	156.4
◆	12-1	8	147.9

GRAIN SIZE DISTRIBUTION

Clayey Silt Till

FIGURE B5



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	12-10	2	185.7
■	12-8	3	178.5
◆	12-9	3	183.5
▲	12-8	7	175.4
▽	12-9	7	180.4
○	12-10	9	178.9

Project Number: 11-1111-0083

Checked By: GL/GDS

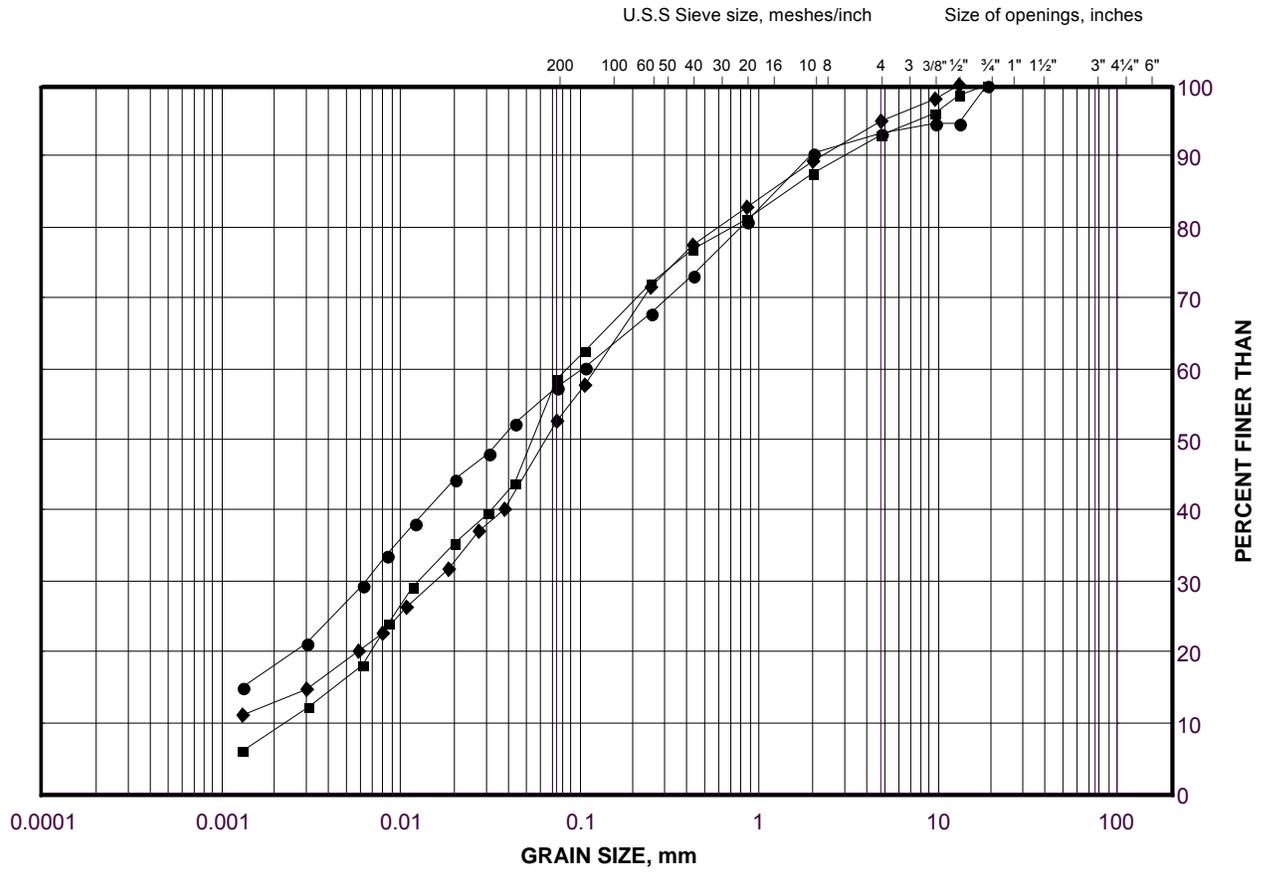
Golder Associates

Date: 11-Jan-13

GRAIN SIZE DISTRIBUTION

Clayey Silt Till

FIGURE B6



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

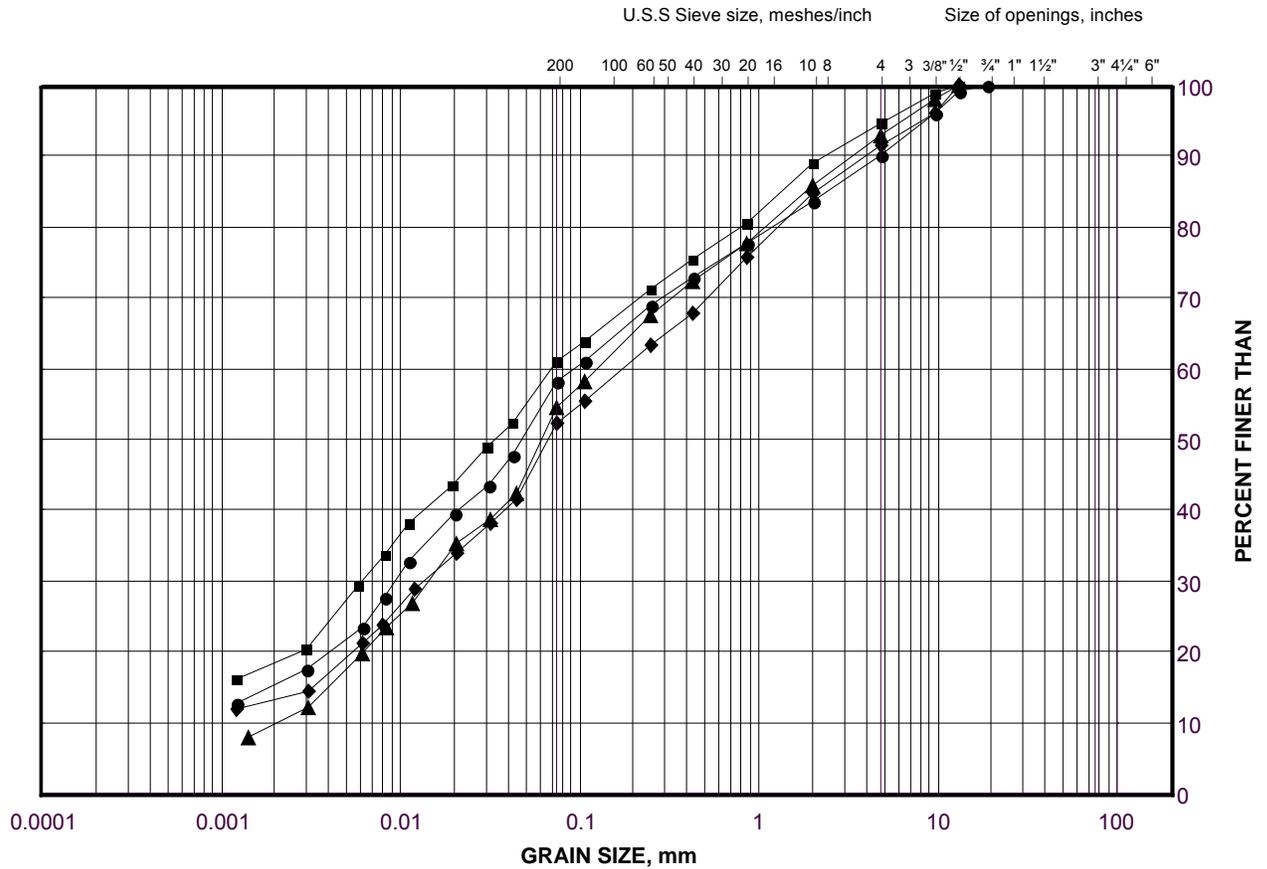
LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	12-12	4	188.1
■	12-11	4	181.7
◆	12-12	9	182.8

GRAIN SIZE DISTRIBUTION

Clayey Silt Till

FIGURE B7



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

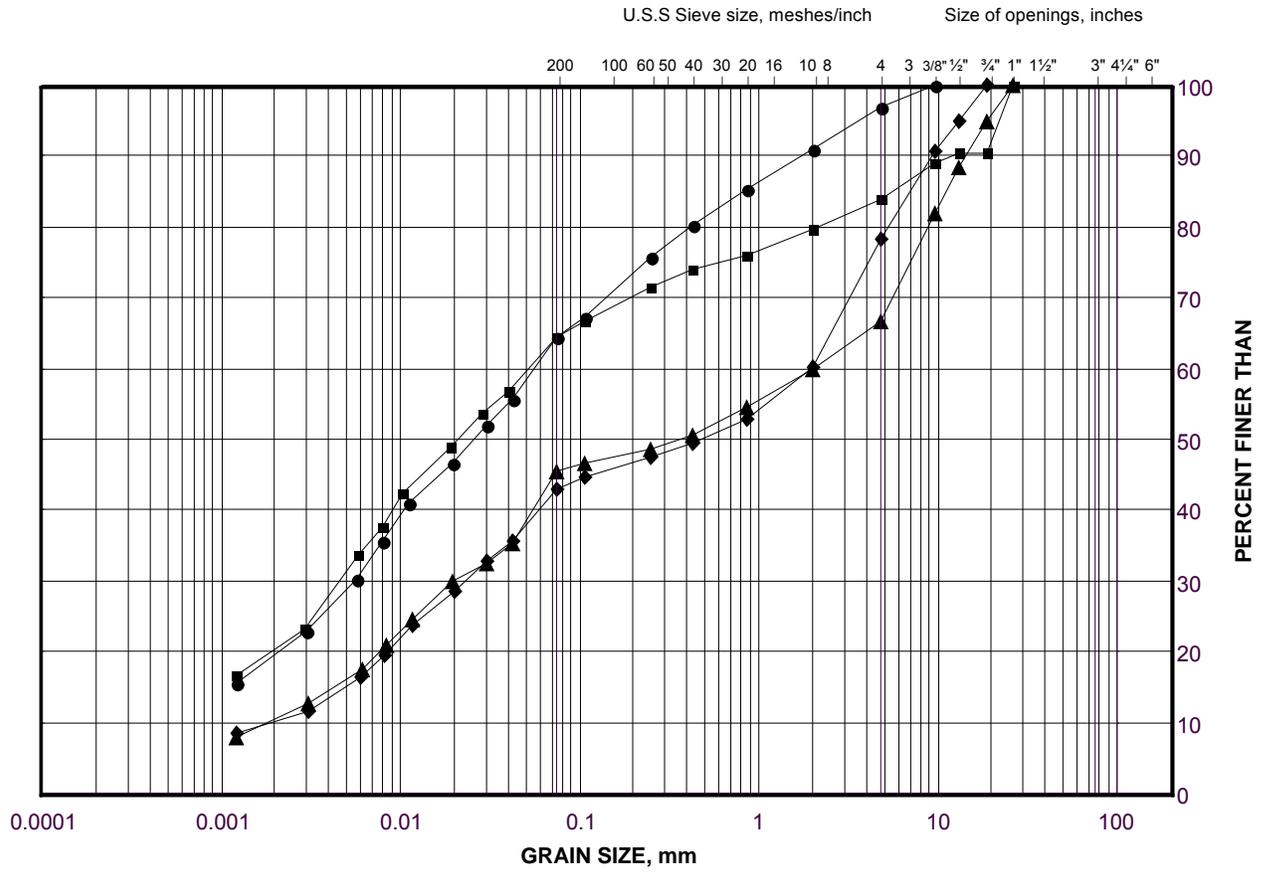
LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	12-15	4	193.7
■	12-14	4	192.5
◆	12-15	6	192.0
▲	12-14	8	188.7

GRAIN SIZE DISTRIBUTION

Clayey Silt Till

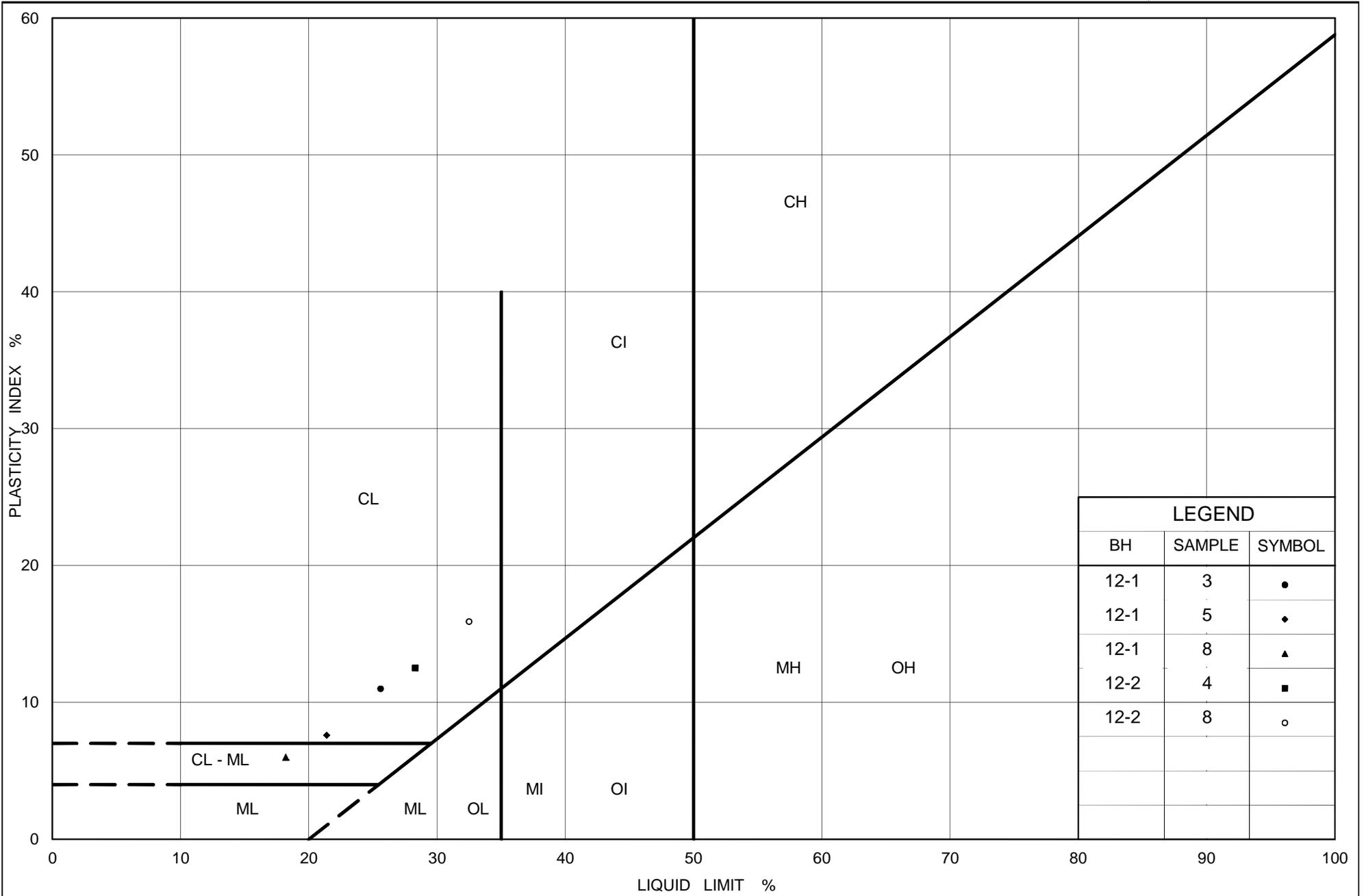
FIGURE B8



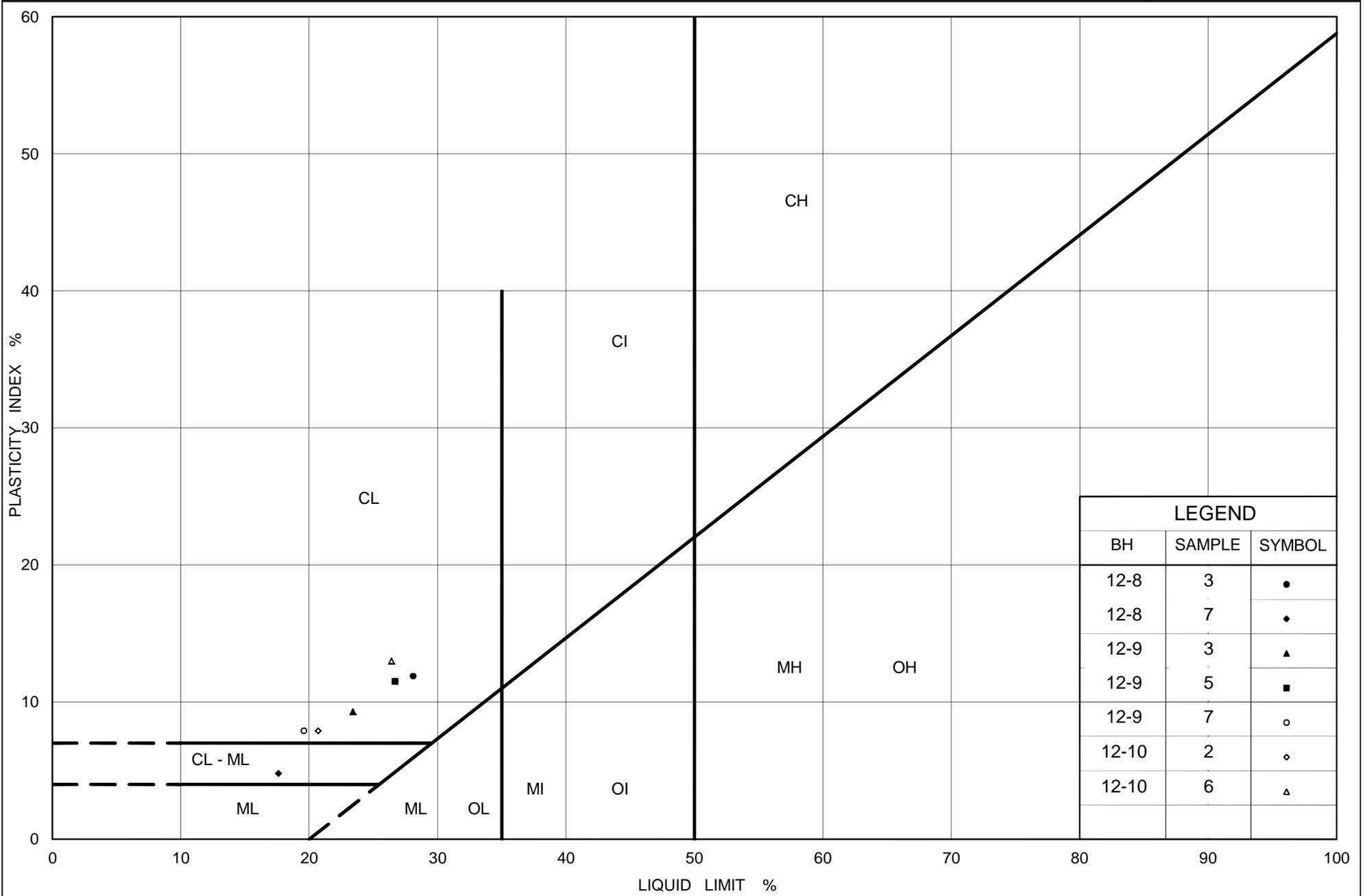
SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	12-16	5	199.0
■	12-17	8	205.4
◆	12-16	9	194.4
▲	12-18	9B	209.1



LEGEND		
BH	SAMPLE	SYMBOL
12-1	3	•
12-1	5	◊
12-1	8	▲
12-2	4	■
12-2	8	○



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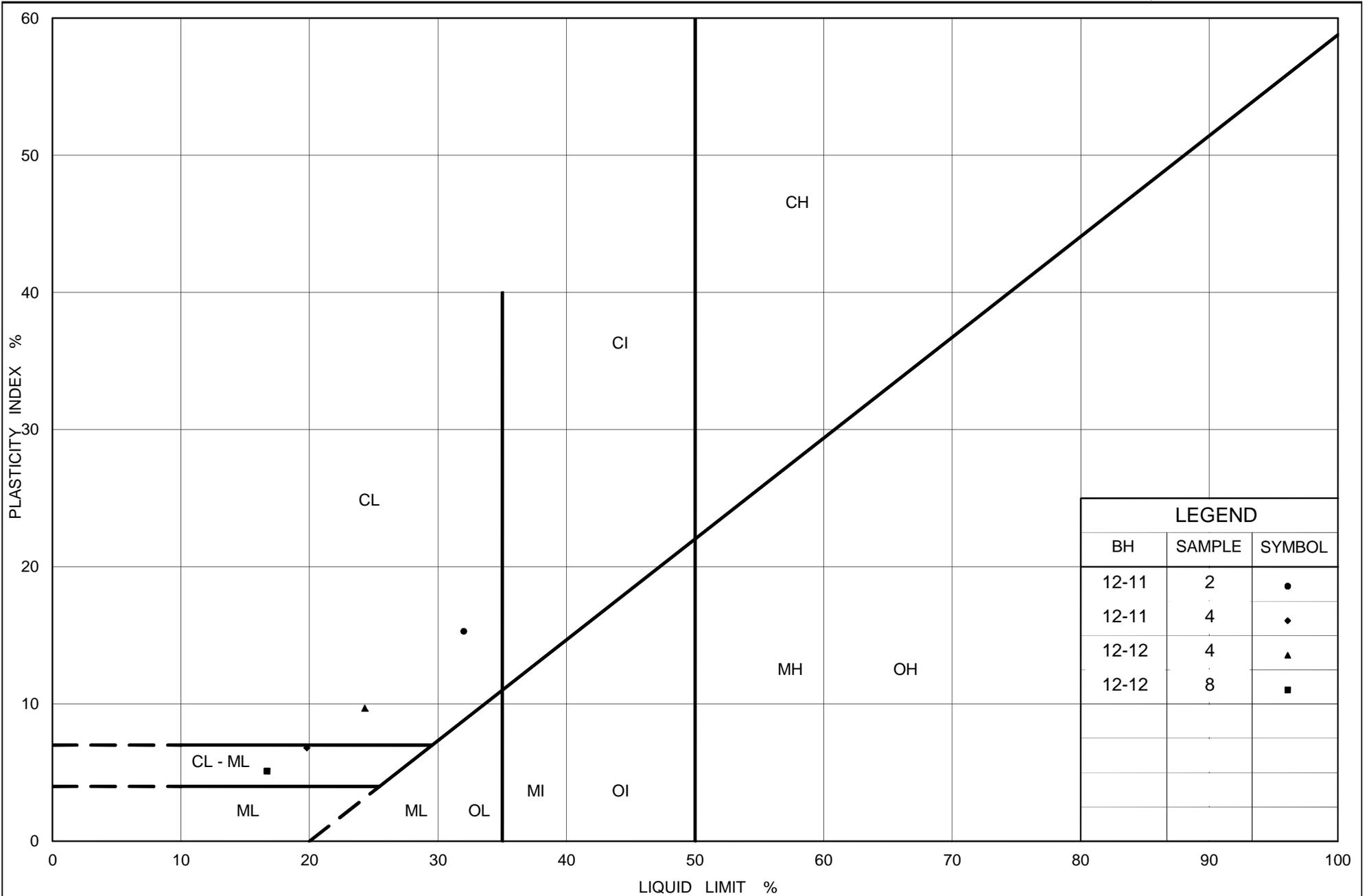
PLASTICITY CHART

Clayey Silt Till

Figure No. B10

Project No. 11-1111-0083

Checked By: GL/GDS



Ministry of Transportation

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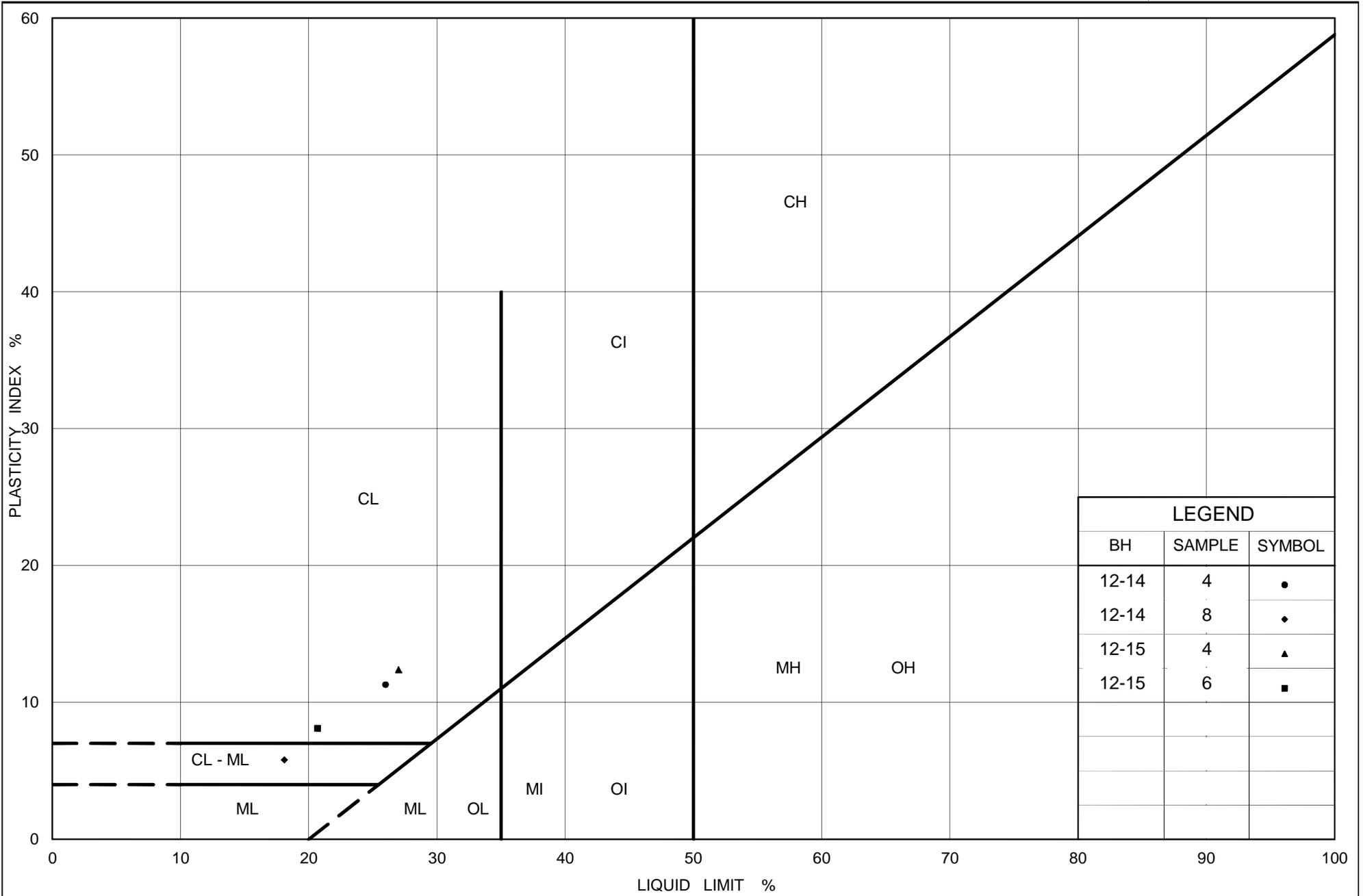
PLASTICITY CHART

Clayey Silt Till

Figure No. B11

Project No. 11-1111-0083

Checked By: GL/GDS



LEGEND		
BH	SAMPLE	SYMBOL
12-14	4	•
12-14	8	◊
12-15	4	▲
12-15	6	■

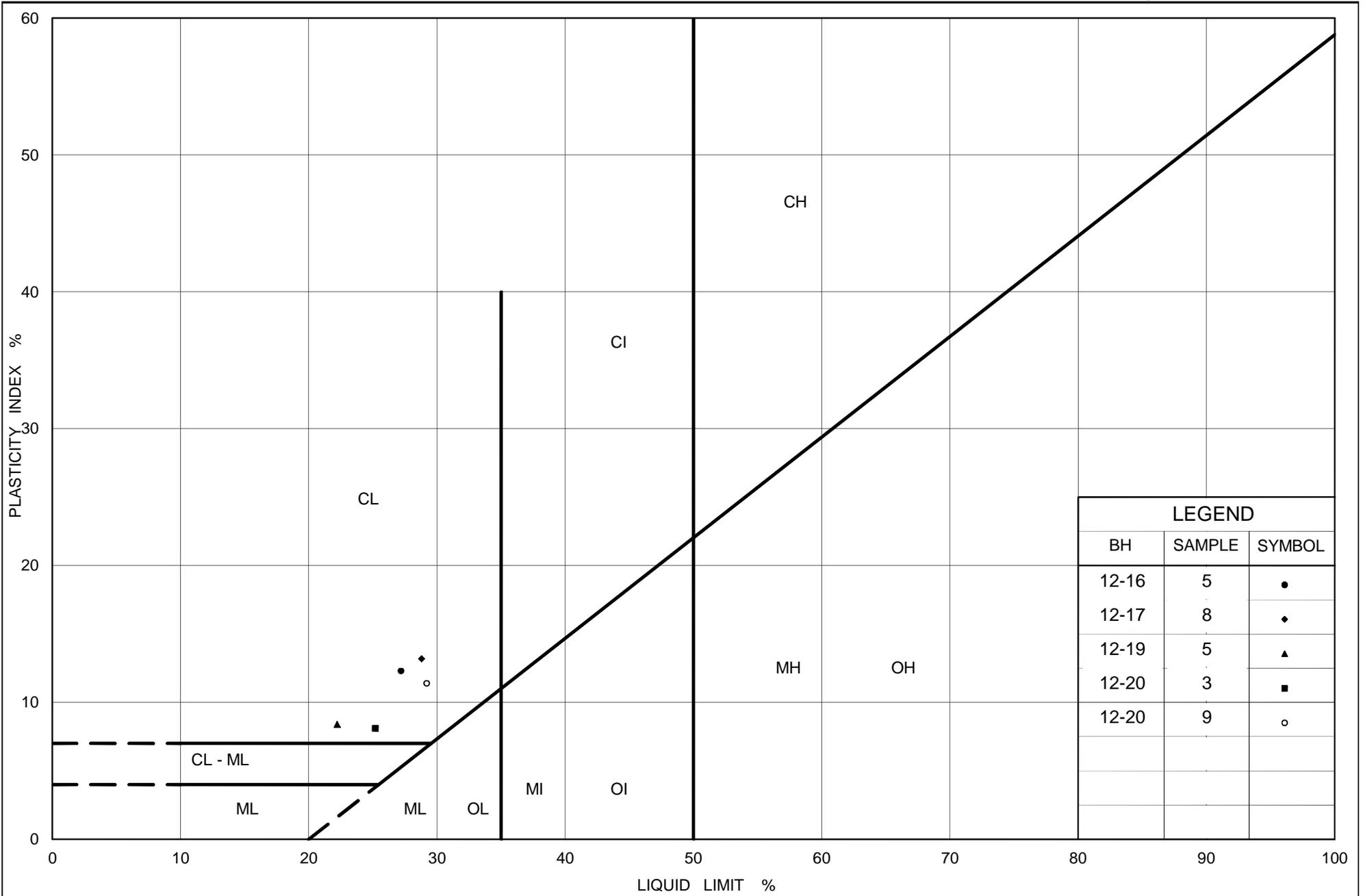


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PLASTICITY CHART Clayey Silt Till

Figure No. B12
 Project No. 11-1111-0083
 Checked By: GL/GDS



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PLASTICITY CHART

Clayey Silt Till

Figure No. B13

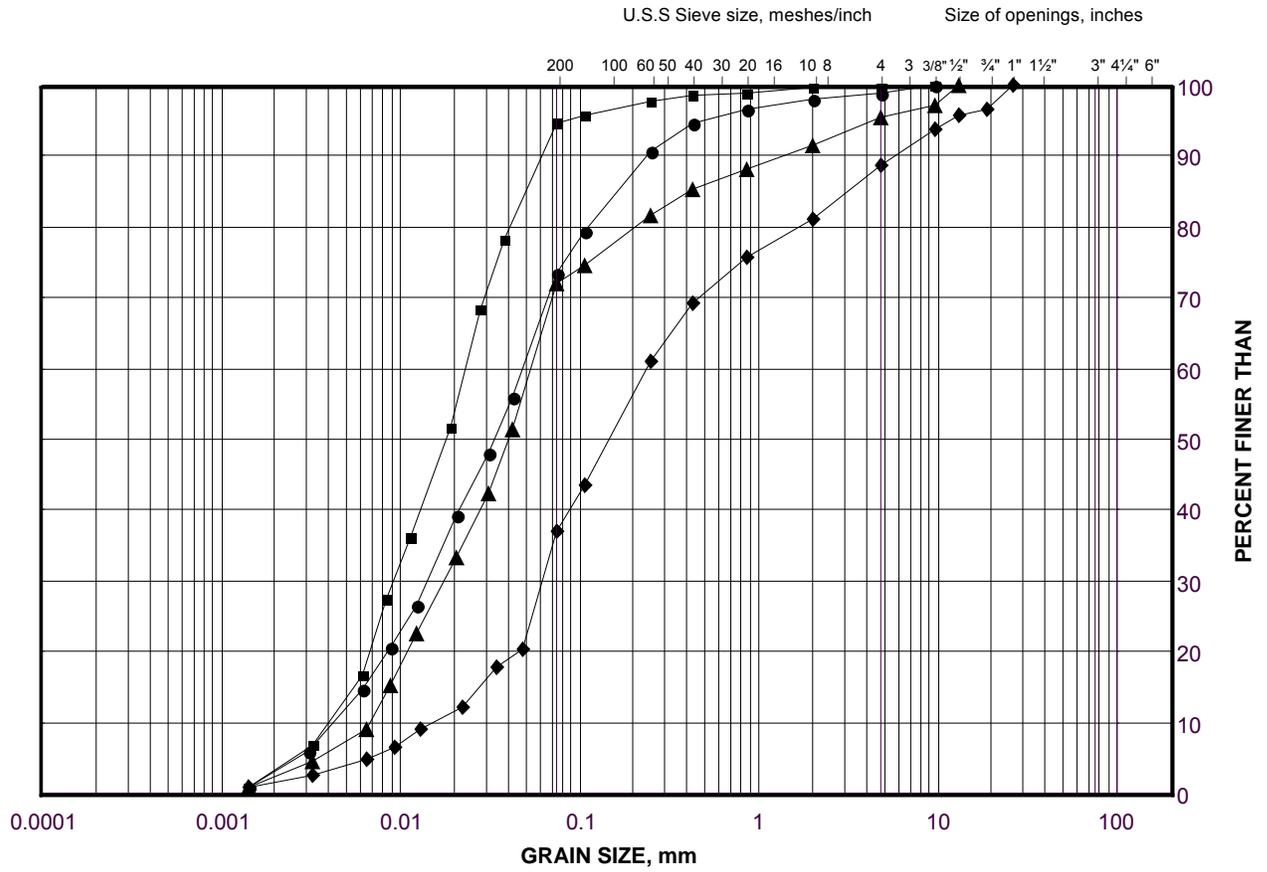
Project No. 11-1111-0083

Checked By: GL/GDS

GRAIN SIZE DISTRIBUTION

Silt to Sand and Silt

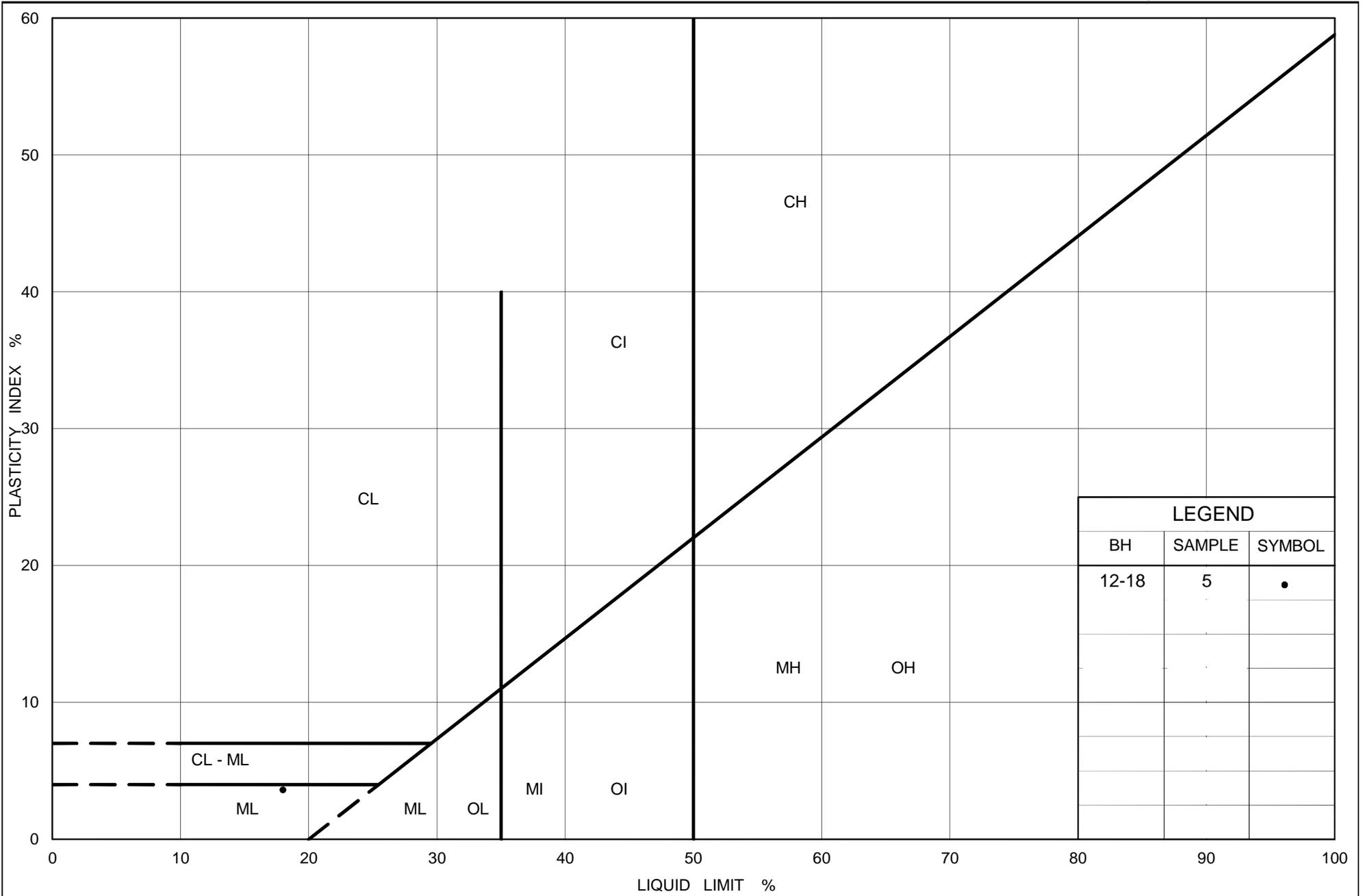
FIGURE B14



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	12-18	6	213.2
■	12-11	6	180.2
◆	12-20	7	213.5
▲	12-11	9	176.4



LEGEND		
BH	SAMPLE	SYMBOL
12-18	5	•



Ontario

PLASTICITY CHART

Silt to Sand and Silt

Figure No. B15

Project No. 11-1111-0083

Checked By: GL/GDS

UNCONFINED COMPRESSION TEST (UC)

ASTM D 7012-07

FIGURE B16

(Sheet 1 of 2)

SAMPLE IDENTIFICATION

PROJECT NUMBER	11-1111-0083	SAMPLE NUMBER	3
BOREHOLE NUMBER	12-4	SAMPLE DEPTH, m	4.00-4.12

TEST CONDITIONS

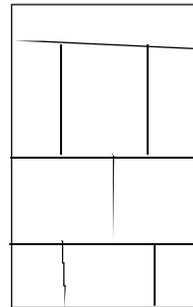
MACHINE SPEED, mm/min	-	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST, min	>2 <15	L/D	2.34

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	11.00	WATER CONTENT, (specimen) %	2.05
SAMPLE DIAMETER, cm	4.71	UNIT WEIGHT, kN/m ³	25.61
SAMPLE AREA, cm ²	17.42	DRY UNIT WT., kN/m ³	25.09
SAMPLE VOLUME, cm ³	191.69	SPECIFIC GRAVITY	-
WET WEIGHT, g	500.71	VOID RATIO	-
DRY WEIGHT, g	490.65		

VISUAL INSPECTION

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	-	COMPRESSIVE STRESS, MPa	33.2
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REMARKS:

DATE:

12/6/2012

Checked By: GL/GDS

Golder Associates

UNCONFINED COMPRESSION TEST

ASTM D7012-07

FIGURE B16

(Sheet 2 of 2)



BEFORE COMPRESSION



AFTER COMPRESSION

Date 12/10/2012
Project 11-1111-0083

Golder Associates

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Chkd. GL/GDS

UNCONFINED COMPRESSION TEST (UC)

ASTM D 7012-07

FIGURE B17

(Sheet 1 of 2)

SAMPLE IDENTIFICATION

PROJECT NUMBER	11-1111-0083	SAMPLE NUMBER	2
BOREHOLE NUMBER	12-5	SAMPLE DEPTH, m	2.52-2.62

TEST CONDITIONS

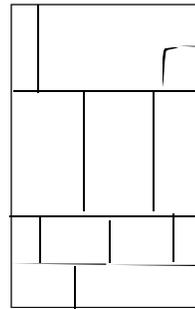
MACHINE SPEED, mm/min	-	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST, min	>2 <15	L/D	1.98

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	9.33	WATER CONTENT, (specimen) %	2.23
SAMPLE DIAMETER, cm	4.71	UNIT WEIGHT, kN/m ³	25.14
SAMPLE AREA, cm ²	17.44	DRY UNIT WT., kN/m ³	24.59
SAMPLE VOLUME, cm ³	162.70	SPECIFIC GRAVITY	-
WET WEIGHT, g	417.25	VOID RATIO	-
DRY WEIGHT, g	408.15		

VISUAL INSPECTION

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	-	COMPRESSIVE STRESS, MPa	20.4
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REMARKS:

DATE:

12/6/2012

Checked By: GL/GDS

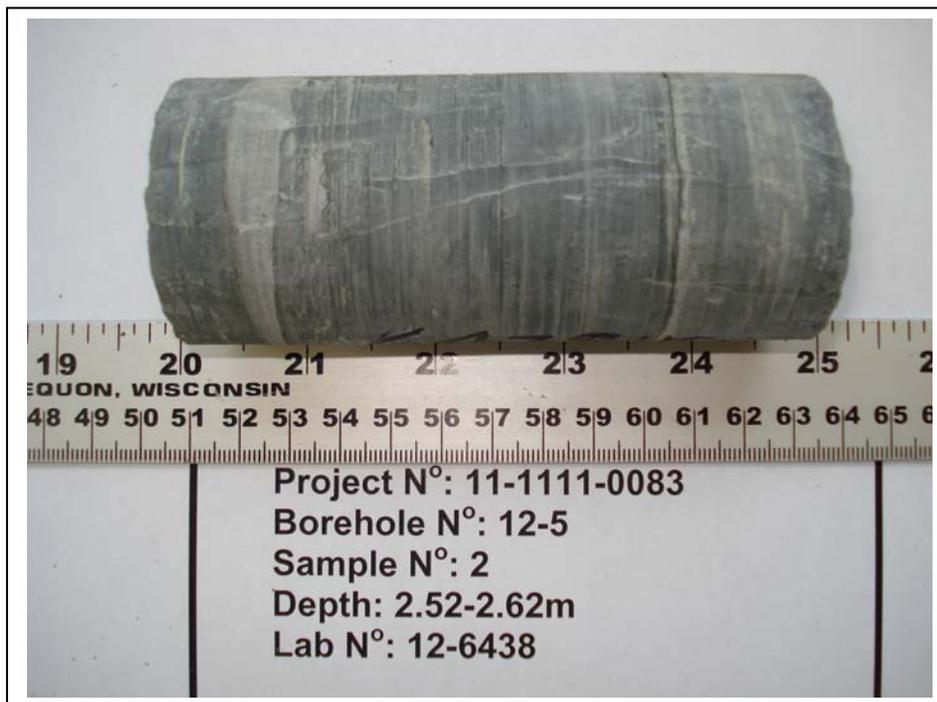
Golder Associates

UNCONFINED COMPRESSION TEST

ASTM D7012-07

FIGURE B17

(Sheet 2 of 2)



BEFORE COMPRESSION



AFTER COMPRESSION

Date 12/10/2012
Project 11-1111-0083

Golder Associates

Drawn Frank
Chkd. GL/GDS

UNCONFINED COMPRESSION TEST (UC)

ASTM D 7012-07

FIGURE B18

(Sheet 1 of 2)

SAMPLE IDENTIFICATION

PROJECT NUMBER	11-1111-0083	SAMPLE NUMBER	3
BOREHOLE NUMBER	12-15	SAMPLE DEPTH, m	8.85-8.98

TEST CONDITIONS

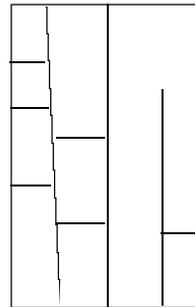
MACHINE SPEED, mm/min	-	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST, min	>2 <15	L/D	2.21

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	10.45	WATER CONTENT, (specimen) %	2.10
SAMPLE DIAMETER, cm	4.73	UNIT WEIGHT, kN/m ³	25.42
SAMPLE AREA, cm ²	17.60	DRY UNIT WT., kN/m ³	24.90
SAMPLE VOLUME, cm ³	183.93	SPECIFIC GRAVITY	-
WET WEIGHT, g	477.01	VOID RATIO	-
DRY WEIGHT, g	467.20		

VISUAL INSPECTION

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	-	COMPRESSIVE STRESS, MPa	21.5
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REMARKS:

DATE:

12/6/2012

Checked By: GL/GDS

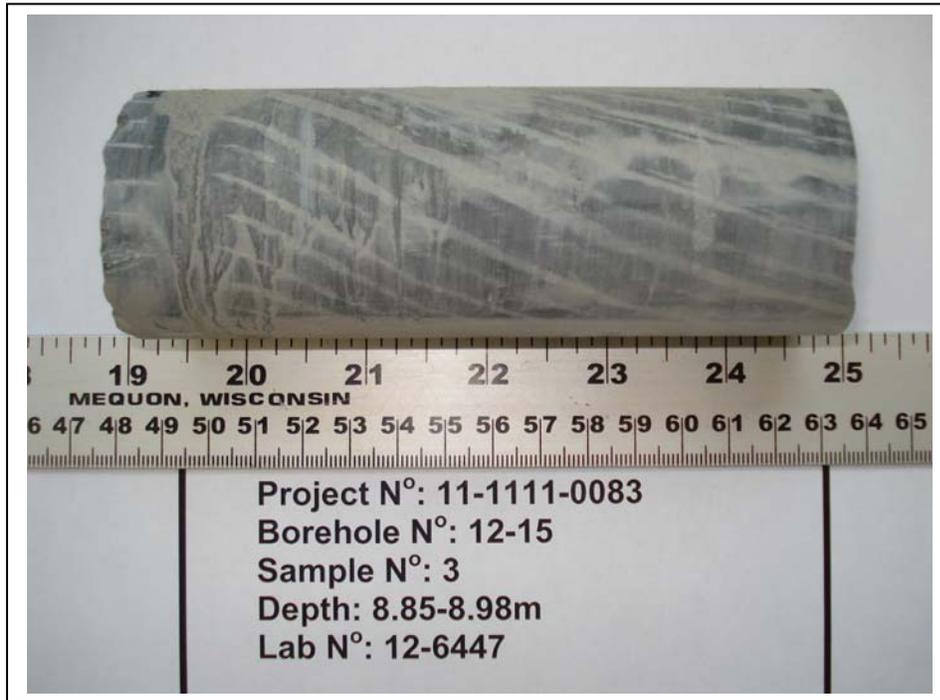
Golder Associates

UNCONFINED COMPRESSION TEST

ASTM D7012-07

FIGURE B18

(Sheet 2 of 2)



BEFORE COMPRESSION



AFTER COMPRESSION

Date 12/10/2012
Project 11-1111-0083

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FORM PRODUCED JUNE 1986

Form GA-D-4 (imperial)

UNCONFINED COMPRESSION TEST (UC)

ASTM D 7012-07

FIGURE B19

(Sheet 1 of 2)

SAMPLE IDENTIFICATION

PROJECT NUMBER	11-1111-0083	SAMPLE NUMBER	3
BOREHOLE NUMBER	12-19	SAMPLE DEPTH, m	8.79-8.98

TEST CONDITIONS

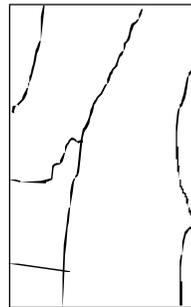
MACHINE SPEED, mm/min	-	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST, min	>2 <15	L/D	2.31

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	10.99	WATER CONTENT, (specimen) %	0.30
SAMPLE DIAMETER, cm	4.75	UNIT WEIGHT, kN/m ³	25.93
SAMPLE AREA, cm ²	17.74	DRY UNIT WT., kN/m ³	25.86
SAMPLE VOLUME, cm ³	194.91	SPECIFIC GRAVITY	-
WET WEIGHT, g	515.63	VOID RATIO	-
DRY WEIGHT, g	514.09		

VISUAL INSPECTION

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	-	COMPRESSIVE STRESS, MPa	145.5
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REMARKS:

DATE:

12/6/2012

Checked By: GL/GDS

Golder Associates

UNCONFINED COMPRESSION TEST

ASTM D7012-07

FIGURE B19

(Sheet 2 of 2)



BEFORE COMPRESSION



AFTER COMPRESSION

Date 12/10/2012
Project 11-1111-0083

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APPENDIX C

Borehole Records from Previous Investigation



APPENDIX C1

Borehole Records from Associated Highway 410 Widening Bridge Sites

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No MB-1	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4832250.3 ; E 292926.1</u>	ORIGINATED BY <u>MS</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers</u>	COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>	DATE <u>November 16, 2011</u>	CHECKED BY <u>LCC</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20	40	60	80	100	10	20
165.7	GROUND SURFACE																							
0.0	TOPSOIL		1	SS	19																			
	Clayey silt with sand, trace to some gravel, containing pockets of silty sand (FILL) Stiff to hard Brown to grey Moist		2	SS	13																			
			3	SS	33																			
			4	SS	19																			
162.7																								
3.0	SILTY CLAY, some gravel, trace to some sand (TILL)		5	SS	61/28																			
162.3	Hard																							
3.4	Brown to grey Moist																							
161.5	SHALE (BEDROCK)		6	SS	98/23																			
4.2	Weathered Grey																							
	END OF BOREHOLE																							
	NOTE: 1. Borehole dry on completion of drilling.																							

GTA-MTO 001 111110083.GPJ GAL-MISS.GDT 8/3/12

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No MB-2	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4832266.9 ; E 292911.9</u>	ORIGINATED BY <u>MS</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers</u>	COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>	DATE <u>January 4 and 5, 2012</u>	CHECKED BY <u>LCC</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)
								20	40	60	80	100						
159.1	GROUND SURFACE																	
0.0	ASPHALT																	
0.2	Sand, trace to some silt, trace gravel (FILL) Compact Brown Moist						158											
157.0							157											
156.7	Gravel, some sand (FILL) Compact Brown Wet		1	SS	65/0.28													
156.2	Weathered SHALE SHALE (BEDROCK)		1	RC	REC 100%		156										RQD = 49%	
			2	RC	REC 100%		155											RQD = 24%
	Bedrock cored from 2.9 m to 7.3 m Refer to Record of Drillhole MB-2 for bedrock coring details		3	RC	REC 100%		154											RQD = 56%
			4	RC	REC 100%		153											RQD = 71%
151.8	END OF BOREHOLE						152											
7.3	NOTES: 1. The top of 2.4 m of soil was removed prior to drilling the borehole using a vacuum truck, because the borehole was located in close proximity to existing underground services. The soil description in the upper 2.4 m is based on visual classification during field operations. 2. Water level in open borehole at a depth of 2.1 m (Elev. 157.0 m) upon completion of overburden drilling.																	

GTA-MTO 001 111110083.GPJ GAL-MISS.GDT 8/3/12

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No MB-3	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4832274.4 ; E 292898.2</u>	ORIGINATED BY <u>MS</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers</u>	COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>	DATE <u>January 4, 2012</u>	CHECKED BY <u>LCC</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
159.1	GROUND SURFACE															
0.0	ASPHALT															
0.2	Silty sand, some gravel, trace clay (FILL) Dense to compact Brown Moist		1	SS	38						○					17 62 20 1
			2	SS	17											
157.7	Gravelly sand, some silt, trace clay (FILL) Loose Grey Wet		3	SS	8						○					28 55 13 4
156.9	Weathered SHALE SHALE (BEDROCK)		4	SS	50/0.13											
2.5			1	RC	REC 91%											RQD = 44%
			2	RC	REC 100%											RQD = 48%
	Bedrock cored from 2.5 m to 7.0 m Refer to Record of Drillhole MB-3 for bedrock coring details		3	RC	REC 100%											RQD = 43%
			4	RC	REC 100%											RQD = 48%
152.1	END OF BOREHOLE															
7.0	NOTES: 1. Water level in open borehole at a depth of 1.5 m (Elev. 157.6 m) upon completion of overburden drilling.															

GTA-MTO 001 111110083.GPJ GAL-MISS.GDT 8/3/12

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT: 11-1111-0083

RECORD OF DRILLHOLE: MB-3

SHEET 1 OF 1

LOCATION: N 4832274.4 ;E 292898.2

DRILLING DATE: January 4, 2012

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 Trackmount

DRILLING CONTRACTOR: Geo-Environmental Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY			Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES							
								TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Ur	Ja	Ln	K, cm/sec				10 ⁰	10 ¹	10 ²				
								8000000	8000000			8000000	8000000	8000000	8000000	8000000	8000000	8000000				8000000	8000000	8000000	8000000	8000000	8000000	8000000
		GROUND SURFACE		156.64																								
3	HQ RC HW Casing	SHALE BEDROCK (GEORGIAN BAY FORMATION), containing fossiliferous LIMESTONE interbeds, and highly weathered clay zones at depths of 3.4 m (Elev. 155.7 m), 5.8 m (Elev. 153.3 m) and 6.7 m (Elev. 152.4 m) Slightly weathered to fresh Grey Laminated Medium strong		2.45	1																							
4				2																								
5				3																								
6				4																								(Axial)
7		END OF DRILLHOLE		152.06 7.03																					(Axial)			
8																												
9																												
10																												
11																												
12																												

GTA-RCK 018 111110083.GPJ GAL-MISS.GDT 8/3/12

DEPTH SCALE

1 : 50



LOGGED: MS

CHECKED: NK

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No MB-4	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4832277.8 ; E 292903.0</u>	ORIGINATED BY <u>MS</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers</u>	COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>	DATE <u>January 5, 2012</u>	CHECKED BY <u>LCC</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)	
						20	40	60	80	100				10	20	30		GR SA SI CL
159.2	GROUND SURFACE																	
0.0	ASPHALT																	
0.2	Silty sand, trace gravel (FILL)		1	SS	36						○							
158.6	Dense Brown Moist																	
0.6	SHALE (BEDROCK) Weathered Grey		2	SS	90/0.25						○							
157.7	SHALE (BEDROCK)																	
1.5	SHALE (BEDROCK)		1	RC	REC 100%													RQD = 0%
			2	RC	REC 100%													RQD = 23%
			3	RC	REC 100%													RQD = 41%
	Bedrock Cored from 1.5 m to 7.6 m Refer to Record of Drillhole MB-4 for bedrock coring details		4	RC	REC 88%													RQD = 27%
			5	RC	REC 100%													RQD = 90%
151.6	END OF BOREHOLE																	
7.6	NOTES: 1. Water level in open borehole at a depth of 1.5 m (Elev. 157.7 m) upon completion of overburden drilling.																	

GTA-MTO 001 111110083.GPJ GAL-MISS.GDT 8/3/12

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT: 11-1111-0083

RECORD OF DRILLHOLE: MB-4

SHEET 1 OF 1

LOCATION: N 4832277.8 ;E 292903.0

DRILLING DATE: January 5, 2012

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 Trackmount

DRILLING CONTRACTOR: Geo-Environmental Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR FLUSH	RECOVERY			R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY			Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES				
							TOTAL CORE %	SOLID CORE %				B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Ur	Ja	Ln				K, cm/sec	10 [°]	10 [°]	10 [°]
							88888888	88888888	88888888			88888888	88888888	88888888	88888888	88888888	88888888				88888888	88888888	88888888	88888888
		GROUND SURFACE		157.66																				
2	HQ RC HW Casing	SHALE BEDROCK (GEORGIAN BAY FORMATION), containing fossiliferous LIMESTONE interbeds Slightly weathered to fresh Grey Laminated Medium strong		1.52	1															(Axial)				
3				2																	(Axial)			
4				3																		(Axial)		
5				4																		(Axial)		
6				5																		(Axial)		
7		END OF BOREHOLE		151.56																UC-15.6 MPa				
8				7.62																				
9																								
10																								
11																								

GTA-RCK 018 111110083.GPJ GAL-MISS.GDT 8/3/12

DEPTH SCALE

1 : 50



LOGGED: MS

CHECKED: NK

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No MB-5	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4832294.2 ; E 292887.4</u>	ORIGINATED BY <u>MS</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers</u>	COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>	DATE <u>November 13, 2011</u>	CHECKED BY <u>LCC</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			20	40	60	80	100			W _p	W	W _L	GR
166.5 0.0	GROUND SURFACE ASPHALT																
0.5	Silty sand and gravel (FILL) Compact Brown Moist																
165.1 1.5	Clayey silt, trace to some sand, trace gravel (FILL) Very stiff Grey Moist	1	SS	22													
165.1 1.5	SILT CLAY with gravel, trace to some sand (TILL) Very stiff to hard Grey Moist to wet	2	SS	15													
163.5 3.1	SHALE (BEDROCK) Weathered Grey	3	SS	60										48	11	27	14
163.5 3.1		4	SS	50/00													
163.5 3.1		5	SS	50/00													
161.9 4.6	END OF BOREHOLE	5	SS	50/00													
NOTE: 1. Water level in piezometer at a depth of 1.6 m (Elev. 164.9 m) on November 13, 2011.																	

GTA-MTO 001 111110083.GPJ GAL-MISS.GDT 8/3/12

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No P1-1	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4833897.9 ; E 291310.4</u>	ORIGINATED BY <u>TWB</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME-55 Track-mount, 152 mm Solid Stem Augers</u>	COMPILED BY <u>MAS</u>	
DATUM <u>Geodetic</u>	DATE <u>August 27, 2012</u>	CHECKED BY <u>LCC</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)			
						20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	W _p	W	W _L	10 20 30	GR SA SI CL
179.5	GROUND SURFACE															
0.0	TOPSOIL															
	CLAYEY SILT, with sand, trace to some gravel, containing rootlets to 0.6 m, containing cobbles and boulders below 3.0 m (TILL) Very stiff to hard Brown becoming grey below a depth of 3.0 m Moist	[Hatched Pattern]	1	SS	22								○			
			2	SS	30											
			3	SS	26								○	—		11 24 42 23
			4	SS	33											
			5	SS	44								○			
			6	SS	106											
			7	SS	31								○	—		18 22 41 19
173.4	SHALE (BEDROCK) Weathered Grey	[Diagonal Pattern]	8	SS	60/0/10	▽										
172.5	END OF BOREHOLE AUGER REFUSAL															
7.0	NOTE: 1. Water level in open borehole at a depth of 6.1 m (Elev. 173.4 m) on completion of drilling.															

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 06/25/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No P1-2	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4833931.4 ; E 291281.0</u>	ORIGINATED BY <u>TWB</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME-55 Track-mount, 152 mm Solid Stem Augers</u>	COMPILED BY <u>MAS</u>	
DATUM <u>Geodetic</u>	DATE <u>August 27, 2012</u>	CHECKED BY <u>LCC</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
			NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
179.8	GROUND SURFACE																
0.9	TOPSOIL																
	CLAYEY SILT with sand, trace gravel, containing rootlets to 0.6 m, containing cobbles and boulders below 3.2 m (TILL) Very stiff to hard Brown, becoming grey below a depth of 3.7 m Moist		1	SS	16												4 21 47 28
			2	SS	32												
			3	SS	23												
			4	SS	27												
			5	SS	60												
			6	SS	39												4 37 43 16
	Augers grinding heavily between 4.7 m and 6.1 m		7	SS	114/0.20												
173.7	SHALE (BEDROCK) Weathered Grey		8	SS	60/0.10												
172.6	END OF BOREHOLE AUGER REFUSAL																
	NOTES: 1. Water level in open borehole at a depth of 6.8 m (Elev. 173.0 m) on completion of drilling. 2. Water level measured in piezometer as follows: Date Depth Elev. Aug. 27/12 6.8 m 173.0 m Sep. 24/12 1.5 m 178.3 m																

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 06/25/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No C4-1	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4834903.6 ; E 290226.0</u>	ORIGINATED BY <u>TWB</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME-55 Track-mount, 152 mm Solid Stem Augers</u>	COMPILED BY <u>MS/NK</u>	
DATUM <u>Geodetic</u>	DATE <u>August 22, 2012</u>	CHECKED BY <u>LCC</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	10 20 30	10 20 30	10 20 30		
185.1	GROUND SURFACE															
0.0	Sand and gravel, some silt, trace clay (FILL) Loose Brown Moist						185									
184.2	Clayey silt, with to some sand, trace gravel, containing rootlets (FILL) Firm to stiff Brown and grey with oxidation stains Moist		1	SS	7		184									
0.9			2	SS	5		183					○				
			3	SS	8		182					○	-----		1 28 37 34	
			4	SS	12		181					○	-----			
			5	SS	6		180					○				
180.4	CLAYEY SILT, trace to some sand, trace gravel, containing cobbles and boulders (TILL) Very stiff to hard Brown with oxidation stains, becoming grey below 5.6 m Moist		6	SS	18		179									
4.7			7	SS	26		178									
			8	SS	64		177					-----			1 8 79 12	
			9	SS	36		176									
174.9	CLAYEY SILT, trace to some sand, trace gravel Hard Grey Moist		10	SS	60/0.08		175					-----		1 12 70 17		
10.2							174.2									
174.2	END OF BOREHOLE															
10.9	NOTES: 1. Borehole dry on completion of drilling.															

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 06/25/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No C4-2	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4834902.1 ; E 290206.4</u>	ORIGINATED BY <u>CS</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>D-50 Track-mount, 108 mm Solid Stem Augers</u>	COMPILED BY <u>MAS/NK</u>	
DATUM <u>Geodetic</u>	DATE <u>August 28, 2012</u>	CHECKED BY <u>LCC</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)						
						20	40	60	80	100	20	40	60	80	100	10	20	30	GR	SA	SI	CL	
182.1	GROUND SURFACE																						
0.0	CLAYEY SILT with sand to some sand, containing rootlets above 1.5 m depth Firm to stiff Brown Moist		1	SS	8																		
			2	SS	12																		
			3	SS	7																		
179.9	CLAYEY SILT, trace sand Hard Brown, becoming grey at 3.1 m Moist		4	SS	30																		
			5	SS	39																		
178.4	CLAYEY SILT to SILT, some sand, trace gravel (TILL) Hard/ very dense Grey Moist to wet		6	SS	84																		
			7	SS	78																		
175.8	END OF BOREHOLE		8	SS	88/0.15																		
6.3	NOTE: 1. Borehole dry on completion of drilling.																						

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 06/25/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No C5-1 SHEET 1 OF 1 **METRIC**

PROJECT 11-1111-0083 G.W.P. 2144-07-00 LOCATION N 4835353.1 ; E 289779.4 ORIGINATED BY TWB

DIST Central HWY 410 BOREHOLE TYPE CME-55 Track-mount, 152 mm Solid Stem Augers COMPILED BY MS/NK

DATUM Geodetic DATE August 22, 2012 CHECKED BY LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)							
						20	40	60	80	100	20	40	60	80	100	10	20	30	GR	SA	SI	CL		
185.0	GROUND SURFACE																							
0.0	Sand and gravel, some silt, trace clay (FILL) Loose Brown Moist																							
184.2	Clayey silt to silty clay, trace to some sand, trace gravel, containing rootlets (FILL) Firm Brown and grey with oxidation staining Moist		1	SS	7																			
0.8			2	SS	8																			
			3	SS	8																			
			4	SS	8																			
			5	SS	7																			
180.7	SAND and SILT, some gravel, trace clay (TILL) Dense Brown with oxidation staining, becoming grey below 5.6 m Moist		6	SS	30																			
4.3			7	SS	41																			
178.6	Silty SAND, trace clay Dense Grey Wet SAND and SILT, some gravel, trace clay (TILL) Dense to very dense Moist		8	SS	95																			
6.6			9	SS	66																			
176.3	CLAYEY SILT with sand, trace gravel (TILL) Hard Grey Moist		10	SS	134/0.23																			
8.7																								
174.0	END OF BOREHOLE																							
11.0	NOTES: 1. Water level in open borehole at a depth of 5.6 m (Elev. 179.4 m) on completion of drilling.																							

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 06/25/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No C5-2	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4835357.7 ; E 289753.8</u>	ORIGINATED BY <u>TWB</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME-55 Track-mount, 152 mm Solid Stem Augers</u>	COMPILED BY <u>MS/NK</u>	
DATUM <u>Geodetic</u>	DATE <u>August 22, 2012</u>	CHECKED BY <u>LCC</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
							20 40 60 80 100	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED									
182.6	GROUND SURFACE																
0.0	TOPSOIL																
0.2	Clayey silt, some sand, trace gravel, containing rootlets to 0.7 m (FILL) Firm to very stiff Brown Moist		1	SS	17		182										
181.2			2	SS	7												
1.4	CLAYEY SILT, some sand, trace gravel Firm Brown and grey, containing oxidation stains Moist		3	SS	4		181										
180.2																	
2.6	Silty SAND, trace clay Very dense Brown Wet		4	SS	71		180										
178.6	CLAYEY SILT with sand to SAND and SILT, some clay, trace to some gravel (TILL) Hard/Very dense Grey, containing oxidation stains to 3.0 m Moist		5	SS	72		179										7 36 43 14
178.3			6	SS	57												
4.3	Silty SAND, trace clay, trace gravel Very dense Grey Wet		7	SS	90		178										17 35 40 8
177	SAND and SILT, trace to some clay, trace to some gravel, containing cobbles and boulders (TILL) Dense to very dense Grey Moist		8	SS	43		177										
176																	
175			9	SS	54		175										15 38 33 14
174																	
173.9	CLAYEY SILT, trace to some sand Hard Grey Moist						174										
173.1			10	SS	50/0.08												
9.5	END OF BOREHOLE																
	NOTES: 1. Water level in open borehole at a depth of 3.9 m (Elev. 178.7 m) on completion of drilling.																

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 06/25/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No P2-1	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4835088.4 ; E 290143.5</u>	ORIGINATED BY <u>TWB</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>D-50 Track-mount, 108 mm Inner Diameter Hollow Stem Augers</u>	COMPILED BY <u>MAS</u>	
DATUM <u>Geodetic</u>	DATE <u>August 8, 2012</u>	CHECKED BY <u>LCC</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa												
								20	40	60	80	100								
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					WATER CONTENT (%)				GR SA SI CL			
184.0	GROUND SURFACE																			
0.0	TOPSOIL																			
0.2	CLAYEY SILT, some sand, containing rootlets to a depth of 0.5 m Stiff Brown Moist SAND and SILT to Silty SAND, trace to some clay, trace to some gravel, containing rootlets to 0.5 m, containing cobbles and boulders below 2.3 m (TILL) Dense to very dense Brown Moist Becoming grey and wet below a depth of approximately 4.3 m		1	SS	8															
183.3		2	SS	30																
0.7		3	SS	38																
		4	SS	54													8	32	47	13
		5	SS	50																
		6	SS	108/0.25																
		7	SS	43													19	43	27	11
		8	SS	33																
		9	SS	89													2	57	33	8
174.4		10	SS	79																
9.8	SAND and GRAVEL, trace silt, trace clay, containing shale fragments Very dense Grey Wet END OF BOREHOLE NOTE: 1. Water level in open borehole at a depth of 4.3 m (Elev. 179.7 m) on completion of drilling.																			

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 06/25/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT 11-1111-0083	RECORD OF BOREHOLE No P2-3	SHEET 1 OF 1	METRIC
G.W.P. 2144-07-00	LOCATION N 4835149.4 ; E 290089.6	ORIGINATED BY TWB	
DIST Central HWY 410	BOREHOLE TYPE D-50 Track-mount, 108 mm Inner Diameter Hollow Stem Augers	COMPILED BY MAS	
DATUM Geodetic	DATE August 9, 2012	CHECKED BY LCC	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
							20 40 60 80 100	○ UNCONFINED	+ FIELD VANE								
							20 40 60 80 100	● QUICK TRIAXIAL	× REMOULDED								
184.0	GROUND SURFACE																
0.0	TOPSOIL																
0.2	CLAYEY SILT, some sand, containing rootlets to 0.5 m Stiff to very stiff Brown Moist		1	SS	10												
182.7			2	SS	19		183										
1.3	SAND and SILT, trace to some gravel, trace to some clay (TILL) Dense to very dense Brown Moist		3	SS	32		182										
			4	SS	54		181										10 31 47 12
180.6			5	SS	35		180										
180.3	SILT, trace clay, trace sand Dense Grey Wet		6	SS	28	∇	180										
3.7	SAND and SILT, trace to some gravel, trace to some clay, containing cobbles and boulders (TILL) Compact to very dense Grey Moist		7	SS	43		179										3 37 49 11
			8	SS	63		178										
			9	SS	60/0.08		177										4 39 49 8
							176										
							175										
174.2	END OF BOREHOLE		10	SS	93												
9.8	NOTE: 1. Water level in open borehole at a depth of 4.2 m (Elev. 179.8 m) on completion of drilling.																

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 06/25/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT 11-1111-0083 **RECORD OF BOREHOLE No P3-1** **SHEET 1 OF 1** **METRIC**
G.W.P. 2144-07-00 **LOCATION** N 4835894.7 ; E 289367.8 **ORIGINATED BY** TWB
DIST Central **HWY** 410 **BOREHOLE TYPE** CME-55 Track-mount, 152 mm Solid Stem Augers **COMPILED BY** MAS
DATUM Geodetic **DATE** August 20, 2012 **CHECKED BY** LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)							
						20	40	60	80	100	20	40	60	80	100	10	20	30		GR	SA	SI	CL	
186.3	GROUND SURFACE																							
0.0	TOPSOIL																							
0.2	Clayey silt, some sand, trace gravel, containing organic matter and rootlets (FILL) Stiff to hard Brown to grey Moist		1	SS	64																			
185.1			2	SS	12																			
1.4	Silty sand, some gravel, trace clay (FILL) Compact Grey Moist		3	SS	7																			7 27 40 26
184.1			4	SS	24																			
2.2	Clayey silt with sand, trace gravel, containing organic matter and rootlets (FILL) Firm Brown to grey Moist		5	SS	49																			
	CLAYEY SILT with sand, trace to some gravel, containing cobbles and boulders below 5.3 m (TILL) Very stiff to hard Brown becoming grey below a depth of 3.9 m Moist		6	SS	87																			7 26 41 26
			7	SS	78																			
			8	SS	74																			
			9	SS	60/0.10																			
177.8																								
8.5	SAND and SILT, trace gravel, trace to some clay (TILL) Very dense Grey Moist		10	SS	132/0.20																			4 40 45 11
176.8																								
9.5	END OF BOREHOLE																							
	NOTE: 1. Water level in open borehole at a depth of 8.6 m (Elev. 177.7 m) on completion of drilling.																							

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 06/25/13

 +³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No P3-2	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4835948.0 ; E 289320.8</u>	ORIGINATED BY <u>TWB</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME-55 Track-mount, 152 mm Solid Stem Augers</u>	COMPILED BY <u>MAS</u>	
DATUM <u>Geodetic</u>	DATE <u>August 21, 2012</u>	CHECKED BY <u>LCC</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL									
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa																		
								20	40	60	80	100														
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					WATER CONTENT (%)													
								20	40	60	80	100	10	20	30											
187.5	GROUND SURFACE																									
0.0	TOPSOIL																									
0.2	Clayey silt, some sand, trace gravel, containing organics and rootlets (FILL) Firm Brown and grey Moist		1	SS	8		187																			
			2	SS	6								○	—			3 19 46 32									
186.1							186																			
1.4	CLAYEY SILT with sand, trace to some gravel, containing cobbles and boulders below 5.2 m (TILL) Very stiff to hard Brown becoming grey below a depth of 4.5 m Moist		3	SS	25																					
			4	SS	48		185																			
			5	SS	66								○	—			4 29 44 23									
			6	SS	108		184																			
			7	SS	48		183						○													
							182																			
			8	SS	107		181						○													
180.5							180						○				20 45 29 6									
7.0	SAND and SILT, some gravel, trace clay (TILL) Very dense Grey Moist		9	SS	109/0.25																					
179.0							179																			
8.5	SHALE (BEDROCK) Weathered Grey																									
178.0			10	SS	126/0.25		178																			
9.5	END OF BOREHOLE																									
	NOTE: 1. Water level in piezometer at a depth of 1.8 m (Elev. 185.7 m) on August 21, 2012. 2. Water level measured in piezometer as follows: <table style="margin-left: 40px; border-collapse: collapse;"> <tr> <td>Date</td> <td>Depth</td> <td>Elev.</td> </tr> <tr> <td>Aug. 27/12</td> <td>1.1 m</td> <td>186.4 m</td> </tr> <tr> <td>Sep. 24/12</td> <td>1.0 m</td> <td>186.5 m</td> </tr> </table>																	Date	Depth	Elev.	Aug. 27/12	1.1 m	186.4 m	Sep. 24/12	1.0 m	186.5 m
Date	Depth	Elev.																								
Aug. 27/12	1.1 m	186.4 m																								
Sep. 24/12	1.0 m	186.5 m																								

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 06/25/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No P3-3	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4835999.4 ; E 289275.7</u>	ORIGINATED BY <u>TWB</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME-55 Track-mount, 152 mm Solid Stem Augers</u>	COMPILED BY <u>MAS</u>	
DATUM <u>Geodetic</u>	DATE <u>August 21, 2012</u>	CHECKED BY <u>LCC</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
187.5	GROUND SURFACE							20	40	60	80	100					
0.0	TOPSOIL																
0.3	Clayey silt, some sand, trace gravel (FILL) Stiff Brown Moist		1	SS	12		187										
186.0	Silty SAND, trace clay, containing organic matter and rootlets (FILL) Loose to compact Brown Moist		2	SS	8		186										
185.7	CLAYEY SILT, some sand, trace gravel, containing rootlets Firm Dark brown Moist		3	SS	6		185										
184.0	CLAYEY SILT with sand, trace to some gravel, containing cobbles and boulders below 3.8 m (TILL) Firm to hard Brown becoming grey below a depth of 3.7 m Moist		4	SS	17		184										7 21 46 26
182.0	SAND and SILT, trace to some clay, trace gravel, containing cobbles and boulders (TILL) Very dense Grey Moist		5	SS	35		183										
181.0			6	SS	65		182										
180.2			7	SS	60/0.13		181										1 37 48 14
180.2	END OF BOREHOLE AUGER REFUSAL NOTE: 1. Open borehole dry upon completion of drilling.		8	SS	103/0.20		180.2										

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 06/25/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No P4-1	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4836957.9 ; E 288322.7</u>	ORIGINATED BY <u>CS</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>D-50 Track-mount, 152 mm Solid Stem Augers</u>	COMPILED BY <u>MAS</u>	
DATUM <u>Geodetic</u>	DATE <u>August 28, 2012</u>	CHECKED BY <u>LCC</u>	

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	20	40	60	80	100	W _p	W			W _L							
192.3	GROUND SURFACE																							
0.0	SILTY CLAY, some sand, trace gravel, containing rootlets	[Hatched]	1	SS	12	[Black]						o												
191.8	Stiff Brown Moist																							
0.5	SHALE (BEDROCK) Weathered Grey	[Diagonal]	2	SS	50/0.10	[Dotted]																		
190.8	END OF BOREHOLE		3	SS	50/0.04	[Dotted]																		
1.5	NOTES: 1. Water level in open borehole at a depth of 1.2 m (Elev. 191.1 m) on completion of drilling. 2. Water level measured in piezometer as follows: <table style="margin-left: 40px; border-collapse: collapse;"> <tr> <td style="padding-right: 20px;">Date</td> <td style="padding-right: 20px;">Depth</td> <td>Elev.</td> </tr> <tr> <td>Aug. 28/12</td> <td>1.1 m</td> <td>191.2 m</td> </tr> <tr> <td>Sep. 24/12</td> <td>1.5 m</td> <td>190.8 m</td> </tr> </table>															Date	Depth	Elev.	Aug. 28/12	1.1 m	191.2 m	Sep. 24/12	1.5 m	190.8 m
Date	Depth	Elev.																						
Aug. 28/12	1.1 m	191.2 m																						
Sep. 24/12	1.5 m	190.8 m																						

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 06/25/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No P4-2	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4836919.7 ; E 288337.0</u>	ORIGINATED BY <u>CS</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>D-50 Track-mount, 152 mm Solid Stem Augers</u>	COMPILED BY <u>MAS</u>	
DATUM <u>Geodetic</u>	DATE <u>August 28 and 30, 2012</u>	CHECKED BY <u>LCC</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					
192.1	GROUND SURFACE																
0.0 191.8 0.3	SILTY CLAY, some sand, trace gravel, containing rootlets Very stiff Brown Moist		1	SS	19		192										7 16 47 30
	SHALE (BEDROCK) Weathered Grey		2	SS	50/0.07		191										
190.4	SHALE (BEDROCK) containing limestone interbeds		3	SS	50/0.13		190										RQD = 0%
1.7	Bedrock cored from 1.5 m to 9.6 m. Refer to Record of Drillhole P4-2 for rock coring details.		1	RC	REC 100%		190										RQD = 43%
			2	RC	REC 93%		189										RQD = 69%
			3	RC	REC 99%		188										RQD = 81%
			4	RC	REC 100%		187										RQD = 90%
			5	RC	REC 100%		186										RQD = 84%
			6	RC	REC 100%		185										
							184										
							183										
182.5	END OF BOREHOLE																
9.6	NOTES: 1. Water level in open borehole at a depth of 1.1 m below ground surface (Elev. 191.0 m) on completion of overburden drilling. 2. Drillhole P4-2 was advanced adjacent to Borehole P4-2 on August 30, 2012; the depth to bedrock and bedrock surface elevation vary between the borehole and drillhole. 3. Driller noted water return losses during coring.																

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 06/25/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT: 11-1111-0083

RECORD OF DRILLHOLE: P4-2

SHEET 1 OF 1

LOCATION: N 4836919.7 ; E 288337.0

DRILLING DATE:

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: D-50 Track-Mount

DRILLING CONTRACTOR: Walker Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY			Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES					
							FLUSH	TOTAL CORE %			SOLID CORE %	B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Ur	Ja				Jn	K, cm/sec	10 ³	10 ²	10 ¹
		SEE RECORD OF BOREHOLE P4-2		190.58																				
2		SHALE BEDROCK containing LIMESTONE interbeds (GEORGIAN BAY FORMATION) Slightly weathered to fresh Dark grey Thinly laminated Weak to medium strong		1.52	1						BD, PL, SM													
				2									JN, PL, SM											
				2									BD, PL, SM											
				2									JN, PL, SM											
				2									BD, PL, SM											
				2									JN, UN, SM											
				2									BD, PL, SM											
				2									JN, UN, SM											
				2									BD, PL, SM											
				2									JN, UN, SM											
3											BD, PL, SM													
4											BD, PL, SM													
5											BD, PL, SM													
6											BD, PL, SM													
7											BD, PL, SM													
8											BD, PL, SM													
9											BD, PL, SM													
10		END OF DRILLHOLE:		182.49							BD, PL, SM													
		NOTES:		9.61							BD, PL, SM													
		1. Driller noted water return losses during coring.									BD, PL, SM													

GTA-RCK 041 111110083.GPJ GAL-MISS.GDT 06/25/13

DEPTH SCALE

1 : 50



LOGGED: CS

CHECKED: LCC

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No EC-1	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4837081.3 ; E 288357.7</u>	ORIGINATED BY <u>MS</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers</u>	COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>	DATE <u>November 15, 2011</u>	CHECKED BY <u>LCC</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					
190.5	GROUND SURFACE																
0.9	TOPSOIL Clayey silt, trace to some sand, trace to some gravel, containing organics (FILL) Firm to hard Brown Moist		1	SS	8		190										
			2	SS	31												
			3	SS	7		189										
			4	SS	16		188	>121 +									
			5	SS	15		187										
186.7	Clayey silt with sand, trace gravel, containing rootlets, wood fragments and organics (Possible FILL / ALLUVIUM)		6	SS	11		186										3 32 50 15
186.0	Stiff Brown Moist		7	SS	5	∇	185										31 46 18 5
	SAND and GRAVEL, some silt, trace clay, containing shale fragments Loose Grey Wet																
184.1	END OF BOREHOLE SPLIT-SPOON REFUSAL ON INFERRED BEDROCK		8	SS	63/20												
6.5	NOTE: 1. Water level in open borehole at a depth of 4.9 m below ground surface (Elev. 185.5 m) on completion of drilling.																

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 1/7/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No EC-2	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4837100.8 ; E 288350.0</u>	ORIGINATED BY <u>MS</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers</u>	COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>	DATE <u>November 15, 2011</u>	CHECKED BY <u>LCC</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
			NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
190.1	GROUND SURFACE																
0.9	TOPSOIL Clayey silt with sand, trace to some gravel, containing organics (FILL) Firm to very stiff Brown to grey Moist		1	SS	7		190										
			2	SS	16		189										
			3	SS	13		188										
			4	SS	7		187										
			5	SS	7		186										
			6	SS	18		185										7 50 30 13
185.6	SAND and GRAVEL, trace to some clay, some silt Compact Grey Wet		7	SS	29		185										24 35 19 22
184.9	SHALE (BEDROCK)		1	RC	REC 79%		184										RQD = 0%
	Bedrock cored from 5.2 m to 8.9 m Refer to Record of Drillhole EC-2 for rock coring details		2	RC	REC 100%		183										RQD = 75%
			3	RC	REC 100%		182										RQD = 58%
181.2	END OF BOREHOLE																
8.9	NOTES: 1. Water level in piezometer at a depth of 3.6 m below ground surface (Elev. 186.5 m) on completion of drilling. 2. Water level in piezometer at a depth of 3.9 m below ground surface (Elev. 186.2 m)																

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 1/7/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT: 11-1111-0083

RECORD OF DRILLHOLE: EC-2

SHEET 1 OF 1

LOCATION: N 4837100.8 ; E 288350.0

DRILLING DATE: November 15, 2011

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 Trackmount

DRILLING CONTRACTOR: Geo-Environmental Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY		Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES		
							TOTAL CORE %	SOLID CORE %			TYPE AND SURFACE DESCRIPTION		Ur	Ja	Ln	K, cm/sec					
							FLUSH	UN			ST	IR	10°	10°	10°						
		GROUND SURFACE		184.94																	
6	HQ RC HW Casing	SHALE BEDROCK (GEORGIAN BAY FORMATION) containing fossiliferous LIMESTONE interbeds and 2-7 cm thick clay seams at depths of 5.4 m (Elev. 184.7 m) and 5.9 m (Elev. 184.2 m) Slightly weathered Grey Laminated Medium strong		5.18	1															(Axial)	
7				2																	
8				3																	
9		END OF DRILLHOLE		181.23																	
10				8.89																	
11																					
12																					
13																					
14																					
15																					

GTA-RCK 018 111110083.GPJ GAL-MISS.GDT 1/7/13

DEPTH SCALE

1 : 50



LOGGED: MS

CHECKED:

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No EC-3	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4837113.8 ; E 288335.9</u>	ORIGINATED BY <u>MS</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers</u>	COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>	DATE <u>November 21, 2011</u>	CHECKED BY <u>LCC</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)			
							20	40	60	80	100									
187.0	GROUND SURFACE																			
0.0	CLAYEY SILT with sand, trace to some gravel Stiff Brown Moist		1	SS	12															
186.3	SAND and GRAVEL, some silt trace clay Dense to very dense Grey Wet		2	SS	47	▽										44	27	24	5	
0.7																				
185.2																				
1.8	SHALE (BEDROCK)																			
	Bedrock cored from 1.8 m to 4.9 m Refer to Record of Drillhole EC-3 for rock coring details		1	RC	REC 100%															RQD = 40%
			2	RC	REC 100%															RQD = 59%
182.1	END OF BOREHOLE																			
4.9	NOTE: 1. Water level in open borehole at a depth of 1.1 m below ground surface (Elev. 185.9 m) on completion of drilling.																			

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 1/7/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT: 11-1111-0083

RECORD OF DRILLHOLE: EC-3

SHEET 1 OF 1

LOCATION: N 4837113.8 ;E 288335.9

DRILLING DATE: November 21, 2011

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 Trackmount

DRILLING CONTRACTOR: Geo-Environmental Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY			Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES					
								TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Ur	Ja	Jn	K, cm/sec				10 ⁰	10 ¹	10 ²		
								000000	000000			000000	000000	000000	000000	000000	000000	000000				000000	000000	000000	000000	000000
		GROUND SURFACE		185.13																						
2	HQ RC HW Casing	SHALE BEDROCK (GEORGIAN BAY FORMATION) containing fossiliferous LIMESTONE interbeds and highly weathered zone from 2.3 m (Elev. 184.7 m) to 2.5 m (Elev. 184.5 m) Slightly weathered Grey Laminated Medium strong		1.83	1																					
3				4	2																					
5		END OF DRILLHOLE		182.09																						
6																										
7																										
8																										
9																										
10																										
11																										

GTA-RCK 018 111110083.GPJ GAL-MISS.GDT 1/7/13

DEPTH SCALE

1 : 50



LOGGED: MS

CHECKED:

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No EC-4	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4837114.0 ; E 288345.6</u>	ORIGINATED BY <u>MS</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers</u>	COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>	DATE <u>November 21, 2011</u>	CHECKED BY <u>LCC</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
186.9	GROUND SURFACE															
0.0	CLAYEY SILT with sand, trace to some gravel, containing cobbles and boulders		1	SS	14											
186.2	Brown Moist SAND and GRAVEL, some silt, trace clay		2	SS	33											
0.7	Dense Grey Wet SHALE (BEDROCK) Weathered Grey		3	SS	70/.15											
185.5															37 19 29 15	
185.1																
1.8	SHALE (BEDROCK) Weathered Grey		1	RC	REC 100%										RQD = 17%	
	SHALE (BEDROCK)															
	Bedrock cored from 1.8 m to 4.9 m															
	Refer to Record of Drillhole EC-4 for rock coring details		2	RC	REC 97%										RQD = 74%	
184																
183																
182.0	END OF BOREHOLE															
4.9	NOTE: 1. Water level in open borehole at a depth of 1.1 m below ground surface (Elev. 185.8 m) on completion of drilling.															

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 1/7/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT: 11-1111-0083

RECORD OF DRILLHOLE: EC-4

SHEET 1 OF 1

LOCATION: N 4837114.0 ;E 288345.6

DRILLING DATE: November 21, 2011

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 Trackmount

DRILLING CONTRACTOR: Geo-Environmental Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR FLUSH	JN - Joint FLT - Fault SH - Shear VN - Vein CJ - Conjugate	BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage	PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular	PO - Polished K - Slickensided SM - Smooth RO - Rough VR - Very Rough	MB - Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.	NOTES												
													RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY			Diametral Point Load Index (MPa)	RMC -Q' AVG.
													TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Ur	Ja	Jn		
		GROUND SURFACE		185.10																				
2	HQ RC HW Casing	SHALE BEDROCK (GEORGIAN BAY FORMATION) containing fossiliferous LIMESTONE interbeds Slightly weathered to fresh Grey Laminated Medium strong		1.83	1																			
3																								
4					2							UC=10.6 MPa (Axial)												
5		END OF DRILLHOLE		182.06																				
4.87																								
6																								
7																								
8																								
9																								
10																								
11																								

GTA-RCK 018 111110083.GPJ GAL-MISS.GDT 1/7/13

DEPTH SCALE

1 : 50



LOGGED: MS

CHECKED:

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No EC-5	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4837114.0 ; E 288355.5</u>	ORIGINATED BY <u>MS</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers</u>	COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>	DATE <u>November 21, 2011</u>	CHECKED BY <u>LCC</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
187.0	GROUND SURFACE															
0.0	CLAYEY SILT with sand, some gravel, containing organics Stiff Brown		1	SS	14											
186.3	Moist		2	SS	43											
0.7	SAND and GRAVEL, some silt, trace clay															
185.6	Dense Grey Wet															
1.4	SHALE (BEDROCK)															
	Bedrock cored from 1.4 m to 4.8 m Refer to Record of Drillhole EC-5 for rock coring details															
			1	RC	REC 100%											RQD = 0%
			2	RC	REC 97%											RQD = 17%
			3	RC	REC 100%											RQD = 84%
182.2	END OF BOREHOLE															
4.8	NOTE: 1. Water level in open borehole at a depth of 1.1 m below ground surface (Elev. 185.9 m) on completion of drilling.															

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 1/7/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT: 11-1111-0083

RECORD OF DRILLHOLE: EC-5

SHEET 1 OF 1

LOCATION: N 4837114.0 ;E 288355.5

DRILLING DATE: November 21, 2011

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 Trackmount

DRILLING CONTRACTOR: Geo-Environmental Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	Legend										NOTES					
							JN - Joint	BD - Bedding	PL - Planar	PO - Polished	MB - Mechanical Break	FLT - Fault	FO - Foliation	CU - Curved	K - Slickensided	BR - Broken Rock		SH - Shear	CO - Contact	UN - Undulating	SM - Smooth	NOTE: For additional abbreviations refer to list of abbreviations & symbols.
							VN - Vein	OR - Orthogonal	ST - Stepped	RO - Rough		CJ - Conjugate	CL - Cleavage	IR - Irregular	VR - Very Rough							
RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY		Diametral Point Load		RMC - Q' AVG.										
FLUSH	TOTAL CORE %	SOLID CORE %		B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Ur	Ja	Ln	K, cm/sec	10 ⁰	10 ¹	10 ²	10 ³	2	4	6					
		GROUND SURFACE		185.63																		
1		SHALE BEDROCK (GEORGIAN BAY FORMATION) containing fossiliferous LIMESTONE interbeds Slightly weathered to fresh Grey Laminated Medium strong		1.37	1																	
2	2																					
3	3																					
4	HQ RC HW Casing			182.20	3													(Axial)				
5		END OF DRILLHOLE		4.80																		

GTA-RCK 018 111110083.GPJ GAL-MISS.GDT 1/7/13

DEPTH SCALE

1 : 50



LOGGED: MS

CHECKED:

PROJECT 11-1111-0083 **RECORD OF BOREHOLE No EC-6** SHEET 1 OF 1 **METRIC**
 G.W.P. 2144-07-00 LOCATION N 4837131.2 ; E 288341.4 ORIGINATED BY MS
 DIST Central HWY 410 BOREHOLE TYPE CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers COMPILED BY NK
 DATUM Geodetic DATE November 22, 2011 CHECKED BY LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)						
						20	40	60	80	100	20	40	60	80	100	10	20	30	GR	SA	SI	CL	
186.6	GROUND SURFACE																						
0.0	CLAYEY SILT with gravel, some sand Stiff Grey Wet		1	SS	12																		54 22 17 7
185.9																							
0.7																							
185.4	SHALE (BEDROCK) Weathered Grey		2	SS	76																		
1.2	SHALE (BEDROCK)		1	RC	REC 100%																		RQD = 0%
	Bedrock cored from 1.2 m to 5.0 m Refer to Record of Drillhole EC-6 for rock coring details		2	RC	REC 100%																		RQD = 47%
			3	RC	REC 100%																		RQD = 48%
181.6	END OF BOREHOLE																						
5.0	NOTE: 1. Water level in open borehole at a depth of 0.9 m below ground surface (Elev. 185.7 m) on completion of drilling.																						

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 1/7/13

PROJECT: 11-1111-0083

RECORD OF DRILLHOLE: EC-6

SHEET 1 OF 1

LOCATION: N 4837131.2 ; E 288341.4

DRILLING DATE: November 22, 2011

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 Trackmount

DRILLING CONTRACTOR: Geo-Environmental Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	Legend										NOTES					
							JN - Joint	BD - Bedding	PL - Planar	PO - Polished	MB - Mechanical Break	FLT - Fault	FO - Foliation	CU - Curved	K - Slickensided	BR - Broken Rock		SH - Shear	CO - Contact	UN - Undulating	SM - Smooth	NOTE: For additional abbreviations refer to list of abbreviations & symbols.
							VN - Vein	OR - Orthogonal	ST - Stepped	RO - Rough		CJ - Conjugate	CL - Cleavage	IR - Irregular	VR - Very Rough							
RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY			Diametral Point Load (MPa)	RMC - Q' AVG.											
FLUSH	TOTAL CORE %	SOLID CORE %		B Angle	DIP w.r.t. AXIS	TYPE AND SURFACE DESCRIPTION	Ur	Ja	Ln	K, cm/sec	2	4	6									
		GROUND SURFACE		185.33																		
1		SHALE BEDROCK (GEORGIAN BAY FORMATION) containing fossiliferous LIMESTONE interbeds Slightly weathered Grey Laminated Medium strong		1.22																		
2																						
3																						
4	HQ RC HW Casing																	(Axial)				
5		END OF DRILLHOLE		181.52	5.03																	

GTA-RCK 018 111110083.GPJ GAL-MISS.GDT 1/7/13

DEPTH SCALE

1 : 50



LOGGED: MS

CHECKED:

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No EC-7	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4837150.1 ; E 288321.9</u>	ORIGINATED BY <u>MS</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers</u>	COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>	DATE <u>November 14, 2011</u>	CHECKED BY <u>LCC</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	SHEAR STRENGTH kPa
191.9	GROUND SURFACE																	
0.0	ASPHALT																	
0.2	Sand and gravel, trace silt and clay (FILL) Compact to dense Brown Moist		1	SS	34													
			2	SS	15													
			3	SS	12													
189.3	CLAYEY SILT, trace to some sand, trace gravel (TILL) Very stiff to hard Grey Moist		4	SS	23													
2.6			5	SS	116/15													
188.2	SHALE (BEDROCK)		6	SS	50/0.03													
187.9	Weathered																	
4.0	SHALE (BEDROCK)		1	RC	REC 100%												RQD = 0%	
	Bedrock cored from 4.0 m to 7.6 m Refer to Record of Drillhole EC-7 for rock coring details		2	RC	REC 100%													RQD = 38%
			3	RC	REC 92%													RQD = 44%
184.3	END OF BOREHOLE																	
7.6	NOTE: 1. Borehole dry on completion of overburden drilling.																	

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 1/7/13

PROJECT: 11-1111-0083

RECORD OF DRILLHOLE: EC-7

SHEET 1 OF 1

LOCATION: N 4837150.1 ; E 288321.9

DRILLING DATE: November 14, 2011

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 Trackmount

DRILLING CONTRACTOR: Geo-Environmental Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR FLUSH	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY			Diameter Point Load (MPa)	RMC -Q' AVG.	NOTES				
							TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Ur	Ja	Jn				K, cm/sec	10°	10°	10°
							88888888	88888888			88888888	88888888	88888888	88888888	88888888	88888888				88888888	88888888	88888888	88888888
		GROUND SURFACE		187.88																			
4	HQ RC HW Casing	'SHALE BEDROCK (GEORGIAN BAY FORMATION) containing fossiliferous LIMESTONE interbeds and 2-10 cm thick clay seams at depths of 4.1 m (Elev. 187.8 m), 6.5 m (Elev. 185.4 m) and 6.7 m (Elev. 185.2 m). Slightly weathered Grey Laminated Me		3.98	1																		
5				2																			
7				3																(Axial)			
		END OF DRILLHOLE		184.24																			
8				7.62																			
9																							
10																							
11																							
12																							
13																							

GTA-RCK 018 111110083.GPJ GAL-MISS.GDT 1/7/13

DEPTH SCALE

1 : 50



LOGGED: MS

CHECKED:

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No EC-8	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4837148.2 ; E 288335.5</u>	ORIGINATED BY <u>MS</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers</u>	COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>	DATE <u>November 22, 2011</u>	CHECKED BY <u>LCC</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					
188.4 0.0	GROUND SURFACE Clayey silt with sand, trace to some gravel, containing cobbles and boulders (FILL) Stiff to hard Brown Moist		1	SS	14		188										
187.0			2	SS	58												
1.5	SHALE (BEDROCK) Weathered Grey SHALE (BEDROCK)		3	SS	160/15		187										RQD = 51%
	Bedrock cored from 1.5 m to 5.1 m Refer to Record of Drillhole EC-8 for rock coring details		1	RC	REC 100%		186										RQD = 35%
			2	RC	REC 100%		185										
			3	RC	REC 100%		184										RQD = 53%
183.3 5.1	END OF BOREHOLE NOTES: 1. Piezometer dry on November 22, 2011 (date of installation). 2. Water level in piezometer at a depth of 2.2 m below ground surface (Elev. 186.2 m) on January 19, 2012.																

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 1/7/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT: 11-1111-0083

RECORD OF DRILLHOLE: EC-8

SHEET 1 OF 1

LOCATION: N 4837148.2 ;E 288335.5

DRILLING DATE: November 22, 2011

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 Trackmount

DRILLING CONTRACTOR: Geo-Environmental Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR FLUSH	JN - Joint FLT - Fault SH - Shear VN - Vein CJ - Conjugate	BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage	PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular	PO - Polished K - Slickensided SM - Smooth RO - Rough VR - Very Rough	MB - Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.	NOTES												
													RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY		Diametral Point Load Index (MPa)	RMC - Q' AVG.
													TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Ur	Ja	Jn		
		GROUND SURFACE		186.87																				
2	HQ RC HW Casing	SHALE BEDROCK (GEORGIAN BAY FORMATION) containing fossiliferous LIMESTONE interbeds Slightly weathered to fresh Grey Laminated Medium strong		1.52	1							(Axial)												
3				2									(Axial)											
4				3										(Axial)										
5		END OF DRILLHOLE		183.31 5.08								(Axial)												

GTA-RCK 018 111110083.GPJ GAL-MISS.GDT 1/7/13

DEPTH SCALE

1 : 50



LOGGED: MS

CHECKED:

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No EC-9	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4837151.0 ; E 288348.1</u>	ORIGINATED BY <u>MS</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers</u>	COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>	DATE <u>November 13-14, 2011</u>	CHECKED BY <u>LCC</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
191.7	GROUND SURFACE															
0.0	ASPHALT															
0.2	Sand and gravel, trace silt and clay (FILL) Compact Brown Moist		1	SS	25						○					39 52 5 4
			2	SS	29											
190.3																
1.5	CLAYEY SILT with gravel and sand (TILL) Hard Brown becoming grey below a depth of 2.2 m Moist		3	SS	30						○					56 26 12 6
			4	SS	34											
			5	SS	92						○	—	—			
188.0																
187.7	SHALE (BEDROCK) Weathered Grey		1	RC	REC 89%											RQD = 54%
4.0	SHALE (BEDROCK)															
	Bedrock cored from 4.0 m to 7.3 m Refer to Record of Drillhole EC-9 for rock coring details		2	RC	REC 100%											RQD = 60%
			3	RC	REC 100%											RQD = 20%
184.4	END OF BOREHOLE															
7.3	NOTE: 1. Borehole dry on completion of overburden drilling.															

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 1/7/13

PROJECT: 11-1111-0083

RECORD OF DRILLHOLE: EC-9

SHEET 1 OF 1

LOCATION: N 4837151.0 ; E 288348.1

DRILLING DATE: November 13-14, 2011

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 Trackmount

DRILLING CONTRACTOR: Geo-Environmental Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR FLUSH	JN - Joint FLT - Fault SH - Shear VN - Vein CJ - Conjugate	BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage	PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular	PO - Polished K - Slickensided SM - Smooth RO - Rough VR - Very Rough	MB - Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.	NOTES												
													RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY			Diameter Point Load Index (MPa)	RMC - Q' AVG.
													TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Ur	Ja	Jn		
		GROUND SURFACE		187.73																				
5	HQ RC HW Casing	SHALE BEDROCK (GEORGIAN BAY FORMATION) containing fossiliferous LIMESTONE interbeds and 3-10 cm clay seams at a depth of 5.0 m (Elev. 186.7 m) and 6.9 m (Elev. 184.4 m) Slightly weathered Grey Laminated Medium strong		4.01	1																			
6					2																			
7						3								(Axial)										
		END OF DRILLHOLE		184.46 7.28																				

GTA-RCK 018 111110083.GPJ GAL-MISS.GDT 1/7/13

DEPTH SCALE

1 : 50



LOGGED: MS

CHECKED:

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No EC-10	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4837173.2 ; E 288324.4</u>	ORIGINATED BY <u>MS</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers</u>	COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>	DATE <u>November 16, 2011</u>	CHECKED BY <u>LCC</u>	

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 (%)			
						20 40 60 80 100	20 40 60 80 100	W _p	W	W _L	10 20 30					
191.4	GROUND SURFACE															
0.0	TOPSOIL Clayey silt with sand, some gravel (FILL) Very stiff to hard Grey Moist		1	SS	23							o				
			2	SS	35											
190.0																
1.5	CLAYEY SILT with sand, some gravel (TILL) Very stiff to hard Grey Moist		3	SS	25							o	-----		27 36 21 16	
			4	SS	78/.18							o				
188.6																
188.2	SHALE (BEDROCK) Weathered Grey		5	SS	100/15											
3.2	SHALE (BEDROCK)		1	RC	REC 70%										RQD = 0%	
	Bedrock cored from 3.2 m to 6.4 m Refer to Record of Drillhole EC-10 for rock coring details		2	RC	REC 99%										RQD = 72%	
			3	RC	REC 100%										RQD = 34%	
185.0																
6.4	END OF BOREHOLE NOTE: 1. Borehole dry on completion of overburden drilling.															

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 1/7/13

+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT: 11-1111-0083

RECORD OF DRILLHOLE: EC-10

SHEET 1 OF 1

LOCATION: N 4837173.2 ; E 288324.4

DRILLING DATE: November 16, 2011

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 Trackmount

DRILLING CONTRACTOR: Geo-Environmental Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY		Diameter Point Load Index (MPa)	RMC -Q' AVG.	NOTES		
								TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Ur	Ja	Ln				K, cm/sec	
								000000	000000			000000	000000	000000	000000	000000	000000				000000	
		GROUND SURFACE		188.16																		
4	HO RC HW Casing	SHALE BEDROCK (GEORGIAN BAY FORMATION) containing fossiliferous LIMESTONE interbeds Slightly weathered to fresh Grey Laminated Medium strong		3.20	1																	
5				2																		
6				3																		
		END OF DRILLHOLE		184.96																		
7				6.40																		
8																						
9																						
10																						
11																						
12																						
13																						

GTA-RCK 018 111110083.GPJ GAL-MISS.GDT 1/7/13

DEPTH SCALE

1 : 50



LOGGED: MS

CHECKED:

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No P5-1	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4837409.1 ; E 288320.9</u>	ORIGINATED BY <u>TWB</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>D-50 Track-mount, 152 mm Solid Stem Augers</u>	COMPILED BY <u>MAS</u>	
DATUM <u>Geodetic</u>	DATE <u>August 26, 2012</u>	CHECKED BY <u>LCC</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
191.7	GROUND SURFACE																
0.9	TOPSOIL																
	CLAYEY SILT with sand, trace to some gravel, containing cobbles and boulders, containing rootlets to 0.8 m (TILL) Hard Brown becoming grey below a depth of 2.7 m Moist		1	SS	34												
			2	SS	39												
			3	SS	60												
			4	SS	68												8 27 44 21
			5	SS	58												
187.4			6	SS	87												
4.3	Gravelly SAND and SILT, trace to some clay, containing cobbles and boulders (TILL) Very dense Grey Moist		7	SS	60/0.10												
			8	SS	97/0.23												22 27 41 10
184.7																	
7.0	SHALE (BEDROCK) Weathered Grey																
183.8			9	SS	86/0.23												
7.9	END OF BOREHOLE AUGER REFUSAL																
	NOTE: 1. Water level in open borehole at a depth of 4.4 m (Elev. 187.3 m) on completion of drilling.																

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 06/25/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No P5-2	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4837502.0 ; E 288275.5</u>	ORIGINATED BY <u>TWB</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME-55 Track-mount, 152 mm Solid Stem Augers</u>	COMPILED BY <u>MAS</u>	
DATUM <u>Geodetic</u>	DATE <u>August 26, 2012</u>	CHECKED BY <u>LCC</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)		
						20	40	60	80	100									
191.8	GROUND SURFACE																		
0.0	TOPSOIL																		
	CLAYEY SILT with sand, some gravel, containing rootlets to 0.8 m (TILL) Stiff to hard Brown becoming grey below a depth of 2.6 m Moist	[Hatched Strat Plot]	1	SS	14														
			2	SS	35														
			3	SS	57														
			4	SS	67														
			5	SS	40														
187.8	Gravelly SAND and SILT, trace clay, containing cobbles and boulders (TILL)		6	SS	85														
187.3	Very dense Grey Moist		7	SS	105														
185.2	CLAYEY SILT, some sand, trace gravel, containing cobbles and boulders (TILL) Hard Grey Moist		8	SS	60/0.05														
6.6	END OF BOREHOLE AUGER REFUSAL																		
	NOTE: 1. Water level in open borehole at a depth of 6.0 m (Elev. 185.8 m) on completion of drilling.																		

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 06/25/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No P5-3	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4837528.2 ; E 288319.0</u>	ORIGINATED BY <u>TWB</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME-55 Track-mount, 152 mm Solid Stem Augers</u>	COMPILED BY <u>MAS</u>	
DATUM <u>Geodetic</u>	DATE <u>August 27, 2012</u>	CHECKED BY <u>LCC</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
			NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
190.6	GROUND SURFACE																
0.0	TOPSOIL																
	CLAYEY SILT with sand to some sand, trace to some gravel, containing rootlets to 0.8 m, containing cobbles and boulders below 2.7 m (TILL) Stiff to hard Brown becoming grey below a depth of 2.7 m Moist		1	SS	12		190										
			2	SS	35												
			3	SS	35		189										6 31 43 20
			4	SS	39		188										
			5	SS	43		187										
186.9	Silty SAND and GRAVEL, trace clay, containing cobbles and boulders (TILL) Very dense to dense Grey Moist becoming wet below a depth of 4.6 m		6	SS	73		186										35 32 28 5
			7	SS	45		185										
185.6	CLAYEY SILT, some sand, some gravel, containing shale fragments below a depth of 5.6 m (TILL) Hard Grey Moist		8	SS	92/0.20		184										
183.9	END OF BOREHOLE AUGER REFUSAL																
6.7	NOTES: 1. Water level in open borehole at a depth of 3.8 m (Elev. 186.8 m) on completion of drilling. 2. Water level measured in piezometer as follows: Date Depth Elev. Aug. 27/12 1.9 m 188.7 m Sep. 24/12 2.1 m 188.5 m																

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 06/25/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No P6-1	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4838326.0 ; E 287902.3</u>	ORIGINATED BY <u>CS</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>D-25 Track-mount, 152 mm Solid Stem Augers</u>	COMPILED BY <u>MAS</u>	
DATUM <u>Geodetic</u>	DATE <u>August 26, 2012</u>	CHECKED BY <u>LCC</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa											
								20	40	60	80	100							
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					WATER CONTENT (%)						
								20	40	60	80	100	10	20	30				
197.7	GROUND SURFACE																		
0.0	Silty sand, some gravel, trace clay, containing rootlets (FILL) Compact Brown Moist		1	SS	14														
197.0							197												
0.7	Clayey silt to silty clay, trace to some sand (FILL) Stiff to very stiff Brown and grey Moist		2	SS	18														
			3	SS	12		196									0	10	57	33
			4	SS	20		195												
194.7																			
3.0	CLAYEY SILT with sand, trace to some gravel, containing cobbles and boulders below 4.6 m (TILL) Very stiff to hard Brown becoming grey below a depth of 4.6 m Moist		5	SS	29														
			6	SS	50/0.08		194												
			7	SS	85/0.28		193									6	25	46	23
			8	SS	91		192												
			9	SS	63/0.15		190												
			10	SS	99/0.28		188									16	35	36	13
186.9			11	SS	74/0.15		187												
10.8	END OF BOREHOLE																		
	NOTE: 1. Open borehole dry upon completion of drilling.																		

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 06/25/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No P6-2	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4838372.4 ; E 287879.1</u>	ORIGINATED BY <u>CS</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>D-50 Track-mount, 152 mm Solid Stem Augers</u>	COMPILED BY <u>MAS</u>	
DATUM <u>Geodetic</u>	DATE <u>August 26 and 27, 2012</u>	CHECKED BY <u>LCC</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)	
						20	40	60	80	100								
199.9 0.0	GROUND SURFACE Clayey silt with sand, some gravel, containing rootlets (FILL) Very stiff to stiff Brown becoming grey below 3.2 m Moist		1	SS	20													
			2	SS	17													
			3	SS	9												16 40 27 17	
			4	SS	10													
			5	SS	18													
196.2 3.7	CLAYEY SILT with sand, trace to some gravel, containing cobbles and boulders below 8.2 m (TILL) Hard Grey Moist		6	SS	39													
			7	SS	50													
			8	SS	61												3 26 49 22	
			9	SS	73													
			10	SS	48												15 23 49 13	
189.1 10.8	END OF BOREHOLE AUGER REFUSAL NOTES: 1. Open borehole dry upon completion of drilling. 2. Water level measured in piezometer as follows: Date Depth Elev. Aug. 27/12 Dry N/A Sep. 24/12 4.3 m 195.6 m																	

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 06/25/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT 11-1111-0083 **RECORD OF BOREHOLE No P6-3** **SHEET 1 OF 1** **METRIC**
G.W.P. 2144-07-00 **LOCATION** N 4838418.2 ; E 287893.0 **ORIGINATED BY** CS
DIST Central **HWY** 410 **BOREHOLE TYPE** D-50 Track-mount, 152 mm Solid Stem Augers **COMPILED BY** MAS
DATUM Geodetic **DATE** August 27, 2012 **CHECKED BY** LCC

SOIL PROFILE		STRAT PLOT	SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)									
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)								
						20	40	60	80	100	20	40	60	80	100	10	20	30		GR	SA	SI	CL		
197.5	GROUND SURFACE																								
0.0	Clayey silt, trace gravel and sand, containing rootlets (FILL) Very stiff Brown Moist Sand, trace gravel, trace silt, trace clay (FILL) Compact Brown Moist Clayey silt, with to some sand, trace to some gravel (FILL) Firm to very stiff Brown to grey Moist		1	SS	24																				
196.8																									
0.7																									
196.1																									
1.5																									
193.8	CLAYEY SILT with to some sand, trace to some gravel (TILL) Very stiff to hard Grey Moist Containing cobbles and boulders below 7.6 m		6	SS	23																				
3.7																									
193																									
192																									
191																									
190																									
189																									
188																									
187																									
186.7																									
10.8	END OF BOREHOLE																								
	NOTE: 1. Open borehole dry upon completion of drilling.																								

GTA-MTO 001 1111110083.GPJ GAL-GTA.GDT 06/25/13

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT 11-1111-0083 **RECORD OF BOREHOLE No GR-1** **SHEET 1 OF 1** **METRIC**
G.W.P. 2144-07-00 **LOCATION** N 4839008.9 ; E 287180.4 **ORIGINATED BY** MS
DIST Central **HWY** 410 **BOREHOLE TYPE** CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers **COMPILED BY** NK
DATUM Geodetic **DATE** November 6, 2011 **CHECKED BY** LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)							
						20	40	60	80	100	20	40	60	80	100	10	20	30	GR	SA	SI	CL		
206.4	GROUND SURFACE																							
0.0	ASPHALT																							
0.2	Silty sand and gravel (FILL)	[Strat Plot Pattern]	1	SS	21																			
205.7	Compact Brown Moist																							
0.7	Clayey silt with sand, some gravel (FILL)		2	SS	12																			
	Firm to very stiff Brown Moist		3	SS	7																			
			4	SS	24																			
			5	SS	12																			
202.7	Sand and silt, trace clay and gravel (FILL)		6	SS	20																			
3.7	Compact Brown Wet		7	SS	11																			
201.9	Clayey silt, some sand, trace to some gravel (FILL)																							
4.5	Stiff Brown Moist	8	SS	30																				
200.8	CLAYEY SILT, trace to some sand, trace gravel (TILL)																							
5.6	Hard Brown Moist																							
199.7	END OF BOREHOLE																							
6.7	NOTE: 1. Borehole dry on completion of drilling.																							

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 9/27/12

 +³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No GR-2	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4839025.0 ; E 287165.3</u>	ORIGINATED BY <u>MS</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers</u>	COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>	DATE <u>November 6, 2011</u>	CHECKED BY <u>LCC</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)									
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)								
						20	40	60	80	100	20	40	60	80	100	10	20	30		GR	SA	SI	CL		
207.1	GROUND SURFACE																								
0.0	Clayey silt with sand, trace gravel (FILL)	[Hatched Strat Plot]	1	SS	11																				
206.4	Stiff Brown Moist		2	SS	10																				
0.7	Sandy silt, trace gravel, trace clay (FILL)		3	SS	5																				
205.6	Compact Brown Moist		4	SS	13																				
1.5	Clayey silt with sand, trace gravel (FILL)		5	SS	6																				
	Firm to stiff Brown Moist		6	SS	6																				
			7	SS	6																				
201.5	CLAYEY SILT with sand, some gravel, containing rootlets (TILL)	[Hatched Strat Plot]	8	SS	15																				
5.6	Very stiff to hard Brown becoming grey at a depth of 7.6 m Moist		9	SS	34																				
			10	SS	50/03																				
198.0	SHALE (BEDROCK)	[Hatched Strat Plot]	1	RC	REC 79%																				
9.1	Bedrock cored from 9.1 m to 12.1 m Refer to Record of Drillhole GR-2 for rock coring details		2	RC	REC 97%																				
195.0	END OF BOREHOLE																								
12.1	NOTE: 1. Borehole dry on completion of overburden drilling.																								

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 9/27/12

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No GR-3	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4839035.9 ; E 287176.5</u>	ORIGINATED BY <u>MS</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers</u>	COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>	DATE <u>November 6, 2011</u>	CHECKED BY <u>LCC</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20	40	60	80	100	10	20
207.2	GROUND SURFACE																							
0.0	Clayey silt with to some sand, some gravel, containing pockets of silty sand (FILL) Firm to very stiff Brown Moist		1	SS	7																			
			2	SS	8																			
			3	SS	6																			
			4	SS	5																			
			5	SS	11																			
			6	SS	10																			
			7	SS	10																			
			8	SS	16																			
200.0																								
7.2	CLAYEY SILT, some sand and gravel (TILL) Very stiff Grey - brown Moist		9	SS	21																			
198.1																								
9.1	SHALE (BEDROCK)		1	RC	REC 79%																			
	Bedrock cored from 9.1 m to 12.2 m Refer to Record of Drillhole GR-3 for rock coring details		2	RC	REC 60%																			
195.0																								
12.2	END OF BOREHOLE																							
	NOTE: 1. Borehole dry on completion of overburden drilling.																							

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 9/27/12

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT: 11-1111-0083

RECORD OF DRILLHOLE: GR-3

SHEET 1 OF 1

LOCATION: N 4839035.9 ; E 287176.5

DRILLING DATE: November 6, 2011

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 Trackmount

DRILLING CONTRACTOR: Geo-Environmental Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY		Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES	
								TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Ur	Ja	Ln				K, cm/sec
								000000	000000			000000	000000	000000	000000	000000	000000				000000
		GROUND SURFACE		198.06																	
10	NQ RC NW Casing	SHALE BEDROCK (GEORGIAN BAY FORMATION) containing fossiliferous LIMESTONE interbeds Slightly weathered Grey Laminated Medium strong		9.14	1																
11				2																	
12				194.96																	(Axial)
		END OF DRILLHOLE		12.24																	

GTA-RCK 018 111110083.GPJ GAL-MISS.GDT 9/27/12

DEPTH SCALE

1 : 50



LOGGED: MS

CHECKED: LCC

RECORD OF BOREHOLE No GR-4 SHEET 1 OF 1 **METRIC**

PROJECT 11-1111-0083 G.W.P. 2144-07-00 LOCATION N 4839040.5 ; E 287149.7 ORIGINATED BY MS

DIST Central HWY 410 BOREHOLE TYPE CME 75 Truck-mount, 108 mm Inner Diameter Hollow Stem Augers COMPILED BY NK

DATUM Geodetic DATE November 3, 2011 CHECKED BY LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)							
						20	40	60	80	100	20	40	60	80	100	10	20	30		GR	SA	SI	CL	
200.4	GROUND SURFACE																							
0.0	Asphalt																							
0.2	Silty sand and gravel (FILL)		1	SS	24																			
199.7	Compact Brown Moist																							
0.7	CLAYEY SILT with to some sand, some gravel (TILL) Very stiff to hard Brown becoming grey at a depth of 0.9 m Moist		2	SS	24																15	26	43	16
			3	SS	45																			
197.8			4	SS	109/0.18																			
2.6	SHALE (BEDROCK)																							
			1	RC	REC 80%																			RQD = 0%
			2	RC	REC 79%																			RQD = 20%
	Bedrock cored from 2.6 m to 6.5 m																							
	Refer to Record of Drillhole GR-4 for rock coring details		3	RC	REC 100%																			RQD = 45%
193.9	END OF BOREHOLE																							
6.5	NOTE: 1. Borehole dry on completion of overburden drilling.																							

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 9/27/12

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT: 11-1111-0083

RECORD OF DRILLHOLE: GR-4

SHEET 1 OF 1

LOCATION: N 4839040.5 ; E 287149.7

DRILLING DATE: November 3, 2011

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 75 Trackmount

DRILLING CONTRACTOR: Geo-Environmental Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY			Diametral Point Load (MPa)	RMC -Q' AVG.	NOTES			
								TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Ur	Ja	Ln	K, cm/sec				10°	10°	10°
								88888888	88888888			88888888	88888888	88888888	88888888	88888888	88888888	88888888				88888888	88888888	88888888
		GROUND SURFACE		197.79																				
3	HQ RC HW Casing	SHALE BEDROCK (GEORGIAN BAY FORMATION) containing fossiliferous LIMESTONE interbeds and 1-5 cm thick clay seams at depths of 3.6 m (Elev. 196.8 m), 5.0 m (Elev. 195.4 m) and 5.5 m (Elev. 194.9 m) Slightly weathered Grey Laminated Medium strong		2.61	1																		(Axial)	
4				2																				(Axial)
5				3																				
6		END OF DRILLHOLE		193.88																				
7				6.52																				
8																								
9																								
10																								
11																								
12																								

GTA-RCK 018 111110083.GPJ GAL-MISS.GDT 9/27/12

DEPTH SCALE

1 : 50



LOGGED: MS

CHECKED: LCC

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No GR-5	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4839049.0 ; E 287164.0</u>	ORIGINATED BY <u>MS</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME 75 Truck-mount, 108 mm Inner Diameter Hollow Stem Augers</u>	COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>	DATE <u>November 3, 2011</u>	CHECKED BY <u>LCC</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			20	40	60	80	100			W _p	W	W _L	GR
200.5	GROUND SURFACE																
0.0	Asphalt																
0.2	Silty sand and gravel (FILL)	1	SS	29													
199.8	Compact Brown Moist																
0.7	SILTY CLAY, some gravel, trace to some sand (TILL)	2	SS	18													
	Very stiff Grey Moist																
		3	SS	17													
198.0	SHALE (BEDROCK)	4	SS	50/0.07													
2.5																	
		1	RC	REC 88%													RQD = 24%
		2	RC	REC 95%													RQD = 7%
	Bedrock cored from 2.5 m to 6.5 m																
		3	RC	REC 100%													RQD = 35%
194.0	Refer to Record of Drillhole GR-5 for rock coring details																
6.5	END OF BOREHOLE																
	NOTES:																
	1. Piezometer dry on completion of drilling.																
	2. Water level in piezometer at a depth of 1.6 m below ground surface (Elev. 198.9 m) on January 19, 2012.																
	3. Water level in piezometer at a depth of 1.7 m below ground surface (Elev. 198.8 m) on January 30, 2012.																

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 9/27/12

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT: 11-1111-0083

RECORD OF DRILLHOLE: GR-5

SHEET 1 OF 1

LOCATION: N 4839049.0 ; E 287164.0

DRILLING DATE: November 3, 2011

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 75 Trackmount

DRILLING CONTRACTOR: Geo-Environmental Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY			Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES				
								TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Ur	Ja	Jn				K, cm/sec	10°	10°	10°
								88888888	88888888			88888888	88888888	88888888	88888888	88888888	88888888				88888888	88888888	88888888	88888888
		GROUND SURFACE		198.01																				
3	HO RC HW Casing	SHALE BEDROCK (GEORGIAN BAY FORMATION) containing fossiliferous LIMESTONE interbeds and 2-10 cm thick clay seams at a depth of 3.2 m (Elev. 197.3 m) and 3.5 (Elev. 197.0 m) Slightly weathered Grey Laminated Medium strong		2.49	1																			
4				2																		(Axial)		
5				3																			(Axial)	
6		END OF DRILLHOLE		193.97	6.53																			
7																								
8																								
9																								
10																								
11																								
12																								

GTA-RCK 018 111110083.GPJ GAL-MISS.GDT 9/27/12

DEPTH SCALE

1 : 50



LOGGED: MS

CHECKED: LCC

RECORD OF BOREHOLE No GR-6 SHEET 1 OF 1 **METRIC**

PROJECT 11-1111-0083 G.W.P. 2144-07-00 LOCATION N 4839053.3 ; E 287147.6 ORIGINATED BY MS

DIST Central HWY 410 BOREHOLE TYPE CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers COMPILED BY NK

DATUM Geodetic DATE November 7, 2011 CHECKED BY LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)							
						20	40	60	80	100	20	40	60	80	100	10	20	30	GR	SA	SI	CL		
207.7	GROUND SURFACE																							
0.0	Clayey silt, trace to some sand, trace gravel (FILL) Firm to stiff Brown Moist		1	SS	5												o							
206.4			2	SS	11																			
1.3	Sand and silt, trace clay, trace gravel (FILL) Compact Brown Moist		3	SS	18												o				4	53	36	7
205.5			4	SS	9																			
2.2	Clayey silt, trace to some sand, trace gravel, containing pockets of sandy silt (FILL) Firm to stiff Brown Moist		5	SS	7												o							
203.4			6	SS	7																			
4.3	Gravelly sand, some silt, trace clay (FILL) Dense Brown Moist		7	SS	31												o				27	58	13	2
202.1			8	SS	15												o							
5.6	Clayey silt, with to some sand, some gravel, containing rootlets (FILL) Very stiff Grey Moist		9	SS	50:05																			
200.7																								
200.4	Boulder																							
7.3	Clayey silt, with to some sand, some gravel (FILL) Very stiff Grey Moist																							
198.3																								
9.4	Concrete																							
197.8																								
9.9	SHALE (BEDROCK)		1	RC	REC 90%																		RQD = 15%	
	Bedrock cored from 9.9 m to 13.0 m Refer to Record of Drillhole GR-6 for rock coring details.		2	RC	REC 94%																			RQD = 16%
			3	RC	REC 91%																			RQD = 21%
194.7																								
13.0	END OF BOREHOLE																							
	NOTE: 1. Borehole dry on completion of overburden drilling.																							

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 9/27/12

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT: 11-1111-0083

RECORD OF DRILLHOLE: GR-6

SHEET 1 OF 1

LOCATION: N 4839053.3 ; E 287147.6

DRILLING DATE: November 7, 2011

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG:

DRILLING CONTRACTOR: Geo-Environmental Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR FLUSH	RECOVERY			FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY			Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES		
							TOTAL CORE %	SOLID CORE %	R.Q.D. %		B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Ur	Ja	Jn				K	cm/sec
							000000	000000	000000		000000	000000	000000	000000	000000	000000				000000	000000
		GROUND SURFACE		197.80																	
10	HQ RC NW Casing	SHALE BEDROCK (GEORGIAN BAY FORMATION) containing fossiliferous LIMESTONE interbeds and a 3 cm thick clay seam at a depth of 12.4 m (Elev. 195.3 m) Slightly weathered Grey Laminated Medium strong		9.90	1																
11				2																(Axial)	
12				3																	(Axial)
13		END OF DRILLHOLE		194.73 12.97																	
14																					
15																					
16																					
17																					
18																					
19																					

GTA-RCK 018 111110083.GPJ GAL-MISS.GDT 9/27/12

DEPTH SCALE

1 : 50



LOGGED: MS

CHECKED: LCC

PROJECT 11-1111-0083 **RECORD OF BOREHOLE No GR-7** SHEET 1 OF 1 **METRIC**
 G.W.P. 2144-07-00 LOCATION N 4839074.4 ; E 287127.5 ORIGINATED BY MS
 DIST Central HWY 410 BOREHOLE TYPE CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers COMPILED BY NK
 DATUM Geodetic DATE November 7, 2011 CHECKED BY LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)						
						20	40	60	80	100	20	40	60	80	100	10	20	30	GR	SA	SI	CL	
207.1	GROUND SURFACE																						
0.0	TOPSOIL																						
206.4	Clayey silt, some sand, containing organics and pockets of sandy silt (FILL)		1	SS	8																		
0.7	Stiff Brown Moist		2	SS	18																		
205.6	Silty sand, containing pockets of clayey silt (FILL)																						
1.5	Compact Brown Moist		3	SS	6																		
	Clayey silt to silty clay, with to some sand, trace gravel, containing organics and pockets of sandy silt (FILL)																						
	Firm to very stiff Brown to black Moist		4	SS	10																		3 36 40 21
			5	SS	16																		
			6	SS	18																		
			7	SS	9																		
			8	SS	11																		
200.4	END OF BOREHOLE																						1 25 59 15
6.7	NOTE: 1. Borehole dry on completion of drilling.																						

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 9/27/12

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No CN-1	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4839425.0 ; E 286786.4</u>	ORIGINATED BY <u>SB</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME-55 Track-mount, 57 mm Inner Diameter Hollow Stem Augers</u>	COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>	DATE <u>March 27, 2012</u>	CHECKED BY <u>LCC</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)							
						20	40	60	80	100	20	40	60	80	100	10	20	30		GR	SA	SI	CL	
216.5	GROUND SURFACE																							
0.0	Clayey silt, some sand, trace gravel, containing rootlets (FILL) Firm to stiff Brown Moist		1	SS	5																			
			2	SS	10																			
215.1																								
1.4	Sand and silt, some gravel, trace to some clay (FILL) Loose to dense Brown Moist to wet		3	SS	26																			
			4	SS	10																			
	Samples 5 and 6 wet between approximately 3.0 m and 4.5 m depth		5	SS	5																			
			6	SS	20																			
			7	SS	20																			
			8	SS	36																			
			9	SS	14																			
207.8																								
8.7	CLAYEY SILT with sand, trace gravel (TILL) Stiff Brown Moist		10	SS	13																			
206.8																								
9.8	END OF BOREHOLE																							
	NOTE: 1. Open borehole dry upon completion of drilling.																							

GTA-MTO 001 111110083.GPJ GAL-MISS.GDT 8/8/12

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT 11-1111-0083 **RECORD OF BOREHOLE No CN-2** **SHEET 1 OF 2** **METRIC**
G.W.P. 2144-07-00 **LOCATION** N 4839441.7 ; E 286770.8 **ORIGINATED BY** SB
DIST Central **HWY** 410 **BOREHOLE TYPE** CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers **COMPILED BY** NK
DATUM Geodetic **DATE** March 27, 2012 **CHECKED BY** LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)											
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			20	40						60	80	100	20	40	60	80	100	10	20	30
217.4	GROUND SURFACE																							
0.0	Clayey silt, some sand, trace gravel, containing rootlets and organics (FILL) Firm Brown Moist Gravelly sand and silt, trace clay, containing pockets of clayey silt (FILL) Very loose to very dense Moist Brown	1	SS	6																				
216.8		2	SS	16																				
0.6		3	SS	15																				
		4	SS	3																				
		5	SS	13																				
		6	SS	9																				
		7	SS	60																				
		8	SS	53																				
210.2	Clayey silt with sand, some gravel (FILL) Stiff Brown Moist	9	SS	10																				
7.2																								
208.7	CLAYEY SILT, some to with sand, trace gravel (TILL) Stiff to hard Brown Moist	10	SS	10																				
8.7																								
		11	SS	39																				
205.4	SHALE (BEDROCK) Weathered Grey SHALE (BEDROCK) containing limestone interbeds Bedrock cored from 12.2 m to 15.4 m Refer to Record of Drillhole CN-2 for rock coring details	12	SS	50/0.15																				
12.2		1	RC	REC 88%																			RQD = 40%	
		2	RC	REC 93%																				RQD = 66%

GTA-MTO 001 111110083.GPJ GAL-MISS.GDT 8/8/12

Continued Next Page

 +³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No CN-2	SHEET 2 OF 2	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4839441.7 ; E 286770.8</u>	ORIGINATED BY <u>SB</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers</u>	COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>	DATE <u>March 27, 2012</u>	CHECKED BY <u>LCC</u>	

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	20	40	60	80	100	W _p	W			W _L	20	40	60
202.0	--- CONTINUED FROM PREVIOUS PAGE ---	[Hatched Box]	2	RC	REC 93%															
15.4	END OF BOREHOLE NOTES: 1. Open borehole dry upon completion of overburden drilling. 2. Water level in piezometer at a depth of 7.2 m (Elev. 210.2 m) on completion of drilling.																			

GTA-MTO 001 111110083.GPJ GAL-MISS.GDT 8/8/12

+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT: 11-1111-0083

RECORD OF DRILLHOLE: CN-2

SHEET 1 OF 1

LOCATION: N 4839441.7 ; E 286770.8

DRILLING DATE: March 27, 2012

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 Trackmount

DRILLING CONTRACTOR: Geo-Environmental Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR FLUSH	JN - Joint FLT - Fault SH - Shear VN - Vein CJ - Conjugate	BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage	PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular	PO - Polished K - Slickensided SM - Smooth RO - Rough VR - Very Rough	MB - Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.	NOTES										
													RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load (MPa)	RMC - Q' AVG.
													TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION			
		GROUND SURFACE		205.23																		
13	NO RC	SHALE BEDROCK (GEORGIAN BAY FORMATION) containing fossiliferous LIMESTONE interbeds Slightly to moderately weathered Dark grey Weak to strong		12.20	1	100%																
14				2	100%																	
15		END OF DRILLHOLE		202.06 15.37																		
16																						
17																						
18																						
19																						
20																						
21																						
22																						

GTA-RCK 018 111110083.GPJ GAL-MISS.GDT 8/8/12

DEPTH SCALE

1 : 50



LOGGED: SB

CHECKED:

PROJECT 11-1111-0083 **RECORD OF BOREHOLE No CN-3** **SHEET 1 OF 1** **METRIC**
G.W.P. 2144-07-00 **LOCATION** N 4839465.8 ; E 286760.7 **ORIGINATED BY** SB
DIST Central **HWY** 410 **BOREHOLE TYPE** CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers **COMPILED BY** NK
DATUM Geodetic **DATE** April 11, 2012 **CHECKED BY** LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)									
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)								
						20	40	60	80	100	20	40	60	80	100	10	20	30		GR	SA	SI	CL		
209.2	GROUND SURFACE																								
0.0	Silty sand, some gravel, trace clay, containing organics (FILL) Loose Brown Moist		1	SS	9																				
208.5	Clayey silt, some sand, trace gravel (FILL) Firm Brown Moist		2	SS	7																				
207.8	CLAYEY SILT with sand, trace to some gravel (TILL) Very stiff to hard Brown Moist		3	SS	17																	9	29	37	25
206.2	SHALE (BEDROCK) Weathered Grey		4	SS	31																				
205.2	SHALE (BEDROCK) containing limestone interbeds Bedrock cored from 4.0 to 7.0 m Refer to Record of Drillhole CN-3 for rock coring details		5	SS	50/0.15																				
205.2			1	RC	REC 79%																			RQD = 0%	
204.0			2	RC	REC 95%																			RQD = 73%	
203.0			3	RC	REC 100%																			RQD = 67%	
202.2	END OF BOREHOLE NOTE: 1. Open borehole dry upon completion of overburden drilling.																								

GTA-MTO 001 111110083.GPJ GAL-MISS.GDT 8/8/12

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT: 11-1111-0083

RECORD OF DRILLHOLE: CN-3

SHEET 1 OF 1

LOCATION: N 4839465.8 ; E 286760.7

DRILLING DATE: April 11, 2012

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 Trackmount

DRILLING CONTRACTOR: Geo-Environmental Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR FLUSH	RECOVERY			FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY			Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES				
							TOTAL CORE %	SOLID CORE %	R.Q.D. %		B Angle	DIP w/ ZL CORE AXIS	TYPE AND SURFACE DESCRIPTION			K, cm/sec	10 ⁰				10 ¹	10 ²		
													JN - Joint	BD - Bedding	PL - Planar								PO - Polished	MB - Mechanical Break
4	NQ RC	GROUND SURFACE		205.23																				
		SHALE BEDROCK (GEORGIAN BAY FORMATION) containing fossiliferous LIMESTONE interbeds Slightly to moderately weathered Dark grey Weak to medium strong		3.96	1	100%																		
5					2	100%																		
6					3	100%																		
7		END OF DRILLHOLE		202.18																				
				7.01																				

GTA-RCK 018 111110083.GPJ GAL-MISS.GDT 8/8/12

DEPTH SCALE

1 : 50



LOGGED: SB

CHECKED: NK

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No CN-4	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4839460.9 ; E 286741.3</u>	ORIGINATED BY <u>SB</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers</u>	COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>	DATE <u>April 11, 2012</u>	CHECKED BY <u>LCC</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
							20	40	60	80	100						
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					WATER CONTENT (%)					
							20	40	60	80	100	10	20	30			
209.0 0.0	GROUND SURFACE Clayey silt, trace to some sand, trace to some gravel, containing organics (FILL) Firm Brown to grey Moist		1	SS	5								○				
207.7			2	SS	5												
1.3	CLAYEY SILT with sand to some sand, some gravel (TILL) Very stiff to hard Brown Moist		3	SS	18								○	—			
			4	SS	45								○			13 21 47 19	
205.7			5	SS	84/0.15								○				
3.3	SHALE (BEDROCK) Weathered Grey																
205.0 4.0	SHALE (BEDROCK) containing limestone interbeds Bedrock cored from 4.0 to 7.3 m Refer to Record of Drillhole CN-4 for rock coring details		1	RC	REC 92%											RQD = 25%	
			2	RC	REC 95%											RQD = 46%	
			3	RC	REC 94%											RQD = 76%	
201.7 7.3	END OF BOREHOLE NOTE: 1. Open borehole dry upon completion of overburden drilling.																

GTA-MTO 001 111110083.GPJ GAL-MISS.GDT 8/8/12

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT: 11-1111-0083

RECORD OF DRILLHOLE: CN-4

SHEET 1 OF 1

LOCATION: N 4839460.9 ; E 286741.3

DRILLING DATE: April 11, 2012

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 Trackmount

DRILLING CONTRACTOR: Geo-Environmental Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR FLUSH	JN - Joint FLT - Fault SH - Shear VN - Vein CJ - Conjugate	BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage	PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular	PO - Polished K - Slickensided SM - Smooth RO - Rough VR - Very Rough	MB - Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.	NOTES											
													RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY		Diameter Point Load Index (MPa)	RMC - Q' AVG.
													TOTAL CORE %	SOLID CORE %			B Angle	DIP w/ L. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Ur	Ja		
		GROUND SURFACE		205.03																			
4	NQ RC	SHALE BEDROCK (GEORGIAN BAY FORMATION) containing fossiliferous LIMESTONE interbeds Slightly to moderately weathered Dark grey Weak to medium strong		3.96	1	100%																	
5				2	100%																		
6				3	100%																		
7		END OF DRILLHOLE		201.67																			
8				7.32																			
9																							
10																							
11																							
12																							
13																							

GTA-RCK 018 111110083.GPJ GAL-MISS.GDT 8/8/12

DEPTH SCALE

1 : 50



LOGGED: SB

CHECKED: NK

PROJECT: 11-1111-0083

RECORD OF DRILLHOLE: CN-5

SHEET 1 OF 1

LOCATION: N 4839489.5 ; E 286737.8

DRILLING DATE: April 9, 2012

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 Trackmount

DRILLING CONTRACTOR: Geo-Environmental Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY		Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES	
								TOTAL CORE %	SOLID CORE %			B Angle	DIP w/ ZL CORE AXIS	TYPE AND SURFACE DESCRIPTION	Ur	Ja	Ln				K, cm/sec
								80000000	80000000			80000000	80000000	80000000	80000000	80000000	80000000				80000000
		GROUND SURFACE		205.78																	
5		SHALE BEDROCK (GEORGIAN BAY FORMATION) containing fossiliferous LIMESTONE interbeds Slightly to moderately weathered Dark grey Weak to medium strong		4.57	1		100%														
6				2																	
7				3																	
8		END OF DRILLHOLE		201.81																	
				8.54																	
9																					
10																					
11																					
12																					
13																					
14																					

GTA-RCK 018 111110083.GPJ GAL-MISS.GDT 8/8/12

DEPTH SCALE

1 : 50



LOGGED: SB

CHECKED: NK

RECORD OF BOREHOLE No CN-6 SHEET 1 OF 1 **METRIC**

PROJECT 11-1111-0083 G.W.P. 2144-07-00 LOCATION N 4839486.8 ; E 286731.4 ORIGINATED BY SB

DIST Central HWY 410 BOREHOLE TYPE CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers COMPILED BY NK

DATUM Geodetic DATE April 10, 2012 CHECKED BY LCC

SOIL PROFILE		STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20	40	60	80	100	10	20
210.2	GROUND SURFACE																							
0.0	Clayey silt, some gravel, trace sand, containing organics (FILL) Stiff Brown Moist		1	SS	8																			
209.5			2	SS	16																			
0.7	CLAYEY SILT with to some sand, trace gravel (TILL) Very stiff to hard Moist Brown		3	SS	28																			
			4	SS	21																			
			5	SS	43																			
			6	SS	77/0.18																			
205.6	SHALE (BEDROCK) containing limestone interbeds		7	SS	50/0.05																			
4.6	Bedrock cored from 4.6 to 8.8 m Refer to Record of Drillhole CN-6 for rock coring details		1	RC	REC 72%																		RQD = 31%	
			2	RC	REC 67%																			RQD = 14%
			3	RC	REC 100%																			RQD = 84%
201.4	END OF BOREHOLE																							
8.8	NOTE: 1. Open borehole dry upon completion of overburden drilling.																							

GTA-MTO 001 111110083.GPJ GAL-MISS.GDT 8/8/12

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT: 11-1111-0083

RECORD OF DRILLHOLE: CN-6

SHEET 1 OF 1

LOCATION: N 4839486.8 ; E 286731.4

DRILLING DATE: April 10, 2012

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 Trackmount

DRILLING CONTRACTOR: Geo-Environmental Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY		Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES		
								TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Ur	Ja	Jn				K	cm/sec
								JN - Joint FLT - Fault SH - Shear VN - Vein CJ - Conjugate	BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage			PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular	PO - Polished K - Slickensided SM - Smooth RO - Rough VR - Very Rough	MB - Mechanical Break BR - Broken Rock								
		GROUND SURFACE		205.64																		
5		SHALE BEDROCK (GEORGIAN BAY FORMATION) containing fossiliferous LIMESTONE interbeds Slightly to moderately weathered Dark grey Weak to medium strong		4.57	1		100%															
6					2		100%															
7					3		100%															
8				201.37																		
9		END OF DRILLHOLE		8.84																		
10																						
11																						
12																						
13																						
14																						

GTA-RCK 018 111110083.GPJ GAL-MISS.GDT 8/8/12

DEPTH SCALE

1 : 50



LOGGED: SB

CHECKED: NK

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No CN-7	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4839485.3 ; E 286719.0</u>	ORIGINATED BY <u>SB</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers</u>	COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>	DATE <u>April 10, 2012</u>	CHECKED BY <u>LCC</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80			100	W _p	W	W _L	GR
210.4	GROUND SURFACE																	
0.0	Clayey silt, with to some sand, trace gravel, containing organics (FILL) Stiff Brown Moist		1	SS	12													
			2	SS	11													1 22 50 27
208.9	CLAYEY SILT with sand, trace to some gravel (TILL) Very stiff to hard Brown Moist		3	SS	24													
1.5			4	SS	27													
			5	SS	26													
			6	SS	50/0.15													10 32 40 18
206.0	SHALE (BEDROCK) Weathered Grey		7	SS	50/0.08													
4.4																		
205.2	SHALE (BEDROCK) containing limestone interbeds Bedrock cored from 5.2 m to 9.2 m Refer to Record of Drillhole CN-7 for rock coring details		1	RC	REC 36%													RQD = 17%
5.2			2	RC	REC 88%													RQD = 59%
			3	RC	REC 100%													RQD = 84%
201.3	END OF BOREHOLE NOTE: 1. Open borehole dry upon completion of overburden drilling.																	
9.2																		

GTA-MTO 001 111110083.GPJ GAL-MISS.GDT 8/8/12

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT 11-1111-0083 **RECORD OF BOREHOLE No CN-8** SHEET 1 OF 2 **METRIC**
 G.W.P. 2144-07-00 LOCATION N 4839507.7 ; E 286707.7 ORIGINATED BY SB
 DIST Central HWY 410 BOREHOLE TYPE CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers COMPILED BY NK
 DATUM Geodetic DATE March 25, 2012 CHECKED BY LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
218.9 0.0	GROUND SURFACE Sand and silt, trace clay, trace to some gravel, containing rootlets and pockets of clayey silt (FILL) Very loose to compact Brown Moist		1	SS	5								
			2	SS	18								
			3	SS	3								10 38 39 13
			4	SS	7								
215.9 3.0	Clayey silt, some sand, trace gravel, containing organics at a depth of 4.0 m (FILL) Soft to very stiff Brown Moist		5	SS	3								
			6	SS	5								
			7	SS	14								2 17 51 30
			8	SS	15								
210.2 8.7	CLAYEY SILT with to some sand, trace to some gravel (TILL) Very stiff to hard Brown Moist		9	SS	19								
			10	SS	19								
			11	SS	28								6 25 42 27
			12	SS	77								
206.0 12.9	SHALE (BEDROCK) Weathered Grey												
205.2 13.7													
			1	RC	REC 93%								RQD = 55%

GTA-MTO 001 111110083.GPJ GAL-MISS.GDT 8/8/12

Continued Next Page

 +³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No CN-8	SHEET 2 OF 2	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4839507.7 ; E 286707.7</u>	ORIGINATED BY <u>SB</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers</u>	COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>	DATE <u>March 25, 2012</u>	CHECKED BY <u>LCC</u>	

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 (%)										
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W _p	W			W _L	20	40	60	80	100	10	20	30	GR
202.0	Shale (BEDROCK) containing limestone interbeds Bedrock cored from 13.7 m to 16.9 m Refer to Record of Drillhole CN-8 for rock coring details	[Hatched Pattern]	1	RC																						RQD = 55%
16.9		[Hatched Pattern]	2	RC	REC 97%	203																				RQD = 80%
16.9	END OF BOREHOLE NOTE: 1. Open borehole dry upon completion of overburden drilling.																									

GTA-MTO 001 111110083.GPJ GAL-MISS.GDT 8/8/12

+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT: 11-1111-0083

RECORD OF DRILLHOLE: CN-8

SHEET 1 OF 1

LOCATION: N 4839507.7 ;E 286707.7

DRILLING DATE: March 25, 2012

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 Trackmount

DRILLING CONTRACTOR: Geo-Environmental Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR	FLUSH	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY		Diametral Point Load (MPa)	RMC -Q' AVG.	NOTES		
								TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Ur	Ja	Jn				K	cm/sec
								80000000	80000000			80000000	80000000	80000000	80000000	80000000	80000000				80000000	80000000
		GROUND SURFACE		205.22																		
14		SHALE BEDROCK (GEORGIAN BAY FORMATION) containing fossiliferous LIMESTONE interbeds Slightly to moderately weathered Dark grey Weak to strong		13.72	1			100%														
15				16	2			100%														
17		END OF DRILLHOLE		202.08 16.86																		
18																						
19																						
20																						
21																						
22																						
23																						

GTA-RCK 018 111110083.GPJ GAL-MISS.GDT 8/8/12

DEPTH SCALE

1 : 50



LOGGED: SB

CHECKED:

PROJECT 11-1111-0083 **RECORD OF BOREHOLE No CN-9** **SHEET 1 OF 2** **METRIC**
G.W.P. 2144-07-00 **LOCATION** N 4839502.3 ; E 286694.8 **ORIGINATED BY** SB
DIST Central **HWY** 410 **BOREHOLE TYPE** CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers **COMPILED BY** NK
DATUM Geodetic **DATE** March 26, 2012 **CHECKED BY** LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20 40 60 80 100	20 40 60 80 100	W _p	W		
219.8	GROUND SURFACE												
0.0	ASPHALT												
0.2	Sand and gravel, some silt (FILL) Compact Brown Moist		1	SS	15			o					
218.4													
1.5	Gravelly sand, some silt, trace clay (FILL) Loose to compact Brown Moist		2	SS	9								
			3	SS	11			o				26 51 18 5	
			4	SS	3								
216.1													
3.7	Clayey silt with sand, some gravel (FILL) Soft to very stiff Brown Moist		5	SS	3								
			6	SS	9							19 35 31 15	
			7	SS	11								
			8	SS	17								
211.1													
8.7	CLAYEY SILT with to some sand, trace gravel, containing rootlets to a depth of 9.8 m (TILL) Stiff to hard Brown Moist		9	SS	13								
			10	SS	33							2 22 47 29	
			11	SS	31								
			12	SS	50/13								
205.5													
14.3			1	RC	REC 89%							RQD = 52%	

GTA-MTO 001 111110083.GPJ GAL-MISS.GDT 8/8/12

Continued Next Page

 +³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT: 11-1111-0083

RECORD OF DRILLHOLE: CN-9

SHEET 1 OF 1

LOCATION: N 4839502.3 ; E 286694.8

DRILLING DATE: March 26, 2012

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 Trackmount

DRILLING CONTRACTOR: Geo-Environmental Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY		Diameter Point Load Index (MPa)	RMC -Q' AVG.	NOTES					
								TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Ur	Ja	Jn				K, cm/sec	10 ⁰	10 ¹	10 ²	10 ³
								80000000	80000000			80000000	80000000	80000000	80000000	80000000	80000000				80000000	80000000	80000000	80000000	80000000
		GROUND SURFACE		205.51																					
15	NQ RC	SHALE BEDROCK (GEORGIAN BAY FORMATION) containing fossiliferous LIMESTONE interbeds Slightly to moderately weathered Dark grey Weak to strong		14.33	1			100%																	
16				2				100%																	
17				202.37																					
18		END OF BOREHOLE		17.47																					
19																									
20																									
21																									
22																									
23																									
24																									

GTA-RCK 018 111110083.GPJ GAL-MISS.GDT 8/8/12

DEPTH SCALE

1 : 50



LOGGED: SB

CHECKED:

RECORD OF BOREHOLE No CN-10 SHEET 1 OF 1 **METRIC**

PROJECT 11-1111-0083 G.W.P. 2144-07-00 LOCATION N 4839520.5 ; E 286693.7 ORIGINATED BY SB

DIST Central HWY 410 BOREHOLE TYPE CME-55 Track-mount, 57 mm Inner Diameter Hollow Stem Augers COMPILED BY NK

DATUM Geodetic DATE March 26, 2012 CHECKED BY LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)
						20	40	60	80	100							
218.5	GROUND SURFACE																
0.0	Clayey silt, some sand, trace gravel, containing rootlets and pockets of silty sand (FILL) Firm to stiff Brown Moist		1	SS	5												
			2	SS	8												
217.1	Sandy silt, trace clay, trace gravel, containing pockets of clayey silt (FILL) Very loose to compact Brown Moist becoming wet below a depth of 3.0 m																
1.5			3	SS	19												
			4	SS	6												
			5	SS	3												
			6	SS	18												
			7	SS	11												
212.9	Clayey silt with sand, some gravel (FILL) Firm to very stiff Moist Brown																
5.6			8	SS	5												
			9	SS	18												
209.8	CLAYEY SILT with sand, trace gravel (TILL) Hard Brown Moist																
8.7			10	SS	34												
208.8	END OF BOREHOLE																
9.8	NOTE: 1. Water level in open borehole at a depth of 5.2 m (Elev. 213.3 m) on completion of drilling.																

GTA-MTO 001 1111110083.GPJ GAL-MISS.GDT 8/8/12

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT 11-1111-0083 **RECORD OF BOREHOLE No OR-1** **SHEET 1 OF 1** **METRIC**
G.W.P. 2144-07-00 **LOCATION** N 4839689.5 ; E 286531.3 **ORIGINATED BY** MS
DIST Central **HWY** 410 **BOREHOLE TYPE** CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers **COMPILED BY** NK
DATUM Geodetic **DATE** November 8, 2011 **CHECKED BY** LCC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20	40	60	80	100	10	20
219.9	GROUND SURFACE																							
0.0	Clayey silt with sand, trace gravel (FILL) Stiff Brown Moist		1	SS	10																			
219.2	Sandy silt, trace clay (FILL) Dense Brown Moist		2	SS	34																			
218.4	Clayey silt with sand, trace gravel (FILL) Very stiff Brown Moist		3	SS	15																			
217.7	Sand and silt, trace to some gravel, trace clay, containing pockets of clayey silt (FILL) Very loose to compact Brown Moist		4	SS	14																			
217.0			5	SS	2																			8 43 41 8
216.5			6	SS	4																			
215.5			7	SS	65																			
214.4	Cobbles/boulders inferred below approximately 5 m depth																							
214.4	Silty clay, some sand, trace to some gravel, containing organics (FILL) Stiff Brown Moist			8	SS	8																		5 18 41 36
213.2																								
213.2	CLAYEY SILT, some sand, trace gravel (TILL) Very stiff Brown Moist		9	SS	29																			
211.7																								
211.7	END OF BOREHOLE																							
8.2	NOTE: 1. Borehole dry on completion of drilling.																							

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 9/27/12

PROJECT 11-1111-0083 **RECORD OF BOREHOLE No OR-2** SHEET 1 OF 2 **METRIC**
 G.W.P. 2144-07-00 LOCATION N 4839702.4 ; E 286519.0 ORIGINATED BY MS
 DIST Central HWY 410 BOREHOLE TYPE CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers COMPILED BY NK
 DATUM Geodetic DATE November 8, 2011 CHECKED BY LCC

SOIL PROFILE		STRAT PLOT	SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)										
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE			"N" VALUES	20						40	60	80	100	20	40	60	80	100	10
220.8	GROUND SURFACE																						
0.0	Silty sand, some gravel (FILL) Compact Brown Moist		1	SS	19																		
220.1																							
0.7	Clayey silt, trace to some sand, trace gravel (FILL) Stiff		2	SS	8																		
219.3																							
1.5	Brown Moist		3	SS	8																		
	Sand and silt, trace to some clay, trace to some gravel, containing pockets of clayey silt (FILL) Loose to compact Brown Moist		4	SS	13																		
			5	SS	11																		
			6	SS	84/20																		9 38 34 19
	Cobbles/boulders inferred below approximately 3.8 m depth		7	SS	19																		8 35 52 5
			8	SS	11																		
			9	SS	17																		
212.1																							
8.7	CLAYEY SILT, some sand, trace to some gravel (TILL) Very stiff to hard Brown becoming grey at a depth of 12 m Moist		10	SS	40																		
			11	SS	26																		6 21 48 25
			12	SS	80/23																		
207.7																							
13.1	SHALE (BEDROCK) Bedrock cored from 13.1 m to 16.9 m Refer to Record of Drillhole OR-2 for rock coring details		1	RC	REC 78%																		RQD = 19%
			2	RC	REC 100%																		RQD = 83%

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 9/27/12

Continued Next Page

 +³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No OR-2	SHEET 2 OF 2	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4839702.4 ; E 286519.0</u>	ORIGINATED BY <u>MS</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers</u>	COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>	DATE <u>November 8, 2011</u>	CHECKED BY <u>LCC</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W _p	W			W _L	10	20	30	GR
	--- CONTINUED FROM PREVIOUS PAGE ---																				
	SHALE (BEDROCK)		2	RC																	RQD = 83%
	Bedrock cored from 13.1 m to 16.9 m																				
	Refer to Record of Drillhole OR-2 for rock coring details		3	RC	REC 100%																RQD = 34%
203.9	END OF BOREHOLE																				
16.9	NOTE: 1. Borehole dry on completion of overburden drilling.																				

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 9/27/12

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT: 11-1111-0083

RECORD OF DRILLHOLE: OR-2

SHEET 1 OF 1

LOCATION: N 4839702.4 ;E 286519.0

DRILLING DATE: November 8, 2011

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 Trackmount

DRILLING CONTRACTOR: Geo-Environmental Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY			Diameter Point Load Index (MPa)	RMC -Q' AVG.	NOTES					
								TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn				K, cm/sec	10 ⁰	10 ¹	10 ²	10 ³
								80000000	80000000			80000000	80000000	80000000	80000000	80000000	80000000				80000000	80000000	80000000	80000000	80000000
		GROUND SURFACE		207.70																					
14	NQ RC NW Casing	SHALE BEDROCK (GEORGIAN BAY FORMATION) containing fossiliferous LIMESTONE interbeds and 2-3 cm thick clay seams at a depth of 13.8 m (Elev. 207.0 m) and 14.4 m (Elev. 206.4 m) Slightly weathered Grey Laminated Medium strong		13.10	1																				
15				2																					
16				3																					
17		END OF DRILLHOLE		203.94 16.86																		(Axial)			

GTA-RCK 018 111110083.GPJ GAL-MISS.GDT 9/27/12

DEPTH SCALE

1 : 50



LOGGED: MS

CHECKED:

PROJECT 11-1111-0083 **RECORD OF BOREHOLE No OR-3** **SHEET 1 OF 1** **METRIC**
G.W.P. 2144-07-00 **LOCATION** N 4839707.0 ; E 286503.7 **ORIGINATED BY** MS
DIST Central **HWY** 410 **BOREHOLE TYPE** CME 75 Truck-mount, 108 mm Inner Diameter Hollow Stem Augers **COMPILED BY** NK
DATUM Geodetic **DATE** November 2, 2011 **CHECKED BY** LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)									
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)								
						20	40	60	80	100	20	40	60	80	100	10	20	30		GR	SA	SI	CL		
213.8	GROUND SURFACE																								
0.0	Asphalt																								
0.2	Silty sand and gravel (FILL)		1	SS	35																				
213.1	Dense Brown Moist																								
0.7	CLAYEY SILT with to some sand, trace to some gravel (TILL) Stiff to hard Brown becoming grey at a depth of 3.8 m Moist		2	SS	17																6	16	53	25	
			3	SS	23																				
			4	SS	19																				
			5	SS	31																				
			6	SS	16																				
			7	SS	14																				
			8	SS	50/0 10																				
207.6	SHALE (BEDROCK)		1	RC	REC 100%																			RQD = 0%	
6.2	Bedrock cored from 6.2 m to 9.5 m Refer to Record of Drillhole OR-3 for rock coring details		2	RC	REC 97%																				RQD = 51%
			3	RC	REC 100%																				RQD = 57%
204.3	END OF BOREHOLE																								
9.5	NOTE: 1. Borehole dry on completion of overburden drilling.																								

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 9/27/12

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT: 11-1111-0083

RECORD OF DRILLHOLE: OR-3

SHEET 1 OF 1

LOCATION: N 4839707.0 ; E 286503.7

DRILLING DATE: November 2, 2011

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 75 Truckmount

DRILLING CONTRACTOR: Geo-Environmental Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY		Diameter Point Load Index (MPa)	RMC -Q' AVG.	NOTES	
								TOTAL CORE %	SOLID CORE %			TYPE AND SURFACE DESCRIPTION		Ur	Ja	Jn	K				cm/sec
								88888888	88888888			B Angle	DIP w.r.t. CORE AXIS	°	°	°	°				°
		GROUND SURFACE		207.60																	
7	HQ RC HW Casing	SHALE BEDROCK (GEORGIAN BAY FORMATION) containing fossiliferous LIMESTONE interbeds and a 5 cm thick clay seams at a depth of 7.2 m (Elev. 206.6 m) Slightly weathered Grey Laminated Medium strong		6.20	1																(Axial)
8					2																
9					3																
10		END OF DRILLHOLE		204.27 9.53																	

GTA-RCK 018 111110083.GPJ GAL-MISS.GDT 9/27/12

DEPTH SCALE

1 : 50



LOGGED: MS

CHECKED:

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No OR-4	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4839713.5 ; E 286519.2</u>	ORIGINATED BY <u>MS</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME 75 Truck-mount, 108 mm Inner Diameter Hollow Stem Augers</u>	COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>	DATE <u>November 2, 2011</u>	CHECKED BY <u>LCC</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					WATER CONTENT (%)				
								20	40	60	80	100	10	20	30		
213.7	GROUND SURFACE																
0.0	Asphalt																
0.2	Sand and gravel, some silt, trace clay (FILL)		1	SS	26												47 42 10 1
213.0	Compact Brown Moist						213										
0.7	CLAYEY SILT with to some sand, trace to some gravel (TILL) Stiff to hard Brown becoming grey at a depth of 3.8 m Moist		2	SS	16												
			3	SS	24		212										
			4	SS	32		211										
			5	SS	25		210									6 24 39 31	
			6	SS	12		209										
			7	SS	12		208										
207.5	SHALE (BEDROCK)		8	SS	50/0 10		207										RQD = 70%
6.2	Bedrock cored from 6.2 m to 9.5 m Refer to Record of Drillhole OR-4 for rock coring details		1	RC	REC 100%		207										RQD = 46%
			2	RC	REC 100%		206										RQD = 50%
			3	RC	REC 100%		205										
204.2	END OF BOREHOLE																
9.5	NOTE: 1. Borehole dry on completion of overburden drilling.																

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 9/27/12

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No OR-5 SHEET 1 OF 1 METRIC

PROJECT 11-1111-0083 G.W.P. 2144-07-00 LOCATION N 4839716.3 ; E 286495.0 ORIGINATED BY MS

DIST Central HWY 410 BOREHOLE TYPE CME 75 Truck-mount, 108 mm Inner Diameter Hollow Stem Augers COMPILED BY NK

DATUM Geodetic DATE November 1, 2011 CHECKED BY LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)										
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)									
						20	40	60	80	100	20	40	60	80	100	10	20	30		GR	SA	SI	CL			
213.8	GROUND SURFACE																									
0.0	Asphalt																									
0.2	Sand and gravel, trace to some silt, trace clay (FILL) Very loose to compact Brown Moist to wet		1	SS	30																					
			2	SS	23																				27 58 7 8	
			3	SS	2																					
211.5	CLAYEY SILT with to some sand, trace to some gravel (TILL) Stiff to hard Brown becoming grey at a depth of 3.8 m Wet		4	SS	34																					
			5	SS	35																					
			6	SS	18																					7 26 45 22
			7	SS	14																					
208.5	SHALE (BEDROCK) Weathered Grey		8	SS	100/0.15																					
207.7	SHALE (BEDROCK) Bedrock cored from 6.1 m to 9.5 m Refer to Record of Drillhole OR-5 for rock coring details		9	SS	5WBC																			RQD = 0%		
6.1			1	HQRC	REC 58%																				RQD = 33%	
			2	HQRC	REC 60%																					RQD = 58%
			3	HQRC	REC 85%																					
204.3	END OF BOREHOLE																									
9.5	NOTES: 1. Water level in piezometer at a depth of 6.8 m below ground surface (Elev. 207.0 m) on November 1, 2011. 2. Water level in piezometer at a depth of 0.9 m below ground surface (Elev. 212.9 m) on November 18, 2011. 3. Water level in piezometer at a depth of 1.1 m below ground surface (Elev. 212.7 m) on January 19, 2012.																									

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 9/27/12

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT 11-1111-0083 **RECORD OF BOREHOLE No OR-6** **SHEET 1 OF 1** **METRIC**
G.W.P. 2144-07-00 **LOCATION** N 4839722.9 ; E 286510.5 **ORIGINATED BY** MS
DIST Central **HWY** 410 **BOREHOLE TYPE** CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers **COMPILED BY** NK
DATUM Geodetic **DATE** November 18, 2011 **CHECKED BY** LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)						
						20	40	60	80	100	20	40	60	80	100	10	20	30	GR	SA	SI	CL	
213.7	GROUND SURFACE																						
0.0	ASPHALT																						
0.2	Silty sand and gravel (FILL) Dense to compact Brown Moist		1	SS	47																		
			2	SS	11																		
212.2																							
1.5	CLAYEY SILT with to some sand, trace to some gravel (TILL) Stiff to hard Brown becoming grey at a depth of 3.4 m Moist		3	SS	18																		
			4	SS	38																		
			5	SS	27																		
			6	SS	13																		
			7	SS	34																		
207.6	SHALE (BEDROCK)		1	RC	REC 93%																		
			2	RC	REC 100%																		
	Bedrock cored from 6.1 m to 9.3 m Refer to Record of Drillhole OR-6 for rock coring details		3	RC	REC 100%																		
204.4	END OF BOREHOLE																						
9.3	NOTE: 1. Borehole dry on completion of overburden drilling.																						

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 9/27/12

PROJECT: 11-1111-0083

RECORD OF DRILLHOLE: OR-6

SHEET 1 OF 1

LOCATION: N 4839722.9 ; E 286510.5

DRILLING DATE: November 18, 2011

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 Trackmount

DRILLING CONTRACTOR: Geo-Environmental Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY		Diametral Point Load Index (MPa)	RMC - Q' AVG.	NOTES	
								TOTAL CORE %	SOLID CORE %			DIP w.r.t. CORE AXIS		TYPE AND SURFACE DESCRIPTION		K, cm/sec	10 ⁰				
								000000	000000			B Angle	000000	000000	000000	000000	000000				
		GROUND SURFACE		207.60																	
7	HO RC HW Casing	SHALE BEDROCK (GEORGIAN BAY FORMATION) containing fossiliferous LIMESTONE interbeds Slightly weathered Grey Laminated Medium Stong		6.10	1															(Axial)	
8				2																	(Axial)
9				3																	
		END OF DRILLHOLE		204.40 9.30																	

GTA-RCK 018 111110083.GPJ GAL-MISS.GDT 9/27/12

DEPTH SCALE

1 : 50



LOGGED: MS

CHECKED:

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No OR-7	SHEET 1 OF 2	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4839726.3 ; E 286495.1</u>	ORIGINATED BY <u>MS</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers</u>	COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>	DATE <u>November 10, 2011</u>	CHECKED BY <u>LCC</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
220.5	GROUND SURFACE															
0.0	Clayey silt with sand, containing pockets of silty sand (FILL) Stiff to very stiff Brown Moist		1	SS	26						○					
			2	SS	12											
219.0																
1.5	Sandy silt to sand and silt, trace clay, trace to some gravel, containing pockets of clayey silt (FILL) Loose to compact Brown Moist		3	SS	5						○	H				
			4	SS	8											
			5	SS	4							H			9 39 41 11	
			6	SS	29											
			7	SS	13						○				5 31 51 13	
			8	SS	29											
213.3																
7.2	CLAYEY SILT, with some sand, trace gravel (TILL) Very stiff Brown becoming grey at a depth of 10.7 m Moist		9	SS	26						○					
			10	SS	27											
			11	SS	19						○	H			3 25 46 26	
208.6																
11.9	SHALE (BEDROCK)		1	RC	REC 63%										RQD = 0%	
			2	RC	REC 66%										RQD = 13%	
	Bedrock cored from 11.9 m to 15.3 m Refer to Record of Drillhole OR-7 for rock coring details		3	RC	REC 99%										RQD = 76%	

GTA-MTO 001 1111110083.GPJ GAL-GTA.GDT 9/27/12

Continued Next Page

 +³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No OR-7	SHEET 2 OF 2	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4839726.3 ; E 286495.1</u>	ORIGINATED BY <u>MS</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers</u>	COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>	DATE <u>November 10, 2011</u>	CHECKED BY <u>LCC</u>	

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	20	40	60	80	100	W _p	W			W _L	20	40
205.2	SHALE (BEDROCK)		3	RC															
15.3	END OF BOREHOLE																		
	NOTE: 1. Borehole dry on completion of overburden drilling.																		

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 9/27/12

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT: 11-1111-0083

RECORD OF DRILLHOLE: OR-7

SHEET 1 OF 1

LOCATION: N 4839726.3 ; E 286495.1

DRILLING DATE: November 10, 2011

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 Trackmount

DRILLING CONTRACTOR: Geo-Environmental Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV.		RUN No.	COLOUR	FLUSH	RECOVERY			R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY			Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES				
				DEPTH (m)					TOTAL CORE %	SOLID CORE %	B Angle			DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Ur	Ja	Jn	K	cm/sec				10 ⁰	10 ¹	10 ²	10 ³
									88888888	88888888	88888888			88888888	88888888	88888888	88888888	88888888	88888888	88888888				88888888	88888888	88888888	88888888
		GROUND SURFACE		208.61																							
12	NO RC NW Casing	SHALE BEDROCK (GEORGIAN BAY FORMATION) containing fossiliferous LIMESTONE interbeds Slightly to highly weathered Grey Laminated Medium strong		11.89		1																					
13				2																							
14				3																							
15		END OF DRILLHOLE		205.16	15.34																			(Axial)			

GTA-RCK 018 111110083.GPJ GAL-MISS.GDT 9/27/12

DEPTH SCALE

1 : 50



LOGGED: MS

CHECKED:

PROJECT <u>11-1111-0083</u>	RECORD OF BOREHOLE No OR-8	SHEET 1 OF 1	METRIC
G.W.P. <u>2144-07-00</u>	LOCATION <u>N 4839738.6 ; E 286484.1</u>	ORIGINATED BY <u>MS</u>	
DIST <u>Central</u> HWY <u>410</u>	BOREHOLE TYPE <u>CME-55 Track-mount, 108 mm Inner Diameter Hollow Stem Augers</u>	COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>	DATE <u>November 10, 2011</u>	CHECKED BY <u>LCC</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20					
219.4	GROUND SURFACE												
0.0	Sandy silt, trace clay, trace gravel, containing pockets of clayey silt, containing organics (FILL) Loose to compact Brown Moist		1	SS	9								
			2	SS	11								
217.9													
1.5	Clayey silt with sand, trace gravel, containing pockets of silty sand (FILL) Hard Brown Moist		3	SS	34								
217.0													
2.4	Sand and silt, some gravel, trace clay, containing pockets of clayey silt (FILL) Compact Brown Moist		4	SS	14								
			5	SS	25								
			6	SS	24								27 30 31 12
215.0													
4.4	Clayey silt, some sand, trace gravel (FILL) Firm Brown Moist		7	SS	6								
213.8													
5.6	CLAYEY SILT, some sand, trace gravel (TILL) Very stiff to hard Brown Moist		8	SS	29								1 11 53 35
211.2			9	SS	34								
8.2	END OF BOREHOLE												
	NOTE: 1. Borehole dry on completion of drilling.												

GTA-MTO 001 111110083.GPJ GAL-GTA.GDT 9/27/12



APPENDIX C2

Historic MTO Boreholes Records

DESIGN SERVICES BRANCH

RECORD OF BOREHOLE NO 3

FOUNDATIONS OFFICE

BH-25-3

JOB 72-11166

LOCATION Co-ords. 856,279 N; 957,758 E.

ORIGINATED BY VK

W.P. 127-66-22

BORING DATE Feb. 20, 1973

COMPILED BY DP

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger and Cone Test

CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W			BULK DENSITY Y	REMARKS			
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	W _p	W	W _L			P.C.F.	GR.	SA.
(m) 183.9	603.2	Ground Level																	
0.0	(Glacial Till) Het. mix. of clayey silt, some sand and gravel. Brown	[Symbol]	1	SS	129	10"													Hole dry at time of investigation
182.2	597.7	Stiff to Hard																	37 13 31 21
1.7	5.5	End of Borehole Probable Bedrock	[Symbol]							100/4"									
						595													

OFFICE REPORT SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 6

BH-25-6

JOB 72-11166

LOCATION Co-ords. 856,151 N; 957,719 E.

ORIGINATED BY UK

W.P. 127-66-22

BORING DATE Feb. 20, 1973

COMPILED BY JB

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger and Cone Test

CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT			BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT					PLASTIC LIMIT	WATER CONTENT			
						20	40	60	80	100		W _p	W			
						SHEAR STRENGTH P.S.F.					W _p	W	W _L			
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT %					
												10	20	30		
185.3 607.8	Ground Level (Glacial Till) Het. mix. of clayey silt, some sand and gravel. Brown		1	SS	36											
182.0 600.2	Stiff to Hard		2	SS	151.2"											
2.3 7.6	End of Borehole Probable Bedrock															

OFFICE REPORT SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 3

BH-26-3

JOB 72-11167

LOCATION Co-ords. 856,608 N; 957,321 E.

ORIGINATED BY VK

W.P. 127-66-20

BORING DATE Feb. 19, 1973

COMPILED BY DB

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger and Cone Test

CHECKED BY *[Signature]*

(m)

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT			BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT	20	40	60	80	100	W _L	W _P		
							SHEAR STRENGTH P.S.F.					WATER CONTENT %				
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					W _p — W — W _L 10 20 30			P.C.F.	GR SA SI CL
183.5	602.0	Ground Level														
0.0		Het. mix. of clayey silty some sand & gravel (Glacial Till)				600										
		Grey	1	SS	37											5 23 47 25
		Stiff to Hard	2	SS	103	595					100/6"					596.5
180.6	592.5															13 12 54 21
180.3	591.5	Weathered Shale	3	SS	100/7"											13 15 46 20
3.2	10.5	End of Borehole				590										

OFFICE REPORT SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 4 BH-26-4

JOB 72-11167
 W.P. 127-66-20
 DATUM Geodetic

LOCATION Co-ords. 856,550 N; 957,385 E.
 BORING DATE Feb. 22, 1973
 BOREHOLE TYPE Hollow Stem Auger, Cone Test & BX Rock Core

ORIGINATED BY VK
 COMPILED BY DB
 CHECKED BY *[Signature]*

(m)

184.3

182.0

2.3

180.1

4.2

174.9

9.4

ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT PLASTIC LIMIT			BULK DENSITY	REMARKS
			NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	W _p	W	W _L		
604.7	Ground Level															
597.0	Het. mix. of clayey silt, some sand and traces of gravel (Glacial Till) Brown Very Stiff to Hard	<i>[Handwritten Strat. Plot]</i>	1	SS	55											3 25 48 24
597.0			2	SS	59											1 28 3 15
597.0	Bedrock	<i>[Handwritten Strat. Plot]</i>	3	HC BX	50%											595.8
597.0	Shale		4	BX	25%											
597.0	Dark Grey		5	BX	100%											
591.0	weathered		6	BX	66%											
591.0			7	BX	74%											
585.0	Interbedded shale and limestone		8	BX	28%											
585.0	Dark Grey		9	BX	90%											
585.0	Sound		10	BX	100%											
574.0	End of Borehole															

OFFICE REPORT SOIL EXPLORATION

DESIGN SERVICES BRANCH

RECORD OF BOREHOLE NO 4

FOUNDATIONS OFFICE

BH-066-4

JOB 73-11074

LOCATION

Co-ords. 15,855,596 N; 958,711 E.

ORIGINATED BY VR

W.P. 127-66-24

BORING DATE

Sept. 15, 1973

COMPILED BY VR

DATUM Geodetic

BOREHOLE TYPE

Auger and core with CME 750

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w w_p — w — w_L	BULK DENSITY γ P.C.F. GR. SA. S.G.	REMARKS
ELEV. DEPTH (m)	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS/FOOT					
181.6	595.9	Ground Level								
0.0	587.9	Het. mix. of silty clay sand and gravel. (Glacial Till)	1	SS	58					1.2k 53
179.2	587.9	Very Stiff to Hard	2	SS	43	590				590.4
2.4	580.0	Sound Shale Bedrock	3	SS	27					0.12 67 2
	575.9		4	BXL	100%					
	575.9		5	BXL	100%	580				
175.5	575.9		6	BXL	100%					
6.1	20.0	End of Borehole				570				

OFFICE REPORT SOIL EXPLORATION

DESIGN SERVICES BRANCH

RECORD OF BOREHOLE No 17

FOUNDATIONS OFFICE

8H-086-17

JOB 73-11014

LOCATION Co-ords. 15,857,245N & 956,874E

ORIGINATED BY V.K.

W.P. 127-66-34

BORING DATE May 16, 1973

COMPILED BY C.S.P.

DATUM Geodetic

BOREHOLE TYPE Auger and BXL Rock Core

CHECKED BY G.P.

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w w_p w w_L			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS/FOOT	SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE		WATER CONTENT %			
179.8	590.0	Ground level										
	0.0	Heterogeneous mixture of clayey silt, sand and gravel (Glacial till)										
177.2	581.3	Interbedded - limestone and shale, weathered BEDROCK - SHALE Occasional limestone layers (up to 7" in thickness) Dark grey Sound	1	BXL RC	83% Rec	580						V.W.L. Elev 587.5 June 1973
176.4	8.7		2	BXL RC	100% Rec							
3.4	572.7		3	BXL RC	100% Rec							
	11.3		4	BXL RC	100% Rec							
172.9	567.5	End of Borehole				570						
6.9	22.5					560						

OFFICE REPORT SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 18

BH-086-18

JOB 73-11014

LOCATION Co-ords. 15,857,388N & 956,614E

ORIGINATED BY V.K.

W.P. 127-66-34

BORING DATE May 14, 1977

COMPILED BY C.S.P.

DATUM Geodetic

BOREHOLE TYPE Auger and EXL Rock Core

CHECKED BY S.R.

ELEV. (m)	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 γ	REMARKS
	ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F.		WATER CONTENT %				
178.5	585.6	Ground level												
177.3	581.6	Heterogeneous mixture of clayey silt, sand and gravel (Glacial till)		1	SS	100%								P.C.F. GWSA. 51. CL
1.2	4.0	SHALE		2	BXL	100%								Elev. 585.6 June 1973
				3	RC	Rec	580							
				4	BXL	67%								
174.5	572.6	Weathered		5	RC	Rec								
4.0	13.0	BEDROCK - SHALE		6	BXL	100%	570							
		Occasional weathered zones		7	RC	Rec								
				8	BXL	100%								
		Occasional limestone layers (up to 6" in thickness)		9	RC	Rec	560							
				10	BXL	73%								
				11	RC	Rec	550							
		Dark grey		12	BXL	96%								
				13	RC	Rec	540							
162.5	533.1	End of Borehole					530							
16	52.5													

OFFICE REPORT ON SOIL EXPLORATION

BH-090-16

BH-090-16

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

DESIGN SERVICES BRANCH

RECORD OF BOREHOLE No.16

FOUNDATION SECTION

JOB 72-11053

LOCATION Co-ord's 856,560 N. 957,399 E.

ORIGINATED BY V.X.

W.P. 127-66-01

BORING DATE April 20, 1972

COMPILED BY A.T.

DATUM Geodetic

BOREHOLE TYPE Auger and Cone Test

CHECKED BY *[Signature]*

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION BLOWS/FOOT	SHEAR STRENGTH P.S.F.	LIQUID LIMIT PLASTIC LIMIT WATER CONTENT	BULK DENSITY	REMARKS
		NUMBER	TYPE						
184.2	Ground level.								
0.0	Clayey silt with some sand, and gravel. (Glacial Till)	1	SS 39	600					
	Hard.	2	SS 110/6"						
		3	SS 100/3"						
180.2	Bedrock	4	SS 116/5"	590					13 27 36 24
4.0	Bedrock <u>Weathered</u>	5	BX 89						
	Dark grey shale with minor limestone bands	6	BX-RC 67%						
177.6	Sound	7	BX RC 77%						
6.6	End of borehole.			580					

(in)

RECORD OF BOREHOLE NO 5 BH-115-5

WP 36-74-02/03 LOCATION Co-ords. 15,853,174 N; 960,970 E. ORIGINATED BY VK
 DIST 6 HWY 403 BORING DATE December 1, 1975 COMPILED BY VK
 DATUM Geodetic BOREHOLE TYPE CME (5.1) M.V.H.S. CHECKED BY M.T.

SOIL PROFILE		STRAT. PLOT	SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARKS			
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L			GR	SA	SI
164.7	540.4	Ground Level																	
		Topsoil																	
0.5	1.5	Weathered	1	SS	91														
161.7	530.4		2	SS	100	1" 530													
3.0	10.0	Sound Shale Bedrock with limestone bands	3	BXL	100% Rec														
			4	BXL	80% Rec														
			5	BXL	80% Rec	520													
			6	BXL	95% Rec														
155.6	510.4	End of Borehole				310													
9.1	30.0																		

OFFICE REPORT ON OIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 6 BH-115-6

WP 36-74-02/03 LOCATION Co-ords. 15,853,030 N; 960,930 E. ORIGINATED BY VK
 DIST 6 HWY 403 BORING DATE December 1, 1975 COMPILED BY VK
 DATUM Geodetic BOREHOLE TYPE CME (5.1) M.V.H.S. CHECKED BY HJ

SOIL PROFILE		SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w w_p — w — w_L WATER CONTENT %	UNIT WEIGHT γ	REMARKS
(m) ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE					
165.2	542.0	Ground Level							
		Topsail							
0.5	1.5	Weathered Shale			540				
163.7	537.0								
1.5	5.0	End of Borehole			530				

BH-189-7

RECORD OF BOREHOLE No 7 **BH-189-7** METRIC

W P 54-82-11 LOCATION Co-ords. N 4 533 016.2; E 291 897.0 ORIGINATED BY DE
 DIST 6 HWY 410/401 BOREHOLE TYPE Solid Stem Auger, BQ Rock Core COMPILED BY HE
 DATUM Geodetic DATE 84 10 01 CHECKED BY CP

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W _n	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE			'W VALUES	20	40	60	80					
172.7	Ground Surface															
0.0	Heterogeneous Mixture															
172.2	Silty Clay some sand															
0.5	Grey Shale Bedrock with Limestone Layers 4 to 20 cm thick		1	RC	BQ		172	69X	21X	Weathering Highly						
			2	RC	BQ		171	100X	14X	Slightly to Unweathered						
		3	RC	BQ		170	100X	25X								
169.4	End of Borehole															
3.3	* Note: Water level not obtained															

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 11

METRIC

W P 94-82-10 LOCATION Co-ords. N 4 833 148; E 291 738 ORIGINATED BY DT
 DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger, B Core COMPILED BY DD
 DATUM Geodetic DATE 84 10 04 CHECKED BY EP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					NATURAL MOISTURE CONTENT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	PLASTIC LIMIT W _p	W	LIQUID LIMIT W _L			WATER CONTENT (%)	GR	SA	SI
173.6	Ground Surface																				
0.0	Silty Clay (CL) with some sand Weathered Unweathered Bedrock Shale with limestone layers		1	SS	14	**															
173.0			2	RC	REC 100%		173														
0.6			3	RC	REC 100%		172														
			4	RC	REC 100%		171														
170.4	End of Borehole																				
3.2	* some/trace gravel stiff to hard **groundwater elevation not determined																				

OFFICE REPORT ON SOIL EXPLORATION

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

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 1 BH-110-1

W.P. 103-69-00 LOCATION Co-ords. 861,012 N; 953,060 E. ORIGINATED BY VR
 DIST. 6 HWY. 410 BORING DATE June 30, July 3, 1975 COMPILED BY OY
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & BX Casing CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			UNIT WEIGHT γ	REMARKS % GR. SA. SI. CL.
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	W_p	W	W_L		
187.5	615.0	Ground Level														
0.0																
			1	SS	33	610									4 26 42 28	
			2	SS	45											
			3	SS	16	600									7 48 34 11	
			4	SS	19											
			5	SS	118	590									7 30 46 17	
			6	SS	140											
			7	SS	180	580									5 27 44 24	
176.1	577.5	Very stiff to Hard														
175.2	574.5	Silty sand & gravel	8	SS	175	570										
123	40.5															
170.7	560.0															
16.8	55.0	Bedrock														
169.2	555.0	Sound Shale	9	BXL	100% REC	560										
18.3	60.0	End of Borehole														

OFFICE REPORT ON SOIL EXPLORATION

(m)

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 2

BH-110-2

W.P. 103-69-00

LOCATION Co-ords. 864,490 N: 949,700 E.

ORIGINATED BY VK

DIST. 6 HWY. 410

BORING DATE June 30, 1975

COMPILED BY OY

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & BX Casing

CHECKED BY

(m)	SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARKS % GR. SA. SI. CL.	
	ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	W VALUES		20	40	60	80	100	w_p	w	w_L			
186.5	611.8	Ground Level																
0.0	591.8	Net. mixture of clayey silt, sand and gravel (Glacial Till) V. Stiff to Hard		1	SS	22											1 9 53 37	
				2	SS	26												
				3	SS	65												
				4	SS	76												4 29 49 18
				5	SS	117												
				6	SS	71												
180.4	591.8	Silty sand with some gravel & trace of clay Very Dense		7	SS	197	8"										11 36 40 13	
6.1	20.0			8	SS	149												
				9	SS	109												17 36 42 5
				10	SS	91												
				11	SS	65												15 36 42 5
172.9	567.3	Bedrock Shale		12	BXL	REC	80%											
172.2	13.6	54.5																
143	47.0	564.8																
		End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 3 BH-110-3

W.P. 103-69-00 LOCATION Co-ords. 867,280 N; 946,985 E. ORIGINATED BY VK
 DIST. 6 HWY. 410 BORING DATE June 26, 1975 COMPILED BY OY
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & BX Casing CHECKED BY [Signature]

SOIL PROFILE		STRAT. PLOT	SAMPLES		GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARKS	
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE		'N' VALUES	20	40	60	80	100	w_p	w			w_L
193.4	634.5	Ground Level														
0.0	Het. mixture of clayey silt, sand and gravel		1	SS	124											
			2	SS	100	6"										
188.8	619.5		Hard													
188.2	617.9		Weathered	3	SS	106	6"									
5.2	17.0	Sound Shale Bedrock			90%											
186.5	612.0		4	BXL	REC											
6.9	22.5	End of Borehole														

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE NO 1(1) (Culvert 1) BH-122-1(1)

WP 103-69-08 LOCATION Co-ords. N 15,865,017 E 949,335 ORIGINATED BY VK
 DIST 6 HWY 410 BORING DATE July 28, 1976 COMPILED BY VK
 DATUM Geodetic BOREHOLE TYPE C.M.E. 5.1. (1) M.V.H.S. CHECKED BY *PK*

(m)

184.7

175.4

9.3

SOIL PROFILE		SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w w_p — w — w_L	UNIT WEIGHT γ	REMARKS	
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE						'N' VALUES
605.9	Ground Level									
0.0	Brown Grey Het. mix. of clayey silt, sand and gravel (Glacial Till) Very Stiff to hard		1	SS	23				4 27 57 27	
			2	SS	60	600				7 28 53 17
			3	SS	72	6"	100/4"			3 27 56 14
			4	SS	172	9"				4 37 50 9
			5	SS	100	6590				
			6	SS	100	6"				
			7	SS	52	580				10 29 51 16
			8	SS	100	6"				
575.4	End of Borehole									

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 1(2) (Culvert 1) BH-122-1(2)

WP 103-69-08 LOCATION Co-ords. N 15,864,997 E 949,213 ORIGINATED BY VK
 DIST 6 HWY 410 BORING DATE July 27, 1976 COMPILED BY VR
 DATUM Geodetic BOREHOLE TYPE C.M.E. 5.1 (1) M.V.H.S. CHECKED BY *CP*

SOIL PROFILE		STRAT. PLOT	SAMPLES		GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT				LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARKS		
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE		'N' VALUES	20	40	60	100	w_p	w			w_L	
185.0 606.8	Ground Level															
0.0			1	SS	28										1 24 54 21	
	Brown		2	SS	67	600										16 23 44 17
	Grey		3	SS	105				100/9"							6 29 46 19
	Het. mix. of clayey silt, sand and gravel (Glacial Till)		4	SS	160											
			5	SS	182	9" 590										
	Very stiff to hard		6	SS	100	6"										11 30 48 11
176.6 579.3					590											
8.4 27.5	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE NO 2 (1) (Culvert 2) BH-122-2(1)

WP 103-69-08 LOCATION Co-ords. N 15,866,682 E 947,725 ORIGINATED BY VE
 DIST 6 HWY 410 BORING DATE July 23, 1976 COMPILED BY VK
 DATUM Geodetic BOREHOLE TYPE C.M.E. 5.1 (1) M.V.H.S. CHECKED BY CP

SOIL PROFILE		SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS	
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		N' VALUES	20	40	60	80	100	w_p	w			w_L
189.2 620.6	Ground Level															
0.0																
	Brown Grey Het. mix. of clayey silt, sand and gravel (Glacial Till) Very stiff to hard		1	SS	27										2 15 57 26	
			2	SS	132											17 33 40 10
			3	SS	119											13 29 45 13
			4	SS	100	6"										
			5	SS	100	6"										
			6	SS	100	6"										30 27 35 8
			7	SS	100	6"										
181.7 7.5 596.1 24.5	End of borehole															

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS - ONTARIO
 ENGINEERING SERVICES BRANCH - GEOTECHNICAL OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 2 (2) (Culvert 2) BH-122-2(2)

WP 103-69-08 LOCATION Co-ords. N 15,866,670 E 947,592 ORIGINATED BY VK
 DIST 6 HWY 410 BORING DATE July 23, 1976 COMPILED BY VK
 DATUM Geodetic BOREHOLE TYPE C.M.E. 5.1 (1) M.V.H.S. CHECKED BY *[Signature]*

(m)

189.7

184.0

5.7

SOIL PROFILE		STRAT. PLOT	SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ P.C.E.	REMARKS
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
622.3	Ground Level															
0.0	Brown Grey Het. mix. of clayey silt, sand and gravel (Glacial Till)		1	SS	LI									Org.	10 32 41 17	
			2	SS	43										0.53%	
			3	SS	64										0.72%	32 17 37 14
			4	SS	144											32 5 46 17
			5	SS	100	3"										49 13 31 7
603.5	Stiff to hard															
18.8	End of Borehole															

20
 15 \diamond 5 % STRAIN AT FAILURE
 10

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 3

BH-135-3

W P 103-69-13 LOCATION Coords. N 861 122; E 952 943 ORIGINATED BY B.L.
 DIST 6 HWY 410 BOREHOLE TYPE 3/4" Hollow Stem Augers COMPILED BY B.L.
 DATUM Geodetic DATE October 12, 1978 CHECKED BY *ef*

(m)
186.4

OFFICE REPORT ON SOIL EXPLORATION

172.8
13.6

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	% VALUES			SHEAR STRENGTH									WATER CONTENT (%)
							20	40	60	80	100						
611.5	Ground Surface																
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till)		1	SS	40												
	Brown Very Stiff Grey to Hard		2	SS	35												
	Stiff to Very Stiff		3	SS	25												
			4	SS	94												
	Hard		5	SS	97												
			6	SS	60												
			7	SS	90/3"												
567.0	(Probable Bedrock) Shale Fragments																
44.5	End of Borehole																

*3, *5: Numbers refer to
Sensitivity

20
15 * 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 4 BH-135-4

W P 103-69-13 LOCATION Coords. N 861 102; E 952 962 ORIGINATED BY B.L.
 DIST 6 HWY 410 BOREHOLE TYPE 3/4" Hollow Stem Augers COMPILED BY B.L.
 DATUM Geodetic DATE October 12, 1978 CHECKED BY *W.J.*

(m)
186.4

OFFICE REPORT ON SOIL EXPLORATION

177.1
9.3

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100		
611.5	Ground Surface													
0.0	Heterogeneous Mixture of Clay, Silt, Sand and Gravel (Glacial Till)		1	SS	56									
	Brown Grey		2	SS	27									
	Hard		3	SS	31									
	Stiff to Very Stiff		4	SS	70									
	Hard		5	SS	47									
581.0			6	SS	94									
30.5	End of Borehole													

RECORD OF BOREHOLE No 7

METRIC

W P 103-69-15 LOCATION Co-ords. 4 835 502.5 N; 289 456 E. ORIGINATED BY JW
 DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AEL
 DATUM Geodetic DATE 1985 12 06 CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					NATURAL MOISTURE CONTENT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	PLASTIC LIMIT W _p	W	LIQUID LIMIT W _L		
187.0	Ground Level																
0.0																	
186.5	Topsoil		1	SS	5	*	187										
0.5																	
	Very stiff		2	SS	23		186										
	Hard		3	SS	22		185										
	Heterogeneous mixture of silty clay, sand & gravel (Glacial Till)		4	SS	40		184										
			5	SS	66		183										
	Brown Grey		6	SS	36		182										
			7	SS	70 / 0.20		181										
			8	SS	78 / 0.15		180										
							179										
							178										
77.4			9	SS	76												
9.6	End of Borehole																
	* Groundwater level not established																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 8

METRIC

W P 103-69-15 LOCATION Co-ords. 4 835 522.5 N; 289 437.5 E. ORIGINATED BY IW
 DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Augers; BX Rock Core COMPILED BY ART
 DATUM Geodetic DATE 1985 12 06-09 CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80					
186.6	Ground Level															
0.0 186.3 0.3	Topsoil		1	SS	8											
	Very stiff		2	SS	28											
	Hard		3	SS	45											
	Heterogeneous mixture of silty clay, sand & gravel (Glacial Till)		4	SS	68											
			5	SS	64											5 33 44 18
	Brown Grey		6	SS	74											
			7	SS	100/ 0.15											
			8	SS	74											7 39 50 4
			9	SS	83											
			10	SS	70											
174.3 12.3	Shale bedrock Weathered Dark Grey		11	SS	80/ 0.15											
			12	RC BX	94%											RQD 25%
171.4			13	RC BX	92%											OZ
15.2	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 4

METRIC

W P 103-69-19 LOCATION Co-ords. N 4 834 458.9; E 290 470.3 ORIGINATED BY TS
 DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Auger COMPILED BY TS
 DATUM Geodetic DATE 87 12 03 CHECKED BY OP

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60					
186.0	Ground Surface														
0.0	Heterogeneous Mixture of Silty Clay Sand and Gravel (Glacial Till) Very Stiff to Hard		1	SS	80										3 29 52 16
	Brown Grey		2	SS	27										
	Stiff		3	SS	17										5 32 43 20
			4	SS	38										
			5	SS	110										
			6	SS	100										
174.9			7	SS	105										
11.1	End of Borehole														

OFFICE REPORT ON SOIL EXPLORATION

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

RECORD OF BOREHOLE No 5

METRIC

W P 103-69-19 LOCATION Co-ords. N 4 834 446.6; E 290 481.3 ORIGINATED BY TS
 DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Auger, Cone Test COMPILED BY TS
 DATUM Geodetic DATE 87 12 03 CHECKED BY GP

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT. PROF.	NUMBER	TYPE			'N' VALUES	20					
186.2	Ground Surface												
0.0	Heterogeneous Mixture of Silty Clay Sand and Gravel (Glacial Till)		1	SS	68								
	Brown Gray		2	SS	38								5 27 47 21
	Hard		3	SS	45								
			4	SS	29								6 28 42 24
			5	SS	25								
	Very Stiff		6	SS	25								
			7	SS	Bounding								
			8	SS	110								
	Hard		9	SS	100/15	15 cm							4 23 66 7
			10	SS	100/15	15 cm							
173.9	End of Borehole Probable Bedrock		11	SS	100/12	12 cm							

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 6

METRIC

W P 103-69-19 LOCATION Co-ords. N 4 834 433.6; E 290 448.2 ORIGINATED BY TS
 DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Auger, Cone Test COMPILED BY TS
 DATUM Geodetic DATE 87 12 04 CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	'N' VALUES			20	40					
167.0	Ground Surface												
0.0	Heterogeneous Mixture of Silty Clay Sand and Gravel (Glacial Till)	1	SS	55								23.1	12 23 41 24
	Brown Gray	2	SS	50									
		3	SS	24									
		4	SS	29								23.6	8 32 44 16
		5	SS	30									
	Very Stiff	6	SS	18									
		7	SS	55									
		8	SS	75									13 30 32 25
	Silt Very Dense	9	SS	70									
		10	SS	100									
	Hard	11	SS	100	15 cm								
173.2		12	SS	100	7 cm								
13.8	End of Borehole Probable Bedrock												

OFFICE REPORT ON SOIL EXPLORATION

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

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO
 ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 4 BH-110-4

W.P. 103-69-00 LOCATION Co-ords. 868,935 N; 946,010 E. ORIGINATED BY VK
 DIST. 6 HWY. 410 BORING DATE June 25, 1975 COMPILED BY OY
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & BX Casing CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_l PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARKS % GR. SA. SI. CL.
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_l		
187.7	615.7	Ground Level														
185.9	609.7	Silty sand with gravel, trace of clay Compact	1	SS	14	610										38 24 28 10
1.3	6.0	Het. mix. of clayey ss. Brown silty gravel to Hard Grey														
184.5	605.2	10.5	2	SS	1007	6"										
3.2	11.5	Weathered Sand Shale Bedrock	3	BXL REC		100%										
182	599.2					600										
5.0	16.5	End of Borehole														

OFFICE REPORT ON SOIL EXPLORATION

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE - SOIL MECHANICS-SECTION

RECORD OF BOREHOLE NO 1 BH-117-01

WP 103-69-09 LOCATION Co-ords. 15,869,046 N; 945,989 E. ORIGINATED BY VK
 DIST 6 HWY 410 BORING DATE April 30, 1976 COMPILED BY VK
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger, BX Casing, BXL Rock Core & Cone Test CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT				LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w		
(m) 186.8	613.0	Ground Level													
185.9	610.0	Clayey silt with sand & gravel. (Glac. Till)													
185.3	608.0	Gravel with silty sand & fr. of clay. Compact	1	SS	19	610									
1.5	5.0	weathered sound Bedrock	2	BXL	65%										
		Grey shale with occ. layers of limestone.	3	BXL	80%										
182.0	597.2		4	BXL	100%	600									
4.8	15.8	End of Borehole													

RECORD OF BOREHOLE No 1

METRIC

W P 103-69-09 LOCATION CO-ORDS. N 4 836 885.2; E 288 337.5 ORIGINATED BY V.K.
 DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger, BX Casing; BXL Rock Core and COMPILED BY V.K.
 DATUM Geodetic DATE 76 04 30 Cone Test CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100					
186.8	Ground Level												
0.0	Silty Clay with Sand and Gravel (Glacial Till)												
185.9	Gravel with Silty Sand and trace Clay		1	SS	19								51 28 (11)
185.3	Compact												
1.5	— weathered		2	BXL	REC 6%								
	Bedrock		3	BXL	REC 80%								
	Grey Shale with occ. layers of Limestone												
	Sound		4	BXL	REC 100%								
182.0													
4.8	End of Borehole												

OFFICE REPORT ON SOIL EXPLORATION

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

RECORD OF BOREHOLE No 4

METRIC

W P 103-69-09 LOCATION CO-ORDS. N 4 836 911.4; E 288 331.7 ORIGINATED BY V.K.
 DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger, BX Casing and BXL Rock Core COMPILED BY V.K.
 DATUM Geodetic DATE 76 05 04 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
186.3	Ground Level																
0.0	Gravel with Shale fragments															GR SA SI CL	
185.5	BEDROCK Grey Shale with occasional layers of Limestone Sound		1	BXL	REC 100%												
0.8																	
					2	BXL	REC 100%										
182.6	End of Borehole																
3.7																	

OFFICE REPORT ON SOIL EXPLORATION

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

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 5 BH-110-5

W.P. 103-69-00 LOCATION Co-ords. 873,421 N: 944,073 E. ORIGINATED BY VK
 DIST. 6 HWY. 410 BORING DATE June 23, 1975 COMPILED BY OY
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & BX Casings CHECKED BY [Signature]

SOIL PROFILE		STRAT. PLOT	SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w w_p — w — w_L WATER CONTENT % 10 20 30	UNIT WEIGHT γ	REMARKS % GR. SA. SI. CL.		
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE	'N' VALUES		20	40	60	80	100					
197.3	647.4	Ground Level														
0.0			1	SS	30										12 25 53 10	
			2	SS	55	640										
			3	SS	60	630										
			4	SS	99	630										19 29 40 12
			5	SS	120	620										
			6	SS	130/5"	620										
186.6	612.4		7	SS	138/4"											
10.7	35.0	Weathered				610										
185.0	606.9		8	SS	285/4 1/2"											
12.3	40.5	Sound Shale Bedrock	9	BXL	REC 98%											
183.3	601.4															
14.0	46.0	End of Borehole														

OFFICE REPORT ON SOIL EXPLORATION

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 3(1) (Culvert 3)

WP 103-69-08 LOCATION Co-ords. N 15,870,340 E 945,576 ORIGINATED BY VK
 DIST 6 HWY 410 BORING DATE July 21, 1976 COMPILED BY VK
 DATUM Geodetic BOREHOLE TYPE C.M.E. 5.1 (1) M.V.H.S. CHECKED BY *CP*

(m)

SOIL PROFILE		SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH □ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W _c W _p — W _c — W _L WATER CONTENT % 10 20 30	UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE					
192.7 632.2	Ground Level								
0.0			1	SS	34				5 18 47 30
	Brown		2	SS	70				
	Grey		3	SS	100	6"			5 28 48 19
	Het. mix. of clayey silt, sand and gravel (Glacial Till)		4	SS	115	6"			
			5	SS	115	6"			13 54 52 1
	Bard		6	SS	75	6"			
			7	SS	70	6"			
183.5 602.1			8	SS	80	1"			2 23 47 26
9.2 30.1	End of Borehole								

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE NO 3(2) (Culvert 3)

WP 103-69-08 LOCATION Co-ords. N 15,870,376; E 945,660 ORIGINATED BY VK
 DIST 6 HWY 410 BORING DATE July 22, 1976 COMPILED BY VK
 DATUM Geodetic BOREHOLE TYPE C.E. 5.1 (1) M.V.H.S. CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
192.0 630.0	Ground Level															
0.0																
	Brown		1	SS	43											6 22 49 21
	Grey		2	SS	129											25 32 29 14
	Het. mixture of clayey silt, sand and gravel (Glacial Till)		3	SS	50	620										9 33 56 2
			4	SS	120											
			5	SS	137	"										
	Hard		6	SS	100	"610										
183.9 603.5			7	SS	160											12 23 56 19
8.1 26.5	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE NO 4(1) (Culvert 4)

WP 103-69-08 LOCATION Co-ords. N 15,871,122; E 945,418 ORIGINATED BY VK
 DIST 6 HWY 410 BORING DATE July 20, 1976 COMPILED BY VK
 DATUM Geodetic BOREHOLE TYPE C.M.E. 5.1 (1) M.V.H.S. CHECKED BY CP

(m)
191.5

SOIL PROFILE		STRAT. PLOT	SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARKS		
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L				
628.4	Ground Level																	
0.0	Het. mix. of clayey silt, sand and gravel (Glacial Till) Very Stiff to hard		1	SS	17										Org.	1.21 55 23		
			2	SS	67											1.92	0.26 57 17	
			3	SS	110/6"													
			4	SS	145													15 30 45 10
			5	SS	100													15 32 43 10
			6	SS	105/8"													
			7	SS	80/3"													
			8	SS	100/3"													18 36 36 10
597.6	End of Borehole																	
30.8																		

OFFICE REPORT ON SOIL EXPLORATION

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 4 (2) (Culvert 4)

WP 103-69-08 LOCATION Co-ords. N 15,871,165; E 945,314 ORIGINATED BY VK
 DIST 6 HWY 410 BORING DATE July 20, 1976 COMPILED BY VK
 DATUM Geodetic BOREHOLE TYPE C.M.E. 5.1 (1) M.V.R.S. CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT				LIQUID LIMIT PLASTIC LIMIT WATER CONTENT			UNITS WEIGHT	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	W _p	W _L		
191.6	628.5	Ground Level													
0.0															
			1	SS	12										
			2	SS	35										
			3	SS	50/2"										
			4	SS	110/9"										
			5	SS	66										
			6	SS	100/1"										
			7	SS	85										
182.2	597.8	Stiff to hard	8	SS	100/2"										
9.4	30.7	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

(m)

Brown
Grey
Het. mixture of
clayey silt, sand
and gravel
(Glacial Till)

RECORD OF BOREHOLE NO 5(1) (Culvert 5)

122-5(1)

WP 103-69-08

LOCATION Co-ords. N 15,872,360; E 944,915

ORIGINATED BY VK

DIST 6 HWY 410

BORING DATE July 15, 1976

COMPILED BY VK

DATUM Geodetic

BOREHOLE TYPE C.M.E. 5.1 (1) M.V.H.S.

CHECKED BY *[Signature]*

SOIL PROFILE		SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT				LIQUID LIMIT w_L PLASTIC LIMIT w_p			UNIT WEIGHT γ	REMARKS				
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		VALUES	20	40	60	80	100	WATER CONTENT w			w_p	w_L	P.C.F.	% GR SA SI CL
631.1	Ground Level																	
0.0	Het. mixture of clayey silt, sand and gravel (Glacial Till) Brown Grey		1	SS	8													
			2	SS	100	6"												
			3	SS	100	5"												
			4	SS	85	5"												
			5	SS	120	5"												
			6	SS	50	5"												
604.2	Stiff to hard																	
26.9	End of Borehole																	

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE NO 5(2) (Culvert 5)

122-5(2)

WP 103-69-08 LOCATION Co-ords. N 15,872,368 E 944,803 ORIGINATED BY VK
 DIST 6 HWY 410 BORING DATE July 15, 1976 COMPILED BY VK
 DATUM Geodetic BOREHOLE TYPE C.M.E. 5.1 (1) M.V.H.S. CHECKED BY *[Signature]*

SOIL PROFILE		SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT				LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ P.C.F.	REMARKS % GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		'N' VALUES	20	40	60	80	100	w_p			w
631.6	Ground Level														
0.0						630									
	Brown Grey Het. mixture of clayey silt, sand & gravel (Glacial Till)		1	SS	20										
			2	SS	97										
			3	SS	85	6"									
			4	SS	80	6"	620								
			5	SS	75	6"									
			6	SS	89		610								
			7	SS	110	3"									
601.6		Very stiff to hard		8	SS	120	6"								
30.0	End of Borehole														

OFFICE REPORT ON SOIL EXPLORATION

BH-187-3

RECORD OF BOREHOLE No 3

METRIC

W P 21-79-18 LOCATION Co-ords. N 4 838 214.5; E 287 746.8 ORIGINATED BY JA
 DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger, Washboring, Cone Test COMPILED BY JA
 DATUM Geodetic DATE 84 08 07 CHECKED BY AS

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE								
197.5	Ground Surface											
0.0	Sand and Gravel (shoulder)											
196.8												
0.7	Heterogeneous Mixture of Silty Clay with sand some gravel (Glacial Till)		1	SS	9							
			2	SS	27							
	Hard		3	SS	32							
	Brown Grey		4	SS	64						12 30 61 17	
			5	SS	42							
			6	SS	72							
			7	SS	82							
			8	SS	128						23 30 34 13	
			9	SS	90/ 10 cm							
			10	SS	100/ 18 cm							
			11	SS	100/ 13 cm							
188.2			12	SS	100/ 18 cm							
9.3	End of Borehole											
	* W.L. not established											

OFFICE REPORT ON SOIL EXPLORATION

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

BH-187-4

RECORD OF BOREHOLE No 4

METRIC

W P 21-79-18 LOCATION Co-ords. N 4 838 214.3; E 287 693.0 ORIGINATED BY JA
 DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger, Washboring, Cone Test COMPILED BY JA
 DATUM Geodetic DATE 84 08 08 CHECKED BY PS

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20						40
197.5	Ground Surface													
0.0	Topsoil, Fill													
196.6	Heterogeneous Mixture of Silty Clay with sand some gravel (Glacial Till) Hard Brown Grey	[Strat Plot]	1	SS	49									
0.9			2	SS	67									
			3	SS	61									
			4	SS	75									
			5	SS	132/25	cm								9 33 48 10
			6	SS	136									
			7	SS	100/15	cm								28 26 33 13
			8	SS	100/13	cm								
189.6			9	SS	100/15	cm								
7.9	End of Borehole													
	* W.L. not established													

OFFICE REPORT ON SOIL EXPLORATION

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

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO
 ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 6 BH-110-6

W.P. 103-69-00 LOCATION Co-ords. 875,402 N; 942,048 E. ORIGINATED BY VK
 DIST. 6 HWY. 410 BORING DATE July 1, 1975 COMPILED BY OY
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & BX Casing CHECKED BY [Signature]

(m)	SOIL PROFILE		SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT Y	REMARKS	
	ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	'N' VALUES		20	40	60	80	100			
261.4	660.8	Ground Level				660								
0.0	0.0	Het. mixture of clayey silt, sand & gravel (Glacial Till) Stiff to Hard	1	SS	13									6 25 50 19
198.2	650.3	Weathered Sound Shale Bedrock	2	SS	100/5"	650								
3.2	10.5													
195.8	642.5		3	BXL	REC									
5.6	18.3	End of Borehole												

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO
 ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 7 BH-110-7

W.P. 103-69-00 LOCATION Co-ords. 876,719 N; 940,790E. ORIGINATED BY VK
 DIST. 6 HWY. 410 BORING DATE July 1, 1975 COMPILED BY OY
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & BX Casing CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT Y	REMARKS % GR. SA. SI. CL.
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
208.3 683.3	Ground Level															
0.0	Het. mixture of clayey silt, sand & gravel (Glacial Till)	[Pattern]	1	SS	35	680									1 21 56 22	
205.1 672.8	Hard Brown Grey	[Pattern]	2	SS	100/16"											
3.2 10.5	Weathered	[Pattern]				670										
202.5 664.3	Sound Shale Bedrock		3	BXL REC	80%											
5.8 19.0	End of Borehole															

OFFICE REPORT ON EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 8

BH-110-8

W.P. 103-69-00

LOCATION Co-ords. 877,610 N; 939,892 E.

ORIGINATED BY VK

DIST. 6 HWY. 410

BORING DATE July 2, 1975

COMPILED BY OY

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & BX Casing

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
214.2	702.6	Ground Level														
0.0	Het. mixture of clayey silt, sand & gravel (Glacial Till)		1	SS	25	700									3 17 55 25	
			2	SS	46	690										
209.0	685.6 Very Stiff to Hard Weathered		3	SS	71											3 5 55 37
5.2	17.0 Sound Shale Bedrock		4	BXL REC	75%											
207.5	680.6															
6.7	22.0	End of Borehole														

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO
 ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

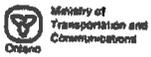
RECORD OF BOREHOLE NO 6(1) (Culvert 6) BH-122-6(1)

WP 103-69-08 LOCATION Co-ords. N 15,878,285; E 939,055 ORIGINATED BY VK
 DIST 6 HWY 410 BORING DATE July 14, 1976 COMPILED BY VK
 DATUM Geodetic BOREHOLE TYPE C.M.E. 5.1 (1) M.V.H.S.-Core with BXL Bit CHECKED BY CP

SOIL PROFILE		STRAT. PLOT	SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W _w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE	'N' VALUES		20	40	60	80	100	W _p	W _L	W _w		
211.5	694.0	Ground Level														
0.0																
		Brown Grey Het. mix. of clayey silt, sand & gravel (glacial till) hard	1	SS	51	690										11.39 42.8
			2	SS	60											21.14 43.22
208.0	682.5		3	SS	100											13.7 60.20
3.5	11.5															
206.5	678.5	Bedrock Sound Shale	4	BXL RC	100% REC	680										
5.0	16.5	End of Borehole														

OFFICE REPORT ON SOIL EXPLORATION

149A-2



RECORD OF BOREHOLE No 2

METRIC 9

W P 21-79-03 LOCATION Co-ords N 4 839 677.2; E 286 283.0 ORIGINATED BY H.S.
 DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Auger COMPILED BY T.J.R.
 DATUM Geodetic DATE 1981 12 08 CHECKED BY CP

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80					
						SHEAR STRENGTH					WATER CONTENT (%)					
						○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	x LAB VANE							
212.8	Ground Surface															
0.0	(Glacial Till)															
	Silty Clay some sand trace of gravel		1	SS	12											
	Stiff to Hard		2	SS	18										8 16 47 29	
	Detached slabs and weathered fragments of shale and limestone		3	SS	33											
			4	SS	74										12 13 51 24	
208.8			5	SS	75	5 cm										
4.0	Shale (weathered) Bedrock soft		6	SS	109	8 cm										
207.7			7	SS	100	2 cm										
5.1	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

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

149A-3

RECORD OF BOREHOLE No 3

METRIC 10

W P 21-79-03 LOCATION Co-ords N 4 839 677.4; E 286 339.1 ORIGINATED BY H.S.
 DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Auger & Rock Core COMPILED BY T.J.K.
 DATUM Geodetic DATE 1981 12 08 and 09 CHECKED BY AP

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	W VALUES			20	40	60	80	100					
212.5	Ground Surface															
0.0	(Glacial Till)					212										
	Silty Clay some sand trace of gravel	1	SS	31		211										0 4 71 25
	Very Stiff to Hard	2	SS	26		210										
	Detached slabs and weathered fragments of shale and limestone	3	SS	72		209										
208.4		4	SS	100	15 cm	208										
4.1	Interbedded soft shales and very hard dolomitic limestone	5	SS	100	13 cm	207										
206.1		6	BX RC	95% REC												
6.4	End of Borehole															
	* Borehole water level after 24 hours															

OFFICE REPORT ON SOIL EXPLORATION

1498-1

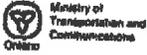
RECORD OF BOREHOLE No 1

METRIC 22

W P 21-79-03 LOCATION Co-ords. N 4 839 738; E 286 378 ORIGINATED BY V.E.
 DIST 6 HWY 410 BOREHOLE TYPE Auger & Sample with C.M.E. - 55 COMPILED BY S.O.
 DATUM Geodetic DATE 74 03 06 CHECKED BY JT

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80						100
212.7	Ground Level																
0.0	Silty Clay, traces of Sand and Gravel		1	SS	9												
211.2	Fill Material, Stiff		2	SS	150	28 cm											
1.5	Net. Mixture of Silty Clay, Sand and Gravel		3	SS	100	28 cm											
208.3	Glacial Till Hard																
4.4	Limestone Bedrock		5	BXL	100												
207.1																	
5.6	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION



1498-2

RECORD OF BOREHOLE No 2

METRIC 23

W P 21-79-03 LOCATION Co-ords. N 4 839 697: E 286 332 ORIGINATED BY V.K.
 DIST E HWY 410 BOREHOLE TYPE Auger & Sample with C.N.E. - 55 COMPILED BY S.O.
 DATUM Geodetic DATE 74 03 05 CHECKED BY LB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80					
212.9	Ground Level															
0.0	Ret. Mixture of Silty Clay, Sand and Gravel Glacial Till Hard		1	SB	70											
			2	SB	168	22										8 26 58 8
208.6			3	SB	100											
4.3	End of Borehole		4	SB	100											

OFFICE REPORT ON SOIL EXPLORATION

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

RECORD OF BOREHOLE No 3

METRIC 24

W P 21-79-03 LOCATION Co-ords. N 4 839 712; E 286 275 ORIGINATED BY V.K.
 DIST 6 HWY 410 BOREHOLE TYPE Auger & Sample with C.N.E. - 55 COMPILED BY S.O.
 DATUM Geodetic DATE 74.03.05 CHECKED BY Lo

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
											○ UNCONFINED	+	FIELD VANE	WATER CONTENT (%)			
											● QUICK TRIAXIAL	x	LAB VANE	10	20	30	
211.5	Ground Level																
0.0	Het. Mixture of Silty Clay, Sand and Gravel Glacial Till Hard		1	SS	100	5											
			2	SS	148												30 13 37 20
208.0																	
3.5	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

* 2, x²: Numbers refer to 20
Sensitivity 15 + 5 (%) STRAIN AT FAILURE
10

1498-4

RECORD OF BOREHOLE No 4

METRIC 25

W P 21-79-03 LOCATION Co-ords. N 4 838 756; E 286 234 ORIGINATED BY V.K.
 DIST 6 HWY A10 BOREHOLE TYPE Auger & Sample with C.M.P. - 55 COMPILED BY S.O.
 DATUM Canadian DATE 74.03.05 CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
211.9	Ground Level															
0.0	Het. Mixture of Silty Clay, Sand and Gravel Glacial Till Hard	1	SS	46												
		2	SS	106											2 6 60 32	
208.4	Limestone Bedrock															
3.5																
207.5		4	BXL	1000												
207.5																
4.4	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

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

149B-5

RECORD OF BOREHOLE No 5

METRIC 26

W.P. 21-79-03 LOCATION Co-ords. N 4 839 800; E 286 192 ORIGINATED BY V.K.
 DIST 6 HWY 410 BOREHOLE TYPE Auger & Sample with G.M.E. - 55 COMPILED BY S.O.
 DATUM Geodetic DATE 74 03 05 CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNY WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			W VALUES	20	40	60	80					
215.0	Ground Level															
0.0	Silty Clay with some Sand and Traces of Gravel and Organics Fill Material. Stiff		1	SS	12											
212.0			2	SS	11											0 19 46 35
3.0	Het. Mixture of Silty Clay, Sand and Gravel Glacial Till Hard		3	SS	100	13 B										
			4	SS	100	13 B										32 23 32 12
208.0			5	SS	100	8 cm										62 20 (18)
7.0	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

+3, x⁵: Numbers refer to Sensitivity
 20
 15 $\frac{1}{5}$ (%) STRAIN AT FAILURE
 10

1498-6

RECORD OF BOREHOLE No 6

METRIC 27

W P 21-79-03 LOCATION Co-ords. N 4 839 843; E 286 149 ORIGINATED BY V.K.
 DIST 6 HWY 410 BOREHOLE TYPE Auger & Sample with C.M.E. - 35 COMPILED BY S.O.
 DATUM Geodetic DATE 76 03 06 CHECKED BY S

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			N ^o VALUES	20	40	60	80					
216.9	Ground Level															
0.0	Silty Clay, Some Sand & Traces of Gravel & Organic Fill Material Stiff		1	SS	14											
			2	SS	14											0 16 57 27
213.5																
3.4	Ret. Mixture of Silty Clay, Sand and Gravel Glacial Till Hard		3	SS	81											
			4	SS	135	30 cm										23 13 40 24
			5	SS	100	15 cm										
206.5			6	SS	100	8 cm										0 32 46 22
8.4	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

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

1498-7

RECORD OF BOREHOLE No 7

METRIC 28

W P 21-79-03 LOCATION Co-ords. N 4 839 887; E 286 105 ORIGINATED BY V.K.
 DIST 6 HWY 410 BOREHOLE TYPE Auger & Sample with C.H.E. - 33 COMPILED BY S.O.
 DATUM Geodetic DATE 74 03 04 CHECKED BY [Signature]

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
			NUMBER	TYPE	'N' VALUES			20	40	60	80					
217.2	Ground Level															
0.0	Silty clay with some Sand and Traces of Gravel and Organics Fill Material Stiff to V. Stiff		1	SS	13		216									
213.8			2	SS	21		214								0 17 52 31	
3.4	Silt with some Sand and Traces of Gravel and Clay Slightly Plastic		3	SS	62		212								5 32 58 5	
211.6	V. Dense		4	SS	100/15		210									
5.6	Het. Mixture of Silty Clay, Sand and Gravel		5	SS	100/13		210								14 16 52 18	
208.7	Hard		6	SS	100/8											
208.7	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

+3, x³: Numbers refer to Sensitivity
 20
 15 + 5 (% STRAIN AT FAILURE)
 10

RECORD OF BOREHOLE No 6 BH-171-6 METRIC 13

W P 21-79-01 LOCATION Co-ords. 4,839,243 N.; 286,750 E. ORIGINATED BY R.M.
 DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger, NXL Rock Core COMPILED BY R.M.
 DATUM Geodetic DATE 1982 08 12 CHECKED BY I.P.L.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80						100
208.5 0.0	GROUND SURFACE																
	Brown hard SILTY CLAY (Glacial Till)		1	SS	46												
			2	SS	41												
			3	SS	75												
205.4 3.1	shale fragments																
	Gray weathered SHALE with hard limestone layers.		4	RC	100%												
					NXL	19%											
203.6 4.9	END OF BOREHOLE																

OFFICE REPORT ON SOIL EXPLORATION

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

RECORD OF BOREHOLE No 7 BH-171-7 METRIC 14

W P 21-79-01 LOCATION Co-ords 4,839,268 N.; 286,726 E. ORIGINATED BY R.M.
 DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger COMPILED BY R.M.
 DATUM Geodetic DATE 1982 07 14 CHECKED BY I.P.L.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
										○ UNCONFINED	+ FIELD VANE	WATER CONTENT (%)				
										● QUICK TRIAXIAL	x LAB VANE	10	20	30	KN/m ³	GR SA SI CL
210.1	GROUND SURFACE															
0.0	0.15 m Topsoil															
	Hard brown	1	SS	36												
	SILTY CLAY															
	some sand and embedded gravel, rock fragments.	2	SS	38											21.4	
	(Glacial Till)	3	SS	31												
																5 19 38 38
		4	SS	79												
		5	SS	50/12	cm											
205.5																
4.6	END OF BOREHOLE REFUSAL, PROBABLY BEDROCK															

OFFICE REPORT ON SOIL EXPLORATION

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

RECORD OF BOREHOLE No 2 BH-186-2 METRIC

W P 21-79-16 LOCATION Corridor # 4 838 845.0; E 287 153.7 ORIGINATED BY DT
 DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Auger COMPILED BY DT
 DATUM Canadian DATE 84-01-10, 11 CHECKED BY GP

SOIL PROFILE		STRAT PLOT	SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CORE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE			W VALUES	20	40	60	80					
201.7	Ground Surface															
0.0	Heterogeneous mixture Silty Clay Trace to some sand, gravel (Glacial Till)		1	SS	17											12 22 43 23
			2	SS	38											
			3	SS	60											
198.8	V. stiff to hard															9 12 55 24
2.9	Grey Shale Bedrock		4	SS	38											
	Highly weathered		5	SS	62	5cm										
197.0	End of Borehole Refusal to auger															

OFFICE REPORT ON SOIL EXPLORATION

+², x⁵: Numbers refer to Sensitivity
 20
 15 → 5 (%) STRAIN AT FAILURE
 10

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE			'N' VALUES	SHEAR STRENGTH					
199.5	Ground Surface												
0.0	Heterogeneous Mixture Silty Clay Trace to Some Sand, Gravel (Glacial Till)		1	SS	49								8 23 52 17
197.5	Hard		2	SS	63								
2.0	Grey Shale Bedrock												
197.2	Weathered												
2.3	End of Borehole Refusal to Auger *Note: Water level not observed												

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to Sensitivity
 20
 15 $\frac{1}{5}$ (%) STRAIN AT FAILURE
 10

WP 697-93-00

RECORD OF BOREHOLE No 21

METRIC

W P 21-79-16 (FORMERLY) LOCATION Co-ords. N 4 838 659.7; E 287 358.3

ORIGINATED BY DT

DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Auger & BXL Rock Core

COMPILED BY DT

DATUM Geodetic DATE 84-01-19, 20

CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60						80	100
199.3	Ground Surface																
0.0	Heterogeneous Mixture Silty Clay Trace to Some Sand, Gravel (Glacial Till)		1	SS	29		199										
			2	SS	34		198									5 15 47 33	
			3	SS	27		197										6 28 51 15
			4	SS	34		196										
195.0			V. Stiff to Hard	5	SS		26	195									
4.3	Grey Shale Bedrock	6	SS	100	3cm	194											
	Weathered Shale randomly interbedded with limestone seams 20-110 mm thick	7	BXL RC	90Z REC		193								RQD = 23%			
192.6	Weathered																
6.7	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

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



APPENDIX D

Non-Standard Special Provision

SUPPLY AND INSTALLATION OF SETTLEMENT MONITORING EQUIPMENT –
Item No.

Non-Standard Special Provision

1.0 GENERAL

1.0.1 Scope

This non-standard special provision contains the requirements for the supply and installation of the following geotechnical instruments:

- Survey Benchmarks (BM);
- Settlement Plates (SP);
- Settlement Pins (S); and,
- Nail Pins (NP).

1.0.2 Purpose

The purpose of these instruments is to monitor settlements of existing structures, including bridges, utilities and the proposed median roadway.

1.0.3 Personnel

The Contractor shall retain a Geotechnical Consultant with MTO classification of Geotechnical (Structures and Embankments) – Medium Complexity, to undertake the supply and installation of geotechnical instruments.

The Contractor shall be understood to refer to the Contractor and their Geotechnical Consultant.

1.0.4 Or Equal

The term, “or equal” shall be understood to indicate that the equal product is the same or better than the specified product in function, performance, reliability, quality and general configuration. Only one supplier should be selected for the supply of any data acquisition system.

1.0.5 Notification

The Contract Administrator shall be notified a minimum of 15 working days in advance of commencing the installation of instruments.

1.0.6 Submission Requirements

The Contractor shall submit details of the proposed installation methods including locations and types of the data acquisition system, monitoring enclosure, survey benchmarks and installation schedule, to the Contract Administrator, a minimum of 15 working days before the start of instrument installation.

1.0.7 Drawings

Reference shall be made to the associated settlement instrumentation and monitoring drawing(s) that should be included in the Contract Documents, and may include:

- Typical Instrument Installation Details;
- Monitoring Program Location Plan; and
- Monitoring Program Plan and Section Detail(s).

1.0.8 Subsurface Conditions

The subsurface conditions at the site are described in Foundation Investigation Report as specified elsewhere in the Contract Documents.

1.0.9 Equipment Operation and Weather Conditions

All installation and monitoring equipment and associated materials shall be capable of withstanding the range of temperatures possible for their location within the ground or on the surface. The instruments shall be capable of operating within the manufacturer's stated accuracy throughout the temperature range. Monitoring shall be conducted year round (or as required).

1.1 INSTALLATION

The quantity and location of instruments should be presented in the Contract Drawings.

1.1.1 Instrument Location

Prior to the installation of instruments, the Contractor shall accurately survey and stake the location of each instrument and obtain a ground elevation at each instrument location.

1.1.2 Survey Benchmarks (BM)

The Contractor shall provide a minimum of two (2) non-yielding deep seated survey Benchmarks for each monitoring point, and shall establish the geodetic elevation of each such Benchmark.

The number and locations of bench marks shall be such that direct sighting is possible from all geotechnical instruments to at least one (1) Benchmark.

1.1.3 Accuracy of Surveying for Elevations

Elevations shall be surveyed to an accuracy of ± 2 mm or better.

1.1.4 Materials and Equipment

The Contractor shall supply all materials and equipment required for the installation of instrumentation unless otherwise noted.

1.1.5 Underground Utilities

The Contractor shall be responsible for locating and protecting all underground utilities prior to drilling boreholes for installing instruments. Any damage to underground utilities caused by the Contractor's work shall be repaired by the Contractor at no cost to the Owner or Contract Administrator.

1.1.6 Marking and Labelling

The location of any above-ground monitoring fixture shall be made clearly visible to nearby traffic before, during and after embankment construction. Marking shall be of sufficient size to be visible from a reversing vehicle and after heavy snow falls.

Instruments shall be clearly labelled in the field, each instrument having a unique identifier. The labelling shall remain legible for at least 5 years.

1.1.7 Protection of Instruments

The Contractor shall adequately protect all instruments such that they are not damaged during construction. Any instrument damaged by the Contractor's work shall be immediately replaced at no cost to the Owner or Contract Administrator.

1.1.8 Boreholes

The Contractor shall make a basic stratigraphic log of boreholes as they are being drilled. In situ or laboratory testing is not required.

Boreholes shall be advanced using conventional drilling methods and shall be as straight and vertical as practical.

1.1.9 Installation Program

Instrument installation shall commence immediately after project award and before any road and / or median sewer construction. A summary of the installation schedule for each monitoring point shall be provided and approved by the MTO prior to any equipment installation.

2.0 SURVEY BENCHMARKS (BM) – SUPPLY AND INSTALLATION

2.1 GENERAL

2.1.1 Scope

This Section contains the requirements for the supply and installation of Benchmarks (BM).

The purpose of the benchmarks is to provide non-settling references for the surveying of the Settlement Plates (SP), Settlement Pins (S) and Nail Pins (N), as required.

2.1.2 General Procedure

The Benchmarks shall be installed prior to the start of construction. The Benchmark shall consist of a steel rod anchored to the bottom of a borehole.

2.1.3 Number and Location

A minimum number and approximate locations of the Benchmarks should be shown on the Contract Drawings. The number and locations of Benchmarks shall be adjusted in the field such that direct sighting is possible from all Settlement Plates, Settlement Pins and Nail Pins to at least one Benchmark.

2.2 MATERIALS

2.2.1 General

The Contractor shall supply all materials and equipment required for the installation of the Benchmarks.

2.2.2 Rod

The Contractor shall supply a steel pipe Schedule 40 with an outside diameter not less than 25.4 mm, supplied in lengths as required to complete the installation as described in Section 2.3.

The top end of each length of rod shall be threaded to receive a cap. A rounded cap shall be installed at the top of the rod in such a way that a single survey point can be clearly identified and returned to.

2.2.3 Sand

The Contractor shall supply clean, washed sand. The sand shall be Sakcrete washed general-purpose sand – or equal.

2.2.4 Grout

The Contractor shall supply cement-bentonite grout. A suitable grout mix design consists of 23 kg of bentonite (OPSS 1205), 143 litres of water and 40 kg of cement (Type GU – OPSS 1301).

2.2.5 Rod Anchor Grout

The Contractor shall supply cement-bentonite grout. A suitable grout mix design consists of 14 kg of bentonite (OPSS 1205), 49 litres of water and 40 kg of cement (Type GU – OPSS 1301).

2.2.6 Friction Reducing Sleeve

The Contractor shall supply a friction reducing sleeve consisting of Schedule 40 – 50.8 mm (2") O.D. PVC pipe cut perpendicular to the axis of the pipe.

2.3 INSTALLATION

2.3.2 General

The Contractor shall install Benchmarks as shown on the Contract Drawings and in accordance with the information below.

2.3.2 Borehole Installation

The borehole shall be advanced to the rod anchor elevations using suitable drilling techniques. The diameter of the borehole shall be sufficient to fit the rod, friction reducing sleeve and rod anchor. The sides of the borehole shall be stable and the borehole shall be free of drilling mud and debris.

2.3.3 Rod

The coupling of the rods shall be such that all sections have the same axis and no separation or contraction will occur at the couplings.

2.3.4 Rod Anchor

The rod shall be installed vertically in the borehole with its bottom end resting at the bottom of the borehole. The bottom portion of the rod shall be fixed against the surrounding native soil by grouting the bottom 0.5 m of the borehole to form a concrete/soil anchor.

Once grouting is completed and the rod anchor grout has set, the contractor shall pour clean sand in the lower 0.5 m length of the borehole above the concrete/soil anchor to create a base for the end of the friction reducing sleeve to rest on.

The elevation of the bottom of the rod anchor shall be determined by measuring the length of the rod to the ground surface elevation.

2.3.5 Friction Reducing Sleeve

The friction reducing sleeve shall be over the entire length of the rod above the rod anchor and sand.

2.3.6 Installation Details

The elevation, easting and northing of the top of the Benchmark rod shall be surveyed.

2.4 **COORDINATION WITH MONITORING**

2.4.2 Notification

The Contractor shall notify the Contract Administrator no later than three (3) working days after installing a benchmark. At this time the Contractor shall also supply the following information to the Contract Administrator.

- BM Northings and Eastings coordinates in the project coordinate system;
- Elevation of the rod anchor and top of rod in Geodetic datum;
- Dates of installation;
- Stratigraphic log of subsurface conditions at the BMs, including drilling method notes;
- Installation notes / sketches; and,
- Description of BM, sleeve and rod anchor.

2.4.3 Monitoring

Monitoring of settlements with reference to the Benchmarks shall be done by others. Monitoring shall be conducted prior and during construction. The Contractor shall provide installation information as specified above and provide access to the Benchmarks for monitoring including, but not limited, to snow clearing in the winter. The Contractor shall provide electric power and general area lighting as needed.

2.5 **REPORTING**

The Contractor shall record and report relevant installation details to the Contract Administrator. These include, but are not limited to:

- BM Northings and Eastings coordinates in the project coordinate system;
- Elevation of the rod anchor and top of rod in Geodetic datum;
- Dates of installation;
- Stratigraphic log of subsurface conditions at the benchmarks, including drilling method notes;
- Installation notes / sketches; and,
- Description of BM, sleeve and rod anchor.

3.0 SETTLEMENT PLATES (SP) – SUPPLY AND INSTALLATION

3.1 GENERAL

3.1.1 Scope

This section contains the requirements for the supply and installation of Settlement Plates (SP).

The purpose of the Settlement Plates is to monitor settlements of the existing structures and utilities and the median roadway. Settlement is measured by survey of the top of the rod with reference to stable, non-settling Benchmarks.

3.1.2 General Procedure

The Settlement Plates shall be attached to a plate at the ground surface or the reference ground elevation level. As construction and / or fill placement proceeds the rods shall be extended as required to the new top of ground.

Sleeves around the rods shall be installed to reduce friction and allow uninhibited movement of the rod with the plate.

A protective surround shall be extended with the rods as construction proceeds.

3.1.3 Location

The locations of the settlement plates should be shown on the Contract Drawings

3.2 MATERIALS

3.2.1 General

The Contractor shall supply all materials and equipment required for the installation of the Settlement Plates (SP).

3.2.2 Plate

The Contractor shall supply a steel plate with thickness of at least 6.35 mm. The plate shall be at least 0.5 m wide by 0.5 m long.

3.2.3 Rod

The Contractor shall supply a steel pipe Schedule 40 with an outside diameter not less than 25.4 mm, supplied in lengths as required to complete the installation as described in Section 3.3.

The top end of each length of rod shall be threaded to receive a cap. A rounded cap shall be installed at the top of the rod in such a way that a single survey point can be clearly identified and returned to.

3.2.4 Friction Reducing Sleeve

The Contractor shall supply a friction reducing sleeve consisting of Schedule 40 – 50.8 mm O.D. PVC pipe cut perpendicular to the axis of the pipe.

3.2.5 Protective Surround

The Contractor shall supply a protective surround for the portion of the rod within the embankment.

The surround shall consist of 300 mm diameter corrugated steel pipe (CSP – OPSS 1801) with the ends cut perpendicular to the axis of the pipe and free of burrs and sharp edges. The space between the CSP and the Friction Reduction Sleeve (PVC pipe) shall be filled with medium to coarse sand.

3.3 INSTALLATION

3.3.1 General

The Contractor shall install Settlement Plates as shown on the Contract Drawings in addition to the information stated or emphasized below.

3.3.2 Settlement Plate

For the various Monitoring Sections, the orientation and placement (i.e. horizontally and on top of native ground or an existing structure) of the settlement plate should be developed prior to construction and specified in the Contract

The elevation of the base of the plate shall be surveyed before backfilling.

3.3.3 Rod

The Settlement Plate rod shall be fixed to the centre of the plate and perpendicular to the plate.

The coupling of the rods shall be such that all sections have the same axis and no separation or contraction will occur at the couplings.

3.3.4 Friction Reducing Sleeve

The friction reducing sleeve shall be over the entire length of the rod that is below ground and within any fill except that the cap on top of the Settlement Plate rod shall extend 25 mm above the top of the friction sleeve at all times

3.3.5 Extension of Rod

The Settlement Plate rods shall be extended upwards as construction and / or fill placement proceeds so that the top of the rod is always at least 0.3 m but not more than 2 m above the surrounding fill.

3.3.6 Protective Surround

The CSP, Friction Reducing Sleeve and sand protective surround shall be extended with the rods.

The Settlement Plate rod shall be in the centre of the CSP and friction-reducing sleeve.

The annulus between the CSP and the friction-reducing sleeve shall be filled with sand to a level not higher than the top of the sleeve.

3.3.7 Installation Details

The elevation, easting and northing of the centre of the base of the plate shall be surveyed.

The elevation, easting and northing of the top of the rod shall be surveyed.

The total distance from the base of the plate to the top of the rod shall be measured to an accuracy of ± 2 mm or better.

3.4 **COORDINATION WITH MONITORING**

3.4.1 Notification

The Contractor shall notify the Contract Administrator no later than three (3) working days after installing a Settlement Plates. At this time the Contractor shall also supply the following information to the Contract Administrator:

- SP Northings and Eastings coordinates in the project coordinate system;
- Elevation of plate and rod in Geodetic datum;
- Dates of installation;
- Installation notes / sketches; and,
- Description of settlement plate rods, sleeve, plate.

Adjustments in the length of any Settlement Plate rod shall be coordinated with the Contract Administrator to allow surveying by others of the elevation of the top of the rod immediately before and immediately after adjustment. This surveying is necessary to accurately track the settlement data.

3.4.2 Monitoring

Monitoring of the Settlement Plates shall be done by others. Monitoring shall be conducted prior to and during construction. The Contractor shall provide installation information as specified above and provide access to the Settlement Plates for monitoring including, but not limited to a scaffolding platform and ladder if required and snow clearing in the winter. The Contractor shall provide electric power and general area lighting as needed for reading the instruments.

3.5 REPORTING

The Contractor shall record and report relevant installation details to the Contract Administrator. These include, but are not limited to:

- SP Northings and Eastings coordinates in the project coordinate system;
- Elevation of plate and rod in Geodetic datum;
- Dates of installation;
- Installation notes / sketches; and,
- Description of settlement plates rods, sleeve, plate.

4.0 SETTLEMENT PINS (S) – SUPPLY AND INSTALLATION

4.1 GENERAL

4.1.1 Scope

This Section contains the requirements for the supply and installation of Settlement Pins.

The purpose of the Settlement Pin is to directly monitor settlement of the existing structures and utilities, and the median roadway. Settlement is measured by survey of the top of the pin with reference to stable non-settling benchmarks.

4.1.2 General Procedure

The Settlement Pins shall be cast into concrete at the locations shown on the Contract Drawings.

The concrete will be cast in situ in a hole dug at the locations of the Settlement Pins.

4.1.3 Location

The locations of the Settlement Pins should be provided in the Contract Drawings.

4.2 MATERIALS

4.2.1 General

The Contractor shall supply material and equipment, required for installation of the Settlement Pins.

4.2.2 Pin

The Contractor shall supply a 25.4 mm minimum diameter reinforcing steel bar (OPSS 905) cut 0.4 m long.

The top of the reinforcing steel bar shall be angled or rounded in such a way that a single survey point can be clearly identified and repeated.

4.2.3 Concrete

The Contractor shall supply concrete (OPSS 1350) of minimum 25 MPa compressive strength and set time sufficient to secure the Settlement Pins within two (2) days of pouring.

4.3 INSTALLATION

4.3.1 General

The contractor shall install Settlement Pins as shown on the Contract Drawings.

4.4 COORDINATION WITH MONITORING

4.4.1 Notification

The Contractor shall notify the Contract Administrator no later than three (3) working days after installing a Settlement Pin. At this time the Contractor shall also supply the following information to the Contract Administrator.

- S Northings and Eastings coordinates in the project coordinate system;
- Elevation of top of pin in Geodetic datum;
- Dates of installation; and,
- Installation notes / sketches.

4.4.2 Monitoring

Monitoring of the Settlement Pins shall be done by others. Monitoring shall be conducted prior to and during construction. The Contractor shall provide installation information as specified above and provide access to the Settlement Pins for monitoring.

4.5 REPORTING

The Contractor shall record and report relevant installation details to the Contract Administrator. These include, but are not limited to:

- S Northings and Eastings coordinates in the project coordinate system;
- Elevation of top of pin in Geodetic datum;
- Dates of installation; and,
- Installation notes / sketches.

5.0 NAIL PIN (NP) – SUPPLY AND INSTALLATION

5.1 GENERAL

5.1.1 Scope

This Section contains the requirements for the supply and installation of Nail Pins.

The purpose of the Nail Pins is to monitor settlement of the existing structures and utilities, and the median roadway. Settlement is measured by survey of the top of the Pin with reference to stable non-settling benchmarks.

5.1.2 General Procedure

The Nail Pins shall be cast into concrete at the locations shown on the Contract Drawings.

5.1.3 Location

The locations of the Nail Pins should be provided in the Contract Drawings.

5.2 MATERIALS

5.2.1 General

The Contractor shall supply all materials and equipment required for the installation of the Nail Pins.

5.2.2 Pin

The Contractor shall supply a 25.4 mm minimum diameter reinforcing steel bar (OPSS 905) cut 0.15 m long or equivalent.

The top of the reinforcing steel bar shall be angled or rounded in such a way that a single survey point can be clearly identified and repeated.

5.2.3 Concrete

The Contractor shall supply concrete (OPSS 1350) of minimum 25 MPa compressive strength and set time sufficient to secure the Nail Pin within two (2) days of pouring.

5.3 INSTALLATION

5.3.1 General

The Contractor shall install nail pins as shown on the Contract Drawings.

5.4 COORDINATION WITH MONITORING

5.4.1 Notification

The Contractor shall notify the Contract Administrator no later than three (3) working days after installing a Nail Pin. At this time, the Contractor shall also supply the following information to the Contract Administrator:

- NP Northings and Eastings coordinates in the project coordinate system;
- Elevation of pin in Geodetic datum;
- Dates of installation; and,
- Installation notes / sketches.

5.4.2 Monitoring

Monitoring of the Nail Pins shall be done by others. Monitoring shall be conducted prior to and during construction. The Contractor shall provide installation information as specified above and provide access to the Nail Pins for monitoring.

5.5 REPORTING

The Contractor shall record and report relevant installation details to the Contract Administrator. These include, but are not limited to:

- NP Northings and Eastings coordinates in the project coordinate system;
- Elevation of pin in Geodetic datum;
- Dates of installation; and,
- Installation notes / sketches.

6.0 DECOMMISSIONING OF INSTRUMENTS

6.1 GENERAL

The Contractor shall decommission all the temporary Benchmarks (BM), Settlement Plates (SPs), Settlement Pins (Ss) and Nail Pins (NPs) at the end of the monitoring program unless advised otherwise by the Contract Administrator. Decommissioning of instrumentation shall be carried out according to the Ontario Water Resources Act, R.R.O. 1990, Regulation 903.

7.0 MEASUREMENT FOR PAYMENT

Measurement for Payment will be made on the basis of the number of units of survey Benchmarks (BMs), Settlement Plates (SPs), Settlement Pins (Ss) and Nail Pins (NPs) installed.

8.0 BASIS OF PAYMENTS

Payment at the Lump Sum price for this tender item shall be full compensation for all labour, monitoring equipment and material to do the work.

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