REPORT

October 4, 2013

DESKTOP REVIEW AND PRELIMINARY RECOMMENDATIONS

Oakville Midtown EA Foundation Study Town of Oakville, Ontario

Submitted to:
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Report Number: 13-1111-0033
Distribution:

2 Copies - Cole Engineering Group Ltd.
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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by Cole Engineering Group Ltd. (Cole) on behalf of the Town of Oakville to provide foundation engineering services in support of the planning and preliminary design purposes for the Oakville Midtown EA project.

This report presents the results of the desktop study compiling available existing subsurface information, and providing preliminary foundation recommendations for five proposed bridge structures in the vicinity of Queen Elizabeth Way (QEW) and Trafalgar Road in Oakville, Ontario. The information provided in this desktop study report is intended for planning and preliminary design purposes only and is not sufficient for detail design. A geotechnical investigation will be required at the proposed bridge structures during detail design to obtain subsurface information specific to the foundation locations and that information should be used for final design of the structure foundations and associated earthworks.

The factual data, interpretations and recommendations contained in this report pertain to a specific project as described in the report and are not applicable to any other project or site location. In addition, this report should be read in conjunction with the "Important Information and Limitations of This Report" contained in Appendix A of this report. The reader's attention is specifically drawn to this information, as it is essential for the proper use and interpretation of this report.

2.0 SITE AND PROJECT DESCRIPTION

The study area for the Oakville Midtown EA project is in the general vicinity of the QEW and Trafalgar Road interchange. The study area extends to about Pearson Drive to the west, the QEW/Royal Windsor Drive Underpass to the east, the Morrison Wedgewood Diversion Channel to the north and Cross Avenue to the south. Based on the information provided, it is understood that five proposed bridge structure sites are being considered as part of the Oakville Midtown EA project; the approximate location of these sites are described below, and shown on Figure 1.

- S1 – QEW eastbound (W-N/S) off-ramp underpass of Trafalgar Road.
- S4 – QEW underpass structure, approximately 400 m east of Trafalgar Road.
- S5 – Morrison Wedgewood Diversion Channel Crossing.
- S6 – Overpass structure of Royal Windsor Drive and the W-N/S Ramp, approximately 600 m east of Eighth Line.
- S8 – Overpass structure to carry Iroquois Shore Road over North Service Road

3.0 AVAILABLE INFORMATION

3.1 Sources of Information

This desktop study is based on information from previous investigations carried out by Golder Associated Ltd. as well as available subsurface information obtained from the existing reports available from Ministry of Transportation, Ontario (MTO) Pavement and Foundations Section's GEOCRES database. The results of these investigations are provided in the reports referenced below. The relevant Record of Borehole sheets and laboratory testing results are provided in Appendix B of this report.

- Golder Associates Ltd., Foundation Investigation and Design Report, Proposed High Mast Light Poles, QEW widening, From Third Line to 1 km east of Trafalgar Road, Oakville, Ontario dated September 2009, Project No. 011-1128-3 HML, Geocres No. 30M5-259.
- Golder Associates Ltd., Foundation Investigation and Design, Queen Elizabeth Way, Trafalgar Road to Highway 403, W.P. 67-98-00 District 4/6, Toronto dated November 1998, Project No. 981-1122, Geocres File No. 30M5-204.
- Golder Associates Ltd., Foundation Investigation and Design, Royal Windsor Drive Underpass, Queen Elizabeth Way Highway 403, W.P. 98-23024, Agreement No. 9820-7411-9820, dated October 1999, Project No. 991-1140, Geocres File No. 30M5-205.
- Associated Technical Services Limited, Foundation Investigation Report for Trafalgar Road Interchange, W.P. 1-79-07, QEW, District 4, Hamilton, dated February 1979, Geocres File No. 30M5-120.
- Ontario Ministry of Natural Resources, Ministry of Environment Water Well Information, dated 2012.

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

The proposed bridge structures are located within the Iroquois Plain physiographic region, as delineated in *The Physiography of Southern Ontario* (Chapman and Putnam, 1984)[1].

The glacial Iroquois Plain stretches along the northern shoreline of Lake Ontario, extending from the Niagara Escarpment in the west to the Scarborough Bluffs in the east. The Iroquois Plain soils consist of glaciolacustrine sediments deposited in Lake Iroquois – primarily sands, silts and gravels, with a shallow cover of till remaining over the bedrock.

The bedrock underlying the Toronto area consists of three shale dominated units: from oldest to youngest, they are the Blue Mountain, Georgian Bay and Queenston Formations. These bedrock formations are essentially horizontally bedded, although on a regional scale, they dip gently to the south. The Georgian Bay Formation which underlies the study area consists mainly of blue-grey shale, containing siltstone, sandstone and limestone

[1] Chapman, L.J. and Putman, D.F., 1984. The Physiography of Southern Ontario, Ontario Geological Society, Special Volume 2, Third Edition. Accompanied by Map p. 2715, Scale 1:600,000.

interbeds. Outcrops of this formation are commonly found along water courses on the west side of Toronto and in Mississauga, notably in the Humber River, Mimico Creek, Etobicoke Creek and Credit River valleys.

4.2 Subsurface Conditions

The anticipated subsurface conditions at each of the five proposed sites was collected from previous investigations carried out in the vicinity of the sites, as referenced in Section 3.0 above. It should be noted that the existing information was collected for other projects, and that the subsurface conditions noted on the existing borehole logs may vary from the current conditions, particularly if construction activities have taken place subsequent to the date of the original investigations. Copies of the relevant Record of Boreholes and laboratory testing results are provided in Appendix B of this report.

In general, the subsurface conditions in the area of the five sites consist of variable fill materials overlying a relatively thin deposit of clayey silt to silty clay till/residual soil. These cohesive native soils are inferred to represent both glacial till and residual soil (i.e. bedrock that has essentially completely weathered to become a soil and has not been transported from its original position) deposits. In some boreholes, residual soil and/or till deposits were encountered separately while at other boreholes the till deposits transition into the underlying residual soils. The till/residual soil contains varying amounts of shale fragments and is underlain by Shale Bedrock. Based on the subsurface conditions encountered, the five sites are located near a geological boundary between the Georgian Bay Formation which is predominantly grey in colour and the Queenston Formation which is predominantly red to reddish brown in colour and both bedrock formations were encountered at some of the sites. The shale bedrock contains limestone, siltstone and sandstone interbeds that are generally stronger and less weathered than the surrounding shale.

A more detailed description of the subsurface conditions encountered near each of the five bridge sites is described in the following sections.

4.2.1 Site S1 – QEW off-ramp Underpass of Trafalgar Road

The location of Site S1 is understood to be approximately 200 m south of Trafalgar Road in the vicinity of Argus Road and Davis Road. A total of five boreholes (identified as Borehole 38, 39, 40, 45 and 46 from Geocres No. 30M05-120) were advanced in the vicinity of Site S1 and utilized for the purpose of this desktop study report.

The existing borehole information indicates that 0.3 m to 0.8 m of fill material is generally present in the area of Site S1; however, two of the existing boreholes (Boreholes 39 and 40) were advanced through the QEW/Trafalgar Road interchange embankment (north of Site S1) and encountered 7.6 m and 7.8 m of fill. The fill material (including embankment fill) consists of silty clay and silty sand. Where boreholes were advanced through roadways, asphalt underlain by ‘crushed stone’ and gravelly sand was present. Underlying the fill materials, a deposit of clayey silt to silty clay till/residual soil was encountered between depths of 0.3 m to 2.4 m. SPT ‘N’ values measured within the till/residual soil range from 13 blows to 68 blows per 0.3 m of penetration, suggesting a stiff to hard consistency. A thin layer of gravelly sand, approximately 0.5 m thick, was encountered beneath the fill material in Boreholes 39 and 40 (Trafalgar Road interchange south embankment).

Both grey and red shale bedrock was encountered beneath the overburden soils at depths of 2.2 m to 2.4 m from ground surface near Argus Road/Davis Road and at depths of 8.3 m and 8.5 m from ground surface at the top of the Trafalgar Road interchange embankment. The approximate bedrock elevation varies from about Elevation 99.2 m near Davis Road to Elevation 104.9 m north of Site S1 at the Trafalgar Road Interchange.

The groundwater level measured in January 1979 in the vicinity of Site S1 was observed at a depth of about 0.6 m within the fill materials in Borehole 38; corresponding to Elevation 105.9 m.

4.2.2 Site S4 – QEW Underpass Structure, east of Trafalgar Road

The location of Site S4 is understood to be approximately 400 m east of Trafalgar Road. A total of six boreholes (identified as Borehole 1 and 2 from Geocres No. 30M05-205 and Boreholes W35, W37, W39 and W40 from Geocres No. 30M5-259) were advanced in the vicinity of Site S4 and utilized for the purpose of this desktop study report.

From the existing borehole information, fill material varying from sand and gravel to silty clay was encountered from ground surface to depths ranging from 0.8 m to 2.2 m below ground surface. Four of the six boreholes were advanced through the QEW, encountering 0.2 m to 0.3 m of asphalt at ground surface. Underlying the fill materials, a 0.6 m to 1.5 m thick deposit of clayey silt to silty clay till/residual soil was encountered. In the till/residual soil deposit, measured Standard Penetration Test (SPT) 'N' values range from 6 blows to greater than 100 blows per 0.3 m of penetration, generally increasing with depth and suggesting a firm to hard consistency.

Grey and reddish brown shale bedrock was described as being encountered beneath the overburden soils at depths of 2.1 m to 2.8 m below ground surface (corresponding to Elevations 103.4 m to 107.4 m).

The groundwater level measured in August 1999 in the vicinity of Site S4 was observed at depths of about 3.7 m to 4.2 m below ground surface (Elevation 102.8 m to 103.8 m); approximately at or below the surface of the bedrock.

4.2.3 Site S5 – Morrison Wedgewood Diversion Channel Crossing

Structure Site S5 is understood to cross the Morrison Wedgewood Diversion Channel approximately 200 m east of Trafalgar Road. Existing subsurface information in close proximity to the location of Site S5 was not publicly available. However, for the purpose of this desktop study report, two boreholes (identified as Borehole 25 and 26 from Geocres No. 30M05-120) advanced in the area of Trafalgar Road and Iroquois Shore Road (approximately 200 m southwest of the site) were considered.

From the existing 1979 borehole information, the overburden material was encountered at ground surface and consisted of about 1.7 m of stiff to hard silty clay. Red shale bedrock was described as being encountered beneath the overburden soils at Elevations 108.1 m and 109.2 m.

The groundwater level measured in January 1979 in the area of Trafalgar Road and Iroquois Shore Road was observed at a depth of about 0.9 m below ground surface (Elevation 108.5 m); at about bedrock surface.

4.2.4 Site S6 – Overpass structure of Royal Windsor Drive and the W-N/S Ramp

The location of Site S6 is understood to be approximately 600 m east of Eighth Line. A total of five boreholes (identified as Boreholes 2 and 3 from Geocres No. 30M05-204 and Boreholes 9, 10 and 14 from Geocres No. 30M5-205) were advanced in the vicinity (slightly north) of Site S6 and utilized for the purpose of this desktop study report.

From the existing borehole information, the surficial fill material at ground surface consists of either topsoil or pavement fills depending on where the boreholes were drilled. The layers of topsoil were up to about 180 mm in thickness, while the existing pavement structure consisted of about 300 mm of asphalt underlain by 300 mm of granular materials. Underlying the topsoil or pavement materials, fill material varying from silty sand to silty clay containing trace topsoil and/or organics was encountered to depths ranging from 0.2 m to 1.5 m below ground surface. Approximately 0.4 m to 0.8 m of very stiff to hard clayey silt to silty clay till/residual soil was encountered beneath the fill materials. Measured SPT 'N' values in the till generally range from 19 blows to 35 blows per 0.3 m of penetration; however, 'N' values up to 50 blows per 0.02 m of penetration were also measured within the till near the surface of the bedrock.

Grey shale bedrock was encountered beneath the overburden soils at depths of 1.5 m to 2.3 m below ground surface, or at about Elevation 102.4 m to Elevation 104.2 m.

The groundwater level measured in a single well (Borehole 2) in October 1998 in the vicinity of Site S6 was observed at a depth of about 2.6 m below ground surface (Elevation 101.3 m); below the surface of the bedrock.

4.2.5 Site S8 – Overpass structure to carry Iroquois Shore Road over North Service Road

A total of three boreholes (identified as Boreholes 1 and 4 from Geocres No. 30M05-204 and Borehole 5 from Geocres No. 30M5-205) were advanced in the vicinity of Site S8 (slightly south) and utilized for the purpose of this desktop study report.

From the existing borehole information, fill material varying from sandy silt to silty clay containing trace topsoil and/or organics was encountered from ground surface to a depth ranging from 0.2 m to 1.5 m below ground surface. Approximately 0.7 m to 0.9 m of clayey silt to silty clay till/residual soil was encountered beneath the fill materials. Measured SPT 'N' values in the till were greater than 100 blows per 0.3 m of penetration, suggesting a hard consistency.

Grey shale bedrock was encountered beneath the overburden soils at depths of 1.2 m to 1.5 m below ground surface, or at about Elevation 103.7 m to Elevation 105.5 m.

The groundwater level measured in the vicinity of Site S8 was observed at a depth of about 2.6 m below ground surface (Elevation 101.3 m); below the surface of the bedrock.

5.0 DISCUSSION AND PRELIMINARY RECOMMENDATIONS

5.1 General

This section of the report provides preliminary foundation design recommendations for the five proposed bridge structures for the Oakville Midtown EA project in Oakville, Ontario. The recommendations are based on interpretation of the factual data obtained from the boreholes completed as part of previous investigations in the area of the proposed structure sites.

It is noted that the preliminary recommendations are based on existing borehole information that provides limited subsurface information in the general area of the structure site rather than at/within the foundation footprints of the proposed structures. The discussion and recommendations presented are intended to provide the designers with sufficient information to assess the feasible foundation alternatives and to carry out the preliminary design of the structure foundations for planning purposes, but is not sufficient for detail design. Therefore, further investigation at the final location of the structure foundations is required during detail design to obtain subsurface information specific to the foundation locations and to confirm the subsurface conditions and provide sufficient information on which to base geotechnical recommendations for detail design.

Where comments are made on construction, they are provided to highlight those aspects that could affect the preliminary design of the project, and for which special provisions or operational constraints may be required in the Contract Documents. Those requiring information on the 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. This report addresses only the geotechnical (physical) aspects of the subsurface conditions at this site.

5.2 Foundations Options

During preparation of this desktop study report, the general location of the proposed structures were provided by Cole; however, details of the proposed structures and associated works (vertical alignment, bridge layout, retaining walls, etc.) are not known at this point in time. As such, the following discussion provides general guidelines with respect to potential foundation alternatives for the proposed structure for use in the planning and preliminary design phase.

As part of the proposed Oakville Midtown EA Project, new bridge structures are to be constructed within the vicinity of the QEW and Trafalgar Road interchange. The new bridge structures will presumably be built in stages to maintain QEW traffic flow during bridge constructions. With space restrictions and the requirement for temporary roadway protection adjacent to the travelled lanes and/or embankments of the QEW, the use of deep foundations (caissons or driven piles) for the new bridge supports may be a feasible foundation alternative which minimizes the depth of excavations by maintaining the pile cap level as high as possible.

Shale bedrock is generally present at relatively shallow depth below ground surface at most of the sites such that shallow foundations (spread footings) supported on bedrock could be considered a feasible alternative for foundation support; however, it should be noted that deeper excavations at some structure sites and/or foundation elements may be required to found on bedrock. Alternatively, caissons (drilled piers) extending into the shale bedrock, for support of the new bridge structure foundations may also be considered.

The following sections provide preliminary recommendations for foundation options to support the proposed five bridge structures in the area of the QEW/Trafalgar Road interchange.

5.2.1 Shallow Foundations

Strip or spread footings are considered feasible for the support of the new bridge structures, but may not be considered practical at every structure site. Shallow foundations would have to be founded below the existing fill, on the native clayey silt to silty clay till or on the shale bedrock. Based on the limited previous nearby investigations, the upper 2 m of bedrock is considered to be highly to moderately weathered and fractured compared to the underlying rock mass and as such, the geotechnical resistance for spread footings will depend on the chosen design founding level. Consideration could be given to 1) placing the footings on the hard clayey silt to silty clay till/residual soil and the weathered bedrock surface or, 2) at a depth of 2.0 m below the surface of the bedrock (i.e. below the weathered bedrock). For these two shallow foundation options, Table 1 provides estimated minimum depths and maximum elevations that may be used for preliminary design purposes.

Table 1: Estimated Founding Depths/Elevations

Structure	Founded on Hard Clayey Silt to Silty Clay Till/Residual Soil or the Upper Weathered Shale Bedrock		Founded on the Slightly Weathered Shale Bedrock (minimum 2 m below the bedrock surface)	
	Estimated Minimum Founding Depth (m)	Estimated Maximum Founding Elevation (m)	Estimated Minimum Founding Depth (m)	Estimated Maximum Founding Elevation (m)
S1	1.2 to 2.1	100.5	4.0	98.0
S4	1.5	104.5	4.5	101.5
S5	n/a*	n/a*	3.5	109.0
S6	1.5	103.0 to 104.0	3.5 to 4.5	100.5 to 101.0
S8	0.8	104.5	3.5	102.0

*Existing subsurface information is not available

All spread footings should be provided with a minimum of 1.2 m soil cover for frost protection. In addition, the bearing soil and fresh concrete should be protected from freezing during cold weather construction.

The following values for factored axial geotechnical resistance at Ultimate Limit States (ULS) and geotechnical reaction at Serviceability Limit States (SLS) may be assumed for preliminary design and planning purposes. For spread footings placed on the hard clayey silt/silty clay till or slightly weathered shale bedrock, the geotechnical resistance at SLS for 25 mm of settlement will be greater than the factored axial resistance at ULS and as a result, ULS conditions will govern.

Table 2: Preliminary Geotechnical Axial Resistances for Shallow Foundations

Founding Stratum	Geotechnical Resistance (kPa)	
	Factored ULS	SLS (for 25 mm of settlement)
Hard clayey silt/silty clay till or Surface of the shale bedrock	600	400
Slightly weathered shale bedrock	1,000	-

The geotechnical axial resistances and founding depths/elevations provided above are based on limited subsurface information and should be considered as preliminary. Additional geotechnical investigation(s) at the proposed footing locations will be required to obtain additional subsurface information for detail design, and in particular the bedrock conditions, to confirm the design recommendations and founding elevations.

5.2.2 Socketted Caissons

As discussed above, the upper 2 m of bedrock is considered to be highly to moderately weathered and fractured compared to the underlying rock mass and as such, the upper 2 m of the bedrock should be discounted when assessing the required caisson socket length into bedrock. The caissons should be extended through the weathered shale and founded within the underlying less weathered to fresh shale bedrock. The surface of the slightly weathered shale bedrock is provided in Table 1 above.

The factored geotechnical axial resistance at ULS for 0.6 m diameter and 0.9 m diameter caissons provided below may be used for preliminary design. The SLS value for 25 mm of settlement will be greater than the factored ULS values; therefore the ULS conditions will govern for this case.

Table 3: Preliminary Geotechnical Axial Resistances for Caissons

Caisson Diameter (m)	Factored Axial Geotechnical Resistance at ULS (kN)	
	2 m Bedrock Socket	3 m Bedrock Socket
0.6	1,600	2,500
0.9	3,200	4,000
1.5	5,700	7,500

The above preliminary geotechnical resistances assume:

- The caisson has a minimum socket length of 2 m to 3 m within the slightly weathered shale bedrock (i.e. typically about 3.5 m below bedrock surface), as indicated above;
- Appropriate equipment is used to clean the base of the caisson, and
- Inspection of the base of the caisson is carried out by qualified personnel, (likely using remote instrumentation) to confirm the adequacy of the base.

The resistances provided above will have to be re-evaluated and modified, as necessary, during detail design in consideration of the additional subsurface investigation at the foundation elements.

The above resistances are provided for a single caisson. Group effects may need to be considered for closely spaced caissons (less than about 3 caisson diameters).

The performance of caissons in compression will depend to a large degree upon the final cleaning and verification of the condition of the base of the caisson. The base of each caisson excavation must be cleaned to remove all loose cuttings to ensure that the concrete is in intimate contact with the competent bearing stratum. A temporary or permanent liner may be required to support the overburden and weathered bedrock during construction and to permit inspection and cleaning of the caisson base if the design relies on visual inspection. Groundwater seepage should be expected into the caissons given the highly fractured nature of the bedrock; this may preclude visual inspection and therefore, alternate measures to ensure adequate cleaning of the base will be required through full length liner installation and pumping from the caisson excavations.

The shale bedrock contains limestone interbeds within its matrix that are significantly harder/stronger than the shale. These hard rock obstructions may pose difficulties during the advancing of caissons/temporary liners (if required). Where encountered, these harder interbeds may require significant effort to penetrate, depending on their thickness.

All caisson caps should be founded at a minimum depth of 1.2 m below final ground surface grade or provided with an equivalent thickness of insulation above the cap for frost protection, in accordance with OPSD 3090.101 (Foundation Frost Penetration Depths for Southern Ontario).

5.2.3 Driven Steel H-Piles

Driven steel H-piles are considered an option for support of the foundations for the proposed bridges and allow for integral foundation design; however, assuming a pile cap level as high as possible with the base at/below the frost penetration depth (i.e. minimum 1.2 m below final grade), the piles would have to extend below the bedrock surface in order to achieve an adequate length of the piles for integral abutment design (i.e. 5 m). It is noted that the glacial till deposit overlying the bedrock has high (greater than 100 blows per 300 mm) 'N' values and likely contains cobbles and boulders. The H-piles could therefore "hang up" and make it difficult to get the piles though the deposit to the bedrock (although further investigation is required in this regard at the detail design stage). Pre-augering through the till deposit and/or bedrock is likely required at most sites and could be considered as an option.

Due to shallow bedrock, driven steel H-piles may not be practical for support of the structure foundations at the five sites. If the proposed bridge structures are to extend through existing road embankments (i.e. possibly at Sites S6 and S8), adequate pile lengths may be achievable and therefore, a feasible option.

Where applicable, the foundations may be supported on steel H-piles driven to found on or socketed into the shale bedrock at the proposed bridge structures. Based on the existing information, for HP310x110 piles driven to bedrock, the factored axial geotechnical resistances at Ultimate Limit States (ULS) for preliminary design of the foundations provided below may be considered. The axial resistance at Serviceability Limit States (SLS) for 25 mm of settlement will be greater than the factored ULS value; therefore the ULS conditions will govern for this case.

Table 4: Preliminary Geotechnical Axial Resistance for Driven Steel H-Piles

Approximate Pile Length	Factored Axial Geotechnical Resistance at ULS (kN)	Axial Geotechnical Resistance at SLS (kN, for 25 mm of settlement)
8 m	1,400	N/A

The pile caps should be constructed at a minimum depth of 1.2 m below final ground surface for frost protection purposes, per OPSD 3090.101 *(Foundation Frost Depths for Southern Ontario).*

For the installation of steel H-piles, consideration must be given to the potential presence of cobbles and boulders within the glacial soil deposits. The piles should be reinforced at the tip with appropriate driving shoes to penetrate the obstructions and seat the piles into the bedrock.

The preliminary geotechnical axial resistance provided above will have to be re-evaluated and modified, as necessary, during detail design in consideration of the additional subsurface investigation at the foundation elements particularly with regard to whether pre-augering prior to pile driving is required.

The resistances provided above will have to be re-evaluated and modified, as necessary, during detail design in consideration of the additional subsurface investigation at the foundation elements

5.3 Resistance to Lateral Forces

Resistance to lateral forces / sliding resistance between the concrete footings and the subgrade should be calculated in accordance with Section 6.7.5 of the Canadian Highway Bridge Design Code (*CHBDC)*. For assessment of sliding resistance for preliminary design, the coefficient of friction between cast in place concrete and clayey silt to silty clay till/residual soil or the shale bedrock may be taken as 0.45.

5.4 Seismic Consideration

According to Section 4.4.4 of the Commentary to the CHBDC (2006), this site is located in Seismic Performance Zone 1. The site-specific zonal acceleration ratio, A, for Oakville area is 0.05. For preliminary seismic design purposes, the Site Coefficient, S, for this site in accordance with Section 4.4.6 of the CHBDC (2006) may be taken as 1.0 consistent with Soil Profile Type I.

5.5 Construction Considerations

The following subsections identify future construction considerations that should be considered at this stage as they may impact the planning and preliminary design.

5.5.1 Excavation and Temporary Roadway Protection

All temporary excavations should be carried out in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects. The existing fill is classified as Type 3 soil; the stiff to hard Upper Till Deposit is classified as Type 2 soil under the Act. Based on the subsurface conditions, temporary open-cut excavations (for example, for shallow foundations) in the Till Deposit may be made with side slopes oriented at 1 horizontal to 1 vertical (1H:1V), with flatter slopes through the fill materials and granular soils if encountered.

At this preliminary/planning design stage, it is anticipated that temporary roadway protection will be required along QEW (and other arterial roads) to facilitate the staged construction of the new structures. These temporary excavation support systems should be designed and constructed in accordance with OPSS 539 (*Temporary Protection Systems).* The lateral movement of the temporary shoring system should meet Performance Level 2 as specified in OPSS 539.

5.5.2 Groundwater Control

Measured groundwater levels across the five study areas obtained from previous 1979 to 1999 investigations were about 0.6 m to 4.2 m below ground surface (at the time of these investigations) and generally indicate that the groundwater elevation slopes towards the south to Lake Ontario. Most existing boreholes were dry upon during drilling, and where water was encountered, measurements were taken in open boreholes after completion of drilling (except in a well at Site S6). The shallow groundwater measurements (i.e. less than 1 m below ground surface) were typically encountered within or just below the fill materials. Groundwater is anticipated to occur from “perched” water within existing fills.

Assuming excavation depths extend through the cohesive till deposit and into the shale bedrock (i.e. granular soils are not anticipated at the sites), the seepage volumes are expected to be relatively small, such that the water inflow can be handled by pumping from filtered sumps placed at the base of the excavations. Granular soils generally were not present on the existing available borehole logs, with the exception of a thin layer of sand encountered beneath fill materials north of Site S1. If granular soils are encountered during detail investigations, some form of groundwater control may need to be considered. An assessment should be made at detailed design with respect to anticipated seepage volumes and whether or not a Permit to Take Water (PTTW) is required for the construction of the foundations.

5.5.3 Obstructions

The soils at this site are glacially derived and as such should be expected to contain cobbles and boulders, and the shale bedrock is expected to contain interbeds of limestone, which could both affect the installation of deep foundations or protection systems. Further observation is recommended at the detailed design stage of investigation for the presence of cobbles and/or boulders as the boreholes are advanced. Construction equipment suitable for penetrating/removing such obstructions and bedrock should be anticipated for construction of the foundations at each bridge site.

5.6 Recommendations for Further Work for Detail Design

Additional investigation will be required within the footprint of the new structure foundations at each of the five sites and the approach embankment widening areas to further assess and/or confirm the subsurface conditions and the preliminary recommendations provided in this report.

All further work for detail design should be done in accordance with MTO's "Guidelines of Foundation Engineering – Geotechnical Speciality for Corridor Encroachment Permit Application", dated April 2008.

6.0 CLOSURE

We trust that this desktop study report meets your current planning and preliminary design requirements. If you have any questions regarding the contents of this report, please do not hesitate to contact this office.

Report Signature Page

GOLDER ASSOCIATES LTD.

Shannon Palmer, P.Eng.
Geotechnical Engineer

Kevin Bentley, P.Eng.
Senior Geotechnical Engineer, Associate

SLP/KJB/slp/jl

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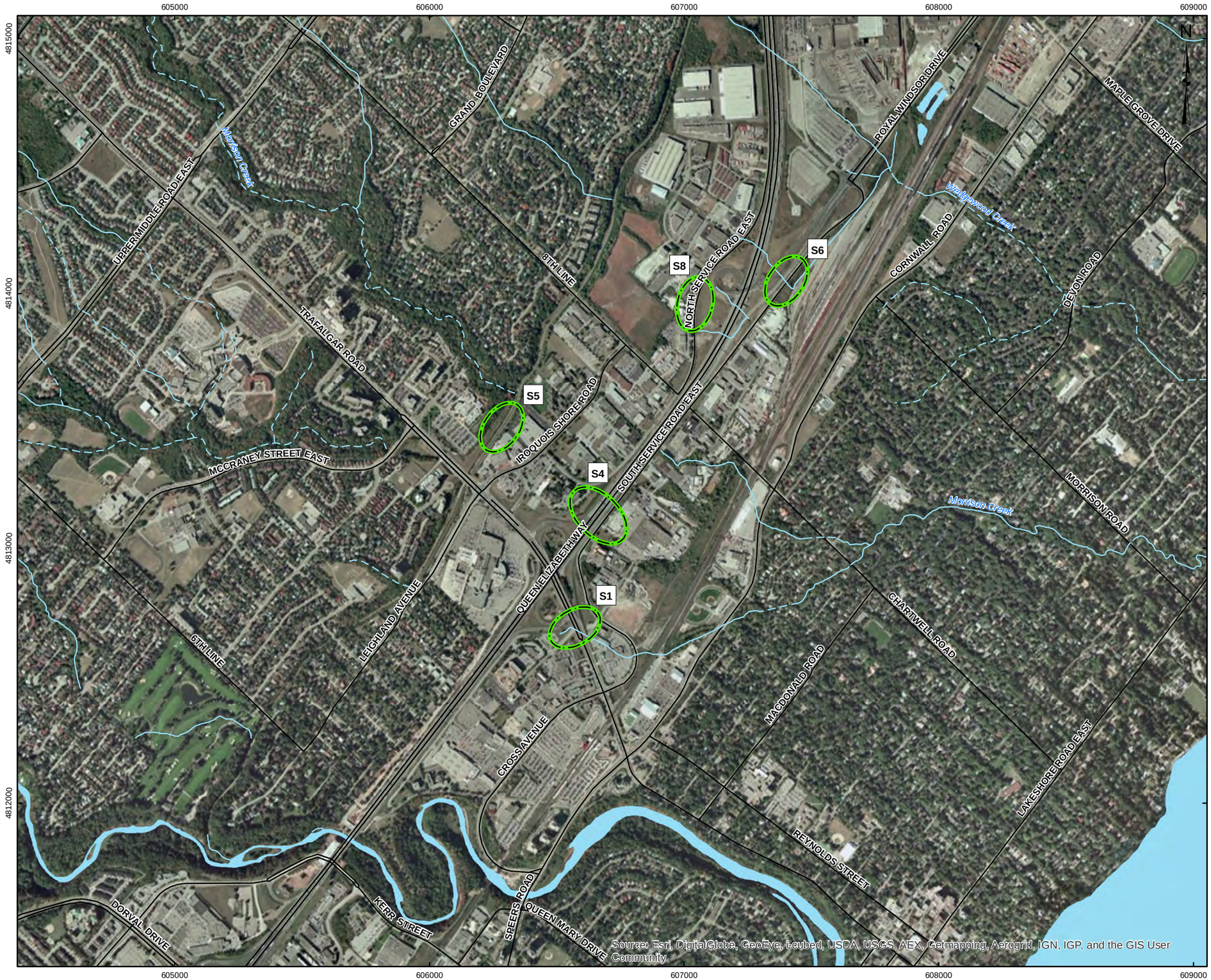


LEGEND

- Major Road
- Watercourse, Permanent
- Watercourse, Intermittent
- Water Area, Permanent
- Approximate Site Location

REFERENCE

Base Data - MNR LIO, obtained 2009
Produced by Golder Associates Ltd under licence from
Ontario Ministry of Natural Resources, © Queens Printer 2012
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 17

250 125 0 250 500 750
METRES
SCALE 1:15,000

PROJECT
OAKVILLE MIDTOWN EA PROJECT

TITLE
SITE LOCATIONS

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1111-0033			SCALE AS SHOWN	REV. 0.0
DESIGN	ME	23 Aug. 2013	FIGURE: 1	
GIS	JO	29 Aug. 2013		
CHECK	SP	29 Aug. 2013		
REVIEW	SP	29 Aug. 2013		

G:\Projects\2013\13-1111-0033\GIS\MXDs\Reporting\Site Locations.mxd

APPENDIX A

Important Information and Limitations of This Report

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

Standard of Care: Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder can not be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without Golder's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, Golder may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to Golder. The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client can not rely upon the electronic media versions of Golder's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder can not be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

Soil, Rock and Groundwater Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

Sample Disposal: Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

Follow-Up and Construction Services: All details of the design were not known at the time of submission of Golder's report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder's report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder's report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Golder's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

Changed Conditions and Drainage: Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

APPENDIX B

Existing Subsurface Information

Site S1

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 38

W P 1-79-07 LOCATION Co-ords 15,791.439 N; 901,192 E. ORIGINATED BY T L

DIST Hamilton HWY Q.E.W. BOREHOLE TYPE Solid Stem Auger COMPILED BY T L

DATUM Geodetic DATE January 23, 1979 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE; 0.5 1.0 1.5 2.0 2.5)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT Wl — WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
349.3	Ground Level										
0.0	Topsoil.		1	AS							
0.4	Asphalt.										
0.6	Wet gravelly sand. Brown		2	AS		▼ (DSA)	348				
346.8											
2.5	Silty clay. Red		3	SS	8		346				
344.8			4	SS	28/12 40/6						
4.5	Severely Weathered shale with horizontal clay seams. Red and Green		5	SS	40		344				
			6	SS	61		342				
340.8			7	SS	41/6" 100/7"		340				
8.7	Apparent Shale Bedrock. End of Borehole										

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications Ontario

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 39

W P 1-79-01 LOCATION Co-ords. 15,791,498 N; 951,245 E. ORIGINATED BY T L

DIST Hamilton HWY Q.E.W. BOREHOLE TYPE Solid Stem Auger COMPILED BY T L

DATUM Geodetic DATE January 11, 1979 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL ◆ FIELD VANE × LAB VANE; 0.5 1.0 1.5 2.0 2.5)	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
372.8	Ground Level										
0.0	Gravelly clayey sand.		1	AS							
0.8	Fill - gravelly silty clay with occasional shale fragments. Red.		2	AS			370				
			3	SS	43					137.2	
							365				
			4	SS	10					128.9	
							360				
			5	SS	14					135.0 143.8	
							355				
			6	SS	14					130.4	
							350				
347.8			7	SS	20						
25.0	Gravelly sand.		8	SS	12						
321.1							345				
26.7	Silty clay. Red										
344.0											
28.0	Apparent Shale Bedrock Red		9		40/6" 100/5"						
30.5											
30.9	End of Borehole										

+3, ×5 : Numbers refer to Sensitivity.

20 / 15 ◇ 5 (%) STRAIN AT FAILURE / 10

Ministry of Transportation and Communications Ontario

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 40

W P 1-79-01 LOCATION Co-ords. 15,791,557 N; 951,280 E. ORIGINATED BY T L

DIST Hamilton HWY Q.E.W. BOREHOLE TYPE Solid Stem Auger COMPILED BY T L

DATUM Geodetic DATE January 12, 1979 CHECKED BY

SOIL PROFILE ELEV/DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE (0.5 1.0 1.5 2.0 2.5)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
373.8	Ground Level									
373.6 0.2	Asphalt		1	AS						
372.8 1.0	Gravelly sand. Fill - silty clay with shale fragments. Red		2	AS			370			
			3	SS			365			
			4	SS	40					
			5	AS			360			
			6	SS	12					
			7	SS	10		355	+		
			8	SS	15					
			9	AS			350			
348.3 25.5	Gravelly sand. Brown		10	SS	58					
346.7 27.1	Apparent Shale Bedrock		11	SS	40/6" 100/5"					
345.9 27.9	End of Borehole									

+³, ×³ : Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications, Ontario

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 45

W P 1-79-07 LOCATION Co-ords 15,790,577 N; 951,724 E. ORIGINATED BY TL

DIST Hamilton HWY Q.E.W. BOREHOLE TYPE Stem Auger COMPILED BY TL

DATUM Geodetic DATE January 15, 1979 CHECKED BY

SOIL PROFILE ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (1.0 2.0 3.0 4.0 5.0)	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
333.6	Ground Level										
0.0	Asphalt.										
0.2	Crushed stone.		1	AS							
0.5	Gravelly silty clay.										
333.6 1.0	Silty clay with frequent shale fragments. Hard Red		2	SS	48		332		○	119.0	
									○	129.8	
			3	SS	50		330				
							328				
			4	SS	68				○ ○	132.0	
326.6 7.0	Apparent shale Bedrock Grey		5	SS	100/3"						
7.2	End of Borehole										

OFFICE REPORT ON SOIL EXPLORATION

^{*3}, ^{*5} Numbers refer to Sensitivity

(3) Plotted from STRAIN GAUGE

Ministry of Transportation and Communications Ontario

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 46

W P 1-79-01 LOCATION Co-ords. 15,790,806 N; 951,650 E. ORIGINATED BY T.L.

DIST Hamilton HWY Q.E.W. BOREHOLE TYPE Solid Stem Auger COMPILED BY T.L.

DATUM Geodetic DATE January 15, 1979 CHECKED BY

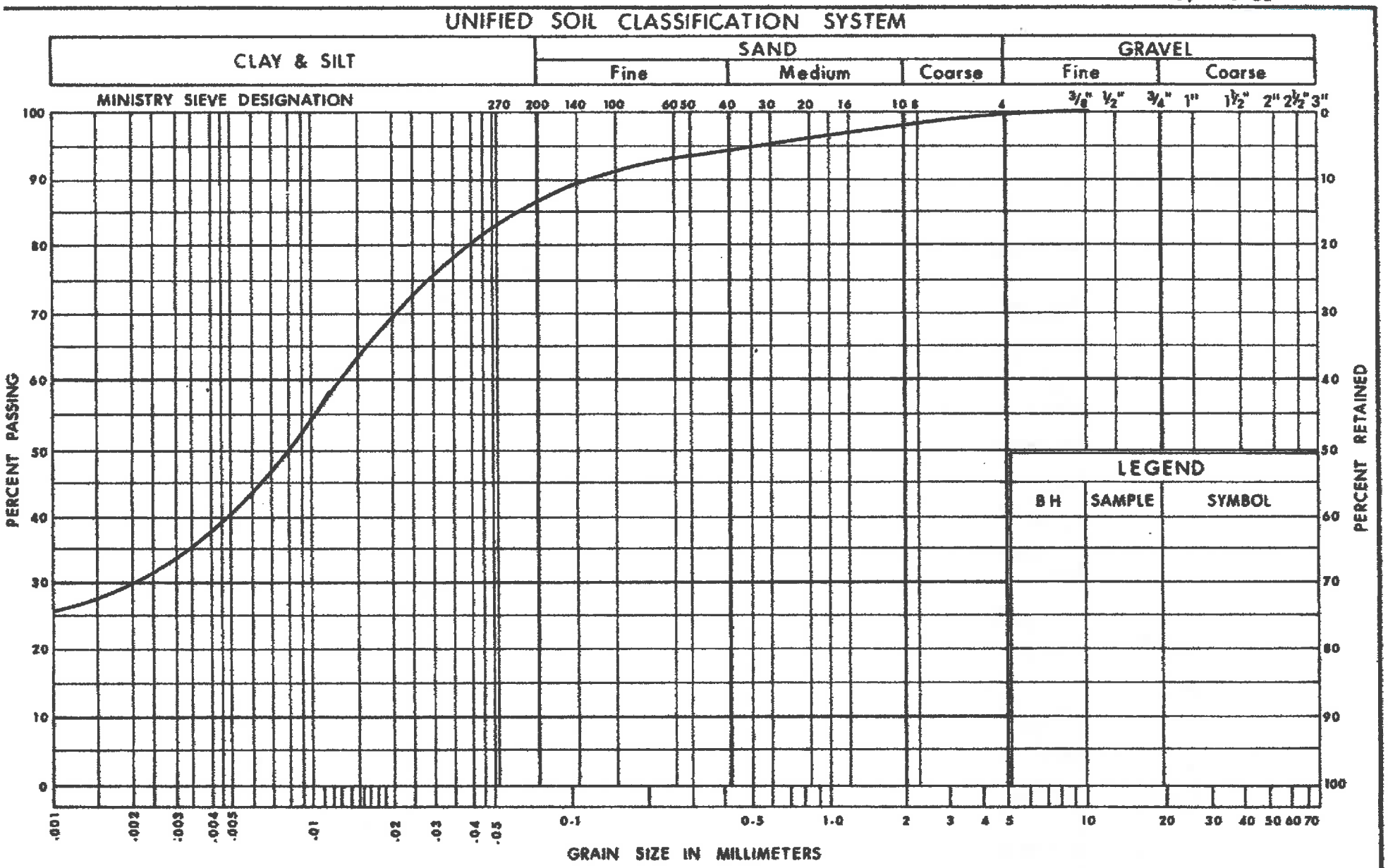
SOIL PROFILE ELEV/DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (o UNCONFINED, • QUICK TRIAXIAL, + FIELD VANE, x LAB VANE) (0.5 1.0 1.5 2.0 2.5)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT Wl — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
337.9	Ground Level									
0.0	Silty clay topsoil.		1	AS						
0.5	Silty clay. Red									
1.0	Crushed stone and Red silty clay.		2	SS	76		336			
2.0	Silty clay with frequent shale fragments		3	SS	28					126.6 / 120.6
							334			
	Stiff Red		4	SS	13					126.1 / 119.9
							332			
			5	SS	13					130.7
			6	SS	9/5" 56/5					
330.0							330			
7.9 329.4	Apparent Shale Bedrock Grey		7	SS	100/6"					
8.5	End of Borehole									

OFFICE REPORT ON SOIL EXPLORATION

+3, x5 : Numbers refer to Sensitivity

15 (20/10) 5 (%) STRAIN AT FAILURE

Oct 75, FF-S-22



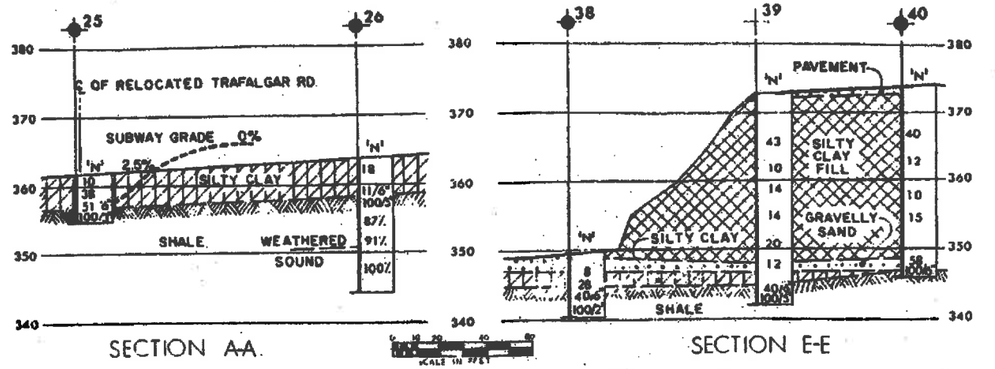
Ministry of Transportation and Communications
Ontario
ENGINEERING SERVICES BRANCH

GRAIN SIZE DISTRIBUTION

TYPICAL RED SILTY CLAY

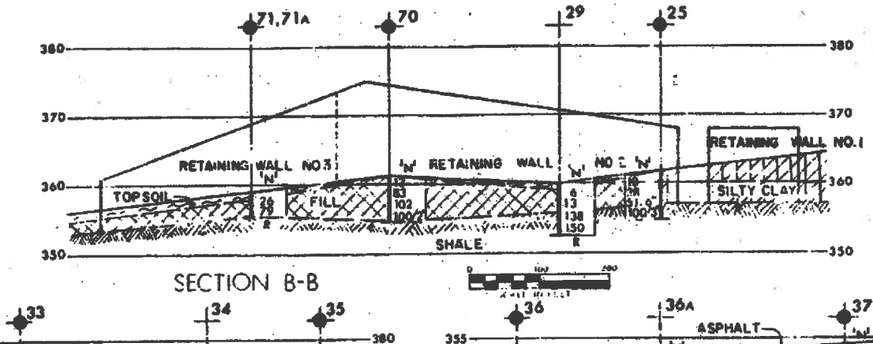
FIG No 1

W P 1-79-01



SECTION A-A.

SECTION E-E



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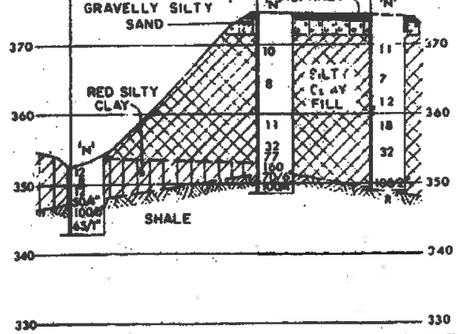

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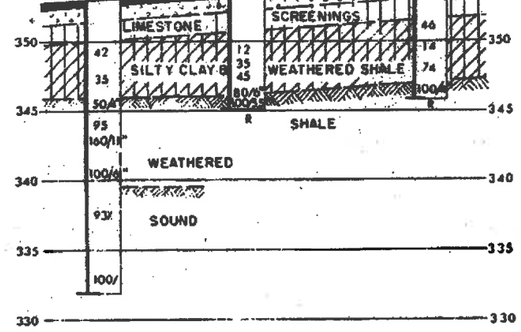

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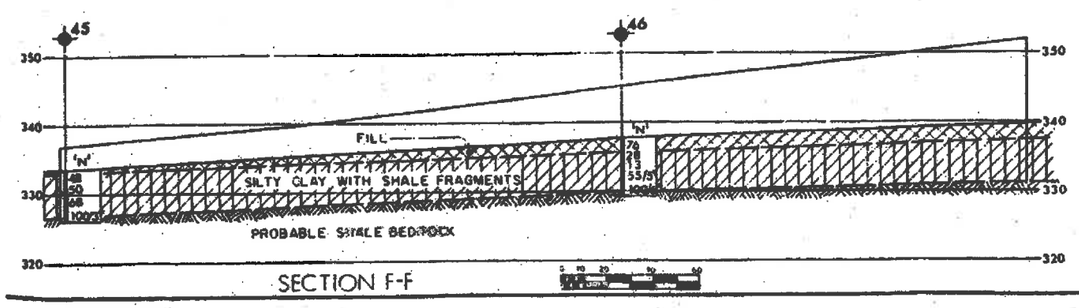

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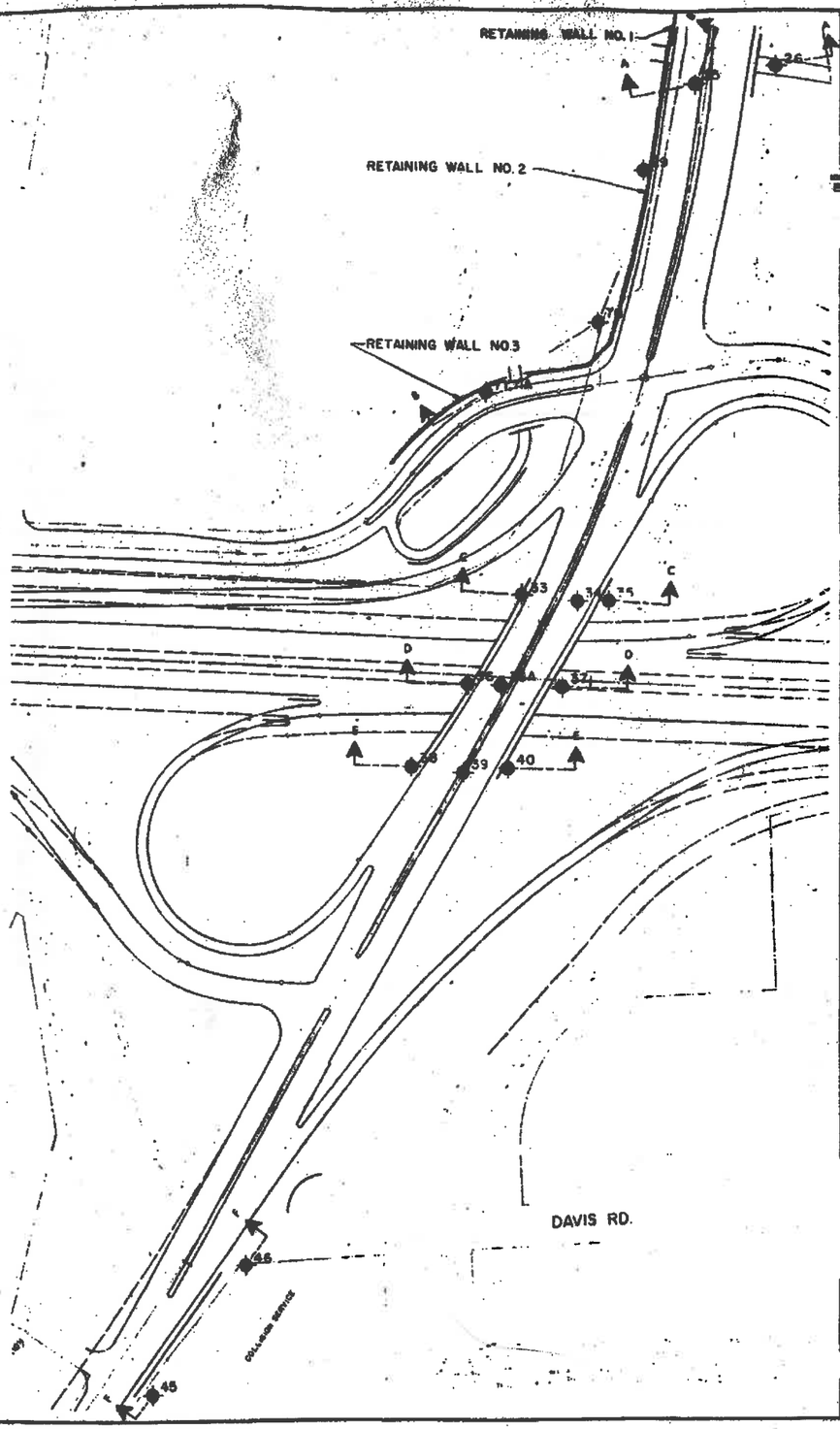


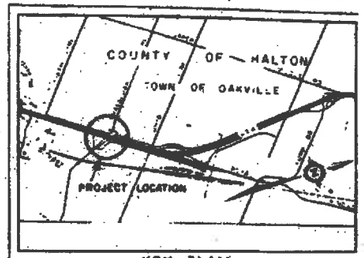
CONT No 79-111
WP No 1-79-07

RETAINING WALLS
BORE HOLE LOCATIONS & SOIL STRATA

SHEET 5

SCALE IN FEET

ASSOCIATED TECHNICAL SERVICES LTD.



KEY PLAN
Scale 1:50,000

LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- 'N' Blows/ft (Std Pen Test 350ft lbs energy)
- CONE Blows/ft (60° Cone, 350ft lbs energy)
- WL at time of investigation
- R No further penetration with power auger

No	ELEVATION	CO-ORDINATES NORTH	EAST
25	361.6	15,792.381	950.605
26	363.8	15,792.494	950.652
29	358.8	15,792.244	950.662
33	352.6	15,791.722	951.081
34	374.8	15,791.785	951.136
35	374.4	15,791.825	951.163
36	352.9	15,791.578	951.141
36A	353.6	15,791.621	951.173
37	354.5	15,791.693	951.228
38	349.3	15,791.439	951.192
39	372.8	15,791.489	951.245
40	373.8	15,791.537	951.280
45	333.6	15,790.577	951.724
46	337.9	15,790.806	951.650
70	361.8	15,792.052	950.816
71	358.9	15,791.857	950.803
71A	358.9	15,791.863	950.800

-NOTE-
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

REVISIONS			
	DATE	BY	DESCRIPTION

HWY No	Q.E.W.		DIST 4
SUBMD	CHECKED	DATE FEB. 22 1979	SITE 10-RW
DRAWN JD	CHECKED	APPROVED	DWG 2

Site S4

RECORD OF BOREHOLE No 1

1 OF 1 **METRIC**

PROJECT 991-1140 | W.P. 99-23024 | LOCATION Sta. 19+750, 30m Left of centerline of the median | ORIGINATED BY SS
DIST ____ | HWY QEW | BOREHOLE TYPE ____ | COMPILED BY BVB
DATUM Geodetic | DATE 10.9.99 | CHECKED BY AMP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED; 20 40 60 80 100)	PLASTIC LIMIT w_p / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
109.01											
0.00	Topsoil										
0.07	Shale Bedrock Weathered Red to grey		1	50 DO	25						
			2	50 DO	>100		107				
			3	50 DO	>100		106				
	(Georgian Bay Formation)										
			4	50 DO	>100		105				
							104				
103.37			5	50 DO	>100						
4.64	END OF BOREHOLE Note: Open hole dry on completion of drilling.										

$+^3, \times^3$: Numbers refer to Sensitivity $O^{3\%}$ STRAIN AT FAILURE

ON_MOT 991-1140.GPJ ON_MOT.GDT 12/10/99

RECORD OF BOREHOLE No 2 — 1 OF 1 — METRIC

PROJECT 991-1140 | W.P. 98-23024 | DIST ____ HWY QEW | DATUM Geodetic

LOCATION Sta. 20+050, 2m Right of centerline of the median | BOREHOLE TYPE ____ | DATE 26.6.99

ORIGINATED BY BVB | COMPILED BY BVB | CHECKED BY AMP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
106.75								
0.00 / 106.46	Pavement							
0.30 / 106.14	Granular Fill							
0.61	Silty Clay, some sand and gravel Firm Reddish grey (Fill)		1	50 DO	6		106	
			2	50 DO	>50		105	
104.62								
2.13	Shale Bedrock Weathered Grey (Georgian Bay Formation)		3	50 DO	50/.08		104	
			4	50 DO	50/.05		103	
102.18			5	50 DO	50/.01			
4.57	END OF BOREHOLE Note: Water level in open borehole at 4.0m depth on completion of drilling.							

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED; 20 40 60 80 100

PLASTIC LIMIT w_p | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%): 20 40 60

UNIT WEIGHT γ kN/m³

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

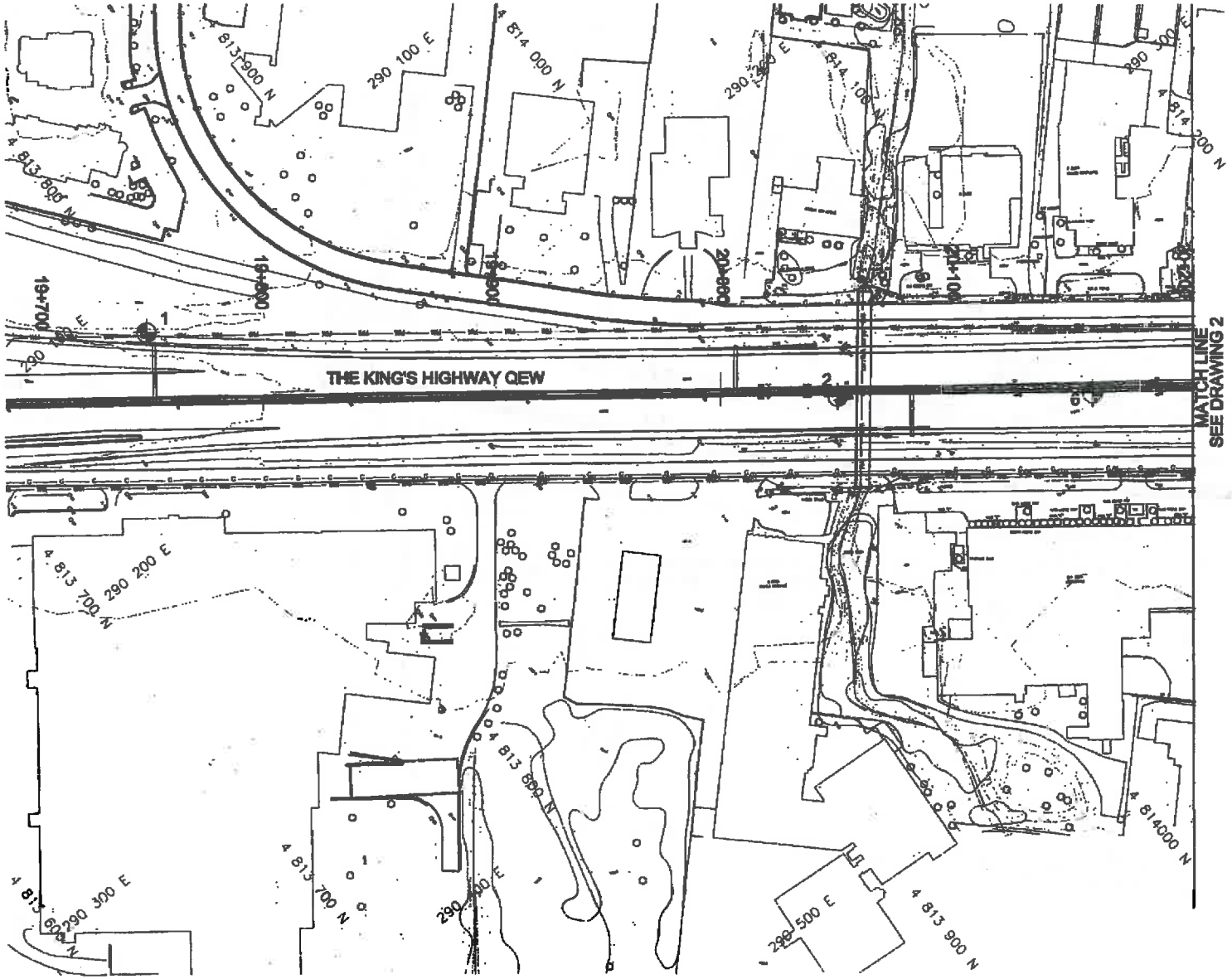
ON_MOT 991-1140.GPJ ON_MOT.GDT 12/10/99

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

CONT. No. 99-08
WO No. 98-2302

QUEEN ELIZABETH WAY
Sta. 19+700 to Sta. 20+200
BOREHOLE LOCATIONS

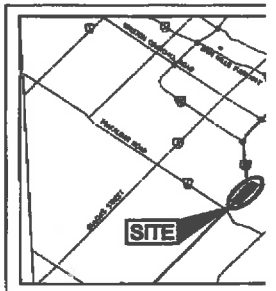
Golder Associates



PLAN

0 50 100 150 200m

SCALE 1:2,000



KEY PLAN

LEGEND

Borehole Location in Plan

No.	ELEVATION	COORD STATION
1	108.01	19+750
2	108.75	20+050
6	108.29	20+160

NOTES
Base Mapping obtained from digital files, B-82-QEW-5A, B-82-QEW-36a83, B-QEW provided by McCormick Rankin Corporation

NO.	DATE	BY	REVISION

Geocres No.

QEW			PROJECT NO.: 991-
SUBM'D.		CHKD:	DATE: 1999
DRAWN: JFC		CHKD.	APPD.

Golder Associates

RECORD OF BOREHOLE No W35

1 OF 1 **METRIC**

PROJECT 011-1128 | G.W.P. 189-00-01 | DIST 4 | HWY QEW | DATUM Geodetic

LOCATION N 4813772.1 ;E 290171.4 | BOREHOLE TYPE CME 75, 100mm O.D. Solid Stem Auger | DATE December 15, 2006

ORIGINATED BY CR | COMPILED BY NK | CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
106.0	GROUND SURFACE										
0.0 105.3	Sand and gravel, some silt (FILL) Compact Brown Moist		1	SS	16						
0.7 103.8	CLAYEY SILT, trace sand, trace gravel (Residual Soil) Very stiff to hard Reddish brown to grey Moist		2	SS	24		105		○		
			3	SS	58		104				
2.2 101.4	SHALE BEDROCK contains limestone inclusions Reddish brown to grey Grinding of augers noted at depths of 2.20 m to 2.90m, 3.35 m to 3.51 m, 3.66 m to 3.76 m, 4.27 m to 4.37 m, 4.57 m to 4.57 m		4	SS	50/0.13		103		○		
			5	SS	50/0.13		102				
			6	SS	50/0.03						
4.6	END OF BOREHOLE Notes: 1. Water level in open borehole at a depth of 1.5 m during drilling. 2. Water level in open borehole at a depth of 1.5 m (Elev. 104.5 m) upon completion of drilling. 3. Water level in piezometer at a depth of 1.9 m (Elev. 104.1 m) on February 13, 2007.										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No W37

1 OF 1 **METRIC**

PROJECT 011-1128 | G.W.P. 189-00-01 | LOCATION N 4813890.6 ;E 290260.4 | ORIGINATED BY CR

DIST 4 | HWY QEW | BOREHOLE TYPE CME 75, 100mm O.D. Solid Stem Auger | COMPILED BY NK

DATUM Geodetic | DATE December 15, 2006 | CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
106.2	GROUND SURFACE										
0.0 / 105.5	Sand and gravel, some silt (FILL) Compact Brown Moist		1	SS	21		106				
0.7 / 104.8	SILTY CLAY, some sand Stiff Reddish brown to grey, mottled Moist		2	SS	12		105		○ at 20	47	
1.4 / 104.1	CLAYEY SILT, some sand, trace gravel (Residual Soil) Hard Reddish brown to grey, mottled Moist		3	SS	40				○ at 20		
2.1	SHALE BEDROCK containslimestone inclusions Grey to reddish brown		4	SS	50/0.1	▽	104				
	Grinding of augers noted at depths of 2.13 m to 2.18 m		5	SS	50/0.07		103		○ at 10		
	Grinding of augers noted at depths of 2.59 m to 2.64 m, 2.79 m to 2.89 m, and 3.66 m to 3.71 m						102				
101.5	Grinding of augers noted at depths of 4.27 m to 4.37 m										
4.7	END OF BOREHOLE										

Notes:

1. Water level in open borehole at a depth of 2.6 m during drilling.

2. Water level in open borehole at a depth of 2.4 m (Elev. 103.8 m) upon completion of drilling.

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No W39

1 OF 1 **METRIC**

PROJECT 011-1128 | G.W.P. 189-00-01 | LOCATION N 4814013.0 ;E 290357.6 | ORIGINATED BY CR

DIST 4 | HWY QEW | BOREHOLE TYPE CME 75, 100mm O.D. Solid Stem Auger | COMPILED BY NK

DATUM Geodetic | DATE December 20, 2006 | CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
106.2	GROUND SURFACE						106				
0.0	ASPHALT										
0.2	Sand and gravel, some silt (FILL) Dense to compact Brown Moist		1	SS	36						
			2	SS	13		105		○		
104.8											
1.4	Clayey silt to silty clay, trace gravel (FILL) Stiff Reddish brown to grey, mottled Moist		3	SS	14						
104.0							104				
2.2	CLAYEY SILT, trace sand, trace gravel (TILL) Hard Moist		4	SS	49				○		
103.4											
2.8	SHALE BEDROCK, contains limestone inclusions Grey Grinding of augers noted at depths of 3.51 m to 3.66 m, 3.96 m to 4.06 m and 4.32 m to 4.42 m		5	SS	50/0.15	▽	103		○		
			6	SS	50/0.07		102				
							101				
100.0			7	SS	50/0.05		100				
6.2	END OF BOREHOLE Notes: 1. Water level in open borehole at a depth of 4.0 m during drilling. 2. Water level in open borehole at a depth of 3.3 m (Elev. 102.9 m) upon completion of drilling.										

$+^3, \times^3$: Numbers refer to Sensitivity $\circ^{3\%}$ STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No W40

1 OF 1 **METRIC**

PROJECT 011-1128 | G.W.P. 189-00-01 | LOCATION N 4814057.8 ;E 290391.4 | ORIGINATED BY CR

DIST 4 | HWY QEW | BOREHOLE TYPE CME 75, 100mm O.D. Solid Stem Auger | COMPILED BY NK

DATUM Geodetic | DATE December 20, 2006 | CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
106.5	GROUND SURFACE										
0.0	ASPHALT										
	Sand and gravel (FILL) Compact Brown Moist		1	SS	19		106				
106.0 / 0.6	Clayey silt to silty clay, some sand, contains sand pockets (FILL) Stiff Reddish brown to grey Moist		2	SS	14				○		
105.1 / 1.4	CLAYEY SILT, trace sand, trace gravel (TILL) Hard Moist		3	SS	60		105		○		
104.3 / 2.2	SHALE BEDROCK, contains limestone inclusions Grey		4	SS	50/0.15		104				
	Grinding of augers noted at depths of 2.74 m to 2.89 m, 2.95 m to 2.99 m, 3.2 m to 3.30 m, 3.40 m to 3.50 m and 3.61 m to 3.81 m		5	SS	50/0.08				○		
102.7 / 3.8	END OF BOREHOLE		6	SS	50/0.01		103				

Notes:

1. Open borehole dry upon completion of drilling.

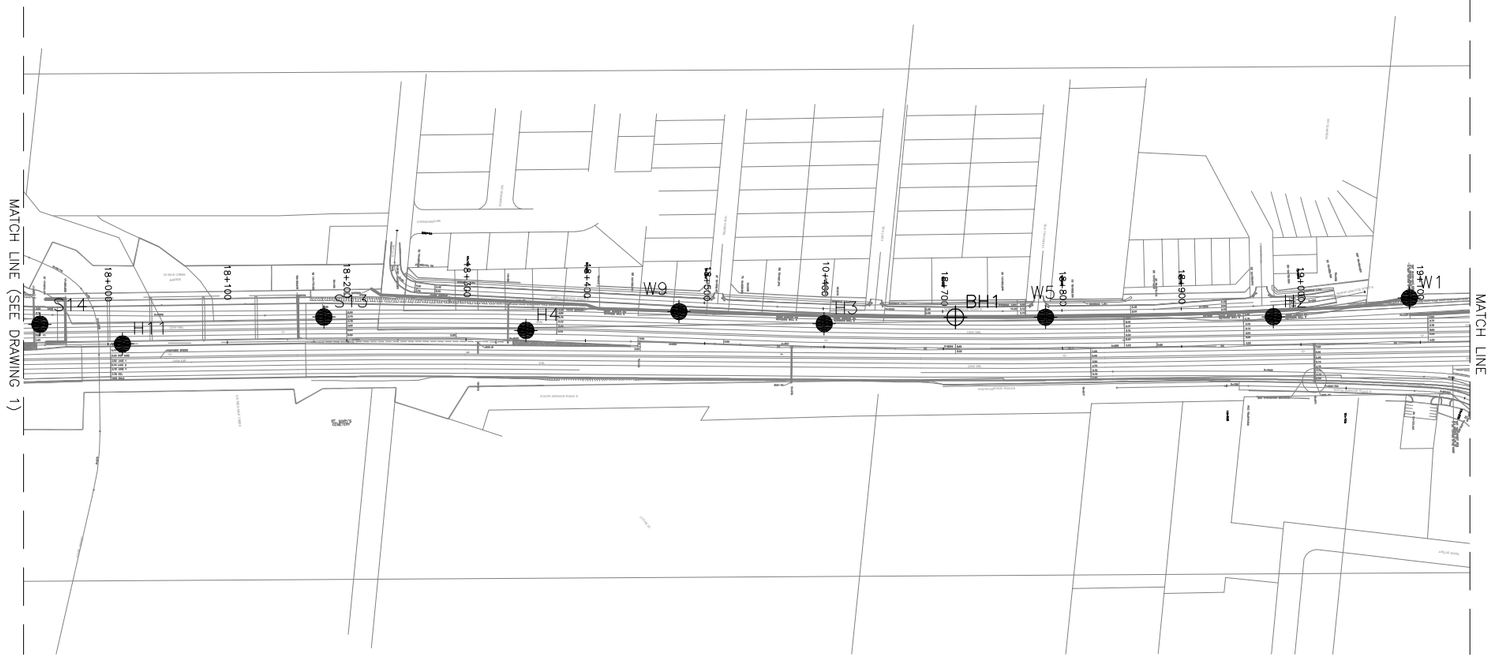
$+^3$, $\times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

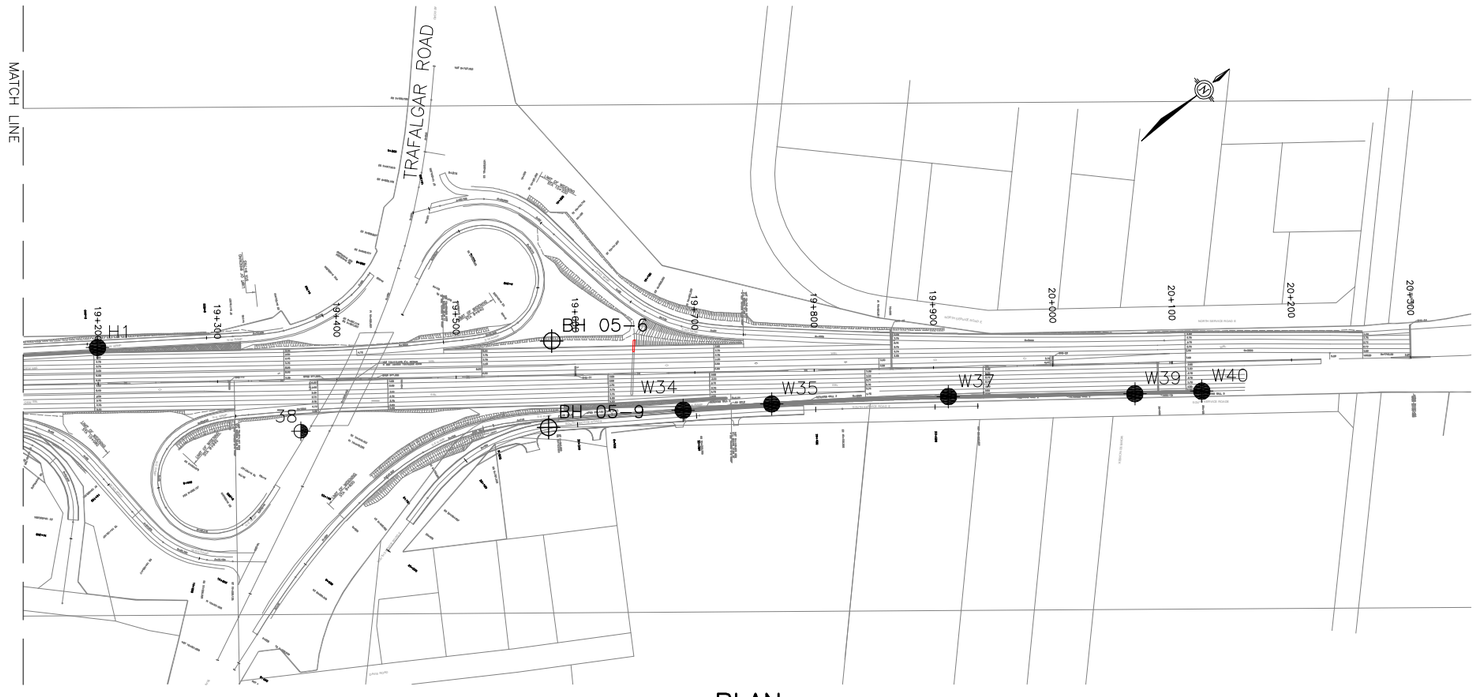
MIS-MTO 001 011-1128.GPJ GAL-MISS.GDT 21/9/09

MINISTRY OF TRANSPORTATION, ONTARIO

METRIC

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





PLAN
SCALE
50 0 50 100 m

CONT No.
WP No. 189-00-01

SHEET

HIGH MAST LIGHT POLES
QEW WIDENING FROM THIRD LINE TO
1 KM EAST OF TRAFALGAR ROAD, OAKVILLE
BOREHOLE LOCATIONS

Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA

KEY PLAN
SCALE
800 0 800 m

LEGEND

- Borehole – Current Investigation
- Borehole – Previous Golder Investigation
- Borehole – Previous Investigation by Others

No.	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
W1	106.3	4813284.1	289704.1
W5	107.5	4813038.0	289523.3
W9	107.3	4812803.2	289325.0
W34	107.0	4813711.4	290128.5
W35	106.0	4813772.1	290171.4
W37	106.2	4813890.6	290260.4
W39	106.2	4814013.0	290357.6
W40	106.5	4814057.8	290391.4
H1	106.2	4813365.0	289777.0
H2	106.5	4813186.0	289644.0
H3	107.3	4812891.0	289410.0
H4	107.4	4812694.0	289256.0
H11	100.8	4812425.1	289050.6
S13	108.6	4812570.0	289140.0
S14	110.0	4812382.0	288994.0
BH 05-6	107.8	4813663.0	290013.8
BH 05-9	109.4	4813615.0	290068.2
38	106.5	4813452.4	289939.2
BH1	107.0	4812979.5	289475.4

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 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, drawing file no. QEW-EL-LS-MTO-60% and QEW Plan, received on December 20, 2006.

NO.	DATE	BY	REVISION

Geocres No. 30M5-259

HWY. QEW	PROJECT NO. 011-1128		DIST.
SUBM'D. NK	CHKD. CN	DATE: May 2007	SITE:
DRAWN: MSM	CHKD. ASP	APPD. JMAC	DWG. 2

PLOT DATE: - September 18, 2009
FILENAME: T:\Projects\2007\011-1128\-EC- (MM)\011128EC002.dwg

Site S5

Ministry of Transportation and Communications Ontario

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 25

W P 1-79-07 LOCATION Co-ords 15,792.381 N; 950.605 E. ORIGINATED BY TL

DIST Hamilton HWY Q.E.W. BOREHOLE TYPE Solid Stem Auger COMPILED BY TL

DATUM Geodetic DATE January 22, 1979 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT N (20 40 60 80 100) / SHEAR STRENGTH (o UNCONFINED, • FIELD VANE, ■ QUICK TRIAXIAL, x LAB VANE; 0.5 1.0 1.5 2.0 2.5)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL; WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH 361.6	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
0.0	Ground Level										
0.1	Topsoil.										
	Silty clay, Stiff to hard Red						360				
			1	SS	10		358		q	130.1	
108.7					38/12"						
356.6			2	SS	51/6"						
5.0	Red Shale Bedrock						356				
108.1											
354.8			3	SS	100/3"						
6.8	End of Borehole										

OFFICE REPORT ON SOIL EXPLORATION

Numbers refer to Geometry

20 15 10 ε (%) STRAIN AT FAILURE

Ministry of Transportation and Communications Ontario

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 26

W P 1-79-01 LOCATION Co-ords. 15,792,494 N; 950,652 E. ORIGINATED BY TL

DIST Hamilton HWY Q.E.W. BOREHOLE TYPE Solid Stem Auger, BXL Rock Core COMPILED BY TL

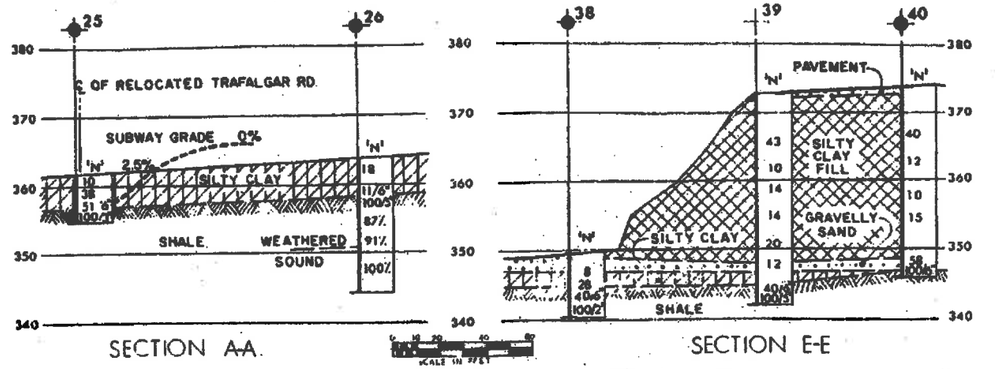
DATUM Geodetic DATE January 16, 1979 CHECKED BY

SOIL PROFILE ELEV/DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 0.5 1.0 1.5 2.0 2.5	PLASTIC LIMIT Wp — NATURAL MOISTURE CONTENT W — LIQUID LIMIT Wl / WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
363.8	Ground Level									
0.0	Silty clay with shale fragments. Stiff Red		1	AS						
			2	SS	18		360			
358.3										
5.5	Shale Bedrock with several thin horizontal layers of silty clay. Decreasing in frequency with depth. Red		3	SS	11/6" 100/5"					
			4	AS						
			5	RC BXL	87%		355			
350.8			6	RC BXL	91%					
13.0	Shale Bedrock Sound Red		7	RC BXL	100%		350			
344.3			8	RC BXL	100%		345			
19.5	End of Borehole									

OFFICE REPORT ON SOIL EXPLORATION

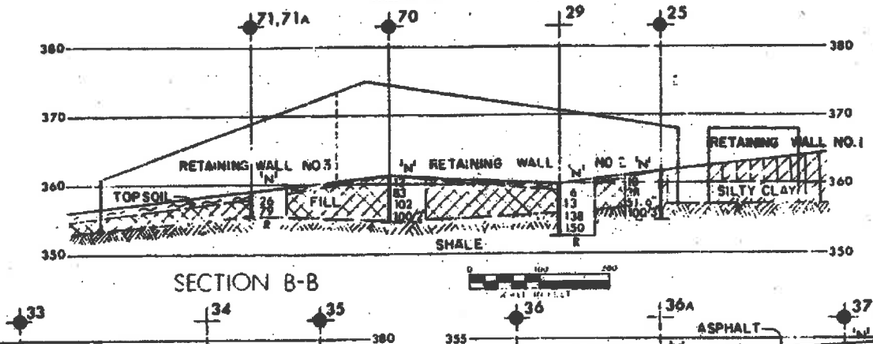
+3, ×3 : Numbers refer to Sensitivity

20 / 15 ◇ 3 / 10 (%) STRAIN AT FAILURE

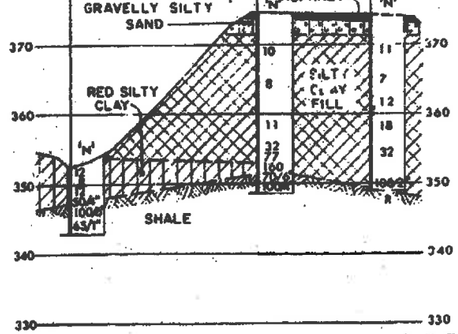


SECTION A-A.

SECTION E-E



SECTION B-B



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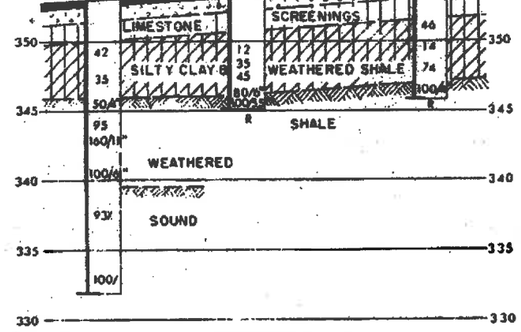
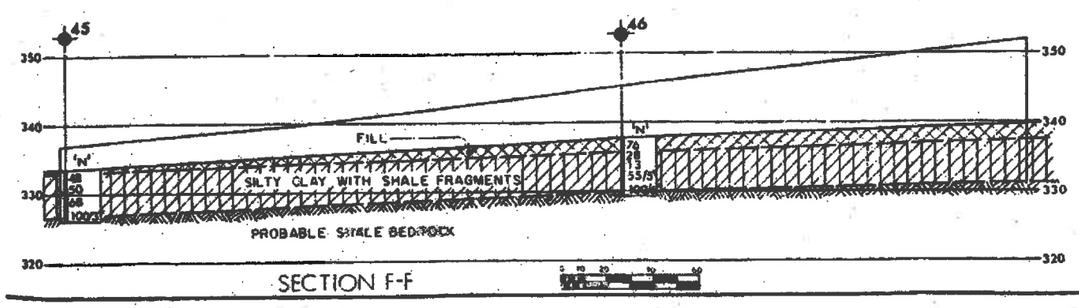


SECTION D-D



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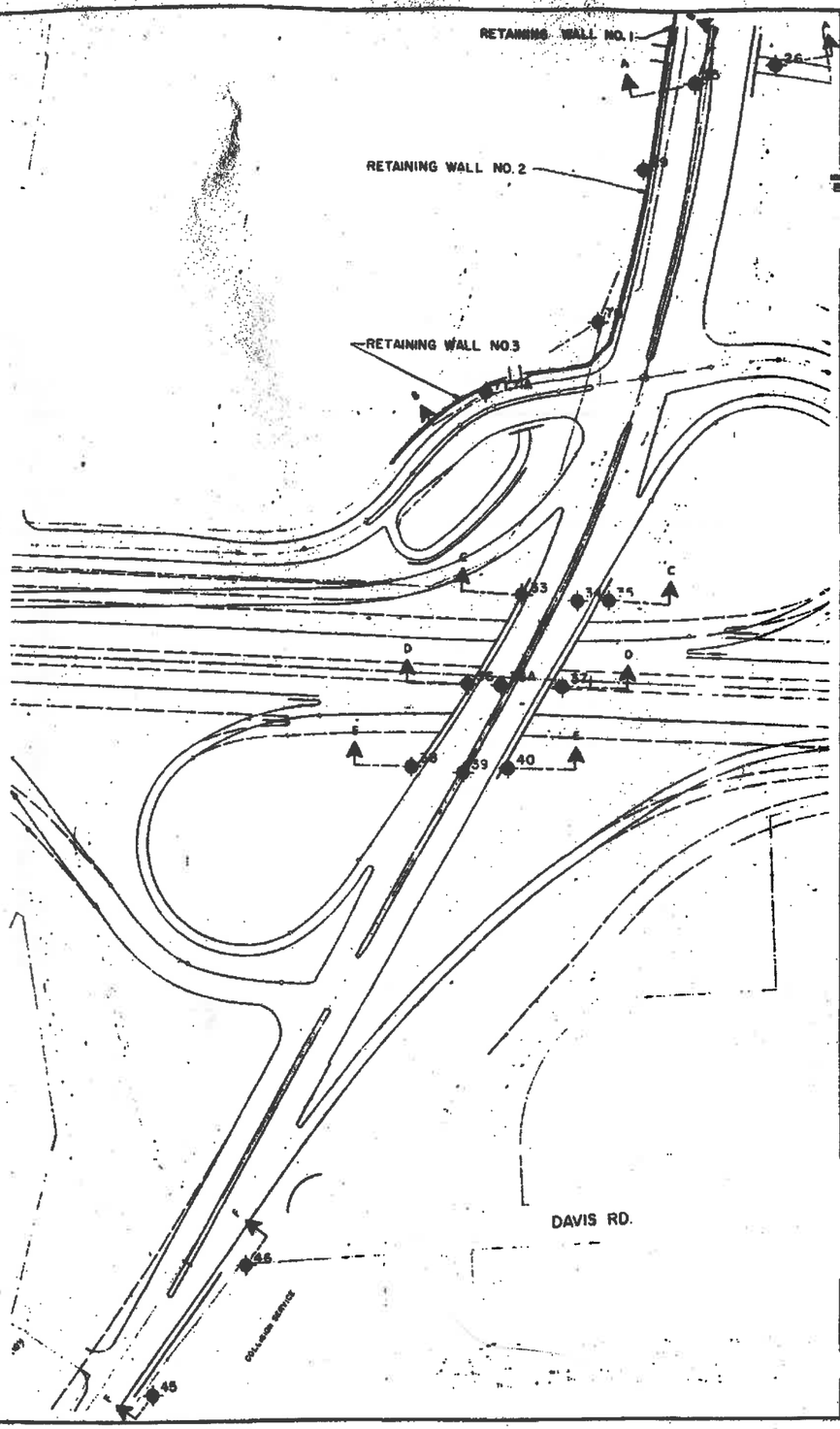


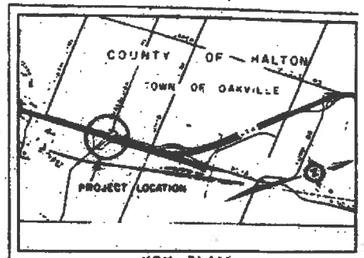
CONT No 79-111
WP No 1-79-07

RETAINING WALLS
BORE HOLE LOCATIONS & SOIL STRATA

SHEET 5

SCALE IN FEET

ASSOCIATED TECHNICAL SERVICES LTD.



KEY PLAN
Scale 1:50,000

LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- 'N' Blows/ft (Std Pen Test 350ft lbs energy)
- CONE Blows/ft (60° Cone, 350ft lbs energy)
- WL at time of investigation
- R No further penetration with power auger

No	ELEVATION	CO-ORDINATES NORTH	EAST
25	361.6	15,792.381	950.605
26	363.8	15,792.494	950.652
29	358.8	15,792.244	950.662
33	352.6	15,791.722	951.081
34	374.8	15,791.785	951.136
35	374.4	15,791.825	951.163
36	352.9	15,791.578	951.141
36A	353.6	15,791.621	951.173
37	354.5	15,791.693	951.228
38	349.3	15,791.439	951.192
39	372.8	15,791.489	951.245
40	373.8	15,791.537	951.280
45	333.6	15,790.577	951.724
46	337.9	15,790.806	951.650
70	361.8	15,792.052	950.816
71	358.9	15,791.857	950.803
71A	358.9	15,791.863	950.800

-NOTE-
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

REVISIONS			
	DATE	BY	DESCRIPTION

HWY No	Q.E.W.		DIST 4
SUBMD	CHECKED	DATE FEB. 22 1979	SITE 10-RW
DRAWN JD	CHECKED	APPROVED	DWG 2

Site S6

W.P. 87-98-00

DIST. QEW / ROYAL WINDSOR DRIVE

LOCATION: 4814635.240N; 290756.997E

RECORD OF BOREHOLE 2

BORING DATE: AUG.10/98

SHEET 1 OF 2

DATUM: GEODETIC

PROJECT: 981-1122

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m	HYDRAULIC CONDUCTIVITY, k, cm/s	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	CME 55 BOMBARDIER SOLID STEM AUGERS	GROUND SURFACE		103.88				SHEAR STRENGTH Cu, kPa: nat V - + Q - ● rem V - ● U - O	WATER CONTENT, PERCENT Wp 10 20 30 40 Wl		
		Topsoil		0.00							
		Silty Clay, some sand, trace gravel, occ. topsoil lenses Very stiff Dark brown and grey (FILL)		0.15	1	SS	21				
1				103.03							BENTONITE SEAL
		Silty Clay, trace sand, trace gravel, trace shale fragments Very stiff Grey and brown, mottled (TILL)		0.85	2	SS	19		O W	MH	
				102.36							
2		Shale Bedrock Weathered Grey (Georgian Bay Formation)		1.52							SAND FILTER
				101.75							
		BOREHOLE CONTINUED FOR BEDROCK CORING DETAILS, REFER TO SHEET 2.		2.13							Note. Open borehole dry during drilling in overburden.
3											
4											
5											
6											
7											
8											
9											
10		CONTINUED ON NEXT PAGE									

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: SB

CHECKED: AMP

DATA INPUT: PS AUG.24/98

SOILMS

N1122002.BHS

W.P. 67-98-00

DIST. QEW / ROYAL WINDSOR DRIVE

LOCATION: 4814635.240N 290756.997E

RECORD OF BOREHOLE: 2

DRILLING DATE: AUG.10/98

DRILL RIG: CME 55 BOMBARDIER

DRILLING CONTRACTOR: MASTER SOILS

SHEET 2 OF 2

DATUM: GEODETIC

PROJECT: 981-1122

FR-FRACTURE CL-CLEAVAGE SH-SHEAR VN-VEIN
F-FAULT J-JOINT P-POLISHED S-SLICKENSIDED
SM-SMOOTH R-ROUGH ST-STEPPED PL-PLANAR
FL-FLEXURED UE-UNEVEN W-WAVY C-CURVED
BC-BROKEN CORE MB-MECH. BREAK B-BEDDING

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (m/min.)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX per 0.3	DISCONTINUITY DATA INP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
0		CONTINUED FROM PREVIOUS PAGE															
1																	
2		CONTINUED FROM SHEET 1.		101.75													
3	NQ CORING AUG.10/98	Highly weathered becoming moderately weathered below 2.4m depth, grey, fine grained, thinly bedded Shale (70%) and fresh crystalline and fossiliferous Limestone (30%) typically in 25mm to 100mm thick layers. (Georgian Bay Formation)		2.13	1	0.25		100						300mm BC 50mm BC 20mm BC 10mm Clay Seam 50mm BC 20mm BC 10mm Clay Seam			SAND FILTER
4					2	0.42		100						50mm BC 10mm BC ST,R,UE ST,R,UE 75mm BC			
5		END OF BOREHOLE		99.70 5.18													
6		Note: Limestone layers greater than 100mm in thickness were encountered at the following depths: 3.22m - 140mm 3.41m - 180mm 4.33m - 270mm 4.90m - 110mm															Note: Water level in piezometer at 101.4m depth on Aug.19, 1998 and at Elev. 101.3m on Oct.3, 1998.
7																	
8																	
9																	
10																	

DEPTH SCALE:
1 to 50

Golder Associates

LOGGED: SB
DATE:
CHECKED: AMP

DATA INPUT: PS AUG.26/98

ROCKMS

K1122982.BHR

W.P. 67-98-00
DIST. QEW / ROYAL WINDSOR DRIVE
LOCATION: 4814612.253N; 290747.229E

RECORD OF BOREHOLE 3

BORING DATE: AUG.10/98

SHEET 1 OF 2
DATUM: GEODETIC
PROJECT: 981-1122

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m	HYDRAULIC CONDUCTIVITY, k, cm/s	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	CME 55 BOMBARDIER SOLID STEM AUGERS	GROUND SURFACE		103.90				SHEAR STRENGTH Cu, kPa: nat V - + Q - ● rem V - ● U - ○	WATER CONTENT, PERCENT Wp — W — Wl (10, 20, 30, 40)		
		Topsoil		0.00							
		Silty Clay, some sand, trace gravel, trace shale fragments, occ. topsoil lenses Very stiff Dark brown and grey (FILL)		0.18	1	SS DO	20				
				103.14							
1		Silty Clay, trace sand, trace gravel, trace shale fragments Very stiff Grey and brown, mottled (TILL)		0.76	2	SS DO	27		O — I	MH	
				102.38							
		Shale Bedrock Weathered Grey		1.52	3	SS DO	60/ .15				
				102.07							
2				1.83							
		BOREHOLE CONTINUED FOR BEDROCK CORING DETAILS, REFER TO SHEET 2.									
3											
4											
5											
6											
7											
8											
9											
10		CONTINUED ON NEXT PAGE									

DEPTH SCALE
1 to 50

Golder Associates

LOGGED: SB
CHECKED: AMP

DATA INPUT: PS AUG.26/98
SCALM6
N1122003.BHB

W.P. 67-98-00

DIST. QEW / ROYAL WINDSOR DRIVE

LOCATION: 4814612.253N;290747.229E

RECORD OF BOREHOLE: 3

DRILLING DATE: AUG 10/98

DRILL RIG: CME 55 BOMBARDIER

DRILLING CONTRACTOR: MASTER SOILS

SHEET 2 OF 2

DATUM: GEODETIC

PROJECT: 981-1122

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (min/m)	FLUSH / % RETURN	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX per 0.1	DISCONTINUITY DATA: INCLINATION w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
0		CONTINUED FROM PREVIOUS PAGE														
1																
		CONTINUED FROM SHEET 1.		102.07												
2	NQ CORING	Highly weathered becoming moderately weathered below 2.7m depth, grey, fine grained, thinly bedded Shale (72%) and fresh crystalline and fossiliferous Limestone interlayers (28%). (Georgian Bay Formation)		1.83	1	0.53	100						50mm Clay Seam 60mm BC 70mm BC 50mm BC 90mm BC 10mm Clay Seam 150mm BC			
3																
4	AUG.20/98				2	0.2	100						70mm BC 50mm BC 20mm Clay Seam 110mm BC 90mm BC 50mm BC			
				99.02												
5		END OF BOREHOLE		4.88												
6		Note: Limestone layers greater than 100mm in thickness were encountered at the following depths: 2.69m - 100mm 3.49m - 140mm 3.67m - 127mm 3.91m - 178mm 4.20m - 292mm														
7																
8																
9																
10																

DISCONTINUITY DATA: INCLINATION w.r.t. CORE AXIS: 0 30 60 90

FRACT. INDEX per 0.1: 0 1 2

DEPTH SCALE:

1 to 50

Golder Associates

LOGGED: SB

DATE:

CHECKED: AMP

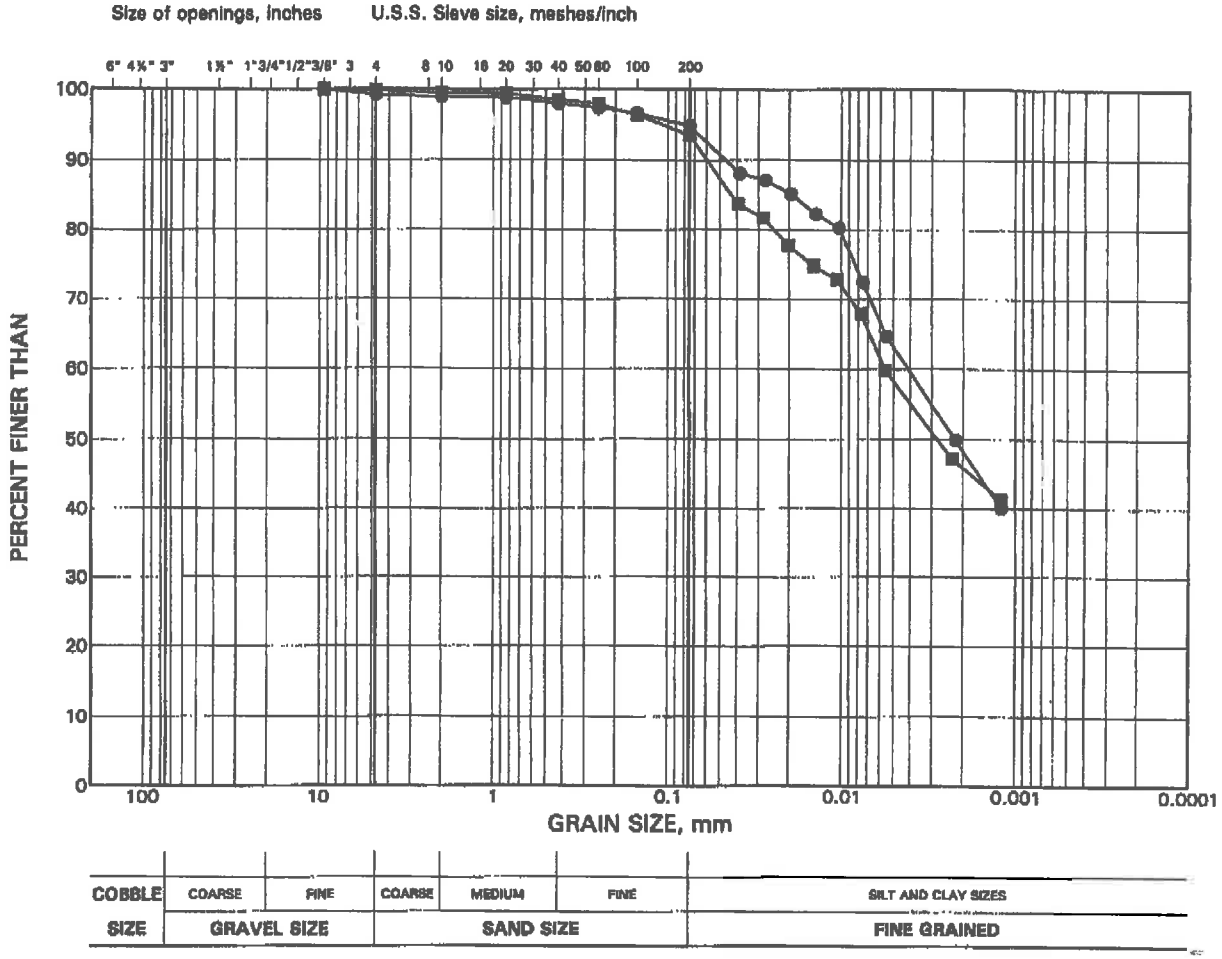
N1122003.BHR

DATA INPUT: PS AUG.26/98

ROCKMS

GRAIN SIZE DISTRIBUTION

FIGURE 1



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	2	2	102.6
■	3	2	102.8

Project 981-1122

Golder Associates

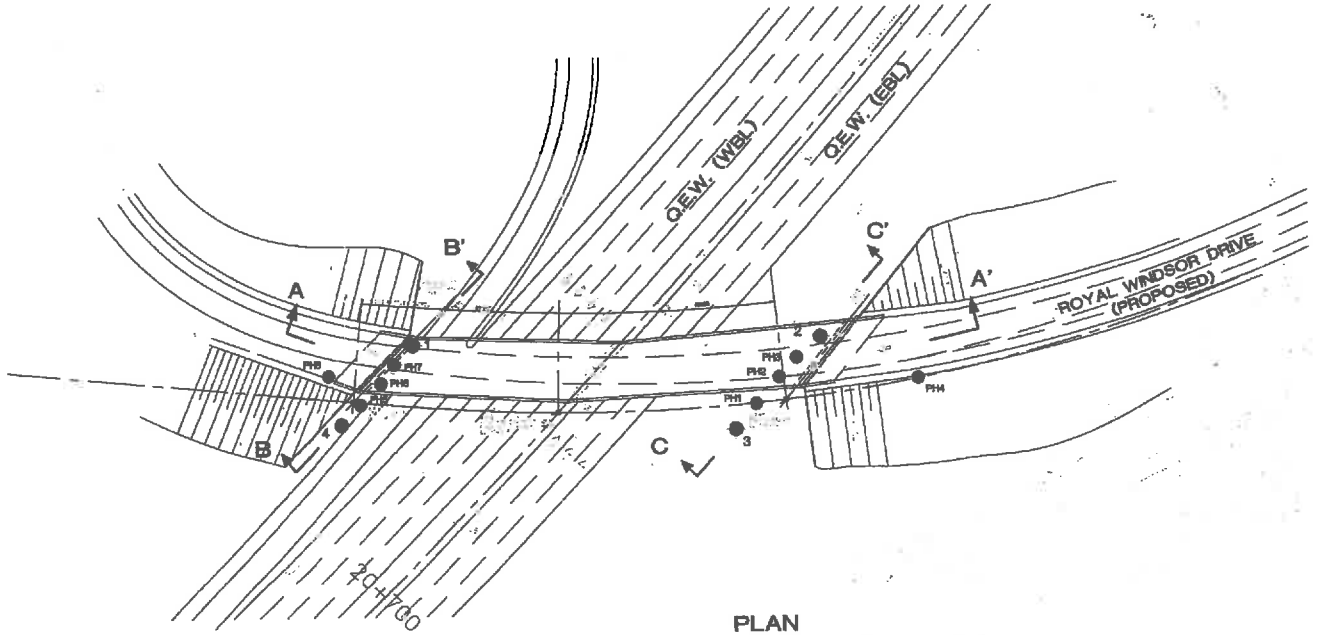
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT. No.
WP No. 67-98-00

SHEET

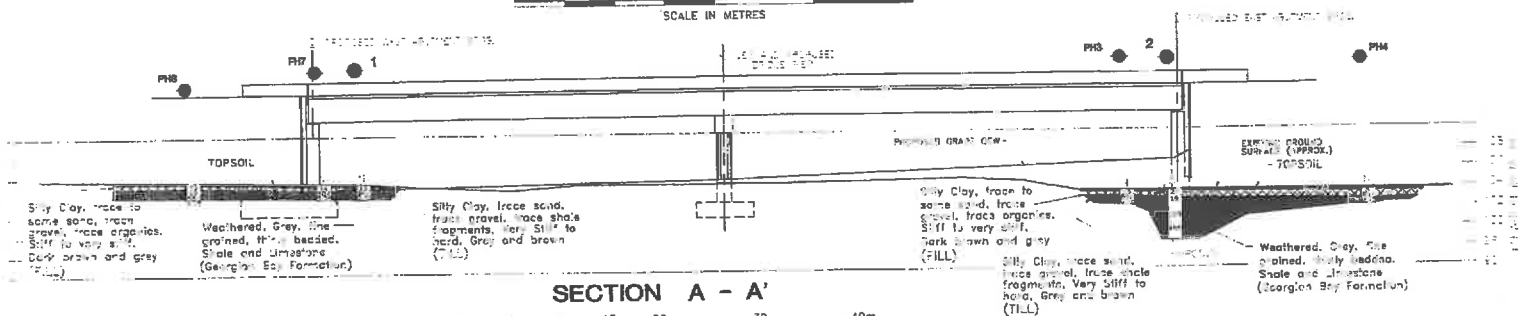
Q.E.W. UNDERPASS AT ROYAL WINDSOR DRIVE
BORE HOLE LOCATIONS & SOIL STRATA

Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



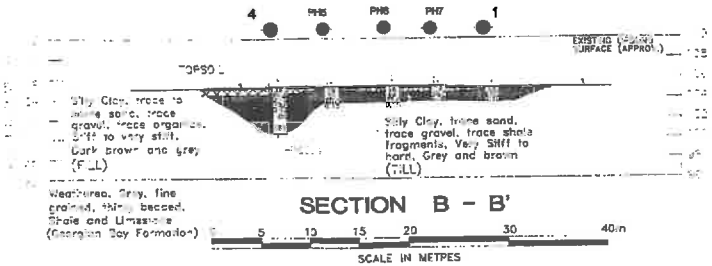
PLAN

0 10 20 30 40 60 80m
SCALE IN METRES



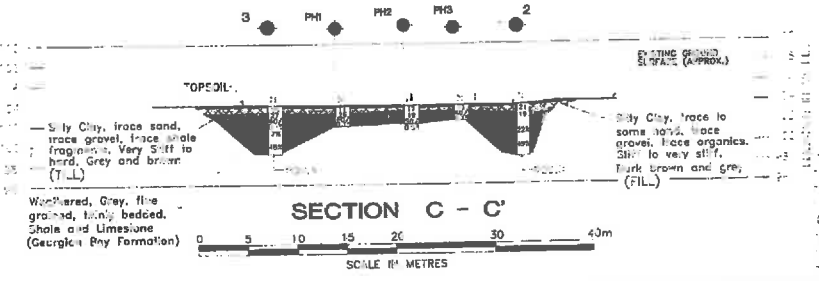
SECTION A - A'

0 5 10 15 20 30 40m
SCALE IN METRES



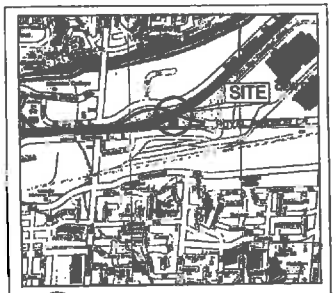
SECTION B - B'

0 5 10 15 20 30 40m
SCALE IN METRES



SECTION C - C'

0 5 10 15 20 30 40m
SCALE IN METRES



KEY PLAN

0.5 0 0.5 1km
SCALE

LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Core
- Blows/0.3m (Std. Pen. Test, 475 J/blow)
- Core — Blows/0.3m (60° Cone, 475 J/blow)
- Water Level at Time of Investigation

No.	ELEVATION	LOCATION NORTHING	LOCATION EASTING
1	105.18	4,814,606.408	290,800.528
2	103.88	4,814,635.260	290,756.997
3	102.90	4,814,610.283	290,747.250
4	105.24	4,814,586.750	290,672.187
PH1	103.37	4,814,606.405	290,680.528
PH2	103.82	4,814,626.405	290,680.528
PH3	103.39	4,814,606.405	290,680.528
PH4	103.63	4,814,606.405	290,680.528
PH5	105.23	4,814,626.405	290,680.528
PH6	105.27	4,814,626.405	290,680.528
PH7	105.25	4,814,626.408	290,680.528
PH8	105.37	4,814,626.408	290,680.528

NO. DATE BY REVISION

Geocres No.

HWY. No. QEW PROJECT NO. 981-1122 DIST. 4/6
SUBMITTED ABP CHKD. ABP DATE: 1998 11 09 SITE 12-165
DRAWN: SJHW CHKD. ABP APPD. GWP: 2112-00

RECORD OF BOREHOLE No 9 — 1 OF 1 — METRIC

PROJECT 991-1140 | W.P. 99-23024 | LOCATION Sta. 20+720, 2m Right of centerline of the median | ORIGINATED BY BVB

DIST ____ | HWY QEW | BOREHOLE TYPE ____ | COMPILED BY BVB

DATUM Geodetic | DATE 27.8.99 | CHECKED BY AMP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_p / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
105.42											
0.00 / 105.12	Pavement										
0.30 / 104.81	Granular Fill						105				
0.61 / 103.90	Silty clay, some sand and gravel Stiff to hard Brown/grey (Fill)		1	50 DO	9						4 22 50 24
1.52 / 103.13	Silty Clay, trace to some sand and gravel Hard Brown/Grey (Till)		2	50 DO	35		104		c		
2.29 / 101.01	Shale Bedrock Weathered Grey (Georgian Bay Formation)		3 4 5	50 DO 50 DO 50 DO	50/.01 50/.01 50/.01		103 102				
4.41	END OF BOREHOLE (AUGER REFUSAL) Note: Open hole dry on completion of drilling.										

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

ON_MOT 991-1140.GPJ ON_MOT.GDT 12/10/99

RECORD OF BOREHOLE No 10 — 1 OF 1 — METRIC

PROJECT 991-1140 | W.P. 98-23024 | DIST | HWY QEW | DATUM Geodetic

LOCATION Sta. 20+970, 2m Left of centerline of the median | BOREHOLE TYPE | DATE 26.8.99

ORIGINATED BY BVB | COMPILED BY BVB | CHECKED BY AMP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
106.02									
0.00 / 105.72	Pavement								
0.30 / 105.41	Granular Fill		1	SS	7				
0.61 / 104.85	Silty Clay, some sand and gravel Stiff Grey (Fill)		2	SS	10		105		
1.37 / 104.19	Silty Clay, trace to some sand and gravel Hard Grey (Till)		3	SS	50/.02				
1.83	Shale Bedrock Weathered Grey		4	SS	75/.08		104		
	(Georgian Bay Formation)		5	SS	100/.1		103		
							102		
101.38 / 4.64	END OF BOREHOLE		6	SS	50/.08	▽			

Note:
Water level in open borehole at 4.5m depth on completion of drilling.

DYNAMIC CONE PENETRATION RESISTANCE PLOT — 20 40 60 80 100

SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × REMOULDED
20 40 60 80 100

PLASTIC LIMIT w_p | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%) 20 40 60

+³, ×³: Numbers refer to Sensitivity

○³% STRAIN AT FAILURE

RECORD OF BOREHOLE No 14 — 1 OF 1 — METRIC

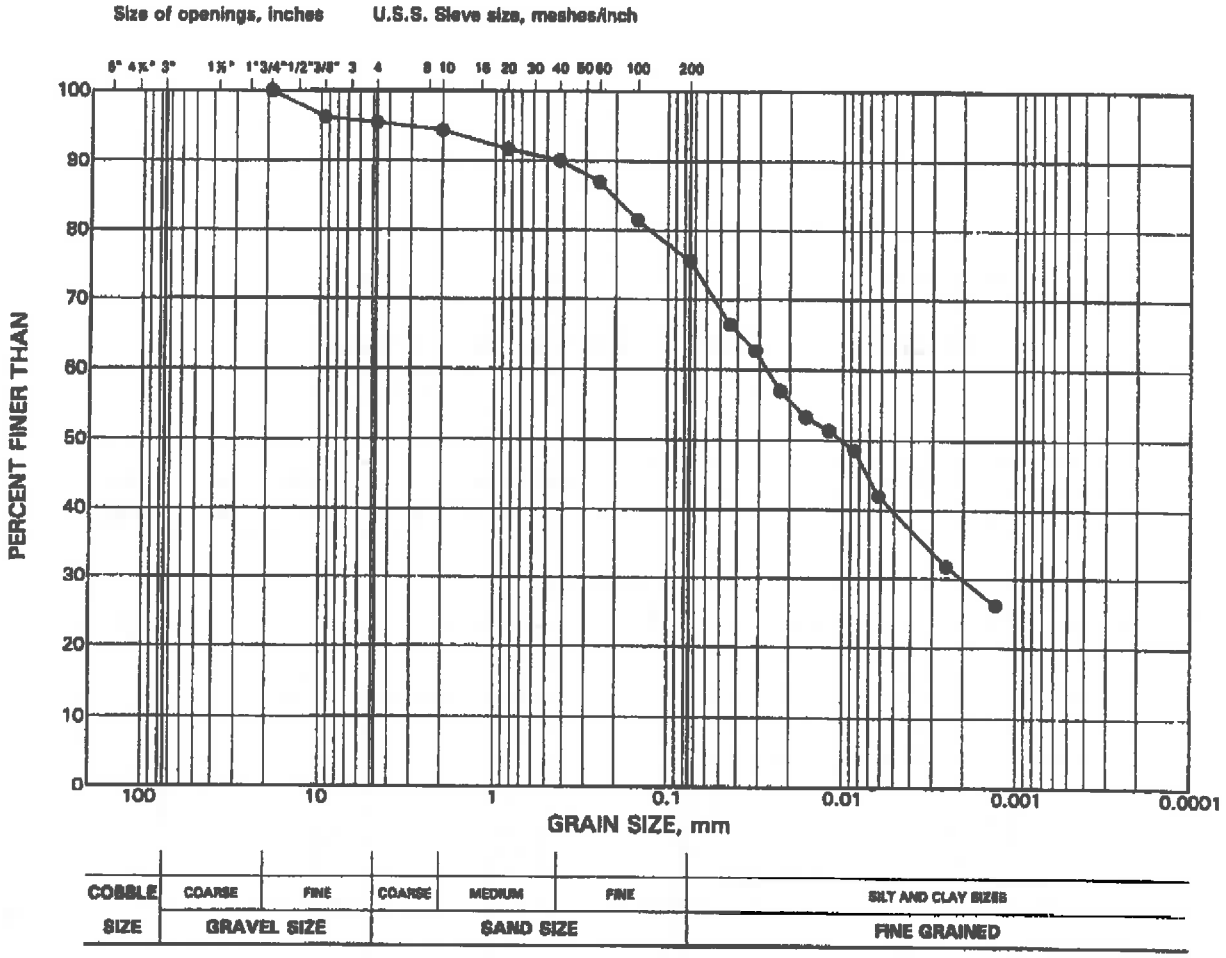
PROJECT 991-1140 | LOCATION Sta. 20+620, 25m Right of centerline of the median | ORIGINATED BY SS
W.P. 98-23024 | BOREHOLE TYPE | COMPILED BY BVS
DIST | HWY QEW | DATUM Geodetic | DATE 10.9.99 | CHECKED BY AMP

SOIL PROFILE ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED 20 40 60 80 100	PLASTIC LIMIT w_P	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w_L / WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
105.00												
0.00	Silty Sand, some gravel, trace clay Dense Brown (Fill)		1	SS DO	32							
104.24												
0.76	Silty Clay, some sand and gravel Very stiff Reddish brown (Fill)		2	SS DO	16		104					
103.60												
1.40	Silty Clay, trace to some sand and gravel Hard Brown/Grey (Till)		3	SS DO	>100							
103.17												
1.83	Shale Bedrock Weathered Grey (Georgian Bay Formation)		4	SS DO	>100		103					
							102					
							101					
100.31			5	SS DO	>100							
4.69	END OF BOREHOLE Note: Open hole dry on completion of drilling. Water level in Piezometer at Elev.102.0m on Sept.29/99.											

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

GRAIN SIZE DISTRIBUTION
Silty Clay, some sand, trace gravel (Fill)

FIGURE 5



LEGEND

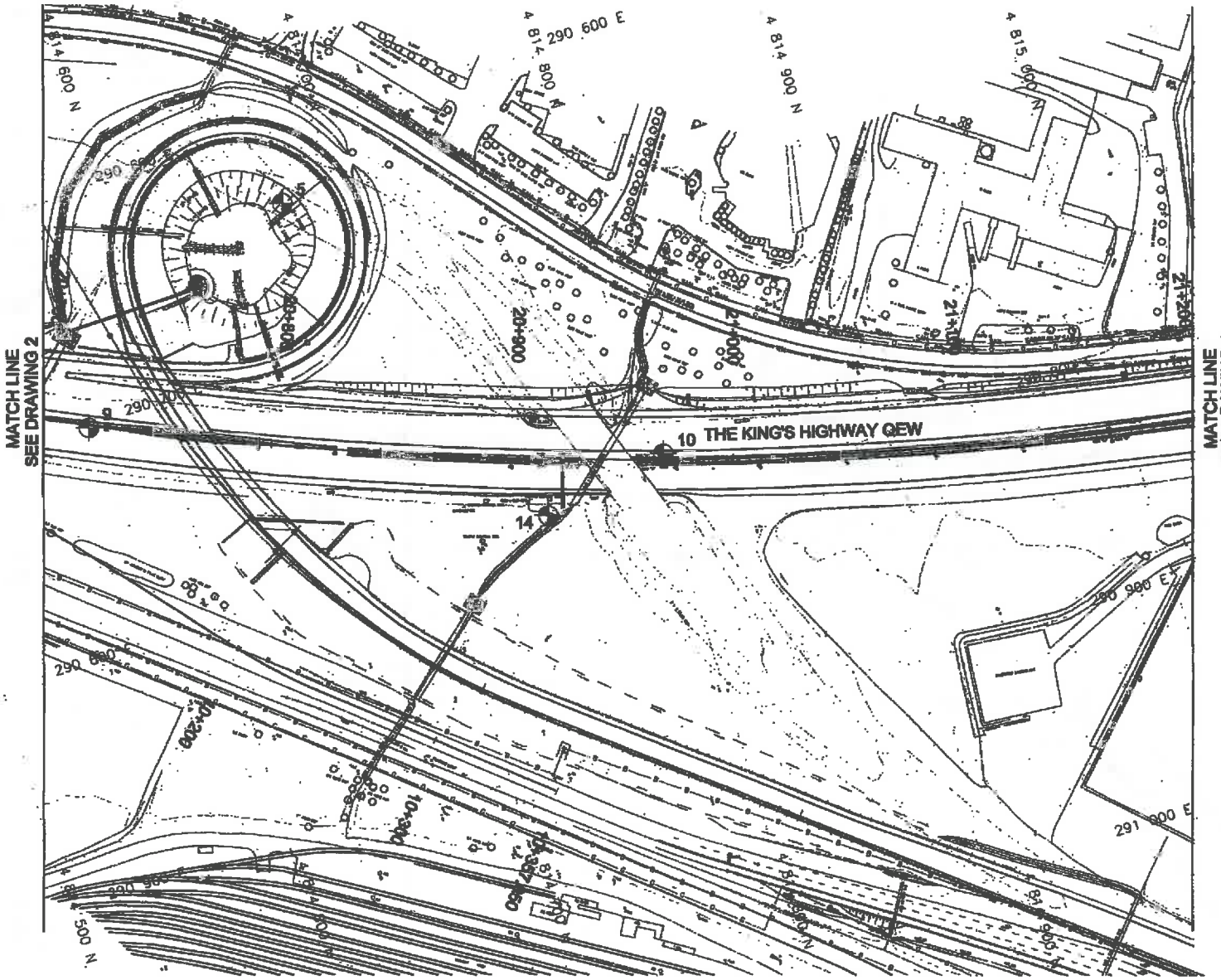
SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	9	1	0.8-1.2

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

CONT. No. 99-08
WO No. 98-2302

QUEEN ELIZABETH WAY
Sta. 20+700 to Sta. 21+200
BOREHOLE LOCATIONS

Golder Associates



PLAN

0 50 100 150 200m

SCALE 1:2,000

KEY PLAN

LEGEND

Borehole Location in Plan

No.	ELEVATION	COORD STATION
5	107.00	20+790
8	105.42	20+720
10	106.02	20+870
14	105.00	20+920

NOTES

Base Mapping obtained from digital files, (
B-02-QEW-35, B-12-QEW-26e83, B-QEW-
provided by McCormick Rankin Corporation.

NO.	DATE	BY	REVISION

Geocres No.

QEW		PROJECT NO.: 991-
SUBM'D.	CHKD:	DATE: 1999 (
DRAWN: JFC	CHKD.	APPD.

Site 8

W.P. 67-98-00

DIST: GEW / ROYAL WINDSOR DRIVE

LOCATION: 4814606.408N; 290680.528E

RECORD OF BOREHOLE 1

BORING DATE: AUG.11/98

SHEET 1 OF 1

DATUM: GEODETIC

PROJECT: 981-1122

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m	HYDRAULIC CONDUCTIVITY, k, cm/s	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	CME 55 BOMBARDIER SOLID STEM AUGERS	GROUND SURFACE		105.18				SHEAR STRENGTH Cu, kPa nat V - + Q - ● rem V - ⊕ U - ○	WATER CONTENT, PERCENT Wp W Wl 10 20 30 40		
		Topsoil		0.00							
		Silty Clay, trace sand, trace gravel, trace organics Very stiff Brown (FILL)		0.15	1	SS	16				
				0.30	2	SS	60/.10				
1		Silty Clay, trace sand, trace gravel, trace shale fragments Very stiff to hard Grey and brown, mottled (TILL)		103.96 1.22							
		Shale Bedrock Weathered Grey (Georgian Bay Formation)		103.66 1.52							
2		END OF BOREHOLE									Note: Open borehole dry on completion of drilling.
3											
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: SB

CHECKED: AMP

N1122061.BHS

DATA INPUT: PS AUG.20/98

SOIL MS

W.P. 67-98-00

DIST. QEW / ROYAL WINDSOR DRIVE

LOCATION: 4814586.730N; 290672.187E

RECORD OF BOREHOLE 4

BORING DATE: AUG.11/98

SHEET 1 OF 2

DATUM: GEODETIC

PROJECT: 981-1122

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m; SHEAR STRENGTH Cu, kPa (nat V - +, rem V - ⊕, Q - ●, U - ○)	HYDRAULIC CONDUCTIVITY, K, cm/s; WATER CONTENT, PERCENT Wp W Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	CME 55 BOMBARDIER SOLID STEM AUGERS	GROUND SURFACE		105.24							
		Topsoil		105.09							
		Silty Clay, some sand, trace gravel, trace organics Very stiff Brown (FILL)		0.15	1	SS	16				BENTONITE SEAL
				104.48							
1		Silty Clay, trace sand, trace gravel, occ. shale fragments Hard Brown and grey, mottled (TILL)		0.76	2	SS	50/ .15				
				103.74							
		Shale Bedrock Weathered Grey (Georgian Bay Formation)		1.50	3	SS	75/ .12				
2				1.67							
		BOREHOLE CONTINUED FOR BEDROCK CORING DETAILS, REFER TO SHEET 2.									
3											
4											
5											
6											
7											
8											
9											
10		CONTINUED ON NEXT PAGE									

Note: Open borehole dry during drilling in overburden.

DEPTH SCALE
1 to 50

Golder Associates

LOGGED: SB
CHECKED: AMP

DATA INPUT: PS AUG.25/98

SOILMS

W.P. 67-98-00

DIST. QEW / ROYAL WINDSOR DRIVE

LOCATION: 4814586.730N;290672.187E

RECORD OF BOREHOLE: 4

DRILLING DATE: AUG.11/98

DRILL RIG: CME 55 BOMBARDIER

DRILLING CONTRACTOR: MASTER SOILS

SHEET 2 OF 2

DATUM: GEODETIC

PROJECT: 981-1122

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R -ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W -WAVY B -BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C -CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (min/ft)	FLUSH % RETURN	COLOUR	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
0		CONTINUED FROM PREVIOUS PAGE															
1		CONTINUED FROM SHEET 1.		103.57 1.67													
2	NO CORING	Highly weathered becoming moderately weathered below 3.2m depth, grey, fine grained, thinly bedded Shale (76%) and fresh crystalline and fossiliferous Limestone (24%) typically in 25mm to 100mm thick layers. (Georgian Bay Formation)			1	0.125	100										BENTONITE SEAL
3																	
4	AUG.20/98				2	0.32	100							25mm BC 10mm clay seam 20mm BC			BAND
5		END OF BOREHOLE		100.52 4.72													Note: Water level in piezometer at Elev. 102.14m on Aug.19, 1998 and on Oct.3, 1998.
6		Note: Limestone layers greater than 100mm in thickness encountered at the follow depth: 3.51m - 140mm 4.23m - 140mm															
7																	
8																	
9																	
10																	

DEPTH SCALE: 1 to 50

Golder Associates

LOGGED: SB

DATE:

CHECKED: AMP

N1122D4.BHR

DATA INPUT: PS AUG.25/98

ROCKMS

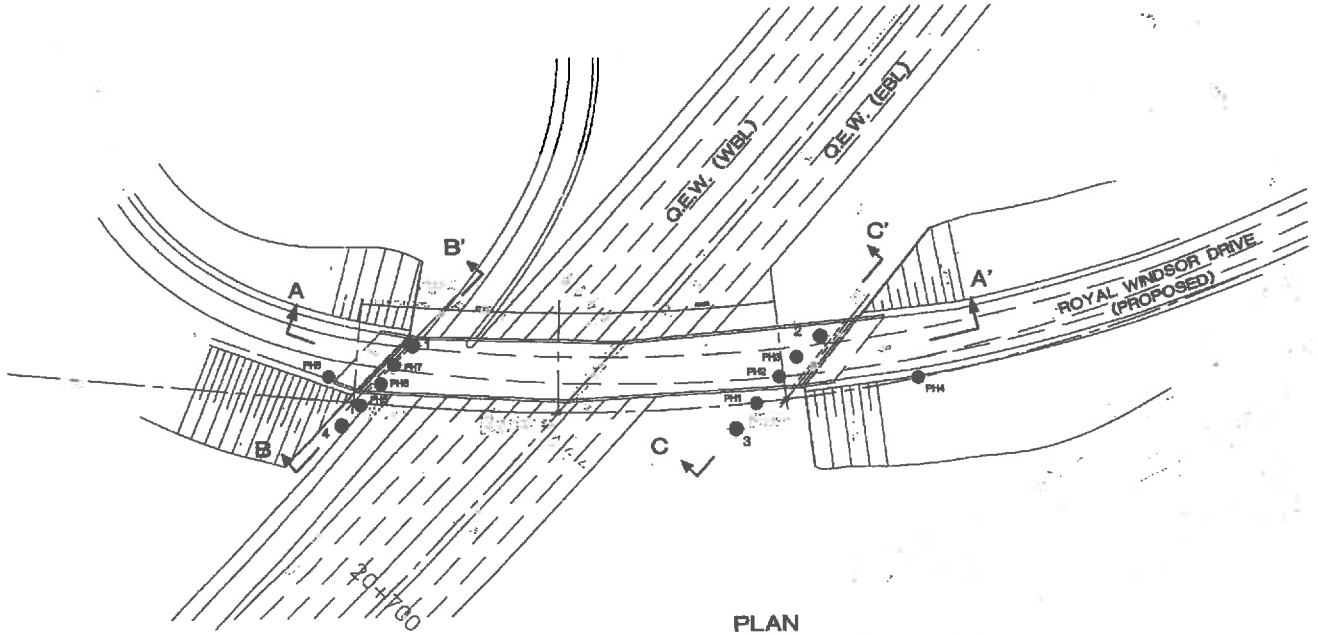
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT. No.
WP No. 67-98-00

SHEET

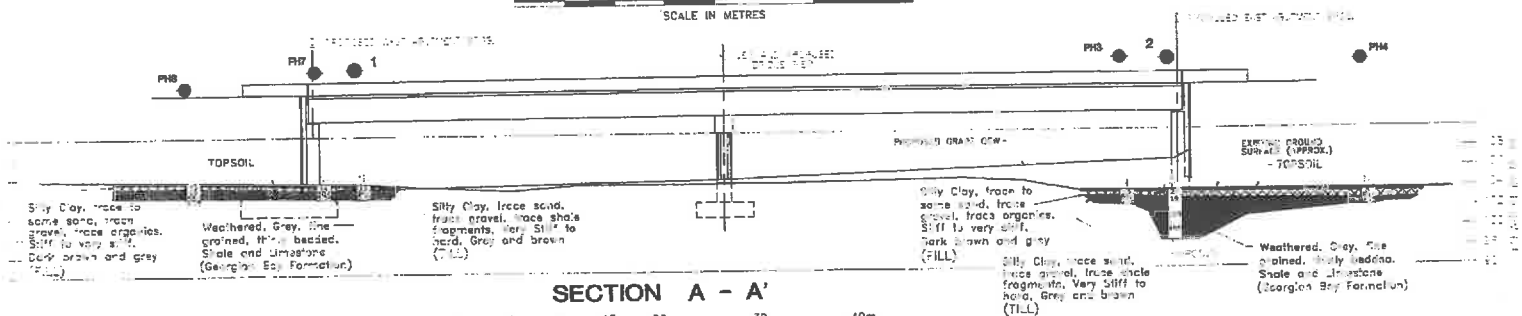
Q.E.W. UNDERPASS AT ROYAL WINDSOR DRIVE
BORE HOLE LOCATIONS & SOIL STRATA

Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



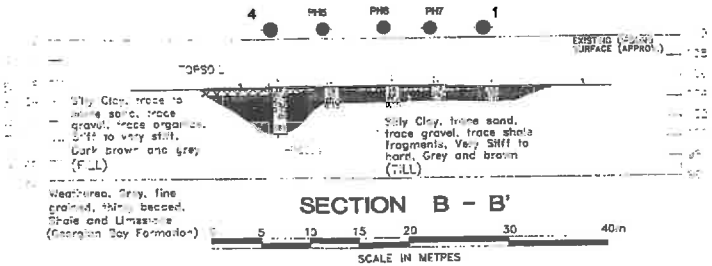
PLAN

0 10 20 30 40 60 80m
SCALE IN METRES



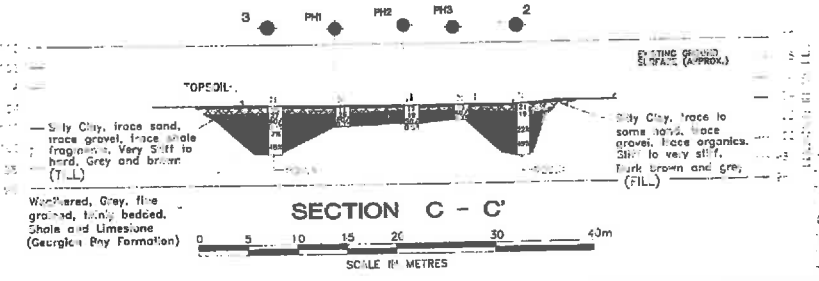
SECTION A - A'

0 5 10 15 20 30 40m
SCALE IN METRES



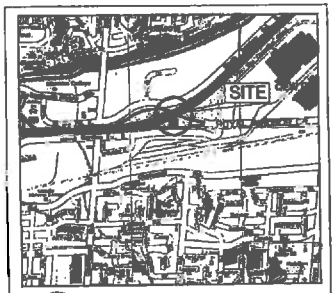
SECTION B - B'

0 5 10 15 20 30 40m
SCALE IN METRES



SECTION C - C'

0 5 10 15 20 30 40m
SCALE IN METRES



KEY PLAN

0.5 0 0.5 1km
SCALE

LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Core
- Blows/0.3m (Std. Pen. Test, 475 J/blow)
- Core — Blows/0.3m (60° Cone, 475 J/blow)
- Water Level at Time of Investigation

No.	ELEVATION	LOCATION NORTHING	LOCATION EASTING
1	105.18	4,814,606.408	290,800.528
2	103.88	4,814,635.260	290,756.997
3	102.90	4,814,610.283	290,747.250
4	105.24	4,814,586.750	290,672.187
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PH3	103.39	4,814,606.405	290,680.528
PH4	103.63	4,814,606.405	290,680.528
PH5	105.23	4,814,626.405	290,680.528
PH6	105.27	4,814,626.405	290,680.528
PH7	105.25	4,814,626.408	290,680.528
PH8	105.37	4,814,626.408	290,680.528

NO. DATE BY REVISION

Geocres No.

HWY. No. QEW PROJECT NO. 981-1122 DIST. 4/6
SUBMITTED ABP CHKD. ABP DATE: 1998 11 09 SITE 12-165
DRAWN: SJHW CHKD. ABP APPD. GWP: 2112-00

PROJECT 991-1140

RECORD OF BOREHOLE No 5

1 OF 1

METRIC

W.P. 98-23024 LOCATION Sta. 20+790, 105m Left of centerline of the median ORIGINATED BY BVS

DIST _____ HWY QEW BOREHOLE TYPE _____ COMPILED BY SB

DATUM Geodetic DATE 10.9.99 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
107.00											
0.00 / 0.05	Topsoil										
	Sandy Silt, some clay, trace gravel Very stiff Black to brown/grey (Fill)		1	50 DO	21				○		
			2	50 DO	22		106		○		
105.48											
1.52	Shale Bedrock Weathered Grey		3	50 DO	>100						
	(Georgian Bay Formation)						105				
			4	50 DO	>100		104				
103.19											
3.81	END OF BOREHOLE (AUGER REFUSAL)										
	Note: Open hole dry on completion of drilling.										

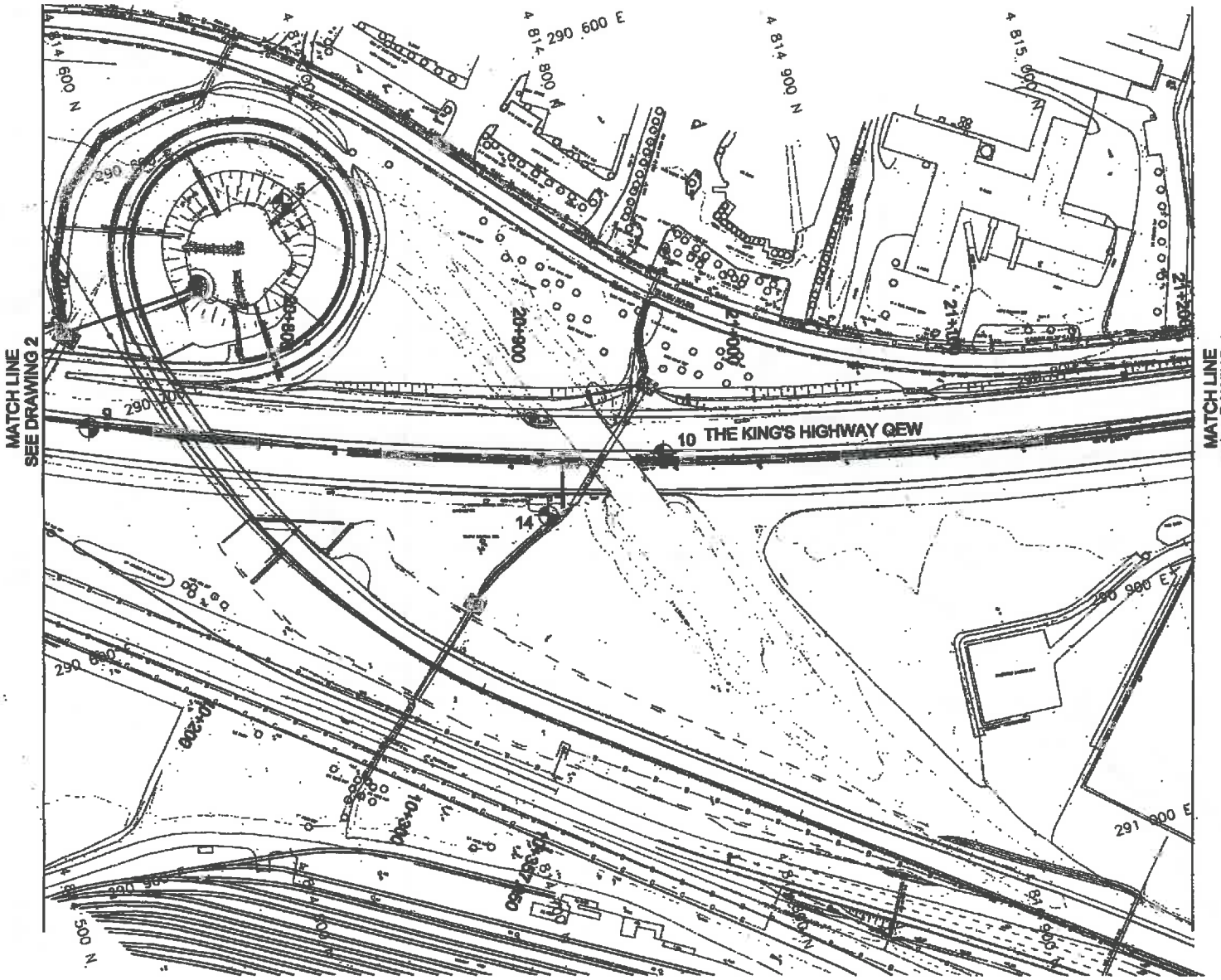
+³, ×³: Numbers refer to Sensitivity ○³% STRAIN AT FAILURE

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

CONT. No. 99-08
WO No. 98-2302

QUEEN ELIZABETH WAY
Sta. 20+700 to Sta. 21+200
BOREHOLE LOCATIONS

Golder Associates



PLAN

0 50 100 150 200m

SCALE 1:2,000

KEY PLAN

LEGEND

Borehole Location in Plan

No.	ELEVATION	COORD STATION
5	107.00	20+790
8	105.42	20+720
10	106.02	20+870
14	105.00	20+920

NOTES

Base Mapping obtained from digital files, (
B-02-QEW-35, B-12-QEW-26e83, B-QEW-
provided by McCormick Rankin Corporation.

NO.	DATE	BY	REVISION

Geocres No.

QEW		PROJECT NO.: 991-
SUBM'D.	CHKD:	DATE: 1999 (
DRAWN: JFC	CHKD.	APPD.

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