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consulting engineers

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**DRAFT  
BECKETT SPROULE FEEDERMAIN  
REGION OF PEEL, ONTARIO**

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## 1.0 INTRODUCTION

Alston Associates Inc. has been retained by Earth Tech Canada Inc. AECOM (Earth Tech) to carry out a supplementary geotechnical investigation pertaining to the design of potential deep tunnels for the installation of Beckett Sproule feedermain, in the Region of Peel, Ontario. The authorization to proceed with this detailed study was given by Neil Johnston, Project Manager, of Earth Tech.

In the course of the preliminary design of the feedermain, geotechnical evaluations of the study site were carried out by Alston Associates Inc. in 2005 and 2006, to characterize the shallow subsurface conditions. The 2005 investigation was carried out with a view to a conventional open cut construction methodology along most of the feedermain alignment, and a shallow tunnel under-crossing at Highway 410. The 2006 investigation was conducted based on watermain information. The findings of those studies were presented in the following reports:

*Alston Associates Inc., 2005, Geotechnical Investigation, Beckett Sproule Feedermain and Hanlan Pumping Station Upgrade, Brampton, Ontario, Alston Ref. No. 04-046, 20 June 2005.*

*Alston Associates Inc., 2006, Geotechnical Investigation Study, Proposed Feedermain from Hanlan Pumping Station/Reservoir to Kennedy Road, Mississauga, Ontario, Alston Ref. No. 04-046-MD, 12 January 2007.*

The Borehole Log Sheets for the earlier studies and the approximate locations of these boreholes are enclosed in this report in Appendix 'B' and those records should be interpreted in conjunction with the current geotechnical data.

The current study supplements data reported previously, and provides additional geotechnical engineering design recommendations based on the current design concept pertaining to the tunnel design at the proposed sites. The fieldwork program for the current study has involved extending the depth of the 2005 and 2006 boreholes to provide subsurface data at the invert elevations for the proposed watermain.

The engineering evaluation of the current and previous subsurface data provides recommendations pertaining to the detail design of the watermain pipeline and the deep under-crossing at the proposed tunnel locations.

## 2.0 SITE DESCRIPTION AND PHYSIOGRAPHY

The study area is located in the physiographic region referred to as the Peel Plain (Chapman and Putnam 1984). The geology of this plain is characterized by till materials (Halton Till) overlying the grey shale bedrock of the Georgian Bay Formation. Seams and layers of saturated granular materials are known to be interbedded in the till deposits. The shale bedrock is interbedded with seams of sandstone, siltstone and limestone. The bedrock stratum is known to contain locked-in stresses which can result in squeeze of the sides and heave in the base occurring in excavations.

It is understood that subsequent to undertaking the preliminary geotechnical investigations, the feedermain pipe design has been finalized. The current design concept will involve pipe installation by tunnelling to undercross roadways and major underground utility plants, at seven locations. These seven locations identified are as follows (based on Drawing Nos. P3, P14, P16, P18, P19, P20 and P21, revision March 2008, by Earth Tech Canada, Project No. 91627):

Borehole No.	Borehole Location	Site Stations	Low Point Pipe Invert Elevation (m)	Proposed Depth of Invert Below Existing Ground Surface (m)	Tunnel Application
201C	2+180	1+940 to 2+220	179.8	7.8	N/A
207C	4+760	4+760 to 5+060	173.0	13.6	4+900 to 4+940
208C	5+501	5+360 to 5+660	173.2	11.6	Not shown
210C	5+835	5+760 to 6+060	160.8	22.2	5+820 to 6+060
211C	6+230	6+060 to 6+340	158.8	18.8	6+060 to 6+265
212C	6+535	6+340 to 6+620	163.1	14.3	Not shown
213C	7+715	6+620 to 6+800	163.1	11.2	6+660 to Limit

### **3.0 FIELDWORK METHODOLOGY**

#### **3.1 General**

The fieldwork for this supplementary study was carried out in the period from 21 October to 14 January 2009, and consisted of advancing a total of seven boreholes at the locations shown in the plan view of Drawing No. 1. This current set of 'C' series of boreholes was advanced at approximately the same location or reasonably close to the previous set of boreholes done for the earlier studies (e.g. 201, 201A and 201C are at close locations).

The current boreholes were advanced to depths ranging from 11.2 to 24.0 m below the existing ground surface. Several boreholes were augered straight to the elevation at bottom of previous boreholes (A or B series) and bedrock core samples below that depth have been taken using diamond tipped core barrels, e.g. 210C and 213C.

In general, the target depth of the boreholes was set at about 1 m below the invert of the proposed feedermain pipeline, or to a sufficient depth into the bedrock stratum to prove continuity and consistency of the material.

The boreholes were advanced in the field using conventional power auger drilling equipment owned and operated by Ontario Drilling Inc. Solid stem augers were used to advance the boreholes in the overburden soil, diamond tipped rock coring equipment was used in bedrock to secure high quality samples of the material.

Ground surface elevations and locations for the current series of boreholes were surveyed using a Sokkia Stratus GPS system.

#### **3.2 Soil Sampling, Rock Coring and In Situ Testing**

Sampling and in situ testing of overburden soils was effected using the Standard Penetration Test method carried out at frequent intervals of depth to take representative soil samples and to measure the penetration index (N-value) of the in situ soils. All soil samples were identified in the field and placed in sealed airtight plastic bags. Rock core samples were preserved in wooden sample boxes.

At the end of each day of drilling, all soil and rock samples were transported to our laboratory for further examination of their texture and condition to prepare office log sheets and to carry out geotechnical testing.

Observations of the groundwater conditions encountered in the boreholes are recorded on the Log Sheets. The recorded observations include the depth at which water was first identified in each boring, the depth of cave in unlined borings and the depth to which water accumulated in the boring, at its completion. Piezometers were installed in two of the boreholes to permit long-term monitoring of the groundwater level.

Conventional borehole pressure packer testing was carried out in selected boreholes to determine the in situ permeability of the rock mass. Low permeability seals were installed in each borehole using bentonite pellets.

The fieldwork for this study was supervised by an experienced soils technician from this office who laid out the positions of the boreholes in the field; arranged locates of buried services; supervised the drilling, sampling and in situ testing on a full time basis; observed groundwater conditions; and prepared field Borehole Log Sheets. Supervision of the testing carried out with the pressure packer was provided by a professional engineer.

#### **4.0 LABORATORY TESTING**

Classification tests consisting of water content, Atterberg limits, grain size distribution and unit weight determinations have been carried out on representative soil samples. The test results are reported on the Borehole Log Sheets and in the attached set of figures. These data have been used to complement visual inspection of soil samples, in preparing soil descriptions.

Representative soil samples were tested for total sulphate content and pH level by Maxxam Analytics.

Unconfined compressive strength and unit weight tests were carried out on representative rock cores specimens.

## **5.0 SUBSURFACE CONDITIONS**

### **5.1 General**

Full details of the subsurface conditions contacted in the current boreholes are given on the Log Sheets for Boreholes 201C, 207C, 208C and 210C through 213C. Other data are given on the Log Sheets for Boreholes 201, 207, 208, 211 through 213 (2005 investigation) and 201A, 207A, 208A, 208B, 210A and 211A (2006 investigation).

The following notes are intended to provide an engineering commentary on the subsurface data.

### **5.2 Surface Cover**

A 300 mm thick layer of topsoil was encountered at ground surface in Borehole 211C. Fill and probable fill materials were contacted at ground surface in Boreholes 201C and 207C. In general, the fill consists of silty clay soils which include a trace of sand, a trace of gravel and occasional topsoil.

Standard penetration tests carried out in the fill measured N-values ranging from 7 to more than 50 blows/300 mm which indicates variable, moderately to well compacted soil conditions within the fill.

The water content of the fill was found to range from 13 to 24%.

Figure 1 shows the results of grain size distribution tests carried out on representative samples of the fill, which indicates that the fill generally consists of about 14 to 17% gravel, 20 to 32% sand, 30 to 42% silt and 21 to 24% clay sized particles.

The fill materials were found to extend to depths of 1.5 to 2.0 m below the ground surface.

### 5.3 Layered Silty Clay

A deposit of faintly layered silty clay was contacted in Borehole 208C. This deposit includes a trace of sand and a trace of gravel. The material is of high plasticity. Standard penetration tests carried out in this deposit measured N-values which range from 12 to more than 50 blows/300 mm. The test results indicated that there is an upper sub-unit of the deposit which consists of soil which is 'stiff' and the lower sub-unit is 'hard'.

The water content of the soil samples ranges from 10 to 15%. Liquid and plastic limits of 51 and 24 respectively, were measured on a sample which indicates that the soil behaviour is represented by a CH/CI designation (refer to Figure 4).

### 5.4 Silty Clay to Sandy Silty Clay to Silt (Plastic)

Below the surface cover in Boreholes 201C, 207C and 211C, and from the ground surface in Borehole 212C, a native deposit of silty clay to sandy silty clay to weakly plastic silt is present. The deposit includes a trace of embedded gravel. Occasional closed fissures were observed in soil samples from this layer and oxidation is often present on the fissure faces. Minor root penetrations were observed in the near surface sub-unit of the layer.

The unsorted character of this soil indicates that these materials are from a glacial origin, which is consistent with the geologic setting of the study area. The deposit extends to depths ranging from 4.4 to 9.1 m below the ground surface.

Standard penetration test N-values measured in the deposit range from 12 to more than 100 blows/300 mm which indicates that the soils are stiff to hard for cohesive soils and compact to dense for cohesionless soils. In general, the stiff and compact soils are at the near surface zones of the deposit below which, the soils are hard or dense. The result of an in situ vane test carried out in the stiff soil conditions at site (in the previous Borehole 205 of 2005 investigation) indicates an undrained shear strength of the soil greater than 190 kPa.



The water content of the soils was found to range from 5 to 24%. The results of Atterberg limits testing on representative samples of the deposit are shown on the Borehole Log Sheets and summarized on the Plasticity Chart, Figure 4. These test results indicate that the cohesive soil material classifies as a clay of low to intermediate plasticity (CL-CI designation).

Depending on borehole locations, the silty clay materials are coloured brown to greyish brown from the ground surface to a depth range of about 1.5 to 6 m, below which the deposit is coloured grey. In Boreholes 207C and 211C, shale fragments are contacted in the lower portion of the deposit.

Obstructions encountered during drilling, interpreted to be boulders or cluster of cobbles embedded within the silty clay deposit have been noted in Boreholes 201C and 207C on the Borehole Log Sheets. It is noted that in the 2006 investigation, boulders were encountered in Borehole 211A.

### **5.5 Shale Bedrock**

Shale bedrock was encountered in all boreholes below the overburden, in the depth range of 2.8 to 9.1 m (Elevation 173.0 to 181.9m).

The shale bedrock is of the Georgian Bay Formation. This material is coloured grey. Generally, there is a highly weathered upper sub-unit of the stratum which exhibits the engineering properties of a hard stony clay soil. There are many shale fragments present in this sub-unit which range in size from fine gravel up to relatively large flaggy pieces. The thickness of this sub-unit ranges from about 0.5 up to about 4 m.

The results of observations made on rock cores indicate that the condition of the shale varies from location to location, with recorded values of rock quality designation (RQD)<sup>(1)</sup>

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(1) Rock quality designation is defined as quotient of sum of length of core pieces in excess of 10 cm, over total length of core run. Based on Canadian Foundation Engineering Manual, 4<sup>th</sup> Edition (2006).

in the range 0 to 75%. An RQD of less than 50% indicates a rock which is of poor quality and an RQD in the range of 50 to 75% indicates a rock which is of fair quality. Reference to the Borehole Log Sheets shows that the rock is generally considered poor based on RQD index.

The grey shale bedrock was found to be interbedded with thin limestone and occasional clay seams.

The limestone layers were found to range in thickness from about 10 to 300 mm in the core samples. However, previous studies indicate that the thickness of the limestone layers may range up to about 450 mm. The limestone layers were contacted in both the weathered and unweathered zones of the bedrock. Occasional clay seams were identified in the rock cores and the seams were found to range in thickness from about 5 to 20 mm. Clay seams were observed throughout the depth extent of the cored bedrock.

Calcareous siltstone is also known to be interbedded within the shale bedrock.

The results of unconfined compressive strength tests carried out on core samples of the bedrock are reported on the Borehole Log Sheets. The test results indicate an unconfined compressive strength of 35 to 55 MPa for relatively intact samples of the shale and a rock strength of 41 to 72 MPa for the limestone. The unit weight of the rock cores was found to be about 25.0 kN/m<sup>3</sup> for both the shale and the limestone.

Pressure packer test results carried out in shale layers indicated a generally fairly high to high permeability of the rocks, however in Borehole 210C, the rock appears to be of locally low permeability based on the results of a pressure packer test carried out at approximately the invert depth (Elevation 160.9 m).

Engineering properties of the shale bedrock encountered in boreholes are summarized in Table 1 of this report. Rock Mass Rating (RMR) index of the shale bedrock at the tunnel invert elevation has been estimated based on the Geomechanics Classification System developed by Bieniawski (1989).

The bedrock layer is known to be under horizontal stresses and some movement is expected in the perimeter of the tunnel excavation as a consequence of a changed stress condition.

### **5.6 Groundwater**

The groundwater level was measured in Boreholes 208C and 213C from installed standpipes at depths from 4.6 to 4.7 m below the ground surface at the time of this study. However, it should be noted that groundwater was encountered at as shallow a depth (1.5 m below the ground surface) in previous investigations.

### **5.7 Sulphate Content**

The test results of total sulphate content, pH and chloride content are given in Appendix 'C'. These results indicate that there is a low likelihood of sulphate attack occurring in densely compacted high quality concrete materials placed in substructures constructed along the feedermain alignment.

## **6.0 DISCUSSION AND RECOMMENDATIONS**

### **6.1 General**

The project will consist of installing approximately 5.4 km of feedermain from the Hanlan Pumping Station to the border between the Cities of Mississauga and Brampton at Kennedy Road. The feedermain will be a 2100 mm diameter pipeline, it is understood that this pipeline will be constructed using concrete pressure pipe (CPP) materials. Mostly, the design invert of the feedermain pipeline will be at a depth of about 5 m below the ground surface and this will follow the ground surface profile, approximately.

Short tunnelled sections are proposed for the undercrossings below major utilities, Highway 410 and Tomken Road.

The proposed diameter for the tunnel liner for each of the undercrossings is about 2.7 m.

## **6.2 Short Tunnel Sections**

### **6.2.1 General**

The key factors in selecting the method to construct the undercrossings are the soil or rock type, and the pipe diameter. The stiff to very stiff becoming hard (sandy) silty clay and weathered shale materials through which the undercrossings are to be constructed, coupled with the large pipe diameter is expected to reduce the efficiency of a pipe jacking method to construct these undercrossings.

In view of the subsurface conditions, it is reasonably probable that a mechanized tunnel boring machine will be used to construct the undercrossings.

### **6.2.2 Site 1 (Stations 1+940 to 2+220, Borehole 201C)**

Between Stations 1+940 and 2+220, the invert of the tunnel is proposed to be at an elevation of 179.8 m, which is about 7.8 m below the ground surface. Based on the results of Borehole 201C, the tunnel excavation is expected to contact both hard shaly clay materials and weathered, fractured shale which is of poor quality. Stiff to hard clay is generally considered favourable for tunnelling construction, since this soil may afford a moderate to good 'stand-up time' at the tunnel face; the fractured shale should exhibit a good 'stand-up time' however, the fractured condition is expected to allow minor rock falls to occur. Pressure packer tests conducted at 10.1 m depth in the borehole show that a permeability of about  $2 \times 10^{-4}$  cm/s characterizes the bedrock condition. This indicates that a fairly rapid flow of groundwater through fractures can be anticipated in the tunnel excavation.

### **6.2.3 Site 2 (Stations 4+760 to 5+060, Borehole 207C)**

From Station 4+760 to Station 5+060, the invert of the tunnel is proposed to be at an elevation of 173 m, which is about 13.6 m below the ground surface. The borehole data indicate that the tunnel alignment will intersect poor quality shale bedrock; the rock is highly fractured consisting of generally poor quality shale interbedded with limestone seams. On account of the fractures in the shale, there is the potential for minor falls to occur and for

groundwater to infiltrate the tunnel. Increased resistance to tunnel excavation is expected to be experienced in the limestone interbeds. The fractured condition of the shale bedrock will require that temporary support is provided prior to construction of the permanent liner system.

#### **6.2.4 Site 3 (Stations 5+360 to 5+660, Borehole 208C)**

From Station 5+360 to Station 5+660, the invert of the tunnel is proposed to be at Elevation 173.2 m, which is about 11.6 m below the ground surface.

This tunnel zone is anticipated to be within the a zone of the shale bedrock which is characterized by RQD values of 12 to 17%, indicating poor quality of rock.

Similar considerations should be adopted as described in Section 6.2.3.

#### **6.2.5 Highway 410 (Stations 5+760 to 6+340, Boreholes 210C and 211C)**

In this section of the alignment, the depth to the tunnel invert at this location is at about Elevation 158.8 to 160.8 m (approximately 19.2 to 22.2 m below the ground surface). The borehole data indicate that the tunnel excavation will be in a very poor to poor quality zone of the shale bedrock stratum, as represented by RQD values ranging from nil to 32%. The groundwater table may be encountered at a depth of 1.5 m below the ground surface, as indicated in the 2006 investigation. Pressure packer tests conducted at a depth of 22.2 m in Borehole 211C measured permeability values in the range  $1 \times 10^{-3}$  to  $2 \times 10^{-3}$  cm/s. The possibility of contacting limestone interbeds should be anticipated in this section of the project. In Borehole 210C, a low permeability was recorded indicating that the rock is locally less fractured.

#### **6.2.6 Tomken Road (Stations 6+340 to 6+800, Boreholes 212C and 213C)**

At this roadway undercrossing, the invert of the tunnel is proposed to be at an Elevation of 163.1 m which is approximately 14.3 m below the ground surface.

From Boreholes 212C and 213C, this tunnel zone is anticipated to be within the fractured shale bedrock stratum. The shale bedrock is observed to be frequently fractured, and infiltration of groundwater should be anticipated through the fractures.

#### **6.2.7 Design Considerations**

The geotechnical properties for soil and bedrock for the design of the tunnelled sections of the feedermain are given in Table 1.

Obstructions may be encountered as indicated by hard augering during drilling in the silty clay (till) deposit. These obstructions are interpreted to be boulders or cluster of cobbles embedded within the silty clay deposit, as have been noted on the Borehole Log Sheets.

The expected frequency of boulders has been provided in the previous study based on historical data in the general vicinity of the site.

At the Highway 410 crossing, the records of boreholes in the 210 and 211 series indicate that the silty clay overburden is about 2 to 4 m thick and is underlain by the shale bedrock which extends beyond the invert of the tunnel. The groundwater table lies above rockhead. Positioning the invert of the tunnel at a depth of about 21 to 22 m will result in the entire tunnel zone being in contact with poor quality shale bedrock which is characterized by a range of RQD of about 0 to 32%.

Historical records of a Cherchar abrasion test carried out on a limestone boulder encountered in till materials in the Greater Toronto Area indicate an abrasiveness index of 2.4 with a standard deviation of 1.1. This abrasiveness index value indicates a high to very high tool wear rate for the cutters on the tunnel boring machine, where these contact limestone interbeds.

It is anticipated that spalling of loose rock will occur from the roof and sides of the tunnel. In accordance with OHSA Section 307, the sides and roof of the tunnel should be supported by timbers set on ribs or beams or by an equivalent system of lining.

### 6.3 Construction Aspects

There are in situ stresses locked in the shale bedrock, in the Mississauga and Brampton areas. Relief of these stresses, such as result from construction of an excavation, often results in swelling occurring in the sides of excavations. Such movement can result in structural damage occurring in support systems, such as tunnel liners. The movement is known as rock squeeze.

Allowance should be made for squeeze to occur, following excavation of the tunnel and prior to construction of the permanent lining. Based on experience of other tunnel excavations which have been constructed in the shale bedrock formation, it is expected that about 80% of the expected movement should have occurred within about two to three months of rock excavation.

Depending on the site conditions, the movement may be complete in a shorter period of time, this should be determined by establishing monitoring points and measuring convergence at weekly intervals. Review of these data will establish the time at which it is safe to construct the permanent liner.

No monitoring of methane gas was carried out in boreholes in the course of the current geotechnical studies. The underlying shale bedrock of the Toronto area is known to contain pockets of methane and hydrogen sulphide and such may be contacted in the tunnelled section of the project. Adequate ventilation and monitoring of gases will be essential during construction.

Shoring at the launch and receiving shafts should be designed to support lateral earth pressures given by the earth pressure envelopes shown in Figure 5, which are reproduced from Figure 26.8 in the Canadian Foundation Engineering Manual, 4<sup>th</sup> Edition (2006).

Using the parameters of degree of weathering, rock strength, joint and bedding spacing and diggability index rating developed by Scoble and Muftuoglu (Trenter 2001), it is anticipated that the effort required to excavate the bedrock materials may be assessed by reference to the following table:

Stratigraphic Unit	Class	Ease of Digging	Typical Plant Fitted with Rock Teeth and Ripper May Be Used Without Blasting
Poor Quality Shale	I	very easy	Hydraulic backhoe <3 m <sup>3</sup> e.g. CAT 235D
Fair Quality Shale	IV	difficult	Hydraulic shovel or backhoe >3 m <sup>3</sup> , e.g. CAT 245 or O&K RH40 (short boom if a backhoe)
Limestone	V	very difficult	Hydraulic shovel or backhoe >4 m <sup>3</sup> e.g. Hitachi EX 100

Pre-treatment of the limestone and probable siltstone layers with a hydraulic breaker may be required to advance the shaft excavations.

The shale bedrock is known to be friable and to slake readily upon exposure to cyclic wetting and drying, and freeze-thaw. In order to prevent the spalling of loose rock, the walls of the excavation should be protected using a system of wire mesh and rock bolts in accordance with OHSa Section 279.

#### **6.4 Ground Surface Monitoring**

Settlement at the ground surface resulting from tunnelling in the rock is expected to be negligible provided that the necessary precautions are taken to prevent rock spalling from the sides and roof of the tunnel as outlined in Section 6.2.

Tunnel drives through the silty clay materials requires close monitoring to ensure that the excavated spoil does not exceed the theoretical tunnel volume by more than 0.5 % (i.e. loss of ground is limited to 0.5% of the tunnel face). Estimated settlements induced by ground loss during the tunnelling are given in the previous studies.



**7.0 LIMITATIONS OF REPORT**

The Limitations of Report, as quoted in Appendix 'A', are an integral part of this report.

**ALSTON ASSOCIATES INC.**

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***References***

Alston Associates Inc., 2005, Geotechnical Investigation, Beckett Sproule Feedermain and Upgrade of Hanlan Pumping Station/Reservoir, Region of Peel, Ontario, Ref. No. 04-046, dated 20 June 2005.

Alston Associates Inc., 2006, Geotechnical Investigation Study, Proposed Feedermain From Hanlan Pumping Station/Reservoir to Kennedy Road, Mississauga, Ontario. Alston Ref. No. 04-046-MD, dated 12 January 2007.

Urban Geology of Canadian Cities, GAC Special Paper 42, 1998

Canadian Foundation Engineering Manual, 4<sup>th</sup> Edition, 206, Canadian Geotechnical Society.

Table 1

BH No.	Station	Depth to Tunnel Invert (m)	Soil or Rock Material	Unconfined Compressive Strength (Intact Cores) (MPa)	Bulk Permeability (cm/s)	Rock Quality Designation (RQD) (%)	Rock Mass Rating (RMR)*	Rock Class*
201C	1+940 to 2+220	7.8	Silty clay, overlying highly weathered shale bedrock (limestone seams)	56 (limestone)	$2 \times 10^{-4}$ (in situ)	Nil to 13	30	IV
207C	4+760 to 5+060	13.6	Highly weathered shale bedrock (limestone seams)	69 (limestone)	N/A	10 to 56	39	IV
208C	5+360 to 5+660	9.9	Highly weathered shale bedrock (limestone seams)	40 (shale)	N/A	12 to 17	38	IV
210C	5+760 to 6+060	24.0	Highly weathered shale bedrock (limestone seams)	72 (limestone) 55 (shale)	locally impermeable	21 to 39	39	IV
211C	6+060 to 6+340	18.8	Highly weathered shale bedrock (limestone seams)	41 (limestone)	$2 \times 10^{-3}$ to $1 \times 10^{-3}$ (in situ)	Nil	33	IV
212C	6+340 to 6+620	14.3	Highly weathered shale bedrock (limestone seams)	N/A	N/A	Nil to 27	33	IV
213C	6+620 to 6+800	11.1	Highly weathered shale bedrock (limestone seams)	35 (shale)	N/A	Nil to 34	38	IV

\*After Bieniawski, 1989

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## **APPENDIX 'A'**

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## **Appendix 'A'**

### **LIMITATIONS OF REPORT**

The conclusions and recommendations in this report are based on information determined at the test hole locations. Soil and groundwater conditions between and beyond the test holes may differ from those encountered at the test hole locations, and conditions may become apparent during construction which could not be detected or anticipated at the time of the soil investigation.

The design recommendations given in this report are applicable only to the project described in the text, and then only if constructed substantially in accordance with details of alignment and elevations stated in the report. Since all details of the design may not be known to us, in our analysis certain assumptions had to be made as set out in this report. The actual conditions may, however, vary from those assumed, in which case changes and modifications may be required to our recommendations.

This report was prepared for Earth Tech Canada Inc. AECOM by Alston Associates Inc. The material in it reflects Alston Associates Inc. judgement in light of the information available to it at the time of preparation. Any use which a Third Party makes of this report, or any reliance on decisions which the Third Party may make based on it, are the sole responsibility of such Third Parties.

We recommend, therefore, that we be retained during the final design stage to review the design drawings and to verify that they are consistent with our recommendations or the assumptions made in our analysis. We recommend also that we be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered in the test holes. In cases where these recommendations are not followed, the company's responsibility is limited to accurately interpreting the conditions encountered at the test holes, only.

The comments given in this report on potential construction problems and possible methods are intended for the guidance of the design engineer, only. The number of test holes may not be sufficient to determine all the factors that may affect construction methods and costs. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work.

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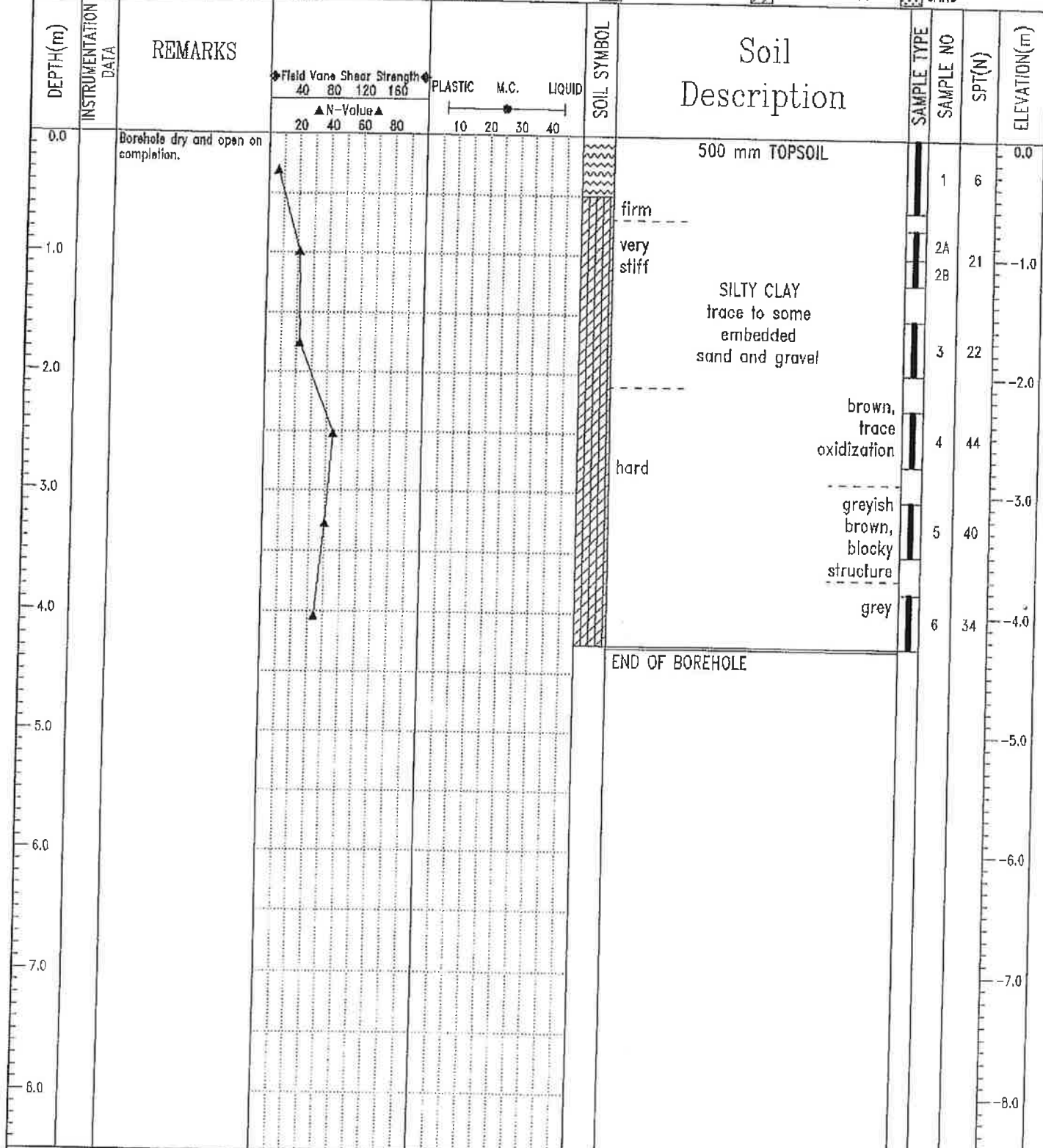
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## **APPENDIX 'B'**

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Earth Tech		Method: Augering & Split Spoon Sampling		BOREHOLE NO: 201	
Beckett Sproule Feedermain				PROJECT NO: 04-046	
Brampton, Ontario		PROJECT ENGINEER: DW		ELEVATION:	
SAMPLE TYPE	<input checked="" type="checkbox"/> AUGER	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> CORING	<input type="checkbox"/> DYNAMIC CONE	<input type="checkbox"/> SHELBY TUBE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS
				<input type="checkbox"/> SAND	



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LOGGED BY: KT	COMPLETION DEPTH: 4.3 m
REVIEWED BY: CA	COMPLETE: 05 04 06
Page 1 of 1	

Earth Tech		Method: Augering & Split Spoon Sampling		BOREHOLE NO: 207	
Beckett Sproule Feedermain				PROJECT NO: 04-046	
Brampton, Ontario		PROJECT ENGINEER: DW		ELEVATION:	
SAMPLE TYPE <input checked="" type="checkbox"/> AUGER		<input type="checkbox"/> NO RECOVERY		<input checked="" type="checkbox"/> CORING	
<input type="checkbox"/> DYNAMIC CONE		<input type="checkbox"/> SHELBY TUBE		<input type="checkbox"/> SPLIT SPOON	
BACKFILL TYPE <input checked="" type="checkbox"/> BENTONITE		<input type="checkbox"/> PEA GRAVEL		<input type="checkbox"/> SLOUGH	
<input type="checkbox"/> GROUT		<input type="checkbox"/> DRILL CUTTINGS		<input type="checkbox"/> SAND	

DEPTH(m)	INSTRUMENTATION DATA	REMARKS	Field Vane Shear Strength 40 80 120 160 ▲ N-Value ▲ 20 40 60 80	PLASTIC M.C. LIQUID 10 20 30 40	SOIL SYMBOL	Soil Description	SAMPLE TYPE	SAMPLE NO	SPT(N)	ELEVATION(m)
0.0		Borehole dry and open on completion.						1	8	0.0
1.0						moderately to well compacted brown with grey silty clay trace to some sand and gravel (FILL)		2	15	-1.0
2.0								3	34	-2.0
3.0								4	15	-3.0
4.0								5A	16	-3.0
								5B		
								6	17	-4.0
4.3		trace rootlets								
		END OF BOREHOLE								
5.0										-5.0
6.0										-6.0
7.0										-7.0
8.0										-8.0

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Earth Tech		Method: Augering & Split Spoon Sampling		BOREHOLE NO: 208						
Beckett Sproule Feedermain				PROJECT NO: 04-046						
Brampton, Ontario		PROJECT ENGINEER: DW		ELEVATION:						
SAMPLE TYPE		NO RECOVERY		CORING						
DYNAMIC CONE		SHELBY TUBE		SPLIT SPOON						
BACKFILL TYPE		PEA GRAVEL		SLOUGH						
GROUT		DRILL CUTTINGS		SAND						
DEPTH(m)	INSTRUMENTATION DATA	REMARKS	Field Vane Shear Strength 40 80 120 160 ▲ N-Value ▲ 20 40 60 80	PLASTIC M.C. LIQUID 10 20 30 40	SOIL SYMBOL	Soil Description	SAMPLE TYPE	SAMPLE NO	SPT(N)	ELEVATION(m)
0.0		Borehole dry and open on completion.				600 mm TOPSOIL	1A			0.0
1.0						SILTY CLAY trace to some embedded sand and gravel	1B	7		-1.0
2.0						brown with grey, oxidization	2	20		-2.0
3.0		Hard augering from 2.6 to 2.9 m depth.				very stiff hard	3	20		-3.0
4.0						greyish brown	4	50/100		-4.0
5.0						END OF BOREHOLE (Refusal to advancement of augers)				-5.0
6.0										-6.0
7.0										-7.0
8.0										-8.0

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REVIEWED BY: CA

COMPLETION DEPTH: 2.9 m

COMPLETE: 05 04 07

05/04/28 11:36AM (AMZ65FY)
Page 1 of 1

Earth Tech		Method: Augering & Split Spoon Sampling		BOREHOLE NO: 210	
Beckett Sproule Feedermain				PROJECT NO: 04-046	
Brampton, Ontario		PROJECT ENGINEER: DW		ELEVATION:	
SAMPLE TYPE <input checked="" type="checkbox"/> AUGER		<input type="checkbox"/> NO RECOVERY		<input checked="" type="checkbox"/> CORING	
<input type="checkbox"/> DYNAMIC CONE		<input type="checkbox"/> SHELBY TUBE		<input type="checkbox"/> SPLIT SPOON	
BACKFILL TYPE <input checked="" type="checkbox"/> BENTONITE		<input type="checkbox"/> PEA GRAVEL		<input type="checkbox"/> SLOUGH	
<input type="checkbox"/> GROUT		<input type="checkbox"/> DRILL CUTTINGS		<input type="checkbox"/> SAND	

DEPTH(m)	INSTRUMENTATION DATA	REMARKS	Field Vane Shear Strength 40 80 120 160 ▲ N-Value ▲ 20 40 60 80	PLASTIC M.C. LIQUID 10 20 30 40	SOIL SYMBOL	Soil Description	SAMPLE TYPE	SAMPLE NO	SPT(N)	ELEVATION(m)
0.0		Borehole dry and open on completion.				600 mm TOPSOIL		1A		0.0
								1B	5	
1.0						stiff brown with grey SILTY CLAY		2	12	-1.0
						trace embedded sand and gravel blocky structure		3	16	-2.0
2.0						very stiff		4	50/75	-2.0
		Hard augering from 2.6 to 2.9 m depth.				highly weathered, grey SHALE BEDROCK				
3.0						END OF BOREHOLE (Refusal to advancement of augers)				-3.0
4.0										-4.0
5.0										-5.0
6.0										-6.0
7.0										-7.0
8.0										-8.0

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05/04/28 11:37AM (SAL/BS/FF)

Earth Tech		Method: Augering & Split Spoon Sampling		BOREHOLE NO: 211	
Beckett Sproule Feedermain				PROJECT NO: 04-046	
Brompton, Ontario		PROJECT ENGINEER: DW		ELEVATION:	
SAMPLE TYPE <input checked="" type="checkbox"/> AUGER		<input checked="" type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> CORING	<input type="checkbox"/> DYNAMIC CONE	<input type="checkbox"/> SHELBY TUBE
BACKFILL TYPE <input checked="" type="checkbox"/> BENTONITE		<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS
				<input type="checkbox"/> SAND	

DEPTH(m)	INSTRUMENTATION DATA	REMARKS	Soil Description	SAMPLE TYPE	SAMPLE NO	SPT(N)	ELEVATION(m)
0.0		Borehole open and water level at 2.5 m below ground surface on completion. Water level measure as 1.9 m below ground surface on 8 April 2005.	600 mm TOPSOIL		1	2	0.0
1.0			stiff		2	11	-1.0
2.0			grey with brown SILTY CLAY trace embedded sand and gravel occasional closed fissures		3	15	-2.0
3.0			very stiff		4	26	-3.0
4.0		Split spoon wet on retrieval of sample 6.	grey highly weathered SHALE BEDROCK		5	50/75	-4.0
5.0					6	50/50	-5.0
6.0					7	50/100	-6.0
7.0					8	50/75	-7.0
8.0			END OF BOREHOLE				-8.0

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		REVIEWED BY: CA	COMPLETE: 05 04 05
		Page 1 of 1	

Earth Tech		Method: Augering & Split Spoon Sampling		BOREHOLE NO: 212	
Beckett Sproule Feedermain				PROJECT NO: 04-046	
Brampton, Ontario		PROJECT ENGINEER: DW		ELEVATION:	
SAMPLE TYPE <input checked="" type="checkbox"/> AUGER		<input type="checkbox"/> NO RECOVERY		<input checked="" type="checkbox"/> CORING	
<input type="checkbox"/> DYNAMIC CONE		<input type="checkbox"/> SHELBY TUBE		<input type="checkbox"/> SPLIT SPOON	
BACKFILL TYPE <input checked="" type="checkbox"/> BENTONITE		<input type="checkbox"/> PEA GRAVEL		<input type="checkbox"/> SLOUGH	
<input type="checkbox"/> GROUT		<input type="checkbox"/> DRILL CUTTINGS		<input type="checkbox"/> SAND	

DEPTH(m)	INSTRUMENTATION DATA	REMARKS	Field Vane Shear Strength 40 80 120 160 ▲ N-Value ▲ 20 40 60 80	PLASTIC M.C. LIQUID 10 20 30 40	SOIL SYMBOL	Soil Description	SAMPLE TYPE	SAMPLE NO	SPT(N)	ELEVATION(m)
0.0		Borehole dry and open on completion.				200 mm TOPSOIL		1	4	0.0
1.0						light to moderately compacted grayish brown silty clay frequent oxidized faces (FILL)		2	14	-1.0
2.0						compact, gray with brown weakly plastic SILT trace sand, trace clay oxidization		3	17	-2.0
3.0						dense, grey SILT trace sand trace gravel occasional oxidized faces		4	49	-3.0
4.0						grey, highly weathered SHALE BEDOCK		5	67	-4.0
4.0			50/75			END OF BOREHOLE		6	50/75	-4.0
5.0										-5.0
6.0										-6.0
7.0										-7.0
8.0										-8.0

alston associates inc. consulting engineers		LOGGED BY: DW REVIEWED BY: CA	COMPLETION DEPTH: 4.0 m COMPLETE: 05 04 05
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Earth Tech		Method: Augering & Split Spoon Sampling		BOREHOLE NO: 213	
Beckett Sproule Feedermain				PROJECT NO: 04-046	
Brampton, Ontario		PROJECT ENGINEER: DW		ELEVATION:	
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<input type="checkbox"/> DYNAMIC CONE		<input type="checkbox"/> SHELBY TUBE		<input type="checkbox"/> SPLIT SPOON	
BACKFILL TYPE <input checked="" type="checkbox"/> BENTONITE		<input type="checkbox"/> PEA GRAVEL		<input type="checkbox"/> SLOUGH	
<input type="checkbox"/> GROUT		<input type="checkbox"/> DRILL CUTTINGS		<input type="checkbox"/> SAND	

DEPTH(m)	SLOTTED PIEZOMETER	REMARKS	Field Vane Shear Strength 40 80 120 160 ▲ N-Value ▲ 20 40 60 80	PLASTIC M.C. LIQUID 10 20 30 40	SOIL SYMBOL	Soil Description	SAMPLE TYPE	SAMPLE NO	SPT(N)	ELEVATION(m)
0.0		Water level measured as 6.0 m below ground surface on 8 April 2005.				150 mm TOPSOIL		1	7	0.0
1.0						lightly to moderately compacted grey silt trace sand trace gravel occasional clayey pocket occasional gravel seam		2	11	-1.0
2.0								3	8	-2.0
3.0								4	6	
3.5							wood fragments	5	8	-3.0
4.0			50/75			grey highly weathered SHALE BEDROCK		6	50/75	-4.0
4.5			50/100					7	50/100	-5.0
6.0		Split spoon wet on retrieval of sample 8.	80/50					8	50/50	-6.0
7.6							END OF BOREHOLE	9	50	-8.0

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REVIEWED BY: CA

COMPLETION DEPTH: 7.6 m  
COMPLETE: 05 04 05

CLIENT: Earth Tech (Canada)			METHOD: Augering and Split Spoon Sampling			BH No.: 201A		
PROJECT: Beckett Sproule Feedermain			PROJECT ENGINEER: DW					
LOCATION: Brampton, ON			STATION: 2+180			PROJECT NO: 04-046		
SAMPLE TYPE <input checked="" type="checkbox"/> AUGER <input checked="" type="checkbox"/> DRIVEN <input type="checkbox"/> CORING <input type="checkbox"/> DYNAMIC CONE <input type="checkbox"/> SHELBY <input type="checkbox"/> SPLIT SPOON								
BACKFILL TYPE <input checked="" type="checkbox"/> BENTONITE <input type="checkbox"/> PEA GRAVEL <input type="checkbox"/> SLOUGH <input type="checkbox"/> GROUT <input type="checkbox"/> DRILL CUTTINGS <input type="checkbox"/> SAND								

DEPTH (m)	INSTRUMENTATION DATA	REMARKS	TCR (%)		N-Value (Blows/300 mm)	PL W.C. LL		SOIL SYMBOL	Soil Description	SAMPLE TYPE	SAMPLE NO	SPT[N]	ELEVATION (m)
			20	40		60	80						
0.0		Borehole dry and open on completion.							Ground Surface				189.0
0.5		Borehole dry on 2 May 2006.							TOPSOIL				
1.0					15				stiff to very stiff		1	15	
1.5					27				very stiff		2	27	188.0
2.0					46				hard		3	46	187.0
2.5					43				greyish brown, trace oxidization, occasional fissure		4	43	
3.0					42				SILTY CLAY trace to some embedded sand and gravel		5	42	186.0
3.5					18				grey, trace brown		6	18	185.0
4.0					50				very stiff		7	50	184.0
4.5					32				hard		8	32	183.0
5.0					7				occasional cobble				
6.0													
7.0									END OF BOREHOLE				182.0
8.0													181.0
9.0													180.0
10.0													179.0

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		REVIEWED BY: DW	Page 1 of 1



CLIENT: Earth Tech (Canada)		METHOD: Augering and Split Spoon Sampling		BH No.: 207A	
PROJECT: Beckett Sproule Feedermain		PROJECT ENGINEER: DW			
LOCATION: Brampton, ON		STATION: 4+760		PROJECT NO: 04-046	
SAMPLE TYPE <input checked="" type="checkbox"/> AUGER <input checked="" type="checkbox"/> DRIVEN <input type="checkbox"/> CORING <input type="checkbox"/> DYNAMIC CONE <input type="checkbox"/> SHELBY <input type="checkbox"/> SPLIT SPOON					
BACKFILL TYPE <input checked="" type="checkbox"/> BENTONITE <input type="checkbox"/> PEA GRAVEL <input type="checkbox"/> SLOUGH <input type="checkbox"/> GROUT <input type="checkbox"/> DRILL CUTTINGS <input type="checkbox"/> SAND					

DEPTH (m)	INSTRUMENTATION DATA	REMARKS	TCR (%)		RQD (%)	N-Value (Blows/300 mm)	PL W.C. LI.			SOIL SYMBOL	Soil Description	SAMPLE TYPE	SAMPLE NO	SPT(N)	ELEVATION (m)
			20	40			60	80	20						
0.0		Water level measured as 8.0 m below ground surface on completion.									Ground Surface				188.0
0.5	Bentonite					7					reddish brown silty clay trace sand trace gravel trace brick fragments trace shale fragments FILL	firm	1	7	
1.0						2						soft to firm	2	2	187.0
2.0	Drill Cuttings					14						stiff	3	14	186.0
3.0						6						firm	4	6	185.0
4.0		Invert				5							5	5	184.0
5.0						45					damp, brown silty sand trace gravel occasional topsoil pocket occasional clay pocket FILL	dense	6	45	183.0
6.0						17					stiff, dark brown partly organic SILTY CLAY	compact	7	17	182.0
7.0						21					brown, trace rootlets	very stiff	BA BB	21	181.0
8.0	2 May 2006 Bentonite	Start of very hard augering at 8.2 m depth				>50					SILTY CLAY trace to some embedded sand and gravel occasional fissure trace oxidization	hard	9	60	180.0
9.0						50					greyish brown		10	50	179.0
10.0	Screen Sand					70					hard, grey SILTY CLAY some shale fragments			70	178.0

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		REVIEWED BY: DW	Page 1 of 2

CLIENT: Earth Tech (Canada)				METHOD: Augering and Split Spoon Sampling				BH No.: 207A					
PROJECT: Beckett Sproule Feedmain				PROJECT ENGINEER: DW									
LOCATION: Brampton, ON				STATION: 4+760				PROJECT NO: 04-046					
SAMPLE TYPE		<input checked="" type="checkbox"/> AUGER		<input checked="" type="checkbox"/> DRIVEN		<input type="checkbox"/> CORING		<input type="checkbox"/> DYNAMIC CONE		<input type="checkbox"/> SHELBY		<input type="checkbox"/> SPLIT SPOON	
BACKFILL TYPE		<input checked="" type="checkbox"/> BENTONITE		<input type="checkbox"/> PEA GRAVEL		<input type="checkbox"/> SLOUGH		<input type="checkbox"/> GROUT		<input type="checkbox"/> DRILL CUTTINGS		<input type="checkbox"/> SAND	

DEPTH (m)	INSTRUMENTATION DATA	REMARKS	TCR (%) ▲ 20 40 60 80 ▲ RQD (%) ● 20 40 60 80 ●	N-Value (Blows/300 mm) 10 20 30 40	PL W.C. LL 20 40 60 80	SOIL SYMBOL	Soil Description	SAMPLE TYPE	SAMPLE NO	SPT(N)	ELEVATION (m)
							hard, grey SILTY CLAY some shale fragments		11	50	177.0
				50 /60			END OF BOREHOLE (Refusal to advancement of augers)				176.0
11.0											175.0
12.0											174.0
13.0											173.0
14.0											172.0
15.0											171.0
16.0											170.0
17.0											169.0
18.0											168.0
19.0											167.0
20.0											166.0

alston associates inc. consulting engineers		LOGGED BY: TA	DRILLING DATE: 28 April 2006
		REVIEWED BY: DW	Page 2 of 2



CLIENT: Earth Tech (Canada)				METHOD: Augering and Split Spoon Sampling				BH No.: 208A					
PROJECT: Beckett Sproule Feedermain				PROJECT ENGINEER: DW									
LOCATION: Brampton, ON				STATION: 5+500				PROJECT NO: 04-046					
SAMPLE TYPE		<input checked="" type="checkbox"/> AUGER		<input checked="" type="checkbox"/> DRIVEN		<input checked="" type="checkbox"/> CORING		<input type="checkbox"/> DYNAMIC CONE		<input type="checkbox"/> SHELBY		<input type="checkbox"/> SPLIT SPOON	
BACKFILL TYPE		<input checked="" type="checkbox"/> BENTONITE		<input type="checkbox"/> PEA GRAVEL		<input type="checkbox"/> SLOUGH		<input type="checkbox"/> GROUT		<input type="checkbox"/> DRILL CUTTINGS		<input type="checkbox"/> SAND	

DEPTH (m)	INSTRUMENTATION DATA	REMARKS	TCR (%)		RQD (%)	N-Value (Blows/300 mm)	PL W.C. LL		SOIL SYMBOL	Soil Description	SAMPLE TYPE	SAMPLE NO	SPT (N)	ELEVATION (m)
			20	40			60	80						
0.0										Ground Surface				184.0
1.0										occasional clay seams		1		183.0
										grey slightly weathered SHALE with limestone interbeds		2		
												3		
2.0										END OF BOREHOLE (Refusal to advancement of coring, move 1 m south)				182.0
3.0														181.0
4.0														180.0
5.0														179.0
6.0		Invert												178.0
7.0														177.0
8.0														176.0
9.0														175.0
10.0														174.0

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		REVIEWED BY: DW	Page 1 of 1

CLIENT: Earth Tech (Canada)			METHOD: Augering and Split Spoon Sampling			BH No.: 208B		
PROJECT: Beckett Sproule Feedermain			PROJECT ENGINEER: DW					
LOCATION: Brampton, ON			STATION: 5+501			PROJECT NO: 04-046		
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DEPTH (m)	INSTRUMENTATION DATA	REMARKS	TCR (%)		RQD (%)	N-Value (Blows/300 mm)	PL W.C. LL			SOIL SYMBOL	Soil Description	SAMPLE TYPE	SAMPLE NO	SPT(N)	ELEVATION (m)
			20	40			60	80	20						
0.0											Ground Surface				184.0
1.0											Auger straight to 1.67 m depth.				183.0
2.0			11		57							1			182.0
3.0			29									2			181.0
4.0			49								occasional clay seam	3			180.0
5.0			34		87						grey SHALE with limestone interbeds	4			179.0
6.0		Invert													178.0
7.0			94		100							5			177.0
8.0			60		100							6			176.0
9.0															175.0
10.0											END OF BOREHOLE				174.0

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		REVIEWED BY: DW	Page 1 of 1

CLIENT: Earth Tech (Canada)				METHOD: Augering and Split Spoon Sampling				BH No.: 210A					
PROJECT: Beckett Sproule Feedermain				PROJECT ENGINEER: DW									
LOCATION: Brampton, ON				STATION: 5+835				PROJECT NO: 04-046					
SAMPLE TYPE		<input checked="" type="checkbox"/> AUGER		<input checked="" type="checkbox"/> DRIVEN		<input type="checkbox"/> CORING		<input type="checkbox"/> DYNAMIC CONE		<input type="checkbox"/> SHELBY		<input type="checkbox"/> SPLIT SPOON	
BACKFILL TYPE		<input checked="" type="checkbox"/> BENTONITE		<input type="checkbox"/> PEA GRAVEL		<input type="checkbox"/> SLOUGH		<input type="checkbox"/> GROUT		<input type="checkbox"/> DRILL CUTTINGS		<input type="checkbox"/> SAND	

DEPTH (m)	INSTRUMENTATION DATA	REMARKS	TCR (%)		RQD (%)	N-Value (Blows/300 mm)	PL W.C. LL		SOIL SYMBOL	Soil Description	SAMPLE TYPE	SAMPLE NO	SPT(N)	ELEVATION (m)
			20	40			60	80						
0.0										Ground Surface				163.0
0.5	2 May 2006	Borehole cave-in at 3.4 m and water level at 2.6 m below ground surface on completion.				8				290 mm clayey TOPSOIL		1	8	
1.0		Water level measured as 1.5 m below ground surface on 2 May 2006.				8				firm to stiff brown veined grey SILTY CLAY trace sand, trace gravel trace topsoil, trace oxidization (possible fill)		2	8	162.0
2.0						49				hard, grey faintly layered to layered SILTY CLAY trace sand		3	49	161.0
2.5						50						4		160.0
3.0						50						5	50	180.0
3.5						50				grey weathered SHALE with interbeds of silty clay		6	50	179.0
4.0						50						7	50	178.0
5.0						50						8		177.0
6.0						100				clay seam		9		176.0
7.0						100				SHALE with limestone interbeds		10		175.0
8.0						100				clay seam		11		174.0
9.0					100								173.0	
10.0					100									

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		REVIEWED BY: DW	Page 1 of 2

CLIENT: Earth Tech (Canada)			METHOD: Augering and Split Spoon Sampling			BH No.: 210A								
PROJECT: Beckett Sproule Feedmain			PROJECT ENGINEER: DW											
LOCATION: Brampton, ON			STATION: 5+835			PROJECT NO: 04-046								
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BACKFILL TYPE <input checked="" type="checkbox"/> BENTONITE <input type="checkbox"/> PEA GRAVEL <input type="checkbox"/> SLOUGH <input type="checkbox"/> GROUT <input type="checkbox"/> DRILL CUTTINGS <input type="checkbox"/> SAND														
DEPTH (m)	INSTRUMENTATION DATA	REMARKS	TCR (%)		N-Value (Blows/300 mm)	PL W.C. LL			SOIL SYMBOL	Soil Description	SAMPLE TYPE	SAMPLE NO	SPT(N)	ELEVATION (m)
			20 40 60 80	20 40 60 80		20 40 60 80	20 40 60 80							
11.0														172.0
12.0			28								12			171.0
13.0											13			170.0
14.0											14			169.0
15.0			20								15			168.0
16.0			49								16			167.0
17.0											17			166.0
18.0			79								18			165.0
19.0			67											164.0
20.0		Invert								END OF BOREHOLE				163.0

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REVIEWED BY: DW

DRILLING DATE: 25/29 April 2006

Page 2 of 2

CLIENT: Earth Tech (Canada)			METHOD: Augering and Split Spoon Sampling			BH No.: 211A		
PROJECT: Beckett Sproule Feedermain			PROJECT ENGINEER: DW					
LOCATION: Brampton, ON			STATION: 6+230			PROJECT NO: 04-046		
SAMPLE TYPE <input checked="" type="checkbox"/> AUGER <input checked="" type="checkbox"/> DRIVEN <input type="checkbox"/> CORING <input type="checkbox"/> DYNAMIC CONE <input type="checkbox"/> SHELBY <input type="checkbox"/> SPLIT SPOON								
BACKFILL TYPE <input checked="" type="checkbox"/> BENTONITE <input type="checkbox"/> PEA GRAVEL <input type="checkbox"/> SLOUGH <input type="checkbox"/> GROUT <input type="checkbox"/> DRILL CUTTINGS <input type="checkbox"/> SAND								

DEPTH (m)	INSTRUMENTATION DATA	REMARKS	TCR (%)		N-Value (Blows/300 mm)	PL W.C. LL			SOIL SYMBOL	Soil Description	SAMPLE TYPE	SAMPLE NO	SPT(N)	ELEVATION (m)	
			20	40		60	80	20							40
0.0										Ground Surface				178.0	
0.5	2 May 2006	Water level measured as 1.4 m below ground surface on 2 May 2008.			12					stiff, brown silty clay, some organics (FILL)	1A	12			
0.8				12					compact, moist, brown sand and gravel (FILL)	1B					
1.2						27				stiff	2	12		177.0	
1.8										brown veined grey	3	27			
2.2										SILTY CLAY trace embedded sand and gravel trace oxidization occasional fissure	very stiff	3		178.0	
2.8						35				greyish brown, trace rootlets	hard	4	35		
3.2			Augers grinding at 3.1 m depth.			50				hard, grey and brown faintly layered to layered SHALY CLAY		5	50		175.0
3.8			Split spoon wet on retrieval of sample 6.			50						6	50		
4.2						100						6	100		174.0
4.8						50						7	50		173.0
5.2						100						7	100		
6.0		Augers grinding			50					grey highly weathered SHALE and SILTY CLAY		8	50		172.0
6.8					80						8	80			
7.2														171.0	
7.8					50						9	50		170.0	
8.2		Augers grinding			80										
8.8															
9.2					60					highly to moderately weathered LIMESTONE and SHALE (possible boulder)		10	60		169.0
9.8					88					SHALE with limestone interbeds		11	88		168.0
10.2					100							11	100		

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		REVIEWED BY: DW	Page 1 of 2

CLIENT: Earth Tech (Canada)				METHOD: Augering and Split Spoon Sampling				BH No.: 211A					
PROJECT: Beckett Sproule Feedermain				PROJECT ENGINEER: DW									
LOCATION: Brampton, ON				STATION: 6+230				PROJECT NO: 04-046					
SAMPLE TYPE		<input checked="" type="checkbox"/> AUGER		<input checked="" type="checkbox"/> DRIVEN		<input type="checkbox"/> CORING		<input type="checkbox"/> DYNAMIC CONE		<input type="checkbox"/> SHELBY		<input type="checkbox"/> SPLIT SPOON	
BACKFILL TYPE		<input checked="" type="checkbox"/> BENTONITE		<input type="checkbox"/> PEA GRAVEL		<input type="checkbox"/> SLOUGH		<input type="checkbox"/> GROUT		<input type="checkbox"/> DRILL CUTTINGS		<input type="checkbox"/> SAND	

DEPTH (m)	INSTRUMENTATION DATA	REMARKS	TCR (%)		RQD (%)	N-Value (Blows/300 mm)	PL W.C. LL			SOIL SYMBOL	Soil Description	SAMPLE TYPE	SAMPLE NO	SPT(N)	ELEVATION (m)
			20	40			60	80	20						
11.0															167.0
12.0												12			166.0
13.0										clay seams		13			165.0
14.0										clay seam					164.0
15.0										clay seam		14			163.0
16.0															162.0
17.0		Invert										15			161.0
18.0															160.0
19.0															159.0
20.0															158.0
END OF BOREHOLE															

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				REVIEWED BY: DW		Page 2 of 2	

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## APPENDIX 'C'

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Maxxam Job #: A8E7384  
Report Date: 2008/12/16

Alston Associates Inc  
Client Project #: REF. NO. 08-174

Your P.O. #: 00396

### RESULTS OF ANALYSES OF SOIL

Maxxam ID		BH3955	BH3956	BH3957		
Sampling Date						
COC Number		n/a	n/a	n/a		
	Units	BOREHOLE 201A, SPLIT SPOON 8	BOREHOLE 207A, SPLIT SPOON 9&8	BOREHOLE 211A, SPLIT SPOON 6&5	RDL	QC Batch

Inorganics						
Available (CaCl2) pH	pH	7.97	8.08	7.89		1701899
Soluble (20:1) Sulphate (SO4)	ug/g	700	460	270	20	1701286
N/A = Not Applicable RDL = Reportable Detection Limit QC Batch = Quality Control Batch						



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**ENCLOSURES**

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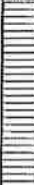

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CLIENT: Earth Tech Canada		METHOD: Augering/Split Spoon Sampling/Coring		BH No.: 201C						
PROJECT: Beckett Sproule Watermain		PROJECT ENGINEER: BF		ELEV. (m) 187.603						
LOCATION: Mississauga, ON		NORTHING:		EASTING:						
PROJECT NO.: 08-174										
SAMPLE TYPE		AUGER		DRIVEN						
		CORING		DYNAMIC CONE						
		SHELBY		SPLIT SPOON						
DEPTH (m)	INSTRUMENTATION DATA	REMARKS	Shear Strength (kPa) 40 80 120 160 N-Value (Blows/300mm) 20 40 60 80	PL W.C. LL 20 40 60 80	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SPT(N)	ELEVATION (m)
0										187.5
0.5			9	21		dark brown, trace black silty clay, trace topsoil trace organics, FILL		1	9	187
1			50/125	24		moist, mottled brown silty clay, trace gravel (PROBABLE FILL)		2	50/125	186.5
1.5										
2			19	23		very stiff		3	19	186
2.5			33	13		moist, brown SANDY SILTY CLAY trace embedded gravel		4	33	185.5
3										
3.5			49	7		hard		5	49	185
4		Water strike at 3.8 m	50/125	11				6	50/125	184.5
4.5										
5		Hard augering starting at 5.2 m depth.	50/125	5				7	50/125	184
5.5										
6						hard, grey SILTY CLAY rock fragments				183.5
6.5			43	6				8	43	183
7										182.5
7.5			50/25					9	50/25	182
8		Sample 10: TCR = 31 %, RQD = 13 % Unconfined compressive strength of rock sample at 7.8 m depth = 56 MPa. Tunnel Invert at Elevation 179.8 m. Sample 11: TCR = 69 %, RQD = 0 % Sample 12: TCR = 72 %, RQD = 0 %								181.5
8.5						very poor, dark grey highly weathered SHALE BEDROCK very close to close joints flat bedding intermittent interbedded limestone seams		10		181
9								11		180.5
9.5										180
										179.5
										179
										178.5
										178

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REVIEWED BY: BF

DRILLING DATE: 08-11-04  
Page 1 of 2

CLIENT: Earth Tech Canada				METHOD: Augering/Split Spoon Sampling/Coring				BH No.: 201C									
PROJECT: Beckett Sproule Watermain				PROJECT ENGINEER: BF		ELEV. (m) 187.603											
LOCATION: Mississauga, ON				NORTHING:		EASTING:		PROJECT NO.: 08-174									
SAMPLE TYPE		<input type="checkbox"/> AUGER <input checked="" type="checkbox"/> DRIVEN <input type="checkbox"/> CORING <input type="checkbox"/> DYNAMIC CONE <input type="checkbox"/> SHELBY						SPLIT SPOON									
DEPTH (m)	INSTRUMENTATION DATA	REMARKS	Shear Strength (kPa)				N-Value (Blows/300mm)				SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SPT (N)	ELEVATION (m)	
			40	80	120	160	20	40	60	80							20
10		Sample 13: TCR = 100 % RQD = 0 %												very poor, dark grey highly weathered SHALE BEDROCK very close to close joints flat bedding intermittent interbedded limestone seams		12	177.5
10.5												177					
11																	176.5
END OF BOREHOLE																	
alston associates inc. consulting engineers										LOGGED BY: KC				DRILLING DATE: 08-11-04			
										REVIEWED BY: BF				Page 2 of 2			

CLIENT: Earth Tech Canada		METHOD: Augering/Split Spoon Sampling/Coring		BH No.: 207C		
PROJECT: Beckett Sproule Watermain		PROJECT ENGINEER: BF	ELEV. (m) 186.585			
LOCATION: Mississauga, ON		NORTHING:	EASTING:	PROJECT NO.: 08-174		
SAMPLE TYPE	AUGER	DRIVEN	CORING	DYNAMIC CONE	SHELBY	SPLIT SPOON
DEPTH (m)	INSTRUMENTATION DATA	REMARKS	Shear Strength (kPa) N-Value (Blows/300mm) PL W.C. LL	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE SAMPLE NO. SPT(N) ELEVATION (m)
0			8 22		firm reddish brown silty clay trace sand trace gravel trace shale fragments trace brick fragments FILL	1 8 186.5
0.5						
1			9 13			2 9 186
1.5						
2			7 14			3 7 185.5
2.5						
3			21 16	very stiff		4 21 185
3.5						
4			43 10			5 43 184.5
4.5						
5		Very hard augering 4.9 m to 6.1 m depth.	50/125 10	hard	moist, brown SANDY SILTY CLAY trace embedded gravel	6 50/125 183
5.5						
6			50/75 22			7 50/75 182.5
6.5						
7			50/125 12			8 50/125 182
7.5						
8			50/50 11		occasional thin limestone seams	9 50/50 181.5
8.5						
9			50/25 15			10 50/25 181
9.5		Sample 11: TCR = 78 % RQD = 33 %			hard moist, grey SHALY CLAY occasional rock fragments	180.5
					poor, dark grey, highly weathered SHALE BEDROCK very close to close joints flat bedding, Intermittent interbedded	180
						179.5
						179
						178.5
						178
						177.5
						177

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DRILLING DATE: 08-10-22  
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CLIENT: Earth Tech Canada				METHOD: Augering/Split Spoon Sampling/Coring				BH No.: 207C							
PROJECT: Beckett Sproule Watermain				PROJECT ENGINEER: BF		ELEV. (m) 186.585									
LOCATION: Mississauga, ON				NORTHING:		EASTING:		PROJECT NO.: 08-174							
SAMPLE TYPE		<input type="checkbox"/> AUGER <input checked="" type="checkbox"/> DRIVEN <input checked="" type="checkbox"/> CORING <input type="checkbox"/> DYNAMIC CONE <input type="checkbox"/> SHELBY						SPLIT SPOON							
DEPTH (m)	INSTRUMENTATION DATA	REMARKS	Shear Strength (kPa)				PL	W.C.	LL	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SPT(N)	ELEVATION (m)
			40	80	120	160									
			N-Value (Blows/300mm)												
			20	40	60	80									
10											limestone seams		11		176.5
10.5											fair				176
11		Sample 12: TCR = 100 % RQD = 56 %													175.5
11.5													12		175
12															174.5
12.5		Sample 13: TCR = 100 % RQD = 20 %									dark grey highly weathered close to close joints flat bedding intermittent interbedded limestone seams				174
13													13		173.5
13.5		Unconfined compressive strength of rock sample at 13.4 m depth = 69 MPa.													173
14		Tunnel Invert at Elevation 173.0 m.													172.5
14.5		Sample 14: TCR = 100 % RQD = 10 %									very poor				172
15													14		171.5
END OF BOREHOLE															
alston associates inc. consulting engineers											LOGGED BY: KC		DRILLING DATE: 08-10-22		
											REVIEWED BY: BF		Page 2 of 2		

CLIENT: Earth Tech Canada			METHOD: Augering/Split Spoon Sampling/Coring			BH No.: 208C														
PROJECT: Beckett Sproule Watermain			PROJECT ENGINEER: BF		ELEV. (m) 184.803															
LOCATION: Mississauga, ON			NORTHING:		EASTING:		PROJECT NO.: 08-174													
SAMPLE TYPE		AUGER		DRIVEN		CORING		DYNAMIC CONE		SHELBY		SPLIT SPOON								
DEPTH (m)	INSTRUMENTATION DATA	REMARKS	Shear Strength (kPa)				N-Value (Blows/300mm)				PL W.C. LL				SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SPT(N)	ELEVATION (m)
			40 80 120 160				20 40 60 80				20 40 60 80									
0																				
0.5															stiff, brown veined grey		1	14	184.5	
1																	2	12	184	
1.5																			183.5	
2																	3	31	183	
2.5																	4	50/125	182.5	
3		Sample 5: TCR = 66 % RQD = 0 %																		182
3.5																			181.5	
4																			181	
4.5		Sample 6: TCR = 71 % RQD = 0 %																		180.5
5																			180	
5.5																			179.5	
6		Sample 7: TCR = 98 % RQD = 16 %																		179
6.5																			178.5	
7																			178	
7.5		Sample 8: TCR = 100 % RQD = 16 %																		177.5
8																			177	
8.5																			176.5	
9		Sample 9: TCR = 98 % RQD = 12 %																		176
9.5																			175.5	
alston associates inc. consulting engineers										LOGGED BY: KC					DRILLING DATE: 08-10-30					
										REVIEWED BY: BF					Page 1 of 3					

CLIENT: Earth Tech Canada				METHOD: Augering/Split Spoon Sampling/Coring				BH No.: 208C			
PROJECT: Beckett Sproule Watermain				PROJECT ENGINEER: BF		ELEV. (m) 184.803					
LOCATION: Mississauga, ON				NORTHING:		EASTING:		PROJECT NO.: 08-174			
SAMPLE TYPE		<input checked="" type="checkbox"/> AUGER		<input checked="" type="checkbox"/> DRIVEN		<input checked="" type="checkbox"/> CORING		<input type="checkbox"/> DYNAMIC CONE		<input type="checkbox"/> SHELBY	
										SPLIT SPOON	

DEPTH (m)	INSTRUMENTATION DATA	REMARKS	Shear Strength (kPa)				N-Value (Blows/300mm)				PL W.C. LL				SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SPT(N)	ELEVATION (m)
			40	80	120	160	20	40	60	80	20	40	60	80						
10																			174.5	
10.5		Sample 10: TCR = 98 % RQD = 17 %																	174	
11																				
11.5		Tunnel Invert at Elevation 173.2 m															10		173.5	
12																			173	
12.5		Sample 11: TCR = 100 % RQD = 21 %																	172.5	
13																	11		172	
13.5		Sample 12: TCR = 88 % RQD = 8 %																	171.5	
14																			171	
14.5																	12		170.5	
15		Sample 13: TCR = 97 % RQD = 20 %																	170	
15.5																			169.5	
16																	13		169	
16.5																			168.5	
17		Sample 14: TCR = 93 % RQD = 16 %																	168	
17.5																			167.5	
18																			167	
18.5		Sample 15: TCR = 97 % RQD = 57 %																	166.5	
19																			166	
19.5																	15		165.5	

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DRILLING DATE: 08-10-30

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CLIENT: Earth Tech Canada			METHOD: Augering/Split Spoon Sampling/Coring			BH No.: 208C								
PROJECT: Beckett Sproule Watermain			PROJECT ENGINEER: BF		ELEV. (m) 184.803									
LOCATION: Mississauga, ON			NORTHING:		EASTING:		PROJECT NO.: 08-174							
SAMPLE TYPE			AUGER		DRIVEN		CORING							
							DYNAMIC CONE							
							SHELBY							
							SPLIT SPOON							
DEPTH (m)	INSTRUMENTATION DATA	REMARKS	Shear Strength (kPa)		N-Value (Blows/300mm)		Pl. W.C. LL		SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SPT(N)	ELEVATION (m)
			40	80	120	160	20	40						
20		Sample 16: TCR = 99 % RQD = 7 % Unconfined compressive strength of rock sample at 20.3 m depth = 40 MPa Unit weight = 24.9 kN/m <sup>3</sup> .								very poor				165
20.5												16		164.5
21														164
21.5		Sample 17: TCR = 97 % RQD = 34 %								poor	dark grey highly weathered SHALE BEDROCK very close to close joints flat bedding intermittent interbedded limestone seams occasional clay seams			163.5
22												17		163
22.5														162.5
23		Sample 18: TCR = 100 % RQD = 55 %								fair				162
												18		161.5
END OF BOREHOLE														



CLIENT: Earth Tech Canada			METHOD: Augering/Split Spoon Sampling/Coring			BH No.: 210C												
PROJECT: Beckett Sproule Watermain			PROJECT ENGINEER: BF		ELEV. (m) 183.048													
LOCATION: Mississauga, ON			NORTHING:		EASTING:		PROJECT NO.: 08-174											
SAMPLE TYPE			<input type="checkbox"/> AUGER <input checked="" type="checkbox"/> DRIVEN <input checked="" type="checkbox"/> CORING <input type="checkbox"/> DYNAMIC CONE <input type="checkbox"/> SHELBY				SPLIT SPOON											
DEPTH (m)	INSTRUMENTATION DATA	REMARKS	Shear Strength (kPa)				N-Value (Blows/300mm)			PL W.C. LL			SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SPT(N)	ELEVATION (m)
			40	80	120	160	20	40	60	80	20	40						
0																		183
0.5																		182.5
1																		182
1.5																		181.5
2																		181
2.5																		180.5
3																		180
3.5																		179.5
4																		179
4.5																		178.5
5																		178
5.5																		177.5
6																		177
6.5																		176.5
7																		176
7.5																		175.5
8																		175
8.5																		174.5
9																		174
9.5																		173.5
alston associates inc. consulting engineers										LOGGED BY: KC				DRILLING DATE: 09-01-14				
										REVIEWED BY: BF				Page 1 of 3				

CLIENT: Earth Tech Canada			METHOD: Augering/Split Spoon Sampling/Coring			BH No.: 210C										
PROJECT: Beckett Sproule Watermain			PROJECT ENGINEER: BF		ELEV. (m) 183.048											
LOCATION: Mississauga, ON			NORTHING:		EASTING:		PROJECT NO.: 08-174									
SAMPLE TYPE <input type="checkbox"/> AUGER <input checked="" type="checkbox"/> DRIVEN <input checked="" type="checkbox"/> CORING <input type="checkbox"/> DYNAMIC CONE <input type="checkbox"/> SHELBY <input type="checkbox"/> SPLIT SPOON																
DEPTH (m)	INSTRUMENTATION DATA	REMARKS	Shear Strength (kPa)				PL W.C. LL			SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SPT(N)	ELEVATION (m)	
			40	80	120	160	20	40	60							80
10																173
10.5																172.5
11																172
11.5																171.5
12																171
12.5																170.5
13																170
13.5																169.5
14																169
14.5																168.5
15																168
15.5																167.5
16																167
16.5																166.5
17																166
17.5																165.5
18		Sample 1: TCR = 100 % RQD = 12 % Unconfined compressive strength of rock sample at 18.7 m depth = 72.5 MPa														165
18.5																164.5
19		Sample 2: TCR = 93 % RQD = 39 %														164
19.5																163.5
alston associates inc. consulting engineers										LOGGED BY: KC		DRILLING DATE: 08-01-14				
										REVIEWED BY: BF		Page 2 of 3				

CLIENT: Earth Tech Canada				METHOD: Augering/Split Spoon Sampling/Coring				BH No.: 210C									
PROJECT: Beckett Sproule Watermain				PROJECT ENGINEER: BF		ELEV. (m) 183.048											
LOCATION: Mississauga, ON				NORTHING:		EASTING:		PROJECT NO.: 08-174									
SAMPLE TYPE		<input type="checkbox"/> AUGER <input checked="" type="checkbox"/> DRIVEN <input checked="" type="checkbox"/> CORING <input type="checkbox"/> DYNAMIC CONE <input type="checkbox"/> SHELBY						SPLIT SPOON									
DEPTH (m)	INSTRUMENTATION DATA	REMARKS	Shear Strength (kPa)								SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SPT(N)	ELEVATION (m)	
			40	80	120	160	40	80	120	160							
20		Unconfined compressive strength of rock sample at 19.8 m depth = 54.9 MPa.												2			183
20.5																	182.5
21		Sample 3: TCR = 98 % RQD = 21 %															182
21.5														3			181.5
22																	181
22.5		Sample 4: TCR = 97 % RQD = 32 %															180.5
23		Tunnel Invert at Elevation 160.8 m												4			180
23.5																	179.5
END OF BOREHOLE																	
alston associates inc. consulting engineers										LOGGED BY: KC REVIEWED BY: BF				DRILLING DATE: 09-01-14 Page 3 of 3			

CLIENT: Earth Tech Canada		METHOD: Augering/Split Spoon Sampling/Coring		BH No.: 211C	
PROJECT: Beckett Sproule Watermain		PROJECT ENGINEER: BF		ELEV. (m) 177.642	
LOCATION: Mississauga, ON		NORTHING:		EASTING:	
SAMPLE TYPE		AUGER		PROJECT NO.: 08-174	
DRIVEN		CORING		DYNAMIC CONE	
SHELBY		SPLIT SPOON			

DEPTH (m)	INSTRUMENTATION DATA	REMARKS	Shear Strength (kPa)		N-Value (Blows/300mm)	PL. W.C. LL		SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SFT(N)	ELEVATION (m)
			40	80		120	160						
0									300 mm TOPSOIL		1A		177.5
0.5											1B	9	177
1					13				stiff		2	13	176.5
1.5					50/125				moist, brown SANDY SILTY CLAY trace embedded gravel trace oxidation occasional fissures		3	50/125	176
2									hard				175.5
2.5					23				very stiff		4	23	175
3					50/100						5	50/100	174.5
3.5									hard, damp grey and brown faintly layered to layered SHALY CLAY rock fragments		6	50/100	174
4					50/100						7		173.5
4.5		Sample 7: TCR = 100 % RQD = 0 %											173
5											8		172.5
5.5													172
6		Sample 9: TCR = 92 % RQD = 0 %											171.5
6.5									very poor dark grey highly weathered SHALE BEDROCK very close to close joints flat bedding intermittent interbedded limestone seams occasional clay seams		9		171
7													170.5
7.5		Sample 10: TCR = 95 % RQD = 0 %											170
8											10		169.5
8.5													169
9		Sample 11: TCR = 98 % RQD = 9 %											168.5
9.5											11		168

alston associates inc. consulting engineers		LOGGED BY: KC	DRILLING DATE: 08-11-05
		REVIEWED BY: BF	Page 1 of 3

CLIENT: Earth Tech Canada			METHOD: Augering/Split Spoon Sampling/Coring			BH No.: 211C													
PROJECT: Beckett Sproule Watermain			PROJECT ENGINEER: BF		ELEV. (m) 177.642														
LOCATION: Mississauga, ON			NORTHING:		EASTING:		PROJECT NO.: 08-174												
SAMPLE TYPE			AUGER		DRIVEN		CORING												
							DYNAMIC CONE												
							SHELBY												
							SPLIT SPOON												
DEPTH (m)	INSTRUMENTATION DATA	REMARKS	Shear Strength (kPa)				N-Value (Blows/300mm)				PL	W.C.	LL	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SPT(N)	ELEVATION (m)
			40	80	120	160	20	40	60	80									
10																			167.5
10.5		Sample 12: TCR = 100 % RQD = 0 %																	167
11																			166.5
11.5																			166
12		Sample 13: TCR = 98 % RQD = 0 %																	165.5
12.5																			165
13																			164.5
13.5		Sample 14: TCR = 99 % RQD = 0 %																	164
14																			163.5
14.5																			163
15		Sample 15: TCR = 97 % RQD = 0 %																	162.5
15.5																			162
16																			161.5
16.5		Sample 16: TCR = 85 % RQD = 0 %																	161
17																			160.5
17.5																			160
18																			159.5
18.5		Sample 17: TCR = 90 % RQD = 0 %																	159
19		Unconfined compressive strength of rock sample at 18.8 m depth = 41 MPa. Tunnel Invert at elevation 158.8 m.																	158.5
19.5																			158
alston associates inc.												LOGGED BY: KC		DRILLING DATE: 08-11-05					
consulting engineers												REVIEWED BY: BF		Page 2 of 3					

CLIENT: Earth Tech Canada			METHOD: Augering/Split Spoon Sampling/Coring			BH No.: 211C														
PROJECT: Beckett Sproule Watermain			PROJECT ENGINEER: BF			ELEV. (m) 177.642														
LOCATION: Mississauga, ON			NORTHING:			EASTING:														
SAMPLE TYPE			AUGER			DRIVEN														
CORING			DYNAMIC CONE			SHELBY														
SPLIT SPOON																				
DEPTH (m)	INSTRUMENTATION DATA	REMARKS	Shear Strength (kPa)	40	80	120	160	PL W.C. LL	20	40	60	80	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SPT(N)	ELEVATION (m)		
20		Sample 18: TCR = 100 % RQD = 0 %																157.5		
20.5																		157		
21																		156.5		
21.5		Sample 19: TCR = 100 % RQD = 0 %																156		
22																		155.5		
22.5																				
END OF BOREHOLE																				
<div>alston associates inc.</div> <div>consulting engineers</div>																			<div>LOGGED BY: KC</div> <div>REVIEWED BY: BF</div>	<div>DRILLING DATE: 08-11-05</div> <div>Page 3 of 3</div>

CLIENT: Earth Tech Canada		METHOD: Augering/Split Spoon Sampling/Coring		BH No.: 212C							
PROJECT: Beckett Sproule Watermain		PROJECT ENGINEER: BF		ELEV. (m) 177.391							
LOCATION: Mississauga, ON		NORTHING:		EASTING:							
PROJECT NO.: 08-174											
SAMPLE TYPE <input type="checkbox"/> AUGER <input checked="" type="checkbox"/> DRIVEN <input checked="" type="checkbox"/> CORING <input type="checkbox"/> DYNAMIC CONE <input type="checkbox"/> SHELBY <input type="checkbox"/> SPLIT SPOON											
DEPTH (m)	INSTRUMENTATION DATA	REMARKS	Shear Strength (kPa)		PL W.C. LL	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SPT(N)	ELEVATION (m)
			40 80 120 160	N-Value (Blows/300mm)							
0			13		15		compact		1	13	177
0.5							trace rootlets				
1			12		18		compact, moist greyish brown weakly plastic SILT trace sand, trace clay frequent oxidized fissures		2	12	176.5
1.5											176
2			22		16				3	22	175.5
2.5							dense		4A		175
3			40		16				4B	40	174.5
3.5											174
4			50/125		9		dense, damp, grey weakly plastic SILT rock fragments		5	50/125	173.5
4.5											173
5		Water strike at 4.6 m depth.	50/100		7				6	50/100	172.5
5.5		Sample 8: TCR = 67 % RQD = 0 %	50/75		3				7	50/75	172
6							very close joint				171.5
6.5		Sample 9: TCR = 96 % RQD = 10 %							8		171
7							close joints				170.5
7.5		Sample 10: TCR = 95 % RQD = 0 %					very poor dark grey highly weathered SHALE BEDROCK flat bedding intermittent interbedded limestone seams occasional clay seams		9		170
8											169.5
8.5									10		169
9											168.5
9.5		Sample 11: TCR = 100 % RQD = 0 %									168
alston associates inc. consulting engineers						LOGGED BY: KC		DRILLING DATE: 08-10-23			
						REVIEWED BY: BF		Page 1 of 2			

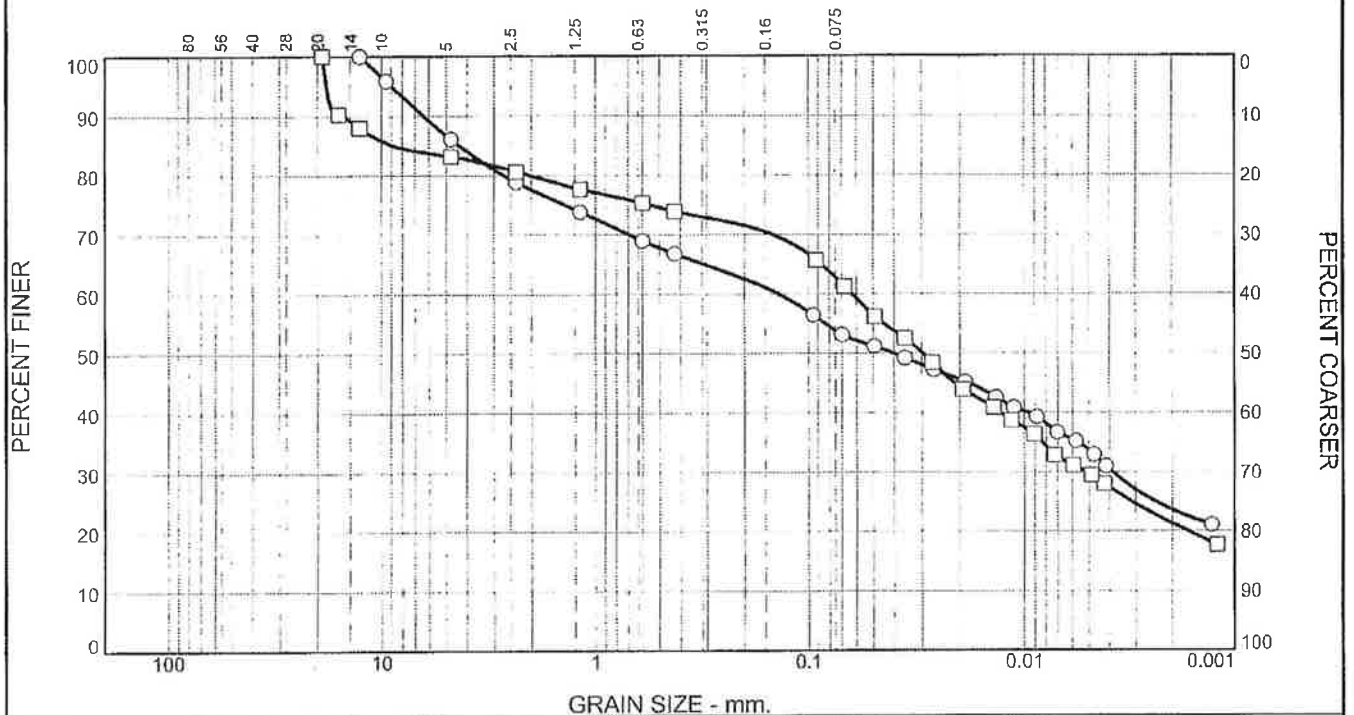
CLIENT: Earth Tech Canada				METHOD: Augering/Split Spoon Sampling/Coring				BH No.: 212C								
PROJECT: Beckett Sproule Watermain				PROJECT ENGINEER: BF		ELEV. (m) 177.391										
LOCATION: Mississauga, ON				NORTHING:		EASTING:		PROJECT NO.: 08-174								
SAMPLE TYPE		<input checked="" type="checkbox"/> AUGER <input checked="" type="checkbox"/> DRIVEN <input checked="" type="checkbox"/> CORING <input type="checkbox"/> DYNAMIC CONE <input type="checkbox"/> SHELBY						SPLIT SPOON								
DEPTH (m)	INSTRUMENTATION DATA	REMARKS	Shear Strength (kPa)		N-Value (Blows/300mm)		PL W.C. LL		SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SPT(N)	ELEVATION (m)		
			40	80	120	160	20	40							60	80
10												11		167.5		
10.5		Sample 12: TCR = 100 % RQD = 0 %												167		
11											very poor	12		166.5		
11.5														166		
12		Sample 13: TCR = 94 % RQD = 0 %												165.5		
12.5												13		165		
13														164.5		
13.5		Sample 14: TCR = 88 % RQD = 27 %												164		
14														163.5		
14.5		Tunnel Invert at Elevation 163.1 m									poor	14		163		
15														162.5		
15.5		Sample 15: TCR = 100 % RQD = 22 %									very poor	15		162		
END OF BOREHOLE																
<div style="display: flex; justify-content: space-between;"> <div>alston associates inc. consulting engineers</div> <div>LOGGED BY: KC REVIEWED BY: BF</div> <div>DRILLING DATE: 08-10-23 Page 2 of 2</div> </div>																



CLIENT: Earth Tech Canada				METHOD: Augering/Split Spoon Sampling/Coring				BH No.: 213C										
PROJECT: Beckett Sproule Watermain				PROJECT ENGINEER: BF		ELEV. (m) 174.265												
LOCATION: Mississauga, ON				NORTHING:		EASTING:		PROJECT NO.: 08-174										
SAMPLE TYPE		<input checked="" type="checkbox"/> AUGER <input checked="" type="checkbox"/> DRIVEN <input checked="" type="checkbox"/> CORING <input type="checkbox"/> DYNAMIC CONE <input type="checkbox"/> SHELBY						SPLIT SPOON										
DEPTH (m)	INSTRUMENTATION DATA	REMARKS	Shear Strength (kPa)				N-Value (Blows/300mm)				PL W.C. LL	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SPT(N)	ELEVATION (m)	
			40	80	120	160	20	40	60	80								20
0																		174
0.5																		173.5
1																		173
1.5																		172.5
2																		172
2.5																		171.5
3																		171
3.5																		170.5
4																		170
4.5																		169.5
5																		169
5.5																		168.5
6																		168
6.5		Sample 2: TCR = 91 % RQD = 24 %														1	50/50	167.5
7																		167
7.5																2		166.5
8		Sample 3: TCR = 100 % RQD = 30 %																166
8.5																		165.5
9																		165
9.5		Sample 4: TCR = 100 % RQD = 34 %																164.5
alston associates inc. consulting engineers												LOGGED BY: KC		DRILLING DATE: 09-01-13				
												REVIEWED BY: BF		Page 1 of 2				

CLIENT: Earth Tech Canada				METHOD: Augering/Split Spoon Sampling/Coring				BH No.: 213C									
PROJECT: Beckett Sproule Watermain				PROJECT ENGINEER: BF		ELEV. (m) 174.265											
LOCATION: Mississauga, ON				NORTHING:		EASTING:		PROJECT NO.: 08-174									
SAMPLE TYPE		<input type="checkbox"/> AUGER <input checked="" type="checkbox"/> DRIVEN <input checked="" type="checkbox"/> CORING <input type="checkbox"/> DYNAMIC CONE <input type="checkbox"/> SHELBY						SPLIT SPOON									
DEPTH (m)	INSTRUMENTATION DATA	REMARKS	Shear Strength (kPa)								SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SPT(N)	ELEVATION (m)	
			40	80	120	160	N-Value (Blows/300mm)										
			20	40	60	80	PL W.C. LL										
10													poor, grey highly weathered SHALE Bedrock close joints flat bedding fractured intermittent interbedded limestone seams occasional clay seams	4			164
10.5		Sample 5: TCR = 100 % RQD = 0 %															
11		Tunnel Invert at Elevation 163.1 m												5			163.5
													END OF BOREHOLE				163
alston associates inc. consulting engineers			LOGGED BY: KC				DRILLING DATE: 09-01-13										
			REVIEWED BY: BF				Page 2 of 2										

# Grain Size Distribution Report



GRAIN SIZE - mm.										
	% +3"	% Gravel		% Sand			% Fines			
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay		
○	0	0	14	8	11	13	30	24		
□	0	0	17	3	6	11	42	21		
×	LL	PL	D <sub>85</sub>	D <sub>60</sub>	D <sub>50</sub>	D <sub>30</sub>	D <sub>15</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>
○			4.3404	0.1382	0.0405	0.0039				
□			8.6816	0.0629	0.0297	0.0052				

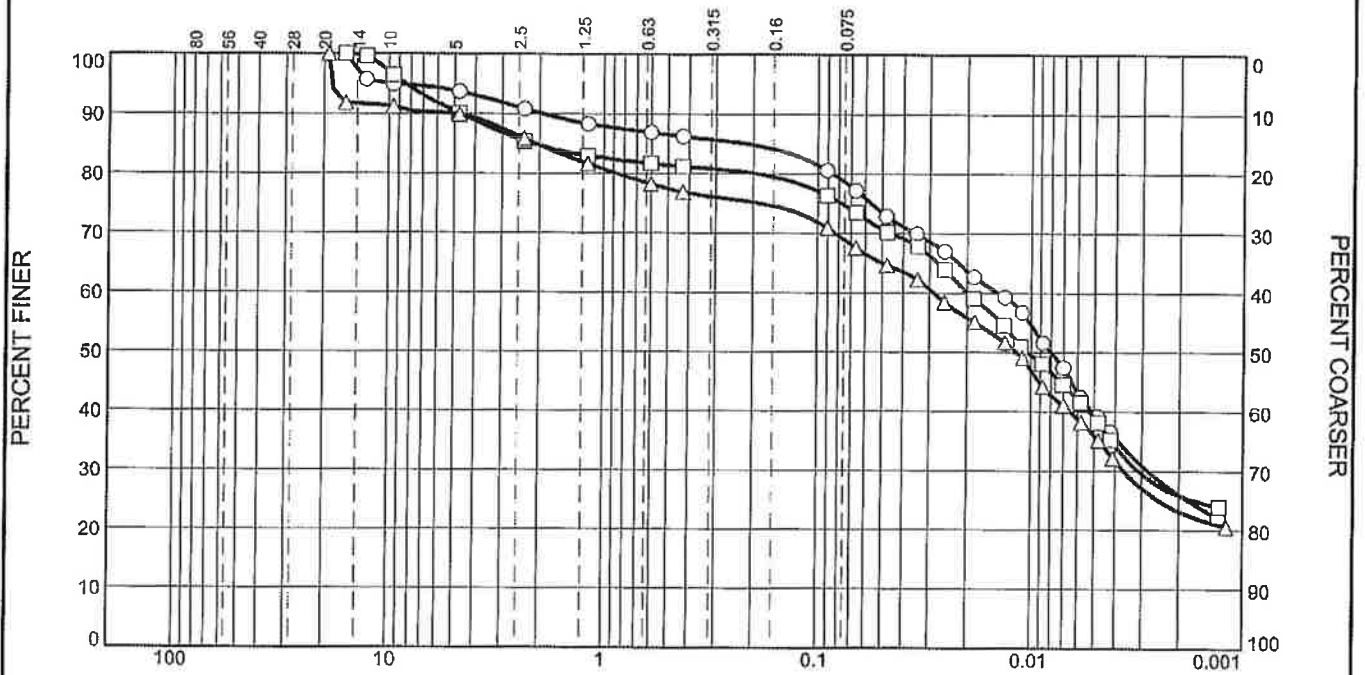
Material Description	USCS	AASHTO
○ SAND and SILTY CLAY, trace gravel		
□ SANDY SILTY CLAY, some gravel		

<b>Project No.</b> 08-174 <b>Client:</b> Earth Tech Canada <b>Project:</b> Beckett Sproule Watermain ○ <b>Sample Number:</b> BH 207C, Sample 2 □ <b>Sample Number:</b> BH 207C, Sample 3	<b>Remarks:</b>          
alston associates inc. consulting engineers	

Figure 1

Tested By: ○ GP    □ NW/AM      Checked By: JB

# Grain Size Distribution Report



GRAIN SIZE - mm.										
	% +3"	% Gravel		% Sand			% Fines			
		Coarse	Fine	Coarse	Medium	Fine	Silt		Clay	
○	0	0	6	4	4	7	53		26	
□	0	0	10	5	4	6	49		26	
△	0	0	10	5	8	8	46		23	
×	LL	PL	D <sub>85</sub>	D <sub>60</sub>	D <sub>50</sub>	D <sub>30</sub>	D <sub>15</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>
○			0.2096	0.0143	0.0080	0.0028				
□			2.1474	0.0199	0.0104	0.0031				
△			2.0716	0.0287	0.0116	0.0036				

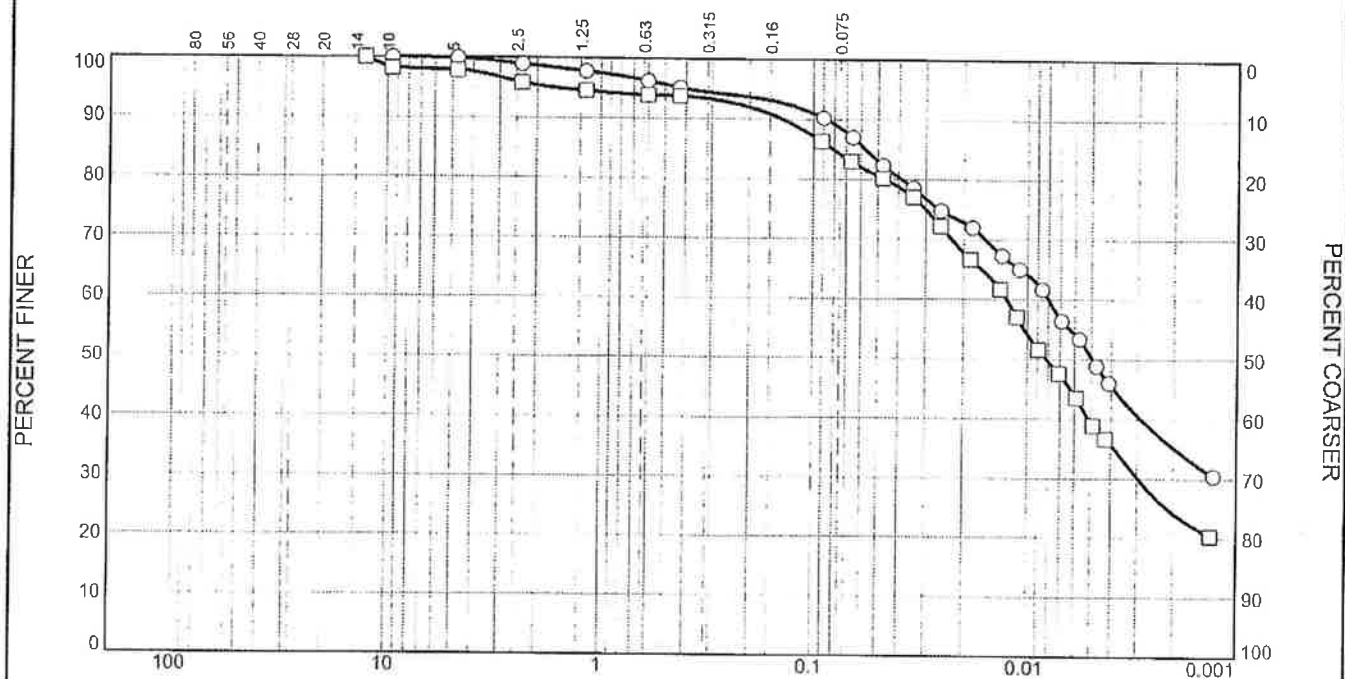
Material Description	USCS	AASHTO
○ SILTY CLAY, some sand, trace gravel		
□ SILTY CLAY, some sand, some gravel		
△ SANDY SILTY CLAY, trace to some gravel		

<b>Project No.</b> 08-174 <b>Client:</b> Earth Tech Canada <b>Project:</b> Beckett Sproule Watermain ○ <b>Sample Number:</b> BH 201, Sample 3 □ <b>Sample Number:</b> BH 208C, Sample 2 △ <b>Sample Number:</b> BH 211C, Sample 4	<b>Remarks:</b>          
alston associates inc. consulting engineers	

Figure 2

Tested By: ○ TS/GP □ TS/GP △ NW/AM Checked By: JB

# Grain Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines		
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay	
<input checked="" type="radio"/>	0	0	0	1	4	6	54	35	
<input type="checkbox"/>	0	0	2	3	1	10	60	24	
<input checked="" type="checkbox"/>	LL	PL	D <sub>85</sub>	D <sub>60</sub>	D <sub>50</sub>	D <sub>30</sub>	D <sub>15</sub>	D <sub>10</sub>	C <sub>c</sub>
<input type="checkbox"/>			0.0569	0.0080	0.0049				
<input type="checkbox"/>			0.0807	0.0126	0.0082	0.0030			

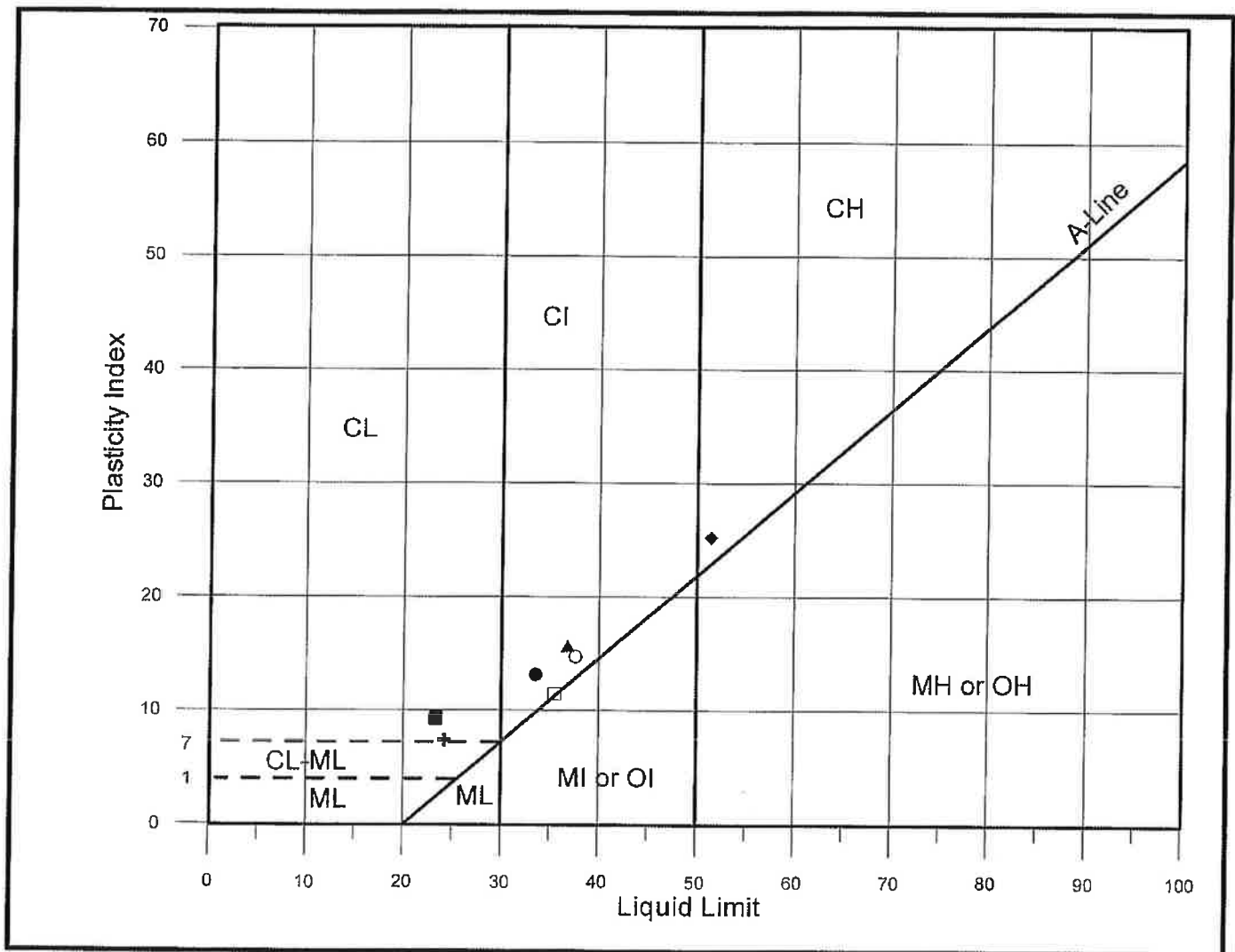
Material Description							USCS	AASHTO
<input checked="" type="radio"/> SILTY CLAY, some sand								
<input type="checkbox"/> SILTY CLAY, some sand, trace gravel								

<b>Project No.</b> 08-174 <b>Client:</b> Earth Tech Canada <b>Project:</b> Beckett Sproule Watermain <input checked="" type="radio"/> <b>Sample Number:</b> BH 212C, Sample 2 <input type="checkbox"/> <b>Sample Number:</b> BH 212C, Sample 5	<b>Remarks:</b>     
<div style="text-align: center;">           alston associates inc.            consulting engineers         </div>	

Figure 3

Tested By: ☒ GP    ☐ TS/GP      Checked By: JB

# PLASTICITY CHART



Client: Earth Tech Canada

Project: Beckett Sproule Watermain, Mississauga, ON

Ref. No.: 08-174

Sample

Symbol

Borehole 201C, Sample 3

●

Borehole 207C, Sample 2

■

Borehole 207C, Sample 3

▲

Borehole 208C, Sample 2

◆

Borehole 211C, Sample 4

+

Borehole 212C, Sample 2

○

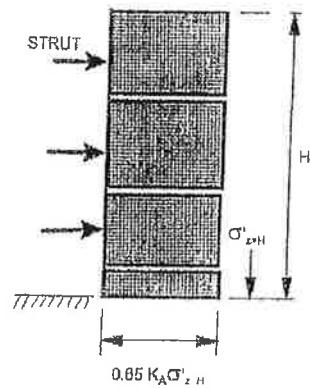
Borehole 212C, Sample 5

□

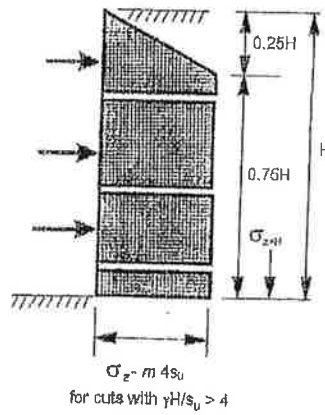
Remarks:

alston associates inc.

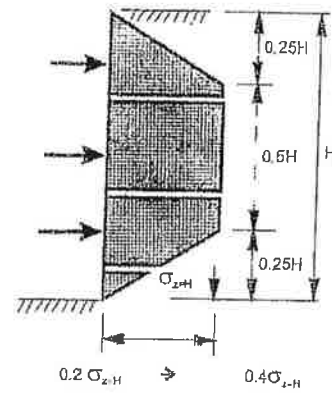
Figure No. 4



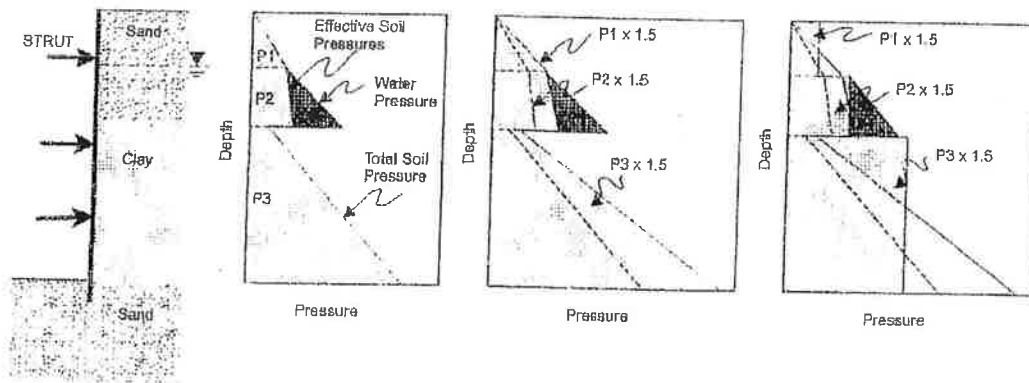
a) granular soils



b) soft to firm cohesive soils (see text for  $m$ )



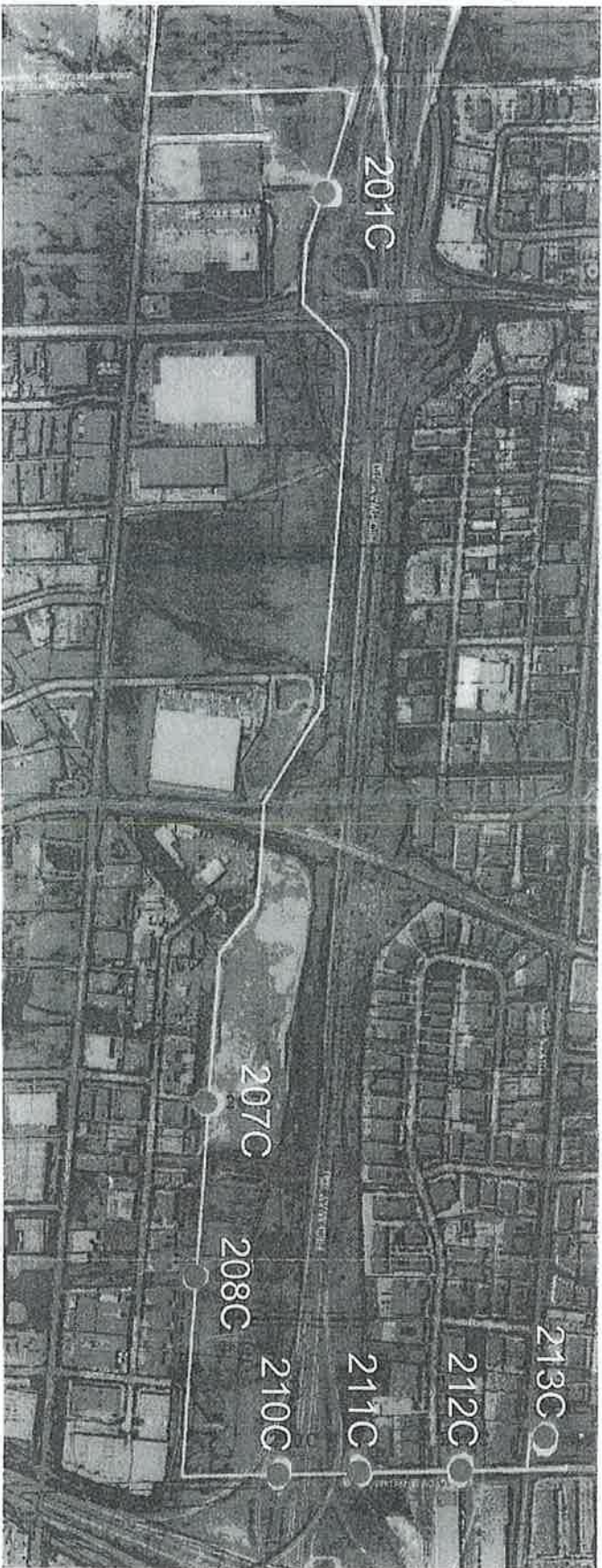
c) stiff to hard cohesive soils



Apparent Earth Pressure Diagram  
Figure 26.8 from the Canadian  
Foundation Engineering Manual (4th Edition)

Figure No. 5  
Ref. No: 08-174  
January 2009





BOREHOLE LOCATION PLAN  
BECKETT SPROULE WATERMAIN  
MISSISSAUGA, ON

Drawing No. 1  
Ref. No. 08-174  
January 2009  
Scale: n.t.s.

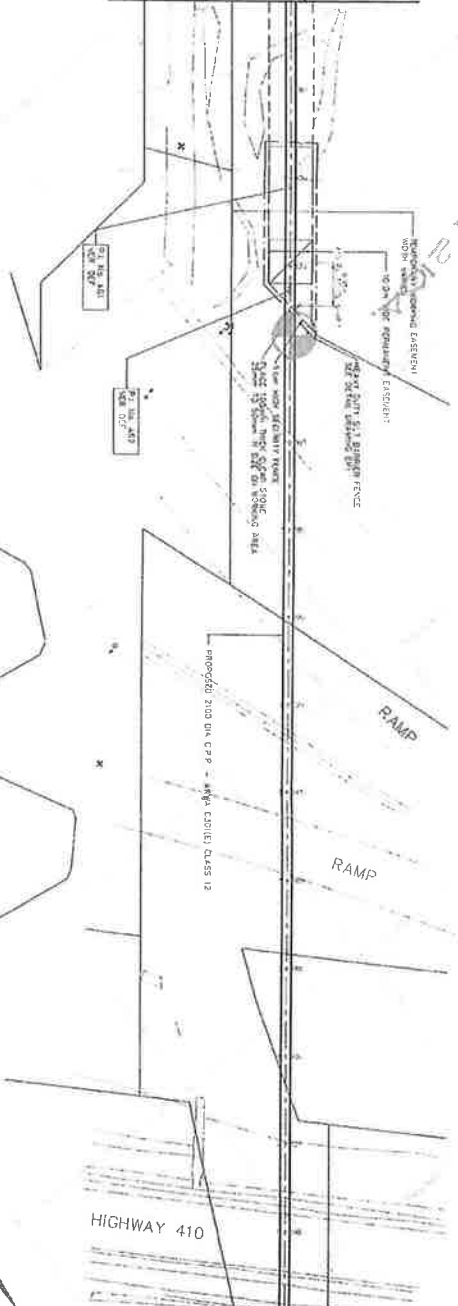


<p><b>Region of Peel</b> Public Works</p> <p>PROPOSED BECKETT SROULE 2100mm FEEDERMAN</p>	<p><b>Region of Peel</b> Public Works</p> <p>PROPOSED BECKETT SROULE 2100mm FEEDERMAN</p>
---	---

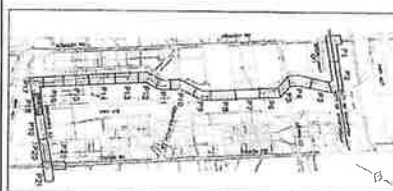




MATCH LINE - STATION 5+760  
REFER TO DRAWING 91627-P17



MATCH LINE - STATION 6+060  
REFER TO DRAWING 91627-P19

[illegible]

LOCATION PLAN(11/15/11)

10) 4-methylpent-1-en-3-yn-1-ol

Agreement with a law aimed at helping Israeli Jews get on better, progress and for the good of the nation on the whole.

**Benchmark:** 2017 is the reference baseline for the first round of the

645 Belvedere Road East (46022)  
 W. Va. 26101  
 1st set directly on the N.W. side of the 2nd corner of the 2nd corner. 1/2 mile from the corner of the 2nd corner. 1/2 mile from the corner of the 2nd corner.

2

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100

100

Particulars	2014	2013
As per cash book	100	100
By bank	100	100
Total	200	200

**NOTICE TO CONTRACTOR**  
AS OWNER'S AGENT TO CONSULTING WORK NOT YET THE FIRM'S OWN,

THE ALLEGED INADEQUACY OF PSLA  
ONE OF SEVERAL REASONS OF THE  
PSLA THROUGH COMPANY  
MANAGEMENT AND REPUTATION

LEONARD'S GAS COMPANY  
WORLD FLETCHER ROAD CTR WILMINGTON  
CAROLINA 28403



 **EarthTech**  
Inc.

WILEY-INTERSCIENCE

## Region of Pa

Public Works

PUBLIC WORKS

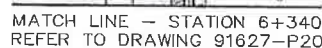
PROPOSED WATERMAIN  
PROPOSED BECKETT SPRING

2100mmØ FEEDERMAIL

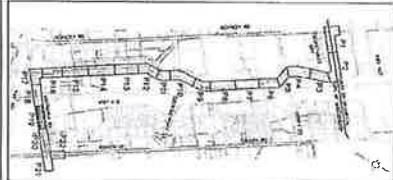
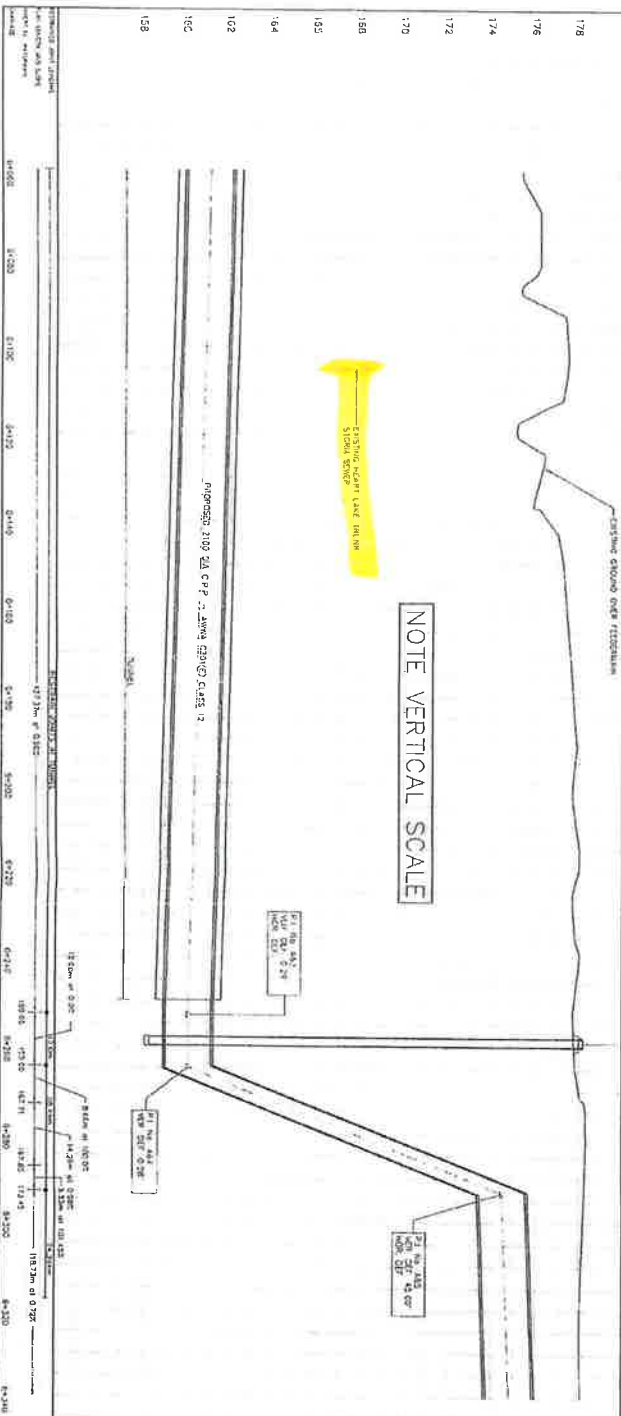
To S10 6+CE0 S10 5+J00

Unit	Area	Project No.
Designed by: <i>W. J.</i>	Drawn by: <i>W. J.</i>	

See notes 2018	Start of	2018
----------------	----------	------



2100 DIA C.P.P. FEEDERMAIN			
P.P. No.	DE-DEPTH S. ALIGN	ELEVATION	NO. OF PIPES
4.4.4	6+756.63	607.935 ±5.6	1833075 ±25
4.4.4	6+766.63	607.940 ±5.6	1833064 ±25
4.4.5	6+775.37	607.953 ±0.4	1833061 ±07



SERVICE DATA		REVENUE		STAFF	
SERVICE	DATE	REVENUE	DATE	STAFF	DATE
1. SERVICE					
2. SERVICE					
3. SERVICE					
4. SERVICE					
5. SERVICE					
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97. SERVICE					
98. SERVICE					
99. SERVICE					
100. SERVICE					

LOCATION PLAN (S)

[illegible][illegible][illegible]

 **EarthTech**  
A Division of The U.S. Green Building Council

 **Region of Peel**  
Public Works

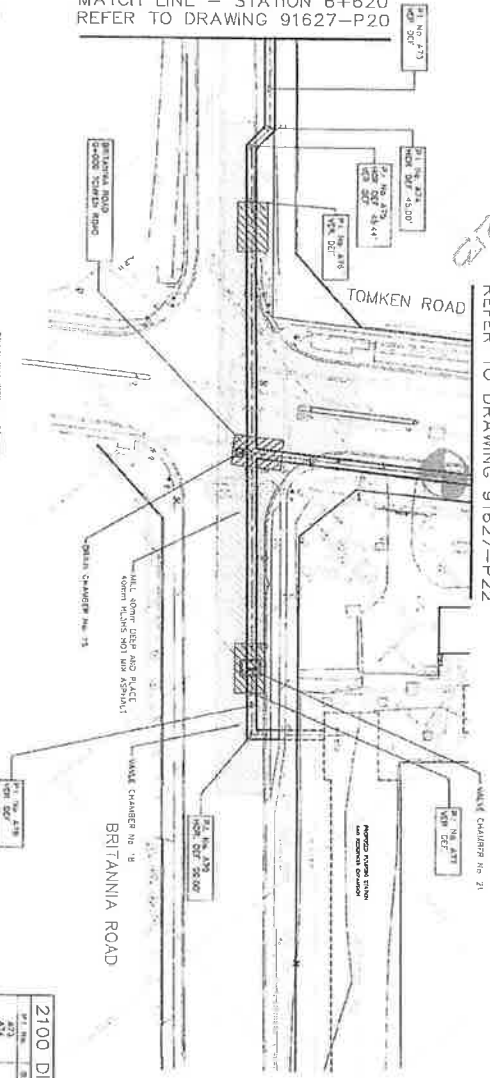
PROPOSED WATERMAIN	PROPOSED BECKETT SPROULE 2100mmØ FEEDERMMAIN	Site 61000	To Site 61345
DATE: 10/10/2018	Drawn By: M. GILL	Checked By: M. GILL	Project No: 2113



2100 DIA

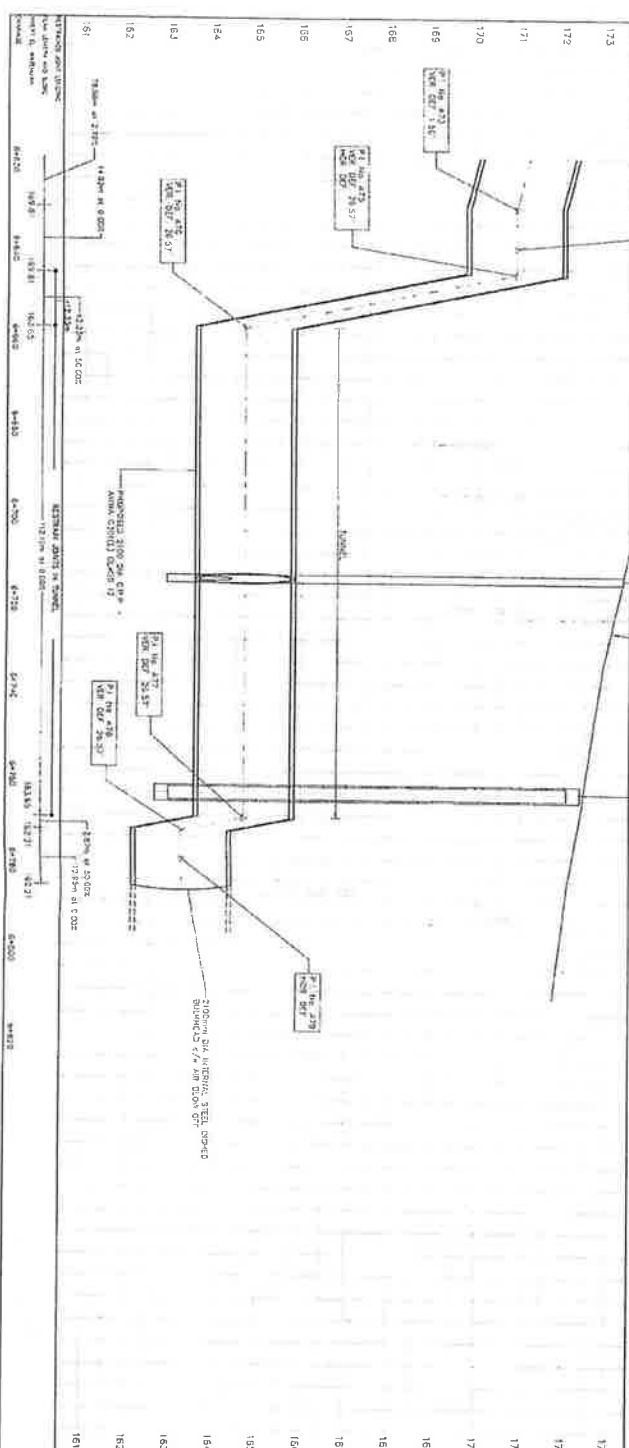
REFER TO DRAWING 91627-P22

MATCH LINE - STATION 6+620  
REFER TO DRAWING 91627-P20



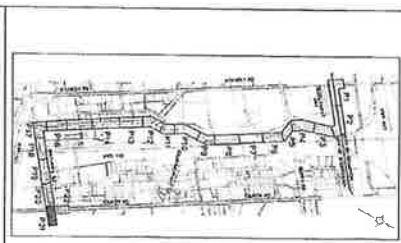
**2100 DIA C.P.P. FEEDERMAIN**

STATION	INVERT	OUTLET	MANHOLE	VALVE	CHAMBER
6+420	64.42	64.42	64.42	64.42	64.42
6+440	64.44	64.44	64.44	64.44	64.44
6+460	64.46	64.46	64.46	64.46	64.46
6+480	64.48	64.48	64.48	64.48	64.48
6+500	64.50	64.50	64.50	64.50	64.50
6+520	64.52	64.52	64.52	64.52	64.52
6+540	64.54	64.54	64.54	64.54	64.54
6+560	64.56	64.56	64.56	64.56	64.56
6+580	64.58	64.58	64.58	64.58	64.58
6+600	64.60	64.60	64.60	64.60	64.60
6+620	64.62	64.62	64.62	64.62	64.62



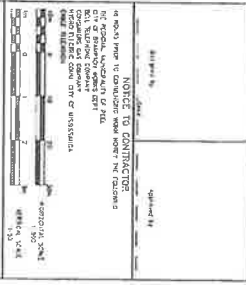
**SPRINKLER DATA**

SPRINKLER	DATE	BY	REVISION
1	10/10/10	10/10/10	10/10/10
2	10/10/10	10/10/10	10/10/10
3	10/10/10	10/10/10	10/10/10
4	10/10/10	10/10/10	10/10/10
5	10/10/10	10/10/10	10/10/10
6	10/10/10	10/10/10	10/10/10
7	10/10/10	10/10/10	10/10/10
8	10/10/10	10/10/10	10/10/10
9	10/10/10	10/10/10	10/10/10
10	10/10/10	10/10/10	10/10/10



**NOTES**

1. The proposed watermain is to be installed in the right-of-way of the City of Peel.
2. The proposed watermain is to be installed in the right-of-way of the City of Peel.
3. The proposed watermain is to be installed in the right-of-way of the City of Peel.
4. The proposed watermain is to be installed in the right-of-way of the City of Peel.
5. The proposed watermain is to be installed in the right-of-way of the City of Peel.
6. The proposed watermain is to be installed in the right-of-way of the City of Peel.
7. The proposed watermain is to be installed in the right-of-way of the City of Peel.
8. The proposed watermain is to be installed in the right-of-way of the City of Peel.
9. The proposed watermain is to be installed in the right-of-way of the City of Peel.
10. The proposed watermain is to be installed in the right-of-way of the City of Peel.



**EarthTech**  
A Division of Peel Region

**Region of Peel**  
Public Works

**PROPOSED WATERMAIN**  
2100mm Ø FEEDERMAIN

**PROPOSED BECKETT SPRULE**  
2100mm Ø FEEDERMAIN

**STATIONING**  
SIC 6+420 TO 6+620

**DATE**  
10/10/10

**BY**  
10/10/10

**REVISION**  
10/10/10