Appendix H
Hydrogeological Report

THURBER ENGINEERING LTD.

April 19, 2023 File No.: 19-1605-196

HATCH
2800 Speakman Drive
Mississauga, Ontario
L5K 2R7

Attention: Melissa Alexander, B.Sc., MCIP, RPP

FINAL THURBER ENGINEERING REPORTS
WINSTON CHURCHILL BOULEVARD CLASS EA STUDY
HIGHWAY 401 TO EMBLETON ROAD
REGION OF PEEL

Dear Ms. Alexander,

This letter accompanies the final reports submitted by Thurber Engineering Ltd. (Thurber) for the Winston Churchill Boulevard Class EA Study project from Highway 401 to Embleton Road.

As requested by HATCH, Thurber has finalized the following 4 reports, which were last issued in draft form in 2016:

- Contaminated Soil Assessment Report, Winston Churchill Boulevard Class EA Study, Highway 401 to Embleton Road, Region of Peel, Ontario" Report Submitted to Hatch Mott MacDonald, dated March 14, 2016. File No. 19-1605-196.
- Geotechnical Investigation Report, Winston Churchill Boulevard Class EA Study, Highway 401 to Embleton Road, Region of Peel" Report Submitted to Hatch Mott MacDonald, dated May 11, 2016. File No. 19-1605-196.
- Hydrogeology Investigation, Winston Churchill Boulevard, Highway 401 to Embleton Road, City of Brampton, Ontario" Report Submitted to Hatch Mott MacDonald, dated July 25, 2016. File No. 19-1605-196.
- Foundation Investigation and Design Report, Winston Churchill Boulevard Class EA Study, Highway 407 Bridge Widening, Region of Peel" Report Submitted to HATCH, dated August 10, 2016. File No. 19-1605-196.

It is a condition of each report that Thurber's performance of its professional services is subject to the attached Statement of Limitations and Conditions.

The final reports are based on the site and subsurface conditions encountered at the time of Thurber's original investigations in 2015 and 2016 and do not reflect any changes in site conditions that may have occurred since this time. The recommendations provided must be reviewed with respect to any changes in site conditions and updates to relevant specifications, standards, regulations, codes or guidelines that have occurred since 2016.

Furthermore, Thurber's reports were produced prior to completion of the preferred design concept for the Winston Churchill Boulevard corridor and were based on existing site information and preliminary design information that was available at the time of preparation of each report. Accordingly, the factual information and foundation and hydrogeological recommendations (including Permit to Take Water requirements) must be reviewed for their

completeness and applicability for the 100% design of the relevant works. Additional investigations may therefore be required to support the 100% design. Some dewatering works may require registration on the Environmental Activity and Sector Registry (EASR).

Thank you and please contact us if you should have any questions.

Yours truly,
Thurber Engineering Ltd.

P.K. Chatterji, P.Eng.
Review Principal

Mark Farrant, P.Eng.
Associate, Senior Geotechnical Engineer

Attachment
- Statement of Limitations and Conditions

THURBER ENGINEERING LTD.

HYDROGEOLOGY INVESTIGATION
WINSTON CHURCHILL BOULEVARD
HIGHWAY 401 TO EMBLETON ROAD
CITY OF BRAMPTON, ONTARIO

Report

to

Hatch Mott MacDonald

Mark Farrant, P.Eng.
Geotechnical Engineer

Steve Sather, P.Eng.
Geotechnical Engineer

Date: July 25, 2016
File: 19-1605-196

P.K. Chatterji, P.Eng.
Review Principal

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APPENDICES

1. INTRODUCTION

This report presents a hydrogeologic study for the portion of Winston Churchill Boulevard between Highway 401 and Embleton Road, located on the border of the City of Brampton and the Town of Halton Hills. The work was undertaken by Thurber Engineering Ltd. (Thurber) for Hatch Mott MacDonald as part of a Schedule 'C' Class Environmental Assessment (EA) for the Regional Municipality of Peel. The purpose of the study is to assess the groundwater conditions and potential water well or aquifer impacts related to future construction for long-term improvement of Winston Churchill Boulevard.

This study was carried out in general accordance with Thurber's proposal letter No. 114-3841, to Hatch Mott MacDonald (The Client). In addition to this investigation, a Geotechnical Investigation, Pavement Investigation, and a Contaminated Soil Assessment were conducted; the results of which are presented in separate Thurber reports.

It is a condition of this report that Thurber's performance of its professional services is subject to the attached Statement of Limitations and Conditions.

2. PROJECT COMPONENTS

Winston Churchill Boulevard (Regional Road 19) is a major north-south arterial road that borders the City of Brampton (Region of Peel) and the Town of Halton Hills (Halton Region). It is understood that the Region of Peel is considering corridor improvements (with potential widening) along Winston Churchill Boulevard, from Highway 401 to Embleton Road. To implement the Region of Peel's Long Range Transportation Plan (LRTP) recommendations; the roadway within the project limits is to be widened to a six lane facility in the year 2021 for the section south of Steeles Avenue, while the section north of Steeles Avenue is to be widened to six lanes in 2031. The ultimate design includes a 45 m wide Right-of-Way (ROW). Part of the widening works will require extensions of existing culverts, as well as new sewers or modifications to existing sewers. The project will also require widening of the bridge crossing Highway 407. Foundation recommendations for the Highway 407 bridge are presented in a separate Foundation Investigation and Design Report by Thurber.

It is understood that Winston Churchill Boulevard was last widened in 2013, which included pavement widening from Steeles Avenue to just north of the entrance to a Maple Lodge Farm's facility, located approximately 900 m north of Steeles Avenue.

Project stationing for this assignment follows the 2010 construction drawings for the 2013 reconstruction provided by HMM, which extended from Steeles Avenue (Station 1+000) to

Embleton Road (Station 4+000). As a point of reference, Station 1+000 was located at the intersection with Steeles Avenue. It should be noted that base plan and alignment drawing received from HMM in February 2016, following the field investigation, shows the project stationing to be offset by 292 m from the 2010 construction drawings. The 2010 stationing is used throughout this report, on the borehole location plan, and for identification of borehole and culvert locations.

3. CHARACTERISATION OF THE HYDROGEOLOGIC SETTING

3.1 Quaternary and Bedrock Geology

The site is located in the physiographic region known as the Peel Plain, which is characterized by beveled till plains (OGS Map P.2226, 1984). The Quaternary geologic mapping for the site (OGS Map M.2223, 2005) indicates that the soil conditions mainly consist of red to brown glacial tills ranging in composition from gritty to clayey silt till (Halton Till). Glaciolacustrine silt and clay deposits are shown near the northern limit of the project and organic deposits are shown near existing streams. The bedrock in the area comprises Upper-Ordovician red shale of the Queenston Formation (Map 2337, 1976). Based on drift thickness mapping for the area (Map 2179, 1969), the depth to the bedrock ranges from approximately 4 to 15 m below the ground surface. Recently, agriculture and road construction activities in the area have likely resulted in placement of anthropogenic (fill) deposits in some areas.

3.2 Surface Conditions

The topography within the study area is relatively flat, with a ground surface elevation of approximately 205 m to 210 m above sea level (over a 4.0 km distance), except for higher areas at the bridges over Highway 401 and Highway 407. Based on visual observations of the site and a review of the City of Brampton and Town of Halton Hills Zoning Maps, the land use is primarily agricultural, except for industrial portions between Highway 407 and Steeles Avenue, and on the east side of Winston Churchill Boulevard at the MLF facility. A small commercial area is also located at the northeast corner of Winston Churchill Boulevard and Steeles Avenue.

The study area is located within the Credit Valley Watershed (Meadowvale and Levi Creek Subwatersheds), managed by the Credit Valley Conservation Authority. No conservation areas are located within the study area, however the Meadowvale Conservation Area is located approximately 2 km east of the project area.

Three 2nd order streams are located within the study area: Mullet Creek crossing at approximate Sta. 1+432, Levi Creek South at approximate Sta. 2+604 and Levi Creek North at approximate

Sta. 3+533. Concrete box culverts facilitate the flow of these larger watercourses across Winston Churchill Boulevard. Minor watercourses are also present along the project corridor. Concrete pipe culverts facilitate the flow of these minor watercourses across Winston Churchill Boulevard. Surface water drainage generally flows eastwards from a drainage divide located about 1.5 km west of Winston Churchill Boulevard.

3.3 Subsurface Conditions

The subsurface conditions at the project area were investigated by Thurber in a geotechnical investigation. Previous geotechnical investigations were also conducted by Golder Associates Ltd. (Golder) in March and December 2009. The detailed results of these subsurface investigations are summarized in the reports referenced below:

- "Geotechnical Investigation Report, Winston Churchill Boulevard Class EA Study, Highway 401 to Embleton Road, Region of Peel" Report Submitted to Hatch Mott MacDonald, dated May 11, 2016. File No. 19-1605-196.
- "Supplementary Geotechnical Investigation, Proposed Watermain Installation, Winston Churchill Boulevard, Steeles Avenue to Embleton Road, Region of Peel, Ontario" Report Submitted to McCormick Rankin Corporation, dated December 2009. Report Number. 08-1111-0038 (7000).
- "Geotechnical Investigation, Winston Churchill Boulevard, Reconstruction and Widening from Steeles Avenue to Embleton Road, Region of Peel, Ontario" Report Submitted to McCormick Rankin Corporation, dated March 2009. Report Number. 08-1111-0038.

The Thurber investigation generally comprised shallow pavement boreholes with the exception of select boreholes at the Highway 407 overpass structure. The Golder reports generally comprised deeper boreholes along the project corridor and at select culvert structures. A plan drawing showing the location of the boreholes from the aforementioned investigations is included in Appendix A.

The generalized description provided below is for summary purposes only. Detailed subsurface conditions are reported in the borehole logs in the reports listed above and should be referenced in preference to these generalized descriptions. A copy of the borehole logs from the Thurber and Golder investigations have been attached in Appendix B and C, respectively.

The subgrade soils along the alignment typically consist of earthfill, silty clay to clayey silt till, with some zones of silt and sand till, and occasional sand and gravel fill layers. A granular deposit was encountered underlying the till in Boreholes 407-2 and 407-4. Shale bedrock was encountered

underlying the overburden in Boreholes 407-2, 407-3 and 407-4. The subgrade soils outside of existing pavement areas are generally overlain by topsoil, or rip rap at the existing culvert locations. Since the Golder information was obtained prior to the 2013 reconstruction work, the subsurface conditions are likely to have changed.

3.4 Groundwater Level Readings

Groundwater depth data was collected from the piezometers, monitoring wells and open boreholes installed during the various geotechnical investigations, and are summarized in Table 3.1 below. The water level depth readings are measured below the ground surface at the location of each borehole.

Table 3.1 – Measured Groundwater Levels

Borehole No.	Water Level Depth/Elev. (m)	Date of Reading	Type of Reading[2]
08-06	Dry 0.1 / 204.6	November 24, 2008 December 16, 2008	Open Borehole Piezometer
08-12	4.8 / 201.2	November 25, 2008	Open Borehole
08-13	0.3 / 204.5 0.5 / 204.3	November 24, 2008 December 16, 2008	Open Borehole Piezometer
08-14	2.9 / 204.6	November 24, 2008	Open Borehole
08-16	Dry 2.0 / 206.1	November 24, 2008 December 16, 2008	Open Borehole Piezometer
08-17	3.0 / 205.4[1]	November 25, 2008	Open Borehole
09-04	7.2 / 198.9	October 20, 2009	Open Borehole
09-05	7.8 / 198.2	October 20, 2009	Open Borehole
09-09	2.1 / 206.2	October 21, 2009	Open Borehole
407-02	11.7 / 205.3 11.8 / 205.2	June 15, 2016 June 22, 2016	Monitoring Well Monitoring Well
407-03	2.1 / 206.7	April 25, 2016	Open Borehole
407-04	17.5 / 199.9	May 20, 2016	Open Borehole
407-05	8.2 / 208.9 9.4 / 207.7	June 15, 2016 June 22, 2016	Monitoring Well Monitoring Well

Note: [1]Seepage noted in the open borehole at the specified depth/elevation.
[2]Groundwater level readings in open boreholes are un-stabilized readings and do not represent the actual groundwater level at the borehole location.

The groundwater readings observed in the monitoring wells and piezometers generally varied from 1.8 m to 3.3 m below the road surface except near 407 where the road is constructed on an

embankment and is at higher elevation than the surrounding area. The groundwater level is likely to be near ground surface near the larger stream crossings as indicated by BH08-06. Groundwater flow direction is expected to be easterly, similar to the surface water flow direction.

The recorded groundwater levels are considered short-term readings and seasonal fluctuations of the groundwater levels are to be expected, particularly after spring snowmelt as well as periods of prolonged and/or significant precipitation.

3.5 Hydraulic Conductivity

To assess hydraulic conductivity, rising head tests were carried out on two monitoring wells (Boreholes 407-2 and 407-5) with inside diameters of 51 mm. The rising head tests were conducted on Wednesday June 22, 2016. Hydraulic conductivity values were determined based on the method developed by Hvorslev in the NAVFAC Soil Mechanics Design Manual 7.01. Plots of the rising head test results are provided in Appendix D. Hydraulic conductivity values were also derived for the granular fill and lower gravelly sand deposits according to Hazen's equation based on a particle size analyses of samples in those layers.

A summary of hydraulic conductivity values based on results from the rising head tests and particle size analyses are shown below in Table 3.2.1 and 3.2.2.

Table 3.2.1 – Hydraulic Conductivity Summary - Hvorslev

Borehole ID	Screen information*					Type of Analysis	Hydraulic Conductivity (m/s)
	Upper Depth (m)	Lower Depth (m)	Upper Elev. (m)	Lower Elev. (m)	Material		
407-2	22.3	25.9	194.7	191.1	Gravelly Sand	Rising Head Test	$2.3x10^{-4}$
407-5	7.3	10.7	209.8	206.4	Sandy Silty Clay Till	Rising Head Test	$5.5x10^{-8}$

* Referencing sand filter as recorded in borehole logs

Table 3.2.2 – Hydraulic Conductivity Summary - Hazen

Borehole ID	Sample ID & Depth	Material	Type of Analysis	Hydraulic Conductivity (m/s)
407-2	SS18, 23.2 m (Elev. 193.8 m)	Gravelly Sand	Hazen	$1.2x10^{-4}$
407-3	SS1, 0.3 m (Elev. 208.5 m)	Sand and Gravel Fill	Hazen	$1.6x10^{-5}$

3.6 Groundwater Quality

For assessment of the general groundwater quality in the project area, groundwater samples were collected from the monitoring well at Borehole 407-2. The groundwater samples were collected on June 15, 2016 and were analyzed for selected parameters included in the Ontario Provincial Water Quality Objectives (PWQO). The groundwater samples were submitted unfiltered to AGAT Laboratories in Mississauga, Ontario for testing. Additional samples were submitted to AGAT Laboratories for filtered testing of selected metals parameters. The analytical test results are presented in Appendix E.

The analytical results of the groundwater testing were compared to limits for the PWQO for surface water discharge. The concentrations of all parameters tested met the criteria established in the PWQO except for the following parameters listed below in Table 3.3.

Table 3.3 – Groundwater Parameters Exceeding Criteria

Sample ID	Parameter	Criteria	Parameter Limit (mg/L)	Result (mg/L)
407-02 (Unfiltered Sample)	Total Suspended Solids	PWQO	-	9590
	Boron	PWQO	0.20	0.426
	Cadmium	PWQO	0.0002	0.0009
	Cobalt	PWQO	0.0009	0.013
	Copper	PWQO	0.005	0.029
	Iron	PWQO	0.3	24.5
	Lead	PWQO	0.005	0.019
	Total Phosphorus	PWQO	0.03	8.76
	Vanadium	PWQO	0.006	0.027
	Zinc	PWQO	0.02	0.072
407-2 (Filtered Sample)	Boron	PWQO	0.20	0.365

The unfiltered monitoring well water sample contained a high amount of suspended solids (9590 mg/L). The concentrations of nutrients (phosphorus) and metals such as Boron, Cadmium, Cobalt, Copper, Iron, Lead, Vanadium and Zinc are commonly associated with the presence of suspended solids. Of the filtered metal parameters tested, only the concentration of dissolved Boron (0.365 mg/L) exceeded the PWQO criteria of 0.2 mg/L. Proper treatment of all water including use of a settling tank and selective filtering is expected to reduce the total suspended solids and most metal exceedances to levels acceptable for discharge. The dissolved boron is a naturally occurring element found in low concentrations in the shale and till locally. It is expected

that most dewatering activities associated with construction of the proposed widening will be well above the shale where lower levels of boron are expected. Alternate disposal requirements or treatment to remove boron may be required in the event elevated boron levels are encountered.

4. STUDY METHODOLOGY

4.1 Method of Analysis

The purpose of this hydrogeologic assessment is to assess the excavation dewatering rates and potential impacts with respect to the Ministry of the Environment and Climate Change (MOECC) permit to take water requirements. This includes providing estimates of dewatering extraction rates, estimated zone of influence and potential for dewatering activities to impact other structures, surface water or groundwater receptors.

Where the expected dewatering rates exceed 50,000 L/day, a Permit to Take Water (PTTW) from the MOECC is required as per the Ontario Water Resources Act, Section 34 and Ontario Regulation 387/04 (Water Taking). Alternatively, the water taking may be eligible for registration on the Environmental Activity and Sector Registry for expected dewatering rates less than 400,000 L/day subject to meeting specific requirements given in the regulations.

The assessment of potential impacts related to the drawdown of the water-table is based on the calculated dewatering rates. The analysis assumes steady-state conditions that would typically take several days to weeks for the maximum extent of drawdown to fully develop. Transient analysis was carried out to assess the potential for high short term pumping rates.

4.2 Excavation Methodology

4.3 Culvert Extensions

Based on the As-Built drawings prepared by McCormick Rankin Corporation in 2010, eleven (11) existing concrete culverts may require extension. The location, type, dimensions, invert elevations, reference boreholes, anticipated footing elevation and soil conditions at each culvert is presented in Table 4.1 below.

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Table 4.1 – Summary of Culvert Dimensions and Subsurface Conditions

Culvert Location	Type and Dimensions	Reference Boreholes	Anticipated Footing Elev. (m)	Soil Conditions	Depth Below Water Table (m)
Sta. 1+145	600 mm dia. concrete pipe, 35 m long	08-03	204.5*	Pavement structure to very stiff silty clay till	Dry[1,3]
Sta. 1+432 (Mullet Creek)	10.4 x 2.4 m concrete open box	08-05, 08-06, 09-01, 09-02	202.4	Topsoil/Fill to hard silty clay till to very dense silt and sand to hard clayey silt to very dense silty sand to silt and sand.	2.2[2]
Sta. 2+300	500 mm dia. concrete pipe, 32 m long	08-11, 09-03	206.3*	Pavement structure to very stiff to hard silty clay to clayey silt till	Dry[1,3]
Sta. 2+415	600 mm dia. concrete pipe, 24.2 m long	09-03	205.0*	Pavement structure to stiff to hard silty clay to clayey silt till	Dry[3]
Sta. 2+604 (Levi Creek South)	5.5 x 2.4 m concrete open box	08-12, 08-13, 09-04, 09-05	203.7	Pavement structure to firm organic silty clay to hard clayey silt with sand to silty clay till (300 mm very dense sand and gravel seam)	0.6[2]
Sta. 2+864	600 mm dia. concrete pipe, 20 m long	09-06	204.8*	Pavement structure to stiff to hard silty clay till	Dry[1,3]
Sta. 3+013	600 mm dia. concrete pipe, 20.2 m long	08-14, 08-15	204.6*	Pavement structure to very stiff silty clay topsoil to very stiff to hard silty clay till	0.0[3]
Sta. 3+227	600 mm dia. concrete pipe, 20 m long	09-07 (log missing), 08-14	204.0*	Pavement structure to stiff to hard silty clay till	0.6[1,3]
Sta. 3+414	600 mm dia. concrete pipe, 23.2 m long	09-8 (log missing), 08-16	205.6*	Fill to stiff organic silty clay to very stiff to hard silty clay to clayey silt till	0.5[2]
Sta. 3+533 (Levi Creek North)	11 x 2.4 m concrete open box	08-16, 08-17, 09-09	205.5	Fill to stiff organic silty clay to stiff to hard silty clay to clayey silt till	0.6[2]
Sta. 3+745	1200 mm dia. concrete pipe, 23.7 m long	09-10	204.5*	Pavement structure to stiff to hard silt clay till	Dry[1,3]

* Headwall

Notes: [1]No boreholes at culvert location; water level based on closest boreholes.

[2]Waterlevel in piezometer (stabilized)

[3]Water level in open borehole (un-stabilized)

A number of separate excavations will be required to accommodate the culvert extensions. The excavations will typically be located at streambeds and will be excavated down to a competent substrate in order to obtain sufficient geotechnical resistance. Excavations are expected to extend a maximum of 2.2 m below the groundwater-table, depending on conditions at the time of construction. For estimation of dewatering rates, an additional allowance of 0.8 m has been added to the groundwater elevations to accommodate seasonal variations.

4.4 Sewers

New storm sewers may be included along Winston Churchill Boulevard as part of the road widening. It is assumed that any excavations related to the rehabilitation or construction of the sewers will be at the same depth as the existing storm sewers and the excavation will be completed in successive segments. For the purposes of this report, it is expected that the trench excavations will be conducted in segments of approximately 100 m long per day that will extend a maximum of 1 m below the groundwater table. It is noted that the proposed sewer dimensions, locations and depths were not available at the time of this report. If the actual construction dimensions differ from the assumptions above, the analysis should be recompleted.

4.5 Highway 407 Bridge Widening

To accommodate the proposed traffic lanes, the existing Winston Churchill Boulevard bridge over Highway 407 will need to be widened. It is noted that the location and type of foundation for the proposed structure was not available at the time of this report. For the purposes of this report, it is assumed that the structure will be widened on the east side only. It is further assumed that excavations on each side of the 401 will be carried out simultaneously. If the actual construction dimensions differ from the assumptions above, the analysis should be reviewed and updated as needed.

4.6 Excavation Dimensions

It is understood that the proposed widening will be on the east side of the right-of-way, and the excavation geometry has been set based on this condition. The estimated dimensions of the culvert, sewer and bridge excavations used for analysis are summarized in Table 4.2 below.

Table 4.2 - Estimated Excavation Dimensions

Excavation Location	Type	Excavation Extent (Approximate)
Winston Churchill Blvd.	Concrete Pipe Culvert Replacements or Extensions (600 mm dia.) (7)	2 m wide x 25 m long x 1.5 to 3 m deep*
Winston Churchill Blvd.	Concrete Pipe Culvert Replacements or Extensions (1200 mm dia.) (1)	2.5 m wide x 25 m long x 1.5 m deep*
Mullet Creek / Levi Creek South / Levi Creek North	Concrete Box Culverts Replacement or Extension (3)	8 to 14 m wide x 25 m long x 3 m deep*
Winston Churchill Blvd.	Sewer (100 m lengths)	1.5 m wide x 100 m long x 1.8 m deep*
Winston Churchill Blvd.	Winston Churchill Bridge over Highway 407	3 excavations x 6 m wide x 25 m long x 3 m deep*

*Depths are maximum likely excavation depth below water-table.

4.7 Precipitation and Infiltration

An allowance for precipitation falling on the surface of the excavation area should also be included in the dewatering quantity requirements. For the Environment Canada weather station at Toronto Pearson International Airport, which is located approximately 16 km east of the Project site, a daily precipitation intensity of 96 mm for a 10 year return period can be used. The Intensity-Duration-Frequency (IDF) curve for Toronto Pearson International Airport is included in Appendix F. This rainfall intensity should be applied over the plan area of the excavation and combined with the groundwater extraction rate to derive the maximum daily discharge rate for short term construction dewatering. Based on anticipated maximum excavation areas of 1500 m^2 for all open excavations, flow rates of 145,000 L/day respectively would be appropriate for removal of precipitation from all excavations. This amount may be prorated if only a portion of the excavations are open at any given time. This estimate assumes that adjacent surface water and stream flow have been diverted away from the excavations.

An allowance for recharge from precipitation infiltration over the zone of influence was included in predicting the dewatering groundwater flow rates. Historical data from the Toronto Pearson International Airport weather station records a maximum monthly mean precipitation rate of

approximately 80 mm. A groundwater infiltration rate of 15% of the maximum monthly mean precipitation rate was applied.

4.8 Hydrogeologic Analysis

Hydrogeologic analysis was carried out to calculate the seepage discharge rate and area of influence for the proposed excavation geometries. The analysis considered seepage though free-draining temporary support systems or sloped excavations.

For linear culverts and sewer trench segments, groundwater flow was modeled based on steady-state conditions using a closed form solution for one-dimensional (Dupuit) flow between two line sources in an unconfined aquifer receiving uniform vertical recharge. For excavations that are rectangular, the Dupuit solution for flow to a well of equivalent radius was used. A sensitivity analysis was also carried out, based on Thiem solution for a confined aquifer, assuming an excavation encountered a hypothetical 300 mm sand layer within the till. Each of the analyses assumes a uniform, homogeneous distribution of hydraulic conductivity.

Steady state conditions are expected to take several weeks to occur and accordingly allowance should be made for transient conditions resulting in higher flow that may be encountered during the initial dewatering operations. The higher transient rates provided assume that the excavations will take a minimum of one or two days to reach full depth and allow for variation in subsurface conditions. Based on the natural variability of subsurface conditions, it is expected that the equivalent hydraulic conductivity could vary significantly.

The results of the dewatering analysis are summarized in Table 4.3 below. The dewatering rates provided are the anticipated maximum daily flow for concrete box culvert extensions, foundation excavations and for an assumed 100 m length of sewer installation.

Table 4.3 – Estimated Flow Rates For Dewatering

Structure Installation	Flow Rate: Steady State (L/day)	Flow Rate: Transient (peak) (L/day)	Flow Rate: Precipitation (1:10 yr event) (L/day)	Radius of Influence (m)
Highway 407 Foundations	1,500	3,000	15,000	20
Concrete Box Culvert Extensions	1,800	3,600	90,000	25
Concrete Pipe Culvert Extensions	2,400	5,300	36,000	18
Sewer Segment (100 m long)	900	1,800	15,000	12

Based on the above values, the estimated daily dewatering permit requirements would be:

- Typical volume per day 6,600 L/day
- Peak volume per day 13,700 L/day
- Allowance for potential sand layer 35,000 L/day

5. IMPACT ASSESSMENT

5.1 Geotechnical Impacts

Dewatering of shallow open excavations is expected to result in a maximum drawdown of the water-table within the overburden deposits by about 3 m near the edges of the excavations. The drawdown of the water-table will decrease to zero at the estimated radius of influence. Considering the relatively stiff silty clay till deposit in the project area has very low compressibility of the native deposits, the potential for impacts related to groundwater related subsidence is considered to be very low.

5.2 Surface Water Impacts

The excavations for culvert replacements will typically be carried out adjacent to the stream channels which will eventually flow through each culvert.

The culvert excavations have some potential to temporarily decrease the hydraulic gradient beneath the channel if open for extended periods. However, considering the very low hydraulic conductivity and the slow rate of drainage within the silty clay till, there is not expected to be a discernible decrease in the surface water flow rates.

5.3 Existing Groundwater Users

5.3.1 *MOE Well Records*

Thurber conducted a search of Ministry of Environment (MOE) well records within a 500 m radius of the Winston Churchill Boulevard corridor between 5 Side Road and Highway 401, which indicated that there are a total of 75 water wells.

A plot of the regional hydrogeologic conditions showing the MOE well record locations within 500 m of the site is included in Figure 2 in Appendix A. A listing of MOE well records within 500 m of the site is included in Table G1 of Appendix G. The precise location of the water wells based on provincial well records is typically uncertain, but the distribution of wells near the Winston Churchill Boulevard corridor is generally consistent with the location of the existing residential development in the area. The well record data indicates that the average depth of the domestic water wells in the region is approximately 16.5 m, indicating an aquifer depth that is generally within the underlying bedrock.

5.3.2 *Water Well Survey*

A survey of residents within 500 m of the Project area was conducted in an effort to confirm the presence or absence of these water wells, and to assess how many wells are within the radius of influence of the proposed works. Existing well location data was also available from a water well monitoring program conducted by Thurber in 2002 and 2003. The monitoring program was conducted for Winston Churchill Boulevard Reconstruction project, and included the monitoring of water wells at 5 properties on Winston Churchill Boulevard between Steeles Avenue and Embleton Road. The information from both the current survey and 2002/2003 monitoring program are presented below.

A list of the properties contacted in the current well survey is included in Table G2 in Appendix G, which is summarized as follows:

- The well survey consisted of mailing or hand-delivering letters to property owners for 65 properties within 500 m of the Project area to request information about their well systems on a voluntary basis. A questionnaire was provided to each property owner with the letter. Follow-up telephone calls/emails were made to the property owners where their contact information could be obtained.
- Responses were received for 8 properties. The remaining 60 declined to participate in the survey or no contact could be made with the property owners.

- A total of 4 existing water wells were confirmed within the survey area at the properties that participated in the survey.
- The remaining 4 property owners responded to the survey and stated that they were on a municipal water distribution system and did not have/use a well on their property. All four properties were located on the east side of Winston Churchill Boulevard (Peel Region).
- A total of 5 existing septic systems were confirmed within the survey area.

The results of the current well survey can be found in Table G3 of Appendix G.

At the time of the 2002/2003 well monitoring program, the location of 5 domestic wells on Winston Churchill Boulevard were confirmed and were in use. A list of the 5 properties monitored in the in the 2002 and 2003 monitoring program is included in Table G2 in Appendix G. The results of the program were as follows:

- 4 of the 5 wells were dug with a 0.9 m diameter casing. The depths of the dug wells are unknown. The remaining well was a 9.8 m deep drilled well with a 0.2 m diameter casing.
- Where recorded on September 18, 2003, the water levels ranged from 3.3 to 8.8 m below the ground surface.
- All wells were for domestic use with 3 used for drinking and 2 used for non-drinking purposes.
- Two of the wells have gone dry in the past.
- The water was identified as “hard”.

5.3.3 *Private Well Impacts*

Figure 2 shows the local hydrogeologic conditions with inferred zone of influence for the sewer and culvert foundation excavations, and the private wells that are closest to the Project site. Based on the anticipated extent of drawdown, there is a potential for dewatering activities to temporarily impact the private wells located along the project corridor.

During construction, a well monitoring program should be implemented to assess the potential impact of dewatering activities on these wells identified during the survey. Provisions for an alternate water supply should also be available for the property owners, should any significant loss of well water occur.

5.4 Other Potential Impacts

With continuing dewatering activities there can be potential for inorganic or organic chemical compounds present within the radius of influence to migrate into open excavations where flow rate and sufficient time permit. A Contaminated Soil Assessment (CSA) Report was prepared by Thurber for this project and is referenced below:

- "Contaminated Soil Assessment Report, Winston Churchill Boulevard Class EA Study Highway 401 to Embleton Road, Region of Peel, Ontario" Report Submitted to Hatch Mott MacDonald, dated March 14, 2016. File No. 19-1605-196.

Considering the temporary duration of dewatering activities and the low conductivity of the till in this area there is a low likelihood that contaminants would be mobilized during dewatering activities. However, the CSA report identified 18 low to high Areas of Potential Environmental Concern (APEC). The locations of the APECs are presented in Appendix H. If these areas fall within the radius of influence of dewatered excavations, then a groundwater quality testing program should be implemented to monitor the quality of groundwater near the excavations. Contaminated groundwater collected from the dewatering operations should be disposed of at a facility licensed to handle such materials.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Permit to Take Water or EASR Registration

Based on the anticipated dewatering rates provided in Section 4.4, the dewatering rates are not expected to be greater than 50,000 L/day and would not require a permit to take water (PTTW) for this task. Diversion of surface water or removal of precipitation from excavation may exceed 50,000 L/day and permit requirements should also be assessed for these tasks.

6.2 Discharge of Groundwater

Based on conditions typically encountered for open excavations in till, it is expected that groundwater would require treatment prior to direct discharge into surface water. Treatment to remove suspended sediment and adjustment of temperature would likely be minimum requirements. Further assessment and review of disposal or treatment options would be required if dewatered excavations are to be made in the vicinity of the areas of potential environmental concern as discussed in Section 5.4. Where feasible, it is recommended that groundwater should be discharged at least 30 m away from any surface water bodies.

The assessment contained herein has been provided for review of permit requirements only. Design of temporary dewatering systems and treatment facilities should be carried out by a dewatering specialist retained by the contractor.

6.3 Control of Impacts

The following measures are recommended to mitigate the potential for the dewatering activities to impact the elements described above:

- Monitoring of water quality for groundwater collected within the excavation dewatering system to confirm the water quality is appropriate for the selected discharge option.
- Groundwater shall be discharged at least 30 m away from any streams.
- If discharge to sewers or near surface water bodies is proposed, treatment of groundwater to meet acceptable levels is required. Suitable treatment would likely include measures to address suspended sediment and adjust temperature to acceptable levels. The operation and monitoring of discharge facilities should be carried out by a qualified specialist familiar with fisheries and water quality requirements.
- Where discharge is to ground surface, temporary erosion control measures should be installed to control erosion at the discharge points.
- For private wells identified within or adjacent to the inferred radius zone of influence, provision should be made for alternate water supply, and a well monitoring program is recommended to assess the potential impacts.

6.4 Well Monitoring Program

The well monitoring program for the private wells identified along Winston Churchill Boulevard in this report should consist of measuring the groundwater level and testing the groundwater quality at each well. The quantity and quality measurements should be collected at least 1 week prior to construction, during the period of construction dewatering, and at approximately 1 month following the completion of construction. The during-construction and post-construction measurements and test results should be compared with the pre-construction results to assess the extent of potential impact, if any. Provision for additional quantity and quality tests should be allowed for if problems arise with the wells during construction.

7. CLOSURE

We trust the above provides the information you require at this time. If you have any questions regarding this report, please do not hesitate to contact us.

THURBER

STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

5. INTERPRETATION OF THE REPORT

a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.

d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

Appendix A

Figures

THE KING'S HIGHWAY 401

WINSTON CHURCHILL BOULEVARD

HIGHWAY NO. 407

BOUNDARY MEADOWPINE BOULEVARD

0+000

0+100

0+200

0+300

0+400

Concrete Bridge

Concrete Island

Bridge Joint

Expansion Joint

500mm CSP

900mm CSP

600mm CSP

300mm HDPE

407-01

407-02

407-03

LEGEND

- APPROX. BOREHOLE LOCATION (CURRENT INVESTIGATION)
- APPROX. BOREHOLE LOCATION (PREVIOUS INVESTIGATIONS)
- APPROX. TESTPIT LOCATION (CURRENT INVESTIGATION)
- 1+000 CENTRELINE STATIONING BASED ON REGION OF PEEL'S 2010 AS-BUILT CONSTRUCTION DRAWINGS

20 0 20 40m

SCALE 1:1000

HATCH MOTT MACDONALD

EA FOR WINSTON CHURCHILL BOULEVARD WIDENING

BOREHOLE LOCATION PLAN

JOB# 19-1605-196

THURBER ENGINEERING LTD.

ENGINEER :	DRAWN :	APPROVED :
RI	MFA/AN	MRA
DATE :	SCALE :	DRAWING No.
JULY 2016	1:1000	19-1605-196-1

FILENAME: R:\ARCHIVES\Drafting\19\1605\196\ted5196-BoreholePlans2.dwg
PLOTDATE: Apr 19, 2023 - 4:22 PM

WINSTON CHURCHILL BOULEVARD

STEELES AVENUE

407-04 407-05 08-1 08-2 08-3 08-4 T1 T2 T3 T4 T5 T6

0+500 0+600 0+700 0+800 0+900 1+000 1+100 1+200 1+300

LEGEND

- APPROX. BOREHOLE LOCATION (CURRENT INVESTIGATION)
- APPROX. BOREHOLE LOCATION (PREVIOUS INVESTIGATIONS)
- APPROX. TESTPIT LOCATION (CURRENT INVESTIGATION)
- 1+000 CENTRELINE STATIONING BASED ON REGION OF PEEL'S 2010 AS-BUILT CONSTRUCTION DRAWINGS

20 0 20 40m

SCALE 1:1000

HATCH MOTT MACDONALD

EA FOR WINSTON CHURCHILL BOULEVARD WIDENING

BOREHOLE LOCATION PLAN

JOB# 19-1605-196

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WINSTON CHURCHILL BOULEVARD

WINSTON CHURCHILL BOULEVARD

LEGEND

- APPROX. BOREHOLE LOCATION (CURRENT INVESTIGATION)
- APPROX. BOREHOLE LOCATION (PREVIOUS INVESTIGATIONS)
- APPROX. TESTPIT LOCATION (CURRENT INVESTIGATION)
- 1+000 CENTRELINE STATIONING BASED ON REGION OF PEEL'S 2010 AS-BUILT CONSTRUCTION DRAWINGS

20 0 20 40m

SCALE 1:1000

HATCH MOTT MACDONALD

EA FOR WINSTON CHURCHILL BOULEVARD WIDENING

BOREHOLE LOCATION PLAN

JOB# 19-1605-196

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WINSTON CHURCHILL BOULEVARD

WINSTON CHURCHILL BOULEVARD

LEGEND

- APPROX. BOREHOLE LOCATION (CURRENT INVESTIGATION)
- APPROX. BOREHOLE LOCATION (PREVIOUS INVESTIGATIONS)
- APPROX. TESTPIT LOCATION (CURRENT INVESTIGATION)
- 1+000 CENTRELINE STATIONING BASED ON REGION OF PEEL'S 2010 AS-BUILT CONSTRUCTION DRAWINGS

20 0 20 40m

SCALE 1:1000

HATCH MOTT MACDONALD

EA FOR WINSTON CHURCHILL BOULEVARD WIDENING

BOREHOLE LOCATION PLAN

JOB# 19-1605-196

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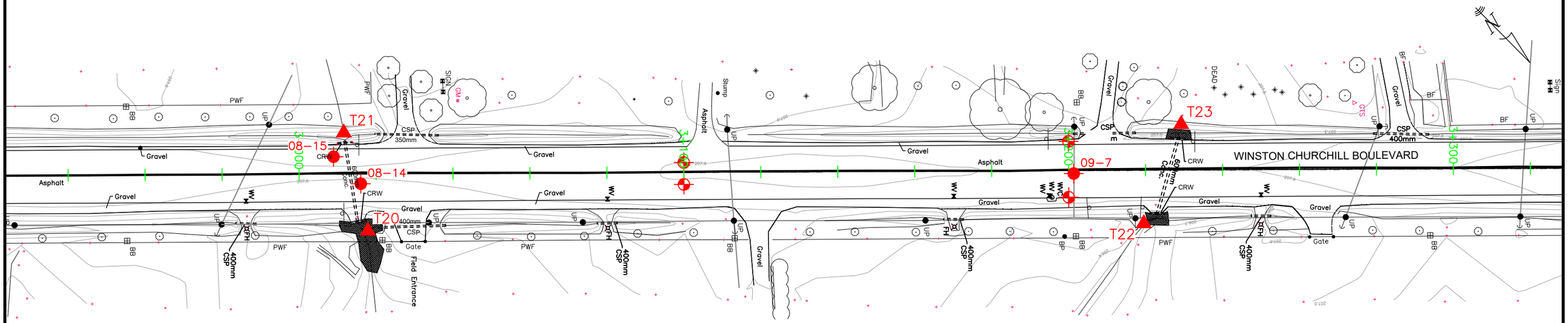

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- APPROX. BOREHOLE LOCATION (PREVIOUS INVESTIGATIONS)
- APPROX. TESTPIT LOCATION (CURRENT INVESTIGATION)
- 1+000 CENTRELINE STATIONING BASED ON REGION OF PEEL'S 2010 AS–BUILT CONSTRUCTION DRAWINGS

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SCALE 1:1000

HATCH MOTT MACDONALD

EA FOR WINSTON CHURCHILL BOULEVARD WIDENING

BOREHOLE LOCATION PLAN

JOB# 19-1605-196

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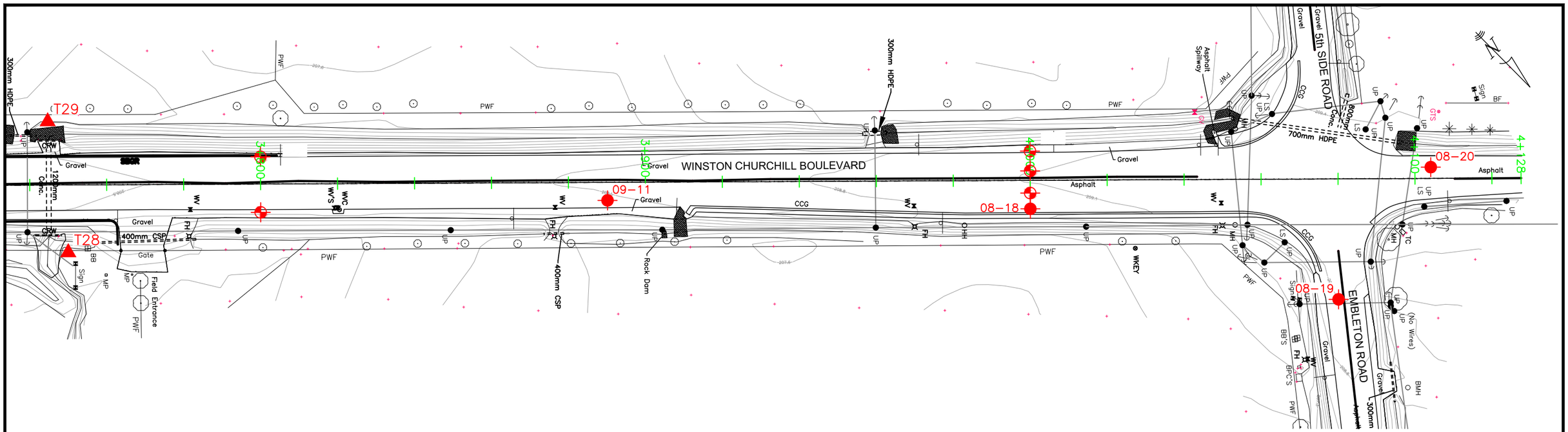

LEGEND

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- APPROX. BOREHOLE LOCATION (PREVIOUS INVESTIGATIONS)
- APPROX. TESTPIT LOCATION (CURRENT INVESTIGATION)
- 1+000 CENTRELINE STATIONING BASED ON REGION OF PEEL'S 2010 AS–BUILT CONSTRUCTION DRAWINGS

20 0 20 40m

SCALE 1:1000

HATCH MOTT MACDONALD

EA FOR WINSTON CHURCHILL BOULEVARD WIDENING

BOREHOLE LOCATION PLAN

JOB# 19-1605-196

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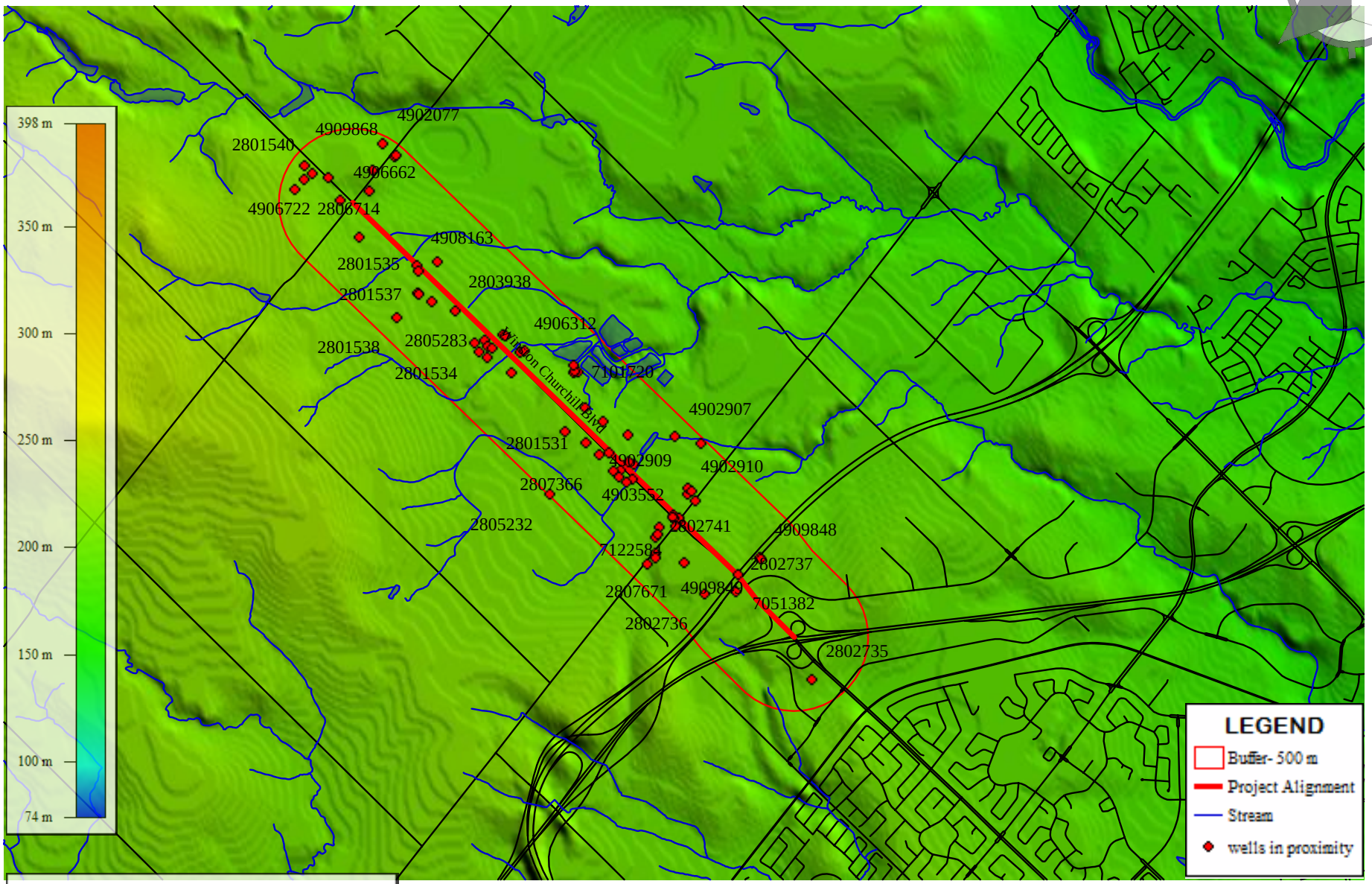


FIGURE 2
WINSTON CHURCHILL BLVD
Regional Hydrogeologic Conditions
MOE Well Records

Appendix B

Record of Borehole Sheets (Thurber Investigation)

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT[(1)] 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

1) Laboratory Triaxial Testing
2) Field Insitu Vane Testing
3) Laboratory Vane Testing
4) SPT value
5) Pocket Penetrometer

4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	SPT "N" VALUE
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Greater than 50

5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample
	TW Thin Wall Shelby Tube Sample		TP Thin Wall Piston Sample
	PH Sampler Advanced by Hydraulic Pressure		PM Sampler Advanced by Manual Pressure
	WH Sampler Advanced by Self Static Weight	RC Rock Core	SC Soil Core

$$\text{Sensitivity} = \frac{\text{Undisturbed Shear Strength}}{\text{Remoulded Shear Strength}}$$

▼ Water Level

C_{pen} Shear Strength Determination by Pocket Penetrometer

(1) SPT 'N' Value Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.

(2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

EXPLANATION OF ROCK LOGGING TERMS

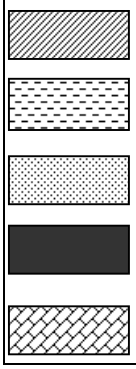
ROCK WEATHERING CLASSIFICATION

Fresh (FR)	No visible signs of weathering.
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.

DISCONTINUITY SPACING

Bedding	**Bedding Plane Spacing**
Very thickly bedded	Greater than 2m
Thickly bedded	0.6 to 2m
Medium bedded	0.2 to 0.6m
Thinly bedded	60mm to 0.2m
Very thinly bedded	20 to 60mm
Laminated	6 to 20mm
Thinly Laminated	Less than 6mm

SYMBOLS



CLAYSTONE

SILTSTONE

SANDSTONE

COAL

BEDROCK

STRENGTH CLASSIFICATION

Rock Strength	**Approximate Uniaxial Compressive Strength (MPa)**	**(psi)**	**Field Estimation of Hardness***
Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail

TERMS

Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length
Solid Core Recovery:(SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run
Rock Quality Designation:(RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a % of total core run length.
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen
Fracture Index:(FI)	Frequency of natural fractures per 0.3m of core run.

UNIFIED SOILS CLASSIFICATION

MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILTS AND CLAYS $W_L < 50\%$	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. ($W_L < 30\%$).
		CI	Inorganic clays of medium plasticity, silty clays. ($30\% < W_L < 50\%$).
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			

Appendix C
Winston Churchill Boulevard Class EA Study
Highway 401 to Embleton Road

Borehole Logs

January 14, 2016

Station 00+300 NB RTL

0- 200	Asph	
End of BH Due to Overhead Utility Conflict		

Station 00+300 NB Lane 2

0- 170	Asph	
End of BH Due to Overhead Utility Conflict		

Station 00+300 SB OSH

0- 220	Asph	
220- 920	Gry Sa(y) Gr Tr Si	Moist
920- 1.5	Br Sa(y) Si W Cl	Moist

Station 00+800 NB Lane 1

0- 200	Asph	
200- 780	Gry Sa(y) Gr Tr Si	Moist
780- 1.5	Br Si W Sa W Cl	Moist

Station 00+800 NB RTL

0- 100	Asph	
100- 870	Br Sa(y) Gr Tr Si	Dry
		w @ 0.6m = 4%
870- 1.5	Br Si W Sa W Cl	Dry
1.5- 2.1	Br Si W Sa W Cl (Stiff)	Dry
	Nvalue=9 blows / 300mm	
		w @ 1.8m = 20%

Station 00+800 SB Lane 2

0- 170	Asph	
170- 540	Gry Sa(y) Gr Tr Si	Dry
540- 1.0	Blk Gr(y) Sa Tr Si (Rap)	Moist
		w @ 0.8m = 5%
1.0 1.5	Br Sa(y) Si W Cl	Moist

Station 01+100 NB Lane 2

0- 190	Asph	
190- 1.1	Br Sa(y) Gr Tr Si	Dry
		w @ 0.5m = 3%
		Percent Passing 4.75 mm = 33%
		75 µm = 2%
		Slightly Coarser Than Granular A
1.1- 1.5	Br Si W Sa W Cl	Moist
1.5- 2.1	Br Si W Sa W Cl (V Stiff)	Moist
	Nvalue=20 blows / 300mm	
		w @ 1.8m = 13%
		Percent Passing 4.75 mm = 96%
		75 µm = 72%
		5 µm = 27%
		Frost Susceptibility = MFSH
		Soil Erodibility = 0.28

Station 01+100 SB RTL

0- 200	Asph	
200- 890	Br Sa(y) Gr Tr Si	Dry
		w @ 0.5m = 4%
890- 1.5	Br Sa(y) Si W Cl	Moist
1.5- 2.1	Br Sa(y) Si W Cl (Stiff)	Moist
	Nvalue=14 blows / 300mm	
		w @ 1.8m = 15%

Station 01+200 NB Lane 1

0- 200	Asph	
200- 900	Gry Sa(y) Gr Tr Si	Dry
		w @ 0.4m = 3%
900- 1.5	Br Si W Sa W Cl	Moist
1.5- 2.1	Br Si W Sa W Cl(V Stiff)	Moist
	Nvalue=20 blows / 300mm	
		w @ 1.8m = 13%

Station 01+200 SB Lane 2

0- 200	Asph	
200- 900	Gry Sa(y) Gr Tr Si	Dry
900- 1.5	Br Sa(y) Si W Cl	Moist

Station 01+400 NB Lane 2

0- 200	Asph	
200- 900	Gry Sa(y) Gr Tr Si	Dry
900- 1.5	Br Si W Sa W Cl	Moist

Station 01+400 SB Lane 2

0- 200	Asph	
200- 1.1	Gry Sa(y) Gr Tr Si	Dry
1.1- 1.5	Br Sa(y) Si W Cl	Moist

Station 01+600 NB Lane 2

0- 200	Asph	
200- 930	Gry Sa(y) Gr Tr Si	Dry
930- 1.5	Br Si W Sa W Cl	Moist

Station 01+600 SB Lane 1

0- 200	Asph	
200- 960	Gry Sa(y) Gr Tr Si	Dry
		w @ 0.6m = 3%
960- 1.5	Br Sa(y) Si Tr Cl	Moist
1.5- 2.1	Br Sa(y) Si Tr Cl (Compact)	Moist
	Nvalue=24 blows / 300mm	
		w @ 1.8m = 11%
		Percent Passing 4.75 mm = 94%
		75 µm = 53%
		5 µm = 9%
		Frost Susceptibility = MFSH
		Soil Erodibility = 0.31

Appendix C
Winston Churchill Boulevard Class EA Study
Highway 401 to Embleton Road
Borehole Logs

January 14, 2016

Station 01+700 NB Lane 2

0- 200	Asph	
200- 930	Gry Sa(y) Gr Tr Si	Dry
930- 1.5	Br Sa(y) Si W Cl	Moist

Station 01+700 SB Lane 2

0- 190	Asph	
190- 920	Gry Sa(y) Gr Tr Si	Dry
920- 1.5	Br Sa(y) Si W Cl	Moist

Station 02+000 NB RTL

0- 220	Asph	
220- 860	Gry Sa Some Gr Some Si	Dry
		w @ 0.5m = 2%
		Percent Passing 4.75 mm = 87%
		75 µm = 15%
		Slightly Finer Than Granular B Type I
860- 1.5	Br Sa(y) Si W Cl	Dry
1.5- 2.1	Br Sa(y) Si W Cl (V Stiff)	Moist
	Nvalue=20 blows / 300mm	
		w @ 1.8m = 11%

Station 02+000 SB Lane 2

0- 200	Asph	
200- 960	Gry Sa(y) Gr Tr Si	Moist
		w @ 0.6m = 2%
960- 1.5	Br Sa(y) Si Tr Cl	Moist
1.5- 2.1	Br Sa(y) Si Tr Cl (Compact)	Moist
	Nvalue=25 blows / 300mm	
		w @ 1.8m = 11%

Station 02+100 NB Lane 1

0- 200	Asph	
200- 400	Br Sa(y) Gr Tr Si	Moist
400- 1.2	Gry Sa Some Gr Some Si	Moist
1.2- 1.5	Br Si W Sa W Cl Tr Gr	Moist
1.5- 2.1	Br Si W Sa W Cl (Stiff)	Moist
	Nvalue=11 blows / 300mm	
		w @ 1.8m = 11%

Station 02+100 SB Lane 1

0- 200	Asph	
200- 700	Gry Sa(y) Gr Tr Si	Dry
700- 1.0	Br Sa Some Gr Some Si	Dry
1.0- 1.5	Br Sa(y) Si W Cl	Moist
		w @ 1.5m = 21%

Station 02+300 NB Lane 2

0- 210	Asph	
210- 1.4	Gry Sa(y) Gr Tr Si	Moist
		w @ 1.0m = 3%
1.4- 1.5	Br Si W Sa W Cl Tr Gr	Moist

Station 02+300 SB Lane 1

0- 210	Asph	
210- 920	Gry Sa(y) Gr Tr Si	Dry
920- 1.5	Br Sa(y) Si W Cl	Moist

Station 02+600 NB OSH

0- 400	Br Gr W Sa Some Si	Moist
400- 1.5	Gry Sa Some Gr Some Si	Moist
1.5- 2.1	Br Si W Sa W Cl	Moist

Station 02+600 NB Lane 1

0- 190	Asph	
190- 390	Br Sa(y) Gr Tr Si	Dry
390- 1.4	Gry Sa Some Gr Some Si	Dry
		w @ 1.0m = 2%
1.4- 1.5	Br Gr(y) Sa Tr Si	Moist
1.5- 2.1	Br Gr(y) Sa Tr Si (Dense)	Moist
	Nvalue=42 blows / 300mm	
		w @ 1.8m = 6%

Station 02+600 SB Lane 1

0- 170	Asph	
170- 600	Gry Sa(y) Gr Tr Si	Dry
600- 1.8	Br Sa Some Gr Some Si	Dry
		w @ 1.0m = 3%
1.8- 2.1	Br Sa(y) Si W Cl (Farm)	Moist
	Nvalue=8 blows / 300mm	
		w @ 1.8m = 12%

Station 02+600 SB OSH

0- 190	Asph	
190- 600	Gry Sa(y) Gr Tr Si	Dry
600- 1.5	Br Sa Some Gr Some Si	Dry

Station 02+900 NB OSH

0- 450	Br Gr W Sa Some Si	Moist
450- 900	Gry Sa Some Gr Some Si	Moist
900- 1.5	Br Sa(y) Si W Cl	Moist

Station 02+900 SB OSH

0- 200	Asph	
200- 930	Gry Sa(y) Gr Tr Si	Dry
930- 1.5	Br Sa(y) Si W Cl	Moist
1.5- 2.1	Br Sa(y) Si W Cl (V Stiff)	Moist
	Nvalue=20 blows / 300mm	
		w @ 1.8m = 12%

Station 03+100 NB Lane 1

0- 200	Asph	
200- 430	Br Sa(y) Gr Tr Si	Moist
		w @ 0.4m = 2%
430- 900	Gry Sa Some Gr Some Si	Moist
		w @ 0.7m = 3%

900- 1.5	Br Sa(y) Si W Cl Tr Gr	Moist
1.5- 2.1	Br Sa(y) Si W Cl (V Stiff)	Moist
	Nvalue=19 blows / 300mm	
		w @ 1.8m = 17%

Station 03+100 SB Lane 1

0- 200	Asph	
200- 900	Gry Sa(y) Gr Tr Si	Dry
900- 1.5	Br Sa(y) Si W Cl	Moist

Station 03+200 NB OSH

0- 400	Br Gr W Sa Some Si	Moist
400- 900	Gry Sa Some Gr Some Si	Moist
900- 1.5	Br Sa(y) Si W Cl	Moist

Station 03+200 SB OSH

0- 170	Asph	
170- 900	Br Sa(y) Gr Tr Si	Dry
900- 1.5	Br Sa(y) Si W Cl	Moist

Station 03+500 NB OSH

0- 300	Gry Gr W Sa Some Si	Moist
		w @ 0.3m = 5%
		Percent Passing 4.75 mm = 40%
		75 µm =12%
		Slightly Finer Than Granular B Type I
300- 900	Br Sa Some Gr Some Si	Moist
		w @ 0.6m = 3%
900- 1.5	Br Sa(y) Si W Cl	Moist

Station 03+500 SB OSH

0- 180	Asph	
180- 1.0	Gry Sa Some Gr Some Si	Dry
		w @ 0.6m = 3%
		Percent Passing 4.75 mm = 87%
		75 µm = 20%
		Slightly Finer Than Granular B Type I
1.0- 1.5	Br Sa(y) Si W Cl	Moist
1.5- 2.1	Br Sa(y) Si W Cl (Stiff)	Moist
	Nvalue=9 blows / 300mm	
		w @ 1.8m = 15%
		Percent Passing 4.75 mm = 99%
		75 µm = 64%
		5 µm = 22%
		Frost Susceptibility = MFSH
		Soil Erodibility = 0.23
		Plastic Limit = 17%
		Liquid Limit = 32%
		Plasticity Index = 15%
		MTC Classification = CL

Station 03+600 NB Lane 1

0- 180	Asph	
180- 1.2	Gry Sa Some Gr Some Si	Dry
		w @ 1.0m = 4%
1.2- 1.5	Br Sa(y) Si W Cl	Moist

Station 03+600 SB Lane 1

0- 200	Asph	
200- 900	Gry Sa Some Gr Some Si	Dry
900- 1.5	Br Sa(y) Si W Cl	Moist

Station 03+800 NB OSH

0- 400	Br Gr W Sa Some Si	Dry
400- 1.1	Gry Sa Some Gr Some Si	Dry
1.1- 1.5	Br Sa(y) Si W Cl	Moist
1.5- 2.1	Br Sa(y) Si W Cl (Farm)	Moist
	Nvalue=8 blows / 300mm	
		w @ 1.8m = 13%

Station 03+800 SB OSH

0- 200	Asph	
200- 1.0	Gry Sa Some Gr Some Si	Dry
1.0- 1.5	Br Sa(y) Si W Cl	Moist
1.5- 2.1	Br Sa(y) Si W Cl (Farm)	Moist
	Nvalue=8 blows / 300mm	

Station 04+000 NB Lane 1

0- 180	Asph	
180- 1.2	Br Sa Some Gr Some Si	Moist
		w @1.0m = 3%
1.2- 1.5	Br Sa(y) Si W Cl	Moist
1.5- 2.1	Br Sa(y) Si W Cl (Stiff)	Moist
	Nvalue=10 blows / 300mm	
		w @ 1.8m = 8%
		Percent Passing 4.75 mm = 99%
		75 µm = 67%
		5 µm = 25%
		Frost Susceptibility = MFSH
		Soil Erodibility = 0.27
		Plastic Limit = 18%
		Liquid Limit = 32%
		Plasticity Index = 14%
		MTC Classification = CL

Station 04+000 SB OSH

0- 1	Gry Sa Some Gr Some Si	Moist
1.0- 1.5	Br Sa(y) Si W Cl	Moist
1.5- 2.1	Br Sa(y) Si W Cl (Farm)	Moist
	Nvalue=8 blows / 300mm	
		w @ 1.8m = 20%

Appendix C
Winston Churchill Boulevard Class EA Study
Highway 401 to Embleton Road

Borehole Logs

January 14, 2016

Station 04+000 SB Lane 1

0- 180	Asph	
180- 1.0	Gry Sa Some Gr Some Si	Moist
		w @ 0.6m = 3%
1- 1.5	Br Sa(y) Si W Cl	Moist
1.5- 2.1	Br Sa(y) Si W Cl (Stiff)	Moist
	Nvalue=9 blows / 300mm	
		w @ 1.8m = 19%

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Ontario

THURBER

RECORD OF BOREHOLE No 407-01 1 OF 2 METRIC

W.P. _____ LOCATION Winston Churchill Blvd. at HWY 407 N 4 828 593.0 E 597 511.1 ORIGINATED BY RMT

DIST _____ HWY 407 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2016.05.13 - 2016.05.13 LATITUDE _____ LONGITUDE _____ CHECKED BY MEF

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 × LAB VANE 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
215.7	GROUND SURFACE										
0.0	**ASPHALT:** (150mm)										
0.2	**SAND** and **GRAVEL**, some silt Dense to Compact Grey to Brown Moist (FILL)		1	SS	38		215		○		39 41 20 (SI+CL)
214.5			2	SS	16				○		
1.2	Silty **CLAY**, sandy, trace gravel Firm to Very Stiff Grey to Brown Moist (FILL)(CL)		3	SS	5		214		○		
			4	SS	20		213		○		2 28 46 24
			5	SS	19				○		
							212				
			6	SS	15		211		○		
							210				
			7	SS	10				○ ⊢		2 30 44 24
							209				
			8	SS	17		208		○		
207.2											
8.5	Silty **CLAY** to Clayey **SILT**, sandy, trace gravel Hard Brown Moist (TILL)(CL-ML)		9	SS	38		207				
							206				

Continued Next Page

+ ³, × ³: Numbers refer to Sensitivity

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

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THURBER

RECORD OF BOREHOLE No 407-01 2 OF 2 METRIC

W.P. _____ LOCATION Winston Churchill Blvd. at HWY 407 N 4 828 593.0 E 597 511.1 ORIGINATED BY RMT

DIST _____ HWY 407 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2016.05.13 - 2016.05.13 LATITUDE _____ LONGITUDE _____ CHECKED BY MEF

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 × LAB VANE 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/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
							205		○		
			10	SS	31						
							204				
202.9	Very Stiff		11	SS	28		203		○⊢		2 31 40 27
12.8	END OF BOREHOLE AT 12.8m. BOREHOLE OPEN TO 12.8m AND BACKFILLED WITH BENTONITE HOLEPLUG TO 0.15m AND ASPHALT PATCH TO SURFACE.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

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

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THURBER

RECORD OF BOREHOLE No 407-02 1 OF 4 METRIC

W.P. _____ LOCATION Winston Churchill Blvd. at HWY 407 N 4 828 596.9 E 597 472.9 ORIGINATED BY RMT/GA

DIST _____ HWY 407 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN

DATUM Geodetic DATE 2016.05.13 - 2016.05.17 LATITUDE _____ LONGITUDE _____ CHECKED BY MEF

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 + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 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/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
217.0	GROUND SURFACE										
0.0	**ASPHALT:** (150mm)										
0.2	Gravely **SAND**, trace silt Very Dense Grey Moist (FILL)		1	SS	56						
	Becoming **SAND**, some gravel Dense		2	SS	36		216				15 83 2 (SI+CL)
215.5											
1.5	Silty **CLAY**, with sand, trace gravel Stiff		3	SS	31		215				
215.2											
1.8	Brown Moist (FILL)										
	Gravelly **SAND**, trace silt Dense Grey Moist (FILL)		4	SS	44		214				
213.6			5	SS	9						3 33 42 22
3.4	Silty **CLAY**, with sand, trace gravel Stiff Brown Moist (FILL)						213				
			6	SS	14		212				
			7	SS	13		211				
							210				
			8	SS	13		209				
208.3											
8.7	Silty **CLAY**, with sand, trace gravel Hard Brown Dry (TILL)(CL)		9	SS	34		208				5 22 41 32

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+ ^{3}, × ^{3}: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No 407-02 2 OF 4 METRIC

W.P. _____ LOCATION Winston Churchill Blvd. at HWY 407 N 4 828 596.9 E 597 472.9 ORIGINATED BY RMT/GA

DIST _____ HWY 407 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN

DATUM Geodetic DATE 2016.05.13 - 2016.05.17 LATITUDE _____ LONGITUDE _____ CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) 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/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Silty **CLAY**, with sand, trace gravel Hard Brown Dry (TILL)(CL)										
			10	SS	36		206		○		
							205				
			11	SS	47				○		
							204				
			12	SS	48		203		○		4 31 39 26
							202				
			13	SS	33				○		
200.2							201				
16.8	Silty **SAND**, trace clay, trace gravel Very Dense Grey Wet		14	SS	49		200		○		7 52 33 8
198.7							199				
18.3	Silty **CLAY**, some sand, trace gravel, occasional shale fragments Hard Brown/Grey Wet (TILL)		15	SS	49				○		
197.2							198				
19.8											

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE

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THURBER

RECORD OF BOREHOLE No 407-02 3 OF 4 METRIC

W.P. _____ LOCATION Winston Churchill Blvd. at HWY 407 N 4 828 596.9 E 597 472.9 ORIGINATED BY RMT/GA

DIST _____ HWY 407 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN

DATUM Geodetic DATE 2016.05.13 - 2016.05.17 LATITUDE _____ LONGITUDE _____ CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Silty **SAND**, some gravel, trace clay, occasional shale fragments Very Dense Grey Wet		16	SS	70				○		13 48 29 10
			17	SS	99		196		○		
							195				
194.1											
22.9	Gravelly **SAND**, silty, trace shale fragments Dense to Very Dense Reddish Brown to Grey Wet		18	SS	45		194		○		31 45 24 (SI+CL)
			19	SS	92		193		○		
							192				
191.1											
25.9	**SHALE**, highly weathered to fresh, thinly bedded, weak to medium strong, reddish brown		20	SS	100/ 0.075		191		○		
	Becoming fresh at 27.1m Horizontal joints (50mm) at 27.2m and (225mm) at 28.3m						190			FI 2 0	
	Siltstone interbeds (25mm) at 27.2m, 28.1m and 28.2m, (150mm) at 27.6m and (100mm) at 28.4m		1	RUN			189			0 0	RUN #1 TCR=100% SCR=100% RQD=90% UCS=24MPa (Average)
	Siltstone interbeds (25mm to 50mm) at 28.6m, 28.8m, 29.6m, 29.8m and 30.1m									2 2	
	Horizontal joints (25mm) at 28.8m and 28.9m		2	RUN			188			0 0 0	RUN #2 TCR=100% SCR=100% RQD=97% UCS=34MPa (Average)

Continued Next Page

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 407-02 4 OF 4 METRIC

W.P. _____ LOCATION Winston Churchill Blvd. at HWY 407 N 4 828 596.9 E 597 472.9 ORIGINATED BY RMT/GA

DIST _____ HWY 407 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN

DATUM Geodetic DATE 2016.05.13 - 2016.05.17 LATITUDE _____ LONGITUDE _____ CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) 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
	Continued From Previous Page										
	Siltstone interbeds (25mm) at 30.3m and 30.6m		3	RUN						0 0 0	RUN #3 TCR=100% SCR=100% RQD=100% ~~UCS=23MPa~~ (Average)
186.3											
30.7	END OF BOREHOLE AT 30.7m. BOREHOLE OPEN TO 30.7m AND WATER LEVEL AT 18.0m. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2016.06.15 11.7 205.3 2016.06.22 11.8 205.2										

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \quad 5}$ (%) STRAIN AT FAILURE
$\frac{}{10}$

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THURBER

RECORD OF BOREHOLE No 407-03 1 OF 2 METRIC

W.P. _____ LOCATION Winston Churchill Blvd. at HWY 407 N 4 828 641.1 E 597 444.2 ORIGINATED BY GA

DIST _____ HWY 407 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2016.04.25 - 2016.04.25 LATITUDE _____ LONGITUDE _____ CHECKED BY MEF

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 × LAB VANE 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
208.8	GROUND SURFACE										
0.0	**SAND** and **GRAVEL**, some silt: (Crusher Run Limestone) Compact Brown		1	SS	12				○		40 46 14 (SI+CL)
208.2											
0.6	Dry (FILL)										
	Silty **CLAY**, some sand, trace gravel Stiff Brown Dry (FILL)		2	SS	12		208		○		
			3	SS	11	▽	207		○		
206.6											
2.2	**SAND**, some gravel, some silt: (Limestone Screenings) Loose Grey Wet		4	SS	9		206		○		
205.7	(FILL)										
3.0	Silty **CLAY**, with sand, trace gravel, occasional oxide staining Very Stiff Brown Dry (TILL)(CL)		5	SS	18		205		○		2 31 39 28
			6	SS	23		204		○		
			7	SS	18		203		○		
			8	SS	16		202		○		
			9	SS	27		201		○		2 36 36 26
							200		○		
							199				

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$+^3$, $\times^3$: Numbers refer to Sensitivity

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

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Ontario

THURBER

RECORD OF BOREHOLE No 407-03 2 OF 2 METRIC

W.P. _____ LOCATION Winston Churchill Blvd. at HWY 407 N 4 828 641.1 E 597 444.2 ORIGINATED BY GA

DIST _____ HWY 407 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2016.04.25 - 2016.04.25 LATITUDE _____ LONGITUDE _____ CHECKED BY MEF

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 × LAB VANE 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/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Becoming hard		10	SS	107		198	○	○		8 30 48 14
196.3			11	SS	102		197		○		
196.1 12.5	**SILT**, trace clay, some sand										
12.6	Very Dense Grey Wet						196				
	SHALE, highly weathered, thinly bedded Very Dense Brown to Grey		12	SS	120/ 0.075		195		○		
193.8			13	SS	100/ 0.075		194				
15.0	END OF BOREHOLE ON AUGER REFUSAL AT 15.0m. BOREHOLE OPEN TO 15.0m AND WATER LEVEL AT 2.1m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15}\oplus\frac{5}{10}$ (%) STRAIN AT FAILURE

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THURBER

RECORD OF BOREHOLE No 407-04 1 OF 4 METRIC

W.P. _____ LOCATION Winston Churchill Blvd. at HWY 407 N 4 828 669.5 E 597 407.0 ORIGINATED BY GA

DIST _____ HWY 407 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN

DATUM Geodetic DATE 2016.05.19 - 2016.05.20 LATITUDE _____ LONGITUDE _____ CHECKED BY MEF

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 × LAB VANE 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/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
217.4	GROUND SURFACE										
0.0	**ASPHALT:** (150mm)										
0.2	**SAND**, some gravel, some silt: (Crusher Run Limestone) Dense to Compact Brown Dry (FILL)		1	SS	33		217		○		
			2	SS	28				○		16 67 17 (SI+CL)
			3	SS	42		216		○		
215.0											
2.4	Silty **CLAY**, with sand, trace gravel Very Stiff Brown Dry (FILL)		4	SS	26		215		○		
			5	SS	22		214		○		
			6	SS	18		213		○		4 31 41 24
	Becoming stiff		7	SS	11		212		○		
210.2							211				
7.2	Silty **CLAY**, with sand, trace gravel Very Stiff to Hard Brown Dry (TILL)(CL)		8	SS	17		210		○		
			9	SS	39		209				
							208		○ ⊢		5 30 48 17

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 407-04 2 OF 4 METRIC

W.P. _____ LOCATION Winston Churchill Blvd. at HWY 407 N 4 828 669.5 E 597 407.0 ORIGINATED BY GA

DIST _____ HWY 407 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN

DATUM Geodetic DATE 2016.05.19 - 2016.05.20 LATITUDE _____ LONGITUDE _____ CHECKED BY MEF

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 (20 40 60 80 100) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	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
	Continued From Previous Page										
							207				
			10	SS	84				○		
							206				
			11	SS	32		205		○		
							204				
			12	SS	28				○		
							203				
			13	SS	19		202		○⊢		3 37 45 15
							201				
	Becoming wet		14	SS	100	▽			○		6 36 45 13
199.1							200				
18.3	**SILT**, some clay, some sand, trace gravel Very Dense Grey Wet		15	SS	81		199		○		
197.6							198				
19.8											

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE
10

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 407-04 3 OF 4 METRIC

W.P. _____ LOCATION Winston Churchill Blvd. at HWY 407 N 4 828 669.5 E 597 407.0 ORIGINATED BY GA

DIST _____ HWY 407 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN

DATUM Geodetic DATE 2016.05.19 - 2016.05.20 LATITUDE _____ LONGITUDE _____ CHECKED BY MEF

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 × LAB VANE) (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
	Continued From Previous Page										
	Silty **CLAY**, some sand, trace gravel Hard Grey Wet (TILL)		16	SS	84		197		○		
196.1											
21.3	Gravelly **SAND**, some silt, occasional cobbles and boulders Very Dense Grey Wet		17	SS	105		196		○		27 55 18 (SI+CL)
			18	SS	100/ 0.150		195		○		
			19	SS	117		194				
							193		○		
			20	SS	100/ 0.050		192				
							191				
190.0							190		○		
27.4	**SHALE**, highly weathered to fresh, thinly bedded, weak to medium strong, reddish brown		21	SS	100/ 0.075		189			FI	
	Siltstone interbeds (25mm) at 28.4m, 28.5m, 28.6m, 28.7m, 29.1m and 29.8m									0	RUN #1 TCR=100% SCR=100% RQD=90% UCS=18MPa (Average)
	Horizontal joints (25mm) at 29.0m, 29.1m, 29.2m and 29.4m		1	RUN			188			0 2 3 0	

Continued Next Page

+ ³, × ³: Numbers refer to Sensitivity

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

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 407-04 4 OF 4 METRIC

W.P. _____ LOCATION Winston Churchill Blvd. at HWY 407 N 4 828 669.5 E 597 407.0 ORIGINATED BY GA

DIST _____ HWY 407 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN

DATUM Geodetic DATE 2016.05.19 - 2016.05.20 LATITUDE _____ LONGITUDE _____ CHECKED BY MEF

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 × LAB VANE) (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/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	Siltstone interbeds (25mm to 75mm) at 29.9m, 30.3m, 30.6m, 30.7m, 30.9mm and 31.1m Horizontal joints (25mm) at 30.5m, 30.6m and 30.8m		2	RUN			187			0 0 2 2 0	RUN #2 TCR=100% SCR=100% RQD=95% UCS=49MPa (Average)
186.0											
31.4	END OF BOREHOLE AT 31.4m. BOREHOLE OPEN TO 31.4m AND WATER LEVEL AT 17.5m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.5m, CONCRETE FROM 0.5m TO 0.2m, THEN ASPHALT PATCH TO SURFACE.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

20
15 5
10
(%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 407-05 1 OF 2 METRIC

W.P. _____ LOCATION Winston Churchill Blvd. at HWY 407 N 4 828 685.6 E 597 390.9 ORIGINATED BY GA

DIST _____ HWY 407 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2016.05.18 - 2016.05.18 LATITUDE _____ LONGITUDE _____ CHECKED BY MEF

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, × LAB VANE) (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
217.1	GROUND SURFACE						217				
0.0	**ASPHALT:** (113mm)										
0.1	**SAND** and **GRAVEL**, some silt: (Crusher Run Limestone) Dense Brown Dry (FILL)		1	SS	30				○		47 38 15 (SI+CL)
216.4							216				
0.7	Silty **CLAY**, sandy, trace gravel Stiff to Very Stiff Brown Dry (FILL)		2	SS	12				○		
			3	SS	9		215		○		
			4	SS	8				○		
			5	SS	15		214		○		0 23 47 30
							213				
			6	SS	27				○		
							212				
			7	SS	23		211		○		
209.5							210				
7.6	Silty **CLAY**, sandy, trace gravel Hard Brown Dry (TILL)(CL)		8	SS	40				○		
							209				
			9	SS	60	▼	208		○ ⊢		4 27 43 26

Continued Next Page

+ ³, × ³: Numbers refer to Sensitivity

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

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 407-05 2 OF 2 METRIC

W.P. _____ LOCATION Winston Churchill Blvd. at HWY 407 N 4 828 685.6 E 597 390.9 ORIGINATED BY GA

DIST _____ HWY 407 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2016.05.18 - 2016.05.18 LATITUDE _____ LONGITUDE _____ CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page						207				
206.1			10	SS	79				o		
11.0	END OF BOREHOLE AT 11.0m. BOREHOLE OPEN TO 11.0m AND DRY. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2016.06.15 8.2 208.9 2016.06.22 9.4 207.7										

SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE

$+^3$, $\times^3$: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

THURBER

Appendix C

Record of Borehole Sheets (Golder Investigation)

PROJECT: 08-1111-0038

RECORD OF BOREHOLE: BH08-1

SHEET 1 OF 1

LOCATION: See Figure 2

BORING DATE: November 21, 2008

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

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 (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● rem V. ⊕ U - ○) (10 20 30 40)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (5 10 15 20)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		207.99							
0	Truck Mounted D-50 100 mm Solid Stem Augers	ASPHALT		0.00							
		Very dense, moist, brown, sand and gravel, some silt, trace clay (FILL)		0.15	1	50 DO	145				
				207.23							
1		Very stiff, brown, silty clay, trace sand and gravel, contains dark grey/black layers / pockets of organic matter (FILL)		0.76							
				0.91	2	50 DO	24				
		Very stiff, brown, SILTY CLAY, some sand, trace to some gravel (TILL)									
					3	50 DO	24				
2				206.01							
		END OF BOREHOLE		1.98							
		NOTE:									
		1. Borehole dry upon completion of drilling.									
3											
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: AM/BC
CHECKED: SLP

MIS-BHS 001 08-1111-0038.GPJ GAL-MIS.GDT 3/25/09 SAC

PROJECT: 08-1111-0038

RECORD OF BOREHOLE: BH08-2

SHEET 1 OF 1

LOCATION: See Figure 2

BORING DATE: November 25, 2008

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

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 (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○) (10 20 30 40)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (5 10 15 20)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		207.49							
0	Truck Mounted D-50 100 mm Solid Stem Augers	ASPHALT		0.00							
		Dense, moist, brown, sand and gravel, trace to some silt (FILL)		0.15	1	50 DO	50		O	MH	
				206.73							
1		Very stiff, dark brown/grey, SILTY CLAY trace to some sand, gravel and rootlets (TOPSOIL / Reworked TILL)		0.76					O		
				206.42	2	50 DO	25		O		
		Very stiff to hard, mottled brown/grey to brown, SILTY CLAY, some sand, trace gravel (TILL)		1.07							
2					3	50 DO	28				
					4	50 DO	51				
3					5	50 DO	52				
				203.83							
		END OF BOREHOLE		3.66							
4		NOTE:									
		1. Borehole dry upon completion of drilling.									
5											
6											
7											
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: AM/BC
CHECKED: SLP

MIS-BHS 001 08-1111-0038.GPJ GAL-MIS.GDT 3/25/09 SAC

PROJECT: 08-1111-0038

RECORD OF BOREHOLE: BH08-3

SHEET 1 OF 1

LOCATION: See Figure 2

BORING DATE: November 21, 2008

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

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 (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○) (10 20 30 40)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (5 10 15 20)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		GROUND SURFACE		207.47							
	Truck Mounted D-50 100 mm Solid Stem Augers	ASPHALT		0.00 / 207.29							
		Very dense, moist, dark brown, sand and gravel, trace silt, slight petroleum hydrocarbon odour (FILL)		0.18 / 206.71	1	50 DO	58				
1		Very stiff, mottled brown/grey, SILTY CLAY, some sand, trace gravel. Contains sand pockets (TILL)		0.76	2	50 DO	22				
					3	50 DO	28				
2		END OF BOREHOLE		205.49 / 1.98							
		NOTE: 1. Borehole dry upon completion of drilling.									

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AM/BC

CHECKED: SLP

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PROJECT: 08-1111-0038

RECORD OF BOREHOLE: BH08-4

SHEET 1 OF 1

LOCATION: See Figure 2

BORING DATE: November 21, 2008

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

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 (20 40 60 80) / SHEAR STRENGTH Cu, kPa (10 20 30 40) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl; 5 10 15 20)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Truck Mounted D-50 100 mm Solid Stem Augers	GROUND SURFACE		207.86							
		ASPHALT		0.00							
		Compact, moist, dark brown, sand and gravel, trace silt (FILL)		0.15							
		Stiff, moist, brown and dark grey, silty clay, trace sand and gravel. Contains organic matter (Reworked TILL / FILL)		0.25	1	50 DO	11				
1		Hard, brown, SILTY CLAY, some sand, trace to some gravel (TILL)		207.25	2	50 DO	32				
				0.61	3	50 DO	39				
2					4	50 DO	33				
3					5	50 DO	52				
4		Auger grinding at 4.1 m depth			6	50 DO	50/ 0.08				
		Becoming grey and contains interlayers of sand and silt below 4.3 m depth			7	50 DO	45				
5				202.68							
		END OF BOREHOLE		5.18							
		NOTE:									
		1. Borehole dry upon completion of drilling.									
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AM/BC

CHECKED: SLP

MIS-BHS 001 08-1111-0038.GPJ GAL-MIS.GDT 3/25/09 SAC

PROJECT: 08-1111-0038

RECORD OF BOREHOLE: BH08-5

SHEET 1 OF 1

LOCATION: See Figure 2

BORING DATE: November 21, 2008

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m
		GROUND SURFACE		205.68			
0	Truck Mounted D-50 100 mm Solid Stem Augers	Gravel (ROAD SHOULDER FILL)		0.00			
		Compact, moist to wet, brown, sand, trace to some gravel. Contains clayey silt pockets (FILL)		0.08	1	50 DO	14
1					2	50 DO	15
				204.31			
		Loose, wet, brown, silty sand, trace to some gravel (FILL)		1.37			
				203.85	3	50 DO	5
2		Firm, grey, Organic SILTY CLAY, trace to some sand, gravel, rootlets		1.83			
				203.24			
		Hard, brown, SILTY CLAY, some sand, trace to some gravel (TILL)		2.44	4	50 DO	63
3					5	50 DO	40
					6	50 DO	50/ 0.08
4		Grinding of augers at 4.1 m depth					
				201.11			
		Auger Refusal		4.57			
5		END OF BOREHOLE					
		NOTE:					
		1. Borehole dry upon completion of drilling.					
6							
7							
8							
9							
10							

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20, 40, 60, 80

SHEAR STRENGTH Cu, kPa: 10, 20, 30, 40

nat V. + Q - ●

rem V. ⊕ U - ○

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}

WATER CONTENT PERCENT: 5, 10, 15, 20

Wp — W — Wl

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AM/BC

CHECKED: SLP

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PROJECT: 08-1111-0038

RECORD OF BOREHOLE: BH08-6

SHEET 1 OF 1

LOCATION: See Figure 2

BORING DATE: November 24, 2008

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (10 20 30 40) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Big Beaver 100 mm Solid Stem	GROUND SURFACE		204.71							
		Stiff, brown, silty clay. Contains roots (TOPSOIL)		0.00 / 204.25	1	50 DO	9				Dec. 16/08
1		Firm, brown, silty clay, trace to some sand, gravel and topsoil (FILL)		0.46 / 203.49	2	50 DO	5				
		Hard, brown, SILTY CLAY, some sand, trace to some gravel (TILL)		1.22 / 202.27	3	50 DO	33				
2					4	50 DO	47				
		Very dense, moist, grey, SILT and SAND, some gravel, trace to some clay (TILL)		2.44 / 201.66	5	50 DO	50			MH	
3		Hard, grey, CLAYEY SILT, trace to some sand and gravel (TILL)		3.05 / 201.05	6	50 DO	50/ 0.13				
		Very dense, moist, red/grey, Silty SAND to SILT and SAND, trace to some gravel, trace clay (TILL)		3.66	7	50 DO	50/ 0.05				
4											
5		Contains shale and limestone fragments			8	50 DO	50/ 0.05				
6				198.56		50 DO	50/ 0.05				
		END OF BOREHOLE		6.15							
7		NOTE: 1. Borehole dry upon completion of drilling. 2. Water level in piezometer measured at 0.1 m depth (Elev. 204.6 m) on December 16, 2008.									
8											
9											
10											

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: AM/BC

CHECKED: SLP

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PROJECT: 08-1111-0038

RECORD OF BOREHOLE: BH08-7

SHEET 1 OF 1

LOCATION: See Figure 2

BORING DATE: November 21, 2009

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

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 (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - O) (10 20 30 40)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (5 10 15 20)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		207.52							
0		ASPHALT		0.00							
		Stiff, moist, blackish brown, silty clay, some sand and gravel, black stained (TOPSOIL/Reworked TILL)		0.15	1	50 DO	14		O		
				206.76							
1		Very stiff to hard, brown, SILTY CLAY, some sand, trace to some gravel (TILL)		0.76	2	50 DO	29		O		
					3	50 DO	39				
2	Truck Mounted D-50				4	50 DO	65				
	100 mm Solid Stem Augers										
3					5	50 DO	57				
					6	50 DO	86/ 0.28				
4				203.22							
		Very dense, moist, brown to grey, Sandy SILT, trace to some gravel, trace clay (TILL)		4.30	7	50 DO	50/ 0.10				
				202.87							
		END OF BOREHOLE		4.65							
5		NOTE:									
		1. Borehole dry upon completion of drilling.									
6											
7											
8											
9											
10											

MIS-BHS 001 08-1111-0038.GPJ GAL-MIS.GDT 3/25/09 SAC

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AM/BC

CHECKED: SLP

PROJECT: 08-1111-0038

RECORD OF BOREHOLE: BH08-8

SHEET 1 OF 1

LOCATION: See Figure 2

BORING DATE: November 25, 2008

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

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 (20 40 60 80) / SHEAR STRENGTH Cu, kPa (10 20 30 40) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		207.89							
0	Truck Mounted D-50 100 mm Solid Stem Augers	ASPHALT		0.00							
		Compact, dark brown/black, sand and gravel, slight petroleum hydrocarbon odour. Contains topsoil (FILL)		0.15 / 207.51	1	50 DO	28				
		TOPSOIL, black		0.38 / 0.48							
1		Very stiff to hard, mottled brown and grey to brown, SILTY CLAY, some sand, trace gravel (TILL)			2	50 DO	16				
					3	50 DO	45				
2				205.76							
		END OF BOREHOLE		2.13							
3		NOTE:									
		1. Borehole dry upon completion of drilling.									
4											
5											
6											
7											
8											
9											
10											

MIS-BHS 001 08-1111-0038.GPJ GAL-MIS.GDT 3/25/09 SAC

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AM/BC

CHECKED: SLP

PROJECT: 08-1111-0038

RECORD OF BOREHOLE: BH08-9

SHEET 1 OF 1

LOCATION: See Figure 2

BORING DATE: November 21, 2008

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

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 (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● rem V. ⊕ U - ○) (10 20 30 40)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl; 5 10 15 20)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		208.21							
0	Truck Mounted D-50 100 mm Solid Stem Augers	Compact, moist, brown, sand and gravel, trace silt (FILL)		0.00	1	50 DO	24		O		
				207.45							
1		Very stiff to hard, mottled brown and grey to brown, SILTY CLAY, trace to some sand and gravel (TILL)		0.76	2	50 DO	20		O	MH	
2					3	50 DO	43				
					4	50 DO	50/ 0.15				
3					5	50 DO	55				
4		Becoming grey/red and auger grinding below 3.8 m depth		204.15	6	50 DO	50/ 0.10				
		END OF BOREHOLE		4.06							
5		NOTE: 1. Borehole dry upon completion of drilling.									
6											
7											
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: AM/BC
CHECKED: SLP

MIS-BHS 001 08-1111-0038.GPJ GAL-MIS.GDT 3/25/09 SAC

PROJECT: 08-1111-0038

RECORD OF BOREHOLE: BH08-10

SHEET 1 OF 1

LOCATION: See Figure 2

BORING DATE: November 24, 2008

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

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 (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕; Q - ●, U - ○) (10 20 30 40)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (5 10 15 20)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		208.23							
0	Truck Mounted D-50 100 mm Solid Stem Augers	Compact, brown, sand and gravel, trace silt (FILL)		0.00	1	50 DO	19				
				207.77							
		Very stiff, brown, silty clay, trace sand and gravel, contains topsoil and rootlets (Possible FILL)		0.46							
				207.47							
		Very stiff to hard, mottled brown/grey to brown, SILTY CLAY, some sand, trace to some gravel (TILL)		0.76	2	50 DO	23				
1											
					3	50 DO	41				
2		Contains sand and silt interlayers below 2.3 m depth			4	50 DO	36				
3					5	50 DO	46				
				204.57							
		END OF BOREHOLE		3.66							
4		NOTE:									
		1. Borehole dry upon completion of drilling.									
5											
6											
7											
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: AM

CHECKED: SLP

MIS-BHS 001 08-1111-0038.GPJ GAL-MIS.GDT 3/25/09 SAC

PROJECT: 08-1111-0038

RECORD OF BOREHOLE: BH08-11

SHEET 1 OF 1

LOCATION: See Figure 2

BORING DATE: November 25, 2008

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

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 (20 40 60 80) / SHEAR STRENGTH Cu, kPa (10 20 30 40) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl; 5 10 15 20)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		208.37							
0	Truck Mounted D-50 100 mm Solid Stem Augers	ASPHALT		0.00							
		Compact, moist, brown, sand and gravel, trace silt (FILL)		0.15	1	50 DO	20		○		
		Very stiff, brown/black, silty clay, trace to some sand and gravel (FILL)		207.76 0.61							
1		Very stiff to hard, mottled brown and grey to brown, SILTY CLAY to CLAYEY SILT, some sand, trace gravel (TILL)		0.76	2	50 DO	24		○		
		Becoming brown below 1.5 m depth			3	50 DO	45				
2					4	50 DO	42				
3		Contains shale fragments			5	50 DO	58				
		END OF BOREHOLE		204.71 3.66							
4		NOTE: 1. Borehole dry upon completion of drilling.									
5											
6											
7											
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: AM/BC

CHECKED: SLP

MIS-BHS 001 08-1111-0038.GPJ GAL-MIS.GDT 3/25/09 SAC

PROJECT: 08-1111-0038

RECORD OF BOREHOLE: BH08-12

SHEET 1 OF 1

LOCATION: See Figure 2

BORING DATE: November 25, 2008

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

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 (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (10 20 30 40)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (5 10 15 20)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		206.02							
0		ASPHALT		0.00							
		Very dense, moist, brown, sand and gravel, trace silt (FILL)		0.15	1	50 DO	50/ 0.08				
				205.41							
		Compact, moist to wet, sand, trace silt and gravel (FILL)		0.61							
1					2	50 DO	10				
				204.50							
		Firm, brown and dark grey, Organic SILTY CLAY, trace to some sand, gravel and rootlets		1.52	3	50 DO	6				
2				203.73							
		Hard, brown to grey, CLAYEY SILT with SAND to SILTY CLAY, some sand trace gravel. Contains silt pockets (TILL)		2.29	4	50 DO	30			26 MH	
	Truck Mounted D-50 / 100 mm Solid Stem Augers				5	50 DO	86				
4					6	50 DO	89/ 0.27				
					7	50 DO	50/ 0.13				
5											
6				199.92							
		Very dense, moist, brownish red, SILT and SAND, trace to some gravel, trace clay (Probable TILL)		6.10	8	50 DO	50/ 0.10				
				6.20							
		END OF BOREHOLE									
		NOTE:									
7		1. Water level measured at 4.8 m depth upon completion of drilling.									
8											
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AM/BC

CHECKED: SLP

MIS-BHS 001 08-1111-0038.GPJ GAL-MIS.GDT 3/25/09 SAC

PROJECT: 08-1111-0038

RECORD OF BOREHOLE: BH08-13

SHEET 1 OF 1

LOCATION: See Figure 2

BORING DATE: November 24, 2008

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

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 (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (10 20 30 40)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl) (5 10 15 20)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		GROUND SURFACE		204.76							
	Big Beaver 100 mm Solid Stem Augers	Firm, brown, SILTY CLAY, some sand, trace gravel. Contains organic matter including roots and grass (Possible FILL)		0.00	1	50 DO	5				Dec. 16/08
1		Stiff to hard, brown CLAYEY SILT, some sand, trace to some gravel (TILL)		203.85 0.91	2	50 DO	12				
					3	50 DO	34				
2		Very dense, moist, brown, SAND and GRAVEL, trace to some silt and clay		202.94 1.82	4	50 DO	57				
		Hard, brown to grey/red, CLAYEY SILT with SAND to CLAYEY SILT, some sand, trace to some gravel (TILL)		202.63 2.13	5	50 DO	57				
3		Auger grinding from 3.0 m to 3.7 m depth			6	50 DO	50/ 0.10				
		Contains sandy silt pockets/interlayers and shale fragments			7	50 DO	50/ 0.08				
4											
5					8	50 DO	50/ 0.08				
				198.97							
6		Hard, moist, reddish brown, CLAYEY SILT, some sand and gravel, shale fragments (Residual Soil/TILL)		5.79 198.51	9	50 DO	120/ 0.15				
		END OF BOREHOLE		6.25							
7		NOTE: 1. Water level in open borehole measured at 0.3 m depth (Elev. 204.5 m) upon completion of drilling. 2. Water level in piezometer measured at 0.5 m depth (Elev. 204.3 m) on December 16, 2008.									
8											
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: BC

CHECKED: SLP

MIS-BHS 001 08-1111-0038.GPJ GAL-MIS.GDT 3/25/09 SAC

PROJECT: 08-1111-0038

RECORD OF BOREHOLE: BH08-14

SHEET 1 OF 1

LOCATION: See Figure 2

BORING DATE: November 24, 2008

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

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 (20 40 60 80) / SHEAR STRENGTH Cu, kPa (10 20 30 40) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		207.49							
0	Truck Mounted D-50 100 mm Solid Stem Augers	ASPHALT		0.00							
		Compact, moist, dark brown, sand and gravel, trace silt (FILL)		0.13	1	50 DO	17				
				206.73							
1		Very stiff, brown and black/grey, SILTY CLAY, trace to some sand and gravel, rootlets (TOPSOIL)		0.76	2	50 DO	18				
				205.97							
		Very stiff to hard, brown, SILTY CLAY, some sand, trace to some gravel (TILL)		1.52	3	50 DO	26				
2		Sandy silt interlayers noted between 1.5 m and 2.1 m depth			4	50 DO	41				
3					5	50 DO	51				
				203.83							
		END OF BOREHOLE		3.66							
4		NOTE:									
		1. Water level measured at 2.9 m depth upon completion of drilling.									
5											
6											
7											
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: AM
CHECKED: SLP

MIS-BHS 001 08-1111-0038.GPJ GAL-MIS.GDT 3/25/09 SAC

PROJECT: 08-1111-0038

RECORD OF BOREHOLE: BH08-15

SHEET 1 OF 1

LOCATION: See Figure 2

BORING DATE: November 25, 2008

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

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 (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○) (10 20 30 40)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (5 10 15 20)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		207.62							
0	Truck Mounted D-50 100 mm Solid Stem Augers	ASPHALT		0.00							
		Compact, moist, brown to dark brown, sand and gravel, trace silt (FILL)		0.15 / 206.86	1	50 DO	14				
1		Very stiff, grey/black to brown, silty clay, trace sand, gravel, rootlets. Contains clay tile fragments (FILL)		0.76 / 205.92	2	50 DO	15				
2		Very stiff to hard, brown, SILTY CLAY, some sand, trace to some gravel (TILL)		1.70 / 203.96	3	50 DO	24				
					4	50 DO	36				
3					5	50 DO	69				
		END OF BOREHOLE		3.66							
4		NOTE: 1. Borehole dry upon completion of drilling.									
5											
6											
7											
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: AM

CHECKED: SLP

MIS-BHS 001 08-1111-0038.GPJ GAL-MIS.GDT 3/25/09 SAC

PROJECT: 08-1111-0038

RECORD OF BOREHOLE: BH08-16

SHEET 1 OF 1

LOCATION: See Figure 2

BORING DATE: November 24, 2008

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

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 (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● rem V. ⊕ U - ○) (10 20 30 40)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (5 10 15 20)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Truck Mounted D-50 / 100 mm Solid Stem Augers	GROUND SURFACE		208.13							
		Loose, moist, dark brown, sand, some gravel, trace silt (FILL)		0.00	1	50 DO	8		O		
				207.37							
1		Firm, brown, silty clay, trace to some sand and gravel. Contains pockets of topsoil (FILL)		0.76	2	50 DO	7		O		
				206.76							
		Stiff, dark grey, Organic SILTY CLAY, trace to some sand, gravel, and rootlets		1.37	3	50 DO	10		O		
2				205.84					26.2		Dec. 16/08
		Very stiff to hard, mottled brown/grey to brown to grey, SILTY CLAY to CLAYEY SILT, some sand, trace to some gravel. Contains sandy silt pockets (TILL)		2.29	4	50 DO	26		O		
3		Becoming grey below 3.0 m depth			5	50 DO	36				
4											
5					6	50 DO	50/ 0.13		O		
6					7	50 DO	52				
					8	50 DO	35				
				201.42							
7		END OF BOREHOLE		6.71							
8		NOTE:									
9		1. Borehole dry upon completion of drilling.									
10		2. Water level in piezometer measured at 2.0 m depth (Elev. 206.1 m) on December 16, 2008.									

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DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AM

CHECKED: SLP

PROJECT: 08-1111-0038

RECORD OF BOREHOLE: BH08-17

SHEET 1 OF 1

LOCATION: See Figure 2

BORING DATE: November 25, 2008

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (10 20 30 40) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl; 5 10 15 20)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Truck Mounted D-50 100 mm Solid Stem Augers	GROUND SURFACE		208.38							
		ASPHALT		0.00							
		Dense, moist, brown, gravelly sand, some silt. Contains clay pockets and asphalt fragments (FILL)		0.15	1	50 DO	31			MH	
1		Stiff, dark brown, silty clay, trace to some sand, gravel, rootlets (TOPSOIL)		207.61 0.77	2	50 DO	11				
				206.65	3	50 DO	10				
2		Stiff, brown, SILTY CLAY, some sand, trace to some gravel, trace topsoil (TILL)		1.73 206.25							
		Hard, brown, SILTY CLAY, some sand, to CLAYEY SILT with sand, trace to some gravel (TILL)		2.13	4	50 DO	30				
3		Contains interlayers of silt and sand			5	50 DO	42			MH	▽
4					6	50 DO	50/ 0.15				
5					7	50 DO	50/ 0.15				
6					8	50 DO	78/ 0.28				
				201.83							
		END OF BOREHOLE		6.55							
7		NOTE: 1. Water seepage noted at 3.0 m depth upon completion of drilling.									
8											
9											
10											

MIS-BHS 001 08-1111-0038.GPJ GAL-MIS.GDT 3/25/09 SAC

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AM

CHECKED: SLP

PROJECT: 08-1111-0038

RECORD OF BOREHOLE: BH08-18

SHEET 1 OF 1

LOCATION: See Figure 2

BORING DATE: November 24, 2008

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

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 (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (10 20 30 40)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl) (5 10 15 20)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		208.49							
0	Truck Mounted D-50, 100 mm Solid Stem Augers	Compact, moist, brown, sand and gravel, trace silt (FILL)		0.00	1	50 DO	19		O		
				207.88							
		Stiff, grey/black turning brown, silty clay, trace to some sand, gravel and rootlets (TOPSOIL)		0.61	2A	50 DO	15				
1				207.27					O		
		Very stiff to hard, mottled brown and grey to brown, SILTY CLAY, some sand, trace to some gravel (TILL)		1.22	2B	50 DO					
2					3	50 DO	19		O		
					4	50 DO	36				
3					5	50 DO	54				
				204.83							
		END OF BOREHOLE		3.66							
4		NOTE:									
		1. Borehole dry upon completion of drilling.									
5											
6											
7											
8											
9											
10											

MIS-BHS 001 08-1111-0038.GPJ GAL-MIS.GDT 3/25/09 SAC

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: AM

CHECKED: SLP

PROJECT: 08-1111-0038

RECORD OF BOREHOLE: BH08-19

SHEET 1 OF 1

LOCATION: See Figure 2

BORING DATE: November 24, 2008

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

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 (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (10 20 30 40)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl) (5 10 15 20)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		209.09							
0	Truck Mounted D-50 / 100 mm Solid Stem Augers	ASPHALT		0.00 / 208.91							
		Very dense, moist, brown, sand and gravel, trace silt (FILL)		0.18 / 208.63	1	50 DO	57				
		Hard, brown/black, silty clay, trace to some sand, gravel and roots (FILL / TOPSOIL)		0.46 / 208.40							
1		Very dense, dark brown, sand and gravel, trace clay. Contains asphalt pieces (FILL)		0.69 / 207.69	2	50 DO	50/ 0.13				
		Very stiff, mottled grey/brown, SILTY CLAY, some sand, trace gravel (TILL)		1.40 / 206.96	3	50 DO	18				
2		END OF BOREHOLE		2.13							
		NOTE: 1. Borehole dry upon completion of drilling.									
3											
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: AM
CHECKED: SLP

MIS-BHS 001 08-1111-0038.GPJ GAL-MIS.GDT 3/25/09 SAC

PROJECT: 08-1111-0038

RECORD OF BOREHOLE: BH08-20

SHEET 1 OF 1

LOCATION: See Figure 2

BORING DATE: November 24, 2008

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

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 (20 40 60 80) / SHEAR STRENGTH Cu, kPa (10 20 30 40) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		209.21							
0	Truck Mounted D-50 / 100 mm Solid Stem Augers	Compact, moist, dark brown, sand and gravel, trace silt (FILL)		0.00 / 208.91	1	50 DO	15				
		Stiff, dark brown/black, silty clay, trace to some sand, gravel, rootlets (TOPSOIL)		0.30 / 208.45							
1		Very stiff to hard, mottled brown/grey to brown, SILTY CLAY to CLAYEY SILT, some sand, trace to some gravel (TILL)		0.76	2	50 DO	22				
2		Contains sand pockets			3	50 DO	32				
					4	50 DO	50				
3					5	50 DO	39				
		END OF BOREHOLE		205.55 / 3.66							
4		NOTE: 1. Borehole dry upon completion of drilling.									
5											
6											
7											
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: AM

CHECKED: SLP

MIS-BHS 001 08-1111-0038.GPJ GAL-MIS.GDT 3/25/09 SAC

PROJECT: 08-1111-0038 (7000)

RECORD OF BOREHOLE: 09-1

SHEET 1 OF 1

LOCATION: N 829294.9 ;E 596719.2

BORING DATE: October 19, 2009

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

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 (20 40 60 80) / SHEAR STRENGTH Cu, kPa (10 20 30 40) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		205.68							
0		ASPHALT		0.00							
				205.43	1	50 DO	12				
		Stiff, moist, black, organic silty clay, some sand and gravel, contains rootlets (FILL)		0.25							
1											
					2	50 DO	8				
2									W 29.7		
				202.94							
		Hard, brown, SILTY CLAY, some sand and gravel, contains cobbles and/or boulders (TILL)		2.74							
3					3	50 DO	35				
4				201.41							
		Hard, moist, brown, SILTY CLAY to CLAYEY SILT, some sand, some gravel (TILL) to very dense, brown, SILT and SAND, trace to some gravel, trace clay (TILL), contains cobbles/boulders		4.27	4	50 DO	69/ 0.3				
5	CME 55 Truck Mount / 150 mm Solid Stem Augers				5	50 DO	70/ 0.22				
6					6	50 DO	65/ 0.10				
7											
					7	50 DO	53/ 0.08				
8											
9				196.44	8	50 DO	65/ 0.10				
		END OF BOREHOLE		9.24							
10		NOTE: 1. Augers were grinding between depths of 4.0 m and 4.3 m, suggesting possible presence of cobbles and/or boulders.									Upon completion of drilling the borehole was open with no free water; the borehole was wet at the bottom.

MIS-BHS 001 08-1111-0038.GPJ GAL-MIS.GDT 1/25/10 SAC

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: BC

CHECKED: CCG

PROJECT: 08-1111-0038 (7000)

RECORD OF BOREHOLE: 09-2

SHEET 1 OF 1

LOCATION: N 829308.5 ;E 596704.2

BORING DATE: October 19, 2009

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

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 (20 40 60 80) / SHEAR STRENGTH Cu, kPa (10 20 30 40) nat V. + Q- ● rem V. ⊕ U- ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		205.73							
0	CME 55 Truck Mount; 150 mm Solid Stem Augers	ASPHALT		0.00 / 205.53							
		Very dense, moist, brown, sand and gravel, trace silt, contains asphalt fragments (FILL)		0.20 / 205.12	1	50 DO	52				
1		Firm, moist, dark grey, organic silty clay, some sand and gravel, contains rootlets and wood fragments (FILL)		0.61 / 204.21	2	50 DO	7				
2		Very stiff to hard, moist, brown, SILTY CLAY, some sand and gravel, contains cobbles and/or boulders (TILL)		1.52	3	50 DO	22				
3					4	50 DO	59				
4		Very dense, moist, brown, SAND and SILT, trace to some gravel and clay (TILL) to hard, brown, CLAYEY SILT (TILL). Contains cobbles and/or boulders.		201.46 / 4.27							
5					5	50 DO	63/ 0.15				
					6	50 DO	68/ 0.30				
6					7	50 DO	61/ 0.15		O —	MH	
7											
8					8	50 DO	50/ 0.25				
9				196.49 / 9.24	9	50 DO	50/ 0.10				
		END OF BOREHOLE NOTE: 1. Augers were grinding at a depth of 4.3 m suggesting possible presence of cobbles and/or boulders.									Upon completion of drilling the borehole was open with no free water; the borehole was wet at the bottom.
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: BC

CHECKED: CCG

MIS-BHS 001 08-1111-0038.GPJ GAL-MIS.GDT 1/25/10 SAC

PROJECT: 08-1111-0038 (7000)

RECORD OF BOREHOLE: 09-3

SHEET 1 OF 1

LOCATION: N 829980.8 ;E 596019.4

BORING DATE: October 19, 2009

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (10 20 30 40) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl; 5 10 15 20)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		207.70							
0	CME 55 Truck Mount, 150 mm Solid Stem Augers	ASPHALT		0.00							
		Dense, moist, brown, sand and gravel, trace silt, contains asphalt fragments (FILL)		0.15	1	50 DO	35				
				207.09							
		Stiff, moist, dark grey to black, organic silty clay, some sand and gravel (FILL)		0.61							
1					2	50 DO	11			OC=7.1%	
				206.18							
		Stiff to hard, moist, brown, SILTY CLAY, some sand and gravel (TILL)		1.52	3	50 DO	10		O		
2											
					4	50 DO	45				
3											
					5	50 DO	56		O		
				204.04							
		Hard, moist, brown to grey, SILTY CLAY to CLAYEY SILT, some sand and gravel (TILL)		3.66							
4					6	50 DO	57		O		
				203.43							
		END OF BOREHOLE		4.27							
5		NOTE: 1. Upon completion of drilling the borehole was open with no free water.									
6											
7											
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: BC
CHECKED: CCG

MIS-BHS 001 08-1111-0038.GPJ GAL-MIS.GDT 1/25/10 SAC

PROJECT: 08-1111-0038 (7000)

RECORD OF BOREHOLE: 09-4

SHEET 1 OF 1

LOCATION: N 595884.6 ;E 830114.0

BORING DATE: October 20, 2009

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

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 (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● rem V. ⊕ U - ○) (10 20 30 40)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl; 5 10 15 20)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		206.07							
0	Power Auger 150 mm O.D. Solid Stem Augers	ASPHALT		0.00 205.87							
		Compact to loose, moist, brown, sand and gravel, trace clay, contains organics (FILL)		0.20	1	50 DO	26				
1				204.47							
		Firm, moist, grey, silty clay, trace to some sand and gravel, contains organics (FILL)		1.60	2	50 DO	7				
2				203.63							
		Stiff, brown to grey, SILTY CLAY, some sand and gravel (TILL)		2.44	3	50 DO	12				
3				202.11							
		Very dense, wet, brown, SAND and GRAVEL, trace silt and clay		3.96	4A	50 DO	68				
4				201.67							
		Hard, moist, brown to reddish brown, SILTY CLAY, some sand and gravel, contains cobbles and/or boulders (TILL)		4.40	4B						
5					5	50 DO	100/ 0.25				
				200.29							
		Very dense, moist to wet, reddish brown, SILT and SAND, some gravel, trace clay, contains cobbles and/or boulders (TILL) Laboratory testing indicates Sample 6 is non-plastic.		5.78	6	50 DO	100/ 0.43			MH	
6				199.36							
		Reddish brown, weathered SHALE		6.71	7	50 DO	90/ 0.30				▽
7											
8											
9				196.87	8	50 DO	50/ 0.05				
		END OF BOREHOLE		9.20							
10		NOTE: 1. Augers were grinding at various depths within the till.									Water level in open borehole at a depth of 7.2 m below ground surface upon completion of drilling.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: TZ

CHECKED: CCG

MIS-BHS 001 08-1111-0038.GPJ GAL-MIS.GDT 1/25/10 SAC

PROJECT: 08-1111-0038 (7000)

RECORD OF BOREHOLE: 09-5

SHEET 1 OF 1

LOCATION: N 595869.7 ;E 830128.3

BORING DATE: October 20, 2009

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

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 (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● rem V. ⊕ U - ○) (10 20 30 40)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (5 10 15 20)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		206.01							
0	Power Auger 150 mm O.D. Solid Stem Augers	ASPHALT		0.00							
		Dense, moist, brown, sand and gravel, contains organics matter and rootlets (FILL)		0.15	1	50 DO	31		W		
1				204.79							
		Stiff, moist, grey, silty clay, trace to some gravel and sand, contains organics matter and rootlets (FILL)		1.22	2	50 DO	10				
2				203.57							
		Hard, moist, brown to reddish brown, SILTY CLAY, some sand and gravel, contains silt seams, cobbles and/or boulders (TILL)		2.44	3	50 DO	52		W		
3											
4					4	50 DO	75/ 0.10		W		
5					5	50 DO	78/ 0.15				
6					6	50 DO	75/ 0.30		W		
7											
8		Reddish brown, weathered SHALE		198.39 7.62	7	50 DO	65/ 0.30		W		▽
9				196.81	8	50 DO	70/ 0.05		W		
		END OF BOREHOLE		9.20							
10		NOTE: 1. Augers were grinding at various depths within the till.									Water level in open borehole at a depth of 7.8 m below ground surface upon completion of drilling.

MIS-BHS 001 08-1111-0038.GPJ GAL-MIS.GDT 1/25/10 SAC

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: TZ

CHECKED: CCG

PROJECT: 08-1111-0038 (7000)

RECORD OF BOREHOLE: 09-6

SHEET 1 OF 1

LOCATION: N 595737.2 ;E 830258.4

BORING DATE: October 20, 2009

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

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 (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (10 20 30 40)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (5 10 15 20)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		GROUND SURFACE		207.54							
		ASPHALT		0.00 / 207.34							
		Compact, moist, brown, sand, some gravel, contains asphalt fragments (FILL)		0.20 / 206.95	1	50 DO	29				
1	Power Auger 150 mm O.D. Solid Stem Augers	Stiff to hard, moist, brown with grey spots, SILTY CLAY, some sand and gravel (TILL)		0.59	2	50 DO	14				
					3	50 DO	23				
2											
3					4	50 DO	34				
4											
		Becoming grey, contains grey shale fragments			5	50 DO	51				
5				202.51							
		END OF BOREHOLE		5.03							Open borehole dry upon completion of drilling.
6											
7											
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: TZ

CHECKED: CCG

MIS-BHS 001 08-1111-0038.GPJ GAL-MIS.GDT 1/25/10 SAC

PROJECT: 08-1111-0038 (7000)

RECORD OF BOREHOLE: 09-9

SHEET 1 OF 1

LOCATION: N 595205.0 ;E 830781.0

BORING DATE: October 21, 2009

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

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 (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● rem V. ⊕ U - ○) (10 20 30 40)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W WI) (5 10 15 20)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		GROUND SURFACE		208.25							
		ASPHALT		0.00 208.05							
	Power Auger / 150 mm O.D. Solid Stem Augers	Dense, moist, brown, sand and gravel, contains silty clay inclusions (FILL)		0.20	1	50 DO	47				
1		Firm to hard, moist, brown with grey spot, SILTY CLAY, some sand, trace to some gravel, contains sandy silt seams, cobbles and/or boulders (TILL)		207.34 0.91	2	50 DO	7				▽
2											
3					3	50 DO	33				
4											
5		Becoming grey			4	50 DO	55				
					5	50 DO	29			MH	
6					6	50 DO	31				
7											
8		Becoming reddish brown and wet			7	50 DO	70				
9											
		END OF BOREHOLE		198.95 9.30	8	50 DO	50/0.15				
10		NOTE: 1. No recovery for Sample 2.									

Groundwater in open borehole encountered at a depth of about 2.1 m below ground surface upon completion of drilling.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: TZ

CHECKED: CCG

MIS-BHS 001 08-1111-0038.GPJ GAL-MIS.GDT 1/25/10 SAC

PROJECT: 08-1111-0038 (7000)

RECORD OF BOREHOLE: 09-9A

SHEET 1 OF 1

LOCATION: Approximately 0.5 m south-west of Borehole 09-9

BORING DATE: October 21, 2009

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (10 20 30 40) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger 150 mm O.D. Solid Stem Augers	GROUND SURFACE									
		ASPHALT		0.00							
				0.20							
1		Moist, brown, SILTY CLAY, some sand and gravel (TILL)		1.52	1	50 DO	9				
2		END OF BOREHOLE		1.98							
		NOTE: 1. Augered from 0 m to 1.52 m to obtain Sample 1 (same depth as missed Sample 2 from Borehole 09-9).									
3											
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: TZ
CHECKED: CCG

MIS-BHS 001 08-1111-0038.GPJ GAL-MIS.GDT 1/25/10 SAC

PROJECT: 08-1111-0038 (7000)

RECORD OF BOREHOLE: 09-10

SHEET 1 OF 1

LOCATION: N 830881.2 ;E 595103.4

BORING DATE: October 21, 2009

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕; Q- ●, U- ○) (10 20 30 40)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (5 10 15 20)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		207.82							
0	Power Auger 150 mm O.D. Solid Stem Augers	ASPHALT		0.00 / 207.62							
		Compact, moist, brown, sand and gravel (FILL)		0.20 / 207.16	1	50 DO	22				
1		Stiff to hard, moist, brown with grey spots, SILTY CLAY, some sand, some gravel (TILL)		0.66	2	50 DO	24		O		
2					3	50 DO	28				
3					4	50 DO	57		O		
				204.32							
		END OF BOREHOLE		3.50							
4		NOTE: 1. Open borehole dry upon completion of drilling.									
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: TZ

CHECKED: CCG

MIS-BHS 001 08-1111-0038.GPJ GAL-MIS.GDT 1/25/10 SAC

PROJECT: 08-1111-0038 (7000)

RECORD OF BOREHOLE: 09-11

SHEET 1 OF 1

LOCATION: N 831025.4 ;E 594957.6

BORING DATE: October 21, 2009

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

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 (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○) (10 20 30 40)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (5 10 15 20)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		207.98							
0	Power Auger 150 mm O.D. Solid Stem Augers	ASPHALT		0.00 / 207.75							
		Loose, moist, brown, sand and gravel (FILL)		0.23 / 207.50	1A	50 DO	9				
		Firm, moist, dark grey to black, organic silty clay, some sand, some gravel (FILL)		0.48 / 207.29	1B						
1		Firm, light grey, silty clay, some sand and gravel (FILL)		0.69 / 206.76	2	50 DO	8				
		Very stiff, brown, SILTY CLAY to CLAYEY SILT with sand, some gravel (TILL)		1.22	3	50 DO	24				
2											
3					4	50 DO	39		O	MH	
				204.48							
		END OF BOREHOLE		3.50							
4		NOTE: 1. Open borehole dry upon completion of drilling.									
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: TZ

CHECKED: CCG

MIS-BHS 001 08-1111-0038.GPJ GAL-MIS.GDT 1/25/10 SAC

THURBER

Appendix D

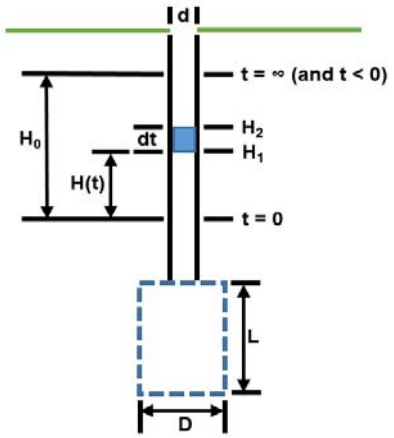
Hydraulic Conductivity Test Results

THURBER

In-Situ Hydraulic Conductivity Test
Hvorslev Analysis
Method based on NAFAC Soil Mechanics Design Manual 7.01

INPUT DATA	Rising Head Test	
Borehole 407-5		
Static Water Level	9.4	mbgs
Well Diameter (d)	0.051	m
Borehole Diameter (D)	0.203	m
Length of Intake (L)	1.10	m
Initial Unbalanced Head (Ho)	0.56	m
Shape Factor (F)	2.90	

Hvorslev (1951)

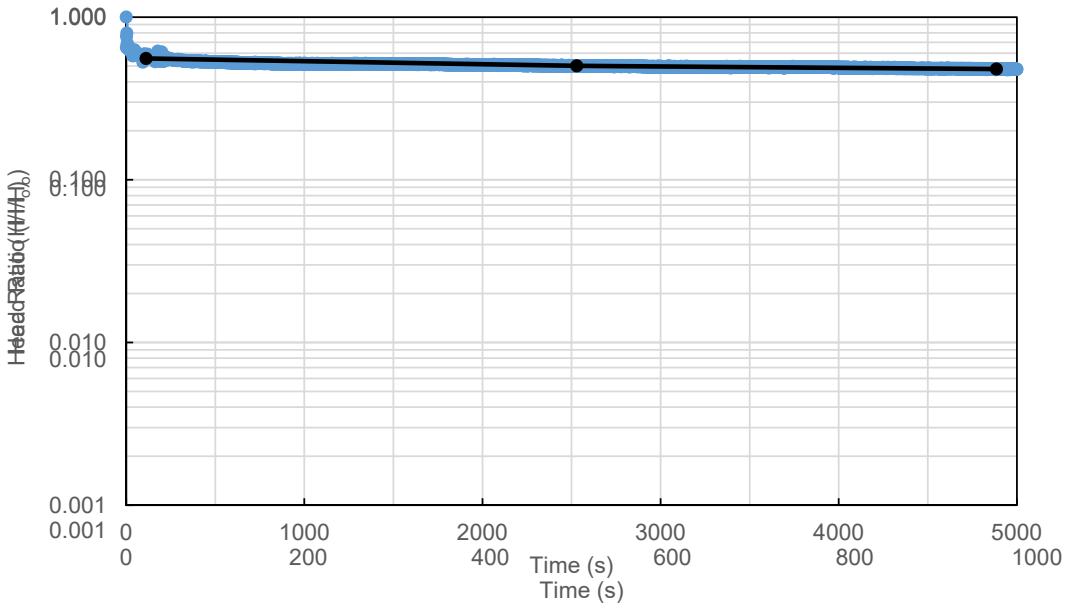


$$K = \frac{A}{F(t_2 - t_1)} \ln\left(\frac{H_1}{H_2}\right)$$

For piezometers of perforated extension of length "L"

$$F = \frac{2\pi L}{ln\left(\frac{L}{R}\right)}$$

K = 5.5E-08 m/s



DATE: Jun-16 PREPARED: DJP

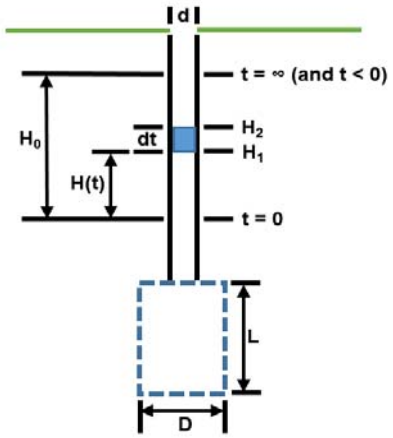
PROJECT: 10041 CHECKED: SMS

THURBER

In-Situ Hydraulic Conductivity Test
Hvorslev Analysis
Method based on NAFAC Soil Mechanics Design Manual 7.01

INPUT DATA	Rising Head Test
Borehole 407-2	
Static Water Level	11.8 mbgs
Well Diameter (d)	0.051 m
Borehole Diameter (D)	0.203 m
Length of Intake (L)	3.70 m
Initial Unbalanced Head (Ho)	0.22 m
Shape Factor (F)	6.46

Hvorslev (1951)

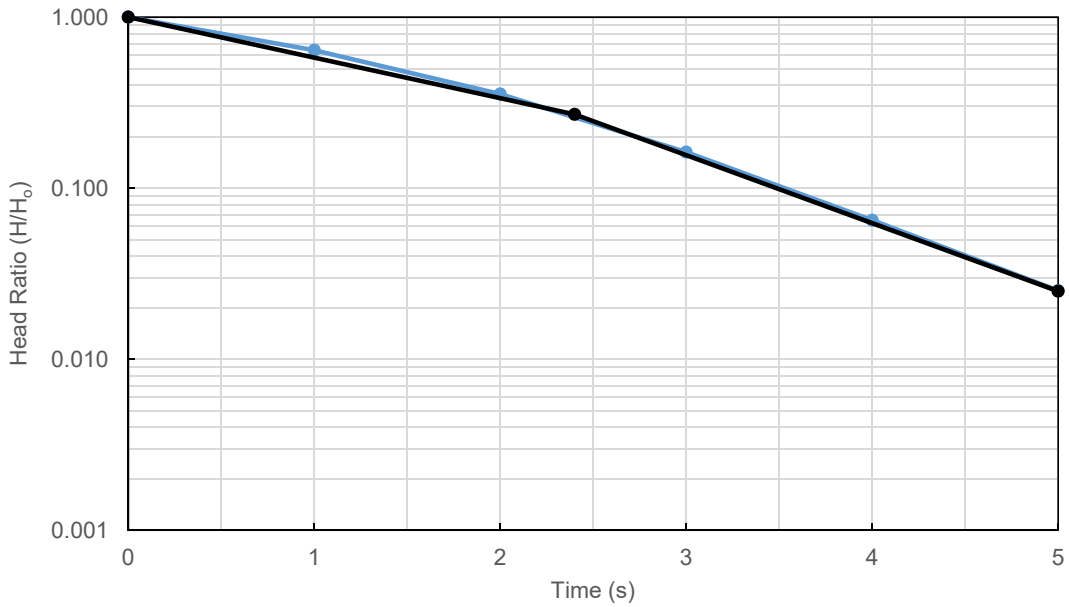


$$K = \frac{A}{F(t_2 - t_1)} \ln\left(\frac{H_1}{H_2}\right)$$

For piezometers of perforated extension of length "L"

$$F = \frac{2\pi L}{ln\left(\frac{L}{R}\right)}$$

K = 2.3E-04 m/s



DATE: Jun-16 PREPARED: DJP

PROJECT: 10041 CHECKED: SMS

THURBER

Appendix E

Groundwater Quality Test Results

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: THURBER ENGINEERING LTD
SUITE 103, 2010 WINSTON PARK DRIVE
OAKVILLE, ON L6H5R7
(905) 829-8666

ATTENTION TO: MARK FARRANT

PROJECT: 19-1605-196

AGAT WORK ORDER: 16T105987

WATER ANALYSIS REVIEWED BY: Parvathi Malemath, Data Reviewer

DATE REPORTED: Jun 30, 2016

PAGES (INCLUDING COVER): 12

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

AGAT Laboratories

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FAX (905)712-5122
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 16T105987

PROJECT: 19-1605-196

CLIENT NAME: THURBER ENGINEERING LTD

ATTENTION TO: MARK FARRANT

SAMPLING SITE:

SAMPLED BY:

Metals Scan (Water)

DATE RECEIVED: 2016-06-16

DATE REPORTED: 2016-06-30

		SAMPLE DESCRIPTION:		407-02
		SAMPLE TYPE:		Water-Filter
		DATE SAMPLED:		6/16/2016
Parameter	Unit	G / S	RDL	7637366
Aluminum	mg/L		0.004	0.021
Antimony	mg/L	0.020	0.003	<0.003
Arsenic	mg/L	0.1	0.003	<0.003
Barium	mg/L		0.002	0.044
Beryllium	mg/L	0.011	0.001	<0.001
Boron	mg/L	0.20	0.010	**0.365**
Cadmium	mg/L	0.0002	0.0001	<0.0001
Chromium	mg/L		0.003	<0.003
Cobalt	mg/L	0.0009	0.0005	<0.0005
Copper	mg/L	0.005	0.003	<0.003
Iron	mg/L	0.3	0.010	<0.010
Lead	mg/L	0.005	0.002	<0.002
Manganese	mg/L		0.002	0.084
Molybdenum	mg/L	0.04	0.002	0.008
Nickel	mg/L	0.025	0.003	<0.003
Selenium	mg/L	0.1	0.004	<0.004
Silver	mg/L	0.0001	0.0001	<0.0001
Strontium	mg/L		0.005	2.05
Thallium	mg/L	0.0003	0.0003	<0.0003
Tin	mg/L		0.002	<0.002
Titanium	mg/L		0.002	0.003
Tungsten	mg/L	0.03	0.010	<0.010
Uranium	mg/L	0.005	0.002	<0.002
Vanadium	mg/L	0.006	0.002	<0.002
Zinc	mg/L	0.02	0.005	<0.005
Zirconium	mg/L	0.004	0.004	<0.004

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to PWQO (mg/L)

Certified By:

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 16T105987

PROJECT: 19-1605-196

CLIENT NAME: THURBER ENGINEERING LTD

ATTENTION TO: MARK FARRANT

SAMPLING SITE:

SAMPLED BY:

TSS (Water)

DATE RECEIVED: 2016-06-16

DATE REPORTED: 2016-06-30

		SAMPLE DESCRIPTION:		407-02
		SAMPLE TYPE:		Water
		DATE SAMPLED:		6/16/2016
Parameter	**Unit**	**G / S**	**RDL**	**7637338**
Total Suspended Solids	mg/L		10	9590

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Certified By:

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Certificate of Analysis

AGAT WORK ORDER: 16T105987

PROJECT: 19-1605-196

CLIENT NAME: THURBER ENGINEERING LTD

ATTENTION TO: MARK FARRANT

SAMPLING SITE:

SAMPLED BY:

Water Quality Assessment (mg/L)

DATE RECEIVED: 2016-06-16

DATE REPORTED: 2016-06-30

		SAMPLE DESCRIPTION:		407-02
		SAMPLE TYPE:		Water
		DATE SAMPLED:		6/16/2016
Parameter	Unit	G / S	RDL	7637338
Electrical Conductivity	uS/cm		2	764
pH	pH Units	6.5-8.5	NA	8.10
Saturation pH				7.02
Langelier Index				1.08
Total Hardness (as CaCO3)	mg/L		0.5	276
Total Dissolved Solids	mg/L		20	394
Alkalinity (as CaCO3)	mg/L		5	252
Bicarbonate (as CaCO3)	mg/L		5	252
Carbonate (as CaCO3)	mg/L		5	<5
Hydroxide (as CaCO3)	mg/L		5	<5
Fluoride	mg/L		0.10	<0.10
Chloride	mg/L		0.20	61.0
Nitrate as N	mg/L		0.10	<0.10
Nitrite as N	mg/L		0.10	<0.10
Bromide	mg/L		0.10	0.47
Sulphate	mg/L		0.20	65.4
Ortho Phosphate as P	mg/L		0.20	<0.20
Reactive Silica	mg/L		0.05	16.4
Ammonia as N	mg/L		0.02	0.47
Total Phosphorus	mg/L	0.03	**0.25**	**8.76**
Total Organic Carbon	mg/L		1.0	3.6
Colour	TCU		5	<5
Turbidity	NTU		0.5	3540
Calcium	mg/L		0.05	51.5
Magnesium	mg/L		0.05	35.8
Sodium	mg/L		0.05	49.8
Potassium	mg/L		0.05	11.0
Aluminum	mg/L		0.004	13.1
Antimony	mg/L	0.020	0.003	<0.003
Arsenic	mg/L	0.1	0.003	0.013

Certified By:

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 16T105987

PROJECT: 19-1605-196

CLIENT NAME: THURBER ENGINEERING LTD

ATTENTION TO: MARK FARRANT

SAMPLING SITE:

SAMPLED BY:

Water Quality Assessment (mg/L)

DATE RECEIVED: 2016-06-16

DATE REPORTED: 2016-06-30

		SAMPLE DESCRIPTION:		407-02
		SAMPLE TYPE:		Water
		DATE SAMPLED:		6/16/2016
Parameter	Unit	G / S	RDL	7637338
Barium	mg/L		0.002	0.325
Beryllium	mg/L	0.011	0.001	0.002
Boron	mg/L	0.20	0.010	**0.426**
Cadmium	mg/L	0.0002	0.0002	**0.0009**
Chromium	mg/L		0.003	0.022
Cobalt	mg/L	0.0009	0.0005	**0.013**
Copper	mg/L	0.005	0.003	**0.029**
Iron	mg/L	0.3	0.010	**24.5**
Lead	mg/L	0.005	0.001	**0.019**
Manganese	mg/L		0.002	6.30
Mercury	mg/L		0.0001	<0.0001
Molybdenum	mg/L	0.04	0.002	<0.002
Nickel	mg/L	0.025	0.003	0.010
Selenium	mg/L	0.1	0.004	<0.004
Silver	mg/L	0.0001	0.0001	<0.0001
Strontium	mg/L		0.005	3.62
Thallium	mg/L	0.0003	0.0002	<0.0002
Tin	mg/L		0.002	<0.002
Titanium	mg/L		0.002	0.223
Tungsten	mg/L	0.03	0.010	<0.010
Uranium	mg/L	0.005	0.002	<0.002
Vanadium	mg/L	0.006	0.002	**0.027**
Zinc	mg/L	0.02	0.005	**0.072**
Zirconium	mg/L	0.004	0.004	<0.004
% Difference/ Ion Balance	%		NA	0.821

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to PWQO (mg/L)

7637338 Elevated RDLs indicate the degree of sample dilutions prior to analyses to keep analytes within the calibration range, reduce matrix interference and/or to avoid contaminating the instruments.

Certified By:

AGAT Laboratories

Guideline Violation

AGAT WORK ORDER: 16T105987

PROJECT: 19-1605-196

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CLIENT NAME: THURBER ENGINEERING LTD

ATTENTION TO: MARK FARRANT

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	GUIDEVALUE	RESULT
7637338	407-02	PWQO (mg/L)	Water Quality Assessment (mg/L)	Boron	0.20	0.426
7637338	407-02	PWQO (mg/L)	Water Quality Assessment (mg/L)	Cadmium	0.0002	0.0009
7637338	407-02	PWQO (mg/L)	Water Quality Assessment (mg/L)	Cobalt	0.0009	0.013
7637338	407-02	PWQO (mg/L)	Water Quality Assessment (mg/L)	Copper	0.005	0.029
7637338	407-02	PWQO (mg/L)	Water Quality Assessment (mg/L)	Iron	0.3	24.5
7637338	407-02	PWQO (mg/L)	Water Quality Assessment (mg/L)	Lead	0.005	0.019
7637338	407-02	PWQO (mg/L)	Water Quality Assessment (mg/L)	Total Phosphorus	0.03	8.76
7637338	407-02	PWQO (mg/L)	Water Quality Assessment (mg/L)	Vanadium	0.006	0.027
7637338	407-02	PWQO (mg/L)	Water Quality Assessment (mg/L)	Zinc	0.02	0.072
7637366	407-02	PWQO (mg/L)	Metals Scan (Water)	Boron	0.20	0.365

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Quality Assurance

CLIENT NAME: THURBER ENGINEERING LTD

AGAT WORK ORDER: 16T105987

PROJECT: 19-1605-196

ATTENTION TO: MARK FARRANT

SAMPLING SITE:

SAMPLED BY:

Water Analysis

RPT Date: Jun 30, 2016

PARAMETER	Batch	Sample Id	DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
			Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Water Quality Assessment (mg/L)															
Electrical Conductivity	7638135		1060	1060	0.0%	< 2	106%	80%	120%	NA			NA		
pH	7638135		8.09	8.00	1.1%	NA	100%	90%	110%	NA			NA		
Total Dissolved Solids	7639588		220	218	0.9%	< 20	116%	80%	120%	NA			NA		
Alkalinity (as CaCO3)	7638135		428	430	0.5%	< 5	94%	80%	120%	NA			NA		
Bicarbonate (as CaCO3)	7638135		428	430	0.5%	< 5	NA			NA			NA		
Carbonate (as CaCO3)	7638135		<5	<5	NA	< 5	NA			NA			NA		
Hydroxide (as CaCO3)	7638135		<5	<5	NA	< 5	NA			NA			NA		
Fluoride	7644477		<0.25	<0.25	NA	< 0.05	92%	90%	110%	95%	90%	110%	93%	80%	120%
Chloride	7644477		231	227	1.7%	< 0.10	104%	90%	110%	98%	90%	110%	90%	80%	120%
Nitrate as N	7644477		<0.25	<0.25	NA	< 0.05	93%	90%	110%	100%	90%	110%	105%	80%	120%
Nitrite as N	7644477		<0.25	<0.25	NA	< 0.05	NA	90%	110%	92%	90%	110%	111%	80%	120%
Bromide	7644477		<0.25	<0.25	NA	< 0.05	102%	90%	110%	94%	90%	110%	97%	80%	120%
Sulphate	7644477		1.11	1.20	7.8%	< 0.10	99%	90%	110%	102%	90%	110%	104%	80%	120%
Ortho Phosphate as P	7644477		<0.50	<0.50	NA	< 0.10	105%	90%	110%	96%	90%	110%	104%	80%	120%
Reactive Silica	7631754		< 0.05	< 0.05	NA	< 0.05	99%	90%	110%	104%	90%	110%	105%	80%	120%
Ammonia as N	7630238		<0.02	<0.02	NA	< 0.02	90%	90%	110%	98%	90%	110%	97%	80%	120%
Total Phosphorus	7637686		<0.05	<0.05	NA	< 0.05	100%	80%	120%	96%	90%	110%	97%	70%	130%
Total Organic Carbon	7635847		37.4	33.9	9.8%	< 0.5	98%	90%	110%	103%	90%	110%	110%	80%	120%
Colour	7633647		<5	<5	NA	< 5	97%	90%	110%	NA			NA		
Turbidity	7638949		<0.5	<0.5	NA	< 0.5	104%	90%	110%	NA			NA		
Calcium	7639576		91.7	93.7	2.2%	< 0.05	106%	90%	110%	105%	90%	110%	107%	70%	130%
Magnesium	7639576		6.95	7.05	1.4%	< 0.05	100%	90%	110%	101%	90%	110%	103%	70%	130%
Sodium	7639576		18.1	18.0	0.6%	< 0.05	99%	90%	110%	99%	90%	110%	98%	70%	130%
Potassium	7639576		0.22	0.24	NA	< 0.05	101%	90%	110%	100%	90%	110%	99%	70%	130%
Aluminum	7637450		<0.004	0.007	NA	< 0.004	103%	90%	110%	103%	90%	110%	96%	70%	130%
Antimony	7637450		<0.003	<0.003	NA	< 0.003	97%	90%	110%	86%	90%	110%	87%	70%	130%
Arsenic	7637450		<0.003	<0.003	NA	< 0.003	99%	90%	110%	94%	90%	110%	98%	70%	130%
Barium	7637450		0.062	0.060	3.3%	< 0.002	97%	90%	110%	95%	90%	110%	92%	70%	130%
Beryllium	7637450		<0.001	<0.001	NA	< 0.001	103%	90%	110%	98%	90%	110%	102%	70%	130%
Boron	7637450		0.014	0.014	NA	< 0.010	106%	90%	110%	99%	90%	110%	91%	70%	130%
Cadmium	7637450		<0.001	<0.001	NA	< 0.001	100%	90%	110%	101%	90%	110%	99%	70%	130%
Chromium	7637450		<0.003	<0.003	NA	< 0.003	99%	90%	110%	97%	90%	110%	98%	70%	130%
Cobalt	7637450		<0.001	<0.001	NA	< 0.001	105%	90%	110%	100%	90%	110%	100%	70%	130%
Copper	7637450		0.016	0.016	0.0%	< 0.003	99%	90%	110%	100%	90%	110%	95%	70%	130%
Iron	7637450		0.060	0.071	16.8%	< 0.010	104%	90%	110%	94%	90%	110%	95%	70%	130%
Lead	7637450		<0.002	<0.002	NA	< 0.002	103%	90%	110%	106%	90%	110%	97%	70%	130%
Manganese	7637450		0.008	0.008	NA	< 0.002	105%	90%	110%	101%	90%	110%	100%	70%	130%
Mercury	7633469		<0.0001	<0.0001	NA	< 0.0001	101%	90%	110%	100%	90%	110%	101%	80%	120%
Molybdenum	7637450		<0.002	<0.002	NA	< 0.002	99%	90%	110%	95%	90%	110%	95%	70%	130%

AGAT Laboratories

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Quality Assurance

CLIENT NAME: THURBER ENGINEERING LTD

AGAT WORK ORDER: 16T105987

PROJECT: 19-1605-196

ATTENTION TO: MARK FARRANT

SAMPLING SITE:

SAMPLED BY:

Water Analysis (Continued)

RPT Date: Jun 30, 2016			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Nickel	7637450		<0.003	<0.003	NA	< 0.003	103%	90%	110%	100%	90%	110%	98%	70%	130%
Selenium	7637450		<0.004	<0.004	NA	< 0.004	99%	90%	110%	96%	90%	110%	97%	70%	130%
Silver	7637450		<0.002	<0.002	NA	< 0.002	101%	90%	110%	104%	90%	110%	106%	70%	130%
Strontium	7637450		0.166	0.169	1.8%	< 0.005	100%	90%	110%	94%	90%	110%	90%	70%	130%
Thallium	7637450		<0.006	<0.006	NA	< 0.006	90%	90%	110%	100%	90%	110%	94%	70%	130%
Tin	7637450		<0.002	<0.002	NA	< 0.002	97%	90%	110%	91%	90%	110%	92%	70%	130%
Titanium	7637450		<0.002	<0.002	NA	< 0.002	101%	90%	110%	97%	90%	110%	94%	70%	130%
Tungsten	7637450		<0.010	<0.010	NA	< 0.010	99%	90%	110%	100%	90%	110%	95%	70%	130%
Uranium	7637450		<0.002	<0.002	NA	< 0.002	94%	90%	110%	106%	90%	110%	101%	70%	130%
Vanadium	7637450		<0.002	<0.002	NA	< 0.002	97%	90%	110%	97%	90%	110%	96%	70%	130%
Zinc	7637450		0.007	0.007	NA	< 0.005	103%	90%	110%	98%	90%	110%	95%	70%	130%
Zirconium	7637450		<0.004	<0.004	NA	< 0.004	97%	90%	110%	93%	90%	110%	92%	70%	130%

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL (Reporting Limit), the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.
QA Qualifier for Antimony: In a multi element scan for lab control standards and matrix spikes, up to 10% of analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

TSS (Water)

Total Suspended Solids	7671414		<10	<10	NA	< 10	96%	80%	120%	NA			NA		

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL (Reporting Limit), the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By:

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

QA Violation

CLIENT NAME: THURBER ENGINEERING LTD

AGAT WORK ORDER: 16T105987

PROJECT: 19-1605-196

ATTENTION TO: MARK FARRANT

RPT Date: Jun 30, 2016			REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Sample Id	Sample Description	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
				Lower	Upper		Lower	Upper		Lower	Upper
Water Quality Assessment (mg/L)											
Antimony		407-02	97%	90%	110%	86%	90%	110%	87%	70%	130%

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL (Reporting Limit), the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.
QA Qualifier for Antimony: In a multi element scan for lab control standards and matrix spikes, up to 10% of analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Method Summary

CLIENT NAME: THURBER ENGINEERING LTD

AGAT WORK ORDER: 16T105987

PROJECT: 19-1605-196

ATTENTION TO: MARK FARRANT

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Water Analysis			
Aluminum	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Antimony	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Arsenic	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Barium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Beryllium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Boron	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Cadmium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Chromium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Cobalt	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Copper	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Iron	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Lead	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Manganese	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Molybdenum	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Nickel	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Selenium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Silver	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Strontium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Thallium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Tin	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Titanium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Tungsten	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Uranium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Vanadium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Zinc	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Zirconium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Total Suspended Solids	INOR-93-6028	SM 2540 D	BALANCE
Electrical Conductivity	INOR-93-6000	SM 2510 B	PC TITRATE
pH	INOR-93-6000	SM 4500-H+ B	PC TITRATE
Saturation pH		SM 2320 B	CALCULATION
Langelier Index		SM 2330B	CALCULATION
Total Hardness (as CaCO3)	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Total Dissolved Solids	INOR-93-6028	SM 2540 C	BALANCE
Alkalinity (as CaCO3)	INOR-93-6000	SM 2320 B	PC TITRATE
Bicarbonate (as CaCO3)	INOR-93-6000	SM 2320 B	PC TITRATE
Carbonate (as CaCO3)	INOR-93-6000	SM 2320 B	PC TITRATE
Hydroxide (as CaCO3)	INOR-93-6000	SM 2320 B	PC TITRATE
Fluoride	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Chloride	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Nitrate as N	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Nitrite as N	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Bromide	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Sulphate	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Ortho Phosphate as P	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Reactive Silica	INOR-93-6047	AQ2 EPA-122A & SM 4500 SiO2 D	AQ2 DISCRETE ANALYSER
Ammonia as N	INOR-93-6059	QuikChem 10-107-06-1-J & SM 4500 NH3-F	LACHAT FIA
Total Phosphorus	INOR-93-6057	QuikChem 10-115-01-3-A & SM 4500-P I	LACHAT FIA

AGAT Laboratories

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MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
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http://www.agatlabs.com

Method Summary

CLIENT NAME: THURBER ENGINEERING LTD

AGAT WORK ORDER: 16T105987

PROJECT: 19-1605-196

ATTENTION TO: MARK FARRANT

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Total Organic Carbon	INOR-93-6049	EPA 415.1 & SM 5310	SHIMADZU CARBON ANALYZER
Colour	INOR-93-6046	SM 2120 B	SPECTROPHOTOMETER
Turbidity	INOR-93-6044	SM 2130 B	NEPHELOMETER
Calcium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Magnesium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Sodium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Potassium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Mercury	MET-93-6100	EPA SW 846 7470 & 245.1	CVAAS
% Difference/ Ion Balance		SM 1030 E	CALCULATION

AGAT Laboratories

1 Blue Cooler

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water intended for human consumption)

Laboratory Use Only

Work Order #: 16T105987

Cooler Quantity:

Arrival Temperatures: 8.9 | 9.1 | 9.1 / 7.9 | 8.1 | 8.1

Custody Seal Intact: ☐Yes ☐No ☐N/A

Notes:

Report Information:

Company: Thurber Engineering Ltd
Contact: Mark Farrant
Address: 103, 2010 Winston Park Drive
Oakville, ON L6H 5R7
Phone: 905-829 8666 Fax: 905-829-1166
Reports to be sent to:
1. Email: mfarrant@thurber.ca
2. Email: dpizycki@thurber.ca

Regulatory Requirements: ☐ No Regulatory Requirement

(Please check all applicable boxes)

☐ Regulation 153/04
Table ____ *Indicate One*
☐ Ind/Com
☐ Res/Park
☐ Agriculture

Soil Texture *(Check One)*
☐ Coarse
☐ Fine

☐ Sewer Use
☐ Sanitary
☐ Storm

Region ____ *Indicate One*

☐ Regulation 558
☐ CCME
☐ Prov. Water Quality Objectives (PWQO)
☐ Other
Indicate One

Is this submission for a **Record of Site Condition?** ☐ Yes ☐ No

Report Guideline on *Certificate of Analysis* ☐ Yes ☐ No

Turnaround Time (TAT) Required:

Regular TAT ☐ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ 1 Business Day

OR Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

Project Information:

Project: 19-160J-196
Site Location: Winston Churchill & Hwy 407
Sampled By: DTP
AGAT Quote #: ____ PO: ____
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☑ No ☐

Company:
Contact:
Address:
Email:

Sample Matrix Legend

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions
407-02	15/06/16		~~6~~ 7	GW	
407-02	15/06/16		1	GW	* Filter in lab.

(Check Applicable)

Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	ORPs: ☐B-HWS ☐Cl ☐CN ☐Cr^{6+} ☐EC ☐FOC ☐NO_3/NO_2 ☐Total N ☐Hg ☐pH ☐SAR	Nutrients: ☐TP ☐NH_3 ☐TKN ☐NO_3 ☐NO_2 ☐NO_3/NO_2	Volatiles: ☐VOC ☐BTEX ☐THM	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	Sewer Use	Water Quality Assessment	Metals
															/	/

Print Name and Sign: V. Deepa Ryder — Date: — Time: — Samples Received By (Print Name and Sign): — Date: 2016/06/16 — Time: 9:10

Print Name and Sign: — Date: 2016/06/16 — Time: 10:35 — Samples Received By (Print Name and Sign): — Date: — Time:

Page 1 of 1

N°: T 022514

Pink Copy - Client | Yellow Copy - AGAT | White Copy - AGAT

Date Issued: November 2, 2015

THURBER

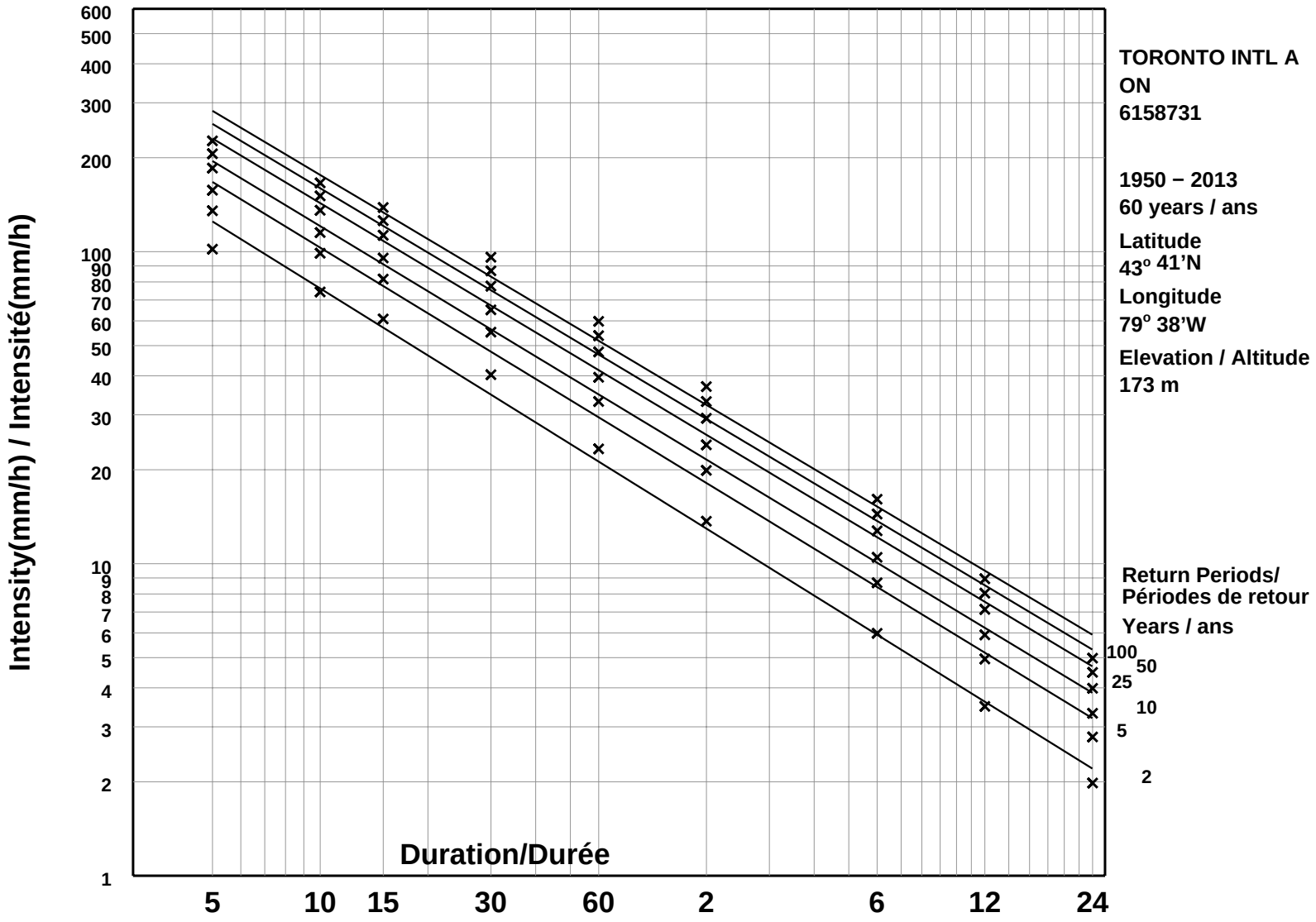
Appendix F

Short Duration Rainfall Intensity-Duration-Frequency Curves

Short Duration Rainfall Intensity−Duration−Frequency Data

2014/12/21

Données sur l’intensité, la durée et la fréquence des chutes de pluie de courte durée



Environment Canada Environnement Canada

Canada

THURBER

Appendix G

MOE Well Records and Well Survey Results

THURBER

TABLE G1
MOE Water Well Record Search
Winston Churchill Boulevard
Highway 401 to Embleton Road
(500 m Radius)

Well ID	Date Completed	Depth (m)	Depth to Bedrock (m)	Static Level (m)	Final Status	Use 1	Use 2
2801534	2/9/1966	19.2	7.6	3.0	Water Supply	Domestic	-
2803938	9/20/1972	10.7	9.1	4.6	Water Supply	Domestic	-
2805283	6/6/1978	9.8	9.1	8.5	Water Supply	Domestic	-
2805332	6/6/1978	21.3	11.0	-	Abandoned-Supply	-	-
2807789	2/25/1991	26.2	6.1	-	Abandoned-Supply	Commerical	-
2807366	3/16/1983	7.6	-	2.4	Water Supply	Domestic	-
4902907	8/8/1968	16.2	15.8	-	Test Hole	-	-
4902910	8/13/1968	19.2	18.6	2.4	Test Hole	Not Used	-
4902077	4/15/1954	38.1	-	12.2	Water Supply	Domestic	-
4906312	6/13/1985	12.2	-	2.1	Water Supply	Domestic	-
4908163	11/21/1996	39.6	18.3	2.7	Water Supply	Irrigation	-
4906662	3/24/1987	18.3	-	1.8	Water Supply	Domestic	-
4903552	2/19/1971	17.4	17.1	4.6	Abandoned-Quality	-	-
4909848	6/28/2005	-	-	1.2	Abandoned-Other	Not Used	-
7122584	11/12/2008	-	-	-	Test Hole	Monitoring and Test Hole	-
7101720	1/21/2008	-	-	-	Monitoring and Test Hole	Monitoring and Test Hole	-
2801538	12/12/1966	10.7	7.0	6.1	Water Supply	Domestic	-
2803937	10/26/1972	13.1	-	4.6	Water Supply	Domestic	-
2805232	6/19/1978	15.2	13.1	-	Abandoned-Supply	-	-
4909849	6/28/2005	-	-	1.5	Abandoned-Other	Not Used	-
4909868	7/18/2005	21.0	-	15.0	Abandoned-Other	Not Used	-
7101720	1/21/2008	7.3	-	-	Monitoring and Test Hole	Monitoring and Test Hole	-
7122584	11/12/2008	6.1	-	-	Test Hole	Monitoring and Test Hole	-
2802741	7/2/1966	14.0	-	6.1	Water Supply	Domestic	-
4902909	8/12/1968	16.5	14.0	-	Test Hole	-	-
7101720	1/21/2008	-	-	-	Monitoring and Test Hole	Monitoring and Test Hole	-
2801535	10/21/1965	7.9	7.6	4.6	Water Supply	Domestic	-
2802736	9/9/1960	17.4	-	4.0	Water Supply	Livestock	Domestic
4906722	8/21/1986	14.3	13.4	6.1	Water Supply	Domestic	-

THURBER

TABLE G1
MOE Water Well Record Search
Winston Churchill Boulevard
Highway 401 to Embleton Road
(500 m Radius)

Well ID	Date Completed	Depth (m)	Depth to Bedrock (m)	Static Level (m)	Final Status	Use 1	Use 2
2801531	12/26/1962	12.8	10.7	7.6	Water Supply	Domestic	-
2801537	12/9/1966	10.1	6.7	4.6	Water Supply	Domestic	-
2801540	12/7/1965	9.8	-	3.0	Water Supply	Domestic	-
2805145	5/6/1977	11.6	-	6.7	Water Supply	Domestic	-
2807362	7/24/1989	10.1	7.3	3.7	Water Supply	Domestic	-
7122584	11/13/2008	-	-	-	Test Hole	Monitoring and Test Hole	-
2801528	9/22/1965	18.3	15.2	3.0	Water Supply	Domestic	-
2802735	4/27/1950	23.5	-	6.1	Water Supply	Domestic	-
2806422	6/16/1982	47.2	17.7	4.6	Water Supply	Domestic	-
4902915	8/21/1968	13.4	11.9	-	Test Hole	-	-
4902064	8/5/1958	15.5	-	3.7	Water Supply	Commerical	Domestic
2801525	6/9/1964	12.2	-	6.1	Water Supply	Domestic	-
2802737	12/27/1954	20.4	-	4.3	Water Supply	Domestic	-
2802739	7/13/1962	13.4	-	9.1	Water Supply	Domestic	-
2805235	6/26/1978	10.7	-	3.4	Water Supply	Domestic	-
4902914	8/19/1968	11.9	11.3	5.8	Test Hole	Not Used	-
4902073	7/11/1959	11.6	-	4.9	Water Supply	Domestic	-
7122584	11/12/2008	-	-	-	Test Hole	Monitoring and Test Hole	-
2801536	11/5/1966	10.1	7.0	4.6	Water Supply	Domestic	-
4905556	7/25/1979	8.8	-	1.5	Water Supply	Domestic	-
7051382	7/13/2007	15.6	-	-	-	Other	-
2807671	3/14/1989	18.3	-	3.4	Water Supply	Commerical	-
4904131	7/25/1973	-	-	-	Abandoned-Quality	-	-
4906321	6/15/1985	22.9	15.8	3.4	Abandoned-Quality	Commerical	-
4902694	10/12/1961	10.4	-	3.7	Water Supply	Domestic	-
4909859	6/4/2005	5	-	-	Test Hole	Not Used	-
7122584	11/11/2008	-	-	-	Test Hole	Monitoring and Test Hole	-
2801526	7/13/1964	13.4	-	6.1	Water Supply	Domestic	-
2807635	7/13/1990	15.2	6.4	4.9	Water Supply	Irrigation	-

THURBER

TABLE G1
MOE Water Well Record Search
Winston Churchill Boulevard
Highway 401 to Embleton Road
(500 m Radius)

Well ID	Date Completed	Depth (m)	Depth to Bedrock (m)	Static Level (m)	Final Status	Use 1	Use 2
2801527	11/13/1964	7.9	-	5.5	Water Supply	Domestic	-
2801530	11/10/1961	11	4.6	5.2	Water Supply	Livestock	-
4904204	9/8/1973	9.1	8.5	4.6	Water Supply	Domestic	-
4902916	8/22/1968	12.8	11.6	-	Test Hole	-	-
4902065	12/20/1958	17.1	14.6	5.5	Water Supply	Domestic	-
2802738	8/6/1955	12.8	-	2.4	Water Supply	Domestic	-
2803940	8/21/1972	10.7	9.1	3.7	Water Supply	Domestic	-
2806714	6/6/1987	11.9	-	3	Water Supply	Domestic	-
4903081	5/6/1968	29.6	22.9	14.3	Water Supply	Domestic	-
4905270	10/27/1976	17.4	-	6.1	Water Supply	Domestic	-
4909869	7/18/2005	2	-	2.2	Abandoned-Other	Not Used	-
2801522	8/1/1955	24.4	12.5	5.5	Water Supply	Domestic	-
2801524	8/20/1960	11.9	-	3	Water Supply	Domestic	-
2805679	8/19/1980	11.6	8.2	3	Water Supply	Domestic	-
2808649	11/14/1996	16.8	9.8	1.2	Water Supply	Domestic	-
2810650	10/13/2006	93	12.2	11.3	Water Supply	Domestic	-
7122584	11/11/2008	-	-	-	Test Hole	Monitoring and Test Hole	-
Averages:		**16.5**	**11.5**	**4.9**			

THURBER

TABLE G2
Winston Churchill Boulevard
Highway 401 to Embleton Road
Record of Residents Contacted

Property	Street Address	Contact Name	Initial Contact (Letter)	Secondary Contact (Phone)	Exsisting Data	Notes on Follow-up Contact	Participation in Survey
1	16574 Steeles Ave.	Unknown	Sent	Unknown	No	Phone Number Unavailable	No
2	16622 Steeles Ave.	Unknown	Sent	Unknown	No	Phone Number Unavailable	No
3	16682 Steeles Ave.	Unknown	Sent	Unknown	No	Phone Number Unavailable	No
4	16764 Steeles Ave.	John Budge	Sent	N/A	No	Responded to Survey by Mail	Yes
5	16784 Steeles Ave.	Unknown	Returned	N/A	No	Letter Returned to Sender	No
6	16786 Steeles Ave.	Unknown	Sent	Unknown	No	Phone Number Unavailable	No
7	16824 Steeles Ave.	Tony Gaspar	Sent	Howeowner Contacted	No	Responded by phone. Did not wish to particpate in the survey.	No
8	16863 Steeles Ave.	Unknown	Sent	Unknown	No	Phone Number Unavailable	No
9	16917 Steeles Ave.	Maria Hachmann	Sent	Unknown	No	Phone Number Unavailable	No
10	1803 Greenview Court	K Blanchard	Returned	N/A	No	Letter Returned to Sender	No
11	2727-2777 Meadowpine Blvd.	Meadowpine Land Inc Attn Dean Cutting	Sent	Unknown	No	Phone Number Unavailable	No
12	2800 Meadowpine Blvd.	Unknown	Sent	Unknown	No	Phone Number Unavailable	No
13	2834 Embleton Rd.	Unknown	Sent	Thurber Contacted	No	Responed by Phone	No
14	2845 Embleton Rd.	Unknown	Sent	Thurber Contacted	No	Phone Number Unavailable	No
15	2846 Embleton Rd.	Unknown	Sent	Thurber Contacted	No	Left Voicemail to No Response	No
16	2847 Embleton Rd.	Unknown	Returned	N/A	No	Letter Returned to Sender	
17	2910 Embleton Rd.	Unknown	Sent	Unknown	No	Phone Number Unavailable	No
18	2913 Embleton Rd.	Unknown	Sent	Unknown	No	Phone Number Unavailable	No
19	2922 Embleton Rd.	Berislav Skoko	Sent	Thurber Contacted	No	Left Voicemail to No Response	No
20	2923 Steeles Ave.	Unknown	Returned	N/A	No	Letter Returned to Sender	No
21	2937 Embleton Rd.	Arno & Norma Ilic	Sent	N/A	No	Responded to Survey by Mail	Yes
22	2938 Embleton Rd.	H Neto	Sent	Thurber Contacted	No	Left Voicemail to No Response	No
23	2942 Steeles Ave.	Unknown	Returned	N/A	No	Letter Returned to Sender	No
24	2970 Embleton Rd.	Unknown	Sent	Unknown	No	Phone Number Unavailable	No

THURBER

TABLE G2
Winston Churchill Boulevard
Highway 401 to Embleton Road
Record of Residents Contacted

Property	Street Address	Contact Name	Initial Contact (Letter)	Secondary Contact (Phone)	Exsisting Data	Notes on Follow-up Contact	Participation in Survey
25	2974 Embleton Rd	Eva Burton	Sent	Unknown	No	Phone Number Unavailable	No
26	7825 Winston Churchill Blvd.	Unknown	Returned	N/A	No	Letter Returned to Sender	No
27	7869 10 Line	Unknown	Returned	N/A	No	Letter Returned to Sender	No
28	7870 Winston Churchill Blvd.	Unknown	Returned	N/A	No	Letter Returned to Sender	No
29	7886 Winston Churchill Blvd.	A Capobianco & Sons Limited	Sent	Unknown	No	Phone Number Unavailable	No
30	7940 Winston Churchill Blvd.	Unknown	Sent	Unknown	No	Phone Number Unavailable	No
31	7954 Winston Churchill Blvd.	A U-Store It Facility Inc	Sent	Unknown	No	Phone Number Unavailable	No
32	7989 10 Line	Unknown	Returned	N/A	No	Letter Returned to Sender	No
33	7995 Winston Churchill Blvd.	Unknown	Sent	Unknown	No	Phone Number Unavailable	No
34	8046 Winston Churchill Blvd.	Fernando Gomes	Sent	Unknown	No	Phone Number Unavailable	No
35	8120 Winston Churchill Blvd.	Helen Whaley	Sent	Unknown	No	Phone Number Unavailable	No
36	8148 Winston Churchill Blvd.	Kenneth Whaley	Sent	Thurber Contacted	No	Verbal confirmation via telephone that the survey will be completed.	No
37	8149 Winston Churchill Blvd.	Unknown	Returned	N/A	No	Letter Returned to Sender	No
38	8175 Winston Churchill Blvd.	William Brohman	Sent	Unknown	No	Phone Number Unavailable	No
39	8182 Winston Churchill Blvd.	Larry May	Sent	Unknown	Yes	Phone Number Unavailable	No
40	8194 Winston Churchill Blvd.	Valda May	Sent	Unknown	Yes	Phone Number Unavailable	No
41	8195 Winston Churchill Blvd.	Slavica Petrovski	Sent	Unknown	No	Phone Number Unavailable	No
42	8214 Winston Churchill Blvd.	Antonio & Antonetta Marinucci	Sent	Attempted	Yes	Phone Number Out of Service	
43	8217 Winston Churchill Blvd.	John May	Sent	Thurber Contacted	No	Phone Number Out of Service	No
44	8232 Winston Churchill Blvd.	John & Deborah Hansma	Sent	Unknown	Yes	Phone Number Unavailable	No
45	8246 Winston Churchill Blvd.	Mahesinder Virk	Sent	Unknown	Yes	Phone Number Unavailable	No
46	8301 Winston Churchill Blvd.	Maple Lodge Farms Ltd.	Sent	Unknown	No	Phone Number Unavailable	No
47	8484 Winston Churchill Blvd.	Primo Manzon	Sent	Thurber Contacted	No	Left Voicemail to No Response	
48	8490 Winston Churchill Blvd.	Ensor Bigelow	Sent	Unknown	No	Phone Number Unavailable	No
49	8504 Winston Churchill Blvd.	Audrey Collier	Sent	Thurber Contacted	No	Verbal confirmation via telephone that the survey will be completed.	No
50	8564 Winston Churchill Blvd.	Kam Lee	Sent	Unknown	No	Phone Number Unavailable	No

THURBER

TABLE G2
Winston Churchill Boulevard
Highway 401 to Embleton Road
Record of Residents Contacted

Property	Street Address	Contact Name	Initial Contact (Letter)	Secondary Contact (Phone)	Exsisting Data	Notes on Follow-up Contact	Participation in Survey
51	8597 Winston Churchill Blvd.	Michael and Marja Mol	Sent	N/A	No	Responded to Survey by Mail	Yes
52	8602 Winston Churchill Blvd.	Sunder Punia	Sent	Thurber Contacted	No	Responded to Survey by Phone	Yes
53	8656 Winston Churchill Blvd.	William Laidlaw	Sent	Unknown	No	Phone Number Unavailable	No
54	8688 Winston Churchill Blvd.	Gwendolyn Laidlaw	Sent	Thurber Contacted	No	Left Voicemail to No Response	No
55	8722 Winston Churchill Blvd.	Henry Golow	Sent	Unknown	No	Phone Number Unavailable	No
56	8748 Winston Churchill Blvd.	Joe Gasparro Limited	Sent	Unknown	No	Phone Number Unavailable	No
57	8768 Winston Churchill Blvd.	Dr. Peter & Penny Chin	Sent	Unknown	No	Phone Number Unavailable	No
58	8773 Winston Churchill Blvd.	Guriqbal Dhaliwal	Sent	Thurber Contacted	No	Responded to Survey Phone	Yes
59	8791 Winston Churchill Blvd.	Satinderpal Randhawa	Sent	Unknown	No	Phone Number Unavailable	No
60	8800 Winston Churchill Blvd.	Gursharan Bharaj	Sent	Unknown	No	Phone Number Unavailable	No
61	8836 Winston Churchill Blvd.	Unknown	Sent	Unknown	No	Phone Number Unavailable	No
62	9021 Winston Churchill Blvd.	Pheasant Ridge Estates Inc.	Sent	Thurber Contacted	No	Phone Number Out of Service	No
63	9065 Winston Churchill Blvd.	Unknown	Returned	N/A	No	Letter Returned to Sender	No
64	9118 Winston Churchill Blvd.	Croatian Center	Sent	N/A	No	Responded to Survey by Mail	Yes
65	Unknown	Infrastructure Ontario Property	Sent	Unknown	No	Phone Number Unavailable	No
66	Unknown	City of Brampton	Sent	Unknown	No	Phone Number Unavailable	No
67	Unknown	Panetta Immacolata	Sent	Unknown	No	Phone Number Unavailable	No
68	Unknown	Orlando Corporation	Sent	Unknown	No	Phone Number Unavailable	No

THURBER

TABLE G3
Winston Churchill Boulevard
Highway 401 to Embleton Road
Well Survey Results

Street Address	Contact Name	Well Type	Well Age (yrs)	Well Depth (m)	Well Depth (ft)	Well Diameter (m)	Water Depth (m)	Water Depth (ft)	Well Use	Used for Drinking	Well Ever Dry	Problems with Water	Additional Notes
16764 Steeles Ave.	John Budge	Drilled	UBO	18.29	UBO	0.9	UBO	UBO	Domestic	Yes	No	No	Continuous flow of water to sump well in house; Water table has become an issue.
2834 Embleton Road	G & A Piscione	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No Wells on Property; Municipal Water Service
2937 Embleton Rd.	Aro and Norma Ilic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No Wells on Property; Municipal Water Service
8597 Winston Churchill Blvd.	Michael and Marja Mol	Dug	Approx 40	9.1	UBO	UBO	UBO	UBO	Domestic	Yes	No	Yes	Iron, Sodium
8602 Winston Churchill Blvd.	Sunder Punia	UBO	UBO	UBO	UBO	UBO	UBO	UBO	Domestic	No	UBO	No	High sodium concentration and potential bacteria. Drinking water test results clean.
8722 Winston Churchill Blvd.	Henry Golow	Dug	49	10.1	UBO	0.76	UBO	UBO	Domestic	Yes	Yes	No	None
8773 Winston Churchill Blvd.	Guriqbal Dhaliwal	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No Wells on Property; Municipal Water Service
9118 Winston Churchill Blvd.	Croatian Center	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No Wells on Property; Municipal Water Service

UBO - Unknown By Owner

THURBER

TABLE G4
Winston Churchill Boulevard
Highway 401 to Embleton Road
Record of Residents Contacted
2002/2003 Well Monitoring Program

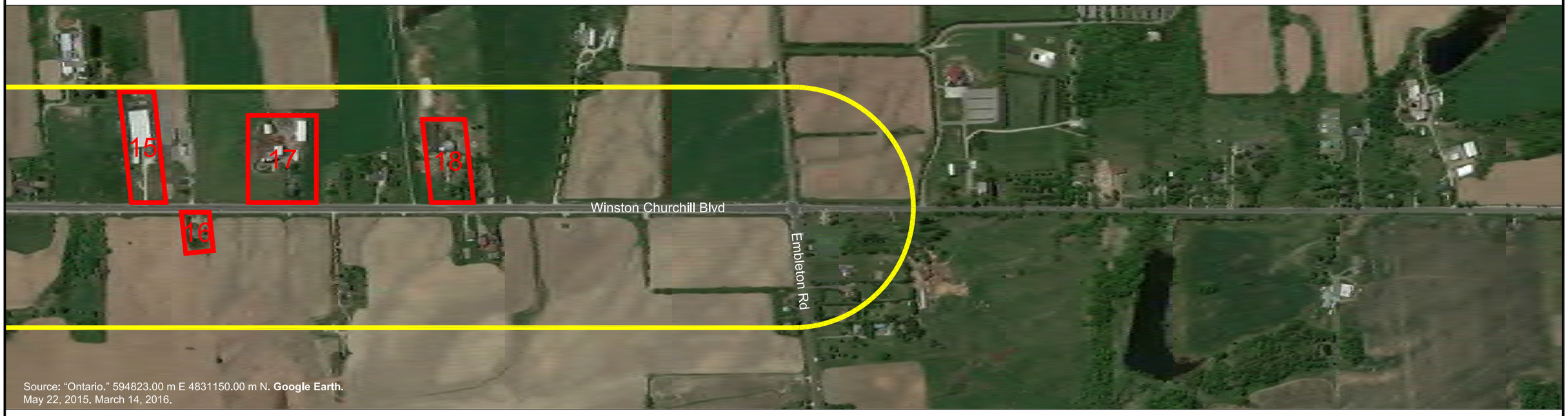
Street Address	Contact Name	Well Type	Well Depth (m)	Water Level (m)	Well Diameter (m)	Well Use	Used for Drinking	Well Ever Dry	Problems with Water	Northing	Easting
8182 Winston Churchill Blvd.	Valda May	Drilled	9.8	UNK	0.2	Domestic	Yes	No	Hard	829382.16	596579.76
8194 Winston Churchill Blvd.	Valda May	Dug	UNK	3.3	0.9	Domestic	No	No	Hard	829410.68	596567.26
8214 Winston Churchill Blvd.	Antonietta Marinucci	Dug	UNK	4.6	0.9	Domestic	Yes	No	Hard	829449.31	596530.94
8232 Winston Churchill Blvd.	John & Deborah Hansma	Dug	UNK	4.1	0.9	Domestic	Yes	Once	Hard	829466.08	596509.50
8246 Winston Churchill Blvd.	Mohinder Virk	Dug	UNK	8.8	0.9	Domestic	No	Yes	Hard	829490.44	596489.38

Notes: UNK - Unknown

THURBER

Appendix H

Areas of Potential Environmental Concern



STUDY AREA

AREAS OF POTENTIAL ENVIRONMENTAL CONCERN

HATCH MOTT MACDONALD

CONTAMINATED SOIL ASSESSMENT
WINSTON CHURCHILL BOULEVARD
CLASS EA STUDY

SITE LOCATION PLAN

JOB# 19-1605-196 BRAMPTON / HALTON HILLS, ONTARIO

THURBER ENGINEERING LTD.

ENGINEER:	DRAWN:	APPROVED:
MEF	MFA	PKC
DATE:	SCALE:	DRAWING No.
MARCH 2016	1:8000	19-1605-196-1

FILENAME: H:\Drafting\19\1605\196\ted5196-SitePlan.dwg
PLOTDATE: Mar 14, 2016 - 4:13 PM