



**THURBER** ENGINEERING LTD.

# **FOUNDATION INVESTIGATION REPORT**

## **FREDERICK STREET UNDERPASS – MUNICIPAL UTILITIES**

**HIGHWAY 7 / 85, KITCHENER, ONTARIO**

**Assignment No. 3020-E-0016-01**

**G.W.P. 3001-22-00**

**GEOCRES NO. 40P08-301**

**Client Name:** MTO

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## TABLE OF CONTENTS

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TABLE OF CONTENTS .....	I
1. INTRODUCTION .....	1
2. SITE AND PROJECT DESCRIPTION .....	1
3. INVESTIGATION PROCEDURES .....	2
3.1 Laboratory Testing .....	4
4. SITE GEOLOGY AND SUBSURFACE CONDITIONS .....	4
4.1 Regional Geology .....	4
4.2 Subsurface Conditions .....	4
4.3 Pavement Structure .....	5
4.4 Topsoil .....	5
4.5 Fill .....	6
4.6 Clayey Silt to Silty Clay Till .....	6
4.7 Silt and Sand .....	7
4.8 Sand .....	8
4.9 Groundwater Conditions .....	9
4.10 Single Well Response Test Results – Hydraulic Conductivity .....	9
5. ANALYTICAL LABORATORY TESTING .....	10
6. MISCELLANEOUS .....	11

STATEMENT OF LIMITATIONS AND CONDITIONS

## **APPENDICES**

### **APPENDIX A**

Borehole Locations and Soil Strata Drawings

### **APPENDIX B**

Record of Borehole Sheets

### **APPENDIX C**

Geotechnical Laboratory Test Results

&

Single Well Response Test (SWRT) Analysis Plots

### **APPENDIX D**

Analytical Test Results

**FOUNDATION INVESTIGATION REPORT  
FREDERICK STREET UNDERPASS - MUNICIPAL UTILITIES  
HIGHWAY 7 – NEW, KITCHENER TO GUELPH  
G.W.P. 3001-22-00**

**GEOCRES NO.:40P08-301**

**PART A: FACTUAL INFORMATION**

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**1. INTRODUCTION**

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Thurber Engineering (Thurber) has been retained by the Ministry of Transportation, Ontario (MTO) to undertake a geotechnical and hydrogeological investigation in support of the proposed utility replacement and relocation along Becker Street, Fife Avenue and Ann Street in the City of Kitchener, Ontario. A site location map is provided on Drawing 1 in Appendix A. This work is part of the foundation investigation for the Frederick Street Bridge Replacement.

This work is completed as per the MTO Work Order Number 1 and 4 of the Retainer Assignment 3020-E-0016 dated September 19, 2022, and July 11, 2023, respectively.

The purpose of the investigation was to explore the subsurface conditions at the site and, based on the data obtained, to provide a borehole location plan, records of boreholes, a stratigraphic profile, laboratory test results and a written description of the subsurface conditions. A model of the subsurface conditions was developed from the data obtained in the course of the investigation.

*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.*

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**2. SITE AND PROJECT DESCRIPTION**

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Due to widening of the Highway corridor at the Frederick Street Underpass location, the existing Frederick Street Underpass will be replaced with a longer structure and the existing utilities currently located in the vicinity will be replaced or relocated.

The proposed site is in the City of Kitchener, and the utility replacement/relocation will occur along Becker Street (southerly from the north end to the Fife Avenue intersection), along Fife Avenue (easterly from Becker Street to Ann Street), and along Ann Street (northerly from Fife Avenue to the north end). The proposed Bridge Underpass structure (MTO Structure Site No. 33X-0234/B0)

and its associated retaining walls are situated approximately 350 meters south of the Highway 7/85 Victoria Street Underpass. Details pertaining to the bridge underpass structure are provided in Thurber's draft report titled Foundation Investigation and Design Report, Frederick Street Underpass, dated September 29, 2023.

Summarized details of the proposed utility replacement / relocation as taken from the 90 % design drawings prepared by GHD are provided below:

The portion of the existing sanitary forcemain along Becker Street east of Highway 7 will be abandoned. The new 500 mm dia. sanitary forcemain (HDPE DR 13.5), situated at depths ranging between 4.0 to 5.5 m, i.e. elevation 323.9 m (location of connection to the existing forcemain) to 318.5 m, will connect to the existing forcemain just south of Fife Avenue and Becker Street intersection. The new forcemain will run along Fife Avenue and continue along Ann Street connecting to the existing forcemain north of Ephraim Street and Ann Street intersection.

Selected portions of the existing sanitary sewer will be removed and replaced by 200 to 600 mm dia. The new sanitary sewer pipe section (PVC and Concrete) is to be located at an approximate depth of 3.5 to 5.5 m, i.e. elevation 322.2 to 318.5 m.

Selected sections of existing storm sewer will be replaced by 375 to 1200 mm dia. storm sewer (PVC and Concrete) to be installed at an approximate depth ranging from 3.5 to 5.5 m, i.e. elevation ranging from 321.5 m to 318.5 m.

The proposed 150 mm dia. and 200 mm dia. Watermain (PVC) will follow the same alignment as the existing watermain of the same dia. except some localized adjustments in the horizontal alignment and vertical profile.

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### **3. INVESTIGATION PROCEDURES**

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The subsurface investigation involved the completion of a total of fifteen (15) boreholes out of which twelve (12) boreholes designated as BH-01 to BH-12, were drilled between December 2022 and January 2023 (Work Order #1). Three additional boreholes designated as BH-13 to BH-15 were advanced under an additional scope of work (Work Order #4) due to a design change in the proposed utility alignment. These boreholes were advanced to an approximate depth ranging between 9.8 m and 12.8 m.

Utility clearances and Permits were obtained prior to mobilization to the site. The borehole locations were marked in the field by Thurber using a Trimble R10 survey unit. The coordinate system MTM NAD 83, Zone 10 was used for the boreholes.

The boreholes were advanced using truck or track mounted drill rig depending on the site access conditions. The drill rigs were supplied and operated by Elements GEO of Hamilton, Ontario. Hollow-stem augers were used to advance the boreholes and the soil samples were obtained using a 50 mm outer diameter split-spoon sampler driven by an automatic hammer in accordance with the Standard Penetration Test (SPT). Due to the proximity of the underground utilities, the upper 3.3 m of the Boreholes BH-13 and BH15 were daylighted by a vacuum truck. At Borehole BH-07, Dynamic Cone Penetration Testing (DCPT) was performed below the sampled depth to 11.5 m depth.

The as-drilled borehole locations were surveyed upon completion of drilling and are shown in the Borehole Location Plan included in Appendix A.

The drilling, sampling and in-situ testing operations were supervised on a full-time basis by a member of Thurber's technical staff. The supervisor logged the boreholes and processed the recovered soil samples for transport to Thurber's laboratory for further examination and testing.

Monitoring wells were installed in Boreholes BH-02, BH-05, BH-08, BH-11, BH-13, BH-14 and BH-15 to permit subsequent hydrogeological investigation and groundwater level monitoring. The monitoring wells consisted of a 50 mm Schedule 40 PVC pipe with a 3.05 m long slotted screen except at BH-02 where a 1.52 m long slotted screen was used. Where monitoring wells were not installed, the boreholes were backfilled with bentonite to the ground surface off the road or up to 0.15 m depth and then backfilled with cold patch asphalt to reinstate the pavement surface.

A summary of the borehole elevations, termination depths and elevations, and monitoring well tip are in the table below.

<b>Borehole</b>	<b>Ground Surface Elevation (m)</b>	<b>Borehole Depth (m) / Borehole Termination Elevation (m)</b>	<b>Monitoring Well Tip Depth (m) / Elevation (m)</b>
BH-1	325.6	9.8 / 315.7	-
BH-2	326.1	9.8 / 316.3	5.3 / 320.8
BH-3	326.3	9.9 / 316.4	-
BH-4	326.6	9.8 / 316.8	-
BH-5	326.9	9.8 / 317.1	8.8 / 318.1
BH-6	327.0	9.8 / 317.2	-
BH-7	326.8	9.8 / 317.0*	-
BH-8	325.9	9.8 / 316.1	9.1 / 316.8

Borehole	Ground Surface Elevation (m)	Borehole Depth (m) / Borehole Termination Elevation (m)	Monitoring Well Tip Depth (m) / Elevation (m)
BH-9	325.0	9.9 / 315.1	-
BH-10	323.8	9.9 / 313.9	-
BH-11	323.4	9.8 / 313.6	7.7 / 315.7
BH-12	323.3	9.8 / 313.5	-
BH-13	323.4	9.8 / 313.6	7.6 / 315.8
BH-14	318.9	12.8 / 306.1	6.1 / 312.8
BH-15	327.6	9.8 / 317.8	7.7 / 319.9

\* Dynamic Cone Penetration test (DCPT) was conducted to 11.5 m depth.

### 3.1 Laboratory Testing

The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. Selected samples were also subjected to grain size analysis and Atterberg Limits testing where appropriate. The results of the laboratory testing are summarized on the Record of Borehole sheets in Appendix B and are shown on figures in Appendix C.

Testing was carried out on samples of the fill and native soils to assess the potential for sulphate attack on buried concrete structures, as well as the potential for corrosion associated with buried steel elements of the structures. The results of the analytical testing are summarized in this report and presented in Appendix D.

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## 4. SITE GEOLOGY AND SUBSURFACE CONDITIONS

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### 4.1 Regional Geology

Based on the Ontario Geological Survey Special Volume 2, The Physiography of Southern Ontario, Third Edition by Chapman and Putnam, the site lies within the physiographic region known as the Waterloo Hills, characterized by ridges of sandy till and kames or kame moraines, with outwash sands occupying the intervening hollows.

### 4.2 Subsurface Conditions

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets included in Appendix B and interpreted stratigraphic profile is presented in Appendix A. A general description of the stratigraphy, based on the conditions encountered in the boreholes is given in

the following sections. However, the factual data presented on the Record of Borehole sheets takes precedence over this general description for interpretation of the site conditions. Classification and descriptions of coarse-grained and fine-grained soils are made in general accordance with ASTM D2487, and MTO's Soil Classification Manual, respectively.

The boundaries between soil strata on the record of boreholes have been inferred from non-continuous sampling, observation of the progress of drilling, and the results of Standard Penetration Testing. Therefore, the boundaries represent the transitions between soil deposits rather than exact planes of geological change. Variation on the stratigraphic boundaries between and beyond boreholes will exist and is to be expected.

In general, the subsurface conditions below the pavement structure and layers of a non-homogeneous fill consist of native deposits of sand and silt overlying clayey silt to silty clay till.

It should be noted that the glacial till and granular deposits may contain boulders. Possible large obstructions can be anticipated in the fill material. Contractor should be prepared for such conditions during construction.

A detailed description of the subsurface conditions is presented in the following sections.

#### **4.3 Pavement Structure**

Boreholes BH-01 to BH-13 were advanced within existing roadway sections. At Boreholes BH-01 to BH-13 locations, asphalt ranging in thickness between 40 and 175 mm was encountered at the ground surface. Asphalt was underlain by 100 to 700 mm thick layer of sand and gravel to gravelly sand fill material in all the boreholes except at Borehole BH-13 location, where approximately 200 mm thick granular base / subbase was encountered underlying asphalt.

The SPT 'N' values within the granular fill material ranged from 5 to 26 blows per 0.3 m of penetration indicating a loose to compact relative density. Natural moisture contents ranged from 3 to 20 percent.

The result of a grain size analysis test conducted on a granular fill sample (BH-10) indicated a gravel content of 28%, a sand content of 49%, and a fines content of 23%.

#### **4.4 Topsoil**

At Boreholes BH-14 and BH-15, topsoil approximately 300 mm thick was encountered at the

ground surface. The topsoil thickness may vary in other areas of the site.

#### 4.5 Fill

Fill material of approximate thickness ranging between 0.7 to 3.0 m and generally consisting of sand / sandy silt / silt and sand / sand and gravel to clayey silt was encountered underlying the pavement structure in all the boreholes except at Borehole BH-14. Boreholes BH-13 and BH-15 were daylighted up to an approximate depth of 3.3 m. The base of the fill was at elevation ranging from 320.1 to 325.3 m.

The SPT 'N' values ranged from 3 to 26 blows per 0.3 m of penetration in the sand and gravel to gravelly sand fill, from 2 to 18 blows in the sandy silt to silty sand fill, and from 6 to 9 blows in the clayey silt fill. The measured SPT 'N' values suggest that the sand and gravel to gravelly sand is very loose to compact, the sandy silt to silty sand fill is very loose to compact, and the clayey silt fill is firm to stiff.

Natural moisture contents ranged from 3 to 20 percent on samples of the sand and gravel to gravelly sand fill, 3 to 20 percent on samples of the sandy silt to silty sand fill, and 4 to 21 percent on samples of the clayey silt fill.

The results of a grain size analysis tests conducted on samples of the fill are provided on the Record of Borehole Sheets in Appendix B and illustrated in Figure 1 to 3 in Appendix C. The results are summarized as follows:

Soil Particles	Sand and Gravel to Gravelly Sand Fill (%)	Sand to Sandy Silt to Silty Sand Fill (%)	Clayey Silt Fill (%)
Gravel	21 to 28	1 to 3	0 to 5
Sand	49 to 69	46 to 90	25 to 26
Silt	10	7 to 42	50 to 57
Clay	0	2 to 9	13 to 24
Silt + Clay	23	-	-

#### 4.6 Clayey Silt to Silty Clay Till

Native clayey silt to silty clay till were encountered in all the boreholes except BH-13 and BH-15. The native cohesive till deposits were encountered underlying the fill material in Boreholes BH-04, BH-06, BH-07, and BH-12 and underlying the native cohesionless soil deposits in Boreholes BH-01, BH-08, BH-09 and BH-11. In Boreholes BH-02, BH-03, BH-04, BH-10, and BH-11, these cohesive soil deposits were found to be interbedded within the native sand deposits. Boreholes

BH-01, BH-02, BH-03, BH-04, BH-08, BH-09, BH-10, BH-12 and BH-14 were terminated within these cohesive soil deposits.

It should be noted that the glacial till deposits inherently contain cobbles and boulders.

The SPT 'N' values encountered within these native cohesive soil deposits ranged between 10 to more than 50 blows per 300 mm penetration, indicating these deposits to be stiff to hard. The measured moisture contents generally ranged from 10 to 22 percent.

The results of grain size analysis testing conducted on samples of the till deposit are provided on the Record of Borehole Sheets in Appendix B and included on Figure 8 in Appendix C. The results are summarized as follows:

<b>Soil Particles</b>	<b>(%)</b>
Gravel	0 to 5
Sand	0 to 44
Silt	35 to 65
Clay	16 to 53
Silt + Clay	72

The results of Atterberg Limits testing conducted on samples of the clayey silt till are included on Figure 9 in Appendix C and summarized below.

<b>Atterberg Limits</b>	<b>(%)</b>
Liquid Limit	16 to 43
Plastic Limit	11 to 18
Plasticity Index	5 to 25

The above results indicate that the clayey silt to silty clay till deposit is of low to medium plasticity with a group symbol ranging from CL-ML to CL and CI.

#### **4.7 Silt and Sand**

In Boreholes BH-04, BH-06 and BH-07, native deposits consisting of silt and sand to sandy silt were encountered underlying the shallow clayey silt till deposits. These layers of cohesionless soil deposits were 0.6 to 1.3 m thick and extended to the approximate depths of 2.9 to 4.1 m (elevation 324.2 to 322.5 m).

SPT 'N' values encountered within these soil deposits ranged between 13 to 21 blows per 300

mm penetration, indicating these deposits to be compact. The measured moisture contents generally ranged from 16 to 19 percent.

The results of grain size analysis testing conducted on samples of the silt and sand deposit are provided on the Record of Borehole Sheets in Appendix B and included on Figures 4 in Appendix C. The results are summarized as follows:

<b>Soil Particles</b>	<b>(%)</b>
Gravel	0 to 3
Sand	24 to 44
Silt	49 to 67
Clay	4 to 9

#### **4.8 Sand**

In all the boreholes, native sand to silty sand deposits were encountered underlying the fill material except at Borehole BH-14 where these soil deposits were encountered underlying the topsoil. These cohesionless soil deposits were generally 2.7 to 8.1 m thick and extended to the approximate depths of 3.0 to 10.1 m (elevation 320.5 to 313.6 m). In Boreholes BH-02, BH-03, BH-04, BH-05, BH-10 and BH-11, native cohesive soil deposits, generally 0.2 to 2.9 m thick were also found within the native cohesionless soil deposits. Boreholes BH-03, BH-05, BH-06, BH-07, BH-11, BH-13 and BH-15 were terminated within the sand deposits.

SPT 'N' values encountered within these native cohesionless soil deposits ranged between 8 to more than 50 blows per 300 mm penetration of split spoon sampler indicating these deposits to be loose to very dense. In Boreholes BH-03, BH-05 and BH-13, SPT 'N' values in the range of 1 to 2 blows per 300 mm penetration were also noted indicating these soil deposits to be in very loose condition. The measured moisture contents generally ranged from 8 to 30 percent.

The results of grain size analysis testing conducted on samples of the sand deposit are provided on the Record of Borehole Sheets in Appendix B and included on Figures 5 to 7 in Appendix C. The results are summarized as follows:

<b>Soil Particles</b>	<b>(%)</b>
Gravel	0 to 12
Sand	72 to 97
Silt	8 to 15
Clay	0 to 5
Silt + Clay	3 to 10

#### 4.9 Groundwater Conditions

Details of the water level observed in the boreholes upon completion of drilling and in monitoring wells are presented on the record of boreholes and summarized below.

Borehole	Date of Measurement	Groundwater Level (m)		Screened Unit	Borehole Cave-in Depth (m) after completion
		Depth	Elevation		
BH-01	-	-	-	-	9.1
BH-02	March 1, 2023	4.6	321.5	Sand	-
BH-03	-	-	-	-	6.7
BH-04	-	-	-	-	5.2
BH-05	February 1, 2023	5.5	321.4	Sand, Clayey Silt	-
	March 1, 2023	5.5	321.4		-
BH-06	-	-	-	-	5.5
BH-07	-	-	-	-	5.8
BH-08	February 1, 2023	5.3	320.6	Sand	-
	March 1, 2023	5.3	320.6		-
BH-09	-	-	-	-	4.6
BH-10	-	-	-	-	5.0
BH-11	March 8, 2023	3.9	319.5	Sand, Clayey Silt	-
BH-12	-	-	-	-	4.6
BH-13	November 9, 2023	4.4	318.9	Sand	-
	November 27, 2023	4.4	318.9		-
BH-14	November 9, 2023	0.7	318.2	Sand, Silty Clay	-
	November 27, 2023	1.0	317.9		-
BH-15	November 9, 2023	5.9	321.7	Sandy Silt, Sand	-
	November 27, 2023	5.9	321.7		-

Seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall. Perched water may be present in the fill material, old trench/infrastructure backfill, granular pavement base and/or more previous sand pockets within the native silty/clayey soils.

#### 4.10 Single Well Response Test Results – Hydraulic Conductivity

The SWRT results were analyzed using the Hvorslev method. The SWRT analysis plots are included in Appendix C. The hydraulic conductivity values calculated from the in-situ SWRTs are summarized in the following table:



Monitoring Well	Screen Interval (m BGS)	Screened Unit	Hydraulic Conductivity (m/s)
BH-02	4.5 – 7.6	Sand	$8.8 \times 10^{-5}$
BH-05	4.5 – 7.6	Sand, Clayey Silt	$4.5 \times 10^{-5}$
BH-08	4.5 – 7.6	Sand	$1.8 \times 10^{-4}$
BH-11	4.5 – 7.6	Sand, Clayey Silt	$7.8 \times 10^{-6}$
BH-13	4.5 – 7.6	Sand	$7.3 \times 10^{-5}$
BH-14	3.0 – 6.1	Sand, Silty Clay	$7.6 \times 10^{-5}$ *
BH-15	4.5 – 7.6	Sand, Sandy Silt	$1.7 \times 10^{-4}$

\*The hydraulic conductivity at BH-14 was estimated based on the grain size analysis using the Hazen method.

## 5. ANALYTICAL LABORATORY TESTING

A total of fifteen selected samples (i.e. one sample per BH) were submitted for analytical testing for corrosivity analysis and sulphide content. The analytical test results for the soil are presented in Appendix D and are summarized below.

Borehole	BH-01	BH-02	BH-03	BH-04	BH-05
Sample	SS1	SS5	SS5	SS4	SS4
Depth (m)	0 – 0.6	3.0 – 3.6	3.0 – 3.6	2.3 – 2.9	2.3 – 2.9
Sulphide (Na <sub>2</sub> CO <sub>3</sub> ) %	<0.04	<0.04	<0.04	<0.04	<0.04
Chloride (µg/g)	350	58	31	83	56
Sulphate (µg/g)	28	5	3.4	4.3	8.8
pH	8.99	9.05	9.20	8.55	9.16
Conductivity (µS/cm)	915	217	142	245	300
Resistivity (Ohm-cm)	1090	4610	7040	4080	3330
Redox Potential (mV)	276	303	242	317	231
Borehole	BH-06	BH-07	BH-08	BH-09	BH-10
Sample	SS6	SS6	SS5	SS3	SS5
Depth (m)	4.6 – 5.2	4.6 – 5.2	3.0 – 3.6	1.5 – 2.1	3.0 – 3.6
Sulphide (Na <sub>2</sub> CO <sub>3</sub> ) %	<0.04	<0.04	<0.04	<0.04	<0.04
Chloride (µg/g)	40	22	14	160	82
Sulphate (µg/g)	4.2	3.4	2.8	12.0	5.4
pH	9.30	9.28	9.32	8.86	9.42
Conductivity (µS/cm)	188	120	113	439	251



Resistivity (Ohm-cm)	5320	8330	8850	2280	3980
Redox Potential (mV)	243	371	252	306	329
<b>Borehole</b>	<b>BH-11</b>	<b>BH-12</b>	<b>BH-13</b>	<b>BH-14</b>	<b>BH-15</b>
<b>Sample</b>	<b>SS3</b>	<b>SS6</b>	<b>SS1</b>	<b>SS4</b>	<b>GS2</b>
Depth (m)	1.5 – 2.1	4.6 – 5.2	3.8 – 4.4	2.3 – 2.9	1.5 – 2.1
Sulphide (Na <sub>2</sub> CO <sub>3</sub> ) %	<0.04	<0.04	<0.01	<0.01	<0.01
Chloride (µg/g)	97	43	54	96	14
Sulphate (µg/g)	10	5.6	7.8	7.9	7.0
pH	9.13	8.91	9.15	9.04	8.48
Conductivity (µS/cm)	446	175	261	380	111
Resistivity (Ohm-cm)	2240	5710	3830	2630	9010
Redox Potential (mV)	280	309	232	238	267

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## 6. MISCELLANEOUS

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Elements Geo of Hamilton, Ontario supplied a truck and track mounted drill rig and conducted the drilling, sampling and in-situ testing operations for the present investigation.

The coordinates and elevations for the boreholes were obtained by Thurber using a Trimble R10.

The drilling and sampling operations in the field for the current investigation were supervised on a full-time basis by Thurber field technicians.

Geotechnical laboratory testing was carried out at Thurber's geotechnical laboratory. Analytical laboratory testing was carried out by SGS Canada Inc.

Overall supervision of the field program, interpretation of the data, and preparation of the report was conducted by Mr. Puneet Verma, P.Eng. and Mr. Justin Rumney, P.Geo. The report was reviewed by Mr. Keli Shi, P.Eng., and Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations projects.



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## 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

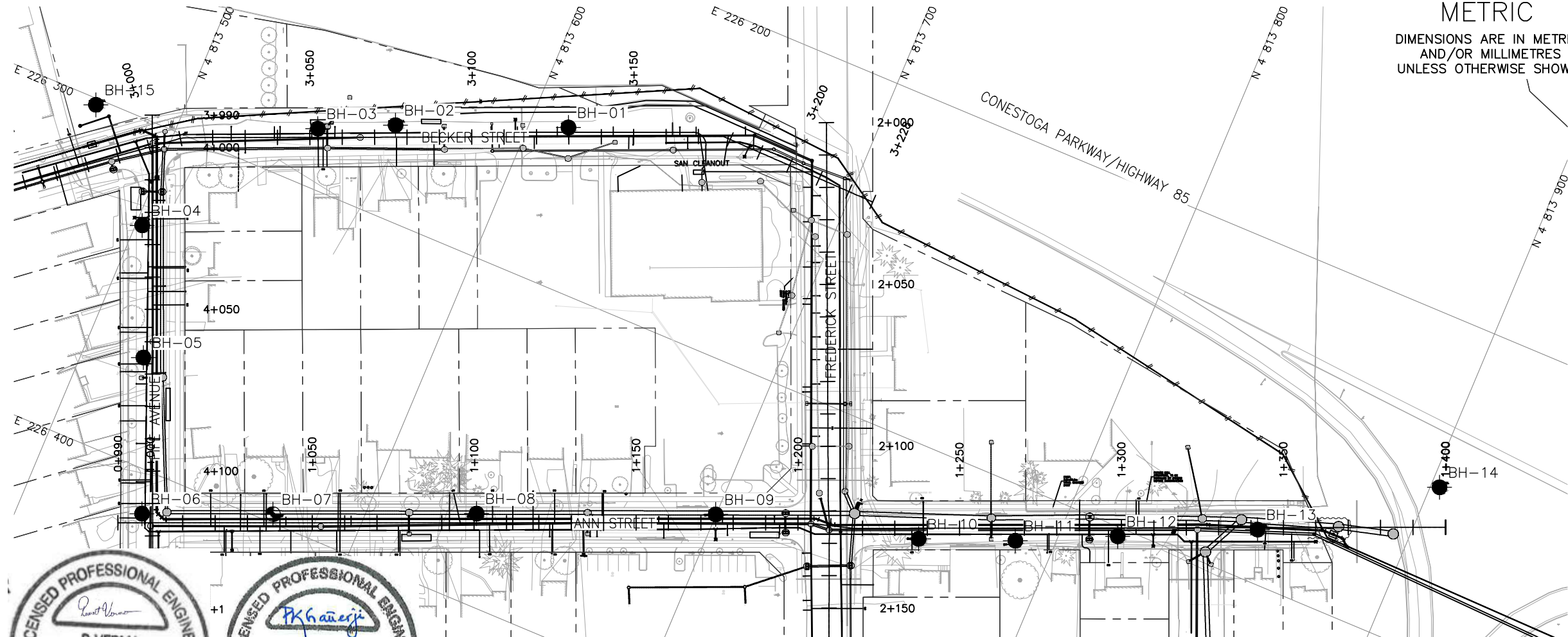
Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, 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

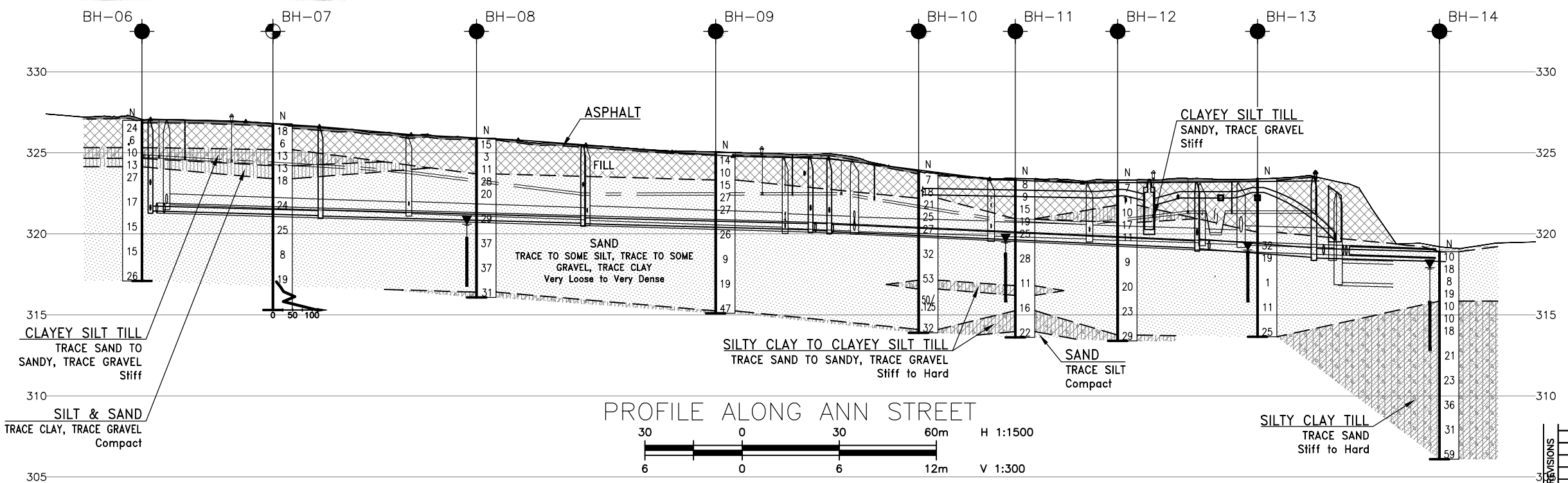
The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or 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**

### Borehole Locations and Soil Strata Drawings



NO	ELEVATION	NORTHING	EASTING
BH-13	323.4	4 813 855.9	226 284.1
BH-14	318.9	4 813 902.7	226 250.3
BH-15	327.6	4 813 474.4	226 301.9



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

CONT No  
WP No 408-88-00

HIGHWAY 85/FREDERICK ST  
MUNICIPAL STREETS  
UTILITY RELOCATIONS  
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET



KEYPLAN

LEGEND

●	Borehole
●	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
W	Water Level Upon Completion of Drilling
M	Water Level in Monitoring Well/Piezometer
W	Monitoring Well/Piezometer Screen
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

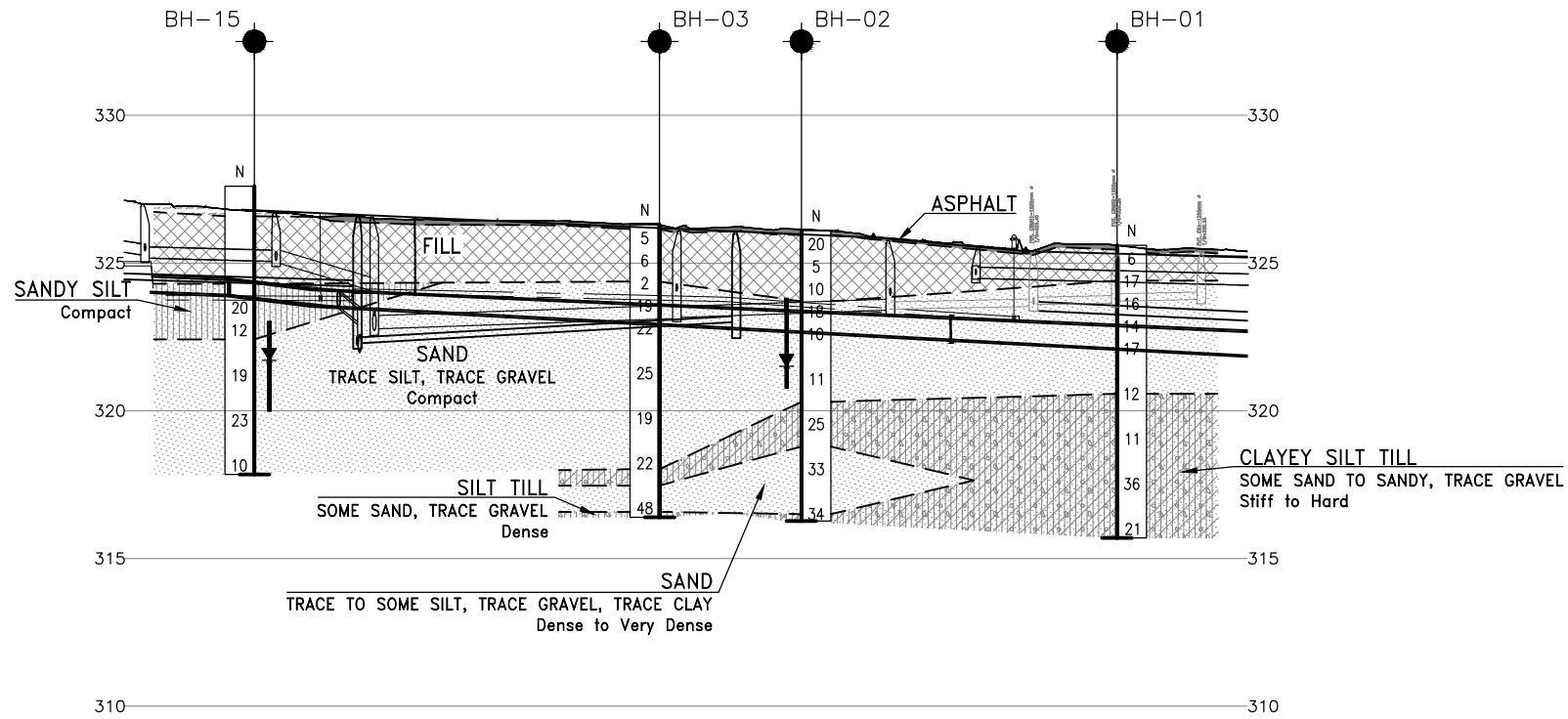
NO	ELEVATION	NORTHING	EASTING
BH-01	325.6	4 813 611.6	226 251.9
BH-02	326.1	4 813 562.1	226 271.9
BH-03	326.3	4 813 540.4	226 282.2
BH-04	326.6	4 813 502.0	226 330.7
BH-05	326.9	4 813 518.1	226 368.2
BH-06	327.0	4 813 536.4	226 412.9
BH-07	326.8	4 813 573.7	226 397.4
BH-08	325.9	4 813 631.6	226 372.8
BH-09	325.0	4 813 699.8	226 344.5
BH-10	323.8	4 813 760.5	226 327.3
BH-11	323.4	4 813 788.3	226 316.2
BH-12	323.3	4 813 816.9	226 302.8

-NOTES-

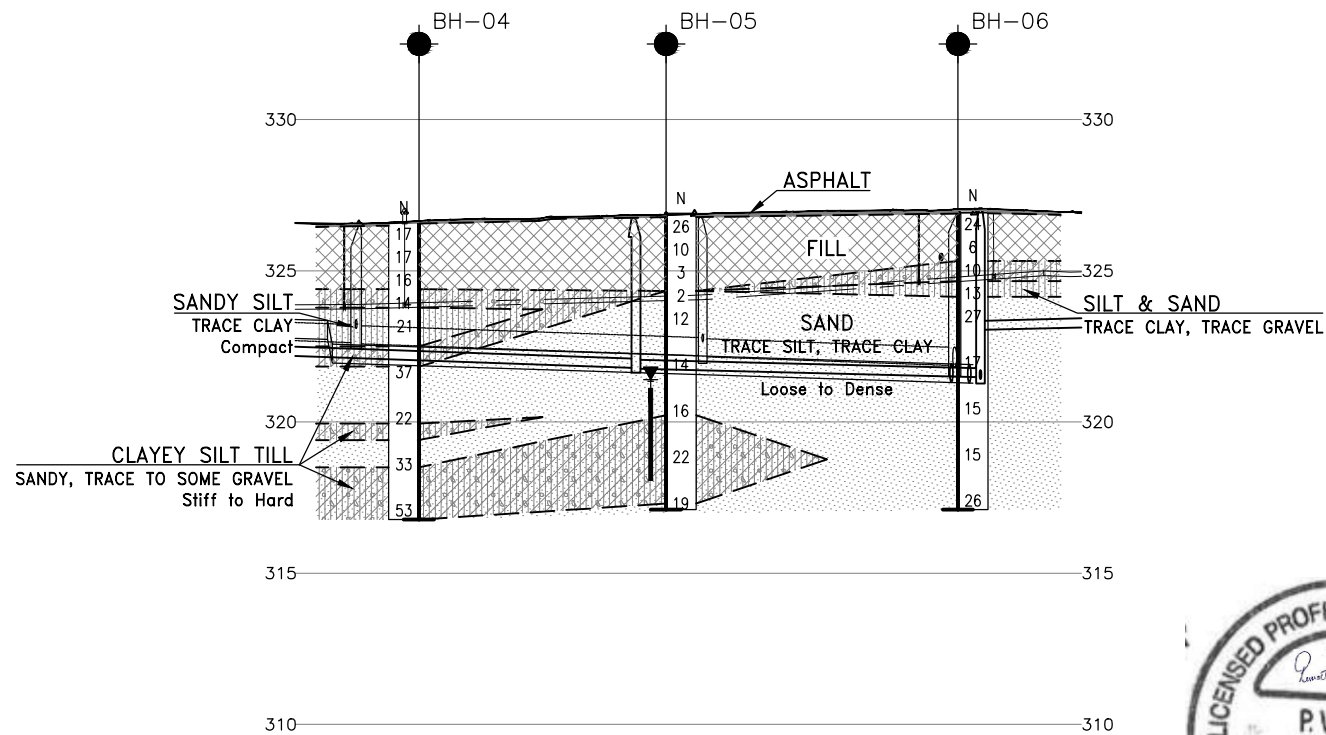
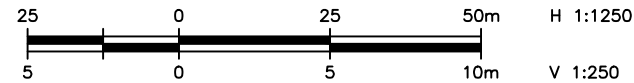
- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- Coordinate system is MTM NAD 83 Zone 10.

GEOCRES No. 40P08-301

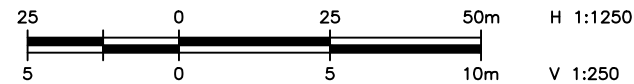
REVISIONS	DATE	BY	DESCRIPTION
DESIGN	GL	CHK -	CODE
DRAWN	MFA	CHK GL	SITE
LOAD	DATE	MAR 2024	
STRUCT	DWG	1	



# PROFILE ALONG BECKER STREET



# PROFILE ALONG FIFE AVENUE



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

CONT No  
WP No 408-88-00






HIGHWAY 85/FREDERICK ST  
MUNICIPAL STREETS  
UTILITY RELOCATIONS  
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET |



## KEYPLAN

## LEGEND

	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level Upon Completion of Drilling
	Water Level in Monitoring Well/Piezometer
	Monitoring Well/Piezometer Screen
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
BH-01	325.6	4 813 611.6	226 251.9
BH-02	326.1	4 813 562.1	226 271.9
BH-03	326.3	4 813 540.4	226 282.2
BH-04	326.6	4 813 502.0	226 330.7
BH-05	326.9	4 813 518.1	226 368.2
BH-06	327.0	4 813 536.4	226 412.9
BH-15	327.6	4 813 474.4	226 301.9

-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- 3) Coordinate system is MTM NAD 83 Zone 10.

**GEOCRES No. 40P08-301**

[illegible]

## **APPENDIX B**

### Record of Borehole Sheets

## 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 <sup>(1)</sup> '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  
 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.

# 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			

# RECORD OF BOREHOLE No BH-01

1 OF 2

METRIC

W.P. 408-88-00 LOCATION N 4 813 611.6 E 226 251.9 ORIGINATED BY HC  
DIST HWY 7/85 BOREHOLE TYPE Hollow-Stem Auger COMPILED BY JW  
DATUM Geodetic DATE 2022.12.16 - 2022.12.16 LATITUDE 43.458296 LONGITUDE -80.470635 CHECKED BY GRL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
325.6	GROUND SURFACE												
0.0	ASPHALT(175 mm)												
0.2	SAND and GRAVEL, some silt												
325.1	Loose		1	SS	6								
0.5	Brown												
	Moist (FILL)												
324.4	Clayey SILT, sandy												
1.2	Firm to Very Stiff		2	SS	17								
	Brown												
	Moist (FILL)												
	SAND, trace silt												
	Compact		3	SS	16								
	Brown												
	Moist												
			4	SS	14								
			5	SS	17								

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

## METRIC

[illegible]

# RECORD OF BOREHOLE No BH-02

1 OF 2

METRIC

W.P. 408-88-00 LOCATION N 4 813 562.1 E 226 271.9 ORIGINATED BY HC  
 DIST HWY 7/85 BOREHOLE TYPE Hollow-Stem Auger COMPILED BY JW  
 DATUM Geodetic DATE 2022.12.20 - 2022.12.20 LATITUDE 43.457853 LONGITUDE -80.470381 CHECKED BY GRL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
326.1	GROUND SURFACE							20	40	60	80	100						
0.0	ASPHALT(175 mm)						326											
0.2	Gravelly SAND Compact Brown Moist (FILL)		1	SS	20													
325.2																		
0.9	Sandy SILT, trace clay, trace gravel Loose Brown Moist (FILL)		2	SS	5		325											
324.5																		
1.6	SAND, trace silt Compact Dark Brown Moist (FILL)		3	SS	10		324											
323.7																		
2.4	SAND, trace gravel, trace fines Compact Brown Moist		4	SS	18		323											
			5	SS	10													
							322											
	Wet																	
			6	SS	11		321										7 90 3 (SI+CL)	
320.3																		
5.8	Clayey SILT, sandy, trace gravel Very Stiff Grey Wet (TILL)		7	SS	25		320										4 26 54 16	
318.8							319											
7.3	Silty SAND Dense Light Brown Wet		8	SS	33		318										0 83 15 2	
							317											
316.5																		
9.6																		
316.3	Clayey SILT, sandy, trace gravel Hard		9	SS	34													
9.8																		

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15 10 5  
(%) STRAIN AT FAILURE

## METRIC

SOIL PROFILE					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES	GROUND WATER CONDITIONS	ELEVATION SCALE
<div>DYNAMIC CONE PENETRATION RESISTANCE PLOT<div>SHEAR STRENGTH kPa<ul style="list-style-type: none"><li>○ UNCONFINED + FIELD VANE</li><li>● QUICK TRIAXIAL x LAB VANE</li></ul></div><div>PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT<div>w<sub>P</sub> w w<sub>L</sub></div></div><div>WATER CONTENT (%)</div><div>UNIT WEIGHT γ</div></div>					
<div>Continued From Previous Page</div> <div>Grey Moist (TILL)</div> <div>END OF BOREHOLE AT 9.8 m. INSTALLATION OF PIEZOMETER CONSISTS OF 50 mm DIAMETER SCHEDULE 40 PVC PIPE WITH A 1.52 m SLOTTED SCREEN.</div> <div>WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2023.03.01      4.6      321.5</div>					

# RECORD OF BOREHOLE No BH-03

1 OF 2

METRIC

W.P. 408-88-00 LOCATION N 4 813 540.4 E 226 282.2 ORIGINATED BY HC  
DIST HWY 7/85 BOREHOLE TYPE Hollow-Stem Auger COMPILED BY JW  
DATUM Geodetic DATE 2022.12.16 - 2022.12.16 LATITUDE 43.457659 LONGITUDE -80.470251 CHECKED BY GRL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE						WATER CONTENT (%) w P                      w                      w L	
326.3	GROUND SURFACE														
0.0	ASPHALT(175 mm)														
0.2	SAND and GRAVEL Brown Moist (FILL)		1	SS	5		326								
325.8															
0.4	SILT and Sand, trace gravel Loose Brown Moist (FILL)		2	SS	6		325								3 46 42 9
324.3			3	SS	2										
1.9	SAND, trace gravel, trace non-plastic fines Compact Brown Moist		4	SS	19		324								2 91 7 (SI+CL)
			5	SS	22		323								
			6	SS	25		322								
			7	SS	19		321								
			8	SS	22		318								
318.0	Clayey SILT, some sand, trace gravel Very Stiff Grey Wet (TILL)						317								
8.3															
317.4			9	SS	48										
8.8	SAND, trace gravel, trace silt Very Dense Brown Wet														
316.6															
318.4	Clayey SILT, some sand, trace														

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No BH-03

2 OF 2

METRIC

W.P. 408-88-00 LOCATION N 4 813 540.4 E 226 282.2 ORIGINATED BY HC  
DIST HWY 7/85 BOREHOLE TYPE Hollow-Stem Auger COMPILED BY JW  
DATUM Geodetic DATE 2022.12.16 - 2022.12.16 LATITUDE 43.457659 LONGITUDE -80.470251 CHECKED BY GRL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
9.9	Continued From Previous Page  gravel Dense Grey Moist (TILL)  END OF BOREHOLE AT 9.9 m. BOREHOLE CAVED TO 6.7 m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.15 m, THEN ASPHALT TO SURFACE.																

# RECORD OF BOREHOLE No BH-04

1 OF 2

METRIC

W.P. 408-88-00 LOCATION N 4 813 502.0 E 226 330.7 ORIGINATED BY HC  
DIST HWY 7/85 BOREHOLE TYPE Hollow-Stem Auger COMPILED BY JW  
DATUM Geodetic DATE 2023.01.11 - 2023.01.11 LATITUDE 43.457318 LONGITUDE -80.469646 CHECKED BY GRL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	W <sub>P</sub> W W <sub>L</sub>	WATER CONTENT (%)	20 40 60	kN/m <sup>3</sup>	GR SA SI CL		
326.6	GROUND SURFACE															
0.0 0.1	ASPHALT (75 mm)															
325.9	Gravelly SAND, silty Compact Brown Moist (FILL)		1	SS	17											
0.7	Sandy SILT, trace to some clay, trace gravel Compact Brown Moist (FILL)		2	SS	17											
324.4	Clayey SILT, sandy, some gravel Stiff Brown Moist (TILL)		3	SS	16											
2.2	Sandy SILT Compact Brown Wet		4	SS	14											
323.8	Clayey SILT, sandy, some gravel Hard Brown Wet (TILL)		5	SS	21											
2.8	SAND, trace silt Dense Brown Wet		6	SS	37											
322.5	Clayey SILT, sandy Very Stiff Grey Wet (TILL)		7	SS	22											
4.1	SAND, trace silt Dense Brown Wet		8	SS	33											
321.9	Clayey SILT, with sand, trace gravel Hard Grey Wet (TILL)		9	SS	53											
4.8	END OF BOREHOLE AT 9.8 m.															
320.0																
6.7																
319.4																
7.2																
318.6																
8.0																
316.8																
9.8																

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

## METRIC

[illegible]

# RECORD OF BOREHOLE No BH-05

1 OF 2

METRIC

W.P. 408-88-00 LOCATION N 4 813 518.1 E 226 368.2 ORIGINATED BY HC  
DIST HWY 7/85 BOREHOLE TYPE Hollow-Stem Auger COMPILED BY JW  
DATUM Geodetic DATE 2023.01.16 - 2023.01.16 LATITUDE 43.457467 LONGITUDE -80.469184 CHECKED BY GRL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE							PLASTIC LIMIT W <sub>P</sub> NATURAL MOISTURE CONTENT W      LIQUID LIMIT W <sub>L</sub>		
326.9	GROUND SURFACE							20	40	60	80	100					
0.0	ASPHALT(125 mm)																
326.6	SAND and GRAVEL Brown Moist (FILL)		1	SS	26												
0.3	Gravelly SAND, some silt Loose to Compact Brown Moist (FILL)		2	SS	10												
			3	SS	3												
324.3																	
2.6	SAND, some non-plastic fines Loose to Compact Light Brown Moist		4	SS	2												
			5	SS	12												
			6	SS	14												
	Wet																
320.2			7	SS	16												
6.7	Clayey SILT, sandy, trace gravel Very Stiff Grey Moist (TILL)																
			8	SS	22												
317.3			9	SS	19												
317.6	SAND, trace silt																
9.8	Compact																

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10  
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No BH-05

2 OF 2

METRIC

W.P. 408-88-00 LOCATION N 4 813 518.1 E 226 368.2 ORIGINATED BY HC  
DIST HWY 7/85 BOREHOLE TYPE Hollow-Stem Auger COMPILED BY JW  
DATUM Geodetic DATE 2023.01.16 - 2023.01.16 LATITUDE 43.457467 LONGITUDE -80.469184 CHECKED BY GRL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					
								○ UNCONFINED	+	FIELD VANE							
								● QUICK TRIAXIAL	×	LAB VANE							
								20	40	60	80	100					
	Continued From Previous Page																
	Brown Wet																
	END OF BOREHOLE AT 9.8 m. INSTALLATION OF PIEZOMETER CONSISTS OF 50 mm DIAMETER SCHEDULE 40 PVC PIPE WITH A 3.05 m SLOTTED SCREEN.																
	WATER LEVEL READINGS																
	DATE DEPTH(m) ELEV.(m)																
	2023.02.01 5.5 321.4																
	2023.03.01 5.5 321.4																

## METRIC

[illegible]

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity

## METRIC

[illegible]

## METRIC

[illegible]

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity

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# RECORD OF BOREHOLE No BH-07

2 OF 2

METRIC

W.P. 408-88-00 LOCATION N 4 813 573.7 E 226 397.4 ORIGINATED BY HC  
 DIST HWY 7/85 BOREHOLE TYPE Hollow-Stem Auger/DCPT COMPILED BY JW  
 DATUM Geodetic DATE 2022.12.22 - 2022.12.22 LATITUDE 43.457970 LONGITUDE -80.468832 CHECKED BY GRL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60	W <sub>p</sub> W W <sub>L</sub>				
	Continued From Previous Page													
315.3							316							
11.5	END OF DCPT AT 11.5 m UPON REFUSAL. BOREHOLE CAVED TO 5.8 m UPON COMPLETION OF DRILLING AND REMOVAL OF AUGERS. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.2 m, THEN ASPHALT TO SURFACE.													

ONTMT452 2020LIBRARY(MTO) - COPY.GLB MTO-35707.GPJ 2/13/24

# RECORD OF BOREHOLE No BH-08

1 OF 2

METRIC

W.P. 408-88-00 LOCATION N 4 813 631.6 E 226 372.8 ORIGINATED BY HC  
DIST HWY 7/85 BOREHOLE TYPE Hollow-Stem Auger COMPILED BY JW  
DATUM Geodetic DATE 2023.01.09 - 2023.01.09 LATITUDE 43.458489 LONGITUDE -80.469144 CHECKED BY GRL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
325.9	GROUND SURFACE							<div><div>20406080100</div><div>○ UNCONFINED + FIELD VANE</div><div>● QUICK TRIAXIAL × LAB VANE</div></div>						
0.0	ASPHALT (75 mm)							<div><div>204060</div><div>W P W W L</div><div>PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT</div><div>WATER CONTENT (%)</div></div>						
0.1														
0.2	SAND and GRAVEL Compact Brown Moist (FILL)		1	SS	15		325							
	Silty SAND, trace gravel Compact to Loose Brown Moist (FILL)		2	SS	3								3 68 24 5	
			3	SS	11		324							
323.7														
2.2	SAND, trace silt Compact to Dense Brown Moist		4	SS	28		323						0 91 8 1	
			5	SS	20									
							322							
			6	SS	29		321							
							320							
			7	SS	37		319							
							318							
			8	SS	37		317							
316.5														
9.4	Silty CLAY, Sandy, trace gravel		9	SS	31								0 90 10 (SI+CL)	
316.1	Hard Grey													
9.8	Moist													

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No BH-08

2 OF 2

METRIC

W.P. 408-88-00 LOCATION N 4 813 631.6 E 226 372.8 ORIGINATED BY HC  
DIST HWY 7/85 BOREHOLE TYPE Hollow-Stem Auger COMPILED BY JW  
DATUM Geodetic DATE 2023.01.09 - 2023.01.09 LATITUDE 43.458489 LONGITUDE -80.469144 CHECKED BY GRL



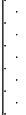
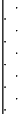
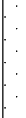




SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	Continued From Previous Page																
	(TILL)																
	END OF BOREHOLE AT 9.8 m. PIEZOMETER INSTALLATION CONSISTS OF 50 mm DIAMETER SCHEDULE 40 PVC PIPE WITH 3.05 m SLOTTED SCREEN.																
	WATER LEVEL READINGS																
	DATE DEPTH(m) ELEV.(m)																
	2023.02.01 5.3 320.6																
	2023.03.01 5.3 320.6																

# RECORD OF BOREHOLE No BH-09

1 OF 2

METRIC

W.P. 408-88-00 LOCATION N 4 813 699.8 E 226 344.5 ORIGINATED BY HC  
DIST HWY 7/85 BOREHOLE TYPE Hollow-Stem Auger COMPILED BY JW  
DATUM Geodetic DATE 2023.01.11 - 2023.01.11 LATITUDE 43.459100 LONGITUDE -80.469503 CHECKED BY GRL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
325.0	GROUND SURFACE													
0.0	ASPHALT(150 mm)													
0.2	Gravelly SAND, trace silt		1	SS	14									
324.6	Compact Brown Moist (FILL)													
0.4	SILTY SAND trace gravel, trace organics Compact Dark Brown Moist (FILL)		2	SS	10									
323.3	SAND, trace non-plastic fines Loose to Compact Brown Moist		3	SS	15									
1.7														
			4	SS	27									
			5	SS	27									
			6	SS	26									
			7	SS	9									
			8	SS	19									
			9	SS	47									
315.3														
314.9	Silty CLAY, sandy, trace gravel													

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity  
20  
15  
10  
(%) STRAIN AT FAILURE

## METRIC

SOIL PROFILE					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES	GROUND WATER CONDITIONS	ELEVATION SCALE
<div>DYNAMIC CONE PENETRATION RESISTANCE PLOT</div> <div>SHEAR STRENGTH kPa</div> <div>○ UNCONFINED + FIELD VANE</div> <div>● QUICK TRIAXIAL × LAB VANE</div> <div>WATER CONTENT (%)</div> <div>UNIT WEIGHT γ</div> <div>REMARKS &amp; GRAIN SIZE DISTRIBUTION (%)</div>					
9.9	<div>Continued From Previous Page</div> <div>Hard Grey Moist (TILL)</div> <div>END OF BOREHOLE AT 9.9 m. BOREHOLE CAVED TO 4.6 m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.2 m, THEN ASPHALT TO SURFACE.</div>				

## METRIC

[illegible]

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity

## METRIC

[illegible]

## METRIC

[illegible]

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH-11

2 OF 2

METRIC

W.P. 408-88-00 LOCATION N 4 813 788.3 E 226 316.2 ORIGINATED BY HC  
DIST HWY 7/85 BOREHOLE TYPE Hollow-Stem Auger COMPILED BY JW  
DATUM Geodetic DATE 2023.01.12 - 2023.01.12 LATITUDE 43.459893 LONGITUDE -80.469866 CHECKED BY GRL










SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	Continued From Previous Page																
	END OF BOREHOLE AT 9.8 m. PIEZOMETER INSTALLATION CONSISTS OF 50 mm DIAMETER SCHEDULE 40 PVC PIPE WITH 3.05 m SLOTTED SCREEN.																
	WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2023.03.08 3.9 319.5																

# RECORD OF BOREHOLE No BH-12

1 OF 2

METRIC

W.P. 408-88-00 LOCATION N 4 813 816.9 E 226 302.8 ORIGINATED BY HC  
DIST HWY 7/85 BOREHOLE TYPE Hollow-Stem Auger COMPILED BY JW  
DATUM Geodetic DATE 2023.01.12 - 2023.01.12 LATITUDE 43.460149 LONGITUDE -80.470036 CHECKED BY GRL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
323.3	GROUND SURFACE							20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT		
0.0	ASPHALT(150 mm)							20 40 60 80 100	W <sub>P</sub>	W	W <sub>L</sub>		
0.2	Gravelly <b>SAND</b> , containing pockets of silty clay Loose Brown Moist (FILL)		1	SS	7		323						
322.8													
0.5													
322.5													
0.8	Clayey <b>SILT</b> , sandy, trace gravel Firm Dark Brown Moist (FILL)		2	SS	11		322						
321.8	Silty <b>SAND</b> , trace clay, trace gravel Compact Brown Moist (FILL)		3	SS	10		321						2 35 45 18
1.5													
320.7													
2.6													
	Clayey <b>SILT</b> , sandy, trace gravel Stiff Brown Moist (TILL)		4	SS	17		320						
	<b>SAND</b> , trace gravel, trace non-plastic fines Loose to Compact Brown Moist		5	SS	11		319						
			6	SS	9		318						
	Wet						317						
			8	SS	23		316						
							315						1 95 4 (SI+CL)
							314						
313.7			9	SS	29								
9.5	Clayey <b>SILT</b> , sandy, trace gravel												
313.5	Very Stiff												
9.8	Grey												

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No BH-12

2 OF 2

METRIC

W.P. 408-88-00 LOCATION N 4 813 816.9 E 226 302.8 ORIGINATED BY HC  
DIST HWY 7/85 BOREHOLE TYPE Hollow-Stem Auger COMPILED BY JW  
DATUM Geodetic DATE 2023.01.12 - 2023.01.12 LATITUDE 43.460149 LONGITUDE -80.470036 CHECKED BY GRL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	Continued From Previous Page																
	Moist (TILL)																
	END OF BOREHOLE AT 9.8 m. BOREHOLE CAVED TO 4.6 m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.2 m, THEN ASPHALT TO SURFACE.																

# RECORD OF BOREHOLE No BH-13

1 OF 2

METRIC

W.P. 408-88-00 LOCATION N 4 813 855.9 E 226 284.1 ORIGINATED BY HC  
DIST HWY 7/85 BOREHOLE TYPE Hydrovac/ Hollow-Stem Auger COMPILED BY JW  
DATUM Geodetic DATE 2023.11.06 - 2023.11.06 LATITUDE 43.460498 LONGITUDE -80.470273 CHECKED BY PV

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
323.4	GROUND SURFACE							20	40	60	80	100						
0.0	ASPHALT:(150 mm)		1	GS				20	40	60	80	100						
0.2	GRANULAR BASE/ SUBBASE(200 mm)		2	GS				20	40	60	80	100						
0.4	SAND, trace to some silt Brown to Light Brown Wet (FILL)							20	40	60	80	100						
			3	GS				20	40	60	80	100						
								20	40	60	80	100						
								20	40	60	80	100						
320.1	Borehole was daylighted up to 3.3 m.							20	40	60	80	100						
3.3	SAND, trace to some silt Compact to Dense Brown to Light Brown Wet							20	40	60	80	100						
			1	SS	32			20	40	60	80	100						
			2	SS	19			20	40	60	80	100						
								20	40	60	80	100						
	Very Loose		3	SS	1			20	40	60	80	100						
								20	40	60	80	100						
	Compact		4	SS	11			20	40	60	80	100						
								20	40	60	80	100						
	Occasional pockets of clayey silt Greyish Brown		5	SS	25			20	40	60	80	100						
313.6								20	40	60	80	100						
9.8	END OF BOREHOLE AT 9.8 m.							20	40	60	80	100						

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No BH-13

2 OF 2

METRIC

W.P. 408-88-00 LOCATION N 4 813 855.9 E 226 284.1 ORIGINATED BY HC  
DIST HWY 7/85 BOREHOLE TYPE Hydrovac/ Hollow-Stem Auger COMPILED BY JW  
DATUM Geodetic DATE 2023.11.06 - 2023.11.06 LATITUDE 43.460498 LONGITUDE -80.470273 CHECKED BY PV

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
	Continued From Previous Page  INSTALLATION OF PIEZOMETER CONSISTS OF 50 mm DIAMETER SCHEDULE 40 PVC PIPE WITH A 3.0 m SLOTTED SCREEN.  WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2023.11.09 4.4 318.9 2023.11.27 4.4 319.0																

# RECORD OF BOREHOLE No BH-14

1 OF 2

METRIC

W.P. 408-88-00 LOCATION N 4 813 902.7 E 226 250.3 ORIGINATED BY HC  
DIST HWY 7/85 BOREHOLE TYPE Hollow-Stem Auger COMPILED BY JW  
DATUM Geodetic DATE 2023.11.04 - 2023.11.04 LATITUDE 43.460916 LONGITUDE -80.470697 CHECKED BY PV

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
318.9	GROUND SURFACE							20	40	60	80	100						
0.0	TOPSOIL: (300 mm)																	
318.6	SAND, trace silt, trace organics Loose to Compact Brown Wet		1	SS	10									○				
0.3															○			
			2	SS	18											○		
			3	SS	8										○			
			4	SS	19										○		1 90 9 0	
315.8																		
3.0	Silty <b>CLAY</b> , trace sand Stiff to Very Stiff Grey Moist (TILL)  300 mm thick layer of sand and trace silt was encountered		5	SS	10									○				
															○			
			6	SS	10											○		0 7 44 49
			7	SS	18										○			
			8	SS	21										○		0 0 47 53	
			9	SS	23										○			
			10	SS	36										○			
	Hard																	

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No BH-14

2 OF 2

METRIC

W.P. 408-88-00 LOCATION N 4 813 902.7 E 226 250.3 ORIGINATED BY HC  
DIST HWY 7/85 BOREHOLE TYPE Hollow-Stem Auger COMPILED BY JW  
DATUM Geodetic DATE 2023.11.04 - 2023.11.04 LATITUDE 43.460916 LONGITUDE -80.470697 CHECKED BY PV

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT								UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa												
								20 40 60 80 100												
Continued From Previous 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# RECORD OF BOREHOLE No BH-15

1 OF 2

METRIC

W.P. 408-88-00 LOCATION N 4 813 474.4 E 226 301.9 ORIGINATED BY HC  
DIST HWY 7/85 BOREHOLE TYPE Hydrovac/ Hollow Stem Auger COMPILED BY JW  
DATUM Geodetic DATE 2023.11.06 - 2023.11.07 LATITUDE 43.457066 LONGITUDE -80.469998 CHECKED BY PV

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
327.6	GROUND SURFACE							20 40 60 80 100						
0.0	TOPSOIL : (300 mm)		1	GS				20 40 60 80 100						
327.3														
0.3	Silty <b>SAND</b> Brown Wet (FILL)						327							
			2	GS			326							
							325							
324.3	Borehole daylighted up to 3.3 m.													
3.3	Sandy <b>SILT</b> Compact Brown Wet		1	SS	20		324							
							323							
322.4			2	SS	12									
5.2	<b>SAND</b> , trace silt Compact Brown Wet						322							
			3	SS	19		321							
							320							
			4	SS	23									
							319							
			5	SS	10									
317.8							318							
9.8	END OF BOREHOLE AT 9.7 m.													

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No BH-15

2 OF 2

METRIC

W.P. 408-88-00 LOCATION N 4 813 474.4 E 226 301.9 ORIGINATED BY HC  
DIST HWY 7/85 BOREHOLE TYPE Hydrovac/ Hollow Stem Auger COMPILED BY JW  
DATUM Geodetic DATE 2023.11.06 - 2023.11.07 LATITUDE 43.457066 LONGITUDE -80.469998 CHECKED BY PV

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	Continued From Previous Page																
	BOREHOLE CAVED TO 7.6 m UPON COMPLETION. INSTALLATION OF PIEZOMETER CONSISTS OS 50 mm DIAMETER SCHEDULE 40 PVC PIPE WITH A 3.0 m SLOTTED SCREEN.																
	WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2023.11.09 5.9 321.7 2023.11.27 5.9 321.7																



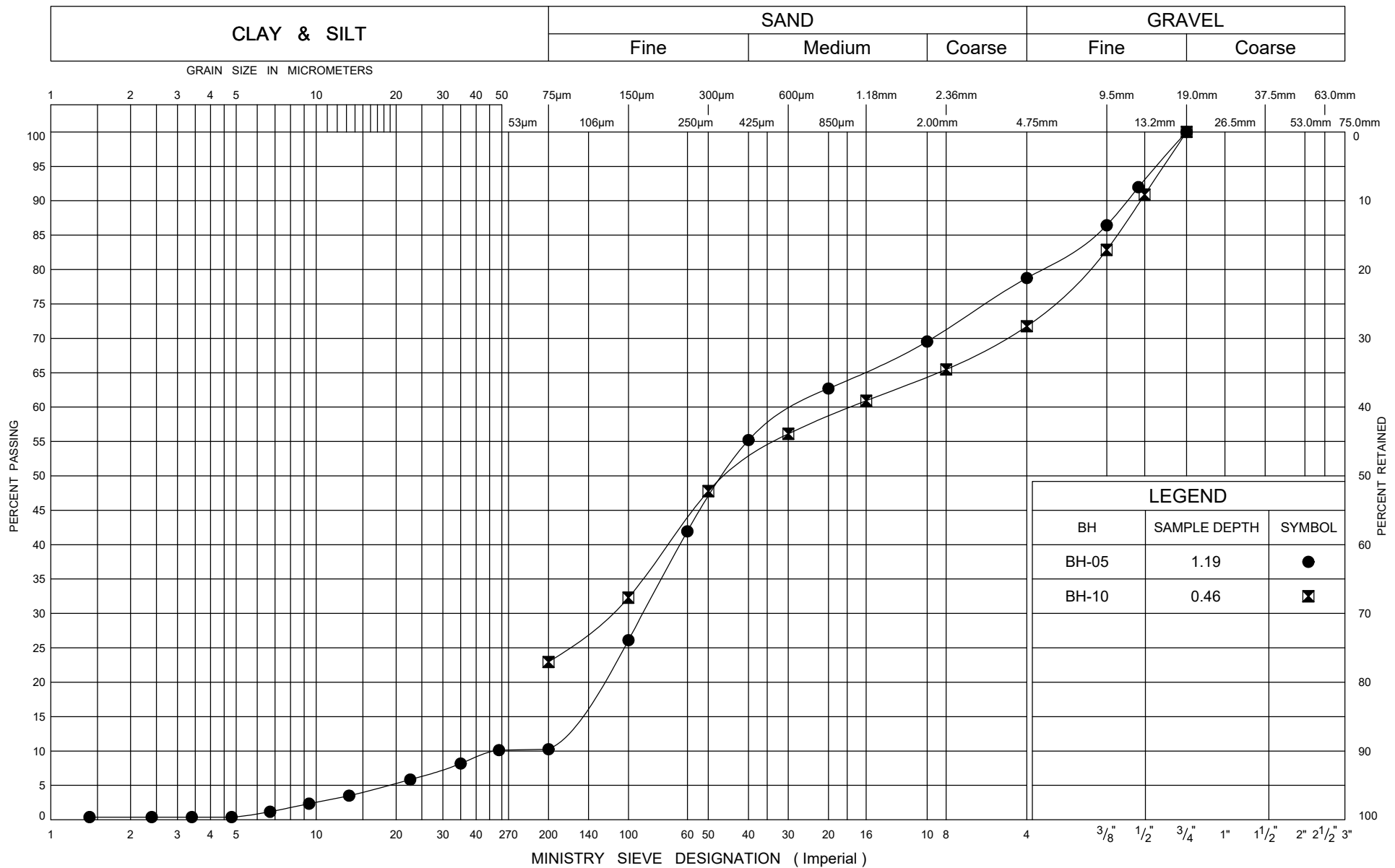
**THURBER** ENGINEERING LTD.

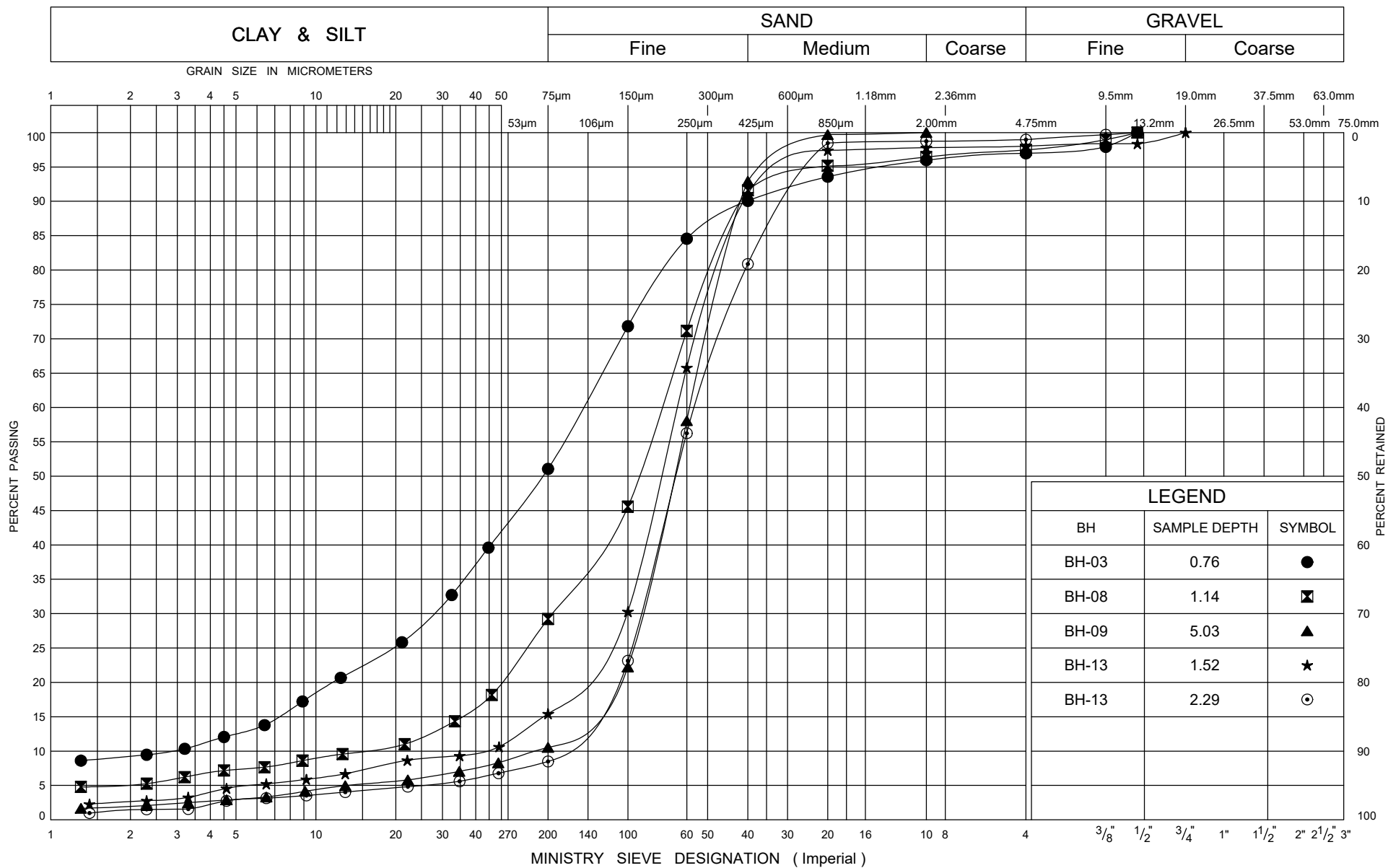
## **APPENDIX C**

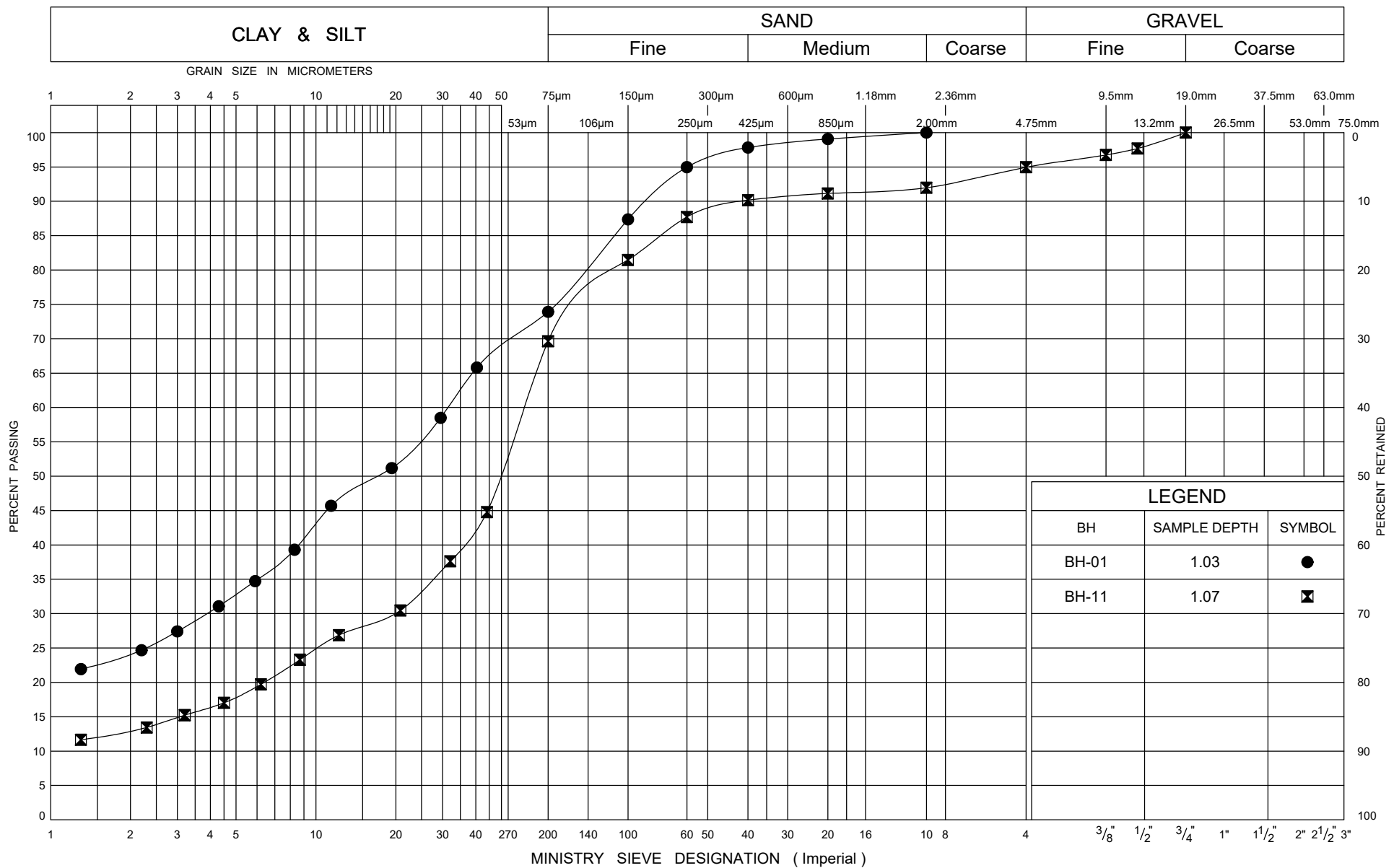
Geotechnical Laboratory Test Results

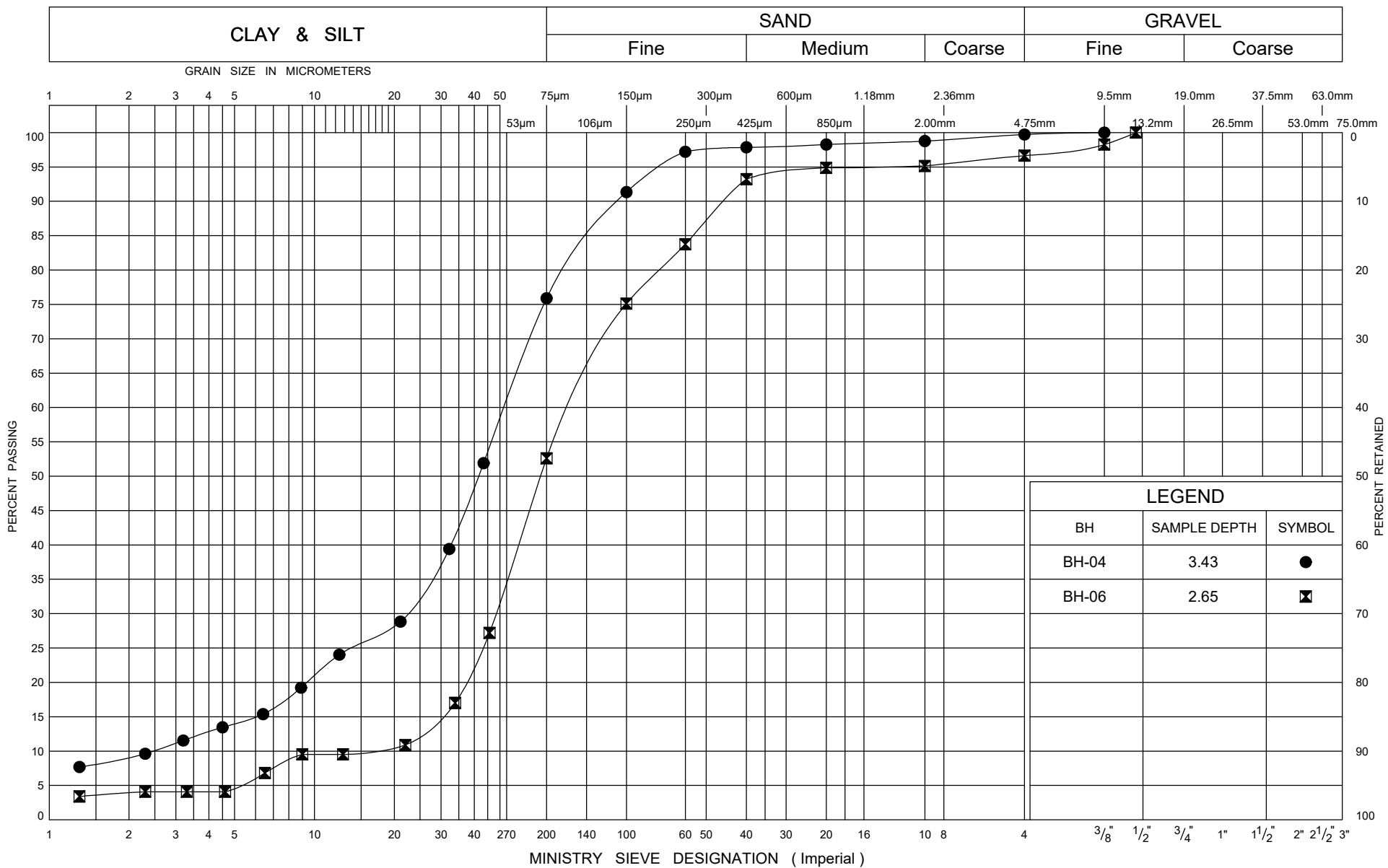
&

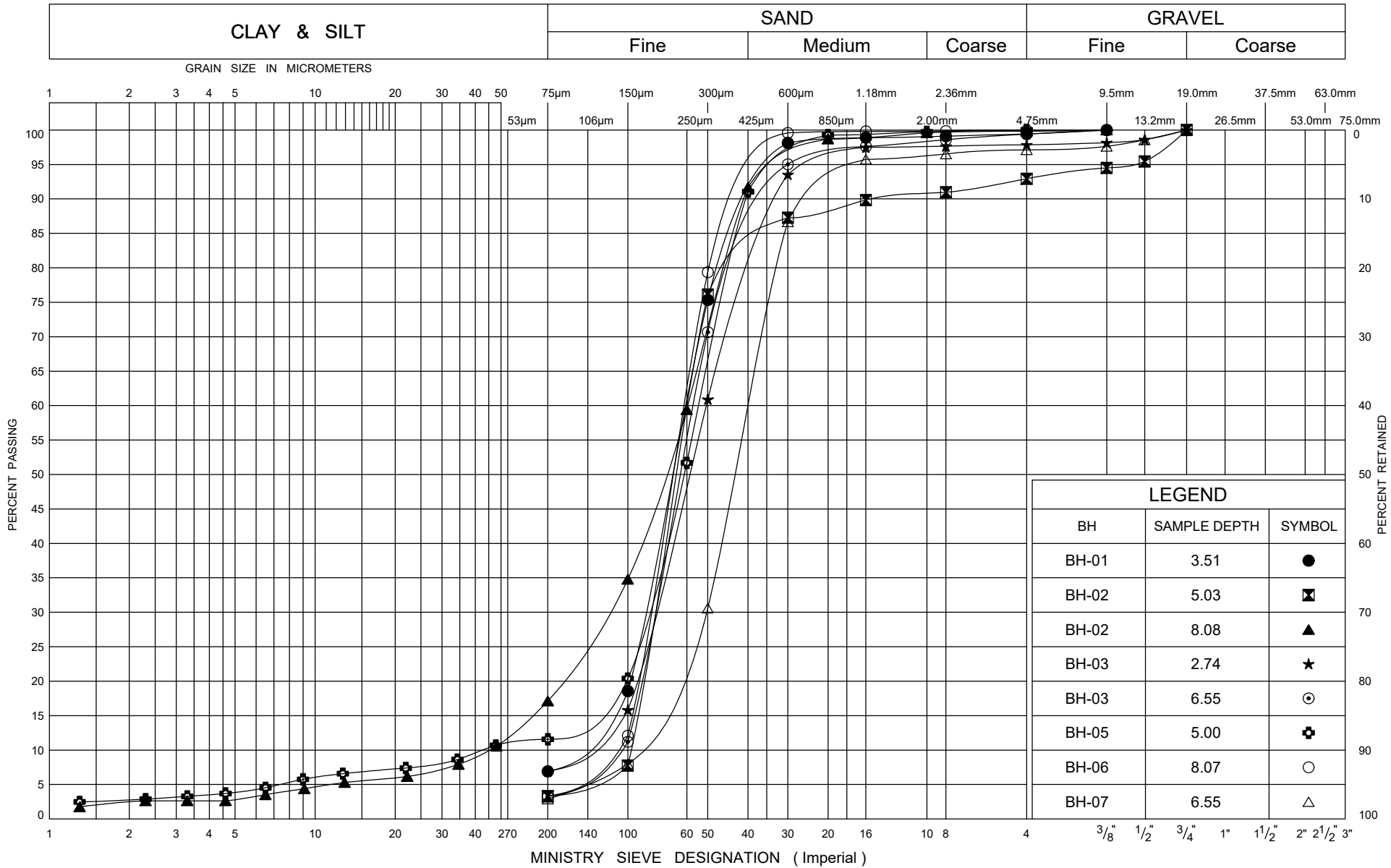
Single Well Response Test (SWRT) Analysis Plots

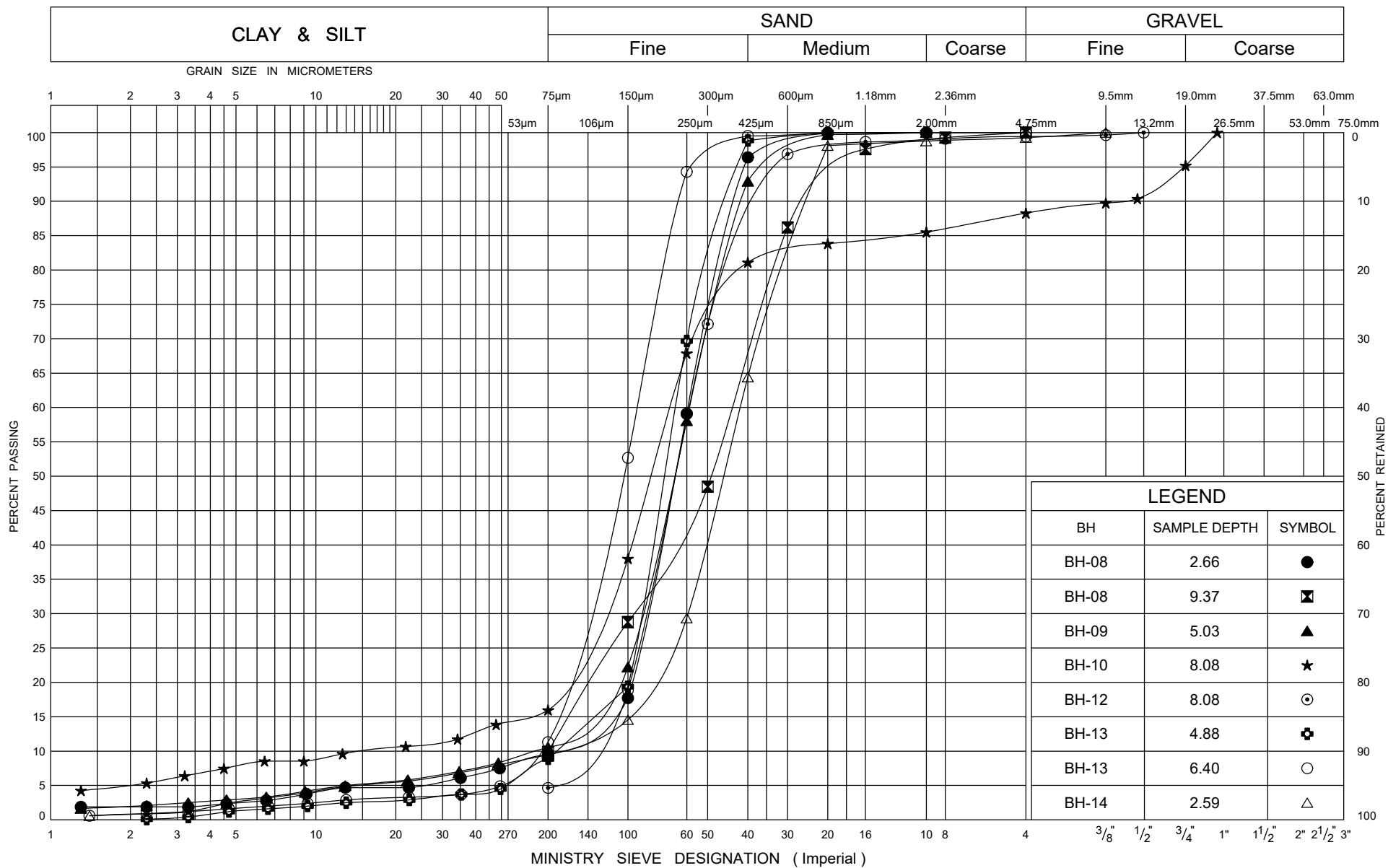








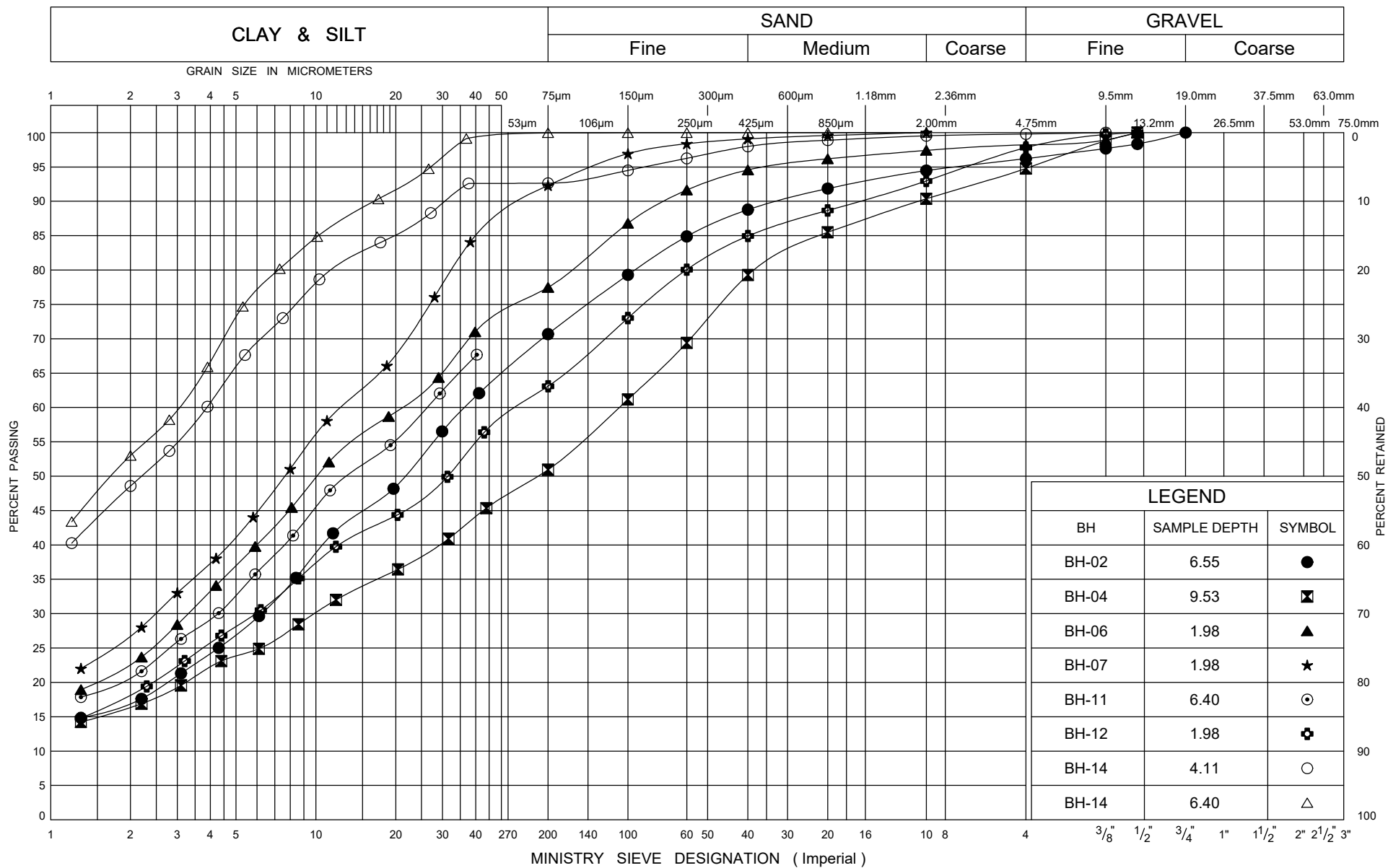


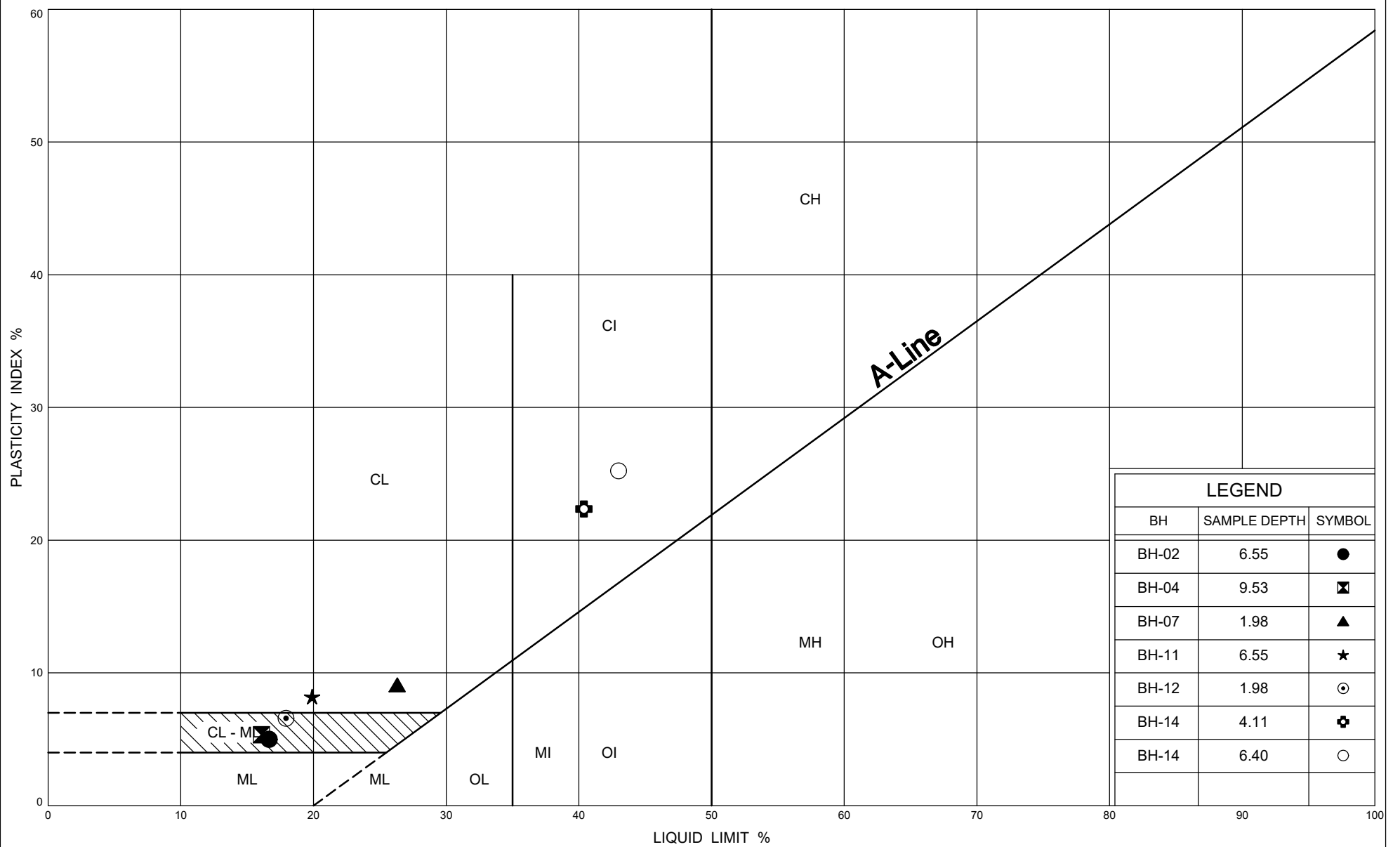




## FIG No 7

W.P. 408-88-00





Ministry of  
Transportation

## PLASTICITY CHART

Clayey SILT TILL

FIG No 9

W.P. 408-88-00



# Slug Test Analysis Report

Project: Frederick Street Utility Relocation

Number: 35707

Client: Ministry of Transportation Ontario

Location: Kitchener

Slug Test: BH2

Test Well: BH2

Test Conducted by: JR

Test Date: 2023-03-01

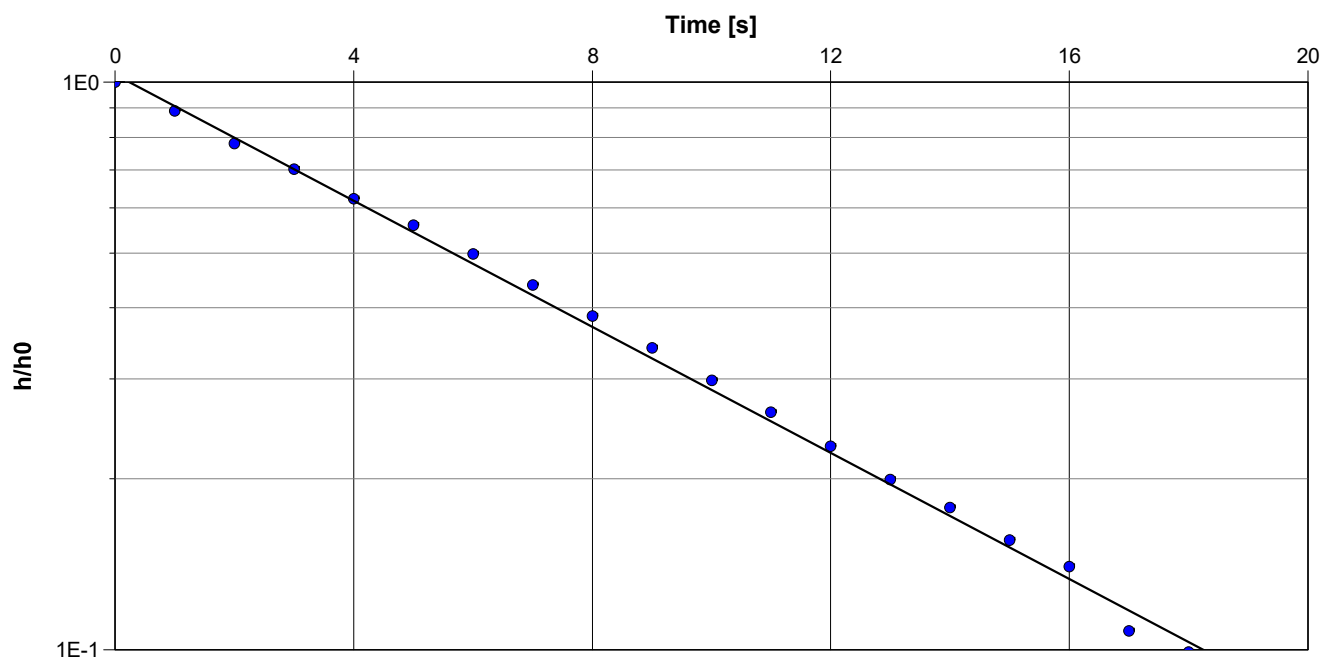
Analysis Performed by: JR

BH2 - SWRT Analysis

Analysis Date: 2023-03-14

Aquifer Thickness:

Reviewed by: AH



Calculation using Hvorslev

Observation Well

Hydraulic Conductivity  
[m/s]

BH2

$8.8 \times 10^{-5}$



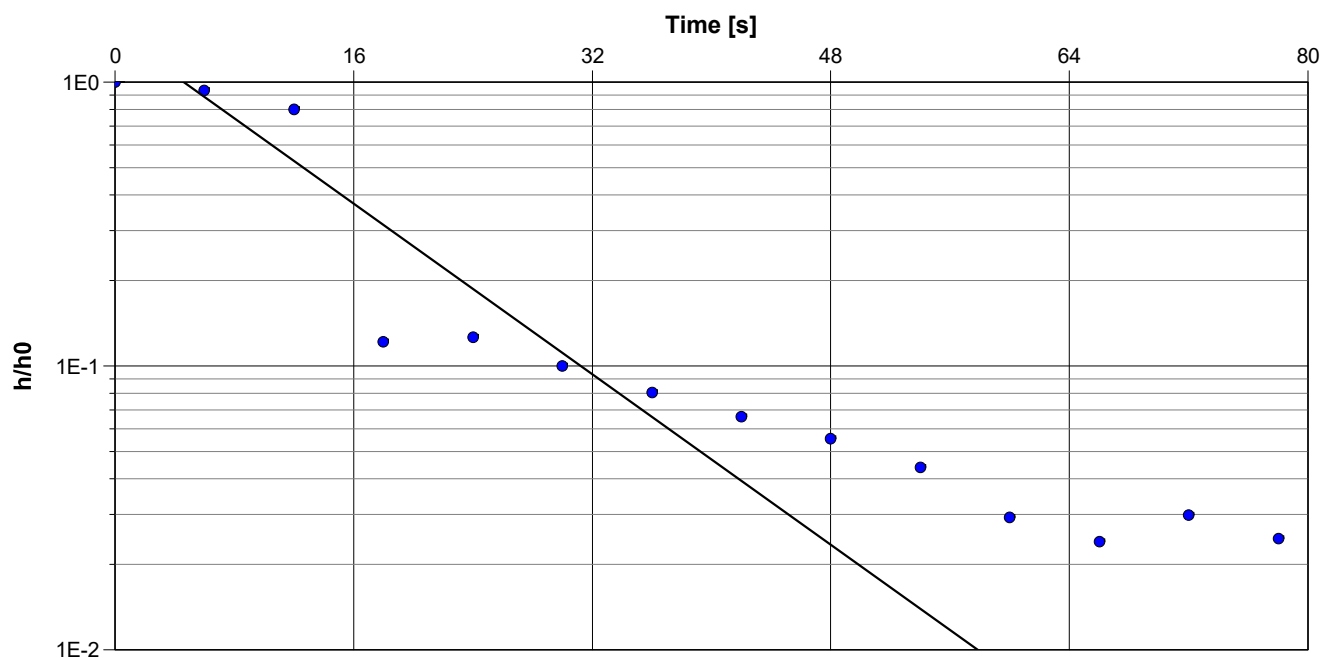
# **Slug Test Analysis Report**

Project: Frederick Street Utility Relocation

Number: 35707

Client: Ministry of Transportation Ontario

Location: Kitchener	Slug Test: BH5	Test Well: BH5
Test Conducted by: HC		Test Date: 2023-02-01
Analysis Performed by: JR	BH5 - SWRT Analysis	Analysis Date: 2023-03-14
Aquifer Thickness: 9.25 m		
Reviewed by: AH		



Calculation using Hvorslev		
Observation Well	Hydraulic Conductivity [m/s]	
BH5	$4.5 \times 10^{-5}$	



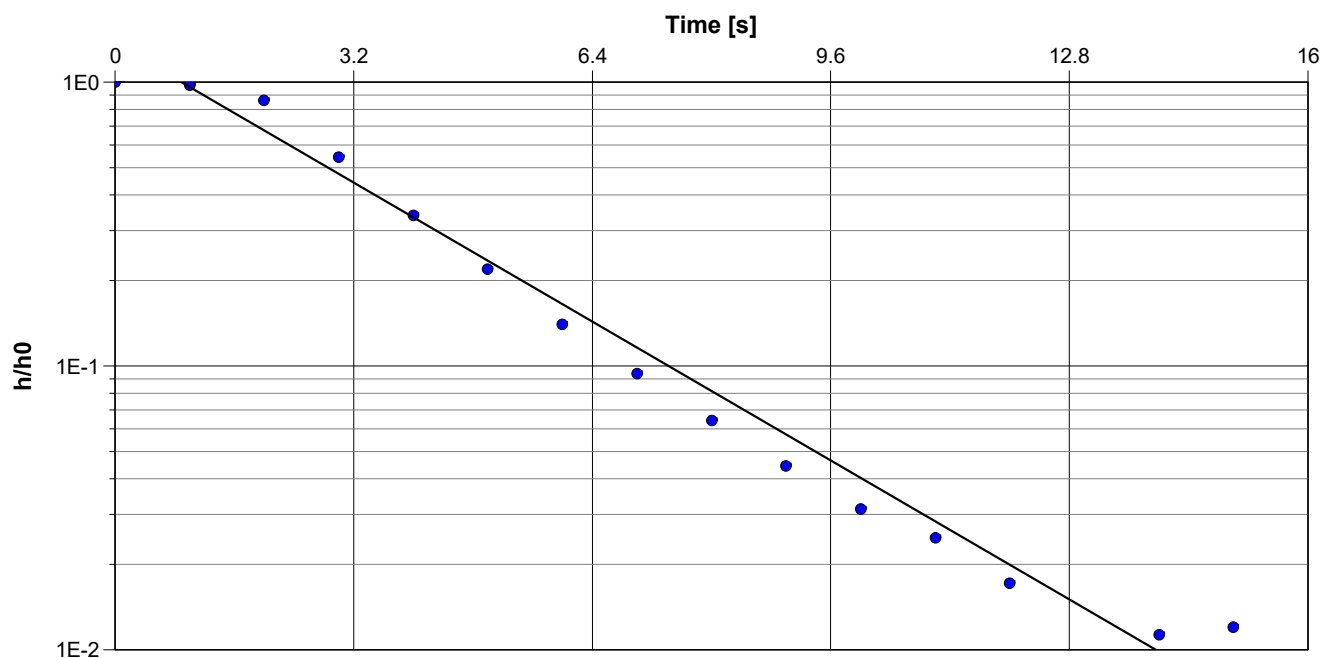
# Slug Test Analysis Report

Project: Frederick Street Utility Relocation

Number: 35707

Client: Ministry of Transportation Ontario

Location: Kitchener	Slug Test: BH8	Test Well: BH8
Test Conducted by: JR		Test Date: 2023-03-01
Analysis Performed by: JR	BH8 - SWRT Analysis	Analysis Date: 2023-03-14
Aquifer Thickness: 9.25 m		
Reviewed by: AH		



Calculation using Hvorslev		
Observation Well	Hydraulic Conductivity [m/s]	
BH8	$1.8 \times 10^{-4}$	



# Slug Test Analysis Report

Project: Frederick Street Utility Relocation

Number: 35707

Client: Ministry of Transportation Ontario

Location: Kitchener

Slug Test: BH11

Test Well: BH11

Test Conducted by: HC

Test Date: 2023-03-08

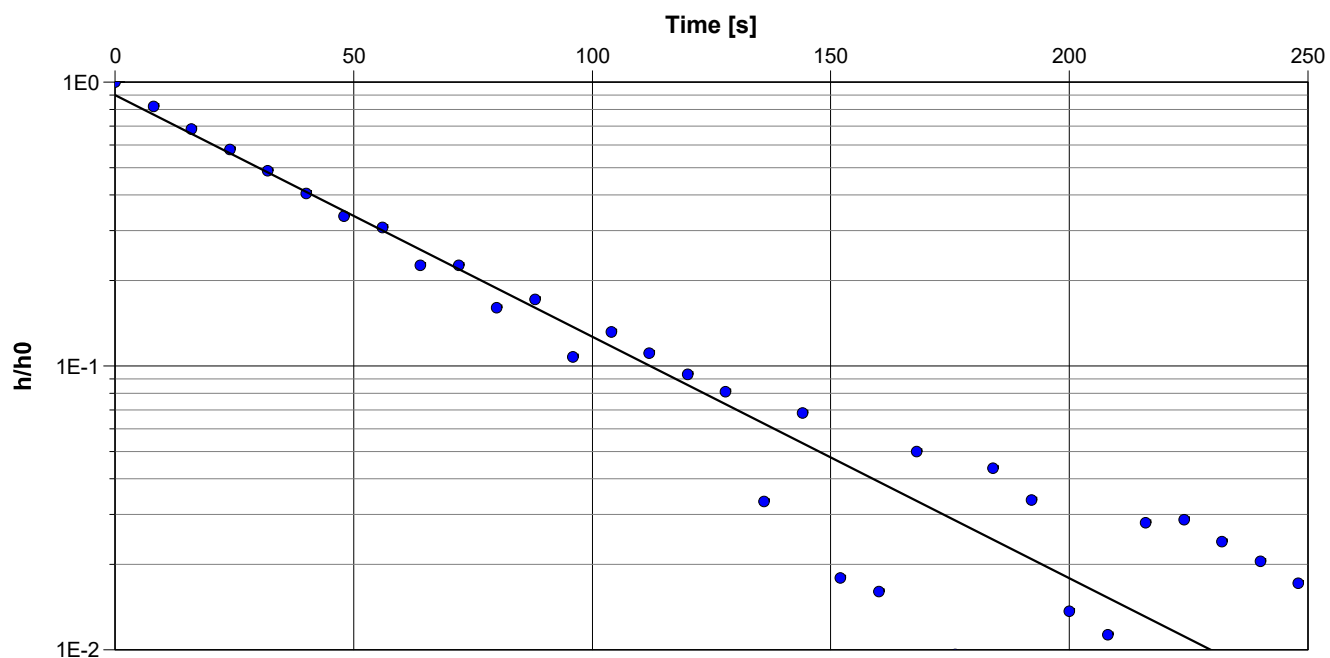
Analysis Performed by: JR

BH11 - SWRT Analysis

Analysis Date: 2023-03-14

Aquifer Thickness: 7.86 m

Reviewed by: AH



Calculation using Bouwer & Rice

Observation Well

Hydraulic Conductivity  
[m/s]

BH11

$7.8 \times 10^{-6}$



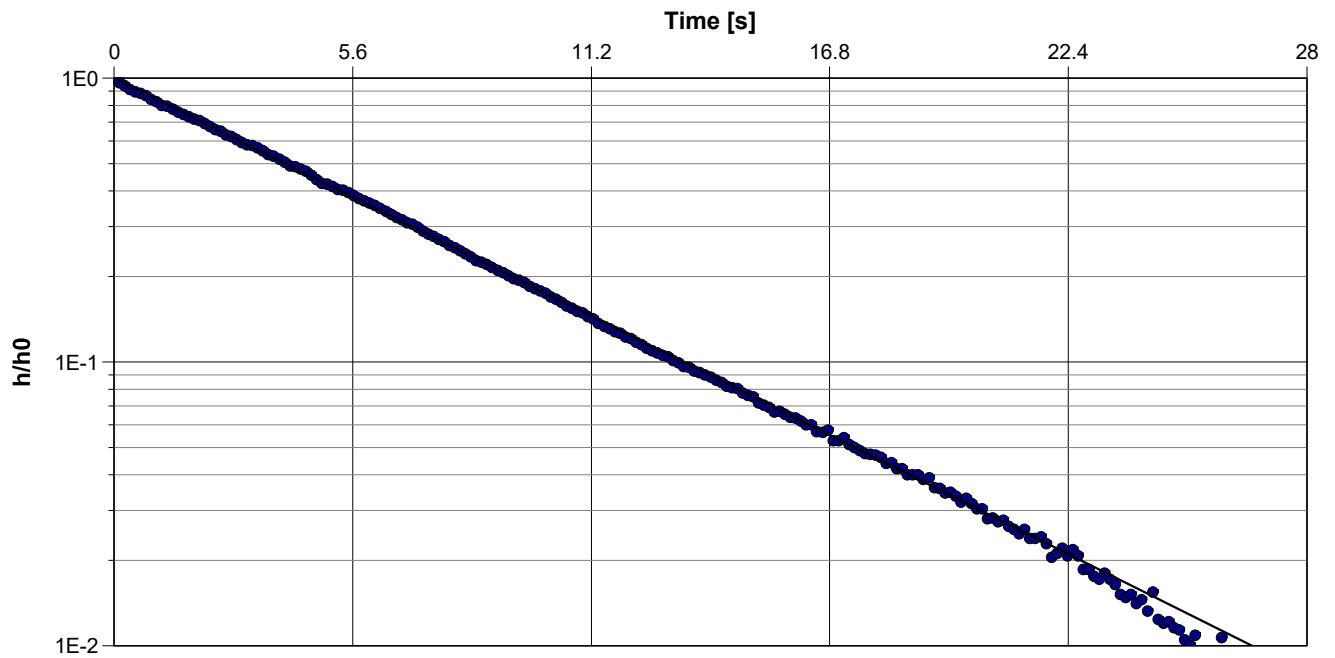
### Slug Test Analysis Report

Project: Frederick Street Structure Replacement

Number: 43743

Client:

Location:	Slug Test: BH13	Test Well: BH13
Test Conducted by: HC		Test Date: 2023-11-23
Analysis Performed by: JR	BH13 - SWRT Analysis	Analysis Date: 2023-11-27
Aquifer Thickness: 7.22 m		
	Reviewed by: AH	



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH13	$7.3 \times 10^{-5}$	



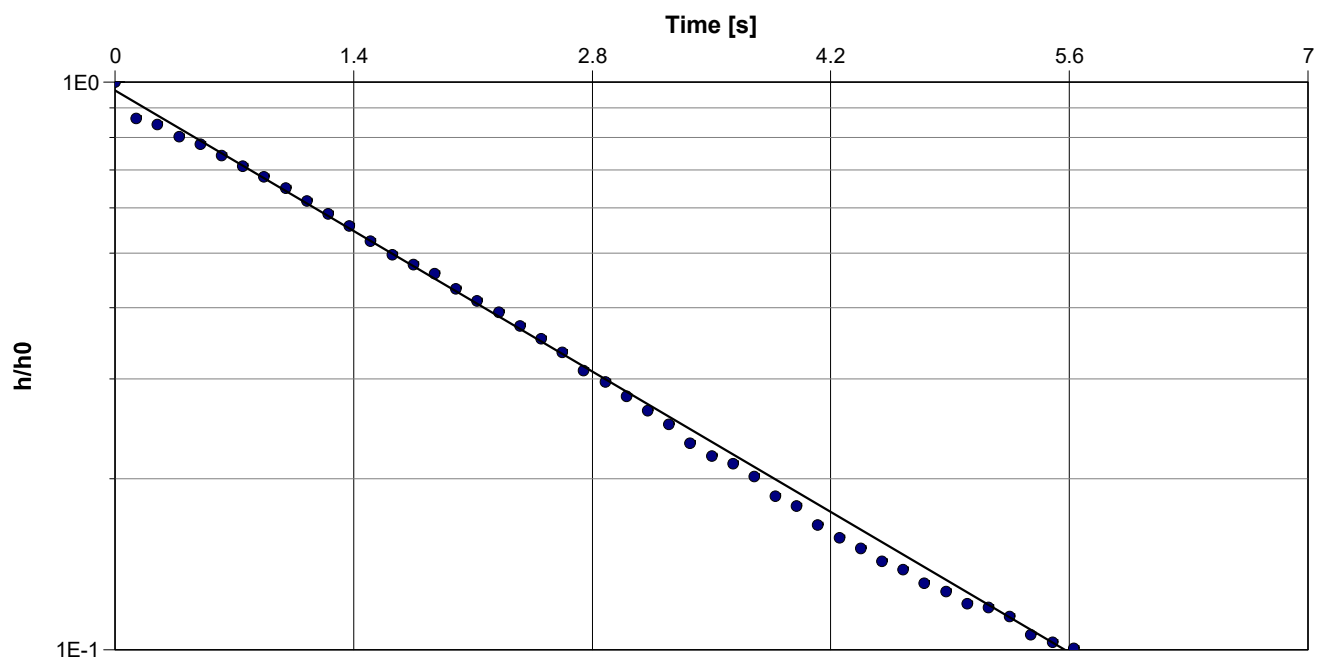
# Slug Test Analysis Report

Project: Frederick Street Structure Replacement

Number: 43743

Client:

Location:	Slug Test: BH15	Test Well: BH15
Test Conducted by: HC		Test Date: 2023-11-23
Analysis Performed by: JR	BH15 - SWRT Analysis	Analysis Date: 2023-11-27
Aquifer Thickness: 9.15 m		
	Reviewed by: AH	



Calculation using Hvorslev		
Observation Well	Hydraulic Conductivity [m/s]	
BH15	$1.7 \times 10^{-4}$	

## **APPENDIX D**

### Analytical Test Results



## FINAL REPORT

CA40275-JAN23 R1

35707, Kitchener

Prepared for

**Thurber Engineering Ltd.**

## First Page

### CLIENT DETAILS

Client **Thurber Engineering Ltd.**

Address **103, 2010 Winston Park Drive  
Oakville, ON  
L6H 5R7, Canada**

Contact **Geoff Lay**

Telephone **905-829-8666**

Facsimile

Email **glay@thurber.ca**

Project **35707, Kitchener**

Order Number

Samples **Soil (12)**

### LABORATORY DETAILS

Project Specialist **Brad Moore Hon. B.Sc**

Laboratory **SGS Canada Inc.**

Address **185 Concession St., Lakefield ON, K0L 2H0**

Telephone **705-652-2143**

Facsimile **705-652-6365**

Email **brad.moore@sgs.com**

SGS Reference **CA40275-JAN23**

Received **01/27/2023**

Approved **02/06/2023**

Report Number **CA40275-JAN23 R1**

Date Reported **02/06/2023**

### COMMENTS

Temperature of Sample upon Receipt: 8 degrees C

Cooling Agent Present: Yes

Custody Seal Present: Yes

Chain of Custody Number: n/a

Corrosivity Index is based on the American Water Works Corrosivity Scale according to AWWA C-105. An index greater than 10 indicates the soil matrix may be corrosive to cast iron alloys.

### SIGNATORIES

Brad Moore Hon. B.Sc

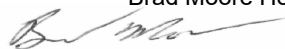




TABLE OF CONTENTS

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First Page..... 1

Index..... 2

Results..... 3-4

QC Summary..... 5-7

Legend..... 8

Annexes..... 9



# FINAL REPORT

CA40275-JAN23 R1

**Client:** Thurber Engineering Ltd.

**Project:** 35707, Kitchener

**Project Manager:** Geoff Lay

**Samplers:** Greg Stanhope

MATRIX: SOIL

Sample Number	5	6	7	8	9	10	11	12
Sample Name	BH-01 SS-1 (0'-2')	BH-02 SS-5 (10'-12')	BH-03 SS-5 (10'-12')	BH-04 SS-4 (7'6"-9'6")	BH-05 SS-4 (7'6"-9'6")	BH-06 SS-6 (15'-17')	BH-07 SS-6 (15'-17')	BH-08 SS-5 (10'-12')
Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date	16/12/2022	20/12/2022	16/12/2022	11/01/2023	16/01/2023	21/12/2022	22/12/2022	09/01/2023

Parameter	Units	RL		Result	Result	Result	Result	Result	Result	Result
-----------	-------	----	--	--------	--------	--------	--------	--------	--------	--------

## Corrosivity Index

Corrosivity Index	none	1		14	3	3	4	4	3	3	3
Soil Redox Potential	mV	no		276	303	242	317	231	243	371	252
Sulphide (Na <sub>2</sub> CO <sub>3</sub> )	%	0.04		< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
pH	pH Units	0.05		8.99	9.05	9.20	8.55	9.16	9.30	9.28	9.32
Resistivity (calculated)	ohms.cm	-9999		1090	4610	7040	4080	3330	5320	8330	8850

## General Chemistry

Conductivity	uS/cm	2		915	217	142	245	300	188	120	113
--------------	-------	---	--	-----	-----	-----	-----	-----	-----	-----	-----

## Metals and Inorganics

Moisture Content	%	0.1		13.2	2.6	2.3	11.8	7.6	1.9	1.7	2.6
Sulphate	µg/g	0.4		28	5.0	3.4	4.3	8.8	4.2	3.4	2.8

## Other (ORP)

Chloride	µg/g	0.4		350	58	31	83	56	40	22	14
----------	------	-----	--	-----	----	----	----	----	----	----	----



# FINAL REPORT

CA40275-JAN23 R1

**Client:** Thurber Engineering Ltd.

**Project:** 35707, Kitchener

**Project Manager:** Geoff Lay

**Samplers:** Greg Stanhope

MATRIX: SOIL

Sample Number	13	14	15	16
Sample Name	BH-09 SS-3 (5'-7')	BH-10 SS-5 (10'-12')	BH-11 SS-3 (5'-7')	BH-12 SS-6 (15'-17')
Sample Matrix	Soil	Soil	Soil	Soil
Sample Date	11/01/2023	16/01/2023	12/01/2023	12/01/2023

Parameter	Units	RL		Result	Result	Result	Result
<b>Corrosivity Index</b>							
Corrosivity Index	none	1		6	3	6	4
Soil Redox Potential	mV	no		306	329	280	309
Sulphide (Na <sub>2</sub> CO <sub>3</sub> )	%	0.04		< 0.04	< 0.04	< 0.04	< 0.04
pH	pH Units	0.05		8.86	9.42	9.13	8.91
Resistivity (calculated)	ohms.cm	-9999		2280	3980	2240	5710
<b>General Chemistry</b>							
Conductivity	uS/cm	2		439	251	446	175
<b>Metals and Inorganics</b>							
Moisture Content	%	0.1		6.6	2.6	10.2	15.1
Sulphate	µg/g	0.4		12	5.4	10	5.6
<b>Other (ORP)</b>							
Chloride	µg/g	0.4		160	82	97	43



FINAL REPORT

CA40275-JAN23 R1

QC SUMMARY

Anions by IC  
Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-IENVIIC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0647-JAN23	µg/g	0.4	<0.4	4	35	94	80	120	92	75	125
Sulphate	DIO0647-JAN23	µg/g	0.4	<0.4	8	35	91	80	120	89	75	125

Carbon/Sulphur  
Method: ASTM E1915-07A | Internal ref.: ME-CA-IENVIARD-LAK-AN-020

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide (Na2CO3)	ECS0087-JAN23	%	0.04	< 0.04	ND	20	115	80	120			



FINAL REPORT

CA40275-JAN23 R1

QC SUMMARY

Conductivity

Method: SM 2510 | Internal ref.: ME-CA-1ENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0472-JAN23	uS/cm	2	< 2	0	20	99	90	110	NA		
Conductivity	EWL0486-JAN23	uS/cm	2	< 2	1	20	99	90	110	NA		

pH

Method: SM 4500 | Internal ref.: ME-CA-1ENVIEWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0472-JAN23	pH Units	0.05	NA	0		100			NA		
pH	EWL0486-JAN23	pH Units	0.05	NA	0		100			NA		

## QC SUMMARY

---

**Method Blank:** a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

**Duplicate:** Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

**LCS/Spike Blank:** Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

**Matrix Spike:** A sample to which a known amount of the analyte of interest has been added. Used to evaluate laboratory accuracy with sample matrix effects.

**Reference Material:** a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

**RL:** Reporting limit

**RPD:** Relative percent difference

**AC:** Acceptance criteria

**Multielement Scan Qualifier:** as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

**Duplicate Qualifier:** for duplicates as the measured result approaches the RL, 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.

**Matrix Spike Qualifier:** for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

## LEGEND

## FOOTNOTES

**NSS** Insufficient sample for analysis.

**RL** Reporting Limit.

↑ Reporting limit raised.

↓ Reporting limit lowered.

**NA** The sample was not analysed for this analyte

**ND** Non Detect

Results relate only to the sample tested.

Data reported represent the sample as submitted to SGS. Solid samples expressed on a dry weight basis.

"Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the "Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act and Excess Soil Quality" published by the Ministry and dated March 9, 2004 as amended.

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SGS Canada Inc. statement of conformity decision rule does not consider uncertainty when analytical results are compared to a specified standard or regulation.

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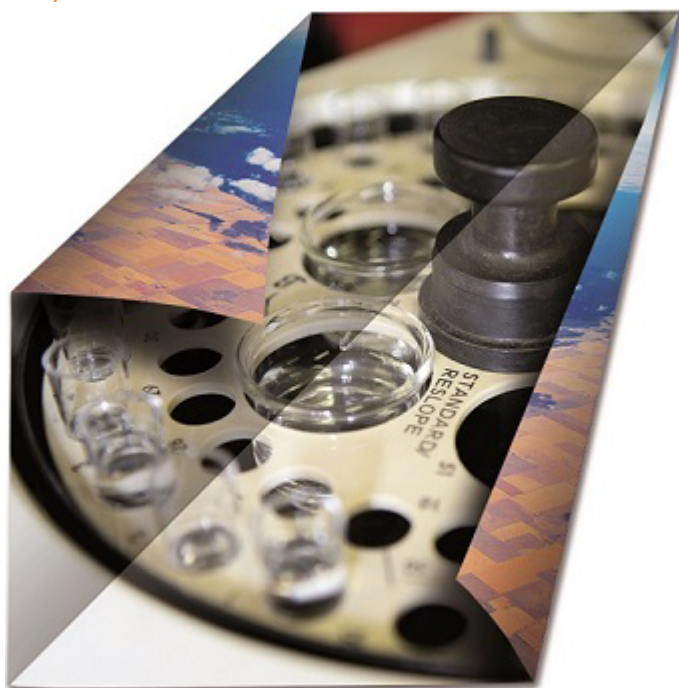
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This report supersedes all previous versions.

-- End of Analytical Report --

## Request for Laboratory Services and CHAIN OF CUSTODY

Laboratory Information Section - Lab use only											
Received By: <u>E.O.</u>		Received By (signature): <u>[Signature]</u>		Cooling Agent Present: <input checked="" type="checkbox"/>		LAB LIMS #: <u>09400755-</u>					
Received Date (mm/dd/yy): <u>1-27-23</u>		Custody Seal Present: <input checked="" type="checkbox"/>		Temperature Upon Receipt (°C): <u>8.3</u>		Project Information					
Received Time: <u>10:05</u>		Custody Seal Init.: <input checked="" type="checkbox"/>		P.O. #: _____		Site Location/ID: <u>Kitchener</u>					
REPORT INFORMATION				INVOICE INFORMATION							
Company: <u>Thurber Engineering Ltd.</u> Contact: <u>Geoff Lay</u> Address: <u>103-2010 Winston Park Drive</u> <u>Oakville, Ontario</u> Phone: <u>905-829-8666</u> Email: <u>glay@thurber.ca</u>				<input checked="" type="checkbox"/> (same as Report Information) Company: _____ Contact: _____ Address: _____ Phone: _____ Email: <u>accountingon@thurber.ca</u>							
REGULATIONS											
Regulation 153/04: Table 1: <input type="checkbox"/> R/P/I      Soil Texture: <input type="checkbox"/> Coarse Table 2: <input type="checkbox"/> I/C/C <input type="checkbox"/> Medium Table 3: <input type="checkbox"/> A/O <input type="checkbox"/> Fine				Other Regulations: <input type="checkbox"/> Reg 347/556 (3 Day min TAT) <input type="checkbox"/> PMO <input type="checkbox"/> MMER <input type="checkbox"/> CCME <input type="checkbox"/> Other: _____ <input type="checkbox"/> MISA			Sewer By-Law: <input type="checkbox"/> Sanitary <input type="checkbox"/> Storm <input type="checkbox"/> Municipality: _____				
RECORD OF SITE CONDITION (RSC)				<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO							
SAMPLE IDENTIFICATION				DATE SAMPLED		TIME SAMPLED		# OF BOTTLES		MATRIX	
1 BH-01 SS-1 (0'-2')				12/16/22				1		SOIL	
2 BH-02 SS-5 (10'-12')				12/20/22				1		SOIL	
3 BH-03 SS-5 (10'-12')				12/16/22				1		SOIL	
4 BH-04 SS-4 (7'6"-9'6")				01/11/23				1		SOIL	
5 BH-05 SS-4 (7'6"-9'6")				01/16/22				1		SOIL	
6 BH-06 SS-6 (15'-17')				12/21/22				1		SOIL	
7 BH-07 SS-6 (15'-17')				12/22/22				1		SOIL	
8 BH-08 SS-5 (10'-12')				01/09/23				1		SOIL	
9 BH-09 SS-3 (5'-7')				01/11/23				1		SOIL	
10 BH-10 SS-5 (10'-12')				01/16/23				1		SOIL	
11 BH-11 SS-3 (5'-7')				01/12/23				1		SOIL	
12 BH-12 SS-6 (15'-17')				01/12/23				1		SOIL	
Observations/Comments: Special Instructions											
Corrosivity testing to include pH, EC, and SAR.											
Sampled By (NAME): <u>Greg Stanhope</u>				Signature: <u>[Signature]</u>				Date: <u>Jan 13, 2022</u> (mm/dd/yy)			
Retinquished by (NAME):				Signature:				Date: _____ (mm/dd/yy)			
ANALYSIS REQUESTED											
Field Filtered (Y/N) <input type="checkbox"/> Metals & Inorganics <input type="checkbox"/> PAH <input type="checkbox"/> ABN <input type="checkbox"/> SVOC(all) <input type="checkbox"/> PCB Total <input type="checkbox"/> Aroclor <input type="checkbox"/> PHC F1-F4 <input type="checkbox"/> VOC <input type="checkbox"/> BTEX <input type="checkbox"/> BTEX/F1 <input type="checkbox"/> F2-F4 <input type="checkbox"/> VOC <input type="checkbox"/> BTEX <input type="checkbox"/> THM <input type="checkbox"/> Pesticides OC <input type="checkbox"/> OP <input type="checkbox"/> TCLP M&I <input type="checkbox"/> VOC <input type="checkbox"/> PCB <input type="checkbox"/> B(a)P <input type="checkbox"/> ABN <input type="checkbox"/> Ignit. <input type="checkbox"/> Water Pkg Gen. <input type="checkbox"/> Ext. <input type="checkbox"/> Sewer Use: <input type="checkbox"/> Corrosivity <input type="checkbox"/> Organic Content <input type="checkbox"/>											
COMMENTS:											
Rush TAT (Additional Charges May Apply): <input type="checkbox"/> 1 Day <input type="checkbox"/> 2 Days <input type="checkbox"/> 3 Days <input type="checkbox"/> 4 Days PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION Specify Due Date: _____ Rush Confirmation ID: _____ NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY											
TURNAROUND TIME (TAT) REQUIRED											
TATs are quoted in business days (exclude statutory holidays & weekends). Samples received after 6pm or on weekends: TAT begins next business day											
Quotation #: _____ P.O. #: _____ Project #: <u>35707</u> Site Location/ID: <u>Kitchener</u>											



## FINAL REPORT

CA40107-NOV23 R1

43743

Prepared for

**Thurber Engineering Ltd.**



# FINAL REPORT

CA40107-NOV23 R1

## First Page

### CLIENT DETAILS

Client                   Thurber Engineering Ltd.

Address                250 Thompson Drive  
Cambridge, ON  
N1T 2H9, Canada

Contact                Puneet Verma

Telephone             905-829-8666

Facsimile

Email                   pverma@thurber.ca

Project                43743

Order Number

Samples               Soil (3)

### LABORATORY DETAILS

Project Specialist     Jill Campbell, B.Sc.,GISAS

Laboratory            SGS Canada Inc.

Address               185 Concession St., Lakefield ON, K0L 2H0

Telephone             2165

Facsimile             705-652-6365

Email                   jill.campbell@sgs.com

SGS Reference         CA40107-NOV23

Received              11/09/2023

Approved              11/16/2023

Report Number        CA40107-NOV23 R1

Date Reported         11/16/2023

### COMMENTS

Temperature of Sample upon Receipt: 9 degrees C

Cooling Agent Present: Yes

Custody Seal Present: Yes

Chain of Custody Number: n/a

Corrosivity Index is based on the American Water Works Corrosivity Scale according to AWWA C-105. An index greater than 10 indicates the soil matrix may be corrosive to cast iron alloys.

### SIGNATORIES



TABLE OF CONTENTS

---

First Page..... 1

Index..... 2

Results..... 3

QC Summary..... 4-5

Legend..... 6

Annexes..... 7



FINAL REPORT

CA40107-NOV23 R1

**Client:** Thurber Engineering Ltd.  
**Project:** 43743  
**Project Manager:** Puneet Verma  
**Samplers:** Hayden Clarke

MATRIX: SOIL

Sample Number	5	6	7
Sample Name	BH 13 SS 1	BH 14 SS 4	BH 15 GS 2
Sample Matrix	Soil	Soil	Soil
Sample Date	06/11/2023	03/11/2023	06/11/2023

Parameter	Units	RL		Result	Result	Result
Corrosivity Index						
Corrosivity Index	none	1		4	5	1
Soil Redox Potential	mV	no		232	238	267
Sulphide (Na2CO3)	%	0.01		< 0.01	< 0.01	< 0.01
pH	pH Units	0.05		9.15	9.04	8.48
Resistivity (calculated)	ohms.cm	-9999		3830	2630	9010

General Chemistry

Conductivity	uS/cm	2		261	380	111
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Metals and Inorganics

Moisture Content	%	0.1		16.4	15.0	14.4
Sulphate	µg/g	0.4		7.8	7.9	7.0

Other (ORP)

Chloride	µg/g	0.4		54	96	14
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FINAL REPORT

CA40107-NOV23 R1

QC SUMMARY

Anions by IC  
Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-IENVIIC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0386-NOV23	µg/g	0.4	<0.4	7	35	98	80	120	119	75	125
Sulphate	DIO0386-NOV23	µg/g	0.4	<0.4	7	35	98	80	120	87	75	125

Carbon/Sulphur  
Method: ASTM E1915-07A | Internal ref.: ME-CA-IENVIARD-LAK-AN-020

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide (Na2CO3)	ECS0048-NOV23	%	0.01	< 0.01								

Conductivity  
Method: SM 2510 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0271-NOV23	uS/cm	2	< 2	0	20	101	90	110	NA		



QC SUMMARY

pH  
Method: SM 4500 | Internal ref.: ME-CA-|ENVIEWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0271-NOV23	pH Units	0.05	NA	0		101			NA		

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Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

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RPD: Relative percent difference

AC: Acceptance criteria

**Multielement Scan Qualifier:** as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

**Duplicate Qualifier:** for duplicates as the measured result approaches the RL, 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.

**Matrix Spike Qualifier:** for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

## LEGEND

### FOOTNOTES

**NSS** Insufficient sample for analysis.

**RL** Reporting Limit.

↑ Reporting limit raised.

↓ Reporting limit lowered.

**NA** The sample was not analysed for this analyte

**ND** Non Detect

Results relate only to the sample tested.

Data reported represent the sample as submitted to SGS. Solid samples expressed on a dry weight basis.

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This report supersedes all previous versions.

-- End of Analytical Report --

Received By: EP  
 Received Date: 11/9/23 (mm/dd/yy)  
 Received Time: 12:51 (hr : min)

Received By (signature):  
 Custody Seal Present: Yes ☐ No ☐  
 Custody Seal Intact: Yes ☐ No ☐

Cooling Agent Present: Yes ☐ No ☒  
 Temperature Upon Receipt (°C) 9.3

LAB LIMS # CA-40107-NOV23

**REPORT INFORMATION**  
 Company: Thurber Engineering Ltd.  
 Contact: Puneet Verma  
 Address: 250 Thompson Drive Unit #3, Cambridge ONT

☐ (same as Report Information)  
 Company: Thurber Engineering Ltd.  
 Contact: Accounts Payable

Address: 2010 Winston Churchill Park Dr. Suite 103  
Oakville, ONT  
 Phone: (905) 829-8666  
 Fax: (905) 829-8666

Quotation #: 43743  
 Project #: 43743

P.O. #:                       
 Site Location/ID: Kitchener

**TURNAROUND TIME (TAT) REQUIRED**  
 TAT's are quoted in business days (exclude statutory holidays & weekends).  
 Samples received after 6pm or on weekends: TAT begins next business day  
☒ Regular TAT (5-7days)  
☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days  
**RUSH TAT (Additional Charges May Apply):**  
**PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION**

**INVOICE INFORMATION**  
 Address: 2010 Winston Churchill Park Dr. Suite 103  
Oakville, ONT  
 Phone: (905) 829-8666  
 Email: accountingON@thurber.ca

**REGULATIONS**  
☐ O.Reg 153/04 ☐ O.Reg 406/19  
 Table 1 ☐ Res/Park ☐ Soil Texture: ☐ Coarse ☐ Medium/Fine  
 Table 2 ☐ Ind/Com ☐ PW/QO ☐ MMER ☐ Other:  
 Table 3 ☐ Agri/Other ☐ CCME ☐ MISA  
 Table ☐ App. ☐ <350m3 ☐ >350m3  
 Soil Volume ☐ <350m3 ☐ >350m3  
 ODWS Not Reportable \*See note

**RECORD OF SITE CONDITION (RSC)**  
☐ YES ☐ NO

**ANALYSIS REQUESTED**

<input type="checkbox"/> O.Reg 153/04		<input type="checkbox"/> O.Reg 406/19		Other Regulations:					Sewer By-Law:		RECORD OF SITE CONDITION (RSC)															COMMENTS:									
Table 1	Table 2	Table 3	Table	Res/Park	Soil Texture:	PWQO	CCME	MISA	Reg 347/558 (3 Day min TAT)	Sanitary	Storm	Municipality:	ODWS Not Reportable *See note																						
Soil Volume																		App.																	

COMMENTS:

Composite Sample

**Signature:** Hayden Clarke **Signature:**                       
**Sampled By (NAME):** Hayden Clarke **Sampled By (NAME):**                       
**Relinquished by (NAME):**                      **Relinquished by (NAME):**                       
 Date of Issue: 11 June 2021 **Date:** 11/9/23 **Date:** 11/9/23  
 Revision # 1.6 **Revision #**                       
 Note: Submission of samples to SGS is acknowledgement that you have been provided direction on sample collection/handling and transportation of samples. (2) Submission of samples to SGS is considered authorization for completion of work. Signatures may appear on this form or be retained on file in the contract, or in an alternative format (e.g. shipping documents). (3) Results may be sent by email to an unlimited number of addresses for no additional cost. Fax is available upon request. This document is issued by the Company under its General Conditions of Service accessible at [http://www.sgs.com/terms\\_and\\_conditions.htm](http://www.sgs.com/terms_and_conditions.htm). (Printed copies are available upon request.) Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.