REPORT ON
PRELIMINARY GEOTECHNICAL AND PAVEMENT INVESTIGATION
CREDITVIEW ROAD CLASS EA STUDY
FROM BANCROFT DRIVE TO OLD CREDITVIEW ROAD
MISSISSAUGA, ONTARIO

Prepared for:

AECOM

By:

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1. GENERAL DATA

1.1 Introduction

SPL Consultants Limited (SPL) was retained by AECOM on behalf of City of Mississauga to undertake a preliminary geotechnical and pavement investigation for the proposed widening and reconstruction of 2.2 km section of Creditview Road, as part of the class EA study, between Bancroft Drive and Old Creditview Road in Mississauga, Ontario.

We understand that the existing road will be rehabilitated/reconstructed and ultimately widened from the existing two-lane road to a four–lane urban section in the long-term solution. We further understand that, based on the Environmental Study Report (ESR), no major roadway profile changes are contemplated.

The purpose of the geotechnical investigation was to determine the subsurface conditions at borehole locations and from the findings in the boreholes, make preliminary engineering recommendations for the proposed underground utilities and pavements.

This report is provided on the basis of the terms of reference presented above and on the assumption that the design will be in accordance with the applicable codes and standards. If there are any changes in the design features relevant to the geotechnical analyses, or if any questions arise concerning the geotechnical aspects of the codes and standards, this office should be contacted to review the design. It may then be necessary to carry out additional borings and reporting before the recommendations of this office can be relied upon.

The site investigation and recommendations follow generally accepted practice for geotechnical consultants in Ontario. The format and contents are guided by client specific needs and economics and do not conform to generalized standards for services. Laboratory testing for most part follows ASTM or CSA Standards or modifications of these standards that have become standard practice.

This report has been prepared for City of Mississauga, AECOM and its designers. Third party use of this report without SPL consent is prohibited. The limitation conditions presented in this report form an integral part of the report and they must be considered in conjunction with this report.

1.2 Project Limits

Creditview Road is a south-north road under the jurisdiction of City of Mississauga. The project site is located between Bancroft Road (south project limit) and Old Creditview Road (north limit). Total length of the project is about 2.2 km.

1.3 Road Classification and Traffic Data

As provided by the City of Mississauga, Creditview Road between Bancroft Drive and Old Creditview Road is classified as Urban Major Collector. Based on the data provided by the City of Mississauga, traffic volumes are presented in Table 1 below.

Table 1: Traffic Volumes on Creditview Road, Within the Project Limits

Location	2013 AADT	% Growth Rate	% Commercial
Creditview Road	22,335	2.5	3

2. FIELD INVESTIGATION AND LABORATORY TESTING

2.1 Field and Laboratory Work

A total of 16 boreholes (BH13-1 to BH13-16) were drilled for the reconstruction/widening of Creditview Road between Bancroft Road and Old Creditview Road. In addition to the boreholes, six (6) shallow hand dug test-pits (TP1 to TP6) were carried out to measure the topsoil thickness in the boulevard/widening areas.

The locations of the boreholes are shown on the Borehole Location Plan, **Drawing 1**.

The boreholes were drilled in October 29 and 30, 2013 with solid stem continuous flight auger equipment by a drilling sub-contractor under the direction and supervision of SPL Consultants Limited personnel. Samples were retrieved at regular intervals with a 50 mm O.D. split-barrel sampler driven with a hammer weighing 624 N and dropping 760 mm in accordance with the Standard Penetration Test (SPT) method. The samples were logged in the field and returned to the SPL Consultants Limited laboratory for detailed examination by the project engineer and for laboratory testing.

Water level observations were made during drilling and in the open boreholes at the completion of the drilling operations. A standpipe piezometer was installed in BH13-1 for stabilized groundwater level monitoring.

As well as visual examination in the laboratory, all of the soil samples were tested for moisture content. Sieve analyses of eight (8) pavement granular fill samples were conducted and the results are presented on **Drawings 18 and 19**. Grain size analyses of three (3) subgrade soil samples were conducted and the results are presented on **Drawing 20**.

Five (5) selected soil samples were subjected to chemical analysis to assess the environmental quality of the soils to assist in determining off-site disposal options. The test results are attached in **Appendix D.**

The surveying of the borehole locations was undertaken by SPL Consultants Limited personnel.

2.2 Pavement Condition

Based on visual/drive through assessment of the site, it appears that Creditview Road was recently paved and the road is currently in fairly good condition and also no major distresses were observed.

Photographs of the project are enclosed in **Appendix A.**

3. PAVEMENT STRUCTURE AND SUBSURFACE CONDITIONS

Detailed subsurface conditions encountered in the boreholes are presented on the Borehole Logs, **Drawings 2 to 17** and are summarized as follows. General notes on the sample descriptions are provided in **Drawing 1A**.

3.1 Existing Pavement Structure

Tables 2 and 3 below present existing pavement structure data obtained from sixteen boreholes (BH13-1 to BH13-16) drilled for the present investigation along Creditview Road and Sideroads, respectively, within the project limits.

Table 2: Existing Pavement Structure Data along Creditview Road

Borehole Location	Asphalt (mm)	Granular Base (mm)	Granular Sub-Base (mm)
BH13-1	180	160	380
BH13-2	150	160	250
BH13-3	170	190	300
BH13-4	180	150	250
BH13-5	150	350	320
BH13-6	180	220	340
BH13-7	145	135	450
BH13-8	165	295	370

Table 3: Existing Pavement Structure Data for Side roads

Borehole Location	Intersecting Road	Offset from C/L of Creditview	Asphalt (mm)	Granular Base (mm)	Granular Sub-Base (mm)
BH13-9	Bancroft Dr.	40 m east	155	100	425
BH13-10	Sir Monty's Dr.	45 m west	125	150	295
BH13-11	Velebit Ct.	14 m west	150	200	280
BH13-12	Kenninghall Crescent	30 m east	200	180	165
BH13-13	Kenninghall Blvd.	35 m west	170	130	150
BH13-14	Falconer Dr.	27 m west	200	160	270
BH13-15	Argentia Rd.	45 m west	185	245	220
BH13-16	Old Creditview Rd.	40 m east	170	130	285

Summary of Existing Pavement Structure

Based on the data obtained from the borehole logs, **Tables 4 and 5** below present the summary of thickness and average GBE for the existing pavement structure for the northbound lane (Bancroft Drive to Old Creditview Road) and southbound lane (Old Creditview Road to Bancroft Drive) respectively.

Details of layer thicknesses are presented in the Pavement Structure Spreadsheet in **Appendix B.**

Table 4: Summary of Existing Pavement Structure along the North-bound lane of Creditview Rd

Route:	Pavement Component	No. of Observations	Thickness (mm)	
			Range	Mean
Northbound Lane of Creditview	Total HMA[1] (from boreholes)	4	150 - 180	169
	Granular Base Material	4	150 - 295	206
	Granular Subbase Material	4	250 – 370	303
	Total Granular Material	4	400 - 665	509
			Average Existing GBE[2]	**517**

1. HMA = Hot Mix Asphalt 2. GBE Factors: Existing Asphalt = 1.25, Existing Granular Base = 0.75, Existing Subbase = 0.5

Table 5: Summary of Existing Pavement Structure along the South-bound lane of Creditview Rd

Route:	Pavement Component	No. of Observations	Thickness (mm)	
			Range	Mean
Southbound Lane of Creditview	Total HMA[1] (from boreholes)	4	145 - 180	161
	Granular Base Material	4	135 – 350	209
	Granular Subbase Material	4	300 – 450	363
	Total Granular Material	4	490 - 670	571
			Average Existing GBE[2]	**539**

1. HMA = Hot Mix Asphalt 2. GBE Factors: Existing Asphalt = 1.25, Existing Granular Base = 0.75, Existing Subbase = 0.5

Combining the above data, Table 6 below presents the summary of the existing pavement structure and average GBE for both lanes for the entire project length.

Table 6: Summary of Existing Pavement Structure along Creditview Rd (both lanes)

Route:	Pavement Component	No. of Observations	Thickness (mm)	
			Range	Mean
Both Lanes of Creditview	Total HMA[1] (from boreholes)	8	145 - 180	165
	Granular Base Material	8	135 - 350	208
	Granular Subbase Material	8	250 - 450	333
	Total Granular Material	8	490 - 670	540
			Average Existing GBE[2]	**528**

1. HMA = Hot Mix Asphalt 2. GBE Factors: Existing Asphalt = 1.25, Existing Granular Base = 0.75, Existing Subbase = 0.5

Table 7 below presents the summary of the existing pavement structure and average GBE for eight intersection sideroads (Bancroft Dr., Sir Monty's Dr., Velebit Ct., Kenninghall Crescent, Kenninghall Blvd, Falconer Dr., Argentia Rd. and Old Creditview Rd.) of the project.

Table 7: Summary of Existing Pavement Structure for sideroads

	Pavement Component	No. of Observations	Thickness (mm)	
			Range	Mean
Route: **Sideroads**	Total HMA[1] (from boreholes)	8	125 - 200	169
	Granular Base Material	8	100 - 245	162
	Granular Subbase Material	8	150 - 425	261
	Total Granular Material	8	280 - 525	423
			Average Existing GBE[2]	**464**

1. HMA = Hot Mix Asphalt 2. GBE Factors: Existing Asphalt = 1.25, Existing Granular Base = 0.75, Existing Subbase = 0.5

From Table 2, eight boreholes along Creditview Road encountered a pavement structure consisting of 145 to 180 mm of asphaltic concrete underlain by 135 mm to 350 mm of granular base and 250 mm to 450 mm of granular subbase materials.

Eight (8) tested samples of the pavement granular base and sub-base material contain 18 to 63% gravel, 27 to 66% sand, 10 to 25% fines (silt and clay size particles). The grain size distribution curves for the samples are presented on Drawing 18 and Drawing 19. The upper limits and lower limits of OPSS Granular 'A' and Granular 'B' Type I are also shown in these drawings. The fines contents in all of the tested samples are higher than the upper limit of 8% of Granular 'A' and Granular 'B' Type I.

3.2 Soil and Groundwater Conditions

3.2.1 Soil Types

Fill Material:

Fill material was encountered below the pavement structure in all of the boreholes, except BH13-14 and BH13-15, to depths varying from 1.0 to 2.1 m. Fill material extended to the maximum explored depth of boreholes in BH13-9 to BH13-12. Fill material was heterogeneous and consisted of clayey silt, silty sand, sand and sand and gravel and was present in a loose to compact, generally compact state, with measured SPT 'N' values varying from 7 to 51 blows per 300 mm of penetration.

Peat:

Peat was encountered in BH13-5 at a depth of about 2.8m and extended to a depth of about 3.5m, embedded within the clayey silt deposit.

Clayey Silt Till:

Underneath the fill material or pavement structure in Boreholes BH13-1, 13-2, 13-3, 13-7, 13-8 and 13-13, the upper native soil consisting of clayey silt till was encountered, extending to the maximum depth of penetration or overlying silty sand till. Clayey silt till deposit was present in a stiff to hard, but generally in very stiff consistency, with measured SPT 'N' values ranging from 11 to 55 blows per 300 mm of penetration. Occasional wet sand seams were noted within the clayey silt till.

Grain size analyses of two (2) samples from clayey silt till (BH13-1/SS4 and BH13-7/SS3)) were conducted. The results are presented on **Drawing 20** and are shown on the respective borehole logs, with the following fractions:

Clay:	23 to 32 %
Silt:	46%
Sand:	17 to 19 %
Gravel:	3 to 14 %

Based on the above grain size analyses, the soil is considered to have moderate susceptibility to frost heaving (MSFH).

Silty Sand Till:

Silty sand till deposit was encountered in BH13-1, BH13-3 and BH13-7 below the upper clayey silt till and continued to the maximum explored depth of the boreholes. Silty sand till was present in a compact to very dense state with measured SPT 'N' values ranging from 21 to more than 50 blows per 300 mm of penetration. Water bearing wet sand seams were noted within the sandy till deposit.

Silt to Clayey Silt:

Silt to clayey silt deposit was encountered in boreholes BH13-4, BH13-5, BH13-6, BH13-14 and BH13-15 below the fill material and continued to the maximum explored depth of the boreholes except at BH13-5 where the deposit extended to a depth of 2.8 m. Silt to clayey silt was present in a loose to compact/stiff to very stiff state, with measured SPT 'N' values ranging from 9 to 24 blows per 300 mm of penetration.

Grain size analysis of one (1) sample from silt to clayey silt (BH13-4/SS4) was conducted. The results are presented on Drawing 20 and are shown on the respective borehole log, with the following fractions:

Clay:	21%
Silt:	78%
Sand:	1%

Based on the above grain size analysis, the soil is considered to have high susceptibility to frost heaving (HSFH).

3.2.2 Groundwater Conditions

The majority of the boreholes were found dry upon completion of drilling, except BH13-1, BH13-6 where short-term (unstabilized) groundwater was found at depths of 4.1 m and 1.5 m respectively. The stabilized groundwater table observed in the piezometer installed in BH13-1 was at a depth of 2.6 m (Elevation 162.5m) on November 19, 2014. It should be noted that the groundwater levels can vary and are subject to seasonal fluctuations in response to major weather events.

4. PAVEMENT STRUCTURE DESIGN

4.1 Existing Pavement Structure

Based on the values shown in Pavement Structure Spreadsheet (**Appendix B), Table 6** and **Table 7**, the chosen design values to represent the existing pavement structure are shown in **Table 8** below:

Table 8 Existing Pavement Structure Design Values

Route	Main Lane			
	Asphaltic layer	Granular Base	Granular Subbase	Total Granular mm
Creditview Road	165	200	340	540
Sideroads	169	150	250	400

4.2 Equivalent Single Axle Load (ESAL's)

The equivalent single axle loads (ESAL) for the design lanes were calculated using traffic data presented in Table 1. The input parameters for the design lane ESAL calculation were derived from MTO publication MI-183 *'Adaptation and Verification of AASHTO Pavement Design Guide for Ontario Conditions' and 'Procedures for Estimating Traffic Loads for Pavement Design, 1995'*. Table 9 presents the input parameters used to calculate ESALs in the two alternatives for design period (15-Year and 20-Year Design life).

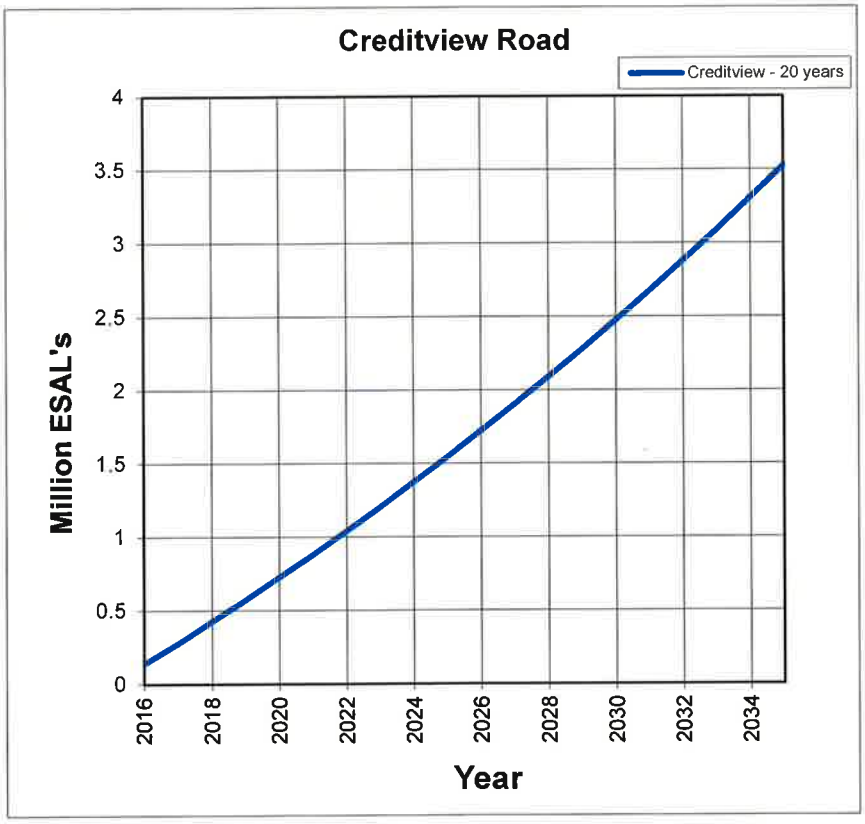
Table 9: Input Parameters for ESAL Calculations (Two-Lane and Four-Lane calculations)

Number of Lane	Base year AADT[1]	% Comm-ercial	Avg. Truck Factor	DD[2]	Annual Traffic Growth (%)[3]	LD[4]	Design No. of Days per Year	Design Period (Year)	Cumulative ESAL's (million)
Four-Lane	24,050	3	1.31	0.5	2.5	0.8	365	15	2.5
Four-Lane	24,050	3	1.31	0.5	2.5	0.8	365	20	3.6

1. Base Year = 2016
2. Directional Distribution
3. Average annual traffic growth rates were derived from traffic data provided.
4. Lane Distribution.

Figure 1 illustrates the cumulative ESAL for four-lane calculations, along Creditview Road within the project limits, for over a 20-year design period.

Figure 1 Cumulative ESAL for Creditview Road (Within the Project Limits)



As provided by the Client, Creditview is classified as Urban Major Collector Road. Presently, Creditview is a two lane road within the project limits with posted speed limit of 60 km/hr.

4.3 Thickness Design

4.3.1 New Construction (Widening)

Pavement structure thickness design for the design lane was determined using the AASHTO design method. Input parameters are shown in **Table 10** below, and the design output sheets are presented in **Appendix C**.

Table 10: Input Parameters for Pavement Structure Calculations

Design Period	Initial/Terminal Serviceability	Cumulative ESAL's (million)	Subgrade Resilient Modulus (M_R), Mpa
20 years	p_i = 4.4 p_t =2.2	3.6	25
Common Parameters	Structural Coefficients ('a' values): New HMA : 0.42 New Gran Base : 0.14		

New Gran Subbase : 0.09

Drainage Coefficient:
m = 1.0 (for new granular base and subbase)
Design Period: 20 Years (for new pavements)
Reliability and Standard Deviation: R = 90 %; S = 0.48

The required pavement structures for Creditview Road based on City of Mississauga Standards and the AASHTO design method, for the input parameters noted in **Table 10** considering Moderate to Highly Susceptibility to Frost Heaving (MSFH to HSFH) soil subgrade, are shown in **Table 11** below:

Table 11: Pavement Design Summary- Creditview (New Construction)

Methodology	Material Thickness (mm)	SN*	GBE (mm)*
City of Mississauga Design Standard	140 mm hot mix, 200 mm Granular A, 400 mm Granular B Type I	123	748
MTO Routine	N/A	-	-
AASHTO	a) 150 mm hot mix, 200 mm Granular A, 450 mm Granular B Type I (minimum structural requirements for 20 years design life)	132	802
	b) 140 mm hot mix, 200 mm Granular A, 500 mm Granular B Type I (minimum structural requirements for 20 years design life)	132	815

*The Structural Number (**SN**) obtained was calculated using the following layer coefficients: HMA = 0.42; New Base= 0.14; New Subbase= 0.09;
GBE was calculated using the equivalency factors: HMA = 2; New Base = 1.0; New Subbase = 0.67.

Table 11 shows that pavement structure recommended by AASHTO pavement design method for 20-yr designs (a and b alternatives) are thicker and stronger than the pavement structure for arterial roads under the City of Mississauga Design Standard and MTO Guideline. As a result, the minimum required Structural Number (SN) for new construction on Creditview Road will conform to the AASHTO design and is as follows:

- For 20 years initial design life: SN= 132

Based on the above and Table 6, the existing pavement structure within the project limits is inadequate to support the future traffic.

4.3.2 Reconstruction/Rehabilitation - Existing Roadway

Pavement structure thickness design for the design lane was determined using the AASHTO design method. Input parameters are shown in **Table 12** below, and the design output sheets are presented in **Appendix C**.

Table 12: Input Parameters for Pavement Structure Calculations

Design Period	Initial/Terminal Serviceability	Cumulative ESAL's (million)	Subgrade Resilient Modulus (M_R), Mpa
20 years	p_i = 4.4 p_t =2.2	3.6	25
Common Parameters	Structural Coefficients ('a' values): New HMA : 0.42 Existing HMA = 0.24 New Gran Base : 0.14 Existing Gran Base= 0.13 New Gran Subbase : 0.09 Existing Gran Subbase= 0.08 Drainage Coefficient: m = 1.0 (for new granular base and subbase) m = 0.9 (for existing granular base and subbase) Design Period: 20 Years (for new pavements) Reliability and Standard Deviation: R = 90 %; S = 0.48		

The required pavement structure for Creditview Road based on the AASHTO design method, for the input parameters noted in **Table 12** considering MSFH to HSFH soil subgrade, is shown in **Table 13** below:

Table 13 Pavement Design Summary – Rehabilitation of existing lanes

Route	Methodology	Material Thickness (mm)	SN*	GBE (mm)*
Creditview Rd existing lanes	AASHTO	**Rehabilitation Option 1 – 20 years Design** 170 mm Hot mix, 300 mm Granular Base, over 235 mm of existing Granular sub-base (minimum structural requirements for 20 years design life)	130	758
	AASHTO	**Rehabilitation Option 2 – 20 years Design** 160 mm Hot mix, 300 mm Granular Base, over 295 mm of existing Granular sub-base (minimum structural requirements for 20 years design life)	130	768
	AASHTO	**Rehabilitation Option 3 – 15 years Design** 140 mm Hot mix,	125	624

		over 75 mm of existing Asphaltic Layer, 200 mm of existing Granular Base and 340 mm of existing Granular sub-base (minimum structural requirements for 15 years design life))		

* The Structural Number (**SN**) obtained was calculated using the following layer coefficients: New HMA = 0.42; Existing HMA = 0.24; New Base = 0.14; Existing Base= 0.13; Existing Subbase= 0.08.; New Subbase= 0.09 and Drainage coefficients for Existing Base and Subbase = 0.9

***GBE** was calculated using the equivalency factors: HMA = 2; Existing HMA = 1.25; New Base = 1.0; Existing Base= 0.75; New Subbase = 0.67; Existing Subbase= 0.5.

4.4 Recommendations

4.4.1 New Construction (Widening)

Based on alternative b of AASHTO design in **Table 11**, the pavement structure for the new construction on the widening section, as a minimum structural requirement (for 20-yr design), for Creditview Road is as follows:

- 140 mm Asphalt
- 200 mm Granular Base
- 500 mm Granular Subbase (structural requirements)

The existing pavement depth is about 705 mm on average as per Table 6 and the proposed pavement depth along the widening is 840 mm. This satisfies the drainage requirements and would provide sufficient lateral subsurface drainage for the widened section, if the existing road will not be reconstructed full depth, assuming no grade raise.

Therefore, the recommended pavement structure for the new construction is as follows:

- 40 mm Superpave 12.5 FC 1 or HL 1 surface course
- 100 mm Superpave 19.0 or HDBC (Heavy Duty Binder Course)
- 200 mm of 19 mm Crusher Run Limestone (CRL) Base Course
- 500 mm Granular B Type II Subbase Course

The above pavement design also applies for full depth reconstruction of the existing pavement, if required.

4.4.2 Reconstruction/Rehabilitation - Existing Roadway

<u>Option 1: Rehabilitation by Excavation - No Grade Raise – 20 Years Design Life</u>

- Mill off 20 mm of existing asphalt surface course.
- Pulverize existing asphalt and underlying granular base to depth of 300 mm.
- Remove Pulverized material and stockpile for re-use.

- Excavate top 150 mm of existing granular material and stockpile for re-use.
- Regrade and compact the exposed surface.
- Place 300 mm new Granular A or 19 mm Crusher Run Limestone (CRL) Base Course (2 lifts)
- Pave 170 mm HMA (40 mm 12.5 FC 1 or HL 1 surface course over 130 mm Superpave 19.0 or HDBC (Heavy Duty Binder Course) in two lifts (60mm upper binder course + 70 mm lower binder course).
- Grade Raise = none

Option 2: Rehabilitation by Excavation – 50 mm Grade Raise – 20 Years Design Life

- Mill off 20 mm from existing asphalt surface course.
- Pulverize existing asphalt and underlying granular base to depth of 300 mm.
- Remove Pulverized material and stockpile for re-use.
- Excavate top 90 mm of existing granular material and stockpile for re-use.
- Re-grading, re-compaction, correction of cross-fall of the existing exposed granular.
- Place 300 mm new Granular A or 19 mm Crusher Run Limestone (CRL) Base Course (2 lifts)
- Pave 160 mm HMA (40 mm 12.5 FC 1 or HL 1 surface course over 120 mm Superpave 19.0 or HDBC (Heavy Duty Binder Course) in two lifts.
- Grade Raise = 50 mm

Option 3: Rehabilitation by milling – 50 mm Grade Raise – 15 Years Design Life

- Mill off 90 mm from existing asphalt surface and binder courses.
- Pave 140 mm HMA (40 mm 12.5 FC 1 or HL 1 surface course over 100 mm Superpave 19.0 or HDBC (Heavy Duty Binder Course) in two lifts.
- Grade Raise = 50 mm

4.4.3 Subgrade Preparation

For the subgrade preparation, all topsoil, organic material, loose fill or other unsuitable soils should be removed prior to the placement of earth fill material for the construction of the pavement widening.

After stripping, the exposed subgrade should be inspected, proof-rolled and approved by a geotechnical engineer who is familiar with this report. Unsuitable or loose materials should also be sub-excavated and replaced with compacted indigenous material.

The long term performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure uniform subgrade conditions are achieved. In addition, the need for adequate drainage is emphasized.

The finished subgrade should be free of depressions and should be sloped (preferably at a grade of 3%) to provide effective sub-surface drainage toward subdrains or ditches.

4.4.4 Pavement Widening

According to the design prepared for the Environmental Assessment, it is understood that the existing road will be ultimately widened to accommodate a four-lane urban section in the long-term solution.

For the widening, after stripping, proof-rolling and approval of the subgrade as mentioned above, all new fills in the widening section should consist of pre-approved common fill (select subgrade), free of topsoil, boulders, frost etc. and pre-screened by this office for its geotechnical and environmental suitability. The new fill should be placed in lifts not exceeding 300 mm before compaction and each lift should be uniformly compacted to at least 95% of the Standard Proctor Maximum Dry Density (SPMDD), increasing to 98% within the top 0.6 m of the subgrade, at a placement water content of ±2% of optimum.

Proper benching of the existing embankment slope should be implemented if and where abutting into the existing embankments. This can be constructed in accordance with OPSD 208.01 – Benching of Earth Slope. Subdrains should be provided on both sides of the road.

The Granular base and Granular subbase must be compacted to 100% of SPMDD and should be placed full-width. The finished pavement surface should be sloped (preferably at a grade of 2 %) to provide effective surface drainage toward catch basins. Surface water should not be allowed to pond adjacent to the outside edges of pavement areas.

Heavy construction equipment may have to be kept off the newly constructed roads before the placement of asphalt and/or immediately thereafter, to avoid damaging the subgrade by heavy truck traffic.

The granular base and sub-base materials should be placed in layers not exceeding 150mm (uncompacted thickness), and should be compacted to 100% *of* their respective SPMDD. The grading of the material should conform to current OPS Specifications.

4.4.5 Re-use of Excavated Material or Pulverized Material

Excavated organic soils are unsuitable for re-use as earth fill. Excavated frost susceptible soils (CL, CI, and ML) shall not be used within frost depth (1.5 m) from pavement surface. Excavated granular material/removed pulverized material may be re-used as subbase or fill for the widening section within road ROW depending on the quality of material. It should be noted that any excavated silty clay or clayey silt is not recommended to be used as a backfill (hard to compact), but it may be used for slope flattening (if required).

4.4.6 Tack Coating

Tack coat should be applied to the surface of all binder courses, as per OPSS PROV 308.

4.4.7 Pavement Transition

Any grade raises should be transitioned to the existing grade over an appropriate length to ensure a smooth riding surface and to minimize differential pavement performance. For example, one lift of asphalt (40 to 50 mm thick) should be transitioned over a minimum length of 10 m (do not feather off, minimum thickness of 30 mm). However, a step joint (5 m step long for each layer) should be provided at the east and west project limits.

5. UNDERGROUND UTILITIES

It is understood that underground services will be installed at the site as part of the road widening or reconstruction. The invert elevations or depths of the proposed utilities are not available to us at the time of writing this report.

5.1 Trenching

Based on the borehole information, the trenches for the proposed utilities in the area of boreholes will be dug through fill material, clayey silt till, silty sand till or silt to clayey silt. No major problems due to groundwater seepage are anticipated in this section of road during construction in trenches dug upto a depth of 4 m, due to the low permeability of till deposits. Occasional wet sand seams and water bearing silt layers were encountered in the boreholes. It is expected that any seepage that occurs from sand and silt seams / interbeds can be removed by pumping from sumps.

The sides of excavations in the native soil can be expected to be temporarily stable at relatively steep side slopes for short periods of time but they should be cut back at slopes no steeper than 1:1 in order to comply with the safety regulations. Where the existing fill is uncompacted (loose to very loose, soft, firm), or peat is encountered, the side slopes in these sections will have to be flattened to 3H:1V or flatter. If steep side slopes are required, the sides should be supported by braced skeleton or close sheeting.

In the planning of the trenches' shoring and excavation, the presence of the adjacent existing buried service pipes should be considered. In addition to the stability of these existing adjacent pipes, which must be maintained without detrimental settlements, the backfill in these trenches and especially the granular bedding surrounding the existing service pipes, manholes, etc. may be a source of water, which, if encountered, must be dealt with.

Provisions must be made in the excavation contract for the removal of possible boulders in till deposits or obstructions in the fill material.

Reference to **Drawing No. 21** indicates zones in which some degree of movement of the ground can be anticipated as a consequence of trench excavation and the position of the existing buried services should be located with regard to this. In this respect, it should also be noted that less ground movements will be experienced outside the excavation if the sides of the excavation are properly

supported by tight, braced sheeting than if the sides are unsupported. Ground movements would be further reduced if the bracing were to be pre-stressed.

All excavations should be carried out in accordance with the Construction Safety Act of the Province and excavation should conform to the Ontario Reg. 213/91 for Construction projects. The fill material can be classified as Type 3 soil above groundwater table. The stiff to hard clayey silt till, stiff to very stiff clayey silt, compact silt and compact to very dense silty sand till can be classified as Type 3 Soil above groundwater table.

5.1.1 Use of Trench Box for Utility Trench Wall Support

Where permissible under the OHSA, contractors often elect to utilize trench boxes for temporary trench support.

While in many situations, the use of trench boxes can result in a high rate of productivity in trenching, it is not without some technical drawbacks. These include:

- Increased loss of ground relative to many other shoring methods; and
- Reduced ability to compact backfill between the trench wall and trench box.

Ground loss, raveling and/or loosening of soils will occur when using a trench box prior to its installation and while moving the box, particularly in pre-existing fill as present at this site.

Granular courses below existing pavements are particularly susceptible and significant undermining can occur. It is important that the trench not be over-excavated to ensure a tight fit between the box and the trench walls. Trench boxes need to be installed expediently. When moving the box, the void space between its outer walls and the trench must be backfilled and compacted. This may require raising the box sequentially prior to sliding it laterally. If this is not done, post-construction settlements will occur along the trench walls.

Where trench boxes are used in the existing roadways, it is prudent to expect pavement structure settlement along both sides of the trench. In such cases, following backfilling of the trench, road reconstruction should include a provision for saw cutting of the asphalt and concrete road base at least 600mm back from the trench walls, recompaction of the upper trench backfill and then paving.

5.1.2 Trenching Adjacent To Existing Service Trenches

In areas where the new utilities impinges on existing utility trenches, unstable trench conditions can occur, particularly where granular backfill, clear stone, or poorly compacted fill of any type are present. In such cases, raveling of the pre-existing fill and high rates of water infiltration through utility bedding can potentially occur which can, in severe cases, put the stability of the adjacent utility in jeopardy. As such, a higher standard of care in shoring is needed where the watermain trench is located closer than 0.75H to an adjacent trench, where H is the depth of the deeper cut. The use of trenching boxes is

poorly suited in this instance, since they do not provide adequate intimate lateral support to the sides of the cut and considerable loss of ground can occur prior to insertion of the box. Closed sheeting or other pre-installed shoring measures are more suitable.

5.2 Bedding

The undisturbed native clayey silt till, silt to clayey silt and silty sand till will provide adequate support for the service pipes and allow the use of Class B type bedding. In the area of BH13-5 where peat was encountered to a depth of 3.5 m, all the peat must be sub-excavated and replaced with granular fill material. The recommended minimum thickness of granular bedding below the invert of the pipes is 150 mm.

The thickness of the bedding may, however, have to be increased depending on the pipe diameter or in accordance with local standards or if wet or weak subgrade conditions are encountered, especially when the soil at the trench base level consists of wet, dilatant silt. The bedding material should consist of well graded granular material such as Granular 'A' or equivalent. After installing the pipe on the bedding, a granular surround of approved bedding material, which extends at least 300 mm above the obvert of the pipe, or as set out by the local Authority, should be placed.

5.3 Backfilling of Trenches

The select inorganic fill materials or native soils free from topsoil / organics can be used as general construction backfill, provided their moisture contents at the time of construction are within 2% of their optimum moisture content.

It is preferable that the native soils be re-used from approximately the position at which they are excavated so that frost response characteristics of the soils after construction remain essentially similar to presently existing.

The clayey soils will be excavated in blocks or chunks, which should be adequately pulverized prior to placement in the trenches. Sheepsfoot / hoe-pack compactors would be best suited for compacting these soils. If such soils are not adequately pulverized, placed in thin lifts and carefully compacted then excessive post construction settlements at the ground surface could occur.

Where the soils are sufficiently fine grained (e.g. silty soils) some moisture conditioning may be required if excess pore air and pore water pressures are generated during compaction process. If bulking is noted, delaying the placement of subsequent lifts may be necessary, to allow for the dissipation of such induced excess pressures.

Consideration may also be given to backfilling trenches with a well-graded, compacted granular soil such as Granular 'B' material. The use of such material, if thoroughly compacted, would reduce the post construction settlements to a negligible amount and may also expedite the compaction process. In this instance, however, frost response characteristics of non-frost susceptible granular fill and the frost

susceptible indigenous soils would be different giving rise to differential frost heave or movement. In this case it would be prudent to use as backfill the on-site excavated, naturally occurring soils to match the existing conditions within the frost zone (i.e. within 1.5 m depth) as well as to provide a frost taper zone (i.e. to provide a zone of taper to prevent a sudden change in frost heave characteristics to reduce the effects of frost heave).

In any case the degree of compaction of the trench backfill should be at least 95% of the material's Standard Proctor Maximum Dry Density (SPMDD). This value should be increased to at least 98% within 2 m of the road surface. The granular pavement sub-base and base materials should be compacted to at least 100% of their respective SPMDD.

5.4 Earth Pressure

The lateral earth pressures acting on temporary shoring may be calculated from the following expression:

$$p = K(\gamma h + q)$$

where p = lateral earth pressure in kPa acting at depth h

K = earth pressure coefficient, assumed to be 0.30 for vertical shoring and horizontal backfill
γ = unit weight of backfill, a value of 21 kN/ m3. may be assumed
h = depth to point of interest in metres
q = equivalent value of surcharge on the ground surface in kPa

The earth pressure diagrams for cohesive and non-cohesive soils are summarized on Drawing No. 22.

6. CREDITVIEW ROAD AND HIGHWAY 401 UNDERPASS

Borehole drilling / geotechnical investigation at the Highway 401 and Creditview Road underpass structure was not part of SPL's scope of work. It is understood that Golder Associates (Golder) conducted a preliminary geotechnical investigation for the proposed widening / realignment of Highway 401 underpass structure at Creditview Road in September 2011. SPL was requested to review the preliminary geotechnical Investigation report by Golder Associates for the Creditview Road Bridge over Hwy 401 and provide comments.

It is understood that the existing underpass structure located at the intersection of Highway 401 and Creditview Road will be widened / replaced. It is also understood that the existing underpass consist of a 65m long by 10m wide four span structure, with the existing abutments supported on piles and the piers supported on spread footings. The existing pavement grade on Creditview Road is at about Elev. 176 m and at Highway 401 is at about Elev. 170m.

Two boreholes (11-201 and 11-202) were drilled by Golder to depths of 14.2 m and 16.4 m, respectively. Logs and location plan of the Golder's boreholes are attached in Appendix E of this report. Based on the

geotechnical information from Golder's logs, the subsoil conditions at the site consisted of fill material to a depth of 2.2 to 2.3 m, overlying soft to very stiff clayey silt to depths of 5.7 to 7.3 m, which is underlain by a deposit of very stiff to hard clayey silt till, overlying shale bedrock. The clayey silt till was interbedded with very dense sand and silt till in Borehole 11-201 from depth 7.2 to 9 m. Shale bedrock was encountered in the Boreholes 11-201 and 11-202 at depths 10.2 m (Elev. 159.5m) and 11.6 m (Elev. 161.8m) respectively. Groundwater level in the piezometer installed in Borehole 11-201 was recorded at Elev. 165.3 m on November 2, 2011.

Based on the subsurface conditions at the site, the upper native soils consisting of soft to very stiff clayey silt are considered unsuitable to support the shallow foundations (footings) of the proposed bridge structures. Deep foundations such as driven steel piles or drilled caissons founded in shale bedrock are required to support the bridge structure.

Both piles and / or caissons are considered suitable for the bridge abutments and piers; however if integral abutments are being considered for the bridge structure, then the abutments can be supported by driven piles and piers can be supported by drilled caissons. The piles can consist of steel H-piles, such as HP310x110.

Based on the borehole information, the proposed structure can be supported by driven piles founded on or in shale bedrock as recommended by Golders in their report, for a factored axial resistance of 1600 kN at ULS and 1400 kN at SLS.

Drilled caissons founded in the shale bedrock can be used to support the bridge structure. Neglecting the top 1 m (probable weathering) of the shale bedrock, the depth of the socket into the sound shale bedrock can be determined using skin friction values of 900 kPa at ULS and 600 kPa at SLS between the concrete and the shale, ignoring the end bearing.

The presence of groundwater in the sand and silt till embedded within the clayey silt till will make the construction of the caissons difficult. An oversize liner will be required and must be sealed in the underlying clayey silt till or bedrock. Prior to the placement of concrete, any seepage water at the caisson bases must be removed. Coring of hard layers in shale bedrock (limestone/siltstone layers) may be required for advancing the caisson hole to the required depth.

A detailed geotechnical investigation is recommended for the design of proposed widening / replacement of the underpass structure to confirm or better assess the preliminary geotechnical findings and the preliminary recommendations provided in Golders geotechnical report.

7. CHEMICAL TESTING

In order to assess options for potential offsite soil disposal at the above captioned site, three (3) soil samples were collected and advanced on the subject site and submitted for analysis of electrical conductivity (EC) and/or sodium adsorption ratio (SAR) as set out in O.Reg. 153/04 as amended, Section XV.1 of the Environmental Protection Act (EPA). In addition, two (2) soil samples were collected and

submitted for analysis of BTEX. The Certificates of Analysis are attached. Sample locations are provided in Drawing 1 included as part of the geotechnical report.

In accordance with SPL sampling protocols, soil samples from the boreholes selected for potential chemical analysis of volatile organic parameters were preserved in a methanol. Approximately 5 g of soil was collected using a designated sampler system and placed into a pre-weighed laboratory supplied vial of methanol. As well, a portion of the soil sample was placed directly into a laboratory supplied glass jars. The methanol sample vial and glass sample jars were kept under refrigerated conditions during field storage and transportation to the environmental analytical laboratory.

Soil samples were collected and handled in accordance with generally accepted procedures used by the environmental consulting industry. Prior to each sampling event, new disposable gloves were used to transfer samples in plastic bags and glass jars supplied by the laboratory. All soil samples were kept under refrigerated conditions during field storage and transportation to the environmental analytical laboratory.

Soil descriptions were logged in the field and a description of the soil conditions observed is presented in the borehole logs included as part of this investigation. The following is the description of the sample name, depth, and soil description of the five (5) soil samples submitted for the analysis of EC, SAR, and BTEX.

- **BH13-9 SS3 (0.8m)** - fill material consisting of clayey silt containing some sand to sandy, trace gravel, and trace organics
- **BH13-13 SS3 (0.8m) -** fill material consisting of clayey silt containing some sand to sandy and trace gravel
- **BH13-7 SS3 (0.8m)** - fill material consisting of clayey silt containing trace organics, trace gravel, and some sand
- **BH13-1 SS8 (4.6m) -** native material consisting of silty sand till containing trace to some clay and trace gravel
- **BH13-5 SS3 (0.8m)** - fill material consisting of silty sand containing trace gravel, some clay, and some organics

The chemical analysis was conducted by AGAT Laboratories located in Mississauga, Ontario. AGAT is a member of the Canadian Association for Laboratory Accreditation (CALA) and meets the requirements of Section 47 of O.Reg. 153/04 certifying that the analytical laboratory be accredited in accordance with the International Standard ISO/IEC 17025 and with standards developed by the Standards Council of Canada.

For the purposes of soil disposal, the results of chemical analyses were compared to the Full Depth Generic Site Condition Standards in Potable and Non-Potable Ground Water Conditions for Residential/Parkland/Institutional (RPI) and Industrial/Commercial/Community (ICC) Property Use as contained in **Tables 2 and 3**, respectively, of the "Soil, Ground Water and Sediments Standards for Use

Under Part XV.1 of the Environmental Protection Act," published by the Ministry of Environment (MOE) on April 15, 2011.

Based on the results of the chemical analysis, SPL provides the following conclusions/recommendations:

- When compared to MOE Table 2 RPI Property Use Standards, three (3) soil samples (BH13-9 SS3, BH13-13 SS3, and BH13-7 SS3) exceed the standard for electrical conductivity (EC) and/or sodium adsorption ratio (SAR). In addition, one (1) soil sample (BH13-5 SS3) exceeds the standard for ethylbenzene and xylenes (total).

- When compared to MOE Table 3 RPI Property Use Standards, four (4) soil samples (BH13-5 SS3, BH13-9 SS3, BH13-13 SS3, and BH13-7 SS3) exceed for the standard for EC and/or SAR and xylenes (total).

- When compared to MOE Table 2 ICC Property Use Standards, three (3) soil samples (BH13-9 SS3, BH13-13 SS3, and BH13-7 SS3) exceed the standard for EC and/or SAR. In addition, one (1) soil sample (BH13-5 SS3) exceeds the standard for ethylbenzene.
- When compared to MOE Table 3 ICC Property Use Standards, three (3) soil samples (BH13-9 SS3, BH13-13 SS3, and BH13-7 SS3) exceed the standard for EC and/or SAR.

- Based on the soil analytical results, it appears that there are EC and SAR impacts greater than the MOE Tables 2 and 3 RPI and ICC Property Use Standards at the site. As the site consists of a roadway EC and SAR impacts are expected to be present in the subsurface soils to varying degrees. Municipal roadways are exempt for all impacts related to de-icing activities (i.e. EC and SAR) and as such the material with EC and SAR impact may be reused within a municipal roadway.

- Separation and re-testing may be an option to reduce disposal cost.

- As soil samples were found to exceed the MOE Table 2 RPI and ICC Property Use Standards, this material may be considered a waste for disposal purposes. As such, a toxicity characteristic leachate procedure (TCLP) analysis may be required to be completed in accordance with O.Reg. 558/00 to determine the waste classification of the soil prior to disposal.

- The results of this testing evaluates the environmental quality of the soil and does not pertain to the geotechnical suitability of the material.

- Acceptance of any excavated soil will be at the discretion of the receiving site.

The purpose of this testing was to chemically characterize the soils analyzed and does not constitute a Phase Two Environmental Site Assessment as defined in O.Reg.153/04, as amended.

It should be noted that if any aesthetically impacted soils are identified during excavation it is recommended that SPL be notified in order to conduct further assessment and/or testing of the material in question.

This report was prepared for the account of AECOM. The material in this report reflects SPL's judgment in light of the information available to it at the time of preparation. Any use, which a Third Party not noted above makes of this report, or any reliance on decisions to be made based on it, are the responsibility of such Third Parties. SPL Consultants Limited accepts no responsibility for damages, if any, suffered by any Third Party as a result of decisions made or actions based on this report.

8. GENERAL COMMENTS AND LIMITATIONS OF REPORT

SPL Consultants Limited should be retained for a general review of the final design and specifications to verify that this report has been properly interpreted and implemented. If not accorded the privilege of making this review, SPL Consultants Limited will assume no responsibility for interpretation of the recommendations in the report.

The comments given in this report are intended only for the guidance of design engineers. The number of boreholes required to determine the localized underground conditions between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc., would be much greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual borehole and test pit results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

This report is intended solely for the Client named. The material in it reflects our best judgment in light of the information available to SPL Consultants Limited at the time of preparation. Unless otherwise agreed in writing by SPL Consultants Limited, it shall not be used to express or imply warranty as to the fitness of the property for a particular purpose. No portion of this report may be used as a separate entity, it is written to be read in its entirety.

The conclusions and recommendations given in this report are based on information determined at the test hole locations. The information contained herein in no way reflects on the environment aspects of the project, unless otherwise stated. Subsurface and groundwater conditions between and beyond the test holes may differ from those encountered at the test hole locations, and conditions may become apparent during construction, which could not be detected or anticipated at the time of the site investigation. The benchmark and elevations used in this report are primarily to establish relative elevation differences between the test hole locations and should not be used for other purposes, such as grading, excavating, planning, development, etc.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. SPL Consultants Limited accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

We accept no responsibility for any decisions made or actions taken as a result of this report unless we are specifically advised of and participate in such action, in which case our responsibility will be as agreed to at that time.

We trust that the information contained in this report is satisfactory. Should you have any questions, please do not hesitate to contact this office.

SPL CONSULTANTS LIMITED

Siamak Gholamin, B.Sc.

for Alka Sangar, M. Eng., P.Eng.

Ramon Miranda, P.Eng.

Drawings

LEGEND

- Approximate Boreholes Location
- Approximate Testpits Location

Client:	AECOM			Project No : 1624-560	Drawing No : 1
Drawn: ZMO		Approved: SG		Title: Boreholes and Testpits Location Plan	
Date: Dec, 2013		Scale: As shown		Project: Pavement Investigation - Class EA Study for Creditview Road from Bancroft Drive to Old Creditview Road, Mississauga, ON	
Original Size: Tabloid		Rev: N/A		SPL Consultants Limited Geotechnical - Environmental - Materials - Hydrogeology	

server\Geotech\1600 Geo projects\1624-560 - Creditview Road EA Study\Drawings\1624-560-BH Location Plan-Mar17-2014 .dwg

Drawing 1A: Notes On Sample Descriptions

1. All sample descriptions included in this report generally follow the Unified Soil Classification. Laboratory grain size analyses provided by SPL also follow the same system. Different classification systems may be used by others, such as the system by the International Society for Soil Mechanics and Foundation Engineering (ISSMFE). Please note that, with the exception of those samples where a grain size analysis and/or Atterberg Limits testing have been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		

0.002 0.006 0.02 0.06 0.2 0.6 2.0 6.0 20 60 200

EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

CLAY (PLASTIC) TO	FINE	MEDIUM	CRS.	FINE	COARSE
SILT (NONPLASTIC)	SAND			GRAVEL	

UNIFIED SOIL CLASSIFICATION

2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional preliminary geotechnical site investigation.

3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

SPL Consultants Limited
Geotechnical Environmental Materials Hydrogeology

LOG OF BOREHOLE BH13-1

PROJECT: Class EA Study for Creditview Road
CLIENT: AECOM
PROJECT LOCATION: from Bancroft Drive to Old Creditview Road, Mississauga, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 (3m east of Creditview Road centre line)

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150 mm
Date: Oct/29/2013

REF. NO.: 1824-560
Drawing No.: 2

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	"N" BLOWS/0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (10 20 30)	POCKET PEN (Cu) (kPa)	NATURAL UNIT WT (Mg/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
165.1												
165.0 / 0.0	**ASPHALT:** 180 mm						165					
164.9 / 0.2	**GRANULAR BASE:** 160 mm (crushed limestone), brown, wet		1	AS								39 39 (22)
164.8 / 0.3	**GRANULAR SUB-BASE:** 380 mm (crushed limestone), brown, wet		2	AS								63 27 (10)
164.4 / 0.7	**FILL:** clayey silt, some sand, trace gravel, grey, moist, stiff		3	SS	12		164					
163.6 / 1.5	**CLAYEY SILT TILL:** some sand, some gravel, occasional sand seams, greyish brown, moist, very stiff to hard		4	SS	18							14 17 46 23
	contains wet sand seams below 2.3 m		5	SS	30	▽	163					
			6	SS	55		162					
161.6 / 3.5	**SILTY SAND TILL:** trace to some clay, trace gravel, grey, moist, very dense		7	SS	50/125 mm		161					
	contains wet sand seams at 4.5 m		8	SS	50/75 mm							
160.2 / 4.9	**END OF BOREHOLE:**											

W. L. 162.5 m Nov 19, 2013

Notes:
1) Borehole was open and ground water was at 4.1 m upon completion.
2) 25 mm piezometer was installed at 4.6 m after completion.
3) Water level in piezometer at 2.6 m on Nov. 19, 2013.

GROUNDWATER ELEVATIONS
Shallow/ Single Installation ▽ ▼ Deep/Dual Installation ▼ ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ $^{\varepsilon=3\%}$ Strain at Failure

SPL SOIL LOG 1824-560 GPJ SPL.GDT 1/4/14

SPL Consultants Limited
Geotechnical Environmental Materials Hydrogeology

LOG OF BOREHOLE BH13-2

PROJECT: Class EA Study for Creditview Road
CLIENT: AECOM
PROJECT LOCATION: from Bancroft Drive to Old Creditview Road, Mississauga, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 (1.2m west of Creditview Road centre line)

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150 mm
Date: Oct/30/2013

REF. NO.: 1824-560
Drawing No.: 3

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS/0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
160.7 / 0.0	**ASPHALT:** 150 mm											
160.6 / 0.2	**GRANULAR BASE:** 160 mm (crushed limestone), brown		1	AS					○			
160.4 / 0.3			2	AS					○			
160.1 / 0.6	**GRANULAR SUB-BASE:** 250 mm (crushed limestone), brown						160					
	FILL: clayey silt, some sand, trace gravel, trace organics, greyish brown, moist, very stiff		3	SS	16				○			
159.2 / 1.5	**CLAYEY SILT TILL:** some sand, trace gravel, greyish brown, moist, very stiff		4	SS	25		159		○			
158.6 / 2.1	**END OF BOREHOLE:**											

Notes:
1) Borehole was open and dry after completion.

GROUNDWATER ELEVATIONS
Shallow/ Single Installation ▽ ▼ Deep/Dual Installation ▽ ▼

GRAPH NOTES +3, ×3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

SPL SOIL LOG 1824-560 GPJ SPL GDT 1/4/14

SPL Consultants Limited
Geotechnical Environmental Materials Hydrogeology

LOG OF BOREHOLE BH13-3

PROJECT: Class EA Study for Creditview Road
CLIENT: AECOM
PROJECT LOCATION: from Bancroft Drive to Old Creditview Road, Mississauga, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 (3.4m east of Creditview Road centre line)

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150 mm
Date: Oct/29/2013

REF. NO.: 1824-560
Drawing No.: 4

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN (Cu) (kPa)	NATURAL UNIT WT (Mg/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
165.9 / 0.0	**ASPHALT:** 170 mm											
165.5 / 0.2	**GRANULAR BASE:** 190 mm (crushed limestone), light brown		1	AS					○			18 57 (25)
165.2 / 0.4	**GRANULAR SUB-BASE:** 300 mm (crushed limestone), brown, wet		2	AS					○			21 66 (13)
164.7 / 0.7	**FILL:** clayey silt, some sand, trace gravel, brown, moist, very stiff		3	SS	19		165		○			
1.2	**CLAYEY SILT TILL:** some sand to sandy, trace gravel, occasional sand seams, greyish brown, moist, very stiff to hard		4	SS	22		164		○			
			5	SS	33				○			
	grey below 3.0 m		6	SS	42		163		○			
	contains wet sand seams, very stiff below 3.8 m		7	SS	21		162		○			
161.0 / 4.9	**SILTY SAND TILL:** trace to some clay, trace gravel, grey, moist, compact		8	SS	21		161		○			
160.7 / 5.2	**END OF BOREHOLE:** Notes: 1) Borehole was dry and caved in at 4.3 m after completion.											

SPL SOIL LOG 1824-560 GPJ SPL GDT 1/4/14

GROUNDWATER ELEVATIONS
Shallow/ Single Installation ▽ ▼ Deep/Dual Installation ▽ ▼

GRAPH NOTES: $+^{3}$, $\times^{3}$: Numbers refer to Sensitivity; $\circ^{\varepsilon=3\%}$ Strain at Failure

SPL Consultants Limited
Geotechnical Environmental Materials Hydrogeology

LOG OF BOREHOLE BH13-4

PROJECT: Class EA Study for Creditview Road
CLIENT: AECOM
PROJECT LOCATION: from Bancroft Drive to Old Creditview Road, Mississauga, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 (2.6m west of Creditview Road centre line)

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150 mm
Date: Oct/30/2013

REF. NO.: 1824-560
Drawing No.: 5

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%) (10 20 30)	POCKET PEN (Cu) (kPa)	NATURAL UNIT WT (Mg/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
170.6 / 0.0	**ASPHALT:** 180 mm											
170.4 / 0.2	**GRANULAR BASE:** 150 mm (crushed limestone), brown		1	AS					○			
170.3 / 0.3			2	AS					○			
170.0 / 0.6	**GRANULAR SUB-BASE:** 250 mm (crushed limestone), brown						170					
169.4 / 1.2	**FILL:** silt some clay to clayey, trace sand, contains wet sand and silty clay seams, brown, wet, compact		3	SS	13				○			
168.5 / 2.1	**CLAYEY SILT:** trace sand, contains wet sand and silty clay seams, brown, very moist, stiff		4	SS	11		169		○			0 1 78 21
	END OF BOREHOLE: Notes: 1) Borehole was open and dry after completion.											

SPL SOIL LOG 1824-560 GPJ SPL GDT 1/4/14

GROUNDWATER ELEVATIONS
Shallow/ Single Installation ▽ ▼ Deep/Dual Installation ▼ ▼

GRAPH NOTES: $+^{3}$, $\times^{3}$: Numbers refer to Sensitivity; ○ $^{\varepsilon=3\%}$ Strain at Failure

SPL Consultants Limited
Geotechnical Environmental Materials Hydrogeology

LOG OF BOREHOLE BH13-5

PROJECT: Class EA Study for Creditview Road
CLIENT: AECOM
PROJECT LOCATION: from Bancroft Drive to Old Creditview Road, Mississauga, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 (5.5m east of Creditview Road centre line)

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150 mm
Date: Oct/29/2013

REF. NO.: 1824-560
Drawing No.: 6

SOIL PROFILE (m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	"N" BLOWS/0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
168.3												
168.0	**ASPHALT:** 150 mm											
0.2 / 167.8	**GRANULAR BASE:** 350 mm (crushed limestone), brown		1	AS			168					42 41 (17)
0.5 / 167.5	**GRANULAR SUB-BASE:** 320 mm (sand and gravel), brown, wet		2	AS								50 40 (10)
0.8 / 166.8	**FILL:** silty sand, some clay, some organics, trace gravel, dark grey, moist, compact		3	SS	41		167					
1.5 / 165.5	**CLAYEY SILT:** some sand, occasional gravel, dark grey to grey, moist, stiff to very stiff peat pockets below 2.7 m		4	SS	18		166					
			5	SS	13							
2.8 / 164.8	**PEAT:** dark grey, moist		6	SS	13		165			195 41		
3.5 / 164.5	**SILTY CLAY:** some peat, dark grey, moist, stiff											
3.8 / 163.1	**CLAYEY SILT TILL:** some sand to sandy, trace gravel, occasional sand seams, greyish brown, moist, very stiff to hard		7	SS	24		164					
			8	SS	25							
5.2	**END OF BOREHOLE:** Notes: 1) Borehole was open and dry after completion											

SPL SOIL LOG 1824-560 GPJ SPL GDT 1/4/14

GROUNDWATER ELEVATIONS
Shallow/ Single Installation ▽ ▼ Deep/Dual Installation ▽ ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ $^{\varepsilon=3\%}$ Strain at Failure

SPL Consultants Limited
Geotechnical Environmental Materials Hydrogeology

LOG OF BOREHOLE BH13-6

PROJECT: Class EA Study for Creditview Road
CLIENT: AECOM
PROJECT LOCATION: from Bancroft Drive to Old Creditview Road, Mississauga, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 (2.5m west of Creditview Road centre line)

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150 mm
Date: Oct/30/2013

REF. NO.: 1824-560
Drawing No.: 7

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3m	GROUND WATER CONDITIONS	ELEVATION
170.2							
170.0 / 0.0	**ASPHALT:** 180 mm						170
169.8 / 0.2	**GRANULAR BASE:** 220 mm (crushed limestone), brown		1	AS			
169.5 / 0.4	**GRANULAR SUB-BASE:** 340 mm (crushed limestone), trace cobbles, brown, wet		2	AS			
169.1 / 0.7	**FILL:** clayey silt, trace sand, contains wet sand and silty clay seams, brown, moist, compact		3	SS	24		169
168.1 / 1.1	**SILT:** some clay, trace sand, contains wet sand and silty clay seams, brown, wet, compact		4	SS	12		
2.1	**END OF BOREHOLE:** Notes: 1) Borehole was open and ground water was at 1.5 m after completion						

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH (kPa): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE; 20 40 60 80 100

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

WATER CONTENT (%): 10 20 30

POCKET PEN (Cu) (kPa)

NATURAL UNIT WT (Mg/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

SPL SOIL LOG 1824-560 GPJ SPL GDT 1/4/14

GROUNDWATER ELEVATIONS

Shallow/ Single Installation ▽ ▼ Deep/Dual Installation ▽ ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity ○ $^{\varepsilon=3\%}$ Strain at Failure

SPL Consultants Limited
Geotechnical Environmental Materials Hydrogeology

LOG OF BOREHOLE BH13-7

PROJECT: Class EA Study for Creditview Road
CLIENT: AECOM
PROJECT LOCATION: from Bancroft Drive to Old Creditview Road, Mississauga, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 (5.5m east of Creditview Road centre line)

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150 mm
Date: Oct/30/2013

REF. NO.: 1824-560
Drawing No.: 8

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	TYPE	"N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (10 20 30)	POCKET PEN (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
168.4												
168.0	**ASPHALT:** 145 mm											
168.1	**GRANULAR BASE:** 135 mm (sand and gravel), brown		1	AS								42 44 (14)
0.3	**GRANULAR SUB-BASE:** 450 mm (crushed limestone), trace cobbles, brown, wet		2	AS			168					59 30 (11)
167.7												
0.7	**FILL:** clayey silt, trace organics, trace gravel, some sand, grey, moist, stiff		3	SS	11							3 19 46 32
167.4												
1.0	**CLAYEY SILT TILL:** some sand, trace gravel, occasional sand seams, brown, moist, stiff to hard		4	SS	24		167					
			5	SS	34		166					
	grey below 2.7 m		6	SS	47		165					
			7	SS	44		164					
163.9												
4.5	**SILTY SAND TILL:** trace to some clay, trace gravel, grey, moist, very dense		8	SS	95/ 250 mm							
163.3												
5.1	**END OF BOREHOLE:**											

Notes:
1) Borehole caved in at 4.3 m and was dry after completion.

SPL SOIL LOG 1824-560 GPJ SPL GDT 1/4/14

GROUNDWATER ELEVATIONS
Shallow/ Single Installation ▽ ▼ Deep/Dual Installation ▽ ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ $^{\varepsilon=3\%}$ Strain at Failure

SPL Consultants Limited
Geotechnical Environmental Materials Hydrogeology

LOG OF BOREHOLE BH13-8

PROJECT: Class EA Study for Creditview Road
CLIENT: AECOM
PROJECT LOCATION: from Bancroft Drive to Old Creditview Road, Mississauga, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 (5.5m west of Creditview Road centre line)

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150 mm
Date: Oct/30/2013

REF. NO.: 1824-560
Drawing No.: 9

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" BLOWS/0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) O UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE & Sensitivity, × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN (Cu) (kPa)	NATURAL UNIT WT (Mg/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
168.4												
168.2	**ASPHALT:** 165 mm											
0.2 / 167.9	**GRANULAR BASE:** 295 mm (crushed limestone), light brown		1	AS			168		o			
0.5 / 167.6	**GRANULAR SUB-BASE:** 370 mm (crushed limestone), trace cobbles, light brown		2	AS					o			
0.8 / 166.8	**FILL:** clayey silt, trace to some sand, trace gravel, greyish brown, moist, stiff		3	SS	11		167		o			
1.6 / 166.3	**CLAYEY SILT TILL:** some sand to sandy, contains sand seams, trace gravel, grey, moist, very stiff		4	SS	23				o			
2.1	**END OF BOREHOLE:** Notes: 1) Borehole was open and dry after completion.											

SPL SOIL LOG 1824-560 GPJ SPL GDT 1/4/14

GROUNDWATER ELEVATIONS
Shallow/ Single Installation ▽ ▼ Deep/Dual Installation ▽ ▼

GRAPH NOTES: $+^{3}$, $\times^{3}$: Numbers refer to Sensitivity; $O^{\varepsilon=3\%}$ Strain at Failure

SPL Consultants Limited
Geotechnical Environmental Materials Hydrogeology

LOG OF BOREHOLE BH13-9

PROJECT: Class EA Study for Creditview Road
CLIENT: AECOM
PROJECT LOCATION: from Bancroft Drive to Old Creditview Road, Mississauga, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 (40m east of Creditview Road centre line)

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150 mm
Date: Oct/29/2013

REF. NO.: 1824-560
Drawing No.: 10

SOIL PROFILE (m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN (Cu) (kPa)	NATURAL UNIT WT (Mg/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
165.0												
164.8	**ASPHALT:** 155 mm											
164.2	**GRANULAR BASE:** 100 mm (crushed limestone), light brown		1	AS					○			
0.3			2	AS					○			
164.3	**GRANULAR SUB-BASE:** 425 mm (crushed limestone), trace cobbles, light brown											
0.7	**FILL:** clayey silt, some sand to sandy, trace gravel, trace organics, greyish brown, moist, firm to stiff		3	SS	8		164		○			
	trace organics, firm at 1.5 m		4	SS	7				○			
162.9							163					
2.1	**END OF BOREHOLE:** Notes: 1) Borehole was open and dry after completion.											

SPL SOIL LOG 1824-560 GPJ SPL GDT 1/4/14

GROUNDWATER ELEVATIONS
Shallow/ Single Installation ▽ ▼ Deep/Dual Installation ▽ ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity ○ $^{\varepsilon=3\%}$ Strain at Failure

SPL Consultants Limited
Geotechnical Environmental Materials Hydrogeology

LOG OF BOREHOLE BH13-10

PROJECT: Class EA Study for Creditview Road
CLIENT: AECOM
PROJECT LOCATION: from Bancroft Drive to Old Creditview Road, Mississauga, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 (45m west of Creditview Road centre line)

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150 mm
Date: Oct/29/2013

REF. NO.: 1824-560
Drawing No.: 11

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L WATER CONTENT (%) (10 20 30)	POCKET PEN (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
165.1 / 0.0	**ASPHALT:** 125 mm						165					
164.8 / 0.3	**GRANULAR BASE:** 150 mm (crushed limestone), brown		1	AS								
164.5 / 0.6	**GRANULAR SUB-BASE:** 295 mm (crushed limestone), trace cobbles, light brown		2	AS								
	FILL: clayey silt, some sand to sandy, trace gravel, greyish brown, moist, very stiff		3	SS	22		164					
163.6 / 1.5	**FILL:** silty sand, trace gravel, trace cobbles, greyish brown, moist, very dense		4	SS	51							
163.0 / 2.1	**END OF BOREHOLE:**						163					

Notes:
1) Borehole was open and dry after completion.

GROUNDWATER ELEVATIONS
Shallow/ Single Installation ▽ ▼ Deep/Dual Installation ▽ ▼

GRAPH NOTES: $+^{3}$, $\times^{3}$: Numbers refer to Sensitivity; $\circ^{\varepsilon=3\%}$ Strain at Failure

SPL SOIL LOG 1824-560 GPJ SPL GDT 1/4/14

SPL Consultants Limited
Geotechnical Environmental Materials Hydrogeology

LOG OF BOREHOLE BH13-11

PROJECT: Class EA Study for Creditview Road
CLIENT: AECOM
PROJECT LOCATION: from Bancroft Drive to Old Creditview Road, Mississauga, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 (14m west of Creditview Road centre line)

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150 mm
Date: Oct/30/2013

REF. NO.: 1824-560
Drawing No.: 12

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	ELEVATION
160.8							
160.6 / 0.2	**ASPHALT:** 150 mm						
160.6 / 0.2	**GRANULAR BASE:** 200mm (sand and gravel), brown		1	AS			
160.2 / 0.4	**GRANULAR SUB-BASE:** 280 mm (sand and gravel), trace cobbles, light brown		2	AS			
0.6	**FILL:** clayey silt, some sand to sandy, trace gravel, greyish brown, moist, very stiff		3	SS	16		160
159.0			4	SS	12		159
158.7 / 1.8	**FILL:** sand, trace gravel, brown to reddish brown, moist, compact						
2.1	**END OF BOREHOLE:** Notes: 1) Borehole was open and dry after completion.						

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH (kPa): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE — 20 40 60 80 100

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

WATER CONTENT (%): 10 20 30

POCKET PEN (Cu) (kPa) | NATURAL UNIT WT (Mg/m³) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) — GR SA SI CL

SPL SOIL LOG 1824-560 GPJ SPL GDT 1/4/14

GROUNDWATER ELEVATIONS
Shallow/ Single Installation ▽ ▼ Deep/Dual Installation ▽ ▼

GRAPH NOTES: $+^{3}$, $\times^{3}$: Numbers refer to Sensitivity ○ $^{\varepsilon=3\%}$ Strain at Failure

SPL Consultants Limited
Geotechnical Environmental Materials Hydrogeology

LOG OF BOREHOLE BH13-12

PROJECT: Class EA Study for Creditview Road
CLIENT: AECOM
PROJECT LOCATION: from Bancroft Drive to Old Creditview Road, Mississauga, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 (30m east of Creditview Road centre line)

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150 mm
Date: Oct/29/2013

REF. NO.: 1824-560
Drawing No.: 13

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
163.1 / 0.0	**ASPHALT:** 200 mm						163					
162.9 / 0.2	**GRANULAR BASE:** 180 mm (crushed limestone), brown		1	AS					○			
162.7 / 0.4			2	AS					○			
162.6 / 0.5	**GRANULAR SUB-BASE:** 165 mm (crushed limestone)											
	FILL: clayey silt, some sand to sandy, trace organics, trace gravel, grey, moist, very stiff to stiff		3	SS	20		162		○			
	contains wet sand seams at 1.5 m		4	SS	11				○			
161.0 / 2.1	**END OF BOREHOLE:** Notes: 1) Borehole was open and dry after completion.						161					

GRAPH NOTES: $+^{3}$, $\times^{3}$: Numbers refer to Sensitivity; ○ $^{\varepsilon=3\%}$ Strain at Failure

GROUNDWATER ELEVATIONS
Shallow/ Single Installation ▽ ▼ Deep/Dual Installation ▽ ▼

SPL SOIL LOG 1824-560 GPJ SPL GDT 1/4/14

SPL Consultants Limited
Geotechnical Environmental Materials Hydrogeology

LOG OF BOREHOLE BH13-13

PROJECT: Class EA Study for Creditview Road
CLIENT: AECOM
PROJECT LOCATION: from Bancroft Drive to Old Creditview Road, Mississauga, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 (35m west of Creditview Road centre line)

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150 mm
Date: Oct/29/2013

REF. NO.: 1824-560
Drawing No.: 14

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" BLOWS/0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN (Cu) (kPa)	NATURAL UNIT WT (Mg/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
164.7												
164.8	**ASPHALT:** 170 mm											
164.7	**GRANULAR BASE:** 130 mm (sand and gravel), brown		1	AS								
164.3			2	AS								
0.5	**GRANULAR SUB-BASE:** 150 mm (sand and gravel)						164					
	FILL: clayey silt, some sand to sandy, trace gravel, brown, moist, very stiff		3	SS	16							
163.5												
1.2	**CLAYEY SILT TILL:** some sand to sandy, trace gravel, occasional sand seams, greyish brown, moist, very stiff		4	SS	24		163					
162.6												
2.1	**END OF BOREHOLE:** Notes: 1) Borehole was open and dry after completion.											

SPL SOIL LOG 1824-560 GPJ SPL GDT 1/4/14

GROUNDWATER ELEVATIONS
Shallow/ Single Installation ▽ ▼ Deep/Dual Installation ▽ ▼

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

SPL Consultants Limited
Geotechnical Environmental Materials Hydrogeology

LOG OF BOREHOLE BH13-14

PROJECT: Class EA Study for Creditview Road
CLIENT: AECOM
PROJECT LOCATION: from Bancroft Drive to Old Creditview Road, Mississauga, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 (27m west of Creditview Road centre line)

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150 mm
Date: Oct/30/2013

REF. NO.: 1824-560
Drawing No.: 15

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN (Cu) (kPa)	NATURAL UNIT WT (Mg/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m							GR SA SI CL
169.6 0.0	**ASPHALT:** 200 mm											
169.4 0.2	**GRANULAR BASE:** 160 mm (sand and gravel), brown		1	AS					○			
169.2 0.4			2	AS					○			
169.0 0.6	**GRANULAR SUB-BASE:** 270 mm (sand and gravel)						169					
	SILT: some clay to clayey, trace sand, occasional gravel, brown to reddish brown, moist, compact		3	SS	20				○			
	wet at 1.5 m						168					
167.5 2.1			4	SS	10				○			
	END OF BOREHOLE: Notes: 1) Borehole was open and dry after completion.											

SPL SOIL LOG 1824-560 GPJ SPL GDT 1/4/14

GROUNDWATER ELEVATIONS
Shallow/ Single Installation ▽ ▼ Deep/Dual Installation ▽ ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity ○ $^{\varepsilon=3\%}$ Strain at Failure

SPL Consultants Limited
Geotechnical Environmental Materials Hydrogeology

LOG OF BOREHOLE BH13-15

PROJECT: Class EA Study for Creditview Road

CLIENT: AECOM

PROJECT LOCATION: from Bancroft Drive to Old Creditview Road, Mississauga, ON

DATUM: Geodetic

BH LOCATION: See Drawing 1 (45m west of Creditview Road centre line)

DRILLING DATA

Method: Solid Stem Auger

Diameter: 150 mm

Date: Oct/30/2013

REF. NO.: 1824-560

Drawing No.: 16

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN (Cu) (kPa)	NATURAL UNIT WT (Mg/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
168.8												
0.0 / 168.8	**ASPHALT:** 185 mm											
0.2 / 168.4	**GRANULAR BASE:** 245 mm (crushed limestone), brown		1	AS					○			
0.4 / 168.2	**GRANULAR SUB-BASE:** 220 mm (sand and gravel)		2	AS					○			
0.7	**SILT:** some clay to clayey, some sand, occasional gravel, brown to reddish brown, moist, loose to compact		3	SS	9		168			○		
	contains wet silt seams at 1.5 m		4	SS	11		167			○		
166.7												
2.1	**END OF BOREHOLE:** Notes: 1) Borehole was open and dry after completion.											

SPL SOIL LOG 1824-560 GPJ SPL.GDT 1/4/14

GROUNDWATER ELEVATIONS

Shallow/ Single Installation ▽ ▼ Deep/Dual Installation ▽ ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ $^{\varepsilon=3\%}$ Strain at Failure

SPL Consultants Limited
Geotechnical Environmental Materials Hydrogeology

LOG OF BOREHOLE BH13-16

PROJECT: Class EA Study for Creditview Road

CLIENT: AECOM

PROJECT LOCATION: from Bancroft Drive to Old Creditview Road, Mississauga, ON

DATUM: Geodetic

BH LOCATION: See Drawing 1 (40m east of Creditview Road centre line)

DRILLING DATA

Method: Solid Stem Auger

Diameter: 150 mm

Date: Oct/30/2013

REF. NO.: 1824-560

Drawing No.: 17

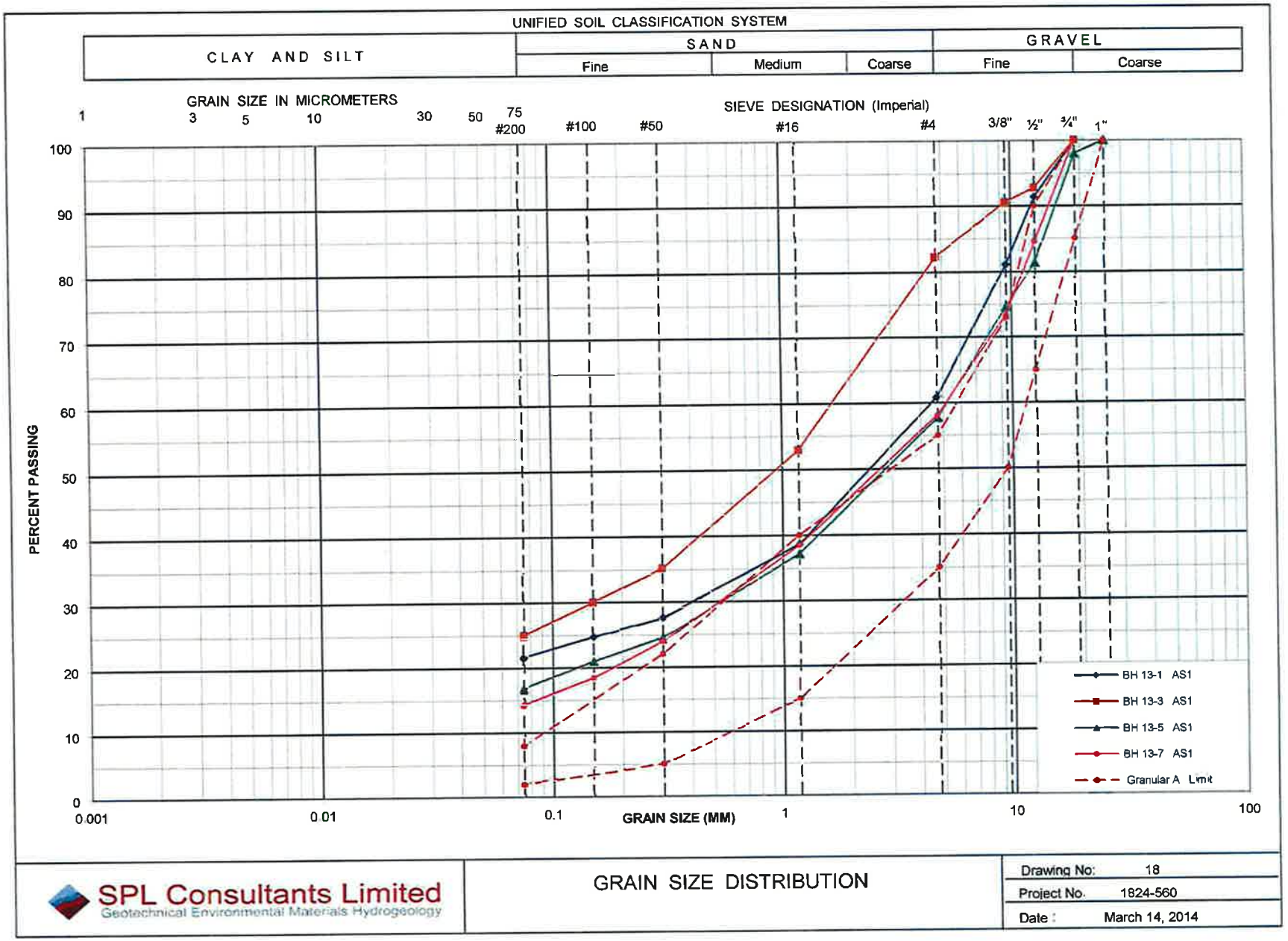
(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" BLOWS/0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) (20 40 60 80 100)	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%) (10 20 30)	POCKET PEN (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
168.9												
168.9 / 0.0	**ASPHALT:** 170 mm											
168.7 / 0.2	**GRANULAR BASE:** 130 mm (sand and gravel), brown		1	AS					o			
168.3 / 0.6	**GRANULAR SUB-BASE:** 285 mm (crushed limestone), trace cobbles		2	AS					o			
	FILL: sand, trace gravel, brown, moist, compact		3	SS	14		168		o			
167.4 / 1.5	**FILL:** sand and gravel, grey, moist, loose		4	SS	9		167		o			
166.8 / 2.1	**END OF BOREHOLE:** Notes: 1) Borehole was open and dry after completion.											

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; $\circ^{\varepsilon=3\%}$ Strain at Failure

GROUNDWATER ELEVATIONS

Shallow/ Single Installation ▽ ▼ Deep/Dual Installation ▼ ▼

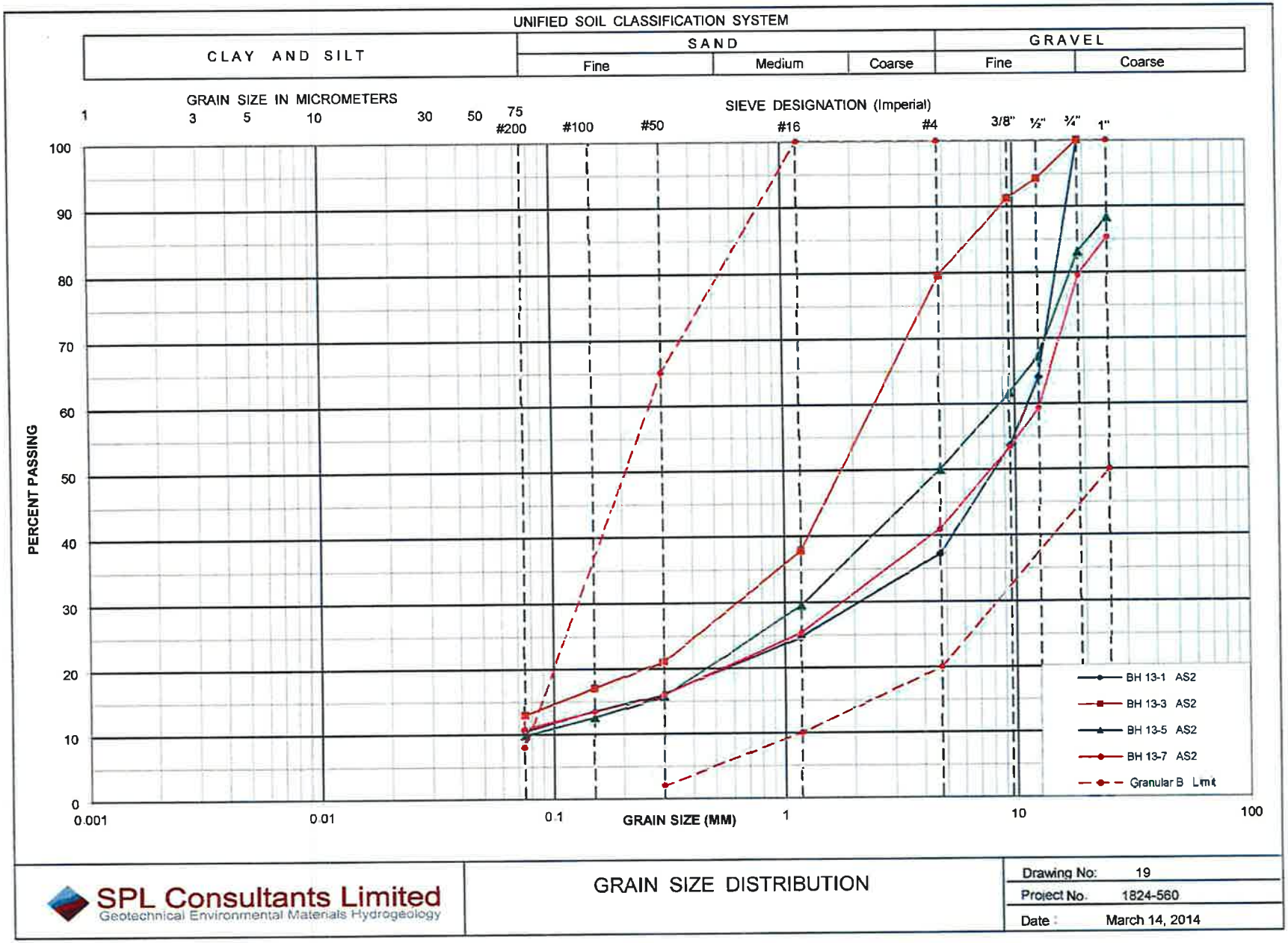
SPL SOIL LOG 1824-560 GPJ SPL.GDT 1/4/14



SPL Consultants Limited
Geotechnical Environmental Materials Hydrogeology

GRAIN SIZE DISTRIBUTION

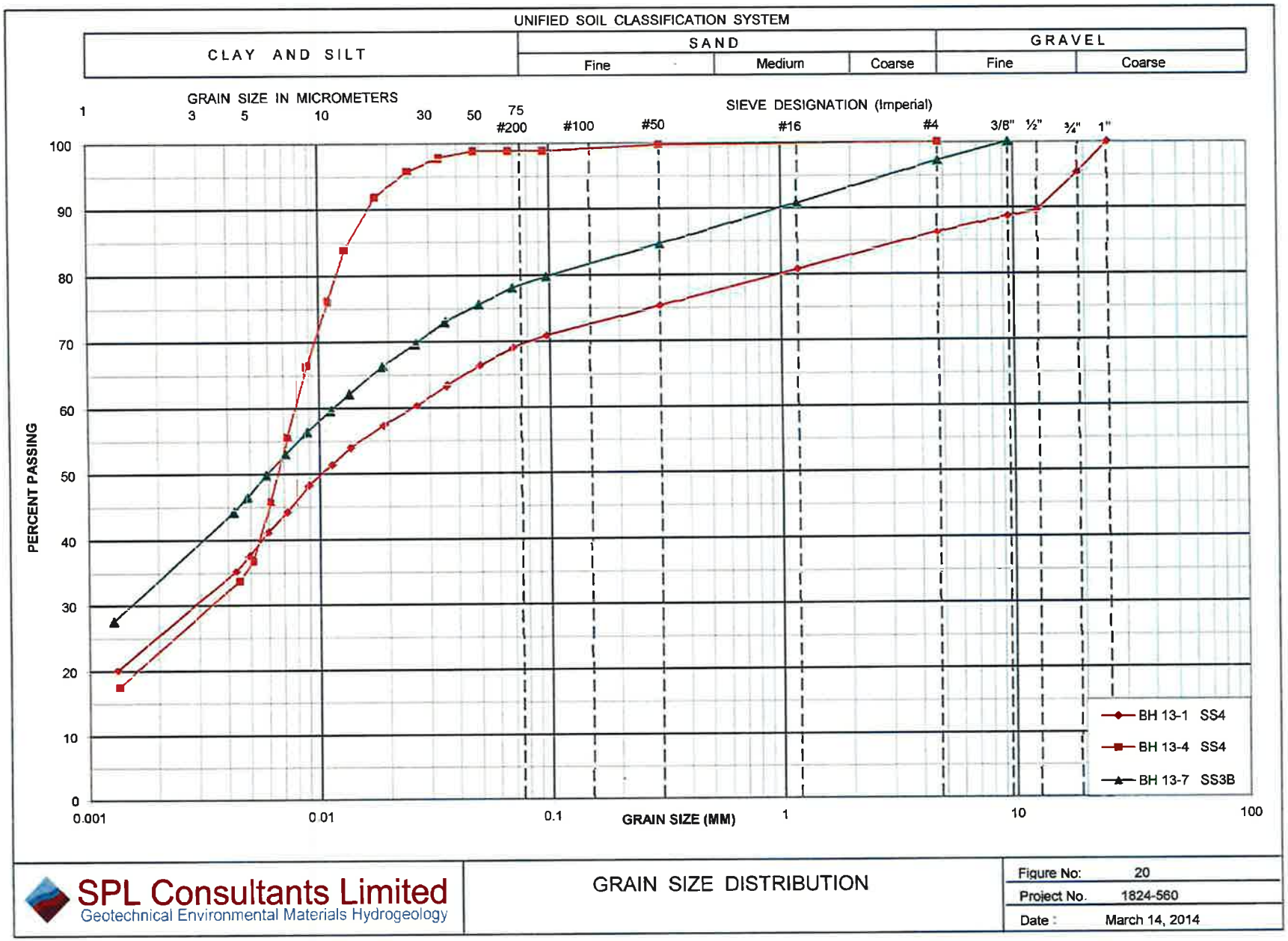
Drawing No: 18
Project No. 1824-560
Date : March 14, 2014



SPL Consultants Limited
Geotechnical Environmental Materials Hydrogeology

GRAIN SIZE DISTRIBUTION

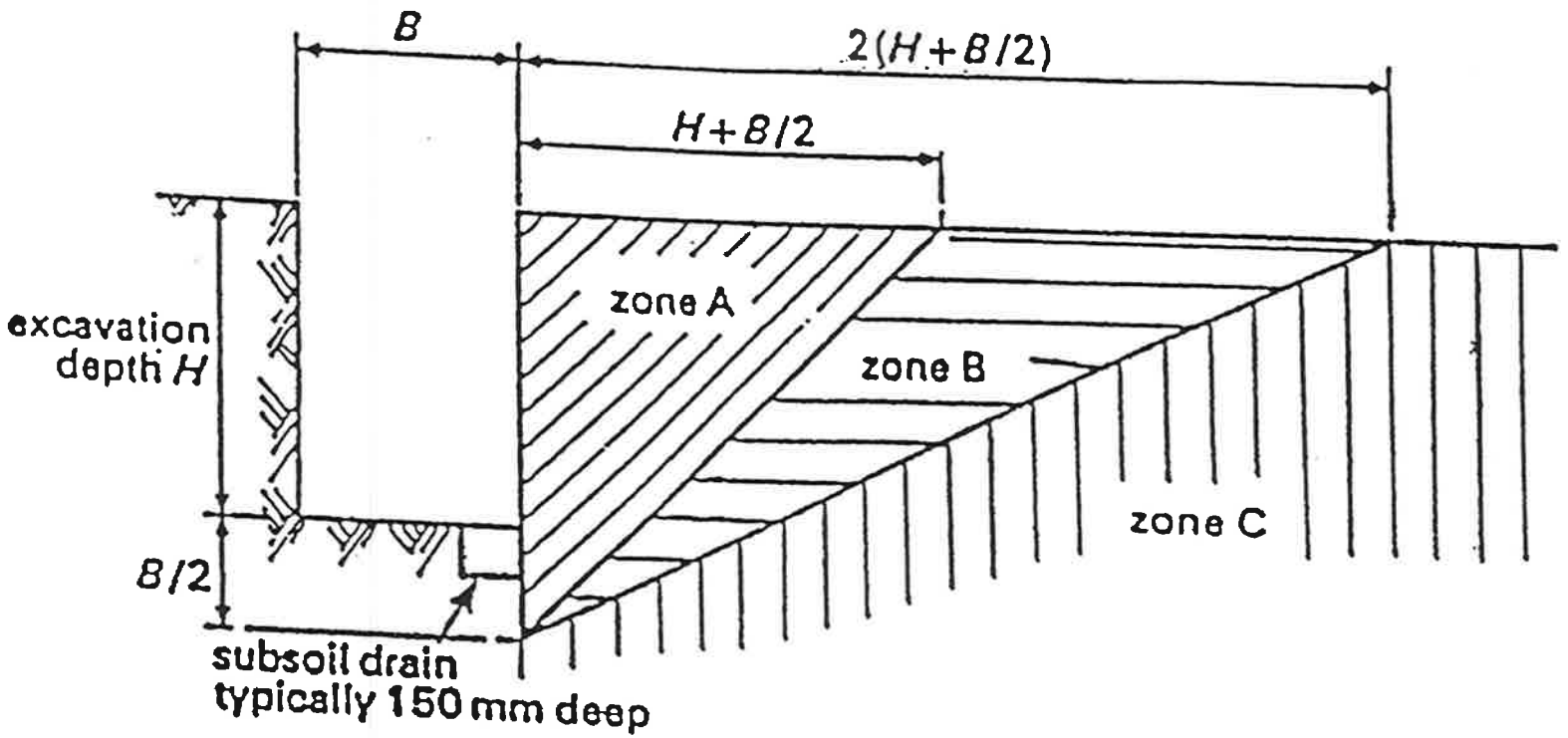
Drawing No: 19
Project No. 1824-560
Date : March 14, 2014



SPL Consultants Limited
Geotechnical Environmental Materials Hydrogeology

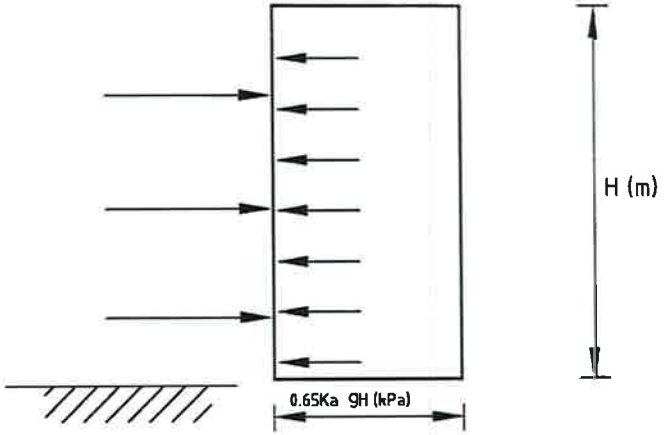
GRAIN SIZE DISTRIBUTION

Figure No: 20
Project No. 1824-560
Date : March 14, 2014



RISK ZONES (after Howe et al., 1980): Zone A is zone of long term risk, Zone B is zone of intermediate risk, Zone C is zone of no risk

Client:	AECOM			Project no:	1824-560	Drawing no:	21
Drawn:	TJ	Approved:	AS	Title:	Risk Zone		
Date:	Feb., 2014	Scale:	N.T.S	Project:	Preliminary Geo. Investigation- Creditview Road Mississauga, ON.		
Original Size:	Letter	Rev:	N/A	SPL Consultants Limited Geotechnical Environmental Materials Hydrogeology			

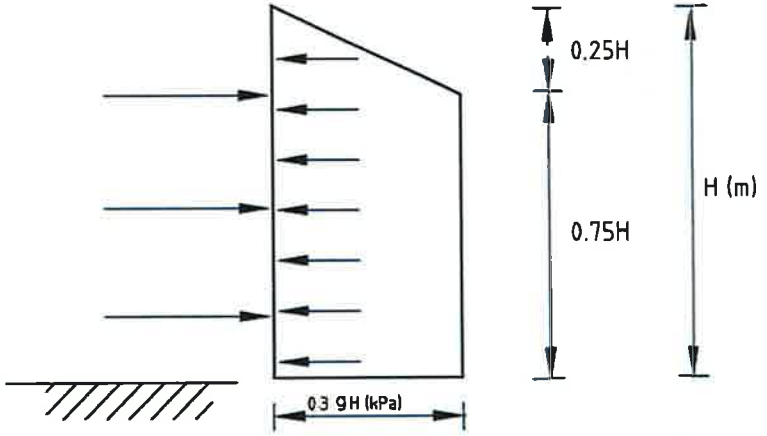


g = unit weight of soil = 21.0 kN/m^3

g' = submerged unit weight of soil (i.e. below ground water level)= 11.2 kN/m^3

Ka = 0.3

IN NON-COHESIVE SOILS (SANDS AND SILTS)



g = unit weight of soil = 21.5 kN/m^3

g' = submerged unit weight of soil (i.e. below ground water level)= 11.7 kN/m^3

ON BRACED SHEETING IN COHESIVE CLAYS OR CLAYEY SOILS

Notes:
1. Check system for partial excavation condition.
2. If the free water level is above the base of the excavation, the hydrostatic pressure must be added to the above pressure distribution.
3. If surcharge loadings are present near the excavation, these must be included in the lateral pressure calculation.

Client:	AECOM			Project No.: 1824-560	Drawing No.: 22
Drawn:	TJ	Approved:	AS	Title:	EARTH PRESSURE DISTRIBUTION
Date:	March, 2014	Scale:	N.T.S	Project:	Preliminary Geotechnical Investigation - Creditview Road Class EA Study , Mississauga, ON
Original Size:	Letter	Rev:	N/A	SPL Consultants Limited Geotechnical - Environmental - Materials - Hydrogeology	

server\Geotech\1800 Geo projects\1824-560 - Creditview Road EA Study\Report-Letters\Drawing 22.dwg

Appendix A: Site Photographs

Photo A1: Creditview Road in area BH13-1

Photo A2: Creditview Road in area BH13-2

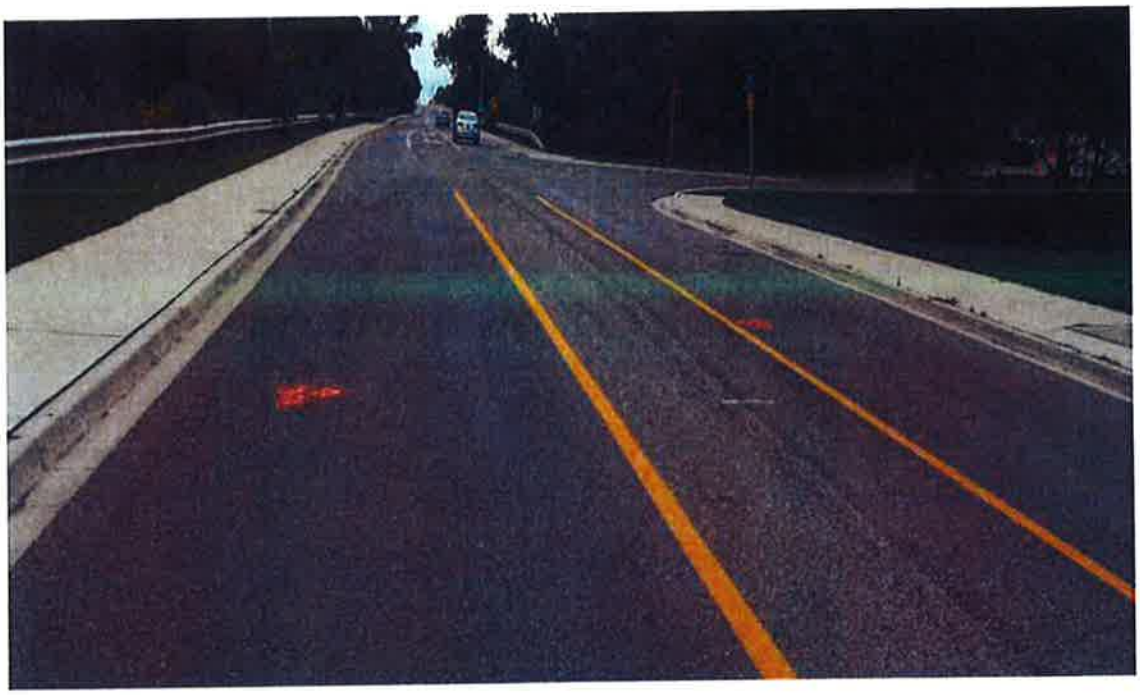


Photo A3: Creditview Road in area BH13-2

Photo A4: Creditview Road in area BH13-3

Photo A5: Creditview Road in area BH13-4

Photo A6: Creditview Road in Area BH13-5 nearby Argentia Road- watching north

Photo A7: Creditview Road in Area BH13-5 - watching south

Photo A8: Creditview Road in area BH13-6 - watching north

Photo A9: Creditview Road

Photo A10: Creditview Road

Photo A11: Bancroft Drive in area BH13-9 nearby Creditview Road intersection

Photo A12: Sir Monty's Drive in area BH13-10 nearby Creditview Road intersection

Photo A13: Velebit Ct. in area BH13-11 nearby Creditview Road intersection

Photo A14: Kenning hall Crescent in Area BH13-12 nearby Creditview Road intersection

Photo A15: Kenning hall Blvd. in area BH13-13 nearby Creditview Road intersection

Photo A16: Falconer Drive in Area BH13-14 nearby Creditview Road intersection

Appendix B: Pavement Structure Spreadsheet

Pavement Structure Spreadsheet for Creditview Road

Widening and reconstruction of Creditview Road between Bancroft Drive and Old Creditview Road in Mississauga, Ontario.

Total Length of Project: 2.2 km

Borehole No.	Offset from Road C/L	West Sideroad				Main Lanes of Creditview Road								East Sideroad				Borehole No.
						South-bound Lane Mid-Lane				North-bound Lane Mid-Lane								
		Asphalt (mm)	Granular Base (mm)	Granular Subbase (mm)	Total Granular (mm)	Asphalt (mm)	Granular Base (mm)	Granular Subbase (mm)	Total Granular (mm)	Asphalt (mm)	Granular Base (mm)	Granular Subbase (mm)	Total Granular (mm)	Asphalt (mm)	Granular Base (mm)	Granular Subbase (mm)	Total Granular (mm)	
Creditview Road and Bancroft Drive Intersection																		
BH 13-9	40 m east													Bancroft Dr. interaction				BH 13-9
														155	100	425	525	
BH 13-10	45 m west	Sir Monty's Dr. intersection																BH 13-10
		125	150	295	445													
BH 13-1	3 m east									180	160	380	540					BH 13-1
BH 13-11	14 m west	Velebit Ct. intersection																BH 13-11
		150	200	280	480													
BH 13-2	1.2 m west					150	160	250	410									BH 13-2
BH 13-12	30 m east													Kenninghall Crescent intersection				BH 13-12
														200	180	165	345	
BH 13-13	35 m west	Kenninghall Blvd intersection																BH 13-13
		170	130	150	280													
BH 13-3	3.4 m east									170	190	300	490					BH 13-3
BH 13-14	27 m west	Falconer Dr. intersection																BH 13-14
		200	160	270	430													
BH 13-4	2.6 m west					180	150	250	400									BH 13-4
BH 13-5	5.5 m east									150	350	320	670					BH 13-5
BH 13-15	45 m west	Argentia Rd. intersection																BH 13-15
		185	245	220	465													
BH 13-6	2.5 m west					180	220	340	560									BH 13-6
BH 13-7	5.5 m east									145	135	450	585					BH 13-7
BH 13-8	5.5 m west					165	295	370	665									BH 13-8
BH 13-16	40 m east													Old Creditview Rd. intersection				BH 13-16
														170	130	285	415	
Creditview Road and Old Creditview Rd Intersection																		

Appendix C: Pavement Thickness Design Output Sheets

1997 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare Computer Software Product

Ministry of Transportation
301 St. Paul Street
St. Catharines
Ontario

Flexible Structural Design Module

Creditview Rd. New Construction- 20 Yr

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	3,600,000
Initial Serviceability	4.4
Terminal Serviceability	2.2
Reliability Level	90 %
Overall Standard Deviation	0.48
Roadbed Soil Resilient Modulus	25,000 kPa
Stage Construction	1
Calculated Design Structural Number	130 mm

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	Hot Mix	0.42	1	140	15	59
2	Granular A - Granular Base Course	0.14	1	200	15	28
3	Granular B- Granular Subbase	0.09	1	500	15	45
Total	-	-	-	840	-	132

Layered Thickness Design

Thickness precision: Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(mm)	Min Thickness (Di)(mm)	Elastic Modulus (kPa)	Width (m)	Calculated Thickness (mm)	Calculated SN (mm)
Total		-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

1997 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare Computer Software Product

Ministry of Transportation
301 St. Paul Street
St. Catharines
Ontario

Flexible Structural Design Module

Creditview Rd.- Rehabilitation Option 1- 20 Years

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	3,600,000
Initial Serviceability	4.4
Terminal Serviceability	2.2
Reliability Level	90 %
Overall Standard Deviation	0.48
Roadbed Soil Resilient Modulus	25,000 kPa
Stage Construction	1
Calculated Design Structural Number	130 mm

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	Hot Mix	0.42	1	170	15	71
2	New Granular A - Base Course	0.14	1	300	15	42
3	Existing Granular B	0.08	0.9	235	15	17
Total	-	-	-	705	-	130

*Note: This value is not represented by the inputs or an error occurred in calculation.

Layered Thickness Design

Thickness precision: Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(mm)	Min Thickness (Di)(mm)	Elastic Modulus (kPa)	Width (m)	Calculated Thickness (mm)	Calculated SN (mm)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

1997 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare Computer Software Product

Ministry of Transportation
301 St. Paul Street
St. Catharines
Ontario

Flexible Structural Design Module

Creditview Rd.- Rehabilitation Option 2- 20 Years

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	3,600,000
Initial Serviceability	4.4
Terminal Serviceability	2.2
Reliability Level	90 %
Overall Standard Deviation	0.48
Roadbed Soil Resilient Modulus	25,000 kPa
Stage Construction	1
Calculated Design Structural Number	130 mm

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	Hot Mix	0.42	1	160	15	67
2	Granular A - Base Course	0.14	1	300	15	42
3	Existing Granular B	0.08	0.9	295	15	21
Total	-	-	-	755	-	130

*Note: This value is not represented by the inputs or an error occurred in calculation.

Layered Thickness Design

Thickness precision: Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(mm)	Min Thickness (Di)(mm)	Elastic Modulus (kPa)	Width (m)	Calculated Thickness (mm)	Calculated SN (mm)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

1997 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare Computer Software Product

Ministry of Transportation
301 St. Paul Street
St. Catharines
Ontario

Flexible Structural Design Module

Creditview Rd.- Rehabilitation Option 3- 15 Years

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	2,500,000
Initial Serviceability	4.4
Terminal Serviceability	2.2
Reliability Level	90 %
Overall Standard Deviation	0.48
Roadbed Soil Resilient Modulus	25,000 kPa
Stage Construction	1
Calculated Design Structural Number	124 mm

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	Hot Mix	0.42	1	140	15	59
2	Existing Asphalt layer	0.24	1	75	15	18
3	Existing Base Course	0.13	0.9	200	15	23
4	Existing Subase	0.08	0.9	340	15	24
Total	-	-	-	755	-	125

Layered Thickness Design

Thickness precision: Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(mm)	Min Thickness (Di)(mm)	Elastic Modulus (kPa)	Width (m)	Calculated Thickness (mm)	Calculated SN (mm)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

Appendix D: Chemical Testing Results

AGAT Laboratories

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

CLIENT NAME: SPL CONSULTANTS
6221 HIGHWAY 7 WEST UNIT 16
VAUGHAN, ON L4H0K8
(905) 856-0065

ATTENTION TO: Nirogini Nalliah

PROJECT NO: 1824-560

AGAT WORK ORDER: 13T780624

SOIL ANALYSIS REVIEWED BY: Sofka Pehlyova, Senior Analyst

TRACE ORGANICS REVIEWED BY: Oksana Gushyla, Trace Organics Lab Supervisor

DATE REPORTED: Nov 14, 2013

PAGES (INCLUDING COVER): 7

VERSION*: 1

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

*NOTES

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

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

Certificate of Analysis

AGAT WORK ORDER: 13T780624

PROJECT NO: 1824-560

CLIENT NAME: SPL CONSULTANTS

ATTENTION TO: Nirogini Nalliah

O. Reg. 153(511) - ORPs (Soil) - EC/SAR

DATE RECEIVED: 2013-11-07

DATE REPORTED: 2013-11-14

						SAMPLE DESCRIPTION:	BH13-9, SS3	BH13-13, SS3	BH13-7, SS3
						SAMPLE TYPE:	Soil	Soil	Soil
						DATE SAMPLED:	10/29/2013	10/29/2013	10/30/2013
Parameter	Unit	G / S: A	G / S: B	G / S: C	G / S: D	RDL	4936574	4936575	4936576
Electrical Conductivity (2:1)	mS/cm	1.4	0.7	1.4	0.7	0.005	1.13[D-C]	1.22[D-C]	1.72[>A]
Sodium Adsorption Ratio	N/A	12	5	12	5	NA	12.1[>A]	12.9[>A]	24.1[>A]

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: A Refers to T2(ICC) - Current, B Refers to T2(RPI) - Current, C Refers to T3(ICC) - Current, D Refers to T3(RPI) - Current

4936574-4936576 EC & SAR were determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil).

Certified By: Sofia Pehlyova

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

Certificate of Analysis

AGAT WORK ORDER: 13T780624

PROJECT NO: 1824-560

CLIENT NAME: SPL CONSULTANTS

ATTENTION TO: Nirogini Nalliah

(P & T) BTEX - Soil (GC/MS) High Level

DATE RECEIVED: 2013-11-07

DATE REPORTED: 2013-11-14

							SAMPLE DESCRIPTION: BH13-1, SS8		BH13-5, SS3
							SAMPLE TYPE: Soil		Soil
							DATE SAMPLED: 10/29/2013		10/29/2013
Parameter	Unit	G / S: A	G / S: B	G / S: C	G / S: D	RDL	4936564	RDL	4936569
Benzene	µg/g	0.32	0.21	0.32	0.21	0.02	<0.02[<B]	0.20	<0.20[<B]
Toluene	µg/g	6.4	2.3	68	2.3	0.05	<0.05[<B]	0.50	<0.50[<B]
Ethylbenzene	µg/g	1.1	1.1	9.5	2	0.05	<0.05[<A]	0.50	1.2[B-D]
m & p - Xylene	µg/g					0.05	<0.05	0.50	3.8
o - Xylene	µg/g					0.05	<0.05	0.50	2.4
Xylenes (Total)	µg/g	26	3.1	26	3.1	0.05	<0.05[<B]	0.50	6.2[D-C]
Moisture Content	%					0.1	7.5	1.0	3.9
TPgH (Gas, C5-C10)	ug/g					7.0	<7.0	7.0	440
TEH (Diesel, C10-C24)	µg/g					8.0	<8.0	8.0	1100
TPH (Gas / Diesel)	ug/g					15	<15	15	1500
Surrogate	Unit			Acceptable Limits					
Toluene-d8	% Recovery			60-130			122		86
4-Bromofluorobenzene	% Recovery			70-130			109		115

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: A Refers to T2(ICC) - Current, B Refers to T2(RPI) - Current, C Refers to T3(ICC) - Current, D Refers to T3(RPI) - Current

4936564 The sample was analysed using the high level technique. The soil sample was extracted using methanol, a small amount of the methanol extract was diluted in water and then purge and trap GC/FID analysis was performed.
Results are based on the dry weight of the soil.

4936564 Results are based on the dry weight of the soil.
The sample was analysed using the high level technique. The sample was extracted using methanol, a small amount of the methanol extract was diluted in water and the purge & trap GC/MS analysis was performed.
Results are based on the dry weight of the soil.

4936569 Results are based on the dry weight of the soil.
The sample was analysed using the high level technique. The sample was extracted using methanol, a small amount of the methanol extract was diluted in water and the purge & trap GC/MS analysis was performed.
Results are based on the dry weight of the soil.
Dilution factor = 10
The sample was diluted because it contained high level of oil. The method detection limit has been corrected for the dilution factor used.

4936569 The sample was analysed using the high level technique. The soil sample was extracted using methanol, a small amount of the methanol extract was diluted in water and then purge and trap GC/FID analysis was performed.
Results are based on the dry weight of the soil.

Certified By:

AGAT Laboratories

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

Guideline Violation

AGAT WORK ORDER: 13T780624

PROJECT NO: 1824-560

CLIENT NAME: SPL CONSULTANTS

ATTENTION TO: Nirogini Nalliah

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	GUIDEVALUE	RESULT
4936569	BH13-5, SS3	T2(ICC) - Current	(P & T) BTEX - Soil (GC/MS) High Level	Ethylbenzene	1.1	1.2
4936569	BH13-5, SS3	T2(RPI) - Current	(P & T) BTEX - Soil (GC/MS) High Level	Ethylbenzene	1.1	1.2
4936569	BH13-5, SS3	T2(RPI) - Current	(P & T) BTEX - Soil (GC/MS) High Level	Xylenes (Total)	3.1	6.2
4936569	BH13-5, SS3	T3(RPI) - Current	(P & T) BTEX - Soil (GC/MS) High Level	Xylenes (Total)	3.1	6.2
4936574	BH13-9, SS3	T2(ICC) - Current	O. Reg. 153(511) - ORPs (Soil) - EC/SAR	Sodium Adsorption Ratio	12	12.1
4936574	BH13-9, SS3	T2(RPI) - Current	O. Reg. 153(511) - ORPs (Soil) - EC/SAR	Electrical Conductivity (2:1)	0.7	1.13
4936574	BH13-9, SS3	T2(RPI) - Current	O. Reg. 153(511) - ORPs (Soil) - EC/SAR	Sodium Adsorption Ratio	5	12.1
4936574	BH13-9, SS3	T3(ICC) - Current	O. Reg. 153(511) - ORPs (Soil) - EC/SAR	Sodium Adsorption Ratio	12	12.1
4936574	BH13-9, SS3	T3(RPI) - Current	O. Reg. 153(511) - ORPs (Soil) - EC/SAR	Electrical Conductivity (2:1)	0.7	1.13
4936574	BH13-9, SS3	T3(RPI) - Current	O. Reg. 153(511) - ORPs (Soil) - EC/SAR	Sodium Adsorption Ratio	5	12.1
4936575	BH13-13, SS3	T2(ICC) - Current	O. Reg. 153(511) - ORPs (Soil) - EC/SAR	Sodium Adsorption Ratio	12	12.9
4936575	BH13-13, SS3	T2(RPI) - Current	O. Reg. 153(511) - ORPs (Soil) - EC/SAR	Electrical Conductivity (2:1)	0.7	1.22
4936575	BH13-13, SS3	T2(RPI) - Current	O. Reg. 153(511) - ORPs (Soil) - EC/SAR	Sodium Adsorption Ratio	5	12.9
4936575	BH13-13, SS3	T3(ICC) - Current	O. Reg. 153(511) - ORPs (Soil) - EC/SAR	Sodium Adsorption Ratio	12	12.9
4936575	BH13-13, SS3	T3(RPI) - Current	O. Reg. 153(511) - ORPs (Soil) - EC/SAR	Electrical Conductivity (2:1)	0.7	1.22
4936575	BH13-13, SS3	T3(RPI) - Current	O. Reg. 153(511) - ORPs (Soil) - EC/SAR	Sodium Adsorption Ratio	5	12.9
4936576	BH13-7, SS3	T2(ICC) - Current	O. Reg. 153(511) - ORPs (Soil) - EC/SAR	Electrical Conductivity (2:1)	1.4	1.72
4936576	BH13-7, SS3	T2(ICC) - Current	O. Reg. 153(511) - ORPs (Soil) - EC/SAR	Sodium Adsorption Ratio	12	24.1
4936576	BH13-7, SS3	T2(RPI) - Current	O. Reg. 153(511) - ORPs (Soil) - EC/SAR	Electrical Conductivity (2:1)	0.7	1.72
4936576	BH13-7, SS3	T2(RPI) - Current	O. Reg. 153(511) - ORPs (Soil) - EC/SAR	Sodium Adsorption Ratio	5	24.1
4936576	BH13-7, SS3	T3(ICC) - Current	O. Reg. 153(511) - ORPs (Soil) - EC/SAR	Electrical Conductivity (2:1)	1.4	1.72
4936576	BH13-7, SS3	T3(ICC) - Current	O. Reg. 153(511) - ORPs (Soil) - EC/SAR	Sodium Adsorption Ratio	12	24.1
4936576	BH13-7, SS3	T3(RPI) - Current	O. Reg. 153(511) - ORPs (Soil) - EC/SAR	Electrical Conductivity (2:1)	0.7	1.72
4936576	BH13-7, SS3	T3(RPI) - Current	O. Reg. 153(511) - ORPs (Soil) - EC/SAR	Sodium Adsorption Ratio	5	24.1

AGAT Laboratories

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

Quality Assurance

CLIENT NAME: SPL CONSULTANTS

PROJECT NO: 1824-560

AGAT WORK ORDER: 13T780624

ATTENTION TO: Nirogini Nalliah

Soil Analysis

RPT Date: Nov 14, 2013			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - ORPs (Soil) - EC/SAR															
Electrical Conductivity (2:1)	1		0.954	0.976	2.3%	< 0.005	100%	90%	110%	NA			NA		
Sodium Adsorption Ratio	4936980		0.119	0.122	2.4%	NA	NA			NA			NA		

Comments: NA Signifies Not Applicable.

Certified By: Sofya Pehlyova

AGAT Laboratories

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Quality Assurance

CLIENT NAME: SPL CONSULTANTS

PROJECT NO: 1824-560

AGAT WORK ORDER: 13T780624

ATTENTION TO: Nirogini Nalliah

Trace Organics Analysis

RPT Date: Nov 14, 2013			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
(P & T) BTEX - Soil (GC/MS) High Level															
TPgH (Gas, C5-C10)	1	4936564	< 7.0	< 7.0	0.0%	< 7.0	111%	60%	130%	91%	60%	130%	110%	60%	130%
TEH (Diesel, C10-C24)	1	4936564	<8.0	<8.0	0.0%	< 8.0	82%	60%	130%	95%	60%	130%	93%	60%	130%
(P & T) BTEX - Soil (GC/MS) High Level															
Benzene	1		< 0.02	< 0.02	0.0%	< 0.02	84%	60%	140%	74%	60%	140%	74%	60%	140%
Toluene	1		< 0.05	< 0.05	0.0%	< 0.05	118%	60%	140%	95%	60%	140%	94%	60%	140%
Ethylbenzene	1		< 0.05	< 0.05	0.0%	< 0.05	87%	60%	140%	88%	60%	140%	86%	60%	140%
m & p - Xylene	1		< 0.05	< 0.05	0.0%	< 0.05	101%	60%	140%	89%	60%	140%	86%	60%	140%
o - Xylene	1		< 0.05	< 0.05	0.0%	< 0.05	95%	60%	140%	84%	60%	140%	81%	60%	140%

Certified By:

AGAT Laboratories

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Method Summary

CLIENT NAME: SPL CONSULTANTS

PROJECT NO: 1824-560

AGAT WORK ORDER: 13T780624

ATTENTION TO: Nirogini Nalliah

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Electrical Conductivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Sodium Adsorption Ratio	INOR-93-6007	McKeague 4.12 & 3.26 & EPA SW-846 6010C	ICP/OES
Trace Organics Analysis			
Benzene	VOL-91-5002	EPA SW-846 5030B & 8015	(P&T)GC/MS
Toluene	VOL-91-5002	EPA SW-846 5030B & 8015	(P&T)GC/MS
Ethylbenzene	VOL-91-5002	EPA SW-846 5030B & 8015	(P&T)GC/MS
m & p - Xylene	VOL-91-5002	EPA SW-846 5030B & 8015	(P&T)GC/MS
o - Xylene	VOL-91-5002	EPA SW-846 5030B & 8015	(P&T)GC/MS
Xylenes (Total)	VOL-91-5002	EPA SW-846 5030B & 8015	(P&T)GC/MS
Toluene-d8	VOL-91-5002	EPA SW-846 5030B & 8015	(P&T)GC/MS
4-Bromofluorobenzene	VOL-91-5002	EPA SW-846 5030B & 8015	(P&T)GC/MS
Moisture Content		MOE E3139	BALANCE
TPgH (Gas, C5-C10)	VOL-91-5004	EPA SW-846 5035 & 8015C	(P&T)GC/FID
TEH (Diesel, C10-C24)	VOL-91- 5006	EPA SW-846 3541 & 8015C	GC/FID
TPH (Gas / Diesel)	VOL 5006 & VOL 5004	EPA SW-846 3541 & 8015C	GC/FID

AGAT Laboratories

SR10

5835 Coopers Avenue
Mississauga, ON
L4Z 1Y2
www.agatlabs.com - webearth.agatlabs.com
P: 905.712.5100 - F: 905.712.5122

Chain of Custody Record

Laboratory Use Only
Arrival Temperature: 4.7, 4.3.9
AGAT WO #: 21634271
Lab Temperature:
Notes: 1317780624

Client Information

Company: SPL Consultants Ltd.
Contact: Niroojini Nalliah
Address: 6221 Highway 7, Units 12-16
Vaughan ON L4H0K8
Phone: 9058760065 Fax: 9058760025
Project: 1824-560 PO:
AGAT Quotation #:

Please note, if quotation number is not provided, client will be billed full price for analysis.

Regulatory Requirements

☑ Regulation 153/04 (Feb. 01/11 Amend.)
Table 1/2/3 (indicate one)
☑ Ind/Com/C
☑ Res/Park/I
☐ Agriculture
Soil Texture (check one) ☐ Coarse ☐ Fine

☐ Sewer Use
Region (indicate one)
☐ Sanitary
☐ Storm

☐ Regulation 558
☐ CCME
☐ Other (specify)
☐ Prov. Water Quality Objectives (PWQO)
☐ None

Turnaround Time Required (TAT) Required*

Regular TAT
☑ 5 to 7 Working Days
Rush TAT (please provide prior notification)
Rush Surcharges Apply
☐ 3 Working Days
☐ 2 Working Days
☐ 1 Working Day
OR
Date Required (Rush surcharges may apply):

*TAT is exclusive of weekends and statutory holidays

Invoice To

Same: Yes ☐ No ☐
Company:
Contact:
Address:

Is this a drinking water sample? (potable water intended for human consumption) ☐ Yes ☐ No
If "Yes", please use the *Drinking Water Chain of Custody Form*

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

Legend Matrix

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

Report Information – reports to be sent to:

1. Name: Niroojini Nalliah
   Email: nnalliah@splconsultants.ca
2. Name: Alka Sangar
   Email: a.sangar@splconsultants.ca

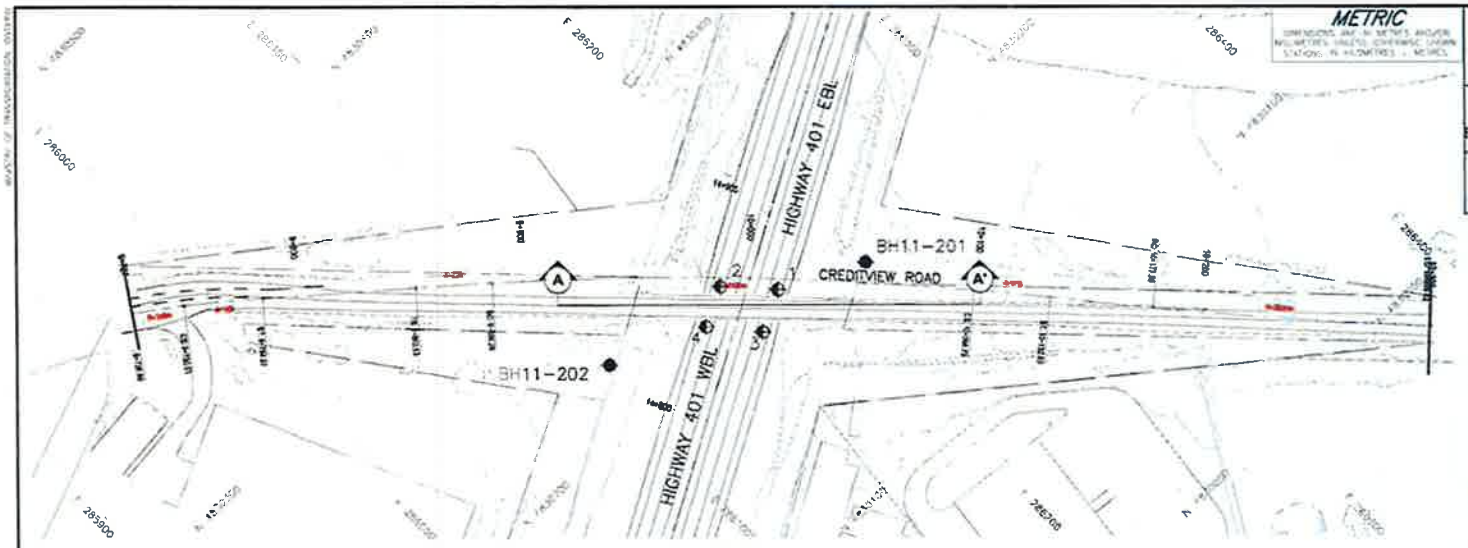
	Sample Identification	Date Sampled	Time Sampled	Sample Matrix	# of Containers	Comments Site/Sample Information	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	ORPs: ☐ B-HWS ☐ Cl- ☐ CN- ☐ EC ☐ FOC ☐ Cr+6 ☐ SAR ☐ Hg ☐ pH ☐ NO3/NO2 ☐ N-Total	Nutrients: ☐ TP ☐ NH3 ☐ TKN ☐ NO3 ☐ NO2 ☐ NO3/NO2	VOC: ☐ VOC ☐ THM ☐ BTEX	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	Sewer Use	TPH	EC/SAR
1	BH13-1, SS8		Oct 29/13			1 jar + 1 vial																V	V
2	BH13-5, SS3		↓			1 jar + 1 vial																V	V
3	BH13-3, SS3																						V
4	BH13-9, SS3																						V
5	BH13-13, SS3																						V
6	BH13-7, SS3		Oct. 30/13																				V
	~~BH13-11, SS3~~																						

Samples Relinquished By (Print Name and Sign)	Date/Time	Samples Received By (Print Name and Sign)	Date/Time
Niroojini Nalliah	Nov. 6/13 5PM		Nov. 7/2013 1:50
Niroojini Nalliah			421

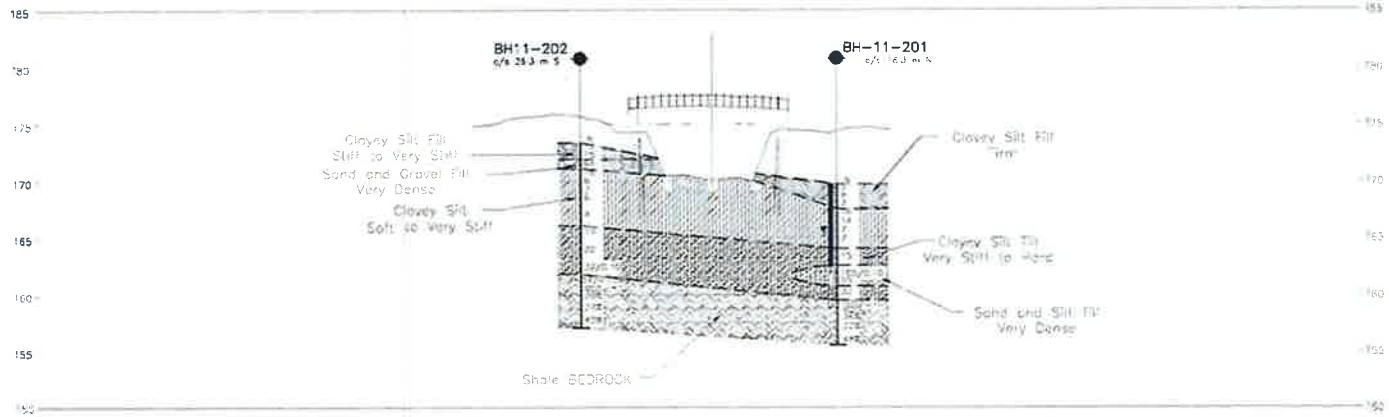
Pink Copy - Client
Yellow Copy - AGAT
White Copy - AGAT

Page 1 of 1
N°: 21604

Appendix E: Logs and Location Plan of Golders Boreholes



PLAN
SCALE
20 0 20 40 m



PROFILE A–A'
HORIZONTAL SCALE
20 0 20 40 m
VERTICAL SCALE

CONT No.
WO No. 07–20021

CREDITVIEW ROAD UNDERPASS
HIGHWAY 401 IMPROVEMENTS
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

Golder Associates
Golder Associates Ltd.
MISSISSAUGA ONTARIO CANADA

LEGEND

- Borehole – Current Investigation
- Borehole – Previous Investigation
- Slot
- Piezometer
- N — Standard Penetration Test Value
- 16 — Blows/0.3m (Unless Otherwise Stated) (Std. Pen. Test, 475 J/blow)
- 100% — Rock Quality Designation (RQD)
- WL in piezometer, measured on November 24, 2011
- WL upon completion of drilling

BOREHOLE CO-ORDINATES

NO.	ELEVATION	NORTHING	EASTING
BH11-202	169.7	4830 405	285319.9
BH11-201	173.4	4830227.6	285184.2

NOTES

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

The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

The complete Preliminary Foundation Investigation and Design Report for this project and other relevant documents may be examined at the Ministry Engineering and Structure Office. Downsview. Information contained in this report and related documents is furnished exclusively in accordance with Section 50.2(5) of OPS General Conditions.

REFERENCE

Base plans provided in digital format by URS drawing file nos. ACAD-X-Base1_in_Topo.dgn dwg, ACAD-Aerials_MTO 40M, Property Boundaries.dwg and Creditview_Profile_A42_Eval.dwg received August 17, 2011, August 29, 2011 and August 15, 2011.

NO.	DATE	BY	REVISION

DESIGN No.	30M12-345		
DRG. No.	401	PROJECT NO.	10-1111-0040
SURVEYED	MM	CHKD.	LCC
DRAWN	JFC	CHKD.	MM
DATE	10/23/2012	APPD.	LOC
SHEET NO.		CHKD.	1

L.C. COYNE
T.W. CLUCK

Golder Associates

RECORD OF BOREHOLE No 11-201

SHEET 1 OF 3 **METRIC**

PROJECT 10-1111-0040
G.W.P. 07-20021
DIST Central HWY 401
DATUM NAD83, Geodetic

LOCATION N 4830180.6 ;E 286216.4
BOREHOLE TYPE Track-Mounted CME55, 108 mm I.D. Hollow Stem Augers
DATE September 12, 2011

ORIGINATED BY AM
COMPILED BY MM
CHECKED BY LCC

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
169.7	GROUND SURFACE										
0.0 / 0.1	TOPSOIL										
	Clayey silt with sand, some gravel, containing rootlets (FILL) Firm Brown Moist		1	SS	5		169				
			2	SS	8				○ ⊢⊣		14 30 42 14
167.5			3	SS	7		168				
2.2	CLAYEY SILT with sand to some sand, trace to some gravel Very stiff to firm Brown Moist Becoming grey below a depth of 3.1 m		4	SS	16		167		○		
			5	SS	14				○⊢⊣		11 26 43 20
			6	SS	7		166				
			7	SS	7	▽	165		○		
164.0											
5.7	CLAYEY SILT with sand to some sand, trace to some gravel (TILL) Very stiff Grey Moist		8	SS	15		164				
162.5							163				
7.2	SAND and SILT, trace to some clay, some gravel, containing cobbles or boulders (TILL) Dense to very dense Grey Moist Split spoon bouncing at a depth of 7.9 m Auger grinding between 7.8 m and 8.2 m		9	SS	105/0.1		162		○		19 37 37 7
			10	SS	55				○		
160.7							161				
9.0	CLAYEY SILT, some sand and gravel (TILL) Hard Grey Moist		11	SS	32				⊢⊣		13 14 55 18
159.5							160				
10.2	Shale (BEDROCK) Highly weathered Grey to black Moist		12	SS	105/0.1		159		○		
158.8 / 10.9	Split spoon bouncing at a depth of 10.9 m Shale (BEDROCK)		1	RC	REC 95%						RQD = 36%
	Bedrock cored between 10.9 m and 14.2 m For bedrock coring details, refer to Record of Drillhole 11-201		2	RC	REC 94%		158				RQD = 22%
			3	RC	REC 81%		157				RQD = 48%
155.5							156				
14.2	END OF BOREHOLE										

Continued Next Page

+³, ×³: Numbers refer to Sensitivity

○³% STRAIN AT FAILURE

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RECORD OF BOREHOLE No 11-201 SHEET 2 OF 3 METRIC

PROJECT 10-1111-0040
G.W.P. 07-20021
DIST Central HWY 401
DATUM NAD83, Geodetic
LOCATION N 4830180.6 ;E 286216.4
BOREHOLE TYPE Track-Mounted CME55, 108 mm I.D. Hollow Stem Augers
DATE September 12, 2011
ORIGINATED BY AM
COMPILED BY MM
CHECKED BY LCC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100	PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L / WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	-- CONTINUED FROM PREVIOUS PAGE --										
	NOTES: 1. Monitoring well was dry and open upon completion of drilling. 2. Water level in monitoring well measured as follows: Date Depth (m) Elev. (m) 11/02/11 4.4 165.3										

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

PROJECT: 10-1111-0040

RECORD OF DRILLHOLE: 11-201

SHEET 3 OF 3

LOCATION: N 4830180.6 ;E 286216.4

DRILLING DATE: September 12, 2011

DATUM: NAD83, Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Track-Mounted CME 55

DRILLING CONTRACTOR: Geo-Environmental Drilling Inc.

JN - Joint; FLT - Fault; SH - Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU- Curved; UN- Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; RO- Rough; VR - Very Rough
MB - Mechanical Break; BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV / DEPTH (m)	RUN No.	COLOUR % RETURN / FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT INDEX PER 0.3 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K, cm/sec	Point Load Index (MPa)	NOTES
		Continued from Record of Borehole BH11-201		158.79												
11		SHALE (BEDROCK) with fossiliferous limestone beds Slightly to moderately weathered Laminated Grey Weak to medium strong		10.91	1											
12																(Axial)
13					2											
14				155.50	3											
		END OF DRILLHOLE		14.20												
15																
16																
17																
18																
19																
20																

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: AM
CHECKED: LCC

GTA-RCK 018 1011110040.GPJ GAL-MISS.GDT 10/23/12 DD

Golder Associates

RECORD OF BOREHOLE No 11-202

SHEET 1 OF 3 **METRIC**

PROJECT 10-1111-0040
G.W.P. 07-20021
DIST Central HWY 401
DATUM NAD83, Geodetic

LOCATION N 4830227.6 ;E 286104.2
BOREHOLE TYPE Track-Mounted CME55, 108 mm I.D. Hollow Stem Augers
DATE September 9, 2011

ORIGINATED BY AM
COMPILED BY MM
CHECKED BY LCC

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
173.4	GROUND SURFACE						173				
0.9	TOPSOIL										
	Clayey silt with sand, trace gravel (FILL) Stiff to very stiff Brown Moist		1	SS	13						
			2	SS	15		172				
172.0											
1.5	Sand and gravel, some silt, trace clay (FILL) Very dense Brown Moist		3	SS	64				o		38 45 14 3
171.1							171				
2.3	CLAYEY SILT with sand to some sand, trace to some gravel Soft to very stiff Brown Moist		4	SS	18						
			5	SS	6		170				
	Wet at a depth of 3.8 m		6	SS	2		169				
	Grey at a depth of 4.6 m		7	SS	6						8 21 41 30
			8	SS	4		168	+			
166.1							167	+			
7.3	CLAYEY SILT with sand, some gravel (TILL) Very stiff Grey Wet		9	SS	19		166		o		13 32 39 16
			10	SS	22		165				
163.5							164				
9.9	CLAYEY SILT with sand and gravel, containing cobbles or boulders (TILL) Hard Grey Wet Split spoon bouncing at a depth of 10.9 m		11	SS	32/0.10		163		o		40 26 27 7
161.8							162				
11.6	Shale (BEDROCK) Highly weathered Black Wet		12	SS	57/0.13						
160.9	Split spoon bouncing at a depth of 12.5 m						161				
12.5	Shale (BEDROCK) Bedrock cored between 12.5 m and 16.4 m For bedrock coring details, refer to Record of Drillhole 11-202		1	RC	REC 83%						RQD = 29%
			2	RC	REC 100%		160				RQD = 27%
			3	RC			159				RQD = 42%

Continued Next Page

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

Golder Associates

RECORD OF BOREHOLE No 11-202 SHEET 2 OF 3 METRIC

PROJECT 10-1111-0040 | G.W.P. 07-20021 | DIST Central | HWY 401 | DATUM NAD83, Geodetic

LOCATION N 4830227.6 ;E 286104.2 | BOREHOLE TYPE Track-Mounted CME55, 108 mm I.D. Hollow Stem Augers | DATE September 9, 2011

ORIGINATED BY AM | COMPILED BY MM | CHECKED BY LCC

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × REMOULDED (20 40 60 80 100)	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---										
	Shale (BEDROCK) Bedrock cored between 12.5 m and 16.4 m For bedrock coring details, refer to Record of Drillhole 11-202		3	RC	REC 97%		158				RQD = 42%
157.1 16.4	END OF BOREHOLE NOTE: 1. Borehole dry on completion of overburden drilling.										

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

PROJECT: 10-1111-0040

RECORD OF DRILLHOLE: 11-202

SHEET 3 OF 3

LOCATION: N 4830227.6 ;E 286104.2

DRILLING DATE: September 9, 2011

DATUM: NAD83, Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Track-Mounted CME 55

DRILLING CONTRACTOR: Geo-Environmental Drilling Inc.

JN - Joint, FLT - Fault, SH - Shear, VN - Vein, CJ - Conjugate | BD - Bedding, FO - Foliation, CO - Contact, OR - Orthogonal, CL - Cleavage | PL - Planar, CU - Curved, UN - Undulating, ST - Stepped, IR - Irregular | PO - Polished, K - Slickensided, SM - Smooth, RO - Rough, VR - Very Rough | MB - Mechanical Break, BR - Broken Rock. NOTE: For additional abbreviations refer to list of abbreviations & symbols

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	% RETURN / FLUSH	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT INDEX PER 0.3 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Js	Ja	Jr	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	UNC. Q' AVG	NOTES
		Continued from Record of Borehole BH11-202		160.90																
13		SHALE (BEDROCK) with fossiliferous limestone beds Slightly to moderately weathered Laminated Grey Weak to medium strong		12.46	1															
14					2															
15					3													2.97		9.97 MPa (Axial)
16				157.01																
		END OF DRILLHOLE		16.35																
17																				
18																				
19																				
20																				
21																				
22																				

GTA-RCK 018 1011110040.GPJ GAL-MISS.GDT 10/23/12 DD

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: AM

CHECKED: LCC